



# Atlantic MOC Variability in Decadal Climate Prediction Systems

Holger Pohlmann, with contributions from

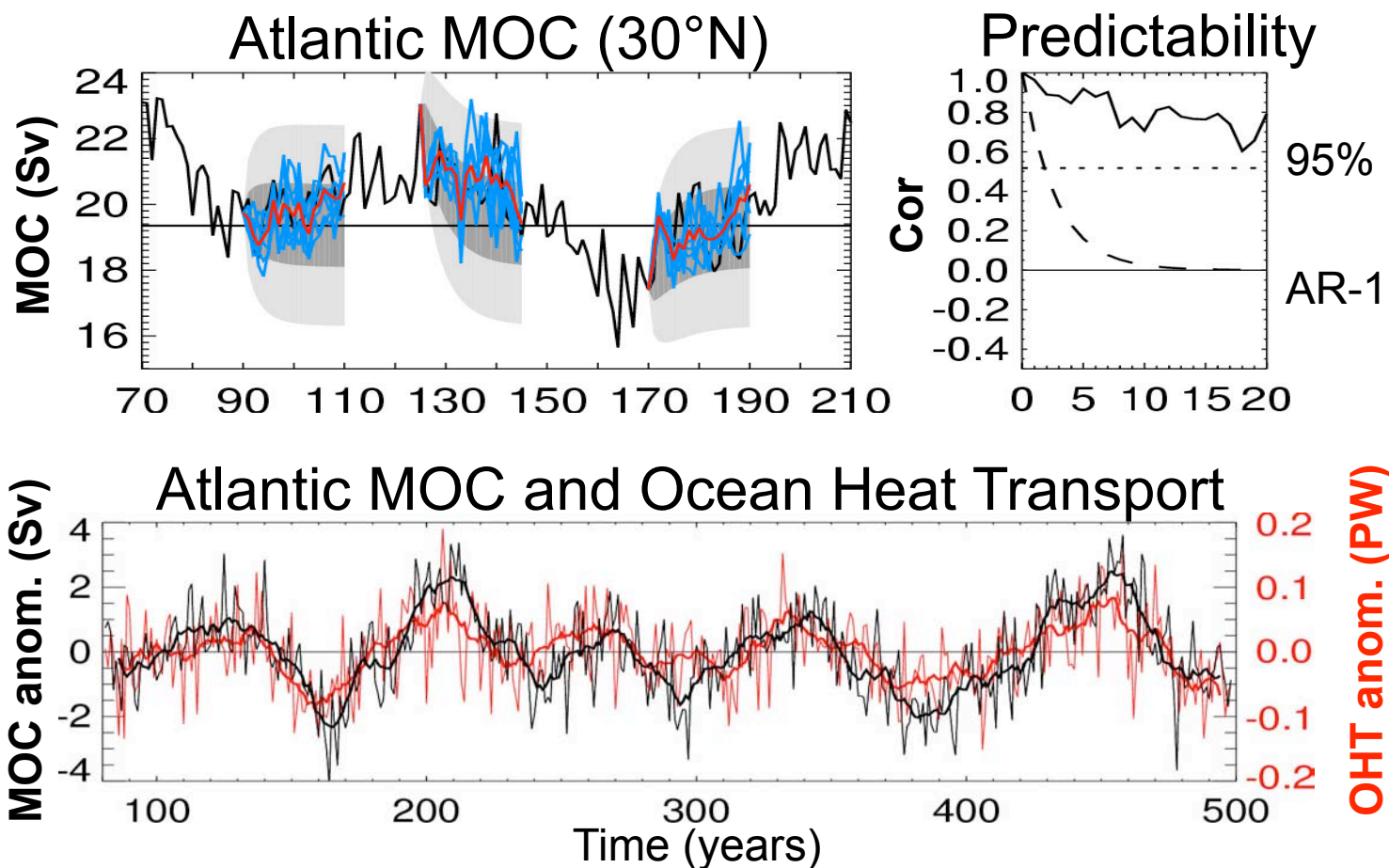
M. Balmaseda, N. Keenlyside, D. Matei, W. Müller, P. Rogel, and D. Smith

# Content

1. Motivation
2. Overview of Experiments
3. AMOC Variability 1960-2005
4. AMOC in Decadal Predictions
5. Conclusions

# 1. Motivation

Idealized Experiments with ECHAM5/MPIOM:

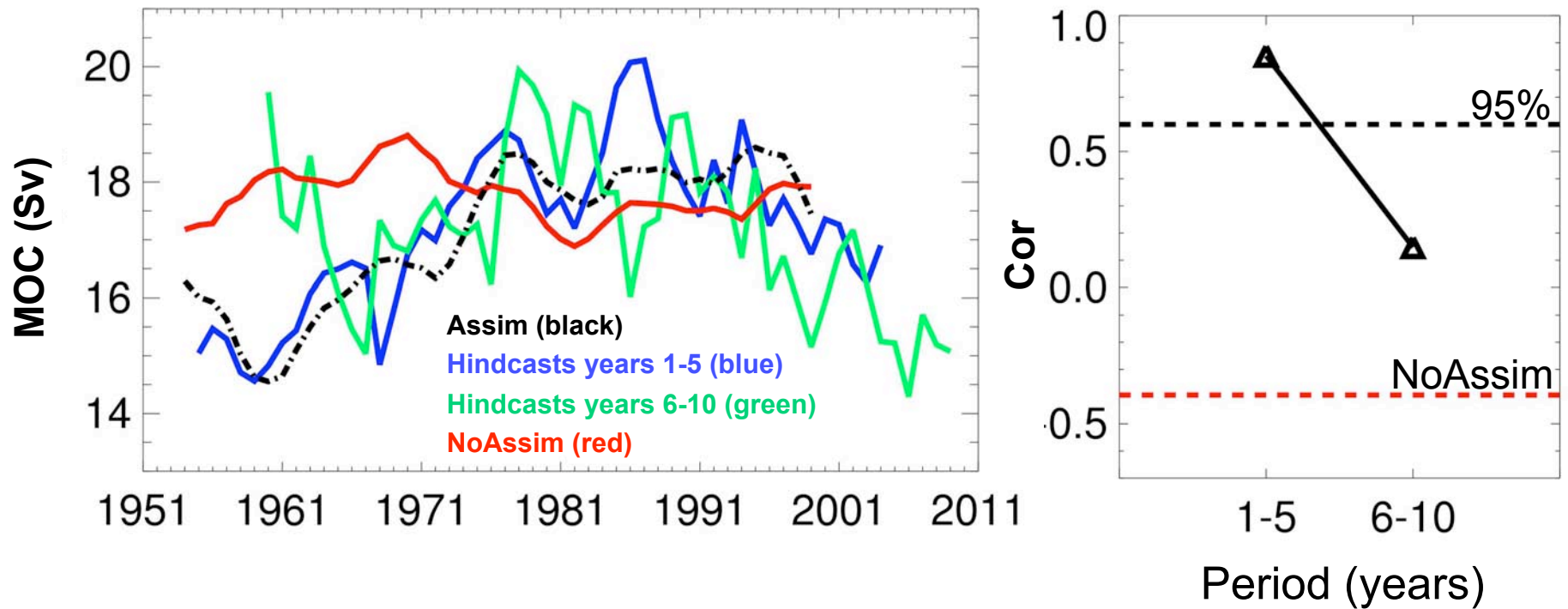


(Pohlmann et al., JoC, 2004 and 2006)

# 1. Motivation

ECHAM5/MPIOM initialized with GECCO (T&S):

AMOC (48°N)



(Pohlmann et al., JoC, 2009)

