



Arctic glacier and ice sheet contributions to sea level rise — a current assessment for 2011-2100

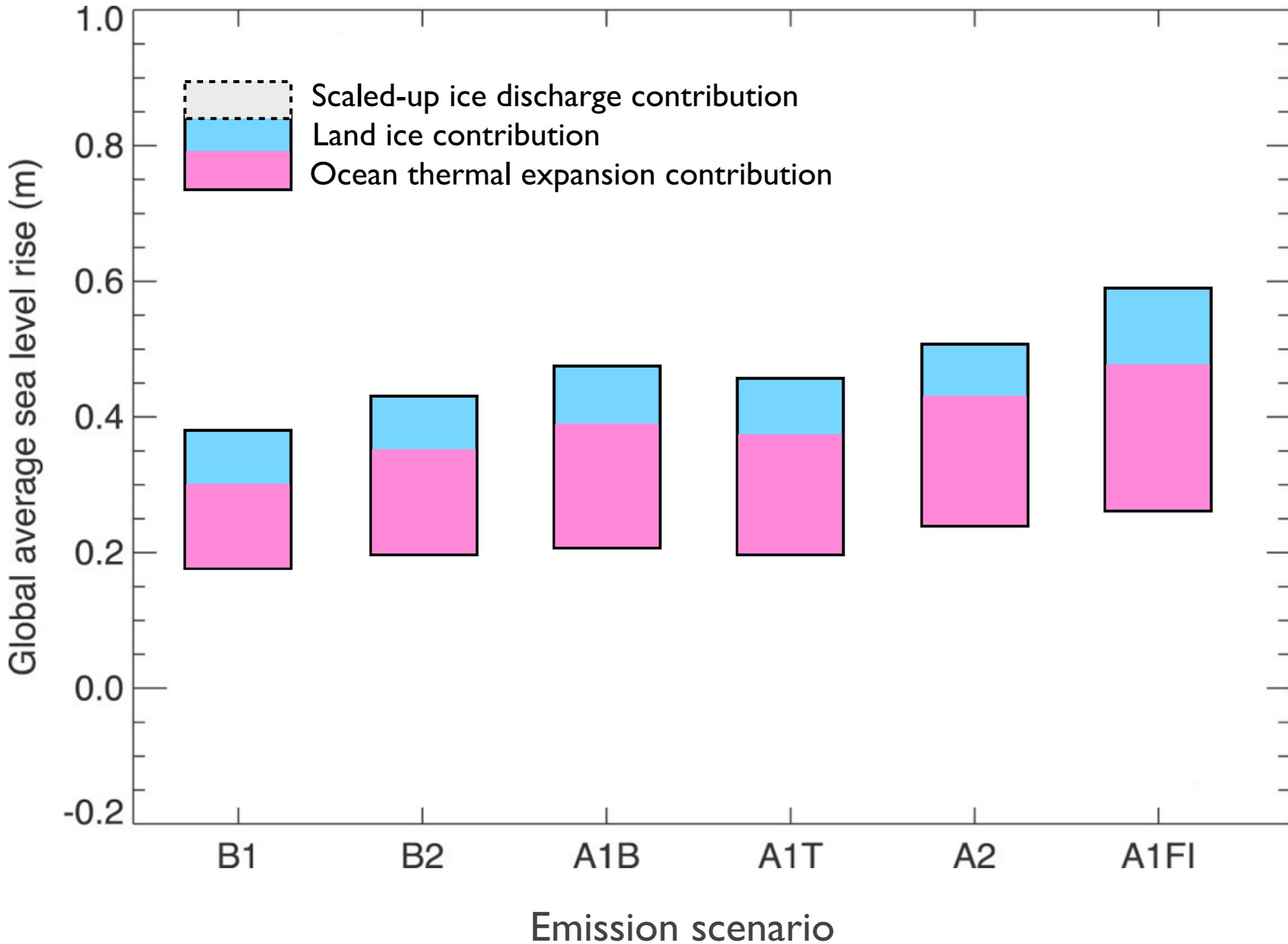
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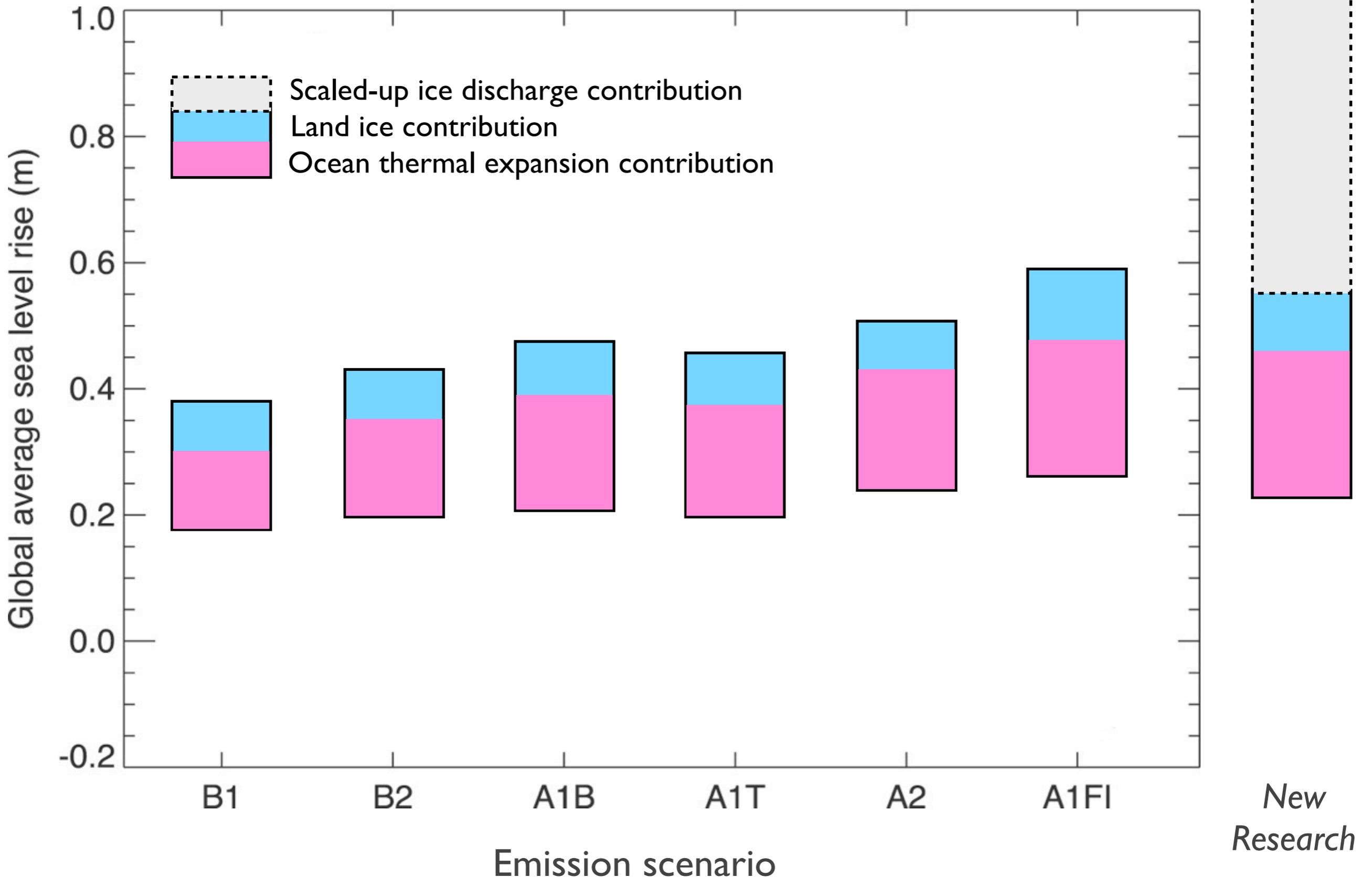
Sea level projections for the 21st century

