

Climate change and consequences for the Antarctic marine environment

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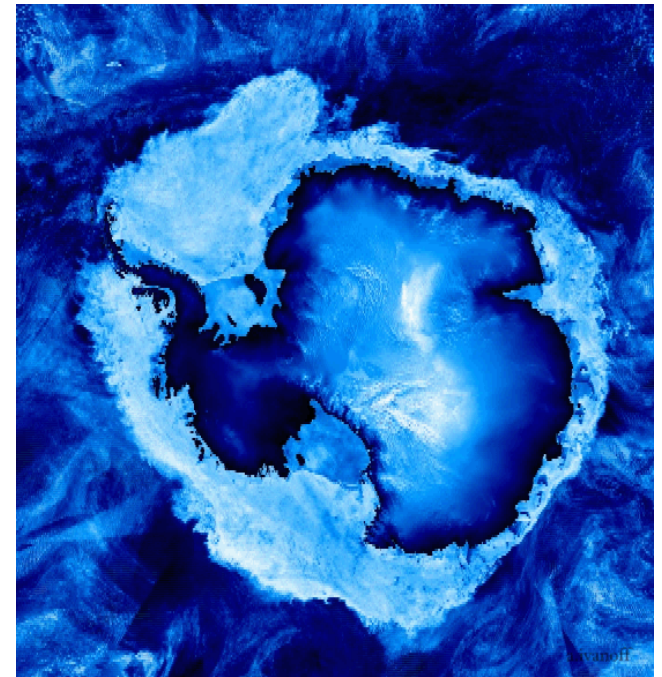
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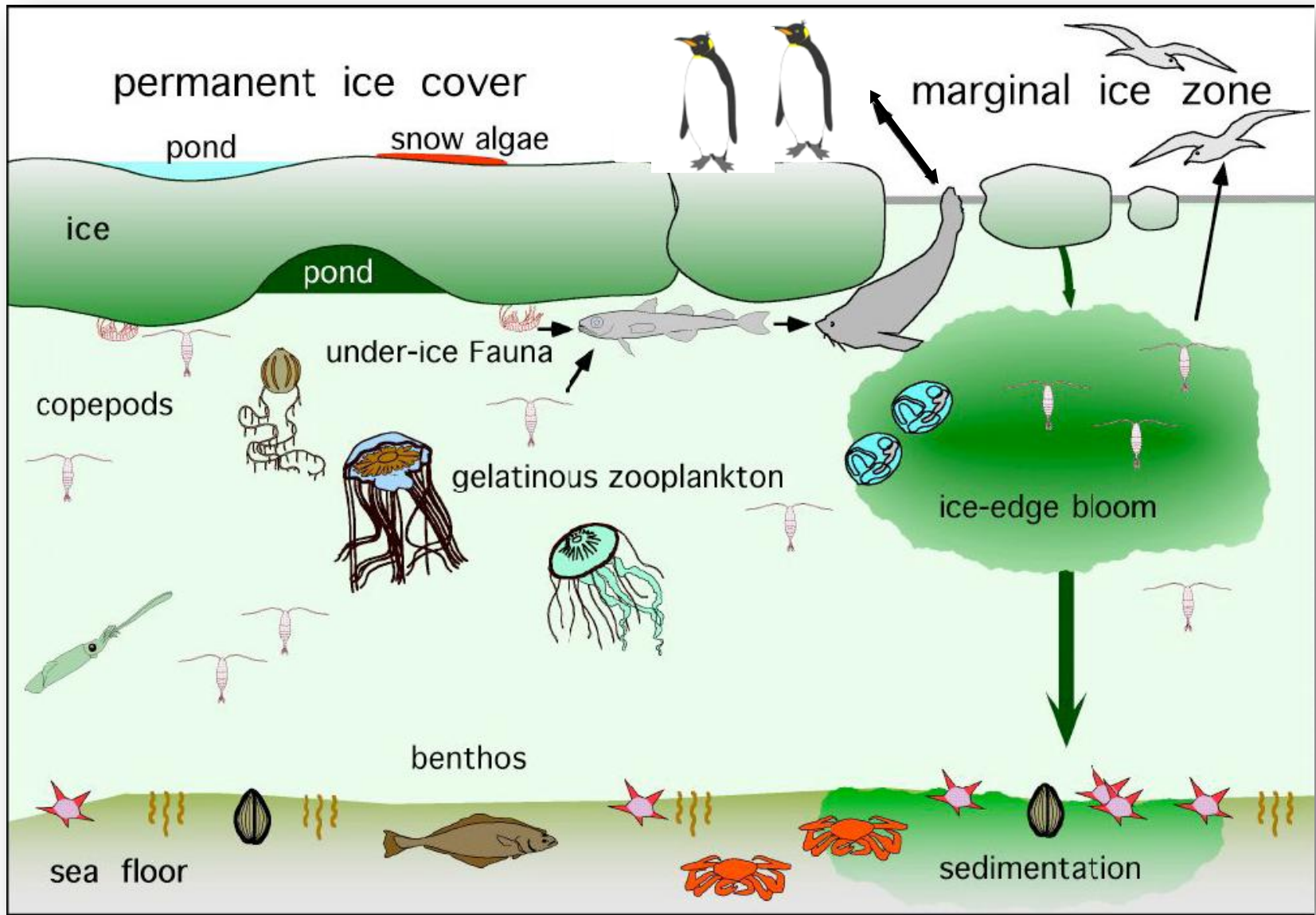
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- Ice
 - Sea-ice and biological consequences
 - West Antarctic ice sheet
- Ocean acidification
- Sustained observations





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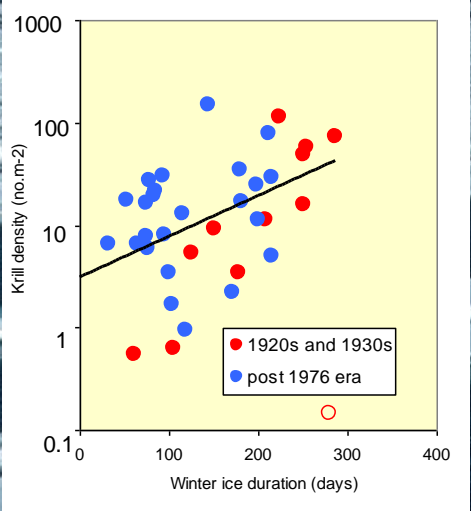
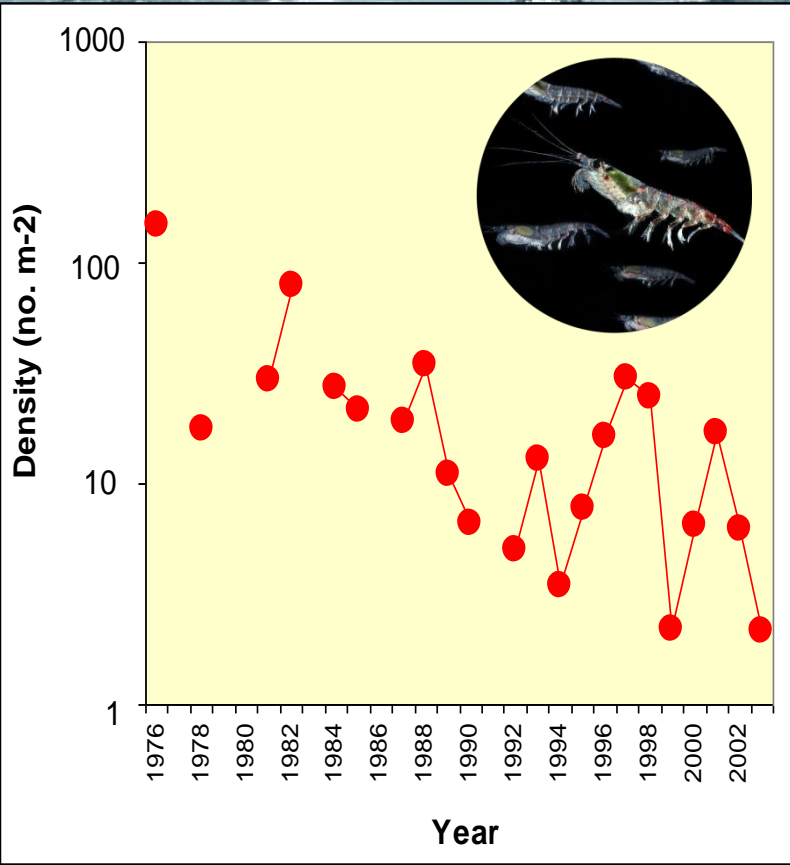
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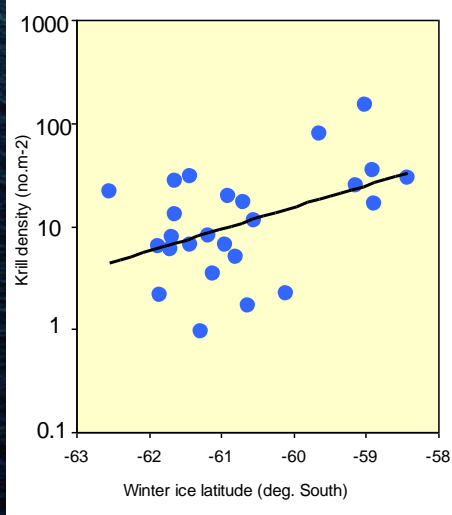


