Authors’ final response

We would like to take this opportunity to thank the reviewers and the editor for their dedicated and meticulous review, as their comments and remarks helped us to present and reinforce our research results even better.

Throughout the discussion, we tried to provide structured and detailed answers to all questions promptly. To our knowledge, all the points raised have already been addressed and clarified. In this final response we will therefore simply summarize all points and reference the changed passages in the manuscript or supplement for traceability.

A recent question, which was only dealt with indirectly in the manuscript and which did not come up in the discussion, is that of the significance of dissolved inorganic carbon for seawater density and its measurement. Since this can essential in a highly accurate density measurement, we took up this question in the manuscript. The related changes in the manuscript, which are self-explanatory, are found below the referees’ comments.

Comments of anonymous referee 1

Since some of the comments refer to details of the substitution measurement method that go beyond the scope of this paper but may nevertheless be of interest, such comments are dealt with in the supplement.

Comment	Change(s) or addition(s)
Was the isotopic composition of the reference water measured before or after degassing?	Page 4 Lines 9–11
What amount of water can be evaporated without a significant change in the water density caused by heavy isotope enrichment?	P4 L10–1; Supplement P2–3
How was the water purified that was used to prepare the seawater samples?	P7 L7
Since theoretical boundary conditions at 'zero density', i.e. $\lim_{S\to 0} \Delta\rho(S)$, are not fulfilled by the mathematical formulation of the density–salinity relation, is there a risk for inconsistencies?	P14 L16–28; P15 L31–38; P32 L9–10, Fig. 7a; P34 L2–3, Fig. 10
Technical comments	P1 L6, L8, L17–8, 23–7; P2 L11, 30; P10 L23; P13 L25; P17 L3–4, 38; P18 L12, 17; P21 L15, 18,21; P29 L1, 2

Comments of anonymous referee 2

Since some of the comments refer to details of the substitution measurement method that go beyond the scope of this paper but may nevertheless be of interest, such comments are dealt with in the supplement.

Comment	Change(s) or addition(s)
What is the impact of a zero-drift on the accuracy of a substitution measurement on standard seawater using a water reference?	Supplement P4–5
The substitution method does not correct a nonlinear characteristic curve. Since the linearity of the DMA 5000 M and HP was checked before, please provide a hint to the reference.	Manuscript P4 L33–36
Why is the uncertainty in the density–salinity relation for high pressures significantly smaller than that in the underlying substitution densities?	M P5 L32–3; M P15 L13–20; M P23 L23; M P26 L12–4; M P27 L5–7, 19–21
Although the density deviation between TEOS-10 and the density-salinity relation for high pressures is consistent, it seems to be high. What are possible causes?	M P19 L19–27
What is the impact of the in/output assembly on a substitution density measured?	S P5
The DMAs inclination affects the measurement density by 2 g m^{-3} per 1 ° (degree). How was this considered?	S P6
How do you ensure that the tube is sufficiently long to avoid diffusion of the oil into the U-tube of the DMA HP during measurements at high pressure?	S P6
Why do we speak of a linear dependence (on salinity) of the deviations of the Millero et al.-measurements from the density–salinity relation, when the deviations (shown in Fig. 11b) may suggest another type of dependence, too, e.g. a quadratic?	M P16 L24–39; M P35 L2–7, Fig. 12

Explanation	Change(s) or addition(s)
Description of density correction for saturation with N_2, O_2, and Ar (changed, as free aqueous CO_2 is now excluded, although its impact is negligible)	P10 L29–33
Quantification of the CO_2-impact	P10 L34–P11 L9
Calculation to quantify impact	P11 Footnotes 6 and 7
Relevance of $\Delta\rho_a^{H_2O}$	P12 L34–7; P13 L15
References added	P24 L10–1, 32–4; P26 L9–11, 22–3; P27 L1–2

Marked-up version of the manuscript

The density–salinity relation of standard seawater

Hannes Schmidt[1], Steffen Seitz[1], Egon Hassel[2], Henning Wolf [1]

[1]Physikalisch-Technische Bundesanstalt, Braunschweig, 38116, Germany
[2]Lehrstuhl für Technische Thermodynamik, Universität Rostock, Rostock, 18051, Germany

Correspondence to: H. Wolf (henning.wolf@ptb.de)

Abstract. The determination of salinity by means of electrical conductivity relies on stable salt proportions in the North Atlantic Ocean, as standard seawater, which is required for salinometer calibration, is produced therefrom. To verify the long-term stability of the standard seawater composition, it was proposed to perform measurements of the standard seawater density, as it is sensitive to all salt components. Thus, density measurements can detect any change in the composition of seawater. A conversion of the density values to salinity can be performed by means of a density–salinity relation. To use such a relation with a target uncertainty in salinity comparable to that in salinity obtained from conductivity measurements, a density measurement with an uncertainty of 2 g m^{-3} is mandatory. In this article, a new density–salinity relation is presented based on such accurate density measurements. The underlying substitution measurement method is described, density corrections for uniform isotopic and chemical compositions are reported, and the density–salinity relation is presented. The comparison of densities calculated using the new relation with those calculated using the present reference equations of state TEOS-10 suggests that the density accuracy of TEOS-10 (as well as that of EOS-80) has been overestimated, as the accuracy of some of its underlying density measurements had been overestimated. The new density–salinity relation may be used to verify the stable composition of standard seawater by means of routine density measurements.

1 Introduction

For almost 40 years, the salinity[3] of seawater has been indirectly determined by means of electrical conductivity. Since the absolute conductivity cannot be measured as accurately as required for precise salinity measurements (Seitz et al., 2010), the conductivity has been measured relative to that of standard seawater[4]; the conversion to salinity is carried out by means of the (relative) conductivity–salinity relation PSS-78 (JPOTS, 1981a and b). In practice, this is achieved by calibrating salinometers and conductivity-temperature-depth devices using standard seawater, which is diluted to obtain the conductivity of the potassium chloride standard (Culkin, 1986; Bacon et al., 2007) used as conductivity reference. An unconditional prerequisite for the comparability of salinity measurements over long periods is, therefore, that the salt proportions in standard seawater are stable. Unfortunately, this cannot be guaranteed, as standard seawater is of natural origin.

Recently, the long-term comparability of salinity measurement results was discussed, with two main deficiencies being elaborated (Pawlowicz et al., 2016): a lack of traceability to a long-term stable and ubiquitous reference like the International System of Units SI and chemical composition variabilities in standard seawater. These variabilities are likely to increase in the

[3] 'Salinity' refers strictly to practical salinity unless there is an exact specification.
[4] Standard seawater recognized by the International Association for the Physical Sciences of the Oceans (IAPSO) prepared from seawater of the Northern Atlantic Ocean.

coming decades, due especially to the absorption of carbon dioxide into the ocean resulting from accumulation in the atmosphere (Millero, 2007). Both of these deficiencies entail a risk of inconsistent long-term salinity values. To remedy the deficiencies, Seitz et al. (2011) proposed to perform routine measurements of the standard seawater density. In practice, this would be achieved by determining the salinity of a standard seawater batch not only by conductivity measurement but also by density measurement; the conversion to salinity is carried out in this second approach by means of a density–salinity relation. Since the salinity obtained from density is sensitive to all components of the standard seawater, a change in its composition would lead to an inconsistency of the "density salinity" and the "KCl salinity".

To obtain a reliable statement about the consistency of the density salinity and the KCl salinity, they have to be compared against the background of their uncertainties. The reproducibility of the KCl salinity is 0.0004 (Bacon et al., 2007). However, this reproducibility is only valid for the time of preparation (Seitz et al., 2010), as, during storage, glass container material dissolves in the seawater, which is mainly silicate (e.g. Poisson, 1978; Higgs and Ridout, 2011; Uchida et al., 2011). The uncertainty in the "conductivity salinity" obtained by means of a salinometer is at least 0.0022 (Le Menn, 2011), and requires freshly prepared standard seawater for calibration. The corresponding values in terms of density are 0.3 g m^{-3} (for 0.0004) und 1.8 g m^{-3} (for 0.0022). The present reference equation of state TEOS-10 (IOC et al., 2010) summarizes the most accurate density measurements obtained from standard seawater conducted by Millero et al. (1976) and by Poisson et al. (1980). TEOS-10, which implicitly contains a density–salinity relation of standard seawater, predicts the density with an estimated uncertainty of at least 8 g m^{-3} (Feistel, 2008), which is significantly higher than 1.8 g m^{-3}, but reflecting the measurement uncertainty in seawater density at that time.

In this article, a new density–salinity relation is presented, whereby the salinity can be determined by means of density measurement with an accuracy of up to 0.003 for salinities up to 35, temperatures between 5 °C and 35 °C and atmospheric pressure, which is similar to the accuracy achieved by salinometers. The density was determined by using the substitution method developed by Schmidt et al. (2016). Because the water-isotopic and salt-chemical compositions, as well as the air saturation, of the seawater samples changed during preparation, storage and measurement, corrections were applied to specify the seawater density for uniform conditions; these corrections are of the same order of magnitude as the measurement uncertainty and are therefore essential for high accuracy. The corrected density values were used to develop a density–salinity relation. The comparison of densities calculated by means of the new relation with those calculated by means of TEOS-10 suggests that TEOS-10 predicts densities significantly too high by up to 15 g m^{-3}. The deviations increase systematically with salinity. A plausible explanation was found in the design of the flotation densimeter (Millero, 1967) that Millero et al. (1976) used for their measurements obtained from standard seawater.

The new density–salinity relation may be used to reliably verify the stable composition of standard seawater by means of routine density measurements. On the one hand, the determination of salinity by means of conductivity is retroactively ensured in case of consistency; on the other hand, in case of inconsistency, a need for action is demonstrated.

2 Density measurements

Determining salinity by means of conductivity measurement is supported by the relations of PSS-78. To develop the density–salinity relation in such a way that it is consistent with PSS-78, the density measurements have to be obtained from seawater whose salinity determination is consistent with the salinity determination of the seawater used to develop PSS-78. In addition to the consistency of salinity determination, the accuracy of the density measurement is decisive. The more accurate the density measurement is, the more accurately the salinity can be determined (by means of the density–salinity relation). To achieve an accuracy in the density salinity that is equal to that in the conductivity salinity, a density uncertainty of 2 g m^{-3} is required. To this end, substitution measurement with a vibrating-tube densimeter relative to a water reference had been proposed (Wolf, 2008) before a substitution method specifically for seawater was developed and validated (Schmidt et al., 2016).

In this section, the preparation of the seawater measured and the determination of its salinity are described. The consistency of the salinities determined in the present, which were used to develop the density–salinity relation, with the salinities determined in 1978, which were used to develop PSS-78, is discussed. The substitution method and the apparatus used for the density measurement are briefly outlined, as they have already been described in detail by Schmidt et al. The uncertainty in density is discussed with regard to the uncertainty in salinity obtained from a density measurement and the subsequent calculation by means of the density–salinity relation.

2.1 Substitution method

In a substitution method, a sample (= seawater) with an unknown density and a similar, well known reference (= water) are measured (ideally, at the same time) using the same measurement device (= densimeter). Deviations in the measurement results caused, for example, by a drift or a temperature deviation can be corrected, as they cause similar effects on seawater and on water. As a result, the measured densities of seawater and water have similar deviations from their true value. The difference equation for calculation of the corrected density from the measurements obtained from seawater and water is:

$$\rho_{\mathrm{subs}}^{\mathrm{SW}} - \rho_{\mathrm{ref}}^{\mathrm{H_2O}} = \rho_{\mathrm{mes}}^{\mathrm{SW}} - \rho_{\mathrm{mes}}^{\mathrm{H_2O}}, \quad (1)$$

where $\rho_{\mathrm{mes}}^{\mathrm{SW}}$ and $\rho_{\mathrm{mes}}^{\mathrm{H_2O}}$ are the measured seawater and water densities, and $\rho_{\mathrm{subs}}^{\mathrm{SW}}$ and $\rho_{\mathrm{ref}}^{\mathrm{H_2O}}$ are the corrected seawater (substitution) density and the well-known water reference density. If the absolute seawater density is determined from a substitution measurement (by calculating $\rho_{\mathrm{mes}}^{\mathrm{SW}} - \rho_{\mathrm{mes}}^{\mathrm{H_2O}} + \rho_{\mathrm{ref}}^{\mathrm{H_2O}}$), the result includes the uncertainty in the water reference density. By contrast, if the seawater density relative to water is determined (by calculating $\rho_{\mathrm{mes}}^{\mathrm{SW}} - \rho_{\mathrm{mes}}^{\mathrm{H_2O}}$), the reference uncertainty is not included.

The water reference density was calculated using the equation of state developed by Wagner and Pruß (2002). A description of the calculation is given in Appendix A. The reference density uncertainty is 1 g m^{-3} for atmospheric pressure, 10 g m^{-3} for pressures up to 10 MPa, and 30 g m^{-3} for up to 100 MPa. The uncertainty in a corrected seawater density resulting from a substitution measurement mainly depends on the uncertainty in the water reference density, but also on the similarity of seawater and water in terms of their relevant thermophysical properties, as well as on the stability and linear characteristics of the densimeter used. It should be noted that the linearity is regularly checked in measurements on reference liquids with densities between 700 kg m^{-3} and 1600 kg m^{-3}; furthermore, the linearity was particularly validated in the seawater density range by means of comparison measurements against a hydrostatic weighing apparatus for both the densimeters used for atmospheric and high pressure; details have been given by Schmidt et al. (2016).

2.2 Materials

2.2.1 Reference water

The water used as the reference liquid in the substitution measurements was prepared using tap water from Braunschweig, Germany. It was purified using a reverse osmosis module, an ion exchanger, and a 0.2 µm-filter. Its purity was checked by measuring the water conductivity at the outlet of the filter; the conductivity at 20 °C to 25 °C was always lower than 0.1 µS cm^{-1}. The water was degassed by boiling it for half an hour under minimum power. Immediately afterwards, it was poured into borosilicate vessels that were sealed in a hot state. This water was used for measurements over the course of one week. The reference water-air saturation was 20 % with an uncertainty of 10 %. The isotopic abundances of deuterium and of oxygen-18 against Vienna Standard Mean Ocean Water were –59 ‰ and –8.5 ‰. The abundances were measured before and after degassing and no significant differences were found. Details that have been given by Schmidt et al. (2016) are complemented by the digital supplement to this article.

2.2.2 Seawater

All seawater samples were obtained from Ocean Scientific International Ltd. (OSIL), Havant, UK, which also determined the salinity values. Samples with salinities of 10, 30, and 35 were taken from batches 10L13, 30L15, and P153. Additionally, diluted seawater with salinities of 5, 15, 20, and 25 was studied. These seawater batches were prepared using the same procedure as that used for the standard batches with salinities 10 and 30: First, a large amount of natural seawater (as used for the preparation of standard seawater) was diluted with water until its salinity was approximately equal to the target salinity. The raw salinity was determined using a modified 8400B Autosal salinometer (Bacon et al., 2007). Then, for calibration, a set of five samples per salinity was obtained by means of weight dilution of standard seawater (from batch P154 with a salinity of 34.9962). The balance used had a readability of 0.1 mg and was calibrated using weight standards traceable to the National Physical Laboratory, Teddington, UK (B. Childs, personal communication, 2017). The salinity was again determined by the Autosal salinometer, on the one hand, and by means of the weights of the standard seawater and the water used for dilution on the other hand. The deviations found between the salinometer salinities and the weight-calculated salinities were used as calibration offsets for the raw salinities of the diluted seawater.

The salinity homogeneity and calibration measurements yielded the values and corresponding standard deviations given in Table 1. The uncertainty in the salinity of standard seawater was adopted from Bacon et al. (2007). The uncertainty in the salinity of diluted seawater includes the standard deviations of homogeneity and calibration measurements, as well as the uncertainty in the salinity of standard seawater. The systematic uncertainty contributions of weighing and refilling are negligible compared to the standard deviations. The uncertainty in the salinity of dilute samples is 0.0006, which corresponds to a density uncertainty of 0.5 g m^{-3}.

2.3 Apparatus

Vibrating-tube densimeters (VTDs) were used for density measurements performed using the substitution method. The core of such a densimeter is a U-shaped tube that is fixed in place on both ends. This tube is filled with the liquid to be measured and then forced to oscillate; the resulting oscillation period is a measure of the liquid density. Since the vibrating tube can be easily accessed from the outside, liquids can be filled in and changed quickly. This feature, together with short-term stability, is necessary for the application of the substitution method. Since the seawater sample and water reference cannot be measured simultaneously, stability is important for the duration of the alternating measurements. Under these conditions, the drift of the

densimeter can be quantified using the deviations from the reference density (of water) to correct the sample density (of seawater).

The set-up used for the density measurements at atmospheric pressure is outlined in Fig. 1a. It comprises a fully automated filling system, a VTD and a peristaltic pump. The filling system was created specifically for small filling volumes to allow more repetitions in the substitution measurements from a limited sample amount. To this end, a sequence of humid air bubbles is used to rinse the previous liquid out of the measuring cell. The bubbles of humid air are inserted into the sample filling tubes using the V2 and V3 valves in addition to the V1 valve to switch between the seawater sample and the water reference. The VTD used for the measurements is a DMA 5000M (Anton Paar GmbH, Graz, Austria). The peristaltic pump used to move the liquids is installed behind the VTD to avoid any interaction of the peristaltic tube material with the seawater or the water before the measurement.

The set-up used for density measurements at high pressures is illustrated in Fig. 1b. It uses an equal filling system to fill the water and seawater like the set-up used for atmospheric pressure. In addition to the filling system, the VTD, and the peristaltic pump, a pressurization part is installed between the VTD and the peristaltic pump. In this part, wherein the pressure is generated and measured, is a syringe pump filled with oil to prevent corrosion of the pressure sensors. The oil transmits the pressure generated in the syringe pump directly to the water without using a pressure transmitter. A long tube is installed between both parts (VTD and pressurization part) to avoid diffusion of oil into the measurement cell of the VTD. Two pressure sensors (P1 up to 14 MPa and P2 up to 70 MPa) are used to increase the accuracy of the pressure measurement. The offsets of these sensors at atmospheric pressure are corrected by the values gained with the atmospheric pressure manometer before each measurement. The VTD used for the measurements at high pressures is a DMA HP (Anton Paar GmbH, Graz, Austria). Details that have been given by Schmidt et al. (2016) are complemented by the digital supplement to this article.

The substitution measurements at atmospheric pressure were performed at a constant temperature. The water and seawater were filled and measured in alternation. The water densities measured were thus compared with the reference density; the deviations found were used to correct the seawater measurements.

The procedure for high pressures is similar to that used for atmospheric pressure; however, the liquid is not replaced during a high pressure run at a constant temperature. Instead, the liquid is replaced after decreasing the pressure back to atmospheric conditions.

2.4 Substitution densities

The seawater density was measured in the temperature range of 5 °C to 35 °C. The densities were corrected to integer temperatures in °C and either to 101325 Pa or to integer pressures in bar, if the substitution density was determined for high pressures. The measured absolute seawater densities have uncertainties of 2 g m^{-3} for atmospheric pressure, 14 g m^{-3} for pressures up to 10 MPa, and 34 g m^{-3} for pressures up to 65 MPa. If stated relative to water, the seawater densities for high pressures have significantly smaller uncertainties, as they do not include the water reference uncertainty. The measured relative densities have uncertainties of 6 g m^{-3} up to 14 g m^{-3} mainly depending on salinity.

Since the salinity uncertainty, which is 0.5 g m^{-3} in terms of density, is significant compared to the density measurement uncertainty for atmospheric pressure, it has to be considered in the development of the density–salinity relation. This had already been done at this point by adding the salinity uncertainty to the density measurement uncertainty.

2.5 Comparability of salinity

For determining salinity by means of conductivity, the PSS-78 relations were developed based on five datasets[5], which comprise conductivity measurements obtained from potassium chloride solutions and from standard seawater solutions with salinities of 2 to 42. Standard seawater obtained from batch P79 was used to define the reference point at salinity 35. To this end, the mass fraction of the potassium chloride solution which has the same conductivity as standard seawater (with salinity 35) was determined. These measurements were reported by Culkin and Smith (1980), Dauphinee et al. (1980a) and Poisson (1980a). Standard seawater obtained from the batches P73, P75, and P79 was used to determine the conductivity of (diluted and concentrated standard seawater with) salinities $\neq 35$ relative to (seawater with) a salinity of 35. These measurements were reported by Bradshaw and Schleicher (1980), Dauphinee et al. (1980b) and Poisson (1980b). For weighing, very precise balances were used, e.g. a Mettler M5 GD with a precision of 1 µg for the potassium chloride or a Mettler B5 C1000 with a precision of 0.1 mg for the solutions. The five datasets were used by Perkin and Lewis (1980) to find the coefficients of empirical correlations between salinity and (relative) conductivity that set PSS-78. The standard deviations of these fits are 0.0007 for atmospheric pressure and 0.0015 for high pressures and correspond to uncertainties of 0.0014 and 0.003 (Le Menn, 2011).

Both the salinities of the samples used to develop the conductivity–salinity relation PSS-78 and the salinities of the samples used to develop the density–salinity relation were thus determined by weighing measurements. If a relation between density and conductivity is set using both relations, then both (relation) uncertainties have be taken into account. It should be noted that the density–conductivity relation is only valid, if standard seawater is consistent in its composition. Conversely, this relation can therefore be used to check the standard seawater composition.

The uncertainty in a salinity determined by means of conductivity measurement that is supported by PSS-78 is (in a best-case scenario) 0.0022 using a laboratory salinometer and 0.0034 using a conductivity-temperature-depth device (Le Menn, 2011). These uncertainties are 2 g m^{-3} and 3 g m^{-3} in terms of density. The accuracy of the seawater densities for atmospheric pressure fulfils these criteria, both in absolute terms and relative to the water reference. In the high-pressure range, it is currently not possible to achieve a comparable accuracy in absolute density using the substitution method and a water reference, as here, the uncertainty in the water reference density is too high. This can be circumvented by stating the seawater density relative to water.

Since the aim of developing the density–salinity relation was to determine the salinity by measuring density with higher accuracy than by measuring conductivity, a *relative density–salinity relation* was developed instead of an *absolute density–salinity relation*. The accuracy of a salinity that is determined by measuring density at high pressure and subsequent calculation using the (relative) density–salinity relation is thus comparable to the salinity accuracy of conductivity-temperature-depth devices.

[5] All publications cited here were also reprinted together (JPOTS, 1981b).

3 Density corrections

Standard seawater is prepared using natural seawater taken from the North Atlantic Ocean. To adjust the required salinity, the natural seawater is diluted with water prepared using groundwater taken from the British mainland; since the groundwater is isotopically depleted, the isotopic water composition of the natural seawater changes during dilution. After preparation, the seawater is poured into borosilicate glass vessels for delivery; these vessels are not completely inert against seawater. Since the seawater was stored in these vessels until the density measurements were made, glass material was dissolved into the seawater, changing the chemical composition by mainly increasing the dissolved silicate.

For the substitution measurements, the seawater was taken directly from these vessels and pumped into the substitution densimeter, where the temperature is altered; since the seawater was air-saturated at 20 °C in the vessels before being pumped into the densimeter, the air saturation changed in measurements at other temperatures. Since the seawater density is significantly affected by these changes compared to the measurement uncertainty of 2 g m^{-3}, it is necessary to apply corrections to uniform isotopic water and chemical composition, as well as to uniform air saturation.

In this section, corrections for these density effects to the following uniform conditions are presented: the hydrogen–deuterium (H–D) and oxygen-16, 17, and 18 (^{16}O–^{17}O–^{18}O) isotopic composition of VSMOW, the initial chemical composition of the seawater before pouring (especially the silicate content), and air saturation, which depends on temperature. The corrections presented had been applied to the measured substitution seawater densities before the density–salinity relation was developed, thereby enabling uniform conditions and thus consistency.

3.1 Isotopic composition

Water shows a variation in its isotopic composition. The natural variation comprises the H–D relation and the ^{16}O–^{17}O–^{18}O relation. The isotopic abundance of a water sample is usually stated relative to that of the reference material VSMOW, whose isotopic composition is based on a mixture of ocean waters (IAEA, 2009). The D isotopic abundance (as well as the ^{18}O abundance) is thus expressed as the ratio of the amount-of-substance ratio of D and H in the sample to the respective ratio in VSMOW, δ_D:

$$\delta_D = \left[\frac{D}{H}\right]^{Sample} \Big/ \left[\frac{D}{H}\right]^{VSMOW} - 1. \quad (2)$$

The ^{17}O abundance is usually not monitored, as it is very small compared to the ^{18}O abundance. In Earth's deep ocean layers, the isotopic composition varies by up to 4 ‰ in D and 0.3 ‰ in ^{18}O, whereas in the surface ocean layers, these variations are up to 35 ‰ and 3 ‰ (Ferronsky and Polyakov, 2012) due to precipitation. A variation in the isotopic abundance affects the density directly: The corresponding variations are 0.1 g m^{-3} for the deep ocean and 1.3 g m^{-3} for the surface ocean if calculated using Eq. (A.2) given in Appendix A. Isotopic composition variations in the water of the pedosphere are even more significant.

The D and ^{18}O isotopic abundances δ_D and δ_{18} in the natural seawater that was used as the raw material for the diluted seawater preparation at the area of sampling were measured in 1972 and made available by Ostlund et al. (1987). The water, which is deionized and used for dilution of the natural seawater (N. Higgs, personal communication, 2011) is tap water from Havant, UK, where the supplier of the IAPSO SSW is located. Darling et al. (2003) analyzed the isotopic composition of fresh waters in the British Isles. They used isotope measurement data collected from around 1978 to 2003, including in the region from that the water for dilution was taken. The relevant values and uncertainties given by Ostlund et al. and Darling et al. are given in Table 2. The equations used to calculate the isotopic abundances of the diluted seawater after mixing standard seawater with water can be derived from the amount-of-substance balance of the isotope considered. For D and ^{18}O, the equations derived are:

$$\delta_{\mathrm{D}}^{\mathrm{DSW}} = \frac{\left(\delta_{\mathrm{D}}^{\mathrm{H_2O}}+1\right)\cdot m^{\mathrm{H_2O}}+\left(\delta_{\mathrm{D}}^{\mathrm{SSW}}+1\right)\cdot m^{\mathrm{SSW}}\cdot(1-S_{\mathrm{A}})}{m^{\mathrm{H_2O}}+m^{\mathrm{SSW}}\cdot(1-S_{\mathrm{A}})} \text{ and} \quad (3)$$

$$\delta_{18}^{\mathrm{DSW}} = \frac{\left(\delta_{18}^{\mathrm{H_2O}}+1\right)\cdot m^{\mathrm{H_2O}}+\left(\delta_{18}^{\mathrm{SSW}}+1\right)\cdot m^{\mathrm{SSW}}\cdot(1-S_{\mathrm{A}})}{m^{\mathrm{H_2O}}+m^{\mathrm{SSW}}\cdot(1-S_{\mathrm{A}})}, \quad (4)$$

where 'DSW' refers to diluted seawater (after mixing) and $S_{\mathrm{A}} = S_{\mathrm{R}} = 35.16504/35 \cdot S_{\mathrm{P}} \cdot (\mathrm{g\ kg^{-1}})$ is the absolute salinity of standard seawater, which is assumed to be equal to the reference salinity of IAPSO SSW according to the recommendation of Millero et al. (2008). The calculated isotopic abundance values and corresponding uncertainties of the seawater samples used for the density measurements are given in Table 2. For calculation of the uncertainty, only the isotopic abundances of the water and seawater were taken into account, as the other contributions are insignificant (for example, the salinity of the natural seawater, which is diluted, may differ by multiple g kg^{-1} without affecting $\delta_{\mathrm{D}}^{\mathrm{DSW}}$ and $\delta_{18}^{\mathrm{DSW}}$ significantly).

The density difference due to the isotopic abundance change during preparation, $\Delta\rho_{\mathrm{prep}}^{\mathrm{SW}}$, is estimated using Eq. (A.2), where $\Delta\delta_{\mathrm{D}} = \delta_{\mathrm{D}}^{\mathrm{DSW}} - \delta_{\mathrm{D}}^{\mathrm{SSW}}$ and $\Delta\delta_{18} = \delta_{18}^{\mathrm{DSW}} - \delta_{18}^{\mathrm{SSW}}$ are inserted for this purpose. Following this procedure, the isotopic abundance effect on density is assumed to be the same for seawater as for water at $T_{\rho_{\max}} = 3.98$ °C and $p_0 = 101325$ Pa and is calculated relative to the isotopic composition of IAPSO SSW. $\Delta\rho_{\mathrm{prep}}^{\mathrm{SW}}$ is approximated by:

$$\frac{\Delta\rho_{\mathrm{prep}}^{\mathrm{SW}}(S,T_{\rho_{\max}},p_0)}{\mathrm{g\ m^{-3}}} = -0.0700 \cdot S + 2.4577, \quad (5)$$

where $\Delta\rho_{\mathrm{prep}}^{\mathrm{SW}}(S,T,p) \approx \Delta\rho_{\mathrm{prep}}^{\mathrm{SW}}\left(S,T_{\rho_{\max}},p_0\right)$, and S, T, and p are the salinity, temperature and (absolute) pressure, respectively. The uncertainty in $\Delta\rho_{\mathrm{prep}}^{\mathrm{SW}}$ is estimated to be 0.3 g m^{-3}; uncertainties in the isotopic abundances are insignificant.

$\Delta\rho_{\mathrm{prep}}^{\mathrm{SW}}$ is illustrated in Fig. 2. The more water is used for dilution, the more the density decreases, as the water is depleted in heavy isotopes compared to seawater. The density difference caused by the difference between the isotopic composition of VSMOW and that of IAPSO SSW (which is given in Table 2), $\Delta\rho_{\mathrm{iso}}^{\mathrm{SW}}$, is 0.3 g m^{-3}.

3.2 Chemical composition

The seawater used for the measurements was stored in 230 mL borosilicate glass vessels (Bacon, 2007) from the time of preparation at OSIL to the time of measurement. During this time, glass material that dissolved into the seawater has significantly altered the chemical composition, and thus the density.

3.2.1 Silicate content of standard seawater

Uchida et al. (2011) analyzed the silicate increase in standard seawater delivered by OSIL that was stored in the vessels mentioned above. The silicate increase is related to the dissolution of silica from the glass vessel material. Uchida et al. measured the silicate molality of samples from batches P144 to P152 depending on their storage time. This data was used to estimate the initial silicate molality of the standard seawater used for the density measurements $b_0(S = 35)$ after it had been prepared, and directly before it was poured into the vessels: 16.5 µmol kg^{-1} with a corresponding estimated uncertainty of 20 %. This silicate molality – which, in terms of conductivity, is insignificant – agrees well with that of standard seawater of batches up to P71 (Poisson et al., 1978) that were analyzed shortly before the conductivity measurements of batch P75 and P79 seawater to develop PSS-78.

3.2.2 Silicate content of the samples used for density measurements

The silicate concentration of some DSW samples from the batches with salinities of 5, 10, 15, 20, 25, and 30 was measured shortly after all density measurements had been performed. The silicate concentration was measured at the *Alfred-Wegener-*

Institut für Polar- und Meeresforschung in Bremerhaven, Germany, using an Evolution III flow-through spectrophotometer (Alliance Instruments GmbH, Salzburg, Austria) according to Grasshoff et al. (1999). The device was calibrated before, between and after the DSW sample measurements by measuring Merck Millipore Certipur silicon standard solutions (Merck KGaA, Darmstadt, Germany), which had a salinity of 36 and reference concentrations of around 7 µmol L^{-1} and 50 µmol L^{-1}. The silicate concentration values of the DSW samples were converted to the molality values that are given in Table 3, including the corresponding storage time. The silicate molality of the seawater that had salinities of 10, 30, and 35 is higher than that of the other batches, as it was stored longer in the vessels (see Table 1 for details).

The reproducibility of a silicate concentration measurement that uses the standards and method described above is usually within 3 % (K.-U. Ludwichowski, personal communication, 2015). Since the dissolution of the vessel material partly depends on the individual vessel, the difference in the silicate molalities of two measurements (e.g. for salinity 10) may be higher.

According to Grasshoff et al., the accuracy of the measured silicate concentrations also depends on the difference in salinity between the Certipur standard solutions and the DSW samples. Grasshoff et al. recommend to correct this effect by applying a constant, device-dependent correction factor derived from calibration measurements. The resulting correction increases linearly based on the salinity difference between the sample (higher salinity) and the standard (lower salinity). For measurements of samples with a salinity of greater than 30, the correction is smaller than 3 %. Assuming a correction due to the salinity effect of 3 % at a salinity difference of 6 and a linear increase thereof, the correction increases to 10 % at a salinity of 15 and to 16 % at a salinity of 5. We considered this by including the effect in the uncertainty and estimated the uncertainty in silicate molalities to be dominated by the batch homogeneity for salinities above 20; for salinities lower than 20 we estimated the uncertainty to be dominated by the correction due to the salinity. Values of the estimated uncertainty in silicate molality are given in Table 3.

3.2.3 Density correction to initial silicate content

Since the density measurements obtained from seawater samples were performed before the silicate molality measurements, the storage time (and the silicate molality) were different at that time.

Uchida et al. (2011) estimated the relation between the silicate molality b and the storage time t in the vessels to be linear. The silicate–storage time relation of the seawater samples used in the density measurements is therefore estimated based on the initial silicate molality b_0 (of Uchida et al.) and the measurements of the silicate molality b_1 (given in Table 3) at storage time t_1 given by:

$$b = b_0 + \frac{b_1 - b_0}{t_1}. \quad (6)$$

The initial silicate molality of the DSW samples that have a salinity of less than 35 is derived from $b_0 = S_\mathrm{P} \cdot b_0(S_\mathrm{P} = 35)/35$, where the water added to the SSW is assumed to be free of silicate.

The borosilicate vessels used to store the seawater samples are assumed to consist of $w_{\mathrm{SiO_2}} = 80$ % (in weight) silica similar to Duran (DURAN Group GmbH, 2009) or Pyrex (Corning Inc., 2014) borosilicate glass. The dissolution of the silica material is determined using the measurements described above. The dissolution of the remaining 20 % borosilicate glass material, which is B_2O_3 (13 %) but also Na_2O, and Al_2O_3, is assumed to be similar to the dissolution of silica (Grambow, 1985). The overall dissolved mass of glass material is therefore given by $\Delta m = M_{\mathrm{SiO_2}}/w_{\mathrm{SiO_2}} \cdot \Delta n_{\mathrm{SiO_2}}$, where $M_{\mathrm{SiO_2}} = 60.08$ kg kmol^{-1} is the molar mass of silica and $\Delta n_{\mathrm{SiO_2}}$ is the amount-of-substance silica from the glass material that was dissolved into seawater (relative to the initial silicate molality). Additionally, $\Delta n_{\mathrm{SiO_2}} \approx (b - b_0) \cdot m$, where m is the seawater mass.

The increase in seawater density due to the dissolution of glass material during storage, $\Delta\rho_{\mathrm{stor}}^{\mathrm{SW}}$, is calculated assuming that the seawater volume remains constant and only the mass increases:

$$\Delta\rho_{\mathrm{stor}}^{\mathrm{SW}} = \rho \cdot \frac{M_{\mathrm{SiO_2}}}{w_{\mathrm{SiO_2}}} \cdot (b - b_0), \tag{7}$$

where ρ is the seawater density. The uncertainty in the density correction due to the dissolution of glass material is estimated using Eq. (7) as a model equation, with Eq. (6) being inserted. Furthermore, the following uncertainties are considered: (i) uncertainty in the silica mass fraction of glass material: 5 %, (ii) uncertainty in the initial silicate content b_0: 20 %, (iii) uncertainty in the measured silicate content b_1: as given in Table 3, and (iv) uncertainty in the storage time t_1: 15 days.

Some values of the density correction that were applied to the measured seawater densities are shown in Fig. 3. The corrections are about 1 g m^{-3} to 3 g m^{-3} and the corresponding estimated uncertainties are 0.4 g m^{-3}, which yields an increase in uncertainty of the measured values at atmospheric pressure of up to 8 %. The scatter of the correction values for high pressures is higher than that for atmospheric pressure, as density measurements at high pressures take significantly longer; as a result, the period between the first and last measurement is longer as well.

3.3 Air saturation

Usually, seawater samples used in highly accurate density measurements in laboratories are air-saturated, as any degassing procedure may change the salt composition. For water, the effect of air solubility on density has been measured directly, e.g. by Bignell (1983) by comparing the densities of saturated and desaturated water.

For our density measurements, the seawater samples were taken directly from the vessels delivered by OSIL as shown in Fig. 1a. The vessels were stored in our laboratory at a temperature of approximately 20 °C, at which the seawater equilibrated with the air inside the (closed) vessels. Since the seawater was also pumped into the VTD at this temperature, the air saturation was 100 % at 20 °C. After filling the VTD, the seawater temperature was altered to the measurement temperature. During this time, the saturation changed to undersaturation at temperatures lower than 20 °C and to oversaturation at temperatures higher than 20 °C, as there was no contact to air during the time of temperature equilibration, which is approximately 15 min. This temperature-dependent aeration is significant compared to the density measurement uncertainty. For consistency of the air saturation, the measured densities have to be corrected to a saturation of either 0 % or 100 %. Because the density corrections to 100 % are significantly smaller than those to 0 %, and because any degassing procedure is problematic, the density values were corrected to 100 % air saturation. Following this procedure, the density–salinity relation was developed with the least loss in accuracy.

The density correction is estimated taking into account the fact that the amount of air molecules remains constant while the liquid temperature changes from 20 °C to measurement temperature before density measurement. To quantify the density change of seawater by saturation with nitrogen, oxygen and argon in an atmosphere with 100 % humidity, a complex calculation similar to that for water of Harvey et al. (2005) was carried out. For this calculation, the partial molar volumes of nitrogen, oxygen and argon in water were assumed to be equal in seawater. Salinity-dependent solubility data of nitrogen and argon were taken from Hamme and Emmerson (2004) and of oxygen from Garcia and Gordon (1992).

Carbon dioxide exists in three different significant forms in seawater, i.e. as free aqueous molecule, CO_2, as bicarbonate ion, HCO_3^-, and as carbonate ion, CO_3^{2-}, the sum of all being called dissolved inorganic carbon (DIC). The DIC concentration as well as that of each species depends on salinity, temperature as well as CO_2 partial pressure, if the seawater is in contact with the atmosphere (as described by Henry's law for CO_2). If the air is humid, the CO_2 partial pressure changes with temperature due to the water vapour pressure, whereby CO_2 is released from (for temperature increase) or absorbed into seawater (for

temperature decrease). Since this affects the HCO_3^- and CO_3^{2-} concentration, the absolute salinity and thus the density are affected by temperature changes. For standard seawater with a salinity of 35 exposed to air with 100 % humidity, DIC is ≈ 2190 µmol kg^{-1} for 0 °C, ≈ 2050 µmol kg^{-1} for 20 °C, and ≈ 1870 µmol kg^{-1} for 40 °C [6], which, starting from 20 °C, results in density changes of +1.7 g m^{-3} for 0 °C and −2.2 g m^{-3} for 40 °C. A removal of all DIC results in a density change of up to 30 g m^{-3} [7]. Since standard seawater is equilibrated with air at ≈ 20 °C for at least 4 weeks during its preparation (Bacon et al., 2007) and the samples used in the substitution measurements had also been stored at ≈ 20 °C, before they were filled into the densimeter, where their temperature was altered, the DIC was conserved and no correction is necessary. By contrast, if seawater is exposed to the atmosphere during a density measurement, as for example in a hydrostatic weighing densimeter, a density correction may be necessary for temperatures different from 20 °C.

The complex calculation showed that the different gas solubilities in water and seawater are negligible in terms of density, as the deviation between the calculated density change of seawater and that of water (of Harvey et al.) is around 0.1 g m^{-3}. Furthermore, it was found that it is sufficient to consider only the nitrogen solubility to calculate the density correction that is approximated by:

$$\Delta\rho_{\mathrm{aer}}^{\mathrm{SW}} = \left(1 - \frac{n_{\mathrm{N_2}}(100\,\%,\,20\,^{\circ}\mathrm{C})}{n_{\mathrm{N_2}}(100\,\%,T)}\right) \cdot \Delta\rho_{\mathrm{a}}^{\mathrm{H_2O}}(100\,\%, T), \tag{8}$$

where $n_{\mathrm{N_2}}(100\,\%, 20\,^{\circ}\mathrm{C})$ and $n_{\mathrm{N_2}}(100\,\%, T)$ are the dissolved nitrogen amounts of substance at 100 % saturation at 20 °C and at measurement temperature as well as $\Delta\rho_{\mathrm{a}}^{\mathrm{H_2O}}(100\,\%, T)$ being the corresponding density effect, whose calculation is described in Appendix A.

At measurement temperatures higher than 20 °C, the seawater is oversaturated during density measurement, as it was saturated at 20 °C before filling. It is assumed that the nucleation of microbubbles due to the oversaturation takes significantly longer than the time of temperature stabilization and density measurement, which is always less than 30 min. The density effect caused by oversaturation is therefore assumed to be proportionally equal to that up to saturation. The calculated density correction and the corresponding estimated uncertainty, which is 0.4 g m^{-3}, are illustrated in Fig. 4. The density correction is significant at temperatures less than 15 °C compared to the measurement uncertainty of 2 g m^{-3}, as the gas solubility is significantly higher at low temperatures.

Based on a measured substitution density, $\rho_{\mathrm{subs}}^{\mathrm{SW}}$, that has been corrected to the uniform isotopic water and chemical compositions and to 100 % air saturation, a seawater density, ρ^{SW}, was calculated by:

$$\rho^{\mathrm{SW}} = \rho_{\mathrm{subs}}^{\mathrm{SW}} - \Delta\rho_{\mathrm{prep}}^{\mathrm{SW}} + \Delta\rho_{\mathrm{iso}}^{\mathrm{SW}} - \Delta\rho_{\mathrm{stor}}^{\mathrm{SW}} + \Delta\rho_{\mathrm{aer}}^{\mathrm{SW}} + \Delta\rho_{\mathrm{tar}}^{\mathrm{SW}}, \tag{9}$$

where $\Delta\rho_{\mathrm{tar}}^{\mathrm{SW}}$ is a density correction to integer salinities introduced for practicability.

[6] DIC was calculated using the CO2calc software developed by Robbins et al. (2010) with the carbonate constants given by Millero (2010) that are also valid for low salinities, the acidity constant of hydrogen sulfate given by Dickson (1990), the boron to chlorinity ratio given by Lee et al. (2010) and the total pH scale. In the calculations, the total alkalinity was 2300 µmol kg^{-1} (IOC et al., 2010), which is constant for CO_2 exchange (Zeebe and Wolf-Gladrow, 2001), and the CO_2 molar fraction was 400 ppm.

[7] The density change was calculated using $\Delta\rho/\Delta\mathrm{DIC} = 0.0120$ g m^{-3}/(µmol kg^{-1}) (Song et al., 2005). Since Bradshaw (1973) found 0.0110 g m^{-3}/(µmol kg^{-1}) and Ohsumi et al. (1992) found 0.0128 g m^{-3}/(µmol kg^{-1}), the uncertainty in $\Delta\rho/\Delta$DIC may be 20 %.

4 Density–salinity relation

In this section, the development of the density–salinity relation is described. Although this relation should be used to determine the salinity by means of density, it was set up as a density function of salinity, temperature, and (absolute) pressure, i.e. $\rho = f(S,T,p)$, as doing so allows the data to be approximated more precisely. As a result, the salinity has to be calculated using inverse methods. Since the relation was developed relative to the water density for higher accuracy, the salinity range from 0 to 5 is included by adding the values of pure water. To make use of this relation even beyond this range and the ranges measured, the uncertainty was estimated for somewhat wider ranges in the absence of measurement data. The relation accuracy was verified by means of a new method that verifies the uncertainty in predicted results locally using the measurement results, taking into account the correlation between the two. This is particularly advantageous for empirical fit equations, as these are not physical laws and are therefore not inherently consistent, i.e. they are not independent of the measurement results themselves.

4.1 Physical model

The density of air-saturated seawater is modelled based on degassed water, whose density is given by $\rho_0^{H_2O}$. Salt that has a relative composition similar to that dissolved in standard seawater is added to the degassed water. The salt content is given implicitly by the salinity. The density of the degassed water changes after the salt is added by $\Delta\rho_0^{SW}$. In addition, air with a defined composition is absorbed, as a result of which the density changes by $\Delta\rho_a^{SW}$. The density of air-saturated seawater, ρ^{SW}, is thus given by:

$$\rho^{SW} = \rho_0^{H_2O} + \Delta\rho_0^{SW} + \Delta\rho_a^{SW}, \tag{10}$$

where $\rho_0^{H_2O}$ is the density of degassed water, $\Delta\rho_0^{SW}$ is the density change due to dissolved salt, and $\Delta\rho_a^{SW}$ is the density change due to absorbed air. The density change due to dissolved salt and absorbed air may be summarized by $\Delta\rho^{SW}$ and may also be called relative density of air-saturated seawater, as the seawater density was measured relative to water in the substitution measurements.

If the salt is added at the atmospheric pressure p_0, the water density changes by $\Delta\rho_0^{SW}(p_0)$. If the salt is added at the pressure $p \neq p_0$, the water density changes by $\Delta\rho_0^{SW}(p)$. If the difference between the two changes is $\Delta\Delta\rho_0^{SW}(p - p_0)$, then the density change due to dissolved salt at any pressure is given by:

$$\Delta\rho_0^{SW} = \Delta\rho_0^{SW}(p_0) + \Delta\Delta\rho_0^{SW}(p - p_0), \tag{11}$$

where $\Delta\rho_0^{SW}(p_0)$ is the density change due to dissolved salt at the atmospheric pressure p_0 and $\Delta\Delta\rho_0^{SW}(p - p_0)$ is the difference between the density changes at the pressure p and at the atmospheric pressure p_0.

The solubility of gases in liquids is well described at infinite dilution and low pressure by means of the Henry law, according to which the number of absorbed gas molecules is proportional to the gas pressure above the liquid. However, since there is no reservoir for additional gas at high pressure, only the air absorption at the gas pressure p_0 is taken into account for modelling. In addition, it is assumed that the absorbed air is incompressible. In the model, the density change due to absorbed air is therefore not treated as a function of pressure, i.e. $\Delta\rho_a^{SW} \neq f(p)$.

The solubility of air in seawater depends on salinity (Hamme and Emmerson, 2004; Garcia and Gordon, 1992). The comparison of the N_2, O_2 and Ar solubilities in water and seawater showed that the resulting density change in both liquids is approximately equal. In the model, the density change due to absorbed air is therefore not a function of the salinity either, i.e. $\Delta\rho_a^{SW} = \Delta\rho_a^{H_2O} \neq f(S)$.

4.2 Fitting of $\Delta\rho_0^{SW}(p_0)$

The values of the seawater density for atmospheric pressure, ρ^{SW}, which were obtained from the measurements and corrected to the uniform conditions, were broken down according to Eq. (10) into the corresponding values of the water density, $\rho_0^{H_2O}$, and the values yielded by the density change due to dissolved salt and absorbed air (or relative density of air-saturated seawater), $\Delta\rho^{SW}$. For this purpose, the water density was calculated using the equation of state developed by Wagner and Pruß (2002), by means of which the water reference density for the substitution measurements was calculated as well. Therefore, the uncertainty in the relative density is up to 20 % lower than that in the absolute density.

The values of the relative density of air-saturated seawater $\Delta\rho^{SW}$ were broken down into the resulting values of the density change due to dissolved salt, $\Delta\rho_0^{SW}(p_0)$, and the corresponding values of density change due to absorbed air, $\Delta\rho_a^{SW}$. For this purpose, the values of $\Delta\rho_a^{SW}$ were calculated using the equation of Harvey et al. (2005), which is valid for the absorption of air into water at $p_0 = 101325$ Pa, but were adopted for the absorption of air into seawater according to the physical model described above:

$$\frac{\Delta\rho_a^{SW}(T)}{\mathrm{g\,m^{-3}}} = 0.103 - 2.371 \times 10^5 \cdot \left(\frac{T}{°C} + 75\right)^{-2.5} + 1.82 \times 10^{-7} \cdot \left(\frac{T}{°C} + 75\right)^3, \quad (12)$$

where the model air composition is 78.1 % N_2, 20.9 % O_2, 0.9 % Ar, and 0.4‰ CO_2. This equation is also given in Appendix A, but is repeated here for clarity. Free aqueous CO_2 contributes less than 0.2 g m^{-3} to $\Delta\rho_a^{SW}$ and is therefore negligible.

The values of the relative density of degassed seawater, $\Delta\rho_0^{SW}(p_0)$, were used to fit the coefficients $a_{i,j}$ of the following empirical equation:

$$\Delta\rho_0(p_0) = \Delta\rho_0^o \cdot \sigma \cdot \sum_{i=0}^{5} \sum_{j=0}^{5-i} a_{i,j} \cdot \tau^i \cdot \sigma^j, \quad (13)$$

where $\Delta\rho_0^o = 30$ kg m^{-3}, $\tau = T/T^o$ is the reduced temperature with T being the temperature in K and $T^o = 288.15$ K, $\sigma = S/S^o$ is the reduced salinity with S being the salinity and $S^o = 35$. The values of $\Delta\rho_0^o$, T^o, S^o (as well as $\Delta\Delta\rho_0^o$ and π^o below) were chosen for practical handling of the fit coefficient values and do not have a physical meaning.

The linear fit coefficients $a_{i,j}$ were determined by uncertainty-weighted least squares fitting within the Monte Carlo based approach described in Appendix B. The fit coefficients were initially averaged from up to $n = 1{,}500$ runs, where no longer significant effects on calculated values or uncertainties thereof were found. Finally, the coefficients were averaged from $n = 15{,}000$ runs to be certain. The fitting yielded the values of $a_{i,j}$ given in Table 4, which were reduced to the significant number of digits.

The residuals of the fit using the coefficients given in Table 4 are illustrated in Fig. 5, where they are compared with the density–salinity relation uncertainty, U, whose determination is described below. The fit standard deviation is 1.1 g m^{-3}. No systematic deviation of the residuals depending on salinity or temperature was found.

If the density of air-saturated seawater is calculated using the density–salinity relation, the (fitted) relative seawater density plus the (artificially inserted) density change due to absorbed air is used, i.e. $\Delta\rho^{SW} = \Delta\rho_0^{SW} + \Delta\rho_a^{SW}$. However, $\Delta\rho_a^{SW}$ has practically no statistical influence on the fitting of $\Delta\rho_0^{SW}$, and therefore no statistical influence on $\Delta\rho^{SW}$. Consequently, if $\Delta\rho^{SW}$ is calculated, its uncertainty is $U(\Delta\rho_0^{SW})$, i.e. that of the degassed seawater density, whereas, if $\Delta\rho_0^{SW}$ is calculated, its uncertainty is $\left[U(\Delta\rho_0^{SW})^2 + U(\Delta\rho_a^{SW})^2\right]^{1/2}$, i.e. that of the degassed seawater density and that of the density change due to absorbed air.

The uncertainty in $\Delta\rho_0^{SW}(p_0)$ was determined and verified using the approach described in Appendix B. The calculated uncertainty is at least (0.7 g m^{-3}) at a salinity of 15 and at 25 °C, and increases as expected at higher salinities, as well as at

lower and higher temperatures (up to 1.2 g m^{-3}). The subsequent uncertainty verification yielded four inconsistent densities whose residuals were higher than their corresponding uncertainties. The uncertainty was therefore increased to 2 g m^{-3} in the entire measurement region of salinities up to 35 and temperatures from 5 °C to 35 °C.

Since the density–salinity relation may be used for calculations in a wider region, e.g. salinities up to 40 and temperatures from 0 °C to 40 °C, we also estimated the uncertainty in $\Delta\rho_0^{SW}(p_0)$ for this region in the absence of measurement data. The density uncertainty in the wider (extrapolation) region was also calculated using the approach described in Appendix B, whereby the possible variation of the fit polynomial outside the measured salinity and temperature region is taken into account. The uncertainties resulting from this calculation are shown in Fig. 6a together with the uncertainty of the measurement region. For practicability, the highest uncertainty in a particular region was assigned. The uncertainties in the extrapolation region are at least twice as much as in the measurement region.

For calculating salinity using relative density and temperature values by means of the density–salinity relation, the uncertainty in salinity was also determined in the measurement and extrapolation region. The salinity uncertainty was calculated by multiplying the density uncertainty by the partial derivative of salinity by density, i.e. $U(S) = U(\Delta\rho^{SW}) \cdot \partial S/\partial\rho$. The uncertainties resulting from this calculation are shown in Fig. 6b. A salinity determined by means of a calculation using the relation has an uncertainty of 3×10^{-3}. If measurement values are used for calculation, their uncertainty has to be considered. Since the mathematical formulation of the density-salinity relation is empirical and does not contain any theoretical boundary conditions for infinite dilution, as for example implemented in TEOS-10, the question arises whether the relation correctly predicts the density for very low salinities. Additionally, no uncertainty verification in the extrapolation region is possible using the fitting data set. Therefore, additional substitution density measurements were conducted: The density of diluted standard seawater with salinity 2 was measured at some temperatures and the density of some samples of the seawater used for determination of the density–salinity relation was measured at 1 °C. The seawater with salinity 2 was prepared like the seawater with salinities from 5 to 30. Unfortunately, the precision in the salinity-2-calibration was lower, so that the uncertainty in salinity is 0.0028 corresponding to an uncertainty in density of 2.2 g m^{-3}. The density results were corrected to the uniform isotopic water and the chemical salt compositions as well as air saturation as described in Sect. 3. The density deviations of the corrected results from the predicted values of the density–salinity relation are shown in Fig. 7. In both cases, the deviations are well within the uncertainty in the density–salinity relation. For the measurements of seawater with salinity 2, even if the uncertainty in salinity is treated as an offset to all deviations, the deviation is within its uncertainty. No inconsistencies are caused by the non-compliance with theoretical boundary conditions for very low salinities and atmospheric pressure.

4.3 Fitting of $\Delta\Delta\boldsymbol{\rho_0^{SW}}(\boldsymbol{p}-\boldsymbol{p_0})$

The values of the seawater density for high pressures, ρ^{SW}, were broken down according to Eq. (10) into corresponding values of the water density, $\rho_0^{H_2O}$, and the values yielded by the density change due to dissolved salt and absorbed air (or relative density of air-saturated seawater), $\Delta\rho^{SW}$. Since the water density was calculated analogously to the atmospheric pressure densities, the uncertainty in the relative density is up to 50 % lower than that in the absolute density for pressures up to 10 MPa and up to 80 % lower for up to 65 MPa.

The values of the relative density of air-saturated seawater, $\Delta\rho^{SW}$, were broken down into the values yielded by the density change due to dissolved salt, $\Delta\rho_0^{SW}$, and the corresponding values of the density change due to absorbed air, $\Delta\rho_a^{SW}$. For this purpose, the values of $\Delta\rho_a^{SW}$ were calculated analogously to the atmospheric pressure densities using Eq. (12).

The values of the density change due to dissolved salt, $\Delta\rho_0^{SW}$, were further broken down according to Eq. (11) into the values of the density change due to dissolved salt at the atmospheric pressure $p_0 = 101325$ Pa, $\Delta\rho_0^{SW}(p_0)$, and the difference between the density change at (high) pressure p and that at the pressure p_0, $\Delta\Delta\rho_0^{SW}(p - p_0)$. The relative density values for atmospheric pressure that had been used to fit the coefficients of Eq. (13), were used for this purpose.

The resulting values of the density difference $\Delta\Delta\rho_0^{SW}(p - p_0)$ were used to fit the coefficients $b_{i,j,k}$ of the following empirical equation:

$$\Delta\Delta\rho_0^{SW}(p - p_0) = \Delta\Delta\rho_0^{o} \cdot \sigma \cdot \pi \cdot \sum_{i=0}^{4} \sum_{j=0}^{4-i} \sum_{k=0}^{4-i-j} b_{i,j,k} \cdot \tau^i \cdot \sigma^j \cdot \pi^k, \quad (14)$$

where $\Delta\Delta\rho_0^{o} = 2$ kg m^{-3}, $\pi = (p/p^{o} - 1)/\pi^{o}$ with p being the pressure in MPa, $p^{o} = p_0 = 0.101325$ MPa and $\pi^{o} = 1000$. Due to the formulation of the dimensionless pressure π, $\Delta\Delta\rho_0$ is exactly zero at p_0, thereby ensuring the high accuracy of the density at atmospheric pressure $\Delta\rho_0(p_0)$.

The linear fit coefficients $b_{i,j,k}$ were determined analogously to the fit coefficients $a_{i,j}$ using the approach described in Appendix B. The fitting yielded the values of $b_{i,j,k}$ given in Table 5, which were reduced to the significant number of digits. The residuals of the fit using the coefficients given in Table 5 are illustrated in Fig. 8. The uncertainty of the measured relative densities underlying the fit range from 6 g m^{-3} up to 14 g m^{-3} for salinities from 5 up to 35 and were estimated conservatively. The fit standard deviation of 2.3 g m^{-3}, which is 5 g m^{-3} for a probability of 95.45 %, and the fact that no systematic deviation of the residuals depending on salinity, temperature, or pressure is found suggest that the uncertainty in the measured relative densities may have been overestimated, i.e. their accuracy may have been underestimated. The density uncertainty in the measurement region was determined using the approach described in Appendix B and yielded an uncertainty of 6 g m^{-3}, thereby supporting the suggestion. The uncertainty of 6 g m^{-3} was therefore adopted for the measurement region. One residual for 41.5 MPa, one for 52 MPa and two for 65 MPa, of 49 respectively, exceed this uncertainty significantly.

