Coupling Oceans and Dynamic Ice-sheets in Climate Models
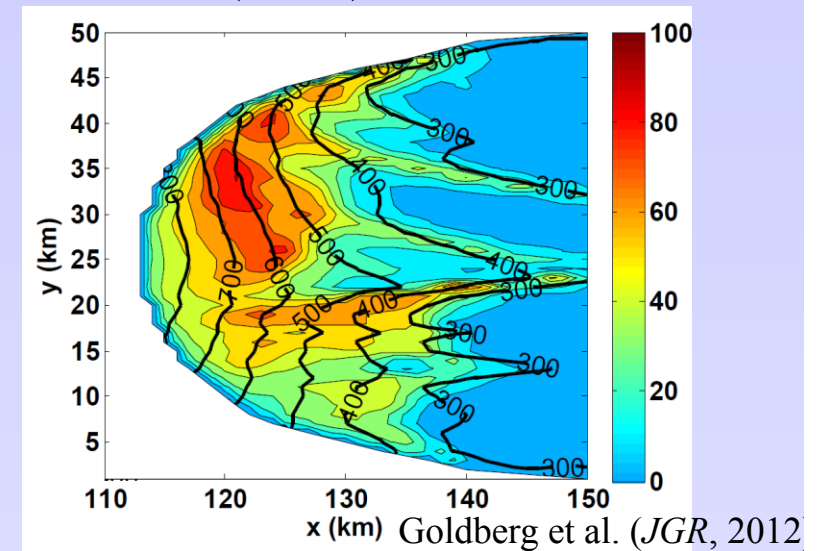
Robert Hallberg and Olga Sergienko
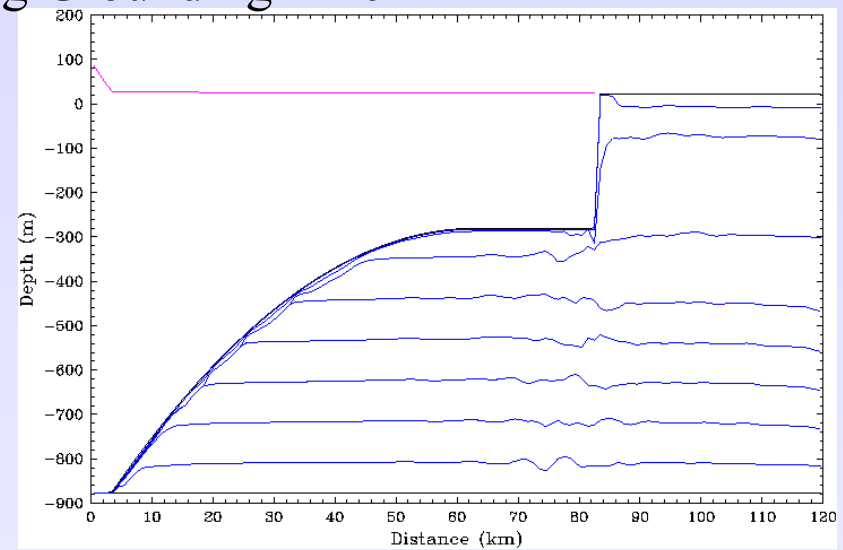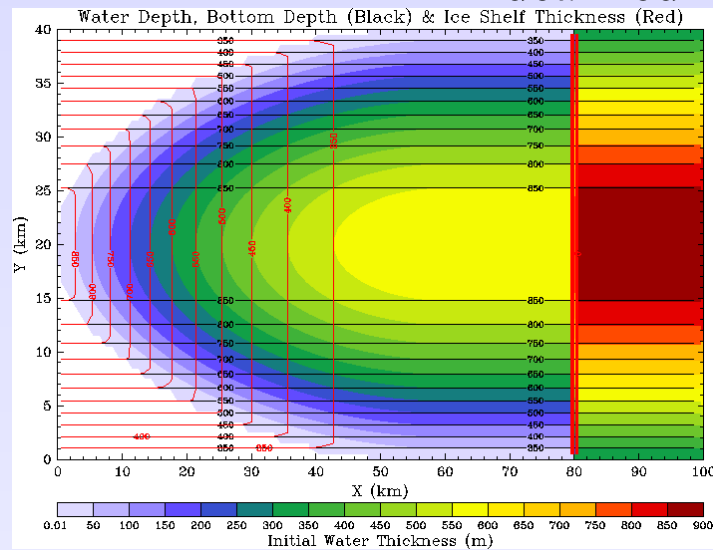
NOAA / GFDL & Princeton University

Idealized interacting ice-sheet/ocean simulations:

- Global ocean model required substantial modifications to simulate idealized ice-shelf / ocean interactions.

