COLA CMIP5 Decadal Forecasts Using CFS Version 2

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Acknowledgement of Contributions

- COLA
  - Jim Kinter
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- NCEP
  - Thanks to NCEP for providing model code, datasets, and technical assistance

Description

- Model CFS version 2 provided by NCEP EMC
- Initial data
  - Atmosphere, land, sea ice CFSR reanalysis
  - Ocean NEMO (ECMWF) interpolated to CFS
- Computer resources
  - NASA Pleiades

THE NCEP CLIMATE FORECAST SYSTEM Version 2 Paper

Suranjana Saha, Shrinivas Moorthi, Xingren Wu, Jiande Wang, Sudhir Nadiga, Patrick Tripp, Hua-Lu Pan, David Behringer, Yu-Tai Hou, Hui-ya Chuang, Mark Iredell, Michael Ek, Jesse Meng, Rongqian Yang, 2011 : The NCEP Climate Forecast System Version 2. To be submitted to the Journal of Climate.

CFS v2

1. An atmosphere at high horizontal resolution (spectral T574, ~27 km) and high vertical resolution (64 sigma-pressure hybrid levels) for the real time analysis
2. An atmosphere of T126L64 for the real time forecasts
3. An interactive ocean with 40 levels in the vertical, to a depth of 4737 m, and horizontal resolution of 0.25 degree at the tropics, tapering to a global resolution of 0.5 degree northwards and southwards of 10N and 10S respectively
4. An interactive 3 layer sea-ice model
5. An interactive land model with 4 soil levels