The data set for fitting $\Delta\Delta\rho_0^{SW}(p - p_0)$ comprises pressures up to 65 MPa. Since the density–salinity relation may be used for calculations over a wider range, e.g. pressures up to 100 MPa, the uncertainty in this range was estimated in the absence of measurement data. Summarized results of this calculation are shown in Fig. 9a and 9c together with the results of the measurement region. For practicability, the highest uncertainty in a particular region was assigned. The uncertainties in the extrapolation region are at least twice as much as in the measurement region. For calculating salinity using relative density, temperature, and pressure values by means of the density–salinity relation, the uncertainty in salinity was also determined in the measurement and extrapolation region. The salinity uncertainty was calculated by multiplying the density uncertainty by the partial derivative of salinity by density, i.e. $U(S) = U(\Delta\rho^{SW}) \cdot \partial S/\partial\rho$. The uncertainties yielded by this calculation are shown in Fig. 9b and 9d. A salinity determined by means of a calculation using the relation in the measurement region has an uncertainty of 8×10^{-3}. If measurement values are used for calculation, their uncertainty has to be included.

As pointed out above, the mathematical formulation of the density–salinity relation is empirical and does not contain any theoretical boundary conditions for infinite dilution. This is also an issue for the density at high pressures, as here the measurement uncertainty in density is higher, thereby causing more variability in the shape of the relation for very low salinities. Therefore, additional measurements were conducted on diluted standard seawater with salinity 2 for some temperatures. The samples used were obtained from the same seawater as described above in Sect. 4.2; the corrections were similar. The density deviations of the corrected values from predicted values of the density–salinity relation are shown in Fig. 10. The deviations are well within the uncertainty in the relation. No inconsistencies are caused by the non-compliance with theoretical boundary conditions for very low salinities and high pressures.

5 Comparison with TEOS-10

The present reference equation of state for thermodynamic properties of seawater is the Thermodynamic Equation of Seawater TEOS-10 adopted by the Intergovernmental Oceanographic Commission (IOC et al., 2010). TEOS-10 describes the properties of degassed seawater in wide ranges of salinity, temperature, and pressure relative to degassed water with the VSMOW isotopic composition. Relative density values calculated using TEOS-10 with salinities from 0 to 40 and temperatures from 0 °C to 40 °C have estimated uncertainties of 8 g m^{-3} for atmospheric pressure, 17 g m^{-3} up to 10 MPa, and 26 g m^{-3} up to 100 MPa. To possibly reduce the density uncertainty in these regions, TEOS-10 was compared with the density–salinity relation.

5.1 Atmospheric pressure

For atmospheric pressure, the density deviation of TEOS-10 from the density–salinity relation is shown in Fig. 11a. TEOS-10 density values are always higher than those of the density–salinity relation. The increase of the deviation with salinity is approximately linear. At salinities higher than 25, the deviation exceeds the estimated uncertainty of 8 g m^{-3} significantly. At salinities smaller than 5, the deviation, although consistent, is unexpectedly high. Salinity 0, which is pure water, defines the zero-line of TEOS-10 and of the density–salinity relation.

To leave the linear increase of the deviation with salinity seen in Fig. 11a out of consideration, a reduced form is shown in Fig. 11b. Here, $\Delta\rho - \Delta\rho(S = 35) \cdot S/35$ is visualized. It is found that the reduced deviation is always less than 5 g m^{-3}.

To find possible causes for the unexpectedly high density deviation, the density data on which TEOS-10 is based, were examined, where the uncertainty in salinity was considered negligible. In the (S, T, p_0)-region of interest, according to Feistel (2003 and 2008), TEOS-10 is based on a dataset (JPOTS, 1981c, pp. 36–56) that consists of normalized density data of Millero et al. (1976) and of Poisson et al. (1980), where the density data of Millero et al. has a significantly higher precision. For atmospheric pressure, this dataset was also used to fit the previous reference equation of state EOS-80 (JPOTS, 1981c), and, therefore, no comparison with EOS-80 was carried out.

Millero et al. measured the density of diluted and standard seawater of batch P63 using a magnetic float densimeter. The comparison between the normalized densities measured by Millero et al. and TEOS-10 shown in Fig. 12a suggests that TEOS-10 is well fitted to these densities. Furthermore, for salinities less than 30 (compared to for salinities greater than or equal to 30), the deviation is strongly scattered and the salinity value of each deviation value is different. This may be explained by the fact that not all density measurements were carried out in a closed measuring vessel (JPOTS, 1981c, p. 35), thereby avoiding evaporation, which would increase the salinity and density during a measurement. To exclude the impact of the data normalization, a comparison of the original densities of Millero et al. (1976) and the density–salinity relation is shown in Fig. 12b, where the measurements that were carried out in a closed measuring vessel are separated from those that were putatively carried out in an open measuring vessel. The deviations of the closed-vessel measurements (for salinity 30 and 35) are the smallest and scatter the least, whereas the deviations of the open-vessel measurements (for all other salinities) scatter highly. If it is assumed that evaporation occurred during the open-vessel measurements, then the measured densities can be systematically too high (or the assigned salinities too small), which would cause the open-vessel deviations to be too high. Furthermore, a linear fit curve that was developed using the closed-vessel deviations is shown, as it is possible that there is a systematic deviation increasing linearly with salinity besides the evaporation. The smallest open-vessel deviations, which are most likely not significantly affected by evaporation, correlate conspicuously with this fit curve, thereby supporting the possibility of systematic deviation. The open-vessel densities for salinity 40, which are visible as the highest deviations in Fig. 12b, were corrected (using the closed-vessel densities) when the density data of Millero et al. and Poisson et al. were normalized (JPOTS, 1981c, pp. 35 and 58), wherefore there are no significant deviations for salinity 40 in Fig. 12a. It should

be noted that for calculation of the density deviations given in Fig. 12a and b, the temperatures at that Millero et al. made their measurements were converted from the International Practical Temperature Scale 1968 to the International Temperature Scale 1990 (CCT, 1997). To identify plausible causes for the systematic deviation, we thoroughly examined the magnetic flotation method used by Millero et al. for possible issues.

Magnetic float densimeters have the advantage over hydrostatic weighing densimeters that no mechanical coupling by means of a suspension is needed to determine the buoyance force acting on a float (or sinker). Instead, this is achieved with a magnetic coupling by placing a magnet into a float. The float is brought to mechanical equilibrium, i.e. floats in the liquid, by means of a current-carrying coil; here, the current is a measure of the force, and thus of the liquid density. However, for density measurement the characterisation of the magnetic coupling is necessary in addition to the determination of the float volume, as in case of a hydrostatic weighing densimeter.

The densimeter used by Millero et al. for measuring the seawater density consisted of a hollow float in the measuring liquid of a vessel that had a volume of 250 mL, with the coil mounted underneath. The float was made of Pyrex, contained a permanent magnet that was a stirring bar and was therefore probably made of Alnico, and had a volume of 32 cm^{-3} (Millero, 1967). The float was weighted with platinum weights to adjust its buoyancy. The current that passed through the coil was used to pull the float to the bottom of the measuring vessel. Subsequently, the current intensity was gradually reduced until the float lifted off the bottom. The equilibrium current determined in this way, which was assumed to define the state of floating, was a measure of the liquid density.

Bignell (2006) discussed various methods for determining the buoyancy force in magnetic float densimeters. For the design of the magnetic coupling system, the magnetic force exerted on a permanent magnet by a current-carrying, circular coil (without a metal core) was given by:

$$F_{\text{mag}} = m \cdot G(z,R) = m \cdot \frac{-3}{2} \cdot \mu \cdot \frac{R^2 \cdot z}{\sqrt{(R^2+z^2)^5}} \cdot I, \tag{15}$$

where m is the magnetic momentum; $G(z,R)$ is the magnetic field gradient (along the axis perpendicular to the coil plane through the coil centre point), μ is the permeability of the medium between the permanent magnet and the coil, R is the circular coil radius, z is the distance between the magnet and the coil, and I is the current. In a measurement obtained from seawater, the magnetic force is therefore dependent on the magnetic water properties and on the magnet-coil distance.

Bignell pointed out that the force on the magnet is also dependent on the magnetic field, even for magnetically hard materials. The magnetic force is therefore not linearly (as in Eq. 15) but quadratically dependent on the equilibrium current, i.e. $F_{\text{mag}} = f_1 \cdot I + f_2 \cdot I^2$, where f_1 and f_2 are magnetic coupling constants. For a magnetically hard material, the force mainly depends on the linear term, whereas the quadratic term is used as a correction.

Millero et al. used a cylindrical (instead of a circular) coil and summarized the magnetic force as $F_{\text{mag}} = f \cdot I$, where the calibration factor f was determined with measurements obtained from air-saturated water by weighing the float with platinum weights. The seawater density was determined relative to water, i.e. relative to the calibration using water:

$$\Delta\rho^{\text{SW}} = \frac{f \cdot (I^{\text{SW}} - I^{\text{H}_2\text{O}})}{V + m_{\text{Pt}}/\rho_{\text{Pt}}}, \tag{16}$$

where I^{SW} and $I^{\text{H}_2\text{O}}$ are the currents resulting from the measurements obtained from air-saturated seawater and water, V is the float volume, which is also determined by the calibration, m_{Pt} and ρ_{Pt} are mass and density of the platinum weights, which were identical in a measurement obtained from seawater and water.

Since seawater and water have different magnetic properties, it is possible that the calibration factor f is significantly different, i.e. $\mu^{\text{SW}} \not\approx \mu^{\text{H}_2\text{O}} \Longrightarrow f^{\text{SW}} \not\approx f^{\text{H}_2\text{O}}$. To rule out this possibility, we carried out a representative calculation. Since, theoretically, $F_{\text{mag}} \propto \mu \cdot I$ for a cylindring (and circular) ring coil, it follows directly that $\mu^{\text{SW}}/\mu^{\text{H}_2\text{O}} = f^{\text{SW}}/f^{\text{H}_2\text{O}}$ if the permanent magnet

is in the same position in both measurements; the calibration factor of seawater is thus calculated from that of water. The permeabilities are calculated by $\mu = \mu_0 \cdot (1 + \chi)$, where $\mu_0 = 4 \cdot \pi \cdot 10^{-7}\ \mathrm{N\,A^{-2}}$ is the vacuum permeability, $\chi^{\mathrm{SW}} = -8.25{\times}10^{-6}$ and $\chi^{\mathrm{H_2O}} = -9.04{\times}10^{-6}$ are the (dimensionless) volume susceptibilities of seawater with a salinity of 29 (Imhmed, 2012) and of water. The relative density deviation due to the different permeabilities being neglected was calculated by $\Delta\rho^{\mathrm{SW}}(f^{\mathrm{SW}}, f^{\mathrm{H_2O}}) - \Delta\rho^{\mathrm{SW}}(f = f^{\mathrm{H_2O}})$ using (i) the calibration factor for water $f = f^{\mathrm{H_2O}} = -3.5308\ \mathrm{g\,A^{-1}}$ for 25 °C (Millero, 1967), (ii) the currents $I^{\mathrm{SW}} = 0.4$ A and $I^{\mathrm{H_2O}} = 0.15$ A, (iii) the platinum mass and density $m_{\mathrm{Pt}} = 0.7$ g and $\rho_{\mathrm{Pt}} = 21450\ \mathrm{kg\,m^{-3}}$, and (iv) the float volume given above. The values (ii) and (iii) were chosen based on a plot of calibration data of the flotation densimeter given by Millero (1967), and correspond to a relative sea water density of 28 kg m^{-3}. The calculation yields a density deviation at the order of 0.01 g m^{-3}; as a result, the differences in the magnetic properties of seawater and water are not problematic.

Since the volume of the float was also determined by means of the calibration measurement using water, it is possible that this resulted in a significant deviation in the relative seawater density. We therefore carried out a further representative calculation using the values (i–iv). Using this calculation, a density deviation of only 3 g m^{-3} is yielded for a relative volume deviation of 10^{-4}. Although the volume results indirectly from an extrapolation of the linear relation of the magnetic coupling, $F_{\mathrm{mag}} = f \cdot I$, which is quadratic even for magnetically hard materials according to Bignell, it is unlikely that a volume deviation of this magnitude will occur in the calibration measurement; the float volume calibration is therefore not problematic.

We performed a final calculation to estimate how significant the precise height positioning of the permanent magnet is, i.e. the distance from the coil. Two reasons for a change of the distance are conceivable. On the one hand, the position of the magnet (inside the float) or of the coil can change in the time between the calibration measurement obtained from water and the measurement obtained from seawater; the permanent magnet was fixed in the hollow float using wax (Millero, 1967). Density deviations that result from such position changes are minimized if, after each measurement obtained from seawater, a measurement obtained from water had also been carried out (a quasi-substitution measurement). On the other hand, the "lift-off" process, wherein the equilibrium current is determined by sight, is not the same for seawater and water in terms of speed (among other factors). Density deviations that result from such dissimilarities are minimized, if, in additional to the "lift-off" current, the "drop-down" current had been determined in the opposite manner and both currents had been averaged for seawater and water, respectively. Or, if in the measurement obtained from seawater, the float was weighted with the aim to yield the same current as in the calibration measurement using water.

For the calculation, it was assumed that the height dependence of the magnetic force given by z in Eq. (15) for the circular coil is similar for the cylindrical coil used by Millero et al. If the distance between magnet and coil is $z + \Delta z$, then $f(z + \Delta z)/f(z) = (z + \Delta z)/z \cdot [(R^2 + z^2)/(R^2 + (z + \Delta z)^2)]^{5/2}$ holds. The displacement of the coil or of the magnet can be treated mathematically as the same, since $f^{\mathrm{SW}} = f(z + \Delta z)$ applies to the measurement obtained from seawater and $f^{\mathrm{H_2O}} = f(z)$ applies to the measurement obtained from water in both cases. Using the values (i–iv), the coil radius $R = 20$ mm and the distance $z = 40$ mm for an unconsidered distance increase of $\Delta z = 3$ µm yields a relative seawater density which is too high by 10 g m^{-3}. R and z were estimated based on a sketch and a dimension of the flotation densimeter used (Millero, 1967). If a temporal or permanent distance increase exists that is not considered, an approximately linear density increase (or decrease) as seen in Fig. 12b results.

The high sensitivity of the measurement density to the magnet height position is one reason why magnetic flotation densimeters that were developed later and that share a similar principle, e.g. that of Bignell (1982), use position sensing systems with accuracies that are at least in the micrometer range to keep the height, z, constant. The actual cause of the significance of the

density deviations seen in Figs. 12a and b may therefore be an overestimation of the accuracy and precision of the magnetic flotation method used.

5.2 High pressure

TEOS-10 may be used to calculate densities for pressures up to 100 MPa. In the $(S, T, p > p_0)$-region of interest, the relative density data given by Chen and Millero (1976), as well as thermal expansion data given by Bradshaw and Schleicher (1970) and speed-of-sound data given by Del Grosso (1974) were used for fitting (Feistel, 2003 and 2008). Chen and Millero directly measured the seawater density, i.e. the specific volume, relative to water using a magnetic float densimeter whose magnetic force on the float was determined as described above. By contrast, the data of Bradshaw and Schleicher, and of Del Grosso allows only the calculation of difference densities using thermodynamic relations, i.e. relative to a reference state of the absolute seawater density with defined salinity, temperature, and pressure.

An overview of the density deviation of TEOS-10 from the density–salinity relation in the entire salinity-temperature region for atmospheric pressure is given in Fig. 13a. The increase in the deviation with salinity seen in Fig. 11a for 5 °C, 20 °C, and 35 °C is also present for 0 °C. For higher temperatures and salinities of around 20, the deviation increases unexpectedly. A similar overview of the density deviation for 30 MPa is given in Fig. 13b. The density deviation for this pressure is higher than that for atmospheric pressure. In the measurement region, this trend continues globally for up to 65 MPa as seen in Fig. 13c, but, in the extrapolation region, discontinues locally for up to 100 MPa as seen in Fig. 13d. For all pressures, the densities calculated using TEOS-10 are higher than the densities calculated using the density–salinity relation. The uncertainty in the deviations, however, is not exceeded significantly for higher pressures.

Chen and Millero measured the seawater density using a densimeter that is similar to that for atmospheric pressure used by Millero et al. (1976), wherefore similar systematic deviations are likely. Both the thermal expansion data of Bradshaw and Schleicher and the speed-of-sound data of Del Grosso can only be compared with the density–salinity relation, if the absolute seawater and water density are included in the calculation. The uncertainty in the water density calculated using IAPWS-95 is 10 g m^{-3} for pressures up to 10 MPa and 30 g m^{-3} for up to 100 MPa. Since the deviation between TEOS-10 and the density–salinity relation shown in Fig. 13b–d is comparable to this uncertainty, the water density may be considered as a cause. For example, Lin and Trusler (2012) showed by rough calculation of the water density using their measured speed-of-sound data that the IAPWS-95 density for 0 °C to 40 °C and pressures up to 100 MPa is within its uncertainty, but may be too low by a few 10 g m^{-3}. A detailed analysis of this issue was given by Wagner and Thol (2015).

6 Summary

A density–salinity relation for IAPSO standard seawater was developed by means of highly accurate density measurements performed using a recently developed substitution method. This relation makes it possible to consistently determine (practical) salinity by means of density measurement at a level of accuracy that is comparable to that achieved by means of a conductivity measurement supported by PSS-78 and related application routines. The relation has been developed as a function of salinity, i.e. $\Delta\rho = f(S,T,p)$, relative to the density of water, as such a function was better fitted to the measurements, thereby increasing the accuracy of the predicted results. The relation is valid for seawater with the chemical salt composition of IAPSO standard seawater, for the isotopic water composition of Vienna Standard Mean Ocean Water, and for an air saturation of 100 % at all temperatures and at atmospheric pressure. The reference density is that of degassed water. The measurement range comprises $0 \leq S \leq 35$, $5\ °C \leq T \leq 35\ °C$, and $0.1\ MPa \leq p \leq 65\ MPa$. In this range, the uncertainty in salinity (calculated from density) is 0.003 for atmospheric pressure and 0.008 for high pressures; the uncertainty in density (calculated from salinity) is 2 g m^{-3} and 6 g m^{-3}, respectively. Since the conditions occurring in the ocean cover a wider range, the relation range of validity has been extended to $0 \leq S \leq 40$, $0\ °C \leq T \leq 40\ °C$, and $0.1\ MPa \leq p \leq 100\ MPa$. In this range, the uncertainty was estimated to be a multiple of that in the measurement range, i.e. usually twice as much. A validation for temperatures down to 0 °C was performed using additional density measurements.

Density corrections for standard seawater were developed. Because the chemical composition was changed by interactions with borosilicate glass material of the storage vessel, and because the seawater samples used in the measurements were stored for different periods, the measured densities were corrected to a uniform (i.e. the original) chemical composition. These corrections are up to 3 g m^{-3}. Because the isotopic water composition of the standard seawater changed due to the addition of water (with less deuterium, oxygen-17 and 18) in the preparation of dilute seawater samples, the measured densities were corrected to the uniform isotopic composition of VSMOW. These corrections are up to 2.5 g m^{-3}. A further density correction was developed to correct the seawater air saturation to 100 %; where the temperature changed while air was excluded, the corrections were up to 1.5 g m^{-3}. Taken together, all corrections total more than 5 g m^{-3}.

The density–salinity relation was compared with the reference equation of state for seawater TEOS-10. For atmospheric pressure, density deviations of up to 15 g m^{-3} were found, which is significantly greater than the deviation uncertainty. Moreover, a systematic, linear dependence on salinity was found. One reason for the deviations is likely an overestimation of the accuracy of the density data that TEOS-10 (as well as EOS-80) is based on in this region. For high pressures, density deviations of up to 40 g m^{-3} were found, which is of the same order of magnitude as the deviation uncertainty.

7 Conclusions

Seawater is changed during storage. Mainly silicon dioxide dissolves from borosilicate glass material and forms silicic acid, but over the long term, the solubility of other glass components is also important. This affects the density of stored seawater. If standard seawater is to be used as a density reference material, the solubility of all glass components must be quantified so that the change in the chemical composition and in density can be calculated. This also includes the dependence of this solution on temperature during storage; storage at low temperatures may minimize this interaction. For long-term storage, container materials that have a greater chemical resistance should be investigated.

Knowledge of the isotopic composition is essential for measurements obtained from seawater samples that are artificially diluted with water from different locations, as the local isotopic water composition varies significantly. For natural seawater, this may be important in marginal seas.

The data situation of recent highly accurate density measurements of standard seawater is poor, which is why further measurements should be carried out using state-of-the-art methods. The data of the density–salinity relation obtained in the present study should be used as a correction to TEOS-10.

Salinity is usually measured by means of a salinometer measuring conductivity and being calibrated by standard seawater, which is of natural origin. A long-term change in the salt proportions in seawater cannot be detected by this way, as it will be overwritten by the (re-)calibrations with standard seawater.

The density is sensitive to all components, including dissolved salts and gases (and even isotopes), and can be determined without natural reference materials. If the salt composition of standard seawater is changing in the long-term, the density–salinity relation provides a metrological basis for detecting this change.

As possible changes in the seawater density are expected to be of the order of measurement uncertainty or even smaller, a periodic assessment should be ensured over several decades. Since the introduction of the salinity determination using standard seawater, forty years have passed without this. We propose a density measurement of any freshly prepared standard seawater batch. A well-known example of such long-term assessment is the Keeling curve of the CO_2 content in the atmosphere (Scripps). For standard seawater, there should be a “Keeling curve” for density in future.

Data availability

The complete data used to develop and validate the density–salinity relation is provided in a digital supplement.

Appendix A: Reference water density

The calculation of the reference densities $\rho_{\mathrm{ref}}^{\mathrm{H_2O}}$ assigned to the water reference for the substitution measurements is based on the equation of state (EOS) given by Wagner and Pruß (2002), which was adopted by the International Association of the Properties of Water and Steam in 1995 as IAPWS-95:

$$\rho_0^{\mathrm{H_2O}} = \rho_{\mathrm{IAPWS\text{-}95}}, \tag{A.1}$$

where $\rho_{\mathrm{IAPWS\text{-}95}}$ is valid for degassed water with VSMOW (IAEA, 2009) isotopic composition. The values calculated with this equation were therefore corrected to the air saturation and isotopic composition of our water reference to calculate its density accurately. The equation to correct for isotopic composition was taken from Tanaka et al. (2001) and is:

$$\frac{\Delta\rho_{\mathrm{c}}^{\mathrm{H_2O}}(T_{\rho\mathrm{max}},p_0)}{\mathrm{g\,m^{-3}}} = 0.233 \cdot \frac{\delta_{18}}{‰} + 0.0166 \cdot \frac{\delta_{\mathrm{D}}}{‰}, \tag{A.2}$$

where $\Delta\rho_{\mathrm{c}}^{\mathrm{H_2O}}$ is the density difference due to isotopic composition, δ_{D} and δ_{18} are the isotopic abundances of deuterium and oxygen-18 relative to VSMOW composition, $T_{\rho_{\mathrm{max}}} = 3.98$ °C (at maximum density), and $p_0 = 101325$ Pa.

The correction for air saturation was taken from Harvey et al. (2005) and is (valid for 0 °C to 50 °C and 101325 Pa):

$$\frac{\Delta\rho_{\mathrm{a}}^{\mathrm{H_2O}}(T,p_0)}{\mathrm{g\,m^{-3}}} = 0.103 - 2.371 \times 10^5 \cdot \left(\frac{T}{°\mathrm{C}} + 75\right)^{-2.5} + 1.82 \times 10^{-7} \cdot \left(\frac{T}{°\mathrm{C}} + 75\right)^3, \tag{A.3}$$

where $\Delta\rho_{\mathrm{a}}^{\mathrm{H_2O}}$ is the density difference due to air saturation and T is the temperature.

We assumed the corrections for isotopic composition and air saturation are dependent on temperature and pressure and applied corrections in the following manner:

$$\Delta\rho_{\mathrm{c}}^{\mathrm{H_2O}}(T,p) = \frac{\Delta\rho_0^{\mathrm{H_2O}}(T,p)}{\Delta\rho_0^{\mathrm{H_2O}}(T_{\rho\mathrm{max}},p_0)} \cdot \Delta\rho_{\mathrm{c}}^{\mathrm{H_2O}}\left(T_{\rho_{\mathrm{max}}},p_0\right) \text{ and} \tag{A.4}$$

$$\Delta\rho_{\mathrm{a}}^{\mathrm{H_2O}}(T,p) = \frac{\Delta\rho_0^{\mathrm{H_2O}}(T,p)}{\Delta\rho_0^{\mathrm{H_2O}}(T,p_0)} \cdot \Delta\rho_{\mathrm{a}}^{\mathrm{H_2O}}(T,p_0), \tag{A.5}$$

where the corrections are scaled to the density of water with VSMOW isotopic composition based on their valid states of temperature T and pressure p. The water reference density is consequently given by:

$$\rho_{\mathrm{ref}}^{\mathrm{H_2O}} = \rho_0^{\mathrm{H_2O}} + \Delta\rho_{\mathrm{c}}^{\mathrm{H_2O}} + \Delta\rho_{\mathrm{a}}^{\mathrm{H_2O}}. \tag{A.6}$$

Uncertainties for the calculated densities $\rho_{\mathrm{IAPWS-95}}$ relevant for the temperature range of 5 °C to 35 °C given by Wagner and Pruß are 1 g m^{-3} for atmospheric pressure, 10 g m^{-3} for pressures up to 10 MPa, and 30 g m^{-3} for pressures up to 100 MPa. The uncertainties of corrections for isotopic composition and air saturation including the measurements and calculations contribute 10 % to the overall uncertainty in the seawater density measurements at atmospheric pressure (Schmidt et al., 2016).

Appendix B: Relation uncertainty

The density–salinity relation is an empirical thermophysical equation of state, the formulation of which is determined by the underlying measurement values and their associated uncertainties, which were determined in accordance with the Guide to the Expression of Uncertainty in Measurement (GUM) adopted by the Joint Committee for Guides in Metrology (JCGM) in 2008 (JCGM GUM, 2008).

To calculate the uncertainty in predicted results of the density–salinity relation, the Monte Carlo method (MCM) as described in Supplement 2 to the GUM (JCGM GUM S2, 2011) was applied. In the MCM, $n = 15{,}000$ random values (for atmospheric and high pressures) of each particular measurement value were generated based on the associated uncertainty distribution; in case of the relative density values $\Delta\rho_0$ and $\Delta\Delta\rho_0$, this is a *t*-distribution. The result is a data set with *n* subsets that are used to fit the equation coefficients n times. The final value of a coefficient is obtained by calculating the mean value of all (random) coefficient values resulting from the n fits. The standard uncertainty in a coefficient is obtained by calculating the standard deviation. For calculation of the uncertainty in a predicted value, the correlations between the fit coefficients have to be taken into account. These are obtained by calculating the particular empirical correlation coefficients using the random data.

Since the applicability of MCM described in the GUM S2 is by definition limited to measurement models that usually involve the use of physical laws, the uncertainty in a predicted value determined in this way may not be consistent. For this reason, the consistency of the predicted uncertainties has to be evaluated.

A common approach to evaluate the consistency of a fit equation is to compare the values of the fit residual Δ against their associated uncertainty $U(\Delta)$. A particular $U(\Delta)$ is calculated using the law of propagation of uncertainty:

$$U(\Delta) = \sqrt{U(\Delta\rho_\mathrm{m})^2 + U\left(\Delta\rho_\mathrm{p}\right)^2 + 2 \cdot U(\Delta\rho_\mathrm{m}) \cdot U\left(\Delta\rho_\mathrm{p}\right) \cdot r\left(\Delta\rho_\mathrm{m}, \Delta\rho_\mathrm{p}\right)}, \tag{B.1}$$

where $r\left(\Delta\rho_\mathrm{m}, \Delta\rho_\mathrm{p}\right)$ is the empirical correlation coefficient of the predicted and the measured value. Because in the fit process e.g. the residual sum of squares (RSS) is minimized, the predicted and measured densities are necessarily correlated; hence, $r\left(\Delta\rho_\mathrm{m}, \Delta\rho_\mathrm{p}\right) \neq 0$. Since this is commonly not considered in the consistency verification, the uncertainty in predicted values may be over- or underestimated (Schmidt, 2017). The correlation coefficient $r\left(\Delta\rho_\mathrm{m}, \Delta\rho_\mathrm{p}\right) \neq 0$ was obtained by calculating the predicted value n times using the n subsets of the fit coefficients gained with the MCM described above.

Next, every calculated residual uncertainty at a probability of 95.45 % was compared to the corresponding residual to evaluate the uncertainty, which is associated to the predicted value. In case of the density–salinity relation consistency verification, 95.45 % of the residuals had to be smaller than their associated uncertainties, thus $|\Delta| = \left|\Delta\rho_\mathrm{m} - \Delta\rho_\mathrm{p}\right| \leq U(\Delta)$. When this was not the case and more than 4.55 % of the residuals were higher than their corresponding uncertainties, the uncertainty in the predicted value was increased gradually until the criterion was fulfilled. The increased uncertainty was then adopted for any predicted value in the corresponding atmospheric or high-pressure region.

Acknowledgements

This work was funded by the European Metrology Research Programme, EMRP Project ENV05. The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union.

The authors greatly value the silicate concentration measurements obtained from seawater performed by Kai-Uwe Ludwichowski in the *Alfred-Wegener-Institut für Polar- und Meeresforschung* (AWI) and would like to thank Dr. Gereon Budéus (AWI) for valuable discussions on oceanographic matters.

This article contributes to the tasks of the Joint SCOR/IAPWS/IAPSO Committee on the Properties of Seawater (JCS).

References

Bignell, N.: A magnetic float densimeter for the measurement of changes in water density on aeration, Journal of Physics E: Scientific Instruments, 15, 378–381, doi:10.1088/0022-3735/15/3/031, 1982.

Bignell, N.: The effect of dissolved air on the density of water, Metrologia, 19, 57–59, doi:10.1088/0026-1394/19/2/002, 1983.

Bignell, N.: Magnetic flotation in densimetry, Measurement Science and Technology, 17, 2574–2580, doi:10.1088/0957-0233/17/10/007, 2006.

Bacon, S., Culkin, F., Higgs, N., and Ridout, P.: IAPSO standard seawater: definition of the uncertainty in the calibration procedure and stability of recent batches, Journal of Atmospheric and Oceanic Technology, 24, 1785–1799, doi:10.1175/JTECH2081.1, 2007.

Bradshaw, A.: The effect of carbon dioxide on the specific volume of seawater, Limnology and Oceanography, 18, 1, 95–105, doi:10.4319/LO.1973.18.1.0095, 1973.

Consultative Committee for Thermometry (CCT): Techniques for approximating the international temperature scale of 1990, 1997 reprint of 1990 first edition, BIPM, Sèvres, France, http://www.bipm.org/utils/common/pdf/ITS-90/ITS-90-Techniques-for-Approximating.pdf, 1997.

Corning Inc.: PYREX® and Corning® glass and reusable plastic product selection guide, Tewksbury, MA, USA, CLS-GL-001 REV9, https://www.corning.com/media/worldwide/cls/documents/CLS-GL-001 REV9.pdf, 2014.

Culkin, F. and Smith, N.: Determination of the concentration of potassium chloride solution having the same electrical conductivity, at 15 °C and infinite frequency, as standard seawater of salinity 35.0000‰ (chlorinity 19.37394‰), IEEE Journal of Oceanic Engineering, OE–5, 1, 22–23, doi:10.1109/JOE.1980.1145443, 1980.

Culkin, F.: Calibration of standard seawater in electrical conductivity, The Science of the Total Environment, 49, 1–7, doi:10.1016/0048-9697(86)90230-5, 1986.

Darling, W. G., Bath, A. H., and Talbot, J. C.: The O & H stable isotopic composition of fresh waters in the British Isles. 2. Surface waters and groundwater, Hydrology and Earth System Sciences, 7, 183–195, doi:10.5194/hess-7-183-2003, 2003.

Dauphinee, T. M., Ancsin, J., Klein, H. P., and Phillips, M. J.: The electrical conductivity of weight diluted and concentrated standard seawater as a function of salinity and temperature, IEEE Journal of Oceanic Engineering, OE–5, 1, 28–41, doi:10.1109/JOE.1980.1145439, 1980a.

Dauphinee, T. M., Ancsin, J., Klein, H. P., and Phillips, M. J.: The effect of concentration and temperature on the conductivity ratio of potassium chloride solutions to standard seawater of salinity 35‰ (Cl 19.3740‰), IEEE Journal of Oceanic Engineering, OE–5, 1, 17–21, doi:10.1109/JOE.1980.1145444, 1980b.

Del Grosso, V. A.: New equation for the speed of sound in natural waters (with comparison to other equations), Journal of the Acoustical Society of America, 32, 285–300, doi:10.1121/1.1903388, 1974.

Dickson, A. G.: Standard potential of the reaction $AgCl(s) + \frac{1}{2}H_2(g) = Ag(s) + HCl(aq)$ and the standard acidity constant of the ion HSO_4^- in synthetic sea water from 273.15 to 318.15 K, The Journal of Chemical Thermodynamics, 22, 2, 113–27, doi:10.1016/0021-9614(90)90074-Z, 1990.

DURAN Group GmbH: DURAN® precision bore tubing, Wertheim, Germany, 50098 d 09078.0 ba/dh, http://www.duran-group.com/uploads/tx_fedownloads/DURAN_Precision_bore_tubing_E.pdf, 2009.

Feistel, R.: A new extended Gibbs thermodynamic potential of seawater, Progress in Oceanography, 58, 43–114, doi:10.1016/S0079-6611(03)00088-0, 2003.

Feistel, R.: A Gibbs function for seawater thermodynamics for −6 to 80 °C and salinity up to 120 g/kg, Deep-Sea Research, 55, 1639–1671, doi:10.1016/j.dsr.2008.07.004, 2008.

Ferronsky, V. I. and Polyakov, V. A.: Isotopes of the Earth's hydrosphere, Springer, Dordrecht, Netherlands, doi:10.1007/978-94-007-2856-1, 2012.

Garcia, H. E. and Gordon, L. I.: Oxygen solubility in seawater – Better fitting equations, Limnology and Oceanography, 37, 1307–1312, doi:10.4319/lo.1992.37.6.1307, 1992.

Girard, G. and Menaché, M.: Variation de la masse volumique de l'eau en fonction de sa composition isotopique, Metrologia, 7, 83–87, doi:10.1088/0026-1394/7/3/001, 1971.

Grambow, B.: A general rate equation for nuclear waste glass corrosion, Materials Research Society Symposium Proceedings, 44, 15–27, doi:10.1557/PROC-44-15, 1985.

Grasshoff, K., Kremling, K., and Ehrhardt, M.: Methods of seawater analysis, 3, Wiley–VCH, Weinheim, Germany, doi:10.1002/9783527613984, 1999.

Hamme, R. C. and Emerson, S. R.: The solubility of neon, nitrogen and argon in distilled water and seawater, Deep-Sea Research I, 51, 1517–1528, doi:10.1016/j.dsr.2004.06.009, 2004.

Harvey, A. H., Kaplan, S. G., and Burnett, J. H.: Effect of dissolved air on the density and refractive index of water, International Journal of Thermophysics, 26, 1495–1514, doi:10.1007/s10765-005-8099-0, 2005.

Higgs, N. and Ridout, P.: Future Requirements for IAPSO standard seawater – The IAPSO standard seawater service, Ocean Scientific International Limited, Havant, UK, https://www.ptb.de/cms/fileadmin/internet/fachabteilungen/abteilung_3/3.1_metrologie_in_der_chemie/aktuell/env05/PTB_presentation_120911.pdf, 2011.

Imhmed, S. A. A.: Application of magnetic susceptibility measurements to oilfield scale management, PhD thesis, Institute of Petroleum Engineering, Heriot-Watt University, Edinburgh, Scotland, UK, http://www.ros.hw.ac.uk/bitstream/handle/10399/2564/ImhmedSAA_0412_pe.pdf, 2012.

International Atomic Energy Agency (IAEA): Vienna Standard Mean Ocean Water (VSMOW) and Standard Light Antarctic Precipitation (SLAP) water, Reference Sheet for International Measurement Standards (1 Dec 2006), https://nucleus.iaea.org/rpst/documents/vsmow_slap.pdf, 2006.

IOC, SCOR and IAPSO: The international thermodynamic equation of seawater – 2010: Calculation and use of thermodynamic properties, Intergovernmental Oceanographic Commission, Manuals and Guides, 56, UNESCO, Paris, France, http://unesdoc.unesco.org/images/0019/001930/193020e.pdf, 2010

Joint Committee for Guides in Metrology (JCGM GUM): JCGM 100-2008 Evaluation of measurement data – Guide to the expression of uncertainty in measurement, BIPM, IEC, IFCC, ILAC, ISO, IUPAC, IUPAP, OIML, http://www.bipm.org/en/publications/guides/gum.html, 2008.

Joint Committee for Guides in Metrology (JCGM GUM S2): JCGM 102:2011 Evaluation of measurement data – Supplement 2 to the "Guide to the expression of uncertainty in measurement" – Extension to any number of output quantities, BIPM, IEC, IFCC, ILAC, ISO, IUPAC, IUPAP, OIML, http://www.bipm.org/en/publications/guides/gum.html, 2011.

Joint Panel on Oceanographic Tables and Standards (JPOTS): Tenth report of the Joint Panel on Oceanographic Tables and Standards – The Practical Salinity Scale 1978 and The International Equation of State of Seawater 1980, Unesco technical papers in marine science, 36, 13–17, UNESCO, Paris, France, http://unesdoc.unesco.org/images/0004/000461/046148eb.pdf, 1981a.

Joint Panel on Oceanographic Tables and Standards (JPOTS): Background papers and supporting data on the Practical Salinity Scale 1978, Unesco technical papers in marine science, 37, UNESCO, Paris, France, http://unesdoc.unesco.org/images/0004/000479/047932eb.pdf, 1981b.

Joint Panel on Oceanographic Tables and Standards (JPOTS): Background papers and supporting data on the International Equation of State of Seawater 1980, Unesco technical papers in marine science, 38, UNESCO, Paris, France, http://unesdoc.unesco.org/images/0004/000479/047932eb.pdf, 1981c.

Le Menn, M.: About uncertainties in practical salinity calculations, Ocean Science, 7, 651–659, doi:10.5194/os-7-651-2011, 2011.

Lee, K., Kim, T. W., Byrne, R. H., Millero, F. J., Feely, R. A. and Liu, Y. M.: The universal ratio of boron to chlorinity for the North Pacific and North Atlantic oceans, Geochim. Cosmochim. Acta, 74, 1801–11, doi:10.1016/J.GCA.2009.12.027, 2010.

Lin, C.-W. and Trusler, J. P. M.: The speed of sound and derived thermodynamic properties of pure water at temperatures between (253 and 473) K and at pressures up to 400 MPa, The Journal of Chemical Physics, 136, 094511, doi:10.1063/1.3688054, 2012.

Millero, F. J.: High precision magnetic float densimeter, The Review of Scientific Instruments, 38, 10, 1441–1444, doi:10.1063/1.1720558, 1967.

Millero, F. J., Gonzalez, A., and Ward, G. K.: The density of seawater solutions at one atmosphere as a function of temperature and salinity, Journal of Marine Research, 34, 1, 61–93, 1976.

Millero, F. J.: The marine inorganic carbon cycle, Chemical Reviews, 107, 308–341, doi:10.1021/cr0503557, 2007.

Millero, F. J., Feistel, R., Wright, D. G., and McDougall, T. J.: The composition of standard seawater and the definition of the reference-composition salinity scale, Deep-Sea Research, 55, 50–72, doi:10.1016/j.dsr.2007.10.001, 2008.

Millero, F. J.: Carbonate constants for estuarine waters, Marine and Freshwater Research, 61, 139–42, doi:10.1071/MF09254, 2010.

Ostlund, H. G., Craig, H., Broecker, W. S., and Spenser, D.: GEOSECS Atlantic, Pacific and Indian Ocean expeditions: shorebased data and graphics, Washington, D. C., USA, http://epic.awi.de/34890/1/atlantic-pacific-indian-ocean-expedition_vol7.pdf, 1987.

Pawlowicz, R., Feistel, R., McDougall, T. J., Ridout, P., Seitz, S., and Wolf, H.: Metrological challenges for measurements of key climatological observables – Part 2: Oceanic salinity, Metrologia, 53, R12–R15, doi:10.1088/0026-1394/53/1/R12, 2016.

Perkin, R. G. and Lewis, E. L.: The Practical Salinity Scale 1978 – Fitting the data, IEEE Journal of Oceanic Engineering, OE–5, 1, 9–16, doi:10.1109/JOE.1980.1145441, 1980.

Poisson, A., Dauphinee, T., Ross, C. K., and Culkin, F.: The reliability of standard seawater as an electrical conductivity standard, Oceanologica Acta, 1, 4, http://archimer.ifremer.fr/doc/00123/23397/21224.pdf, 1978.

Poisson, A.: Conductivity, salinity, temperature relationship of diluted and concentrated standard seawater, IEEE Journal of Oceanic Engineering, OE–5, 1, 41–50, doi:10.1109/JOE.1980.1145442, 1980a.

Poisson, A.: The concentration of the KCl solution whose conductivity is that of standard seawater (35‰) at 15 °C, IEEE Journal of Oceanic Engineering, OE–5, 1, 24–28, doi:10.1109/JOE.1980.1145440, 1980b.

Poisson, A., Brunet, C., and Brun-Cottan, J. C.: Density of standard seawater solutions at atmospheric pressure, Deep-Sea Research, 27A, 1013–1028, doi:10.1016/0198-0149(80)90062-X, 1980.

Robbins, L. L., Hansen, M. E., Kleypas, J. A. and Meylan, S. C.: CO_2calc – Seawater carbon calculator, U.S. Geological Survey, Open-File Report 2010–1280, 2010.

Schmidt, H., Wolf, H., and Hassel, E.: A method to measure the density of seawater accurately to the level of 10^{-6}, Metrologia, 53, 770–786, doi:10.1088/0026-1394/53/2/770, 2016.

Schmidt, H.: Consistency verification of equations of state – Significance of the correlation between measured and predicted data, Thermophysical Properties for Technical Thermodynamics (THERMAM), Rostock, Germany, 17–18 July 2017, 978-3-941554-17-7, doi:10.13140/RG.2.2.10997.06888, 2017.

Scripps: http://scrippsco2.ucsd.edu.

Seitz, S., Feistel, R., Wright, D. G., Weinreben, S., Spitzer, P. and de Bievre, P.: Metrological traceability of oceanographic salinity measurement results, Ocean Science, 7, 45–62, doi:10.5194/os-7-45-2011, 2011.

Seitz, S., Spitzer, P., and Brown, R. J. C.: CCQM-P111 study on traceable determination of practical salinity and mass fraction of major seawater components, Accreditation and Quality Assurance, 15, 9–17, doi:10.1007/s00769-009-0578-8, 2010.

Tanaka, M., Girard, G., Davis, R., Peuto, A., and Bignell, N.: Recommended table for the density of water between 0 °C and 40 °C based on recent experimental reports, Metrologia, 38, 301–309, doi:10.1088/0026-1394/38/4/3, 2001.

Uchida, H., Kawano, T., Aoyama, M., and Murata, A.: Absolute salinity measurements of standard seawaters for conductivity and nutrients, La mer, 49, 119–126, http://www.sfjo-lamer.org/la_mer/49-3_4/49-3-4-5.pdf, 2011.

Wagner, W. and Pruß, A.: The IAPWS formulation 1995 for the thermodynamic properties of ordinary water substance for general and scientific use, Journal of Physical and Chemical Reference Data, 31, 387–535, doi:10.1063/1.1461829, 2002.

Wagner, W. and Thol, M.: The behaviour of IAPWS-95 from 250 to 300 K and pressures up to 400 MPa – Evaluation based on recently derived property data, Journal of Physical and Chemical Reference Data, 44, 043102-1–40, doi:10.1063/1.4931475, 2015.

Table 1. Summary of the batches of the standard seawater samples.

Date of manufacture mm/yyyy	Salinity			Homogeneity		Calibration		
	S	U [a]	ν_{eff} [d]	σ [b]	ν [e]	σ [c]	ν [e]	Reference
10/2011	4.9958	0.0006	4	0.0000	4	0.0002	4	P154
03/2011	9.9887	0.0006	6	0.0001 [f]	4 [f]	0.0002 [f]	4 [f]	P153
10/2011	14.9999	0.0005	8	0.0001	4	0.0002	4	P154
10/2011	20.0009	0.0007	7	0.0001	4	0.0002	4	P154
10/2011	25.0047	0.0005	17	0.0001	4	0.0002	4	P154
03/2011	29.9689	0.0006	25	0.0001 [f]	4 [f]	0.0002 [f]	4 [f]	P153
03/2011	34.9917	0.0004	∞	–	–	–	–	P153

[a] Uncertainty calculated based on [b], [c], and reference salinity (of standard seawater).
[b] Mean standard deviation of 5 samples from batches delivered.
[c] Mean standard deviation of 5 samples used for calibration.
[d] Effective degrees of freedom calculated based on those of homogeneity, calibration, and reference salinity.
[e] Degrees of freedom.
[f] Values are estimated.

Table 2. Isotopic abundances of water and seawater (NSW – natural, DSW – diluted).

Type	S	δ_{D}	U	δ_{18}	U	Source
–	–	‰	‰	‰	‰	–
NSW	36.4	6.8	2.0 [a]	1.06	0.20 [a]	(Ostlund et al., 1987)
H_2O	–	–40.0	2.0	–6.50	0.20	(Darling et al., 2003)
DSW	5	–33.8	1.8	–5.50	0.18	–
DSW	10	–27.5	1.6	–4.48	0.16	–
DSW	15	–21.1	1.4	–3.45	0.14	–
DSW	20	–14.7	1.4	–2.42	0.14	–
DSW	25	–8.2	1.6	–1.37	0.16	–
DSW	30	–1.7	1.6	–0.32	0.16	–
IAPSO SSW	35	4.9	2.0	0.76	0.20	–

[a] Value is estimated.

Table 3. Dissolved silicate molality of some DSW samples.

Vessel	Salinity	Storage time in years	Silicate µmol kg^{-1}	Uncertainty µmol kg^{-1}	Batch
1	5	4.1	36.1	5.4	P154
1	10	4.7	43.2	7.2	P153
2	10	4.7	48.5		P153
1	15	4.1	37.9	5.6	P154
1	20	4.1	41.4	4.0	P154
2	20	4.1	39.5		P154
1	25	4.1	39.7	4.0	P154
1	30	4.7	57.6	6.0	P153
2	30	4.7	59.9		P153
-	35	4.7	61.3 [a]	6.2 [a]	P153

[a] Estimated based on silicate molalities for salinities of 10 and 30.

Table 4. Values of the coefficients $a_{i,j}$ of Eq. (13).

i	j	Value	i	j	Value	i	j	Value
0	0	$2.65627133 \times 10^{+2}$	1	1	$8.0658117 \times 10^{+1}$	2	3	-4.1658×10^{-1}
0	1	$-2.272462 \times 10^{+1}$	1	2	-8.62107×10^{0}	3	0	$-1.996354156 \times 10^{+3}$
0	2	3.17932×10^{0}	1	3	6.3513×10^{-1}	3	1	$6.332479 \times 10^{+1}$
0	3	-2.78076×10^{-1}	1	4	6.7777×10^{-2}	3	2	-2.182108×10^{0}
0	4	-3.7051×10^{-2}	2	0	$2.182680018 \times 10^{+3}$	4	0	$9.16301655 \times 10^{+2}$
0	5	-6.648×10^{-3}	2	1	$-1.0724787 \times 10^{+2}$	4	1	$-1.4043174 \times 10^{+1}$
1	0	$-1.198640497 \times 10^{+3}$	2	2	7.686316×10^{0}	5	0	$-1.68713114 \times 10^{+2}$

Table 5. Values of the coefficients $b_{i,j,k}$ of Eq. (14).

i	j	k	Value	i	j	k	Value
0	0	0	$-7.739482 \times 10^{+2}$	1	0	3	3.8065×10^{-1}
0	0	1	$7.621224 \times 10^{+1}$	1	1	0	2.09786×10^{0}
0	0	2	-2.47174×10^{0}	1	1	1	4.38047×10^{0}
0	0	3	-5.109×10^{-1}	1	1	2	-2.5183×10^{-1}
0	0	4	5.975×10^{-2}	1	2	0	8.72384×10^{0}
0	1	0	2.95926×10^{0}	1	2	1	1.7845×10^{0}
0	1	1	-1.98326×10^{0}	1	3	0	-1.2344×10^{-1}
0	1	2	5.0082×10^{-1}	2	0	0	$-3.72241428 \times 10^{+3}$
0	1	3	-6.353×10^{-2}	2	0	1	$1.8587744 \times 10^{+2}$
0	2	0	-4.73032×10^{0}	2	0	2	-2.80757×10^{0}
0	2	1	-1.2834×10^{0}	2	1	0	$-1.147437 \times 10^{+1}$
0	2	2	-7.863×10^{-2}	2	1	1	-2.9345×10^{0}
0	3	0	4.9266×10^{-1}	2	2	0	-4.66432×10^{0}
0	3	1	-1.9762×10^{-1}	3	0	0	$2.2414666 \times 10^{+3}$
0	4	0	-5.466×10^{-2}	3	0	1	$-5.56069 \times 10^{+1}$
1	0	0	$2.7623136 \times 10^{+3}$	3	1	0	6.98502×10^{0}
1	0	1	$-2.061301 \times 10^{+2}$	4	0	0	$-5.0878713 \times 10^{-6}$
1	0	2	5.30055×10^{0}				

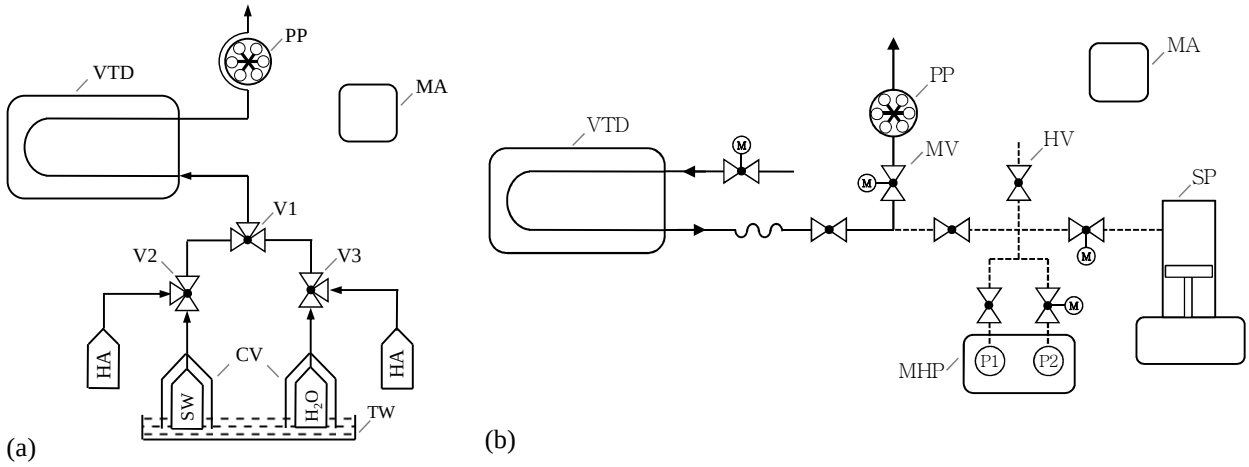


Figure 1. Set–up used to measure the seawater density (a) at atmospheric pressure and (b) at high pressures (Schmidt et al., 2016). The arrows indicate flow direction in capillary tubes.

VTD – Densimeter, PP – Peristaltic pump, V1 – Liquid switching valve, V2/V3 – Air switching valves, SW – Seawater, H_2O – Water, HA – Humid air, CV – Cover, TW – Tap water, MA – Manometer for atmospheric pressure, MV – Motor-driven valve, HV – Manual valve, SP – Syringe pump, MHP – Manometer for high pressure (P1 – Full-range sensor, P2 – Low-range sensor). Dashed lines indicate tubes filled with oil.

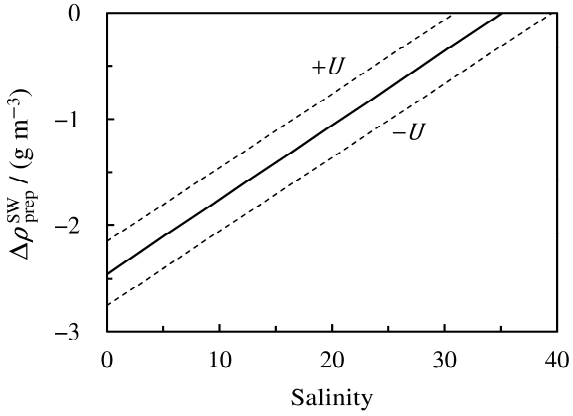


Figure 2. Density difference $\Delta\rho^{SW}_{prep}$ caused by isotopic water composition change (relative to IAPSO SSW) during preparation. U – Estimated uncertainty.

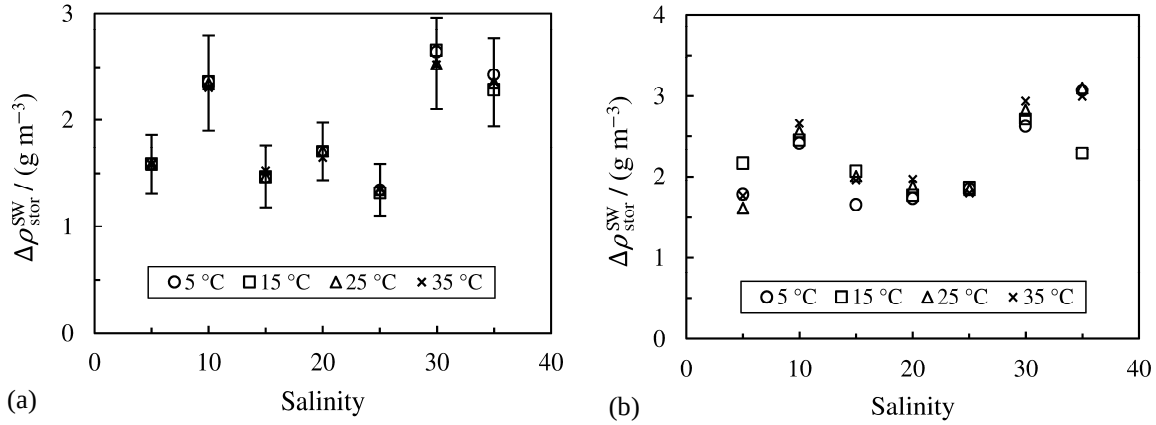


Figure 3. Seawater density increase $\Delta\rho_{\mathrm{stor}}^{\mathrm{SW}}$ caused by dissolution of glass material during storage. Some calculated values of samples used for density measurements (a) at atmospheric pressure and (b) at high pressures (b). Uncertainty bars in (a) are examples that indicate some uncertainties assigned to values at 25 °C.

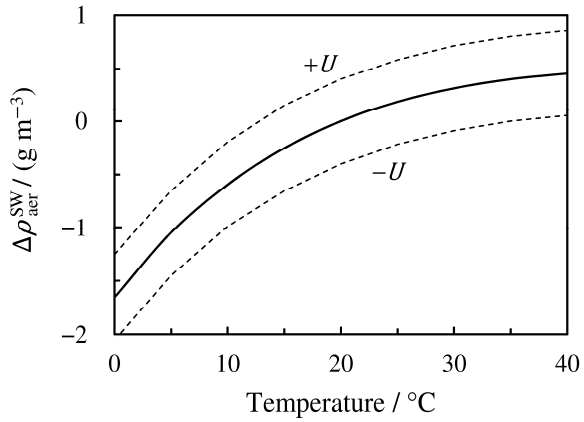


Figure 4. Density correction due to air saturation correction based on 100 % saturation at 20 °C. U – Estimated uncertainty.

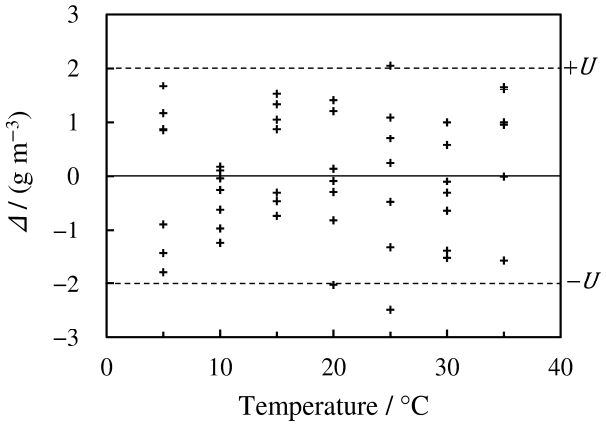


Figure 5. Residuals Δ (measured minus the predicted values) resulting from the fit of $\Delta\rho_0^{\mathrm{SW}}(p_0)$. U – Uncertainty in the density–salinity relation.

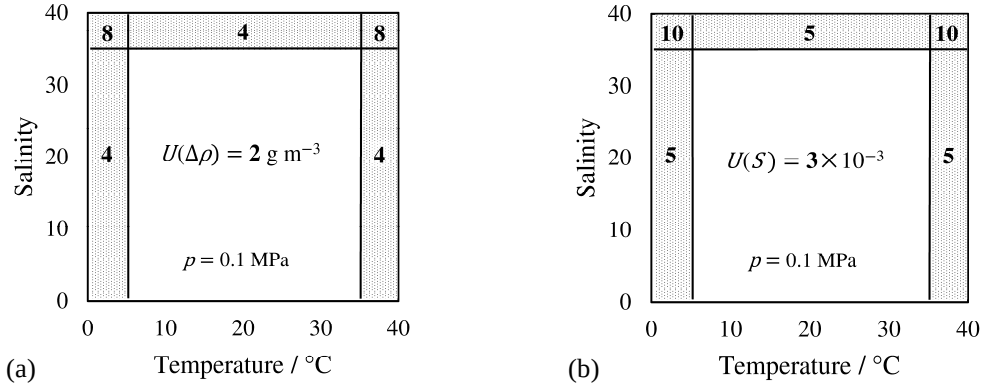


Figure 6. Uncertainty in the density–salinity relation at 101325 Pa. (a) Uncertainty in the relative density of air-saturated seawater, $U(\Delta\rho^{SW})$, that results from a calculation using salinity and temperature values. (b) Uncertainty in salinity, $U(S)$, that results from an inverse calculation using the relative density of air-saturated seawater and temperature values. The white area indicates the measurement region equal to that of the data set used for fitting. The grey area indicates the extrapolation region.

