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Interactive comment on "Numerical implementation and oceanographic application of the Gibbs thermodynamic potential of seawater" *by* R. Feistel

D. Webb

david.webb@soc.soton.ac.uk

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My experience of the UNESCO (EOS80) equation of state routines is that they are widely used, often by people with very little knowledge of physics or thermodynamics. So I can imagine with the present routines that there will be many readers asking questions along the lines of Why the Gibbs Function? What is it? What has it to do with reality? Why cannot we just have the density/sound speed/specific heat equation?

In fact Feistel makes a good job of explaining the advantages of the Gibbs Function, referring in the classic way to recent papers which then depend a lot on earlier papers and textbook results. The advantages of the Gibbs Function appear to have been known in Maxwell's day - maybe oceanographers were a bit slow in cottoning on.

To allow for the additional audience for the present paper, I wonder if it is worth adding a short Appendix here, aimed at the intelligent but less expert community and with the references linking to good modern textbooks.

The type of topics that could be covered (and I agree that bits of this are already spread through the text) include:

- that the discovery of the potential functions and their properties was one of the great successes of classical thermodynamics.

- that when potential functions are expanded as functions of appropriate variables, all the quantities of interest, such as density, specific heat and sound speed, can be expressed using derivatives of the potential function and the appropiate variables themselves.

- that a simple example of a potential function is the Internal Energy U of a mass of substance. Physically this is the internal property that is increased by heating or squeezing the mass. It is also affected by changes in chemical composition.

- that unfortunately the appropriate variables of Internal Energy are entropy S and volume V (or 1/density) per unit mass. Entropy cannot be measured and density is often the thing we want.

- that other potential functions can be constructed by adding or subtracting the products TS and PV, both products representing energy per unit mass.

- that the advantage of the Gibbs Function (G = U -TS + PV) is that its appropriate variables are pressure P and temperature T, both readily measured physical quantities.

- that many types of accurate measurements can be combined in a consistent way when constructing the Gibbs Function.

- that the quantities like density, specific heat, adiabatic lapse rate and sound speed are all consistent when calculated from a single Gibbs Function. This is not true for the

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separate EOS80 functions.

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