DECADAL PREDICTION EXPERIMENTS WITH CCSM4

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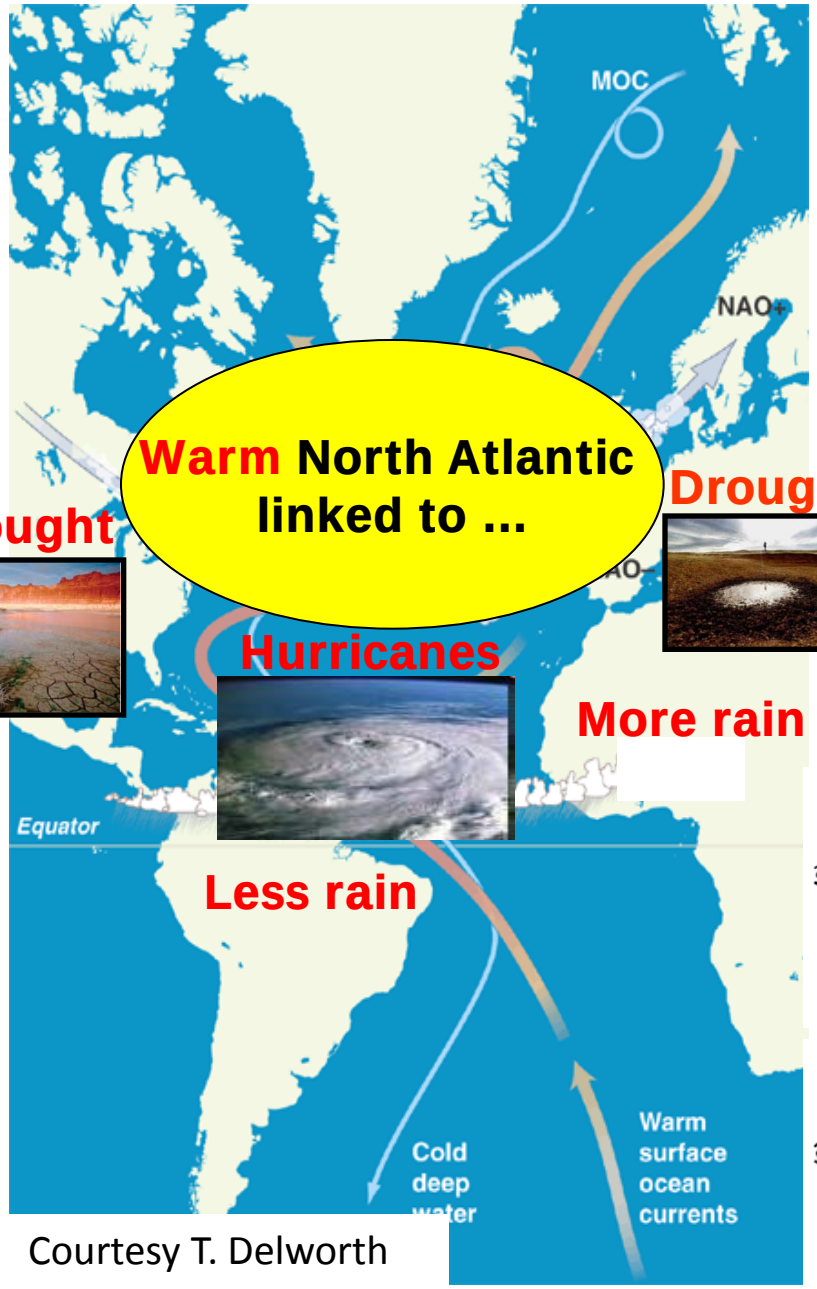
PetaApps

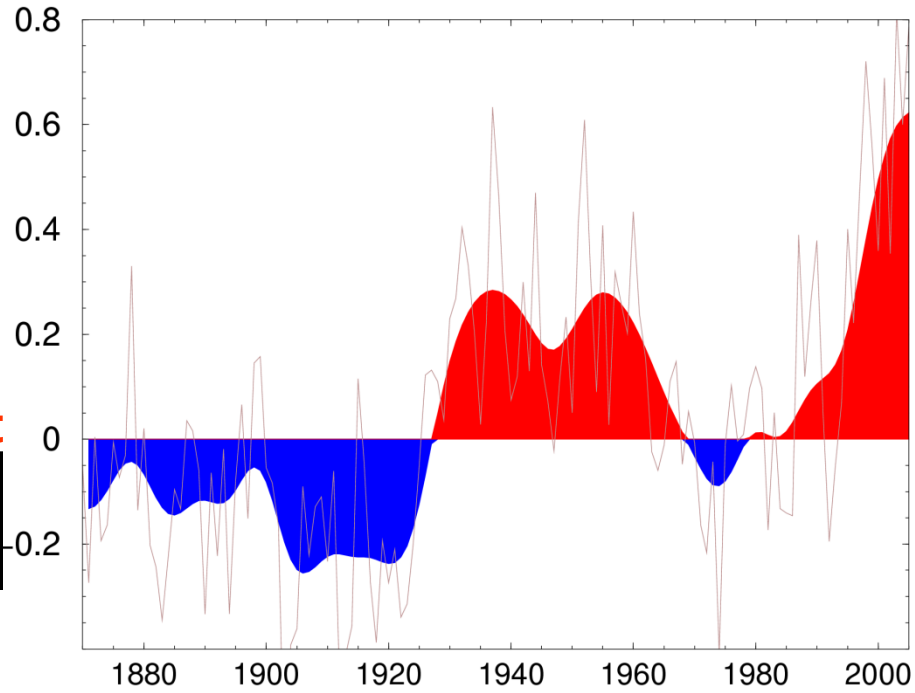
Decadal prediction is both a boundary value and initial condition problem.