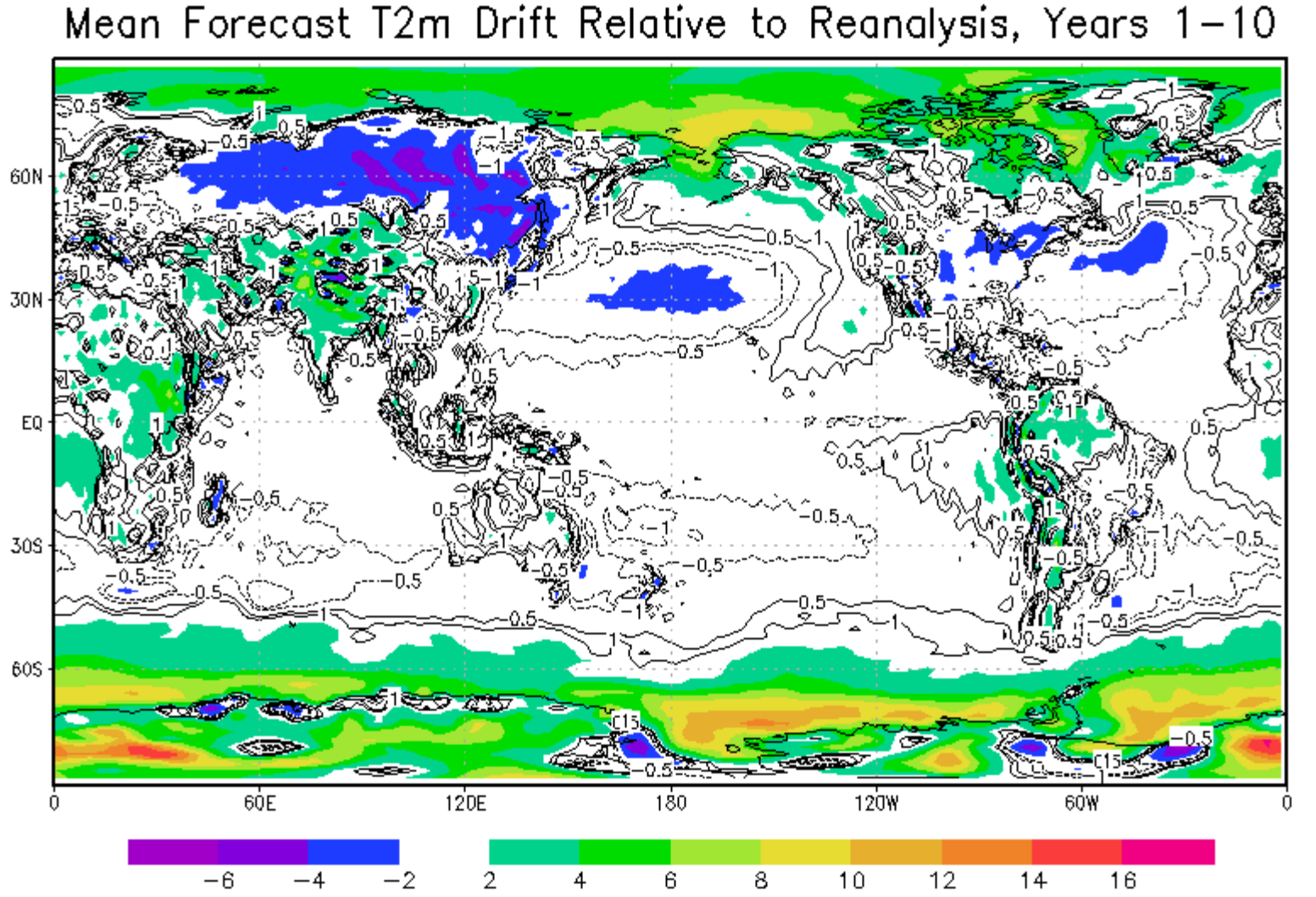
Status of Runs

- Ten year 4 member forecast ensembles from 1960, 1965, …, 2000 completed
- 30 year 4 member forecast ensembles from 1960, 1980 (mostly completed)
- 2005 cases not yet started, pending choice of future scenario.