Summer krill abundance versus ice cover the previous winter

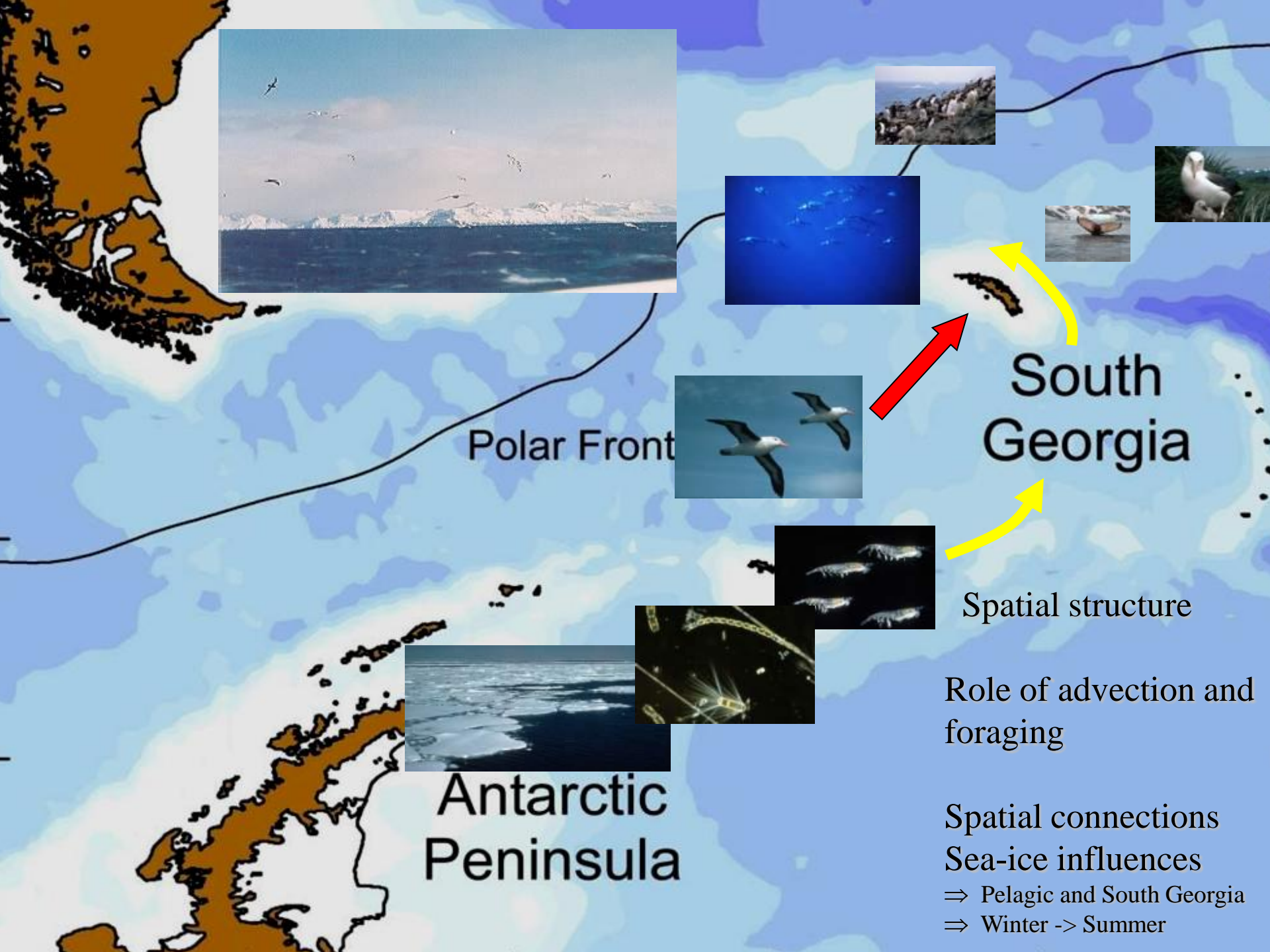
Declining krill population



Ice duration at the South Orkneys



Ice extension across Scotia Sea (satellite observations in Sept)



Polar Front

South Georgia

Antarctic Peninsula

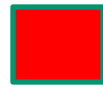
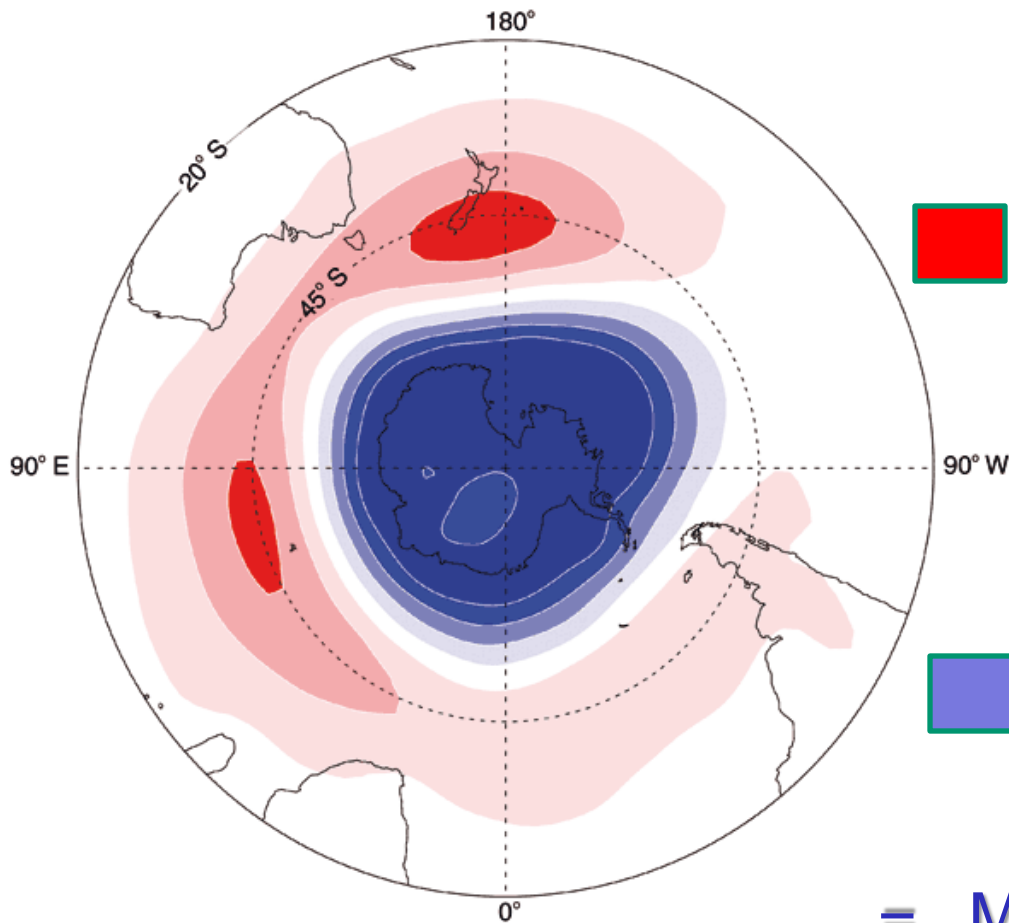
Spatial structure

Role of advection and foraging

Spatial connections
Sea-ice influences

- ⇒ Pelagic and South Georgia
- ⇒ Winter -> Summer

Southern Annular Mode - SAM



Above average atmospheric pressure at 'temperate' latitudes



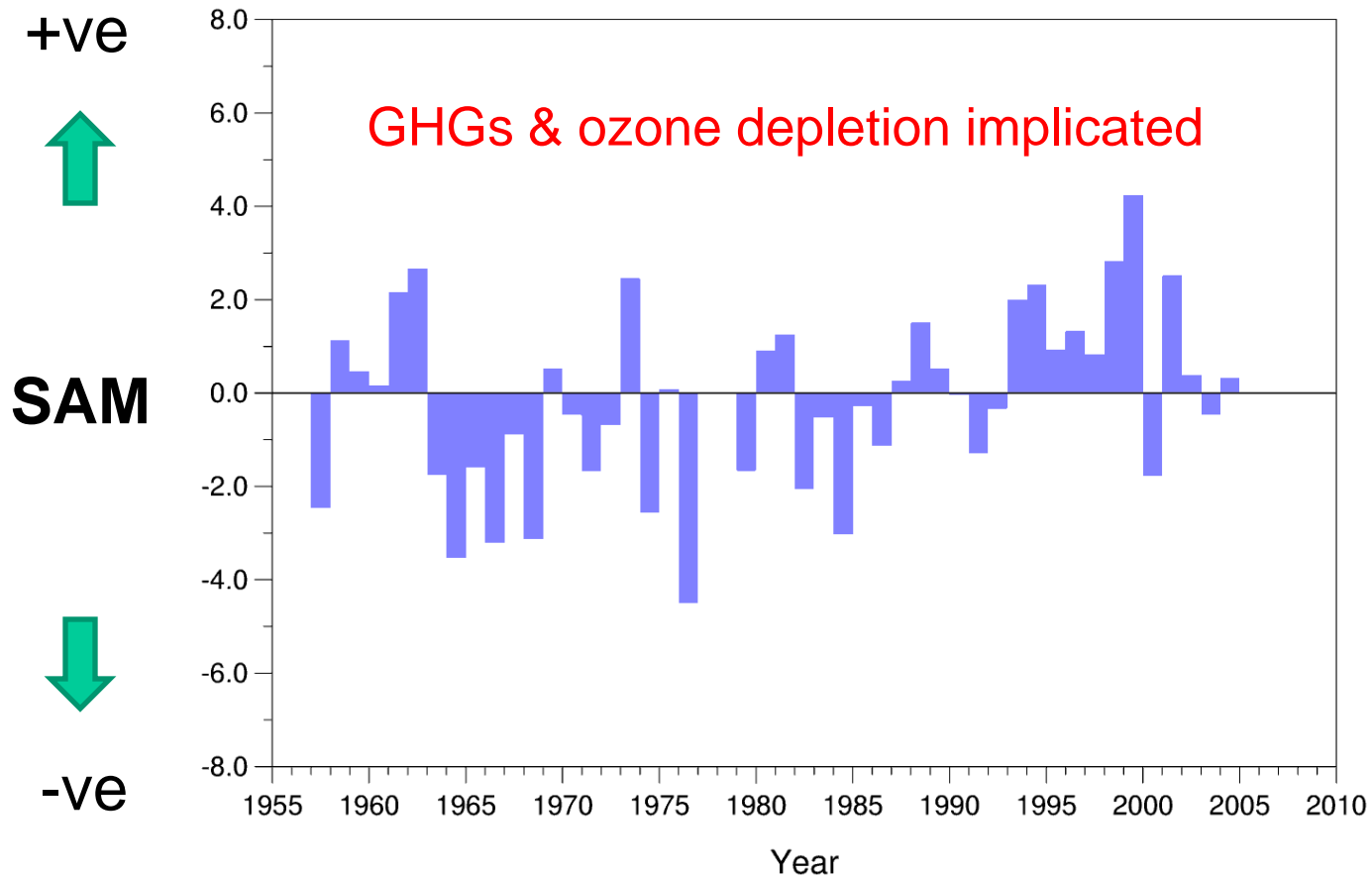
Below average atmospheric pressure at 'polar' latitudes

+ ve 'mode'

