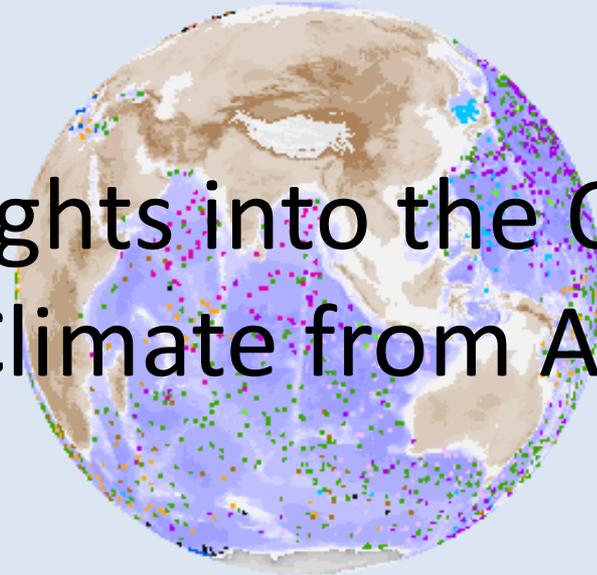




# New Insights into the Oceans and Climate from Argo



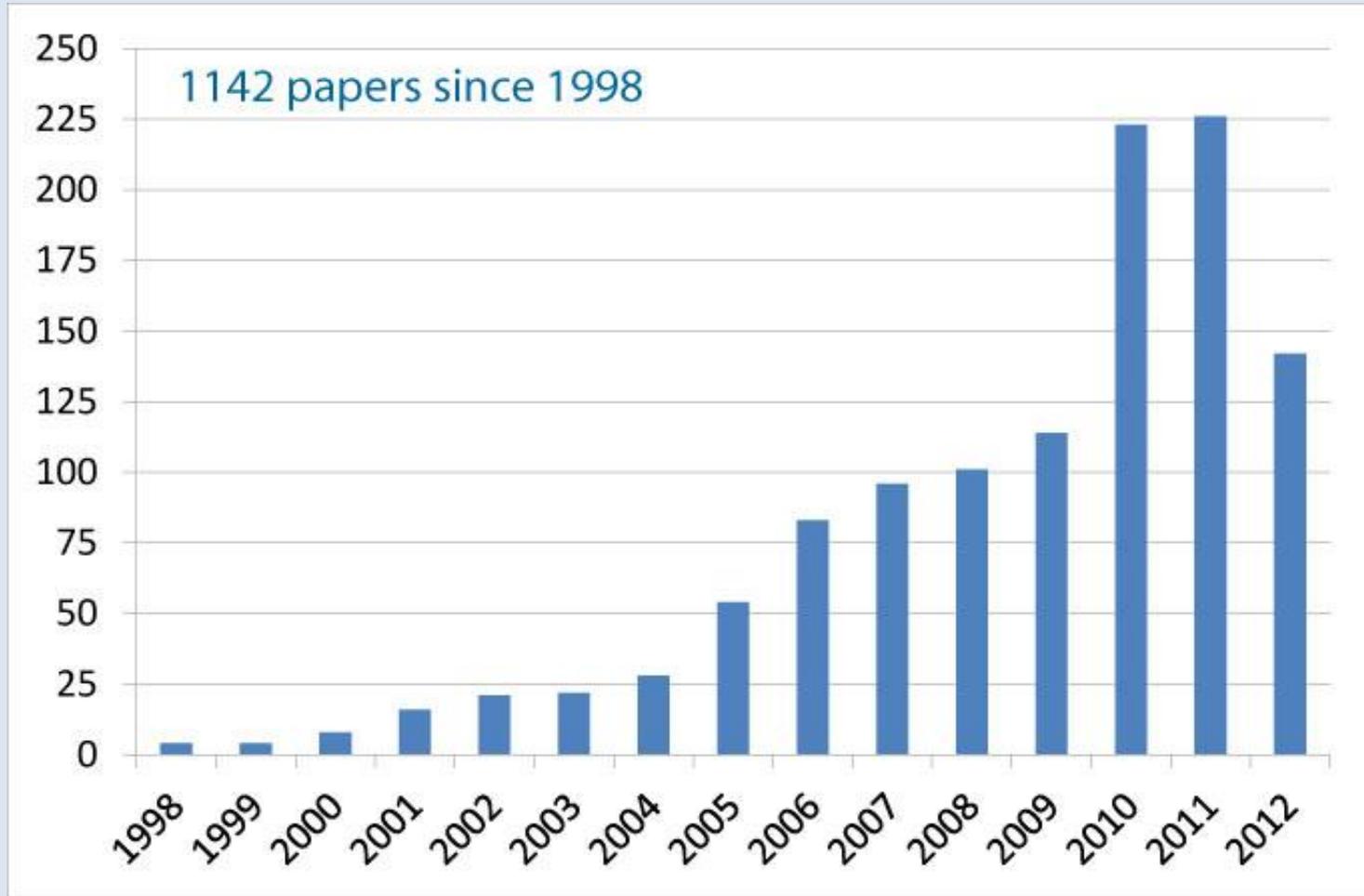
Susan Wijffels, CSIRO/Centre for Australian Weather and Climate Research, Australia

Dean Roemmich, Scripps Institution of Oceanography, USA  
and  
The Argo Steering Team

December 2012

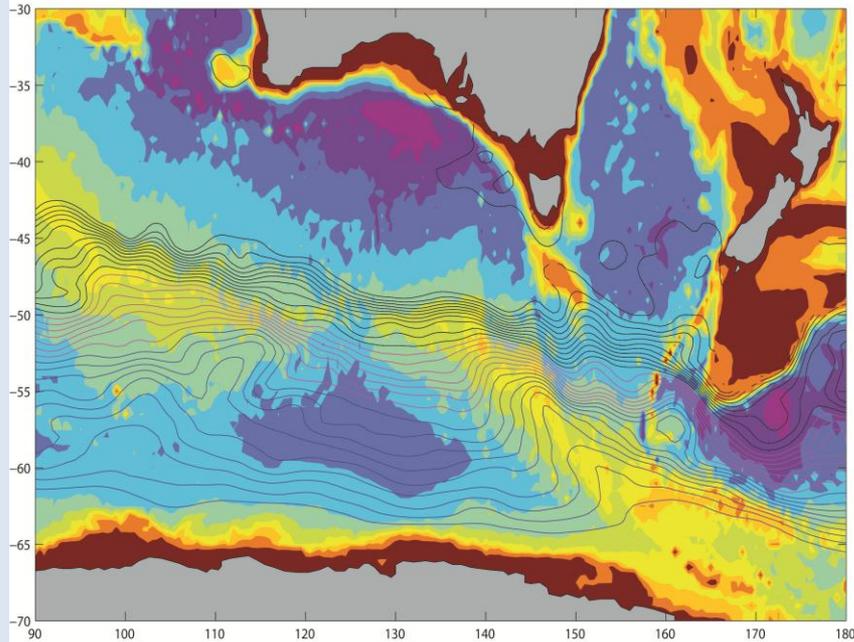


# Research Community uptake is now strong





# Improving the Global Climatology with Argo: towards mesoscale resolution



Flow of the Antarctic Circumpolar Current is revealed to be closely related to underlying topography

