Improved predictions of East Asia

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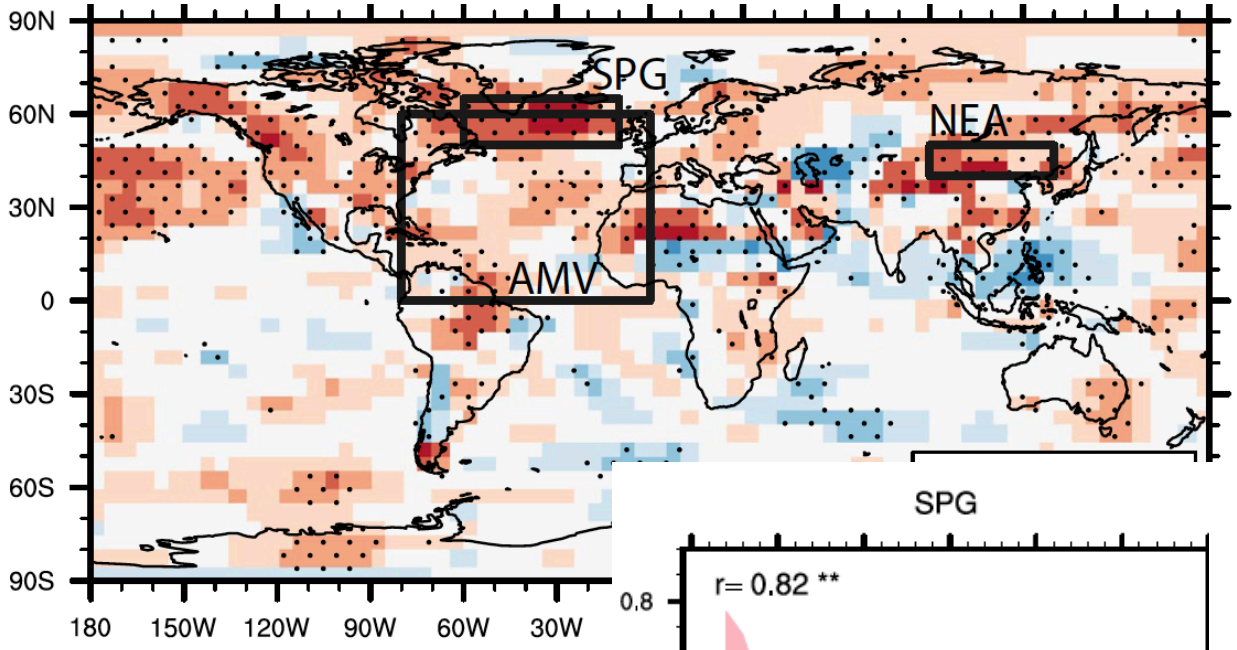
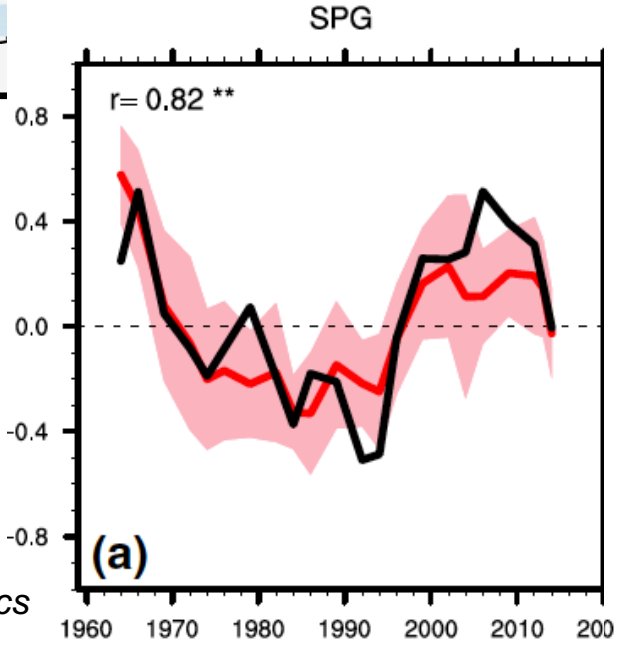
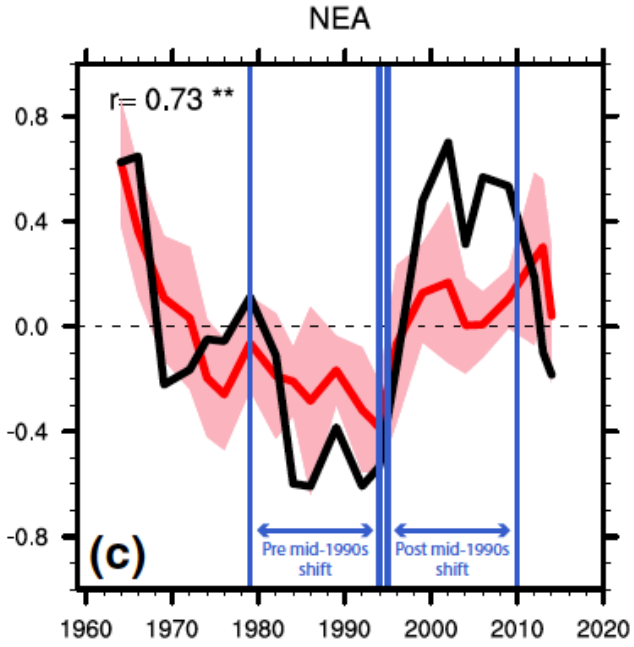
ACC skill score for SAT in summer (JJAS) at a lead time of 2-5 years.







Monerie et al. 2018, Climate Dynamics

Circumglobal teleconnection ?

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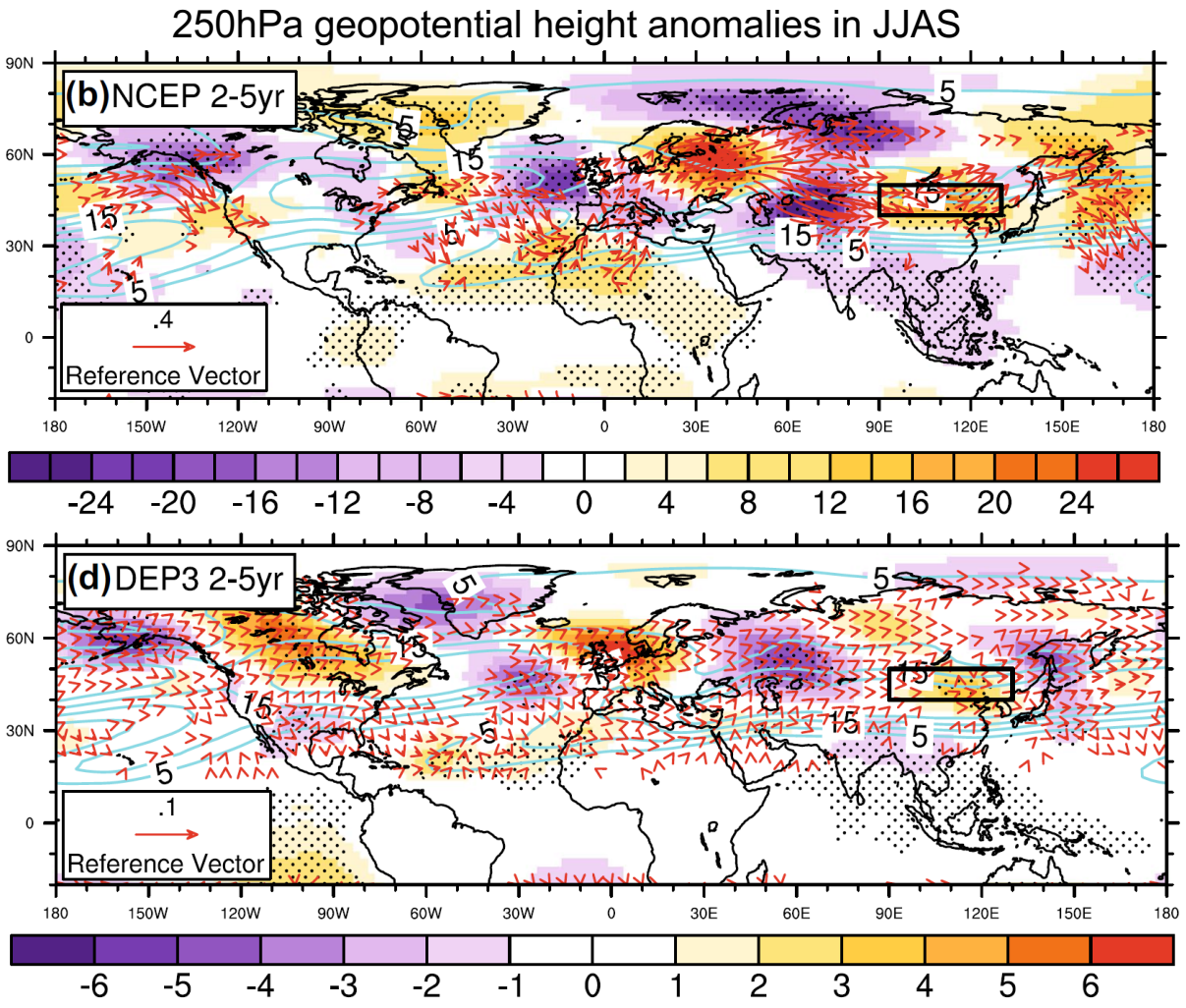

propagation of a Rossby wave similar to Circumglobal teleconnection

Consistent with a role for the North Atlantic – e.g. Lin et al, 2016 and Wang et al, 2017

However, direct attribution to North Atlantic difficult

Monerie et al. 2018, Climate Dynamics

Circumglobal teleconnection ?