- MOM6 now allows dynamically evolving ice-shelf cavity shapes & moving ice-fronts.

- NOAA/GFDL is working to couple fully dynamic ice sheet models into our coupled climate models, but there remain many substantial challenges. (See poster.)

Coupled ocean / dynamic ice sheet melt rates (color) and shelf thickness

Goldberg et al. (*JGR*, 2012)

An Idealized Moving Grounding Line

Water Depth, Bottom Depth (Black) & Ice Shelf Thickness (Red)

0.01 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800 850 900
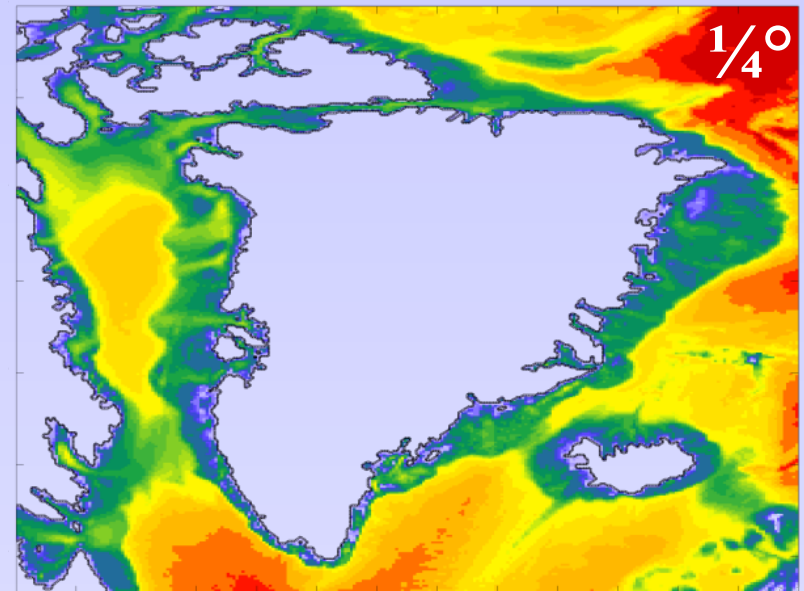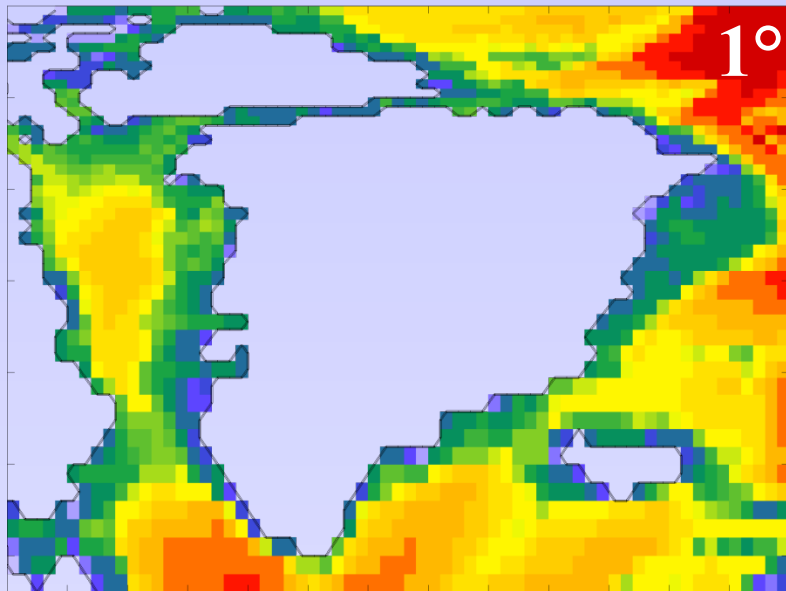Initial Water Thickness (m)