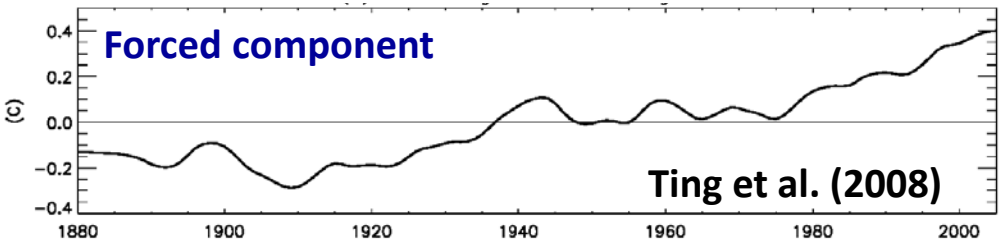
Ocean plays an important role.

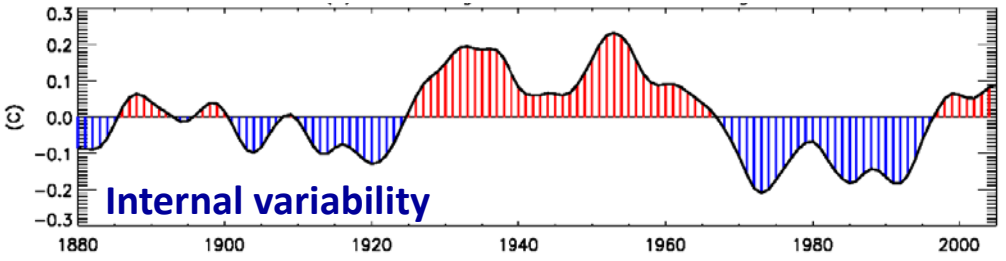


Courtesy T. Delworth

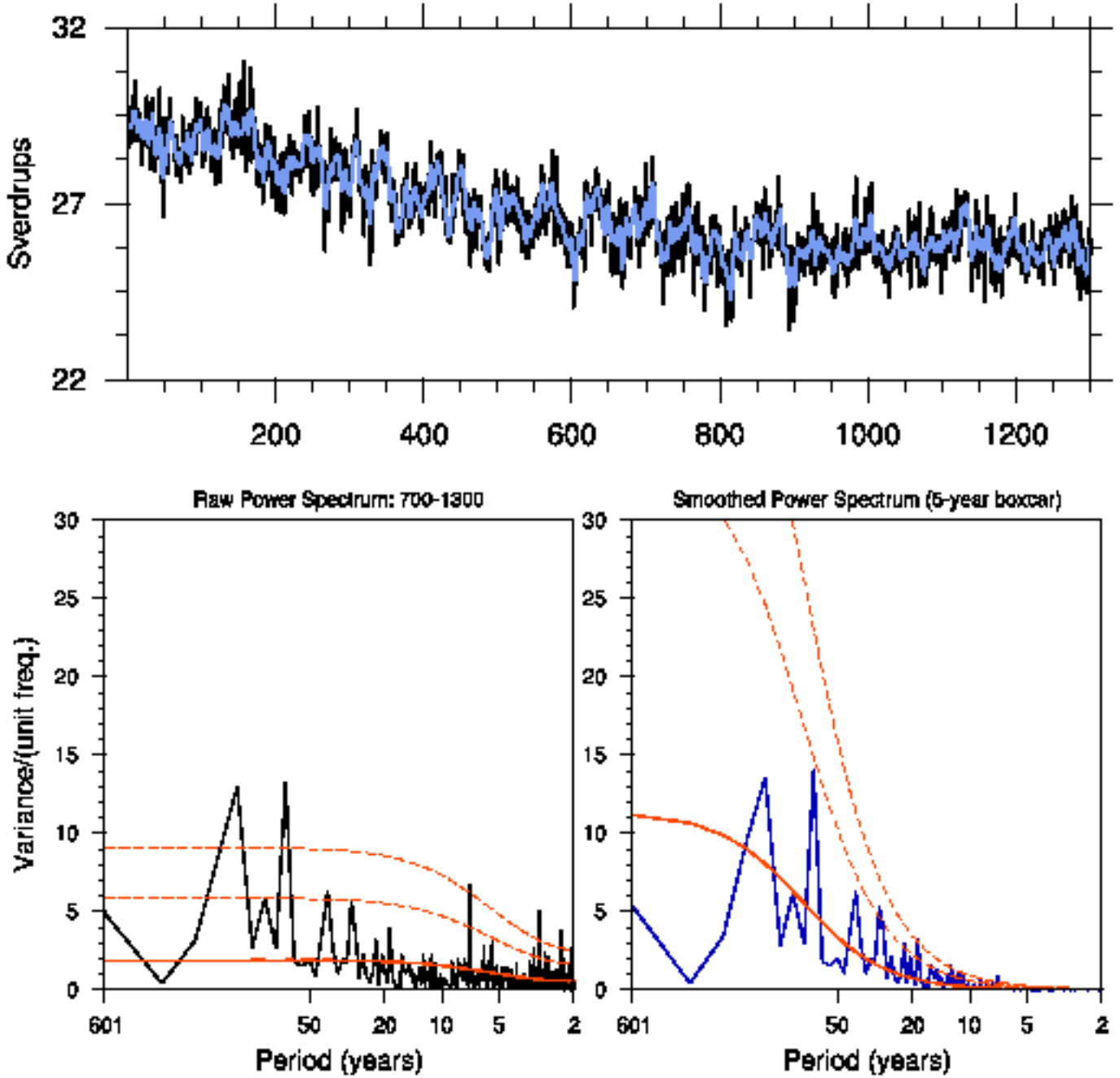
North Atlantic SST



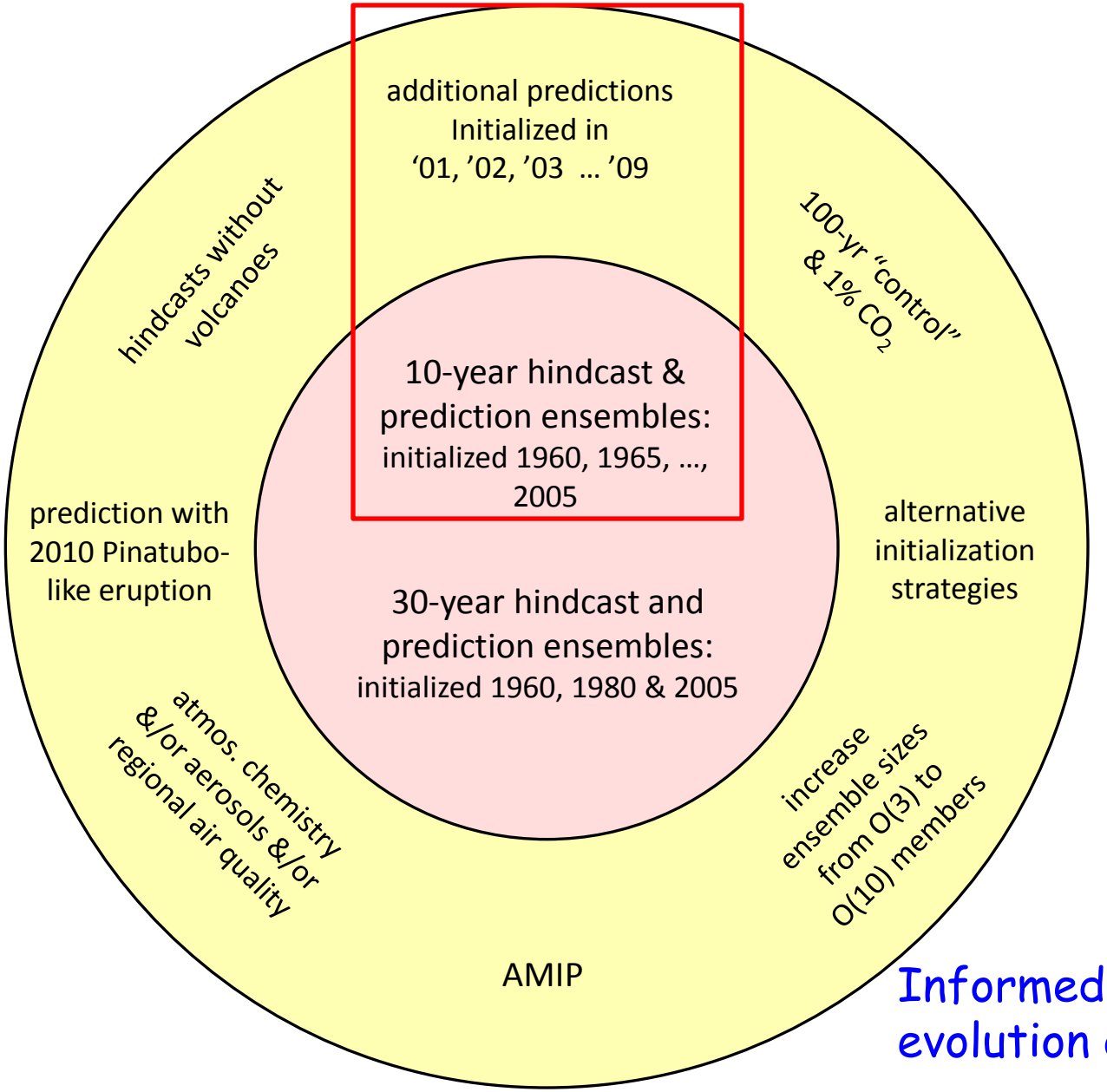




ATLANTIC MERIDIONAL OVERTURNING CIRCULATION MAXIMUM (1850)



CMIP5 Decadal Prediction Experiments



- Our first prediction experiments start from 1 January 2000.
- Further strategy related to the IPCC experiment set will be determined by the CCSM SSC (March 2010).