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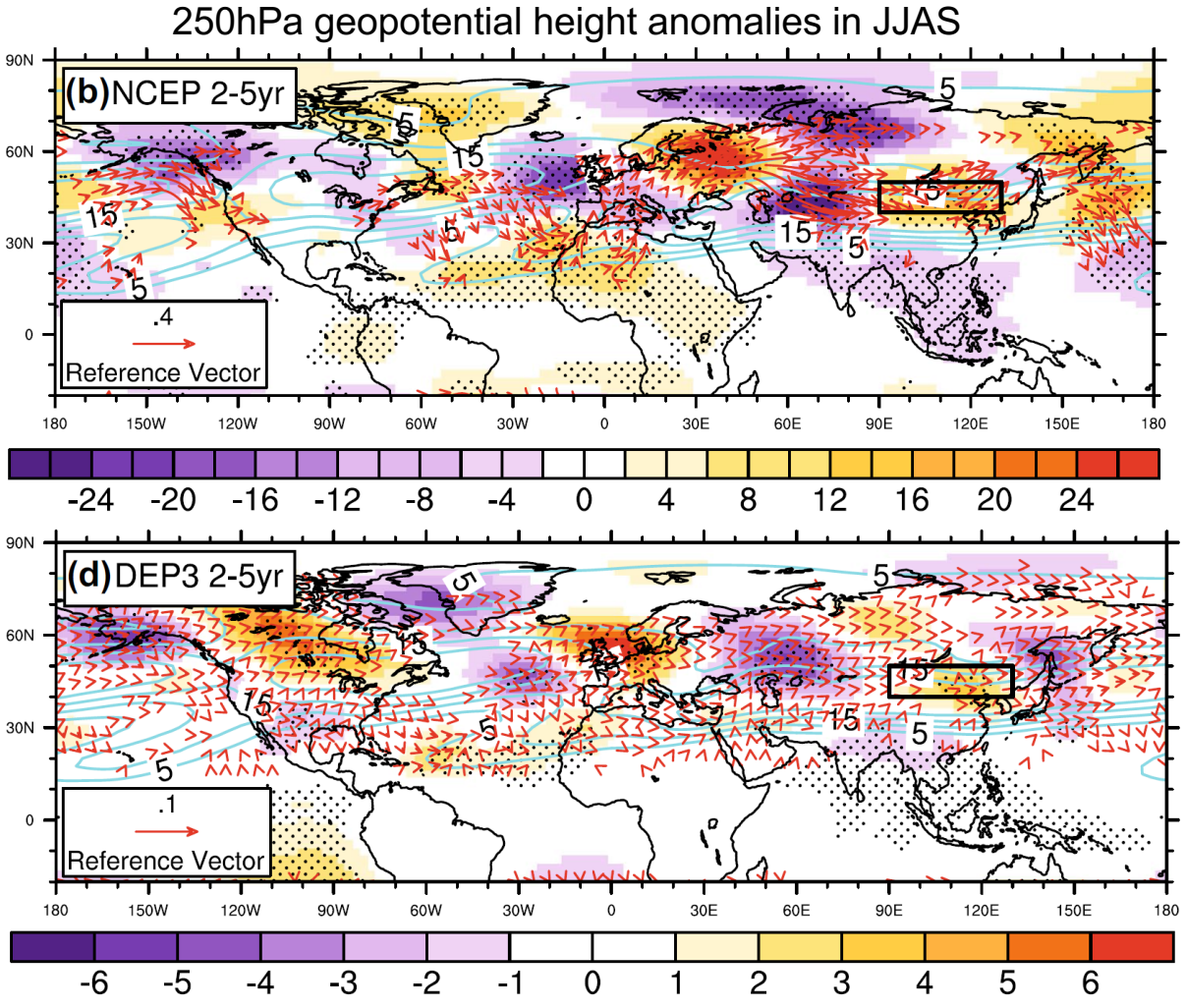

Monerie et al. 2018, Climate Dynamics

propagation of a Rossby wave similar to Circumglobal teleconnection

Consistent with a role for the North Atlantic – e.g. Lin et al, 2016 and Wang et al, 2017

However, direct attribution to North Atlantic difficult

But similar mechanism seen in DCPP idealised AMV experiment

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Some issues for S2D predictions of the North Atlantic

”signal-to-noise” paradox

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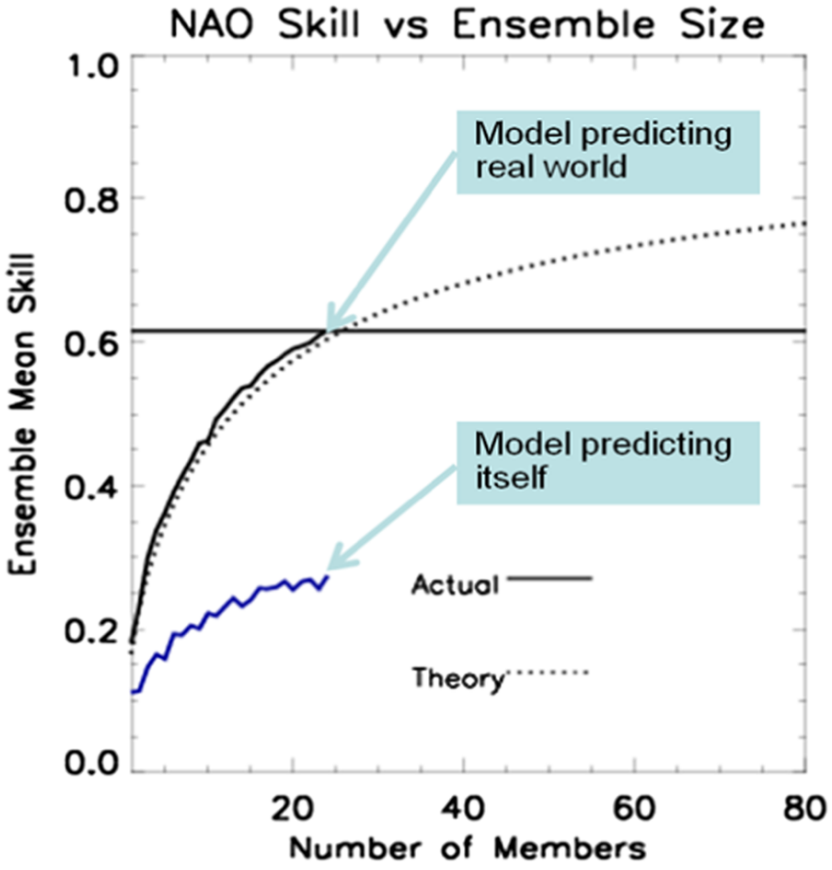
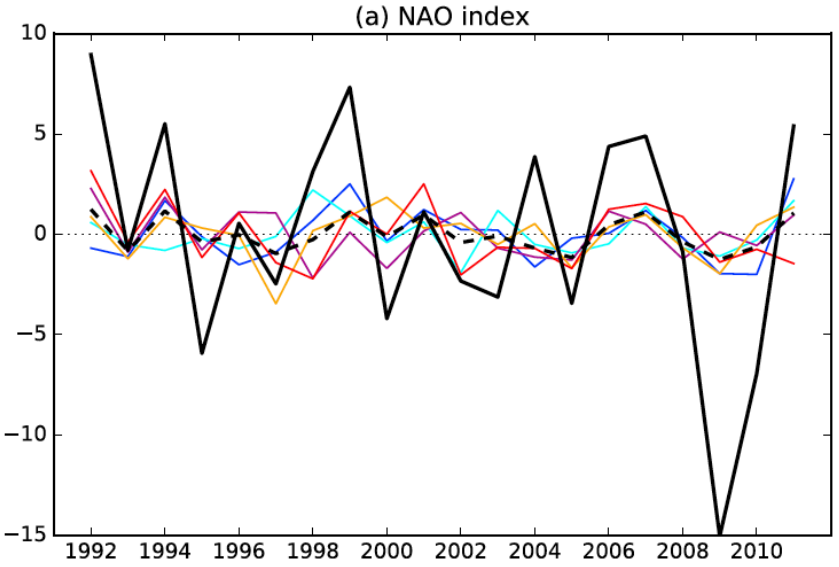


