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Global singularity-free grids in ocean modelling

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The spherical coordinates are probably the most natural choice to represent dynamic processes on the sphere but they suffer from the so-called pole problem: The meridians converge towards poles on a sphere which affects the numerical stability in view of the Courant–Friedrichs–Lewy (CFL) condition. The ocean general circulation models (OGCMs) typically solve the problem by using computational grids with the North-Pole singularity relocated to a continent(s). However, environmental models that operate over continents, such as atmospheric models, can not use grids with relocated poles. The OGCM that is based on a global singularity-free grid is thus required for a seamlessly coupled environmental model. Besides, such an OGCM is also required for the so-called aqua-planet simulations in which the entire planetary surface is covered by one global ocean. We implemented and tested the Yin-Yang grid (Kageyama et al., 2004) and the reduced spherical coordinate grid according to Starius (2014) in our OGCM called LSOMG. We present the results of modelling using the two global singularity-free grids.