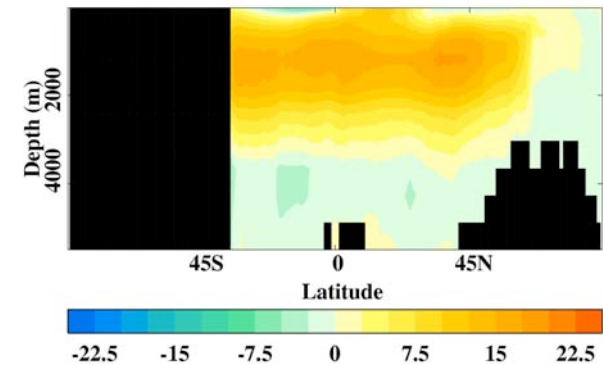
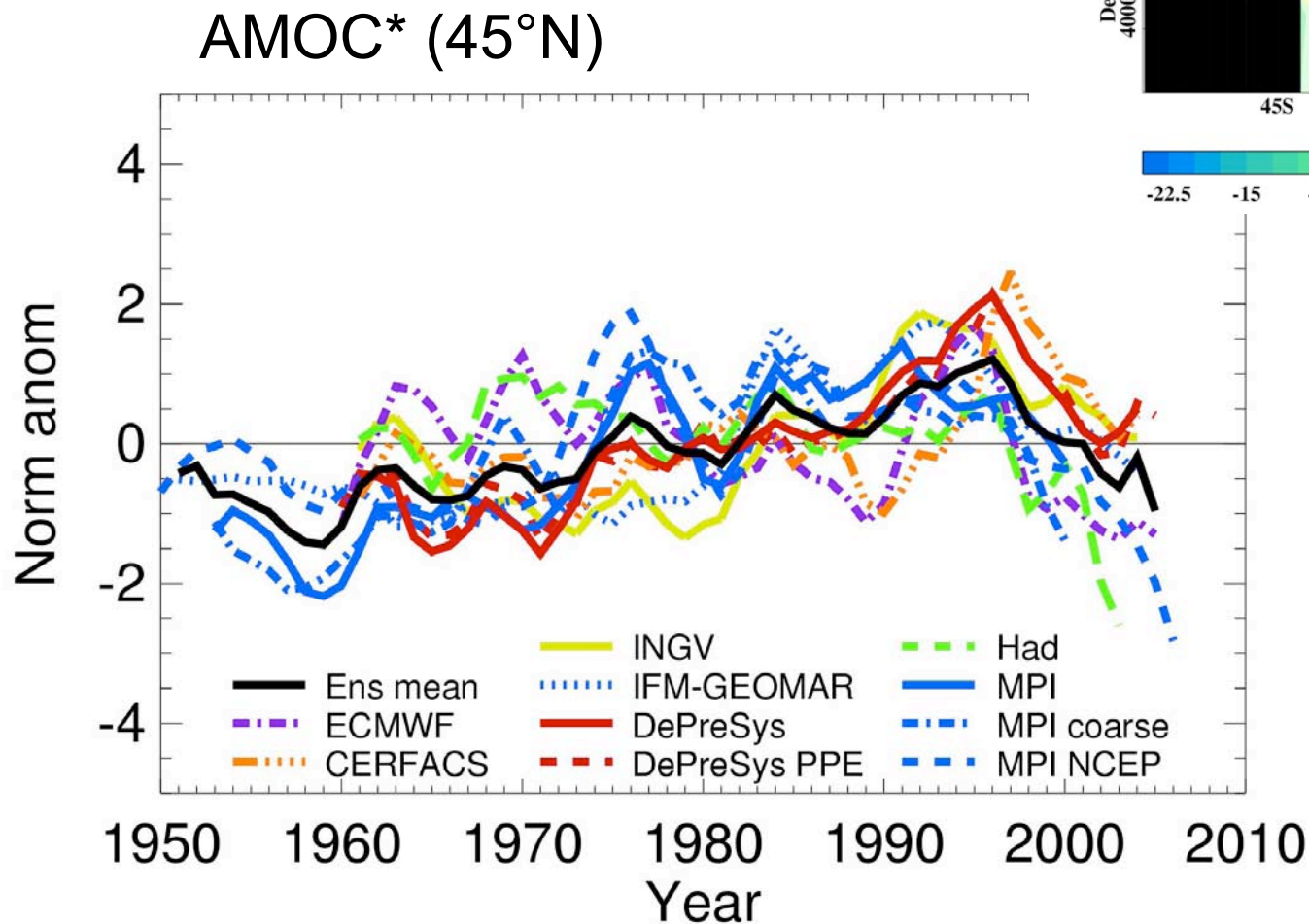
## 2. Overview of Experiments

From ENSEMBLES and other projects:

Institute	Model	Assimilation period (ens size)	Hind- and Forecasts (start dates x ens size)
ECMWF	IFS-HOPE	1959-2006 (5)	1960, 65, ...-2005 (10x3)
CERFACS	ARPEGE-OPA	1960-2005 (9)	1960, 65, ...-2005 (10x3)
INGV	ECHAM4-OPA	1960-2005 (3)	
IFM-GEOMAR	ECHAM5-MPIOM	1950-2005 (3)	1955, 60, ...-2005 (11x3)
MOHC	HadGEM2	1960-2004 (3)	
MOHC	DePreSys PPE	1959-2006 (9)	1960, 61, ...-2005 (46x9)
MOHC	DePreSys	1960-2005 (1)	1960, 65, ...-2005 (10x10)
MPI	ECHAM5-MPIOM	1952-2001 (1)	1952, 53, ...-2001 (50x1)
MPI	ECHAM5-MPIOM	1952-2001 (2)	1960, 61, ...-2001 (42x1)
MPI	ECHAM5-MPIOM	1948-2007 (1)	1948, 49, ...-2007 (60x1)

# 3. AMOC Variability 1960-2005

Assimilation Experiments:

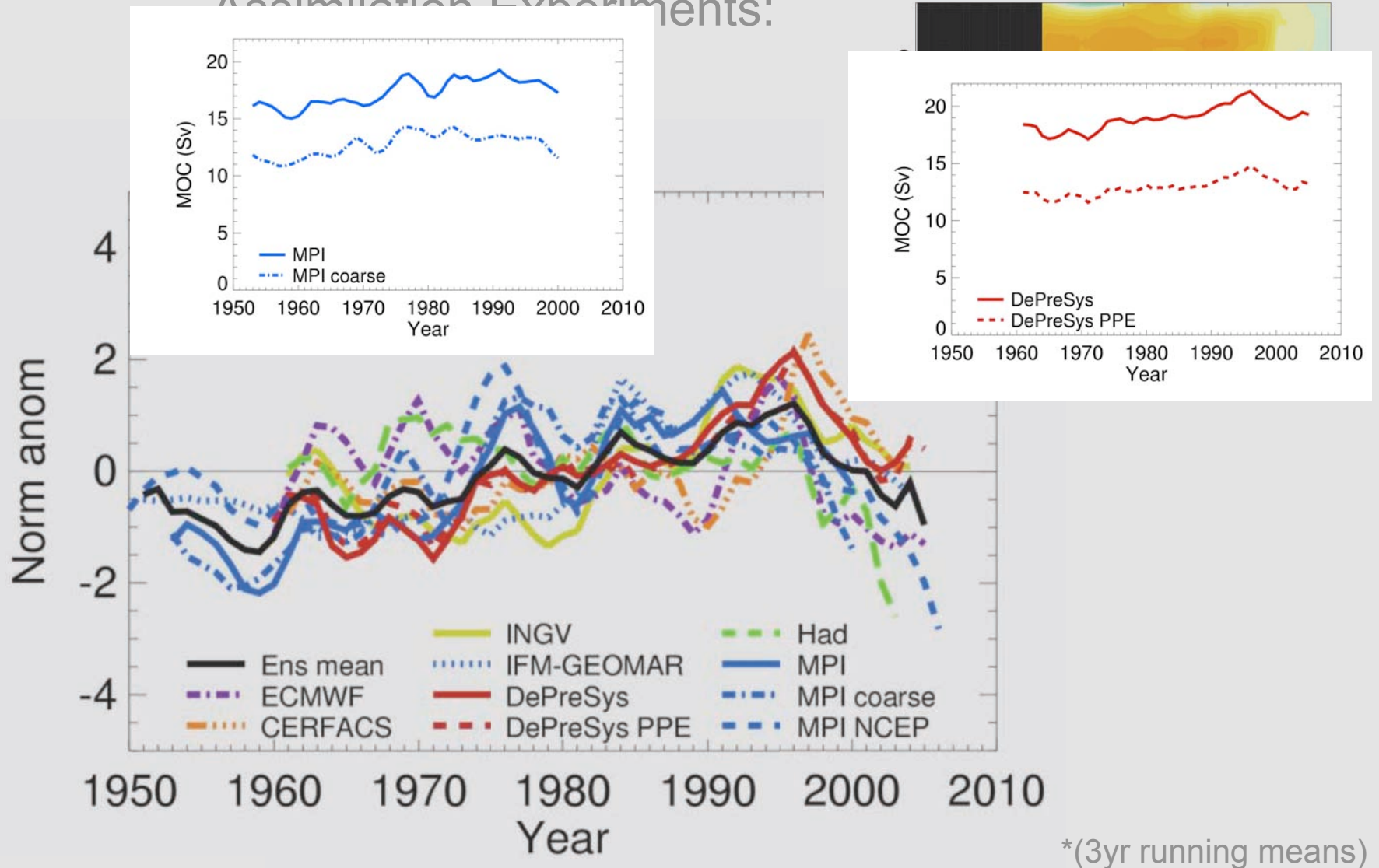


\*(3yr running means)



### 3. AMOC Variability 1960-2005

Assimilation Experiments:

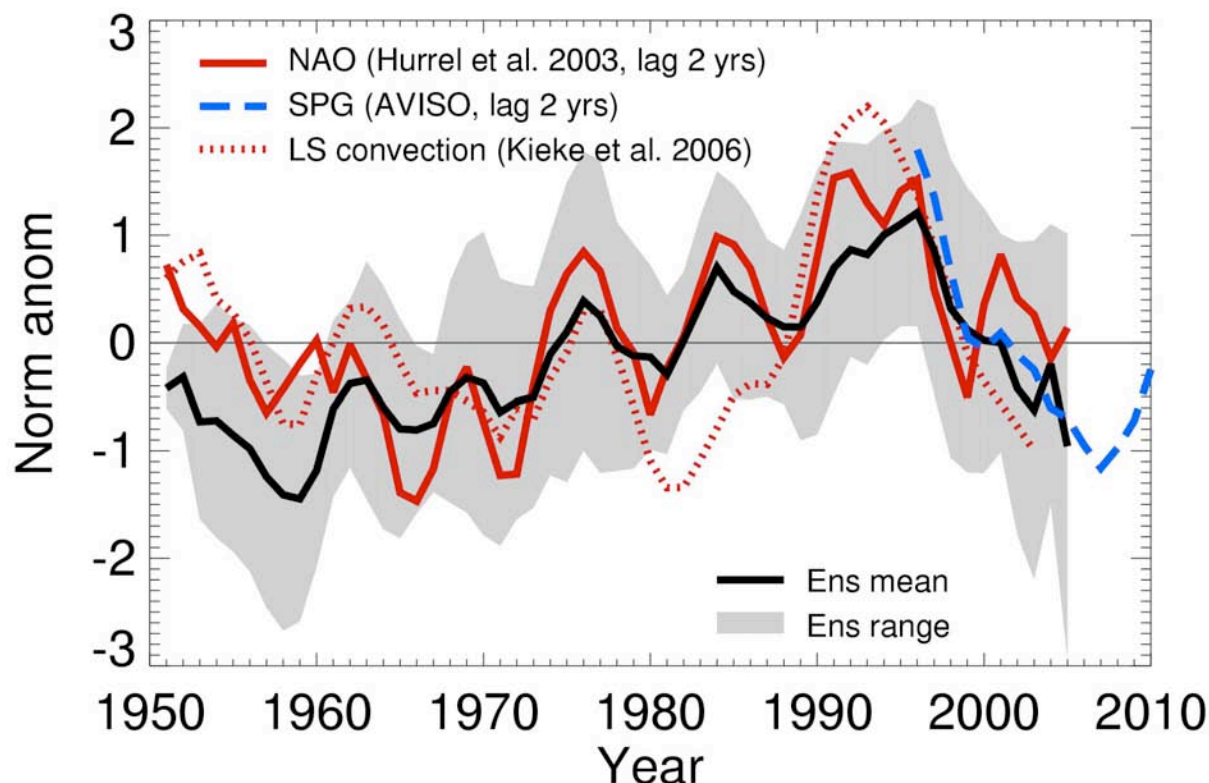


\*(3yr running means)

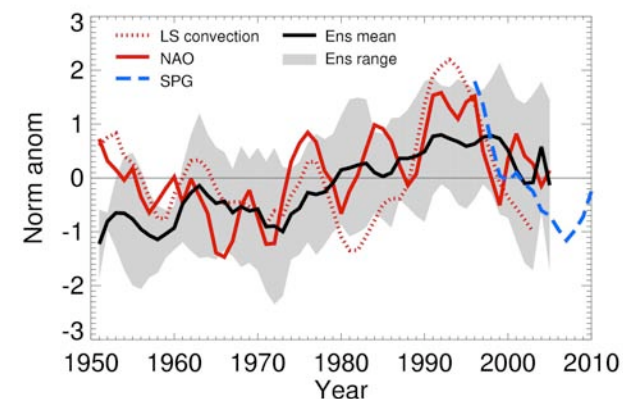
# 3. AMOC Variability 1960-2005

Assimilation Experiments:

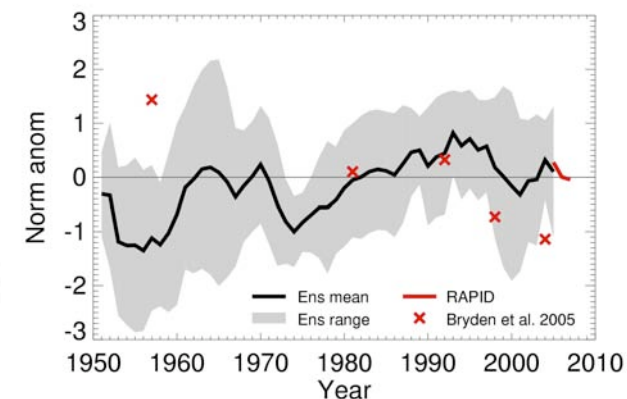
## AMOC (45°N)



