M.Sc. Topic in Polar Oceanography

(open to PEP and German Physics master students)

For supervision starting May 2021 earliest

"Parametrization of basal melting in a shallow grounding zone using FESOM1.4"

Supervisors:

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Background: Ocean-driven ice-shelf basal melting is one of the two dominant terms in the mass balance of the Antarctic Ice Sheet. Basal melting affects the ice shelf's ability to control the flow of inland ice towards the ocean (buttressing effect) and, thus, has an impact on global sea level rise. The buttressing effect is most pronounced near the grounding line where the inland ice starts to float and the water column is only a few tens of meters thick. Numerical models, the most promising tool for determining ice-shelf basal melting, fail to resolve this shallow area due to numerical stability constraints. However, a new parametrization of basal melting in shallow grounding zones has been proposed in the framework of the EU-Horizon 2020 project TiPACCs but still needs to be tested in a numerical ocean-ice-model. This test is supposed to be the subject of a master thesis using AWI's coupled finite element model FESOM1.4, applied to the Filchner-Ronne Ice Shelf cavity.

Goal:

- Implement the new parametrization in FESOM1.4.
- Test the applicability of the new parametrization.
- Determine the impact of the new parametrization on cavity circulation and ice-shelf-wide basal melting.
- Assess the impact of the new parametrization on ice sheet dynamics (**Optional**).

Data and Methods: The tool for testing the new parametrization will be AWI's global sea ice-ice shelf-ocean model, FESOM1.4, with a focus on the marginal seas of the Southern Ocean and the fringing ice shelf cavities. FESOM1.4 is a primitive-equation ocean model based on the finite element method, using an unstructured mesh. It is the 'working horse' for studying Southern Ocean tipping points and providing oceanic boundary conditions for various regional ocean and ice-sheet models in the framework of the EU-project TiPACCs.

Requirements: The successful candidate will learn how to operate a large numerical model and evaluate its output, and will gain a deep understanding of ocean-ice shelf interaction and its impact on sub-ice shelf circulation and mass balance. Good basic knowledge of ocean physics and advanced programing skills (FORTRAN, MATLAB or PYTHON) are required. The publication of results in a peer-reviewed journal will be encouraged.