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Southern Ocean air-sea buoyancy flux from an ocean state estimate: can ocean observations provide a valuable constraint on the atmospheric state?

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We have carried out a comparison of the Southern Ocean air-sea heat and freshwater flux estimates for the years 2005-2007 from the eddy-resolving "Southern Ocean State Estimate" (SOSE) by Mazloff et al. (2010) with five other widely used air-sea flux estimates to assess the accuracy of SOSE fluxes, identify the main weaknesses of the SOSE solution and determine how the SOSE solution could be improved. The differences between both heat and freshwater flux estimates by the six products considered here are large, greatest over strong ocean currents where mesoscale activity is heightened (e.g. the ACC and western boundary currents); this emphasizes the importance of allowing for a two-way atmosphere-ocean feedback and resolving mesoscale oceanic features.
The large differences between both heat and freshwater flux estimates for the six products considered here clearly indicate that significant uncertainty remains, and they highlight the need for high-quality in-situ observations. Our results suggest that these observations need not strictly be of atmospheric variables, as ocean observations provide a valuable constraint on the atmospheric state.

SOSE air-sea fluxes are an important advance for the oceanographic studies such as e.g. the study of water mass formation which requires a complete and internally consistent set of surface flux fields and the three-dimensional oceanographic fields such as the fields SOSE provides. SOSE fluxes and three-dimensional oceanic fields are correspondingly used to investigate Subantarctic Mode Water (SAMW) formation and destruction by diapycnal buoyancy supply at the ocean surface and in the ocean interior as well as to identify and quantify SAMW transport pathways.