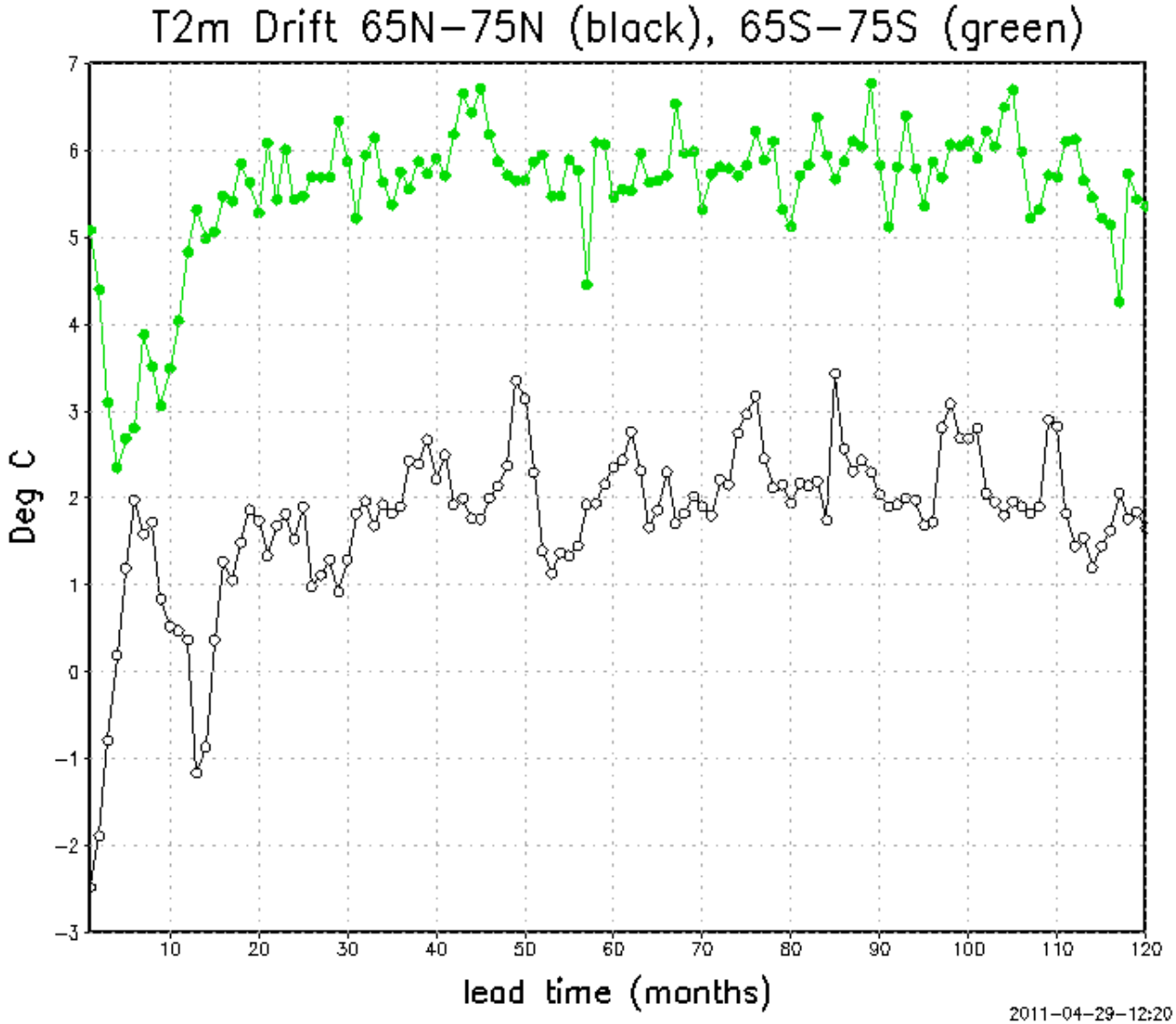
Results: Biases

- “mean drift” for 10 year hindcasts: average (forecast – obs) over all lead times
- Drift evolution (high latitudes)

Mean Drift


Mean Forecast T2m Drift Relative to Reanalysis, Years 1-10
60N
30N
EQ
30S
60S
0
60E
120E
180
120W
60W
0
-6
-4
-2
2
4
6
8
10
12
14
16
GrADS: COLA/IGES
2011-04-29-12:20