Scaife and Smith, 2018

- S2D systems show that the predictable signal in the real world is larger than in models



Baker et al, 2018

Decadal predictions do not predict LSD or AMOC changes

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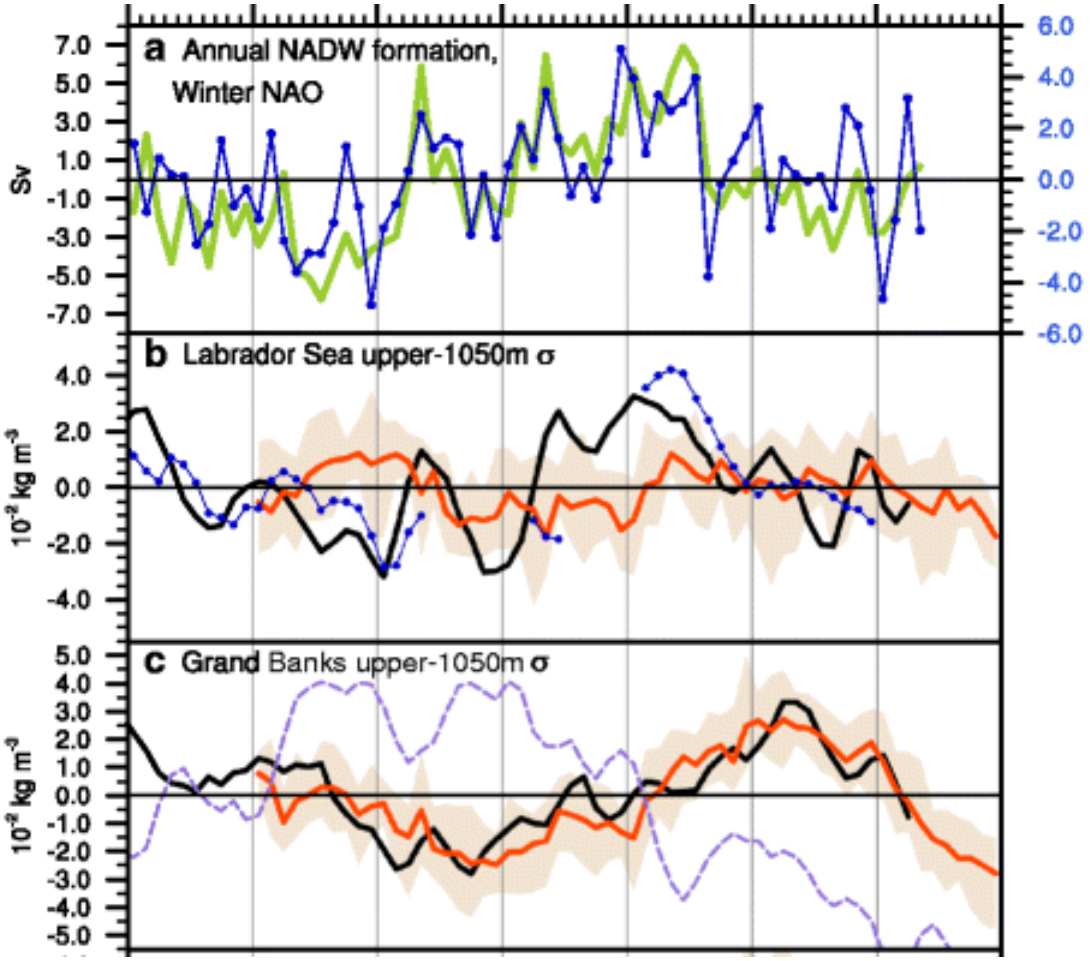
Successful Predictions of SPG depend on *initialisation* of and *evolution of density anomalies at depth*

Why not?
NAO not very predictable?

Signal-to-noise paradox?
If magnitude of the predictable signal too low → predictable AMOC variability even lower?

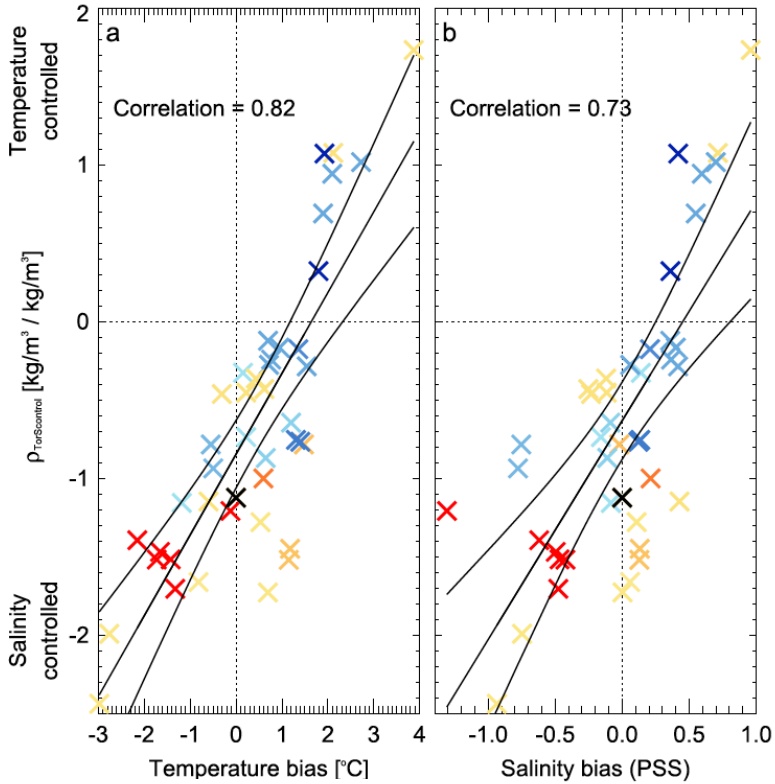


Yeager and Robson, 2017

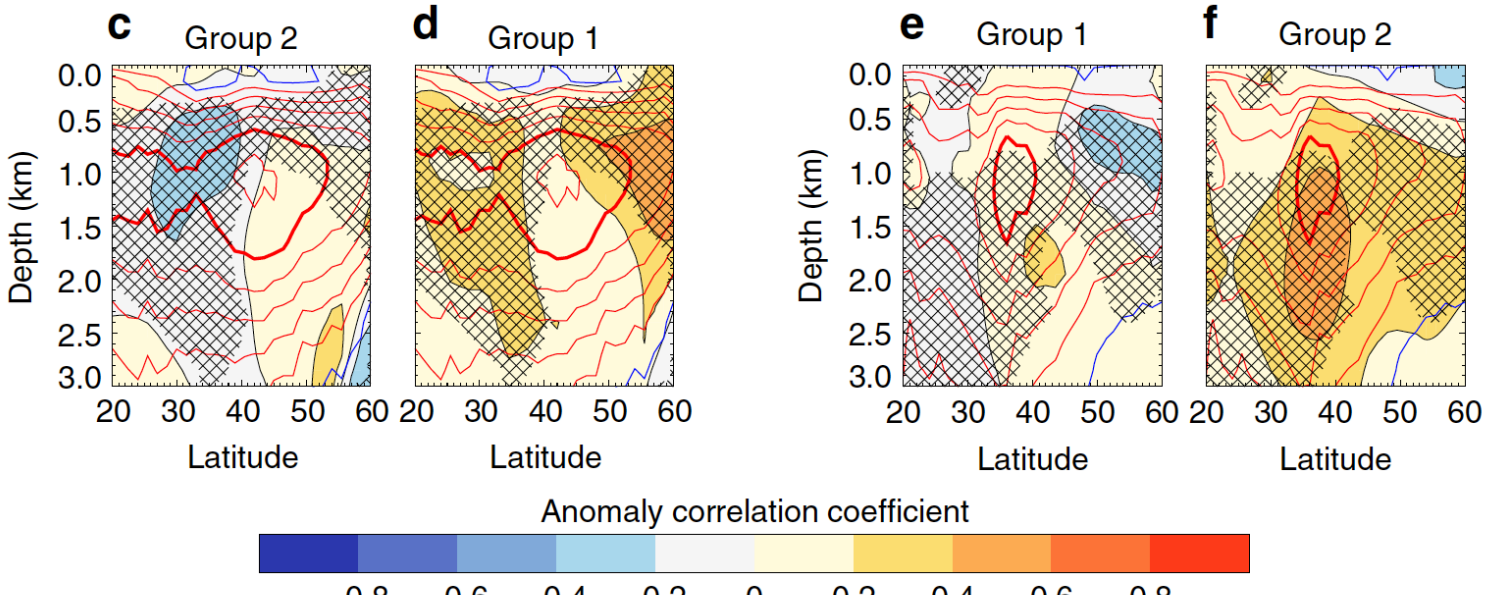
Density drivers of Labrador Sea density

substantial uncertainty in what dominates density variability in models - *and also in ocean reanalysis*

