Decadal Predictions with CCSM: Progress and Plans

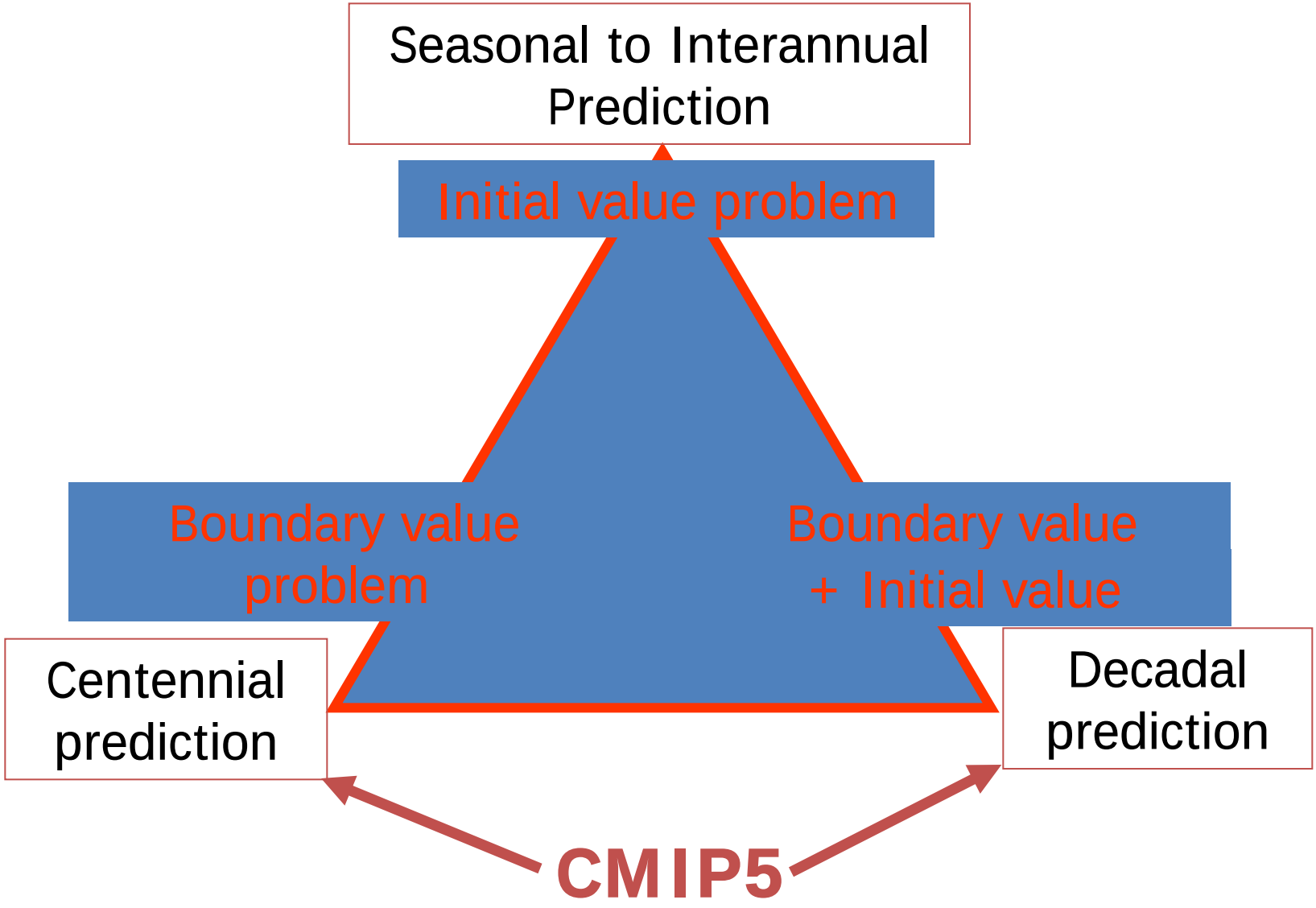
Joe Tribbia

NCAR/NESL/CGD/AMP

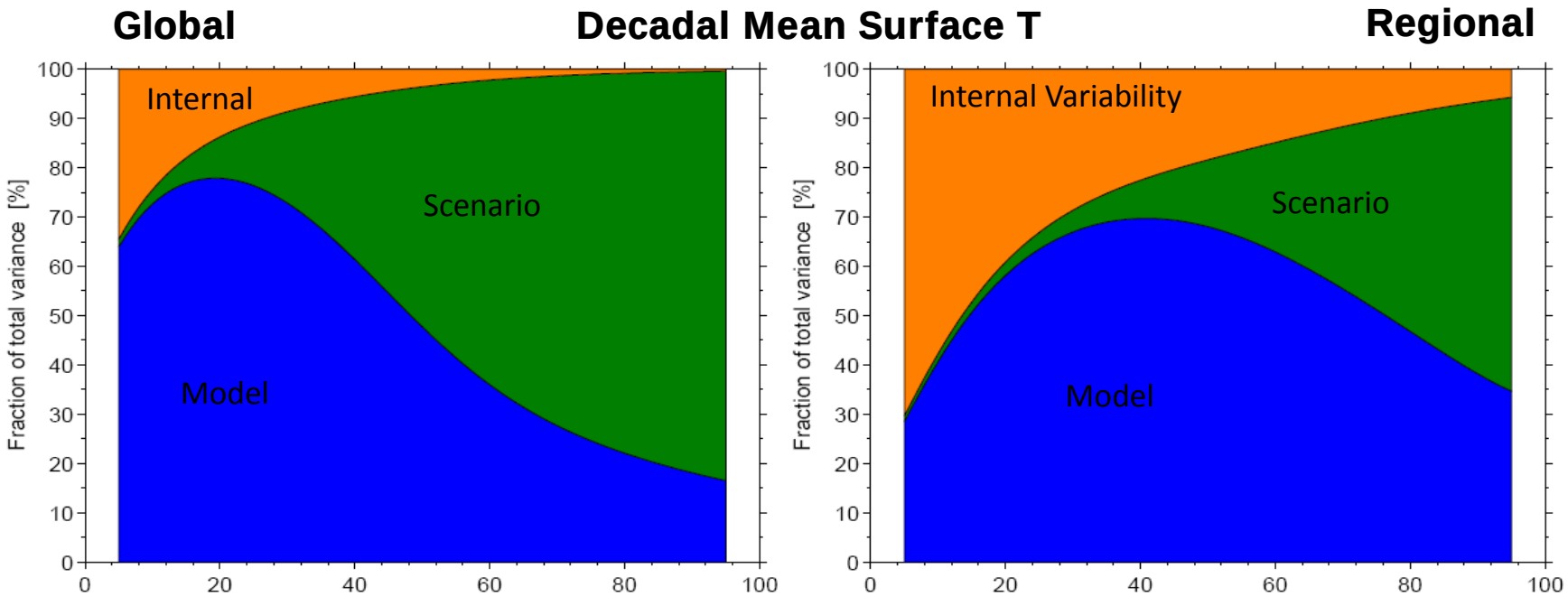
AR5 CMIP5 calls for ‘Decadal Predictions’

- Informed guidance on near–term evolution of the climate system
- Reduced uncertainty from GHG emission scenarios
- Information from ‘initial state’
- Short range and higher resolution for regional guidance
- Target modes of natural decadal variability (PDO, AMO, AO etc)

