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Modelling the influence of tides on ice-shelf melt rates in the Amundsen Sea, Antarctica.

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Variations in melt beneath ice- shelves may trigger ice-sheet instabilities, in particular in West Antarctica. Therefore, improving the understanding and modelling of ice-shelf basal melt rates has been a major focus over the last decades. In this presentation, we provide further insight into the role of tides on basal melt rates, and we assess several methods to account for tides in models that do not include an explicit representation of tides.

First, we use an explicit representation of tides in a regional configuration of the NEMO-3.6 model deployed over the Amundsen Sea. We show that most of the tidal influence on ice-shelf melt is explained by four tidal constituents. Tides enhance melt by more than 30% in some cavities like Abbot, Cosgrove and Dotson, but by less than 10% in others like Thwaites and Pine Island. Over the entire Amundsen Sea sector, tides enhance melt by 92 Gt/yr, which is mostly induced by tidal velocities along ice drafts (+148 Gt/yr), partly compensated by tide-induced change in thermal forcing (-31 Gt/yr) and co-variations between tidal velocities and thermal forcing (-26 Gt/yr).

In the second part of this presentation, we show that using uniform tidal velocities to account for tides effects in ocean models with no explicit tides produces large biases in melt rates. By contrast, prescribing non-uniform tidal velocities allows an accurate representation of the dynamical effects of tides on melt rates.