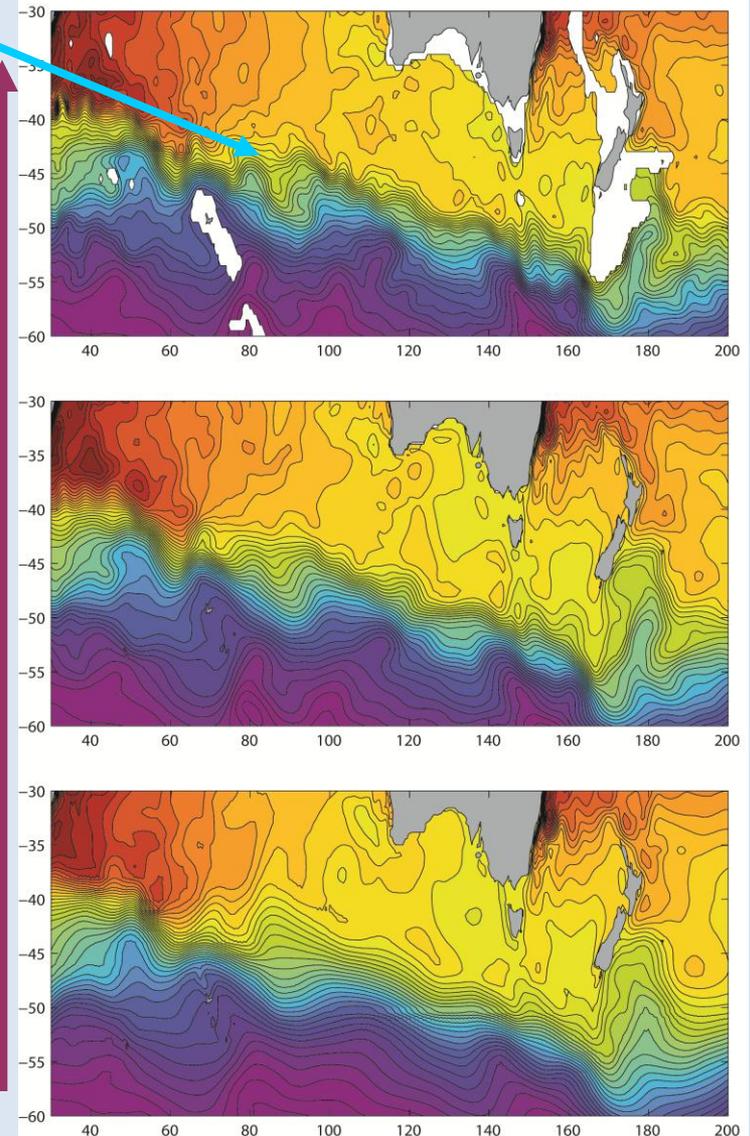
Realistic ACC

2010

2006

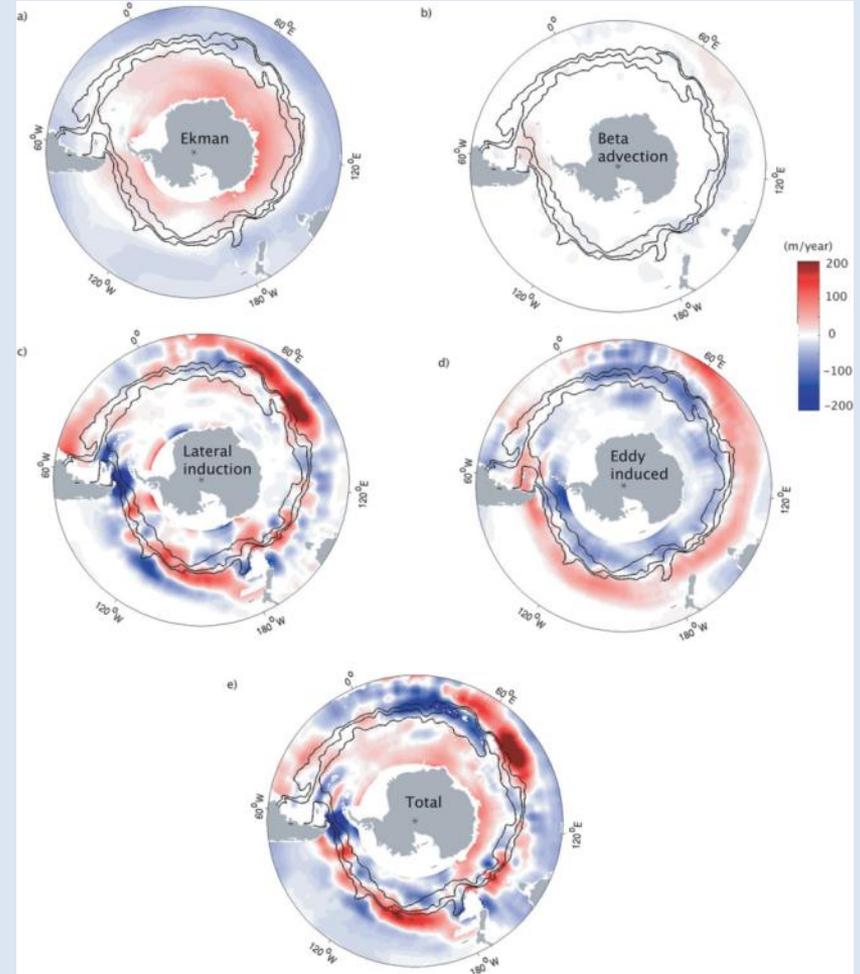
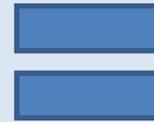
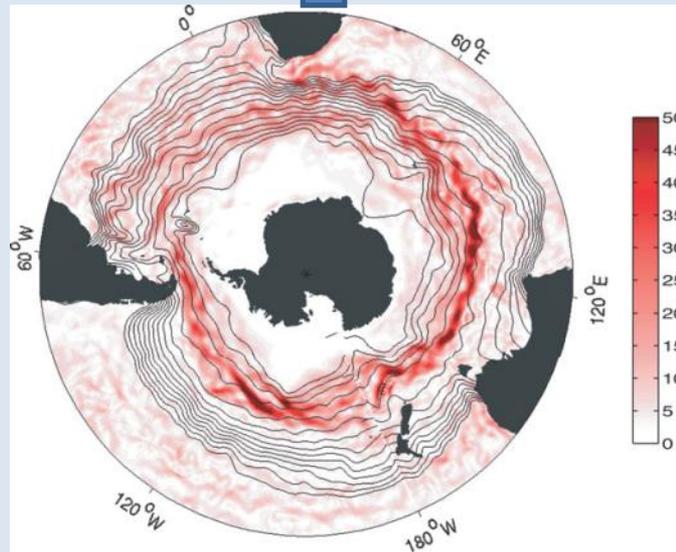
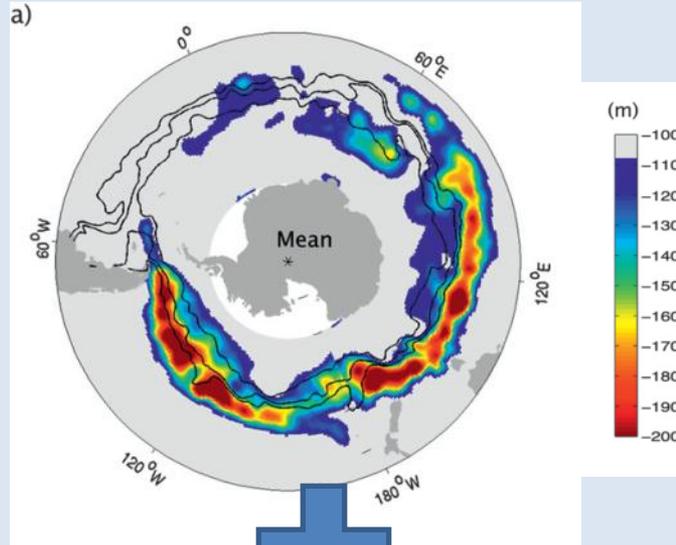
2000

Increasing spatial resolution





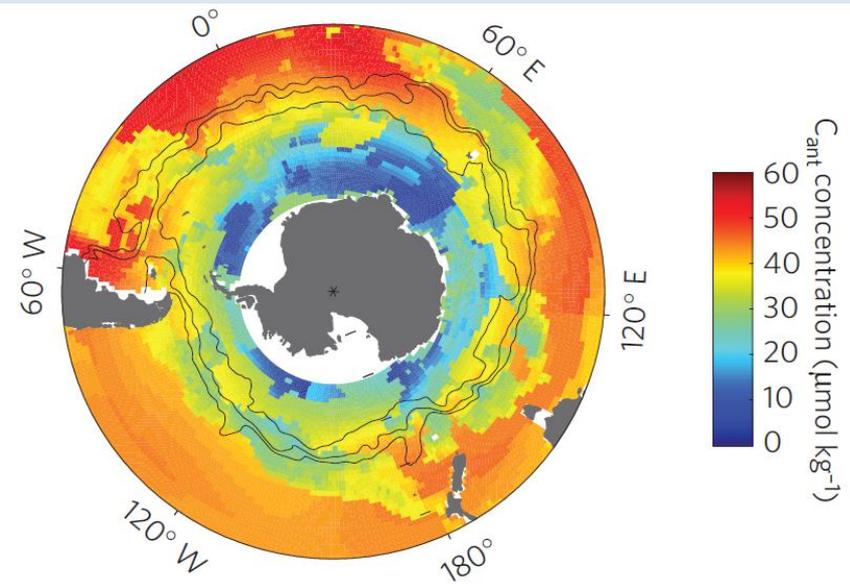
# Revealing the complexity of Southern Ocean subduction



