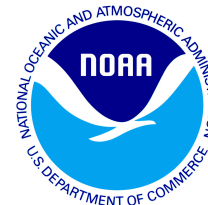


ATLANTIC MERIDIONAL OVERTURNING CIRCULATION (AMOC) VARIABILITY AND DECADAL PREDICTION INITIALIZATION APPROACHES IN CESM

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PetaApps

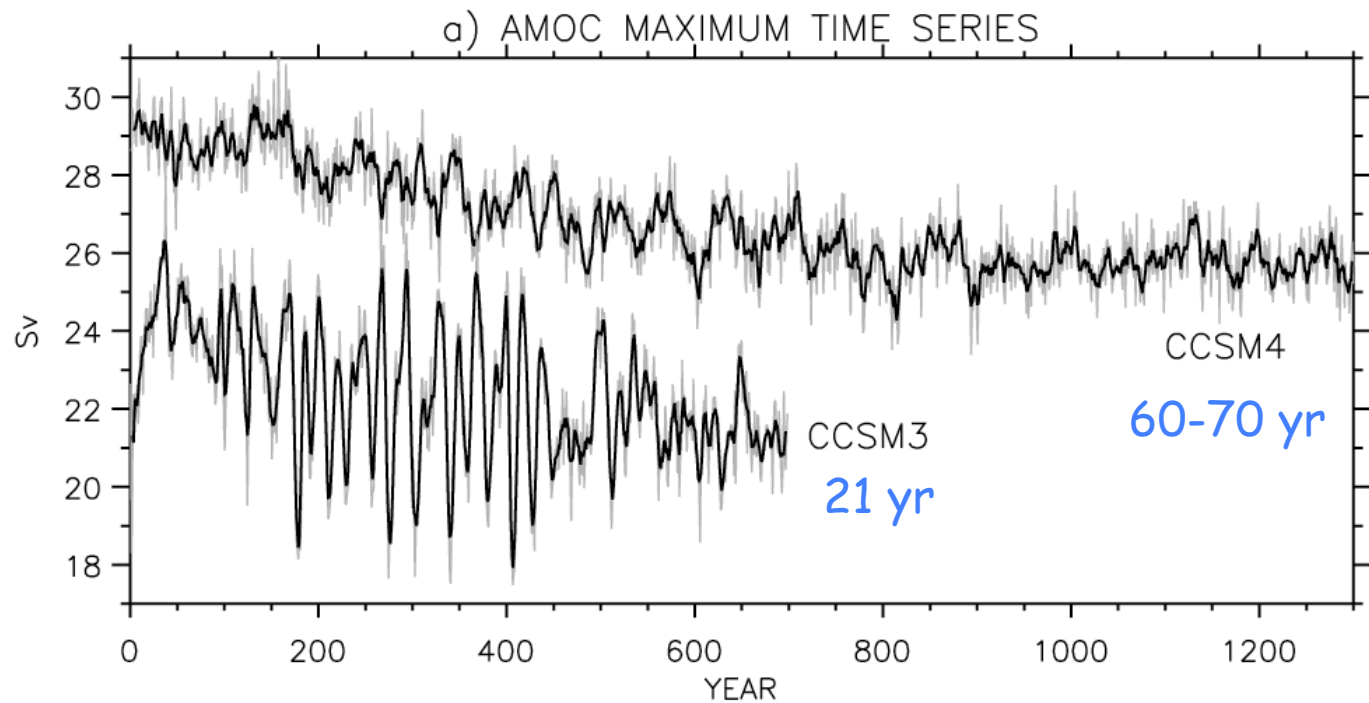


OUTLINE:

- AMOC variability in CESM,
- (Ocean) initialization approaches for decadal prediction,
- Example of model drift - bias issues,
- Summary

