Modelling the Canadian Arctic Archipelago

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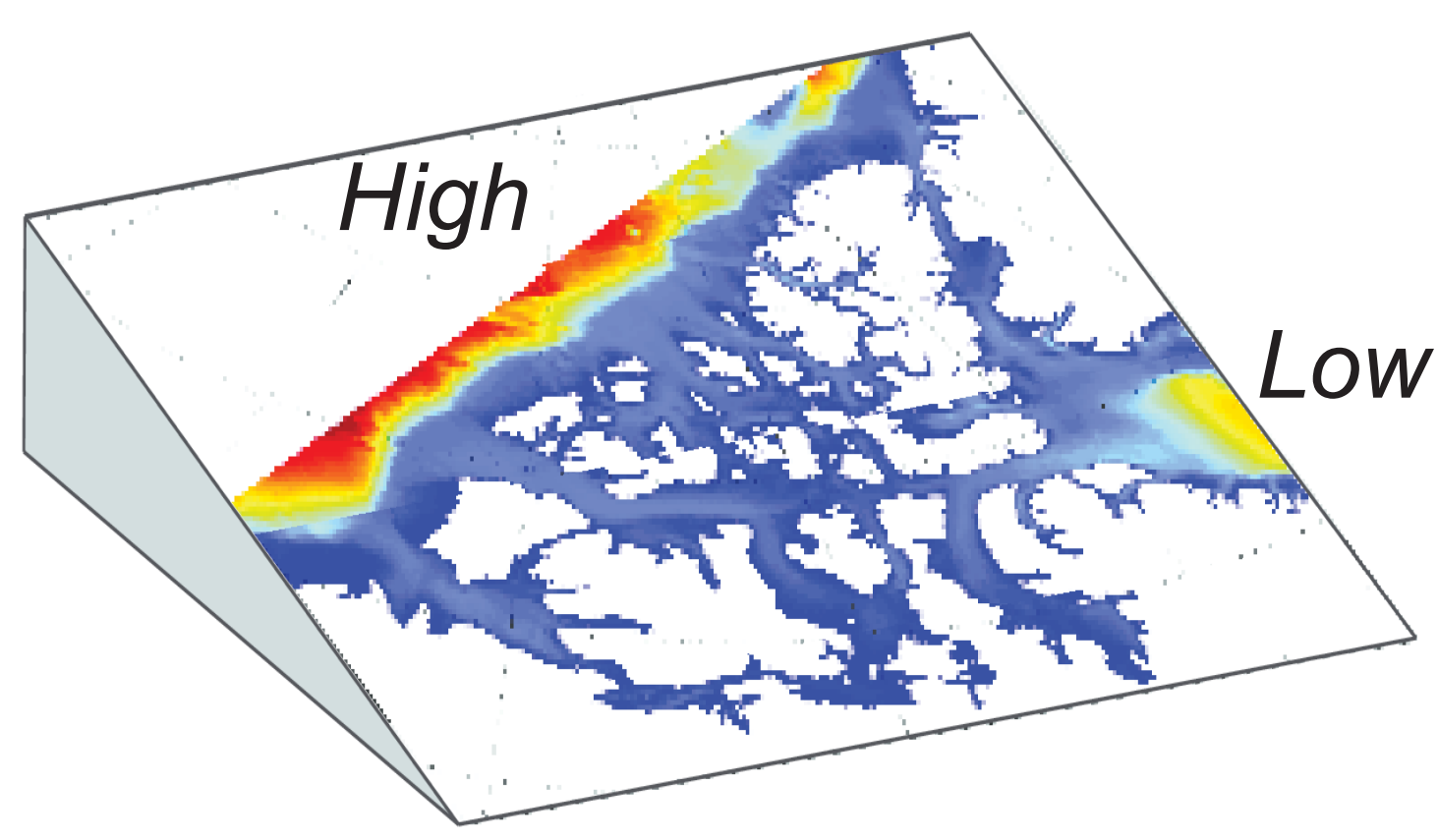
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The Canadian Arctic Archipelago is one of the two major gathways between the Arctic Ocean and the Atlantic Oceans. While the limited number of observations is slowly increasing, understanding of the physical processes that drive the flow is stil lacking. This study addresses these processes using a 3D model.
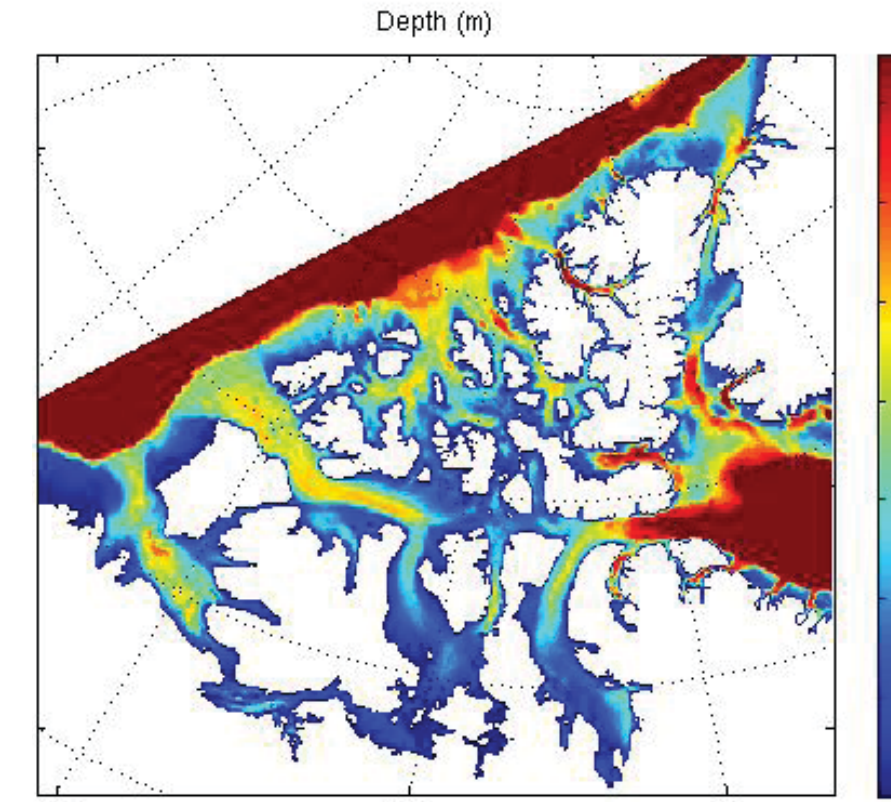
Barotropic pressure gradient