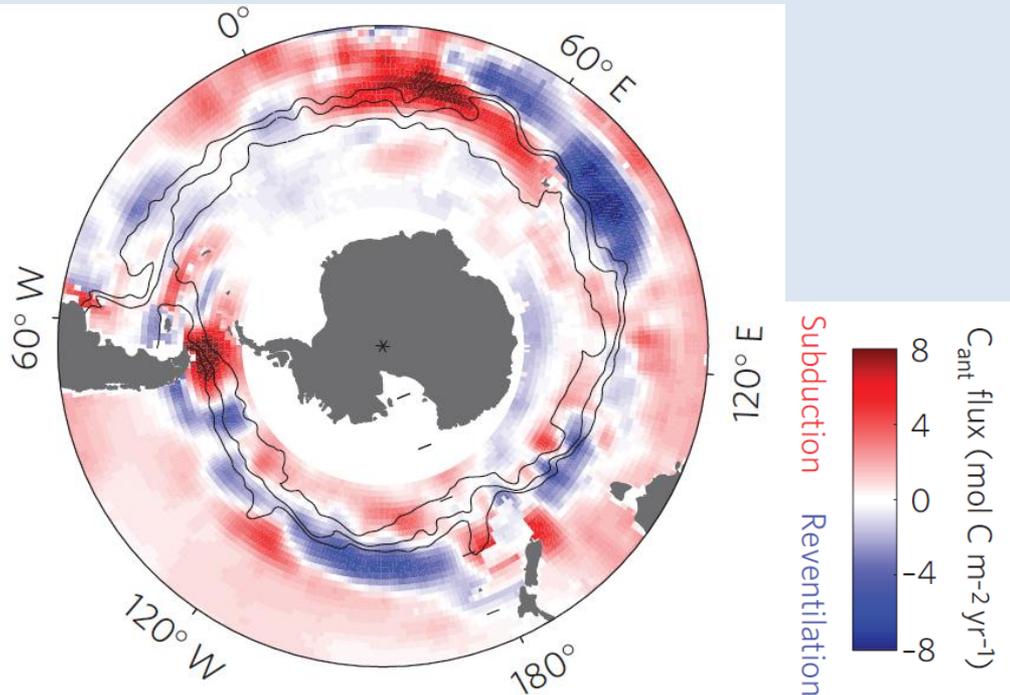


# Enabling estimates of anthropogenic carbon uptake into subduction 'hotspots'

## Mixed Layer Concentrations

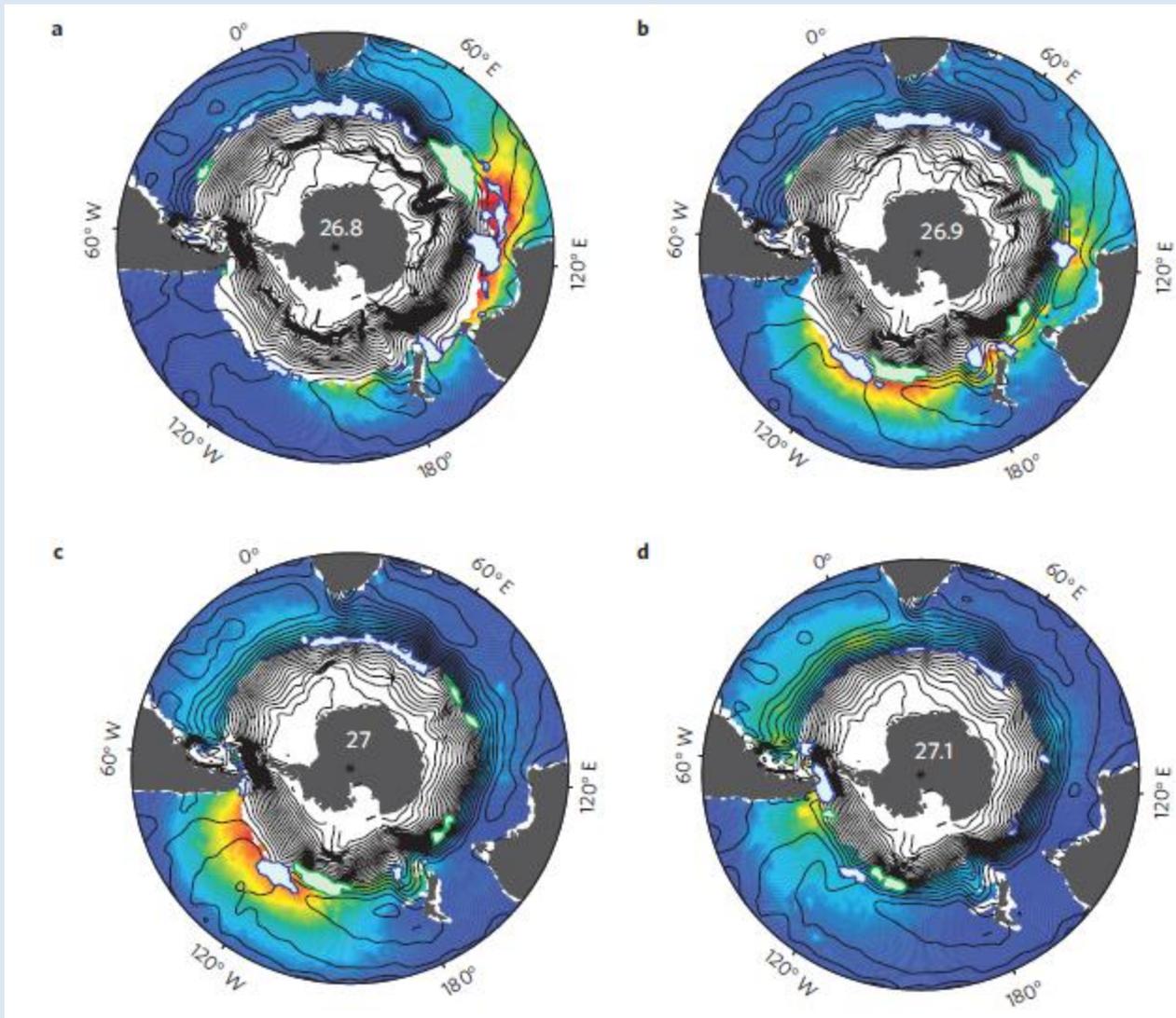


## Subduction rates



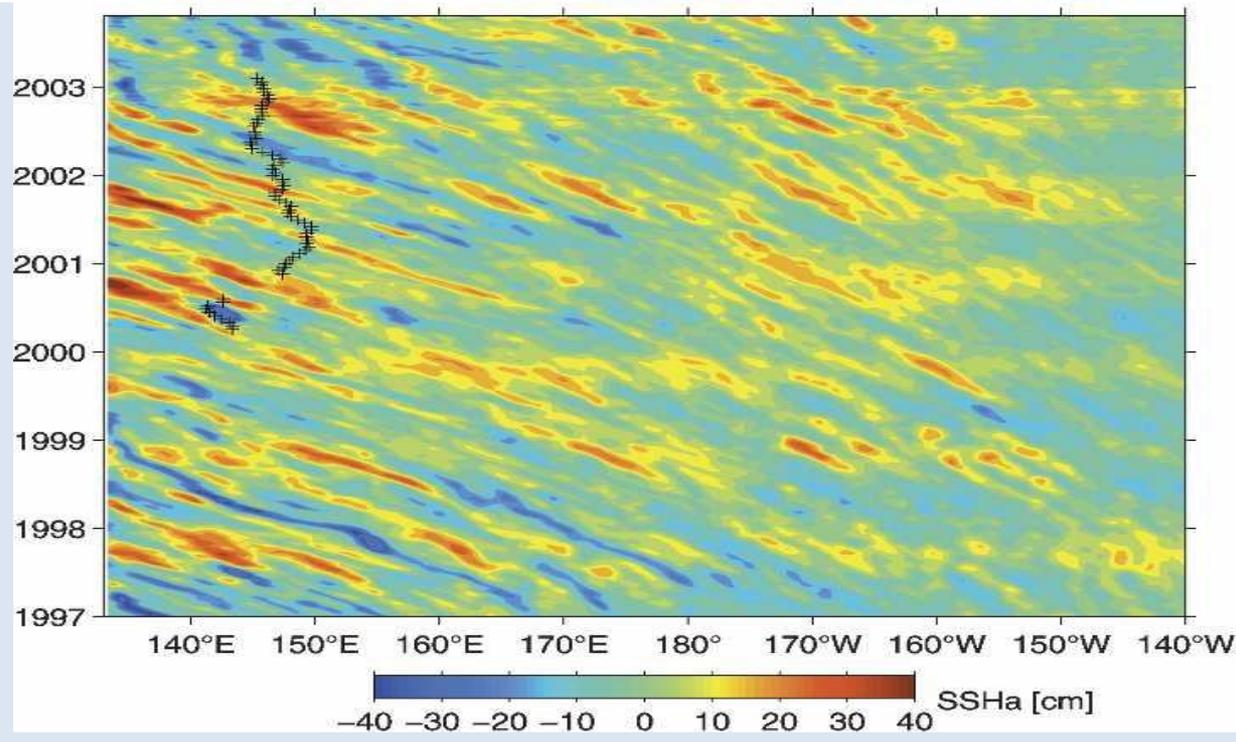
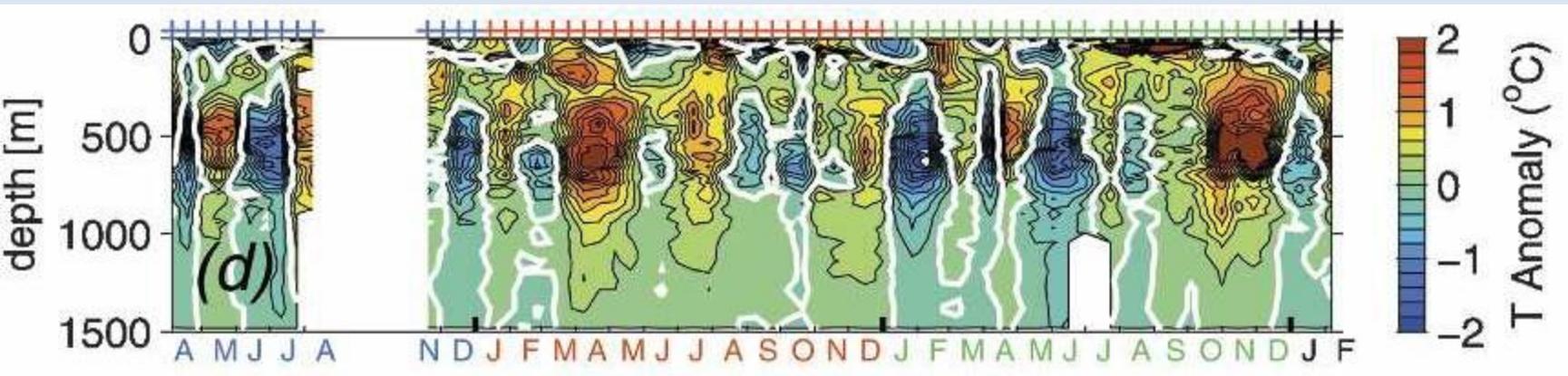