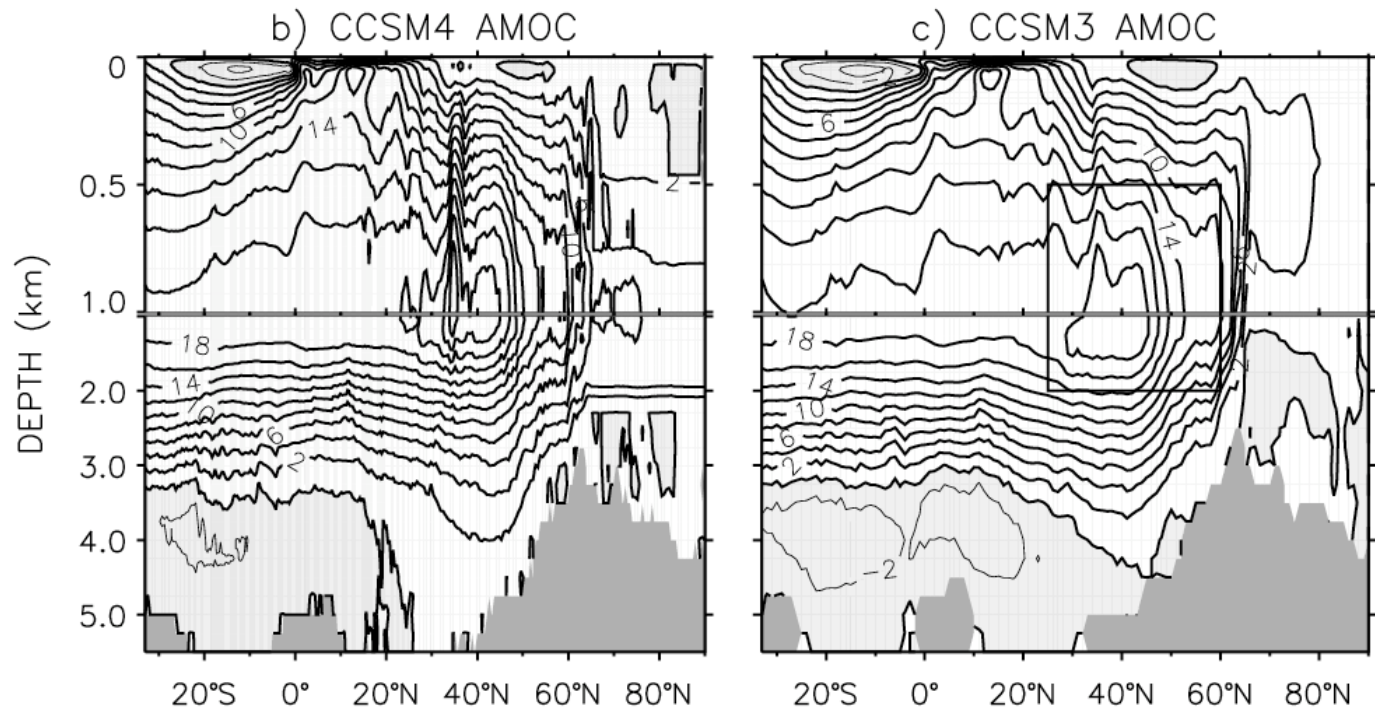
CCSM3: T85x1,
present-day

CCSM4: FV 1°,
pre-industrial

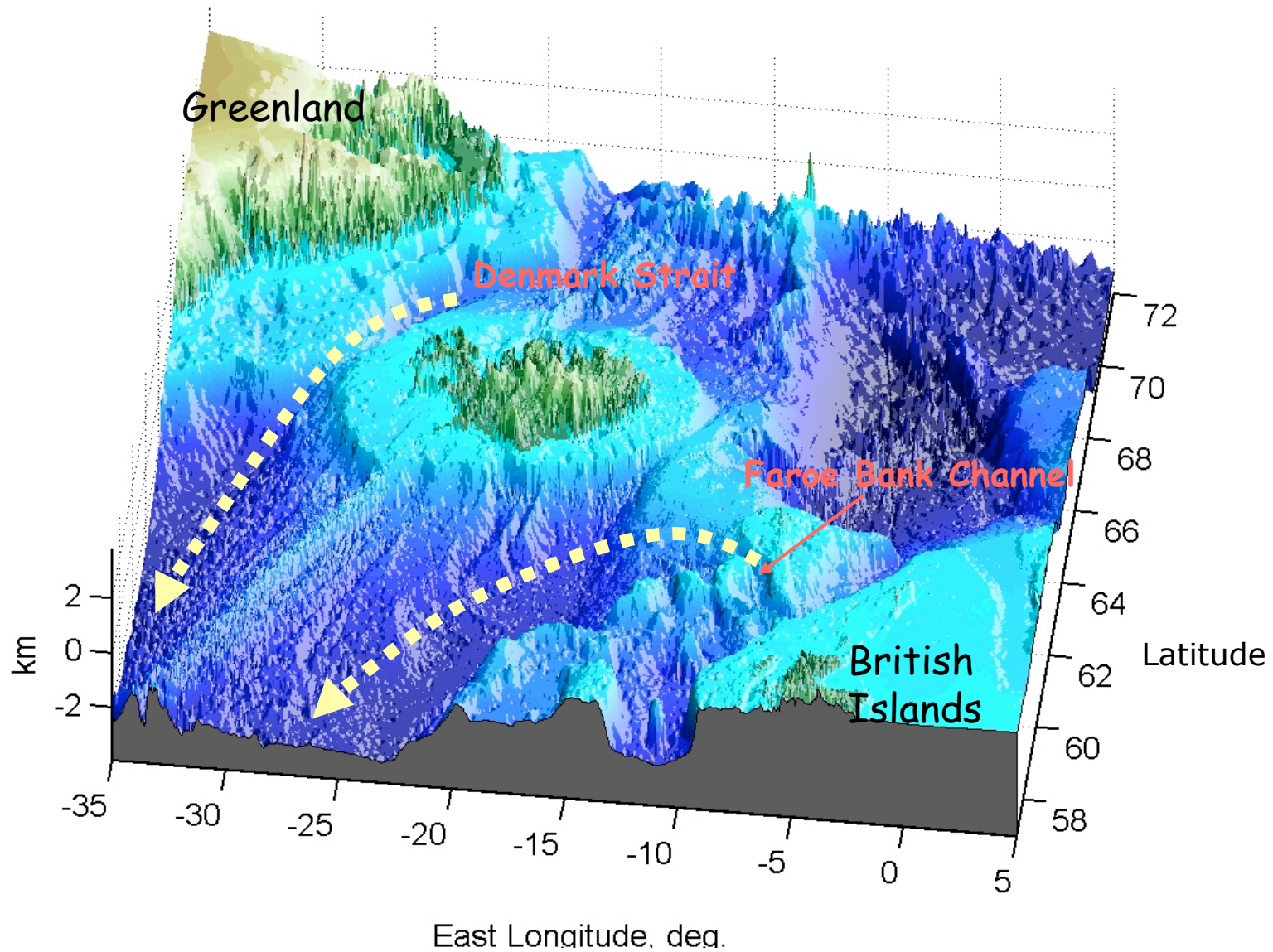


Mean
AMOC

Danabasoglu et al.
(2011, J. Climate)