Driving an Ice Shelf Forward at 3 km /day
Demonstrates wetting & drying and a moving grounding line
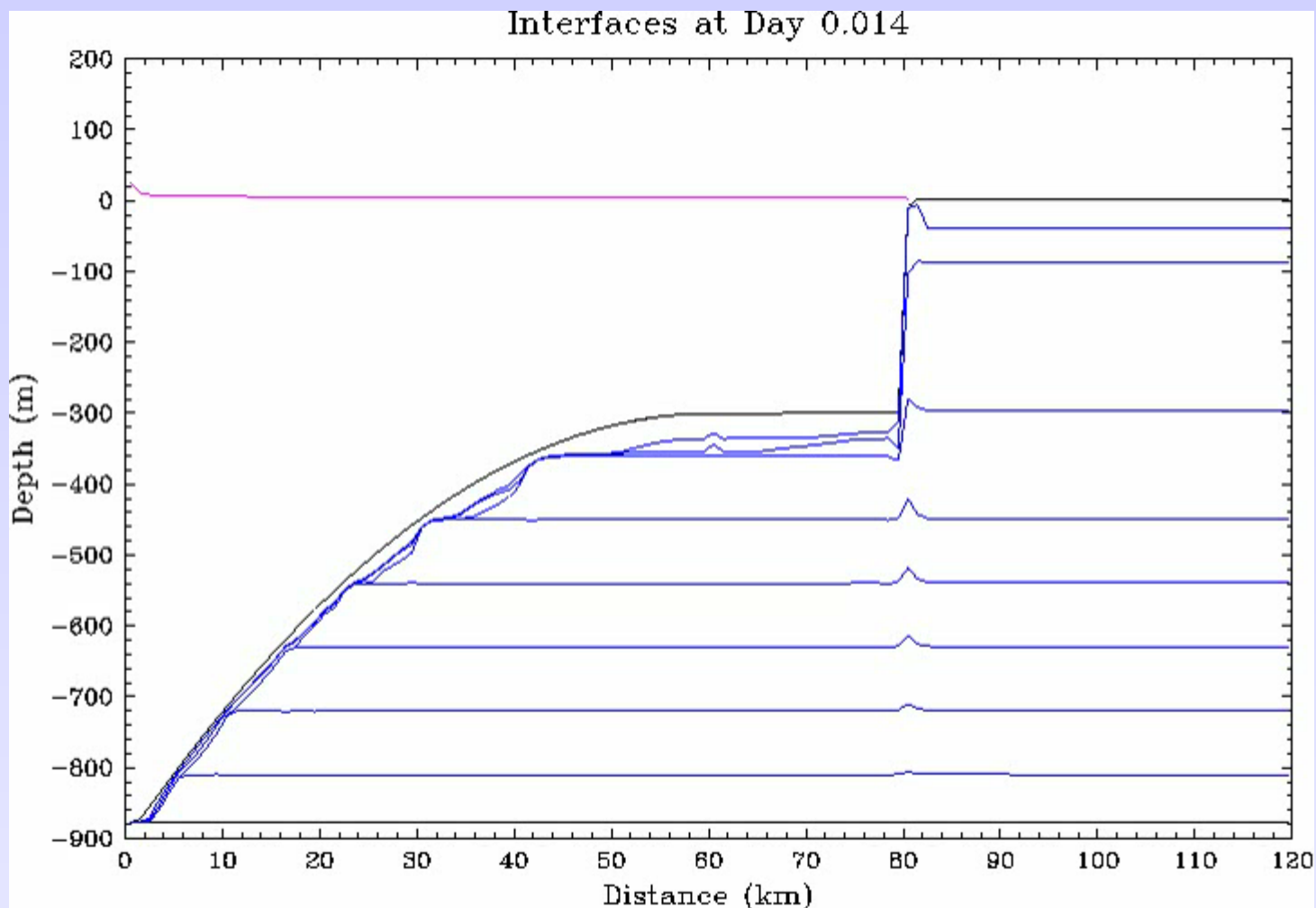
Representing Greenland Oceans at 1° & ¼° Resolution

ESM2G (IPCC AR5): 1° ocean

    40 yr/day on ~400 processors

    Fjords wholly absent (40 km)

ESM4 (IPCC AR6?): ¼° ocean

    10 yr/day on ~10,000 processors

    Fjords marginally present (10 km)

    but rely on parameterizations.

Jakobshavn & ¼° Mercator grid