Related to uncertainty mechanisms and timescales of variability – and also on predictions



ACC of AMOC stream function



Menary et al, 2015

Menary and Hermanson, 2018

What is the role of external forcing in Atlantic variability and skill

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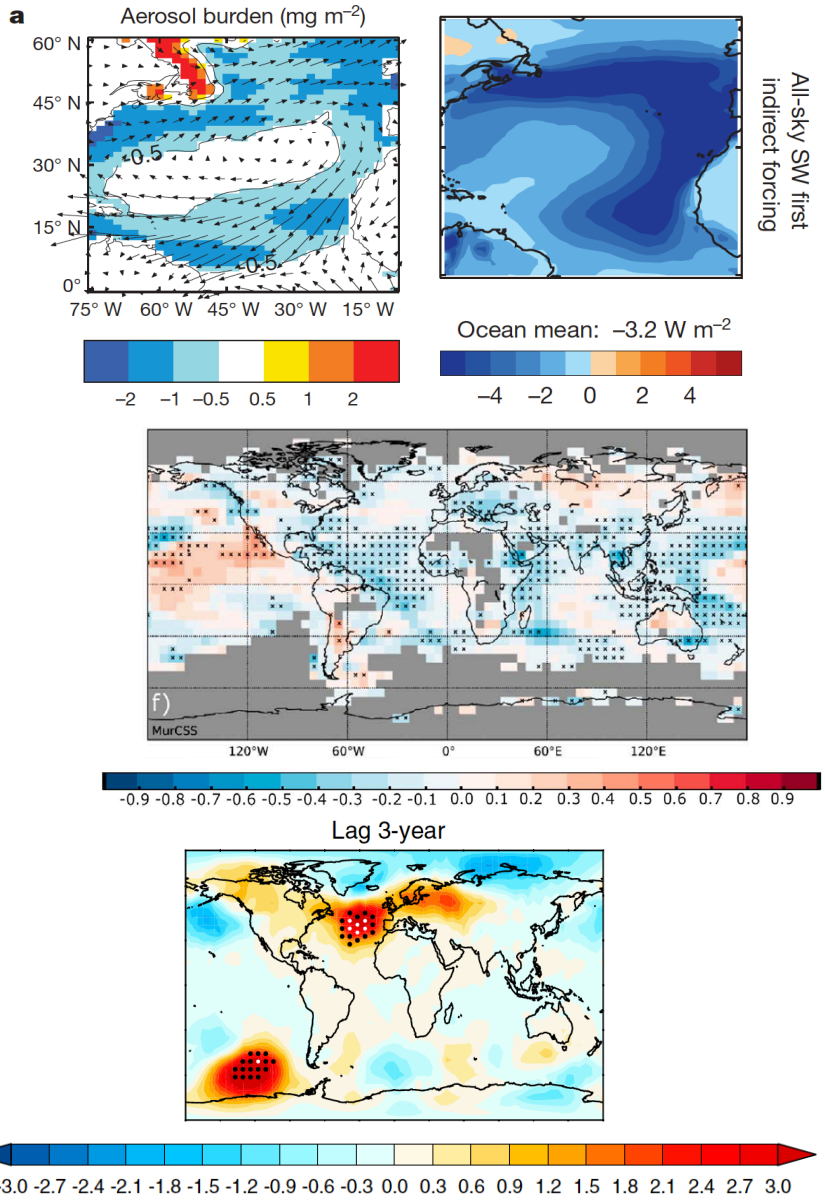
- Aerosols
  - SST *(Booth et al, 2012)*
  - AMOC *(Menary et al, 2013)*
- Volcanoes
  - SST skill *(Timerick et al, 2013)*
  - AMOC *(Swingedouw et al, 2015)*
  - NAO *(Driscoll et al, 2012)*
- Solar
  - Driver of NAO *(Gray et al, 2013)*
  - Skill in NAO *(Dunstone et al, 2016)*



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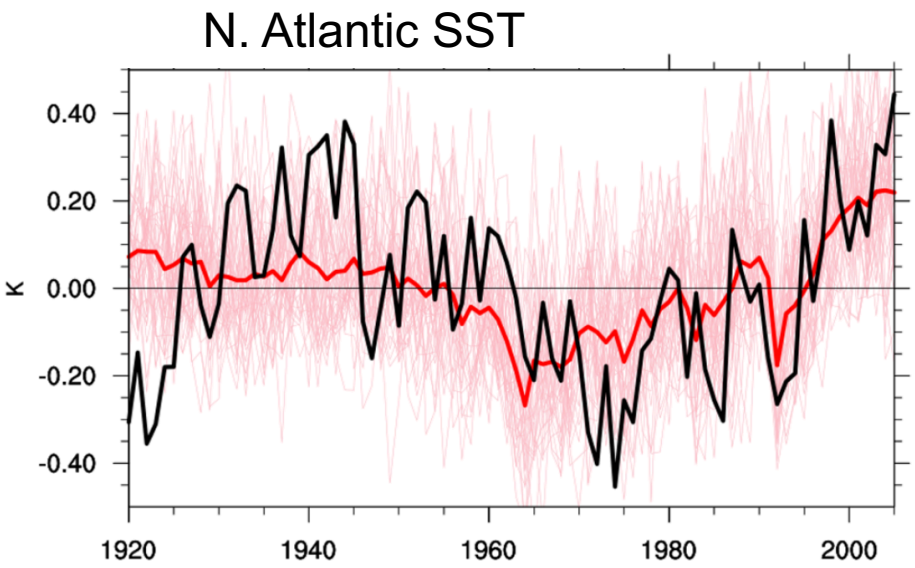

Bellomo et al, 2018

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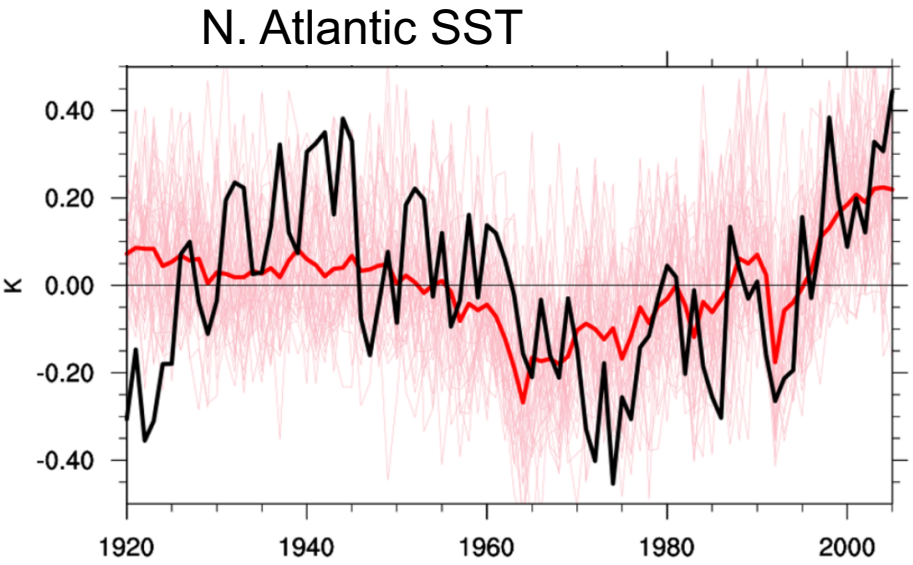
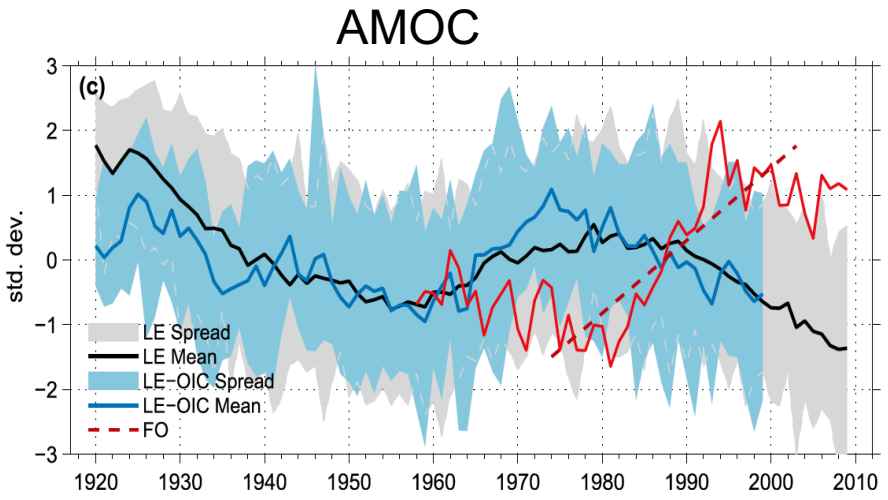