Climate Prediction



Sources of Prediction Uncertainty



Hawkins and Sutton 2009

Initial Initialization Options

1) Use ocean model ‘hindcast/spin-up’ for ocean and ice, AMIP for land
2) Use modified ocean analyses from another center, compatible ice and AMIP for land
3) Embark on ocean data assimilation using DART (Jeff Anderson et al CISL/IMAGe)

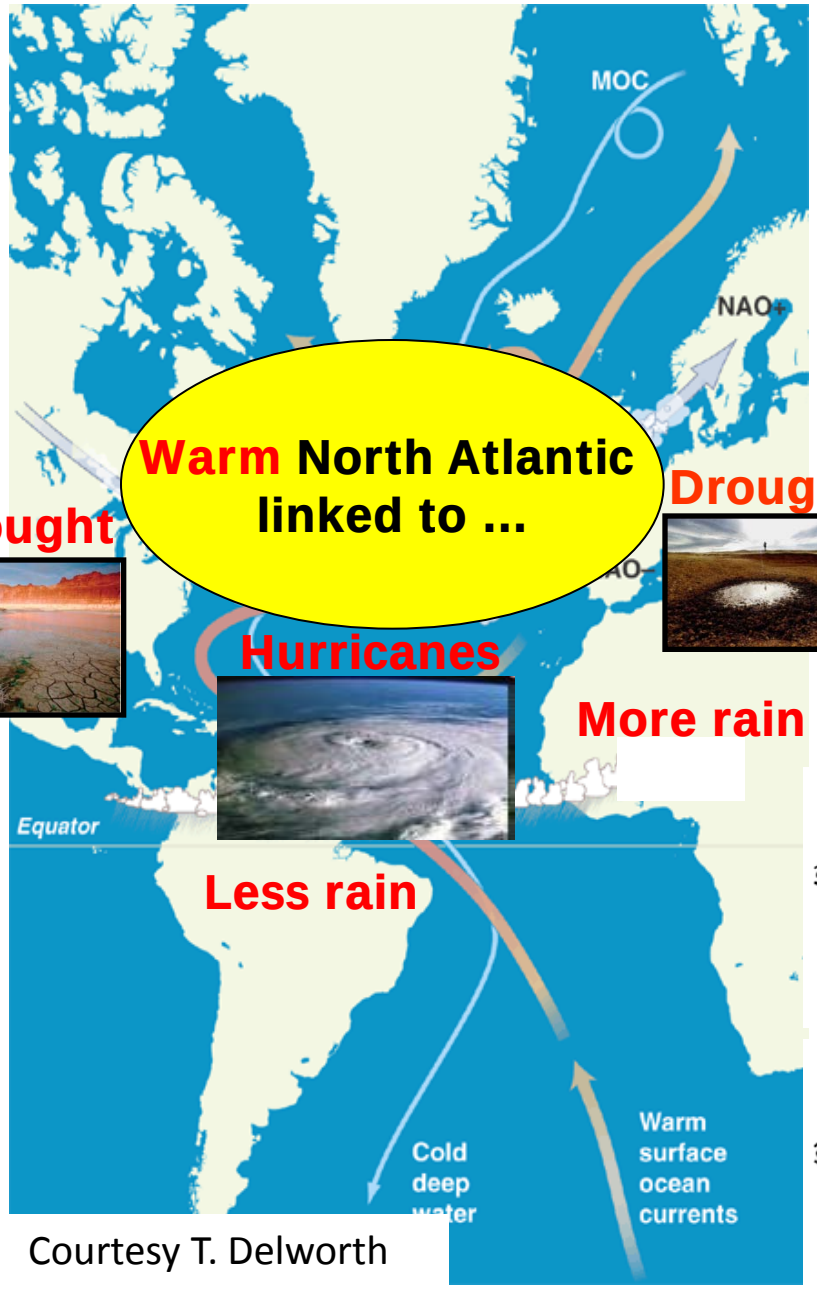
Prediction experiments currently being examined

