

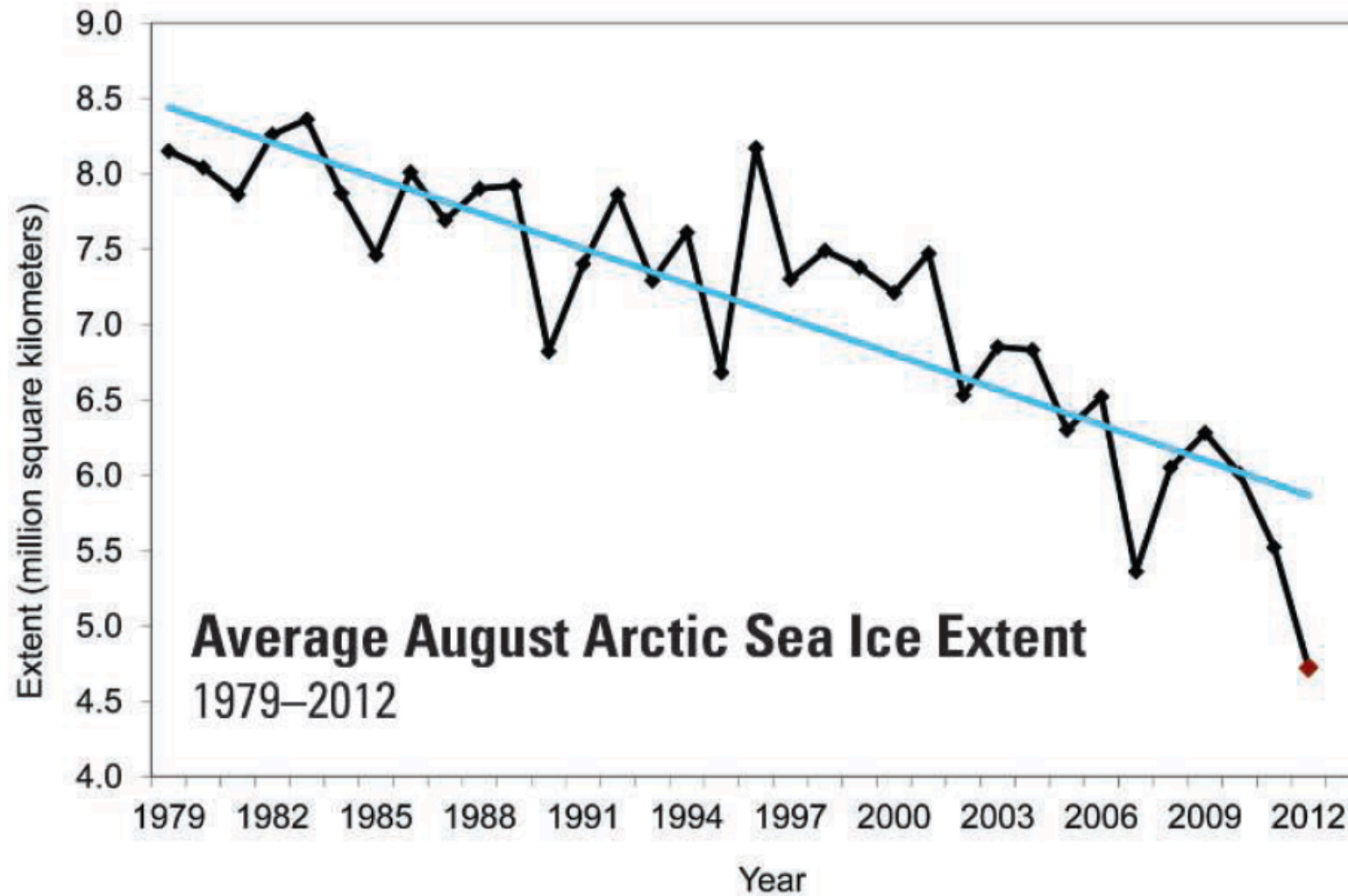
Polar oceans and sea ice and their importance for the global climate system

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- Arctic sea ice decline
- Antarctic ice shelves and sea level rise
- Summary