Informed guidance on near-term evolution of the climate system

Initial Initialization Options for the Ocean Model

- Use 'hindcast' solutions from ocean-only or ocean-ice coupled simulations forced with CORE 2 interannual data sets for 1948-2007.
- Use modified ocean analyses from another center, i.e., GFDL and ECCO products.
- Embark on ocean data assimilation using Data Assimilation Research Testbed (DART).

Sea ice, atmosphere, and land initial conditions ?????

Prediction experiments currently being examined

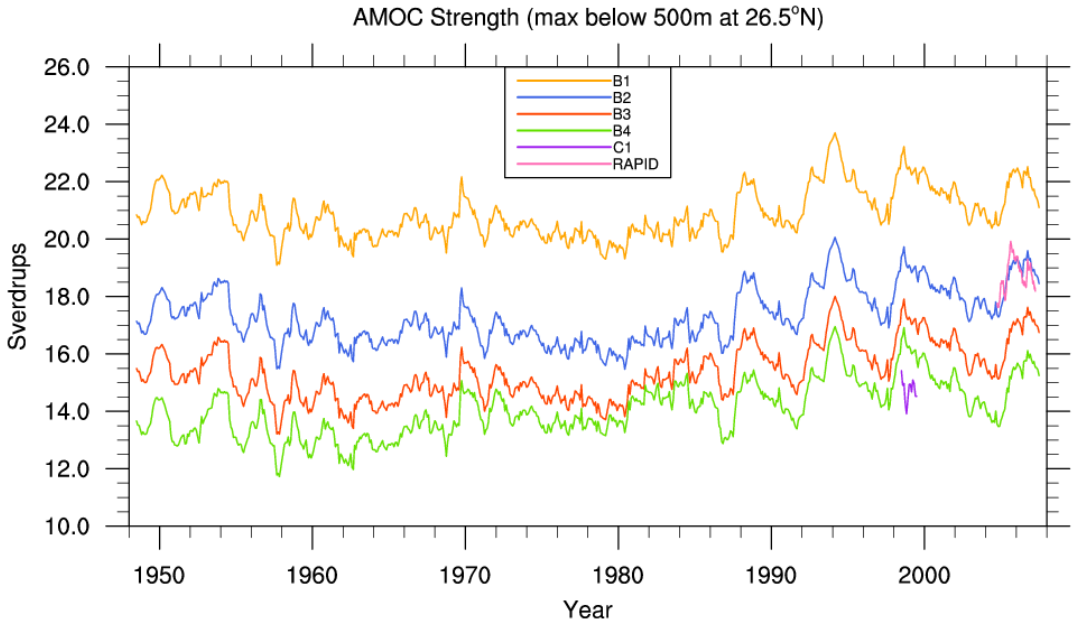
Case	Configuration	Forcing	Salinity Restoring	Physics
A1	Ocean only	CORE2 1948-2007	none	CCSM4
A2	Ocean only	CORE2 1948-2007	τ = 4 years	CCSM4
A3	Ocean only	CORE2 1948-2007	τ = 1 year	CCSM4
A4	Ocean only	CORE2 1948-2007	τ = 30 days	CCSM4
A5	Ocean only	CORE2 1949-2006	τ = 4 years	CCSM3.5
B1	Ocean-ice	CORE2 1948-2007	none	CCSM4
B2	Ocean-ice	CORE2 1948-2007	τ = 4 years	CCSM4
B3	Ocean-ice	CORE2 1948-2007	τ = 1 year	CCSM4
B4	Ocean-ice	CORE2 1948-2007	τ = 30 days	CCSM4
B5	Ocean-ice	CORE2 1949-2006	τ = 4 years	CCSM3.5
C1	Ocean only, data assim	CORE2 1998-1999	N/A	CCSM4/DART

