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Melting West Antarctic ice-shelves: role of coastal warming versus changes in cavity geometries

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The mass loss of West Antarctic glaciers has accelerated over the last 15 years, most likely in response to ocean warming in Antarctic coastal waters. This oceanic warming in Antarctic coastal waters has recently been suggested to be caused by the positive trend of the Southern Annular Mode. But the mechanisms controlling he changes in melt rates underneath outlet glaciers are still poorly understood. For instance, despite recent developments in glacier modeling, melt rates are usually prescribed in glacier models. This strongly limits the ability of glacier models to predict the future evolution of West Antarctic glaciers.

Several ocean models are now able to simulate ocean circulation beneath ice-shelves, therefore allowing a direct study of the mechanisms controlling the changes in melting rates underneath outlet glaciers. Building upon these developments, we here investigate the relative influence of ocean warming in coastal waters and changes in ice-shelves cavern geometries on melting rates underneath West Antarctic glaciers.

To this purpose, we use a regional ocean/sea-ice model configuration based on NEMO, centered on the Admundsen sea, that explicitly represents flows in ice-shelves cavities. A series of sensitivity experiments is conducted with different cavern geometries and under different atmospheric forcing scenarios in order to identify the leading mechanism controlling the changes in melt rates underneath West Antarctic glaciers over the 21st century. Our results provide a first assessment on the importance of coupling glacier models to ocean models for predicting the future evolution of outlet glaciers.