

# Conclusions

*Did the ocean influence North Atlantic Climate in the recent past?*

- The model results suggest that SSTs did influence N. Atl. climate during 1951-'94.

*What was the nature of the atmospheric response?*

- In 3/4 models dominant DJF mode of SST-forced MSLP variability an NAO-like dipole pattern

*What regions of the oceans were most influential in affecting N. Atl. Climate.*

- In 3/4 models variations in SSTs in the TNA region are strongly related to this pattern, suggesting that TNA may play a key role in influencing N. Atl. Climate.

*How did the ocean influence vary with timescale?*

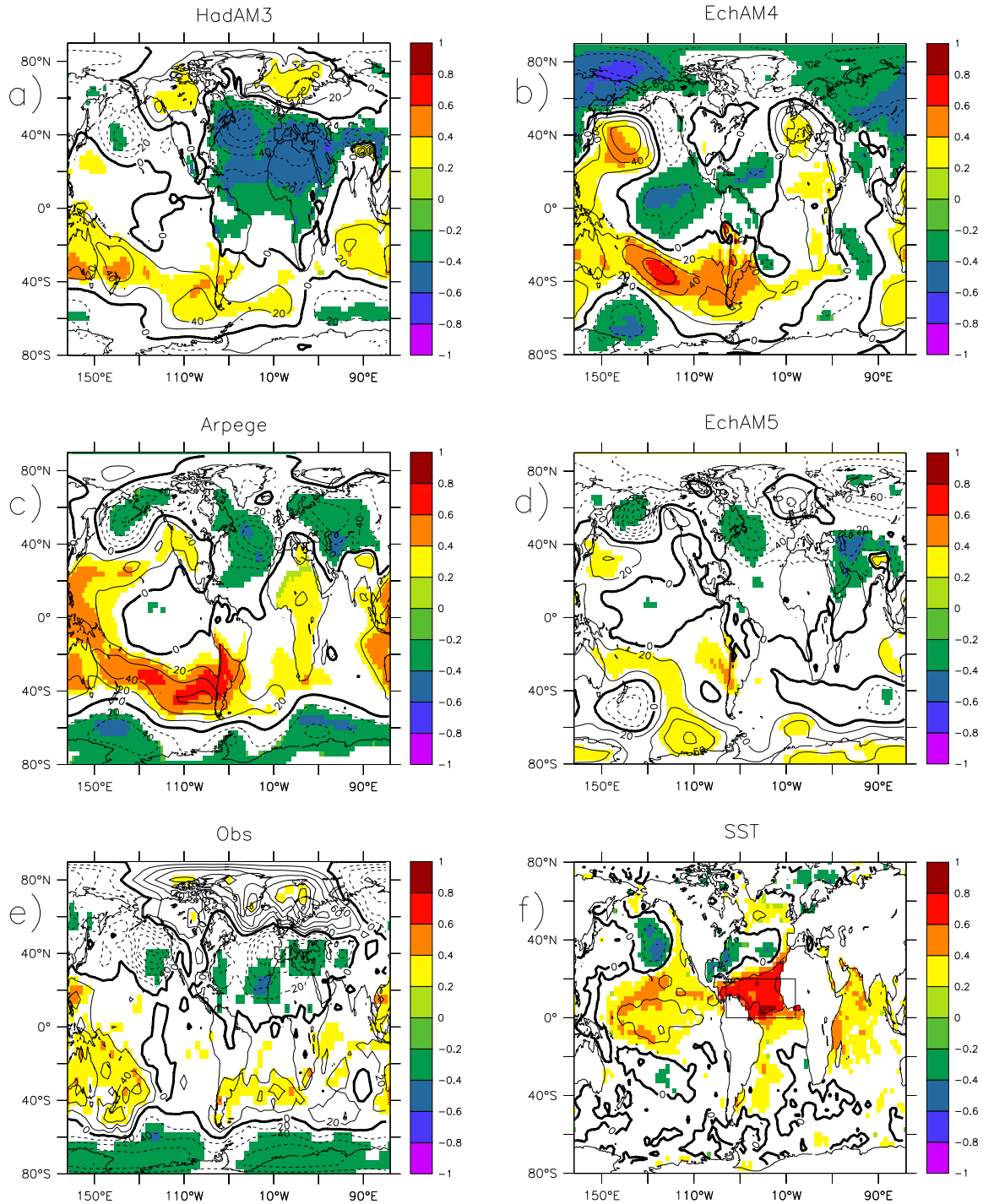
- Trends in NAO seen in 3/4 models suggesting that observed trend in the NAO is due, in part, to historical changes in SSTs.
- The models vary widely in the strength of their response to detrended TNA SSTs.