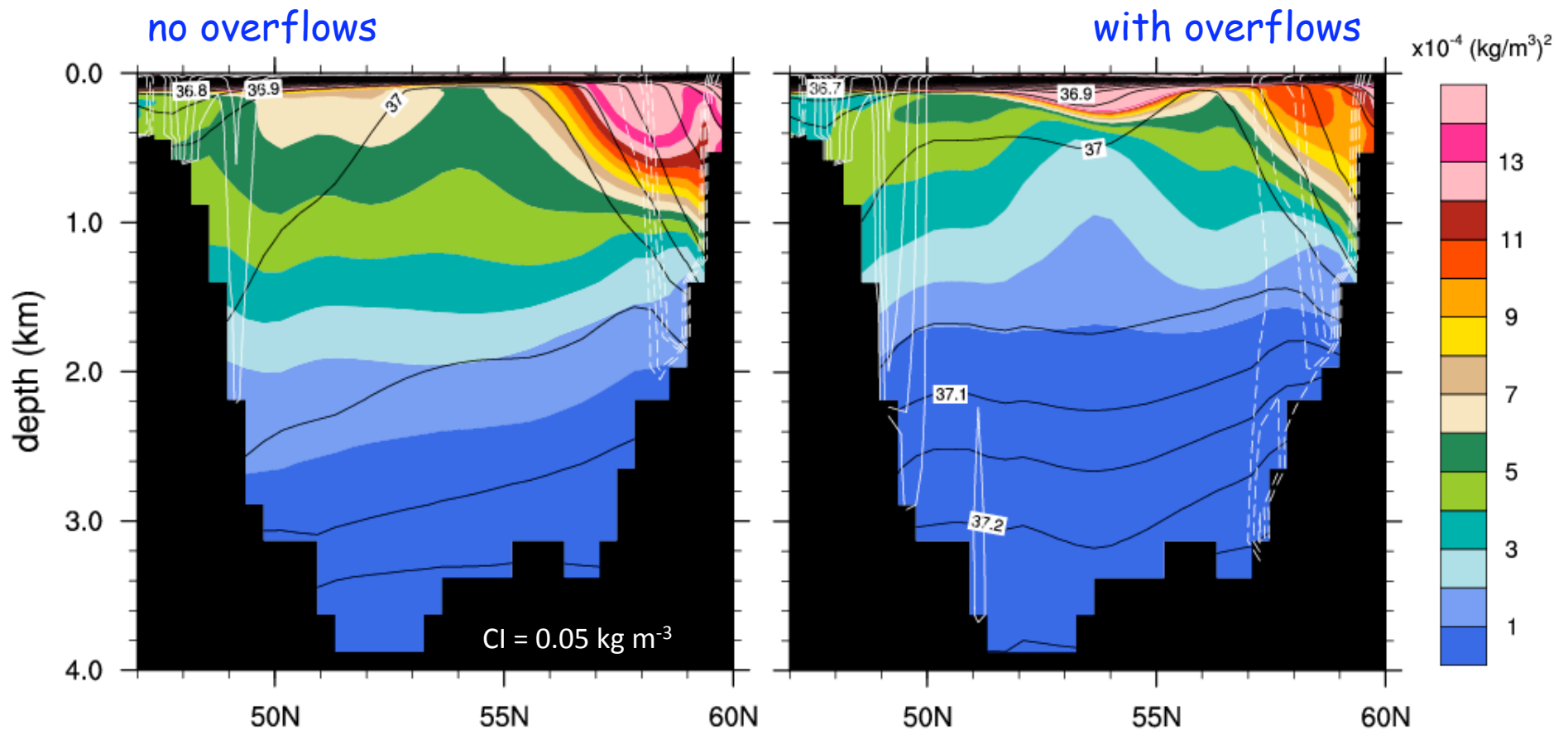


PARAMETERIZED NORDIC SEA OVERFLOWS IN CESM



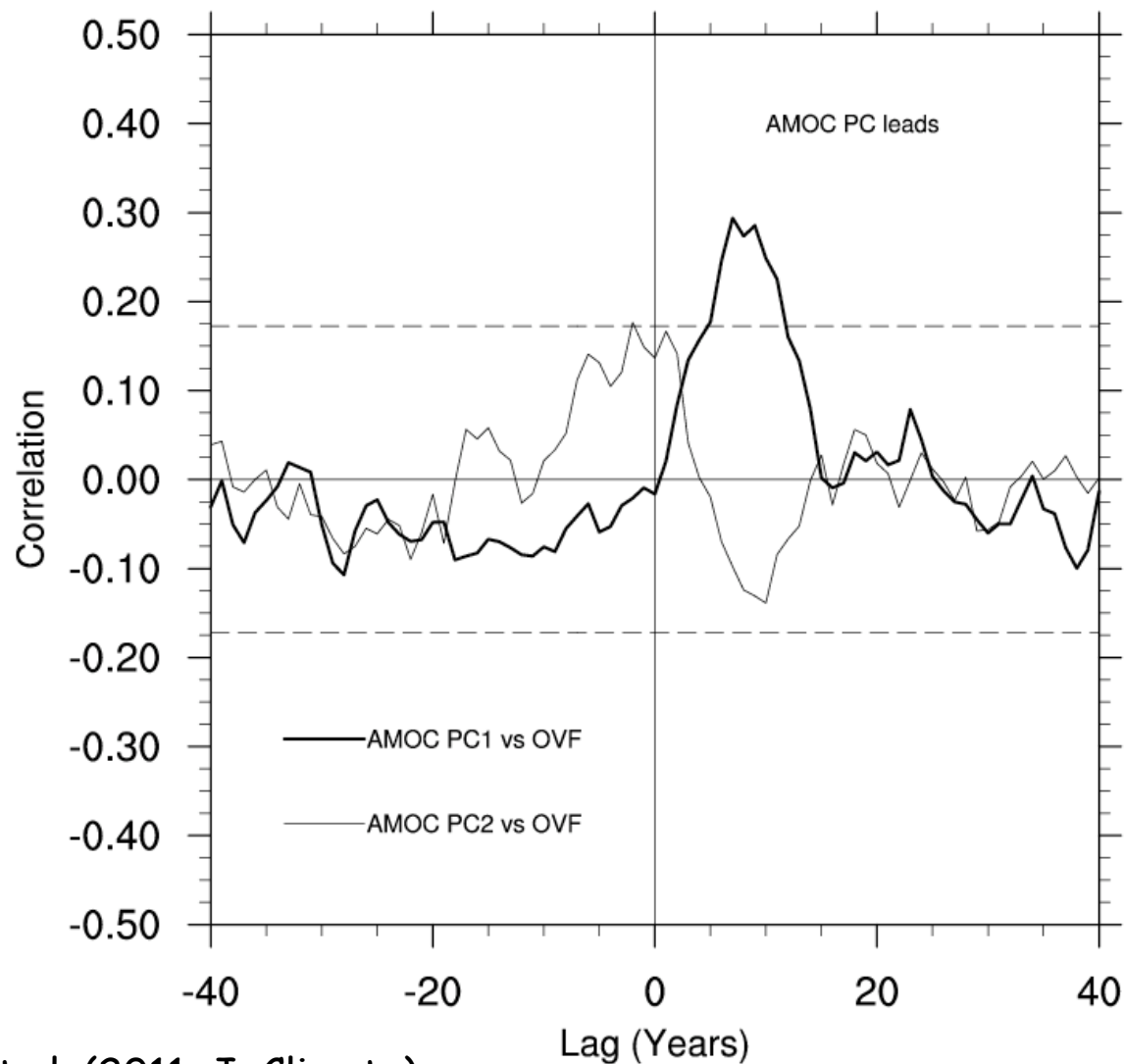
Danabasoglu, Large, Briegleb (2010, JGR)

Density variance (color) and mean (black lines)
Zonal velocity (white lines)



Yeager and Danabasoglu (2011, J. Climate)

AMOC PC and overflow product water transport (OVF) time series correlations



Danabasoglu et al. (2011, J. Climate)

DECADAL PREDICTION WORK WITH CESM

- Nominal 1° horizontal resolution versions of all component models are used,
- We use full fields instead of the anomaly initialization approaches.

We consider two initialization options for the ocean model:

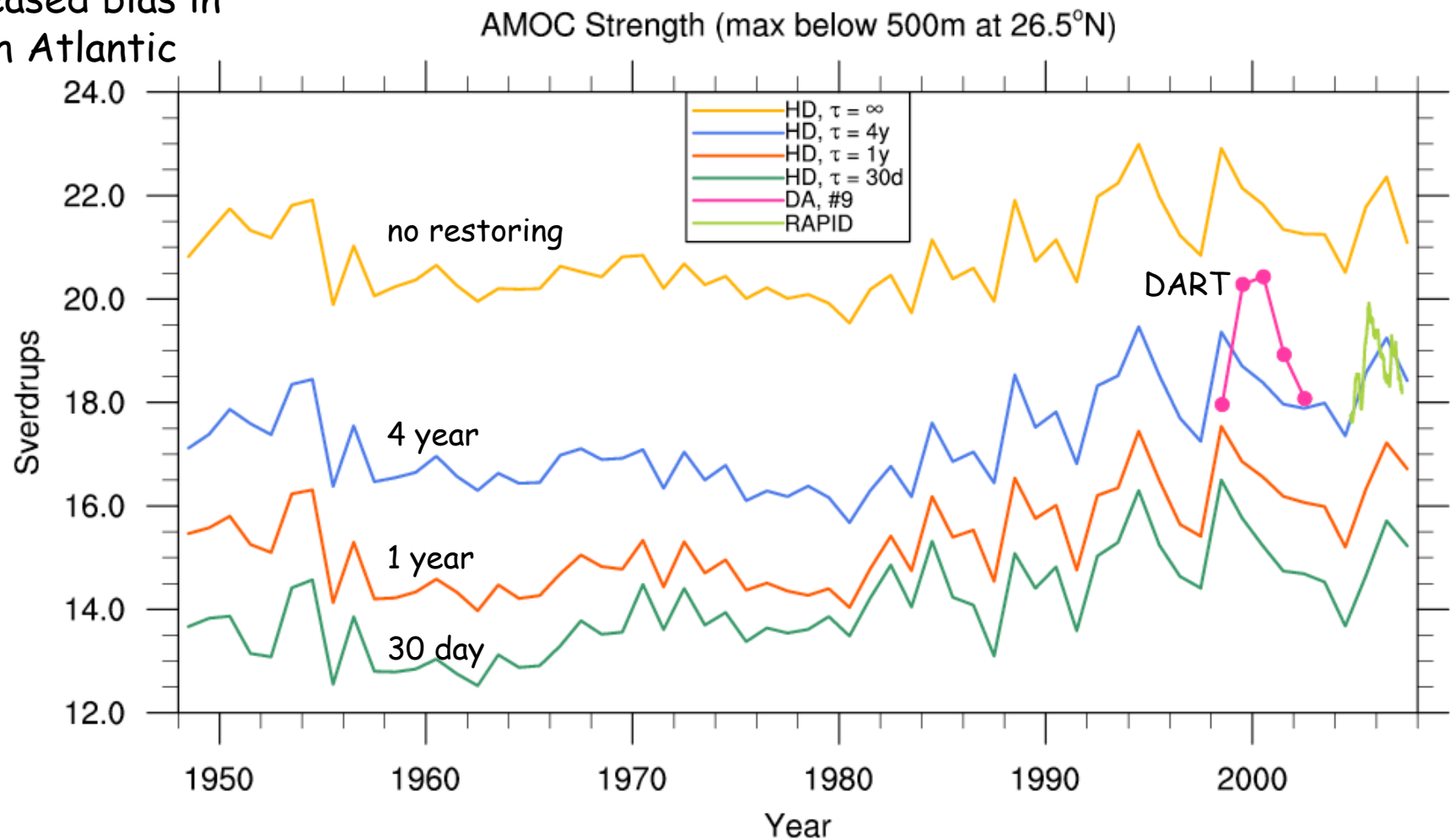
1. Hindcast solutions from ocean-only or ocean-ice coupled simulations,
2. Reanalysis products from ocean data assimilation using Data Assimilation Research Testbed (DART).