Adapted and modified from Figure 10.33 (IPCC, 2007)

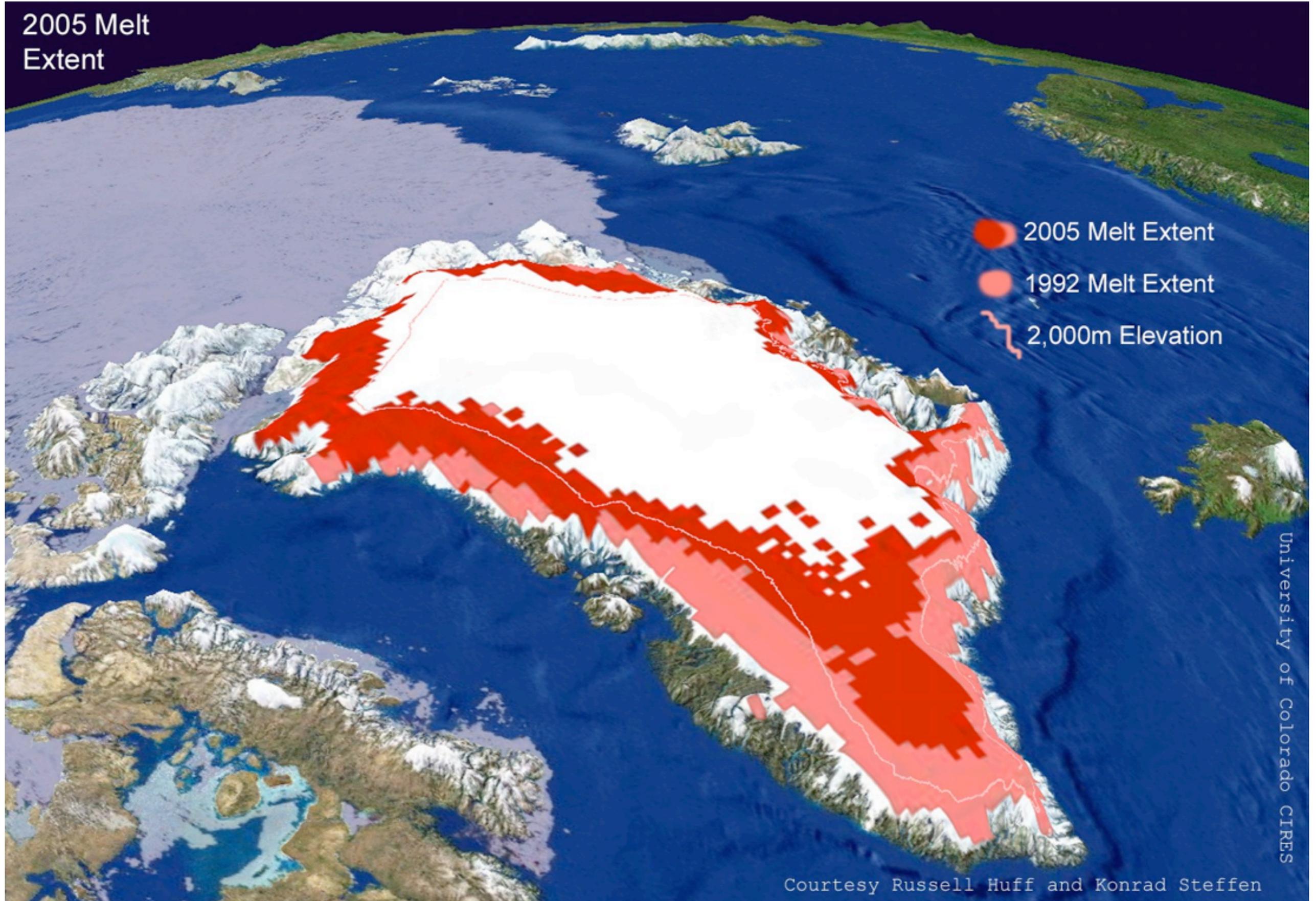


Sea level projections for the 21st century