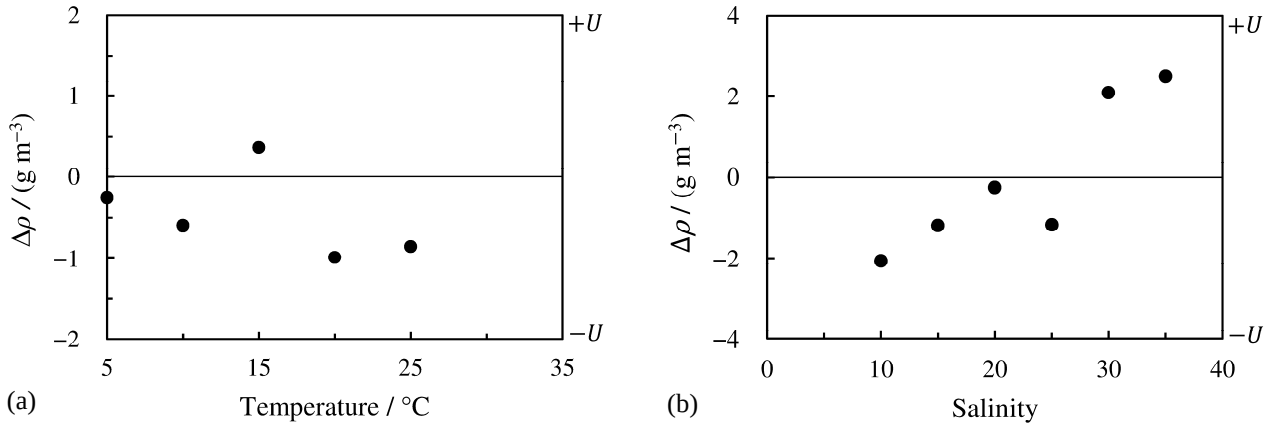


Figure 7. Deviation of measured from predicted seawater densities $\Delta\rho$. (a) In the interpolation region at salinity 2 and (b) in the extrapolation region at 1 °C and atmospheric pressure, respectively. U – Uncertainty in the density–salinity relation.

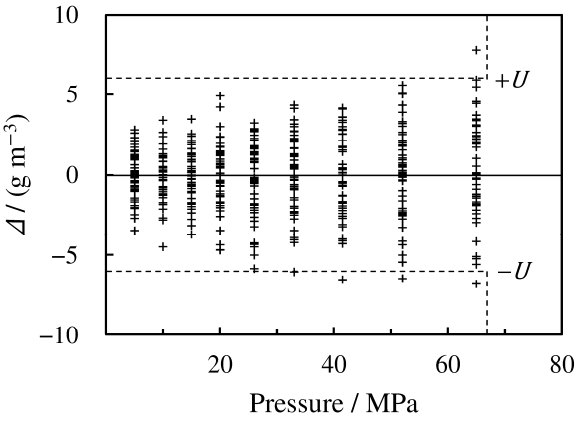


Figure 8. Residuals Δ (measured minus the predicted values) yielded by the fit of $\Delta\Delta\rho_0^{\mathrm{SW}}(p - p_0)$. U – Uncertainty in the density–salinity relation for high pressures.

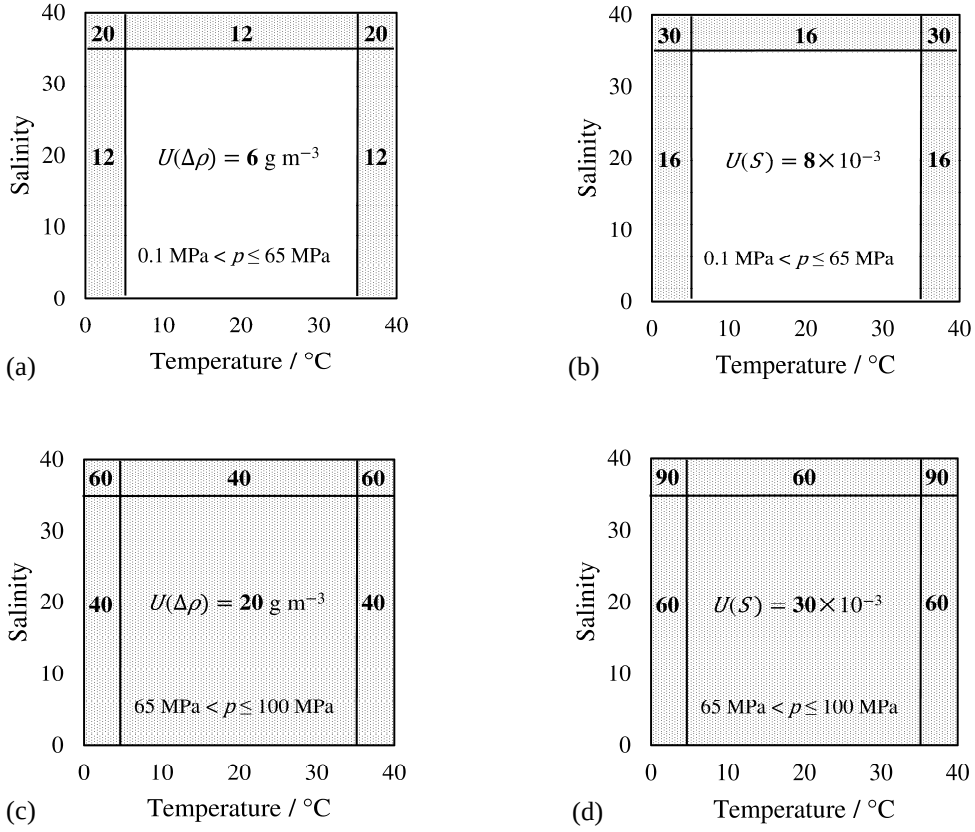


Figure 9. Uncertainty in the density–salinity relation at high pressures. Uncertainty in the relative density of air-saturated seawater, $U(\Delta\rho^{\mathrm{SW}})$, that results from a calculation using salinity and temperature values for pressures (a) up to 65 MPa and (c) up to 100 MPa. Uncertainty in salinity, $U(S)$, that results from an inverse calculation using the relative density of air-saturated seawater and temperature values for pressures (b) up to 65 MPa and (d) up to 100 MPa. The white area indicates the interpolation region equal to that of the data set used for fitting. The grey area indicates the extrapolation region.

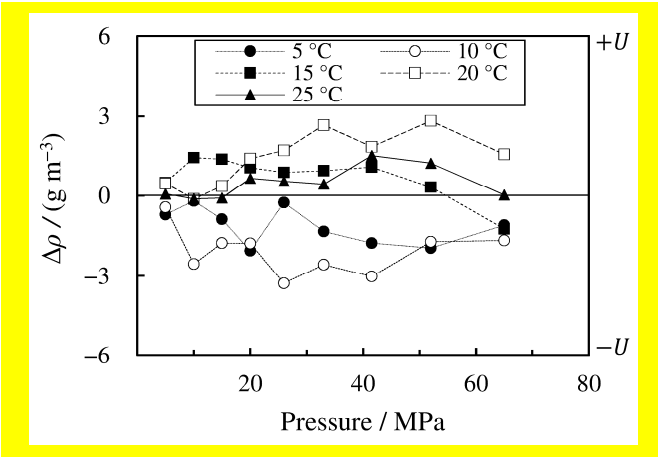


Figure 10. Deviation of measured from predicted seawater densities $\Delta\rho$ in the interpolation region at salinity 2. U – Uncertainty in the density–salinity relation.

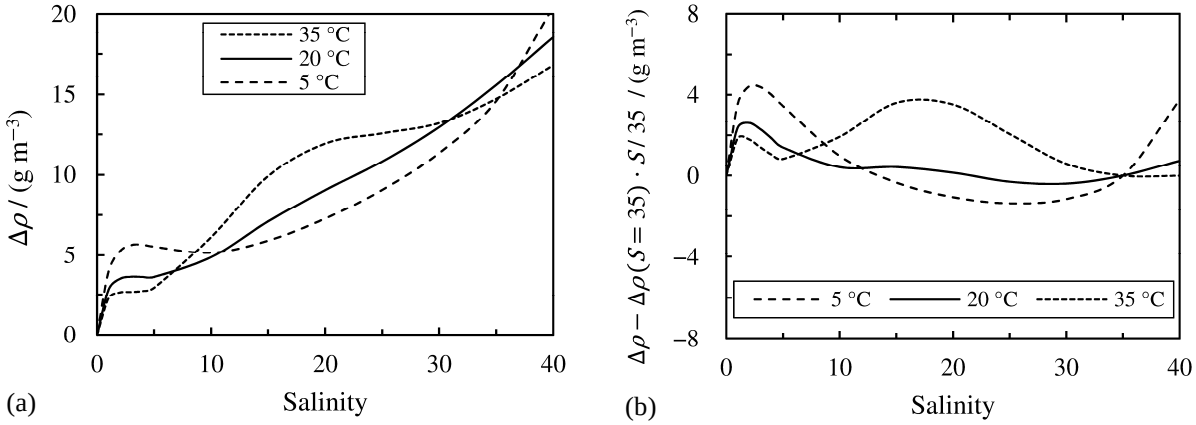


Figure 11. Density deviation of TEOS-10 from the density–salinity relation (i.e. TEOS-10 minus DSR) for degassed seawater at selected temperatures and atmospheric pressure. (a) The deviation $\Delta\rho$ increases linearly with salinity. The uncertainty in the deviation is 8 g m^{-3}, and is significantly exceeded at salinities higher than 20. (b) By contrast, the salinity-35-reduced deviation is less than 5 g m^{-3}.

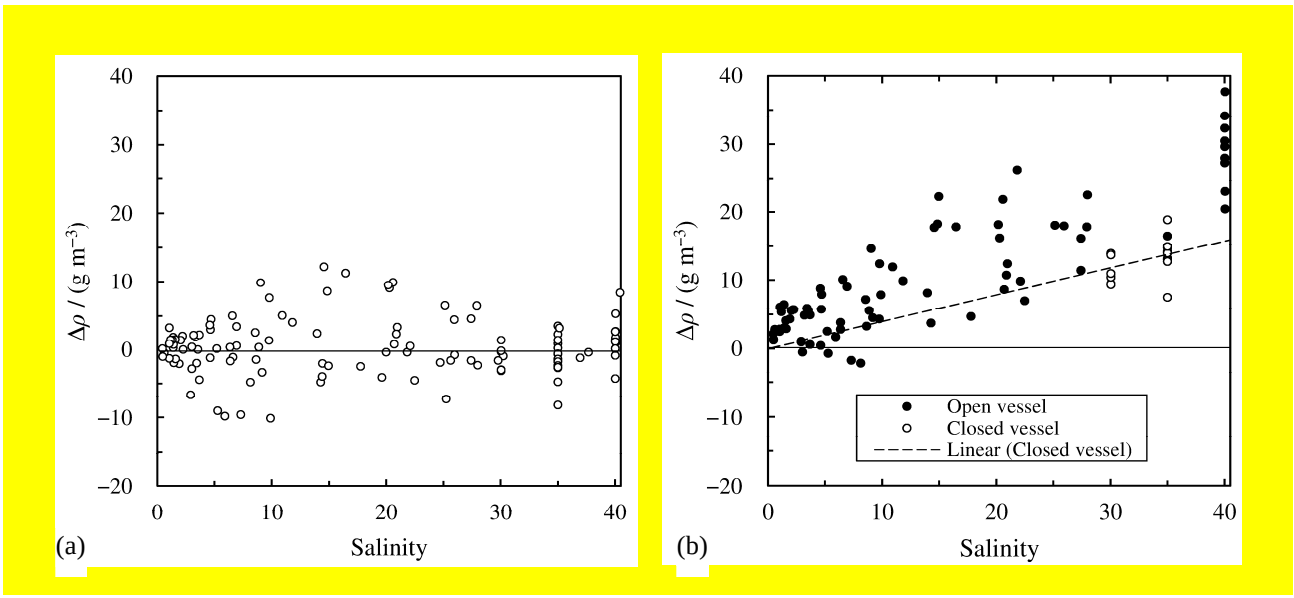


Figure 12. Deviation of densities obtained from standard seawater using a magnetic float densimeter by Millero et al. (a) The deviation of the normalized densities of Millero et al. (JPOTS, 1981c, pp. 51–56) from TEOS-10 (i.e. Millero et al. minus TEOS-10) suggest that TEOS-10 is well fitted thereto. (b) The deviation of the original densities of Millero et al. (1976) (i.e. Millero et al. minus DSR) suggest a deviation that systematically increases with salinity. The density uncertainty calculated using the accuracy and reproducibility claimed by Millero et al. (1976) is 2 g m^{-3} and is significantly exceeded by most of the deviations.

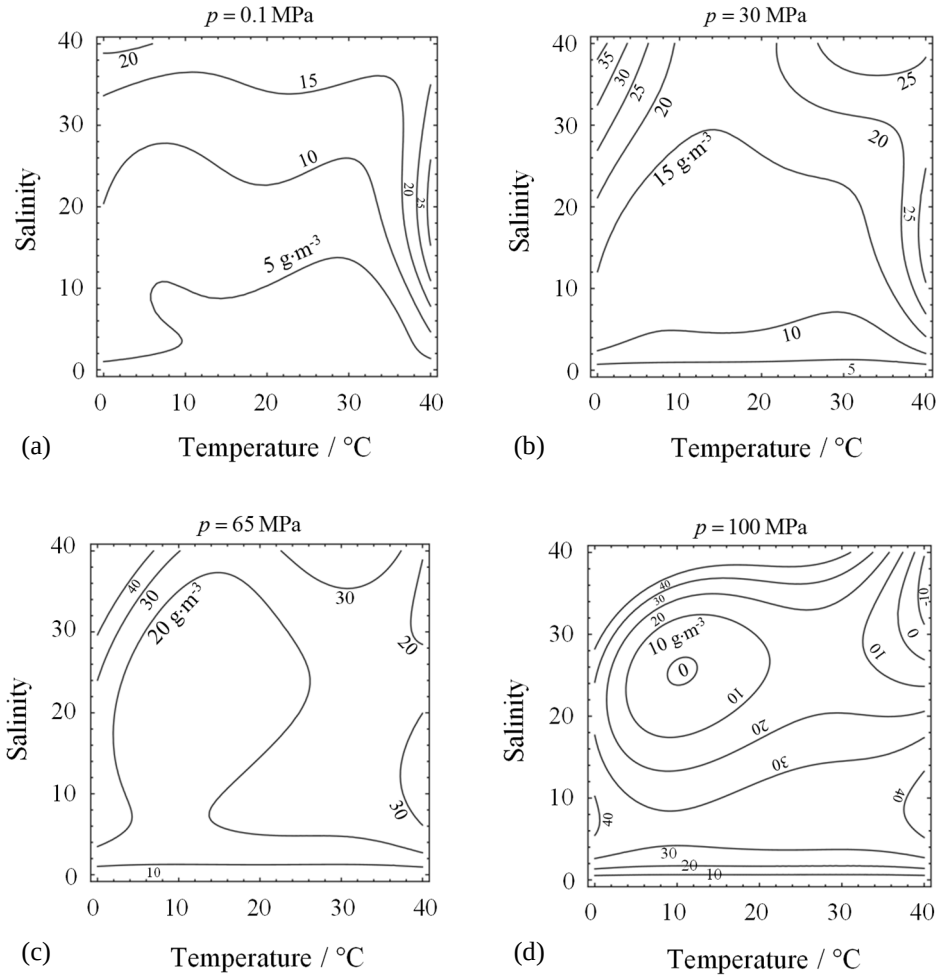


Figure 13. Density deviation of TEOS-10 from the density–salinity relation (i.e. TEOS-10 minus DSR) for degassed seawater (a) at atmospheric pressure, (b) at 30 MPa, (c) at 65 MPa, and (d) at 100 MPa. The uncertainties in the deviation are 8 g m^{-3}, 26 g m^{-3}, 26 g m^{-3}, and 33 g m^{-3}. The deviations only exceed these uncertainties significantly at atmospheric pressure.

Marked-up version of the supplement

Supplement to ‘The density–salinity relation of standard seawater’

Hannes Schmidt[1], Steffen Seitz[1], Egon Hassel[2], Henning Wolf [1]

[1]Physikalisch-Technische Bundesanstalt, Braunschweig, 38116, Germany
[2]Lehrstuhl für Technische Thermodynamik, Universität Rostock, Rostock, 18051, Germany

Correspondence to: H. Wolf (henning.wolf@ptb.de)

Notes

In Sect. 1, some previously unpublished details of the substitution method used are described that concern both the substitution densimeter itself and the preparation of the water reference. Although these topics were adressed in the discussion and found to be worthy of mention, they relate to our article on the substitution method[3] and are beyond the scope of this article, wherefore they are found here.

In Sect. 2, the data used to develop and validate the density–salinity relation is tabulated. For practicability, an .htm- and an .xlsx-file containing the data are attached to this supplement. Uncertainties are given either as combined uncertainties, u, with corresponding degrees of freedom, or as uncertainties for a probability of 95.45 %, U, in accordance with the JCGM ‘Guide to the Expression of Uncertainty in Measurement’ of 2008.

[3] Schmidt, H., Wolf, H., and Hassel, E.: A method to measure the density of seawater accurately to the level of 10^{-6}, Metrologia, 53, 770–786, doi:10.1088/0026-1394/53/2/770, 2016.

Previously unpublished details related to 'A method to measure the density of seawater accurately to the level of 10^{-6}'

Impact of heavy isotope enrichment on density caused by evaporation

Ultrapure water was used as a density reference in the substitution measurements. To remove the air dissolved in it, it was boiled without refeeding the vapour. Since the frequency of the (heavy) isotopes deuterium, oxygen-17, and oxygen-18 is higher in the liquid than in the vapour, heavy isotopes accumulate in the liquid during evaporation, thereby increasing the water density. By a simple theoretical approach, the impact on the water density is quantified. The results suggest that the water density changes insignificantly in moderate boiling and, additionally, that evaporation at low temperatures causes higher density changes than evaporation at high temperatures.

If a flask contains a very small vapour (v) compared to a liquid phase (l) each consisting of water, and the water contains ^{1}H and ^{2}H, or D, atoms and ^{16}O, ^{17}O, and ^{18}O atoms, then the frequency of these atoms in the liquid and vapour is different. The frequency of an isotope in the liquid relative to that in the vapour is described by means of the isotopic fractionation factor α, which is for deuterium:

$$\alpha_{\mathrm{D}} = \frac{n_{\mathrm{D}}^{l}/n_{\mathrm{H}}^{l}}{n_{\mathrm{D}}^{v}/n_{\mathrm{H}}^{v}},$$

where n is the amount-of-substance. For example, n_{D}^{l} is the amount-of-substance deuterium in the liquid. The fractionation factor is temperature-dependent[4].

If a very small amount is repeatedly removed from the vapour at very long intervals, some molecules from the liquid „vaporize" at (almost) constant temperature. The infinitesimal changes in the H- and D-amount-of-substance in the liquid and vapour are then linked by $\mathrm{d}n_{\mathrm{D}}^{v} = -\mathrm{d}n_{\mathrm{D}}^{l}$ and $\mathrm{d}n_{\mathrm{H}}^{v} = -\mathrm{d}n_{\mathrm{H}}^{l}$. For the ratio D to H of the vapour, it follows that $n_{\mathrm{D}}^{v}/n_{\mathrm{H}}^{v} \approx \mathrm{d}n_{\mathrm{D}}^{l}/\mathrm{d}n_{\mathrm{H}}^{l}$. Inserting this formula into above formula, transforming and integrating from the beginning (I) to the end of vaporization (II) results in:

$$\frac{n_{\mathrm{D}}^{\mathrm{II}}}{n_{\mathrm{D}}^{\mathrm{I}}} = \sqrt[\alpha_{\mathrm{D}}]{\frac{n_{\mathrm{H}}^{\mathrm{II}}}{n_{\mathrm{H}}^{\mathrm{I}}}},$$

where all amount-of-substances refer to the liquid.

The isotopic composition of deuterium and oxygen-18 in water is given by isotopic abundances relative to VSMOW, δ_{D} and δ_{18}, see article. The use of the isotopic abundance instead of the amount-of-substance in above formula yields:

$$\frac{\delta_{\mathrm{D}}^{\mathrm{II}} + 1}{\delta_{\mathrm{D}}^{\mathrm{I}} + 1} = \left(\frac{n_{\mathrm{H}}^{\mathrm{II}}}{n_{\mathrm{H}}^{\mathrm{I}}}\right)^{\frac{1-\alpha_{\mathrm{D}}}{\alpha_{\mathrm{D}}}}.$$

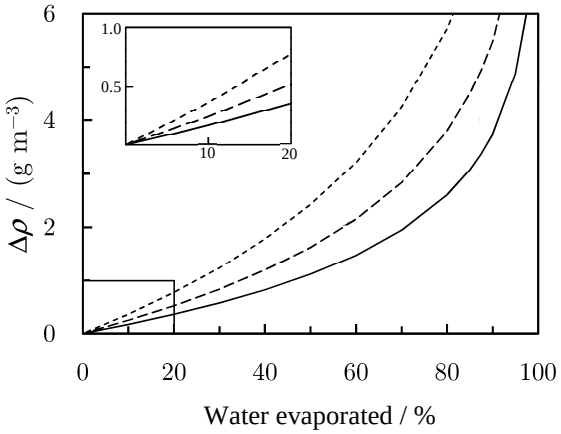
For oxygen the formula is similar.

[4] Horita, J. and Wesolowksi, D. J.: Liquid-vapor fractionation of oxygen and hydrogen isotopes of water from the freezing to the critical temperature, Geochimica et Cosmochimica Acta, 58, 16, 3425–37, doi:10.1016/0016-7037(94)90096-5, 1994.

The density change caused by the accumulation of deuterium, oxygen-17 and -18 can be calculated using the formula of Girard and Menaché[5] that is given in appendix A of the article.

The change in density of water caused by boiling is shown in the figure below. If 10 % of the liquid water vaporize in boiling, then the density increases by a maximum of 0.3 g m^{-3} independent of the temperature, thereby suggesting that, in moderate boiling, heavy isotopes accumulate insignificantly in the liquid in terms of the density uncertainty of 2 g m^{-3}.

Figure. Density increase of water, $\Delta\rho$, due to isotope enrichment during boiling. Calculated curves for vapourization into a pure water vapour phase at 20 °C (- - -), 60 °C (– –) and 100 °C.



Impact of glass dissolution on water density caused by boiling in a borosilicate flask

The ultrapure water used as water reference in the substitution measurements was boiled for degassing in a 1 L-Duran borosilicate glass flask. A test of the hydrolytic resistance of Duran according to ISO 719, in which 2 g glass powder with a grain diameter of 0.4 mm to 0.6 mm is exposed to 50 mL of water at 98 °C, results in a sodium molality of 0.1 nmol kg^{-1} after 1 hour[6]. If this molality is converted from the glass powder surface to the Duran flask surface, then this results in a density increase << 0.1 g m^{-3} Since ISO 719 test does not take into account the solubility of all glass components, it is sometimes considered insufficient[7].

A different test of the hydrolytic resistance of 10 mL borosilicate glass ampoules with a composition of 75 % SiO_2, 11 % B_2O_3, 7 % Na_2O und 5 % Al_2O_3 at 121 °C yielded silicon molalities up to 6.4 µmol kg^{-1} after 60 min[8]. If this molality is converted from the surface of the 10 mL glass flask to that the Duran flask, then a molality of 1.4 µmol kg^{-1} results corresponding to an increase in density of 0.08 g m^{-3}. Other borosilicate glass ampoules containing 70 % SiO_2, on the other hand, caused an increase in density of only 0.04 g m^{-3}. A linear SiO_2-amount-of-substance dependence suggests an increase

[5] Girard, G. and Menaché, M.: Variation de la masse volumique de l'eau en fonction de sa composition isotopique, Metrologia, 7, 83–87, doi:10.1088/0026-1394/7/3/001, 1971.
[6] SCHOTT AG: Technical glasses – Physical and technical properties, Mainz, Germany, 08150.05 kn/sei, http://www.schott.com/d/epackaging/2fbc7180-e37c-4209-9eec-617ad9208e51/1.0/18.11.15_final_schott_technical_glasses_row.pdf, 2014.
[7] Bach, H. and Krause, D. (Eds.): Analysis of the composition and structure of glass and glass ceramics, Ed. 1, Springer, doi: 10.1007/978-3-662-03746-1, 1999.
[8] Bohrer, D., Bortoluzzi, F., Nascimento, P. C., Carvalho, L. M. and Ramirez, A. G.: Silicate release from glass for pharmaceutical preparations, International Journal of Pharmaceutics, 355, 174–183, doi:10.1016/j.ijpharm.2007.12.025, 2008.

in density of 0.16 g m^{-3} for Duran (with 80 % SiO_2). The glass dissolution increases exponentially with temperature[9], so that, after conversion to the water boiling temperature of 100 °C, a density increase of < 0.1 g m^{-3} is yielded for the water that, for degassing, was boiled in the 1 L-Duran flask. This shows that the increase in density can be neglected, but also that the water must not boil much longer in borosilicate flasks, because otherwise its density increases significantly compared to the density uncertainty of 2 g m^{-3}.

Impact of a densimeter zero-drift on the accuracy of a seawater substitution density

Any densimeter tends to drift significantly sooner or later, wherefore regular calibration and appropriate adjustment is necessary to yield consistent results. Vibrating-tube densimeters (VTDs) are quick-adjusted using air and water. The drift of a vibrating tube made of glass can be different for air and water. Therefore, the drift is not completely corrected, if seawater substitution measurements are conducted using a water reference. A theoretical approach is used to quantify the zero-drift impact on the (seawater) substitution density, which is similar to that for air. The results suggest that the deviation in the substitution density is insignificant, if the densimeter is adjusted regularly.

The VTD used in the substitution measurements is a DMA 5000 M that is adjusted by the manufacturer. The standards used for this purpose are multiple reference fluids (including air and water), whereof the density and viscosity are known, respectively. A quick-adjustment is provided to the customer using air and water. We performed a quick-adjustment before any substitution measurement.

For the calculation of air density, the formula given by Spieweck and Bettin [10] for a relative humidity of 50 % is used by the internal firmware of the device[11]. The air pressure is either measured by an internal barometer or provided by the customer. We used an external high precision barometer that was calibrated to provide the air pressure. The DMA 5000 M manual[11] also contains data tables. The formula given by Spieweck and Bettin deviates significantly less than 1 g m^{-3} for 20 °C and 50 %rh from the recent formulation of air density CIPM-2007[12]. A change in relative humidity of 10 % at 20 °C changes the air density by 1 g m^{-3}.

The impact of a densimeter zero-drift, or deviation in air density, on the substitution density can be estimated using the formula:

$$\Delta\rho_{SW} = (1-\gamma)\cdot\Delta\rho_A + \gamma\cdot\Delta\rho_{H_2O} \quad \text{with} \quad \gamma = (\rho_{SW}-\rho_A)/(\rho_{H_2O}-\rho_A),$$

where ρ_A and $\Delta\rho_A$ are the air reference density and deviation therefrom (ref. minus meas.), ρ_{H_2O} and $\Delta\rho_{H_2O}$ are the water reference density and deviation therefrom (ref. minus meas.), and $\Delta\rho_{SW}$ is the difference between substitution and measured seawater density (subs. minus meas.).

The idea behind the formula is illustrated in (and may be derived from) the figure below.

---

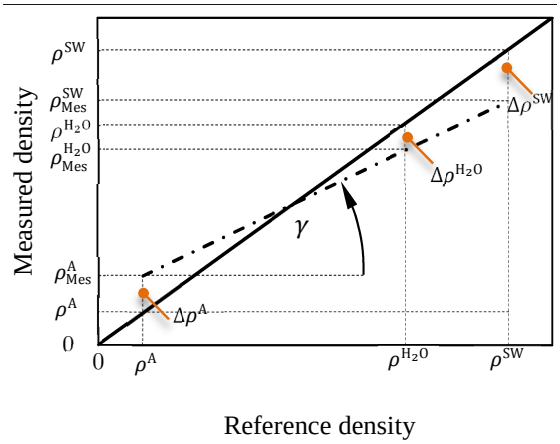
[9] Hunter, F. M. I., Hoch, A. R., Heath, T. G. and Baston, G. M. N., Review of glass dissolution models and application to UK glasses, AMEC, Didcot, UK, web:https://rwm.nda.gov.uk/publication/review-of-glass-dissolution-models-and-application-to-uk-glasses/?download, 2015.

[10] Spieweck, F. and Bettin, H.: Review – Solid and liquid density determination, Technisches Messen 7/8, 1992, p. 291.

[11] Anton Paar GmbH: Manual – DMA 4100, DMA 4500 M, DMA 5000 M, Firmware-Version: V2.20, 18th January 2012.
A more recent manual (in English) may be obtained using the link (after registration):
https://www.anton-paar.com/?eID=documentsDownload&document=5471&L=1

[12] Picard, A., Davis, R. S., Gläser, M. and Fujii, K.: Revised formula for the density of moist air (CIPM-2007), Metrologia, 45, 149–155, doi:10.1088/0026-1394/45/2/004, 2007.

Figure. Linear characteristic curve of an ideal densimeter (——) and of a densimeter with a zero-offset (– · –).



A maximum deviation in air density of 20 g m^{-3} (ref. minus meas.) without a deviation in water density causes a non-considered deviation in the substitution density of seawater with salinity 35 of 0.5 g m^{-3}. If, additionally, there is a maximum deviation in water density of −10 g m^{-3} (in the opposite direction), then a non-considered deviation in the substitution density of 0.8 g m^{-3} results. However, we never saw such deviations during our substitution measurements. Additionally, such deviations are random, and are therefore considered in the repeatability of a substitution measurement, which for our measurements at atmospheric pressure was 1 g m^{-3}. Therefore, the impact is negligible, provided that the densimeter is regularly quick-adjusted by the user, which is usual in a well-managed lab.

Impact of U-tube-input assembly on the seawater density

Measuring the density not using the substitution method. Shortly after a quick-adjustment, even if the densimeter was filled manually using syringes that were directly and coarsely connected to the inlet of the oscillating U-tube, we never observed deviations > ±5 g m^{-3}. The inlet may be mechanically decoupled to avoid such deviations.

Measuring the density using the substitution method (and a permanent filling installation). Such impacts are eliminated, as the impact on the measurement of water and seawater density is identical and no parts are being moved during the measurements. The density is determined from the oscillation frequency and has to be corrected for damping effects that are caused by the friction between fluid layers due to viscosity. To correct for this effect, the first harmonic oscillation frequency is used by the firmware[13]. The impact of the input assembly on density measurement therefore has to be considered before this background. Frankly speaking, the damping-corrected density has to be used instead of the non-damping-corrected density. Using the non-damping-corrected density in a substitution measurement of seawater can cause the density being measured too high by up to 10 g m^{-3}, if syringes are used for filling, and 2 g m^{-3} to 3 g m^{-3}, even if a permament installation is used for filling, as damping effects force the base frequency being too low, i.e. the oscillation period too long, thereby pretending a higher density.

[13] Stabinger, H.: Density measurement using modern oscillating transducers, South Yorkshire Trading Unit, Sheffield, 1994.

Impact of densimeter inclination on the seawater substitution density

The impact of a (post-adjustment) densimeter inclination on the measurement density is 1.82 g m^{-3} per 1 °. Apart from the fact that the DMAs used to measure the seawater density were set up on fixed straight surfaces, such deviations are corrected by the substitution method. If a DMA is used without the substitution method, it can also be quick-adjusted at an inclination and then used afterwards. The decisive factor is that the inclination does not change between adjustment and measurement. This may be a problem in measurements aboard ship.

Avoidance of oil diffusion into the U-tube of the DMA HP during measurements at high pressure

In the substitution densimeter for high pressures, oil is used to prevent corrosion of the pressure sensors. For reasons of accuracy, no pressure diaphragm was used. Oil and water were therefore in direct contact.

Oil and water are not miscible, so there is always a phase boundary between both liquids. The phase boundary is reinforced, as the capillary tube in that both liquids meet has a small diameter of 1.6 mm. The density of the oil is lower than that of the water. Advantage was taken of that by installing the density measurement part at a lower level than the pressurization part that is filled with oil, thereby preventing convection downwards (into the DMA).

After each substitution measurement, the filling line was rinsed with ethanol and water and thoroughly dried using filtered dry air, thereby removing any oil that may stick to and creep on the inner tube wall, as such oil remains can disturb a clean replacement of seawater by water and vice versa. If, nonetheless, there is such a disturbance, this was seen in an increase in the water density or decrease in the seawater density measured, provided a measurement series is conducted, i.e. water – seawater – water – seawater – … – water. For the high pressure measurements, we performed usually 5 repeated substitution measurements per temperature-pressure density point, i.e. 11 liquid replacements (water was always first and last); obeying the cleaning routine, replacement of liquids that were accompanied by impurities never occurred.

Data related to ‘The density–salinity relation of standard seawater’

Sect. 2 & 3

Density for atmospheric pressure

Date of salinity measurement	Practical salinity from measurement					Temperature	Pressure	Date of density measurement	Seawater density from substitution measurement			Density correction to (integer) target salinity			Density change due to preparation (isotopic composition)				Density change due to storage (salt composition)			Density correction due to measurement (air saturation)			Practical salinity	Temperature	Pressure	Seawater density (at uniform conditions)		
–	S	$u(S)$	$d\rho/dS$	$u(\rho)$	ν	T	p	–	$\rho_{SW,subs}$	u	ν_{eff}	$\Delta\rho_{SW,tar}$	u	ν_{eff}	$\Delta\rho_{SW,prep}$	$\Delta\rho_{SW,iso}$	u	ν_{eff}	$\Delta\rho_{SW,stor}$	u	ν_{eff}	$\Delta\rho_{SW,aer}$	u	ν_{eff}	S	T	p	ρ_{SW}	u	ν_{eff}
–	–	–	kg m^{-3}	kg m^{-3}	–	°C	MPa	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	–	°C	MPa	kg m^{-3}	kg m^{-3}	–
2011–10	4.9958	0.0002	0.79	0.0002	4	5	0.101325	2014–05	1003.9370	0.0008	60	0.0033	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0016	0.0001	∞	-0.0010	0.0002	∞	5	5	0.101325	1003.9395	0.0009	79
2011–10	4.9958	0.0002	0.78	0.0002	4	10	0.101325	2014–11	1003.5999	0.0008	60	0.0033	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0006	0.0002	∞	5	10	0.101325	1003.6026	0.0009	80
2011–10	4.9958	0.0002	0.77	0.0002	4	15	0.101325	2014–05	1002.9437	0.0008	60	0.0032	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0016	0.0001	∞	-0.0003	0.0002	∞	5	15	0.101325	1002.9470	0.0009	78
2011–10	4.9958	0.0002	0.76	0.0002	4	20	0.101325	2014–08	1001.9989	0.0008	60	0.0032	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0017	0.0002	∞	0.0000	0.0000	∞	5	20	0.101325	1002.0022	0.0009	71
2011–10	4.9958	0.0002	0.75	0.0002	4	25	0.101325	2014–05	1000.8038	0.0008	60	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0016	0.0001	∞	0.0002	0.0002	∞	5	25	0.101325	1000.8074	0.0009	78
2011–10	4.9958	0.0002	0.74	0.0002	4	30	0.101325	2014–08	999.3709	0.0008	60	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0017	0.0002	∞	0.0003	0.0002	∞	5	30	0.101325	999.3744	0.0009	79
2011–10	4.9958	0.0002	0.74	0.0002	4	35	0.101325	2014–05	997.7317	0.0008	60	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0016	0.0001	∞	0.0004	0.0002	∞	5	35	0.101325	997.7355	0.0009	78
2011–03	9.9887	0.0003	0.79	0.0002	6	5	0.101325	2014–09	1007.8874	0.0009	70	0.0089	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0024	0.0002	∞	-0.0010	0.0002	∞	10	5	0.101325	1007.8944	0.0009	98
2011–03	9.9887	0.0003	0.78	0.0002	6	10	0.101325	2014–11	1007.4827	0.0009	70	0.0088	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0024	0.0002	∞	-0.0006	0.0002	∞	10	10	0.101325	1007.4899	0.0009	99
2011–03	9.9887	0.0003	0.77	0.0002	6	15	0.101325	2014–10	1006.7688	0.0009	70	0.0087	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0024	0.0002	∞	-0.0003	0.0002	∞	10	15	0.101325	1006.7764	0.0009	98
2011–03	9.9887	0.0003	0.76	0.0002	6	20	0.101325	2014–09	1005.7779	0.0009	70	0.0085	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0024	0.0002	∞	0.0000	0.0000	∞	10	20	0.101325	1005.7856	0.0009	90
2011–03	9.9887	0.0003	0.75	0.0002	6	25	0.101325	2014–09	1004.5416	0.0009	70	0.0085	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0023	0.0002	∞	0.0002	0.0002	∞	10	25	0.101325	1004.5494	0.0009	98
2011–03	9.9887	0.0003	0.74	0.0002	6	30	0.101325	2014–09	1003.0796	0.0009	70	0.0084	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0023	0.0002	∞	0.0003	0.0002	∞	10	30	0.101325	1003.0875	0.0009	98
2011–03	9.9887	0.0003	0.74	0.0002	6	35	0.101325	2014–09	1001.4099	0.0009	70	0.0083	0.0000	∞	-0.0017	-0.0003	0.0002	∞	0.0023	0.0002	∞	0.0004	0.0002	∞	10	35	0.101325	1001.4178	0.0009	98
2011–10	14.9999	0.0002	0.79	0.0002	8	5	0.101325	2014–05	1011.8451	0.0009	79	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0015	0.0001	∞	-0.0010	0.0002	∞	15	5	0.101325	1011.8438	0.0009	102
2011–10	14.9999	0.0002	0.78	0.0002	8	10	0.101325	2014–11	1011.3736	0.0009	79	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0017	0.0002	∞	-0.0006	0.0002	∞	15	10	0.101325	1011.3725	0.0010	104
2011–10	14.9999	0.0002	0.77	0.0002	8	15	0.101325	2014–05	1010.6052	0.0009	79	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0015	0.0001	∞	-0.0003	0.0002	∞	15	15	0.101325	1010.6047	0.0009	102
2011–10	14.9999	0.0002	0.76	0.0002	8	20	0.101325	2014–08	1009.5695	0.0009	79	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0016	0.0002	∞	0.0000	0.0000	∞	15	20	0.101325	1009.5691	0.0009	94
2011–10	14.9999	0.0002	0.75	0.0002	8	25	0.101325	2014–05	1008.2930	0.0009	79	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0015	0.0001	∞	0.0002	0.0002	∞	15	25	0.101325	1008.2929	0.0009	102
2011–10	14.9999	0.0002	0.74	0.0002	8	30	0.101325	2014–08	1006.7974	0.0009	79	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0016	0.0002	∞	0.0003	0.0002	∞	15	30	0.101325	1006.7973	0.0009	103
2011–10	14.9999	0.0002	0.74	0.0002	8	35	0.101325	2014–06	1005.1035	0.0009	79	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0015	0.0002	∞	0.0004	0.0002	∞	15	35	0.101325	1005.1036	0.0009	102
2011–10	20.0009	0.0003	0.79	0.0002	7	5	0.101325	2014–10	1015.7959	0.0009	89	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0017	0.0001	∞	-0.0010	0.0002	∞	20	5	0.101325	1015.7933	0.0010	114
2011–10	20.0009	0.0003	0.78	0.0002	7	10	0.101325	2014–11	1015.2609	0.0009	89	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	-0.0006	0.0002	∞	20	10	0.101325	1015.2587	0.0010	114
2011–10	20.0009	0.0003	0.77	0.0002	7	15	0.101325	2014–10	1014.4347	0.0009	89	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0017	0.0001	∞	-0.0003	0.0002	∞	20	15	0.101325	1014.4329	0.0010	114
2011–10	20.0009	0.0003	0.76	0.0002	7	20	0.101325	2014–10	1013.3558	0.0009	89	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0017	0.0001	∞	0.0000	0.0000	∞	20	20	0.101325	1013.3542	0.0010	104
2011–10	20.0009	0.0003	0.75	0.0002	7	25	0.101325	2014–10	1012.0405	0.0009	89	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0017	0.0001	∞	0.0002	0.0002	∞	20	25	0.101325	1012.0391	0.0010	113
2011–10	20.0009	0.0003	0.74	0.0002	7	30	0.101325	2014–09	1010.5130	0.0009	89	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0017	0.0001	∞	0.0003	0.0002	∞	20	30	0.101325	1010.5117	0.0010	113
2011–10	20.0009	0.0003	0.74	0.0002	7	35	0.101325	2014–09	1008.7942	0.0009	89	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0016	0.0001	∞	0.0004	0.0002	∞	20	35	0.101325	1008.7931	0.0010	113
2011–10	25.0047	0.0002	0.79	0.0002	17	5	0.101325	2014–05	1019.7509	0.0009	99	-0.0037	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0013	0.0001	∞	-0.0010	0.0002	∞	25	5	0.101325	1019.7453	0.0010	124
2011–10	25.0047	0.0002	0.78	0.0002	17	10	0.101325	2014–10	1019.1497	0.0009	99	-0.0037	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0016	0.0001	∞	-0.0006	0.0002	∞	25	10	0.101325	1019.1443	0.0010	125
2011–10	25.0047	0.0002	0.77	0.0002	17	15	0.101325	2014–04	1018.2751	0.0009	99	-0.0036	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0013	0.0001	∞	-0.0003	0.0002	∞	25	15	0.101325	1018.2704	0.0010	123
2011–10	25.0047	0.0002	0.76	0.0002	17	20	0.101325	2014–10	1017.1465	0.0009	99	-0.0036	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0016	0.0001	∞	0.0000	0.0000	∞	25	20	0.101325	1017.1418	0.0010	115
2011–10	25.0047	0.0002	0.75	0.0002	17	25	0.101325	2014–05	1015.7978	0.0009	99	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0013	0.0001	∞	0.0002	0.0002	∞	25	25	0.101325	1015.7935	0.0010	123
2011–10	25.0047	0.0002	0.75	0.0002	17	30	0.101325	2014–08	1014.2440	0.0009	99	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0015	0.0001	∞	0.0003	0.0002	∞	25	30	0.101325	1014.2398	0.0010	124
2011–10	25.0047	0.0002	0.74	0.0002	17	35	0.101325	2014–06	1012.4960	0.0009	99	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0014	0.0001	∞	0.0004	0.0002	∞	25	35	0.101325	1012.4920	0.0010	123
2011–03	29.9689	0.0003	0.79	0.0002	25	5	0.101325	2014–10	1023.6786	0.0010	110	0.0246	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0026	0.0002	∞	-0.0010	0.0002	∞	30	5	0.101325	1023.6997	0.0010	150
2011–03	29.9689	0.0003	0.78	0.0002	25	10	0.101325	2014–10	1023.0160	0.0010	110	0.0242	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0026	0.0002	∞	-0.0006	0.0002	∞	30	10	0.101325	1023.0371	0.0010	149
2011–03	29.9689	0.0003	0.77	0.0002	25	15	0.101325	2014–10	1022.0893	0.0010	110	0.0239	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0027	0.0002	∞	-0.0003	0.0002	∞	30	15	0.101325	1022.1105	0.0010	149
2011–03	29.9689	0.0003	0.76	0.0002	25	20	0.101325	2014–10	1020.9208	0.0010	110	0.0237	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0027	0.0002	∞	0.0000	0.0000	∞	30	20	0.101325	1020.9420	0.0010	138
2011–03	29.9689	0.0003	0.75	0.0002	25	25	0.101325	2014–08	1019.5348	0.0010	110	0.0234	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0025	0.0002	∞	0.0002	0.0002	∞	30	25	0.101325	1019.5560	0.0010	148
2011–03	29.9689	0.0003	0.75	0.0002	25	30	0.101325	2014–08	1017.9495	0.0010	110	0.0233	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0025	0.0002	∞	0.0003	0.0002	∞	30	30	0.101325	1017.9706	0.0010	148
2011–03	29.9689	0.0003	0.74	0.0002	25	35	0.101325	2014–08	1016.1762	0.0010	110	0.0231	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0025	0.0002	∞	0.0004	0.0002	∞	30	35	0.101325	1016.1973	0.0010	147
2011–03	34.9917	0.0002	0.79	0.0002	∞	5	0.101325	2014–06	1027.6542	0.0010	121	0.0066	0.0000	∞	0.0000	-0.0003	0.0000	∞	0.0024	0.0002	∞	-0.0010	0.0002	∞	35	5	0.101325	1027.6570	0.0010	149
2011–03	34.9917	0.0002	0.78	0.0002	∞	10	0.101325	2014–10	1026.9354	0.0010	121	0.0065	0.0000	∞	0.0000	-0.0003	0.0000	∞	0.0026	0.0002	∞	-0.0006	0.0002	∞	35	10	0.101325	1026.9384	0.0011	151
2011–03	34.9917	0.0002	0.77	0.0002	∞	15	0.101325	2014–04	1025.9565	0.0010	121	0.0064	0.0000	∞	0.0000	-0.0003	0.0000	∞	0.0023	0.0002	∞	-0.0003	0.0002	∞	35	15	0.101325	1025.9601	0.0010	147
2011–03	34.9917	0.0002	0.76	0.0002	∞	20	0.101325	2014–10	1024.7445	0.0010	121	0.0063	0.0000	∞	0.0000	-0.0003	0.0000	∞	0.0026	0.0002	∞	0.0000	0.0000	∞	35	20	0.101325	1024.7480	0.0010	140
2011–03	34.9917	0.0002	0.76	0.0002	∞	25	0.101325	2014–05	1023.3230	0.0010	121	0.0063	0.0000	∞	0.0000	-0.0003	0.0000	∞	0.0024	0.0002	∞	0.0002	0.0002	∞	35	25	0.101325	1023.3268	0.0010	147
2011–03	34.9917	0.0002	0.75	0.0001	∞	30	0.101325	2014–10	1021.7042	0.0010	121	0.0062	0.0000	∞	0.0000	-0.0003	0.0000	∞	0.0026	0.0002	∞	0.0003	0.0002	∞	35	30	0.101325	1021.7079	0.0011	150
2011–03	34.9917	0.0002	0.74	0.0001	∞	35	0.101325	2014–05	1019.9105	0.0010	121	0.0062	0.0000	∞	0.0000	-0.0003	0.0000	∞	0.0024	0.0002	∞	0.0004	0.0002	∞	35	35	0.101325	1019.9145	0.0010	147

Density for high pressures

Salinity 5

Date of salinity measurement	Practical salinity from measurement					Temperature	Pressure	Date of density measurement	Seawater density from substitution measurement			Density correction to (integer) target salinity			Density change due to preparation (isotopic composition)				Density change due to storage (salt composition)			Density correction due to measurement (air saturation)			Practical salinity	Temperature	Pressure	Seawater density (at uniform conditions)		
–	S	$u(S)$	$\mathrm{d}\rho/\mathrm{d}S$	$u(\rho)$	ν	T	p	–	$\rho_{SW,subs}$	u	ν_{eff}	$\Delta\rho_{SW,int}$	u	ν_{eff}	$\Delta\rho_{SW,prep}$	$\Delta\rho_{SW,iso}$	u	ν_{eff}	$\Delta\rho_{SW,stor}$	u	ν_{eff}	$\Delta\rho_{SW,aer}$	u	ν_{eff}	S	T	p	ρ_{SW}	u	ν_{eff}
–	–	–	kg m^{-3}	kg m^{-3}	–	°C	MPa	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	–	°C	MPa	kg m^{-3}	kg m^{-3}	–
2011–10	4.9958	0.0002	0.79	0.0002	4	5	5.0	2014–09	1006.3104	0.0058	71	0.0033	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	-0.0010	0.0002	∞	5	5	5.0	1006.3128	0.0058	71
2011–10	4.9958	0.0002	0.79	0.0002	4	5	10.0	2014–09	1008.7060	0.0058	71	0.0033	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	-0.0010	0.0002	∞	5	5	10.0	1008.7083	0.0059	72
2011–10	4.9958	0.0002	0.79	0.0002	4	5	15.0	2014–09	1011.0763	0.0154	3414	0.0033	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	-0.0010	0.0002	∞	5	5	15.0	1011.0785	0.0154	3418
2011–10	4.9958	0.0002	0.79	0.0002	4	5	20.0	2014–09	1013.4212	0.0154	3444	0.0033	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	-0.0010	0.0002	∞	5	5	20.0	1013.4235	0.0154	3448
2011–10	4.9958	0.0002	0.79	0.0002	4	5	26.0	2014–09	1016.2007	0.0155	3480	0.0032	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	-0.0010	0.0002	∞	5	5	26.0	1016.2030	0.0155	3483
2011–10	4.9958	0.0002	0.79	0.0002	4	5	33.0	2014–09	1019.3983	0.0155	3521	0.0032	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	-0.0010	0.0002	∞	5	5	33.0	1019.4005	0.0155	3525
2011–10	4.9958	0.0002	0.79	0.0002	4	5	41.5	2014–09	1023.2149	0.0156	3570	0.0032	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	-0.0010	0.0002	∞	5	5	41.5	1023.2171	0.0156	3573
2011–10	4.9958	0.0002	0.79	0.0002	4	5	52.0	2014–09	1027.8385	0.0156	3626	0.0032	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	-0.0010	0.0002	∞	5	5	52.0	1027.8407	0.0156	3630
2011–10	4.9958	0.0002	0.79	0.0002	4	5	65.0	2014–09	1033.4192	0.0157	3688	0.0031	0.0000	∞	-0.0022	-0.0003	0.0002	∞	0.0018	0.0002	∞	-0.0010	0.0002	∞	5	5	65.0	1033.4214	0.0157	3692
2011–10	4.9958	0.0002	0.78	0.0002	4	10	5.0	2014–09	1005.9111	0.0058	71	0.0033	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	-0.0006	0.0002	∞	5	10	5.0	1005.9137	0.0058	71
2011–10	4.9958	0.0002	0.78	0.0002	4	10	10.0	2014–09	1008.2423	0.0058	71	0.0032	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	-0.0006	0.0002	∞	5	10	10.0	1008.2449	0.0059	72
2011–10	4.9958	0.0002	0.78	0.0002	4	10	15.0	2014–09	1010.5477	0.0154	3414	0.0032	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	-0.0006	0.0002	∞	5	10	15.0	1010.5503	0.0154	3418
2011–10	4.9958	0.0002	0.78	0.0002	4	10	20.0	2014–09	1012.8315	0.0154	3444	0.0032	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	-0.0006	0.0002	∞	5	10	20.0	1012.8341	0.0154	3448
2011–10	4.9958	0.0002	0.78	0.0002	4	10	26.0	2014–09	1015.5428	0.0155	3480	0.0032	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	-0.0006	0.0002	∞	5	10	26.0	1015.5455	0.0155	3483
2011–10	4.9958	0.0002	0.78	0.0002	4	10	33.0	2014–09	1018.6603	0.0155	3521	0.0032	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0006	0.0002	∞	5	10	33.0	1018.6629	0.0155	3525
2011–10	4.9958	0.0002	0.78	0.0002	4	10	41.5	2014–09	1022.3857	0.0156	3570	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0006	0.0002	∞	5	10	41.5	1022.3883	0.0156	3573
2011–10	4.9958	0.0002	0.78	0.0002	4	10	52.0	2014–09	1026.8948	0.0156	3626	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0006	0.0002	∞	5	10	52.0	1026.8973	0.0156	3630
2011–10	4.9958	0.0002	0.78	0.0002	4	10	65.0	2014–09	1032.3480	0.0157	3688	0.0031	0.0000	∞	-0.0022	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0006	0.0002	∞	5	10	65.0	1032.3505	0.0157	3692
2011–10	4.9958	0.0002	0.77	0.0002	4	15	5.0	2015–04	1005.2011	0.0058	71	0.0032	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0022	0.0002	∞	-0.0003	0.0002	∞	5	15	5.0	1005.2037	0.0058	71
2011–10	4.9958	0.0002	0.77	0.0002	4	15	10.0	2015–04	1007.4814	0.0058	71	0.0032	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0022	0.0002	∞	-0.0003	0.0002	∞	5	15	10.0	1007.4840	0.0059	72
2011–10	4.9958	0.0002	0.77	0.0002	4	15	15.0	2015–04	1009.7375	0.0154	3414	0.0032	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0022	0.0002	∞	-0.0003	0.0002	∞	5	15	15.0	1009.7401	0.0154	3418
2011–10	4.9958	0.0002	0.77	0.0002	4	15	20.0	2015–04	1011.9697	0.0154	3444	0.0032	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0022	0.0002	∞	-0.0003	0.0002	∞	5	15	20.0	1011.9723	0.0154	3448
2011–10	4.9958	0.0002	0.77	0.0002	4	15	26.0	2015–04	1014.6199	0.0155	3480	0.0032	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0022	0.0002	∞	-0.0003	0.0002	∞	5	15	26.0	1014.6225	0.0155	3484
2011–10	4.9958	0.0002	0.77	0.0002	4	15	33.0	2015–04	1017.6696	0.0155	3521	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0022	0.0002	∞	-0.0003	0.0002	∞	5	15	33.0	1017.6722	0.0155	3525
2011–10	4.9958	0.0002	0.77	0.0002	4	15	41.5	2015–04	1021.3154	0.0156	3570	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0022	0.0002	∞	-0.0003	0.0002	∞	5	15	41.5	1021.3179	0.0156	3573
2011–10	4.9958	0.0002	0.77	0.0002	4	15	52.0	2015–04	1025.7321	0.0156	3626	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0022	0.0002	∞	-0.0003	0.0002	∞	5	15	52.0	1025.7346	0.0156	3630
2011–10	4.9958	0.0002	0.77	0.0002	4	15	65.0	2015–04	1031.0771	0.0157	3688	0.0031	0.0000	∞	-0.0022	-0.0003	0.0002	∞	0.0022	0.0002	∞	-0.0003	0.0002	∞	5	15	65.0	1031.0796	0.0157	3692
2011–10	4.9958	0.0002	0.76	0.0002	4	20	5.0	2014–09	1004.2168	0.0058	71	0.0032	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0000	0.0000	∞	5	20	5.0	1004.2200	0.0058	71
2011–10	4.9958	0.0002	0.76	0.0002	4	20	10.0	2014–09	1006.4538	0.0058	71	0.0032	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0000	0.0000	∞	5	20	10.0	1006.4570	0.0058	71
2011–10	4.9958	0.0002	0.76	0.0002	4	20	15.0	2014–09	1008.6687	0.0154	3414	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0000	0.0000	∞	5	20	15.0	1008.6719	0.0154	3417
2011–10	4.9958	0.0002	0.76	0.0002	4	20	20.0	2014–09	1010.8616	0.0154	3444	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0000	0.0000	∞	5	20	20.0	1010.8648	0.0154	3446
2011–10	4.9958	0.0002	0.76	0.0002	4	20	26.0	2014–09	1013.4616	0.0155	3480	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0000	0.0000	∞	5	20	26.0	1013.4648	0.0155	3482
2011–10	4.9958	0.0002	0.76	0.0002	4	20	33.0	2014–09	1016.4616	0.0155	3521	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0000	0.0000	∞	5	20	33.0	1016.4647	0.0155	3523
2011–10	4.9958	0.0002	0.76	0.0002	4	20	41.5	2014–09	1020.0434	0.0156	3570	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0000	0.0000	∞	5	20	41.5	1020.0465	0.0156	3572
2011–10	4.9958	0.0002	0.76	0.0002	4	20	52.0	2014–09	1024.3847	0.0156	3626	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0000	0.0000	∞	5	20	52.0	1024.3878	0.0156	3629
2011–10	4.9958	0.0002	0.76	0.0002	4	20	65.0	2014–09	1029.6361	0.0157	3688	0.0030	0.0000	∞	-0.0022	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0000	0.0000	∞	5	20	65.0	1029.6392	0.0157	3691
2011–10	4.9958	0.0002	0.75	0.0002	4	25	5.0	2014–05	1002.9869	0.0058	71	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0016	0.0001	∞	0.0002	0.0002	∞	5	25	5.0	1002.9904	0.0058	71
2011–10	4.9958	0.0002	0.75	0.0002	4	25	10.0	2014–05	1005.1934	0.0058	71	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0016	0.0001	∞	0.0002	0.0002	∞	5	25	10.0	1005.1969	0.0059	71
2011–10	4.9958	0.0002	0.75	0.0002	4	25	15.0	2014–05	1007.3765	0.0154	3414	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0016	0.0001	∞	0.0002	0.0002	∞	5	25	15.0	1007.3800	0.0154	3418
2011–10	4.9958	0.0002	0.75	0.0002	4	25	20.0	2014–05	1009.5377	0.0154	3444	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0016	0.0001	∞	0.0002	0.0002	∞	5	25	20.0	1009.5412	0.0154	3447
2011–10	4.9958	0.0002	0.75	0.0002	4	25	26.0	2014–05	1012.1016	0.0155	3480	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0016	0.0001	∞	0.0002	0.0002	∞	5	25	26.0	1012.1051	0.0155	3483
2011–10	4.9958	0.0002	0.75	0.0002	4	25	33.0	2014–05	1015.0546	0.0155	3521	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0016	0.0001	∞	0.0002	0.0002	∞	5	25	33.0	1015.0581	0.0155	3524
2011–10	4.9958	0.0002	0.75	0.0002	4	25	41.5	2014–05	1018.5849	0.0156	3570	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0016	0.0001	∞	0.0002	0.0002	∞	5	25	41.5	1018.5884	0.0156	3573
2011–10	4.9958	0.0002	0.75	0.0002	4	25	52.0	2014–05	1022.8660	0.0156	3626	0.0030	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0016	0.0001	∞	0.0002	0.0002	∞	5	25	52.0	1022.8694	0.0156	3630
2011–10	4.9958	0.0002	0.75	0.0002	4	25	65.0	2014–05	1028.0455	0.0157	3688	0.0030	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0017	0.0001	∞	0.0002	0.0002	∞	5	25	65.0	1028.0489	0.0157	3692
2011–10	4.9958	0.0002	0.74	0.0002	4	30	5.0	2015–02	1001.5288	0.0058	71	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0021	0.0002	∞	0.0003	0.0002	∞	5	30	5.0	1001.5320	0.0058	71
2011–10	4.9958	0.0002	0.74	0.0002	4	30	10.0	2015–02	1003.7096	0.0058	71	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0021	0.0002	∞	0.0003	0.0002	∞	5	30	10.0	1003.7128	0.0059	72
2011–10	4.9958	0.0002	0.74	0.0002	4	30	15.0	2015–02	1005.8669	0.0154	3414	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0021	0.0002	∞	0.0003	0.0002	∞	5	30	15.0	1005.8700	0.0154	3418
2011–10	4.9958	0.0002	0.74	0.0002	4	30	20.0	2015–02	1008.0030	0.0154	3444	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0021	0.0002	∞	0.0003	0.0002	∞	5	30	20.0	1008.0061	0.0154	3448
2011–10	4.9958	0.0002	0.74	0.0002	4	30	26.0	2015–02	1010.5370	0.0155	3480	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0021	0.0002	∞	0.0003	0.0002	∞	5	30	26.0	1010.5402	0.0155	3484
2011–10	4.9958	0.0002	0.74	0.0002	4	30	33.0	2015–02	1013.4554	0.0155	3521	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0021	0.0002	∞	0.0003	0.0002	∞	5	30	33.0	1013.4585	0.0155	3525
2011–10	4.9958	0.0002	0.74	0.0002	4	30	41.5	2015–02	1016.9455	0.0156	3570	0.0030	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0021	0.0002	∞	0.0003	0.0002	∞	5	30	41.5	1016.9486	0.0156	3573
2011–10	4.9958	0.0002	0.74	0.0002	4	30	52.0	2015–02	1021.1768	0.0156	3626	0.0030	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0021	0.0002	∞	0.0003	0.0002	∞	5	30	52.0	1021.1799	0.0156	3630
2011–10	4.9958	0.0002	0.74	0.0002	4	30	65.0	2015–02	1026.2979	0.0157	3688	0.0030	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0021	0.0002	∞	0.0003	0.0002	∞	5	30	65.0	1026.3010	0.0157	3692
2011–10	4.9958	0.0002	0.74	0.0002	4	35	5.0	2014–08	999.8682	0.0058	71	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0004	0.0002	∞	5	35	5.0	999.8718	0.0058	71
2011–10	4.9958	0.0002	0.74	0.0002	4	35	10.0	2014–08	1002.0285	0.0058	71	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0004	0.0002	∞	5	35	10.0	1002.0320	0.0059	71
2011–10	4.9958	0.0002	0.74	0.0002	4	35	15.0	2014–08	1004.1681	0.0154	3414	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0004	0.0002	∞	5	35	15.0	1004.1716	0.0154	3418
2011–10	4.9958	0.0002	0.74	0.0002	4	35	20.0	2014–08	1006.2850	0.0154	3444	0.0031	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0004	0.0002	∞	5	35	20.0	1006.2885	0.0154	3448
2011–10	4.9958	0.0002	0.74	0.0002	4	35	26.0	2014–08	1008.7936	0.0155	3480	0.0030	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0004	0.0002	∞	5	35	26.0	1008.7971	0.0155	3483
2011–10	4.9958	0.0002	0.74	0.0002	4	35	33.0	2014–08	1011.6847	0.0155	3521	0.0030	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0004	0.0002	∞	5	35	33.0	1011.6882	0.0155	3524
2011–10	4.9958	0.0002	0.74	0.0002	4	35	41.5	2014–08	1015.1436	0.0156	3570	0.0030	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0004	0.0002	∞	5	35	41.5	1015.1471	0.0156	3573
2011–10	4.9958	0.0002	0.74	0.0002	4	35	52.0	2014–08	1019.3366	0.0156	3626	0.0030	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0004	0.0002	∞	5	35	52.0	1019.3401	0.0156	3630
2011–10	4.9958	0.0002	0.74	0.0002	4	35	65.0	2014–08	1024.4120	0.0157	3688	0.0030	0.0000	∞	-0.0021	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0004	0.0002	∞	5	35	65.0	1024.4154	0.0157	3692

