Met Office
Hadley Centre

Is Atlantic multi-decadal variability about to change phase?

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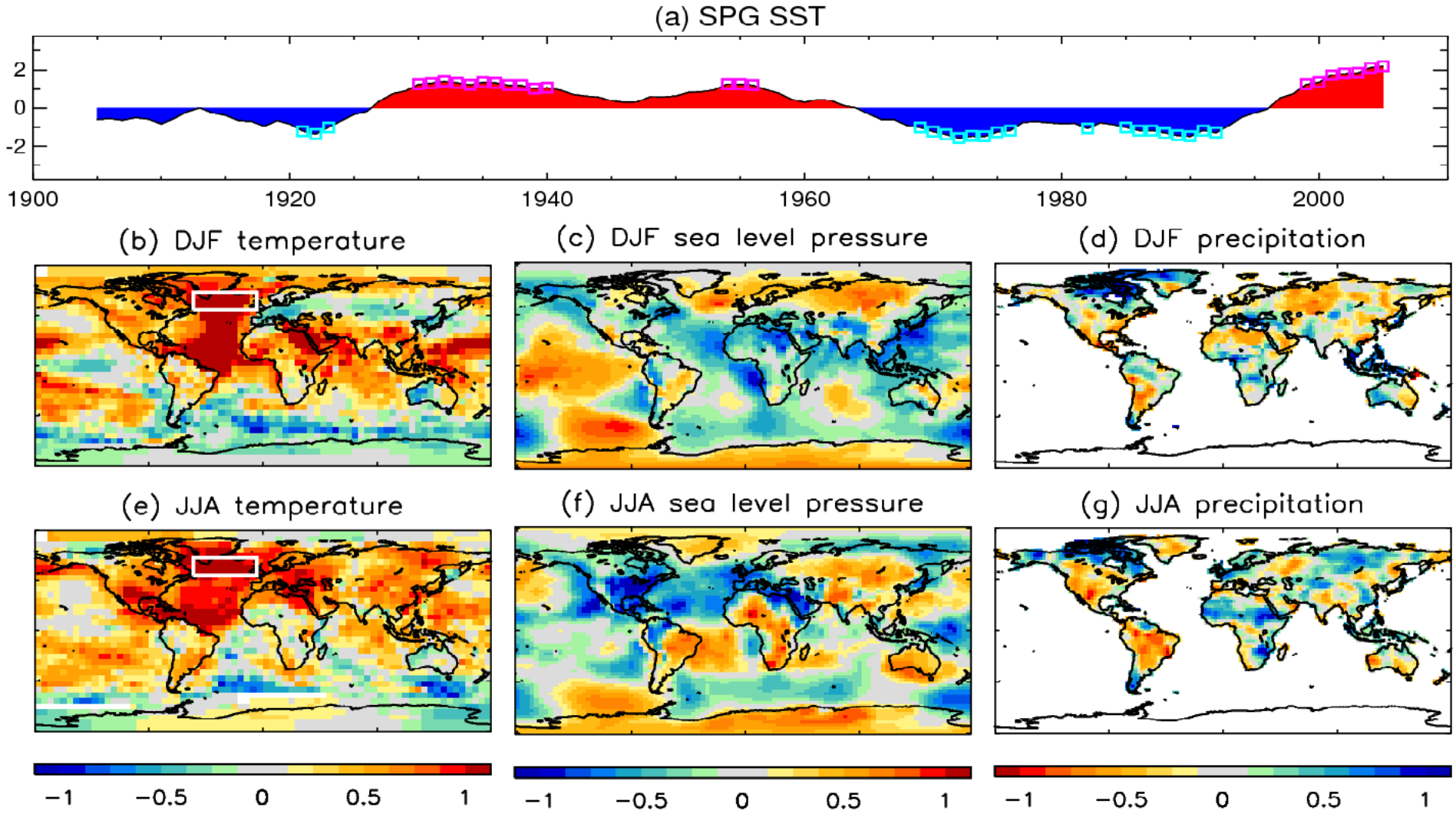
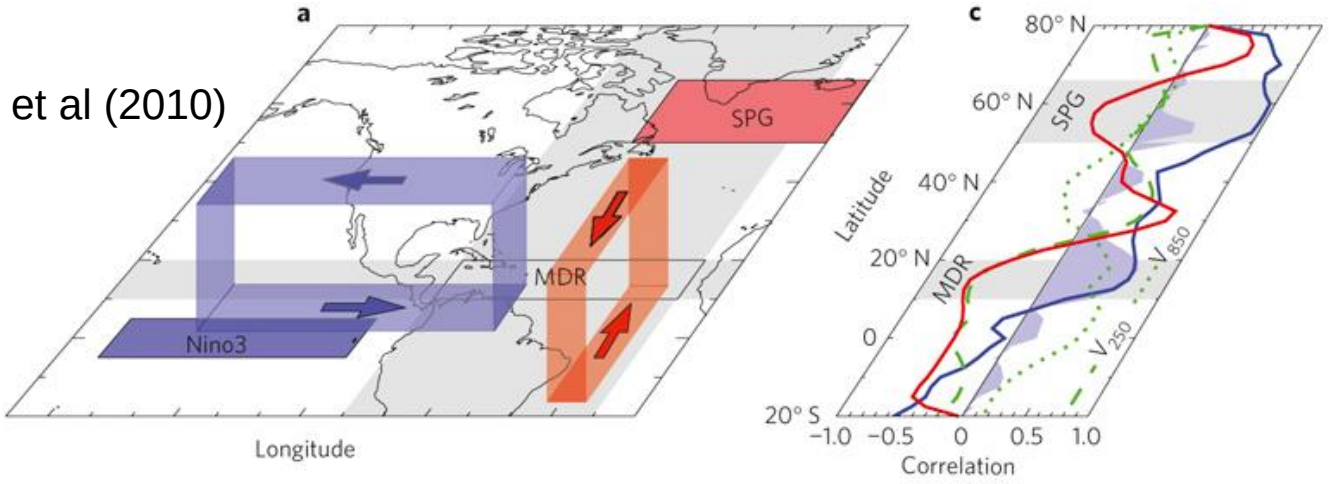
Impacts of temperature changes in the Atlantic subpolar gyre

