Towards better simulations of ice/ocean coupling in the Amundsen Sea Sector, West Antarctica, using a coupled ocean, sea-ice, and ice-sheet model

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Currently, observations of polar ice sheets (Antarctica and Greenland) show a contribution to Sea Level Rise (SLR) of approximately 1 mm/yr, out of 3.4 mm/yr globally. This contribution is expected to increase significantly in the future, to a point where steric expansion will be overtaken by the contribution of melt-water runoff as well as calving and melting of ice shelves. It is therefore paramount to better understand the interaction between the ocean and ice-sheets, in order to better quantify the feedbacks between melting under ice shelves, ocean circulation, and ice-sheet dynamics. Here, we show recent results of coupled ice/ocean simulations in the Amundsen Sea Embayment region of Antarctica, using the Massachusetts Institute of Technology general circulation model (MITgcm) and the Ice Sheet System Model (ISSM), over a period of 20 years, coinciding with the acceleration of the Pine Island and Thwaites Glaciers. Our simulations take into account the shape of the cavities (generated by the ice-sheet model), as well as melting rates (generated by the ocean circulation model) under ice shelves in a fully two-way coupled mode. We show results on the sensitivity of ice-sheet dynamics and ocean circulation to the shape of the cavity, as well as the underlying circulation. Our approach demonstrates the influence of a fully coupled approach on the evolution of the Ocean/Ice System, and presents an efficient way of implementing such two-way coupling.

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