# Hotspots feed spreading pathways into the interior



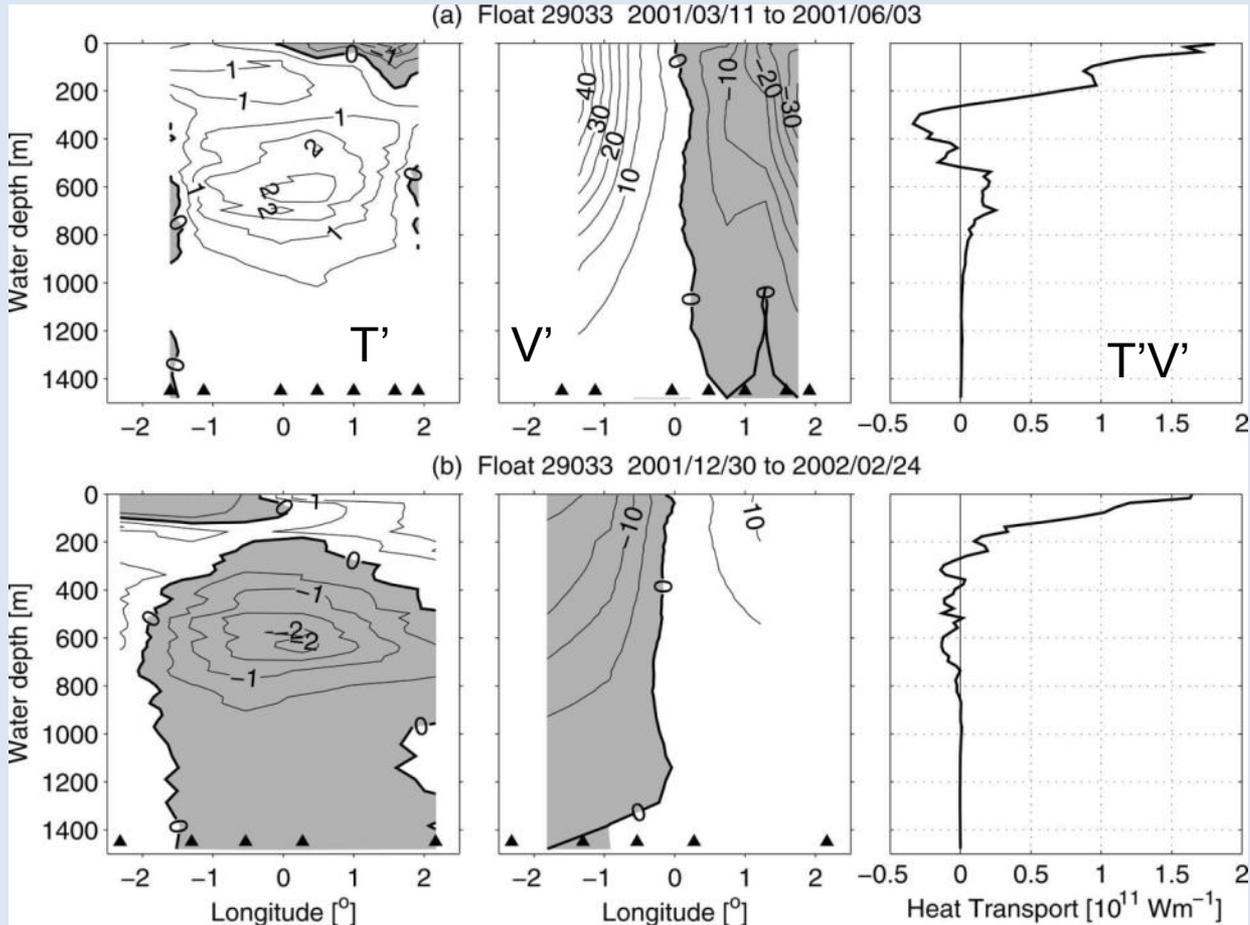


Argo is being combined with satellite data to quantify ocean eddy heat fluxes





# Eddy westward tilts = poleward heat flux



Warm core

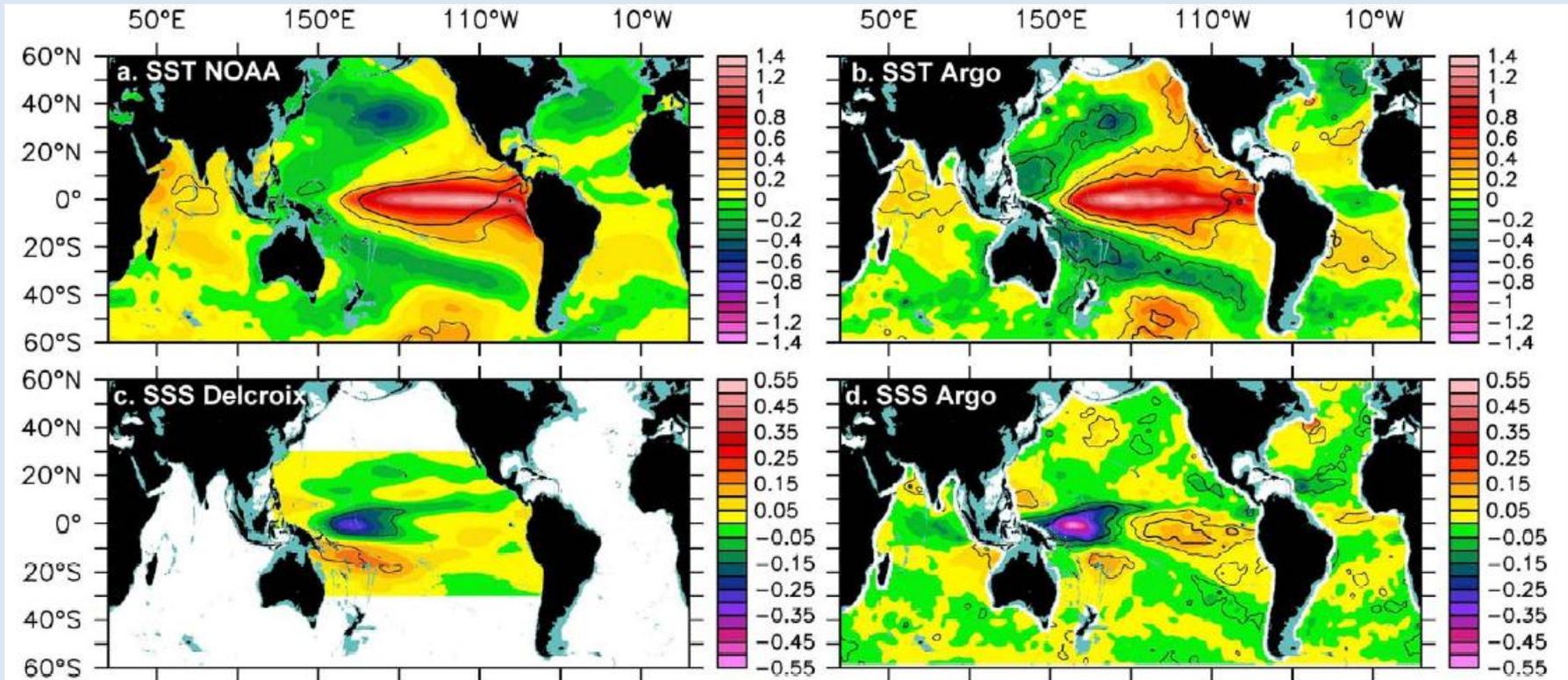
Cold core