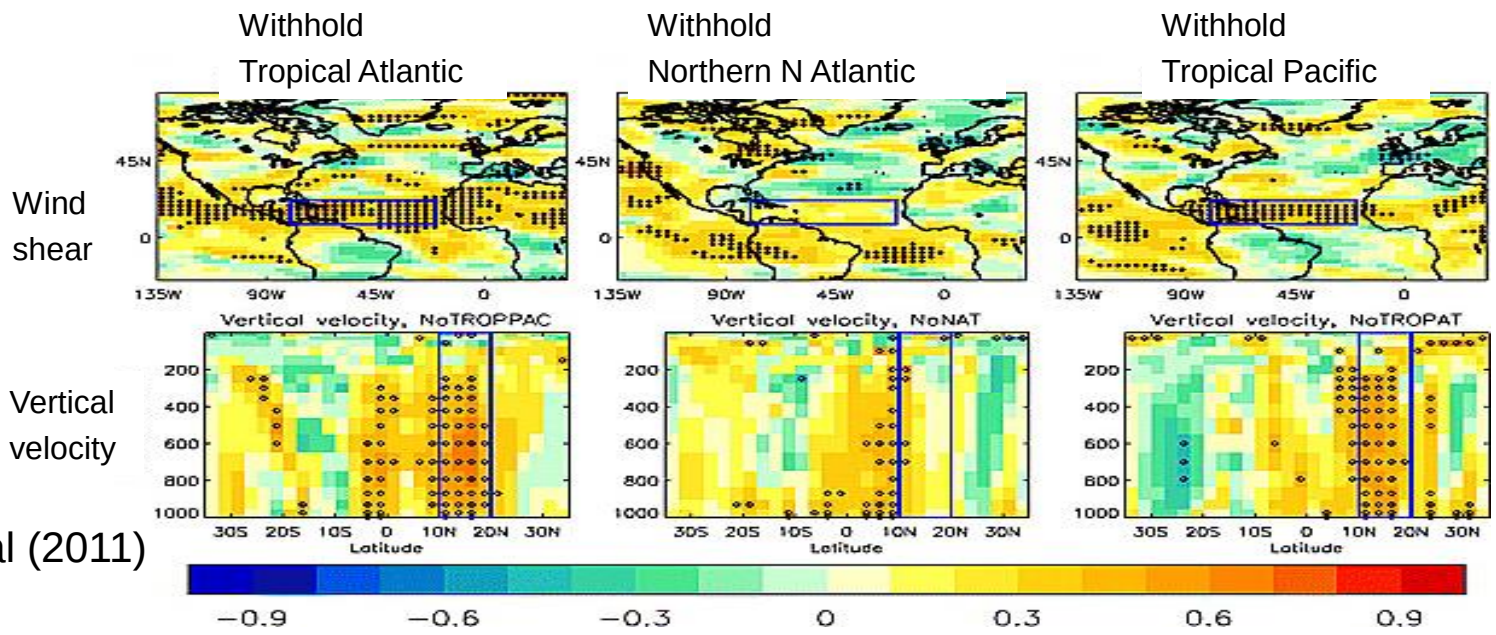


Subpolar gyre impacts on hurricanes

- There is an observed correlation between SPG temperatures and hurricane counts
- Withholding the northern North Atlantic in assimilation removes predictability of tropical Atlantic

Smith et al (2010)





Dunstone et al (2011)

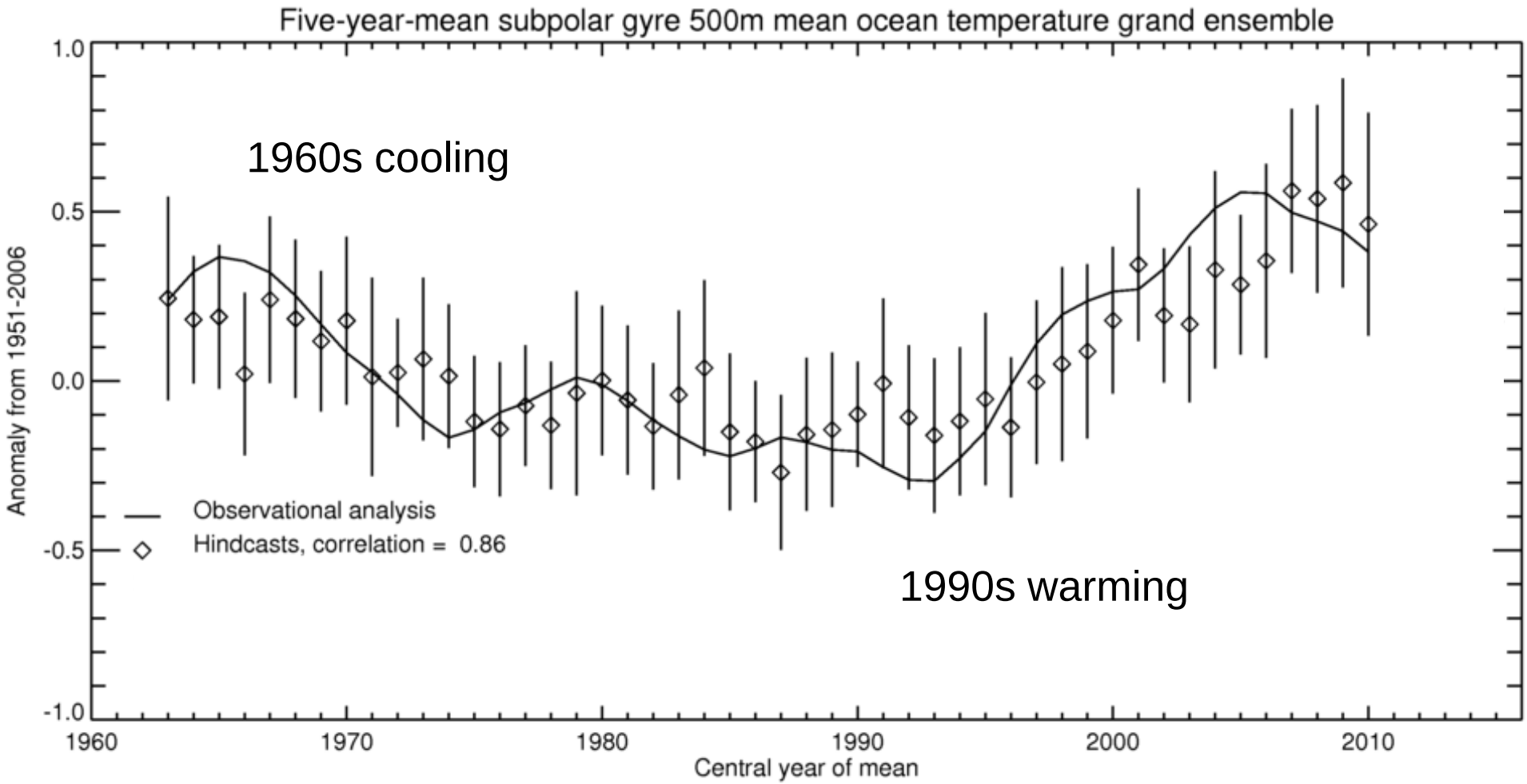
The Met Office Decadal Prediction System (DePreSys)