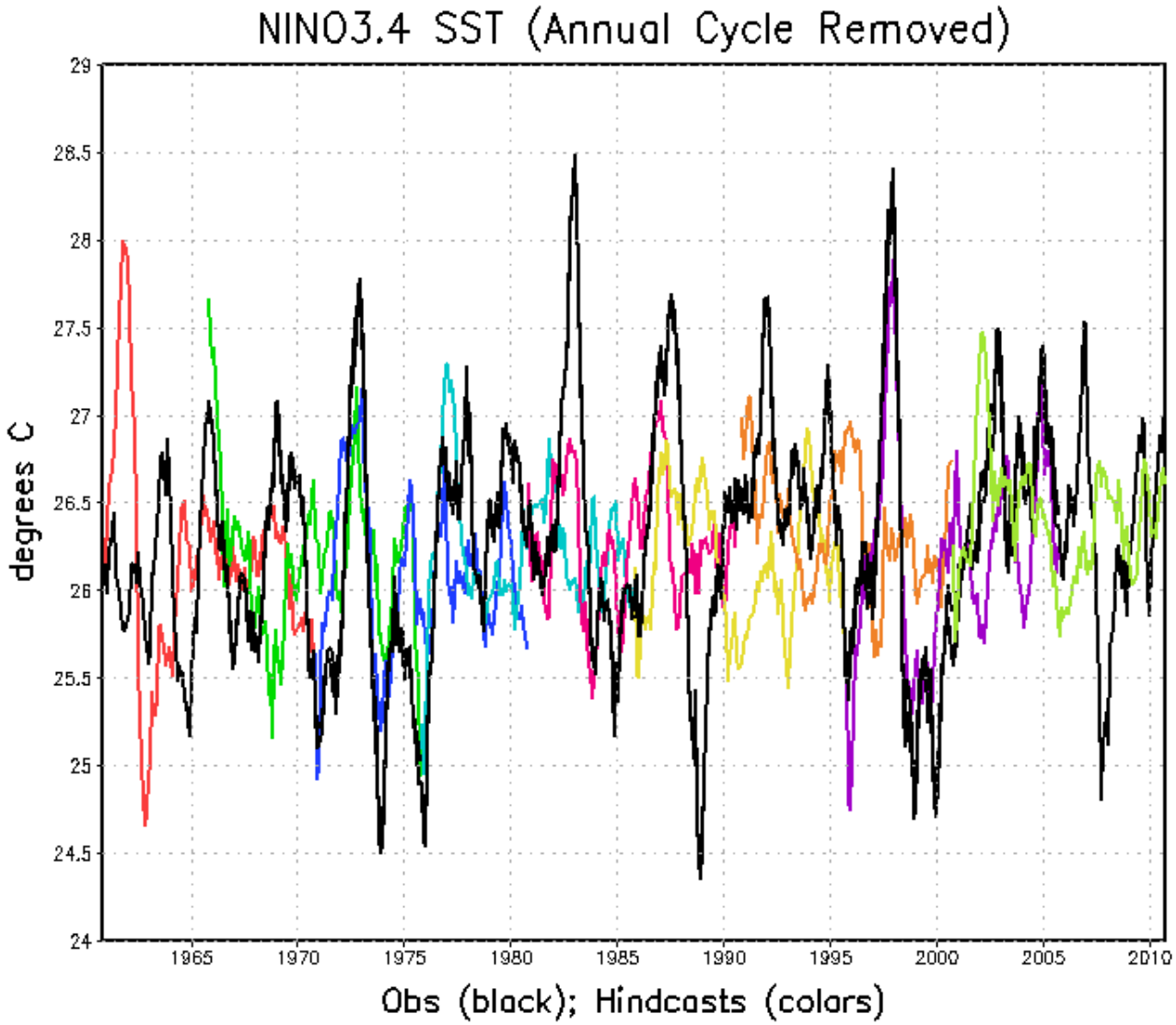
Drift Evolution High Latitudes



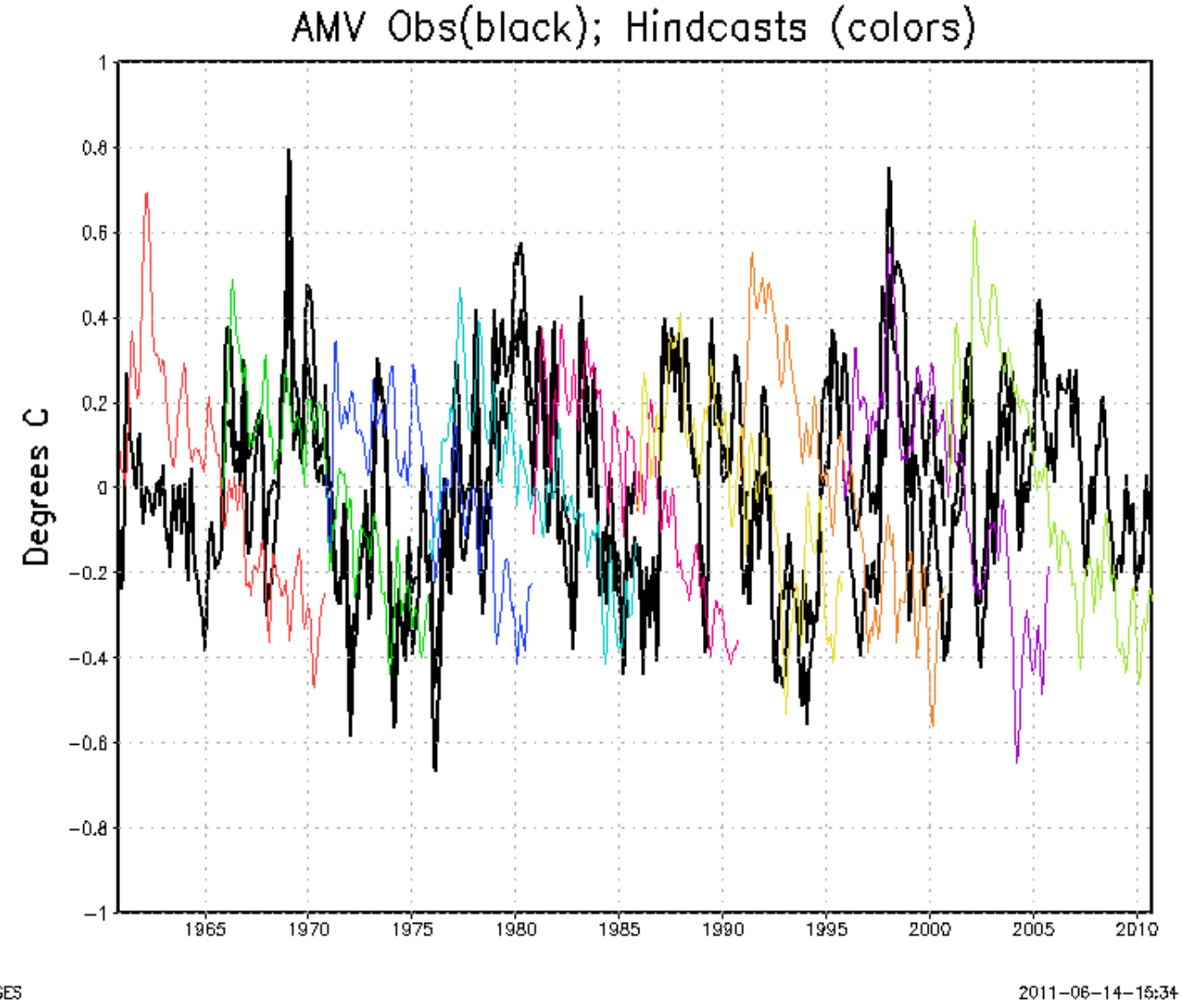
Results: Ensemble Mean Hindcast Anomalies