High

Low

Figuur 1: Artist impression of a pressure gradient over the Archipelago.

A barotropic pressure gradient between the Arctic Ocean and Baffin Bay is thought to be a major drive for flow through the Archipelago.
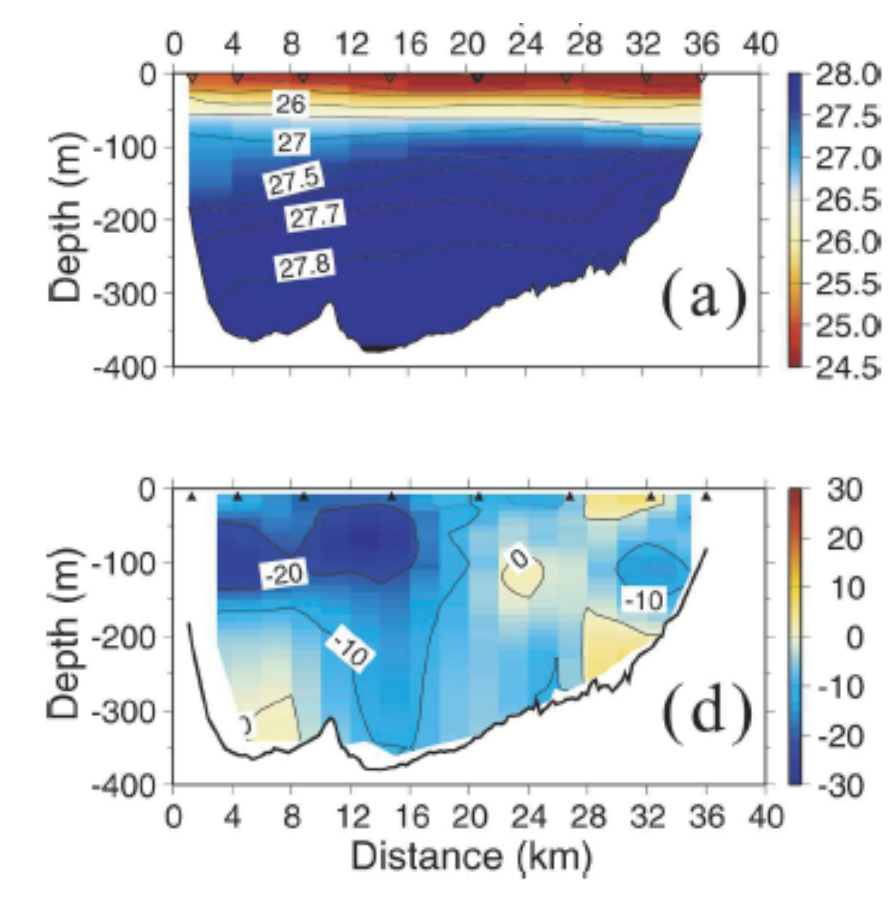
Bathymetry