Foundation of a heat flux scaling between remotely sensed sea level and SST



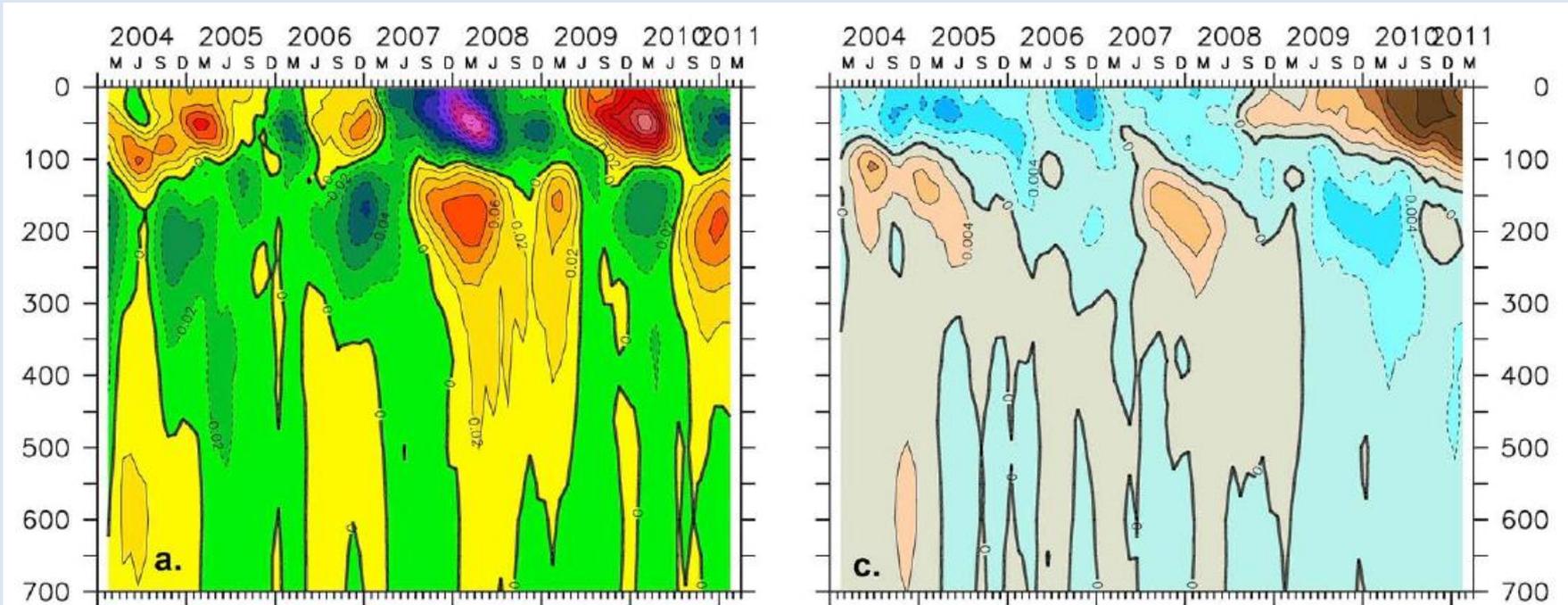


# New global views of major modes of variability: El Nino/Southern Oscillation





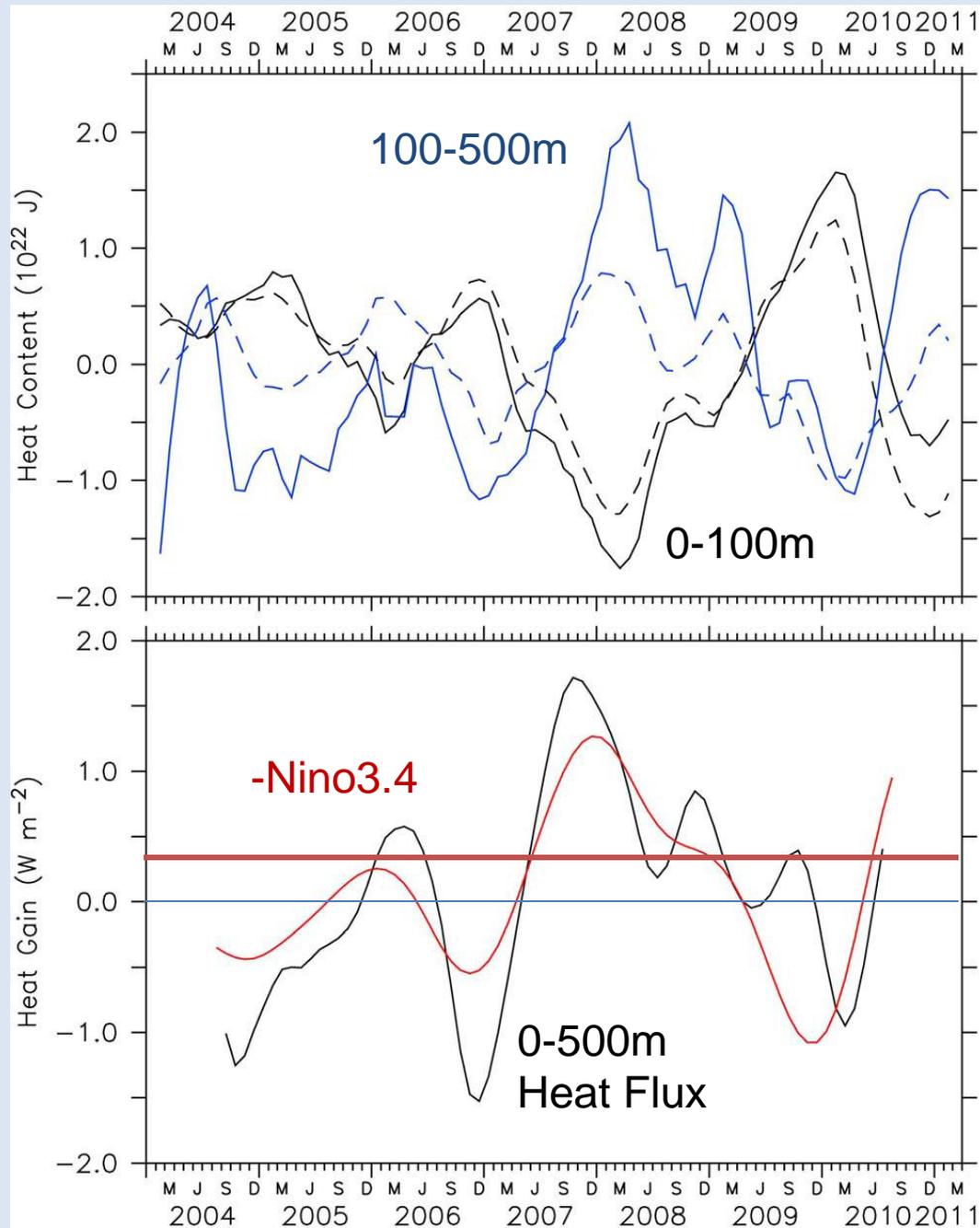
# Seeing below the surface: global ENSO footprint