Salinity 10

Date of salinity measurement	Practical salinity from measurement					Temperature	Pressure	Date of density measurement	Seawater density from substitution measurement			Density correction to (integer) target salinity			Density change due to preparation (isotopic composition)				Density change due to storage (salt composition)			Density correction due to measurement (air saturation)			Practical salinity	Temperature	Pressure	Seawater density (at uniform conditions)		
–	S	$u(S)$	$\mathrm{d}\rho/\mathrm{d}S$	$u(\rho)$	ν	T	p	–	$\rho_{SW,subs}$	u	ν_{eff}	$\Delta\rho_{SW,tar}$	u	ν_{eff}	$\Delta\rho_{SW,prep}$	$\Delta\rho_{SW,iso}$	u	ν_{eff}	$\Delta\rho_{SW,stor}$	u	ν_{eff}	$\Delta\rho_{SW,aer}$	u	ν_{eff}	S	T	p	ρ_{SW}	u	ν_{eff}
–	–	–	kg m^{-3}	kg m^{-3}	–	°C	MPa	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	–	°C	MPa	kg m^{-3}	kg m^{-3}	–
2011–03	9.9887	0.0003	0.79	0.0002	6	5	5.0	2014–10	1010.2405	0.0061	82	0.0089	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0024	0.0002	∞	-0.0010	0.0002	∞	10	5	5.0	1010.2474	0.0061	82
2011–03	9.9887	0.0003	0.79	0.0002	6	5	10.0	2014–10	1012.6166	0.0061	82	0.0088	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0024	0.0002	∞	-0.0010	0.0002	∞	10	5	10.0	1012.6235	0.0061	83
2011–03	9.9887	0.0003	0.79	0.0002	6	5	15.0	2014–10	1014.9675	0.0155	3480	0.0088	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0024	0.0002	∞	-0.0010	0.0002	∞	10	5	15.0	1014.9743	0.0155	3485
2011–03	9.9887	0.0003	0.79	0.0002	6	5	20.0	2014–10	1017.2863	0.0155	3509	0.0088	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0024	0.0002	∞	-0.0010	0.0002	∞	10	5	20.0	1017.2931	0.0155	3514
2011–03	9.9887	0.0003	0.79	0.0002	6	5	26.0	2014–10	1020.0430	0.0156	3540	0.0087	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0024	0.0002	∞	-0.0010	0.0002	∞	10	5	26.0	1020.0497	0.0156	3545
2011–03	9.9887	0.0003	0.79	0.0002	6	5	33.0	2014–10	1023.2180	0.0156	3567	0.0086	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0025	0.0002	∞	-0.0010	0.0002	∞	10	5	33.0	1023.2246	0.0156	3572
2011–03	9.9887	0.0003	0.79	0.0002	6	5	41.5	2014–10	1027.0086	0.0157	3578	0.0086	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0025	0.0002	∞	-0.0010	0.0002	∞	10	5	41.5	1027.0152	0.0157	3583
2011–03	9.9887	0.0003	0.79	0.0002	6	5	52.0	2014–10	1031.5922	0.0157	3542	0.0085	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0025	0.0002	∞	-0.0010	0.0002	∞	10	5	52.0	1031.5987	0.0158	3547
2011–03	9.9887	0.0003	0.79	0.0002	6	5	65.0	2014–10	1037.1289	0.0158	3397	0.0084	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0025	0.0002	∞	-0.0010	0.0002	∞	10	5	65.0	1037.1353	0.0159	3402
2011–03	9.9887	0.0003	0.78	0.0002	6	10	5.0	2015–05	1009.7742	0.0061	82	0.0087	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0028	0.0003	∞	-0.0006	0.0002	∞	10	10	5.0	1009.7811	0.0061	83
2011–03	9.9887	0.0003	0.78	0.0002	6	10	10.0	2015–05	1012.8876	0.0061	82	0.0087	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0028	0.0003	∞	-0.0006	0.0002	∞	10	10	10.0	1012.8944	0.0061	83
2011–03	9.9887	0.0003	0.78	0.0002	6	10	15.0	2015–05	1014.3779	0.0155	3480	0.0087	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0028	0.0003	∞	-0.0006	0.0002	∞	10	10	15.0	1014.3846	0.0155	3485
2011–03	9.9887	0.0003	0.78	0.0002	6	10	20.0	2015–05	1016.6439	0.0155	3509	0.0086	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0028	0.0003	∞	-0.0006	0.0002	∞	10	10	20.0	1016.6506	0.0155	3515
2011–03	9.9887	0.0003	0.78	0.0002	6	10	26.0	2015–05	1019.3304	0.0156	3540	0.0086	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0028	0.0003	∞	-0.0006	0.0002	∞	10	10	26.0	1019.3371	0.0156	3546
2011–03	9.9887	0.0003	0.78	0.0002	6	10	33.0	2015–05	1022.4234	0.0156	3567	0.0085	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0028	0.0003	∞	-0.0006	0.0002	∞	10	10	33.0	1022.4300	0.0156	3573
2011–03	9.9887	0.0003	0.78	0.0002	6	10	41.5	2015–05	1026.1202	0.0157	3578	0.0085	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0028	0.0003	∞	-0.0006	0.0002	∞	10	10	41.5	1026.1268	0.0157	3584
2011–03	9.9887	0.0003	0.78	0.0002	6	10	52.0	2015–05	1030.5974	0.0157	3542	0.0084	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0028	0.0003	∞	-0.0006	0.0002	∞	10	10	52.0	1030.6039	0.0158	3548
2011–03	9.9887	0.0003	0.78	0.0002	6	10	65.0	2015–05	1036.0099	0.0158	3397	0.0083	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0029	0.0003	∞	-0.0006	0.0002	∞	10	10	65.0	1036.0163	0.0159	3402
2011–03	9.9887	0.0003	0.77	0.0002	6	15	5.0	2014–11	1009.0104	0.0061	82	0.0086	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0025	0.0002	∞	-0.0003	0.0002	∞	10	15	5.0	1009.0179	0.0061	82
2011–03	9.9887	0.0003	0.77	0.0002	6	15	10.0	2014–11	1011.2747	0.0061	82	0.0086	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0025	0.0002	∞	-0.0003	0.0002	∞	10	15	10.0	1011.2821	0.0061	83
2011–03	9.9887	0.0003	0.77	0.0002	6	15	15.0	2014–11	1013.5161	0.0155	3480	0.0085	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0025	0.0002	∞	-0.0003	0.0002	∞	10	15	15.0	1013.5235	0.0155	3485
2011–03	9.9887	0.0003	0.77	0.0002	6	15	20.0	2014–11	1015.7356	0.0155	3509	0.0085	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0025	0.0002	∞	-0.0003	0.0002	∞	10	15	20.0	1015.7429	0.0155	3514
2011–03	9.9887	0.0003	0.77	0.0002	6	15	26.0	2014–11	1018.3651	0.0156	3540	0.0085	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0025	0.0002	∞	-0.0003	0.0002	∞	10	15	26.0	1018.3723	0.0156	3545
2011–03	9.9887	0.0003	0.77	0.0002	6	15	33.0	2014–11	1021.3940	0.0156	3567	0.0084	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0025	0.0002	∞	-0.0003	0.0002	∞	10	15	33.0	1021.4012	0.0156	3572
2011–03	9.9887	0.0003	0.77	0.0002	6	15	41.5	2014–11	1025.0161	0.0157	3578	0.0084	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0025	0.0002	∞	-0.0003	0.0002	∞	10	15	41.5	1025.0232	0.0157	3583
2011–03	9.9887	0.0003	0.77	0.0002	6	15	52.0	2014–11	1029.4044	0.0157	3542	0.0083	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0025	0.0002	∞	-0.0003	0.0002	∞	10	15	52.0	1029.4115	0.0158	3547
2011–03	9.9887	0.0003	0.77	0.0002	6	15	65.0	2014–11	1034.7140	0.0158	3397	0.0082	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0025	0.0002	∞	-0.0003	0.0002	∞	10	15	65.0	1034.7210	0.0159	3402
2011–03	9.9887	0.0003	0.76	0.0002	6	20	5.0	2014–12	1007.9802	0.0061	82	0.0085	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0025	0.0002	∞	0.0000	0.0000	∞	10	20	5.0	1007.9877	0.0061	82
2011–03	9.9887	0.0003	0.76	0.0002	6	20	10.0	2014–12	1010.2007	0.0061	82	0.0085	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0025	0.0002	∞	0.0000	0.0000	∞	10	20	10.0	1010.2082	0.0061	83
2011–03	9.9887	0.0003	0.76	0.0002	6	20	15.0	2014–12	1012.4014	0.0155	3480	0.0084	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0025	0.0002	∞	0.0000	0.0000	∞	10	20	15.0	1012.4089	0.0155	3484
2011–03	9.9887	0.0003	0.76	0.0002	6	20	20.0	2014–12	1014.5822	0.0155	3509	0.0084	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0025	0.0002	∞	0.0000	0.0000	∞	10	20	20.0	1014.5896	0.0155	3513
2011–03	9.9887	0.0003	0.76	0.0002	6	20	26.0	2014–12	1017.1658	0.0156	3540	0.0084	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0025	0.0002	∞	0.0000	0.0000	∞	10	20	26.0	1017.1732	0.0156	3544
2011–03	9.9887	0.0003	0.76	0.0002	6	20	33.0	2014–12	1020.1429	0.0156	3567	0.0083	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0025	0.0002	∞	0.0000	0.0000	∞	10	20	33.0	1020.1502	0.0156	3571
2011–03	9.9887	0.0003	0.76	0.0002	6	20	41.5	2014–12	1023.7018	0.0157	3578	0.0083	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0025	0.0002	∞	0.0000	0.0000	∞	10	20	41.5	1023.7090	0.0157	3582
2011–03	9.9887	0.0003	0.76	0.0002	6	20	52.0	2014–12	1028.0182	0.0157	3542	0.0082	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0025	0.0002	∞	0.0000	0.0000	∞	10	20	52.0	1028.0255	0.0157	3546
2011–03	9.9887	0.0003	0.76	0.0002	6	20	65.0	2014–12	1033.2400	0.0158	3397	0.0081	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0026	0.0002	∞	0.0000	0.0000	∞	10	20	65.0	1033.2471	0.0158	3401
2011–03	9.9887	0.0003	0.75	0.0002	6	25	5.0	2015–01	1006.7123	0.0061	82	0.0084	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0026	0.0002	∞	0.0002	0.0002	∞	10	25	5.0	1006.7199	0.0061	82
2011–03	9.9887	0.0003	0.75	0.0002	6	25	10.0	2015–01	1008.9038	0.0061	82	0.0084	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0026	0.0002	∞	0.0002	0.0002	∞	10	25	10.0	1008.9113	0.0061	83
2011–03	9.9887	0.0003	0.75	0.0002	6	25	15.0	2015–01	1011.0723	0.0155	3480	0.0084	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0026	0.0002	∞	0.0002	0.0002	∞	10	25	15.0	1011.0797	0.0155	3485
2011–03	9.9887	0.0003	0.75	0.0002	6	25	20.0	2015–01	1013.2208	0.0155	3509	0.0083	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0026	0.0002	∞	0.0002	0.0002	∞	10	25	20.0	1013.2283	0.0155	3514
2011–03	9.9887	0.0003	0.75	0.0002	6	25	26.0	2015–01	1015.7691	0.0156	3540	0.0083	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0026	0.0002	∞	0.0002	0.0002	∞	10	25	26.0	1015.7766	0.0156	3545
2011–03	9.9887	0.0003	0.75	0.0002	6	25	33.0	2015–01	1018.7036	0.0156	3567	0.0083	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0026	0.0002	∞	0.0002	0.0002	∞	10	25	33.0	1018.7109	0.0156	3572
2011–03	9.9887	0.0003	0.75	0.0002	6	25	41.5	2015–01	1022.2140	0.0157	3578	0.0082	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0026	0.0002	∞	0.0002	0.0002	∞	10	25	41.5	1022.2213	0.0157	3583
2011–03	9.9887	0.0003	0.75	0.0002	6	25	52.0	2015–01	1026.4687	0.0157	3542	0.0082	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0026	0.0002	∞	0.0002	0.0002	∞	10	25	52.0	1026.4759	0.0158	3547
2011–03	9.9887	0.0003	0.75	0.0002	6	25	65.0	2015–01	1031.6185	0.0158	3397	0.0081	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0026	0.0002	∞	0.0002	0.0002	∞	10	25	65.0	1031.6257	0.0159	3402
2011–03	9.9887	0.0003	0.74	0.0002	6	30	5.0	2015–03	1005.2250	0.0061	82	0.0084	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0026	0.0002	∞	0.0003	0.0002	∞	10	30	5.0	1005.2325	0.0061	82
2011–03	9.9887	0.0003	0.74	0.0002	6	30	10.0	2015–03	1007.3910	0.0061	82	0.0083	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0027	0.0002	∞	0.0003	0.0002	∞	10	30	10.0	1007.3985	0.0061	83
2011–03	9.9887	0.0003	0.74	0.0002	6	30	15.0	2015–03	1009.5367	0.0155	3480	0.0083	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0027	0.0003	∞	0.0003	0.0002	∞	10	30	15.0	1009.5441	0.0155	3485
2011–03	9.9887	0.0003	0.74	0.0002	6	30	20.0	2015–03	1011.6588	0.0155	3509	0.0083	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0027	0.0003	∞	0.0003	0.0002	∞	10	30	20.0	1011.6663	0.0155	3514
2011–03	9.9887	0.0003	0.74	0.0002	6	30	26.0	2015–03	1014.1769	0.0156	3540	0.0082	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0027	0.0003	∞	0.0003	0.0002	∞	10	30	26.0	1014.1843	0.0156	3545
2011–03	9.9887	0.0003	0.74	0.0002	6	30	33.0	2015–03	1017.0796	0.0156	3567	0.0082	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0027	0.0003	∞	0.0003	0.0002	∞	10	30	33.0	1017.0869	0.0156	3572
2011–03	9.9887	0.0003	0.74	0.0002	6	30	41.5	2015–03	1020.5483	0.0157	3578	0.0082	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0027	0.0003	∞	0.0003	0.0002	∞	10	30	41.5	1020.5556	0.0157	3583
2011–03	9.9887	0.0003	0.74	0.0002	6	30	52.0	2015–03	1024.7563	0.0157	3542	0.0081	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0027	0.0003	∞	0.0003	0.0002	∞	10	30	52.0	1024.7636	0.0158	3547
2011–03	9.9887	0.0003	0.74	0.0002	6	30	65.0	2015–03	1029.8488	0.0158	3397	0.0080	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0027	0.0003	∞	0.0003	0.0002	∞	10	30	65.0	1029.8560	0.0159	3402
2011–03	9.9887	0.0003	0.74	0.0002	6	35	5.0	2015–03	1003.5351	0.0061	82	0.0083	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0027	0.0003	∞	0.0004	0.0002	∞	10	35	5.0	1003.5426	0.0061	82
2011–03	9.9887	0.0003	0.74	0.0002	6	35	10.0	2015–03	1005.6844	0.0061	82	0.0083	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0027	0.0003	∞	0.0004	0.0002	∞	10	35	10.0	1005.6919	0.0061	83
2011–03	9.9887	0.0003	0.74	0.0002	6	35	15.0	2015–03	1007.8104	0.0155	3480	0.0082	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0027	0.0003	∞	0.0004	0.0002	∞	10	35	15.0	1007.8178	0.0155	3485
2011–03	9.9887	0.0003	0.74	0.0002	6	35	20.0	2015–03	1009.9149	0.0155	3509	0.0082	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0027	0.0003	∞	0.0004	0.0002	∞	10	35	20.0	1009.9223	0.0155	3514
2011–03	9.9887	0.0003	0.74	0.0002	6	35	26.0	2015–03	1012.4093	0.0156	3540	0.0082	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0027	0.0003	∞	0.0004	0.0002	∞	10	35	26.0	1012.4167	0.0156	3545
2011–03	9.9887	0.0003	0.74	0.0002	6	35	33.0	2015–03	1015.2864	0.0156	3567	0.0082	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0027	0.0003	∞	0.0004	0.0002	∞	10	35	33.0	1015.2938	0.0156	3572
2011–03	9.9887	0.0003	0.74	0.0002	6	35	41.5	2015–03	1018.7244	0.0157	3578	0.0081	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0027	0.0003	∞	0.0004	0.0002	∞	10	35	41.5	1018.7318	0.0157	3583
2011–03	9.9887	0.0003	0.74	0.0002	6	35	52.0	2015–03	1022.8940	0.0157	3542	0.0081	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0027	0.0003	∞	0.0004	0.0002	∞	10	35	52.0	1022.9012	0.0158	3547
2011–03	9.9887	0.0003	0.74	0.0002	6	35	65.0	2015–03	1027.9426	0.0158	3397	0.0080	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0027	0.0003	∞	0.0004	0.0002	∞	10	35	65.0	1027.9498	0.0159	3402

Salinity 15

Date of salinity measurement	Practical salinity from measurement					Temperature	Pressure	Date of density measurement	Seawater density from substitution measurement			Density correction to (integer) target salinity			Density change due to preparation (isotopic composition)				Density change due to storage (salt composition)			Density correction due to measurement (air saturation)			Practical salinity	Temperature	Pressure	Seawater density (at uniform conditions)		
–	S	$u(S)$	$\partial\rho/\partial S$	$u(\rho)$	ν	T	p	–	$\rho_{SW,subs}$	u	ν_{eff}	$\Delta\rho_{SW,tar}$	u	ν_{eff}	$\Delta\rho_{SW,prep}$	$\Delta\rho_{SW,iso}$	u	ν_{eff}	$\Delta\rho_{SW,stor}$	u	ν_{eff}	$\Delta\rho_{SW,aer}$	u	ν_{eff}	S	T	p	ρ_{SW}	u	ν_{eff}
–	–	–	kg m^{-3}	kg m^{-3}	–	°C	MPa	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	–	°C	MPa	kg m^{-3}	kg m^{-3}	–
2011–10	14.9999	0.0002	0.79	0.0002	8	5	5.0	2014–09	1014.1787	0.0063	93	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0017	0.0002	∞	-0.0010	0.0002	∞	15	5	5.0	1014.1773	0.0063	94
2011–10	14.9999	0.0002	0.79	0.0002	8	5	10.0	2014–09	1016.5344	0.0063	94	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0017	0.0002	∞	-0.0010	0.0002	∞	15	5	10.0	1016.5329	0.0063	95
2011–10	14.9999	0.0002	0.79	0.0002	8	5	15.0	2014–09	1018.8647	0.0156	3528	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0017	0.0002	∞	-0.0010	0.0002	∞	15	5	15.0	1018.8632	0.0156	3531
2011–10	14.9999	0.0002	0.79	0.0002	8	5	20.0	2014–09	1021.1706	0.0156	3548	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0017	0.0002	∞	-0.0010	0.0002	∞	15	5	20.0	1021.1691	0.0156	3551
2011–10	14.9999	0.0002	0.79	0.0002	8	5	26.0	2014–09	1023.9044	0.0156	3551	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0017	0.0002	∞	-0.0010	0.0002	∞	15	5	26.0	1023.9030	0.0157	3554
2011–10	14.9999	0.0002	0.79	0.0002	8	5	33.0	2014–09	1027.0504	0.0157	3507	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0017	0.0002	∞	-0.0010	0.0002	∞	15	5	33.0	1027.0489	0.0157	3511
2011–10	14.9999	0.0002	0.79	0.0002	8	5	41.5	2014–09	1030.8067	0.0158	3360	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0017	0.0002	∞	-0.0010	0.0002	∞	15	5	41.5	1030.8052	0.0158	3363
2011–10	14.9999	0.0002	0.79	0.0002	8	5	52.0	2014–09	1035.3561	0.0159	3017	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0017	0.0002	∞	-0.0010	0.0002	∞	15	5	52.0	1035.3546	0.0159	3020
2011–10	14.9999	0.0002	0.79	0.0002	8	5	65.0	2014–09	1040.8511	0.0160	2418	0.0001	0.0000	∞	-0.0015	-0.0003	0.0002	∞	0.0017	0.0002	∞	-0.0010	0.0002	∞	15	5	65.0	1040.8496	0.0160	2421
2011–10	14.9999	0.0002	0.78	0.0002	8	10	5.0	2014–09	1013.6440	0.0063	93	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0017	0.0002	∞	-0.0006	0.0002	∞	15	10	5.0	1013.6430	0.0063	94
2011–10	14.9999	0.0002	0.78	0.0002	8	10	10.0	2014–09	1015.9433	0.0063	94	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0017	0.0002	∞	-0.0006	0.0002	∞	15	10	10.0	1015.9422	0.0063	95
2011–10	14.9999	0.0002	0.78	0.0002	8	10	15.0	2014–09	1018.2167	0.0156	3528	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0017	0.0002	∞	-0.0006	0.0002	∞	15	10	15.0	1018.2157	0.0156	3531
2011–10	14.9999	0.0002	0.78	0.0002	8	10	20.0	2014–09	1020.4611	0.0156	3548	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0017	0.0002	∞	-0.0006	0.0002	∞	15	10	20.0	1020.4600	0.0156	3551
2011–10	14.9999	0.0002	0.78	0.0002	8	10	26.0	2014–09	1023.1265	0.0156	3551	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0017	0.0002	∞	-0.0006	0.0002	∞	15	10	26.0	1023.1255	0.0157	3554
2011–10	14.9999	0.0002	0.78	0.0002	8	10	33.0	2014–09	1026.1972	0.0157	3507	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0017	0.0002	∞	-0.0006	0.0002	∞	15	10	33.0	1026.1962	0.0157	3511
2011–10	14.9999	0.0002	0.78	0.0002	8	10	41.5	2014–09	1029.8673	0.0158	3360	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0017	0.0002	∞	-0.0006	0.0002	∞	15	10	41.5	1029.8663	0.0158	3363
2011–10	14.9999	0.0002	0.78	0.0002	8	10	52.0	2014–09	1034.3139	0.0159	3017	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0017	0.0002	∞	-0.0006	0.0002	∞	15	10	52.0	1034.3129	0.0159	3020
2011–10	14.9999	0.0002	0.78	0.0002	8	10	65.0	2014–09	1039.6887	0.0160	2418	0.0001	0.0000	∞	-0.0015	-0.0003	0.0002	∞	0.0017	0.0002	∞	-0.0006	0.0002	∞	15	10	65.0	1039.6877	0.0160	2420
2011–10	14.9999	0.0002	0.77	0.0002	8	15	5.0	2015–06	1012.8307	0.0063	93	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0021	0.0002	∞	-0.0003	0.0002	∞	15	15	5.0	1012.8296	0.0063	94
2011–10	14.9999	0.0002	0.77	0.0002	8	15	10.0	2015–06	1015.0789	0.0063	94	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0021	0.0002	∞	-0.0003	0.0002	∞	15	15	10.0	1015.0778	0.0063	95
2011–10	14.9999	0.0002	0.77	0.0002	8	15	15.0	2015–06	1017.3043	0.0156	3528	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0021	0.0002	∞	-0.0003	0.0002	∞	15	15	15.0	1017.3032	0.0156	3532
2011–10	14.9999	0.0002	0.77	0.0002	8	15	20.0	2015–06	1019.5060	0.0156	3548	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0021	0.0002	∞	-0.0003	0.0002	∞	15	15	20.0	1019.5049	0.0156	3552
2011–10	14.9999	0.0002	0.77	0.0002	8	15	26.0	2015–06	1022.1185	0.0156	3551	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0021	0.0002	∞	-0.0003	0.0002	∞	15	15	26.0	1022.1174	0.0157	3554
2011–10	14.9999	0.0002	0.77	0.0002	8	15	33.0	2015–06	1025.1258	0.0157	3507	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0021	0.0002	∞	-0.0003	0.0002	∞	15	15	33.0	1025.1246	0.0157	3511
2011–10	14.9999	0.0002	0.77	0.0002	8	15	41.5	2015–06	1028.7222	0.0158	3360	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0021	0.0002	∞	-0.0003	0.0002	∞	15	15	41.5	1028.7211	0.0158	3364
2011–10	14.9999	0.0002	0.77	0.0002	8	15	52.0	2015–06	1033.0827	0.0159	3017	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0021	0.0002	∞	-0.0003	0.0002	∞	15	15	52.0	1033.0816	0.0159	3020
2011–10	14.9999	0.0002	0.77	0.0002	8	15	65.0	2015–06	1038.3559	0.0160	2418	0.0001	0.0000	∞	-0.0015	-0.0003	0.0002	∞	0.0021	0.0002	∞	-0.0003	0.0002	∞	15	15	65.0	1038.3548	0.0160	2421
2011–10	14.9999	0.0002	0.76	0.0002	8	20	5.0	2015–05	1011.7574	0.0063	93	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0000	0.0000	∞	15	20	5.0	1011.7566	0.0063	94
2011–10	14.9999	0.0002	0.76	0.0002	8	20	10.0	2015–05	1013.9670	0.0063	94	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0000	0.0000	∞	15	20	10.0	1013.9662	0.0063	95
2011–10	14.9999	0.0002	0.76	0.0002	8	20	15.0	2015–05	1016.1533	0.0156	3528	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0021	0.0002	∞	0.0000	0.0000	∞	15	20	15.0	1016.1525	0.0156	3531
2011–10	14.9999	0.0002	0.76	0.0002	8	20	20.0	2015–05	1018.3153	0.0156	3548	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0021	0.0002	∞	0.0000	0.0000	∞	15	20	20.0	1018.3145	0.0156	3550
2011–10	14.9999	0.0002	0.76	0.0002	8	20	26.0	2015–05	1020.8839	0.0156	3551	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0021	0.0002	∞	0.0000	0.0000	∞	15	20	26.0	1020.8831	0.0157	3553
2011–10	14.9999	0.0002	0.76	0.0002	8	20	33.0	2015–05	1023.8407	0.0157	3507	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0021	0.0002	∞	0.0000	0.0000	∞	15	20	33.0	1023.8399	0.0157	3510
2011–10	14.9999	0.0002	0.76	0.0002	8	20	41.5	2015–05	1027.3764	0.0158	3360	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0021	0.0002	∞	0.0000	0.0000	∞	15	20	41.5	1027.3756	0.0158	3362
2011–10	14.9999	0.0002	0.76	0.0002	8	20	52.0	2015–05	1031.6636	0.0159	3017	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0021	0.0002	∞	0.0000	0.0000	∞	15	20	52.0	1031.6628	0.0159	3019
2011–10	14.9999	0.0002	0.76	0.0002	8	20	65.0	2015–05	1036.8463	0.0160	2418	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0021	0.0002	∞	0.0000	0.0000	∞	15	20	65.0	1036.8455	0.0160	2420
2011–10	14.9999	0.0002	0.75	0.0002	8	25	5.0	2015–04	1010.4471	0.0063	93	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0002	0.0002	∞	15	25	5.0	1010.4465	0.0063	94
2011–10	14.9999	0.0002	0.75	0.0002	8	25	10.0	2015–04	1012.6252	0.0063	94	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0002	0.0002	∞	15	25	10.0	1012.6246	0.0063	95
2011–10	14.9999	0.0002	0.75	0.0002	8	25	15.0	2015–04	1014.7815	0.0156	3528	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0002	0.0002	∞	15	25	15.0	1014.7809	0.0156	3532
2011–10	14.9999	0.0002	0.75	0.0002	8	25	20.0	2015–04	1016.9139	0.0156	3548	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0002	0.0002	∞	15	25	20.0	1016.9133	0.0156	3552
2011–10	14.9999	0.0002	0.75	0.0002	8	25	26.0	2015–04	1019.4455	0.0156	3551	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0002	0.0002	∞	15	25	26.0	1019.4449	0.0157	3554
2011–10	14.9999	0.0002	0.75	0.0002	8	25	33.0	2015–04	1022.3605	0.0157	3507	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0002	0.0002	∞	15	25	33.0	1022.3599	0.0157	3511
2011–10	14.9999	0.0002	0.75	0.0002	8	25	41.5	2015–04	1025.8487	0.0158	3360	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0002	0.0002	∞	15	25	41.5	1025.8481	0.0158	3363
2011–10	14.9999	0.0002	0.75	0.0002	8	25	52.0	2015–04	1030.0797	0.0159	3017	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0002	0.0002	∞	15	25	52.0	1030.0791	0.0159	3020
2011–10	14.9999	0.0002	0.75	0.0002	8	25	65.0	2015–04	1035.2009	0.0160	2418	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0021	0.0002	∞	0.0002	0.0002	∞	15	25	65.0	1035.2003	0.0160	2421
2011–10	14.9999	0.0002	0.74	0.0002	8	30	5.0	2015–02	1008.9286	0.0063	93	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0003	0.0002	∞	15	30	5.0	1008.9282	0.0063	94
2011–10	14.9999	0.0002	0.74	0.0002	8	30	10.0	2015–02	1011.0827	0.0063	94	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0003	0.0002	∞	15	30	10.0	1011.0823	0.0063	95
2011–10	14.9999	0.0002	0.74	0.0002	8	30	15.0	2015–02	1013.2148	0.0156	3528	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0003	0.0002	∞	15	30	15.0	1013.2145	0.0156	3532
2011–10	14.9999	0.0002	0.74	0.0002	8	30	20.0	2015–02	1015.3253	0.0156	3548	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0003	0.0002	∞	15	30	20.0	1015.3249	0.0156	3551
2011–10	14.9999	0.0002	0.74	0.0002	8	30	26.0	2015–02	1017.8280	0.0156	3551	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0003	0.0002	∞	15	30	26.0	1017.8277	0.0157	3554
2011–10	14.9999	0.0002	0.74	0.0002	8	30	33.0	2015–02	1020.7124	0.0157	3507	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0003	0.0002	∞	15	30	33.0	1020.7120	0.0157	3511
2011–10	14.9999	0.0002	0.74	0.0002	8	30	41.5	2015–02	1024.1624	0.0158	3360	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0003	0.0002	∞	15	30	41.5	1024.1620	0.0158	3363
2011–10	14.9999	0.0002	0.74	0.0002	8	30	52.0	2015–02	1028.3449	0.0159	3017	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0003	0.0002	∞	15	30	52.0	1028.3445	0.0159	3020
2011–10	14.9999	0.0002	0.74	0.0002	8	30	65.0	2015–02	1033.4108	0.0160	2418	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0003	0.0002	∞	15	30	65.0	1033.4104	0.0160	2421
2011–10	14.9999	0.0002	0.74	0.0002	8	35	5.0	2015–03	1007.2185	0.0063	93	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0004	0.0002	∞	15	35	5.0	1007.2182	0.0063	94
2011–10	14.9999	0.0002	0.74	0.0002	8	35	10.0	2015–03	1009.3557	0.0063	94	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0004	0.0002	∞	15	35	10.0	1009.3554	0.0063	95
2011–10	14.9999	0.0002	0.74	0.0002	8	35	15.0	2015–03	1011.4691	0.0156	3528	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0004	0.0002	∞	15	35	15.0	1011.4687	0.0156	3532
2011–10	14.9999	0.0002	0.74	0.0002	8	35	20.0	2015–03	1013.5645	0.0156	3548	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0004	0.0002	∞	15	35	20.0	1013.5641	0.0156	3551
2011–10	14.9999	0.0002	0.74	0.0002	8	35	26.0	2015–03	1016.0459	0.0156	3551	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0004	0.0002	∞	15	35	26.0	1016.0455	0.0157	3554
2011–10	14.9999	0.0002	0.74	0.0002	8	35	33.0	2015–03	1018.9064	0.0157	3507	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0004	0.0002	∞	15	35	33.0	1018.9060	0.0157	3511
2011–10	14.9999	0.0002	0.74	0.0002	8	35	41.5	2015–03	1022.3246	0.0158	3360	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0004	0.0002	∞	15	35	41.5	1022.3242	0.0158	3363
2011–10	14.9999	0.0002	0.74	0.0002	8	35	52.0	2015–03	1026.4695	0.0159	3017	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0004	0.0002	∞	15	35	52.0	1026.4692	0.0159	3020
2011–10	14.9999	0.0002	0.74	0.0002	8	35	65.0	2015–03	1031.4903	0.0160	2418	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0004	0.0002	∞	15	35	65.0	1031.4899	0.0160	2421

Salinity 20

Date of salinity measurement	Practical salinity from measurement					Temperature	Pressure	Date of density measurement	Seawater density from substitution measurement			Density correction to (integer) target salinity			Density change due to preparation (isotopic composition)				Density change due to storage (salt composition)			Density correction due to measurement (air saturation)			Practical salinity	Temperature	Pressure	Seawater density (at uniform conditions)		
–	S	$u(S)$	$\partial\rho/\partial S$	$u(\rho)$	ν	T	p	–	$\rho_{SW,subs}$	u	ν_{eff}	$\Delta\rho_{SW,tar}$	u	ν_{eff}	$\Delta\rho_{SW,prep}$	$\Delta\rho_{SW,iso}$	u	ν_{eff}	$\Delta\rho_{SW,stor}$	u	ν_{eff}	$\Delta\rho_{SW,aer}$	u	ν_{eff}	S	T	p	ρ_{SW}	u	ν_{eff}
–	–	–	kg m^{-3}	kg m^{-3}	–	°C	MPa	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	–	°C	MPa	kg m^{-3}	kg m^{-3}	–
2011–10	20.0009	0.0003	0.79	0.0002	7	5	5.0	2014–10	1018.1096	0.0065	105	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0017	0.0001	∞	-0.0010	0.0002	∞	20	5	5.0	1018.1069	0.0065	106
2011–10	20.0009	0.0003	0.79	0.0002	7	5	10.0	2014–10	1020.4467	0.0065	106	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0017	0.0001	∞	-0.0010	0.0002	∞	20	5	10.0	1020.4440	0.0065	107
2011–10	20.0009	0.0003	0.79	0.0002	7	5	15.0	2014–10	1022.7583	0.0157	3553	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0017	0.0001	∞	-0.0010	0.0002	∞	20	5	15.0	1022.7556	0.0157	3556
2011–10	20.0009	0.0003	0.79	0.0002	7	5	20.0	2014–10	1025.0437	0.0157	3544	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0017	0.0001	∞	-0.0010	0.0002	∞	20	5	20.0	1025.0410	0.0157	3548
2011–10	20.0009	0.0003	0.79	0.0002	7	5	26.0	2014–10	1027.7557	0.0158	3470	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	-0.0010	0.0002	∞	20	5	26.0	1027.7530	0.0158	3473
2011–10	20.0009	0.0003	0.79	0.0002	7	5	33.0	2014–10	1030.8769	0.0158	3260	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	-0.0010	0.0002	∞	20	5	33.0	1030.8742	0.0158	3264
2011–10	20.0009	0.0003	0.79	0.0002	7	5	41.5	2014–10	1034.6033	0.0159	2822	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	-0.0010	0.0002	∞	20	5	41.5	1034.6007	0.0159	2825
2011–10	20.0009	0.0003	0.79	0.0002	7	5	52.0	2014–10	1039.1168	0.0160	2134	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	-0.0010	0.0002	∞	20	5	52.0	1039.1142	0.0160	2136
2011–10	20.0009	0.0003	0.79	0.0002	7	5	65.0	2014–10	1044.5711	0.0162	1373	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	-0.0010	0.0002	∞	20	5	65.0	1044.5684	0.0162	1375
2011–10	20.0009	0.0003	0.78	0.0002	7	10	5.0	2014–10	1017.5148	0.0065	105	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0017	0.0001	∞	-0.0006	0.0002	∞	20	10	5.0	1017.5126	0.0065	106
2011–10	20.0009	0.0003	0.78	0.0002	7	10	10.0	2014–10	1019.7938	0.0065	106	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0017	0.0001	∞	-0.0006	0.0002	∞	20	10	10.0	1019.7916	0.0065	107
2011–10	20.0009	0.0003	0.78	0.0002	7	10	15.0	2014–10	1022.0469	0.0157	3553	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0017	0.0001	∞	-0.0006	0.0002	∞	20	10	15.0	1022.0447	0.0157	3556
2011–10	20.0009	0.0003	0.78	0.0002	7	10	20.0	2014–10	1024.2754	0.0157	3544	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0017	0.0001	∞	-0.0006	0.0002	∞	20	10	20.0	1024.2731	0.0157	3548
2011–10	20.0009	0.0003	0.78	0.0002	7	10	26.0	2014–10	1026.9222	0.0158	3470	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	-0.0006	0.0002	∞	20	10	26.0	1026.9200	0.0158	3473
2011–10	20.0009	0.0003	0.78	0.0002	7	10	33.0	2014–10	1029.9723	0.0158	3260	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	-0.0006	0.0002	∞	20	10	33.0	1029.9701	0.0158	3263
2011–10	20.0009	0.0003	0.78	0.0002	7	10	41.5	2014–10	1033.6168	0.0159	2822	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	-0.0006	0.0002	∞	20	10	41.5	1033.6146	0.0159	2825
2011–10	20.0009	0.0003	0.78	0.0002	7	10	52.0	2014–10	1038.0312	0.0160	2134	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	-0.0006	0.0002	∞	20	10	52.0	1038.0290	0.0160	2136
2011–10	20.0009	0.0003	0.78	0.0002	7	10	65.0	2014–10	1043.3680	0.0162	1373	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	-0.0006	0.0002	∞	20	10	65.0	1043.3658	0.0162	1375
2011–10	20.0009	0.0003	0.77	0.0002	7	15	5.0	2014–11	1016.6447	0.0065	105	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	-0.0003	0.0002	∞	20	15	5.0	1016.6428	0.0065	106
2011–10	20.0009	0.0003	0.77	0.0002	7	15	10.0	2014–11	1018.8775	0.0065	106	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	-0.0003	0.0002	∞	20	15	10.0	1018.8756	0.0065	107
2011–10	20.0009	0.0003	0.77	0.0002	7	15	15.0	2014–11	1021.0872	0.0157	3553	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	-0.0003	0.0002	∞	20	15	15.0	1021.0853	0.0157	3556
2011–10	20.0009	0.0003	0.77	0.0002	7	15	20.0	2014–11	1023.2737	0.0157	3544	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	-0.0003	0.0002	∞	20	15	20.0	1023.2718	0.0157	3548
2011–10	20.0009	0.0003	0.77	0.0002	7	15	26.0	2014–11	1025.8677	0.0158	3470	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	-0.0003	0.0002	∞	20	15	26.0	1025.8658	0.0158	3473
2011–10	20.0009	0.0003	0.77	0.0002	7	15	33.0	2014–11	1028.8547	0.0158	3260	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	-0.0003	0.0002	∞	20	15	33.0	1028.8528	0.0158	3263
2011–10	20.0009	0.0003	0.77	0.0002	7	15	41.5	2014–11	1032.4267	0.0159	2822	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	-0.0003	0.0002	∞	20	15	41.5	1032.4248	0.0159	2825
2011–10	20.0009	0.0003	0.77	0.0002	7	15	52.0	2014–11	1036.7570	0.0160	2134	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	-0.0003	0.0002	∞	20	15	52.0	1036.7551	0.0160	2136
2011–10	20.0009	0.0003	0.77	0.0002	7	15	65.0	2014–11	1041.9957	0.0162	1373	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	-0.0003	0.0002	∞	20	15	65.0	1041.9938	0.0162	1375
2011–10	20.0009	0.0003	0.76	0.0002	7	20	5.0	2014–12	1015.5285	0.0065	105	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	0.0000	0.0000	∞	20	20	5.0	1015.5268	0.0065	105
2011–10	20.0009	0.0003	0.76	0.0002	7	20	10.0	2014–12	1017.7236	0.0065	106	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	0.0000	0.0000	∞	20	20	10.0	1017.7219	0.0065	107
2011–10	20.0009	0.0003	0.76	0.0002	7	20	15.0	2014–12	1019.8945	0.0157	3553	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	0.0000	0.0000	∞	20	20	15.0	1019.8928	0.0157	3555
2011–10	20.0009	0.0003	0.76	0.0002	7	20	20.0	2014–12	1022.0421	0.0157	3544	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	0.0000	0.0000	∞	20	20	20.0	1022.0404	0.0157	3546
2011–10	20.0009	0.0003	0.76	0.0002	7	20	26.0	2014–12	1024.5947	0.0158	3470	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	0.0000	0.0000	∞	20	20	26.0	1024.5930	0.0158	3472
2011–10	20.0009	0.0003	0.76	0.0002	7	20	33.0	2014–12	1027.5358	0.0158	3260	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	0.0000	0.0000	∞	20	20	33.0	1027.5342	0.0158	3262
2011–10	20.0009	0.0003	0.76	0.0002	7	20	41.5	2014–12	1031.0510	0.0159	2822	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0018	0.0001	∞	0.0000	0.0000	∞	20	20	41.5	1031.0493	0.0159	2824
2011–10	20.0009	0.0003	0.76	0.0002	7	20	52.0	2014–12	1035.3101	0.0160	2134	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0019	0.0001	∞	0.0000	0.0000	∞	20	20	52.0	1035.3084	0.0160	2136
2011–10	20.0009	0.0003	0.76	0.0002	7	20	65.0	2014–12	1040.4691	0.0162	1373	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0019	0.0001	∞	0.0000	0.0000	∞	20	20	65.0	1040.4674	0.0162	1374
2011–10	20.0009	0.0003	0.75	0.0002	7	25	5.0	2015–01	1014.1836	0.0065	105	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0019	0.0001	∞	0.0002	0.0002	∞	20	25	5.0	1014.1820	0.0065	106
2011–10	20.0009	0.0003	0.75	0.0002	7	25	10.0	2015–01	1016.3484	0.0065	106	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0019	0.0001	∞	0.0002	0.0002	∞	20	25	10.0	1016.3469	0.0065	107
2011–10	20.0009	0.0003	0.75	0.0002	7	25	15.0	2015–01	1018.4927	0.0157	3553	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0019	0.0001	∞	0.0002	0.0002	∞	20	25	15.0	1018.4912	0.0157	3556
2011–10	20.0009	0.0003	0.75	0.0002	7	25	20.0	2015–01	1020.6124	0.0157	3544	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0019	0.0001	∞	0.0002	0.0002	∞	20	25	20.0	1020.6108	0.0157	3548
2011–10	20.0009	0.0003	0.75	0.0002	7	25	26.0	2015–01	1023.1294	0.0158	3470	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0019	0.0001	∞	0.0002	0.0002	∞	20	25	26.0	1023.1278	0.0158	3473
2011–10	20.0009	0.0003	0.75	0.0002	7	25	33.0	2015–01	1026.0298	0.0158	3260	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0019	0.0001	∞	0.0002	0.0002	∞	20	25	33.0	1026.0282	0.0158	3264
2011–10	20.0009	0.0003	0.75	0.0002	7	25	41.5	2015–01	1029.4969	0.0159	2822	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0002	0.0002	∞	20	25	41.5	1029.4954	0.0159	2825
2011–10	20.0009	0.0003	0.75	0.0002	7	25	52.0	2015–01	1033.7033	0.0160	2134	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0002	0.0002	∞	20	25	52.0	1033.7017	0.0160	2136
2011–10	20.0009	0.0003	0.75	0.0002	7	25	65.0	2015–01	1038.7924	0.0162	1373	-0.0006	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0002	0.0002	∞	20	25	65.0	1038.7909	0.0162	1375
2011–10	20.0009	0.0003	0.74	0.0002	7	30	5.0	2015–03	1012.6338	0.0065	105	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0003	0.0002	∞	20	30	5.0	1012.6323	0.0065	106
2011–10	20.0009	0.0003	0.74	0.0002	7	30	10.0	2015–03	1014.7754	0.0065	106	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0003	0.0002	∞	20	30	10.0	1014.7739	0.0065	107
2011–10	20.0009	0.0003	0.74	0.0002	7	30	15.0	2015–03	1016.8940	0.0157	3553	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0003	0.0002	∞	20	30	15.0	1016.8925	0.0157	3556
2011–10	20.0009	0.0003	0.74	0.0002	7	30	20.0	2015–03	1018.9921	0.0157	3544	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0003	0.0002	∞	20	30	20.0	1018.9906	0.0157	3548
2011–10	20.0009	0.0003	0.74	0.0002	7	30	26.0	2015–03	1021.4831	0.0158	3470	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0003	0.0002	∞	20	30	26.0	1021.4816	0.0158	3473
2011–10	20.0009	0.0003	0.74	0.0002	7	30	33.0	2015–03	1024.3510	0.0158	3260	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0003	0.0002	∞	20	30	33.0	1024.3495	0.0158	3264
2011–10	20.0009	0.0003	0.74	0.0002	7	30	41.5	2015–03	1027.7803	0.0159	2822	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0003	0.0002	∞	20	30	41.5	1027.7788	0.0159	2825
2011–10	20.0009	0.0003	0.74	0.0002	7	30	52.0	2015–03	1031.9407	0.0160	2134	-0.0006	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0003	0.0002	∞	20	30	52.0	1031.9392	0.0160	2136
2011–10	20.0009	0.0003	0.74	0.0002	7	30	65.0	2015–03	1036.9776	0.0162	1373	-0.0006	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0003	0.0002	∞	20	30	65.0	1036.9761	0.0162	1375
2011–10	20.0009	0.0003	0.74	0.0002	7	35	5.0	2015–03	1010.8969	0.0065	105	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0004	0.0002	∞	20	35	5.0	1010.8955	0.0065	106
2011–10	20.0009	0.0003	0.74	0.0002	7	35	10.0	2015–03	1013.0213	0.0065	106	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0004	0.0002	∞	20	35	10.0	1013.0198	0.0065	107
2011–10	20.0009	0.0003	0.74	0.0002	7	35	15.0	2015–03	1015.1234	0.0157	3553	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0004	0.0002	∞	20	35	15.0	1015.1219	0.0157	3556
2011–10	20.0009	0.0003	0.74	0.0002	7	35	20.0	2015–03	1017.2035	0.0157	3544	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0004	0.0002	∞	20	35	20.0	1017.2020	0.0157	3548
2011–10	20.0009	0.0003	0.74	0.0002	7	35	26.0	2015–03	1019.6728	0.0158	3470	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0004	0.0002	∞	20	35	26.0	1019.6714	0.0158	3473
2011–10	20.0009	0.0003	0.74	0.0002	7	35	33.0	2015–03	1022.5168	0.0158	3260	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0004	0.0002	∞	20	35	33.0	1022.5153	0.0158	3264
2011–10	20.0009	0.0003	0.74	0.0002	7	35	41.5	2015–03	1025.9185	0.0159	2822	-0.0006	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0004	0.0002	∞	20	35	41.5	1025.9170	0.0159	2825
2011–10	20.0009	0.0003	0.74	0.0002	7	35	52.0	2015–03	1030.0440	0.0160	2134	-0.0006	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0004	0.0002	∞	20	35	52.0	1030.0426	0.0160	2136
2011–10	20.0009	0.0003	0.74	0.0002	7	35	65.0	2015–03	1035.0400	0.0162	1373	-0.0006	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0020	0.0002	∞	0.0004	0.0002	∞	20	35	65.0	1035.0385	0.0162	1375