Figuur 4: CAA Bathymetry, 0-800 m.

The CAA has a complicated bathymetry, with islands, channels, sills and basins. This undoubtedly affects the transport through the CAA.

Baroclinic density gradient

Figuur 5[3]: Density section and geo-strophic velocity in Nares Strait.

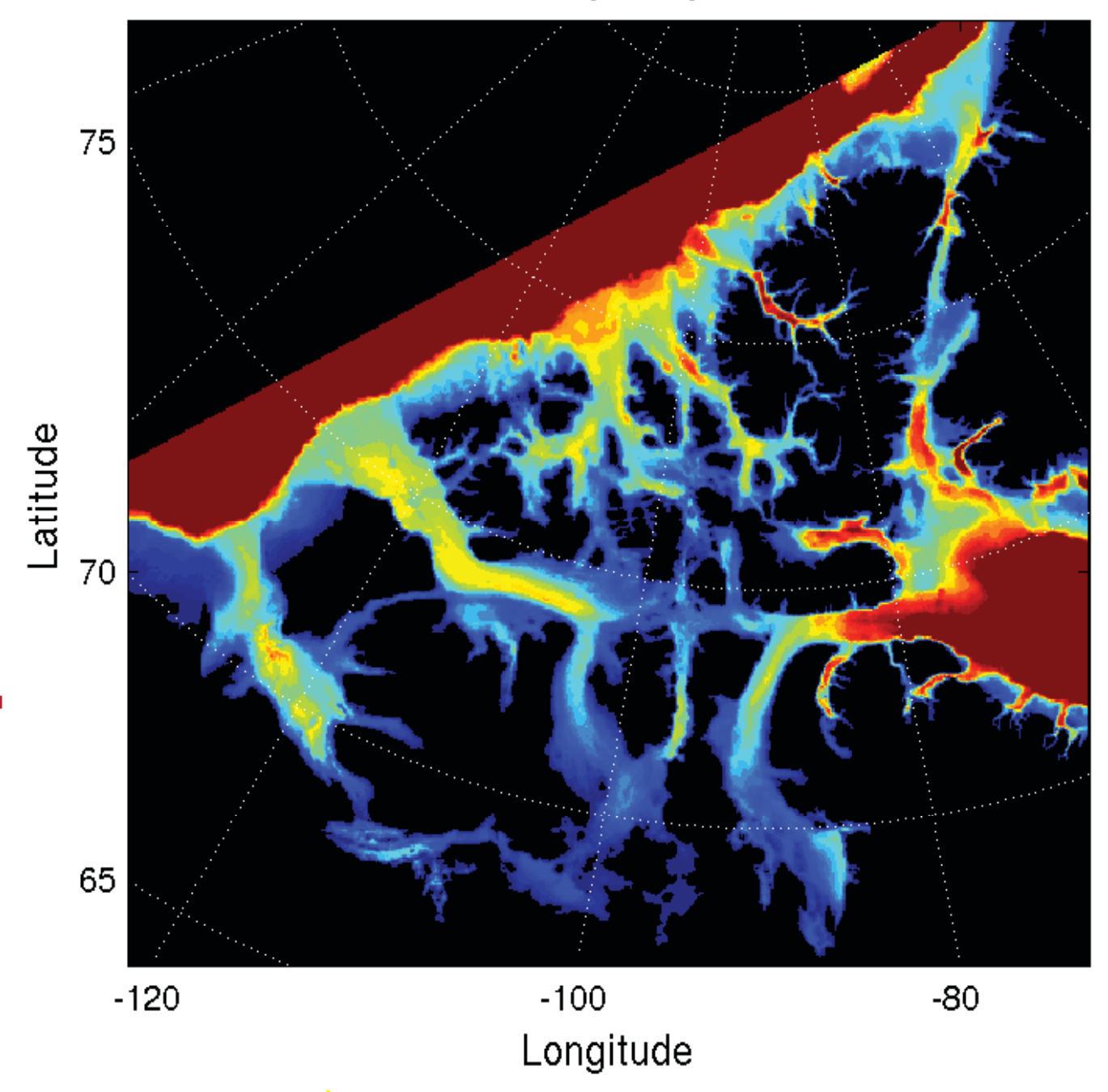The density gradient over the strait, set by the salinity gradient, drives the geostrophic part of the flow.