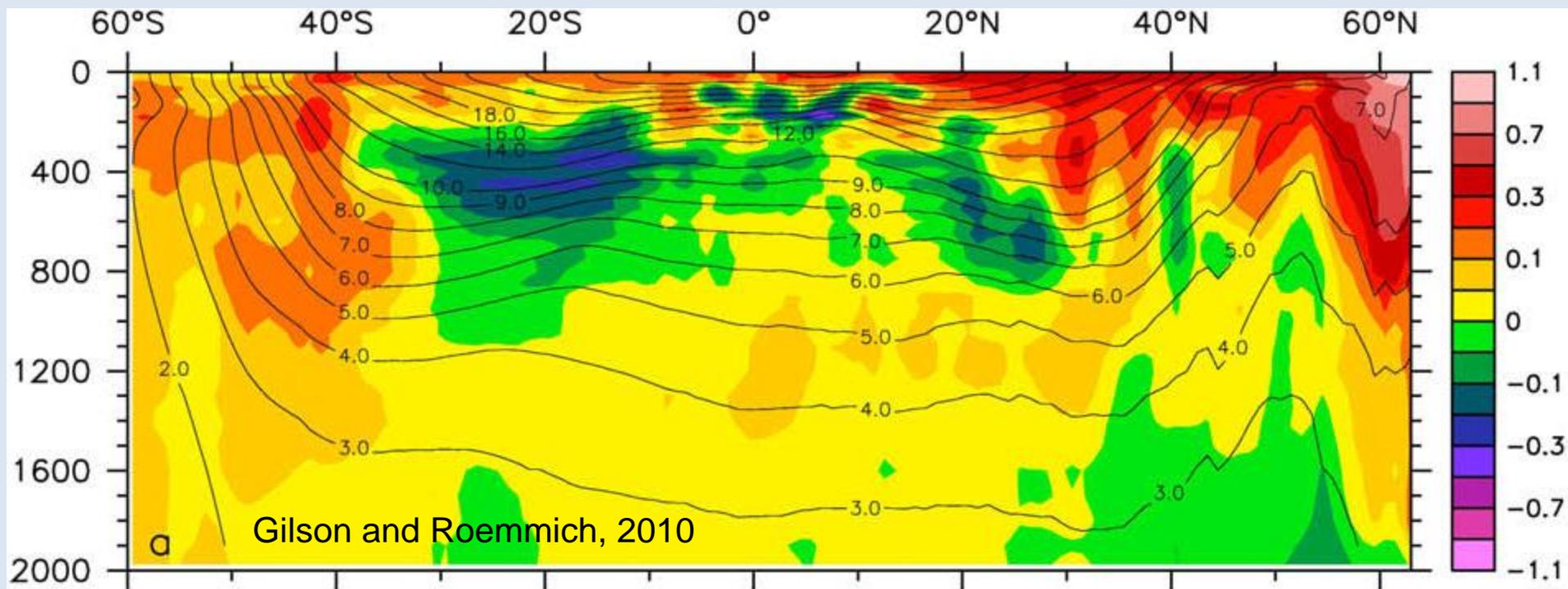
Upper and deep oceans heat content changes are out of phase

Global inferred flux variations  $\sim 1-1.5 \text{ W/m}^2$





# The modern Argo baseline makes change detection much more robust

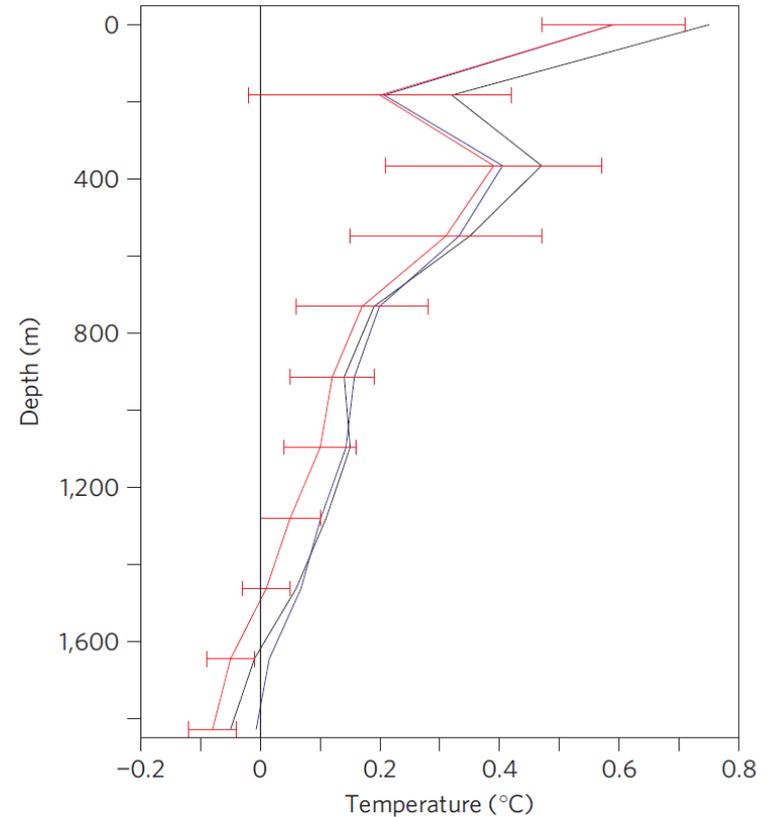
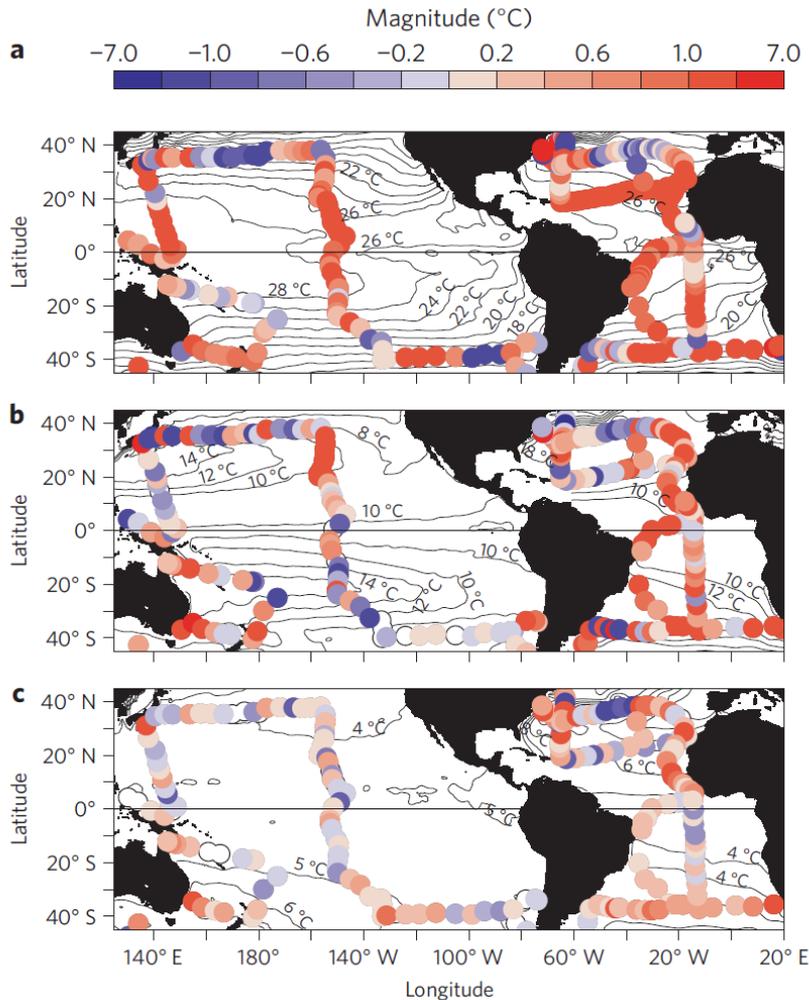