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2005 Melt Extent





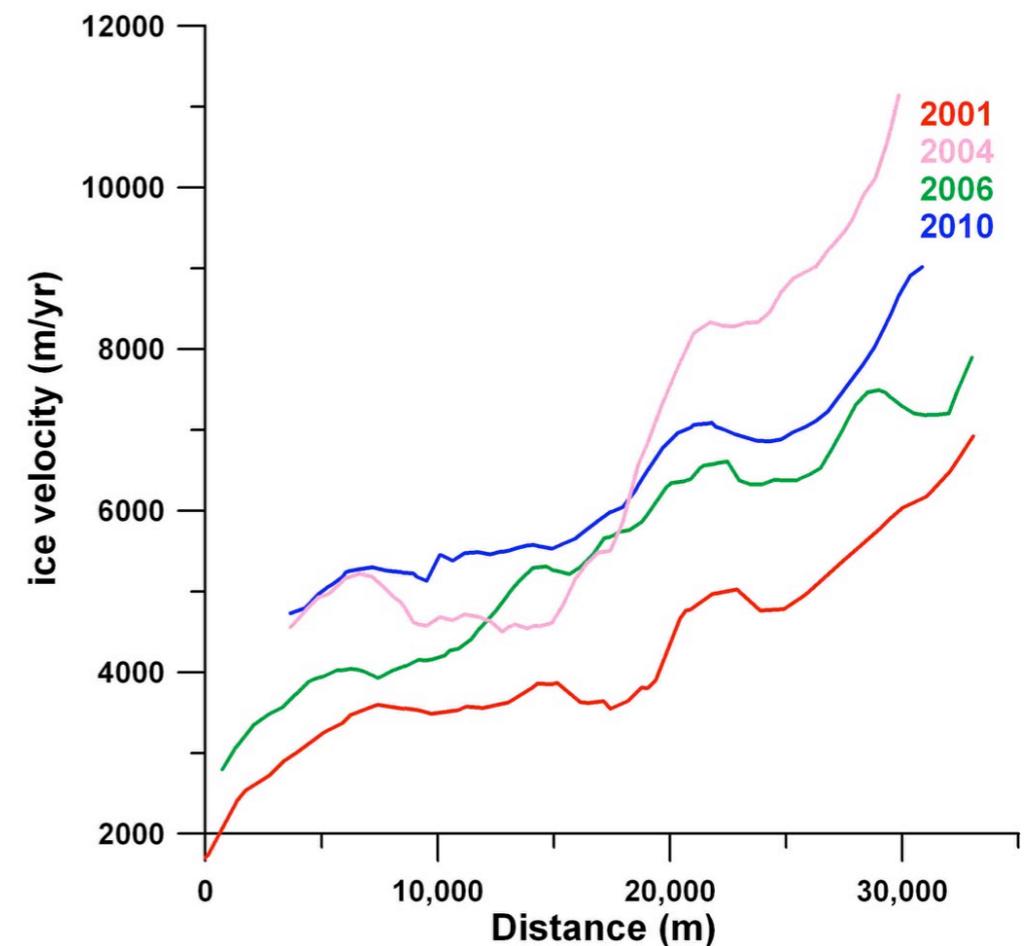
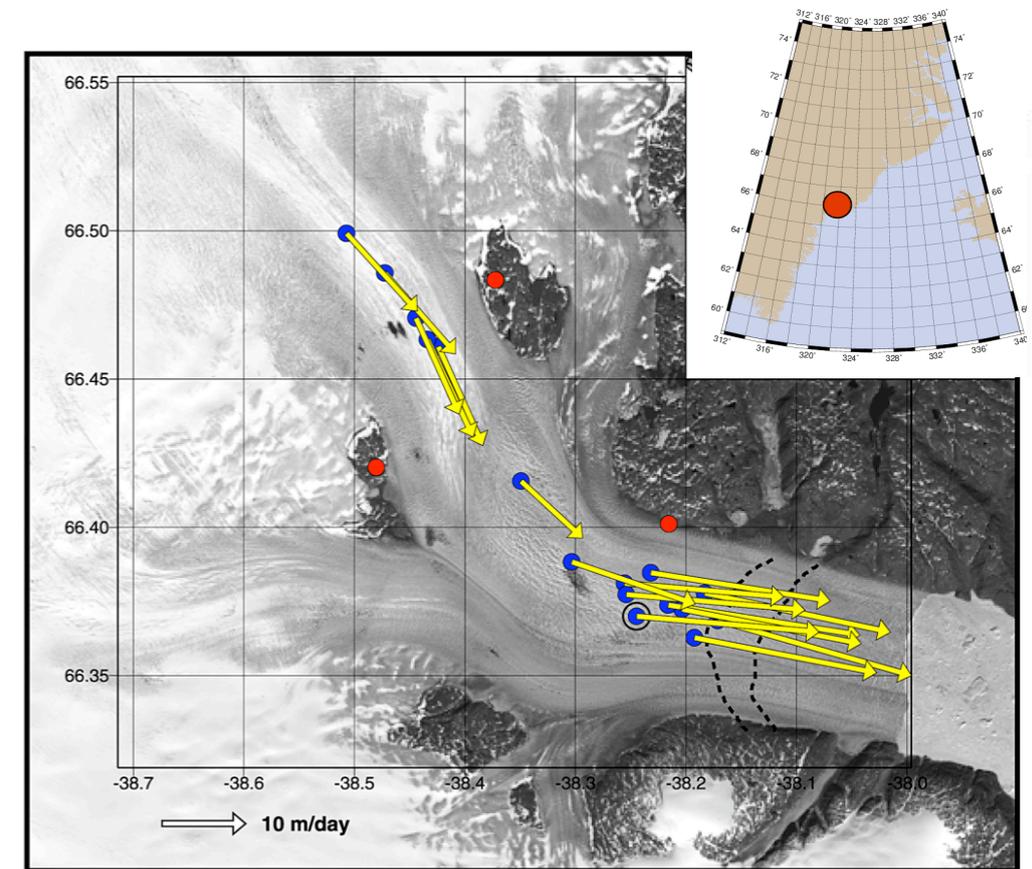