HINDCAST SIMULATIONS:

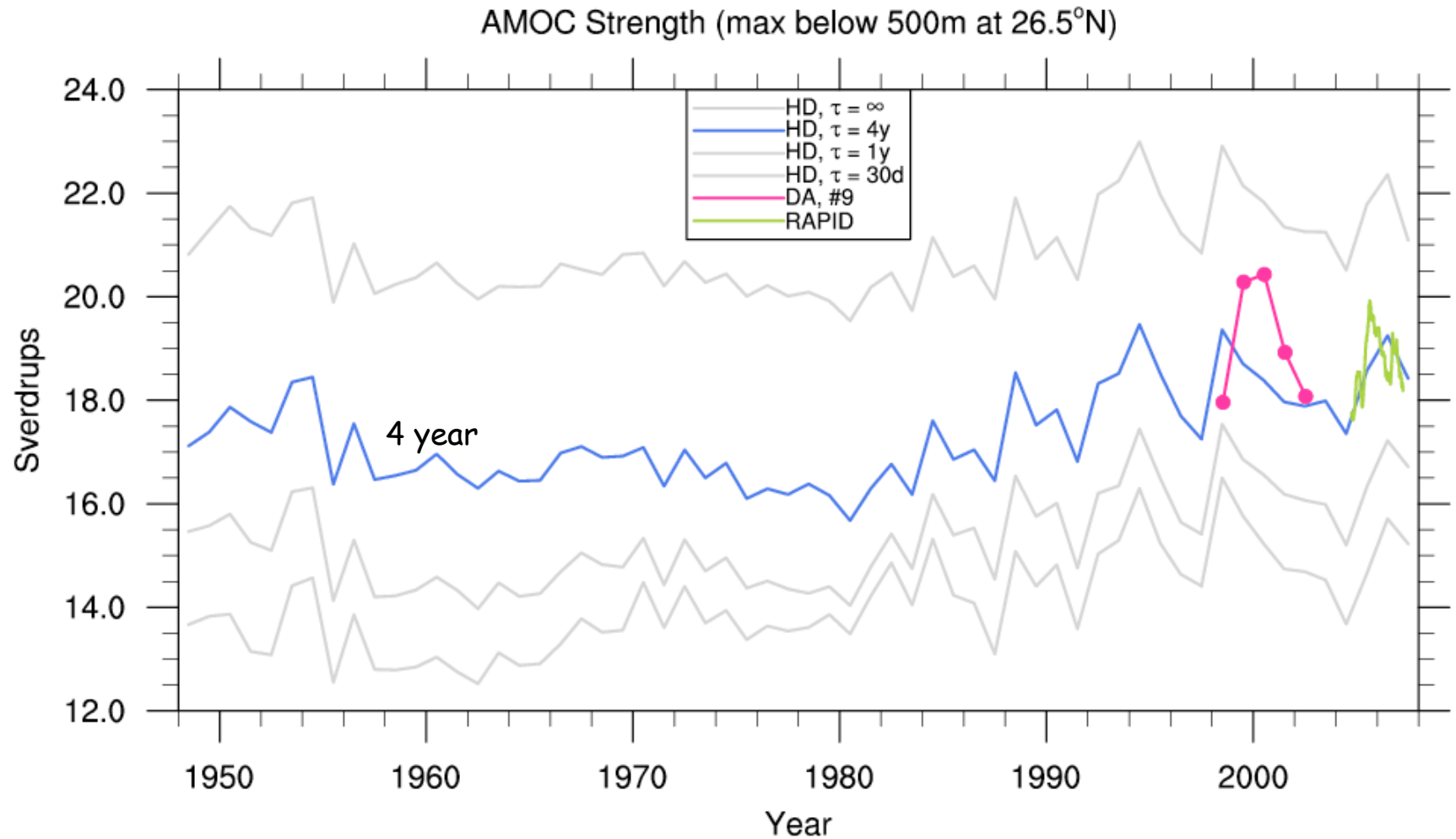
- Forced with the Coordinated Ocean-ice Reference Experiments version 2 (CORE2) data sets for 1948-2007 (Large and Yeager 2004; 2009).
- Repeat the 60-year forcing cycle a few times and use the ocean and sea-ice solutions at a given date from the last forcing cycle as initial conditions for prediction experiments.
- Assess the sensitivity of model solutions (particularly AMOC) to surface salinity restoring strength.