Salinity 25

Date of salinity measurement	Practical salinity from measurement					Temperature	Pressure	Date of density measurement	Seawater density from substitution measurement			Density correction to (integer) target salinity			Density change due to preparation (isotopic composition)				Density change due to storage (salt composition)			Density correction due to measurement (air saturation)			Practical salinity	Temperature	Pressure	Seawater density (at uniform conditions)		
–	S	$u(S)$	$\partial\rho/\partial S$	$u(\rho)$	ν	T	p	–	$\rho_{SW,subs}$	u	ν_{eff}	$\Delta\rho_{SW,tar}$	u	ν_{eff}	$\Delta\rho_{SW,prep}$	$\Delta\rho_{SW,iso}$	u	ν_{eff}	$\Delta\rho_{SW,stor}$	u	ν_{eff}	$\Delta\rho_{SW,aer}$	u	ν_{eff}	S	T	p	ρ_{SW}	u	ν_{eff}
–	–	–	kg m^{-3}	kg m^{-3}	–	°C	MPa	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	–	°C	MPa	kg m^{-3}	kg m^{-3}	–
2011–10	25.0047	0.0002	0.79	0.0002	17	5	5.0	2015–05	1022.0450	0.0067	117	-0.0037	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0018	0.0002	∞	-0.0010	0.0002	∞	25	5	5.0	1022.0388	0.0067	117
2011–10	25.0047	0.0002	0.79	0.0002	17	5	10.0	2015–05	1024.3617	0.0067	118	-0.0037	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0010	0.0002	∞	25	5	10.0	1024.3556	0.0067	119
2011–10	25.0047	0.0002	0.79	0.0002	17	5	15.0	2015–05	1026.6521	0.0157	3548	-0.0037	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0010	0.0002	∞	25	5	15.0	1026.6460	0.0157	3551
2011–10	25.0047	0.0002	0.79	0.0002	17	5	20.0	2015–05	1028.9206	0.0158	3479	-0.0036	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0010	0.0002	∞	25	5	20.0	1028.9145	0.0158	3483
2011–10	25.0047	0.0002	0.79	0.0002	17	5	26.0	2015–05	1031.6097	0.0159	3262	-0.0036	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0010	0.0002	∞	25	5	26.0	1031.6037	0.0159	3265
2011–10	25.0047	0.0002	0.79	0.0002	17	5	33.0	2015–05	1034.7043	0.0159	2809	-0.0036	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0010	0.0002	∞	25	5	33.0	1034.6983	0.0159	2811
2011–10	25.0047	0.0002	0.79	0.0002	17	5	41.5	2015–05	1038.4022	0.0161	2105	-0.0036	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0010	0.0002	∞	25	5	41.5	1038.3961	0.0161	2107
2011–10	25.0047	0.0002	0.79	0.0002	17	5	52.0	2015–05	1042.8818	0.0162	1334	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0010	0.0002	∞	25	5	52.0	1042.8758	0.0162	1335
2011–10	25.0047	0.0002	0.79	0.0002	17	5	65.0	2015–05	1048.2969	0.0164	737	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0010	0.0002	∞	25	5	65.0	1048.2909	0.0164	738
2011–10	25.0047	0.0002	0.78	0.0002	17	10	5.0	2014–10	1021.3889	0.0067	117	-0.0036	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0015	0.0001	∞	-0.0006	0.0002	∞	25	10	5.0	1021.3835	0.0067	117
2011–10	25.0047	0.0002	0.78	0.0002	17	10	10.0	2014–10	1023.6521	0.0067	118	-0.0036	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0015	0.0001	∞	-0.0006	0.0002	∞	25	10	10.0	1023.6468	0.0067	119
2011–10	25.0047	0.0002	0.78	0.0002	17	10	15.0	2014–10	1025.8888	0.0157	3548	-0.0036	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0015	0.0001	∞	-0.0006	0.0002	∞	25	10	15.0	1025.8835	0.0157	3551
2011–10	25.0047	0.0002	0.78	0.0002	17	10	20.0	2014–10	1028.1045	0.0158	3479	-0.0036	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0016	0.0001	∞	-0.0006	0.0002	∞	25	10	20.0	1028.0992	0.0158	3482
2011–10	25.0047	0.0002	0.78	0.0002	17	10	26.0	2014–10	1030.7318	0.0159	3262	-0.0036	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0016	0.0001	∞	-0.0006	0.0002	∞	25	10	26.0	1030.7266	0.0159	3265
2011–10	25.0047	0.0002	0.78	0.0002	17	10	33.0	2014–10	1033.7587	0.0159	2809	-0.0036	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0016	0.0001	∞	-0.0006	0.0002	∞	25	10	33.0	1033.7534	0.0159	2811
2011–10	25.0047	0.0002	0.78	0.0002	17	10	41.5	2014–10	1037.3744	0.0161	2105	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0016	0.0001	∞	-0.0006	0.0002	∞	25	10	41.5	1037.3692	0.0161	2107
2011–10	25.0047	0.0002	0.78	0.0002	17	10	52.0	2014–10	1041.7590	0.0162	1334	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0016	0.0001	∞	-0.0006	0.0002	∞	25	10	52.0	1041.7538	0.0162	1335
2011–10	25.0047	0.0002	0.78	0.0002	17	10	65.0	2014–10	1047.0594	0.0164	737	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0016	0.0001	∞	-0.0006	0.0002	∞	25	10	65.0	1047.0542	0.0164	738
2011–10	25.0047	0.0002	0.77	0.0002	17	15	5.0	2015–05	1020.4685	0.0067	117	-0.0036	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0003	0.0002	∞	25	15	5.0	1020.4633	0.0067	117
2011–10	25.0047	0.0002	0.77	0.0002	17	15	10.0	2015–05	1022.6852	0.0067	118	-0.0036	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0003	0.0002	∞	25	15	10.0	1022.6800	0.0067	119
2011–10	25.0047	0.0002	0.77	0.0002	17	15	15.0	2015–05	1024.8775	0.0157	3548	-0.0036	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0003	0.0002	∞	25	15	15.0	1024.8723	0.0157	3551
2011–10	25.0047	0.0002	0.77	0.0002	17	15	20.0	2015–05	1027.0475	0.0158	3479	-0.0036	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0003	0.0002	∞	25	15	20.0	1027.0423	0.0158	3483
2011–10	25.0047	0.0002	0.77	0.0002	17	15	26.0	2015–05	1029.6256	0.0159	3262	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0003	0.0002	∞	25	15	26.0	1029.6204	0.0159	3265
2011–10	25.0047	0.0002	0.77	0.0002	17	15	33.0	2015–05	1032.5900	0.0159	2809	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0003	0.0002	∞	25	15	33.0	1032.5848	0.0159	2811
2011–10	25.0047	0.0002	0.77	0.0002	17	15	41.5	2015–05	1036.1382	0.0161	2105	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0003	0.0002	∞	25	15	41.5	1036.1331	0.0161	2107
2011–10	25.0047	0.0002	0.77	0.0002	17	15	52.0	2015–05	1040.4403	0.0162	1334	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0003	0.0002	∞	25	15	52.0	1040.4351	0.0162	1335
2011–10	25.0047	0.0002	0.77	0.0002	17	15	65.0	2015–05	1045.6458	0.0164	737	-0.0034	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0003	0.0002	∞	25	15	65.0	1045.6407	0.0164	738
2011–10	25.0047	0.0002	0.76	0.0002	17	20	5.0	2015–06	1019.3046	0.0067	117	-0.0036	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0000	0.0000	∞	25	20	5.0	1019.2996	0.0067	117
2011–10	25.0047	0.0002	0.76	0.0002	17	20	10.0	2015–06	1021.4826	0.0067	118	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0000	0.0000	∞	25	20	10.0	1021.4776	0.0067	119
2011–10	25.0047	0.0002	0.76	0.0002	17	20	15.0	2015–06	1023.6416	0.0157	3548	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0000	0.0000	∞	25	20	15.0	1023.6366	0.0157	3550
2011–10	25.0047	0.0002	0.76	0.0002	17	20	20.0	2015–06	1025.7759	0.0158	3479	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0000	0.0000	∞	25	20	20.0	1025.7710	0.0158	3482
2011–10	25.0047	0.0002	0.76	0.0002	17	20	26.0	2015–06	1028.3098	0.0159	3262	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0000	0.0000	∞	25	20	26.0	1028.3048	0.0159	3264
2011–10	25.0047	0.0002	0.76	0.0002	17	20	33.0	2015–06	1031.2292	0.0159	2809	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0000	0.0000	∞	25	20	33.0	1031.2242	0.0159	2811
2011–10	25.0047	0.0002	0.76	0.0002	17	20	41.5	2015–06	1034.7204	0.0161	2105	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0000	0.0000	∞	25	20	41.5	1034.7155	0.0161	2106
2011–10	25.0047	0.0002	0.76	0.0002	17	20	52.0	2015–06	1038.9561	0.0162	1334	-0.0034	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0000	0.0000	∞	25	20	52.0	1038.9512	0.0162	1335
2011–10	25.0047	0.0002	0.76	0.0002	17	20	65.0	2015–06	1044.0820	0.0164	737	-0.0034	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0000	0.0000	∞	25	20	65.0	1044.0771	0.0164	737
2011–10	25.0047	0.0002	0.75	0.0002	17	25	5.0	2015–05	1017.9275	0.0067	117	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0002	0.0002	∞	25	25	5.0	1017.9228	0.0067	117
2011–10	25.0047	0.0002	0.75	0.0002	17	25	10.0	2015–05	1020.0783	0.0067	118	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0002	0.0002	∞	25	25	10.0	1020.0735	0.0067	119
2011–10	25.0047	0.0002	0.75	0.0002	17	25	15.0	2015–05	1022.2082	0.0157	3548	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0002	0.0002	∞	25	25	15.0	1022.2035	0.0157	3551
2011–10	25.0047	0.0002	0.75	0.0002	17	25	20.0	2015–05	1024.3155	0.0158	3479	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0002	0.0002	∞	25	25	20.0	1024.3108	0.0158	3483
2011–10	25.0047	0.0002	0.75	0.0002	17	25	26.0	2015–05	1026.8185	0.0159	3262	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0002	0.0002	∞	25	25	26.0	1026.8138	0.0159	3265
2011–10	25.0047	0.0002	0.75	0.0002	17	25	33.0	2015–05	1029.6994	0.0159	2809	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0002	0.0002	∞	25	25	33.0	1029.6947	0.0159	2811
2011–10	25.0047	0.0002	0.75	0.0002	17	25	41.5	2015–05	1033.1455	0.0161	2105	-0.0034	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0002	0.0002	∞	25	25	41.5	1033.1409	0.0161	2107
2011–10	25.0047	0.0002	0.75	0.0002	17	25	52.0	2015–05	1037.3270	0.0162	1334	-0.0034	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0002	0.0002	∞	25	25	52.0	1037.3224	0.0162	1335
2011–10	25.0047	0.0002	0.75	0.0002	17	25	65.0	2015–05	1042.3889	0.0164	737	-0.0034	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0002	0.0002	∞	25	25	65.0	1042.3843	0.0164	738
2011–10	25.0047	0.0002	0.75	0.0002	17	30	5.0	2015–03	1016.3522	0.0067	117	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0017	0.0002	∞	0.0003	0.0002	∞	25	30	5.0	1016.3477	0.0067	117
2011–10	25.0047	0.0002	0.75	0.0002	17	30	10.0	2015–03	1018.4788	0.0067	118	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0003	0.0002	∞	25	30	10.0	1018.4744	0.0067	119
2011–10	25.0047	0.0002	0.75	0.0002	17	30	15.0	2015–03	1020.5865	0.0157	3548	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0003	0.0002	∞	25	30	15.0	1020.5821	0.0157	3551
2011–10	25.0047	0.0002	0.75	0.0002	17	30	20.0	2015–03	1022.6720	0.0158	3479	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0003	0.0002	∞	25	30	20.0	1022.6675	0.0158	3482
2011–10	25.0047	0.0002	0.75	0.0002	17	30	26.0	2015–03	1025.1484	0.0159	3262	-0.0034	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0003	0.0002	∞	25	30	26.0	1025.1440	0.0159	3265
2011–10	25.0047	0.0002	0.75	0.0002	17	30	33.0	2015–03	1027.9988	0.0159	2809	-0.0034	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0003	0.0002	∞	25	30	33.0	1027.9944	0.0159	2811
2011–10	25.0047	0.0002	0.75	0.0002	17	30	41.5	2015–03	1031.4100	0.0161	2105	-0.0034	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0003	0.0002	∞	25	30	41.5	1031.4056	0.0161	2107
2011–10	25.0047	0.0002	0.75	0.0002	17	30	52.0	2015–03	1035.5480	0.0162	1334	-0.0034	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0003	0.0002	∞	25	30	52.0	1035.5436	0.0162	1335
2011–10	25.0047	0.0002	0.75	0.0002	17	30	65.0	2015–03	1040.5567	0.0164	737	-0.0034	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0003	0.0002	∞	25	30	65.0	1040.5523	0.0164	738
2011–10	25.0047	0.0002	0.74	0.0002	17	35	5.0	2015–04	1014.5871	0.0067	117	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0004	0.0002	∞	25	35	5.0	1014.5827	0.0067	117
2011–10	25.0047	0.0002	0.74	0.0002	17	35	10.0	2015–04	1016.6978	0.0067	118	-0.0035	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0004	0.0002	∞	25	35	10.0	1016.6933	0.0067	119
2011–10	25.0047	0.0002	0.74	0.0002	17	35	15.0	2015–04	1018.7886	0.0157	3548	-0.0034	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0004	0.0002	∞	25	35	15.0	1018.7842	0.0157	3551
2011–10	25.0047	0.0002	0.74	0.0002	17	35	20.0	2015–04	1020.8564	0.0158	3479	-0.0034	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0004	0.0002	∞	25	35	20.0	1020.8520	0.0158	3483
2011–10	25.0047	0.0002	0.74	0.0002	17	35	26.0	2015–04	1023.3122	0.0159	3262	-0.0034	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0004	0.0002	∞	25	35	26.0	1023.3078	0.0159	3265
2011–10	25.0047	0.0002	0.74	0.0002	17	35	33.0	2015–04	1026.1412	0.0159	2809	-0.0034	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0004	0.0002	∞	25	35	33.0	1026.1368	0.0159	2811
2011–10	25.0047	0.0002	0.74	0.0002	17	35	41.5	2015–04	1029.5227	0.0161	2105	-0.0034	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0004	0.0002	∞	25	35	41.5	1029.5184	0.0161	2107
2011–10	25.0047	0.0002	0.74	0.0002	17	35	52.0	2015–04	1033.6256	0.0162	1334	-0.0034	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0004	0.0002	∞	25	35	52.0	1033.6213	0.0162	1335
2011–10	25.0047	0.0002	0.74	0.0002	17	35	65.0	2015–04	1038.5944	0.0164	737	-0.0033	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0004	0.0002	∞	25	35	65.0	1038.5901	0.0164	738

Salinity 30

Date of salinity measurement	Practical salinity from measurement					Temperature	Pressure	Date of density measurement	Seawater density from substitution measurement			Density correction to (integer) target salinity			Density change due to preparation (isotopic composition)				Density change due to storage (salt composition)			Density correction due to measurement (air saturation)			Practical salinity	Temperature	Pressure	Seawater density (at uniform conditions)		
–	S	$u(S)$	$\mathrm{d}\rho/\mathrm{d}S$	$u(\rho)$	ν	T	p	–	$\rho_{SW,subs}$	u	ν_{eff}	$\Delta\rho_{SW,tar}$	u	ν_{eff}	$\Delta\rho_{SW,prep}$	$\Delta\rho_{SW,iso}$	u	ν_{eff}	$\Delta\rho_{SW,stor}$	u	ν_{eff}	$\Delta\rho_{SW,aer}$	u	ν_{eff}	S	T	p	ρ_{SW}	u	ν_{eff}
–	–	–	kg m^{-3}	kg m^{-3}	–	°C	MPa	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	–	°C	MPa	kg m^{-3}	kg m^{-3}	–
2011–03	29.9689	0.0003	0.79	0.0002	25	5	5.0	2014–10	1025.9554	0.0071	140	0.0245	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0026	0.0002	∞	-0.0010	0.0002	∞	30	5	5.0	1025.9763	0.0071	141
2011–03	29.9689	0.0003	0.79	0.0002	25	5	10.0	2014–10	1028.2516	0.0071	142	0.0244	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0026	0.0002	∞	-0.0010	0.0002	∞	30	5	10.0	1028.2724	0.0071	143
2011–03	29.9689	0.0003	0.79	0.0002	25	5	15.0	2014–10	1030.5233	0.0159	3425	0.0243	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0026	0.0002	∞	-0.0010	0.0002	∞	30	5	15.0	1030.5440	0.0159	3429
2011–03	29.9689	0.0003	0.79	0.0002	25	5	20.0	2014–10	1032.7752	0.0160	3120	0.0242	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0026	0.0002	∞	-0.0010	0.0002	∞	30	5	20.0	1032.7958	0.0160	3124
2011–03	29.9689	0.0003	0.79	0.0002	25	5	26.0	2014–10	1035.4443	0.0161	2498	0.0240	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0027	0.0002	∞	-0.0010	0.0002	∞	30	5	26.0	1035.4647	0.0161	2502
2011–03	29.9689	0.0003	0.79	0.0002	25	5	33.0	2014–10	1038.5156	0.0162	1693	0.0239	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0027	0.0002	∞	-0.0010	0.0002	∞	30	5	33.0	1038.5359	0.0162	1695
2011–03	29.9689	0.0003	0.79	0.0002	25	5	41.5	2014–10	1042.1817	0.0164	973	0.0237	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0027	0.0002	∞	-0.0010	0.0002	∞	30	5	41.5	1042.2018	0.0164	974
2011–03	29.9689	0.0003	0.79	0.0002	25	5	52.0	2014–10	1046.6291	0.0166	501	0.0235	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0027	0.0002	∞	-0.0010	0.0002	∞	30	5	52.0	1046.6490	0.0166	501
2011–03	29.9689	0.0003	0.79	0.0002	25	5	65.0	2014–10	1052.0012	0.0169	247	0.0232	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0027	0.0002	∞	-0.0010	0.0002	∞	30	5	65.0	1052.0208	0.0169	247
2011–03	29.9689	0.0003	0.78	0.0002	25	10	5.0	2015–05	1025.2380	0.0071	140	0.0241	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0031	0.0003	∞	-0.0006	0.0002	∞	30	10	5.0	1025.2586	0.0071	141
2011–03	29.9689	0.0003	0.78	0.0002	25	10	10.0	2015–05	1027.4818	0.0071	142	0.0240	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0031	0.0003	∞	-0.0006	0.0002	∞	30	10	10.0	1027.5022	0.0071	143
2011–03	29.9689	0.0003	0.78	0.0002	25	10	15.0	2015–05	1029.7016	0.0159	3425	0.0239	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0031	0.0003	∞	-0.0006	0.0002	∞	30	10	15.0	1029.7220	0.0159	3430
2011–03	29.9689	0.0003	0.78	0.0002	25	10	20.0	2015–05	1031.8998	0.0160	3120	0.0238	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0031	0.0003	∞	-0.0006	0.0002	∞	30	10	20.0	1031.9201	0.0160	3124
2011–03	29.9689	0.0003	0.78	0.0002	25	10	26.0	2015–05	1034.5084	0.0161	2498	0.0237	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0031	0.0003	∞	-0.0006	0.0002	∞	30	10	26.0	1034.5285	0.0161	2502
2011–03	29.9689	0.0003	0.78	0.0002	25	10	33.0	2015–05	1037.5099	0.0162	1693	0.0236	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0031	0.0003	∞	-0.0006	0.0002	∞	30	10	33.0	1037.5299	0.0162	1696
2011–03	29.9689	0.0003	0.78	0.0002	25	10	41.5	2015–05	1041.1004	0.0164	973	0.0234	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0031	0.0003	∞	-0.0006	0.0002	∞	30	10	41.5	1041.1202	0.0164	975
2011–03	29.9689	0.0003	0.78	0.0002	25	10	52.0	2015–05	1045.4496	0.0166	501	0.0232	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0031	0.0003	∞	-0.0006	0.0002	∞	30	10	52.0	1045.4692	0.0166	501
2011–03	29.9689	0.0003	0.78	0.0002	25	10	65.0	2015–05	1050.7152	0.0169	247	0.0230	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0032	0.0003	∞	-0.0006	0.0002	∞	30	10	65.0	1050.7346	0.0169	247
2011–03	29.9689	0.0003	0.77	0.0002	25	15	5.0	2014–11	1024.2668	0.0071	140	0.0238	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0027	0.0002	∞	-0.0003	0.0002	∞	30	15	5.0	1024.2878	0.0071	141
2011–03	29.9689	0.0003	0.77	0.0002	25	15	10.0	2014–11	1026.4703	0.0071	142	0.0237	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0027	0.0002	∞	-0.0003	0.0002	∞	30	15	10.0	1026.4912	0.0071	143
2011–03	29.9689	0.0003	0.77	0.0002	25	15	15.0	2014–11	1028.6502	0.0159	3425	0.0236	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0027	0.0002	∞	-0.0003	0.0002	∞	30	15	15.0	1028.6709	0.0159	3429
2011–03	29.9689	0.0003	0.77	0.0002	25	15	20.0	2014–11	1030.8036	0.0160	3120	0.0235	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0027	0.0002	∞	-0.0003	0.0002	∞	30	15	20.0	1030.8242	0.0160	3124
2011–03	29.9689	0.0003	0.77	0.0002	25	15	26.0	2014–11	1033.3623	0.0161	2498	0.0234	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0027	0.0002	∞	-0.0003	0.0002	∞	30	15	26.0	1033.3828	0.0161	2502
2011–03	29.9689	0.0003	0.77	0.0002	25	15	33.0	2014–11	1036.3099	0.0162	1693	0.0233	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0028	0.0002	∞	-0.0003	0.0002	∞	30	15	33.0	1036.3303	0.0162	1695
2011–03	29.9689	0.0003	0.77	0.0002	25	15	41.5	2014–11	1039.8309	0.0164	973	0.0232	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0028	0.0002	∞	-0.0003	0.0002	∞	30	15	41.5	1039.8511	0.0164	974
2011–03	29.9689	0.0003	0.77	0.0002	25	15	52.0	2014–11	1044.1021	0.0166	501	0.0230	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0028	0.0002	∞	-0.0003	0.0002	∞	30	15	52.0	1044.1222	0.0166	501
2011–03	29.9689	0.0003	0.77	0.0002	25	15	65.0	2014–11	1049.2738	0.0169	247	0.0228	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0028	0.0002	∞	-0.0003	0.0002	∞	30	15	65.0	1049.2936	0.0169	247
2011–03	29.9689	0.0003	0.76	0.0002	25	20	5.0	2015–01	1023.0649	0.0071	140	0.0236	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0028	0.0002	∞	0.0000	0.0000	∞	30	20	5.0	1023.0857	0.0071	141
2011–03	29.9689	0.0003	0.76	0.0002	25	20	10.0	2015–01	1025.2317	0.0071	142	0.0235	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0028	0.0002	∞	0.0000	0.0000	∞	30	20	10.0	1025.2525	0.0071	142
2011–03	29.9689	0.0003	0.76	0.0002	25	20	15.0	2015–01	1027.3766	0.0159	3425	0.0234	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0028	0.0002	∞	0.0000	0.0000	∞	30	20	15.0	1027.3973	0.0159	3428
2011–03	29.9689	0.0003	0.76	0.0002	25	20	20.0	2015–01	1029.4978	0.0160	3120	0.0233	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0028	0.0002	∞	0.0000	0.0000	∞	30	20	20.0	1029.5184	0.0160	3123
2011–03	29.9689	0.0003	0.76	0.0002	25	20	26.0	2015–01	1032.0172	0.0161	2498	0.0232	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0028	0.0002	∞	0.0000	0.0000	∞	30	20	26.0	1032.0377	0.0161	2501
2011–03	29.9689	0.0003	0.76	0.0002	25	20	33.0	2015–01	1034.9185	0.0162	1693	0.0231	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0028	0.0002	∞	0.0000	0.0000	∞	30	20	33.0	1034.9389	0.0162	1695
2011–03	29.9689	0.0003	0.76	0.0002	25	20	41.5	2015–01	1038.3908	0.0164	973	0.0230	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0029	0.0002	∞	0.0000	0.0000	∞	30	20	41.5	1038.4110	0.0164	974
2011–03	29.9689	0.0003	0.76	0.0002	25	20	52.0	2015–01	1042.6001	0.0166	501	0.0228	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0029	0.0002	∞	0.0000	0.0000	∞	30	20	52.0	1042.6201	0.0166	501
2011–03	29.9689	0.0003	0.76	0.0002	25	20	65.0	2015–01	1047.6980	0.0169	247	0.0226	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0029	0.0002	∞	0.0000	0.0000	∞	30	20	65.0	1047.7179	0.0169	247
2011–03	29.9689	0.0003	0.75	0.0002	25	25	5.0	2015–01	1021.6503	0.0071	140	0.0234	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0028	0.0002	∞	0.0002	0.0002	∞	30	25	5.0	1021.6712	0.0071	141
2011–03	29.9689	0.0003	0.75	0.0002	25	25	10.0	2015–01	1023.7910	0.0071	142	0.0233	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0028	0.0002	∞	0.0002	0.0002	∞	30	25	10.0	1023.8118	0.0071	143
2011–03	29.9689	0.0003	0.75	0.0002	25	25	15.0	2015–01	1025.9073	0.0159	3425	0.0232	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0028	0.0002	∞	0.0002	0.0002	∞	30	25	15.0	1025.9279	0.0159	3429
2011–03	29.9689	0.0003	0.75	0.0002	25	25	20.0	2015–01	1027.9994	0.0160	3120	0.0231	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0029	0.0002	∞	0.0002	0.0002	∞	30	25	20.0	1028.0200	0.0160	3124
2011–03	29.9689	0.0003	0.75	0.0002	25	25	26.0	2015–01	1030.4877	0.0161	2498	0.0230	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0029	0.0002	∞	0.0002	0.0002	∞	30	25	26.0	1030.5081	0.0161	2502
2011–03	29.9689	0.0003	0.75	0.0002	25	25	33.0	2015–01	1033.3510	0.0162	1693	0.0229	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0029	0.0002	∞	0.0002	0.0002	∞	30	25	33.0	1033.3713	0.0162	1695
2011–03	29.9689	0.0003	0.75	0.0002	25	25	41.5	2015–01	1036.7780	0.0164	973	0.0228	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0029	0.0002	∞	0.0002	0.0002	∞	30	25	41.5	1036.7982	0.0164	974
2011–03	29.9689	0.0003	0.75	0.0002	25	25	52.0	2015–01	1040.9332	0.0166	501	0.0226	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0029	0.0002	∞	0.0002	0.0002	∞	30	25	52.0	1040.9532	0.0166	501
2011–03	29.9689	0.0003	0.75	0.0002	25	25	65.0	2015–01	1045.9678	0.0169	247	0.0225	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0029	0.0002	∞	0.0002	0.0002	∞	30	25	65.0	1045.9876	0.0169	247
2011–03	29.9689	0.0003	0.75	0.0002	25	30	5.0	2015–03	1020.0437	0.0071	140	0.0232	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0029	0.0002	∞	0.0003	0.0002	∞	30	30	5.0	1020.0644	0.0071	141
2011–03	29.9689	0.0003	0.75	0.0002	25	30	10.0	2015–03	1022.1609	0.0071	142	0.0231	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0029	0.0002	∞	0.0003	0.0002	∞	30	30	10.0	1022.1815	0.0071	143
2011–03	29.9689	0.0003	0.75	0.0002	25	30	15.0	2015–03	1024.2551	0.0159	3425	0.0230	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0029	0.0002	∞	0.0003	0.0002	∞	30	30	15.0	1024.2756	0.0159	3429
2011–03	29.9689	0.0003	0.75	0.0002	25	30	20.0	2015–03	1026.3293	0.0160	3120	0.0229	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0029	0.0002	∞	0.0003	0.0002	∞	30	30	20.0	1026.3497	0.0160	3124
2011–03	29.9689	0.0003	0.75	0.0002	25	30	26.0	2015–03	1028.7908	0.0161	2498	0.0229	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0029	0.0002	∞	0.0003	0.0002	∞	30	30	26.0	1028.8111	0.0161	2502
2011–03	29.9689	0.0003	0.75	0.0002	25	30	33.0	2015–03	1031.6252	0.0162	1693	0.0228	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0030	0.0002	∞	0.0003	0.0002	∞	30	30	33.0	1031.6454	0.0162	1695
2011–03	29.9689	0.0003	0.75	0.0002	25	30	41.5	2015–03	1035.0148	0.0164	973	0.0226	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0030	0.0002	∞	0.0003	0.0002	∞	30	30	41.5	1035.0349	0.0164	974
2011–03	29.9689	0.0003	0.75	0.0002	25	30	52.0	2015–03	1039.1295	0.0166	501	0.0225	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0030	0.0002	∞	0.0003	0.0002	∞	30	30	52.0	1039.1494	0.0166	501
2011–03	29.9689	0.0003	0.75	0.0002	25	30	65.0	2015–03	1044.1127	0.0169	247	0.0223	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0030	0.0002	∞	0.0003	0.0002	∞	30	30	65.0	1044.1324	0.0169	247
2011–03	29.9689	0.0003	0.74	0.0002	25	35	5.0	2015–03	1018.2547	0.0071	140	0.0230	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0029	0.0002	∞	0.0004	0.0002	∞	30	35	5.0	1018.2753	0.0071	141
2011–03	29.9689	0.0003	0.74	0.0002	25	35	10.0	2015–03	1020.3546	0.0071	142	0.0229	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0030	0.0002	∞	0.0004	0.0002	∞	30	35	10.0	1020.3751	0.0071	143
2011–03	29.9689	0.0003	0.74	0.0002	25	35	15.0	2015–03	1022.4334	0.0159	3425	0.0229	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0030	0.0002	∞	0.0004	0.0002	∞	30	35	15.0	1022.4538	0.0159	3429
2011–03	29.9689	0.0003	0.74	0.0002	25	35	20.0	2015–03	1024.4906	0.0160	3120	0.0228	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0030	0.0002	∞	0.0004	0.0002	∞	30	35	20.0	1024.5110	0.0160	3124
2011–03	29.9689	0.0003	0.74	0.0002	25	35	26.0	2015–03	1026.9326	0.0161	2498	0.0227	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0030	0.0002	∞	0.0004	0.0002	∞	30	35	26.0	1026.9528	0.0161	2502
2011–03	29.9689	0.0003	0.74	0.0002	25	35	33.0	2015–03	1029.7451	0.0162	1693	0.0226	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0030	0.0002	∞	0.0004	0.0002	∞	30	35	33.0	1029.7653	0.0162	1695
2011–03	29.9689	0.0003	0.74	0.0002	25	35	41.5	2015–03	1033.1090	0.0164	973	0.0225	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0030	0.0002	∞	0.0004	0.0002	∞	30	35	41.5	1033.1290	0.0164	974
2011–03	29.9689	0.0003	0.74	0.0002	25	35	52.0	2015–03	1037.1909	0.0166	501	0.0224	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0030	0.0002	∞	0.0004	0.0002	∞	30	35	52.0	1037.2108	0.0166	501
2011–03	29.9689	0.0003	0.74	0.0002	25	35	65.0	2015–03	1042.1351	0.0169	247	0.0222	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0030	0.0002	∞	0.0004	0.0002	∞	30	35	65.0	1042.1548	0.0169	247

Salinity 35

Date of salinity measurement	Practical salinity from measurement					Temperature	Pressure	Date of density measurement	Seawater density from substitution measurement			Density correction to (integer) target salinity			Density change due to preparation (isotopic composition)				Density change due to storage (salt composition)			Density correction due to measurement (air saturation)			Practical salinity	Temperature	Pressure	Seawater density (at uniform conditions)		
–	S	$u(S)$	$\mathrm{d}\rho/\mathrm{d}S$	$u(\rho)$	ν	T	p	–	$\rho_{SW,subs}$	u	ν_{eff}	$\Delta\rho_{SW,tar}$	u	ν_{eff}	$\Delta\rho_{SW,prep}$	$\Delta\rho_{SW,iso}$	u	ν_{eff}	$\Delta\rho_{SW,stor}$	u	ν_{eff}	$\Delta\rho_{SW,aer}$	u	ν_{eff}	S	T	p	ρ_{SW}	u	ν_{eff}
–	–	–	kg m^{-3}	kg m^{-3}	–	°C	MPa	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	–	°C	MPa	kg m^{-3}	kg m^{-3}	–
2011–03	34.9917	0.0002	0.79	0.0002	∞	5	5.0	2015–05	1029.9117	0.0070	136	0.0065	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0031	0.0003	∞	-0.0010	0.0002	∞	35	5	5.0	1029.9139	0.0070	137
2011–03	34.9917	0.0002	0.79	0.0002	∞	5	10.0	2015–05	1032.1909	0.0070	138	0.0065	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0031	0.0003	∞	-0.0010	0.0002	∞	35	5	10.0	1032.1931	0.0071	139
2011–03	34.9917	0.0002	0.79	0.0002	∞	5	15.0	2015–05	1034.4473	0.0158	3377	0.0065	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0031	0.0003	∞	-0.0010	0.0002	∞	35	5	15.0	1034.4494	0.0158	3381
2011–03	34.9917	0.0002	0.79	0.0002	∞	5	20.0	2015–05	1036.6762	0.0159	3107	0.0065	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0031	0.0003	∞	-0.0010	0.0002	∞	35	5	20.0	1036.6783	0.0159	3111
2011–03	34.9917	0.0002	0.79	0.0002	∞	5	26.0	2015–05	1039.3231	0.0160	2534	0.0064	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0031	0.0003	∞	-0.0010	0.0002	∞	35	5	26.0	1039.3252	0.0160	2537
2011–03	34.9917	0.0002	0.79	0.0002	∞	5	33.0	2015–05	1042.3698	0.0161	1754	0.0064	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0031	0.0003	∞	-0.0010	0.0002	∞	35	5	33.0	1042.3718	0.0161	1756
2011–03	34.9917	0.0002	0.79	0.0002	∞	5	41.5	2015–05	1046.0040	0.0162	1023	0.0063	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0031	0.0003	∞	-0.0010	0.0002	∞	35	5	41.5	1046.0059	0.0163	1025
2011–03	34.9917	0.0002	0.79	0.0002	∞	5	52.0	2015–05	1050.4136	0.0165	529	0.0063	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0031	0.0003	∞	-0.0010	0.0002	∞	35	5	52.0	1050.4155	0.0165	530
2011–03	34.9917	0.0002	0.79	0.0002	∞	5	65.0	2015–05	1055.7430	0.0168	260	0.0062	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0032	0.0003	∞	-0.0010	0.0002	∞	35	5	65.0	1055.7447	0.0168	260
2011–03	34.9917	0.0002	0.78	0.0002	∞	10	5.0	2015–02	1029.1420	0.0070	136	0.0065	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0029	0.0002	∞	-0.0006	0.0002	∞	35	10	5.0	1029.1447	0.0070	137
2011–03	34.9917	0.0002	0.78	0.0002	∞	10	10.0	2015–02	1031.3697	0.0070	138	0.0064	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0029	0.0002	∞	-0.0006	0.0002	∞	35	10	10.0	1031.3723	0.0071	139
2011–03	34.9917	0.0002	0.78	0.0002	∞	10	15.0	2015–02	1033.5732	0.0158	3377	0.0064	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0029	0.0002	∞	-0.0006	0.0002	∞	35	10	15.0	1033.5758	0.0158	3381
2011–03	34.9917	0.0002	0.78	0.0002	∞	10	20.0	2015–02	1035.7553	0.0159	3107	0.0064	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0029	0.0002	∞	-0.0006	0.0002	∞	35	10	20.0	1035.7579	0.0159	3110
2011–03	34.9917	0.0002	0.78	0.0002	∞	10	26.0	2015–02	1038.3443	0.0160	2534	0.0063	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0029	0.0002	∞	-0.0006	0.0002	∞	35	10	26.0	1038.3469	0.0160	2537
2011–03	34.9917	0.0002	0.78	0.0002	∞	10	33.0	2015–02	1041.3254	0.0161	1754	0.0063	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0029	0.0003	∞	-0.0006	0.0002	∞	35	10	33.0	1041.3280	0.0161	1756
2011–03	34.9917	0.0002	0.78	0.0002	∞	10	41.5	2015–02	1044.8882	0.0162	1023	0.0063	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0030	0.0003	∞	-0.0006	0.0002	∞	35	10	41.5	1044.8906	0.0163	1025
2011–03	34.9917	0.0002	0.78	0.0002	∞	10	52.0	2015–02	1049.2087	0.0165	529	0.0062	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0030	0.0003	∞	-0.0006	0.0002	∞	35	10	52.0	1049.2111	0.0165	530
2011–03	34.9917	0.0002	0.78	0.0002	∞	10	65.0	2015–02	1054.4357	0.0168	260	0.0062	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0030	0.0003	∞	-0.0006	0.0002	∞	35	10	65.0	1054.4380	0.0168	260
2011–03	34.9917	0.0002	0.77	0.0002	∞	15	5.0	2014–04	1028.1205	0.0070	136	0.0064	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0023	0.0002	∞	-0.0003	0.0002	∞	35	15	5.0	1028.1240	0.0070	137
2011–03	34.9917	0.0002	0.77	0.0002	∞	15	10.0	2014–04	1030.3050	0.0070	138	0.0063	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0023	0.0002	∞	-0.0003	0.0002	∞	35	15	10.0	1030.3085	0.0071	138
2011–03	34.9917	0.0002	0.77	0.0002	∞	15	15.0	2014–04	1032.4690	0.0158	3377	0.0063	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0023	0.0002	∞	-0.0003	0.0002	∞	35	15	15.0	1032.4725	0.0158	3381
2011–03	34.9917	0.0002	0.77	0.0002	∞	15	20.0	2014–04	1034.6100	0.0159	3107	0.0063	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0023	0.0002	∞	-0.0003	0.0002	∞	35	15	20.0	1034.6135	0.0159	3110
2011–03	34.9917	0.0002	0.77	0.0002	∞	15	26.0	2014–04	1037.1512	0.0160	2534	0.0063	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0023	0.0002	∞	-0.0003	0.0002	∞	35	15	26.0	1037.1546	0.0160	2536
2011–03	34.9917	0.0002	0.77	0.0002	∞	15	33.0	2014–04	1040.0798	0.0161	1754	0.0062	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0023	0.0002	∞	-0.0003	0.0002	∞	35	15	33.0	1040.0832	0.0161	1755
2011–03	34.9917	0.0002	0.77	0.0002	∞	15	41.5	2014–04	1043.5784	0.0162	1023	0.0062	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0023	0.0002	∞	-0.0003	0.0002	∞	35	15	41.5	1043.5818	0.0163	1024
2011–03	34.9917	0.0002	0.77	0.0002	∞	15	52.0	2014–04	1047.8235	0.0165	529	0.0062	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0023	0.0002	∞	-0.0003	0.0002	∞	35	15	52.0	1047.8268	0.0165	530
2011–03	34.9917	0.0002	0.77	0.0002	∞	15	65.0	2014–04	1052.9626	0.0168	260	0.0061	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0024	0.0002	∞	-0.0003	0.0002	∞	35	15	65.0	1052.9659	0.0168	260
2011–03	34.9917	0.0002	0.76	0.0002	∞	20	5.0	2014–11	1026.8740	0.0070	136	0.0063	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0027	0.0002	∞	0.0000	0.0000	∞	35	20	5.0	1026.8773	0.0070	137
2011–03	34.9917	0.0002	0.76	0.0002	∞	20	10.0	2014–11	1029.0253	0.0070	138	0.0063	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0027	0.0002	∞	0.0000	0.0000	∞	35	20	10.0	1029.0285	0.0071	138
2011–03	34.9917	0.0002	0.76	0.0002	∞	20	15.0	2014–11	1031.1540	0.0158	3377	0.0063	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0028	0.0002	∞	0.0000	0.0000	∞	35	20	15.0	1031.1572	0.0158	3380
2011–03	34.9917	0.0002	0.76	0.0002	∞	20	20.0	2014–11	1033.2627	0.0159	3107	0.0062	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0028	0.0002	∞	0.0000	0.0000	∞	35	20	20.0	1033.2659	0.0159	3109
2011–03	34.9917	0.0002	0.76	0.0002	∞	20	26.0	2014–11	1035.7654	0.0160	2534	0.0062	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0028	0.0002	∞	0.0000	0.0000	∞	35	20	26.0	1035.7686	0.0160	2536
2011–03	34.9917	0.0002	0.76	0.0002	∞	20	33.0	2014–11	1038.6463	0.0161	1754	0.0062	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0028	0.0002	∞	0.0000	0.0000	∞	35	20	33.0	1038.6495	0.0161	1755
2011–03	34.9917	0.0002	0.76	0.0002	∞	20	41.5	2014–11	1042.0935	0.0162	1023	0.0061	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0028	0.0002	∞	0.0000	0.0000	∞	35	20	41.5	1042.0966	0.0163	1024
2011–03	34.9917	0.0002	0.76	0.0002	∞	20	52.0	2014–11	1046.2737	0.0165	529	0.0061	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0028	0.0002	∞	0.0000	0.0000	∞	35	20	52.0	1046.2767	0.0165	530
2011–03	34.9917	0.0002	0.76	0.0002	∞	20	65.0	2014–11	1051.3389	0.0168	260	0.0061	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0028	0.0002	∞	0.0000	0.0000	∞	35	20	65.0	1051.3419	0.0168	260
2011–03	34.9917	0.0002	0.76	0.0002	∞	25	5.0	2015–05	1025.4271	0.0070	136	0.0062	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0031	0.0003	∞	0.0002	0.0002	∞	35	25	5.0	1025.4301	0.0070	137
2011–03	34.9917	0.0002	0.76	0.0002	∞	25	10.0	2015–05	1027.5504	0.0070	138	0.0062	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0031	0.0003	∞	0.0002	0.0002	∞	35	25	10.0	1027.5534	0.0071	139
2011–03	34.9917	0.0002	0.76	0.0002	∞	25	15.0	2015–05	1029.6542	0.0158	3377	0.0062	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0031	0.0003	∞	0.0002	0.0002	∞	35	25	15.0	1029.6572	0.0158	3381
2011–03	34.9917	0.0002	0.76	0.0002	∞	25	20.0	2015–05	1031.7355	0.0159	3107	0.0062	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0031	0.0003	∞	0.0002	0.0002	∞	35	25	20.0	1031.7384	0.0159	3111
2011–03	34.9917	0.0002	0.76	0.0002	∞	25	26.0	2015–05	1034.2059	0.0160	2534	0.0062	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0031	0.0003	∞	0.0002	0.0002	∞	35	25	26.0	1034.2089	0.0160	2537
2011–03	34.9917	0.0002	0.76	0.0002	∞	25	33.0	2015–05	1037.0539	0.0161	1754	0.0061	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0031	0.0003	∞	0.0002	0.0002	∞	35	25	33.0	1037.0568	0.0161	1756
2011–03	34.9917	0.0002	0.76	0.0002	∞	25	41.5	2015–05	1040.4573	0.0162	1023	0.0061	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0031	0.0003	∞	0.0002	0.0002	∞	35	25	41.5	1040.4601	0.0163	1025
2011–03	34.9917	0.0002	0.76	0.0002	∞	25	52.0	2015–05	1044.5903	0.0165	529	0.0061	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0032	0.0003	∞	0.0002	0.0002	∞	35	25	52.0	1044.5931	0.0165	530
2011–03	34.9917	0.0002	0.76	0.0002	∞	25	65.0	2015–05	1049.5926	0.0168	260	0.0060	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0032	0.0003	∞	0.0002	0.0002	∞	35	25	65.0	1049.5954	0.0168	260
2011–03	34.9917	0.0002	0.75	0.0001	∞	30	5.0	2015–03	1023.7875	0.0070	136	0.0062	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0029	0.0002	∞	0.0003	0.0002	∞	35	30	5.0	1023.7908	0.0070	137
2011–03	34.9917	0.0002	0.75	0.0001	∞	30	10.0	2015–03	1025.8898	0.0070	138	0.0062	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0029	0.0002	∞	0.0003	0.0002	∞	35	30	10.0	1025.8931	0.0071	139
2011–03	34.9917	0.0002	0.75	0.0001	∞	30	15.0	2015–03	1027.9730	0.0158	3377	0.0062	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0029	0.0002	∞	0.0003	0.0002	∞	35	30	15.0	1027.9763	0.0158	3381
2011–03	34.9917	0.0002	0.75	0.0001	∞	30	20.0	2015–03	1030.0337	0.0159	3107	0.0061	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0029	0.0003	∞	0.0003	0.0002	∞	35	30	20.0	1030.0370	0.0159	3110
2011–03	34.9917	0.0002	0.75	0.0001	∞	30	26.0	2015–03	1032.4794	0.0160	2534	0.0061	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0029	0.0003	∞	0.0003	0.0002	∞	35	30	26.0	1032.4827	0.0160	2537
2011–03	34.9917	0.0002	0.75	0.0001	∞	30	33.0	2015–03	1035.2993	0.0161	1754	0.0061	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0030	0.0003	∞	0.0003	0.0002	∞	35	30	33.0	1035.3025	0.0161	1756
2011–03	34.9917	0.0002	0.75	0.0001	∞	30	41.5	2015–03	1038.6716	0.0162	1023	0.0061	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0030	0.0003	∞	0.0003	0.0002	∞	35	30	41.5	1038.6747	0.0163	1025
2011–03	34.9917	0.0002	0.75	0.0001	∞	30	52.0	2015–03	1042.7639	0.0165	529	0.0060	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0030	0.0003	∞	0.0003	0.0002	∞	35	30	52.0	1042.7670	0.0165	530
2011–03	34.9917	0.0002	0.75	0.0001	∞	30	65.0	2015–03	1047.7170	0.0168	260	0.0060	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0030	0.0003	∞	0.0003	0.0002	∞	35	30	65.0	1047.7200	0.0168	260
2011–03	34.9917	0.0002	0.74	0.0001	∞	35	5.0	2015–04	1021.9792	0.0070	136	0.0062	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0030	0.0003	∞	0.0004	0.0002	∞	35	35	5.0	1021.9825	0.0070	137
2011–03	34.9917	0.0002	0.74	0.0001	∞	35	10.0	2015–04	1024.0656	0.0070	138	0.0061	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0030	0.0003	∞	0.0004	0.0002	∞	35	35	10.0	1024.0689	0.0071	139
2011–03	34.9917	0.0002	0.74	0.0001	∞	35	15.0	2015–04	1026.1323	0.0158	3377	0.0061	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0030	0.0003	∞	0.0004	0.0002	∞	35	35	15.0	1026.1356	0.0158	3381
2011–03	34.9917	0.0002	0.74	0.0001	∞	35	20.0	2015–04	1028.1790	0.0159	3107	0.0061	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0030	0.0003	∞	0.0004	0.0002	∞	35	35	20.0	1028.1823	0.0159	3110
2011–03	34.9917	0.0002	0.74	0.0001	∞	35	26.0	2015–04	1030.6078	0.0160	2534	0.0061	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0030	0.0003	∞	0.0004	0.0002	∞	35	35	26.0	1030.6110	0.0160	2537
2011–03	34.9917	0.0002	0.74	0.0001	∞	35	33.0	2015–04	1033.4048	0.0161	1754	0.0061	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0030	0.0003	∞	0.0004	0.0002	∞	35	35	33.0	1033.4080	0.0161	1756
2011–03	34.9917	0.0002	0.74	0.0001	∞	35	41.5	2015–04	1036.7514	0.0162	1023	0.0060	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0030	0.0003	∞	0.0004	0.0002	∞	35	35	41.5	1036.7546	0.0163	1025
2011–03	34.9917	0.0002	0.74	0.0001	∞	35	52.0	2015–04	1040.8106	0.0165	529	0.0060	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0031	0.0003	∞	0.0004	0.0002	∞	35	35	52.0	1040.8137	0.0165	530
2011–03	34.9917	0.0002	0.74	0.0001	∞	35	65.0	2015–04	1045.7291	0.0168	260	0.0060	0.0000	∞	0.0000	-0.0003	0.0002	∞	0.0031	0.0003	∞	0.0004	0.0002	∞	35	35	65.0	1045.7321	0.0168	260

Sect. 4 (data)

Density for atmospheric pressure

Practical salinity	Temperature	Pressure	Water reference density			Seawater density			Relative seawater density			Silicate molality			$\Delta\rho$-S–Relation									
															Air	Dataset			Relation			Air	Residua	Salt + Air	
S	T	p	$\rho_{H2O,0}$	u	ν_{eff}	ρ_{SW}	u	ν_{eff}	$\Delta\rho_{SW}$	u	ν_{eff}	b_0	u	ν_{eff}	$\Delta\rho_{SW,a}$	$\Delta\rho_{SW,0}$	$\Delta\rho_{SW,0}(p_0)$	$\Delta\Delta\rho_{SW,0}(p)$	$\Delta\rho_{SW,0}(p_0)$	$\Delta\Delta\rho_{SW,0}(p)$	$\Delta\rho_{SW,0}$	$\Delta\rho_{SW,a}$	Δ	$\Delta\rho_{SW}$	U
–	°C	MPa	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	µmol kg^{-1}	µmol kg^{-1}	–	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}
0	5	0.101325	999.9666	0.0005	∞	999.9627	0.0008	∞	-0.0039	0.0006	∞	0.0	0.0	∞	-0.0039	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0039	0.0000	-0.0039	0.0013
0	10	0.101325	999.7025	0.0005	∞	999.6991	0.0008	∞	-0.0033	0.0006	∞	0.0	0.0	∞	-0.0033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0033	0.0000	-0.0033	0.0011
0	15	0.101325	999.1026	0.0005	∞	999.0998	0.0007	∞	-0.0028	0.0005	∞	0.0	0.0	∞	-0.0028	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0028	0.0000	-0.0028	0.0010
0	20	0.101325	998.2072	0.0005	∞	998.2047	0.0007	∞	-0.0024	0.0004	∞	0.0	0.0	∞	-0.0024	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0024	0.0000	-0.0024	0.0009
0	25	0.101325	997.0476	0.0005	∞	997.0456	0.0006	∞	-0.0021	0.0004	∞	0.0	0.0	∞	-0.0021	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0021	0.0000	-0.0021	0.0008
0	30	0.101325	995.6495	0.0005	∞	995.6477	0.0006	∞	-0.0018	0.0004	∞	0.0	0.0	∞	-0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0018	0.0000	-0.0018	0.0008
0	35	0.101325	994.0333	0.0005	∞	994.0318	0.0007	∞	-0.0015	0.0004	∞	0.0	0.0	∞	-0.0015	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0015	0.0000	-0.0015	0.0008
5	5	0.101325	999.9666	0.0005	∞	1003.9395	0.0009	79	3.9729	0.0007	37	2.4	0.2	∞	-0.0039	3.9768	3.9768	0.0000	3.9757	0.0000	3.9757	-0.0039	0.0012	3.9717	0.0020
5	10	0.101325	999.7025	0.0005	∞	1003.6026	0.0009	80	3.9001	0.0007	38	2.4	0.2	∞	-0.0033	3.9034	3.9034	0.0000	3.9043	0.0000	3.9043	-0.0033	-0.0009	3.9010	0.0020
5	15	0.101325	999.1026	0.0005	∞	1002.9470	0.0009	78	3.8443	0.0007	37	2.4	0.2	∞	-0.0028	3.8472	3.8472	0.0000	3.8463	0.0000	3.8463	-0.0028	0.0009	3.8435	0.0020
5	20	0.101325	998.2072	0.0005	∞	1002.0022	0.0009	71	3.7951	0.0007	32	2.4	0.2	∞	-0.0024	3.7975	3.7975	0.0000	3.7989	0.0000	3.7989	-0.0024	-0.0014	3.7965	0.0020
5	25	0.101325	997.0476	0.0005	∞	1000.8074	0.0009	78	3.7598	0.0007	37	2.4	0.2	∞	-0.0021	3.7618	3.7618	0.0000	3.7602	0.0000	3.7602	-0.0021	0.0017	3.7581	0.0020
5	30	0.101325	995.6495	0.0005	∞	999.3744	0.0009	79	3.7249	0.0007	38	2.4	0.2	∞	-0.0018	3.7267	3.7267	0.0000	3.7285	0.0000	3.7285	-0.0018	-0.0018	3.7267	0.0020
5	35	0.101325	994.0333	0.0005	∞	997.7355	0.0009	78	3.7021	0.0007	37	2.4	0.2	∞	-0.0015	3.7037	3.7037	0.0000	3.7028	0.0000	3.7028	-0.0015	0.0009	3.7013	0.0020
10	5	0.101325	999.9666	0.0005	∞	1007.8944	0.0009	98	7.9278	0.0008	51	4.7	0.5	∞	-0.0039	7.9317	7.9317	0.0000	7.9320	0.0000	7.9320	-0.0039	-0.0003	7.9281	0.0020
10	10	0.101325	999.7025	0.0005	∞	1007.4899	0.0009	99	7.7875	0.0008	52	4.7	0.5	∞	-0.0033	7.7908	7.7908	0.0000	7.7914	0.0000	7.7914	-0.0033	-0.0006	7.7881	0.0020
10	15	0.101325	999.1026	0.0005	∞	1006.7764	0.0009	98	7.6737	0.0008	51	4.7	0.5	∞	-0.0028	7.6766	7.6766	0.0000	7.6764	0.0000	7.6764	-0.0028	0.0002	7.6736	0.0020
10	20	0.101325	998.2072	0.0005	∞	1005.7856	0.0009	90	7.5785	0.0008	45	4.7	0.5	∞	-0.0024	7.5809	7.5809	0.0000	7.5819	0.0000	7.5819	-0.0024	-0.0010	7.5794	0.0020
10	25	0.101325	997.0476	0.0005	∞	1004.5494	0.0009	98	7.5018	0.0008	51	4.7	0.5	∞	-0.0021	7.5039	7.5039	0.0000	7.5039	0.0000	7.5039	-0.0021	0.0000	7.5018	0.0020
10	30	0.101325	995.6495	0.0005	∞	1003.0875	0.0009	98	7.4381	0.0008	51	4.7	0.5	∞	-0.0018	7.4399	7.4399	0.0000	7.4398	0.0000	7.4398	-0.0018	0.0001	7.4380	0.0020
10	35	0.101325	994.0333	0.0005	∞	1001.4178	0.0009	98	7.3845	0.0008	51	4.7	0.5	∞	-0.0015	7.3861	7.3861	0.0000	7.3873	0.0000	7.3873	-0.0015	-0.0012	7.3858	0.0020
15	5	0.101325	999.9666	0.0005	∞	1011.8438	0.0009	102	11.8772	0.0008	53	7.1	0.7	∞	-0.0039	11.8812	11.8812	0.0000	11.8816	0.0000	11.8816	-0.0039	-0.0005	11.8777	0.0020
15	10	0.101325	999.7025	0.0005	∞	1011.3725	0.0010	104	11.6700	0.0008	54	7.1	0.7	∞	-0.0033	11.6734	11.6734	0.0000	11.6741	0.0000	11.6741	-0.0033	-0.0007	11.6708	0.0020
15	15	0.101325	999.1026	0.0005	∞	1010.6047	0.0009	102	11.5021	0.0008	53	7.1	0.7	∞	-0.0028	11.5050	11.5050	0.0000	11.5036	0.0000	11.5036	-0.0028	0.0013	11.5008	0.0020
15	20	0.101325	998.2072	0.0005	∞	1009.5691	0.0009	94	11.3619	0.0008	47	7.1	0.7	∞	-0.0024	11.3644	11.3644	0.0000	11.3628	0.0000	11.3628	-0.0024	0.0015	11.3604	0.0020
15	25	0.101325	997.0476	0.0005	∞	1008.2929	0.0009	102	11.2453	0.0008	53	7.1	0.7	∞	-0.0021	11.2474	11.2474	0.0000	11.2463	0.0000	11.2463	-0.0021	0.0010	11.2442	0.0020
15	30	0.101325	995.6495	0.0005	∞	1006.7973	0.0009	103	11.1479	0.0008	53	7.1	0.7	∞	-0.0018	11.1497	11.1497	0.0000	11.1500	0.0000	11.1500	-0.0018	-0.0003	11.1482	0.0020
15	35	0.101325	994.0333	0.0005	∞	1005.1036	0.0009	102	11.0703	0.0008	53	7.1	0.7	∞	-0.0015	11.0718	11.0718	0.0000	11.0710	0.0000	11.0710	-0.0015	0.0009	11.0694	0.0020
20	5	0.101325	999.9666	0.0005	∞	1015.7933	0.0010	114	15.8266	0.0008	62	9.4	0.9	∞	-0.0039	15.8306	15.8306	0.0000	15.8307	0.0000	15.8307	-0.0039	-0.0001	15.8267	0.0020
20	10	0.101325	999.7025	0.0005	∞	1015.2587	0.0010	114	15.5562	0.0008	62	9.4	0.9	∞	-0.0033	15.5596	15.5596	0.0000	15.5583	0.0000	15.5583	-0.0033	0.0012	15.5550	0.0020
20	15	0.101325	999.1026	0.0005	∞	1014.4329	0.0010	114	15.3303	0.0008	62	9.4	0.9	∞	-0.0028	15.3331	15.3331	0.0000	15.3339	0.0000	15.3339	-0.0028	-0.0008	15.3311	0.0020
20	20	0.101325	998.2072	0.0005	∞	1013.3542	0.0010	104	15.1470	0.0008	55	9.4	0.9	∞	-0.0024	15.1495	15.1495	0.0000	15.1481	0.0000	15.1481	-0.0024	0.0014	15.1456	0.0020
20	25	0.101325	997.0476	0.0005	∞	1012.0391	0.0010	113	14.9914	0.0008	62	9.4	0.9	∞	-0.0021	14.9935	14.9935	0.0000	14.9938	0.0000	14.9938	-0.0021	-0.0003	14.9917	0.0020
20	30	0.101325	995.6495	0.0005	∞	1010.5117	0.0010	113	14.8623	0.0008	62	9.4	0.9	∞	-0.0018	14.8641	14.8641	0.0000	14.8661	0.0000	14.8661	-0.0018	-0.0020	14.8643	0.0020
20	35	0.101325	994.0333	0.0005	∞	1008.7931	0.0010	113	14.7598	0.0008	62	9.4	0.9	∞	-0.0015	14.7613	14.7613	0.0000	14.7612	0.0000	14.7612	-0.0015	0.0001	14.7597	0.0020
25	5	0.101325	999.9666	0.0005	∞	1019.7453	0.0010	124	19.7786	0.0009	69	11.8	1.2	∞	-0.0039	19.7826	19.7826	0.0000	19.7819	0.0000	19.7819	-0.0039	0.0007	19.7779	0.0020
25	10	0.101325	999.7025	0.0005	∞	1019.1443	0.0010	125	19.4418	0.0009	70	11.8	1.2	∞	-0.0033	19.4452	19.4452	0.0000	19.4465	0.0000	19.4465	-0.0033	-0.0013	19.4432	0.0020
25	15	0.101325	999.1026	0.0005	∞	1018.2704	0.0010	123	19.1677	0.0009	69	11.8	1.2	∞	-0.0028	19.1706	19.1706	0.0000	19.1695	0.0000	19.1695	-0.0028	0.0011	19.1666	0.0020
25	20	0.101325	998.2072	0.0005	∞	1017.1418	0.0010	115	18.9347	0.0008	63	11.8	1.2	∞	-0.0024	18.9371	18.9371	0.0000	18.9396	0.0000	18.9396	-0.0024	-0.0025	18.9371	0.0020
25	25	0.101325	997.0476	0.0005	∞	1015.7935	0.0010	123	18.7459	0.0009	69	11.8	1.2	∞	-0.0021	18.7480	18.7480	0.0000	18.7485	0.0000	18.7485	-0.0021	-0.0005	18.7464	0.0020
25	30	0.101325	995.6495	0.0005	∞	1014.2398	0.0010	124	18.5903	0.0009	69	11.8	1.2	∞	-0.0018	18.5921	18.5921	0.0000	18.5901	0.0000	18.5901	-0.0018	0.0021	18.5883	0.0020
25	35	0.101325	994.0333	0.0005	∞	1012.4920	0.0010	123	18.4587	0.0009	69	11.8	1.2	∞	-0.0015	18.4602	18.4602	0.0000	18.4599	0.0000	18.4599	-0.0015	0.0002	18.4584	0.0020
30	5	0.101325	999.9666	0.0005	∞	1023.6997	0.0010	150	23.7330	0.0009	90	14.1	1.4	∞	-0.0039	23.7370	23.7370	0.0000	23.7364	0.0000	23.7364	-0.0039	0.0006	23.7324	0.0020
30	10	0.101325	999.7025	0.0005	∞	1023.0371	0.0010	149	23.3347	0.0009	89	14.1	1.4	∞	-0.0033	23.3380	23.3380	0.0000	23.3395	0.0000	23.3395	-0.0033	-0.0015	23.3362	0.0020
30	15	0.101325	999.1026	0.0005	∞	1022.1105	0.0010	149	23.0078	0.0009	89	14.1	1.4	∞	-0.0028	23.0107	23.0107	0.0000	23.0110	0.0000	23.0110	-0.0028	-0.0003	23.0082	0.0020
30	20	0.101325	998.2072	0.0005	∞	1020.9420	0.0010	138	22.7348	0.0009	81	14.1	1.4	∞	-0.0024	22.7372	22.7372	0.0000	22.7379	0.0000	22.7379	-0.0024	-0.0006	22.7354	0.0020
30	25	0.101325	997.0476	0.0005	∞	1019.5560	0.0010	148	22.5084	0.0009	88	14.1	1.4	∞	-0.0021	22.5104	22.5104	0.0000	22.5105	0.0000	22.5105	-0.0021	-0.0001	22.5085	0.0020
30	30	0.101325	995.6495	0.0005	∞	1017.9706	0.0010	148	22.3212	0.0009	88	14.1	1.4	∞	-0.0018	22.3230	22.3230	0.0000	22.3220	0.0000	22.3220	-0.0018	0.0010	22.3202	0.0020
30	35	0.101325	994.0333	0.0005	∞	1016.1973	0.0010	147	22.1640	0.0009	88	14.1	1.4	∞	-0.0015	22.1655	22.1655	0.0000	22.1669	0.0000	22.1669	-0.0015	-0.0014	22.1654	0.0020
35	5	0.101325	999.9666	0.0005	∞	1027.6570	0.0010	149	27.6904	0.0009	89	16.5	1.7	∞	-0.0039	27.6944	27.6944	0.0000	27.6944	0.0000	27.6944	-0.0039	0.0000	27.6904	0.0020
35	10	0.101325	999.7025	0.0005	∞	1026.9384	0.0011	151	27.2359	0.0009	90	16.5	1.7	∞	-0.0033	27.2392	27.2392	0.0000	27.2376	0.0000	27.2376	-0.0033	0.0017	27.2342	0.0020
35	15	0.101325	999.1026	0.0005	∞	1025.9601	0.0010	147	26.8575	0.0009	87	16.5	1.7	∞	-0.0028	26.8604	26.8604	0.0000	26.8588	0.0000	26.8588	-0.0028	0.0016	26.8559	0.0020
35	20	0.101325	998.2072	0.0005	∞	1024.7480	0.0010	140	26.5408	0.0009	82	16.5	1.7	∞	-0.0024	26.5433	26.5433	0.0000	26.5433	0.0000	26.5433	-0.0024	0.0000	26.5408	0.0020
35	25	0.101325	997.0476	0.0005	∞	1023.3268	0.0010	147	26.2792	0.0009	88	16.5	1.7	∞	-0.0021	26.2813	26.2813	0.0000	26.2803	0.0000	26.2803	-0.0021	0.0010	26.2782	0.0020
35	30	0.101325	995.6495	0.0005	∞	1021.7079	0.0011	150	26.0584	0.0009	90	16.5	1.7	∞	-0.0018	26.0602	26.0602	0.0000	26.0618	0.0000	26.0618	-0.0018	-0.0016	26.0600	0.0020
35	35	0.101325	994.0333	0.0005	∞	1019.9145	0.0010	147	25.8812	0.0009	88	16.5	1.7	∞	-0.0015	25.8827	25.8827	0.0000	25.8818	0.0000	25.8818	-0.0015	0.0010	25.8802	0.0020

