Master of Science Project **release date: November 2021**

Geoscience and Remote Sensing

Theme: Ice-ocean interactions

The role of melt channels on ice shelf rifting.

Summary

Calving events on large ice shelves often follow the propagation of through-thickness rifts, posing a serious risk to the stability of ice shelves. Ice mélange, a slushy concoction of windblown snow, iceberg debris and frozen seawater, is thought to fill fractured areas of ice shelves and 'glue' rift flanks together [Rignot 1998]. Enhanced ocean and/or atmospheric warming may melt ice mélange encased in between ice cracks leading to rift re-activation [Larour 2021].

Digital elevation models have long shown the existence of melt channels at the bottom of floating ice shelves [e.g. Rignot 2008, Mankoff 2012]. These are thought to alter the ocean dynamics underneath ice shelves, by channeling the buoyant flow of meltwater from the grounding line toward the ice front [Millgate 2013]. As consequence, ice mélange that evolves in ice shelf rifts in the proximity of the ice front should be impacted by redistributed flow due to channelized melt.

In this project, we will investigate the role of melt channels in the ocean dynamics beneath an ice shelf using an existing ocean model. Results from this work are expected to have broad significance in the current and future modeling of ice-ocean interactions. Findings will provide a better understanding of how mutual interactions between rifts and melt channels can impact ice-ocean dynamics.

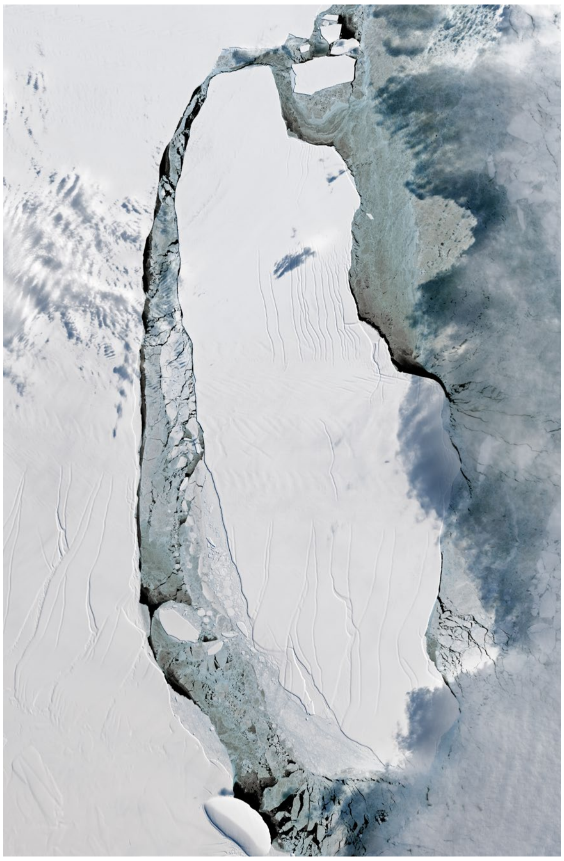
Research objective

To quantify the impact of melt channels on sub-shelf ocean dynamics, ice mélange evolution and rifting, by using a high resolution and finite volume-based ocean model.

Project description

The student will perform various numerical simulations and analyze results of an ocean model installed and running on the NASA Pleiades supercomputer.

The project has a nominal workload of 40EC and will be carried out in collaboration with NASA Jet Propulsion Laboratory (JPL) in Pasadena and University of California, Irvine (UCI). During the research period, a visit to JPL and/or UCI can be organized (possibly in summer 2022) depending on the funding situation as well as on travel restrictions due to the COVID19 pandemic.



The figure shows the extension of iceberg A68 from LANDSAT data (credit: Joshua Stevens). A mixture of ice mélange and sea ice fill the area between the new iceberg and the ice front.

Student profile

We are looking for a motivated student with good programming skills (Python, MATLAB and Fortran as optional). Experience with linux/unix systems will be helpful but not a requirement. Familiarity with basic concepts of cryosphere physics (CIE4602), physical oceanography (CIE5325) and/or modeling of fluids (CIE5315, CIE5312) is preferred.

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For students of Geoscience and Remote Sensing or Hydraulic Engineering