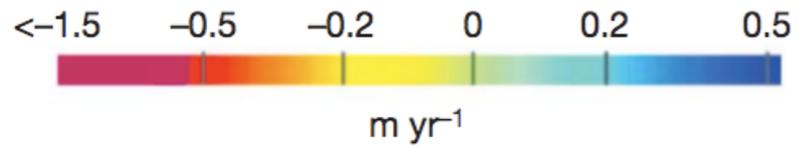
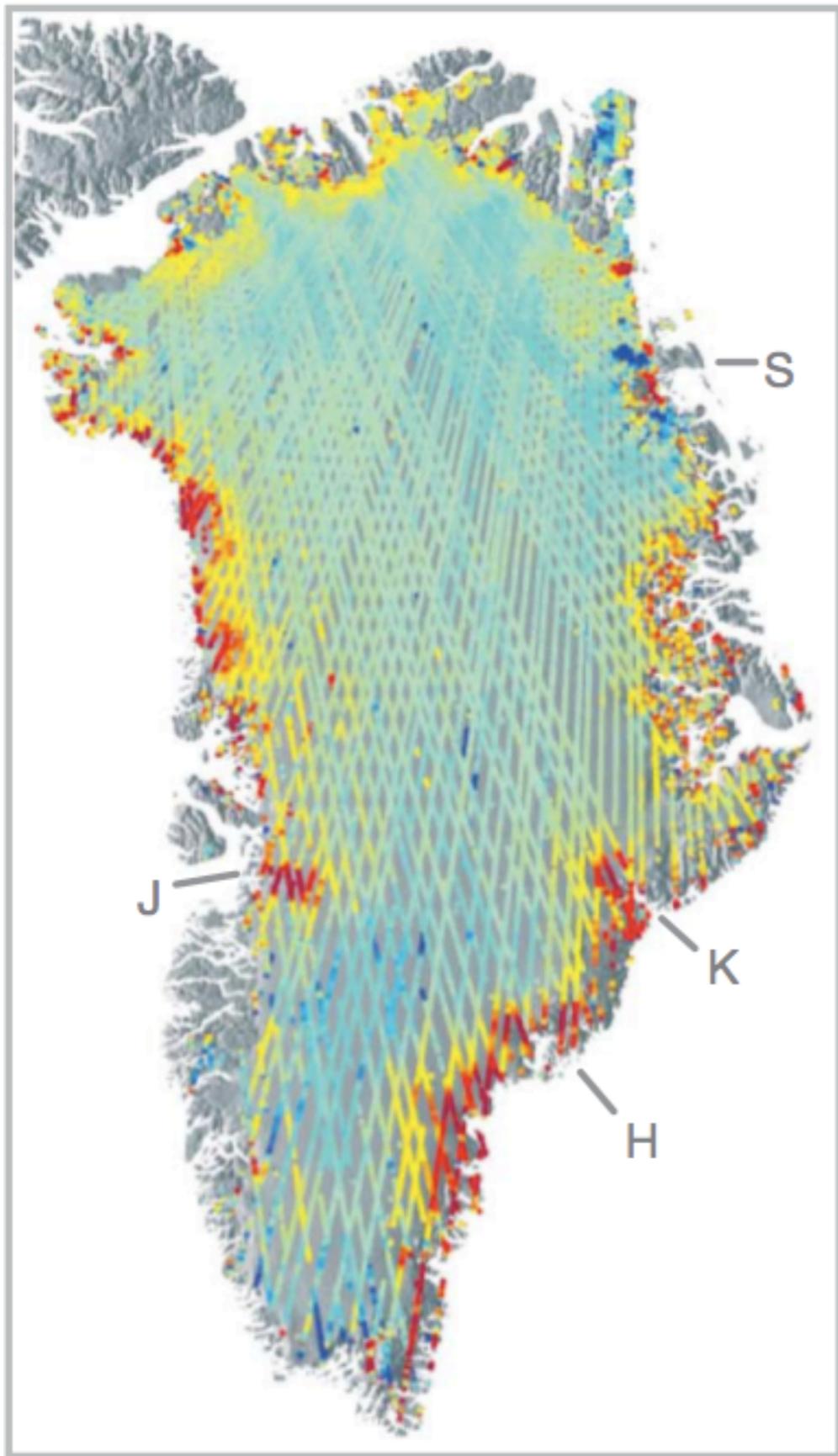
Dynamics vs melting

Helheim Glacier **retreated** (~8 km), **accelerated** (from 7 km/yr to 11 km/yr) and **thinned** (~200 m) between 2003 and 2006.

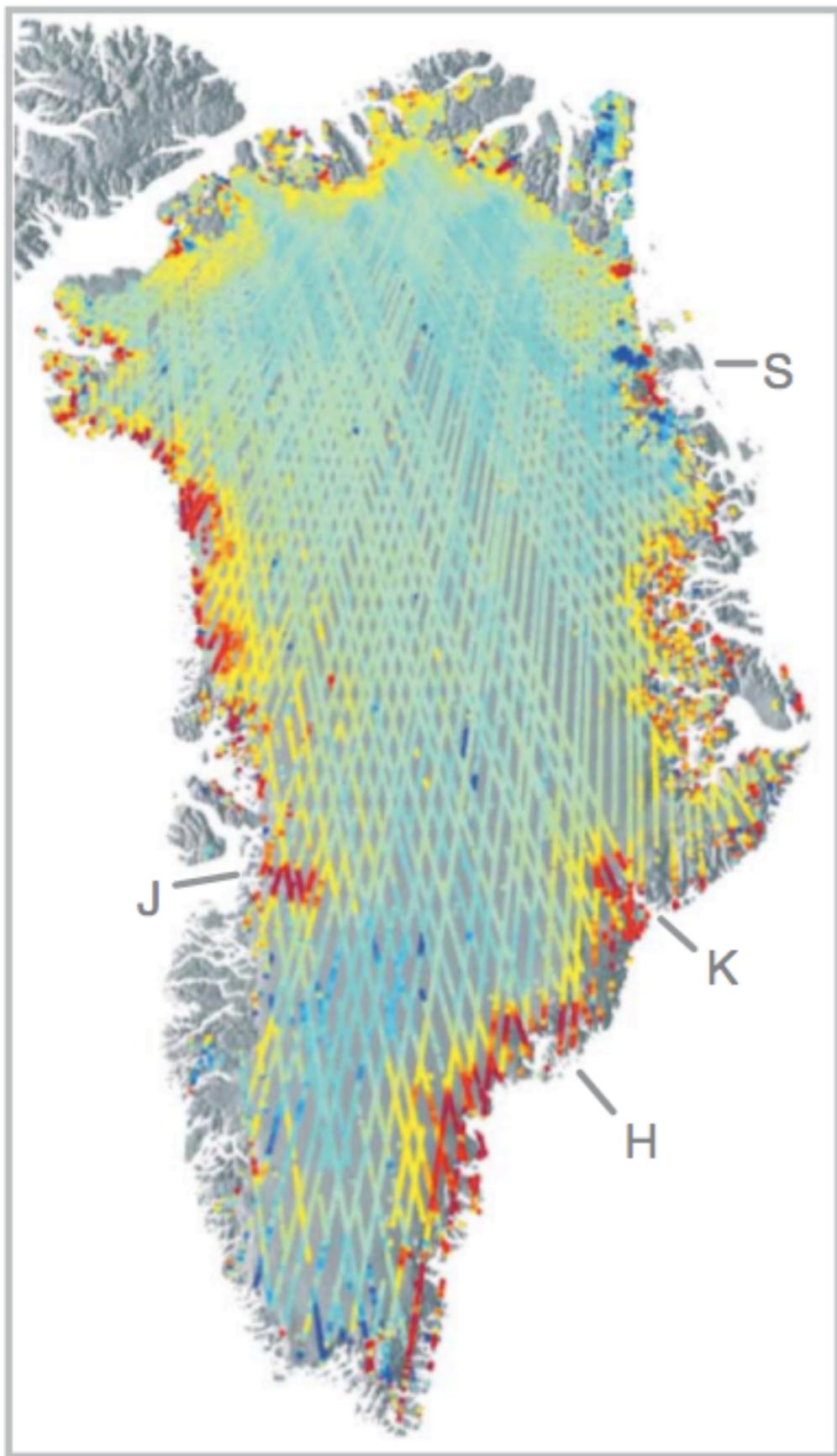
Other **tidewater** glaciers in Greenland did similar things at almost the same time.

