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Ocean Science Discussions

Interactive comment on "Numerical implementation and oceanographic application of the thermodynamic potentials of water, vapour, ice, seawater and air – Part 1: Background and equations" *by* R. Feistel et al.

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The paper presents a comprehensive source code library for the thermodynamic properties of liquid water, water vapour, ice, seawater and humid air, where the the newly adopted International Thermodynamic Equation of Sewawater 2010 (TEOS-10) is implemented. This library will be the established standard tool for oceanographers who need to perform calculations related to the thermodynamic properties of seawater (for example calculate the equation of state), and probably also for scientists and engineers in other related fields. The basic idea of its structure is to start by defining numerical

routines for the basic thermodynamic potentials and its derivatives, and then define all other properties by differentiation of these potentials. This ensures that there are no inconsistencies, and it should also make it fairly easy to implement new routines to compute quantities not included in the library (though the list of already implemented quantities seems very extensive).

The paper is very well written. However, I have a few suggestions that could help potential readers.

1. I suspect that many potential users are unfamiliar with the definitions of potential temparature and potential density as partial derivatives of the enthalpy given in section 4.3. The usual (equivalent) definitions are as the temperature and density a parcel would have if it were brought adiabatically to the reference pressure. I suggest mentioning these usual definitions as well, to reassure all readers that these are the same quantities that they are familiar with.

2. Trevor McDougall, who has been deeply involved in the work on TEOS-10, although he is not an author of the present paper, has recently argued convincingly that conservative temperature should be used instead of potential temperature in ocean models. Many oceanographers will probably look in the present paper for information about how to implement this. It would therefore be helpful to discuss this issue briefly in section 4.3, and to give the definition of conservative temperature. In the present version, connservative temperature is merely mentioned in connection with the thermal expansion coefficient α^{Θ}, just after eq. (4.19), but never actually defined.

3. The last two paragraphs of section 4.3 were unclear to me. In what sense are all properties in Tables S9, S10 immediately available from the entropy, provided by the routine 'sea_eta_entropy_si'? And isn't this routine an explicit representation of eq. (4.35), although it is said that one has refrained from this? I also simply

do not understand the last sentence, beginning ’In the libratry discussed in Part II ...’.

4. In some of the tables listing library routines the independent variables are given in the tables themselves (e.g. tables S6 and S15), but in others they are only given in the caption (e.g. tables S2 and S5). I think a uniform practice of always giving them in the tables would be better.

5. The routines for the basic potentials, e.g. ‘flu_f_si’, are not listed in any of the tables. I think it would be useful to include them in a separate table.

Interactive comment on Ocean Sci. Discuss., 7, 521, 2010.