## AMOC (40°N)



## AMOC (26°N)

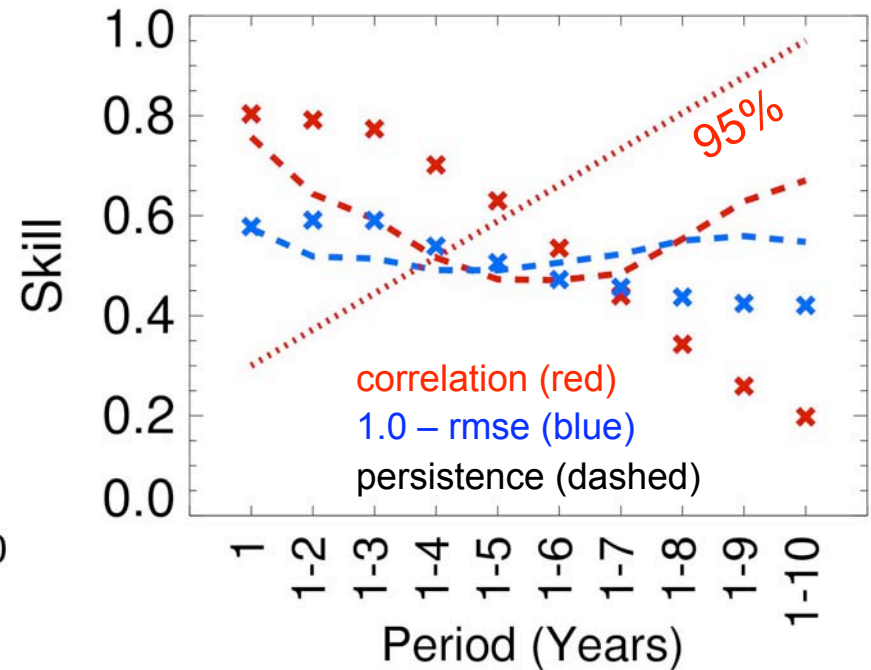
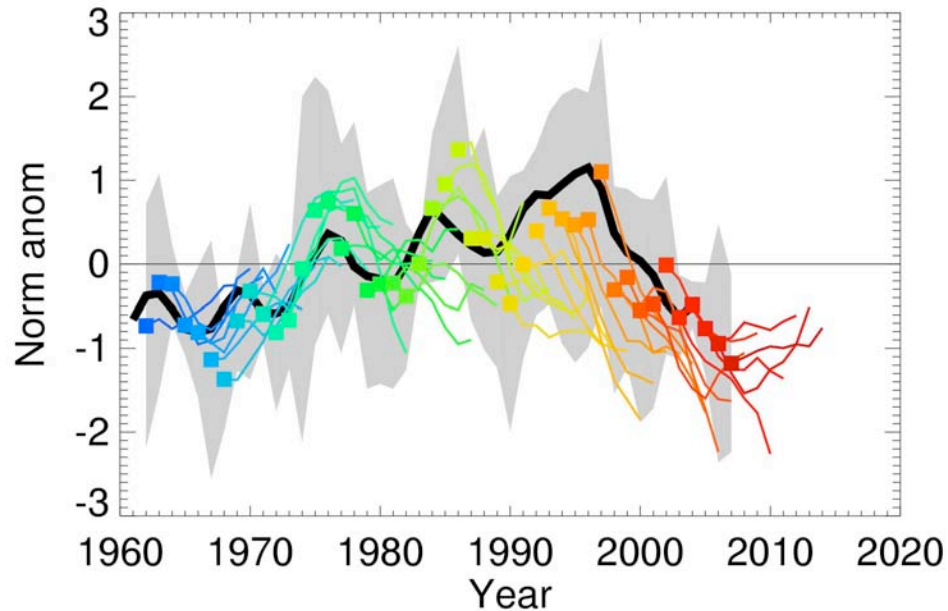




## 4. AMOC in Decadal Predictions

Multi-model mean:

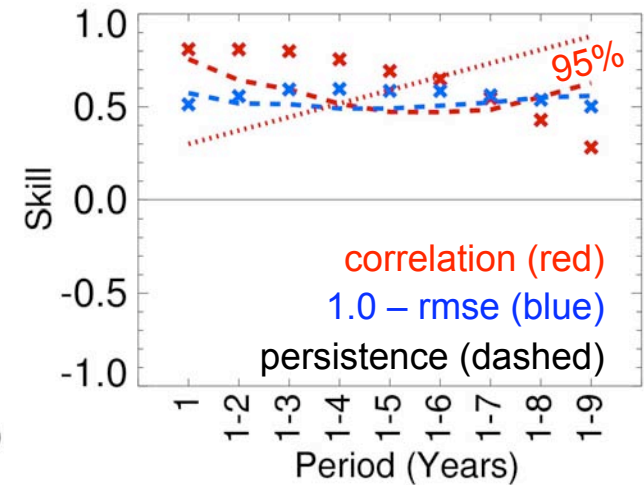
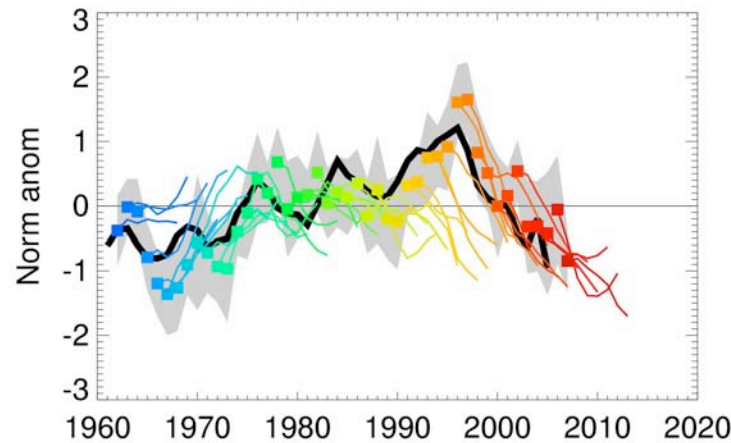
AMOC (45°N)



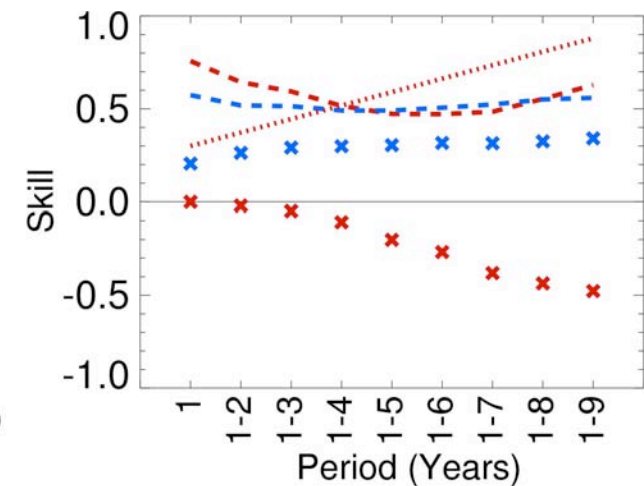
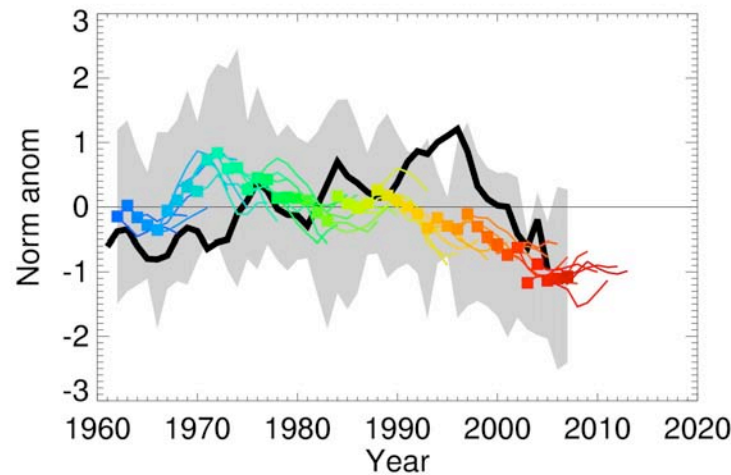
## 4. AMOC in Decadal Predictions

DePreSys PPE (AMOC 45°N):