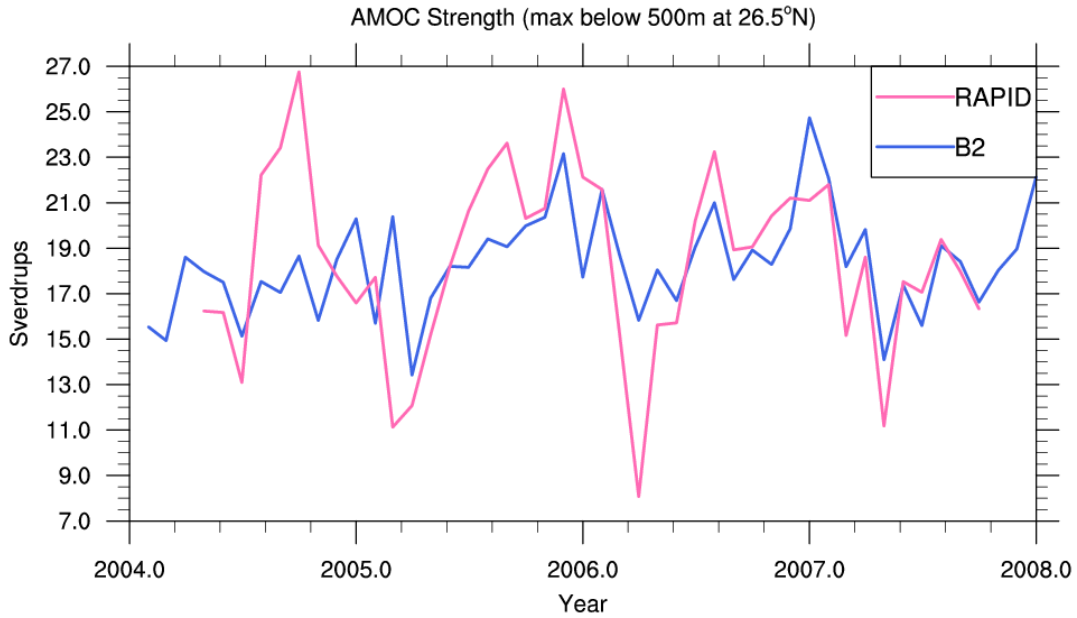
Initial Condition Experiments

Case	Configuration	Initialization	Physics
20C	20th Century, 1850-2005	1850 Control	CCSM4
P1	Prediction Test, 2000-2005	ocn/ice: B2 atm/lnd: AMIP	CCSM4
P2	Prediction Test, 2000-2005	ocn/ice: B2 atm/lnd: 20C	CCSM4
P3	Prediction Test, 2000-2005	ocn/ice: C1/B4 atm/lnd: AMIP	CCSM4
P4	Prediction Test, 2000-2005	ocn/ice: C1/B4 atm/lnd: 20C	CCSM4

Prediction Experiments

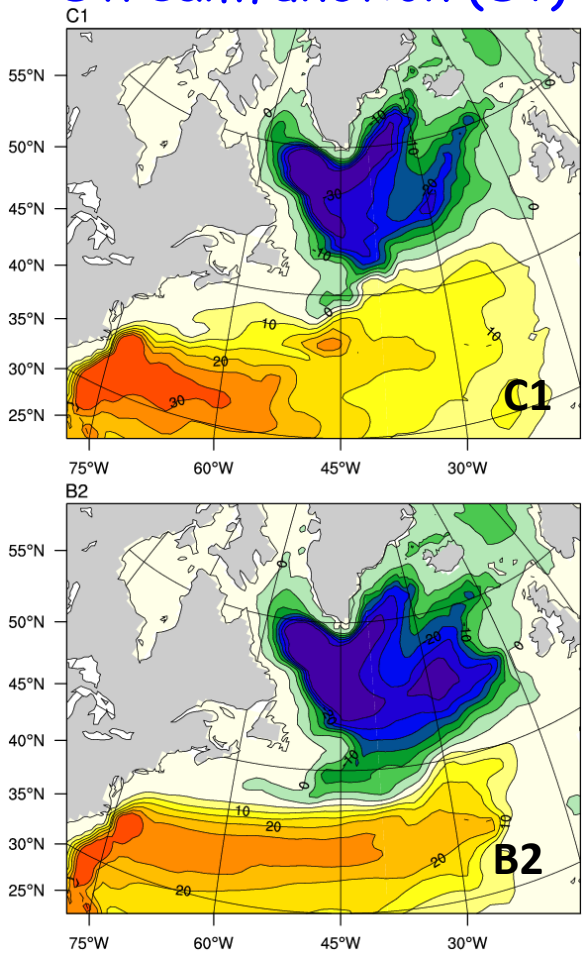
ATLANTIC MERIDIONAL OVERTURNING CIRCULATION (AMOC) TIME SERIES