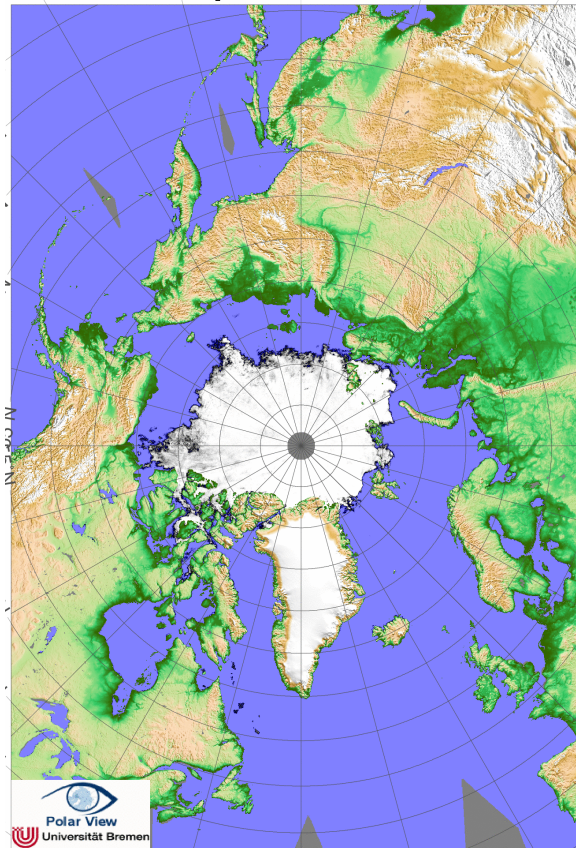
Arctic sea ice decline



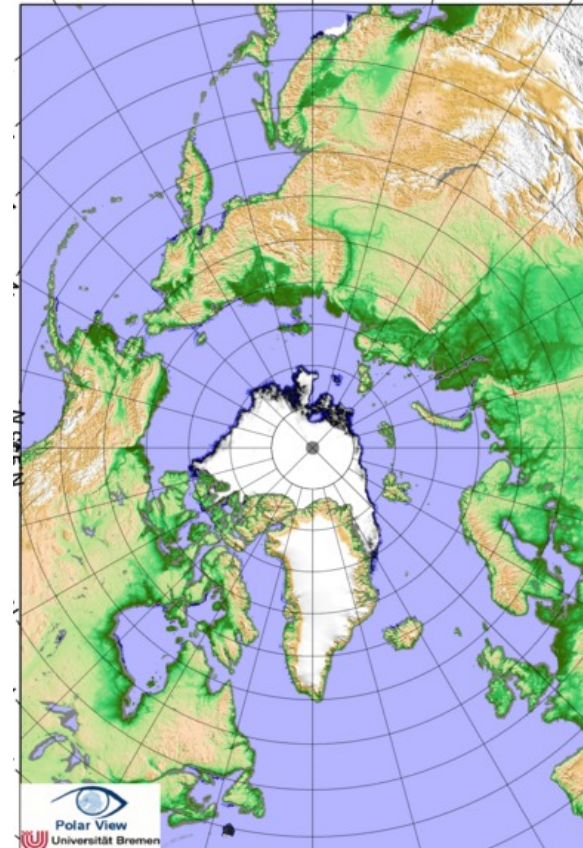
Kerr (2012)