- NINO3.4 SST index
- North Atlantic AMV SST index
- Ensemble mean for each hindcast
- Annual cycle removed

NINO3.4 Hindcasts

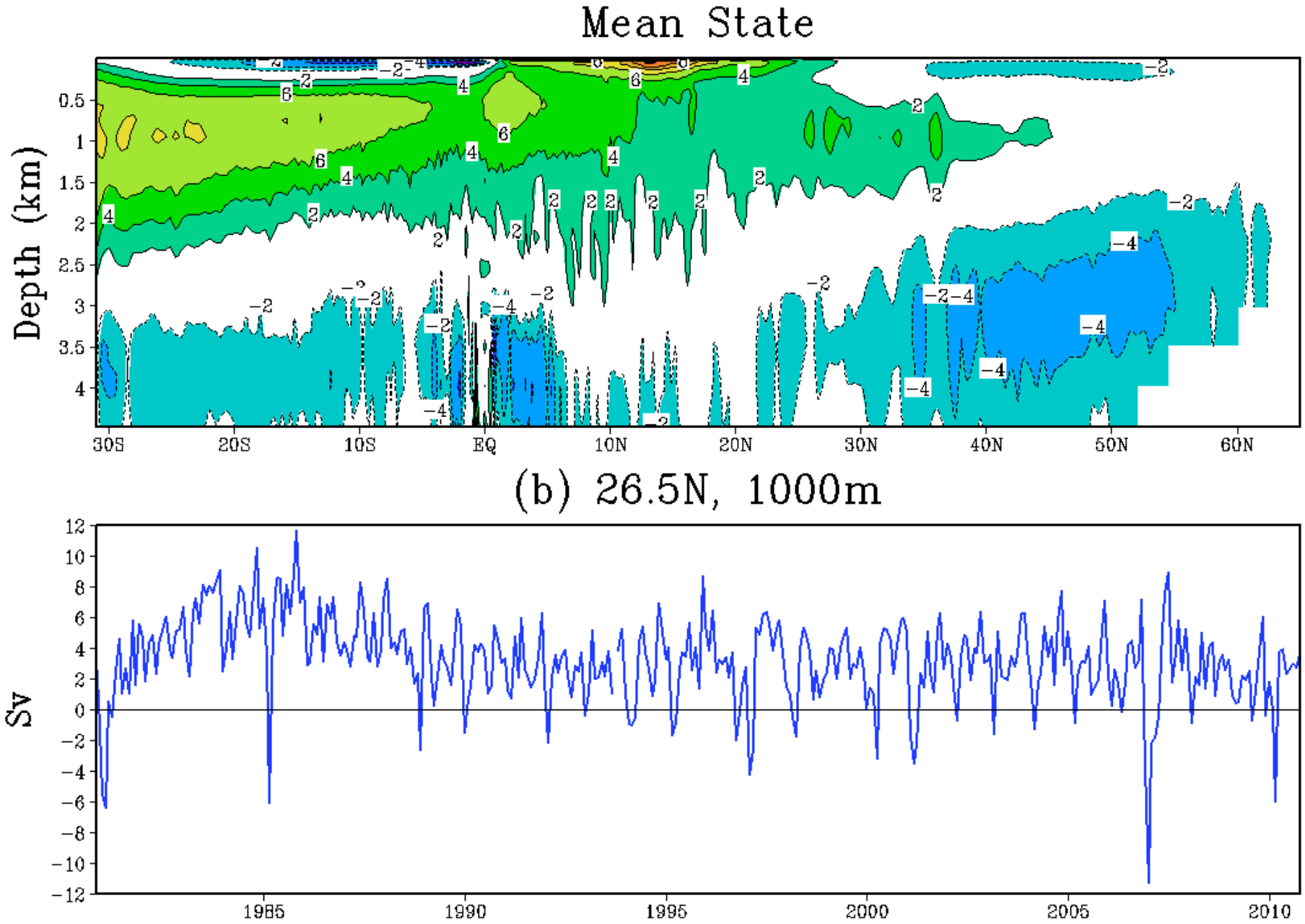


North Atlantic Seasonal AMV Index
T2m Averaged 0N-60N, 300E-360E (Land Included)

