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Implied ocean heat transports in the standard and super-parameterized community atmospheric models

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Implied ocean heat transports (To) based on net surface energy fluxes have analyzed for two versions of the Community Atmospheric Model (CAM, version 3.0). The first version is the standard CAM with parameterized convection. The second is the Multi-Scale Modeling Framework (MMF), in which parameterized convection is replaced with a two-dimensional cloud-resolving model in each GCM grid column. Net surface shortwave radiation and latent heat fluxes over the oceans are the primary causes of To errors in the MMF. Surface shortwave radiation biases in the MMF are associated with excessive ice water content in deep tropical convection and a deficit of marine stratocumulus clouds. MMF marine stratocumulus clouds are overly sensitive to low-level relative humidity, and form only with nearly saturated conditions and a shallow boundary layer. Latent heat flux errors in the MMF are similar to those found in the CAM. When observed shortwave fluxes are used, both CAM and MMF produce greatly improved To curves for both hemispheres. When To is computed using observed latent heat fluxes, CAM To degrades slightly, and MMF To improves, especially in the sign of Southern Hemisphere transport.