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

Hindcast Experiments

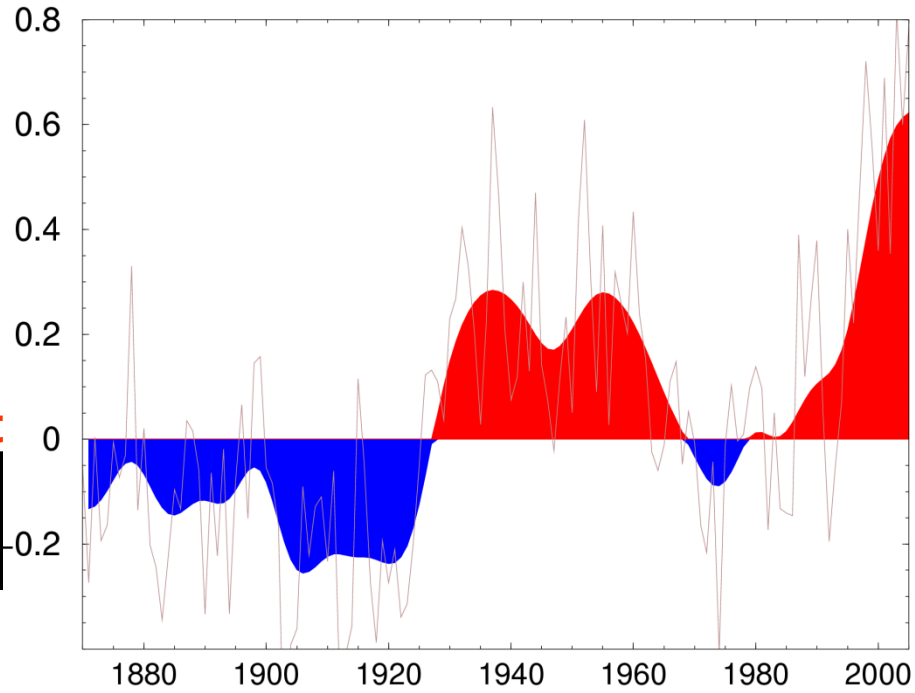
Case	Configuration	Initialization	Physics
20C	20th Century, 1850-2005	1850 Control	CCSM4
P1	Prediction Test, 2000-2005	ocn/ice: B2 atm/lnd: AMIP	CCSM4
P2	Prediction Test, 2000-2005	ocn/ice: B2 atm/lnd: 20C	CCSM4
P3	Prediction Test, 2000-2005	ocn/ice: C1/B4 atm/lnd: AMIP	CCSM4
P4	Prediction Test, 2000-2005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

