

Interactive comment on “The location of the thermodynamic atmosphere–ice interface in fully-coupled models” by A. E. West et al.

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In this short study, the authors examine how the two most widely used methods for thermodynamically coupling the sea-ice surface to an atmosphere model affect simulation results. They find that a tight coupling of the sea-ice surface to the atmospheric state significantly improves the simulation as opposed to a setup where the ice surface is only loosely tied to the atmosphere state at each coupling time step.

I find this study relevant, well written and easy to follow and recommend publication with very minor revision, which should address the following few items:

p.9710, l.9: The coupling across the interface could be implicit, too, if the entire sea-ice temperature field is updated by the atmosphere solver. This is for example sometimes

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done in land models for the calculation of soil-temperature profiles, based on the description by Richtmyer and Morton (1967). The coupling of Winton's model in GFDL behaves like an implicit scheme, too (Winton, A reformulated three layer model, 2000)

p.9711, Eq. (1): κ is usually used for heat diffusivity, while heat conductivity is denoted by k . ($\kappa = k/(\rho c)$). I suggest following this standard for clarity.

p.9714, l.6: This sounds as if the surface temperature directly controls incoming short-wave and incoming longwave, which is not the case. It might help to make more explicit that the entire atmospheric state is affected by surface temperature, which then indirectly affects the incoming fluxes.

p.9716, l.17: It'd be helpful to briefly discuss how an *increased* amplitude at the surface can cause a *decreased* amplitude further down in the ice.

p.9716, l.23: I could not identify any solid grey lines.

p.9721, l.9ff: The CICE documentation suggests that "accuracy may be significantly reduced" by placing the interface below the surface. It'd be helpful to here briefly explain as to why the present study reaches a different conclusion. In that context, it might also be helpful to briefly discuss other model setups, in particular forced ocean-model simulations. While this obviously goes beyond the current focus on "fully-coupled models", this study provides helpful context for such discussion.

– Some typos etc. I spotted:

p.9709, l.20: I recommend putting "(HadGEM3)" after "Centre" in the following line

l.26: no comma after "calculated"

p.9714, l.4: Not clear what "this difficulty" refers to, no real difficulty was mentioned before.

p.9716, l.26: Something is wrong with "our 'truth' the 'CICE' method"

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p.9720, l.25: "T_{atmos}"

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GMDD

8, C3086–C3088, 2015

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