- An experimental, anomaly initialised, coupled dynamic model prediction system for inter-annual to decadal time scales
  - Version 1 exists as both non-flux corrected (v1) and flux-corrected perturbed physics (PPE)
  - Version 2 exists only as non-flux corrected (v2)
  - All temperatures in this presentation have a bias and lead-time dependent trend correction
- Combining these three systems gives us a powerful tool to average out noise in the forecast and find the signal
- We have studied the Atlantic ocean temperature in this combined forecast

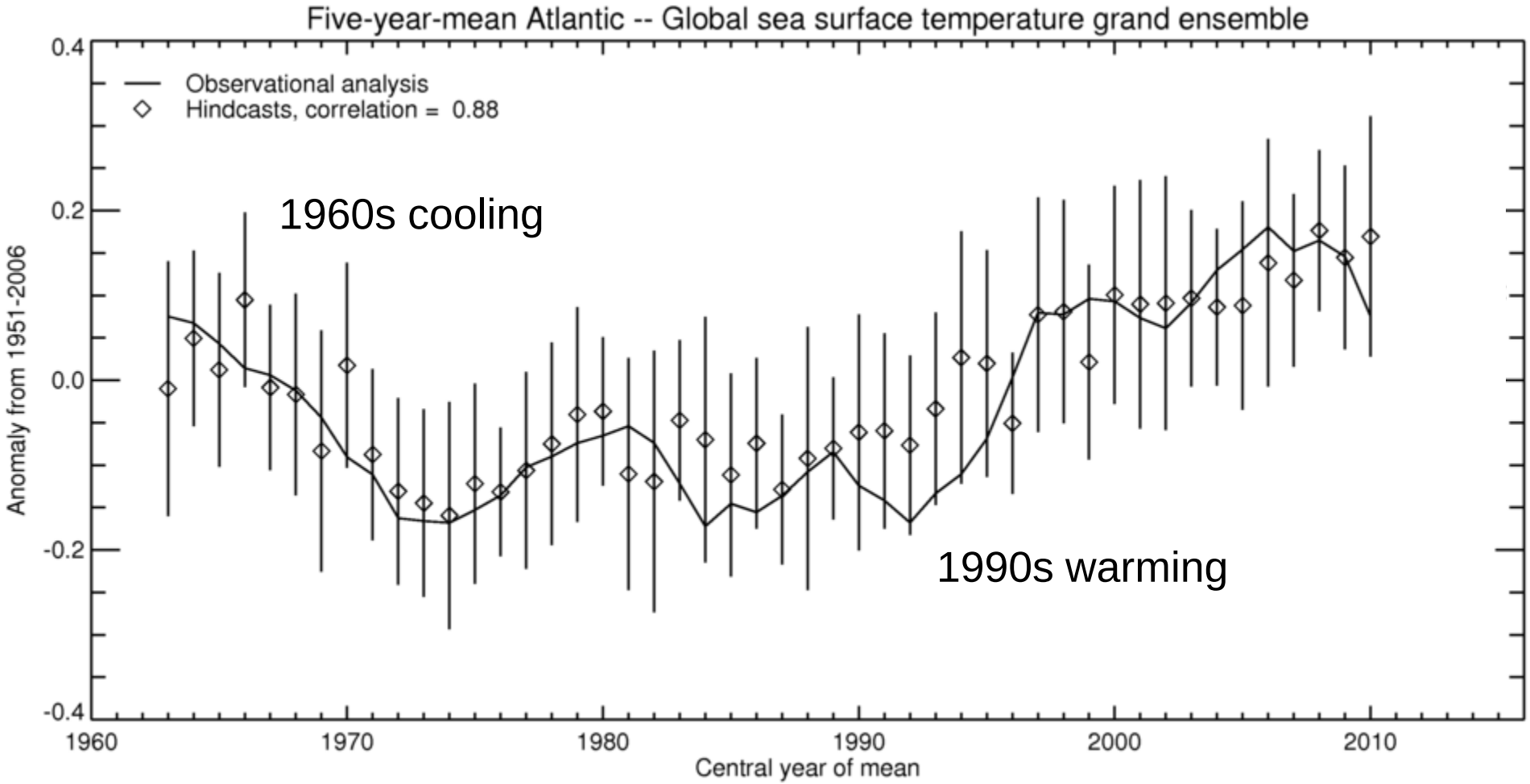
Model differences between versions

	Version 1	Version 2
Model	HadCM3 UM v4.7	HadGEM3 UM v7.7
Atmosphere	N48: 2.5°×3.75° ~300km 19 levels	N96: 1.25°×1.875° ~150km 85 levels
Ocean	UM 1.25°×1.25° ~120km 20 levels	NEMO 1°×1° ~100km 75 levels