Density for high pressures

Salinity 0

Practical salinity	Temperature	Pressure	Water reference density			Seawater density			Relative seawater density			Silicate molality			$\Delta\rho$–S–Relation										
															Air	Dataset			Relation			Air	Residua	Salt + Air	
S	T	p	$\rho_{H2O,0}$	u	ν_{eff}	ρ_{SW}	u	ν_{eff}	$\Delta\rho_{SW}$	u	ν_{eff}	b_0	u	ν_{eff}	$\Delta\rho_{SW,a}$	$\Delta\rho_{SW,0}$	$\Delta\rho_{SW,0}(p_0)$	$\Delta\Delta\rho_{SW,0}(p)$	$\Delta\rho_{SW,0}(p_0)$	$\Delta\Delta\rho_{SW,0}(p)$	$\Delta\rho_{SW,0}$	$\Delta\rho_{SW,a}$	Δ	$\Delta\rho_{SW}$	U
–	°C	MPa	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	µmol kg^{-1}	µmol kg^{-1}	–	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}
0	5	5.0	1002.3620	0.0050	∞	1002.3581	0.0058	71	-0.0039	0.0030	∞	0.0	0.0	∞	-0.0039	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0039	0.0000	-0.0039	0.0060
0	5	10.0	1004.7801	0.0050	∞	1004.7762	0.0059	72	-0.0039	0.0030	∞	0.0	0.0	∞	-0.0039	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0039	0.0000	-0.0039	0.0060
0	5	15.0	1007.1716	0.0151	∞	1007.1676	0.0154	3418	-0.0039	0.0029	∞	0.0	0.0	∞	-0.0039	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0039	0.0000	-0.0039	0.0058
0	5	20.0	1009.5367	0.0151	∞	1009.5328	0.0154	3448	-0.0039	0.0029	∞	0.0	0.0	∞	-0.0039	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0039	0.0000	-0.0039	0.0058
0	5	26.0	1012.3408	0.0152	∞	1012.3368	0.0155	3483	-0.0039	0.0029	∞	0.0	0.0	∞	-0.0039	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0039	0.0000	-0.0039	0.0058
0	5	33.0	1015.5660	0.0152	∞	1015.5620	0.0155	3525	-0.0039	0.0029	∞	0.0	0.0	∞	-0.0039	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0039	0.0000	-0.0039	0.0058
0	5	41.5	1019.4167	0.0153	∞	1019.4128	0.0156	3573	-0.0039	0.0029	∞	0.0	0.0	∞	-0.0039	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0039	0.0000	-0.0039	0.0058
0	5	52.0	1024.0766	0.0154	∞	1024.0726	0.0156	3630	-0.0039	0.0029	∞	0.0	0.0	∞	-0.0039	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0039	0.0000	-0.0039	0.0058
0	5	65.0	1029.7021	0.0154	∞	1029.6981	0.0157	3692	-0.0039	0.0029	∞	0.0	0.0	∞	-0.0039	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0039	0.0000	-0.0039	0.0058
0	10	5.0	1002.0313	0.0050	∞	1002.0280	0.0058	71	-0.0033	0.0030	∞	0.0	0.0	∞	-0.0033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0033	0.0000	-0.0033	0.0060
0	10	10.0	1004.3831	0.0050	∞	1004.3797	0.0059	72	-0.0033	0.0030	∞	0.0	0.0	∞	-0.0033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0033	0.0000	-0.0033	0.0060
0	10	15.0	1006.7096	0.0151	∞	1006.7063	0.0154	3418	-0.0033	0.0030	∞	0.0	0.0	∞	-0.0033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0033	0.0000	-0.0033	0.0059
0	10	20.0	1009.0115	0.0151	∞	1009.0081	0.0154	3448	-0.0033	0.0030	∞	0.0	0.0	∞	-0.0033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0033	0.0000	-0.0033	0.0059
0	10	26.0	1011.7415	0.0152	∞	1011.7381	0.0155	3483	-0.0033	0.0030	∞	0.0	0.0	∞	-0.0033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0033	0.0000	-0.0033	0.0059
0	10	33.0	1014.8829	0.0152	∞	1014.8796	0.0155	3525	-0.0033	0.0030	∞	0.0	0.0	∞	-0.0033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0033	0.0000	-0.0033	0.0059
0	10	41.5	1018.6358	0.0153	∞	1018.6325	0.0156	3573	-0.0033	0.0030	∞	0.0	0.0	∞	-0.0033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0033	0.0000	-0.0033	0.0059
0	10	52.0	1023.1806	0.0153	∞	1023.1773	0.0156	3630	-0.0033	0.0030	∞	0.0	0.0	∞	-0.0033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0033	0.0000	-0.0033	0.0060
0	10	65.0	1028.6722	0.0154	∞	1028.6689	0.0157	3692	-0.0033	0.0030	∞	0.0	0.0	∞	-0.0033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0033	0.0000	-0.0033	0.0060
0	15	5.0	1001.3779	0.0050	∞	1001.3751	0.0058	71	-0.0028	0.0030	∞	0.0	0.0	∞	-0.0028	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0028	0.0000	-0.0028	0.0060
0	15	10.0	1003.6761	0.0050	∞	1003.6732	0.0059	72	-0.0028	0.0030	∞	0.0	0.0	∞	-0.0028	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0028	0.0000	-0.0028	0.0060
0	15	15.0	1005.9500	0.0151	∞	1005.9472	0.0154	3418	-0.0028	0.0030	∞	0.0	0.0	∞	-0.0028	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0028	0.0000	-0.0028	0.0060
0	15	20.0	1008.2003	0.0151	∞	1008.1975	0.0154	3448	-0.0028	0.0030	∞	0.0	0.0	∞	-0.0028	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0028	0.0000	-0.0028	0.0060
0	15	26.0	1010.8698	0.0152	∞	1010.8670	0.0155	3484	-0.0028	0.0030	∞	0.0	0.0	∞	-0.0028	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0028	0.0000	-0.0028	0.0060
0	15	33.0	1013.9426	0.0152	∞	1013.9398	0.0155	3525	-0.0028	0.0030	∞	0.0	0.0	∞	-0.0028	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0028	0.0000	-0.0028	0.0061
0	15	41.5	1017.6149	0.0153	∞	1017.6121	0.0156	3573	-0.0028	0.0030	∞	0.0	0.0	∞	-0.0028	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0028	0.0000	-0.0028	0.0061
0	15	52.0	1022.0644	0.0153	∞	1022.0615	0.0156	3630	-0.0028	0.0031	∞	0.0	0.0	∞	-0.0028	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0028	0.0000	-0.0028	0.0061
0	15	65.0	1027.4442	0.0154	∞	1027.4414	0.0157	3692	-0.0028	0.0031	∞	0.0	0.0	∞	-0.0028	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0028	0.0000	-0.0028	0.0062
0	20	5.0	1000.4396	0.0050	∞	1000.4372	0.0058	71	-0.0024	0.0030	∞	0.0	0.0	∞	-0.0024	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0024	0.0000	-0.0024	0.0060
0	20	10.0	1002.6946	0.0050	∞	1002.6922	0.0058	71	-0.0024	0.0030	∞	0.0	0.0	∞	-0.0024	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0024	0.0000	-0.0024	0.0060
0	20	15.0	1004.9262	0.0151	∞	1004.9238	0.0154	3417	-0.0024	0.0031	∞	0.0	0.0	∞	-0.0024	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0024	0.0000	-0.0024	0.0062
0	20	20.0	1007.1348	0.0151	∞	1007.1323	0.0154	3446	-0.0024	0.0031	∞	0.0	0.0	∞	-0.0024	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0024	0.0000	-0.0024	0.0062
0	20	26.0	1009.7552	0.0151	∞	1009.7528	0.0155	3482	-0.0024	0.0031	∞	0.0	0.0	∞	-0.0024	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0024	0.0000	-0.0024	0.0062
0	20	33.0	1012.7721	0.0152	∞	1012.7696	0.0155	3523	-0.0024	0.0031	∞	0.0	0.0	∞	-0.0024	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0024	0.0000	-0.0024	0.0062
0	20	41.5	1016.3784	0.0152	∞	1016.3760	0.0156	3572	-0.0024	0.0031	∞	0.0	0.0	∞	-0.0024	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0024	0.0000	-0.0024	0.0063
0	20	52.0	1020.7493	0.0153	∞	1020.7469	0.0156	3629	-0.0024	0.0032	∞	0.0	0.0	∞	-0.0024	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0024	0.0000	-0.0024	0.0063
0	20	65.0	1026.0366	0.0154	∞	1026.0342	0.0157	3691	-0.0024	0.0032	∞	0.0	0.0	∞	-0.0024	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0024	0.0000	-0.0024	0.0064
0	25	5.0	999.2462	0.0050	∞	999.2441	0.0058	71	-0.0021	0.0030	∞	0.0	0.0	∞	-0.0021	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0021	0.0000	-0.0021	0.0061
0	25	10.0	1001.4670	0.0050	∞	1001.4649	0.0059	71	-0.0021	0.0030	∞	0.0	0.0	∞	-0.0021	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0021	0.0000	-0.0021	0.0061
0	25	15.0	1003.6648	0.0151	∞	1003.6627	0.0154	3418	-0.0021	0.0032	∞	0.0	0.0	∞	-0.0021	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0021	0.0000	-0.0021	0.0064
0	25	20.0	1005.8400	0.0151	∞	1005.8379	0.0154	3447	-0.0021	0.0032	∞	0.0	0.0	∞	-0.0021	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0021	0.0000	-0.0021	0.0064
0	25	26.0	1008.4210	0.0151	∞	1008.4190	0.0155	3483	-0.0021	0.0032	∞	0.0	0.0	∞	-0.0021	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0021	0.0000	-0.0021	0.0064
0	25	33.0	1011.3928	0.0152	∞	1011.3907	0.0155	3524	-0.0021	0.0032	∞	0.0	0.0	∞	-0.0021	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0021	0.0000	-0.0021	0.0064
0	25	41.5	1014.9457	0.0152	∞	1014.9437	0.0156	3573	-0.0021	0.0032	∞	0.0	0.0	∞	-0.0021	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0021	0.0000	-0.0021	0.0065
0	25	52.0	1019.2528	0.0153	∞	1019.2507	0.0156	3630	-0.0021	0.0033	∞	0.0	0.0	∞	-0.0021	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0021	0.0000	-0.0021	0.0065
0	25	65.0	1024.4644	0.0154	∞	1024.4623	0.0157	3692	-0.0021	0.0033	∞	0.0	0.0	∞	-0.0021	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0021	0.0000	-0.0021	0.0066
0	30	5.0	997.8217	0.0050	∞	997.8199	0.0058	71	-0.0018	0.0030	∞	0.0	0.0	∞	-0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0018	0.0000	-0.0018	0.0061
0	30	10.0	1000.0159	0.0050	∞	1000.0141	0.0059	72	-0.0018	0.0030	∞	0.0	0.0	∞	-0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0018	0.0000	-0.0018	0.0061
0	30	15.0	1002.1873	0.0150	∞	1002.1855	0.0154	3418	-0.0018	0.0033	∞	0.0	0.0	∞	-0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0018	0.0000	-0.0018	0.0066
0	30	20.0	1004.3364	0.0151	∞	1004.3346	0.0154	3448	-0.0018	0.0033	∞	0.0	0.0	∞	-0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0018	0.0000	-0.0018	0.0066
0	30	26.0	1006.8864	0.0151	∞	1006.8846	0.0155	3484	-0.0018	0.0033	∞	0.0	0.0	∞	-0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0018	0.0000	-0.0018	0.0066
0	30	33.0	1009.8225	0.0151	∞	1009.8208	0.0155	3525	-0.0018	0.0033	∞	0.0	0.0	∞	-0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0018	0.0000	-0.0018	0.0067
0	30	41.5	1013.3330	0.0152	∞	1013.3312	0.0156	3573	-0.0018	0.0033	∞	0.0	0.0	∞	-0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0018	0.0000	-0.0018	0.0067
0	30	52.0	1017.5889	0.0153	∞	1017.5872	0.0156	3630	-0.0018	0.0034	∞	0.0	0.0	∞	-0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0018	0.0000	-0.0018	0.0068
0	30	65.0	1022.7396	0.0153	∞	1022.7378	0.0157	3692	-0.0018	0.0034	∞	0.0	0.0	∞	-0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0018	0.0000	-0.0018	0.0068
0	35	5.0	996.1859	0.0050	∞	996.1844	0.0058	71	-0.0015	0.0031	∞	0.0	0.0	∞	-0.0015	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0015	0.0000	-0.0015	0.0061
0	35	10.0	998.3601	0.0050	∞	998.3586	0.0059	71	-0.0015	0.0031	∞	0.0	0.0	∞	-0.0015	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0015	0.0000	-0.0015	0.0061
0	35	15.0	1000.5116	0.0150	∞	1000.5100	0.0154	3418	-0.0015	0.0034	∞	0.0	0.0	∞	-0.0015	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0015	0.0000	-0.0015	0.0068
0	35	20.0	1002.6408	0.0150	∞	1002.6393	0.0154	3448	-0.0015	0.0034	∞	0.0	0.0	∞	-0.0015	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0015	0.0000	-0.0015	0.0068
0	35	26.0	1005.1671	0.0151	∞	1005.1656	0.0155	3483	-0.0015	0.0034	∞	0.0	0.0	∞	-0.0015	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0015	0.0000	-0.0015	0.0068
0	35	33.0	1008.0758	0.0151	∞	1008.0743	0.0155	3524	-0.0015	0.0034	∞	0.0	0.0	∞	-0.0015	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0015	0.0000	-0.0015	0.0069
0	35	41.5	1011.5534	0.0152	∞	1011.5519	0.0156	3573	-0.0015	0.0035	∞	0.0	0.0	∞	-0.0015	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0015	0.0000	-0.0015	0.0069
0	35	52.0	1015.7696	0.0152	∞	1015.7681	0.0156	3630	-0.0015	0.0035	∞	0.0	0.0	∞	-0.0015	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0015	0.0000	-0.0015	0.0070
0	35	65.0	1020.8723	0.0153	∞	1020.8708	0.0157	3692	-0.0015	0.0035	∞	0.0	0.0	∞	-0.0015	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0015	0.0000	-0.0015	0.0071

Salinity 5

Practical salinity	Temperature	Pressure	Water reference density			Seawater density			Relative seawater density			Silicate molality			Δρ-S-Relation										
															Air	Dataset			Relation				Air	Residua	Salt + Air	
S	T	p	$\rho_{H2O,0}$	u	ν_{eff}	ρ_{SW}	u	ν_{eff}	$\Delta\rho_{SW}$	u	ν_{eff}	b_0	u	ν_{eff}	$\Delta\rho_{SW,a}$	$\Delta\rho_{SW,0}$	$\Delta\rho_{SW,0}(p_0)$	$\Delta\Delta\rho_{SW,0}(p)$	$\Delta\rho_{SW,0}(p_0)$	$\Delta\Delta\rho_{SW,0}(p)$	$\Delta\rho_{SW,0}$	$\Delta\rho_{SW,a}$	A	$\Delta\rho_{SW}$	U
–	°C	MPa	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	µmol kg^{-1}	µmol kg^{-1}	–	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}
5	5	5.0	1002.3620	0.0050	∞	1006.3128	0.0061	82	3.9508	0.0034	8	2.4	0.2	∞	-0.0039	3.9547	3.9768	-0.0221	3.9757	-0.0219	3.9537	-0.0039	0.0009	3.9498	0.0060
5	5	10.0	1004.7801	0.0050	∞	1008.7083	0.0061	83	3.9282	0.0034	8	2.4	0.2	∞	-0.0039	3.9322	3.9768	-0.0447	3.9757	-0.0438	3.9319	-0.0039	0.0003	3.9279	0.0060
5	5	15.0	1007.1716	0.0151	∞	1011.0785	0.0155	3485	3.9070	0.0034	8	2.4	0.2	∞	-0.0039	3.9109	3.9768	-0.0659	3.9757	-0.0651	3.9105	-0.0039	0.0004	3.9066	0.0060
5	5	20.0	1009.5367	0.0151	∞	1013.4235	0.0155	3514	3.8867	0.0034	8	2.4	0.2	∞	-0.0039	3.8907	3.9768	-0.0861	3.9757	-0.0860	3.8897	-0.0039	0.0010	3.8858	0.0060
5	5	26.0	1012.3408	0.0152	∞	1016.2030	0.0156	3545	3.8622	0.0034	8	2.4	0.2	∞	-0.0039	3.8661	3.9768	-0.1107	3.9757	-0.1103	3.8654	-0.0039	0.0008	3.8614	0.0060
5	5	33.0	1015.5660	0.0152	∞	1019.4005	0.0156	3572	3.8346	0.0034	8	2.4	0.2	∞	-0.0039	3.8385	3.9768	-0.1383	3.9757	-0.1378	3.8379	-0.0039	0.0006	3.8339	0.0060
5	5	41.5	1019.4167	0.0153	∞	1023.2171	0.0157	3583	3.8004	0.0034	8	2.4	0.2	∞	-0.0039	3.8044	3.9768	-0.1724	3.9757	-0.1699	3.8057	-0.0039	-0.0013	3.8018	0.0060
5	5	52.0	1024.0766	0.0154	∞	1027.8407	0.0158	3547	3.7641	0.0035	8	2.4	0.2	∞	-0.0039	3.7680	3.9768	-0.2088	3.9757	-0.2078	3.7679	-0.0039	0.0002	3.7639	0.0060
5	5	65.0	1029.7021	0.0154	∞	1033.4214	0.0159	3402	3.7193	0.0036	9	2.4	0.2	∞	-0.0039	3.7232	3.9768	-0.2536	3.9757	-0.2522	3.7234	-0.0039	-0.0002	3.7195	0.0060
5	10	5.0	1002.0313	0.0050	∞	1005.9137	0.0061	83	3.8824	0.0034	8	2.4	0.2	∞	-0.0033	3.8857	3.9034	-0.0177	3.9043	-0.0196	3.8847	-0.0033	0.0010	3.8814	0.0060
5	10	10.0	1004.3831	0.0050	∞	1008.2449	0.0061	83	3.8619	0.0034	8	2.4	0.2	∞	-0.0033	3.8652	3.9034	-0.0382	3.9043	-0.0392	3.8652	-0.0033	0.0000	3.8618	0.0060
5	10	15.0	1006.7096	0.0151	∞	1010.5503	0.0155	3485	3.8407	0.0034	8	2.4	0.2	∞	-0.0033	3.8440	3.9034	-0.0594	3.9043	-0.0583	3.8461	-0.0033	-0.0020	3.8427	0.0060
5	10	20.0	1009.0115	0.0151	∞	1012.8341	0.0155	3515	3.8227	0.0034	8	2.4	0.2	∞	-0.0033	3.8260	3.9034	-0.0774	3.9043	-0.0769	3.8274	-0.0033	-0.0014	3.8241	0.0060
5	10	26.0	1011.7415	0.0152	∞	1015.5455	0.0156	3546	3.8040	0.0034	8	2.4	0.2	∞	-0.0033	3.8073	3.9034	-0.0961	3.9043	-0.0987	3.8056	-0.0033	0.0017	3.8023	0.0060
5	10	33.0	1014.8829	0.0152	∞	1018.6629	0.0156	3573	3.7799	0.0034	8	2.4	0.2	∞	-0.0033	3.7833	3.9034	-0.1202	3.9043	-0.1233	3.7810	-0.0033	0.0023	3.7776	0.0060
5	10	41.5	1018.6358	0.0153	∞	1022.3883	0.0157	3584	3.7525	0.0035	9	2.4	0.2	∞	-0.0033	3.7558	3.9034	-0.1476	3.9043	-0.1521	3.7522	-0.0033	0.0036	3.7488	0.0060
5	10	52.0	1023.1806	0.0153	∞	1026.8973	0.0158	3548	3.7167	0.0035	9	2.4	0.2	∞	-0.0033	3.7200	3.9034	-0.1834	3.9043	-0.1862	3.7182	-0.0033	0.0019	3.7148	0.0060
5	10	65.0	1028.6722	0.0154	∞	1032.3505	0.0159	3402	3.6783	0.0036	9	2.4	0.2	∞	-0.0033	3.6816	3.9034	-0.2218	3.9043	-0.2261	3.6782	-0.0033	0.0034	3.6749	0.0060
5	15	5.0	1001.3779	0.0050	∞	1005.2037	0.0061	82	3.8257	0.0034	8	2.4	0.2	∞	-0.0028	3.8286	3.8472	-0.0186	3.8463	-0.0178	3.8285	-0.0028	0.0001	3.8257	0.0060
5	15	10.0	1003.6761	0.0050	∞	1007.4840	0.0061	83	3.8079	0.0034	8	2.4	0.2	∞	-0.0028	3.8108	3.8472	-0.0364	3.8463	-0.0355	3.8108	-0.0028	0.0000	3.8079	0.0060
5	15	15.0	1005.9500	0.0151	∞	1009.7401	0.0155	3485	3.7900	0.0034	9	2.4	0.2	∞	-0.0028	3.7929	3.8472	-0.0543	3.8463	-0.0529	3.7935	-0.0028	-0.0006	3.7906	0.0060
5	15	20.0	1008.2003	0.0151	∞	1011.9723	0.0155	3514	3.7719	0.0035	9	2.4	0.2	∞	-0.0028	3.7748	3.8472	-0.0724	3.8463	-0.0698	3.7765	-0.0028	-0.0017	3.7737	0.0060
5	15	26.0	1010.8698	0.0152	∞	1014.6225	0.0156	3545	3.7527	0.0035	9	2.4	0.2	∞	-0.0028	3.7555	3.8472	-0.0917	3.8463	-0.0896	3.7567	-0.0028	-0.0012	3.7539	0.0060
5	15	33.0	1013.9426	0.0152	∞	1017.6722	0.0156	3572	3.7295	0.0035	9	2.4	0.2	∞	-0.0028	3.7324	3.8472	-0.1148	3.8463	-0.1119	3.7344	-0.0028	-0.0020	3.7315	0.0060
5	15	41.5	1017.6149	0.0153	∞	1021.3179	0.0157	3583	3.7030	0.0035	9	2.4	0.2	∞	-0.0028	3.7058	3.8472	-0.1414	3.8463	-0.1381	3.7082	-0.0028	-0.0024	3.7054	0.0060
5	15	52.0	1022.0644	0.0153	∞	1025.7346	0.0158	3547	3.6703	0.0036	10	2.4	0.2	∞	-0.0028	3.6731	3.8472	-0.1741	3.8463	-0.1690	3.6773	-0.0028	-0.0042	3.6745	0.0060
5	15	65.0	1027.4442	0.0154	∞	1031.0796	0.0159	3402	3.6354	0.0037	10	2.4	0.2	∞	-0.0028	3.6382	3.8472	-0.2089	3.8463	-0.2053	3.6410	-0.0028	-0.0028	3.6381	0.0060
5	20	5.0	1000.4396	0.0050	∞	1004.2200	0.0061	82	3.7804	0.0034	8	2.4	0.2	∞	-0.0024	3.7828	3.7975	-0.0147	3.7989	-0.0164	3.7826	-0.0024	0.0003	3.7801	0.0060
5	20	10.0	1002.6946	0.0050	∞	1006.4570	0.0061	83	3.7623	0.0034	8	2.4	0.2	∞	-0.0024	3.7648	3.7975	-0.0327	3.7989	-0.0327	3.7662	-0.0024	-0.0015	3.7638	0.0060
5	20	15.0	1004.9262	0.0151	∞	1008.6719	0.0155	3484	3.7457	0.0035	9	2.4	0.2	∞	-0.0024	3.7481	3.7975	-0.0494	3.7989	-0.0486	3.7503	-0.0024	-0.0022	3.7479	0.0060
5	20	20.0	1007.1348	0.0151	∞	1010.8648	0.0155	3513	3.7300	0.0035	9	2.4	0.2	∞	-0.0024	3.7324	3.7975	-0.0651	3.7989	-0.0642	3.7347	-0.0024	-0.0023	3.7323	0.0060
5	20	26.0	1009.7552	0.0151	∞	1013.4648	0.0156	3544	3.7096	0.0035	10	2.4	0.2	∞	-0.0024	3.7120	3.7975	-0.0855	3.7989	-0.0824	3.7165	-0.0024	-0.0045	3.7141	0.0060
5	20	33.0	1012.7721	0.0152	∞	1016.4647	0.0156	3571	3.6926	0.0036	10	2.4	0.2	∞	-0.0024	3.6951	3.7975	-0.1024	3.7989	-0.1030	3.6960	-0.0024	-0.0009	3.6935	0.0060
5	20	41.5	1016.3784	0.0152	∞	1020.0465	0.0157	3582	3.6681	0.0036	10	2.4	0.2	∞	-0.0024	3.6706	3.7975	-0.1269	3.7989	-0.1270	3.6719	-0.0024	-0.0014	3.6695	0.0060
5	20	52.0	1020.7493	0.0153	∞	1024.3878	0.0157	3546	3.6385	0.0037	11	2.4	0.2	∞	-0.0024	3.6409	3.7975	-0.1566	3.7989	-0.1554	3.6435	-0.0024	-0.0026	3.6411	0.0060
5	20	65.0	1026.0366	0.0154	∞	1029.6392	0.0158	3401	3.6026	0.0038	11	2.4	0.2	∞	-0.0024	3.6050	3.7975	-0.1925	3.7989	-0.1888	3.6101	-0.0024	-0.0051	3.6077	0.0060
5	25	5.0	999.2462	0.0050	∞	1002.9904	0.0061	82	3.7442	0.0034	9	2.4	0.2	∞	-0.0021	3.7463	3.7618	-0.0155	3.7602	-0.0153	3.7449	-0.0021	0.0015	3.7428	0.0060
5	25	10.0	1001.4670	0.0050	∞	1005.1969	0.0061	83	3.7300	0.0035	9	2.4	0.2	∞	-0.0021	3.7320	3.7618	-0.0298	3.7602	-0.0305	3.7296	-0.0021	0.0024	3.7276	0.0060
5	25	15.0	1003.6648	0.0151	∞	1007.3800	0.0155	3485	3.7153	0.0036	10	2.4	0.2	∞	-0.0021	3.7174	3.7618	-0.0445	3.7602	-0.0454	3.7148	-0.0021	0.0026	3.7127	0.0060
5	25	20.0	1005.8400	0.0151	∞	1009.5412	0.0155	3514	3.7012	0.0036	10	2.4	0.2	∞	-0.0021	3.7033	3.7618	-0.0585	3.7602	-0.0599	3.7003	-0.0021	0.0030	3.6982	0.0060
5	25	26.0	1008.4210	0.0151	∞	1012.1051	0.0156	3545	3.6840	0.0036	11	2.4	0.2	∞	-0.0021	3.6861	3.7618	-0.0757	3.7602	-0.0768	3.6833	-0.0021	0.0028	3.6812	0.0060
5	25	33.0	1011.3928	0.0152	∞	1015.0581	0.0156	3572	3.6653	0.0037	11	2.4	0.2	∞	-0.0021	3.6674	3.7618	-0.0945	3.7602	-0.0960	3.6642	-0.0021	0.0032	3.6621	0.0060
5	25	41.5	1014.9457	0.0152	∞	1018.5884	0.0157	3583	3.6426	0.0037	11	2.4	0.2	∞	-0.0021	3.6447	3.7618	-0.1171	3.7602	-0.1183	3.6418	-0.0021	0.0029	3.6398	0.0060
5	25	52.0	1019.2528	0.0153	∞	1022.8694	0.0158	3547	3.6167	0.0038	12	2.4	0.2	∞	-0.0021	3.6188	3.7618	-0.1431	3.7602	-0.1447	3.6154	-0.0021	0.0033	3.6133	0.0060
5	25	65.0	1024.4644	0.0154	∞	1028.0489	0.0159	3402	3.5845	0.0039	12	2.4	0.2	∞	-0.0021	3.5866	3.7618	-0.1752	3.7602	-0.1757	3.5844	-0.0021	0.0022	3.5823	0.0060
5	30	5.0	997.8217	0.0050	∞	1001.5320	0.0061	82	3.7103	0.0035	9	2.4	0.2	∞	-0.0018	3.7121	3.7267	-0.0146	3.7285	-0.0145	3.7140	-0.0018	-0.0020	3.7123	0.0060
5	30	10.0	1000.0159	0.0050	∞	1003.7128	0.0061	83	3.6969	0.0035	9	2.4	0.2	∞	-0.0018	3.6987	3.7267	-0.0280	3.7285	-0.0288	3.6996	-0.0018	-0.0010	3.6979	0.0060
5	30	15.0	1002.1873	0.0150	∞	1005.8700	0.0155	3485	3.6827	0.0037	11	2.4	0.2	∞	-0.0018	3.6845	3.7267	-0.0422	3.7285	-0.0429	3.6856	-0.0018	-0.0011	3.6838	0.0060
5	30	20.0	1004.3364	0.0151	∞	1008.0061	0.0155	3514	3.6698	0.0037	11	2.4	0.2	∞	-0.0018	3.6715	3.7267	-0.0552	3.7285	-0.0566	3.6719	-0.0018	-0.0004	3.6701	0.0060
5	30	26.0	1006.8864	0.0151	∞	1010.5402	0.0156	3545	3.6538	0.0037	12	2.4	0.2	∞	-0.0018	3.6555	3.7267	-0.0712	3.7285	-0.0725	3.6560	-0.0018	-0.0004	3.6542	0.0060
5	30	33.0	1009.8225	0.0151	∞	1013.4585	0.0156	3572	3.6359	0.0038	12	2.4	0.2	∞	-0.0018	3.6377	3.7267	-0.0890	3.7285	-0.0905	3.6380	-0.0018	-0.0003	3.6362	0.0060
5	30	41.5	1013.3330	0.0152	∞	1016.9486	0.0157	3583	3.6156	0.0038	13	2.4	0.2	∞	-0.0018	3.6174	3.7267	-0.1093	3.7285	-0.1115	3.6170	-0.0018	0.0004	3.6152	0.0060
5	30	52.0	1017.5889	0.0153	∞	1021.1799	0.0158	3547	3.5910	0.0039	13	2.4	0.2	∞	-0.0018	3.5928	3.7267	-0.1340	3.7285	-0.1363	3.5922	-0.0018	0.0006	3.5904	0.0060
5	30	65.0	1022.7396	0.0153	∞	1026.3010	0.0159	3402	3.5614	0.0040	14	2.4	0.2	∞	-0.0018	3.5632	3.7267	-0.1635	3.7285	-0.1653	3.5631	-0.0018	0.0001	3.5614	0.0060
5	35	5.0	996.1859	0.0050	∞	999.8718	0.0061	82	3.6858	0.0035	9	2.4	0.2	∞	-0.0015	3.6874	3.7037	-0.0163	3.7028	-0.0138	3.6890	-0.0015	-0.0016	3.6874	0.0060
5	35	10.0	998.3601	0.0050	∞	1002.0320	0.0061	83	3.6719	0.0035	9	2.4	0.2	∞	-0.0015	3.6734	3.7037	-0.0302	3.7028	-0.0276	3.6752	-0.0015	-0.0018	3.6737	0.0060
5	35	15.0	1000.5116	0.0150	∞	1004.1716	0.0155	3485	3.6601	0.0038	12	2.4	0.2	∞	-0.0015	3.6616	3.7037	-0.0421	3.7028	-0.0410	3.6618	-0.0015	-0.0002	3.6603	0.0060
5	35	20.0	1002.6408	0.0150	∞	1006.2885	0.0155	3514	3.6478	0.0038	13	2.4	0.2	∞	-0.0015	3.6493	3.7037	-0.0544	3.7028	-0.0540	3.6488	-0.0015	0.0005	3.6473	0.0060
5	35	26.0	1005.1671	0.0151	∞	1008.7971	0.0156	3545	3.6300	0.0038	13	2.4	0.2	∞	-0.0015	3.6315	3.7037	-0.0722	3.7028	-0.0692	3.6336	-0.0015	-0.0021	3.6321	0.0060
5	35	33.0	1008.0758	0.0151	∞	1011.6882	0.0156	3572	3.6124	0.0039	13	2.4	0.2	∞	-0.0015	3.6139	3.7037	-0.0897	3.7028	-0.0863	3.6165	-0.0015	-0.0025	3.6150	0.0060
5	35	41.5	1011.5534	0.0152	∞	1015.1471	0.0157	3583	3.5937	0.0039	14	2.4	0.2	∞	-0.0015	3.5952	3.7037	-0.1084	3.7028	-0.1063	3.5965	-0.0015	-0.0013	3.5950	0.0060
5	35	52.0	1015.7696	0.0152	∞	1019.3401	0.0158	3547	3.5705	0.0040	15	2.4	0.2	∞	-0.0015	3.5720	3.7037	-0.1316	3.7028	-0.1298	3.5730	-0.0015	-0.0010	3.5715	0.0060
5	35	65.0	1020.8723	0.0153	∞	1024.4154	0.0159	3402	3.5431	0.0041	15	2.4	0.2	∞	-0.0015	3.5446	3.7037	-0.1590	3.7028	-0.1572	3.5456	-0.0015	-0.0009	3.5441	0.0060

Salinity 10

Practical salinity	Temperature	Pressure	Water reference density			Seawater density			Relative seawater density			Silicate molality			Δρ-S-Relation										
															Air	Dataset			Relation			Air	Residua	Salt + Air	
S	T	p	$\rho_{H2O,0}$	u	ν_{eff}	ρ_{SW}	u	ν_{eff}	$\Delta\rho_{SW}$	u	ν_{eff}	b_0	u	ν_{eff}	$\Delta\rho_{SW,a}$	$\Delta\rho_{SW,0}$	$\Delta\rho_{SW,0}(p_0)$	$\Delta\Delta\rho_{SW,0}(p)$	$\Delta\rho_{SW,0}(p_0)$	$\Delta\Delta\rho_{SW,0}(p)$	$\Delta\rho_{SW,0}$	$\Delta\rho_{SW,a}$	A	$\Delta\rho_{SW}$	U
–	°C	MPa	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	µmol kg^{-1}	µmol kg^{-1}	–	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}
10	5	5.0	1002.3620	0.0050	∞	1010.2474	0.0063	94	7.8854	0.0038	12	4.7	0.5	∞	-0.0039	7.8893	7.9317	-0.0424	7.9320	-0.0425	7.8895	-0.0039	-0.0002	7.8855	0.0060
10	5	10.0	1004.7801	0.0050	∞	1012.6235	0.0063	95	7.8433	0.0038	13	4.7	0.5	∞	-0.0039	7.8473	7.9317	-0.0845	7.9320	-0.0850	7.8470	-0.0039	0.0003	7.8430	0.0060
10	5	15.0	1007.1716	0.0151	∞	1014.9743	0.0156	3531	7.8028	0.0037	12	4.7	0.5	∞	-0.0039	7.8067	7.9317	-0.1250	7.9320	-0.1266	7.8054	-0.0039	0.0013	7.8014	0.0060
10	5	20.0	1009.5367	0.0151	∞	1017.2931	0.0156	3551	7.7564	0.0038	12	4.7	0.5	∞	-0.0039	7.7603	7.9317	-0.1714	7.9320	-0.1673	7.7647	-0.0039	-0.0044	7.7608	0.0060
10	5	26.0	1012.3408	0.0152	∞	1020.0497	0.0157	3554	7.7089	0.0038	12	4.7	0.5	∞	-0.0039	7.7128	7.9317	-0.2189	7.9320	-0.2149	7.7171	-0.0039	-0.0043	7.7132	0.0060
10	5	33.0	1015.5660	0.0152	∞	1023.2246	0.0157	3511	7.6587	0.0038	13	4.7	0.5	∞	-0.0039	7.6626	7.9317	-0.2691	7.9320	-0.2687	7.6633	-0.0039	-0.0007	7.6594	0.0060
10	5	41.5	1019.4167	0.0153	∞	1027.0152	0.0158	3363	7.5985	0.0039	13	4.7	0.5	∞	-0.0039	7.6025	7.9317	-0.3293	7.9320	-0.3317	7.6003	-0.0039	0.0022	7.5964	0.0060
10	5	52.0	1024.0766	0.0154	∞	1031.5987	0.0159	3020	7.5221	0.0040	13	4.7	0.5	∞	-0.0039	7.5261	7.9317	-0.4057	7.9320	-0.4061	7.5259	-0.0039	0.0002	7.5219	0.0060
10	5	65.0	1029.7021	0.0154	∞	1037.1353	0.0160	2421	7.4332	0.0042	12	4.7	0.5	∞	-0.0039	7.4371	7.9317	-0.4946	7.9320	-0.4935	7.4385	-0.0039	-0.0014	7.4346	0.0060
10	10	5.0	1002.0313	0.0050	∞	1009.7811	0.0063	94	7.7497	0.0038	12	4.7	0.5	∞	-0.0033	7.7531	7.7908	-0.0377	7.7914	-0.0379	7.7535	-0.0033	-0.0004	7.7502	0.0060
10	10	10.0	1004.3831	0.0050	∞	1012.0944	0.0063	95	7.7114	0.0038	13	4.7	0.5	∞	-0.0033	7.7147	7.7908	-0.0761	7.7914	-0.0759	7.7156	-0.0033	-0.0008	7.7122	0.0060
10	10	15.0	1006.7096	0.0151	∞	1014.3846	0.0156	3531	7.6750	0.0038	12	4.7	0.5	∞	-0.0033	7.6783	7.7908	-0.1125	7.7914	-0.1130	7.6784	-0.0033	-0.0001	7.6751	0.0060
10	10	20.0	1009.0115	0.0151	∞	1016.6506	0.0156	3551	7.6392	0.0038	12	4.7	0.5	∞	-0.0033	7.6425	7.7908	-0.1483	7.7914	-0.1494	7.6421	-0.0033	0.0004	7.6387	0.0060
10	10	26.0	1011.7415	0.0152	∞	1019.3371	0.0157	3554	7.5956	0.0038	13	4.7	0.5	∞	-0.0033	7.5990	7.7908	-0.1918	7.7914	-0.1919	7.5995	-0.0033	-0.0005	7.5962	0.0060
10	10	33.0	1014.8829	0.0152	∞	1022.4300	0.0157	3511	7.5471	0.0039	13	4.7	0.5	∞	-0.0033	7.5504	7.7908	-0.2404	7.7914	-0.2401	7.5513	-0.0033	-0.0009	7.5480	0.0060
10	10	41.5	1018.6358	0.0153	∞	1026.1268	0.0158	3363	7.4910	0.0040	13	4.7	0.5	∞	-0.0033	7.4943	7.7908	-0.2965	7.7914	-0.2966	7.4948	-0.0033	-0.0005	7.4915	0.0060
10	10	52.0	1023.1806	0.0153	∞	1030.6039	0.0159	3020	7.4232	0.0041	13	4.7	0.5	∞	-0.0033	7.4266	7.7908	-0.3642	7.7914	-0.3635	7.4280	-0.0033	-0.0014	7.4246	0.0060
10	10	65.0	1028.6722	0.0154	∞	1036.0163	0.0160	2420	7.3441	0.0043	12	4.7	0.5	∞	-0.0033	7.3474	7.7908	-0.4434	7.7914	-0.4421	7.3493	-0.0033	-0.0019	7.3460	0.0060
10	15	5.0	1001.3779	0.0050	∞	1009.0179	0.0063	94	7.6399	0.0038	12	4.7	0.5	∞	-0.0028	7.6428	7.6766	-0.0338	7.6764	-0.0343	7.6421	-0.0028	0.0007	7.6393	0.0060
10	15	10.0	1003.6761	0.0050	∞	1011.2821	0.0063	95	7.6060	0.0038	13	4.7	0.5	∞	-0.0028	7.6089	7.6766	-0.0677	7.6764	-0.0687	7.6078	-0.0028	0.0011	7.6049	0.0060
10	15	15.0	1005.9500	0.0151	∞	1013.5235	0.0156	3532	7.5734	0.0038	13	4.7	0.5	∞	-0.0028	7.5763	7.6766	-0.1003	7.6764	-0.1023	7.5741	-0.0028	0.0022	7.5713	0.0060
10	15	20.0	1008.2003	0.0151	∞	1015.7429	0.0156	3552	7.5425	0.0038	13	4.7	0.5	∞	-0.0028	7.5454	7.6766	-0.1312	7.6764	-0.1352	7.5412	-0.0028	0.0042	7.5383	0.0060
10	15	26.0	1010.8698	0.0152	∞	1018.3723	0.0157	3554	7.5025	0.0039	14	4.7	0.5	∞	-0.0028	7.5053	7.6766	-0.1713	7.6764	-0.1738	7.5026	-0.0028	0.0027	7.4997	0.0060
10	15	33.0	1013.9426	0.0152	∞	1021.4012	0.0157	3511	7.4585	0.0039	14	4.7	0.5	∞	-0.0028	7.4614	7.6766	-0.2152	7.6764	-0.2176	7.4589	-0.0028	0.0025	7.4560	0.0060
10	15	41.5	1017.6149	0.0153	∞	1025.0232	0.0158	3364	7.4083	0.0040	14	4.7	0.5	∞	-0.0028	7.4111	7.6766	-0.2654	7.6764	-0.2689	7.4076	-0.0028	0.0036	7.4047	0.0060
10	15	52.0	1022.0644	0.0153	∞	1029.4115	0.0159	3020	7.3471	0.0042	14	4.7	0.5	∞	-0.0028	7.3500	7.6766	-0.3266	7.6764	-0.3297	7.3467	-0.0028	0.0032	7.3439	0.0060
10	15	65.0	1027.4442	0.0154	∞	1034.7210	0.0160	2421	7.2768	0.0043	13	4.7	0.5	∞	-0.0028	7.2796	7.6766	-0.3970	7.6764	-0.4013	7.2751	-0.0028	0.0045	7.2722	0.0060
10	20	5.0	1000.4396	0.0050	∞	1007.9877	0.0063	94	7.5481	0.0038	12	4.7	0.5	∞	-0.0024	7.5505	7.5809	-0.0304	7.5819	-0.0315	7.5504	-0.0024	0.0002	7.5479	0.0060
10	20	10.0	1002.6946	0.0050	∞	1010.2082	0.0063	95	7.5135	0.0038	13	4.7	0.5	∞	-0.0024	7.5160	7.5809	-0.0649	7.5819	-0.0630	7.5188	-0.0024	-0.0028	7.5164	0.0060
10	20	15.0	1004.9262	0.0151	∞	1012.4089	0.0156	3531	7.4827	0.0039	14	4.7	0.5	∞	-0.0024	7.4851	7.5809	-0.0958	7.5819	-0.0939	7.4879	-0.0024	-0.0028	7.4855	0.0060
10	20	20.0	1007.1348	0.0151	∞	1014.5896	0.0156	3550	7.4548	0.0039	14	4.7	0.5	∞	-0.0024	7.4573	7.5809	-0.1236	7.5819	-0.1242	7.4577	-0.0024	-0.0004	7.4553	0.0060
10	20	26.0	1009.7552	0.0151	∞	1017.1732	0.0157	3553	7.4180	0.0039	14	4.7	0.5	∞	-0.0024	7.4204	7.5809	-0.1605	7.5819	-0.1596	7.4223	-0.0024	-0.0018	7.4198	0.0060
10	20	33.0	1012.7721	0.0152	∞	1020.1502	0.0157	3510	7.3782	0.0040	15	4.7	0.5	∞	-0.0024	7.3806	7.5809	-0.2003	7.5819	-0.1998	7.3821	-0.0024	-0.0015	7.3796	0.0060
10	20	41.5	1016.3784	0.0152	∞	1023.7090	0.0158	3362	7.3307	0.0041	15	4.7	0.5	∞	-0.0024	7.3331	7.5809	-0.2478	7.5819	-0.2470	7.3349	-0.0024	-0.0018	7.3325	0.0060
10	20	52.0	1020.7493	0.0153	∞	1028.0255	0.0159	3019	7.2762	0.0042	15	4.7	0.5	∞	-0.0024	7.2786	7.5809	-0.3023	7.5819	-0.3029	7.2789	-0.0024	-0.0003	7.2765	0.0060
10	20	65.0	1026.0366	0.0154	∞	1033.2471	0.0160	2420	7.2105	0.0044	14	4.7	0.5	∞	-0.0024	7.2129	7.5809	-0.3680	7.5819	-0.3689	7.2129	-0.0024	0.0000	7.2105	0.0060
10	25	5.0	999.2462	0.0050	∞	1006.7199	0.0063	94	7.4737	0.0038	13	4.7	0.5	∞	-0.0021	7.4758	7.5039	-0.0281	7.5039	-0.0293	7.4746	-0.0021	0.0012	7.4725	0.0060
10	25	10.0	1001.4670	0.0050	∞	1008.9113	0.0063	95	7.4443	0.0038	13	4.7	0.5	∞	-0.0021	7.4464	7.5039	-0.0575	7.5039	-0.0586	7.4453	-0.0021	0.0011	7.4432	0.0060
10	25	15.0	1003.6648	0.0151	∞	1011.0797	0.0156	3532	7.4150	0.0040	15	4.7	0.5	∞	-0.0021	7.4171	7.5039	-0.0868	7.5039	-0.0874	7.4165	-0.0021	0.0005	7.4145	0.0060
10	25	20.0	1005.8400	0.0151	∞	1013.2283	0.0156	3552	7.3883	0.0040	15	4.7	0.5	∞	-0.0021	7.3904	7.5039	-0.1135	7.5039	-0.1155	7.3884	-0.0021	0.0020	7.3863	0.0060
10	25	26.0	1008.4210	0.0151	∞	1015.7766	0.0157	3554	7.3555	0.0040	16	4.7	0.5	∞	-0.0021	7.3576	7.5039	-0.1463	7.5039	-0.1485	7.3555	-0.0021	0.0021	7.3534	0.0060
10	25	33.0	1011.3928	0.0152	∞	1018.7109	0.0157	3511	7.3181	0.0041	16	4.7	0.5	∞	-0.0021	7.3202	7.5039	-0.1837	7.5039	-0.1858	7.3181	-0.0021	0.0021	7.3160	0.0060
10	25	41.5	1014.9457	0.0152	∞	1022.2213	0.0158	3363	7.2756	0.0042	16	4.7	0.5	∞	-0.0021	7.2777	7.5039	-0.2262	7.5039	-0.2297	7.2742	-0.0021	0.0034	7.2722	0.0060
10	25	52.0	1019.2528	0.0153	∞	1026.4759	0.0159	3020	7.2232	0.0043	16	4.7	0.5	∞	-0.0021	7.2253	7.5039	-0.2786	7.5039	-0.2817	7.2222	-0.0021	0.0031	7.2201	0.0060
10	25	65.0	1024.4644	0.0154	∞	1031.6257	0.0160	2421	7.1614	0.0045	15	4.7	0.5	∞	-0.0021	7.1634	7.5039	-0.3404	7.5039	-0.3431	7.1608	-0.0021	0.0027	7.1587	0.0060
10	30	5.0	997.8217	0.0050	∞	1005.2325	0.0063	94	7.4108	0.0038	13	4.7	0.5	∞	-0.0018	7.4126	7.4399	-0.0273	7.4398	-0.0276	7.4121	-0.0018	0.0005	7.4104	0.0060
10	30	10.0	1000.0159	0.0050	∞	1007.3985	0.0063	95	7.3826	0.0038	13	4.7	0.5	∞	-0.0018	7.3844	7.4399	-0.0555	7.4398	-0.0553	7.3845	-0.0018	-0.0002	7.3827	0.0060
10	30	15.0	1002.1873	0.0150	∞	1009.5441	0.0156	3532	7.3568	0.0040	16	4.7	0.5	∞	-0.0018	7.3586	7.4399	-0.0813	7.4398	-0.0823	7.3575	-0.0018	0.0011	7.3557	0.0060
10	30	20.0	1004.3364	0.0151	∞	1011.6663	0.0156	3551	7.3299	0.0041	16	4.7	0.5	∞	-0.0018	7.3317	7.4399	-0.1082	7.4398	-0.1087	7.3310	-0.0018	0.0006	7.3292	0.0060
10	30	26.0	1006.8864	0.0151	∞	1014.1843	0.0157	3554	7.2979	0.0041	17	4.7	0.5	∞	-0.0018	7.2997	7.4399	-0.1402	7.4398	-0.1397	7.3000	-0.0018	-0.0004	7.2982	0.0060
10	30	33.0	1009.8225	0.0151	∞	1017.0869	0.0157	3511	7.2644	0.0042	17	4.7	0.5	∞	-0.0018	7.2662	7.4399	-0.1737	7.4398	-0.1748	7.2649	-0.0018	0.0012	7.2631	0.0060
10	30	41.5	1013.3330	0.0152	∞	1020.5556	0.0158	3363	7.2226	0.0043	18	4.7	0.5	∞	-0.0018	7.2244	7.4399	-0.2155	7.4398	-0.2160	7.2237	-0.0018	0.0007	7.2219	0.0060
10	30	52.0	1017.5889	0.0153	∞	1024.7636	0.0159	3020	7.1746	0.0044	18	4.7	0.5	∞	-0.0018	7.1764	7.4399	-0.2635	7.4398	-0.2649	7.1749	-0.0018	0.0016	7.1731	0.0060
10	30	65.0	1022.7396	0.0153	∞	1029.8560	0.0160	2421	7.1164	0.0046	16	4.7	0.5	∞	-0.0018	7.1182	7.4399	-0.3217	7.4398	-0.3226	7.1172	-0.0018	0.0010	7.1154	0.0060
10	35	5.0	996.1859	0.0050	∞	1003.5426	0.0063	94	7.3567	0.0038	13	4.7	0.5	∞	-0.0015	7.3582	7.3861	-0.0278	7.3873	-0.0263	7.3610	-0.0015	-0.0027	7.3594	0.0060
10	35	10.0	998.3601	0.0050	∞	1005.6919	0.0063	95	7.3318	0.0038	13	4.7	0.5	∞	-0.0015	7.3334	7.3861	-0.0527	7.3873	-0.0526	7.3347	-0.0015	-0.0013	7.3331	0.0060
10	35	15.0	1000.5116	0.0150	∞	1007.8178	0.0156	3532	7.3063	0.0041	18	4.7	0.5	∞	-0.0015	7.3078	7.3861	-0.0783	7.3873	-0.0784	7.3089	-0.0015	-0.0011	7.3074	0.0060
10	35	20.0	1002.6408	0.0150	∞	1009.9223	0.0156	3551	7.2815	0.0042	18	4.7	0.5	∞	-0.0015	7.2831	7.3861	-0.1030	7.3873	-0.1035	7.2838	-0.0015	-0.0007	7.2823	0.0060
10	35	26.0	1005.1671	0.0151	∞	1012.4167	0.0157	3554	7.2496	0.0042	19	4.7	0.5	∞	-0.0015	7.2511	7.3861	-0.1350	7.3873	-0.1329	7.2544	-0.0015	-0.0033	7.2528	0.0060
10	35	33.0	1008.0758	0.0151	∞	1015.2938	0.0157	3511	7.2179	0.0043	19	4.7	0.5	∞	-0.0015	7.2194	7.3861	-0.1666	7.3873	-0.1663	7.2210	-0.0015	-0.0016	7.2195	0.0060
10	35	41.5	1011.5534	0.0152	∞	1018.7318	0.0158	3363	7.1783	0.0044	20	4.7	0.5	∞	-0.0015	7.1799	7.3861	-0.2062	7.3873	-0.2053	7.1820	-0.0015	-0.0021	7.1804	0.0060
10	35	52.0	1015.7696	0.0152	∞	1022.9012	0.0159	3020	7.1316	0.0045	19	4.7	0.5	∞	-0.0015	7.1332	7.3861	-0.2529	7.3873	-0.2517	7.1356	-0.0015	-0.0025	7.1341	0.0060
10	35	65.0	1020.8723	0.0153	∞	1027.9498	0.0160	2421	7.0775	0.0047	18	4.7	0.5	∞	-0.0015	7.0791	7.3861	-0.3070	7.3873	-0.3063	7.0810	-0.0015	-0.0020	7.0795	0.0060

