

Do we need non-Boussinesq effects in an ocean general circulation model for climate simulations?

Freitag, 12. April 2024 12:10 (20 Minuten)

The Boussinesq approximation is commonly made in ocean general circulation models (OGCMs). As a consequence, the model ocean is incompressible and conserves volume, but not mass. It has been argued that these consequences introduce errors at the noise level of coarse OGCMs, but that non-Boussinesq modeling is preferable simply for tidiness. Here, we use the height-pressure coordinate isomorphism implemented in the MITgcm to construct a non-Boussinesq OGCM and revisit the differences between Boussinesq and non-Boussinesq models at a resolution comparable to IPCC climate models. Subtleties such as the choice of a proper equation of state that includes the effect of pressure on heat capacity, but also the use of mass as a convenient alternative to pressure coordinates are discussed.

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Sitzung Einordnung: Conference