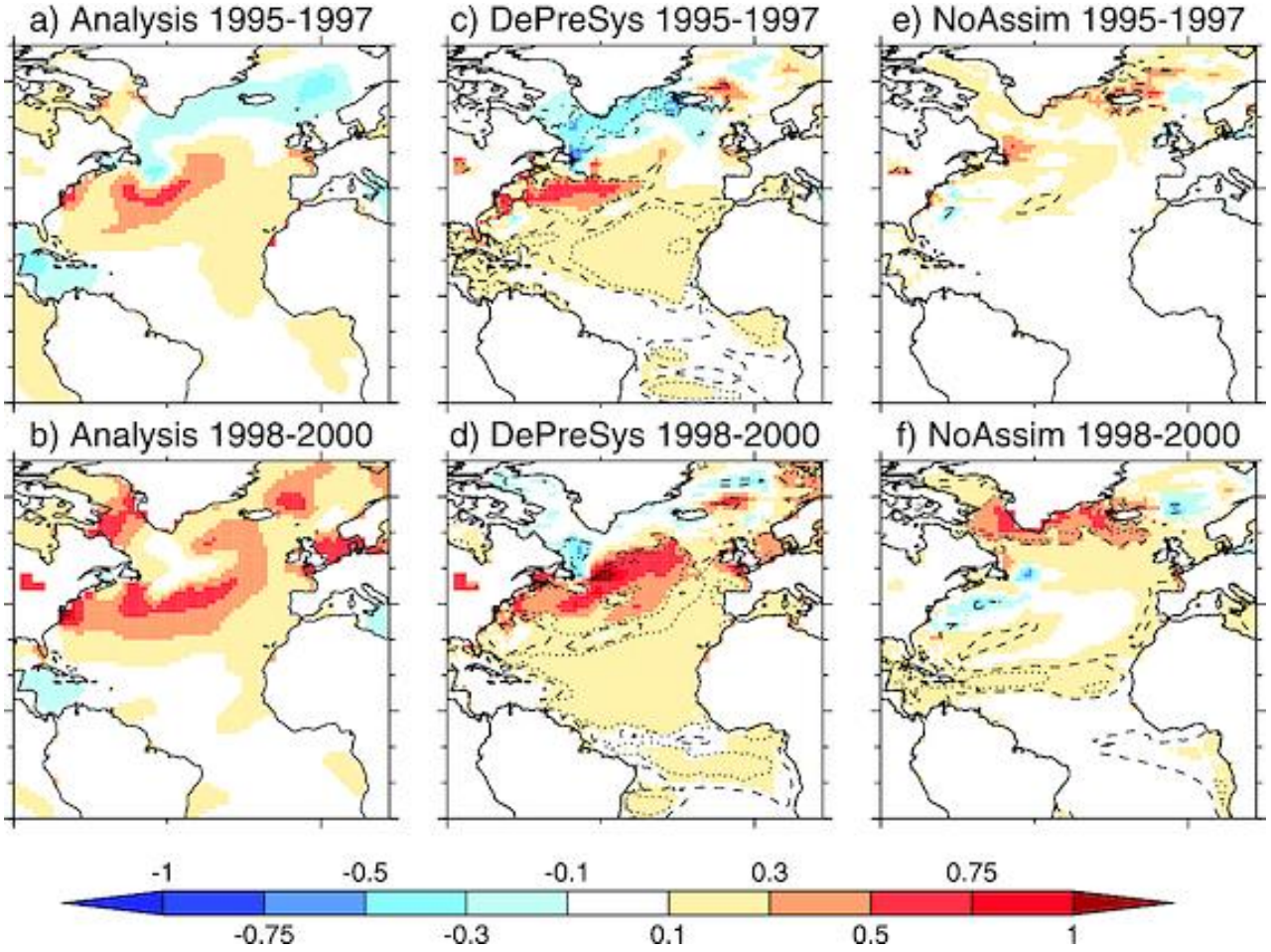
DePreSys has high skill in Atlantic subpolar gyre top 500m temperature



…and Atlantic Multidecadal Variability
(North Atlantic SST – Global SST)