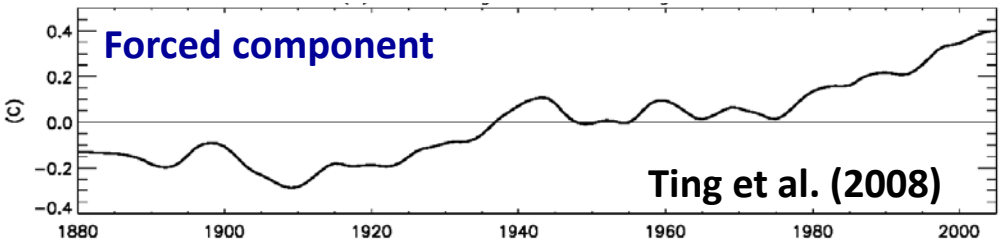
Prediction Experiments

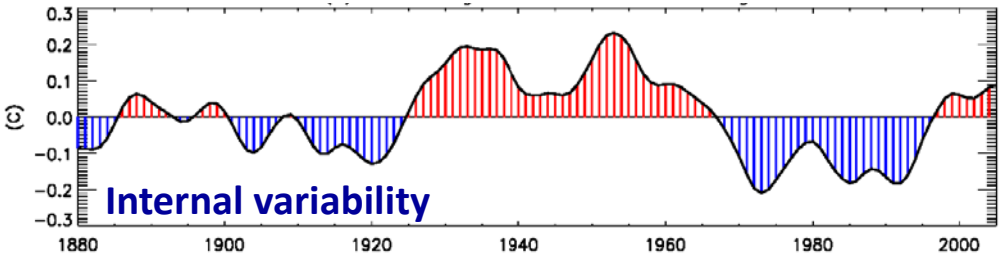


Courtesy T. Delworth

North Atlantic SST

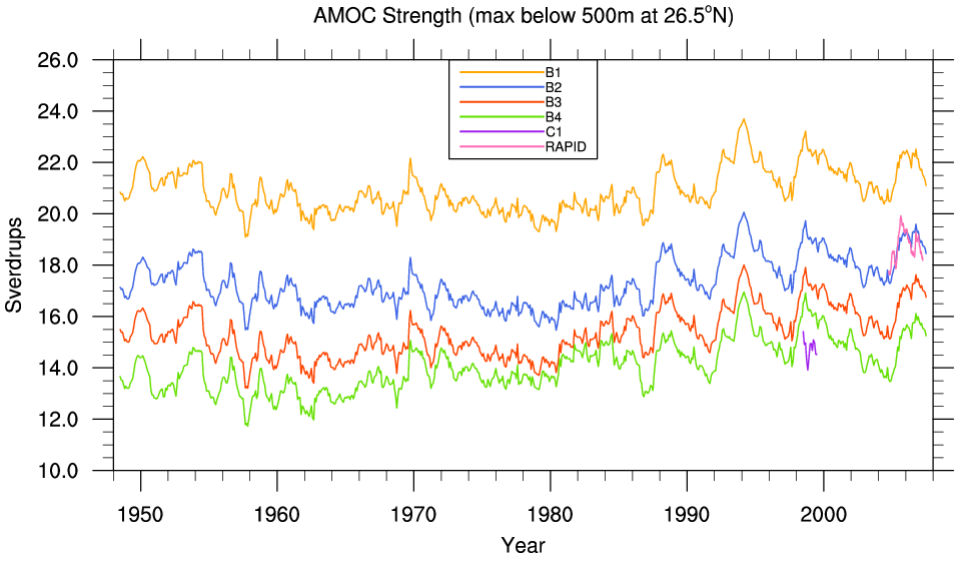




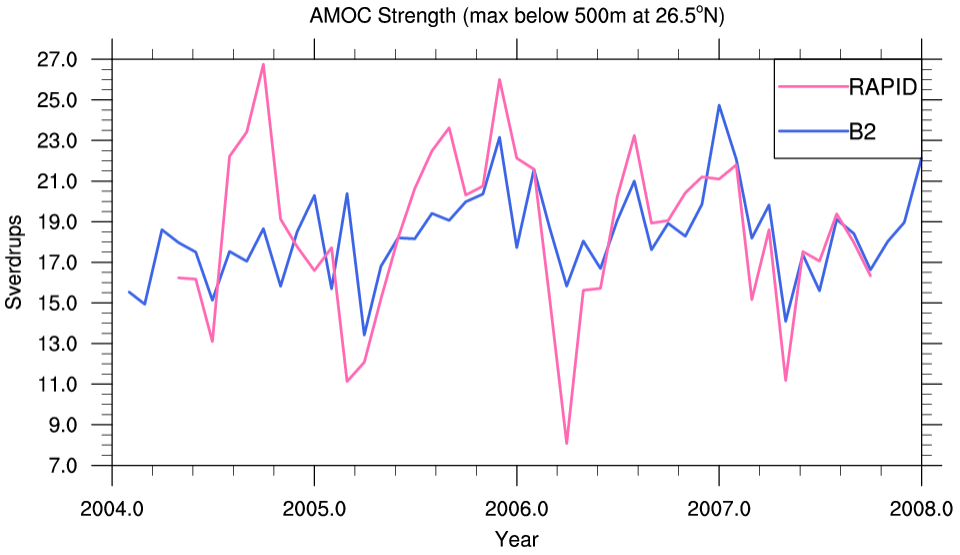


Atlantic Meridional Overturning Circulation (AMOC)