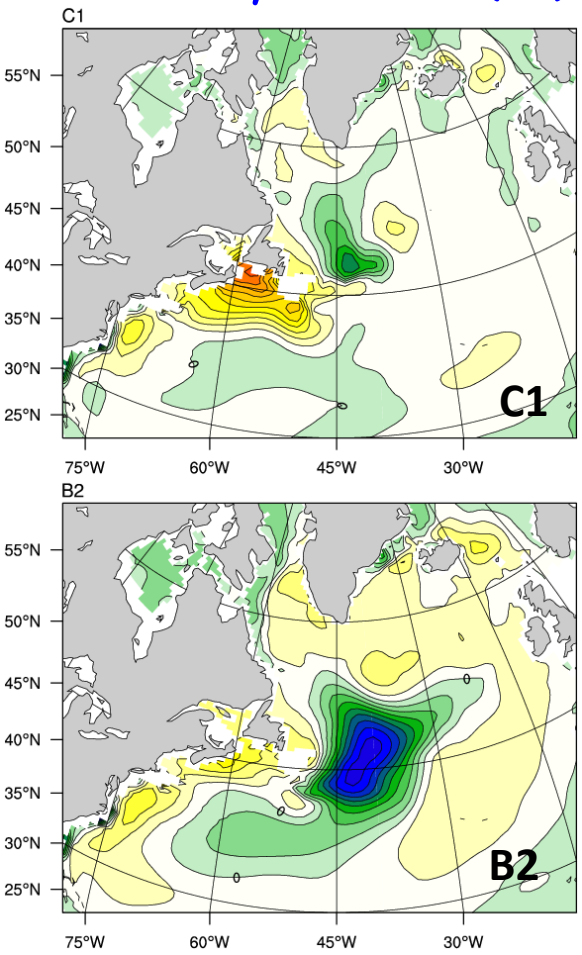


Benefits of Assimilation

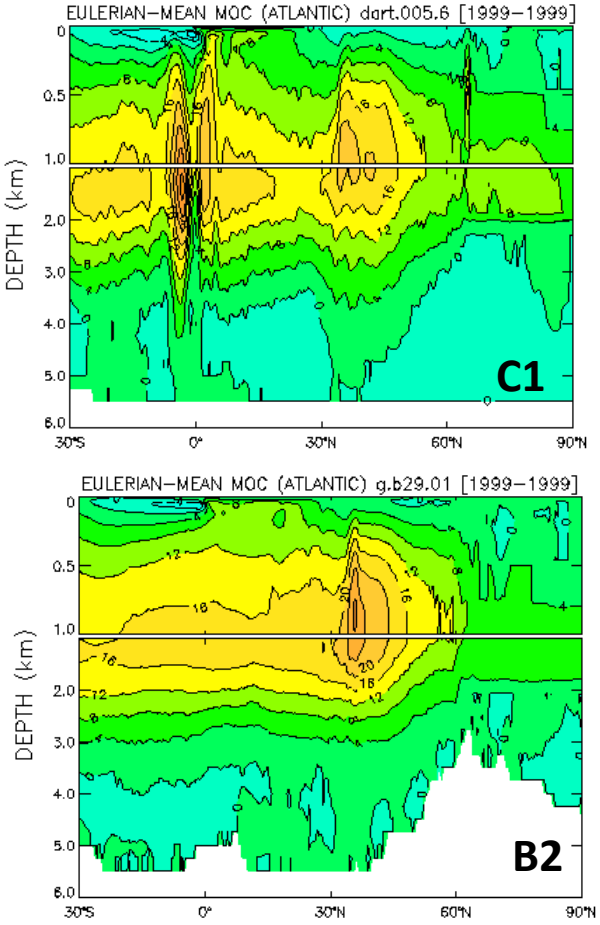
Barotropic Streamfunction (Sv)



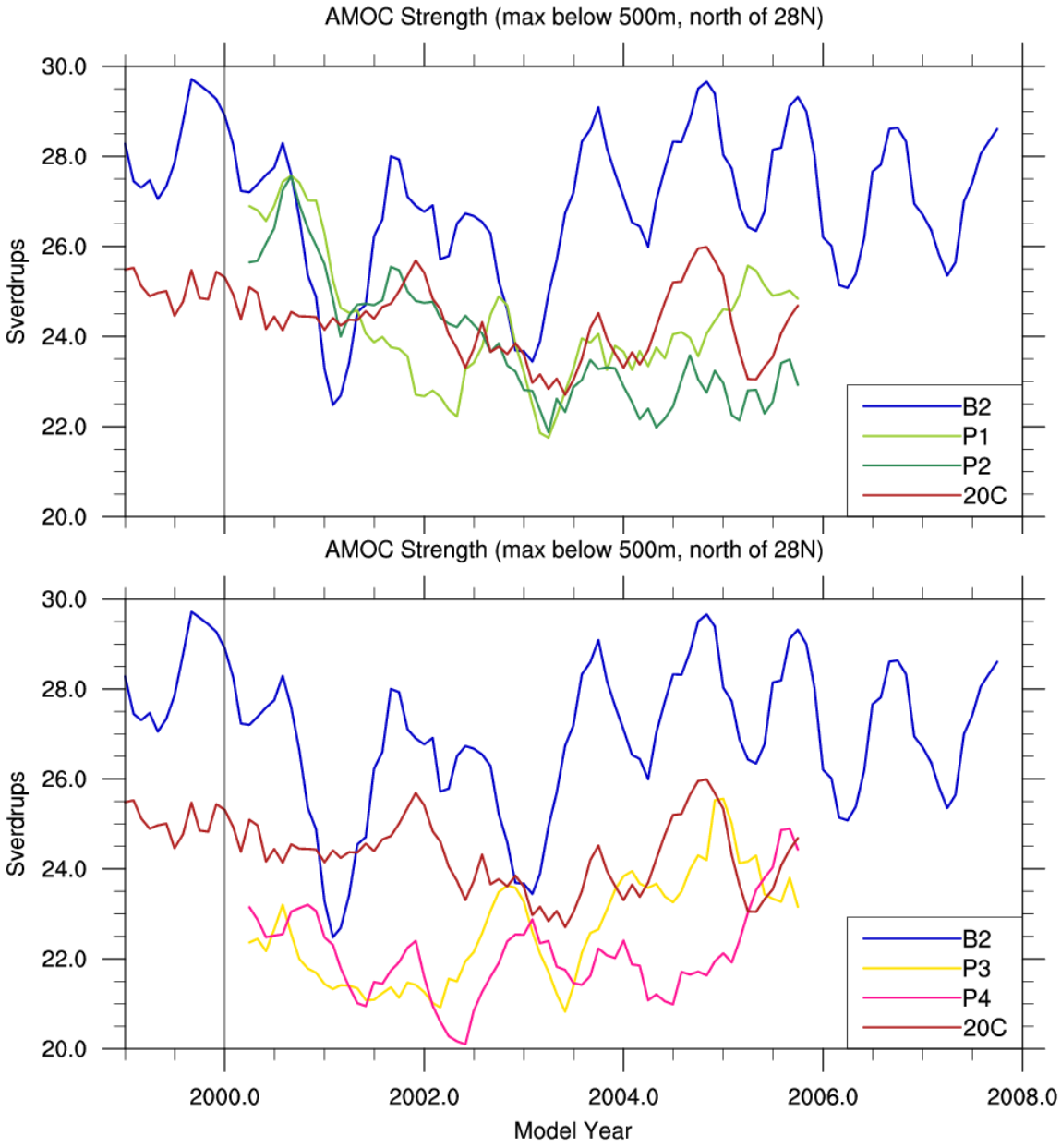
Temperature Anomaly at 95m (°C)



