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Mean Circulation and Structures of Tilted Ocean Deep Convection

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Convection in a homogeneous ocean is investigated by numerically integrating the three dimensional Boussinesq equations in a tilted-rotating frame (f-F-plane) subject to a negative buoyancy flux (cooling) at the surface. The study focuses on determining the influence of the angle (tilt) between the axis of rotation and gravity on the convection process. To this end we vary two essential parameters: (i) the magnitude of the surface heat flux, and (ii) the angle (tilt) between the axis of rotation and gravity. The range of the parameters investigated is a subset of typical open ocean deep convection events.

We demonstrate that when gravity and rotation vector are tilted with respect to each other: (i) the Taylor-Proudman-Poincaré theorem leaves an imprint in the convective structures, (ii) a horizontal mean circulation is established, (iii) the second order moments involving horizontal velocity components are considerably increased.

Tilted rotation thus leaves a substantial imprint in the dynamics of ocean convection.