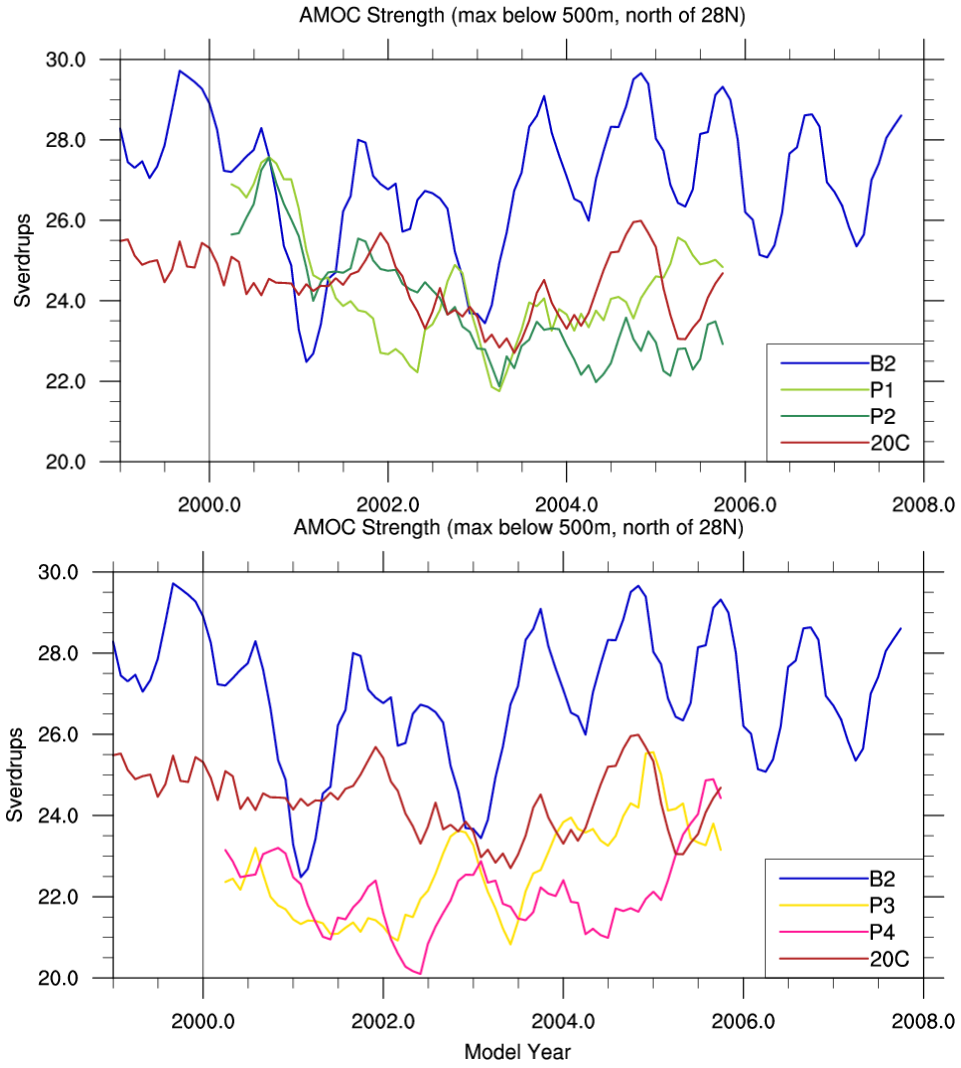
Varies with hindcast/assimilation



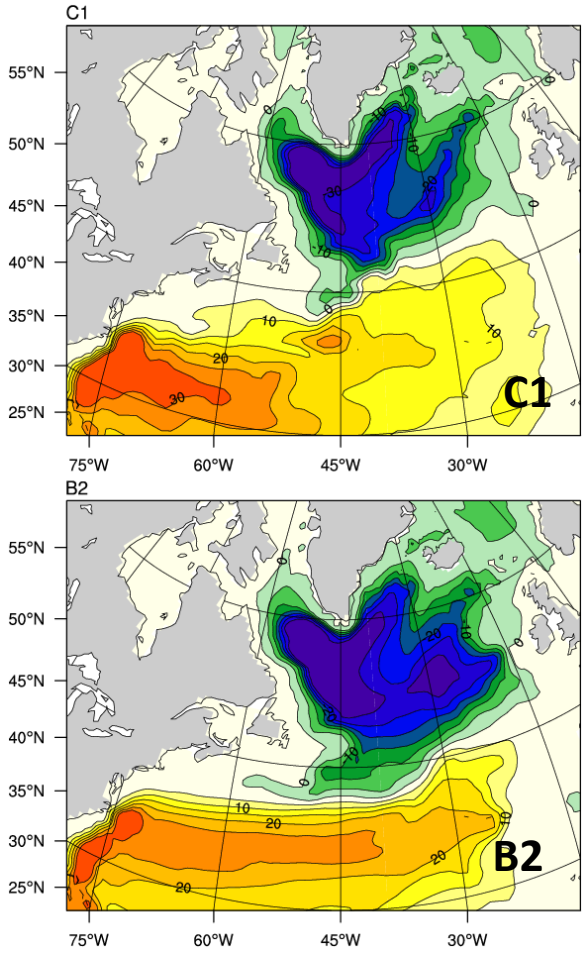
B2 compares with observations



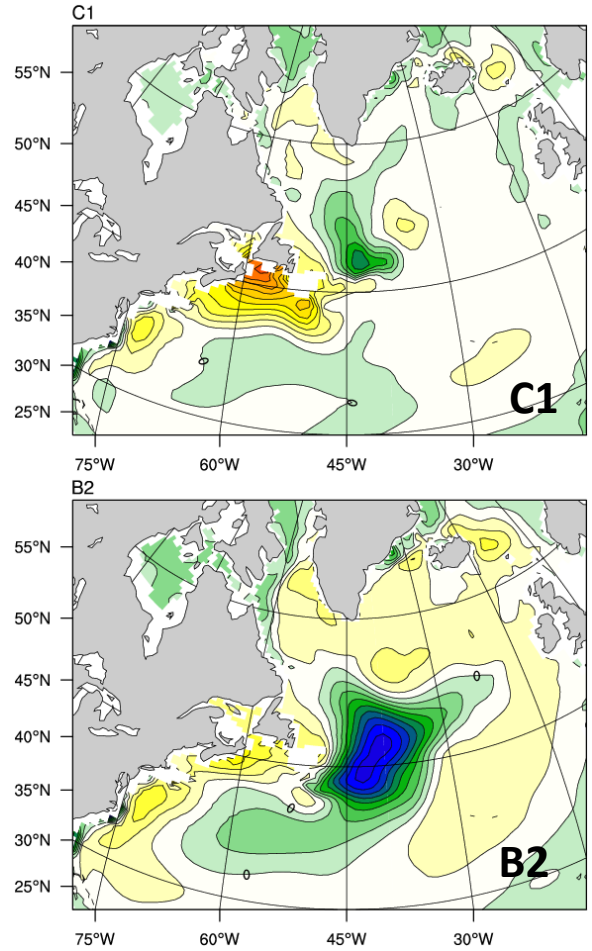
AMOC Predictability/Periodicity and Climate Drift