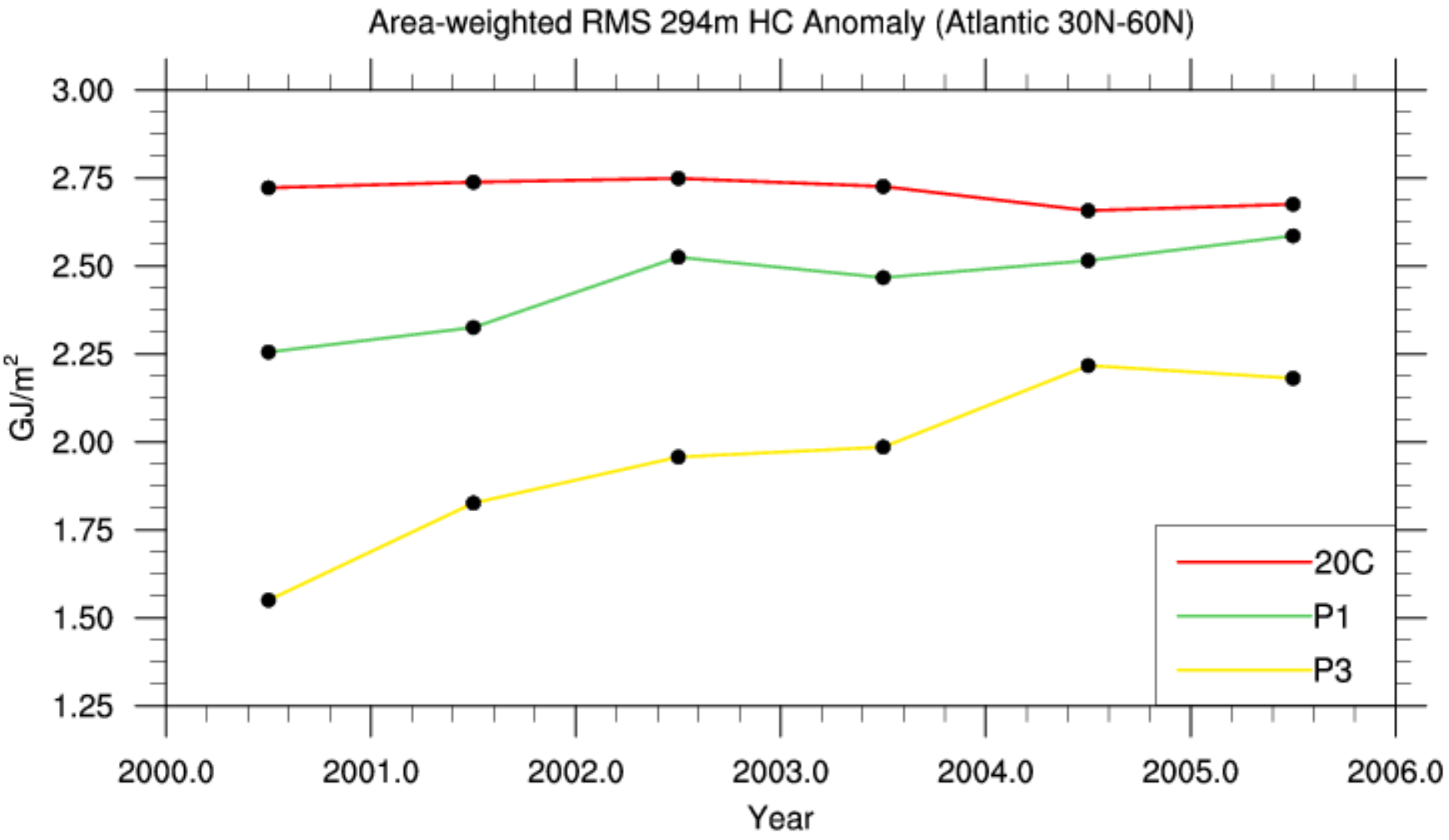
AMOC (Sv)



