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Importance of physics in global hindcast simulations of sea ice with NEMO-LIM

Francois Massonnet, Thierry Fichefet, Hugues Goosse, Martin Vancoppenolle, Pierre Mathiot, and Christof König Beatty

Université Catholique de Louvain, Earth and Life Institute, Georges Lemaître Centre for Earth and Climate Research, Belgium (francois.massonnet@uclouvain.be)

Current General Circulation Models (GCMs) show large intermodel spread in simulating projected sea ice characteristics (e.g. extent, volume) at the decadal to centennial timescales. A potential source of spread is the representation of physical processes. In this study, we proceed in three steps: (1) We run the coupled sea ice-ocean GCMs NEMO-LIM2 and NEMO-LIM3 on a 1° tripolar global grid. LIM2 is a two-level thermodynamic-dynamic sea ice model with simple representations of thermodynamic processes; LIM3 is a comprehensive multi-category sea ice thickness distribution model with more sophisticated physics. We keep all other experimental conditions identical (i.e. atmospheric forcing, resolution and initial conditions). (2) We develop a specific metric for sea ice that quantifies the models skill in ice concentration/extent, thickness and drift. We apply this metric to our two experiments. (3) We discuss the impacts of running a more sophisticated sea ice model in light of the metric developed in (2). In particular we find that (i) simulated Arctic ice concentration and thickness are more realistic with NEMO-LIM3 (both for mean state and interannual variability), and (ii) modelled Antarctic ice concentration and thickness are misrepresented in both cases, probably because of the coarse grid resolution and uncertainties in the forcing.