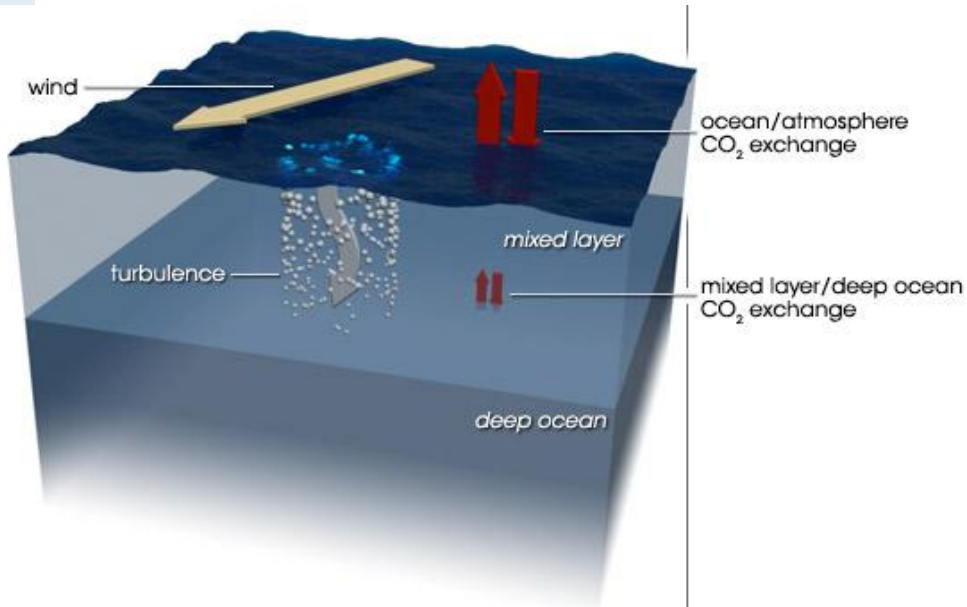
= More intense W winds in S latitudes



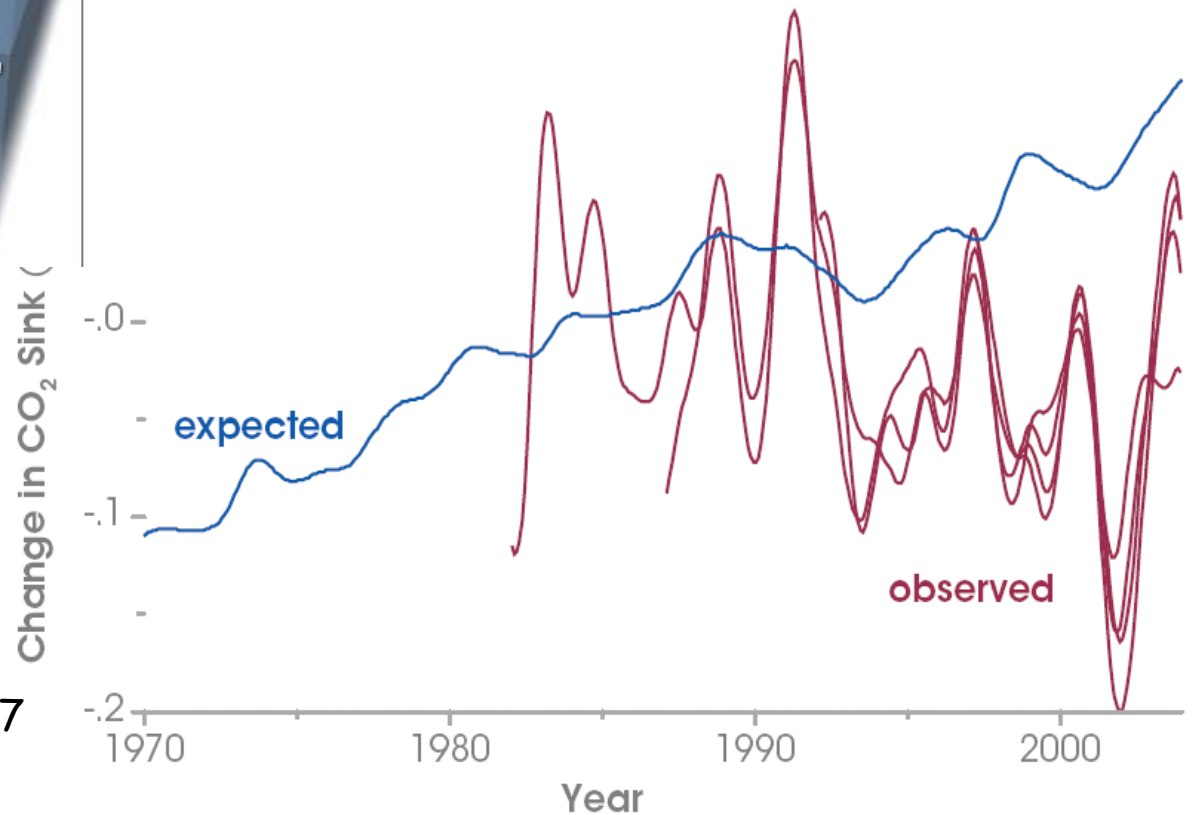
Changes in the summer SAM



Less carbon draw down from the atmosphere into the oceans



Cause:
Increase in Southern Ocean winds
- anthropogenic



Le Quéré et al., Science, 2007

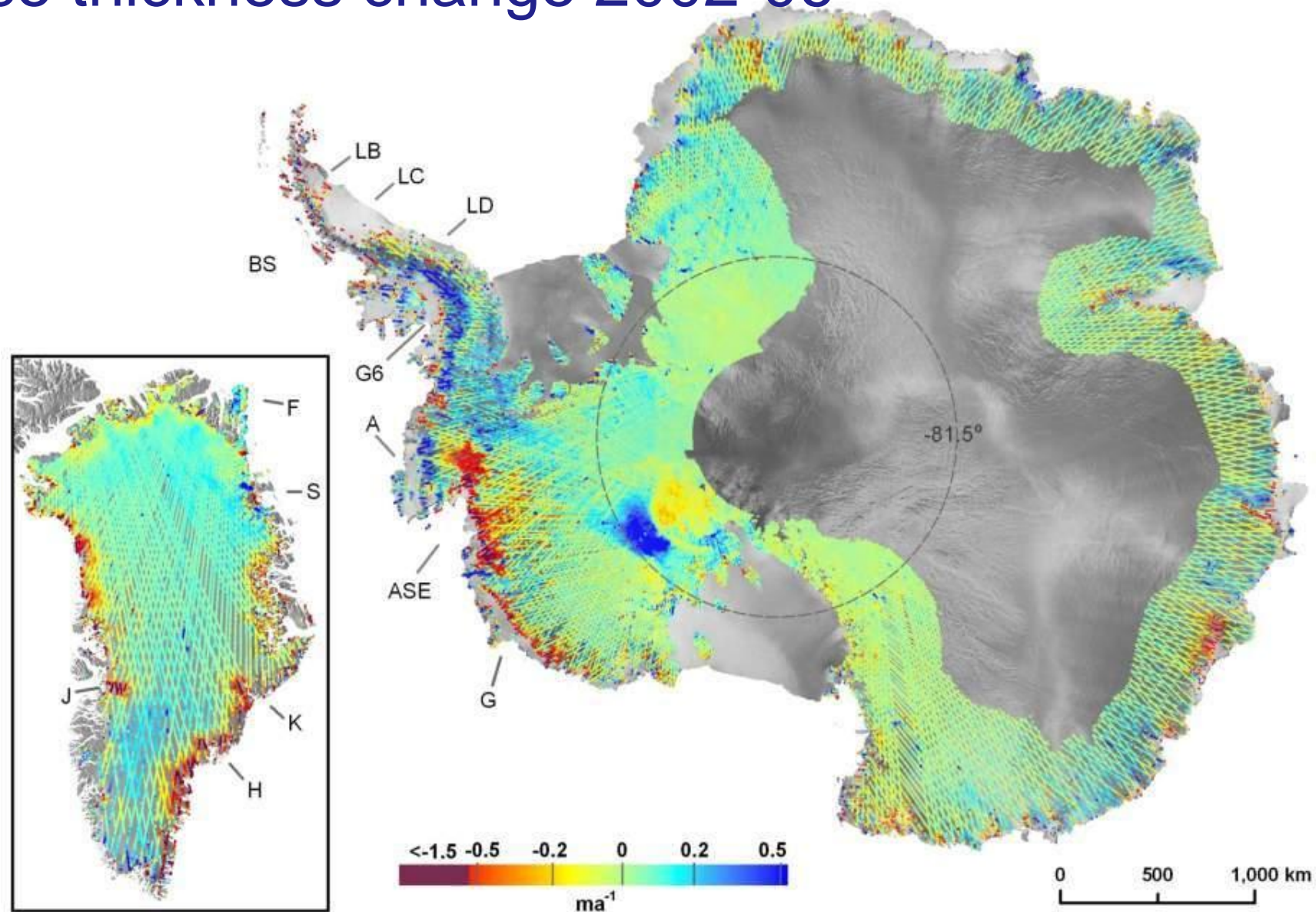
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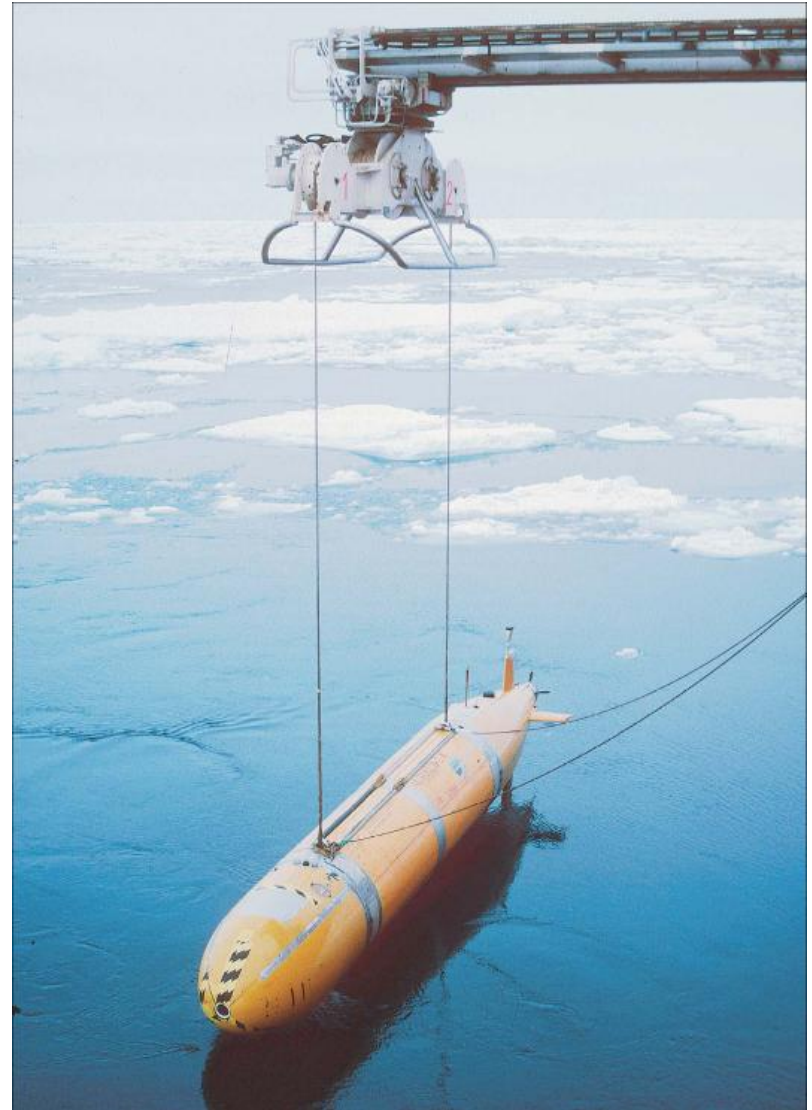
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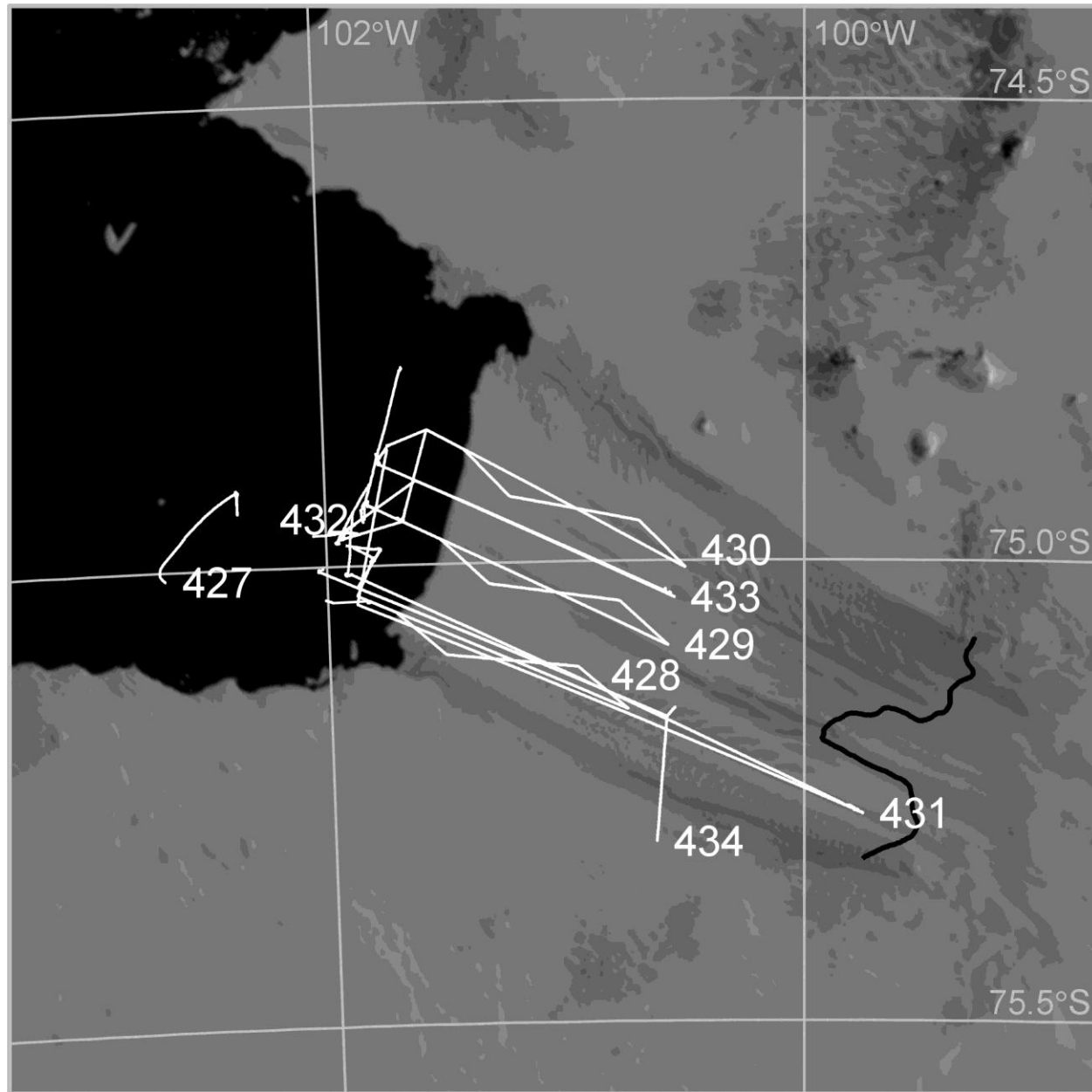
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Ice thickness change 2002-06