## Further Work

- Investigate the influence that SST patterns associated with trends and other long time scale fluctuations have on N. Atl. Climate
- What are the mechanisms by which N. Atl. SSTs could influence N. Atl. Climate ?

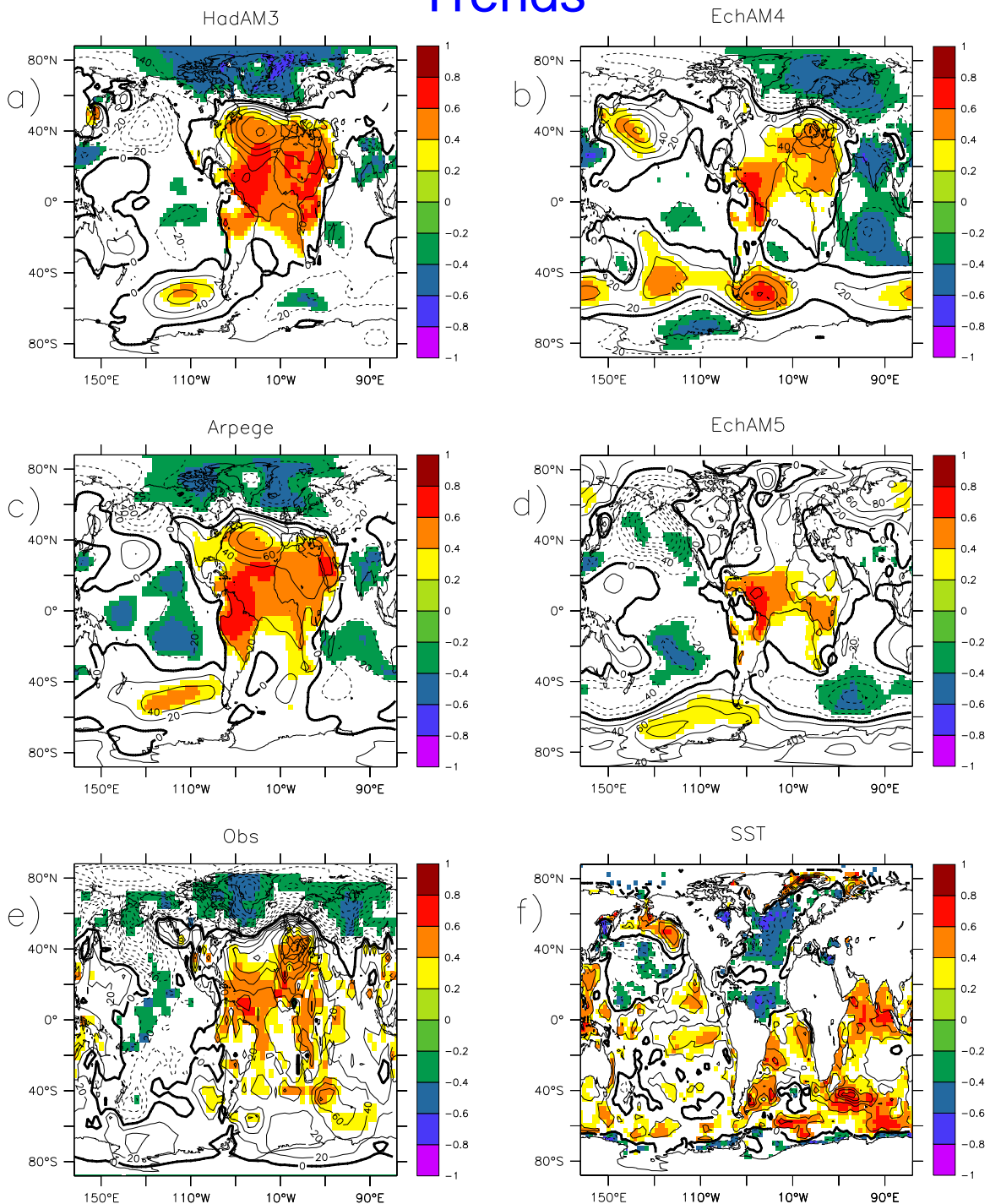
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# Detrended TNA SST Index