Argo atlases differ consistently with pre-Argo climatologies such as NOAA's WOA01

- Warmer
- Distinct salinity changes



# Argo(2004-2010)-HMS Challenger (1872-76) 135 years of warming

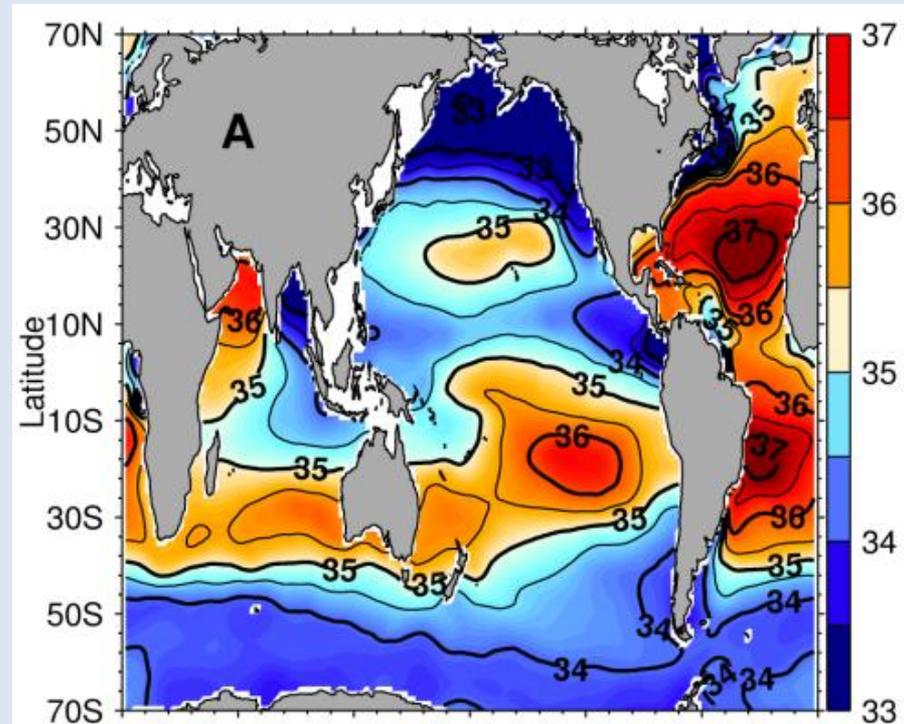
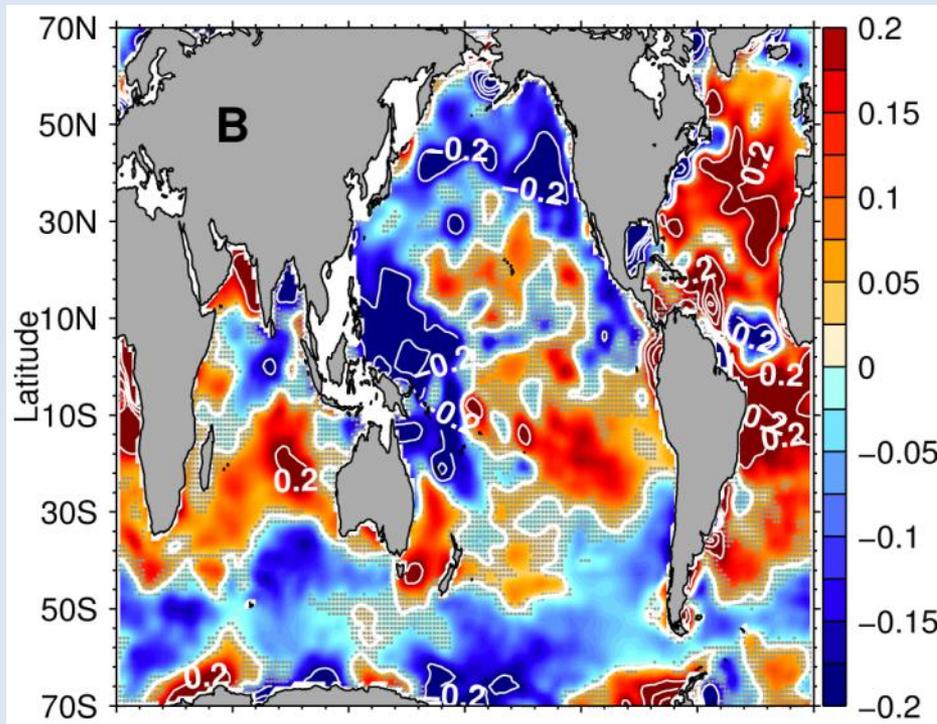


Roemmich, Gould and Gilson, NCC, 2012



# 50-Year Trends in Ocean Surface Salinity

- Surface salinity trends show remarkable similarity to the mean spatial pattern
- Inter-basin contrasts increase (saltier Atlantic, fresher Pacific)





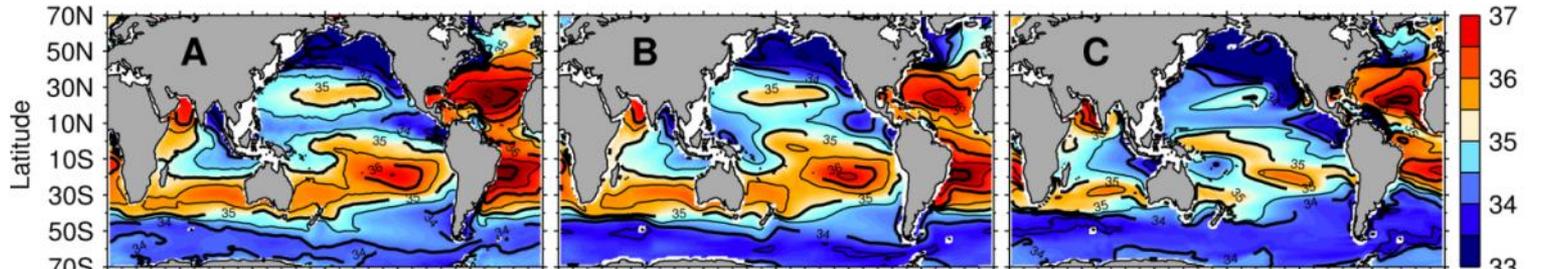
# Do coupled climate models (CMIP3) amplify their salinity patterns in the 20C?