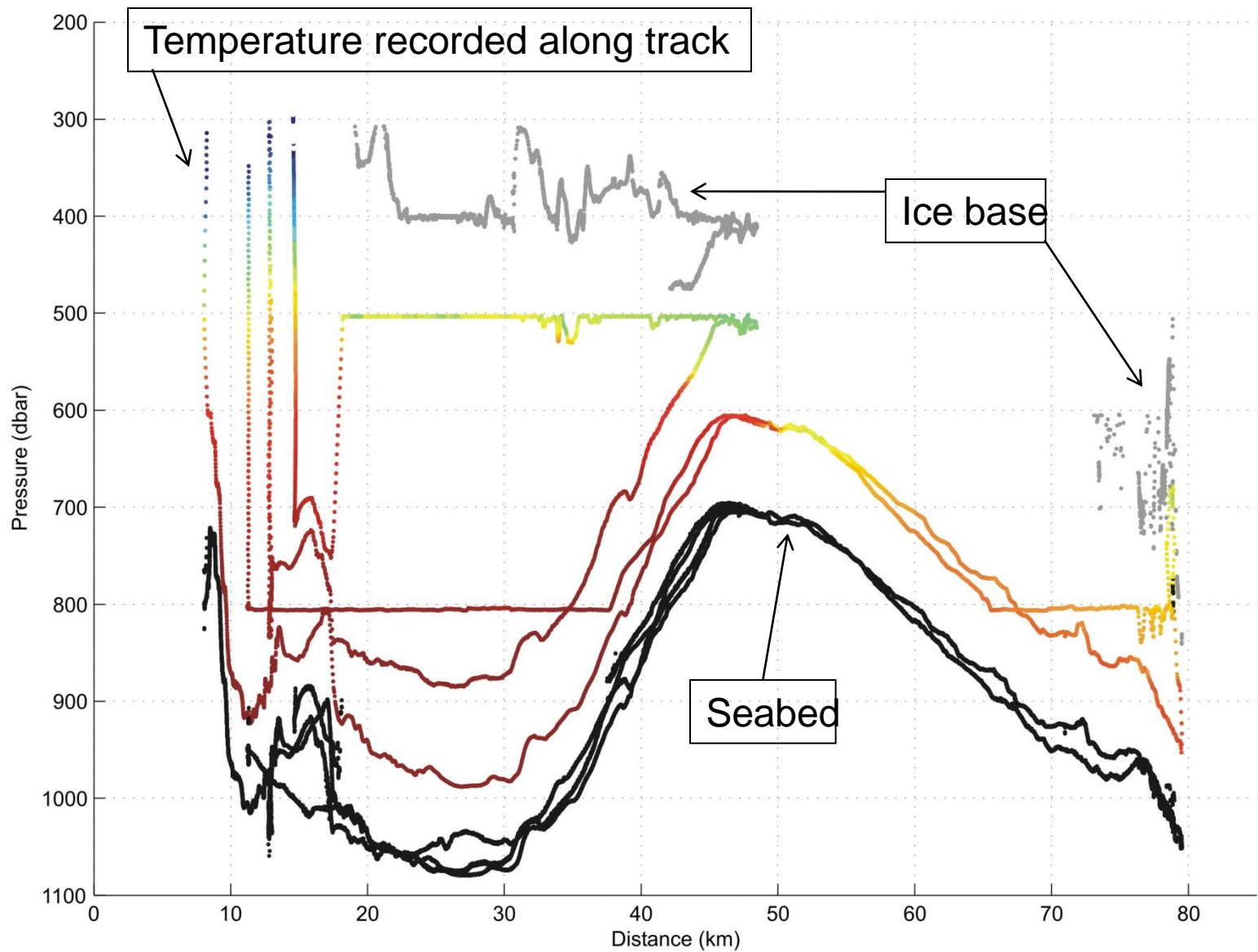


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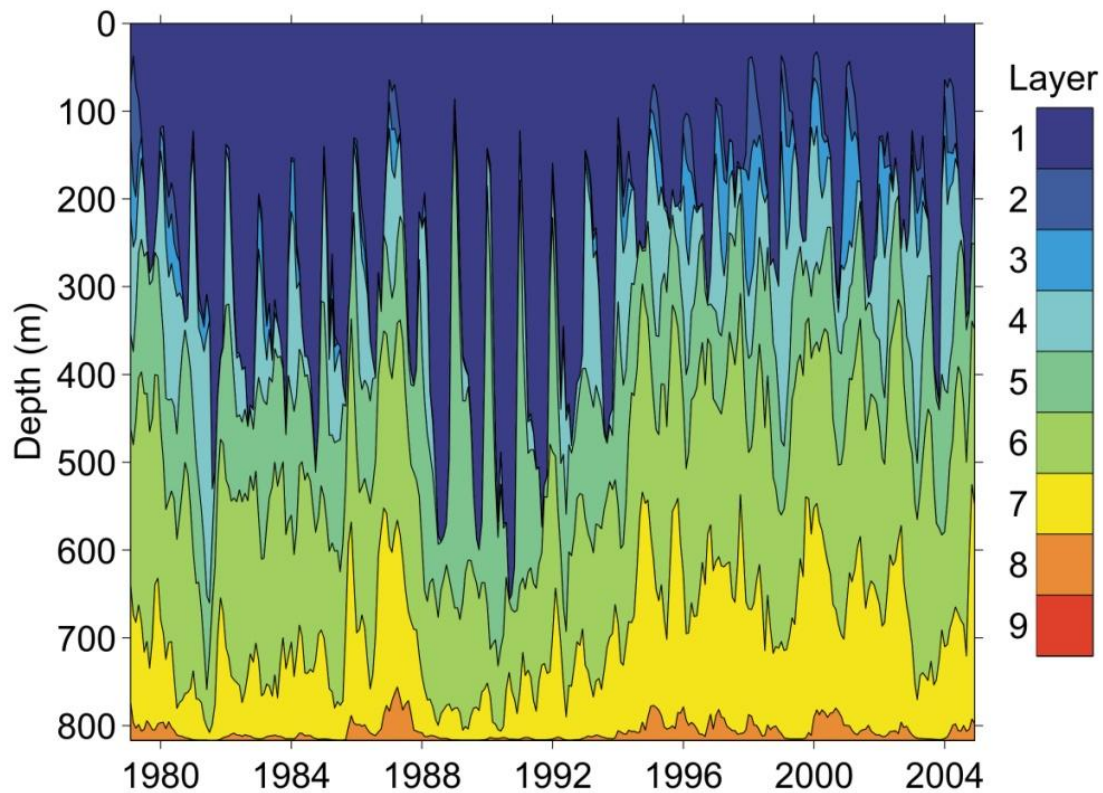
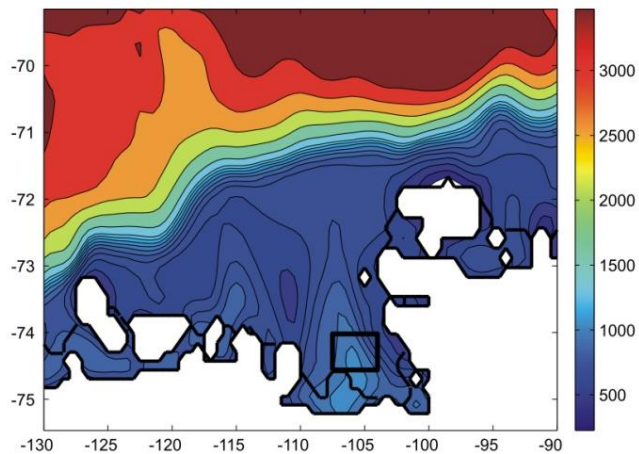
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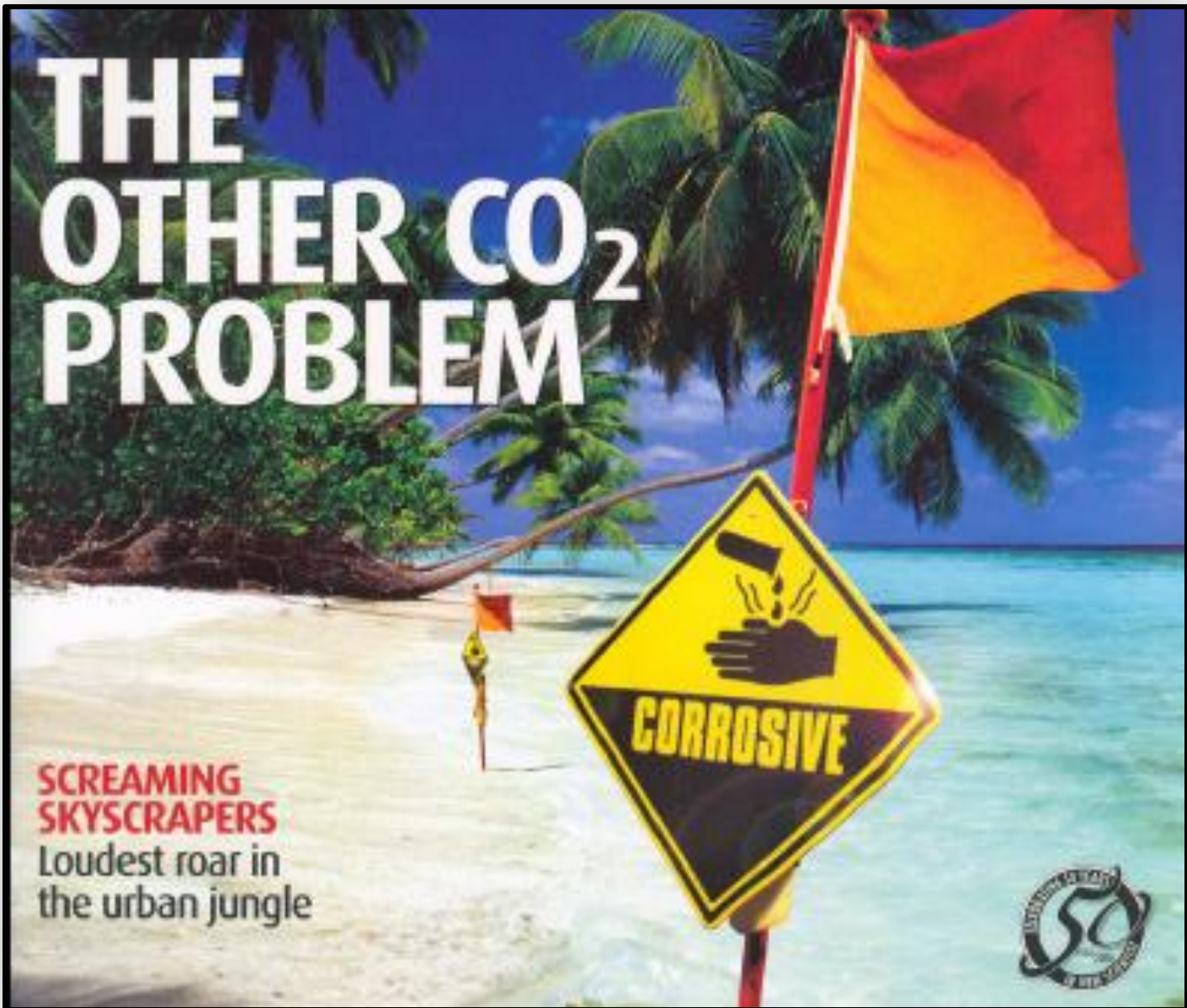




