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Ocean Science Discussions

Interactive comment on "The density of seawater as a function of salinity (5 to 70 g kg^{-1}) and temperature (0 to 90 °C)" *by* F. J. Millero and F. Huang

Anonymous Referee #1

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The manuscript extends the range of density measurements on seawater towards higher densities and salinities. Generally, the underlying work is important and interesting for the scientific community. Several important aspects, however, in the description of the experimental approach are missing, and also one gets the impression that the paper was written in a hurry: in several instances the manuscript is unclear and incomplete. It requires major revision as detailed below:

Abstract: line 21: add unit for absolute salinity

line 16: what is meant by "The earlier density measurements"?

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Interactive Discussion

Discussion Paper

The estimated uncertainty of the measurements should be stated, not only various standard deviations from the fits.

Page 155: line 11: add unit for density

Page 156: Generally, the authors are much too short on their experimental procedure. Estimates on uncertainty of the measurements (and the individual parameters!) should be given.

What was the motivation for using two different samples? Later on no reference is made to the different samples! Are results consistent?

How can you be sure or ensured that no salts precipitated at high T/S?

State uncertainty in T/S measurement!

How much is the absolute uncertainty of the measurement? How was the instrument calibrated?

line 9: state measurement principle of the Paar instrument!

line 12: "...were then made.."

line 13: " Density measurements ..."

line 13: "... were reproducible..". Better use "repeatability" (one lab, one instrument, ...). How was the repeatability obtained? Measurements (how many?) on one sample or measurements on different, independently prepared samples. The latter approach would of course be preferable as it includes errors in sample preparation. Were later measurements made only once per condition or are the data given averages for repeated runs?

Why are measurements on pure water based on the equations of Kell (1975) and not on a newer standard (IAPWS-95)? I do not see a reasonable substantiation for it.

lines 24 ff Especially under the heading "Experimental methods" reference to other

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density measurements should include some general hint to the types of densimeter used.

Page 158: lines 4/5: "This is similar to the errors in the density measurements..". How exactly were these errors (why plural?) assessed?

lines 7/8: "measurements ..are in reasonable agreement (+/- 0.006) with the measurements of Poisson and Badhouni (1993)." Add unit! Some discussion on these differences is required. Is there a systematic trend? To assess this question it would be helpful if the data of Poisson and Badhouni (1993) were included in the plot for comparison. Is there an indication that the previous data are less reliable?

Eq: (5a): coefficient a_5

Inconsistent handling of units in Eqs. (5)-(5c): some quantities (rho, S_A) have units, while t (meant as t/°C instead of t °C) has not.

line 26 ff: "Most of the data are within 2 sigma". This statement has quite limited value: it is characteristic of a standard deviation that most data (in the case of a normal distribution 95%) are within 2 sigma. In the present case it seems to be much less (if the lines are to represent 2 sigma), why ? I understand that there is some systematic deviation at high T and low S. It is unclear if these deviations occur if both conditions are fulfilled (high T / low S simultaneously) or if they show up at high T (irrespective of S) and vice versa. Fig. 3 is not conclusive in this respect, but tentatively supports the former assumption. From the data presented (neither from the appendices) no deviation from the fit can be obtained for the individual data points (unless one performs the fit by oneself). An augmented presentation and discussion is required. A possible form would be to include designated symbols for selected values, similarly as in Fig. 5 (e.g., for 3-4 different temperatures in the plot with S_A on the abscissa and vice versa).

Table 1: Unit for std error is missing

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Tables 2 /3: unclear: Eq. (5)? Exponents do not comply with those given in Eq. (5) Better directly give coefficients a_i, b_i, c_0

Figures: No reference to Figs. 4 and 5 is made in the text

Fig:1 What does the batch number refer to, why 90-115? Should be explained in the exp. section.

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