Arctic sea ice decline

16. September 2003



17. September 2012

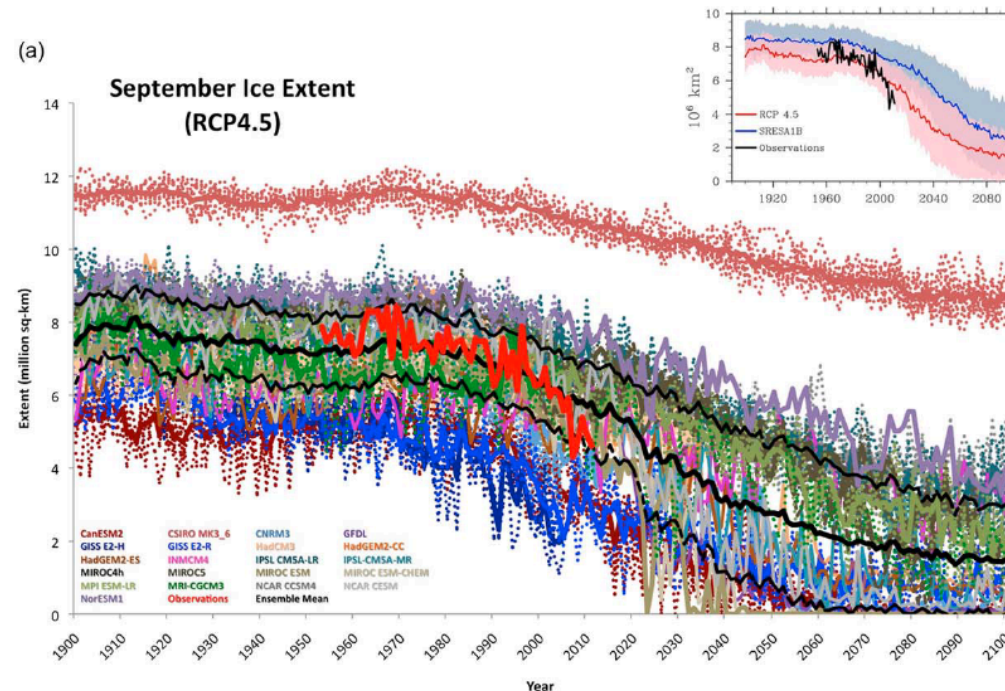


Source: Georg Heygster, University of Bremen

What will happen next?

"This collapse, I predict would occur in 2015-16 at which time the summer Arctic (August to September) would become ice-free." (Peter Wadhams in The Guardian)

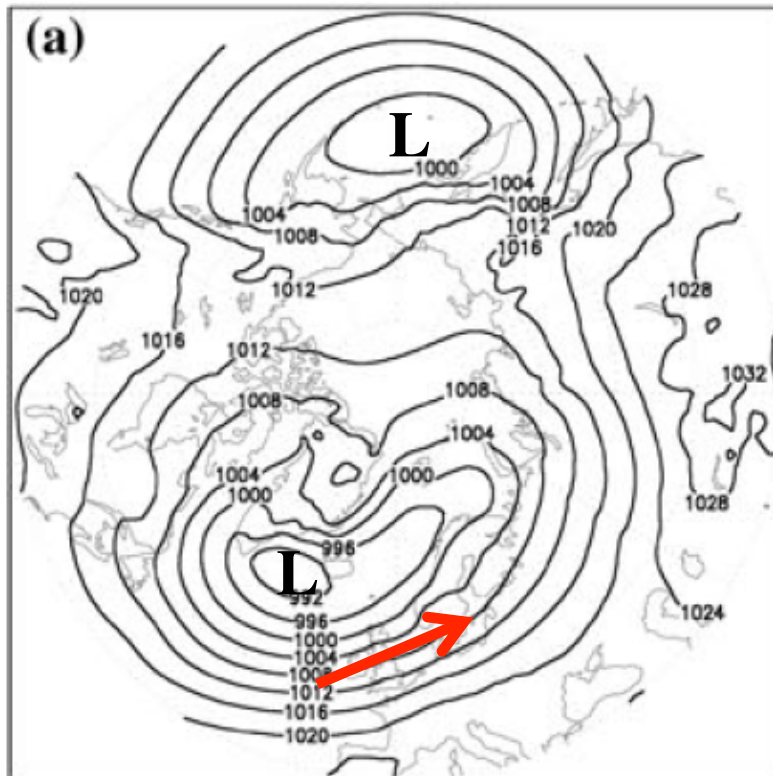
"If Arctic sea ice will follow a linear trend then ice will be vanished in 10 years." (Georg Heygster, University of Bremen)



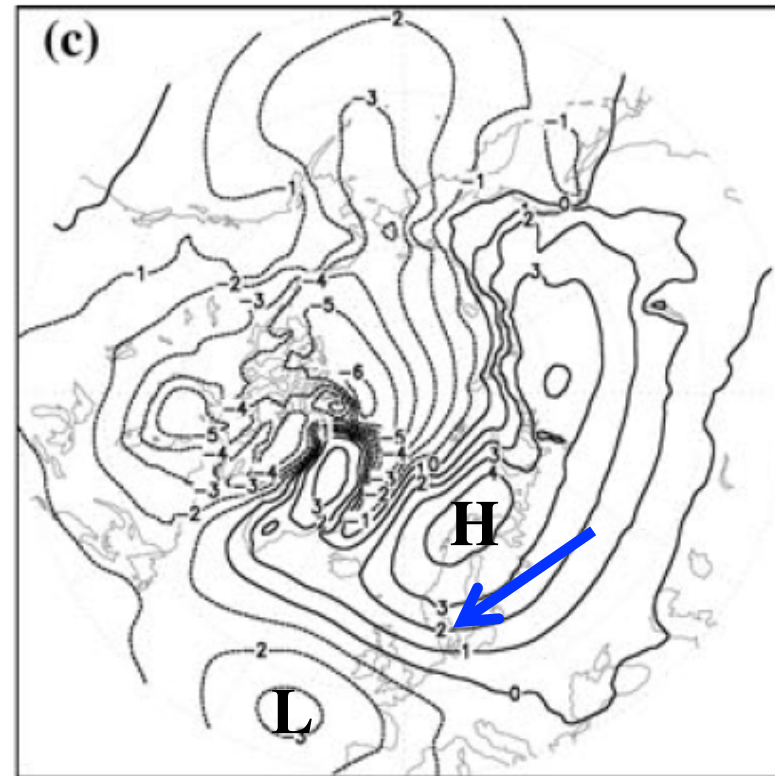
Stroeve et al. (2012)