- clear differences between models -> different sensitivities to changes in TNA SST
- Much scatter -Hadam3 has the strongest dipole structure

# Trends



- NAO-like dipole in MSLP
- SST trends: NA cooling - similar patterns seen in THC impact studies.
- Trend in Obs NAO due, in part, to changes in SST
- These changes in SST could be a response to changes in the THC

# Optimal Detection

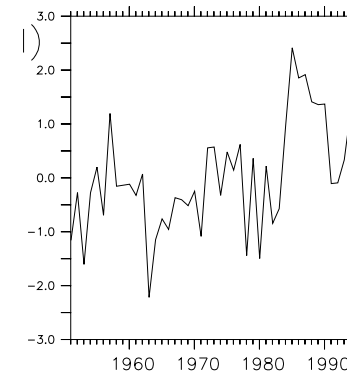
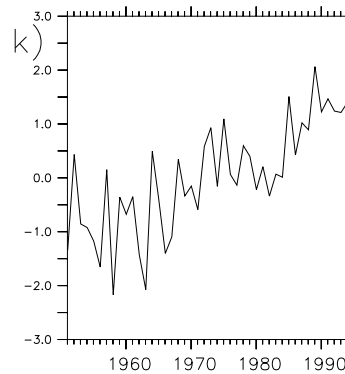
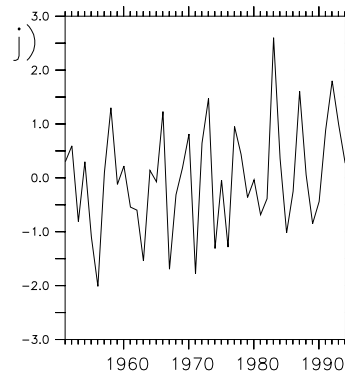
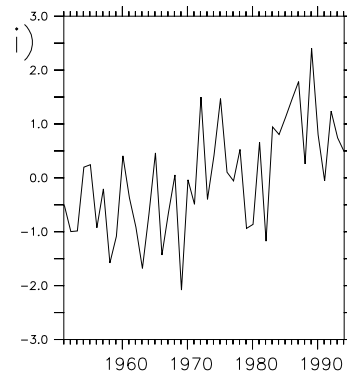
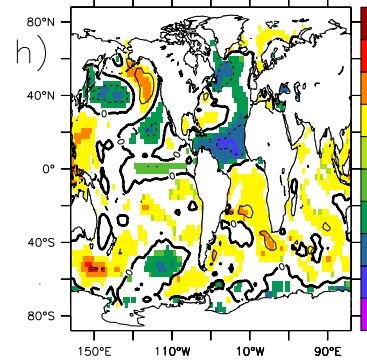
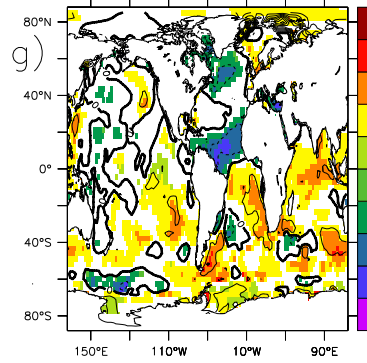
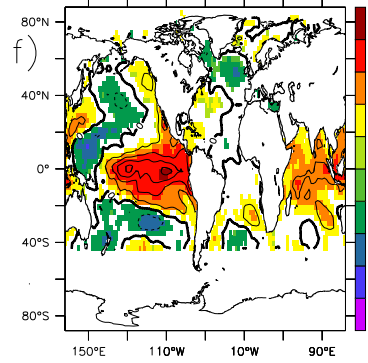
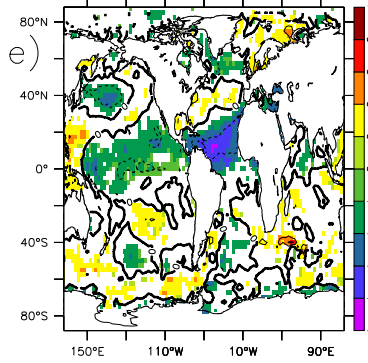
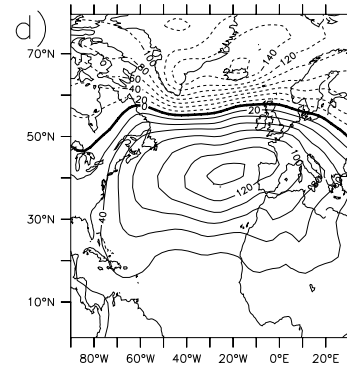
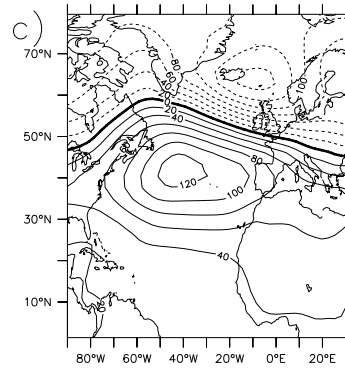
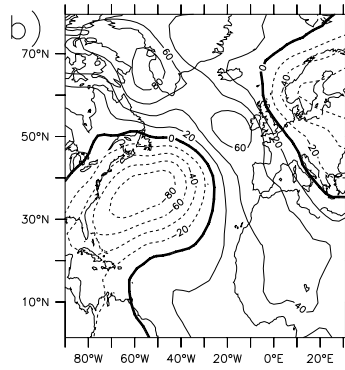
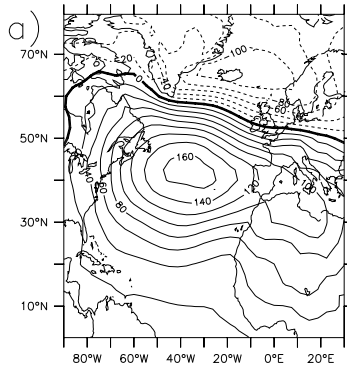
DJF