Unpublished data with preliminary calibrations from Missions 428 and 431.







THE OTHER CO₂ PROBLEM

**SCREAMING
SKYSCRAPERS**
Loudest roar in
the urban jungle



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Google™

climate change

Search

Search: the web pages from the UK

Web

Results 1 - 10 of about **47,000,000** for [climate change](#).

Google™

global warming

Search

Search: the web pages from the UK

Web

Results 1 - 10 of about **35,900,000** for [global warming](#) [[definition](#)].

Google™

ocean acidification

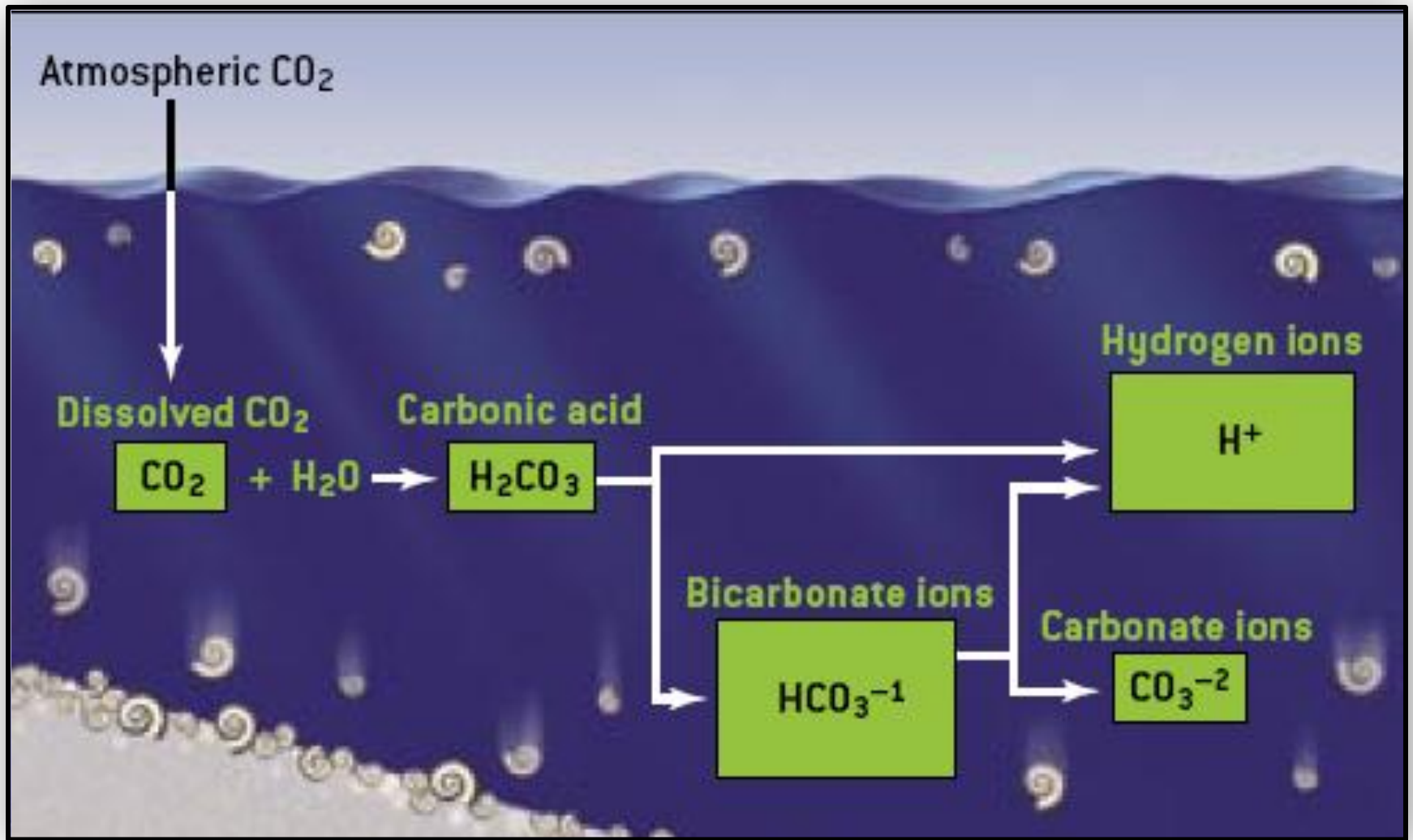
Search

Search: the web pages from the UK

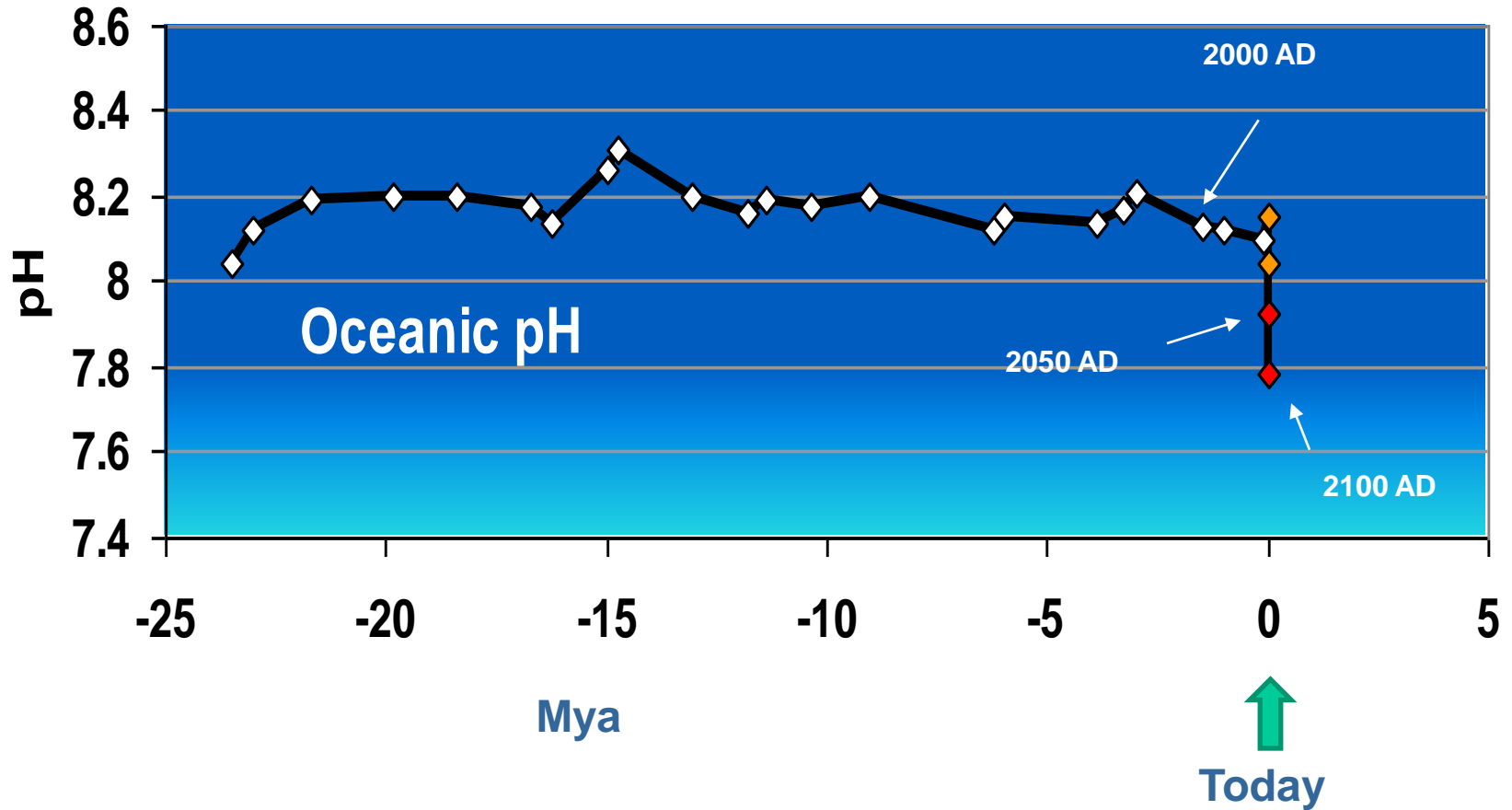
Web

Results 1 - 10 of about **201,000** for [ocean acidification](#).