Bellomo et al, 2018



Kim et al, 2018

What is the role of external forcing in Atlantic variability and skill

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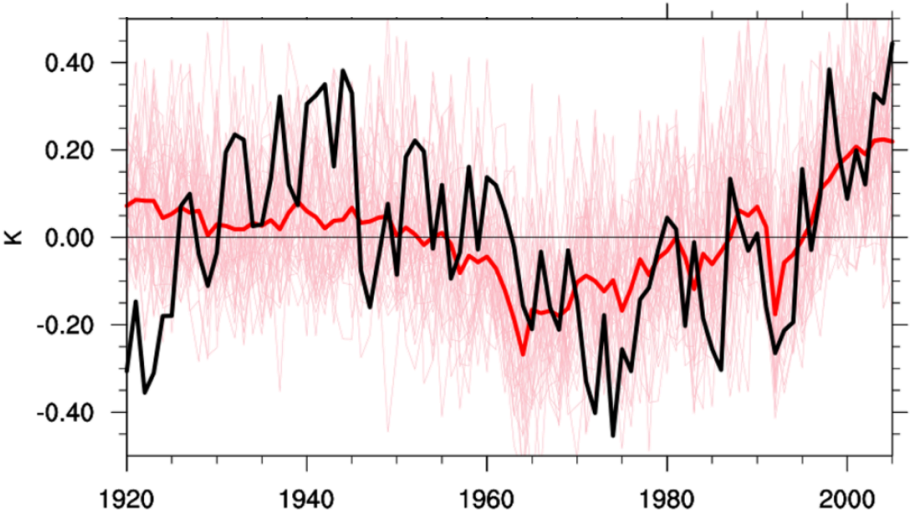
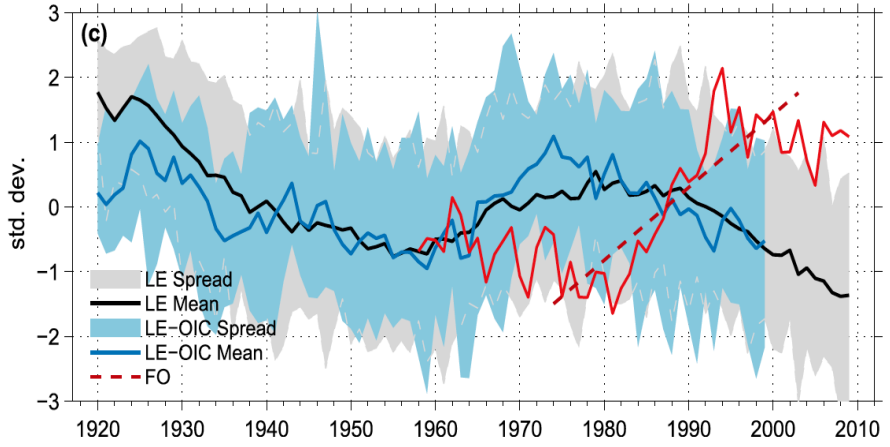
N. Atlantic SST

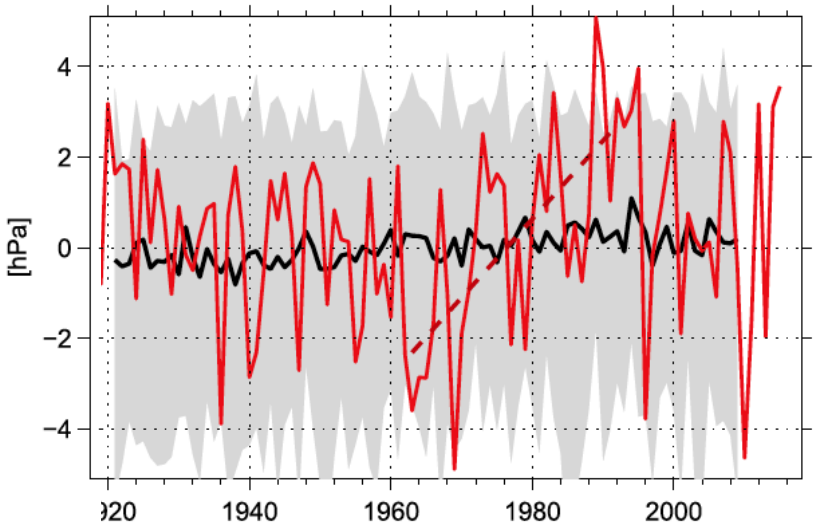


Bellomo et al, 2018

AMOC



NAO



Kim et al, 2018

Summary

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- A wide range of mechanisms contribute to skill in S2D predictions
- Models and observations support a key role of the the NAO in driving AMOC, and a lagged relationship with the SPG
- Improved predictions in the N. Atlantic on multi-year timescales are consistent with the initialization of the ocean circulation
- However, there are still many fundamental uncertainties
  - The signal-to-noise “paradox”
  - The role of external forcing
  - The drivers of density anomalies
  - Temporal variability in teleconnections/predictability

Some ways forward?

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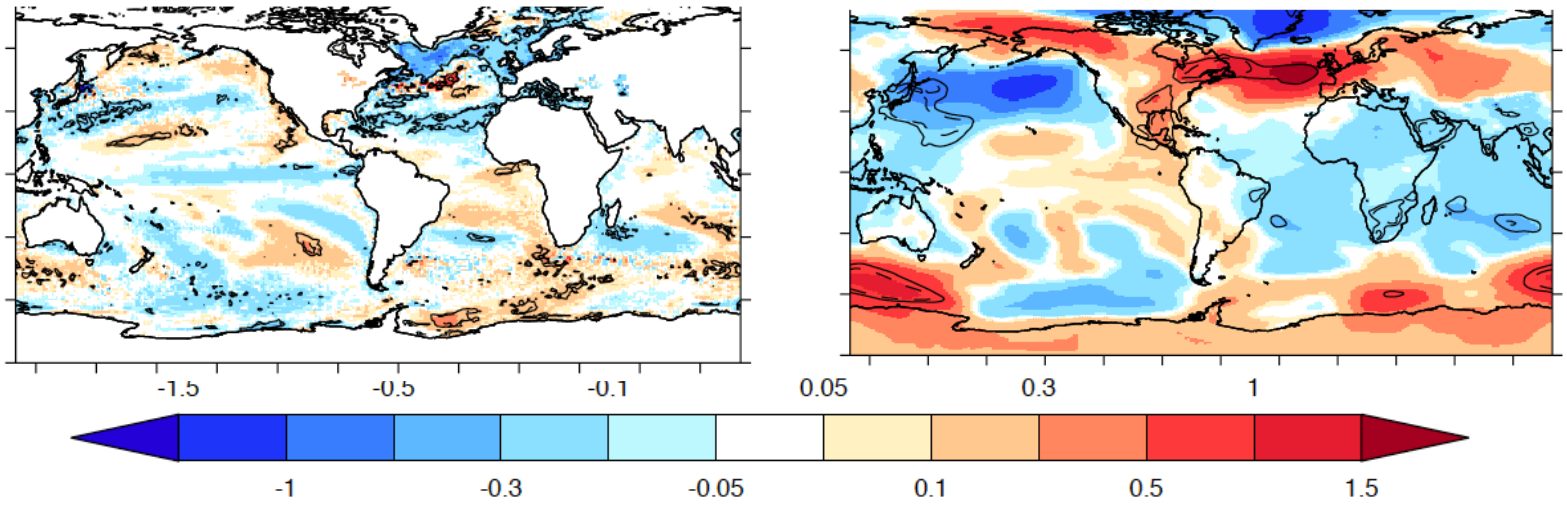
- Understanding, and evaluating, the important mechanisms is crucial to make progress in simulating North Atlantic climate variability
  - Focus should be on multi-model analysis
- Using initialised predictions alongside other sensitivity runs (i.e. DCPP component C) – e.g. the no SPG experiment



- Potential to use S2D systems more in an attribution framework?