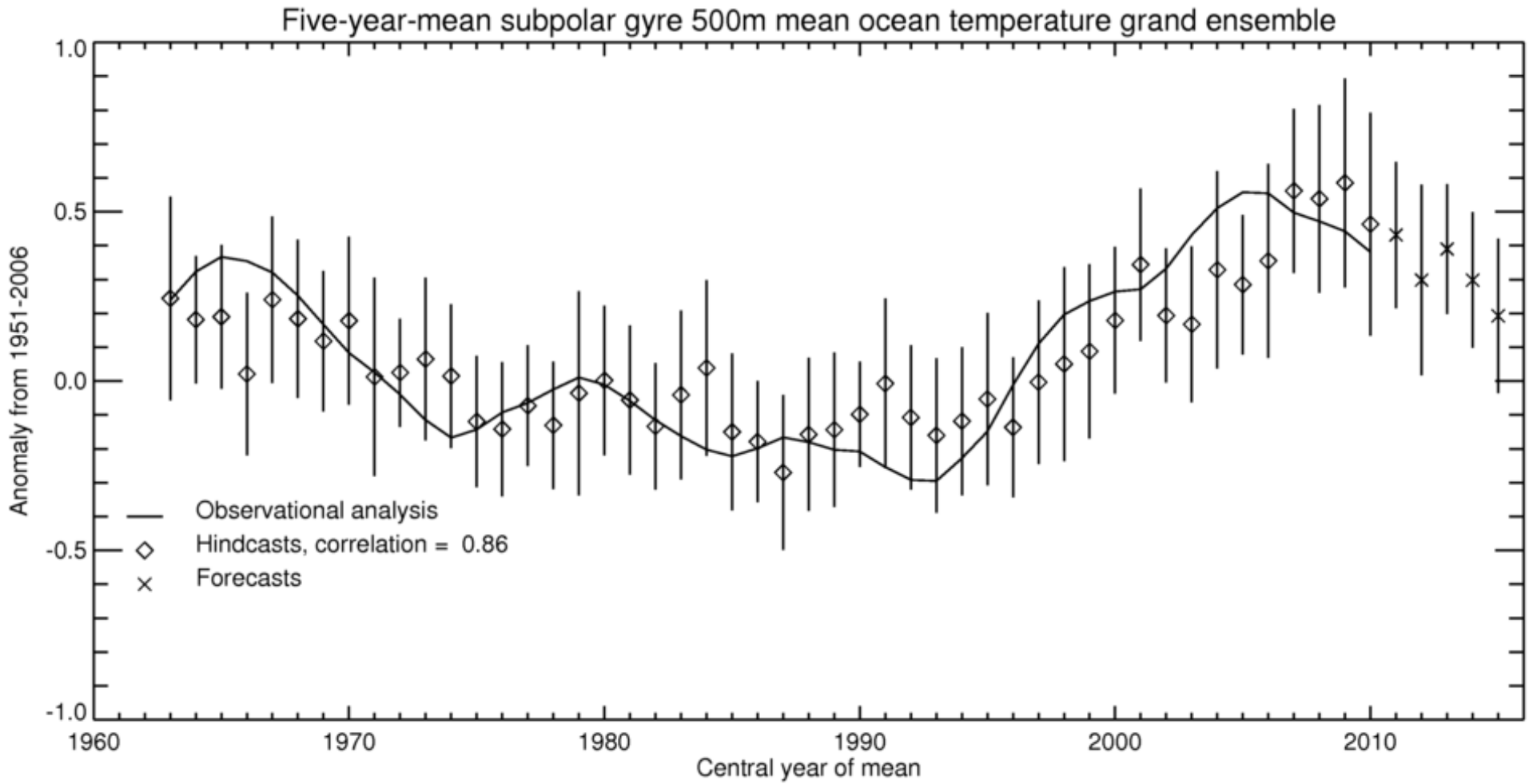


The 1990s warming was correctly predicted



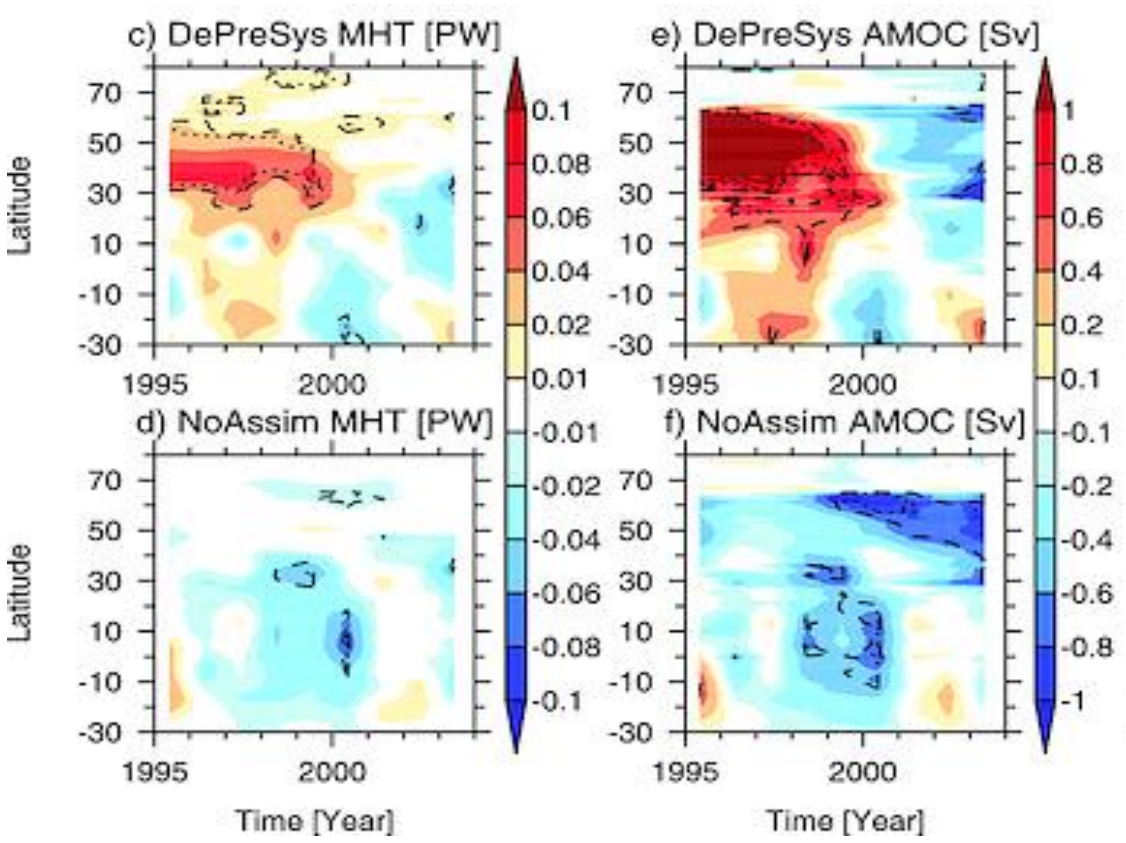
Robson et al (2012)