AMOC TIME SERIES FROM OCEAN-ICE COUPLED HINDCAST SIMULATIONS

Increased bias in
North Atlantic



AMOC TIME SERIES FROM OCEAN-ICE COUPLED HINDCAST SIMULATIONS



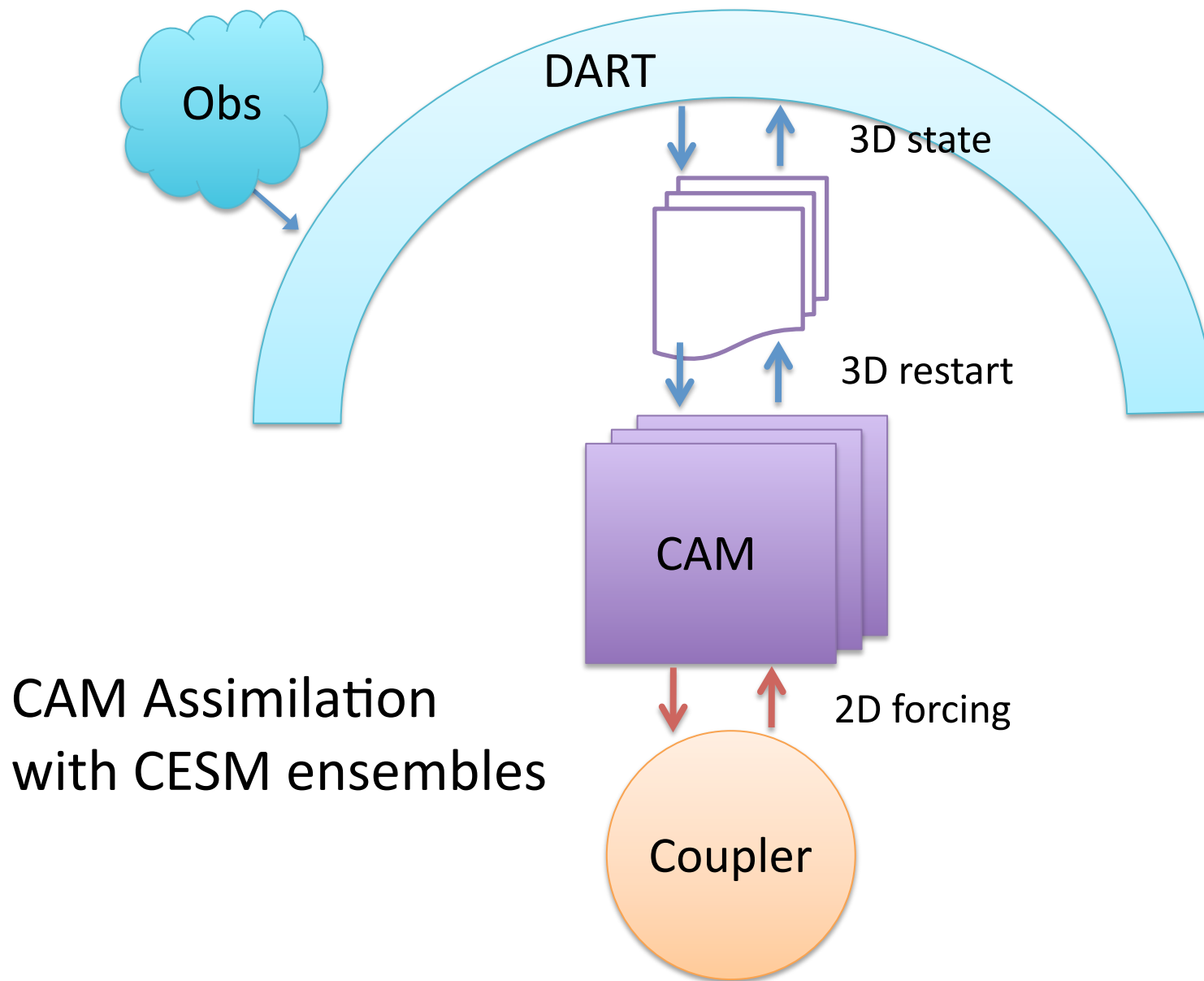
Ensemble Data Assimilation for CESM

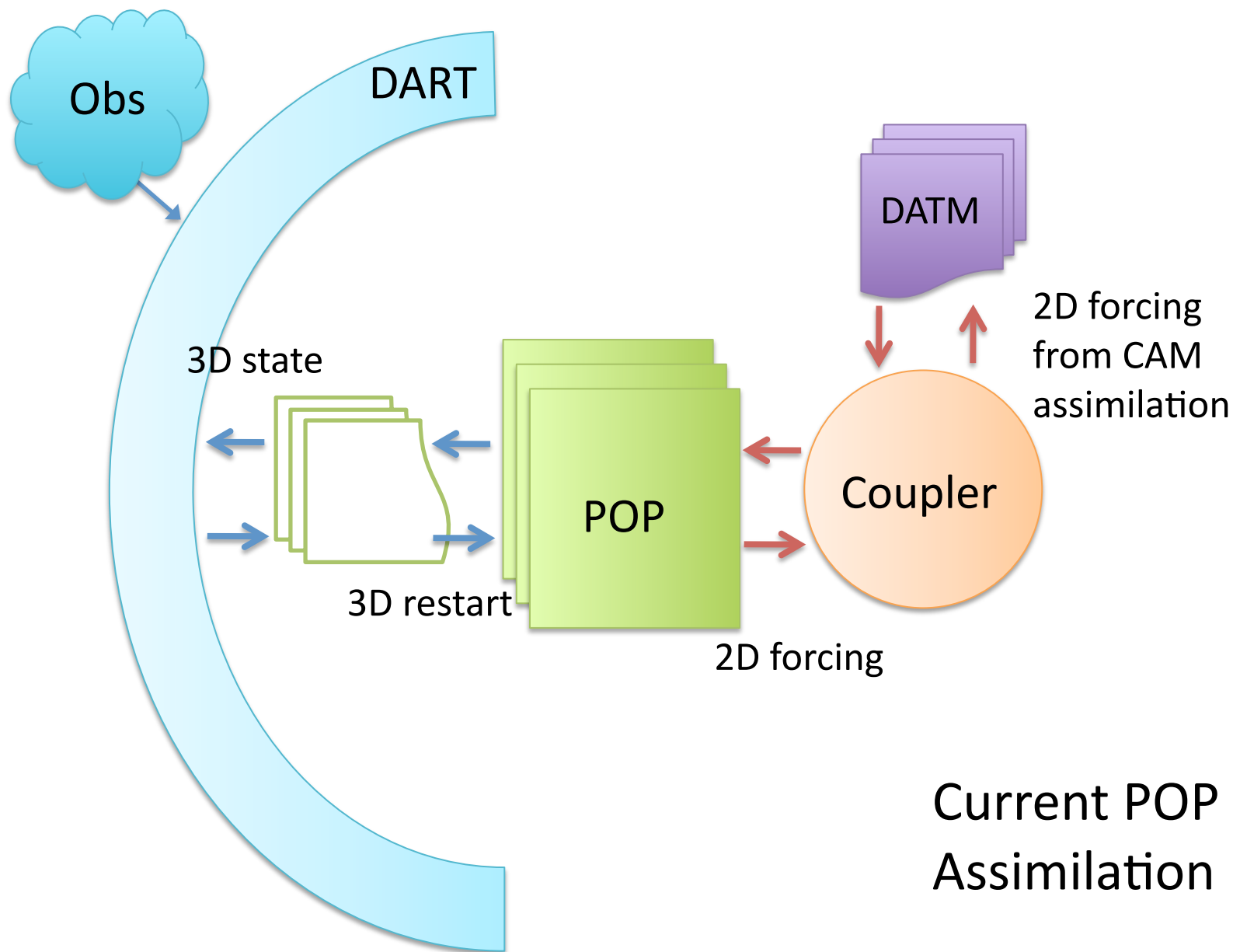


Tim Hoar, Nancy Collins, Kevin Raeder, and Jeffrey Anderson
NCAR Institute for Math Applied to Geophysics
Data Assimilation Research Section