Does it matter?

Winter climatology

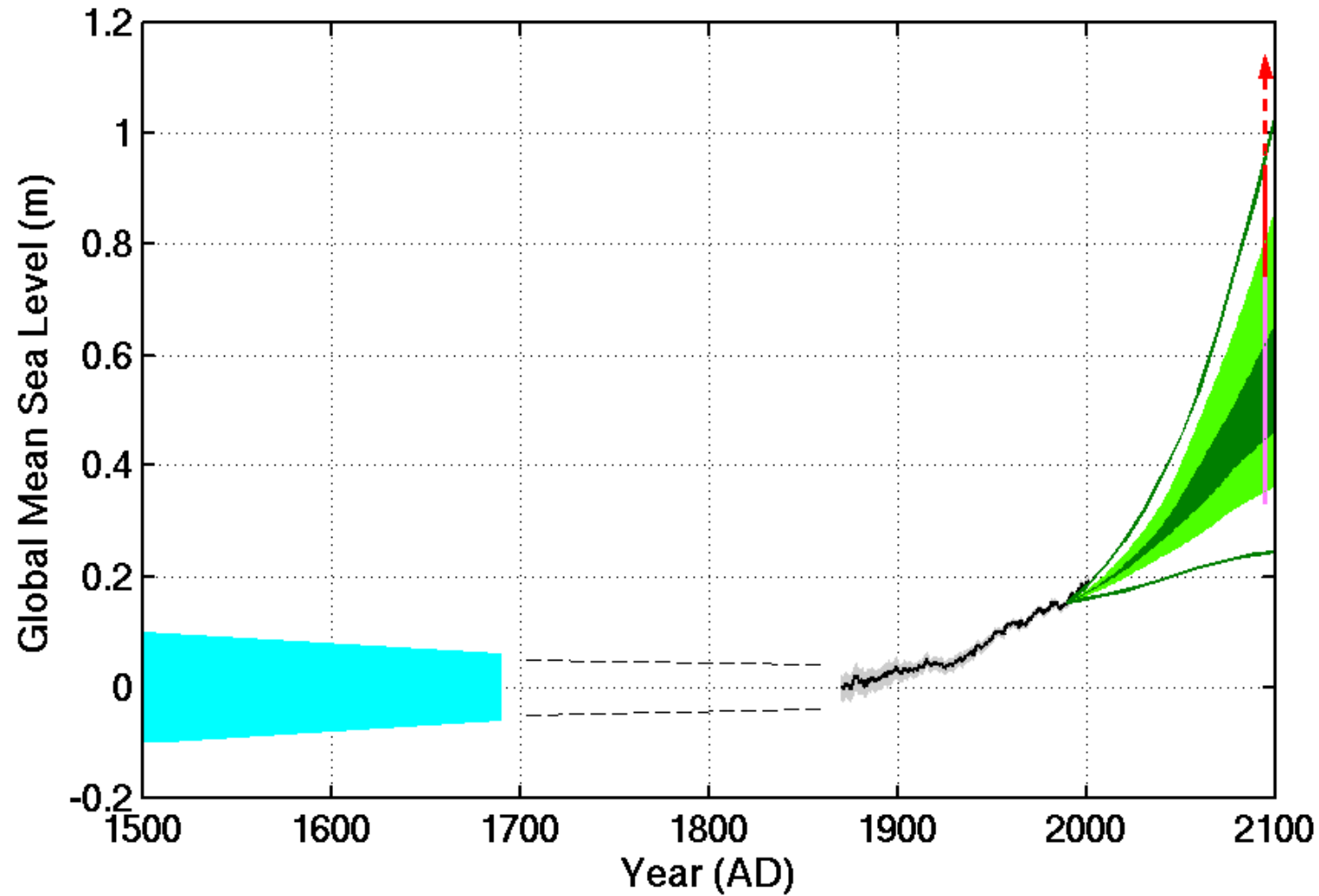


Response to an ice-free Arctic



Semmler et al. (2012)