Forecasts of Atlantic subpolar gyre top 500m temperature

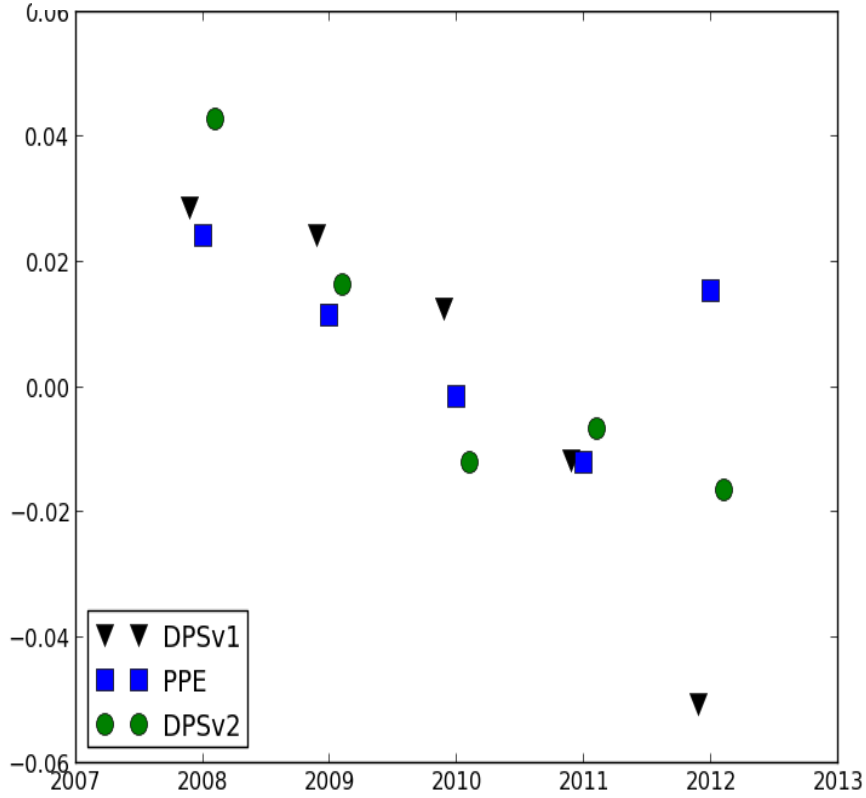


Ocean heat convergence into the Atlantic subpolar gyre

1990s warming event

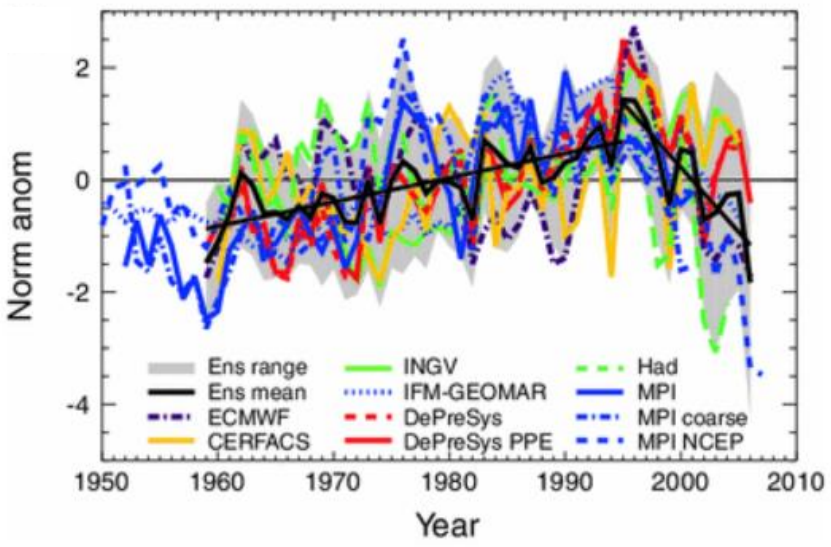


Forecasts 2008-2012



Robson et al (2012)

