Interactive comment on “Understanding mixing efficiency in the oceans: do the nonlinearities of the equation of state for seawater matter?” by R. Tailleux

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Michael,

I believe that saying that “energy conversions are inherently non-unique” is looking at energetics from a mathematician’s viewpoint, not a physicist’s viewpoint. My impression is that many colleagues will find it ok, starting from the following equations:

\[
\frac{d(E_1)}{dt} = C_1 \\
\frac{d(E_2)}{dt} = C_2
\]

in which there is no conversion between the reservoirs \( E_1 \) and \( E_2 \) (\( C_1 \) and \( C_2 \) being source/sink terms for \( E_1 \) and \( E_2 \)), to rewrite the equations as follows:

\[
\frac{d(E_1)}{dt} = (C_1 - C_3) + C_3 = C_1^* + C_3 \\
\frac{d(E_2)}{dt} = C_2 + C_3 - C_3 = C_2^* - C_3
\]

and then say that \( C_3 \) is a conversion term between \( E_1 \) and \( E_2 \). If this approach were ok, then it would basically amount to say not only that energy conversions are inherently non-unique, but in fact that energy conversions are completely arbitrary as well, since I can define \( C_3 \) as it pleases me.

In contrast, the approach undertaken in Tailleux (2008) takes the (physical) viewpoint that in nature, the energy must flow in a specific and determined way, and that there must exist a rigorous way to look at the issue of energy conversions that eliminates the above arbitrariness. The conclusions I have reached is that in order to derive a rigorous theory of energy conversions, a number of non-standard energy reservoirs have to be introduced in the context of the fully compressible Navier-Stokes equations. As far as I can judge, my approach allows to make energy conversions well-defined and unique, and establishes that the kind of approach described above is just a mathematical game with no physical justification.

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