Hindcasts



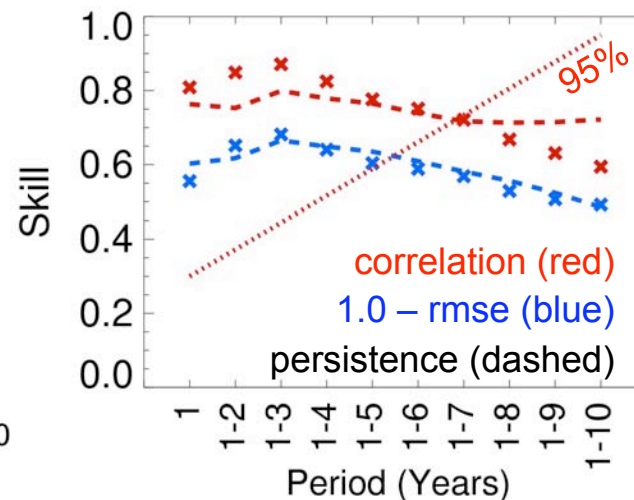
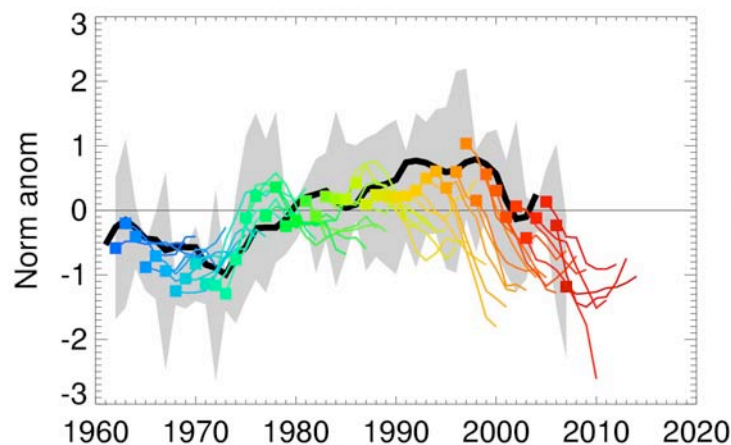
NoAssim



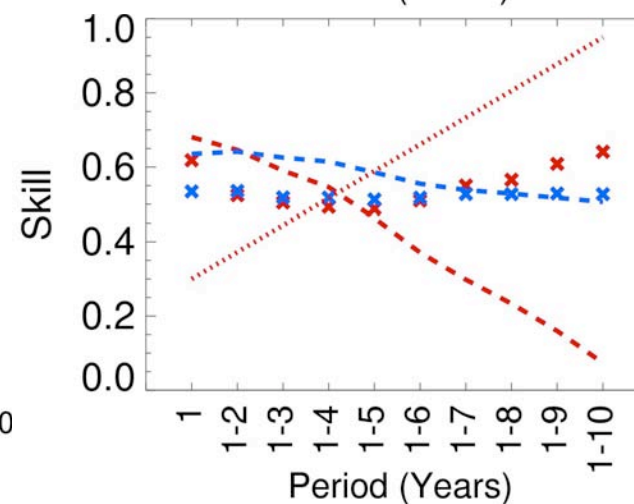
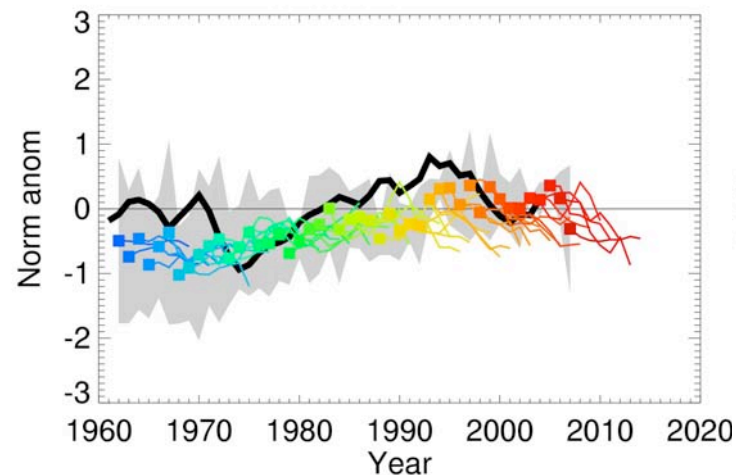
## 4. AMOC in Decadal Predictions

Multi-model mean:

AMOC (40°N)



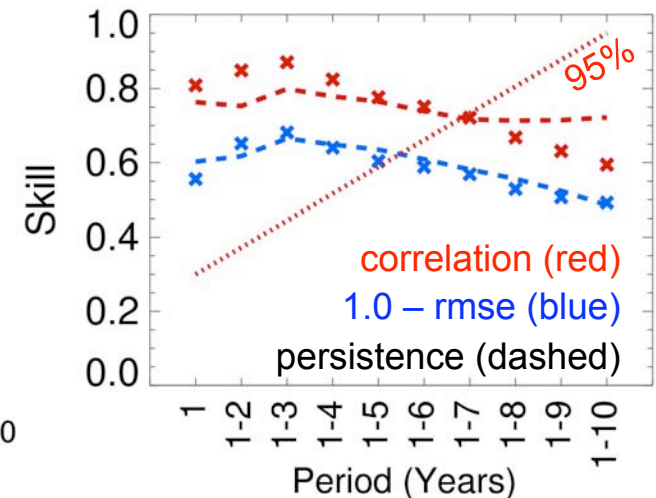
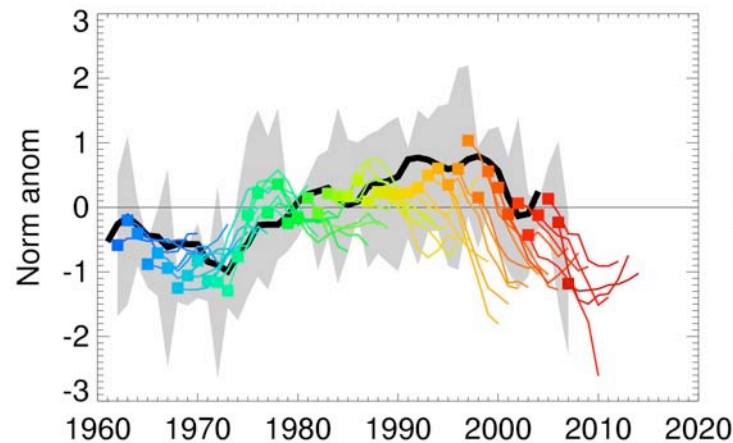
AMOC (26°N)



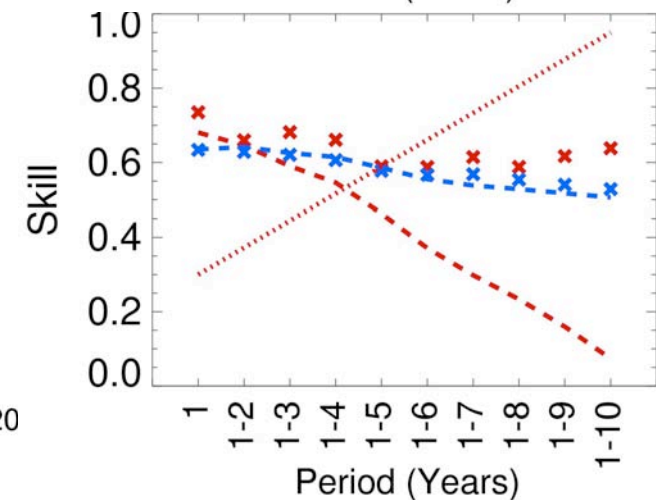
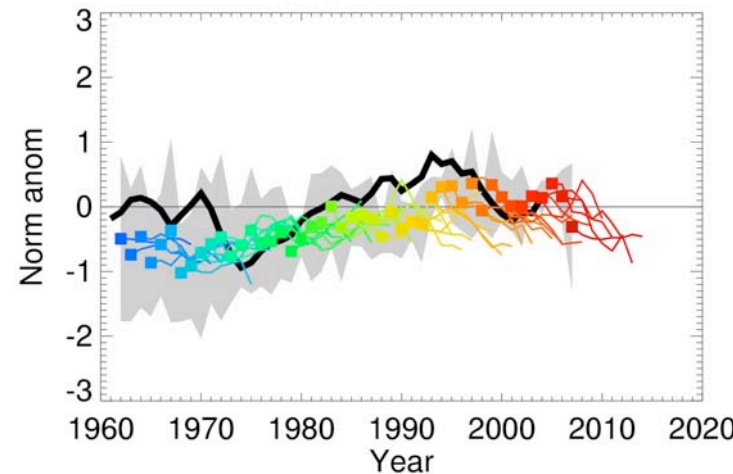
## 4. AMOC in Decadal Predictions