Predictions with HiGEM-DP are also consistent with important role of ocean

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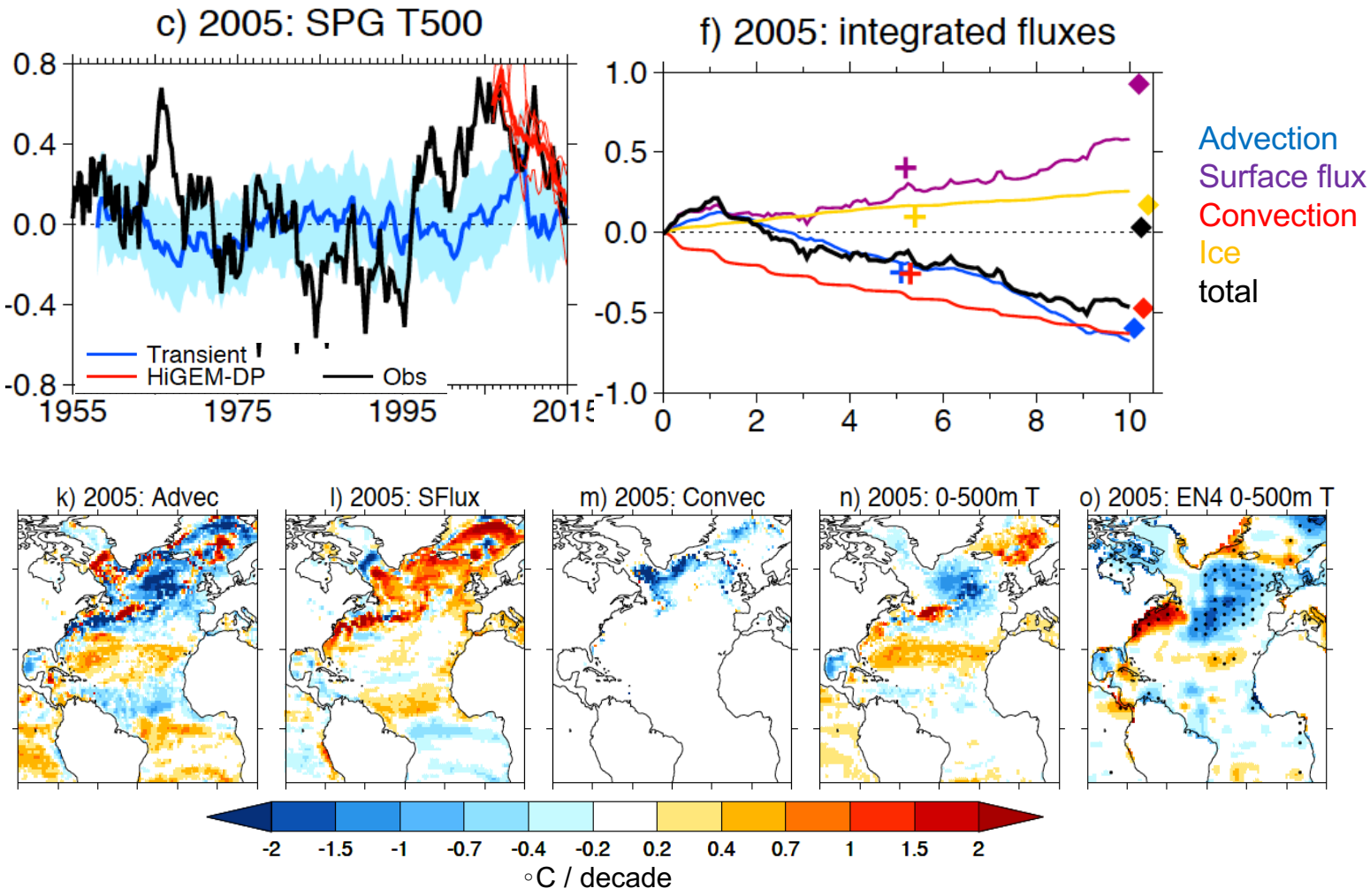

But what about other models

AMOC and the Gyre….

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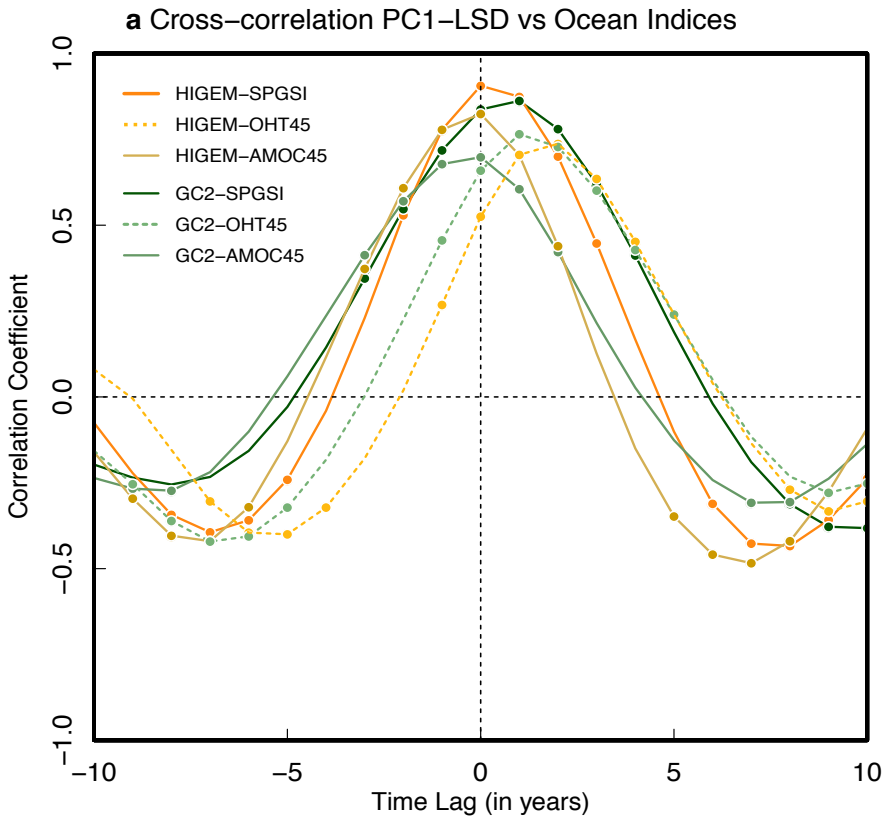