Salinity 15

Practical salinity	Temperature	Pressure	Water reference density			Seawater density			Relative seawater density			Silicate molality			$\Delta\rho$–S–Relation										
															Air	Dataset			Relation				Air	Residua	Salt + Air	
S	T	p	$\rho_{H2O,0}$	u	ν_{eff}	ρ_{SW}	u	ν_{eff}	$\Delta\rho_{SW}$	u	ν_{eff}	b_0	u	ν_{eff}	$\Delta\rho_{SW,a}$	$\Delta\rho_{SW,0}$	$\Delta\rho_{SW,0}(p_0)$	$\Delta\Delta\rho_{SW,0}(p)$	$\Delta\rho_{SW,0}(p_0)$	$\Delta\Delta\rho_{SW,0}(p)$	$\Delta\rho_{SW,0}$	$\Delta\rho_{SW,a}$	A	$\Delta\rho_{SW}$	U
–	°C	MPa	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	µmol kg^{-1}	µmol kg^{-1}	–	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}
15	5	5.0	1002.3620	0.0050	∞	1014.1773	0.0065	106	11.8152	0.0041	17	7.1	0.7	∞	-0.0039	11.8192	11.8812	-0.0620	11.8816	-0.0624	11.8192	-0.0039	0.0000	11.8153	0.0060
15	5	10.0	1004.7801	0.0050	∞	1016.5329	0.0065	107	11.7528	0.0041	17	7.1	0.7	∞	-0.0039	11.7567	11.8812	-0.1245	11.8816	-0.1249	11.7567	-0.0039	0.0000	11.7527	0.0060
15	5	15.0	1007.1716	0.0151	∞	1018.8632	0.0157	3556	11.6917	0.0041	17	7.1	0.7	∞	-0.0039	11.6956	11.8812	-0.1856	11.8816	-0.1862	11.6954	-0.0039	0.0002	11.6915	0.0060
15	5	20.0	1009.5367	0.0151	∞	1021.1691	0.0157	3548	11.6324	0.0041	17	7.1	0.7	∞	-0.0039	11.6363	11.8812	-0.2448	11.8816	-0.2462	11.6355	-0.0039	0.0009	11.6315	0.0060
15	5	26.0	1012.3408	0.0152	∞	1023.9030	0.0158	3473	11.5622	0.0042	18	7.1	0.7	∞	-0.0039	11.5661	11.8812	-0.3151	11.8816	-0.3164	11.5653	-0.0039	0.0009	11.5613	0.0060
15	5	33.0	1015.5660	0.0152	∞	1027.0489	0.0158	3264	11.4830	0.0043	18	7.1	0.7	∞	-0.0039	11.4869	11.8812	-0.3942	11.8816	-0.3959	11.4857	-0.0039	0.0012	11.4818	0.0060
15	5	41.5	1019.4167	0.0153	∞	1030.8052	0.0159	2825	11.3885	0.0044	17	7.1	0.7	∞	-0.0039	11.3925	11.8812	-0.4887	11.8816	-0.4892	11.3925	-0.0039	0.0000	11.3885	0.0060
15	5	52.0	1024.0766	0.0154	∞	1035.3546	0.0160	2136	11.2780	0.0046	14	7.1	0.7	∞	-0.0039	11.2820	11.8812	-0.5992	11.8816	-0.5994	11.2823	-0.0039	-0.0003	11.2783	0.0060
15	5	65.0	1029.7021	0.0154	∞	1040.8496	0.0162	1375	11.1476	0.0049	11	7.1	0.7	∞	-0.0039	11.1515	11.8812	-0.7296	11.8816	-0.7288	11.1529	-0.0039	-0.0014	11.1489	0.0060
15	10	5.0	1002.0313	0.0050	∞	1013.6430	0.0065	106	11.6117	0.0041	17	7.1	0.7	∞	-0.0033	11.6150	11.6734	-0.0584	11.6741	-0.0556	11.6185	-0.0033	-0.0035	11.6152	0.0060
15	10	10.0	1004.3831	0.0050	∞	1015.9422	0.0065	107	11.5592	0.0041	17	7.1	0.7	∞	-0.0033	11.5625	11.6734	-0.1109	11.6741	-0.1113	11.5628	-0.0033	-0.0003	11.5594	0.0060
15	10	15.0	1006.7096	0.0151	∞	1018.2157	0.0157	3556	11.5060	0.0041	17	7.1	0.7	∞	-0.0033	11.5094	11.6734	-0.1640	11.6741	-0.1660	11.5081	-0.0033	0.0013	11.5048	0.0060
15	10	20.0	1009.0115	0.0151	∞	1020.4600	0.0157	3548	11.4486	0.0042	18	7.1	0.7	∞	-0.0033	11.4519	11.6734	-0.2215	11.6741	-0.2196	11.4546	-0.0033	-0.0026	11.4512	0.0060
15	10	26.0	1011.7415	0.0152	∞	1023.1255	0.0158	3473	11.3840	0.0042	18	7.1	0.7	∞	-0.0033	11.3874	11.6734	-0.2860	11.6741	-0.2824	11.3918	-0.0033	-0.0044	11.3884	0.0060
15	10	33.0	1014.8829	0.0152	∞	1026.1962	0.0158	3263	11.3132	0.0043	18	7.1	0.7	∞	-0.0033	11.3166	11.6734	-0.3568	11.6741	-0.3536	11.3205	-0.0033	-0.0040	11.3172	0.0060
15	10	41.5	1018.6358	0.0153	∞	1029.8663	0.0159	2825	11.2305	0.0045	17	7.1	0.7	∞	-0.0033	11.2338	11.6734	-0.4396	11.6741	-0.4372	11.2369	-0.0033	-0.0031	11.2336	0.0060
15	10	52.0	1023.1806	0.0153	∞	1034.3129	0.0160	2136	11.1323	0.0046	15	7.1	0.7	∞	-0.0033	11.1356	11.6734	-0.5378	11.6741	-0.5362	11.1379	-0.0033	-0.0023	11.1345	0.0060
15	10	65.0	1028.6722	0.0154	∞	1039.6877	0.0162	1375	11.0155	0.0049	12	7.1	0.7	∞	-0.0033	11.0188	11.6734	-0.6546	11.6741	-0.6529	11.0213	-0.0033	-0.0025	11.0179	0.0060
15	15	5.0	1001.3779	0.0050	∞	1012.8296	0.0065	106	11.4517	0.0041	17	7.1	0.7	∞	-0.0028	11.4545	11.5050	-0.0504	11.5036	-0.0502	11.4534	-0.0028	0.0011	11.4505	0.0060
15	15	10.0	1003.6761	0.0050	∞	1015.0778	0.0065	107	11.4018	0.0041	18	7.1	0.7	∞	-0.0028	11.4046	11.5050	-0.1003	11.5036	-0.1006	11.4030	-0.0028	0.0016	11.4002	0.0060
15	15	15.0	1005.9500	0.0151	∞	1017.3032	0.0157	3556	11.3531	0.0042	18	7.1	0.7	∞	-0.0028	11.3560	11.5050	-0.1490	11.5036	-0.1501	11.3535	-0.0028	0.0024	11.3507	0.0060
15	15	20.0	1008.2003	0.0151	∞	1019.5049	0.0157	3548	11.3046	0.0042	18	7.1	0.7	∞	-0.0028	11.3074	11.5050	-0.1975	11.5036	-0.1986	11.3050	-0.0028	0.0024	11.3022	0.0060
15	15	26.0	1010.8698	0.0152	∞	1022.1174	0.0158	3473	11.2476	0.0043	19	7.1	0.7	∞	-0.0028	11.2504	11.5050	-0.2545	11.5036	-0.2555	11.2481	-0.0028	0.0023	11.2453	0.0060
15	15	33.0	1013.9426	0.0152	∞	1025.1246	0.0158	3263	11.1820	0.0044	19	7.1	0.7	∞	-0.0028	11.1849	11.5050	-0.3201	11.5036	-0.3201	11.1835	-0.0028	0.0013	11.1807	0.0060
15	15	41.5	1017.6149	0.0153	∞	1028.7211	0.0159	2825	11.1062	0.0045	18	7.1	0.7	∞	-0.0028	11.1090	11.5050	-0.3959	11.5036	-0.3961	11.1076	-0.0028	0.0015	11.1047	0.0060
15	15	52.0	1022.0644	0.0153	∞	1033.0816	0.0160	2136	11.0172	0.0047	16	7.1	0.7	∞	-0.0028	11.0201	11.5050	-0.4849	11.5036	-0.4862	11.0174	-0.0028	0.0027	11.0146	0.0060
15	15	65.0	1027.4442	0.0154	∞	1038.3548	0.0162	1375	10.9106	0.0050	12	7.1	0.7	∞	-0.0028	10.9134	11.5050	-0.5915	11.5036	-0.5926	10.9110	-0.0028	0.0024	10.9082	0.0060
15	20	5.0	1000.4396	0.0050	∞	1011.7566	0.0065	105	11.3170	0.0041	17	7.1	0.7	∞	-0.0024	11.3194	11.3644	-0.0449	11.3628	-0.0460	11.3168	-0.0024	0.0026	11.3144	0.0060
15	20	10.0	1002.6946	0.0050	∞	1013.9662	0.0065	107	11.2716	0.0041	18	7.1	0.7	∞	-0.0024	11.2740	11.3644	-0.0903	11.3628	-0.0922	11.2706	-0.0024	0.0034	11.2682	0.0060
15	20	15.0	1004.9262	0.0151	∞	1016.1525	0.0157	3555	11.2263	0.0042	19	7.1	0.7	∞	-0.0024	11.2287	11.3644	-0.1356	11.3628	-0.1376	11.2252	-0.0024	0.0035	11.2228	0.0060
15	20	20.0	1007.1348	0.0151	∞	1018.3145	0.0157	3546	11.1797	0.0043	19	7.1	0.7	∞	-0.0024	11.1821	11.3644	-0.1822	11.3628	-0.1821	11.1807	-0.0024	0.0014	11.1783	0.0060
15	20	26.0	1009.7552	0.0151	∞	1020.8831	0.0158	3472	11.1279	0.0043	20	7.1	0.7	∞	-0.0024	11.1303	11.3644	-0.2340	11.3628	-0.2344	11.1285	-0.0024	0.0018	11.1261	0.0060
15	20	33.0	1012.7721	0.0152	∞	1023.8399	0.0158	3262	11.0678	0.0044	20	7.1	0.7	∞	-0.0024	11.0703	11.3644	-0.2941	11.3628	-0.2937	11.0691	-0.0024	0.0012	11.0667	0.0060
15	20	41.5	1016.3784	0.0152	∞	1027.3756	0.0159	2824	10.9972	0.0046	19	7.1	0.7	∞	-0.0024	10.9996	11.3644	-0.3648	11.3628	-0.3636	10.9993	-0.0024	0.0003	10.9968	0.0060
15	20	52.0	1020.7493	0.0153	∞	1031.6628	0.0160	2136	10.9135	0.0048	17	7.1	0.7	∞	-0.0024	10.9159	11.3644	-0.4485	11.3628	-0.4466	10.9163	-0.0024	-0.0004	10.9138	0.0060
15	20	65.0	1026.0366	0.0154	∞	1036.8455	0.0162	1374	10.8089	0.0050	13	7.1	0.7	∞	-0.0024	10.8113	11.3644	-0.5531	11.3628	-0.5447	10.8181	-0.0024	-0.0068	10.8157	0.0060
15	25	5.0	999.2462	0.0050	∞	1010.4465	0.0065	106	11.2004	0.0041	18	7.1	0.7	∞	-0.0021	11.2025	11.2474	-0.0449	11.2463	-0.0428	11.2035	-0.0021	-0.0011	11.2015	0.0060
15	25	10.0	1001.4670	0.0050	∞	1012.6246	0.0065	107	11.1577	0.0042	18	7.1	0.7	∞	-0.0021	11.1598	11.2474	-0.0876	11.2463	-0.0857	11.1606	-0.0021	-0.0009	11.1585	0.0060
15	25	15.0	1003.6648	0.0151	∞	1014.7809	0.0157	3556	11.1161	0.0043	20	7.1	0.7	∞	-0.0021	11.1182	11.2474	-0.1291	11.2463	-0.1278	11.1185	-0.0021	-0.0002	11.1164	0.0060
15	25	20.0	1005.8400	0.0151	∞	1016.9133	0.0157	3548	11.0733	0.0043	21	7.1	0.7	∞	-0.0021	11.0754	11.2474	-0.1720	11.2463	-0.1692	11.0771	-0.0021	-0.0017	11.0751	0.0060
15	25	26.0	1008.4210	0.0151	∞	1019.4449	0.0158	3473	11.0238	0.0044	21	7.1	0.7	∞	-0.0021	11.0259	11.2474	-0.2214	11.2463	-0.2177	11.0286	-0.0021	-0.0027	11.0265	0.0060
15	25	33.0	1011.3928	0.0152	∞	1022.3599	0.0158	3264	10.9671	0.0045	21	7.1	0.7	∞	-0.0021	10.9692	11.2474	-0.2782	11.2463	-0.2729	10.9734	-0.0021	-0.0043	10.9713	0.0060
15	25	41.5	1014.9457	0.0152	∞	1025.8481	0.0159	2825	10.9023	0.0046	20	7.1	0.7	∞	-0.0021	10.9044	11.2474	-0.3429	11.2463	-0.3378	10.9085	-0.0021	-0.0040	10.9064	0.0060
15	25	52.0	1019.2528	0.0153	∞	1030.0791	0.0160	2136	10.8263	0.0048	18	7.1	0.7	∞	-0.0021	10.8284	11.2474	-0.4189	11.2463	-0.4151	10.8312	-0.0021	-0.0028	10.8291	0.0060
15	25	65.0	1024.4644	0.0154	∞	1035.2003	0.0162	1375	10.7359	0.0051	14	7.1	0.7	∞	-0.0021	10.7380	11.2474	-0.5093	11.2463	-0.5066	10.7397	-0.0021	-0.0017	10.7377	0.0060
15	30	5.0	997.8217	0.0050	∞	1008.9282	0.0065	106	11.1065	0.0041	18	7.1	0.7	∞	-0.0018	11.1083	11.1497	-0.0414	11.1500	-0.0402	11.1098	-0.0018	-0.0015	11.1080	0.0060
15	30	10.0	1000.0159	0.0050	∞	1011.0823	0.0065	107	11.0664	0.0042	18	7.1	0.7	∞	-0.0018	11.0682	11.1497	-0.0815	11.1500	-0.0806	11.0694	-0.0018	-0.0012	11.0677	0.0060
15	30	15.0	1002.1873	0.0150	∞	1013.2145	0.0157	3556	11.0272	0.0044	22	7.1	0.7	∞	-0.0018	11.0289	11.1497	-0.1207	11.1500	-0.1201	11.0298	-0.0018	-0.0009	11.0281	0.0060
15	30	20.0	1004.3364	0.0151	∞	1015.3249	0.0157	3548	10.9886	0.0044	22	7.1	0.7	∞	-0.0018	10.9903	11.1497	-0.1593	11.1500	-0.1590	10.9910	-0.0018	-0.0007	10.9892	0.0060
15	30	26.0	1006.8864	0.0151	∞	1017.8277	0.0158	3473	10.9412	0.0045	23	7.1	0.7	∞	-0.0018	10.9430	11.1497	-0.2067	11.1500	-0.2046	10.9454	-0.0018	-0.0024	10.9436	0.0060
15	30	33.0	1009.8225	0.0151	∞	1020.7120	0.0158	3264	10.8895	0.0046	23	7.1	0.7	∞	-0.0018	10.8912	11.1497	-0.2584	11.1500	-0.2564	10.8936	-0.0018	-0.0023	10.8918	0.0060
15	30	41.5	1013.3330	0.0152	∞	1024.1620	0.0159	2825	10.8290	0.0047	22	7.1	0.7	∞	-0.0018	10.8308	11.1497	-0.3189	11.1500	-0.3174	10.8326	-0.0018	-0.0018	10.8308	0.0060
15	30	52.0	1017.5889	0.0153	∞	1028.3445	0.0160	2136	10.7556	0.0049	19	7.1	0.7	∞	-0.0018	10.7574	11.1497	-0.3923	11.1500	-0.3900	10.7600	-0.0018	-0.0026	10.7582	0.0060
15	30	65.0	1022.7396	0.0153	∞	1033.4104	0.0162	1375	10.6709	0.0052	15	7.1	0.7	∞	-0.0018	10.6726	11.1497	-0.4770	11.1500	-0.4760	10.6740	-0.0018	-0.0014	10.6722	0.0060
15	35	5.0	996.1859	0.0050	∞	1007.2182	0.0065	106	11.0322	0.0042	18	7.1	0.7	∞	-0.0015	11.0338	11.0718	-0.0381	11.0710	-0.0382	11.0327	-0.0015	0.0010	11.0312	0.0060
15	35	10.0	998.3601	0.0050	∞	1009.3554	0.0065	107	10.9953	0.0042	18	7.1	0.7	∞	-0.0015	10.9968	11.0718	-0.0750	11.0710	-0.0766	10.9944	-0.0015	0.0024	10.9929	0.0060
15	35	15.0	1000.5116	0.0150	∞	1011.4687	0.0157	3556	10.9572	0.0045	23	7.1	0.7	∞	-0.0015	10.9587	11.0718	-0.1131	11.0710	-0.1141	10.9568	-0.0015	0.0019	10.9553	0.0060
15	35	20.0	1002.6408	0.0150	∞	1013.5641	0.0157	3548	10.9233	0.0045	24	7.1	0.7	∞	-0.0015	10.9249	11.0718	-0.1470	11.0710	-0.1510	10.9200	-0.0015	0.0049	10.9184	0.0060
15	35	26.0	1005.1671	0.0151	∞	1016.0455	0.0158	3473	10.8784	0.0046	25	7.1	0.7	∞	-0.0015	10.8799	11.0718	-0.1919	11.0710	-0.1942	10.8767	-0.0015	0.0032	10.8752	0.0060
15	35	33.0	1008.0758	0.0151	∞	1018.9060	0.0158	3264	10.8302	0.0047	25	7.1	0.7	∞	-0.0015	10.8317	11.0718	-0.2401	11.0710	-0.2434	10.8276	-0.0015	0.0042	10.8261	0.0060
15	35	41.5	1011.5534	0.0152	∞	1022.3242	0.0159	2825	10.7708	0.0048	23	7.1	0.7	∞	-0.0015	10.7723	11.0718	-0.2995	11.0710	-0.3012	10.7697	-0.0015	0.0026	10.7682	0.0060
15	35	52.0	1015.7696	0.0152	∞	1026.4692	0.0160	2136	10.6996	0.0050	20	7.1	0.7	∞	-0.0015	10.7011	11.0718	-0.3707	11.0710	-0.3700	10.7009	-0.0015	0.0002	10.6994	0.0060
15	35	65.0	1020.8723	0.0153	∞	1031.4899	0.0162	1375	10.6176	0.0053	16	7.1	0.7	∞	-0.0015	10.6191	11.0718	-0.4527	11.0710	-0.4516	10.6194	-0.0015	-0.0003	10.6179	0.0060

Salinity 20

Practical salinity	Temperature	Pressure	Water reference density			Seawater density			Relative seawater density			Silicate molality			Δρ-S-Relation										
															Air	Dataset			Relation				Air	Residua	Salt + Air	
S	T	p	$\rho_{H2O,0}$	u	ν_{eff}	ρ_{SW}	u	ν_{eff}	$\Delta\rho_{SW}$	u	ν_{eff}	b_0	u	ν_{eff}	$\Delta\rho_{SW,a}$	$\Delta\rho_{SW,0}$	$\Delta\rho_{SW,0}(p_0)$	$\Delta\Delta\rho_{SW,0}(p)$	$\Delta\rho_{SW,0}(p_0)$	$\Delta\Delta\rho_{SW,0}(p)$	$\Delta\rho_{SW,0}$	$\Delta\rho_{SW,a}$	A	$\Delta\rho_{SW}$	U
–	°C	MPa	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	µmol kg^{-1}	µmol kg^{-1}	–	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}
20	5	5.0	1002.3620	0.0050	∞	1018.1069	0.0067	117	15.7449	0.0044	23	9.4	0.9	∞	-0.0039	15.7488	15.8306	-0.0817	15.8307	-0.0819	15.7487	-0.0039	0.0001	15.7448	0.0060
20	5	10.0	1004.7801	0.0050	∞	1020.4440	0.0067	119	15.6638	0.0045	23	9.4	0.9	∞	-0.0039	15.6678	15.8306	-0.1628	15.8307	-0.1641	15.6666	-0.0039	0.0012	15.6626	0.0060
20	5	15.0	1007.1716	0.0151	∞	1022.7556	0.0157	3551	15.5840	0.0044	22	9.4	0.9	∞	-0.0039	15.5880	15.8306	-0.2426	15.8307	-0.2447	15.5860	-0.0039	0.0020	15.5820	0.0060
20	5	20.0	1009.5367	0.0151	∞	1025.0410	0.0158	3483	15.5043	0.0045	23	9.4	0.9	∞	-0.0039	15.5082	15.8306	-0.3224	15.8307	-0.3237	15.5070	-0.0039	0.0012	15.5030	0.0060
20	5	26.0	1012.3408	0.0152	∞	1027.7530	0.0159	3265	15.4122	0.0046	23	9.4	0.9	∞	-0.0039	15.4161	15.8306	-0.4144	15.8307	-0.4163	15.4144	-0.0039	0.0017	15.4105	0.0060
20	5	33.0	1015.5660	0.0152	∞	1030.8742	0.0159	2811	15.3082	0.0047	21	9.4	0.9	∞	-0.0039	15.3121	15.8306	-0.5184	15.8307	-0.5212	15.3094	-0.0039	0.0027	15.3055	0.0060
20	5	41.5	1019.4167	0.0153	∞	1034.6007	0.0161	2107	15.1840	0.0049	18	9.4	0.9	∞	-0.0039	15.1879	15.8306	-0.6427	15.8307	-0.6443	15.1864	-0.0039	0.0016	15.1824	0.0060
20	5	52.0	1024.0766	0.0154	∞	1039.1142	0.0162	1335	15.0376	0.0052	14	9.4	0.9	∞	-0.0039	15.0415	15.8306	-0.7891	15.8307	-0.7899	15.0408	-0.0039	0.0008	15.0368	0.0060
20	5	65.0	1029.7021	0.0154	∞	1044.5684	0.0164	738	14.8664	0.0056	10	9.4	0.9	∞	-0.0039	14.8703	15.8306	-0.9603	15.8307	-0.9609	14.8698	-0.0039	0.0005	14.8658	0.0060
20	10	5.0	1002.0313	0.0050	∞	1017.5126	0.0067	117	15.4812	0.0044	23	9.4	0.9	∞	-0.0033	15.4846	15.5596	-0.0750	15.5583	-0.0729	15.4854	-0.0033	-0.0008	15.4821	0.0060
20	10	10.0	1004.3831	0.0050	∞	1019.7916	0.0067	119	15.4085	0.0045	23	9.4	0.9	∞	-0.0033	15.4118	15.5596	-0.1477	15.5583	-0.1462	15.4122	-0.0033	-0.0004	15.4088	0.0060
20	10	15.0	1006.7096	0.0151	∞	1022.0447	0.0157	3551	15.3351	0.0045	23	9.4	0.9	∞	-0.0033	15.3384	15.5596	-0.2211	15.5583	-0.2181	15.3403	-0.0033	-0.0019	15.3369	0.0060
20	10	20.0	1009.0115	0.0151	∞	1024.2731	0.0158	3482	15.2617	0.0045	23	9.4	0.9	∞	-0.0033	15.2650	15.5596	-0.2945	15.5583	-0.2886	15.2697	-0.0033	-0.0047	15.2664	0.0060
20	10	26.0	1011.7415	0.0152	∞	1026.9200	0.0159	3265	15.1785	0.0046	23	9.4	0.9	∞	-0.0033	15.1819	15.5596	-0.3777	15.5583	-0.3714	15.1869	-0.0033	-0.0050	15.1836	0.0060
20	10	33.0	1014.8829	0.0152	∞	1029.9701	0.0159	2811	15.0872	0.0047	22	9.4	0.9	∞	-0.0033	15.0905	15.5596	-0.4690	15.5583	-0.4654	15.0929	-0.0033	-0.0024	15.0896	0.0060
20	10	41.5	1018.6358	0.0153	∞	1033.6146	0.0161	2107	14.9788	0.0049	19	9.4	0.9	∞	-0.0033	14.9821	15.5596	-0.5774	15.5583	-0.5758	14.9825	-0.0033	-0.0004	14.9792	0.0060
20	10	52.0	1023.1806	0.0153	∞	1038.0290	0.0162	1335	14.8484	0.0052	14	9.4	0.9	∞	-0.0033	14.8517	15.5596	-0.7078	15.5583	-0.7067	14.8516	-0.0033	0.0001	14.8483	0.0060
20	10	65.0	1028.6722	0.0154	∞	1043.3658	0.0164	738	14.6936	0.0056	10	9.4	0.9	∞	-0.0033	14.6969	15.5596	-0.8626	15.5583	-0.8609	14.6975	-0.0033	-0.0006	14.6941	0.0060
20	15	5.0	1001.3779	0.0050	∞	1016.6428	0.0067	117	15.2649	0.0044	23	9.4	0.9	∞	-0.0028	15.2677	15.3331	-0.0654	15.3339	-0.0659	15.2681	-0.0028	-0.0003	15.2652	0.0060
20	15	10.0	1003.6761	0.0050	∞	1018.8756	0.0067	119	15.1995	0.0045	23	9.4	0.9	∞	-0.0028	15.2024	15.3331	-0.1308	15.3339	-0.1321	15.2019	-0.0028	0.0005	15.1990	0.0060
20	15	15.0	1005.9500	0.0151	∞	1021.0853	0.0157	3551	15.1353	0.0045	24	9.4	0.9	∞	-0.0028	15.1381	15.3331	-0.1950	15.3339	-0.1971	15.1368	-0.0028	0.0013	15.1339	0.0060
20	15	20.0	1008.2003	0.0151	∞	1023.2718	0.0158	3483	15.0715	0.0046	24	9.4	0.9	∞	-0.0028	15.0744	15.3331	-0.2588	15.3339	-0.2610	15.0729	-0.0028	0.0014	15.0701	0.0060
20	15	26.0	1010.8698	0.0152	∞	1025.8658	0.0159	3265	14.9960	0.0047	24	9.4	0.9	∞	-0.0028	14.9988	15.3331	-0.3343	15.3339	-0.3360	14.9979	-0.0028	0.0010	14.9950	0.0060
20	15	33.0	1013.9426	0.0152	∞	1028.8528	0.0159	2811	14.9102	0.0048	23	9.4	0.9	∞	-0.0028	14.9130	15.3331	-0.4201	15.3339	-0.4213	14.9126	-0.0028	0.0004	14.9097	0.0060
20	15	41.5	1017.6149	0.0153	∞	1032.4248	0.0161	2107	14.8098	0.0050	19	9.4	0.9	∞	-0.0028	14.8127	15.3331	-0.5204	15.3339	-0.5217	14.8123	-0.0028	0.0004	14.8094	0.0060
20	15	52.0	1022.0644	0.0153	∞	1036.7551	0.0162	1335	14.6907	0.0053	15	9.4	0.9	∞	-0.0028	14.6936	15.3331	-0.6395	15.3339	-0.6408	14.6931	-0.0028	0.0005	14.6903	0.0060
20	15	65.0	1027.4442	0.0154	∞	1041.9938	0.0164	738	14.5496	0.0056	10	9.4	0.9	∞	-0.0028	14.5524	15.3331	-0.7807	15.3339	-0.7815	14.5524	-0.0028	0.0000	14.5495	0.0060
20	20	5.0	1000.4396	0.0050	∞	1015.5268	0.0067	117	15.0872	0.0044	23	9.4	0.9	∞	-0.0024	15.0896	15.1495	-0.0598	15.1481	-0.0604	15.0877	-0.0024	0.0019	15.0853	0.0060
20	20	10.0	1002.6946	0.0050	∞	1017.7219	0.0067	119	15.0273	0.0045	23	9.4	0.9	∞	-0.0024	15.0297	15.1495	-0.1198	15.1481	-0.1210	15.0270	-0.0024	0.0027	15.0246	0.0060
20	20	15.0	1004.9262	0.0151	∞	1019.8928	0.0157	3550	14.9666	0.0046	25	9.4	0.9	∞	-0.0024	14.9690	15.1495	-0.1804	15.1481	-0.1807	14.9674	-0.0024	0.0017	14.9649	0.0060
20	20	20.0	1007.1348	0.0151	∞	1022.0404	0.0158	3482	14.9056	0.0046	25	9.4	0.9	∞	-0.0024	14.9080	15.1495	-0.2414	15.1481	-0.2393	14.9088	-0.0024	-0.0007	14.9063	0.0060
20	20	26.0	1009.7552	0.0151	∞	1024.5930	0.0159	3264	14.8378	0.0047	25	9.4	0.9	∞	-0.0024	14.8403	15.1495	-0.3092	15.1481	-0.3082	14.8399	-0.0024	0.0004	14.8374	0.0060
20	20	33.0	1012.7721	0.0152	∞	1027.5342	0.0159	2811	14.7621	0.0048	24	9.4	0.9	∞	-0.0024	14.7645	15.1495	-0.3850	15.1481	-0.3866	14.7615	-0.0024	0.0030	14.7591	0.0060
20	20	41.5	1016.3784	0.0152	∞	1031.0493	0.0161	2106	14.6709	0.0050	20	9.4	0.9	∞	-0.0024	14.6733	15.1495	-0.4762	15.1481	-0.4789	14.6692	-0.0024	0.0041	14.6668	0.0060
20	20	52.0	1020.7493	0.0153	∞	1035.3084	0.0162	1335	14.5591	0.0053	15	9.4	0.9	∞	-0.0024	14.5615	15.1495	-0.5879	15.1481	-0.5886	14.5594	-0.0024	0.0021	14.5570	0.0060
20	20	65.0	1026.0366	0.0154	∞	1040.4674	0.0164	737	14.4308	0.0057	11	9.4	0.9	∞	-0.0024	14.4333	15.1495	-0.7162	15.1481	-0.7185	14.4295	-0.0024	0.0037	14.4271	0.0060
20	25	5.0	999.2462	0.0050	∞	1014.1820	0.0067	117	14.9359	0.0044	23	9.4	0.9	∞	-0.0021	14.9379	14.9935	-0.0556	14.9938	-0.0560	14.9378	-0.0021	0.0002	14.9357	0.0060
20	25	10.0	1001.4670	0.0050	∞	1016.3469	0.0067	119	14.8799	0.0045	23	9.4	0.9	∞	-0.0021	14.8820	14.9935	-0.1115	14.9938	-0.1124	14.8815	-0.0021	0.0005	14.8794	0.0060
20	25	15.0	1003.6648	0.0151	∞	1018.4912	0.0157	3551	14.8264	0.0046	26	9.4	0.9	∞	-0.0021	14.8285	14.9935	-0.1650	14.9938	-0.1678	14.8260	-0.0021	0.0024	14.8240	0.0060
20	25	20.0	1005.8400	0.0151	∞	1020.6108	0.0158	3483	14.7708	0.0047	27	9.4	0.9	∞	-0.0021	14.7729	14.9935	-0.2206	14.9938	-0.2222	14.7716	-0.0021	0.0013	14.7695	0.0060
20	25	26.0	1008.4210	0.0151	∞	1023.1278	0.0159	3265	14.7068	0.0048	27	9.4	0.9	∞	-0.0021	14.7089	14.9935	-0.2847	14.9938	-0.2862	14.7076	-0.0021	0.0013	14.7055	0.0060
20	25	33.0	1011.3928	0.0152	∞	1026.0282	0.0159	2811	14.6354	0.0049	25	9.4	0.9	∞	-0.0021	14.6375	14.9935	-0.3560	14.9938	-0.3591	14.6347	-0.0021	0.0027	14.6327	0.0060
20	25	41.5	1014.9457	0.0152	∞	1029.4954	0.0161	2107	14.5496	0.0051	21	9.4	0.9	∞	-0.0021	14.5517	14.9935	-0.4418	14.9938	-0.4449	14.5489	-0.0021	0.0028	14.5468	0.0060
20	25	52.0	1019.2528	0.0153	∞	1033.7017	0.0162	1335	14.4489	0.0054	16	9.4	0.9	∞	-0.0021	14.4510	14.9935	-0.5425	14.9938	-0.5471	14.4467	-0.0021	0.0043	14.4446	0.0060
20	25	65.0	1024.4644	0.0154	∞	1038.7909	0.0164	738	14.3265	0.0058	11	9.4	0.9	∞	-0.0021	14.3286	14.9935	-0.6649	14.9938	-0.6682	14.3256	-0.0021	0.0030	14.3235	0.0060
20	30	5.0	997.8217	0.0050	∞	1012.6323	0.0067	117	14.8106	0.0045	23	9.4	0.9	∞	-0.0018	14.8124	14.8641	-0.0517	14.8661	-0.0526	14.8135	-0.0018	-0.0010	14.8117	0.0060
20	30	10.0	1000.0159	0.0050	∞	1014.7739	0.0067	119	14.7580	0.0045	24	9.4	0.9	∞	-0.0018	14.7598	14.8641	-0.1043	14.8661	-0.1056	14.7605	-0.0018	-0.0008	14.7588	0.0060
20	30	15.0	1002.1873	0.0150	∞	1016.8925	0.0157	3551	14.7052	0.0047	28	9.4	0.9	∞	-0.0018	14.7070	14.8641	-0.1571	14.8661	-0.1576	14.7085	-0.0018	-0.0015	14.7067	0.0060
20	30	20.0	1004.3364	0.0151	∞	1018.9906	0.0158	3482	14.6543	0.0048	28	9.4	0.9	∞	-0.0018	14.6560	14.8641	-0.2080	14.8661	-0.2087	14.6574	-0.0018	-0.0013	14.6556	0.0060
20	30	26.0	1006.8864	0.0151	∞	1021.4816	0.0159	3265	14.5952	0.0048	28	9.4	0.9	∞	-0.0018	14.5970	14.8641	-0.2671	14.8661	-0.2688	14.5973	-0.0018	-0.0003	14.5955	0.0060
20	30	33.0	1009.8225	0.0151	∞	1024.3495	0.0159	2811	14.5270	0.0050	27	9.4	0.9	∞	-0.0018	14.5287	14.8641	-0.3353	14.8661	-0.3372	14.5289	-0.0018	-0.0001	14.5271	0.0060
20	30	41.5	1013.3330	0.0152	∞	1027.7788	0.0161	2107	14.4458	0.0052	23	9.4	0.9	∞	-0.0018	14.4476	14.8641	-0.4165	14.8661	-0.4179	14.4482	-0.0018	-0.0006	14.4465	0.0060
20	30	52.0	1017.5889	0.0153	∞	1031.9392	0.0162	1335	14.3503	0.0054	17	9.4	0.9	∞	-0.0018	14.3521	14.8641	-0.5120	14.8661	-0.5139	14.3522	-0.0018	-0.0001	14.3504	0.0060
20	30	65.0	1022.7396	0.0153	∞	1036.9761	0.0164	738	14.2366	0.0058	12	9.4	0.9	∞	-0.0018	14.2384	14.8641	-0.6257	14.8661	-0.6279	14.2382	-0.0018	0.0001	14.2364	0.0060
20	35	5.0	996.1859	0.0050	∞	1010.8955	0.0067	117	14.7095	0.0045	23	9.4	0.9	∞	-0.0015	14.7111	14.7613	-0.0503	14.7612	-0.0500	14.7112	-0.0015	-0.0001	14.7097	0.0060
20	35	10.0	998.3601	0.0050	∞	1013.0198	0.0067	119	14.6597	0.0045	24	9.4	0.9	∞	-0.0015	14.6612	14.7613	-0.1001	14.7612	-0.1002	14.6610	-0.0015	0.0003	14.6594	0.0060
20	35	15.0	1000.5116	0.0150	∞	1015.1219	0.0157	3551	14.6104	0.0048	30	9.4	0.9	∞	-0.0015	14.6119	14.7613	-0.1494	14.7612	-0.1496	14.6116	-0.0015	0.0003	14.6101	0.0060
20	35	20.0	1002.6408	0.0150	∞	1017.2020	0.0158	3483	14.5613	0.0048	30	9.4	0.9	∞	-0.0015	14.5628	14.7613	-0.1985	14.7612	-0.1980	14.5631	-0.0015	-0.0004	14.5616	0.0060
20	35	26.0	1005.1671	0.0151	∞	1019.6714	0.0159	3265	14.5043	0.0049	30	9.4	0.9	∞	-0.0015	14.5058	14.7613	-0.2555	14.7612	-0.2550	14.5062	-0.0015	-0.0004	14.5047	0.0060
20	35	33.0	1008.0758	0.0151	∞	1022.5153	0.0159	2811	14.4395	0.0051	28	9.4	0.9	∞	-0.0015	14.4410	14.7613	-0.3203	14.7612	-0.3198	14.4414	-0.0015	-0.0003	14.4398	0.0060
20	35	41.5	1011.5534	0.0152	∞	1025.9170	0.0161	2107	14.3636	0.0052	24	9.4	0.9	∞	-0.0015	14.3651	14.7613	-0.3962	14.7612	-0.3963	14.3649	-0.0015	0.0002	14.3634	0.0060
20	35	52.0	1015.7696	0.0152	∞	1030.0426	0.0162	1335	14.2730	0.0055	18	9.4	0.9	∞	-0.0015	14.2745	14.7613	-0.4868	14.7612	-0.4873	14.2739	-0.0015	0.0007	14.2723	0.0060
20	35	65.0	1020.8723	0.0153	∞	1035.0385	0.0164	738	14.1662	0.0059	12	9.4	0.9	∞	-0.0015	14.1678	14.7613	-0.5936	14.7612	-0.5955	14.1657	-0.0015	0.0020	14.1642	0.0060

Salinity 25

Practical salinity	Temperature	Pressure	Water reference density			Seawater density			Relative seawater density			Silicate molality			$\Delta\rho$–S–Relation										
															Air	Dataset			Relation			Air	Residua	Salt + Air	
S	T	p	$\rho_{H2O,0}$	u	ν_{eff}	ρ_{SW}	u	ν_{eff}	$\Delta\rho_{SW}$	u	ν_{eff}	b_0	u	ν_{eff}	$\Delta\rho_{SW,a}$	$\Delta\rho_{SW,0}$	$\Delta\rho_{SW,0}(p_0)$	$\Delta\Delta\rho_{SW,0}(p)$	$\Delta\rho_{SW,0}(p_0)$	$\Delta\Delta\rho_{SW,0}(p)$	$\Delta\rho_{SW,0}$	$\Delta\rho_{SW,a}$	A	$\Delta\rho_{SW}$	U
–	°C	MPa	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	µmol kg^{-1}	µmol kg^{-1}	–	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}
25	5	5.0	1002.3620	0.0050	∞	1022.0388	0.0071	141	19.6768	0.0050	35	11.8	1.2	∞	-0.0039	19.6808	19.7826	-0.1018	19.7819	-0.1011	19.6808	-0.0039	0.0000	19.6768	0.0060
25	5	10.0	1004.7801	0.0050	∞	1024.3556	0.0071	143	19.5755	0.0050	36	11.8	1.2	∞	-0.0039	19.5794	19.7826	-0.2032	19.7819	-0.2027	19.5792	-0.0039	0.0002	19.5753	0.0060
25	5	15.0	1007.1716	0.0151	∞	1026.6460	0.0159	3429	19.4744	0.0051	35	11.8	1.2	∞	-0.0039	19.4784	19.7826	-0.3042	19.7819	-0.3024	19.4795	-0.0039	-0.0012	19.4756	0.0060
25	5	20.0	1009.5367	0.0151	∞	1028.9145	0.0160	3124	19.3778	0.0052	34	11.8	1.2	∞	-0.0039	19.3817	19.7826	-0.4008	19.7819	-0.4002	19.3817	-0.0039	0.0000	19.3778	0.0060
25	5	26.0	1012.3408	0.0152	∞	1031.6037	0.0161	2502	19.2629	0.0053	30	11.8	1.2	∞	-0.0039	19.2668	19.7826	-0.5158	19.7819	-0.5149	19.2670	-0.0039	-0.0002	19.2630	0.0060
25	5	33.0	1015.5660	0.0152	∞	1034.6983	0.0162	1695	19.1323	0.0055	23	11.8	1.2	∞	-0.0039	19.1362	19.7826	-0.6463	19.7819	-0.6451	19.1368	-0.0039	-0.0006	19.1329	0.0060
25	5	41.5	1019.4167	0.0153	∞	1038.3961	0.0164	974	18.9794	0.0058	16	11.8	1.2	∞	-0.0039	18.9834	19.7826	-0.7992	19.7819	-0.7978	18.9841	-0.0039	-0.0007	18.9801	0.0060
25	5	52.0	1024.0766	0.0154	∞	1042.8758	0.0166	501	18.7992	0.0063	10	11.8	1.2	∞	-0.0039	18.8031	19.7826	-0.9794	19.7819	-0.9786	18.8033	-0.0039	-0.0001	18.7993	0.0060
25	5	65.0	1029.7021	0.0154	∞	1048.2909	0.0169	247	18.5888	0.0069	7	11.8	1.2	∞	-0.0039	18.5928	19.7826	-1.1898	19.7819	-1.1910	18.5908	-0.0039	0.0020	18.5869	0.0060
25	10	5.0	1002.0313	0.0050	∞	1021.3835	0.0071	141	19.3522	0.0050	35	11.8	1.2	∞	-0.0033	19.3556	19.4452	-0.0896	19.4465	-0.0900	19.3565	-0.0033	-0.0009	19.3531	0.0060
25	10	10.0	1004.3831	0.0050	∞	1023.6468	0.0071	143	19.2637	0.0050	36	11.8	1.2	∞	-0.0033	19.2671	19.4452	-0.1781	19.4465	-0.1806	19.2660	-0.0033	0.0011	19.2626	0.0060
25	10	15.0	1006.7096	0.0151	∞	1025.8835	0.0159	3430	19.1738	0.0051	36	11.8	1.2	∞	-0.0033	19.1772	19.4452	-0.2680	19.4465	-0.2695	19.1770	-0.0033	0.0002	19.1736	0.0060
25	10	20.0	1009.0115	0.0151	∞	1028.0992	0.0160	3124	19.0878	0.0052	35	11.8	1.2	∞	-0.0033	19.0911	19.4452	-0.3541	19.4465	-0.3569	19.0896	-0.0033	0.0015	19.0863	0.0060
25	10	26.0	1011.7415	0.0152	∞	1030.7266	0.0161	2502	18.9851	0.0053	30	11.8	1.2	∞	-0.0033	18.9885	19.4452	-0.4567	19.4465	-0.4595	18.9870	-0.0033	0.0015	18.9837	0.0060
25	10	33.0	1014.8829	0.0152	∞	1033.7534	0.0162	1696	18.8705	0.0056	24	11.8	1.2	∞	-0.0033	18.8738	19.4452	-0.5714	19.4465	-0.5761	18.8704	-0.0033	0.0034	18.8671	0.0060
25	10	41.5	1018.6358	0.0153	∞	1037.3692	0.0164	975	18.7333	0.0059	16	11.8	1.2	∞	-0.0033	18.7367	19.4452	-0.7085	19.4465	-0.7131	18.7334	-0.0033	0.0033	18.7301	0.0060
25	10	52.0	1023.1806	0.0153	∞	1041.7538	0.0166	501	18.5731	0.0063	11	11.8	1.2	∞	-0.0033	18.5765	19.4452	-0.8687	19.4465	-0.8756	18.5709	-0.0033	0.0056	18.5675	0.0060
25	10	65.0	1028.6722	0.0154	∞	1047.0542	0.0169	247	18.3820	0.0070	7	11.8	1.2	∞	-0.0033	18.3854	19.4452	-1.0598	19.4465	-1.0671	18.3794	-0.0033	0.0059	18.3761	0.0060
25	15	5.0	1001.3779	0.0050	∞	1020.4633	0.0071	141	19.0853	0.0050	35	11.8	1.2	∞	-0.0028	19.0882	19.1706	-0.0824	19.1695	-0.0814	19.0881	-0.0028	0.0000	19.0853	0.0060
25	15	10.0	1003.6761	0.0050	∞	1022.6800	0.0071	143	19.0040	0.0050	36	11.8	1.2	∞	-0.0028	19.0068	19.1706	-0.1638	19.1695	-0.1632	19.0063	-0.0028	0.0005	19.0034	0.0060
25	15	15.0	1005.9500	0.0151	∞	1024.8723	0.0159	3429	18.9223	0.0051	37	11.8	1.2	∞	-0.0028	18.9251	19.1706	-0.2455	19.1695	-0.2438	18.9257	-0.0028	-0.0006	18.9229	0.0060
25	15	20.0	1008.2003	0.0151	∞	1027.0423	0.0160	3124	18.8420	0.0052	35	11.8	1.2	∞	-0.0028	18.8449	19.1706	-0.3257	19.1695	-0.3229	18.8466	-0.0028	-0.0017	18.8438	0.0060
25	15	26.0	1010.8698	0.0152	∞	1029.6204	0.0161	2502	18.7506	0.0054	31	11.8	1.2	∞	-0.0028	18.7534	19.1706	-0.4172	19.1695	-0.4159	18.7536	-0.0028	-0.0001	18.7507	0.0060
25	15	33.0	1013.9426	0.0152	∞	1032.5848	0.0162	1695	18.6421	0.0056	24	11.8	1.2	∞	-0.0028	18.6450	19.1706	-0.5256	19.1695	-0.5217	18.6478	-0.0028	-0.0028	18.6449	0.0060
25	15	41.5	1017.6149	0.0153	∞	1036.1331	0.0164	974	18.5181	0.0059	17	11.8	1.2	∞	-0.0028	18.5210	19.1706	-0.6496	19.1695	-0.6463	18.5232	-0.0028	-0.0023	18.5204	0.0060
25	15	52.0	1022.0644	0.0153	∞	1040.4351	0.0166	501	18.3708	0.0064	11	11.8	1.2	∞	-0.0028	18.3736	19.1706	-0.7970	19.1695	-0.7942	18.3753	-0.0028	-0.0017	18.3724	0.0060
25	15	65.0	1027.4442	0.0154	∞	1045.6407	0.0169	247	18.1965	0.0070	7	11.8	1.2	∞	-0.0028	18.1993	19.1706	-0.9713	19.1695	-0.9689	18.2006	-0.0028	-0.0013	18.1977	0.0060
25	20	5.0	1000.4396	0.0050	∞	1019.2996	0.0071	141	18.8600	0.0050	35	11.8	1.2	∞	-0.0024	18.8625	18.9371	-0.0746	18.9396	-0.0746	18.8650	-0.0024	-0.0025	18.8626	0.0060
25	20	10.0	1002.6946	0.0050	∞	1021.4776	0.0071	142	18.7830	0.0050	36	11.8	1.2	∞	-0.0024	18.7854	18.9371	-0.1517	18.9396	-0.1496	18.7899	-0.0024	-0.0045	18.7875	0.0060
25	20	15.0	1004.9262	0.0151	∞	1023.6366	0.0159	3428	18.7104	0.0052	38	11.8	1.2	∞	-0.0024	18.7128	18.9371	-0.2243	18.9396	-0.2235	18.7160	-0.0024	-0.0032	18.7136	0.0060
25	20	20.0	1007.1348	0.0151	∞	1025.7710	0.0160	3123	18.6362	0.0053	37	11.8	1.2	∞	-0.0024	18.6387	18.9371	-0.2984	18.9396	-0.2962	18.6434	-0.0024	-0.0047	18.6410	0.0060
25	20	26.0	1009.7552	0.0151	∞	1028.3048	0.0161	2501	18.5496	0.0054	32	11.8	1.2	∞	-0.0024	18.5521	18.9371	-0.3850	18.9396	-0.3816	18.5579	-0.0024	-0.0059	18.5555	0.0060
25	20	33.0	1012.7721	0.0152	∞	1031.2242	0.0162	1695	18.4522	0.0056	25	11.8	1.2	∞	-0.0024	18.4546	18.9371	-0.4825	18.9396	-0.4789	18.4607	-0.0024	-0.0061	18.4582	0.0060
25	20	41.5	1016.3784	0.0152	∞	1034.7155	0.0164	974	18.3371	0.0060	17	11.8	1.2	∞	-0.0024	18.3395	18.9371	-0.5975	18.9396	-0.5935	18.3461	-0.0024	-0.0065	18.3437	0.0060
25	20	52.0	1020.7493	0.0153	∞	1038.9512	0.0166	501	18.2019	0.0064	11	11.8	1.2	∞	-0.0024	18.2043	18.9371	-0.7328	18.9396	-0.7298	18.2098	-0.0024	-0.0055	18.2073	0.0060
25	20	65.0	1026.0366	0.0154	∞	1044.0771	0.0169	247	18.0405	0.0070	7	11.8	1.2	∞	-0.0024	18.0429	18.9371	-0.8942	18.9396	-0.8911	18.0485	-0.0024	-0.0056	18.0461	0.0060
25	25	5.0	999.2462	0.0050	∞	1017.9228	0.0071	141	18.6766	0.0050	35	11.8	1.2	∞	-0.0021	18.6787	18.7480	-0.0693	18.7485	-0.0693	18.6792	-0.0021	-0.0005	18.6771	0.0060
25	25	10.0	1001.4670	0.0050	∞	1020.0735	0.0071	143	18.6066	0.0051	36	11.8	1.2	∞	-0.0021	18.6087	18.7480	-0.1393	18.7485	-0.1390	18.6094	-0.0021	-0.0008	18.6074	0.0060
25	25	15.0	1003.6648	0.0151	∞	1022.2035	0.0159	3429	18.5387	0.0052	39	11.8	1.2	∞	-0.0021	18.5408	18.7480	-0.2072	18.7485	-0.2077	18.5408	-0.0021	0.0000	18.5387	0.0060
25	25	20.0	1005.8400	0.0151	∞	1024.3108	0.0160	3124	18.4708	0.0053	38	11.8	1.2	∞	-0.0021	18.4729	18.7480	-0.2751	18.7485	-0.2752	18.4733	-0.0021	-0.0004	18.4712	0.0060
25	25	26.0	1008.4210	0.0151	∞	1026.8138	0.0161	2502	18.3928	0.0055	34	11.8	1.2	∞	-0.0021	18.3949	18.7480	-0.3531	18.7485	-0.3546	18.3938	-0.0021	0.0010	18.3918	0.0060
25	25	33.0	1011.3928	0.0152	∞	1029.6947	0.0162	1695	18.3019	0.0057	26	11.8	1.2	∞	-0.0021	18.3040	18.7480	-0.4440	18.7485	-0.4451	18.3034	-0.0021	0.0006	18.3013	0.0060
25	25	41.5	1014.9457	0.0152	∞	1033.1409	0.0164	974	18.1951	0.0060	18	11.8	1.2	∞	-0.0021	18.1972	18.7480	-0.5508	18.7485	-0.5516	18.1968	-0.0021	0.0004	18.1947	0.0060
25	25	52.0	1019.2528	0.0153	∞	1037.3224	0.0166	501	18.0696	0.0065	12	11.8	1.2	∞	-0.0021	18.0717	18.7480	-0.6763	18.7485	-0.6786	18.0699	-0.0021	0.0018	18.0678	0.0060
25	25	65.0	1024.4644	0.0154	∞	1042.3843	0.0169	247	17.9199	0.0071	8	11.8	1.2	∞	-0.0021	17.9220	18.7480	-0.8260	18.7485	-0.8289	17.9195	-0.0021	0.0025	17.9175	0.0060
25	30	5.0	997.8217	0.0050	∞	1016.3477	0.0071	141	18.5260	0.0050	36	11.8	1.2	∞	-0.0018	18.5278	18.5921	-0.0644	18.5901	-0.0651	18.5249	-0.0018	0.0028	18.5232	0.0060
25	30	10.0	1000.0159	0.0050	∞	1018.4744	0.0071	143	18.4585	0.0051	37	11.8	1.2	∞	-0.0018	18.4603	18.5921	-0.1319	18.5901	-0.1307	18.4594	-0.0018	0.0009	18.4576	0.0060
25	30	15.0	1002.1873	0.0150	∞	1020.5821	0.0159	3429	18.3948	0.0053	41	11.8	1.2	∞	-0.0018	18.3965	18.5921	-0.1956	18.5901	-0.1952	18.3949	-0.0018	0.0017	18.3931	0.0060
25	30	20.0	1004.3364	0.0151	∞	1022.6675	0.0160	3124	18.3311	0.0054	40	11.8	1.2	∞	-0.0018	18.3329	18.5921	-0.2592	18.5901	-0.2586	18.3315	-0.0018	0.0014	18.3297	0.0060
25	30	26.0	1006.8864	0.0151	∞	1025.1440	0.0161	2502	18.2576	0.0055	35	11.8	1.2	∞	-0.0018	18.2594	18.5921	-0.3328	18.5901	-0.3332	18.2569	-0.0018	0.0025	18.2551	0.0060
25	30	33.0	1009.8225	0.0151	∞	1027.9944	0.0162	1695	18.1719	0.0058	27	11.8	1.2	∞	-0.0018	18.1736	18.5921	-0.4185	18.5901	-0.4181	18.1719	-0.0018	0.0017	18.1702	0.0060
25	30	41.5	1013.3330	0.0152	∞	1031.4056	0.0164	974	18.0726	0.0061	19	11.8	1.2	∞	-0.0018	18.0744	18.5921	-0.5178	18.5901	-0.5183	18.0718	-0.0018	0.0026	18.0700	0.0060
25	30	52.0	1017.5889	0.0153	∞	1035.5436	0.0166	501	17.9546	0.0065	12	11.8	1.2	∞	-0.0018	17.9564	18.5921	-0.6357	18.5901	-0.6376	17.9525	-0.0018	0.0039	17.9507	0.0060
25	30	65.0	1022.7396	0.0153	∞	1040.5523	0.0169	247	17.8128	0.0072	8	11.8	1.2	∞	-0.0018	17.8146	18.5921	-0.7776	18.5901	-0.7790	17.8111	-0.0018	0.0035	17.8093	0.0060
25	35	5.0	996.1859	0.0050	∞	1014.5827	0.0071	141	18.3967	0.0050	36	11.8	1.2	∞	-0.0015	18.3983	18.4602	-0.0619	18.4599	-0.0619	18.3981	-0.0015	0.0002	18.3965	0.0060
25	35	10.0	998.3601	0.0050	∞	1016.6933	0.0071	143	18.3332	0.0051	37	11.8	1.2	∞	-0.0015	18.3348	18.4602	-0.1254	18.4599	-0.1241	18.3358	-0.0015	-0.0011	18.3343	0.0060
25	35	15.0	1000.5116	0.0150	∞	1018.7842	0.0159	3429	18.2727	0.0054	44	11.8	1.2	∞	-0.0015	18.2742	18.4602	-0.1860	18.4599	-0.1853	18.2746	-0.0015	-0.0005	18.2731	0.0060
25	35	20.0	1002.6408	0.0150	∞	1020.8520	0.0160	3124	18.2112	0.0055	42	11.8	1.2	∞	-0.0015	18.2127	18.4602	-0.2475	18.4599	-0.2454	18.2145	-0.0015	-0.0018	18.2130	0.0060
25	35	26.0	1005.1671	0.0151	∞	1023.3078	0.0161	2502	18.1407	0.0056	37	11.8	1.2	∞	-0.0015	18.1423	18.4602	-0.3179	18.4599	-0.3161	18.1438	-0.0015	-0.0015	18.1423	0.0060
25	35	33.0	1008.0758	0.0151	∞	1026.1368	0.0162	1695	18.0610	0.0058	28	11.8	1.2	∞	-0.0015	18.0625	18.4602	-0.3976	18.4599	-0.3966	18.0633	-0.0015	-0.0008	18.0618	0.0060
25	35	41.5	1011.5534	0.0152	∞	1029.5184	0.0164	974	17.9649	0.0061	19	11.8	1.2	∞	-0.0015	17.9664	18.4602	-0.4937	18.4599	-0.4915	17.9684	-0.0015	-0.0020	17.9669	0.0060
25	35	52.0	1015.7696	0.0152	∞	1033.6213	0.0166	501	17.8517	0.0066	12	11.8	1.2	∞	-0.0015	17.8532	18.4602	-0.6070	18.4599	-0.6046	17.8553	-0.0015	-0.0021	17.8538	0.0060
25	35	65.0	1020.8723	0.0153	∞	1038.5901	0.0169	247	17.7178	0.0072	8	11.8	1.2	∞	-0.0015	17.7193	18.4602	-0.7409	18.4599	-0.7388	17.7212	-0.0015	-0.0018	17.7196	0.0060