Observations 1950-2000

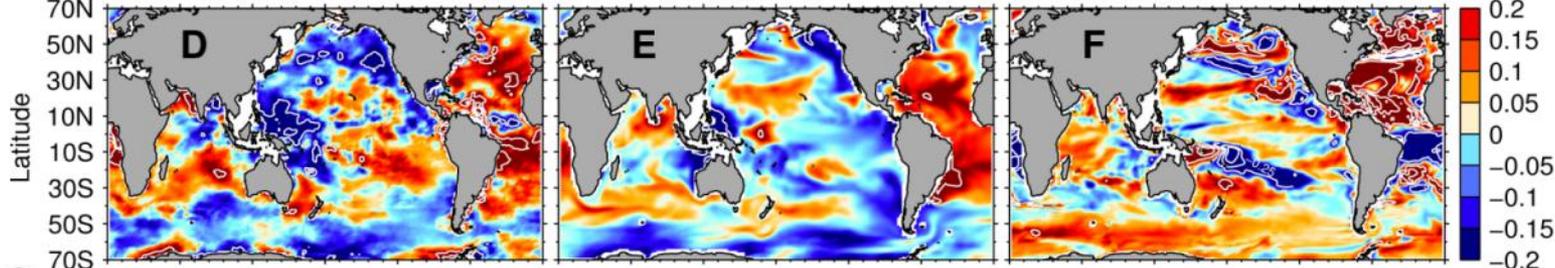
Model 5 1950-2000

Model 58 1950-2000

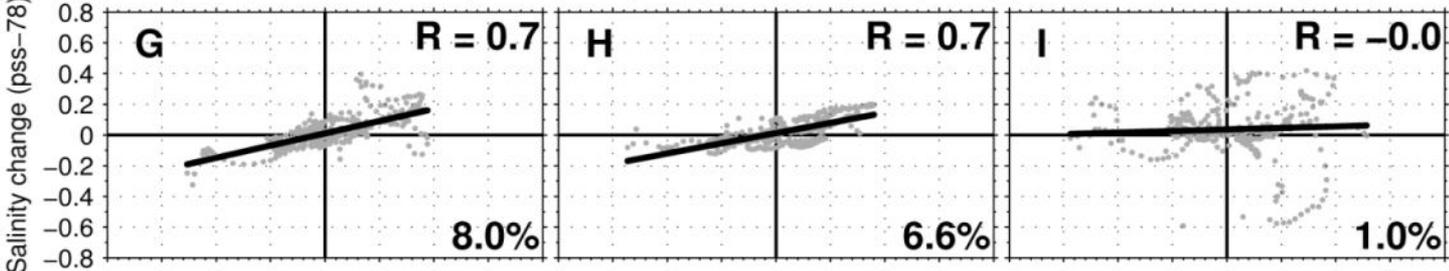
Mean SSS



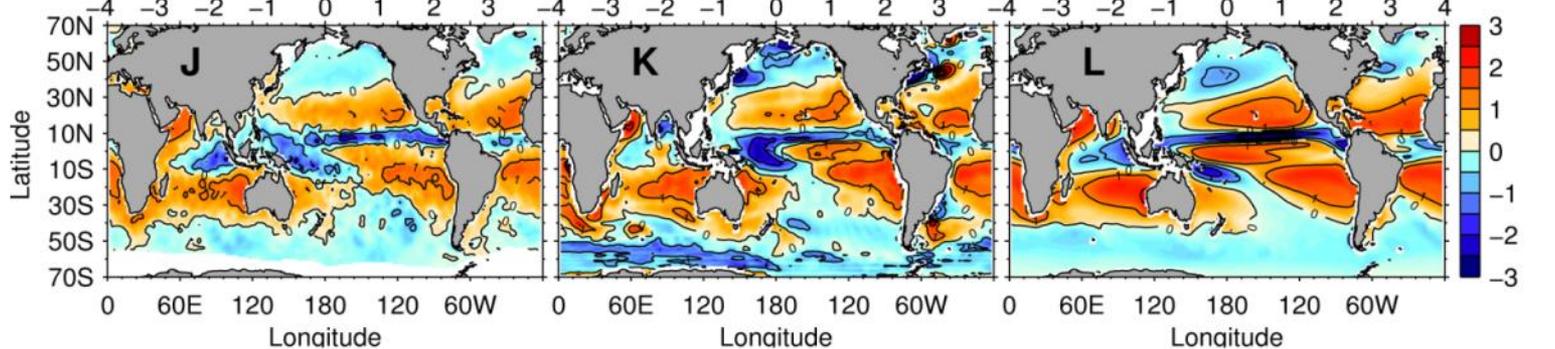
50 year change SSS



Regression

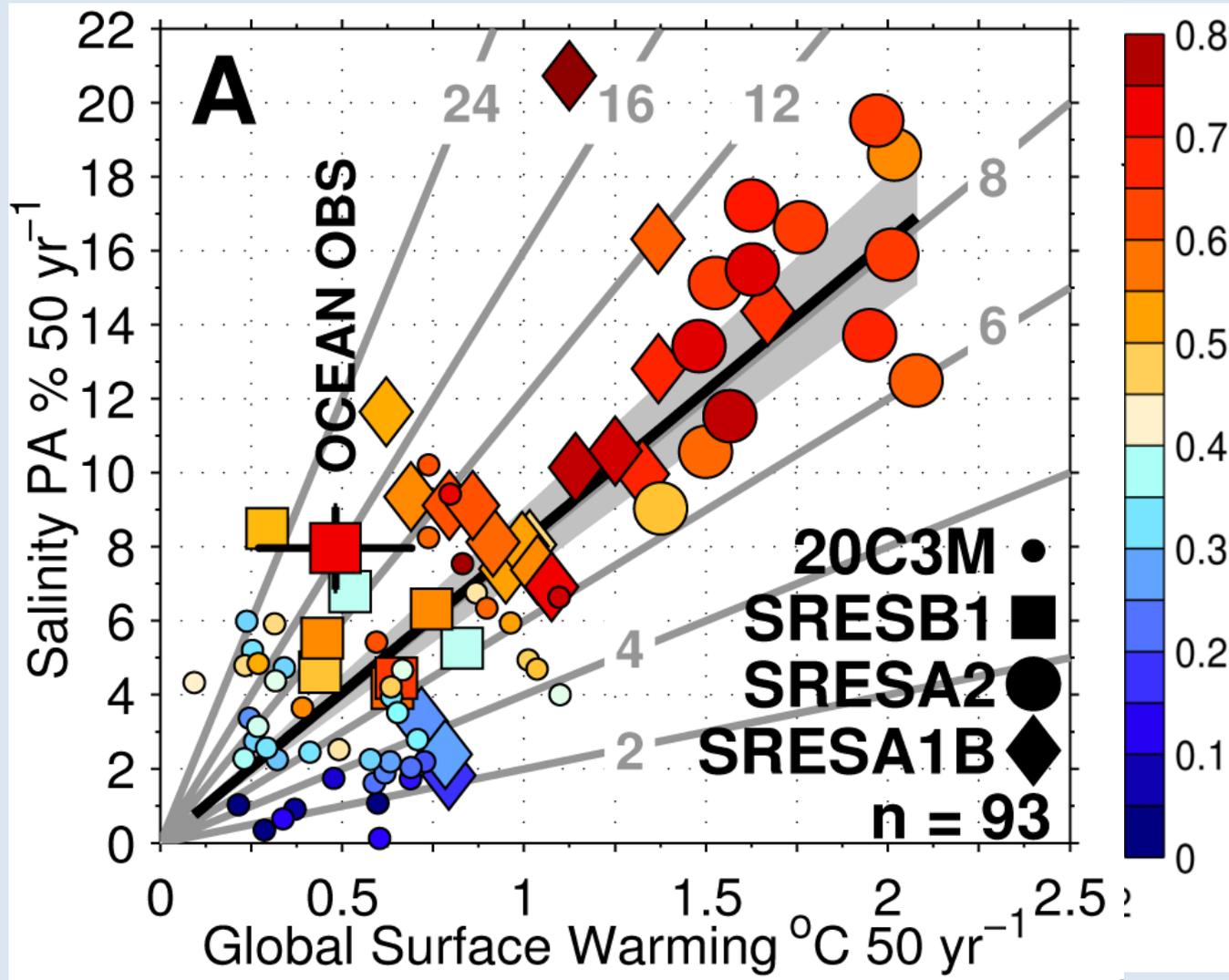


E-P pattern





# CMIP3 future scenario behaviour?



Stronger warming = stronger correlations and amplification: 8%/K



# Summary

Argo is enabling a new view of the ocean, its change and variability and its role in climate, allowing us to quantify and explore processes that have been poorly known to date

## **Future:**

Clearer view of Argo's impact on seasonal prediction

Initialisation and validation of Decadal Prediction Systems

Studies of ocean mixing – enabled by high resolution profiles

New missions and parameters will service whole new areas of scientific endeavor



# Thank you

## Acknowledgements

- The Argo Steering Team, Argo Data Management Team, past co-chairs (Howard Freeland), past Director (John Gould)
- The many, many agencies and nations that contribute to Argo in ways both small and large.

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