Sea level change



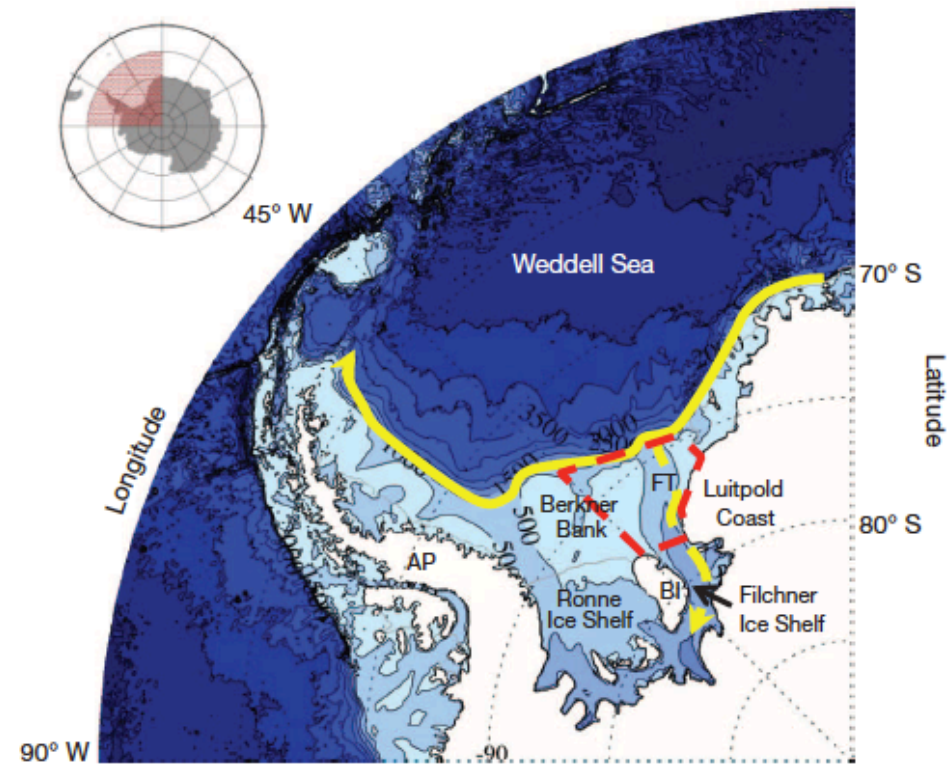
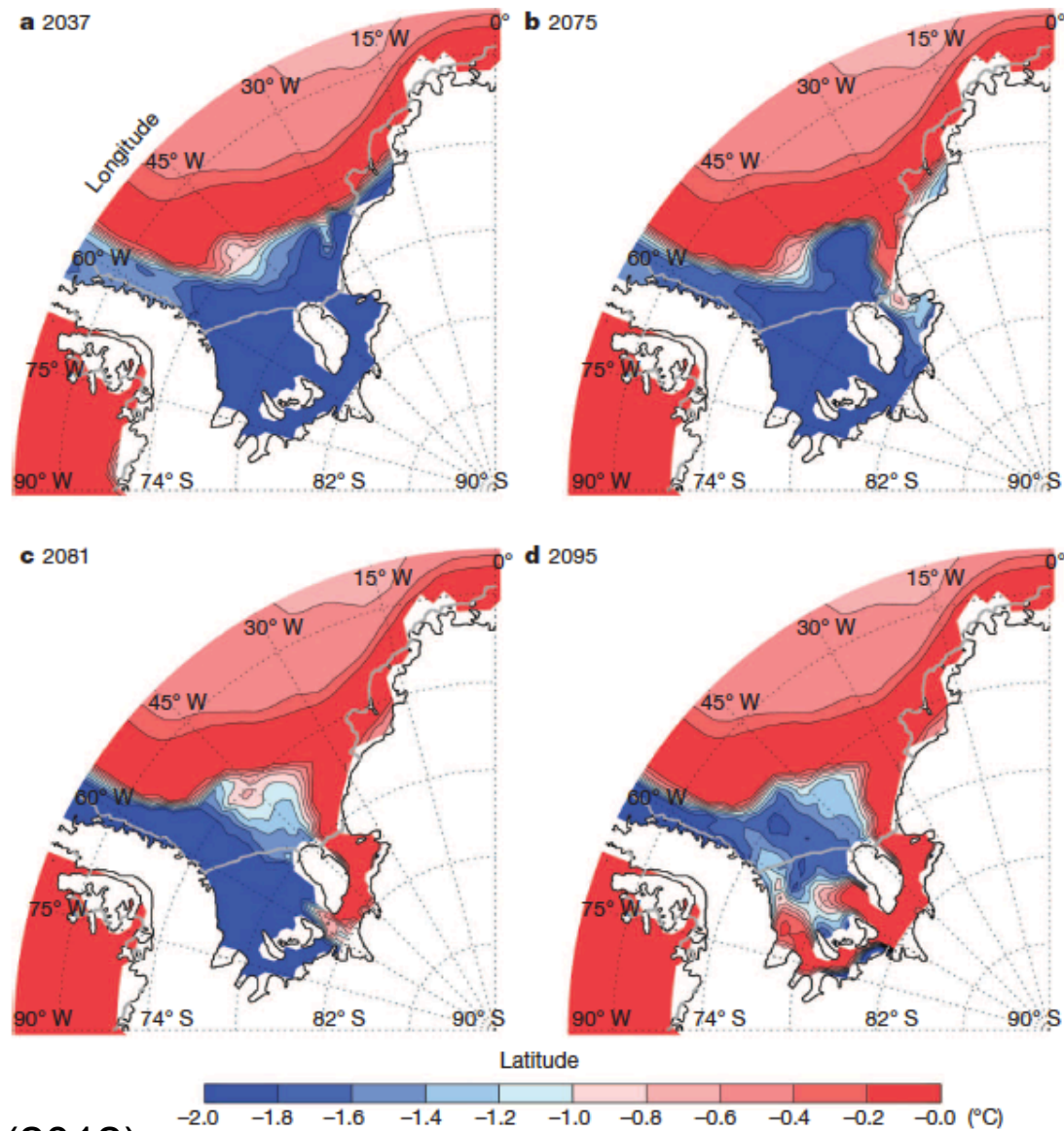