Ocean pH – Past and Predicted



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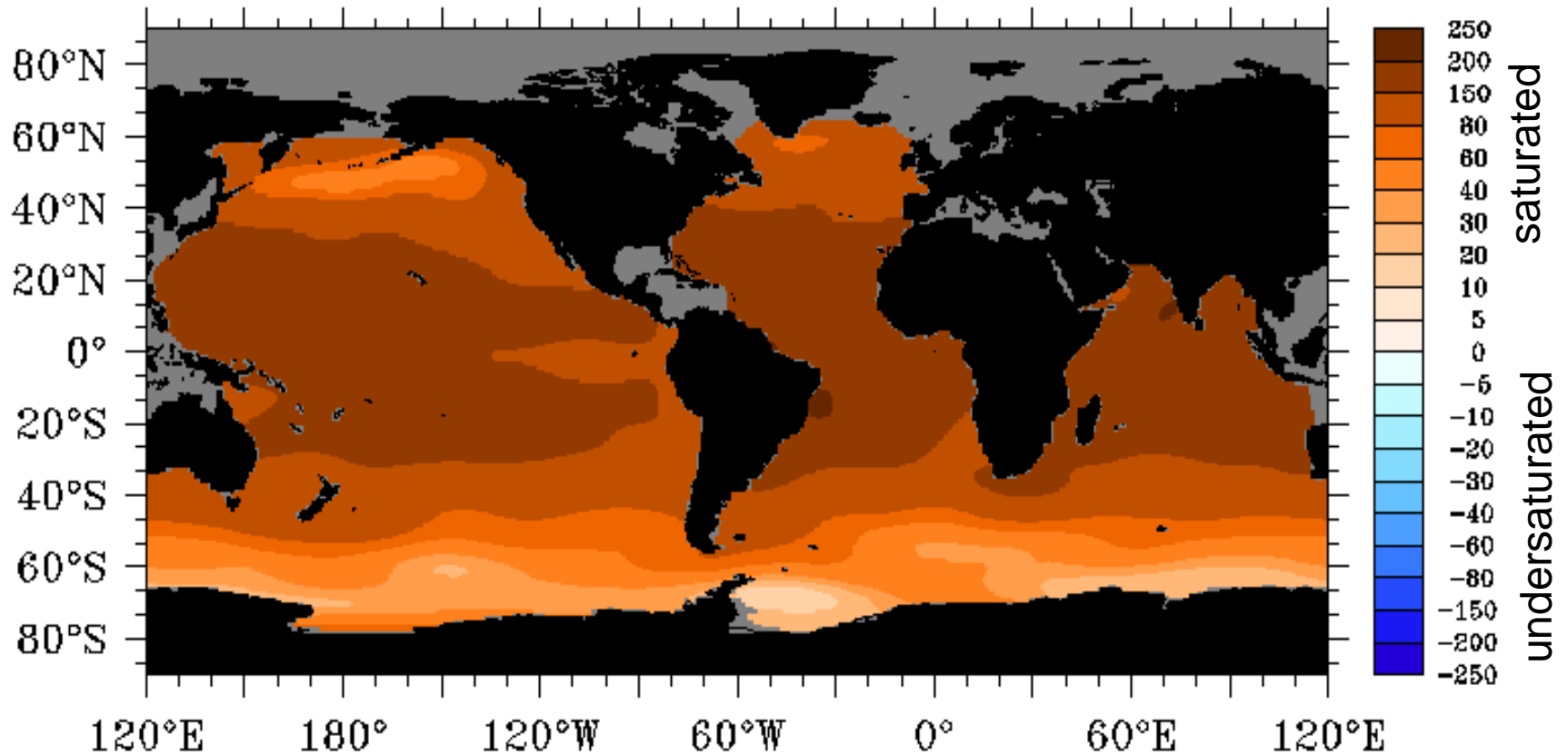
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Past (Pearson and Palmer, 2000) and predicted (Blackford et al 2006) variability of marine pH.



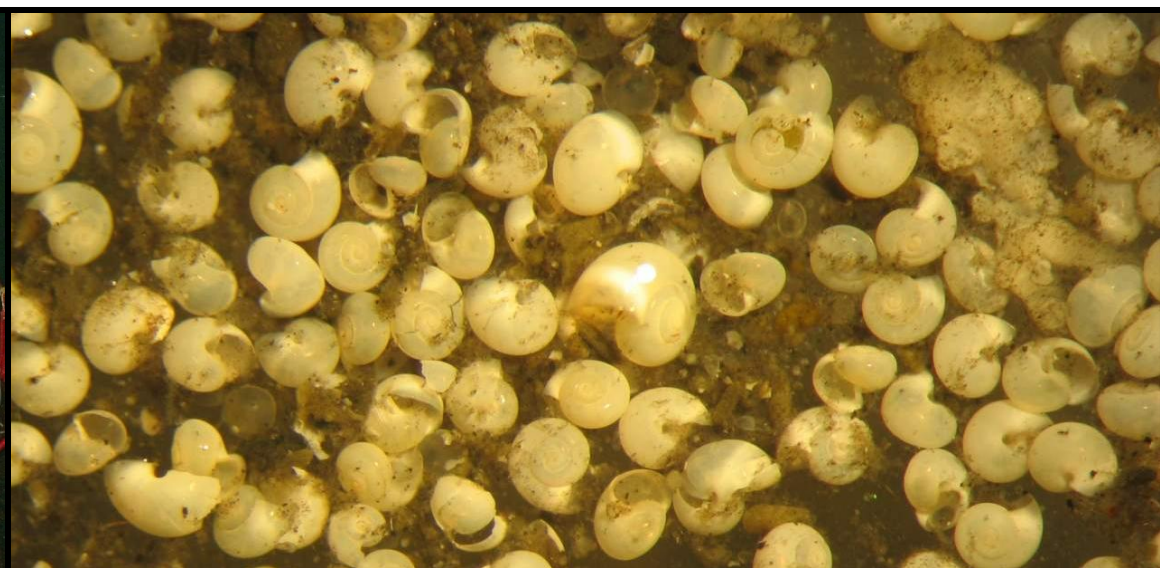
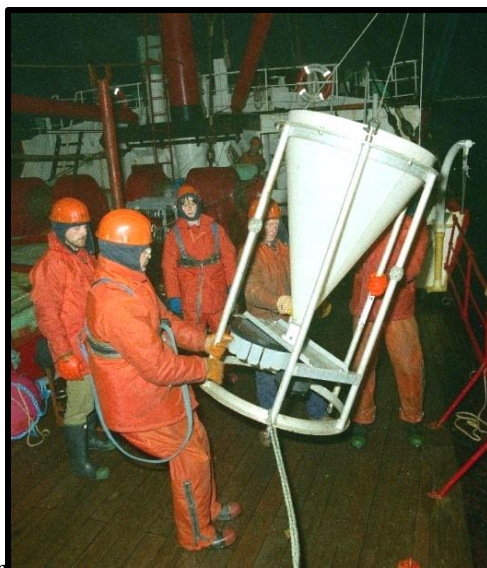
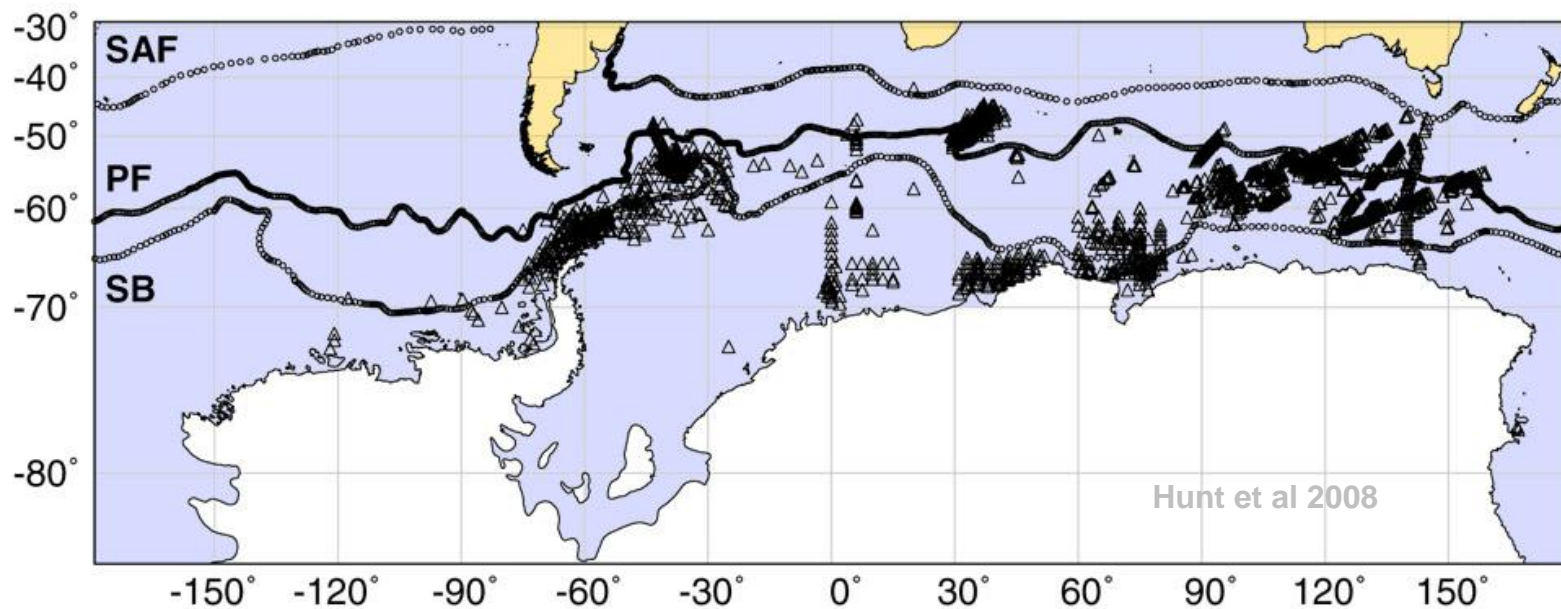
Aragonite saturation state of surface waters

Year 2000

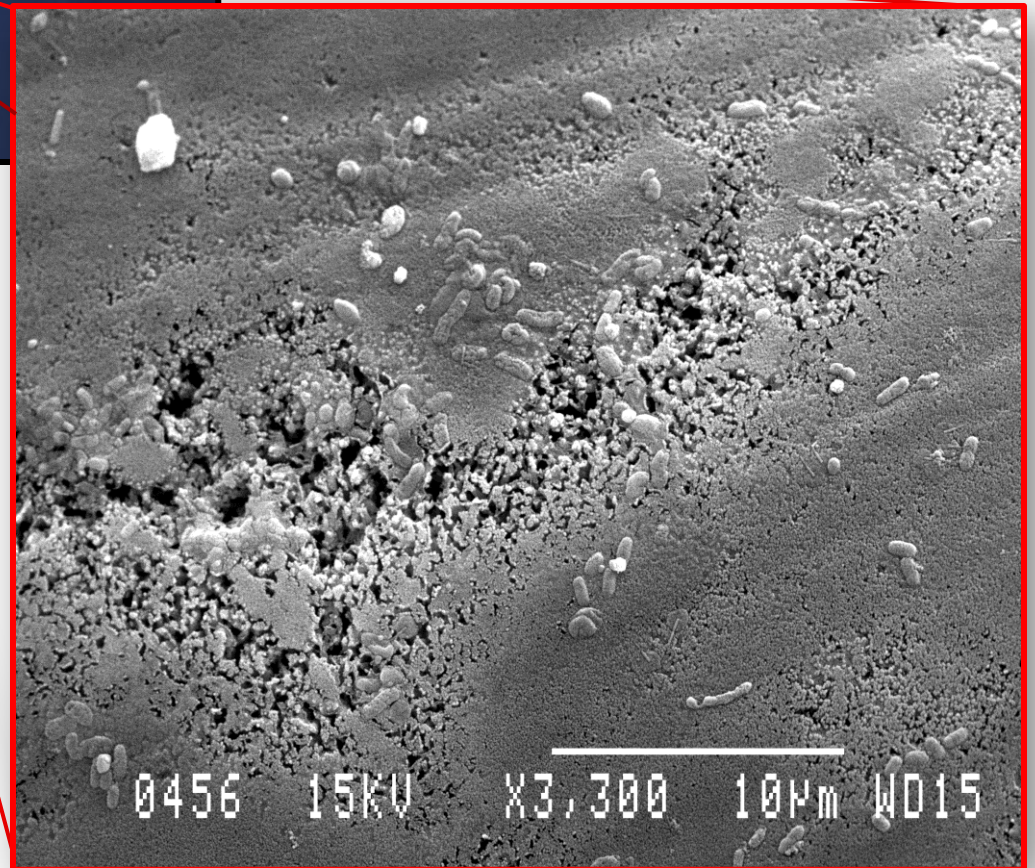
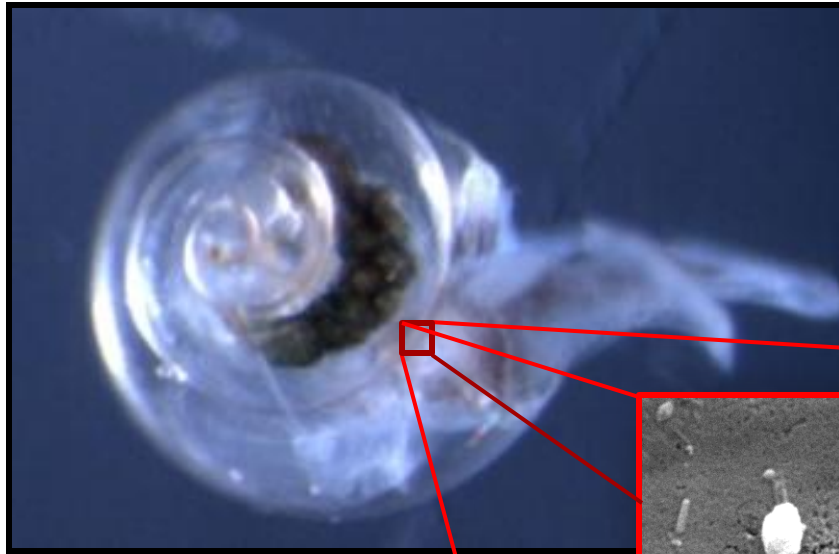