Salinity 30

Practical salinity	Temperature	Pressure	Water reference density			Seawater density			Relative seawater density			Silicate molality			Δρ-S-Relation										
															Air	Dataset			Relation				Air	Residua	Salt + Air	
S	T	p	$\rho_{H2O,0}$	u	ν_{eff}	ρ_{SW}	u	ν_{eff}	$\Delta\rho_{SW}$	u	ν_{eff}	b_0	u	ν_{eff}	$\Delta\rho_{SW,a}$	$\Delta\rho_{SW,0}$	$\Delta\rho_{SW,0}(p_0)$	$\Delta\Delta\rho_{SW,0}(p)$	$\Delta\rho_{SW,0}(p_0)$	$\Delta\Delta\rho_{SW,0}(p)$	$\Delta\rho_{SW,0}$	$\Delta\rho_{SW,a}$	Δ	$\Delta\rho_{SW}$	U
–	°C	MPa	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	µmol kg^{-1}	µmol kg^{-1}	–	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}
30	5	5.0	1002.3620	0.0050	∞	1025.9763	0.0070	137	23.6143	0.0049	33	14.1	1.4	∞	-0.0039	23.6183	23.7370	-0.1187	23.7364	-0.1199	23.6165	-0.0039	0.0018	23.6126	0.0060
30	5	10.0	1004.7801	0.0050	∞	1028.2724	0.0071	139	23.4923	0.0050	34	14.1	1.4	∞	-0.0039	23.4963	23.7370	-0.2407	23.7364	-0.2404	23.4960	-0.0039	0.0002	23.4921	0.0060
30	5	15.0	1007.1716	0.0151	∞	1030.5440	0.0158	3381	23.3724	0.0047	27	14.1	1.4	∞	-0.0039	23.3764	23.7370	-0.3606	23.7364	-0.3589	23.3775	-0.0039	-0.0011	23.3736	0.0060
30	5	20.0	1009.5367	0.0151	∞	1032.7958	0.0159	3111	23.2591	0.0048	27	14.1	1.4	∞	-0.0039	23.2630	23.7370	-0.4740	23.7364	-0.4752	23.2612	-0.0039	0.0018	23.2573	0.0060
30	5	26.0	1012.3408	0.0152	∞	1035.4647	0.0160	2537	23.1239	0.0050	24	14.1	1.4	∞	-0.0039	23.1279	23.7370	-0.6091	23.7364	-0.6118	23.1246	-0.0039	0.0032	23.1207	0.0060
30	5	33.0	1015.5660	0.0152	∞	1038.5359	0.0161	1756	22.9699	0.0052	19	14.1	1.4	∞	-0.0039	22.9738	23.7370	-0.7631	23.7364	-0.7669	22.9695	-0.0039	0.0044	22.9655	0.0060
30	5	41.5	1019.4167	0.0153	∞	1042.2018	0.0163	1025	22.7851	0.0055	14	14.1	1.4	∞	-0.0039	22.7890	23.7370	-0.9479	23.7364	-0.9492	22.7872	-0.0039	0.0018	22.7833	0.0060
30	5	52.0	1024.0766	0.0154	∞	1046.6490	0.0165	530	22.5724	0.0060	9	14.1	1.4	∞	-0.0039	22.5763	23.7370	-1.1606	23.7364	-1.1651	22.5713	-0.0039	0.0051	22.5673	0.0060
30	5	65.0	1029.7021	0.0154	∞	1052.0208	0.0168	260	22.3187	0.0066	6	14.1	1.4	∞	-0.0039	22.3227	23.7370	-1.4143	23.7364	-1.4192	22.3172	-0.0039	0.0055	22.3132	0.0060
30	10	5.0	1002.0313	0.0050	∞	1025.2586	0.0070	137	23.2273	0.0049	33	14.1	1.4	∞	-0.0033	23.2306	23.3380	-0.1074	23.3395	-0.1068	23.2327	-0.0033	-0.0021	23.2294	0.0060
30	10	10.0	1004.3831	0.0050	∞	1027.5022	0.0071	139	23.1192	0.0050	34	14.1	1.4	∞	-0.0033	23.1225	23.3380	-0.2155	23.3395	-0.2143	23.1252	-0.0033	-0.0027	23.1219	0.0060
30	10	15.0	1006.7096	0.0151	∞	1029.7220	0.0158	3381	23.0123	0.0048	28	14.1	1.4	∞	-0.0033	23.0157	23.3380	-0.3223	23.3395	-0.3201	23.0194	-0.0033	-0.0038	23.0161	0.0060
30	10	20.0	1009.0115	0.0151	∞	1031.9201	0.0159	3110	22.9086	0.0049	27	14.1	1.4	∞	-0.0033	22.9120	23.3380	-0.4260	23.3395	-0.4240	22.9155	-0.0033	-0.0035	22.9121	0.0060
30	10	26.0	1011.7415	0.0152	∞	1034.5285	0.0160	2537	22.7870	0.0050	25	14.1	1.4	∞	-0.0033	22.7904	23.3380	-0.5476	23.3395	-0.5462	22.7933	-0.0033	-0.0029	22.7900	0.0060
30	10	33.0	1014.8829	0.0152	∞	1037.5299	0.0161	1756	22.6469	0.0052	20	14.1	1.4	∞	-0.0033	22.6503	23.3380	-0.6877	23.3395	-0.6852	22.6544	-0.0033	-0.0041	22.6510	0.0060
30	10	41.5	1018.6358	0.0153	∞	1041.1202	0.0163	1025	22.4843	0.0055	14	14.1	1.4	∞	-0.0033	22.4877	23.3380	-0.8503	23.3395	-0.8486	22.4909	-0.0033	-0.0033	22.4876	0.0060
30	10	52.0	1023.1806	0.0153	∞	1045.4692	0.0165	530	22.2886	0.0060	9	14.1	1.4	∞	-0.0033	22.2919	23.3380	-1.0461	23.3395	-1.0426	22.2969	-0.0033	-0.0050	22.2936	0.0060
30	10	65.0	1028.6722	0.0154	∞	1050.7346	0.0168	260	22.0623	0.0066	6	14.1	1.4	∞	-0.0033	22.0657	23.3380	-1.2723	23.3395	-1.2714	22.0681	-0.0033	-0.0025	22.0648	0.0060
30	15	5.0	1001.3779	0.0050	∞	1024.2878	0.0070	137	22.9098	0.0049	33	14.1	1.4	∞	-0.0028	22.9127	23.0107	-0.0980	23.0110	-0.0966	22.9144	-0.0028	-0.0017	22.9116	0.0060
30	15	10.0	1003.6761	0.0050	∞	1026.4912	0.0071	138	22.8151	0.0050	34	14.1	1.4	∞	-0.0028	22.8180	23.0107	-0.1927	23.0110	-0.1939	22.8171	-0.0028	0.0008	22.8143	0.0060
30	15	15.0	1005.9500	0.0151	∞	1028.6709	0.0158	3381	22.7209	0.0048	29	14.1	1.4	∞	-0.0028	22.7238	23.0107	-0.2869	23.0110	-0.2897	22.7213	-0.0028	0.0024	22.7185	0.0060
30	15	20.0	1008.2003	0.0151	∞	1030.8242	0.0159	3110	22.6239	0.0049	28	14.1	1.4	∞	-0.0028	22.6268	23.0107	-0.3839	23.0110	-0.3839	22.6271	-0.0028	-0.0003	22.6242	0.0060
30	15	26.0	1010.8698	0.0152	∞	1033.3828	0.0160	2536	22.5130	0.0051	25	14.1	1.4	∞	-0.0028	22.5158	23.0107	-0.4949	23.0110	-0.4947	22.5163	-0.0028	-0.0004	22.5134	0.0060
30	15	33.0	1013.9426	0.0152	∞	1036.3303	0.0161	1755	22.3877	0.0053	20	14.1	1.4	∞	-0.0028	22.3905	23.0107	-0.6202	23.0110	-0.6209	22.3901	-0.0028	0.0004	22.3873	0.0060
30	15	41.5	1017.6149	0.0153	∞	1039.8511	0.0163	1024	22.2362	0.0056	14	14.1	1.4	∞	-0.0028	22.2390	23.0107	-0.7717	23.0110	-0.7694	22.2416	-0.0028	-0.0026	22.2388	0.0060
30	15	52.0	1022.0644	0.0153	∞	1044.1222	0.0165	530	22.0578	0.0060	10	14.1	1.4	∞	-0.0028	22.0607	23.0107	-0.9500	23.0110	-0.9459	22.0651	-0.0028	-0.0044	22.0622	0.0060
30	15	65.0	1027.4442	0.0154	∞	1049.2936	0.0168	260	21.8494	0.0067	6	14.1	1.4	∞	-0.0028	21.8523	23.0107	-1.1584	23.0110	-1.1545	21.8565	-0.0028	-0.0042	21.8536	0.0060
30	20	5.0	1000.4396	0.0050	∞	1023.0857	0.0070	137	22.6461	0.0049	33	14.1	1.4	∞	-0.0024	22.6486	22.7372	-0.0887	22.7379	-0.0887	22.6492	-0.0024	-0.0007	22.6468	0.0060
30	20	10.0	1002.6946	0.0050	∞	1025.2525	0.0071	138	22.5579	0.0050	34	14.1	1.4	∞	-0.0024	22.5603	22.7372	-0.1769	22.7379	-0.1780	22.5599	-0.0024	0.0004	22.5575	0.0060
30	20	15.0	1004.9262	0.0151	∞	1027.3973	0.0158	3380	22.4711	0.0048	30	14.1	1.4	∞	-0.0024	22.4735	22.7372	-0.2637	22.7379	-0.2660	22.4719	-0.0024	0.0016	22.4695	0.0060
30	20	20.0	1007.1348	0.0151	∞	1029.5184	0.0159	3109	22.3836	0.0049	29	14.1	1.4	∞	-0.0024	22.3861	22.7372	-0.3512	22.7379	-0.3525	22.3853	-0.0024	0.0007	22.3829	0.0060
30	20	26.0	1009.7552	0.0151	∞	1032.0377	0.0160	2536	22.2824	0.0051	26	14.1	1.4	∞	-0.0024	22.2849	22.7372	-0.4524	22.7379	-0.4544	22.2835	-0.0024	0.0014	22.2810	0.0060
30	20	33.0	1012.7721	0.0152	∞	1034.9389	0.0161	1755	22.1668	0.0053	21	14.1	1.4	∞	-0.0024	22.1692	22.7372	-0.5680	22.7379	-0.5704	22.1675	-0.0024	0.0017	22.1651	0.0060
30	20	41.5	1016.3784	0.0152	∞	1038.4110	0.0163	1024	22.0326	0.0056	15	14.1	1.4	∞	-0.0024	22.0350	22.7372	-0.7022	22.7379	-0.7070	22.0309	-0.0024	0.0042	22.0284	0.0060
30	20	52.0	1020.7493	0.0153	∞	1042.6201	0.0165	530	21.8709	0.0061	10	14.1	1.4	∞	-0.0024	21.8733	22.7372	-0.8639	22.7379	-0.8696	21.8683	-0.0024	0.0050	21.8658	0.0060
30	20	65.0	1026.0366	0.0154	∞	1047.7179	0.0168	260	21.6813	0.0067	7	14.1	1.4	∞	-0.0024	21.6837	22.7372	-1.0535	22.7379	-1.0620	21.6759	-0.0024	0.0078	21.6735	0.0060
30	25	5.0	999.2462	0.0050	∞	1021.6712	0.0070	137	22.4250	0.0049	33	14.1	1.4	∞	-0.0021	22.4271	22.5104	-0.0834	22.5105	-0.0825	22.4280	-0.0021	-0.0010	22.4260	0.0060
30	25	10.0	1001.4670	0.0050	∞	1023.8118	0.0071	139	22.3448	0.0050	34	14.1	1.4	∞	-0.0021	22.3469	22.5104	-0.1635	22.5105	-0.1656	22.3449	-0.0021	0.0019	22.3429	0.0060
30	25	15.0	1003.6648	0.0151	∞	1025.9279	0.0158	3381	22.2632	0.0049	31	14.1	1.4	∞	-0.0021	22.2653	22.5104	-0.2452	22.5105	-0.2474	22.2631	-0.0021	0.0022	22.2610	0.0060
30	25	20.0	1005.8400	0.0151	∞	1028.0200	0.0159	3111	22.1800	0.0050	31	14.1	1.4	∞	-0.0021	22.1821	22.5104	-0.3284	22.5105	-0.3280	22.1826	-0.0021	-0.0005	22.1805	0.0060
30	25	26.0	1008.4210	0.0151	∞	1030.5081	0.0160	2537	22.0871	0.0052	28	14.1	1.4	∞	-0.0021	22.0892	22.5104	-0.4213	22.5105	-0.4227	22.0878	-0.0021	0.0013	22.0858	0.0060
30	25	33.0	1011.3928	0.0152	∞	1033.3713	0.0161	1756	21.9785	0.0054	22	14.1	1.4	∞	-0.0021	21.9806	22.5104	-0.5298	22.5105	-0.5306	21.9800	-0.0021	0.0006	21.9779	0.0060
30	25	41.5	1014.9457	0.0152	∞	1036.7982	0.0163	1025	21.8525	0.0057	15	14.1	1.4	∞	-0.0021	21.8545	22.5104	-0.6559	22.5105	-0.6577	21.8528	-0.0021	0.0017	21.8507	0.0060
30	25	52.0	1019.2528	0.0153	∞	1040.9532	0.0165	530	21.7005	0.0061	10	14.1	1.4	∞	-0.0021	21.7026	22.5104	-0.8079	22.5105	-0.8090	21.7015	-0.0021	0.0011	21.6994	0.0060
30	25	65.0	1024.4644	0.0154	∞	1045.9876	0.0168	260	21.5233	0.0068	7	14.1	1.4	∞	-0.0021	21.5254	22.5104	-0.9851	22.5105	-0.9882	21.5223	-0.0021	0.0031	21.5202	0.0060
30	30	5.0	997.8217	0.0050	∞	1020.0644	0.0070	137	22.2427	0.0049	33	14.1	1.4	∞	-0.0018	22.2445	22.3230	-0.0785	22.3220	-0.0777	22.2443	-0.0018	0.0002	22.2425	0.0060
30	30	10.0	1000.0159	0.0050	∞	1022.1815	0.0071	139	22.1656	0.0050	34	14.1	1.4	∞	-0.0018	22.1674	22.3230	-0.1556	22.3220	-0.1559	22.1661	-0.0018	0.0013	22.1643	0.0060
30	30	15.0	1002.1873	0.0150	∞	1024.2756	0.0158	3381	22.0883	0.0050	33	14.1	1.4	∞	-0.0018	22.0901	22.3230	-0.2329	22.3220	-0.2329	22.0891	-0.0018	0.0010	22.0873	0.0060
30	30	20.0	1004.3364	0.0151	∞	1026.3497	0.0159	3110	22.0133	0.0051	32	14.1	1.4	∞	-0.0018	22.0151	22.3230	-0.3078	22.3220	-0.3086	22.0134	-0.0018	0.0017	22.0116	0.0060
30	30	26.0	1006.8864	0.0151	∞	1028.8111	0.0160	2537	21.9247	0.0052	29	14.1	1.4	∞	-0.0018	21.9265	22.3230	-0.3965	22.3220	-0.3976	21.9243	-0.0018	0.0022	21.9225	0.0060
30	30	33.0	1009.8225	0.0151	∞	1031.6454	0.0161	1756	21.8228	0.0054	23	14.1	1.4	∞	-0.0018	21.8246	22.3230	-0.4983	22.3220	-0.4990	21.8230	-0.0018	0.0017	21.8212	0.0060
30	30	41.5	1013.3330	0.0152	∞	1035.0349	0.0163	1025	21.7019	0.0058	16	14.1	1.4	∞	-0.0018	21.7036	22.3230	-0.6193	22.3220	-0.6185	21.7035	-0.0018	0.0001	21.7017	0.0060
30	30	52.0	1017.5889	0.0153	∞	1039.1494	0.0165	530	21.5605	0.0062	11	14.1	1.4	∞	-0.0018	21.5623	22.3230	-0.7607	22.3220	-0.7606	21.5613	-0.0018	0.0010	21.5595	0.0060
30	30	65.0	1022.7396	0.0153	∞	1044.1324	0.0168	260	21.3929	0.0068	7	14.1	1.4	∞	-0.0018	21.3947	22.3230	-0.9283	22.3220	-0.9291	21.3929	-0.0018	0.0017	21.3911	0.0060
30	35	5.0	996.1859	0.0050	∞	1018.2753	0.0070	137	22.0893	0.0049	34	14.1	1.4	∞	-0.0015	22.0909	22.1655	-0.0746	22.1669	-0.0739	22.0930	-0.0015	-0.0021	22.0915	0.0060
30	35	10.0	998.3601	0.0050	∞	1020.3751	0.0071	139	22.0150	0.0050	35	14.1	1.4	∞	-0.0015	22.0165	22.1655	-0.1490	22.1669	-0.1483	22.0187	-0.0015	-0.0022	22.0171	0.0060
30	35	15.0	1000.5116	0.0150	∞	1022.4538	0.0158	3381	21.9422	0.0051	35	14.1	1.4	∞	-0.0015	21.9437	22.1655	-0.2218	22.1669	-0.2214	21.9455	-0.0015	-0.0018	21.9440	0.0060
30	35	20.0	1002.6408	0.0150	∞	1024.5110	0.0159	3110	21.8702	0.0052	34	14.1	1.4	∞	-0.0015	21.8717	22.1655	-0.2938	22.1669	-0.2932	21.8737	-0.0015	-0.0020	21.8721	0.0060
30	35	26.0	1005.1671	0.0151	∞	1026.9528	0.0160	2537	21.7857	0.0053	31	14.1	1.4	∞	-0.0015	21.7873	22.1655	-0.3783	22.1669	-0.3777	21.7892	-0.0015	-0.0019	21.7877	0.0060
30	35	33.0	1008.0758	0.0151	∞	1029.7653	0.0161	1756	21.6894	0.0055	24	14.1	1.4	∞	-0.0015	21.6910	22.1655	-0.4746	22.1669	-0.4738	21.6931	-0.0015	-0.0021	21.6916	0.0060
30	35	41.5	1011.5534	0.0152	∞	1033.1290	0.0163	1025	21.5756	0.0058	17	14.1	1.4	∞	-0.0015	21.5771	22.1655	-0.5884	22.1669	-0.5870	21.5799	-0.0015	-0.0028	21.5784	0.0060
30	35	52.0	1015.7696	0.0152	∞	1037.2108	0.0165	530	21.4412	0.0063	11	14.1	1.4	∞	-0.0015	21.4427	22.1655	-0.7228	22.1669	-0.7218	21.4451	-0.0015	-0.0024	21.4436	0.0060
30	35	65.0	1020.8723	0.0153	∞	1042.1548	0.0168	260	21.2825	0.0069	7	14.1	1.4	∞	-0.0015	21.2840	22.1655	-0.8815	22.1669	-0.8814	21.2855	-0.0015	-0.0015	21.2840	0.0060

Salinity 35

Practical salinity	Temperature	Pressure	Water reference density			Seawater density			Relative seawater density			Silicate molality			Δρ-S-Relation										
															Air	Dataset			Relation				Air	Residua	Salt + Air	
S	T	p	$\rho_{H2O,0}$	u	ν_{eff}	ρ_{SW}	u	ν_{eff}	$\Delta\rho_{SW}$	u	ν_{eff}	b_0	u	ν_{eff}	$\Delta\rho_{SW,a}$	$\Delta\rho_{SW,0}$	$\Delta\rho_{SW,0}(p_0)$	$\Delta\Delta\rho_{SW,0}(p)$	$\Delta\rho_{SW,0}(p_0)$	$\Delta\Delta\rho_{SW,0}(p)$	$\Delta\rho_{SW,0}$	$\Delta\rho_{SW,a}$	Δ	$\Delta\rho_{SW}$	U
–	°C	MPa	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	µmol kg^{-1}	µmol kg^{-1}	–	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}
35	5	5.0	1002.3620	0.0050	∞	1029.9139	0.0070	137	27.5519	0.0049	33	16.5	1.7	∞	-0.0039	27.5558	27.6944	-0.1385	27.6944	-0.1379	27.5565	-0.0039	-0.0006	27.5525	0.0060
35	5	10.0	1004.7801	0.0050	∞	1032.1931	0.0071	139	27.4129	0.0050	34	16.5	1.7	∞	-0.0039	27.4169	27.6944	-0.2775	27.6944	-0.2767	27.4176	-0.0039	-0.0007	27.4137	0.0060
35	5	15.0	1007.1716	0.0151	∞	1034.4494	0.0158	3381	27.2778	0.0047	27	16.5	1.7	∞	-0.0039	27.2818	27.6944	-0.4126	27.6944	-0.4134	27.2809	-0.0039	0.0008	27.2770	0.0060
35	5	20.0	1009.5367	0.0151	∞	1036.6783	0.0159	3111	27.1416	0.0048	27	16.5	1.7	∞	-0.0039	27.1455	27.6944	-0.5488	27.6944	-0.5478	27.1466	-0.0039	-0.0011	27.1426	0.0060
35	5	26.0	1012.3408	0.0152	∞	1039.3252	0.0160	2537	26.9844	0.0050	24	16.5	1.7	∞	-0.0039	26.9883	27.6944	-0.7060	27.6944	-0.7058	26.9886	-0.0039	-0.0003	26.9846	0.0060
35	5	33.0	1015.5660	0.0152	∞	1042.3718	0.0161	1756	26.8058	0.0052	19	16.5	1.7	∞	-0.0039	26.8098	27.6944	-0.8846	27.6944	-0.8855	26.8088	-0.0039	0.0009	26.8049	0.0060
35	5	41.5	1019.4167	0.0153	∞	1046.0059	0.0163	1025	26.5892	0.0055	14	16.5	1.7	∞	-0.0039	26.5932	27.6944	-1.1012	27.6944	-1.0970	26.5973	-0.0039	-0.0042	26.5934	0.0060
35	5	52.0	1024.0766	0.0154	∞	1050.4155	0.0165	530	26.3389	0.0060	9	16.5	1.7	∞	-0.0039	26.3428	27.6944	-1.3515	27.6944	-1.3482	26.3461	-0.0039	-0.0033	26.3422	0.0060
35	5	65.0	1029.7021	0.0154	∞	1055.7447	0.0168	260	26.0427	0.0066	6	16.5	1.7	∞	-0.0039	26.0466	27.6944	-1.6477	27.6944	-1.6447	26.0496	-0.0039	-0.0030	26.0457	0.0060
35	10	5.0	1002.0313	0.0050	∞	1029.1447	0.0070	137	27.1134	0.0049	33	16.5	1.7	∞	-0.0033	27.1167	27.2392	-0.1225	27.2376	-0.1230	27.1146	-0.0033	0.0021	27.1113	0.0060
35	10	10.0	1004.3831	0.0050	∞	1031.3723	0.0071	139	26.9893	0.0050	34	16.5	1.7	∞	-0.0033	26.9926	27.2392	-0.2466	27.2376	-0.2469	26.9907	-0.0033	0.0019	26.9873	0.0060
35	10	15.0	1006.7096	0.0151	∞	1033.5758	0.0158	3381	26.8662	0.0048	28	16.5	1.7	∞	-0.0033	26.8695	27.2392	-0.3697	27.2376	-0.3690	26.8686	-0.0033	0.0009	26.8653	0.0060
35	10	20.0	1009.0115	0.0151	∞	1035.7579	0.0159	3110	26.7465	0.0049	27	16.5	1.7	∞	-0.0033	26.7498	27.2392	-0.4894	27.2376	-0.4891	26.7485	-0.0033	0.0013	26.7451	0.0060
35	10	26.0	1011.7415	0.0152	∞	1038.3469	0.0160	2537	26.6054	0.0050	25	16.5	1.7	∞	-0.0033	26.6088	27.2392	-0.6304	27.2376	-0.6304	26.6071	-0.0033	0.0016	26.6038	0.0060
35	10	33.0	1014.8829	0.0152	∞	1041.3280	0.0161	1756	26.4450	0.0052	20	16.5	1.7	∞	-0.0033	26.4484	27.2392	-0.7909	27.2376	-0.7913	26.4462	-0.0033	0.0022	26.4429	0.0060
35	10	41.5	1018.6358	0.0153	∞	1044.8906	0.0163	1025	26.2548	0.0055	14	16.5	1.7	∞	-0.0033	26.2581	27.2392	-0.9811	27.2376	-0.9809	26.2567	-0.0033	0.0015	26.2533	0.0060
35	10	52.0	1023.1806	0.0153	∞	1049.2111	0.0165	530	26.0304	0.0060	9	16.5	1.7	∞	-0.0033	26.0338	27.2392	-1.2055	27.2376	-1.2063	26.0312	-0.0033	0.0025	26.0279	0.0060
35	10	65.0	1028.6722	0.0154	∞	1054.4380	0.0168	260	25.7658	0.0066	6	16.5	1.7	∞	-0.0033	25.7691	27.2392	-1.4701	27.2376	-1.4729	25.7647	-0.0033	0.0045	25.7613	0.0060
35	15	5.0	1001.3779	0.0050	∞	1028.1240	0.0070	137	26.7461	0.0049	33	16.5	1.7	∞	-0.0028	26.7489	26.8604	-0.1114	26.8588	-0.1114	26.7474	-0.0028	0.0015	26.7445	0.0060
35	15	10.0	1003.6761	0.0050	∞	1030.3085	0.0071	138	26.6325	0.0050	34	16.5	1.7	∞	-0.0028	26.6353	26.8604	-0.2250	26.8588	-0.2236	26.6351	-0.0028	0.0002	26.6323	0.0060
35	15	15.0	1005.9500	0.0151	∞	1032.4725	0.0158	3381	26.5224	0.0048	29	16.5	1.7	∞	-0.0028	26.5253	26.8604	-0.3351	26.8588	-0.3343	26.5244	-0.0028	0.0008	26.5216	0.0060
35	15	20.0	1008.2003	0.0151	∞	1034.6135	0.0159	3110	26.4132	0.0049	28	16.5	1.7	∞	-0.0028	26.4160	26.8604	-0.4443	26.8588	-0.4433	26.4155	-0.0028	0.0005	26.4127	0.0060
35	15	26.0	1010.8698	0.0152	∞	1037.1546	0.0160	2536	26.2848	0.0051	25	16.5	1.7	∞	-0.0028	26.2877	26.8604	-0.5727	26.8588	-0.5715	26.2873	-0.0028	0.0004	26.2844	0.0060
35	15	33.0	1013.9426	0.0152	∞	1040.0832	0.0161	1755	26.1406	0.0053	20	16.5	1.7	∞	-0.0028	26.1434	26.8604	-0.7169	26.8588	-0.7176	26.1412	-0.0028	0.0023	26.1383	0.0060
35	15	41.5	1017.6149	0.0153	∞	1043.5818	0.0163	1024	25.9668	0.0056	14	16.5	1.7	∞	-0.0028	25.9697	26.8604	-0.8907	26.8588	-0.8898	25.9690	-0.0028	0.0007	25.9661	0.0060
35	15	52.0	1022.0644	0.0153	∞	1047.8268	0.0165	530	25.7624	0.0060	10	16.5	1.7	∞	-0.0028	25.7653	26.8604	-1.0951	26.8588	-1.0947	25.7640	-0.0028	0.0012	25.7612	0.0060
35	15	65.0	1027.4442	0.0154	∞	1052.9659	0.0168	260	25.5217	0.0067	6	16.5	1.7	∞	-0.0028	25.5245	26.8604	-1.3358	26.8588	-1.3374	25.5214	-0.0028	0.0031	25.5185	0.0060
35	20	5.0	1000.4396	0.0050	∞	1026.8773	0.0070	137	26.4377	0.0049	33	16.5	1.7	∞	-0.0024	26.4401	26.5433	-0.1031	26.5433	-0.1024	26.4409	-0.0024	-0.0007	26.4384	0.0060
35	20	10.0	1002.6946	0.0050	∞	1029.0285	0.0071	138	26.3339	0.0050	34	16.5	1.7	∞	-0.0024	26.3364	26.5433	-0.2069	26.5433	-0.2056	26.3376	-0.0024	-0.0013	26.3352	0.0060
35	20	15.0	1004.9262	0.0151	∞	1031.1572	0.0158	3380	26.2310	0.0048	30	16.5	1.7	∞	-0.0024	26.2334	26.5433	-0.3098	26.5433	-0.3074	26.2359	-0.0024	-0.0024	26.2334	0.0060
35	20	20.0	1007.1348	0.0151	∞	1033.2659	0.0159	3109	26.1311	0.0049	29	16.5	1.7	∞	-0.0024	26.1336	26.5433	-0.4097	26.5433	-0.4076	26.1357	-0.0024	-0.0021	26.1332	0.0060
35	20	26.0	1009.7552	0.0151	∞	1035.7686	0.0160	2536	26.0134	0.0051	26	16.5	1.7	∞	-0.0024	26.0159	26.5433	-0.5274	26.5433	-0.5255	26.0177	-0.0024	-0.0019	26.0153	0.0060
35	20	33.0	1012.7721	0.0152	∞	1038.6495	0.0161	1755	25.8774	0.0053	21	16.5	1.7	∞	-0.0024	25.8798	26.5433	-0.6634	26.5433	-0.6599	25.8834	-0.0024	-0.0035	25.8809	0.0060
35	20	41.5	1016.3784	0.0152	∞	1042.0966	0.0163	1024	25.7182	0.0056	15	16.5	1.7	∞	-0.0024	25.7206	26.5433	-0.8226	26.5433	-0.8183	25.7250	-0.0024	-0.0043	25.7225	0.0060
35	20	52.0	1020.7493	0.0153	∞	1046.2767	0.0165	530	25.5274	0.0061	10	16.5	1.7	∞	-0.0024	25.5299	26.5433	-1.0134	26.5433	-1.0069	25.5364	-0.0024	-0.0065	25.5339	0.0060
35	20	65.0	1026.0366	0.0154	∞	1051.3419	0.0168	260	25.3053	0.0067	7	16.5	1.7	∞	-0.0024	25.3077	26.5433	-1.2355	26.5433	-1.2303	25.3130	-0.0024	-0.0052	25.3105	0.0060
35	25	5.0	999.2462	0.0050	∞	1025.4301	0.0070	137	26.1840	0.0049	33	16.5	1.7	∞	-0.0021	26.1861	26.2813	-0.0952	26.2803	-0.0955	26.1848	-0.0021	0.0013	26.1827	0.0060
35	25	10.0	1001.4670	0.0050	∞	1027.5534	0.0071	139	26.0865	0.0050	34	16.5	1.7	∞	-0.0021	26.0886	26.2813	-0.1927	26.2803	-0.1917	26.0886	-0.0021	0.0000	26.0865	0.0060
35	25	15.0	1003.6648	0.0151	∞	1029.6572	0.0158	3381	25.9925	0.0049	31	16.5	1.7	∞	-0.0021	25.9945	26.2813	-0.2867	26.2803	-0.2865	25.9937	-0.0021	0.0008	25.9916	0.0060
35	25	20.0	1005.8400	0.0151	∞	1031.7384	0.0159	3111	25.8984	0.0050	31	16.5	1.7	∞	-0.0021	25.9005	26.2813	-0.3807	26.2803	-0.3798	25.9004	-0.0021	0.0001	25.8983	0.0060
35	25	26.0	1008.4210	0.0151	∞	1034.2089	0.0160	2537	25.7879	0.0052	28	16.5	1.7	∞	-0.0021	25.7899	26.2813	-0.4913	26.2803	-0.4897	25.7906	-0.0021	-0.0007	25.7885	0.0060
35	25	33.0	1011.3928	0.0152	∞	1037.0568	0.0161	1756	25.6640	0.0054	22	16.5	1.7	∞	-0.0021	25.6661	26.2813	-0.6152	26.2803	-0.6147	25.6656	-0.0021	0.0005	25.6635	0.0060
35	25	41.5	1014.9457	0.0152	∞	1040.4601	0.0163	1025	25.5144	0.0057	15	16.5	1.7	∞	-0.0021	25.5165	26.2813	-0.7648	26.2803	-0.7621	25.5182	-0.0021	-0.0017	25.5161	0.0060
35	25	52.0	1019.2528	0.0153	∞	1044.5931	0.0165	530	25.3403	0.0061	10	16.5	1.7	∞	-0.0021	25.3424	26.2813	-0.9389	26.2803	-0.9375	25.3428	-0.0021	-0.0004	25.3407	0.0060
35	25	65.0	1024.4644	0.0154	∞	1049.5954	0.0168	260	25.1310	0.0068	7	16.5	1.7	∞	-0.0021	25.1331	26.2813	-1.1482	26.2803	-1.1453	25.1350	-0.0021	-0.0019	25.1329	0.0060
35	30	5.0	997.8217	0.0050	∞	1023.7908	0.0070	137	25.9691	0.0049	33	16.5	1.7	∞	-0.0018	25.9709	26.0602	-0.0893	26.0618	-0.0901	25.9716	-0.0018	-0.0008	25.9699	0.0060
35	30	10.0	1000.0159	0.0050	∞	1025.8931	0.0071	139	25.8772	0.0050	34	16.5	1.7	∞	-0.0018	25.8790	26.0602	-0.1812	26.0618	-0.1809	25.8809	-0.0018	-0.0019	25.8791	0.0060
35	30	15.0	1002.1873	0.0150	∞	1027.9763	0.0158	3381	25.7890	0.0050	33	16.5	1.7	∞	-0.0018	25.7908	26.0602	-0.2694	26.0618	-0.2703	25.7915	-0.0018	-0.0007	25.7897	0.0060
35	30	20.0	1004.3364	0.0151	∞	1030.0370	0.0159	3110	25.7006	0.0051	32	16.5	1.7	∞	-0.0018	25.7024	26.0602	-0.3578	26.0618	-0.3582	25.7036	-0.0018	-0.0012	25.7018	0.0060
35	30	26.0	1006.8864	0.0151	∞	1032.4827	0.0160	2537	25.5963	0.0052	29	16.5	1.7	∞	-0.0018	25.5980	26.0602	-0.4622	26.0618	-0.4615	25.6003	-0.0018	-0.0022	25.5985	0.0060
35	30	33.0	1009.8225	0.0151	∞	1035.3025	0.0161	1756	25.4799	0.0054	23	16.5	1.7	∞	-0.0018	25.4817	26.0602	-0.5785	26.0618	-0.5791	25.4827	-0.0018	-0.0010	25.4809	0.0060
35	30	41.5	1013.3330	0.0152	∞	1038.6747	0.0163	1025	25.3417	0.0058	16	16.5	1.7	∞	-0.0018	25.3435	26.0602	-0.7167	26.0618	-0.7176	25.3442	-0.0018	-0.0007	25.3424	0.0060
35	30	52.0	1017.5889	0.0153	∞	1042.7670	0.0165	530	25.1780	0.0062	11	16.5	1.7	∞	-0.0018	25.1798	26.0602	-0.8804	26.0618	-0.8823	25.1795	-0.0018	0.0003	25.1777	0.0060
35	30	65.0	1022.7396	0.0153	∞	1047.7200	0.0168	260	24.9805	0.0068	7	16.5	1.7	∞	-0.0018	24.9823	26.0602	-1.0779	26.0618	-1.0773	24.9845	-0.0018	-0.0022	24.9827	0.0060
35	35	5.0	996.1859	0.0050	∞	1021.9825	0.0070	137	25.7966	0.0049	34	16.5	1.7	∞	-0.0015	25.7981	25.8827	-0.0846	25.8818	-0.0860	25.7958	-0.0015	0.0023	25.7942	0.0060
35	35	10.0	998.3601	0.0050	∞	1024.0689	0.0071	139	25.7088	0.0050	35	16.5	1.7	∞	-0.0015	25.7103	25.8827	-0.1724	25.8818	-0.1725	25.7093	-0.0015	0.0011	25.7077	0.0060
35	35	15.0	1000.5116	0.0150	∞	1026.1356	0.0158	3381	25.6240	0.0051	35	16.5	1.7	∞	-0.0015	25.6256	25.8827	-0.2572	25.8818	-0.2576	25.6242	-0.0015	0.0014	25.6227	0.0060
35	35	20.0	1002.6408	0.0150	∞	1028.1823	0.0159	3110	25.5415	0.0052	34	16.5	1.7	∞	-0.0015	25.5430	25.8827	-0.3397	25.8818	-0.3411	25.5406	-0.0015	0.0024	25.5391	0.0060
35	35	26.0	1005.1671	0.0151	∞	1030.6110	0.0160	2537	25.4438	0.0053	31	16.5	1.7	∞	-0.0015	25.4454	25.8827	-0.4373	25.8818	-0.4393	25.4425	-0.0015	0.0029	25.4410	0.0060
35	35	33.0	1008.0758	0.0151	∞	1033.4080	0.0161	1756	25.3321	0.0055	24	16.5	1.7	∞	-0.0015	25.3337	25.8827	-0.5490	25.8818	-0.5509	25.3309	-0.0015	0.0028	25.3294	0.0060
35	35	41.5	1011.5534	0.0152	∞	1036.7546	0.0163	1025	25.2011	0.0058	17	16.5	1.7	∞	-0.0015	25.2027	25.8827	-0.6801	25.8818	-0.6821	25.1996	-0.0015	0.0030	25.1981	0.0060
35	35	52.0	1015.7696	0.0152	∞	1040.8137	0.0165	530	25.0441	0.0063	11	16.5	1.7	∞	-0.0015	25.0456	25.8827	-0.8371	25.8818	-0.8381	25.0436	-0.0015	0.0020	25.0421	0.0060
35	35	65.0	1020.8723	0.0153	∞	1045.7321	0.0168	260	24.8598	0.0069	7	16.5	1.7	∞	-0.0015	24.8613	25.8827	-1.0214	25.8818	-1.0227	24.8590	-0.0015	0.0023	24.8575	0.0060

Sect. 4 (coefficients)

Auxiliary coefficients		
Cofficient	Unit	Value
S_o	-	35
T_o	K	288.15
p_o	MPa	0.101325
π_o	-	1000
$\Delta\rho_{o,0}$	kg m^{-3}	30
$\Delta\Delta\rho_{o,0}$	kg m^{-3}	2

Coefficients of $\Delta\rho_{SW,0}(p_0)$		
i	j	$a_{i,j}$
0	0	2.65627133E+02
0	1	-2.272462E+01
0	2	3.17932E+00
0	3	-2.78076E-01
0	4	-3.7051E-02
0	5	-6.648E-03
1	0	-1.198640497E+03
1	1	8.0658117E+01
1	2	-8.62107E+00
1	3	6.3513E-01
1	4	6.7777E-02
2	0	2.182680018E+03
2	1	-1.0724787E+02
2	2	7.686316E+00
2	3	-4.1658E-01
3	0	-1.996354156E+03
3	1	6.332479E+01
3	2	-2.182108E+00
4	0	9.16301655E+02
4	1	-1.4043174E+01
5	0	-1.68713114E+02

Coefficients of $\Delta\Delta\rho_{SW,0}(p - p_0)$			
i	j	k	$b_{i,j,k}$
0	0	0	-7.739482E+02
0	0	1	7.621224E+01
0	0	2	-2.47174E+00
0	0	3	-5.109E-01
0	0	4	5.975E-02
0	1	0	2.95926E+00
0	1	1	-1.98326E+00
0	1	2	5.0082E-01
0	1	3	-6.353E-02
0	2	0	-4.73032E+00
0	2	1	-1.2834E+00
0	2	2	-7.863E-02
0	3	0	4.9266E-01
0	3	1	-1.9762E-01
0	4	0	-5.466E-02
1	0	0	2.7623136E+03
1	0	1	-2.061301E+02
1	0	2	5.30055E+00
1	0	3	3.8065E-01
1	1	0	2.09786E+00
1	1	1	4.38047E+00
1	1	2	-2.5183E-01
1	2	0	8.72384E+00
1	2	1	1.7845E+00
1	3	0	-1.2344E-01
2	0	0	-3.72241428E+03
2	0	1	1.8587744E+02
2	0	2	-2.80757E+00
2	1	0	-1.147437E+01
2	1	1	-2.9345E+00
2	2	0	-4.66432E+00
3	0	0	2.2414666E+03
3	0	1	-5.56069E+01
3	1	0	6.98502E+00
4	0	0	-5.0878713E+02

Coefficients of $\Delta\rho_{SW,a}$	
i	c_i
0	1.03E-01
1	-2.371E+05
2	1.82E-07
ΔT	75

Sect. 4 (validation measurements)

Date of salinity measurement	Practical salinity from measurement					Temperature	Pressure	Date of density measurement	Seawater density from substitution measurement			Density correction to (integer) target salinity			Density change due to preparation (isotopic composition)				Density change due to storage (salt composition)			Density correction due to measurement (air saturation)			Practical salinity	Temperature	Pressure	Water reference density			Seawater density (at uniform conditions)			Relative seawater density			Silicate molality			Air	Dataset			Deviation
–	S	$u(S)$	$d\rho/dS$	$u(\rho)$	ν	T	p	–	$\rho_{SW,subs}$	u	ν_{eff}	$\Delta\rho_{SW,tar}$	u	ν_{eff}	$\Delta\rho_{SW,prep}$	$\Delta\rho_{SW,iso}$	u	ν_{eff}	$\Delta\rho_{SW,stor}$	u	ν_{eff}	$\Delta\rho_{SW,aer}$	u	ν_{eff}	S	T	p	$\rho_{H2O,0}$	u	ν_{eff}	ρ_{SW}	u	ν_{eff}	$\Delta\rho_{SW}$	u	ν_{eff}	b_0	u	ν_{eff}	$\Delta\rho_{SW,a}$	$\Delta\rho_{SW,0}$	$\Delta\rho_{SW,0}(p_0)$	$\Delta\Delta\rho_{SW,0}(p)$	Δ
–	–	–	kg m^{-3}	kg m^{-3}	–	°C	MPa	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	–	°C	MPa	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	kg m^{-3}	kg m^{-3}	–	µmol kg^{-1}	µmol kg^{-1}	–	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}	kg m^{-3}
2011–10	2.0010	0.0011	0.80	0.0009	2	5	0.101325	2014–09	1001.5578	0.0008	60	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0018	0.0002	∞	-0.0010	0.0002	∞	2	5	0.101325	999.9666	0.0005	∞	1001.5562	0.0012	8	1.5896	0.0011	6	0.9	0.1	∞	-0.0039	1.5935	1.5935	0.0000	-0.3
2011–10	2.0010	0.0011	0.78	0.0009	2	10	0.101325	2014–09	1001.2647	0.0008	60	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0018	0.0002	∞	-0.0006	0.0002	∞	2	10	0.101325	999.7025	0.0005	∞	1001.2636	0.0012	8	1.5611	0.0011	6	0.9	0.1	∞	-0.0033	1.5644	1.5644	0.0000	-0.6
2011–10	2.0010	0.0011	0.77	0.0008	2	15	0.101325	2014–09	1000.6427	0.0008	60	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0018	0.0002	∞	-0.0003	0.0002	∞	2	15	0.101325	999.1026	0.0005	∞	1000.6419	0.0012	8	1.5393	0.0011	6	0.9	0.1	∞	-0.0028	1.5421	1.5421	0.0000	0.4
2011–10	2.0010	0.0011	0.76	0.0008	2	20	0.101325	2014–09	999.7271	0.0008	60	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0000	0.0000	∞	2	20	0.101325	998.2072	0.0005	∞	999.7266	0.0012	8	1.5194	0.0011	6	0.9	0.1	∞	-0.0024	1.5219	1.5219	0.0000	-1.0
2011–10	2.0010	0.0011	0.75	0.0008	2	25	0.101325	2014–09	998.5525	0.0008	60	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0018	0.0002	∞	0.0002	0.0002	∞	2	25	0.101325	997.0476	0.0005	∞	998.5522	0.0012	9	1.5046	0.0011	6	0.9	0.1	∞	-0.0021	1.5066	1.5066	0.0000	-0.9
2011–03	9.9887	0.0003	0.80	0.0002	6	1	0.101325	2015–09	1007.9566	0.0009	70	0.0091	0.0000	∞	-0.0018	-0.0003	0.0002	∞	0.0030	0.0002	∞	-0.0015	0.0002	∞	10	1	0.101325	999.9018	0.0005	∞	1007.9627	0.0009	93	8.0608	0.0008	47	4.7	0.5	∞	-0.0045	8.0654	8.0654	0.0000	-1.9
2011–10	14.9999	0.0002	0.80	0.0002	8	1	0.101325	2015–09	1011.9786	0.0009	79	0.0001	0.0000	∞	-0.0014	-0.0003	0.0002	∞	0.0022	0.0002	∞	-0.0015	0.0002	∞	15	1	0.101325	999.9018	0.0005	∞	1011.9762	0.0009	103	12.0743	0.0008	53	7.1	0.7	∞	-0.0045	12.0789	12.0789	0.0000	-1.8
2011–10	20.0009	0.0003	0.80	0.0002	7	1	0.101325	2015–09	1015.9912	0.0009	89	-0.0007	0.0000	∞	-0.0011	-0.0003	0.0002	∞	0.0021	0.0002	∞	-0.0015	0.0002	∞	20	1	0.101325	999.9018	0.0005	∞	1015.9877	0.0010	115	16.0859	0.0008	63	9.4	0.9	∞	-0.0045	16.0904	16.0904	0.0000	-0.7
2011–10	25.0047	0.0002	0.80	0.0002	17	1	0.101325	2015–09	1020.0045	0.0009	99	-0.0038	0.0000	∞	-0.0007	-0.0003	0.0002	∞	0.0020	0.0002	∞	-0.0015	0.0000	∞	25	1	0.101325	999.9018	0.0005	∞	1019.9977	0.0010	116	20.0959	0.0008	64	11.8	1.2	∞	-0.0045	20.1004	20.1004	0.0000	-1.5
2011–03	29.9689	0.0003	0.80	0.0002	25	1	0.101325	2015–09	1023.9936	0.0010	110	0.0250	0.0000	∞	-0.0004	-0.0003	0.0002	∞	0.0033	0.0002	∞	-0.0015	0.0002	∞	30	1	0.101325	999.9018	0.0005	∞	1024.0139	0.0010	144	24.1121	0.0009	85	14.1	1.4	∞	-0.0045	24.1166	24.1166	0.0000	2.1
2011–03	34.9917	0.0002	0.80	0.0002	∞	1	0.101325	2015–09	1028.0270	0.0010	121	0.0067	0.0000	∞	0.0000	-0.0003	0.0000	∞	0.0034	0.0002	∞	-0.0015	0.0002	∞	35	1	0.101325	999.9018	0.0005	∞	1028.0285	0.0010	144	28.1267	0.0009	85	16.5	1.7	∞	-0.0045	28.1312	28.1312	0.0000	2.4
2011–10	2.0010	0.0011	0.80	0.0009	2	5	5.0	2014–11	1003.9439	0.0058	71	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0010	0.0002	∞	2	5	5.0	1002.3620	0.0050	∞	1003.9422	0.0059	73	1.5802	0.0031	6	0.9	0.1	∞	-0.0039	1.5841	1.5935	-0.0094	-0.7
2011–10	2.0010	0.0011	0.80	0.0009	2	5	10.0	2014–11	1006.3535	0.0058	71	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0010	0.0002	∞	2	5	10.0	1004.7801	0.0050	∞	1006.3518	0.0059	73	1.5717	0.0031	6	0.9	0.1	∞	-0.0039	1.5757	1.5935	-0.0179	-0.2
2011–10	2.0010	0.0011	0.80	0.0009	2	5	15.0	2014–11	1008.7356	0.0154	3414	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0010	0.0002	∞	2	5	15.0	1007.1716	0.0151	∞	1008.7339	0.0154	3379	1.5623	0.0030	5	0.9	0.1	∞	-0.0039	1.5663	1.5935	-0.0273	-0.9
2011–10	2.0010	0.0011	0.80	0.0009	2	5	20.0	2014–11	1011.0911	0.0154	3444	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0010	0.0002	∞	2	5	20.0	1009.5367	0.0151	∞	1011.0894	0.0154	3408	1.5526	0.0030	5	0.9	0.1	∞	-0.0039	1.5566	1.5935	-0.0369	-2.1
2011–10	2.0010	0.0011	0.80	0.0009	2	5	26.0	2014–11	1013.8870	0.0155	3480	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0010	0.0002	∞	2	5	26.0	1012.3408	0.0152	∞	1013.8853	0.0155	3443	1.5445	0.0030	5	0.9	0.1	∞	-0.0039	1.5485	1.5935	-0.0450	-0.3
2011–10	2.0010	0.0011	0.80	0.0009	2	5	33.0	2014–11	1017.0999	0.0155	3521	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0010	0.0002	∞	2	5	33.0	1015.5660	0.0152	∞	1017.0982	0.0155	3484	1.5323	0.0030	5	0.9	0.1	∞	-0.0039	1.5362	1.5935	-0.0573	-1.4
2011–10	2.0010	0.0011	0.80	0.0009	2	5	41.5	2014–11	1020.9372	0.0156	3570	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0010	0.0002	∞	2	5	41.5	1019.4167	0.0153	∞	1020.9355	0.0156	3532	1.5188	0.0030	5	0.9	0.1	∞	-0.0039	1.5227	1.5935	-0.0708	-1.8
2011–10	2.0010	0.0011	0.80	0.0009	2	5	52.0	2014–11	1025.5815	0.0156	3626	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0010	0.0002	∞	2	5	52.0	1024.0766	0.0154	∞	1025.5798	0.0157	3588	1.5032	0.0030	5	0.9	0.1	∞	-0.0039	1.5072	1.5935	-0.0863	-1.9
2011–10	2.0010	0.0011	0.80	0.0009	2	5	65.0	2014–11	1031.1899	0.0157	3688	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0010	0.0002	∞	2	5	65.0	1029.7021	0.0154	∞	1031.1882	0.0157	3649	1.4861	0.0030	5	0.9	0.1	∞	-0.0039	1.4900	1.5935	-0.1035	-1.0
2011–10	2.0010	0.0011	0.78	0.0009	2	10	5.0	2015–05	1003.5861	0.0058	71	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0022	0.0002	∞	-0.0006	0.0002	∞	2	10	5.0	1002.0313	0.0050	∞	1003.5845	0.0059	73	1.5532	0.0031	6	0.9	0.1	∞	-0.0033	1.5566	1.5644	-0.0079	-0.4
2011–10	2.0010	0.0011	0.78	0.0009	2	10	10.0	2015–05	1005.9277	0.0058	71	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0022	0.0002	∞	-0.0006	0.0002	∞	2	10	10.0	1004.3831	0.0050	∞	1005.9261	0.0059	73	1.5431	0.0031	6	0.9	0.1	∞	-0.0033	1.5464	1.5644	-0.0180	-2.6
2011–10	2.0010	0.0011	0.78	0.0009	2	10	15.0	2015–05	1008.2472	0.0154	3414	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0022	0.0002	∞	-0.0006	0.0002	∞	2	10	15.0	1006.7096	0.0151	∞	1008.2457	0.0154	3382	1.5360	0.0031	5	0.9	0.1	∞	-0.0033	1.5394	1.5644	-0.0250	-1.8
2011–10	2.0010	0.0011	0.78	0.0009	2	10	20.0	2015–05	1010.5414	0.0154	3444	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0022	0.0002	∞	-0.0006	0.0002	∞	2	10	20.0	1009.0115	0.0151	∞	1010.5399	0.0154	3412	1.5284	0.0031	5	0.9	0.1	∞	-0.0033	1.5318	1.5644	-0.0327	-1.8
2011–10	2.0010	0.0011	0.78	0.0009	2	10	26.0	2015–05	1013.2610	0.0155	3480	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0022	0.0002	∞	-0.0006	0.0002	∞	2	10	26.0	1011.7415	0.0152	∞	1013.2595	0.0155	3447	1.5180	0.0031	5	0.9	0.1	∞	-0.0033	1.5214	1.5644	-0.0431	-3.3
2011–10	2.0010	0.0011	0.78	0.0009	2	10	33.0	2015–05	1016.3931	0.0155	3521	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0022	0.0002	∞	-0.0006	0.0002	∞	2	10	33.0	1014.8829	0.0152	∞	1016.3916	0.0155	3487	1.5087	0.0031	5	0.9	0.1	∞	-0.0033	1.5120	1.5644	-0.0524	-2.6
2011–10	2.0010	0.0011	0.78	0.0009	2	10	41.5	2015–05	1020.1339	0.0156	3570	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0022	0.0002	∞	-0.0006	0.0002	∞	2	10	41.5	1018.6358	0.0153	∞	1020.1324	0.0156	3535	1.4966	0.0031	5	0.9	0.1	∞	-0.0033	1.4999	1.5644	-0.0645	-3.0
2011–10	2.0010	0.0011	0.78	0.0009	2	10	52.0	2015–05	1024.6662	0.0156	3626	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0022	0.0002	∞	-0.0006	0.0002	∞	2	10	52.0	1023.1806	0.0153	∞	1024.6647	0.0157	3591	1.4841	0.0031	5	0.9	0.1	∞	-0.0033	1.4874	1.5644	-0.0770	-1.7
2011–10	2.0010	0.0011	0.78	0.0009	2	10	65.0	2015–05	1030.1417	0.0157	3688	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0022	0.0002	∞	-0.0006	0.0002	∞	2	10	65.0	1028.6722	0.0154	∞	1030.1402	0.0157	3653	1.4680	0.0031	6	0.9	0.1	∞	-0.0033	1.4713	1.5644	-0.0931	-1.7
2011–10	2.0010	0.0011	0.77	0.0008	2	15	5.0	2014–11	1002.9109	0.0058	71	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0003	0.0002	∞	2	15	5.0	1001.3779	0.0050	∞	1002.9100	0.0059	73	1.5321	0.0031	6	0.9	0.1	∞	-0.0028	1.5349	1.5421	-0.0072	0.5
2011–10	2.0010	0.0011	0.77	0.0008	2	15	10.0	2014–11	1005.2027	0.0058	71	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0003	0.0002	∞	2	15	10.0	1003.6761	0.0050	∞	1005.2018	0.0059	73	1.5258	0.0031	6	0.9	0.1	∞	-0.0028	1.5286	1.5421	-0.0135	1.5
2011–10	2.0010	0.0011	0.77	0.0008	2	15	15.0	2014–11	1007.4695	0.0154	3414	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0003	0.0002	∞	2	15	15.0	1005.9500	0.0151	∞	1007.4686	0.0154	3385	1.5186	0.0031	6	0.9	0.1	∞	-0.0028	1.5214	1.5421	-0.0207	1.4
2011–10	2.0010	0.0011	0.77	0.0008	2	15	20.0	2014–11	1009.7125	0.0154	3444	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0003	0.0002	∞	2	15	20.0	1008.2003	0.0151	∞	1009.7117	0.0154	3414	1.5113	0.0031	6	0.9	0.1	∞	-0.0028	1.5142	1.5421	-0.0279	1.1
2011–10	2.0010	0.0011	0.77	0.0008	2	15	26.0	2014–11	1012.3738	0.0155	3480	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0003	0.0002	∞	2	15	26.0	1010.8698	0.0152	∞	1012.3729	0.0155	3450	1.5031	0.0031	6	0.9	0.1	∞	-0.0028	1.5059	1.5421	-0.0362	0.9
2011–10	2.0010	0.0011	0.77	0.0008	2	15	33.0	2014–11	1015.4376	0.0155	3521	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0003	0.0002	∞	2	15	33.0	1013.9426	0.0152	∞	1015.4367	0.0155	3490	1.4940	0.0031	6	0.9	0.1	∞	-0.0028	1.4969	1.5421	-0.0452	0.9
2011–10	2.0010	0.0011	0.77	0.0008	2	15	41.5	2014–11	1019.0994	0.0156	3570	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0003	0.0002	∞	2	15	41.5	1017.6149	0.0153	∞	1019.0985	0.0156	3538	1.4836	0.0032	6	0.9	0.1	∞	-0.0028	1.4864	1.5421	-0.0557	1.1
2011–10	2.0010	0.0011	0.77	0.0008	2	15	52.0	2014–11	1023.5355	0.0156	3626	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0003	0.0002	∞	2	15	52.0	1022.0644	0.0153	∞	1023.5346	0.0157	3594	1.4703	0.0032	6	0.9	0.1	∞	-0.0028	1.4731	1.5421	-0.0690	0.3
2011–10	2.0010	0.0011	0.77	0.0008	2	15	65.0	2014–11	1028.8991	0.0157	3688	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	-0.0003	0.0002	∞	2	15	65.0	1027.4442	0.0154	∞	1028.8982	0.0157	3656	1.4540	0.0032	6	0.9	0.1	∞	-0.0028	1.4569	1.5421	-0.0852	-1.3
2011–10	2.0010	0.0011	0.76	0.0008	2	20	5.0	2014–12	1001.9543	0.0058	71	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0000	0.0000	∞	2	20	5.0	1000.4396	0.0050	∞	1001.9537	0.0059	73	1.5141	0.0031	6	0.9	0.1	∞	-0.0024	1.5166	1.5219	-0.0053	0.5
2011–10	2.0010	0.0011	0.76	0.0008	2	20	10.0	2014–12	1004.2020	0.0058	71	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0000	0.0000	∞	2	20	10.0	1002.6946	0.0050	∞	1004.2014	0.0059	73	1.5068	0.0031	6	0.9	0.1	∞	-0.0024	1.5093	1.5219	-0.0126	-0.1
2011–10	2.0010	0.0011	0.76	0.0008	2	20	15.0	2014–12	1006.4276	0.0154	3414	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0000	0.0000	∞	2	20	15.0	1004.9262	0.0151	∞	1006.4270	0.0154	3386	1.5008	0.0032	6	0.9	0.1	∞	-0.0024	1.5032	1.5219	-0.0187	0.3
2011–10	2.0010	0.0011	0.76	0.0008	2	20	20.0	2014–12	1008.6308	0.0154	3444	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0000	0.0000	∞	2	20	20.0	1007.1348	0.0151	∞	1008.6302	0.0154	3415	1.4954	0.0032	6	0.9	0.1	∞	-0.0024	1.4979	1.5219	-0.0240	1.4
2011–10	2.0010	0.0011	0.76	0.0008	2	20	26.0	2014–12	1011.2441	0.0155	3480	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0000	0.0000	∞	2	20	26.0	1009.7552	0.0151	∞	1011.2435	0.0155	3450	1.4883	0.0032	6	0.9	0.1	∞	-0.0024	1.4908	1.5219	-0.0311	1.7
2011–10	2.0010	0.0011	0.76	0.0008	2	20	33.0	2014–12	1014.2536	0.0155	3521	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0000	0.0000	∞	2	20	33.0	1012.7721	0.0152	∞	1014.2530	0.0155	3491	1.4809	0.0032	6	0.9	0.1	∞	-0.0024	1.4833	1.5219	-0.0385	2.6
2011–10	2.0010	0.0011	0.76	0.0008	2	20	41.5	2014–12	1017.8493	0.0156	3570	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0000	0.0000	∞	2	20	41.5	1016.3784	0.0152	∞	1017.8487	0.0156	3539	1.4703	0.0032	7	0.9	0.1	∞	-0.0024	1.4727	1.5219	-0.0491	1.8
2011–10	2.0010	0.0011	0.76	0.0008	2	20	52.0	2014–12	1022.2097	0.0156	3626	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0000	0.0000	∞	2	20	52.0	1020.7493	0.0153	∞	1022.2091	0.0157	3595	1.4598	0.0033	7	0.9	0.1	∞	-0.0024	1.4622	1.5219	-0.0597	2.8
2011–10	2.0010	0.0011	0.76	0.0008	2	20	65.0	2014–12	1027.4823	0.0157	3688	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0019	0.0002	∞	0.0000	0.0000	∞	2	20	65.0	1026.0366	0.0154	∞	1027.4816	0.0157	3657	1.4450	0.0033	7	0.9	0.1	∞	-0.0024	1.4475	1.5219	-0.0744	1.5
2011–10	2.0010	0.0011	0.75	0.0008	2	25	5.0	2015–01	1000.7458	0.0058	71	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0020	0.0001	∞	0.0002	0.0002	∞	2	25	5.0	999.2462	0.0050	∞	1000.7453	0.0059	73	1.4992	0.0031	6	0.9	0.1	∞	-0.0021	1.5012	1.5066	-0.0054	0.1
2011–10	2.0010	0.0011	0.75	0.0008	2	25	10.0	2015–01	1002.9602	0.0058	71	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0020	0.0001	∞	0.0002	0.0002	∞	2	25	10.0	1001.4670	0.0050	∞	1002.9596	0.0059	73	1.4927	0.0031	6	0.9	0.1	∞	-0.0021	1.4948	1.5066	-0.0119	-0.1
2011–10	2.0010	0.0011	0.75	0.0008	2	25	15.0	2015–01	1005.1519	0.0154	3414	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0020	0.0001	∞	0.0002	0.0002	∞	2	25	15.0	1003.6648	0.0151	∞	1005.1514	0.0154	3388	1.4866	0.0033	7	0.9	0.1	∞	-0.0021	1.4887	1.5066	-0.0179	-0.1
2011–10	2.0010	0.0011	0.75	0.0008	2	25	20.0	2015–01	1007.3219	0.0154	3444	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0020	0.0001	∞	0.0002	0.0002	∞	2	25	20.0	1005.8400	0.0151	∞	1007.3214	0.0154	3418	1.4814	0.0033	7	0.9	0.1	∞	-0.0021	1.4835	1.5066	-0.0232	0.6
2011–10	2.0010	0.0011	0.75	0.0008	2	25	26.0	2015–01	1009.8959	0.0155	3480	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0020	0.0001	∞	0.0002	0.0002	∞	2	25	26.0	1008.4210	0.0151	∞	1009.8954	0.0155	3453	1.4744	0.0033	7	0.9	0.1	∞	-0.0021	1.4764	1.5066	-0.0302	0.5
2011–10	2.0010	0.0011	0.75	0.0008	2	25	33.0	2015–01	1012.8598	0.0155	3521	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0020	0.0001	∞	0.0002	0.0002	∞	2	25	33.0	1011.3928	0.0152	∞	1012.8593	0.0155	3494	1.4664	0.0033	7	0.9	0.1	∞	-0.0021	1.4685	1.5066	-0.0381	0.4
2011–10	2.0010	0.0011	0.75	0.0008	2	25	41.5	2015–01	1016.4047	0.0156	3570	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0020	0.0001	∞	0.0002	0.0002	∞	2	25	41.5	1014.9457	0.0152	∞	1016.4042	0.0156	3542	1.4584	0.0033	7	0.9	0.1	∞	-0.0021	1.4605	1.5066	-0.0461	1.5
2011–10	2.0010	0.0011	0.75	0.0008	2	25	52.0	2015–01	1020.7007	0.0156	3626	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0020	0.0001	∞	0.0002	0.0002	∞	2	25	52.0	1019.2528	0.0153	∞	1020.7002	0.0157	3598	1.4475	0.0034	8	0.9	0.1	∞	-0.0021	1.4495	1.5066	-0.0571	1.3
2011–10	2.0010	0.0011	0.75	0.0008	2	25	65.0	2015–01	1025.8986	0.0157	3688	-0.0008	0.0000	∞	-0.0023	-0.0003	0.0002	∞	0.0020	0.0001	∞	0.0002	0.0002	∞	2	25	65.0	1024.4644	0.0154	∞	1025.8981	0.0157	3659	1.4338	0.0034	8	0.9	0.1	∞	-0.0021	1.4359	1.5066	-0.0708	0.1