Hadam3

Echam 4

Arpege

Echam 5



- North Atlantic Oscillation (NAO)-like dipoles
- Consistent region of high FVE in Tropical North Atlantic (TNA) regions in 3/4 models.

i)MSLP pattern consistent in sign with TNA region

ii)TNA pattern - NAO relationship consistent with other experimental results (Sutton et al 2001)

- Echam 4 - remote ENSO response
- NAO trends

## Analysis

- For each model we processed the ensemble using an optimal detection technique (Venzke et al, 1999). This allows separation of ( $F$ ) the variability common to each ensemble member ( $i$ ) from variability due to internal noise ( $n_i$ ).

$$X_i = F + n_i$$

- Optimal Detection technique is similar to Principal Component (EOF) Analysis, except that it maximises *signal-to-noise* rather than total variance.
- To examine different timescales we analysed both trends and detrended data.

# Experiments

## Basic Method:

Force an Atmospheric General Circulation Model (AGCM) with a reconstruction of historical Sea Surface Temperature (SST) patterns.

## Ensembles:

To aid detection of the response to forcing (signal) above the internal variability (noise), we ran an ensemble of forced AGCMs; each with identical SST forcing but differing in their initial atmospheric conditions.

## Models:

In order to assess the model dependence of the results we performed an ensemble experiment with each of four different AGCMs.

Model	No. of Ensemble members	SST forcing dataset	Time Period	GHG Forcing?
Arpege-climat	8	GISST2.3+3.0	1949-1998	No
Echam 4	6	GISST 2.2	1951-1994	Yes
Echam 5	4	HadISST	1949-1997	No
HadAM3	6	HadISST	1871-1997	No

**Aim:**

To examine the influence of the Ocean on the behaviour of North Atlantic Climate.

**Motivation:**

- Understand the role of oceans in climate variability.
- Issues for climate change -> understanding the causes of past climate variability.
- Prediction: Potential long timescale predictability of the ocean could allow long timescale forecasts of climate.

**Key Questions:**

- Did the ocean influence North Atlantic Climate in the recent past?
- What was the nature of the atmospheric response?
- What regions of the oceans were most influential in affecting N. Atl. Climate.
- How did the ocean influence vary with timescale?

**Influence of the Oceans on North Atlantic  
Climate Variability:  
A comparison of results from four at-  
mospheric GCMs**

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