Pteropods – a key organism at the base of the food-chain: particularly in polar waters





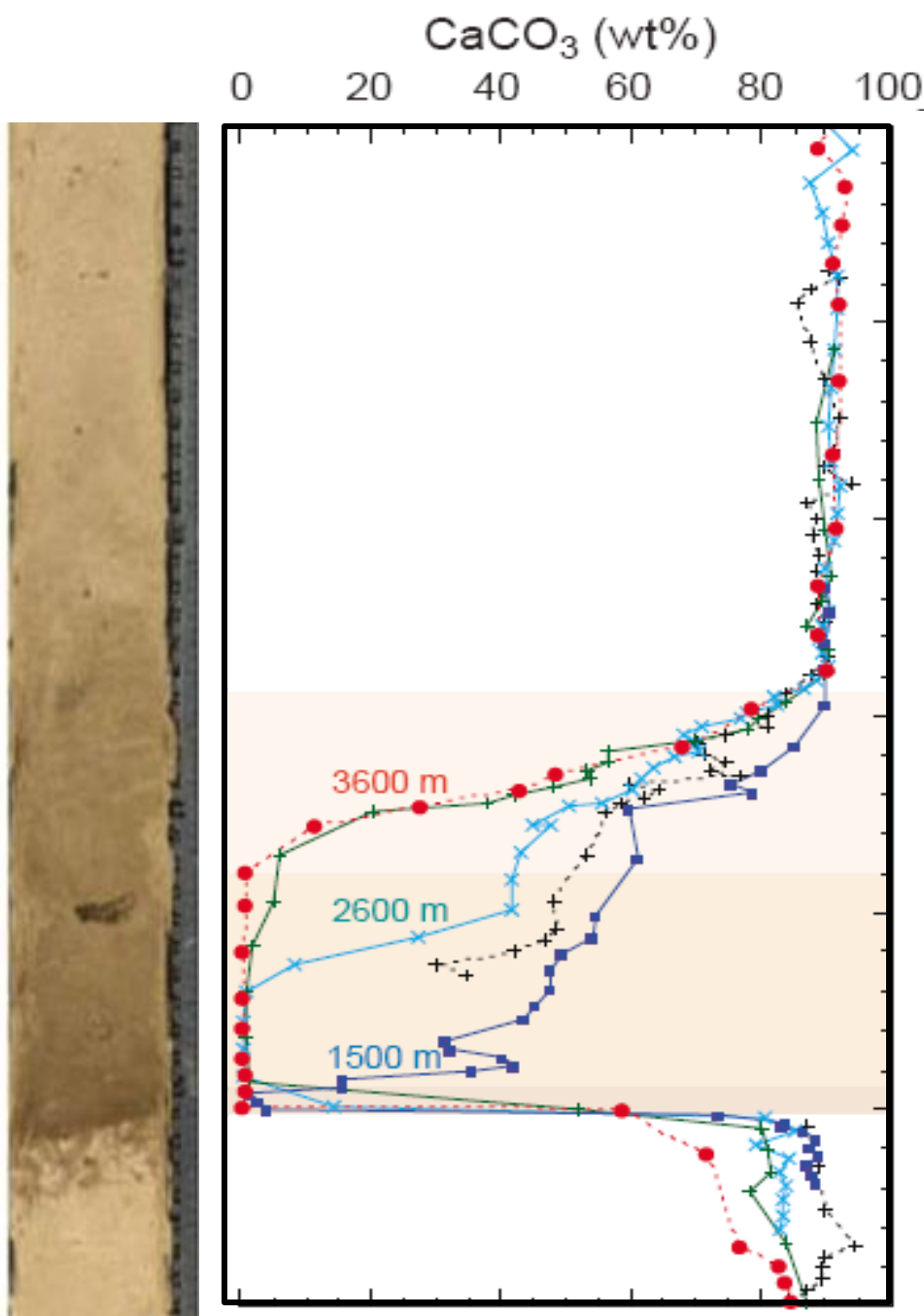
Direct experiments



Bednarsek *et al* , BAS in prep







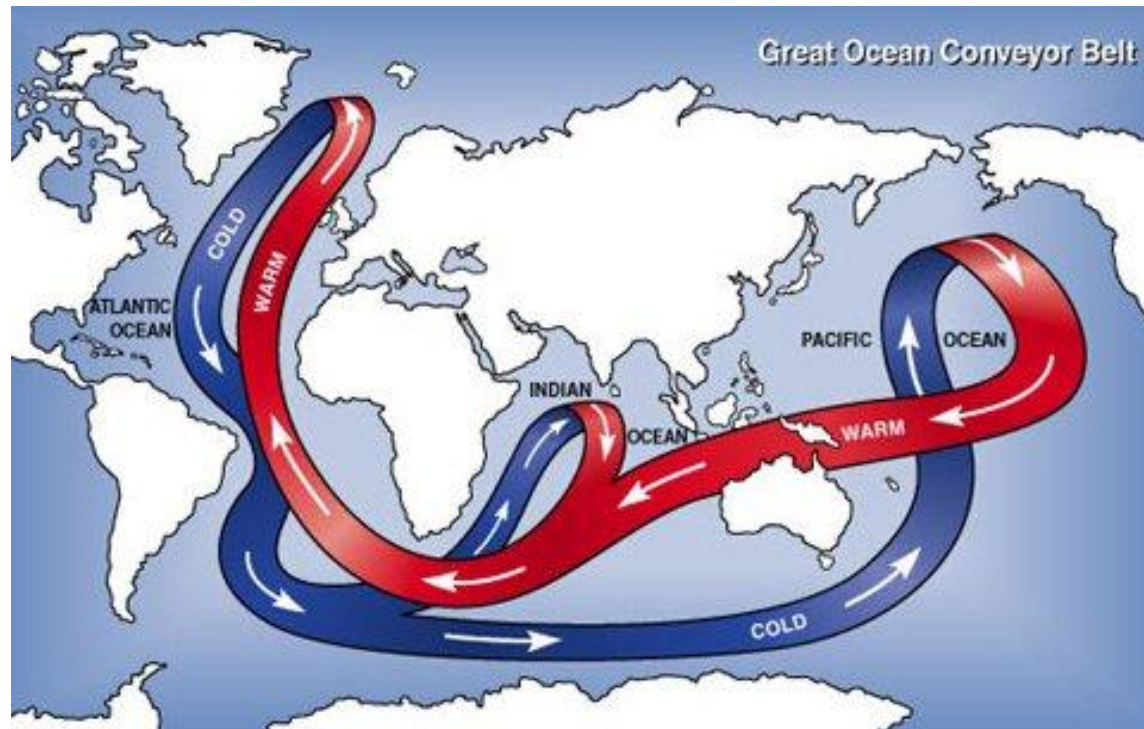
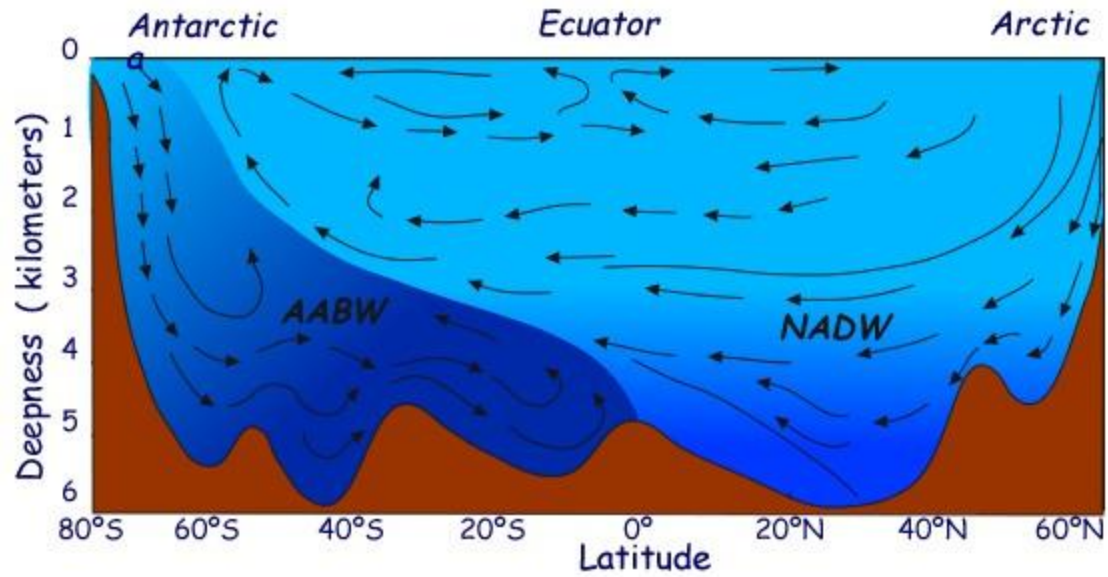
~ 54 Myr