Increased **flux** through these tidewater glaciers now dominates Greenland's contribution to sea level.

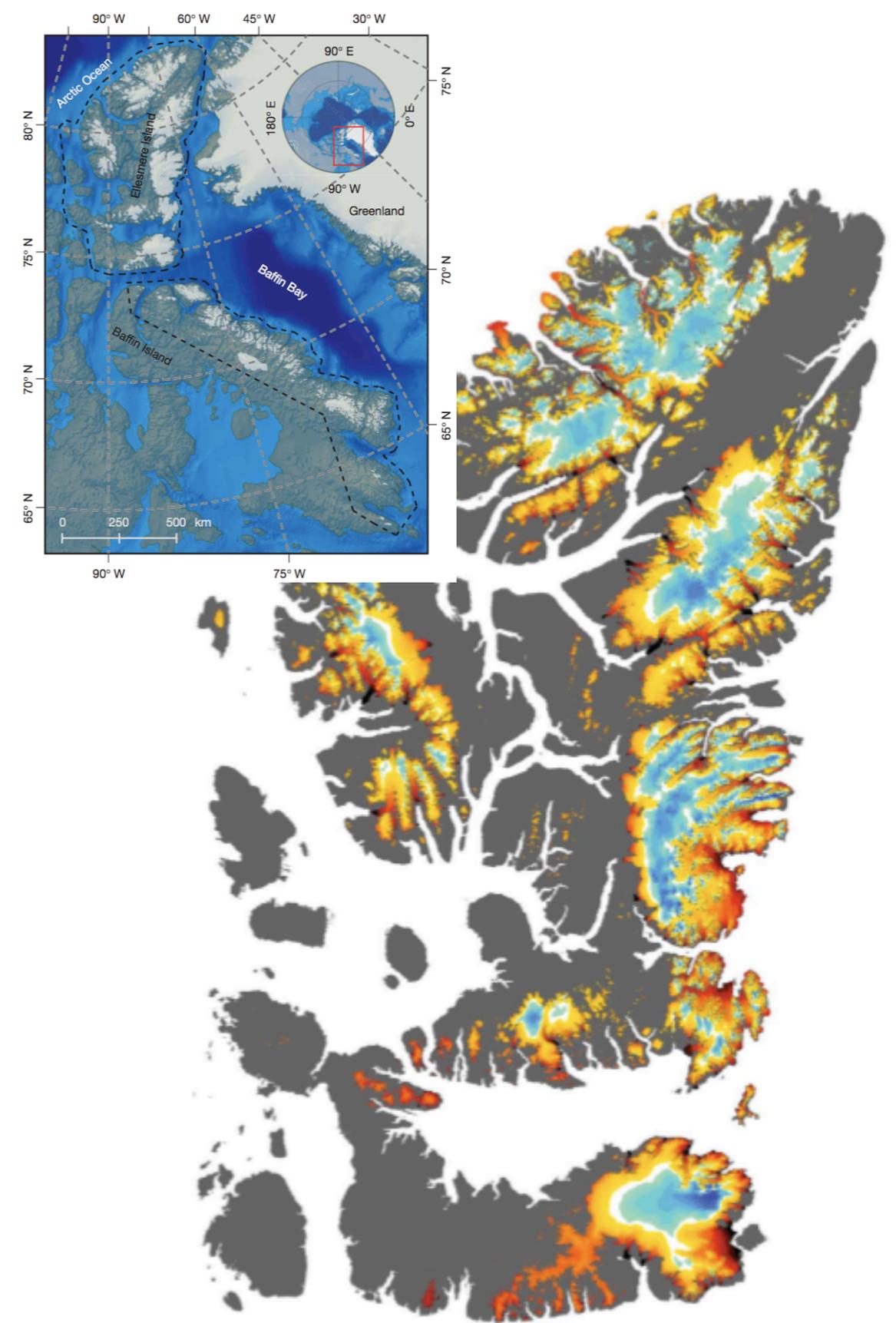




Pritchard et al., 2009 (*Nature*)