Figure 1 | Map of Weddell Sea bathymetry south of 60° S. Bathymetry is based on RTopo-1 (ref. 29) with a colour contour interval of 500 m. Inset represents the model domain, with the red dashed line showing the map location within the circumpolar Southern Ocean. The solid yellow arrow marks the present course of the coastal current in the Weddell Sea. The possibility of pulsing into the Filchner Trough (FT) is marked by the dashed yellow arrow. The region bounded by the dashed red line provided the integrated and mean values in Fig. 3. The solid grey line off the coastline indicates the ice-shelf front. AP, Antarctic Peninsula; BI, Berkner Island.

Redirection of a coastal current



Hellmer et al. (2012)

- Projected increase of basal melting of Filchner-Ronne Ice Shelf from 83 Gt/yr to 1600 Gt/yr
- Current total loss of Greenland's ice sheets of 240 Gt/yr
- Increased basal melting would lead to an additional sea level rise of 4.4 mm/yr
- Compare this to observed total sea level rise of 3.2 mm/yr

- Polar regions are hotspots of anthropogenic climate change („polar amplification“)
- Polar climate change affects the global climate system
- There is still a lack of thorough understanding of polar climate variability and change (→ large uncertainty)
 - Arctic sea ice decline
 - Sea level rise due to cryospheric changes
- What needs to be done?
 - Further development of monitoring capabilities
 - Need to narrow uncertainties

Thank you!



$$\begin{aligned} \frac{dv}{dt} &= -\alpha \nabla p - \nabla \phi - 2\Omega \times v + F \\ \frac{\partial \rho}{\partial t} &= -\nabla \cdot (\rho v) \\ c_p \frac{dT}{dt} &= \alpha \frac{dp}{dt} + Q \\ p\alpha &= RT \\ \frac{\partial \rho q}{\partial t} &= -\nabla \cdot (\rho v q) + \rho(E - C) \end{aligned}$$