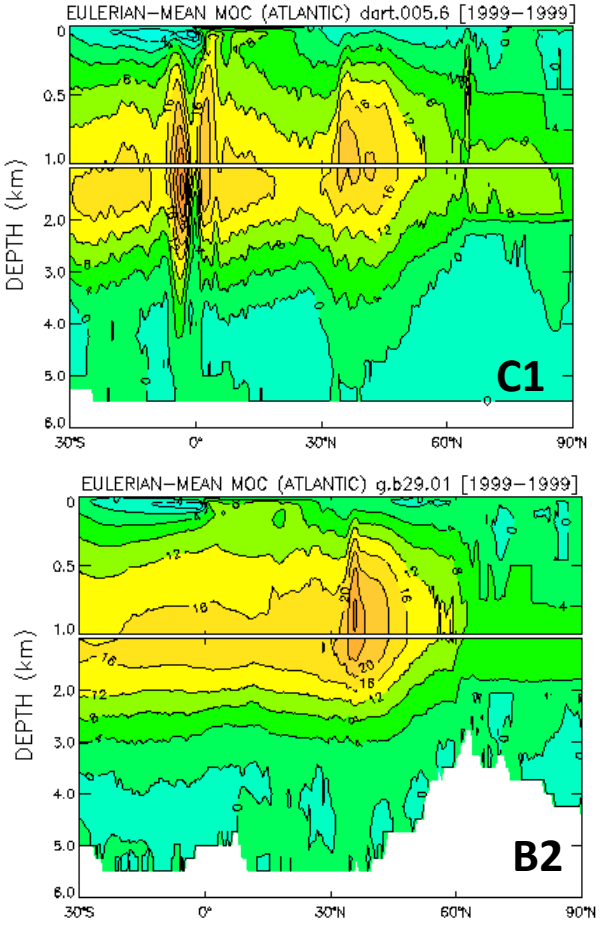
Benefits of Assimilation



Barotropic Streamfunction

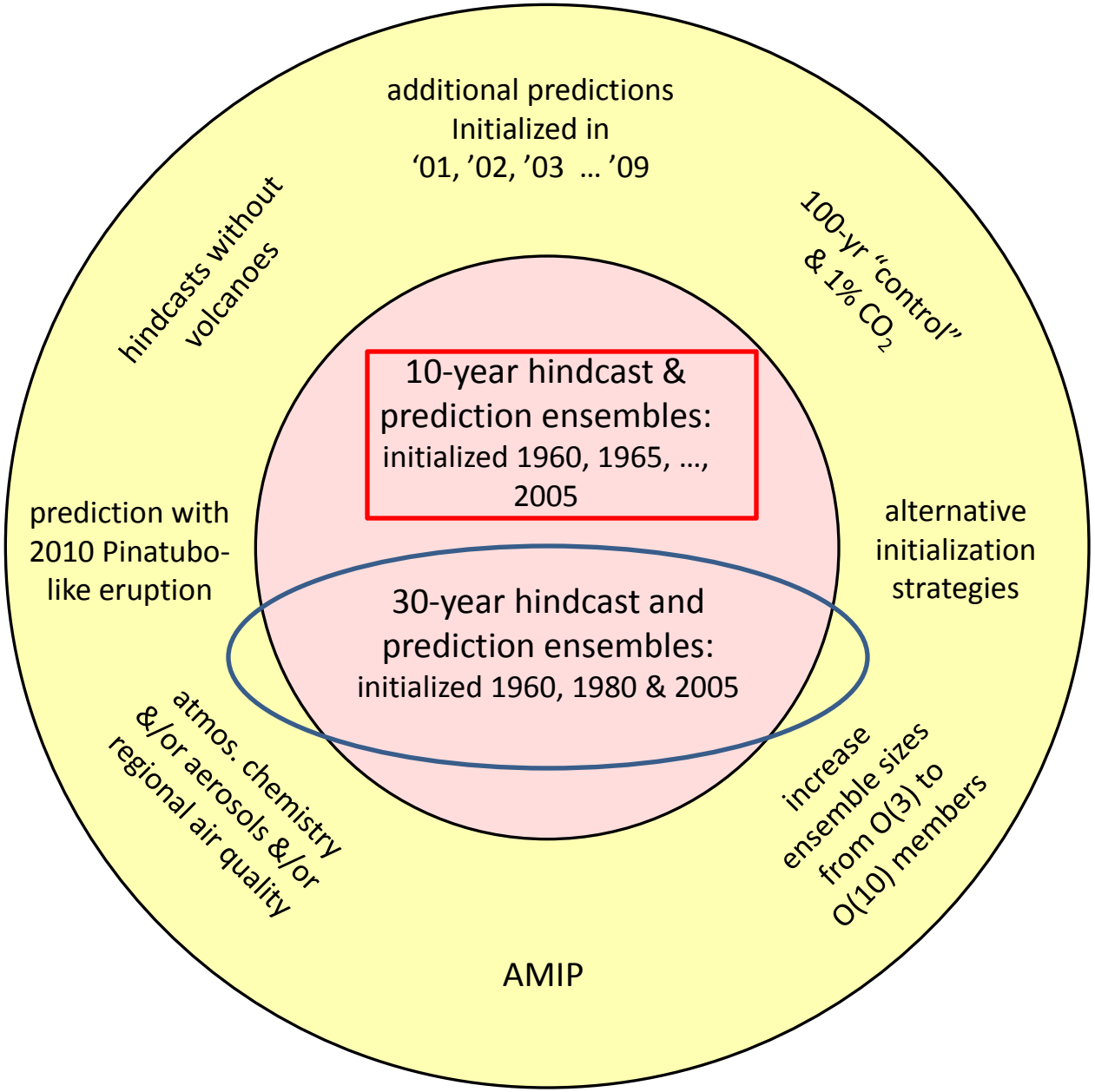


TS anomaly



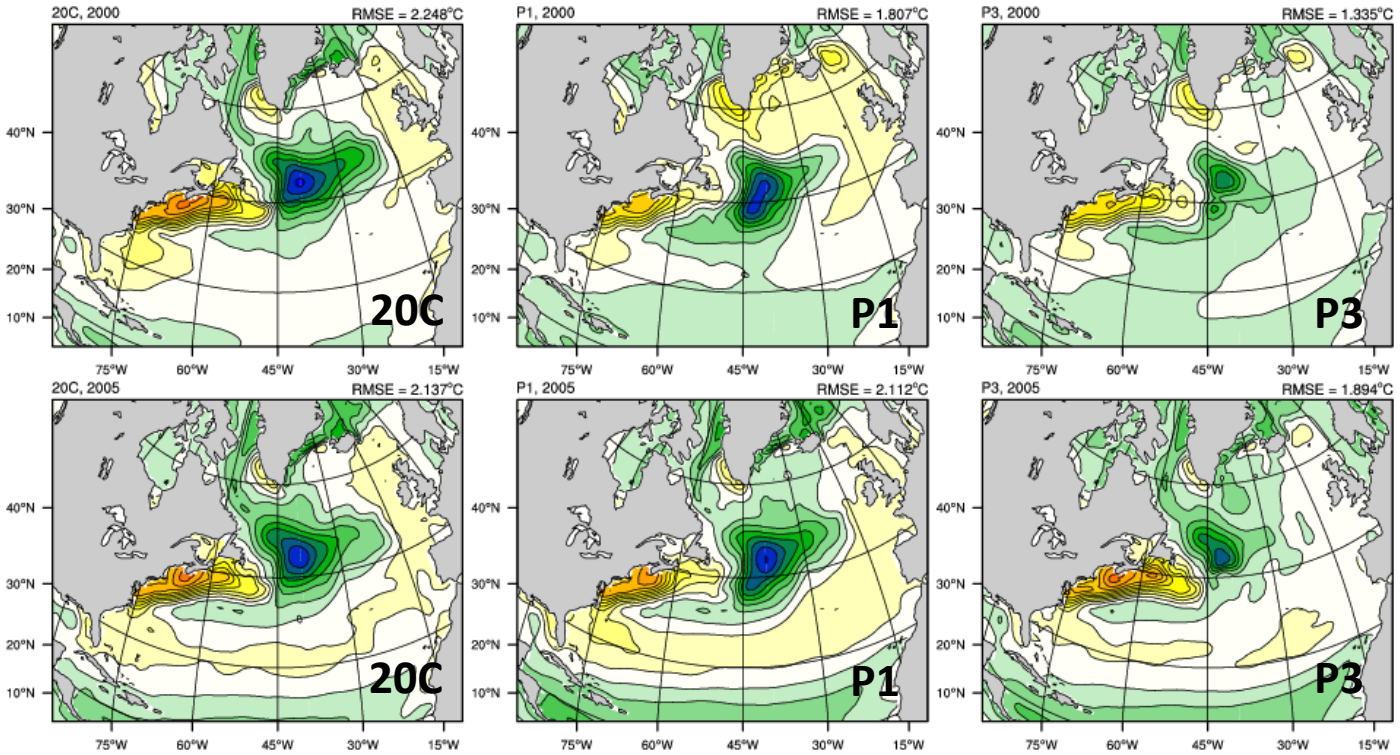
AMOC

CMIP5 Decadal Prediction Experiments: current plan



- Ensemble initial conditions from ODA (DART facility)
- Ocean analysis for 1998-1999 (-2007)