Long lead predictability of Rainfall related to ENSO

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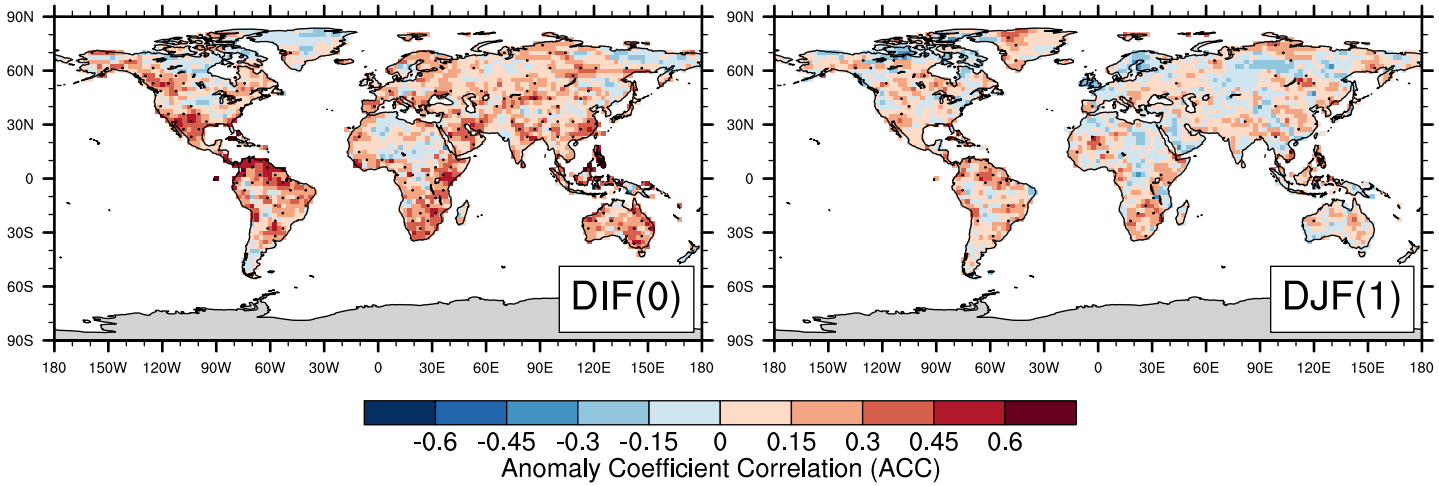
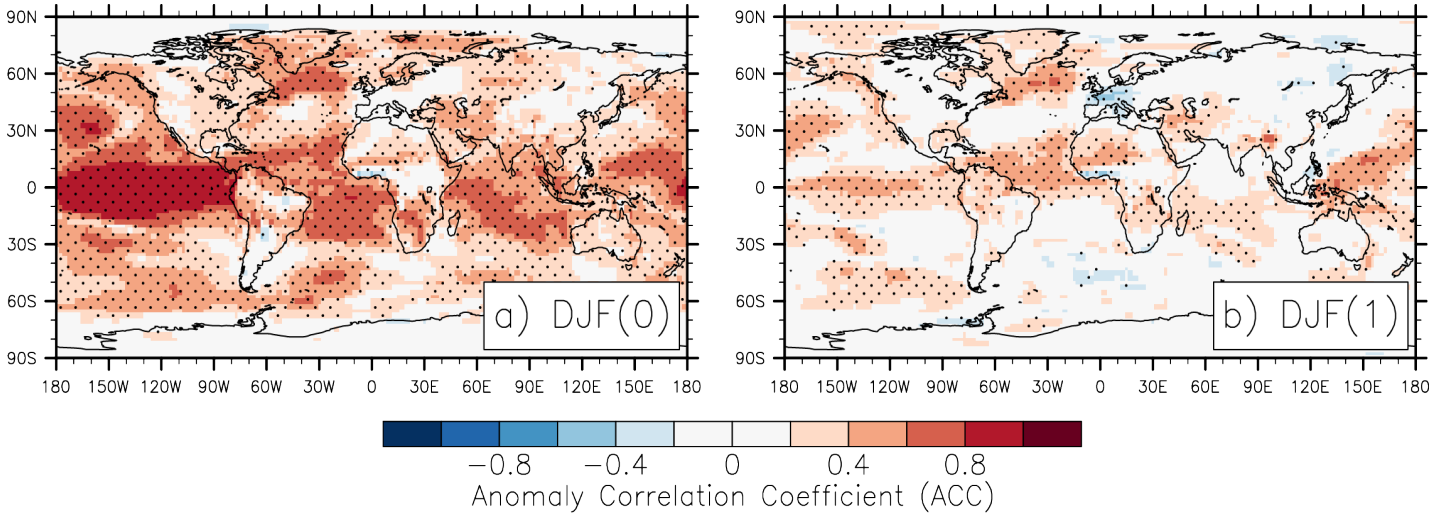
ACC of precipitation in DePreSys3 1959-2015 – 40 Ensemble members



ACC of SAT in DePreSys3



Decadal variability in ENSO teleconnections?

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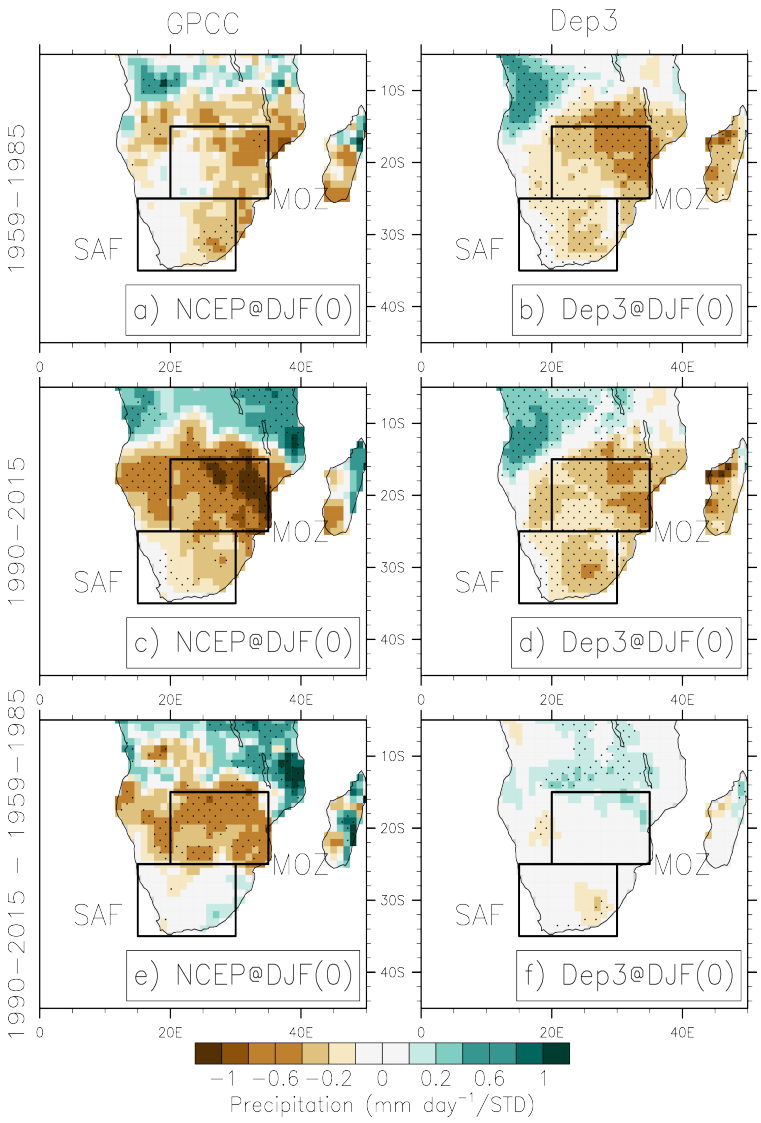
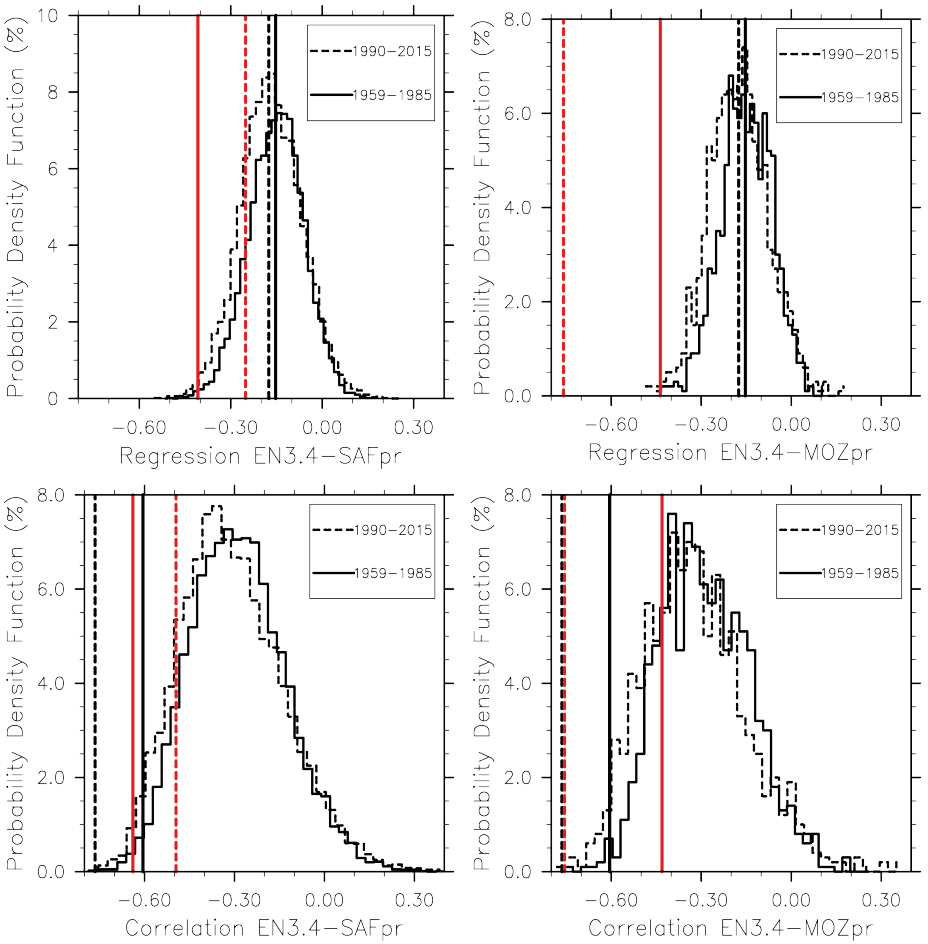
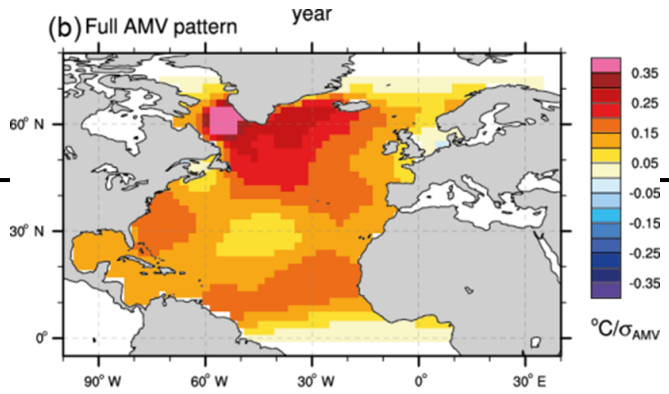
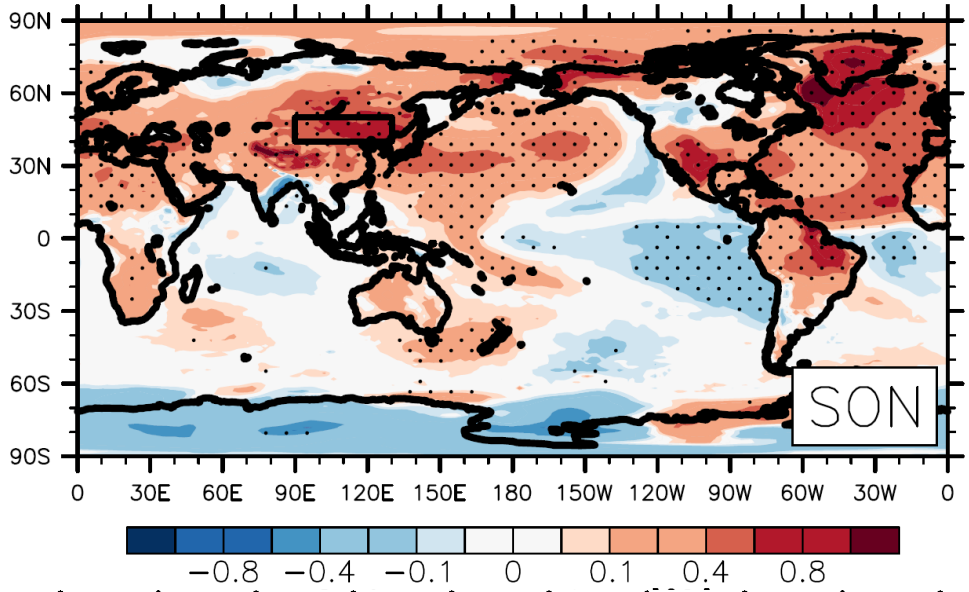
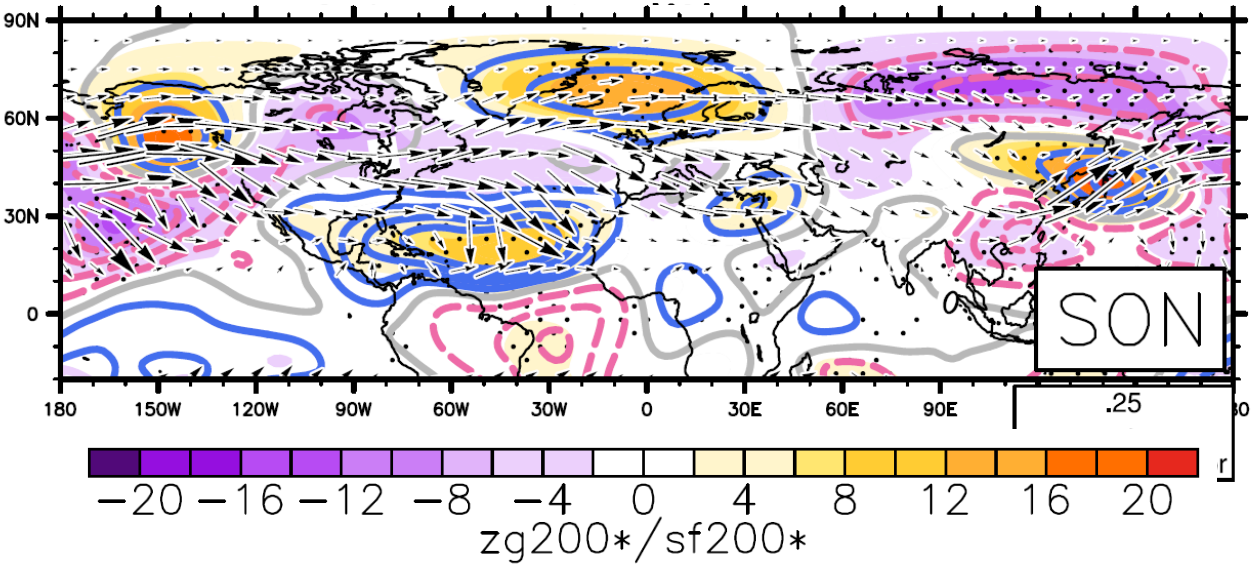