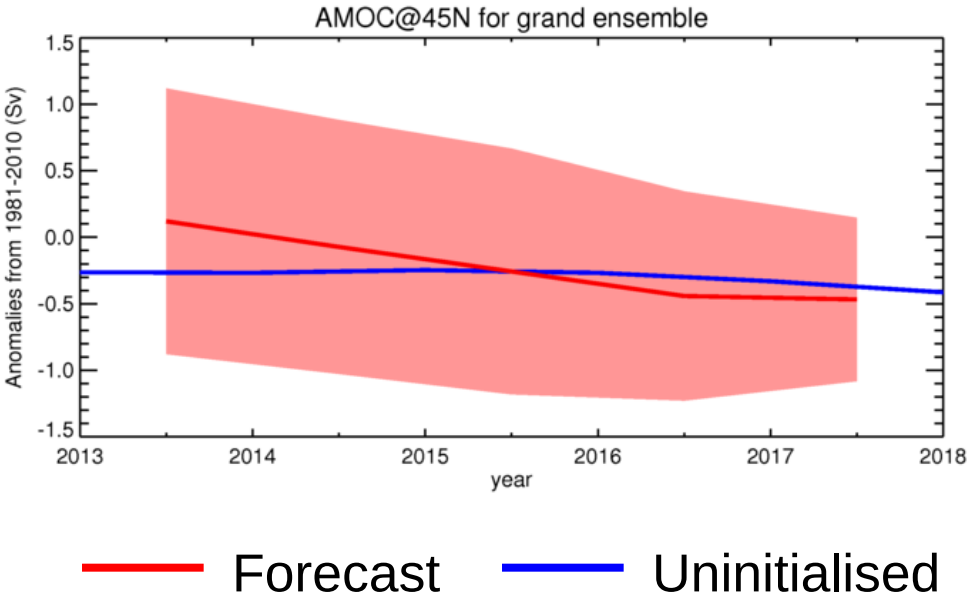
Atlantic Meridional Overturning at 45°N



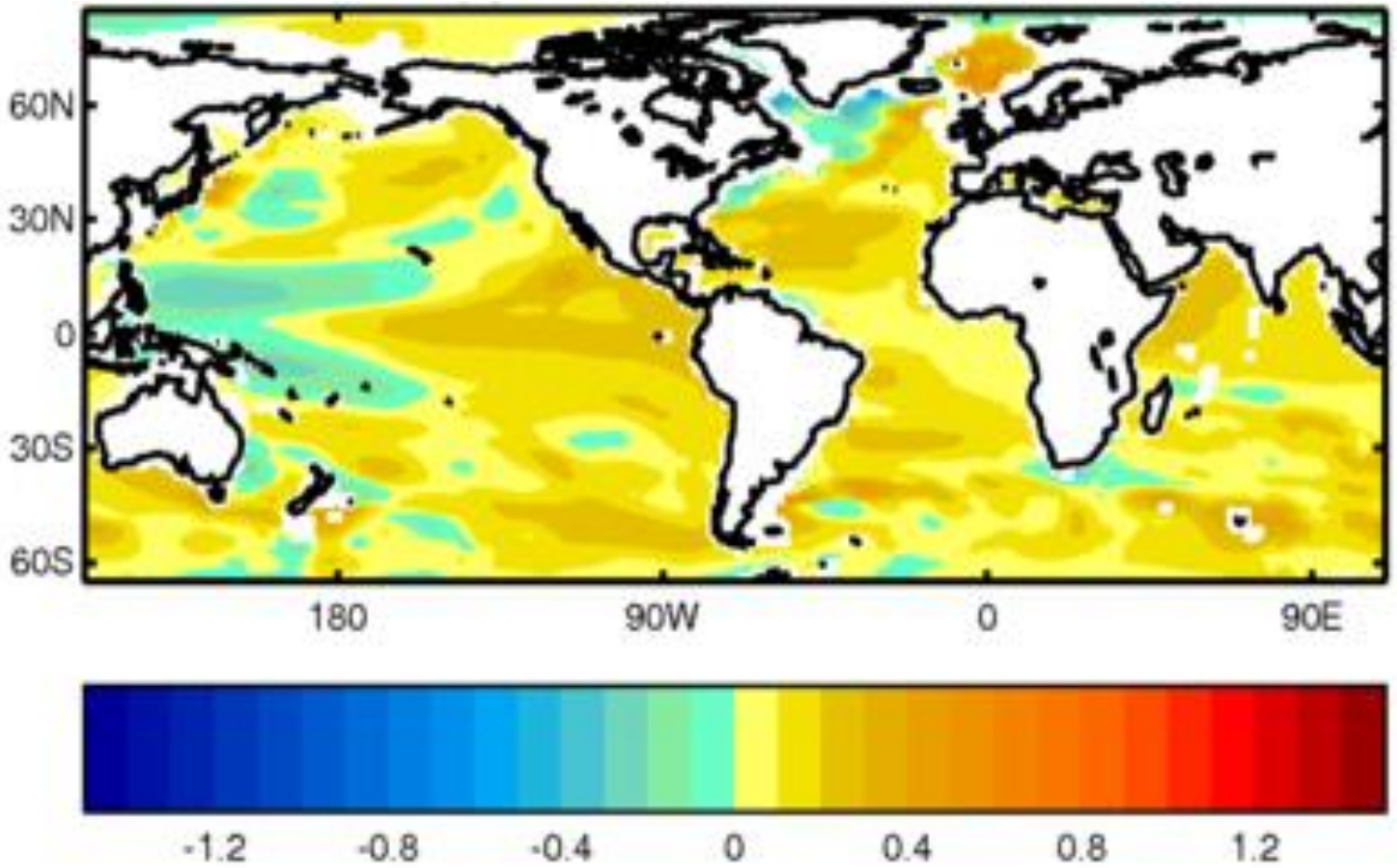
- To our best knowledge the AMOC at 45°N increased until the late 1990s and has decreased since

Pohlmann et al (2013)

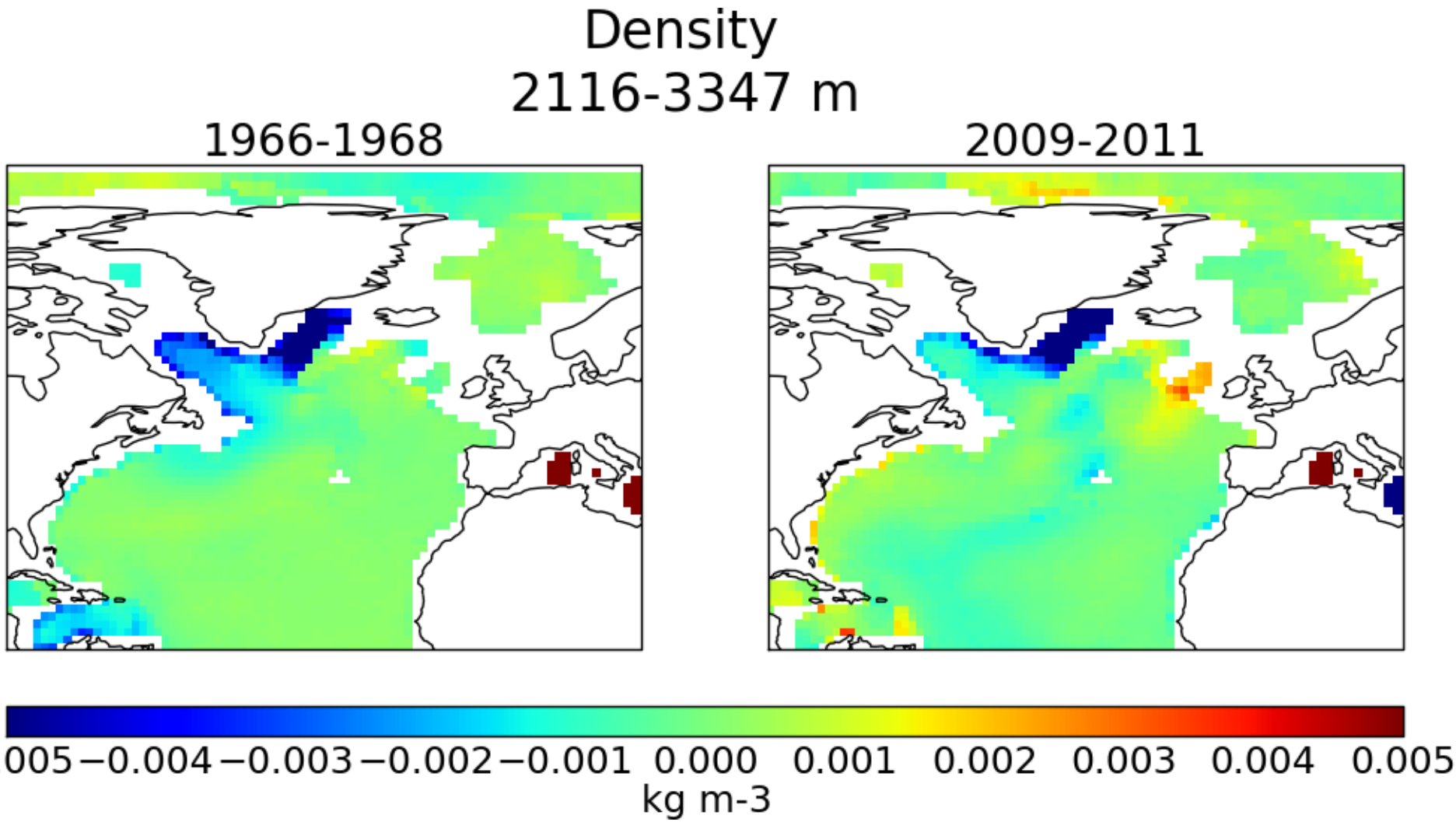
- Our forecasts show that the AMOC is predicted to continue to decrease at a greater rate than expected from climate change alone