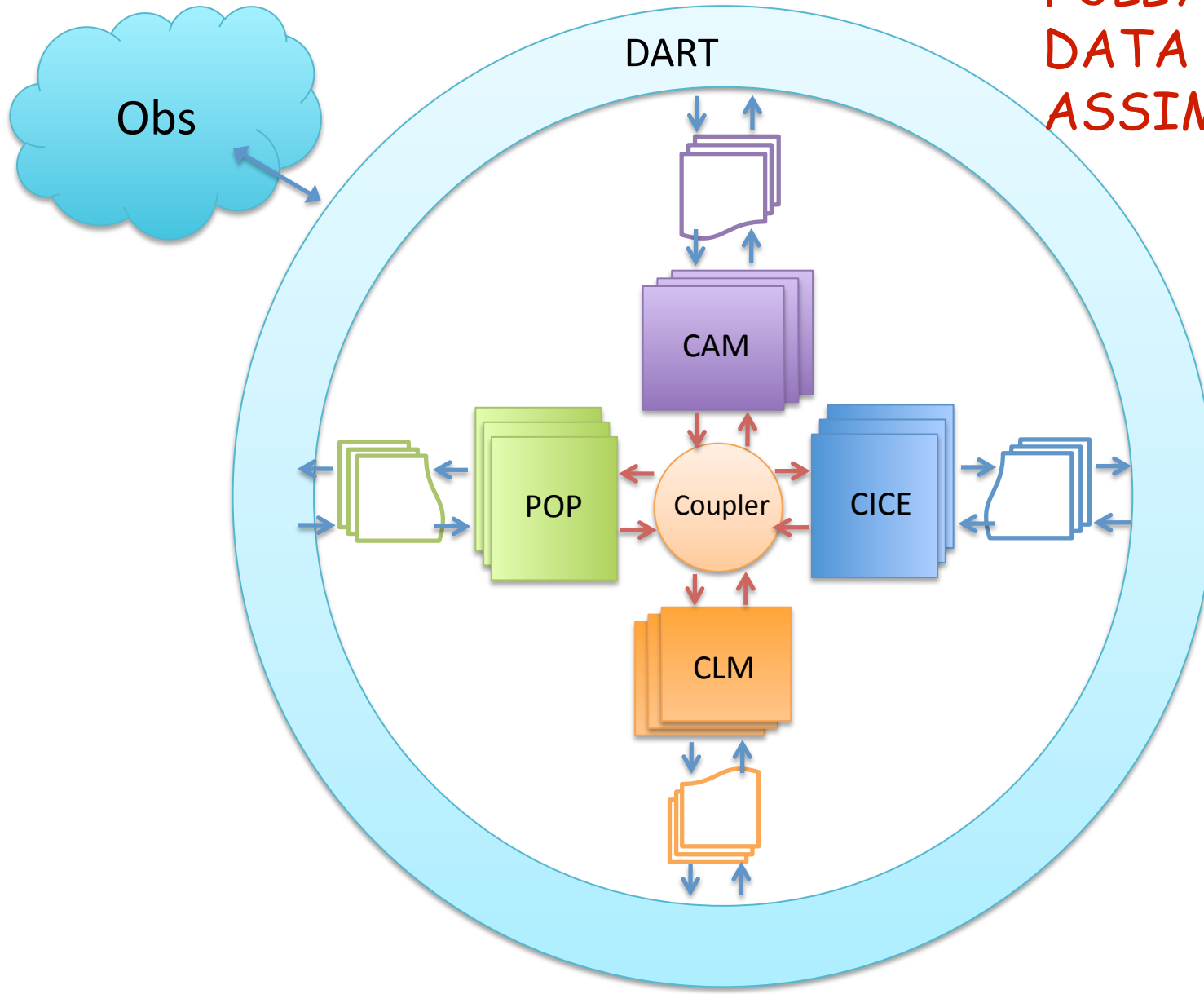
CESM - DART WEAKLY-COUPLED DATA ASSIMILATION FRAMEWORK

- DART - Community Atmosphere Model (CAM4) reanalysis:
 - 80 members,
 - all data from NCEP / NCAR reanalysis,
 - each member is forced from below by the same SSTs.
- DART - POP2 reanalysis:
 - 48 members,
 - each member is forced by a different estimate of the atmospheric forcing obtained from above,
 - All temperature and salinity observations available in World Ocean Database are used,
 - Assimilation is done once a day in a +/- 12-hour window centered at midnight.