Idealized AMV experiment







- Results suggest AMV can modulate North East Asian temperature through:-

  A) circumglobal teleconnection

  B) Pacific-Japan pattern - following the modulation of Pacific surface temperature

Predictions of 1990s warming similarity with internal variability?

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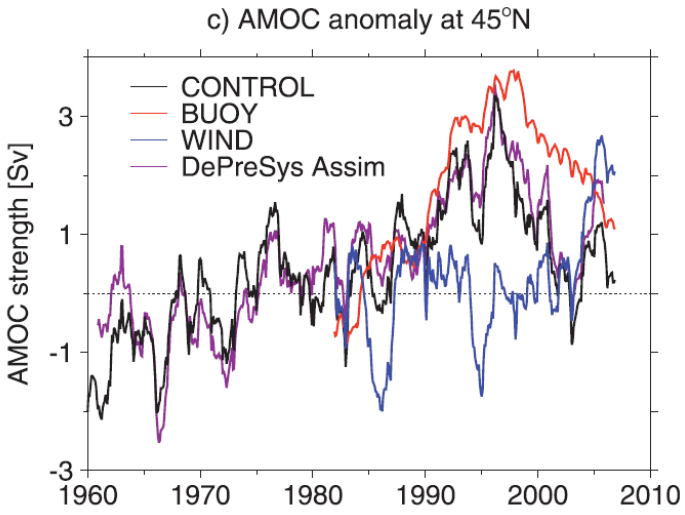
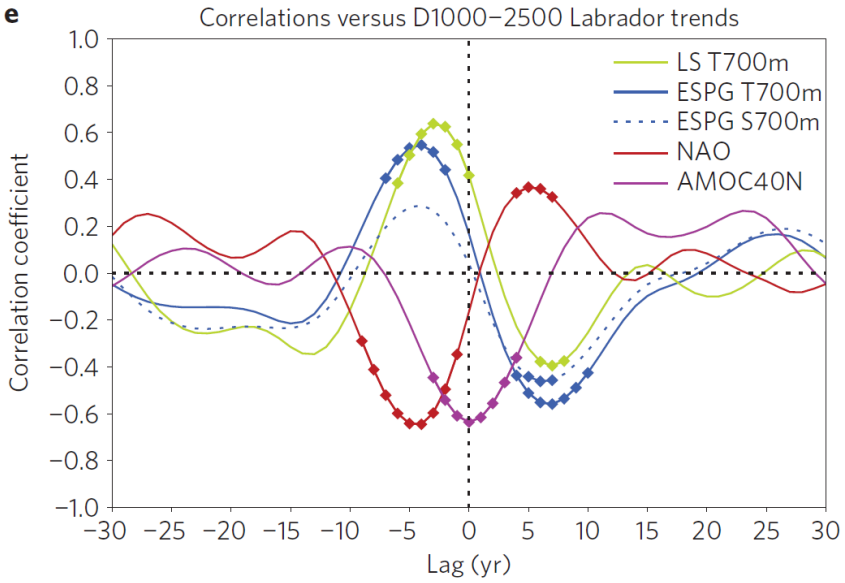
- Mid-1990s warming came after a sustained trend towards more positive NAO.
- Lagged increase in the buoyancy forced ocean circulation (AMOC and Gyre), and northward heat transport
- Similar to coupled model *internal variability*, including HiGEM and HadGEM3-GC2 (*i.e. Hodson et al, 2012; Menary et al, 2015; Robson et al, 2016; Ortega et al, 2017*)



Robson et al, 2012



Robson et al, 2016