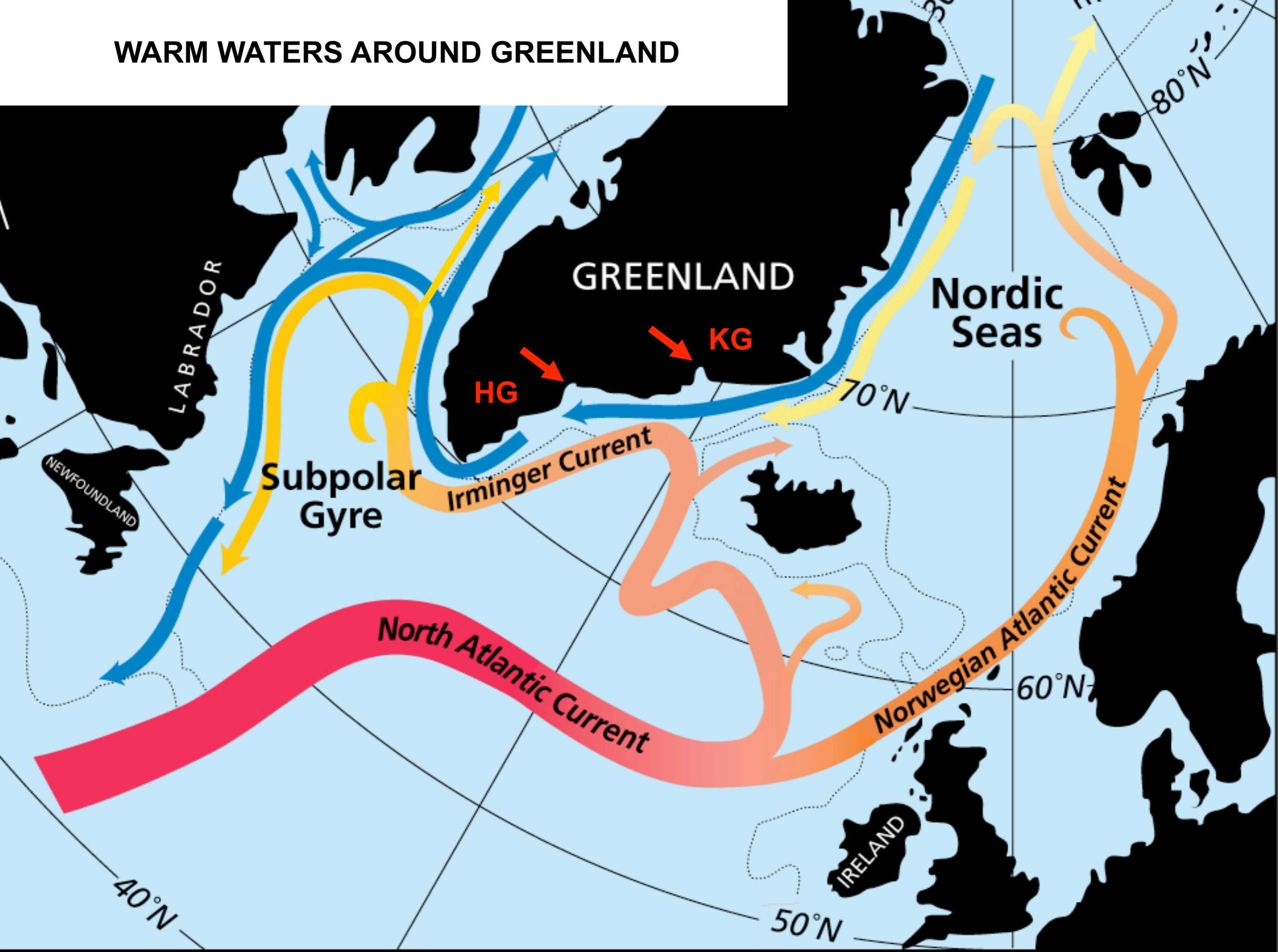


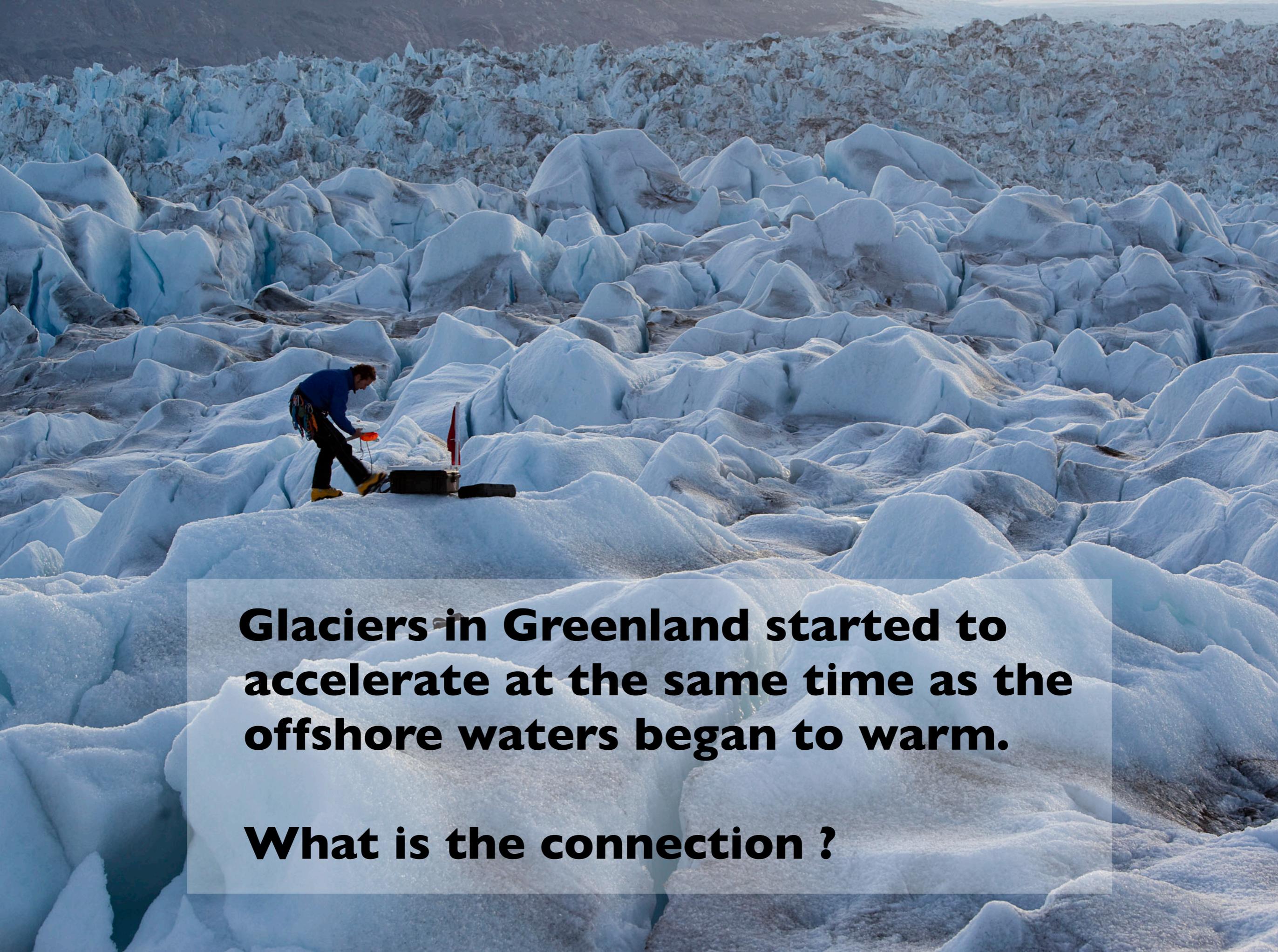
Pritchard et al., 2009 (*Nature*)