Wind stress

Wind stress can reach much higher values here than weather models predict, because of the steep clifs surrounding the narrow straits.
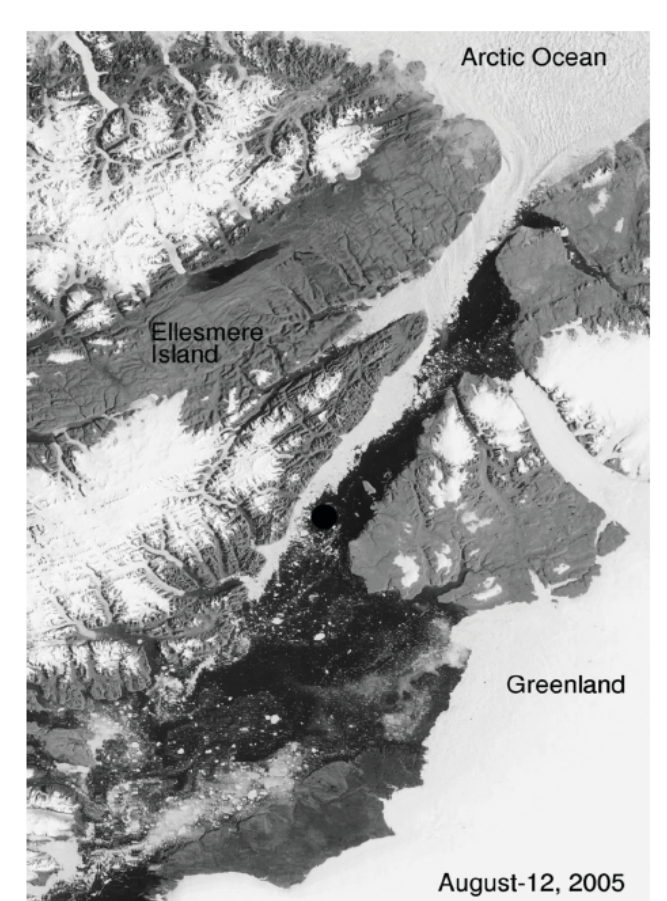