Grand ensemble forecast 2013-2017
Top 500m ocean temperature
(anomalies from 2003-2012)



Analogue in the analysis of observations with the 1960s?

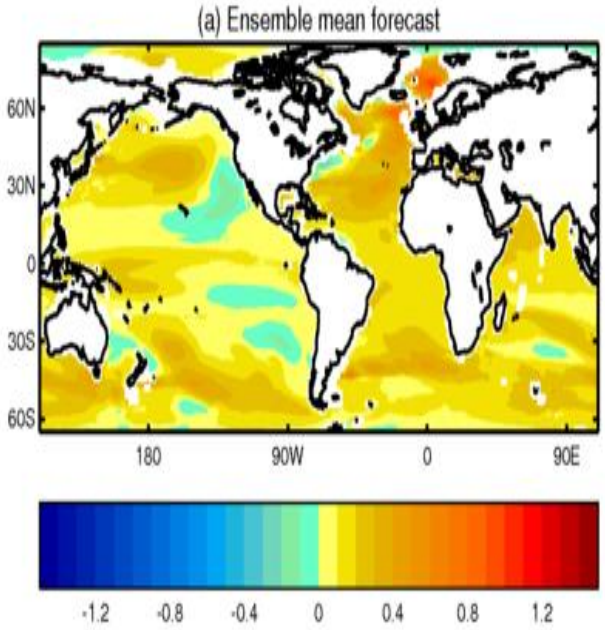


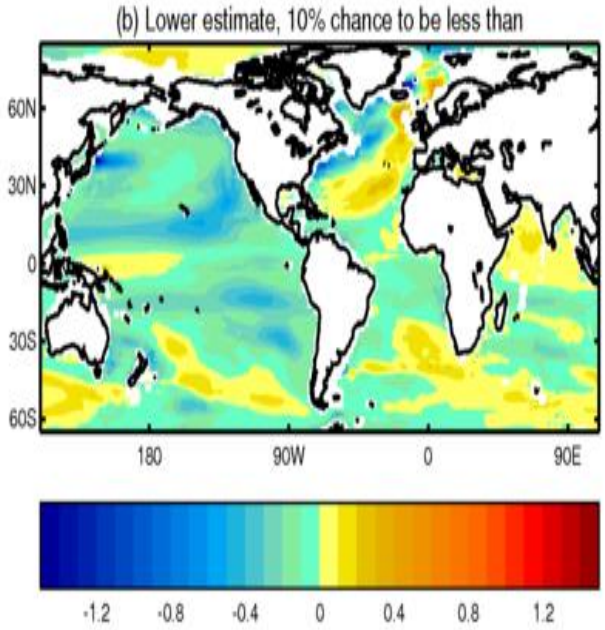
Summary

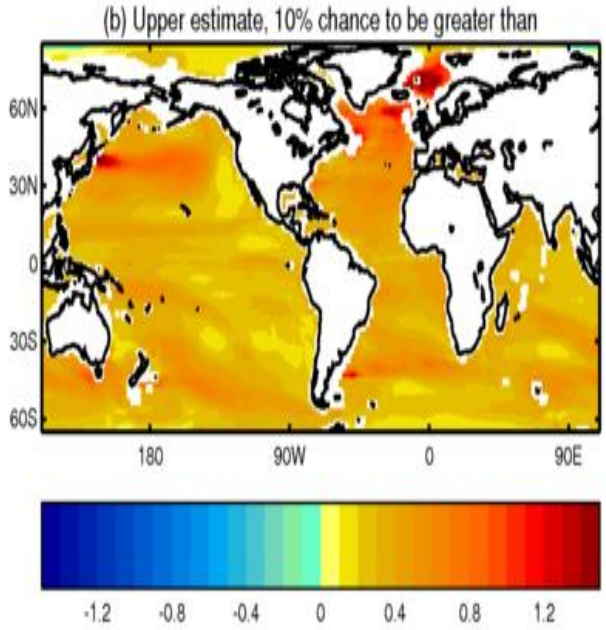
- Impacts of subpolar gyre cooling are widespread, including surface temperature, precipitation and Atlantic hurricanes
- A skillful forecast is constructed from three decadal prediction systems, including one with perturbed physics members
- The last five forecasts (2008-2012) consistently show a cooling Atlantic subpolar gyre
- This is consistent with the forecast decreased ocean heat convergence into the subpolar gyre and continued slow down of the AMOC

Supplementary slides

Grand ensemble forecast (anomalies from 1971-2000)







Correcting the forecasts

- Correct both bias and trend
- Correction is lead time dependent
- Only really necessary for version 2