Gardner et al., 2011 (*Nature*)

WARM WATERS AROUND GREENLAND

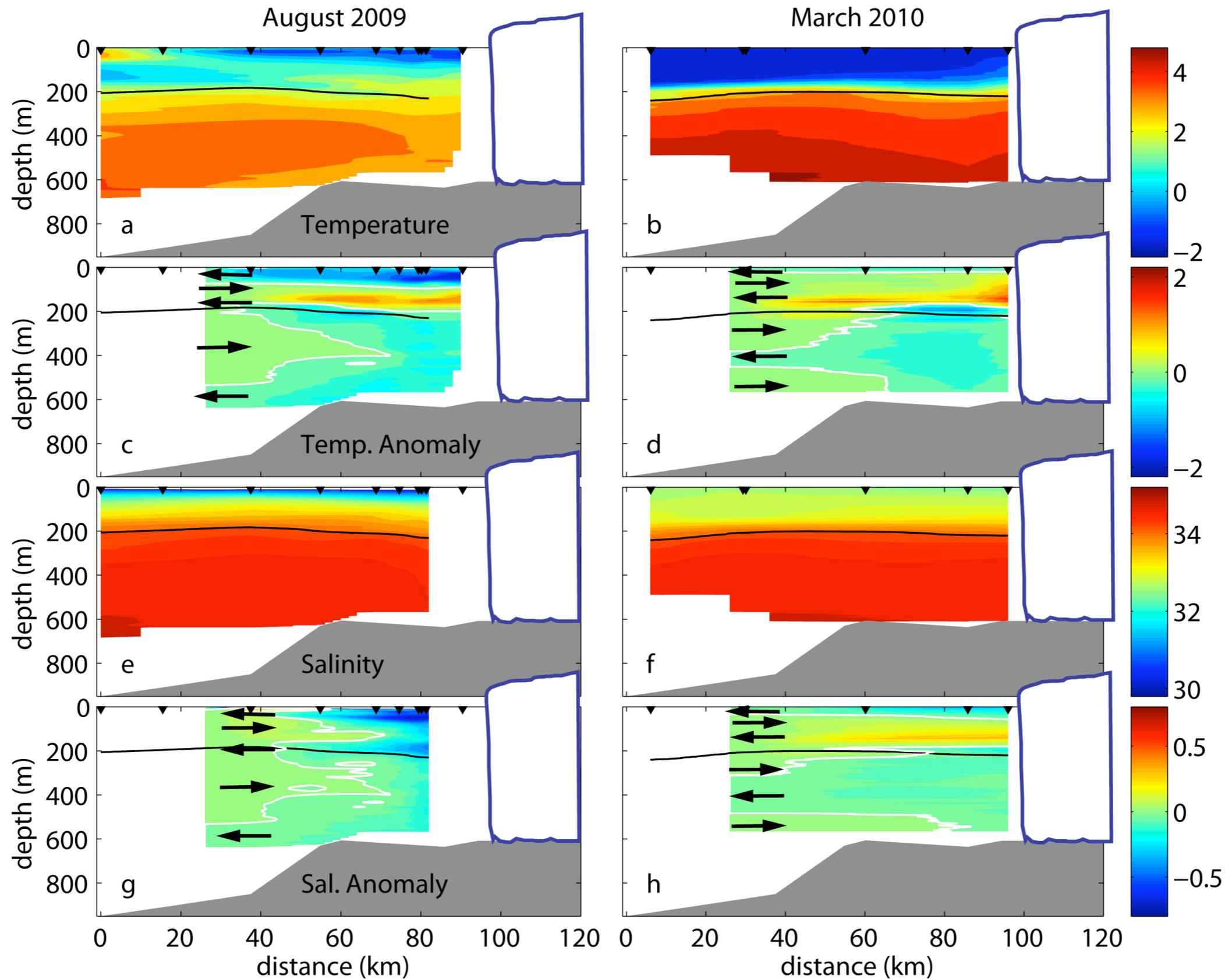


A person in a blue jacket and black pants is working on a glacier. The glacier is composed of many large, rounded ice blocks, some of which are a deep blue color. The person is standing on one of the ice blocks and appears to be using a tool to work on the ice. The background shows a vast expanse of the glacier stretching towards the horizon.

Glaciers in Greenland started to accelerate at the same time as the offshore waters began to warm.

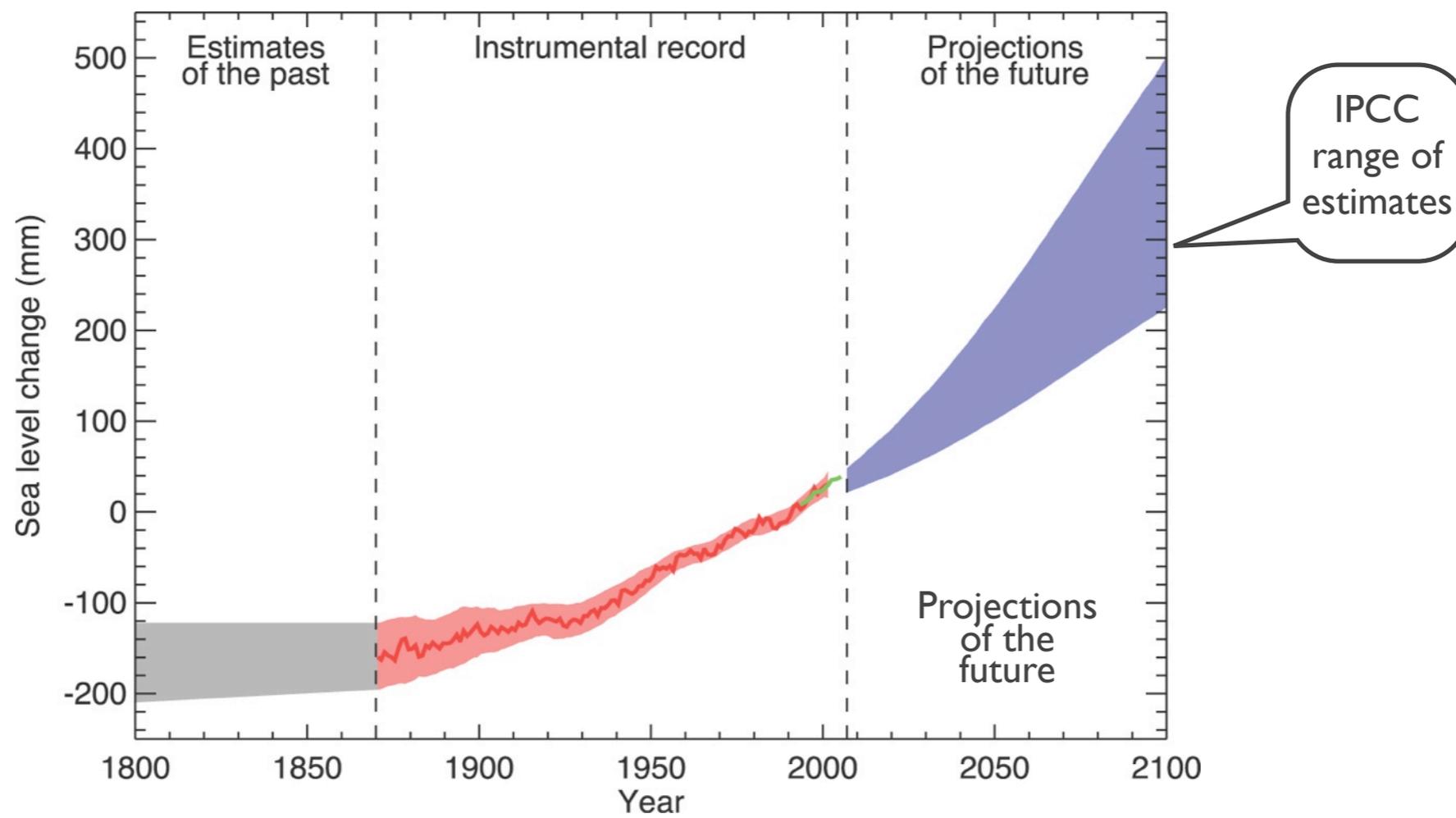
What is the connection ?