Multi-model mean:

AMOC (40°N)



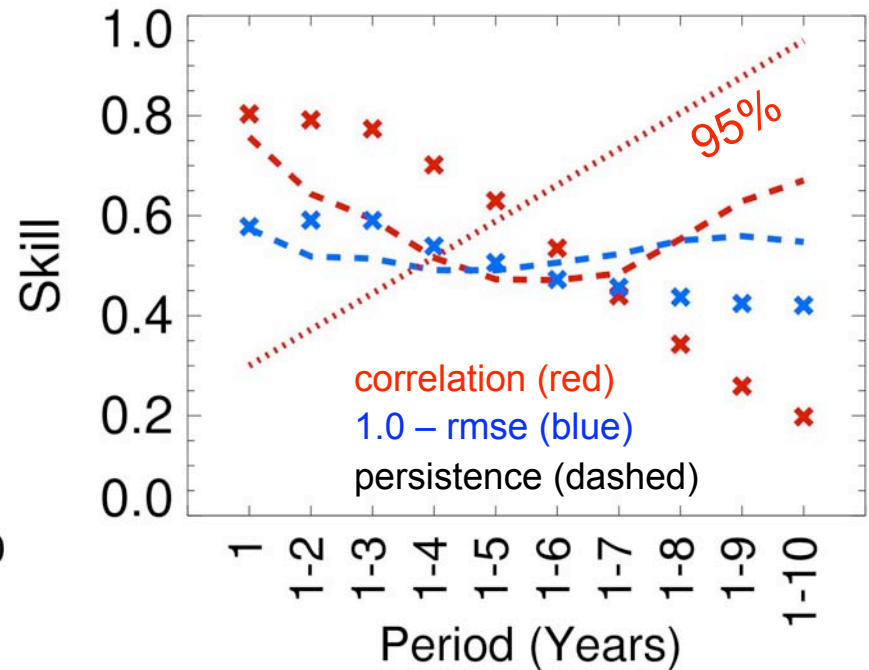
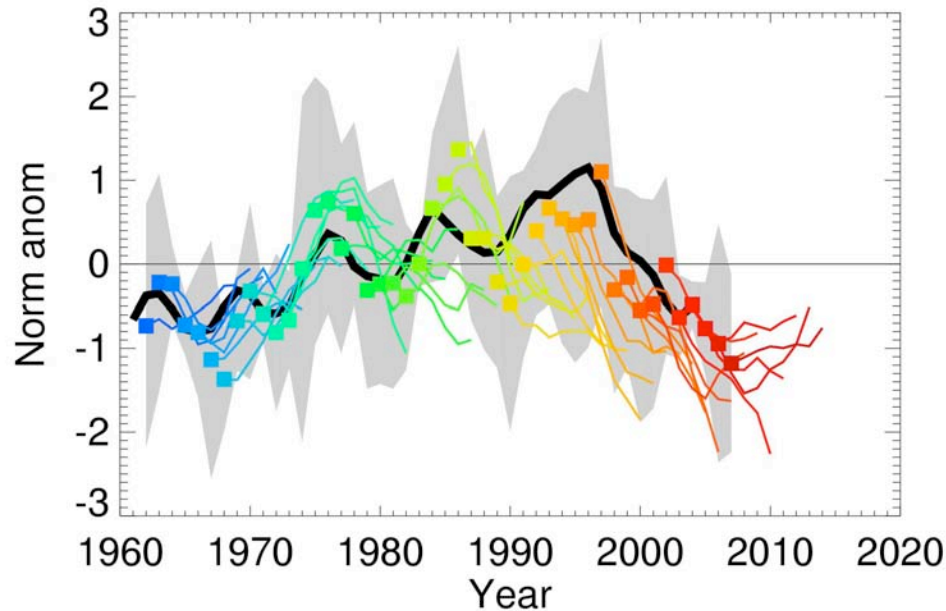
AMOC (26°N)



## 4. AMOC in Decadal Predictions

What is causing the problem in the 1990s?

AMOC (45°N)

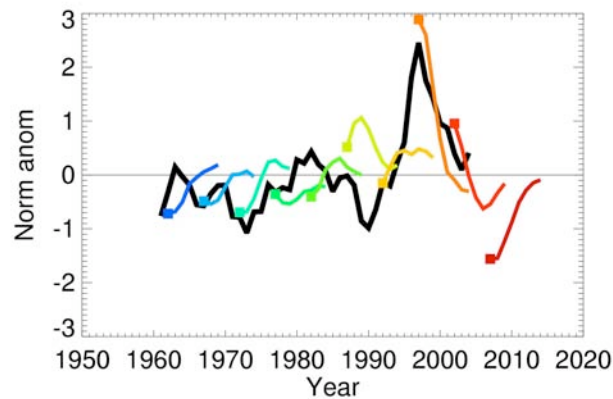




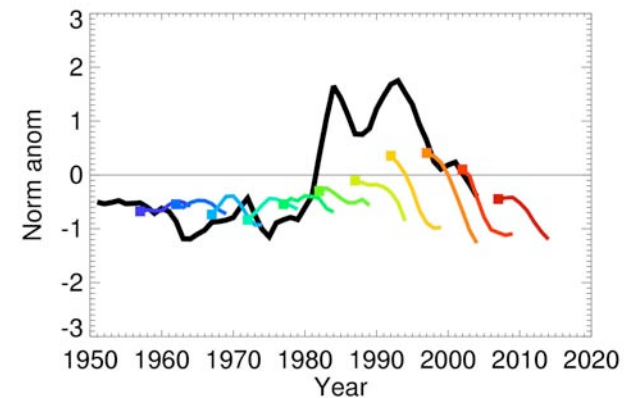
## 4. AMOC in Decadal Predictions

AMOC (45°N) in Each System:

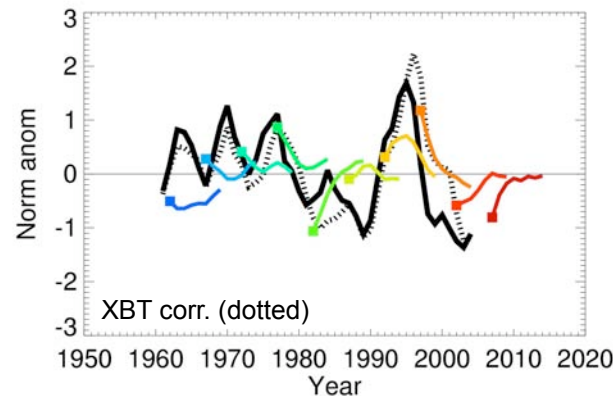
CERFAS



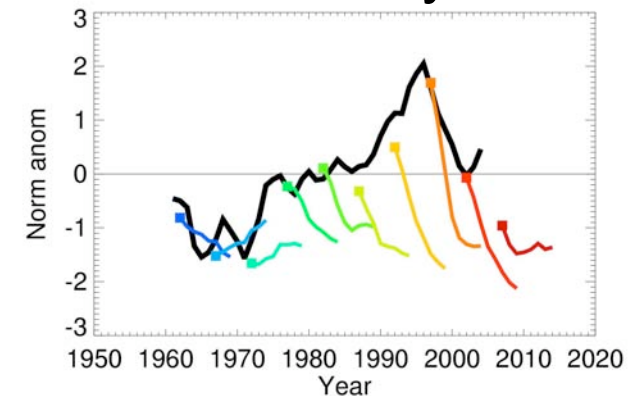
IFM-GEOMAR



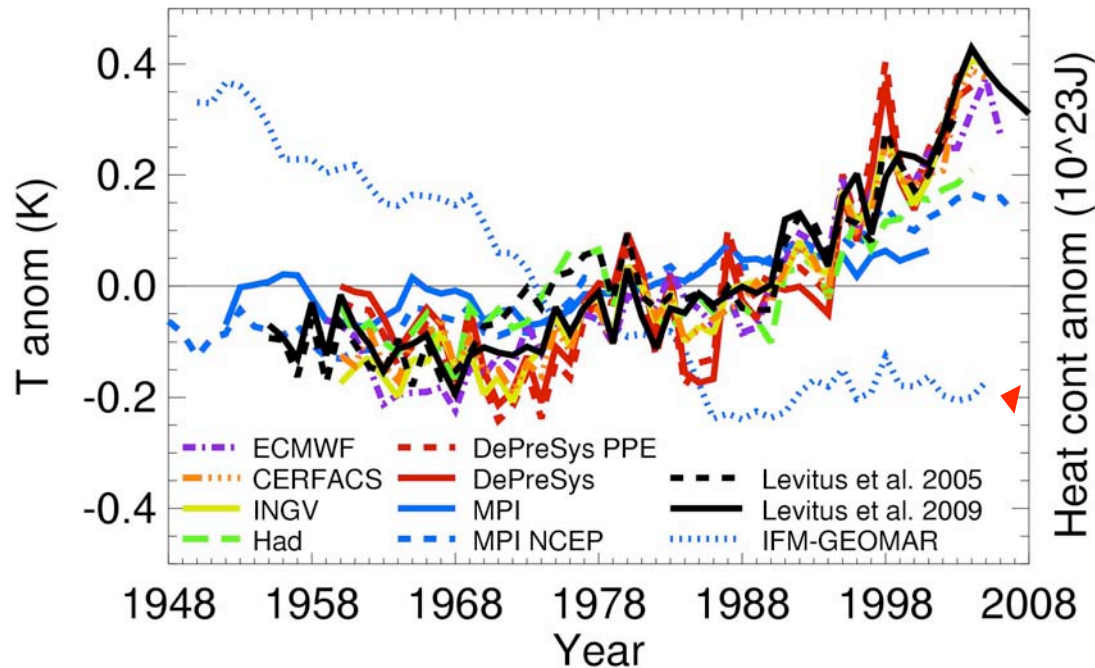
ECMWF



DePreSys



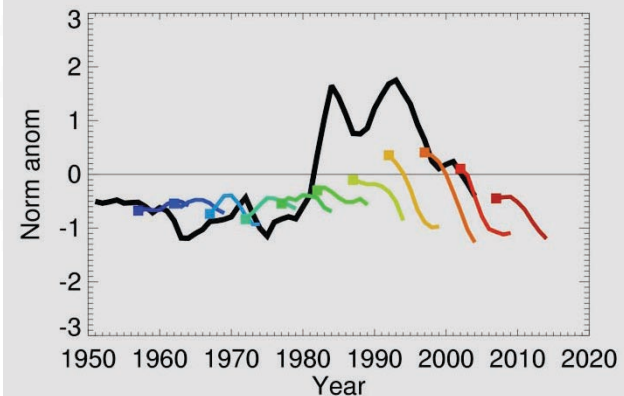
## North Atlantic Heat Content:



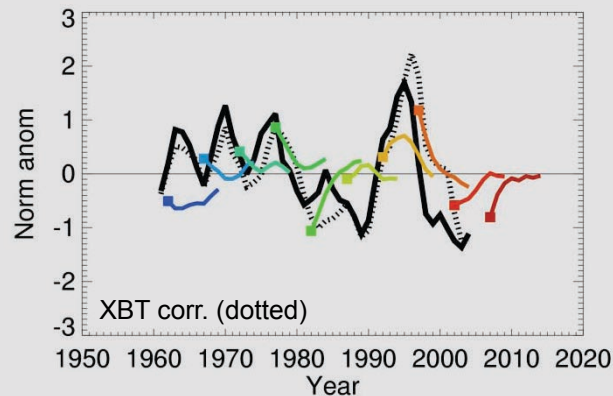
## adal Predictions

stem:

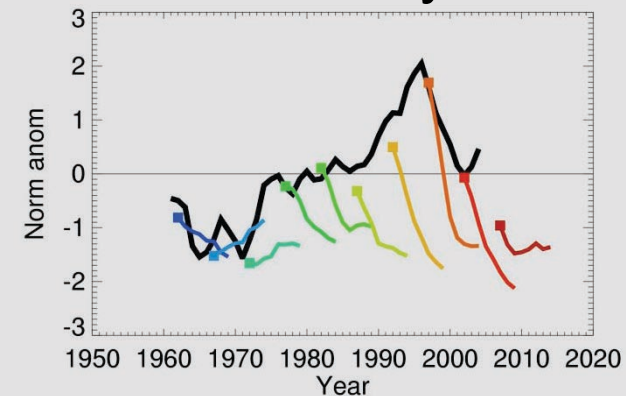
### IFM-GEOMAR



### ECMWF



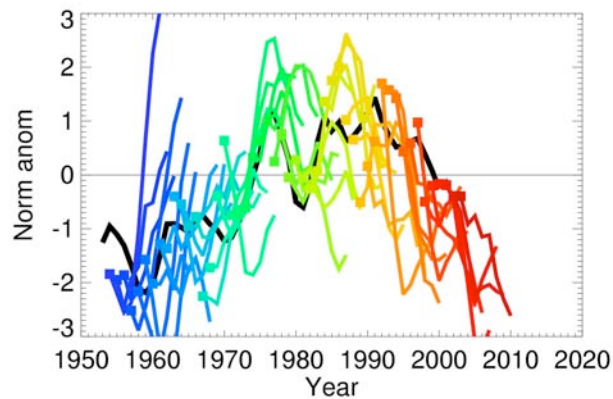
### DePreSys



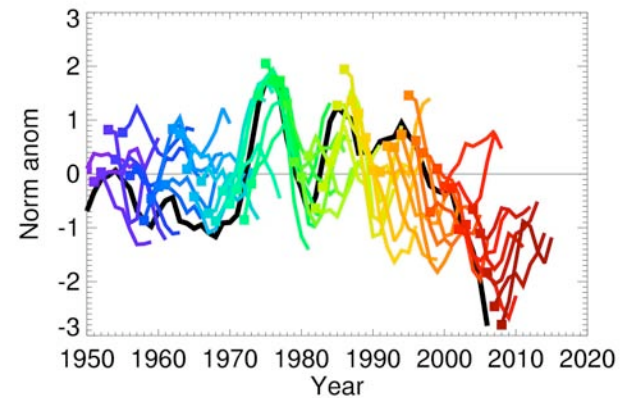
## 4. AMOC in Decadal Predictions

AMOC (45°N) in Each System:

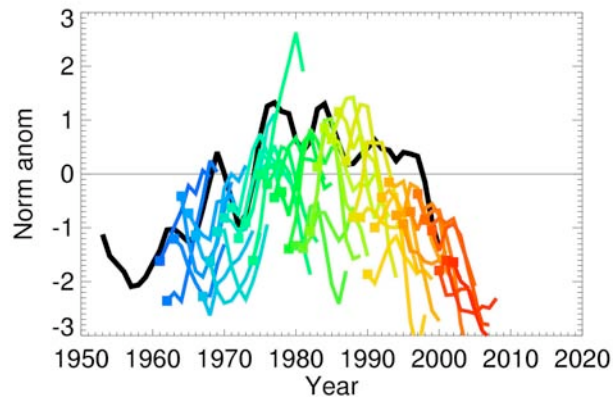
MPI



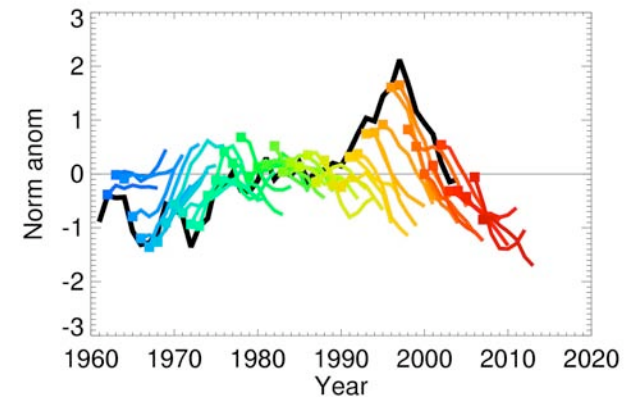
MPI-NCEP



MPI coarse

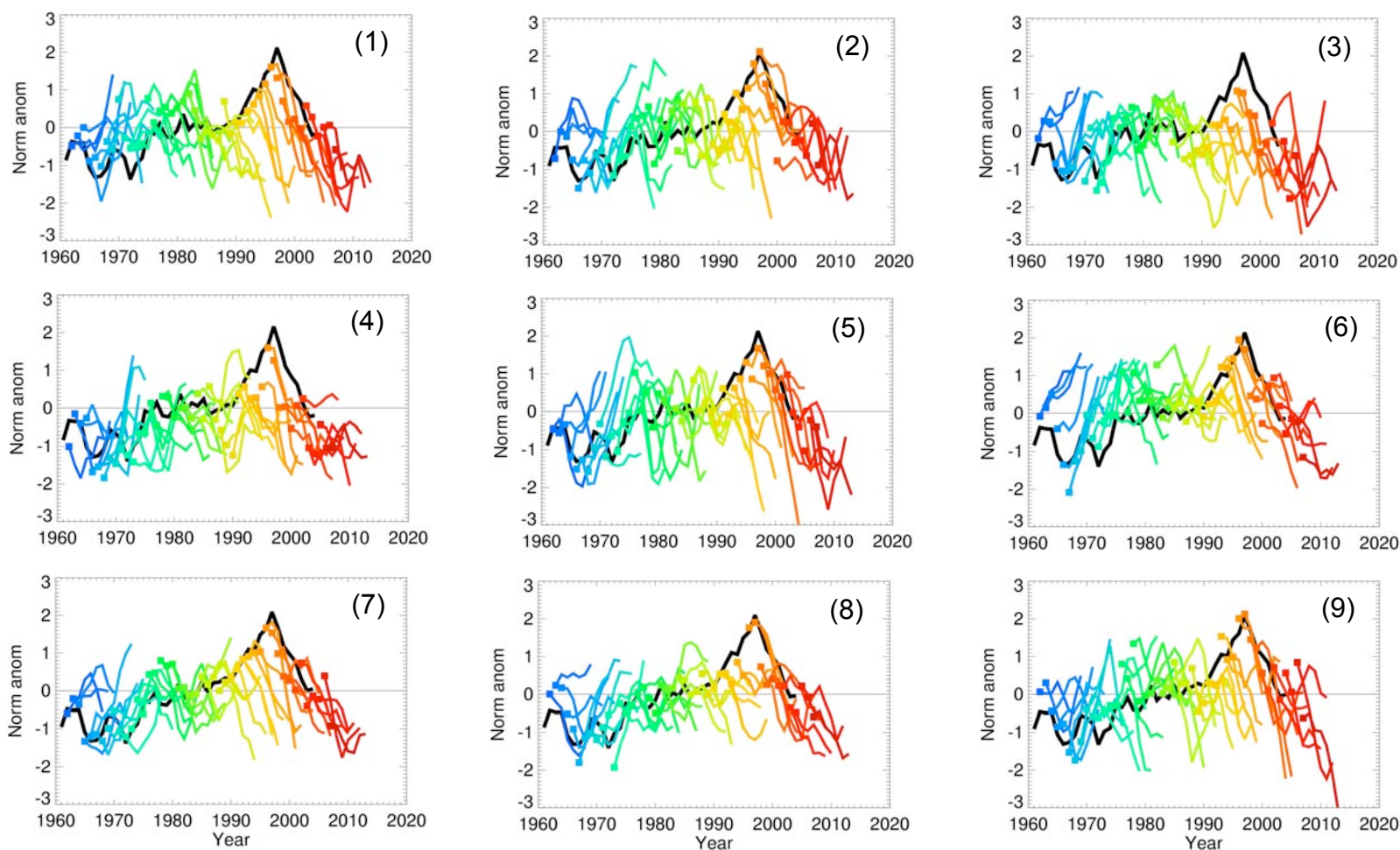


DePreSys PPE



## 4. AMOC in Decadal Predictions

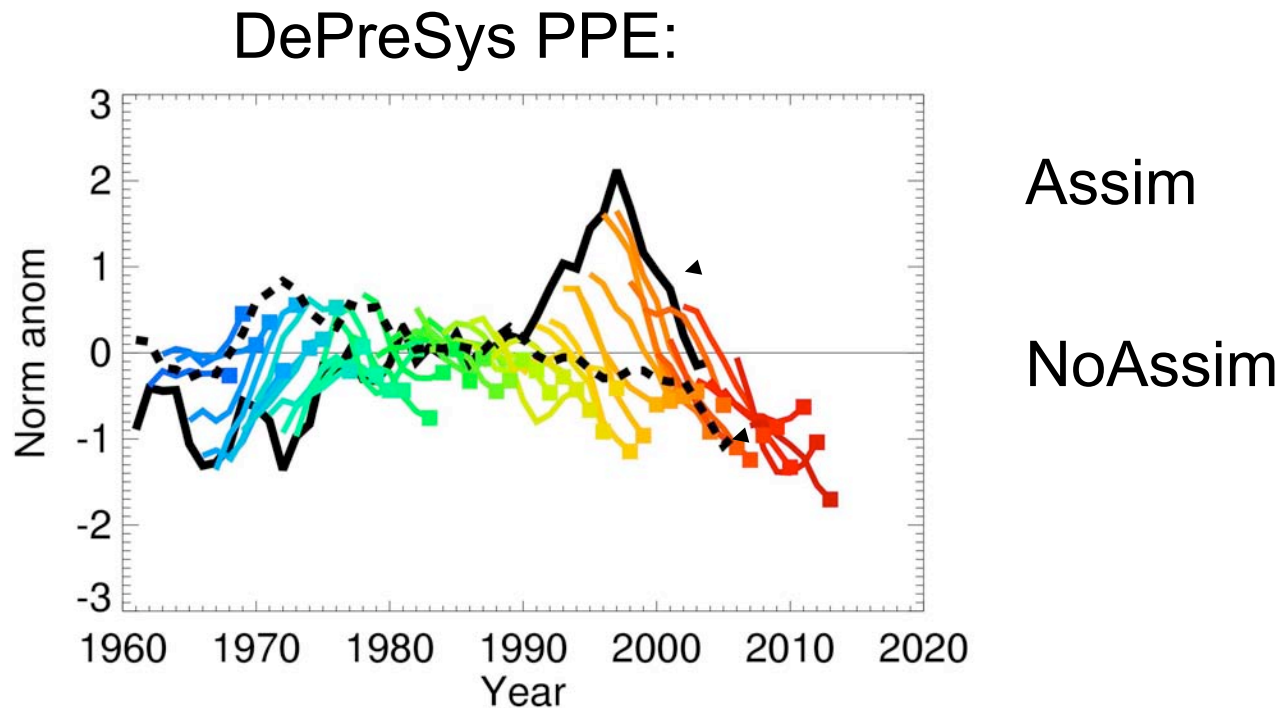
AMOC (45°N) in Each DePreSys PPE Member:





## 4. AMOC in Decadal Predictions

What is causing the problem in the 1990s?



=> The hindcasts heading in general towards NoAssim



# Conclusions

## Assimilation Experiments:

When the AMOCs at 45°N are normalized we find a signal in the ensemble mean of increasing strength from the 1960s to the 1990s and a decrease thereafter.

This signal matches observed variations in NAO, SPG, and LS convection.

## Hindcast Experiments:

Multi-model ensemble predictions are skilful up to about 5 years.

Beyond the 5 years the AMOCs of the the DePreSys PPE hindcasts follow their transient experiments.



# Questions?