1. Motivation

Recent numerical models of glacier/fjord systems have focused on the 2D circulation. We seek to investigate the following questions in a newly developed 3-D numerical model of Rink Isbræ fjord in west Greenland.

Does buoyancy forcing at the glacial grounding line drive an estuarine exchange flow in the fjord?

Do bathymetric and rotational effects strongly influence the buoyancy-driven circulation?

Can tidal and wind-forcing cause significant variability in heat and freshwater transport to the glacier?

2. Approach

Develop a 3-D fjord model with realistic bathymetry and forcing.

Forcing

Subglacial discharge at grounding line
Uniform katabatic wind stress
AOTIM-5 tides
T, S are restored at N,S,W boundaries

MTgcm with 100 m grid spacing, 39 z-cells, model is run for 45 days.

3. Glacial Boundary Conditions

We use a non-hydrostatic 2-D model to create the glacial boundary conditions that result from submarine melting and subglacial discharge.

4. Results: Buoyancy Forcing

Subglacial discharge drives an estuarine exchange flow

Glacial fjord circulation is a complex, 3D process

5. Buoyancy Results with Wind and Tidal Forcing

Wind and tidal forcing strongly modify the heat and freshwater flux toward the glacier

6. Summary

The tested ranges of subglacial discharge produce a estuarine exchange flow.

Bathymetry and rotational effects influence the buoyancy-driven circulation.

Ocean and atmosphere forcing cause significant variability in heat and freshwater transport.

Future work will involve a large-scale model (Fig. 10) of two outlet glacier systems (Rink Isbræ and Kangerdlugssup Sermersiit). The glaciers are in close proximity to each other, yet have exhibited different mass balances during the last decade.

References