Warm waters are reaching the ice sheet

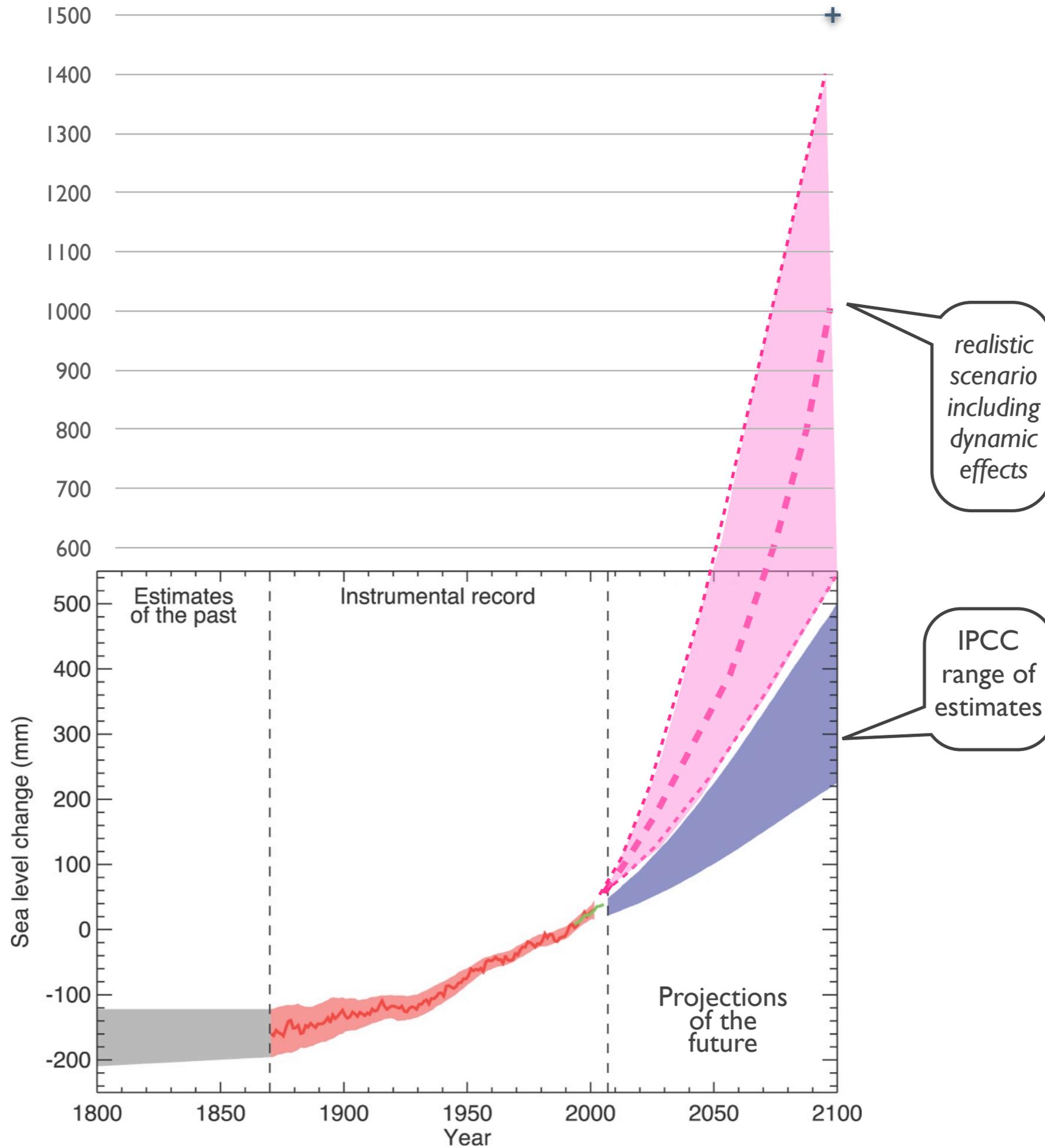


from Straneo, Hamilton et al., 2011 **Nature Geoscience**

Adapted and modified
from Figure 5.1
(IPCC, 2007)



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(IPCC, 2007)



Summary

- A 1.0 m sea level rise by 2100 is very likely (*i.e.*, ~2x the highest IPCC estimate).
- Ice sheet dynamics is the dominant cause, not melting.
- Uncertainties remain in quantifying ice sheet behavior at decadal/centennial timescales, but we do know that outlet glaciers show a very rapid dynamic response to a relatively small perturbation (possibly ocean warming). Because the oceans will continue to accumulate heat, the dynamic ice sheet response will persist for decades.