FULLY-COUPLED DATA ASSIMILATION

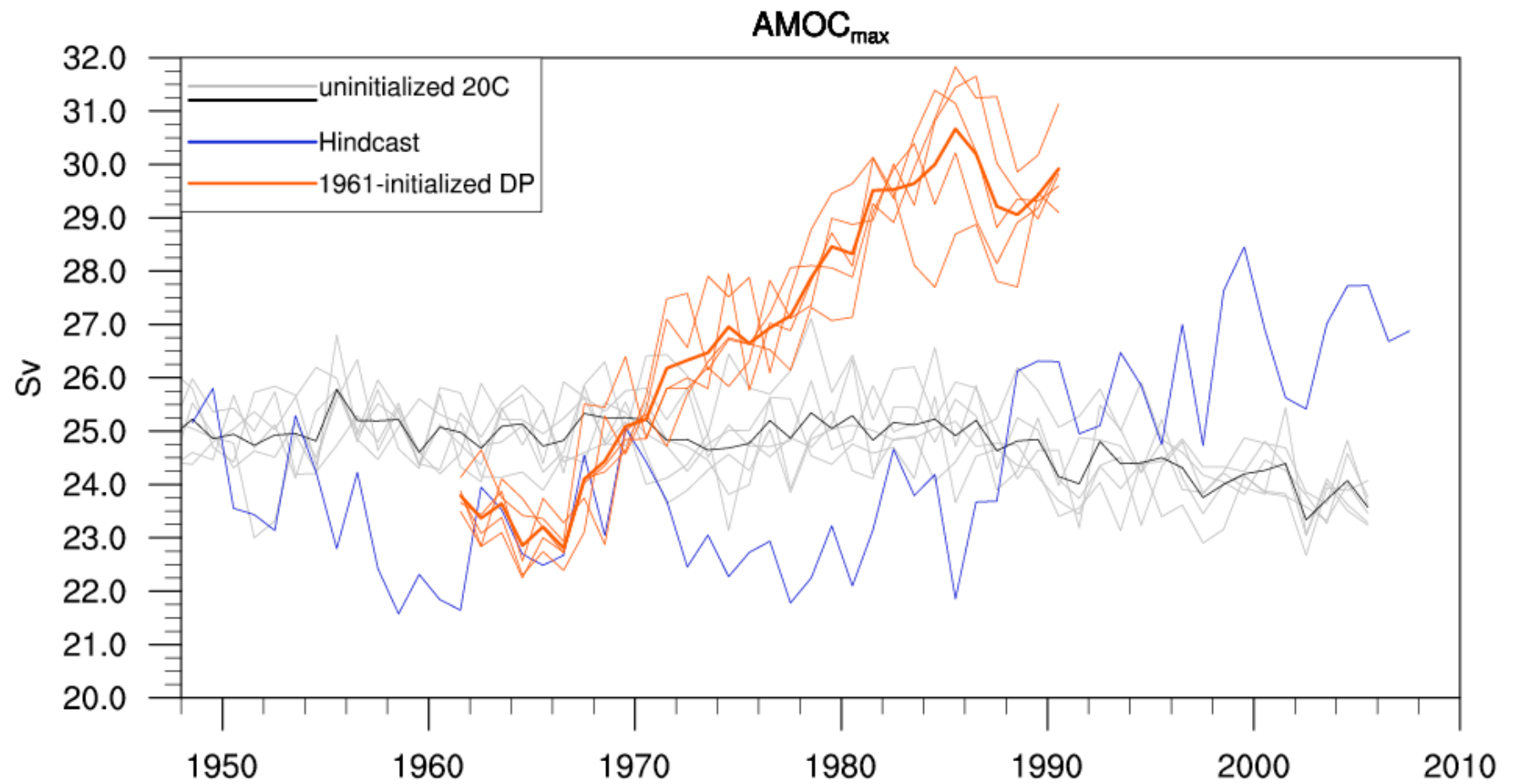


AVAILABLE INITIAL CONDITIONS FOR DECADEAL PREDICTION SIMULATIONS

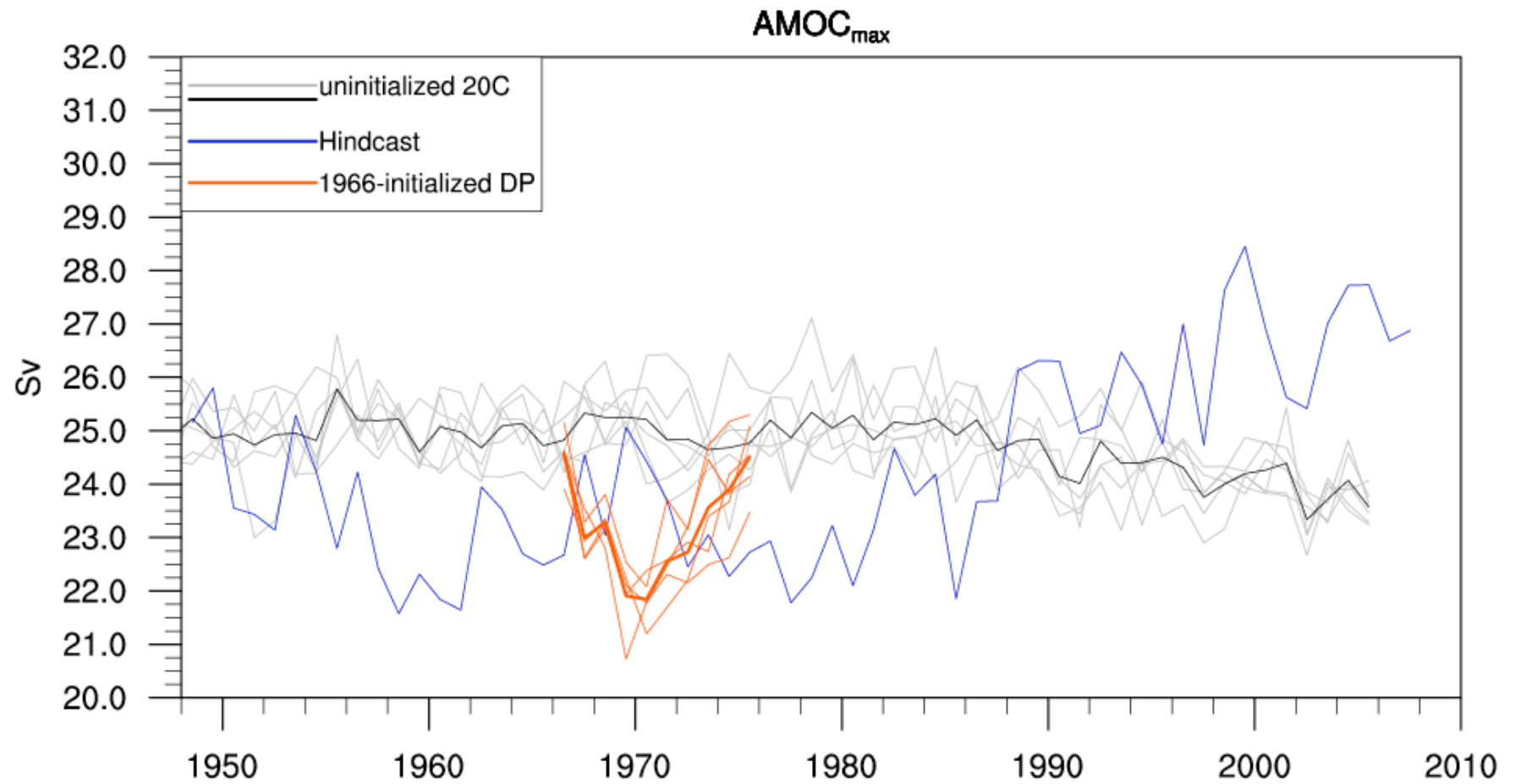
	INTEGRATION LENGTH	OCEAN	ICE (HD)	ATM/LND
HD:	1948-2007	1961-2008	1961-2008	20C
DA:	1998-2005(9)	2000-2006	1961-2008	20C

- HD initialized experiments starting from 1961 to 2006 (every 5 years) are complete,
- DA initialized experiments starting from 2000 to 2006 (every year) are complete,
- DA initialized experiments starting from 1980 are complete, and 1975 initialized cases are ongoing,
- 10-member ensembles for each start date,
- 10-year or 30-year long simulations.