- Improved depiction of Gulf Stream separation and reduced upper-ocean T bias compared to hindcasts
- First experiments to be for yr 2000 start
- Further strategy tbd by SSC (March 2010) may include 1970-2000

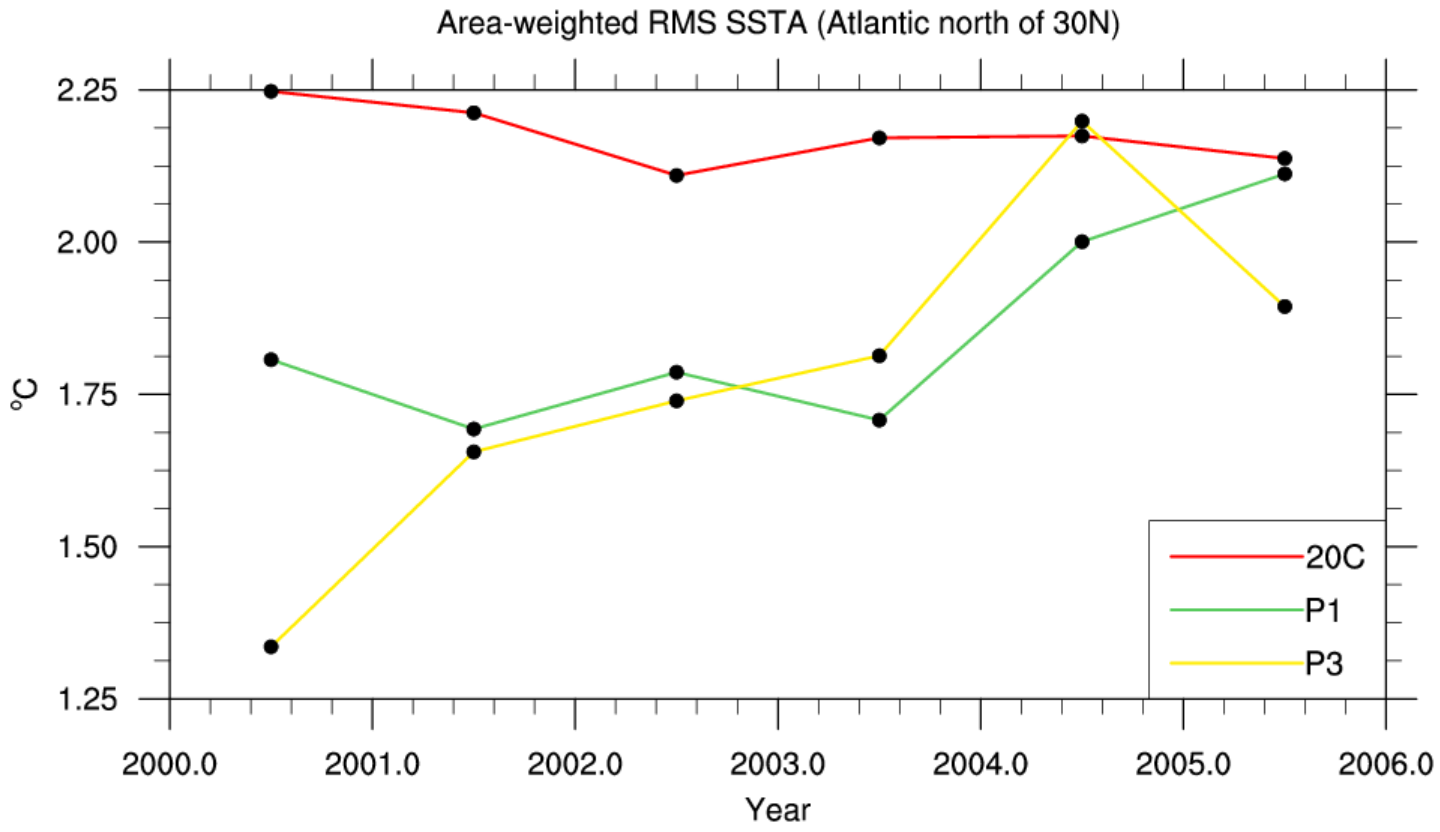
Positive: Reduced SST BIAS persists



2000

2005

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



Issues and Questions

- Very few realizations of decadal variability have been observed
- Decadal variability mainly resides in the ocean-*very poorly observed -especially before 2003!*
- Are atmospheric decadal modes of variability predictable in any sense
- How to optimally initialize and how much effort to expend in doing so-*signal to noise*