AMOC Predictability and Climate Drift



Upper ocean (0-300 m) heat content anomaly in the North Atlantic

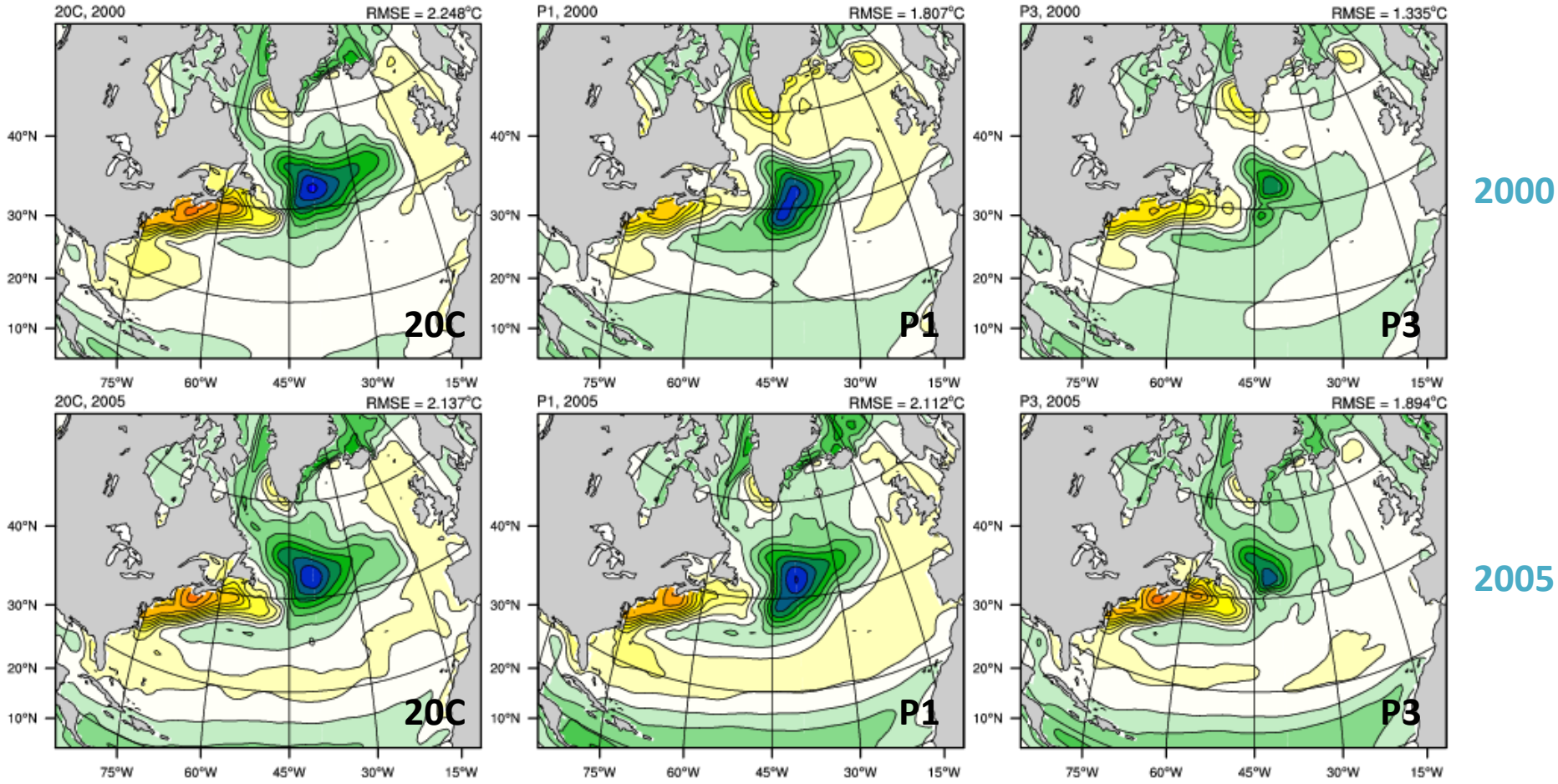


Open Questions and Challenges

- What are the mechanisms for decadal variability?
- To what extent is decadal variability predictable?
- What is the optimal initialization for the components?
- Does oceanic variability have atmospheric relevance?

- Adequate climate observing system?
- Reliable assimilation systems to initialize models?
- Are models “good enough” to make skillful predictions?

Reduced SST Bias persists



SST information in the North Atlantic persists for 4-5 years