Paleocene – Eocene thermal maximum

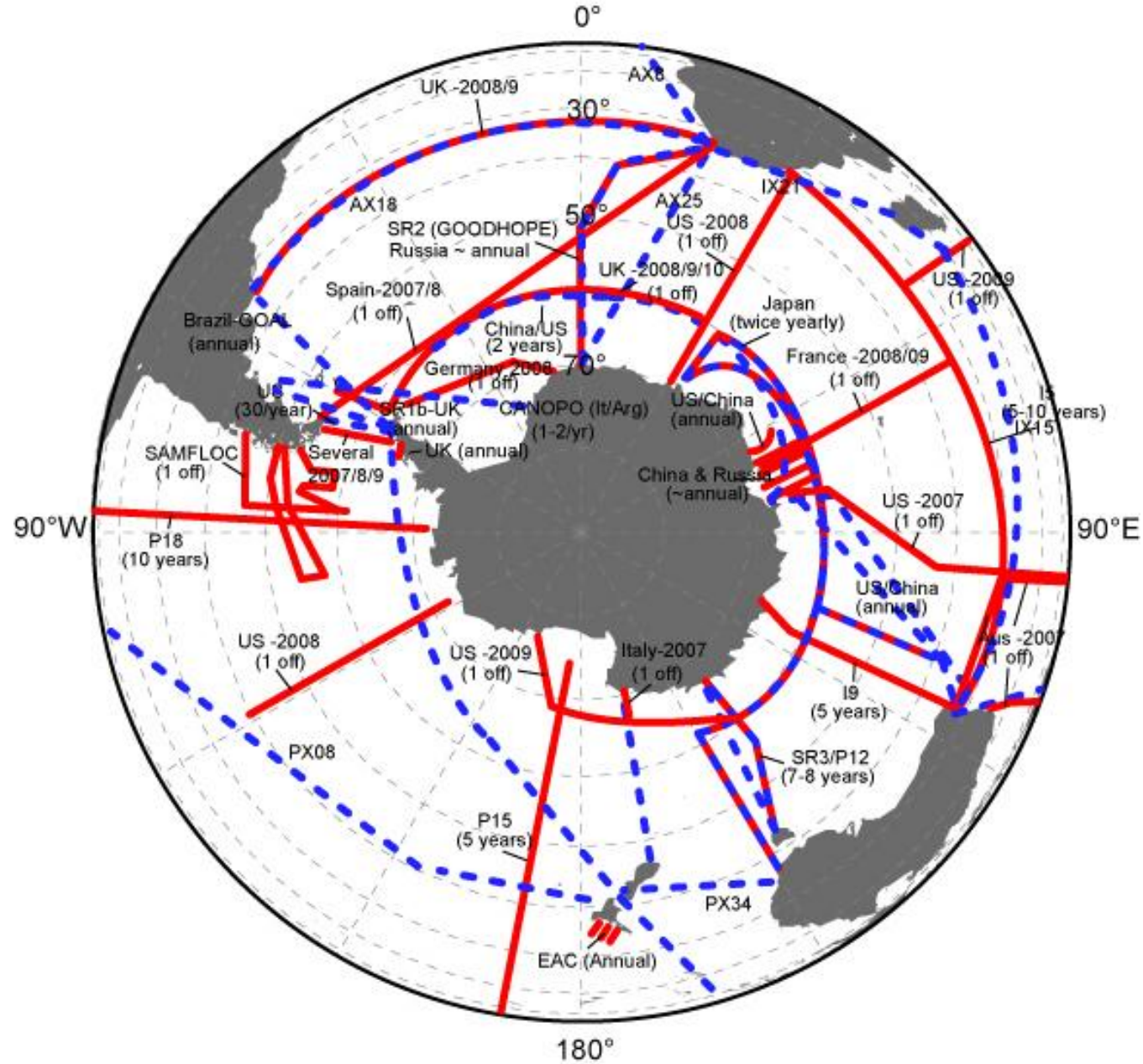
Extinctions of bottom living organisms

~ 55 Myr

← + CO₂



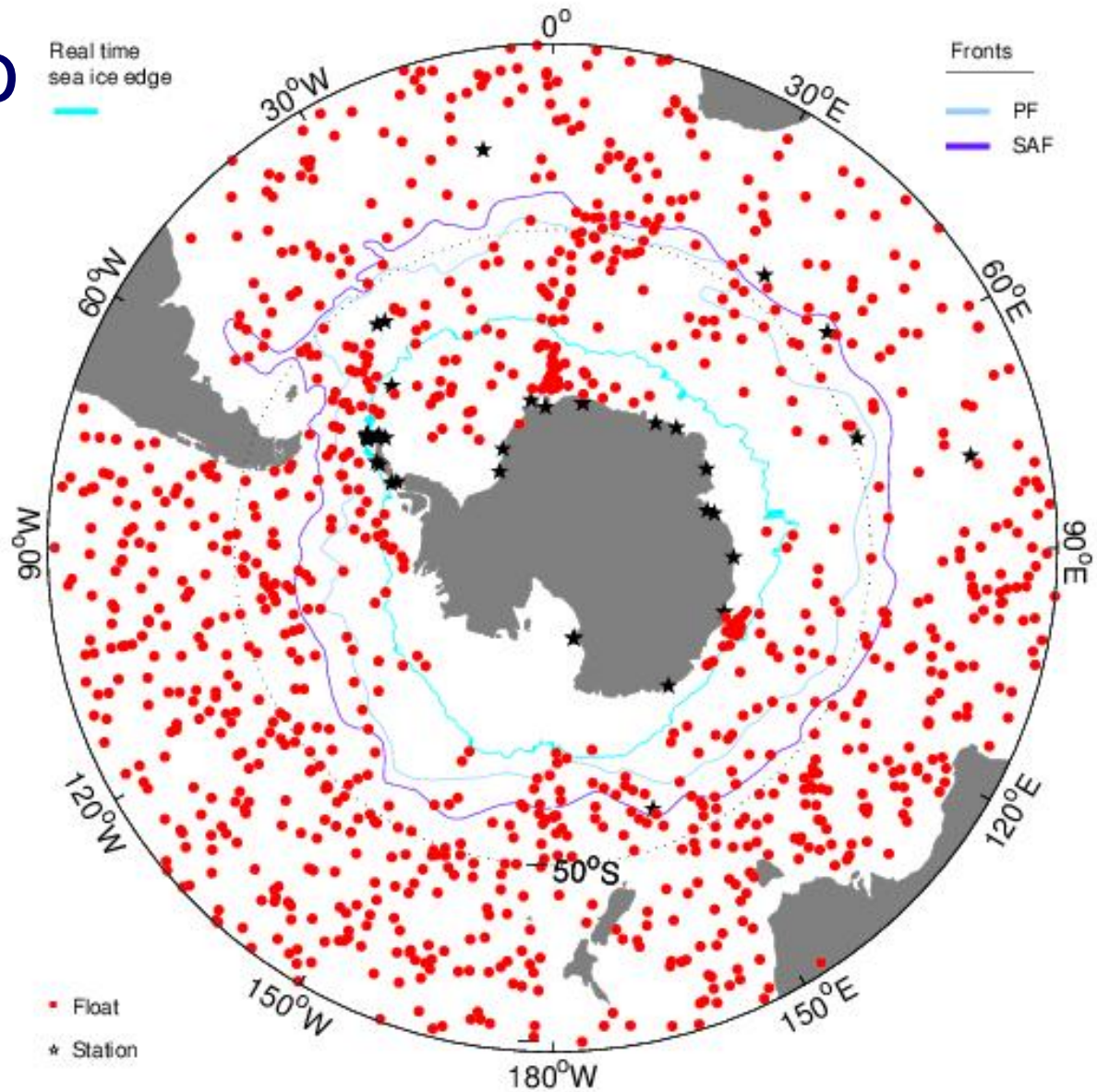
Hydrography
CTD/XBT/CO2
5-10 yr interval



- CTD stations
- - - XBT/underway sections



Argo

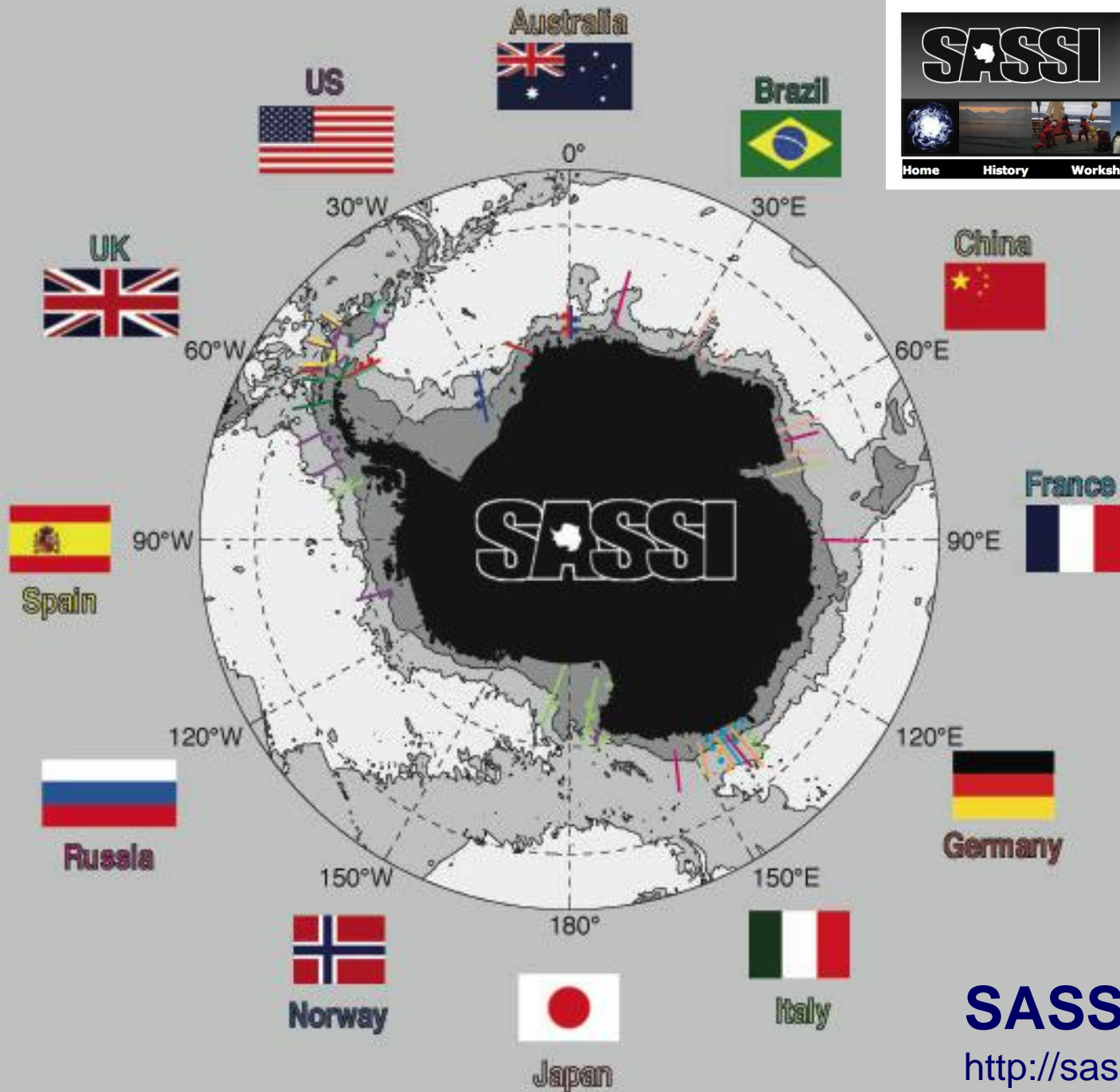


SASSI

Synoptic Antarctic Shelf-Slope Interactions Study



Home History Workshops Links Contacts



**6th major
project
coordinated
by iAnZone
as a
contribution
to IPY**

**One goal is
to design
observing
system**

SASSI website:

<http://sassi.tamu.edu>

Gaps

- No commitment to sustain any aspect of present observing system
- Under sea ice and glacial ice
- Transport monitoring (ACC, DWBC, slope)
- Zonal lines in Indian and Pacific to measure interbasin exchange
- Sections don't all reach continent at southern end
- No sustained monitoring of deep outflows/DWBCs
- Sparse coverage in Pacific (other than Argo)
- Air-sea fluxes
- Time series stations
- Deep ocean



Conclusions/key needs

- Oceans are key to Antarctic climate change
- Commitment to sustained, co-ordinated multi-national observation campaign
 - Oceanography (broadest sense – physics, chemistry and biology)
 - Atmosphere/meteorological
- Greater use of remote sensing
 - Aircraft, submersibles, in-situ instrumentation, satellites