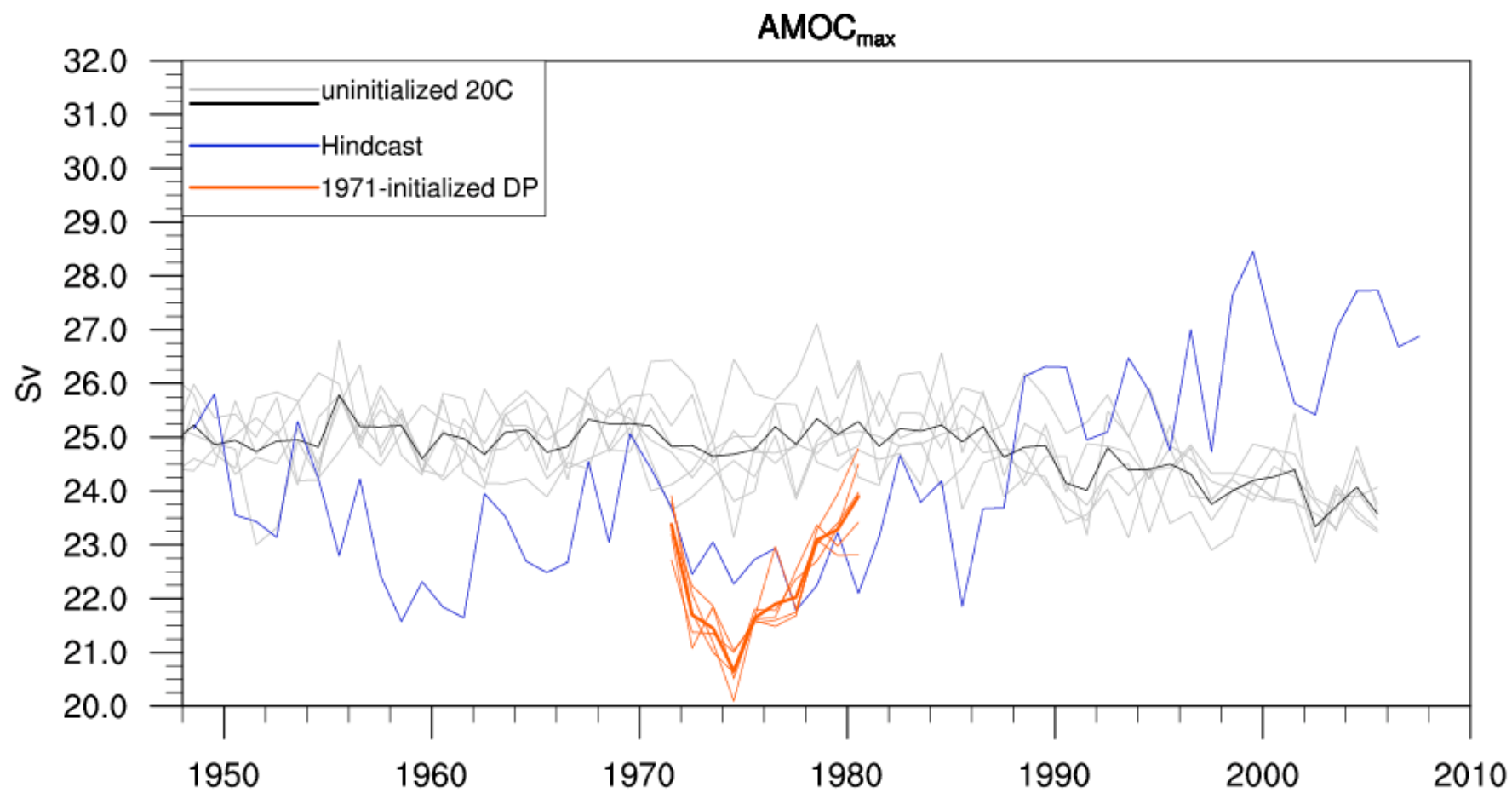
MODEL DRIFT



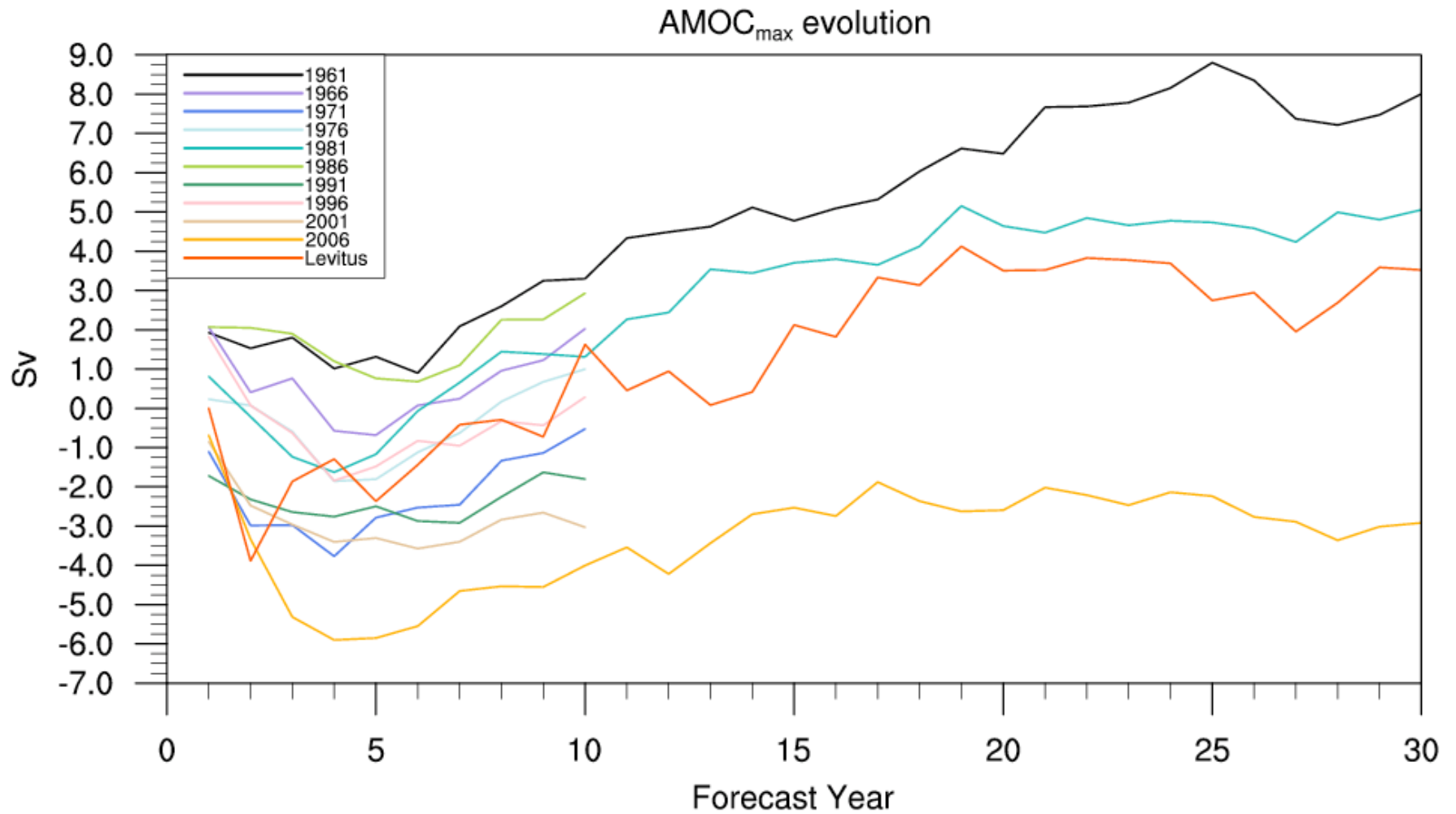
MODEL DRIFT



MODEL DRIFT



$AMOC_{max}$ change from its initial state in hindcast initialized decadal prediction experiments



SUMMARY

- At decadal and longer time scales, modeled AMOC variability is rather sensitive to sub-grid-scale parameterizations,
- We are using two ocean full-field initialization approaches in CESM - hindcast and data assimilation,
- Bias (or drift) correction will be key to how these decadal prediction experiments are analyzed,
- Steve Yeager's talk (tomorrow morning).