Figuur 2: Dr Andreas Münchow leaning into the very strong wind at Cape Baird.
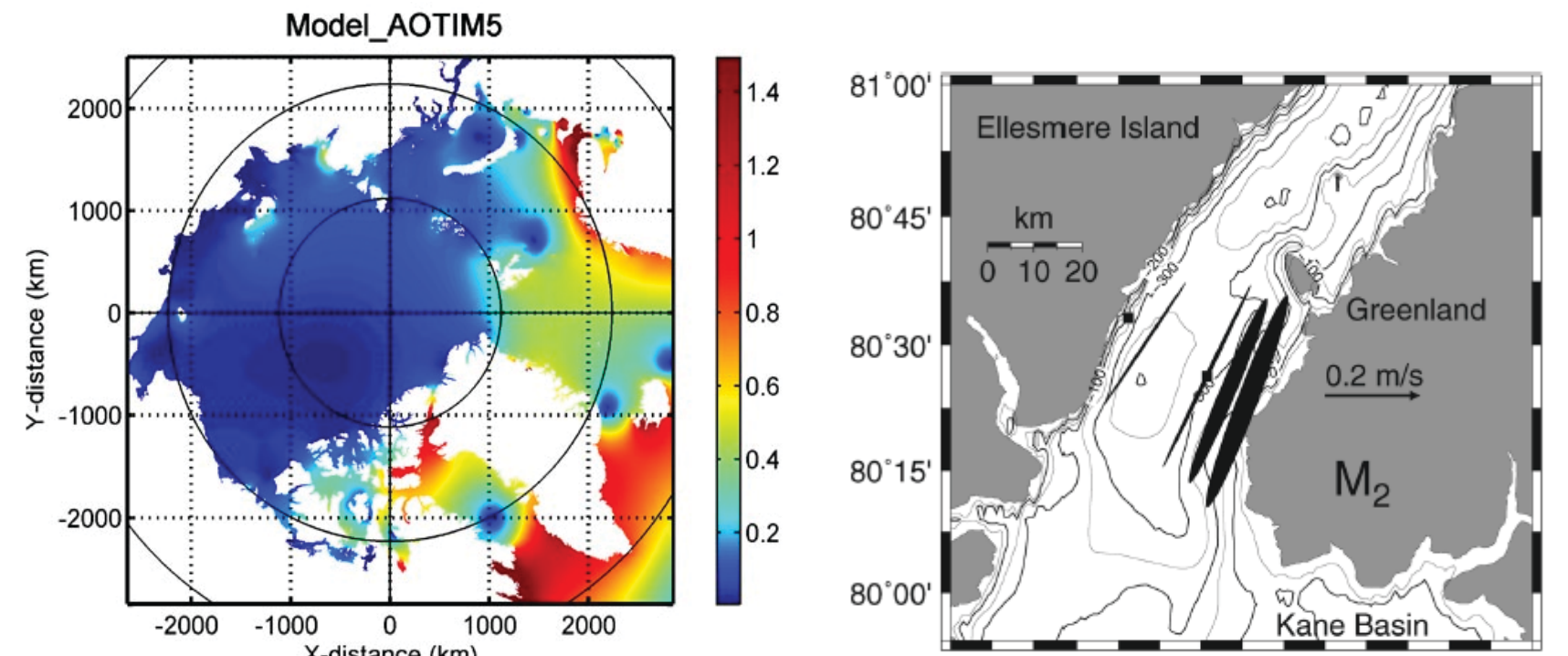
Sea-ice cover

Figuur 6[2]: Summer time sea-ice cover in Nares Strait

Sea ice affects the influence of wind on the flow, creates a top boundary layer for tidal flow and changes the salinity of the top layer. In winter, ice bridges form which limit the flow. In summer, sea ice partly melts and retreats.

Figuur 7: Model bathymetry

Tides

Unlike in most of the Arctic Ocean, tidal elevations are substantial and tidal flows are an order of magnitude larger than the residual flow in the CAA.

Figuur 3: Elevation (Arctic wide) and amplitude[2] (Nares Strait) of the M2 tide.

Question: Which physical processes drive the flow through the Canadian Arctic Archipelago?

Model setup:
- regional configuration for the CAA
- 4 km resolution
- realistic bathymetry, idealised forcing

[2]Münchow, A . and H. Melling (2008). *Journal of Marine Research,* 66, 801-833.

[3]Münchow, A . et al. (2006). *Journal of Physical Oceanography,* 36, 2025-2041.

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