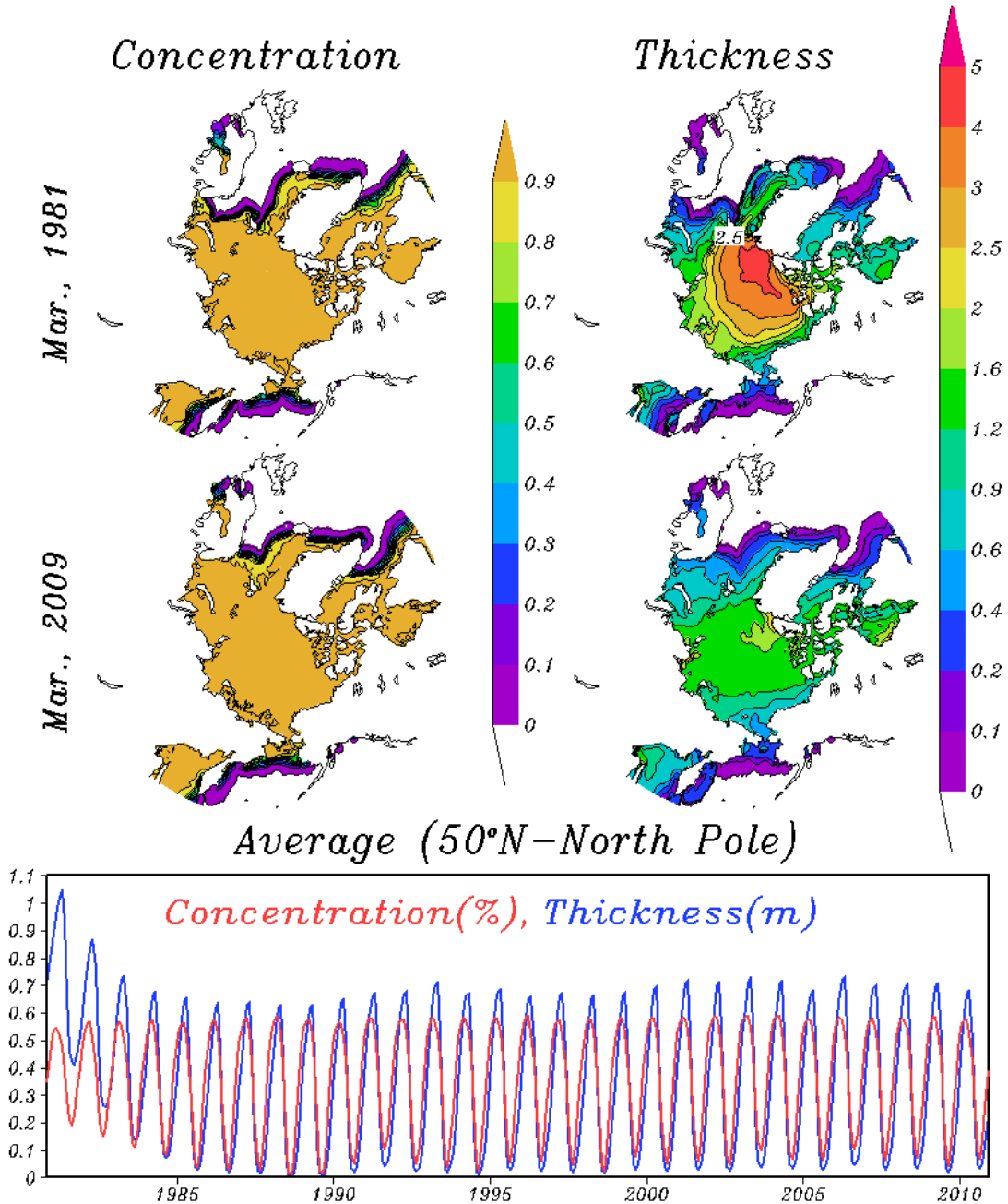


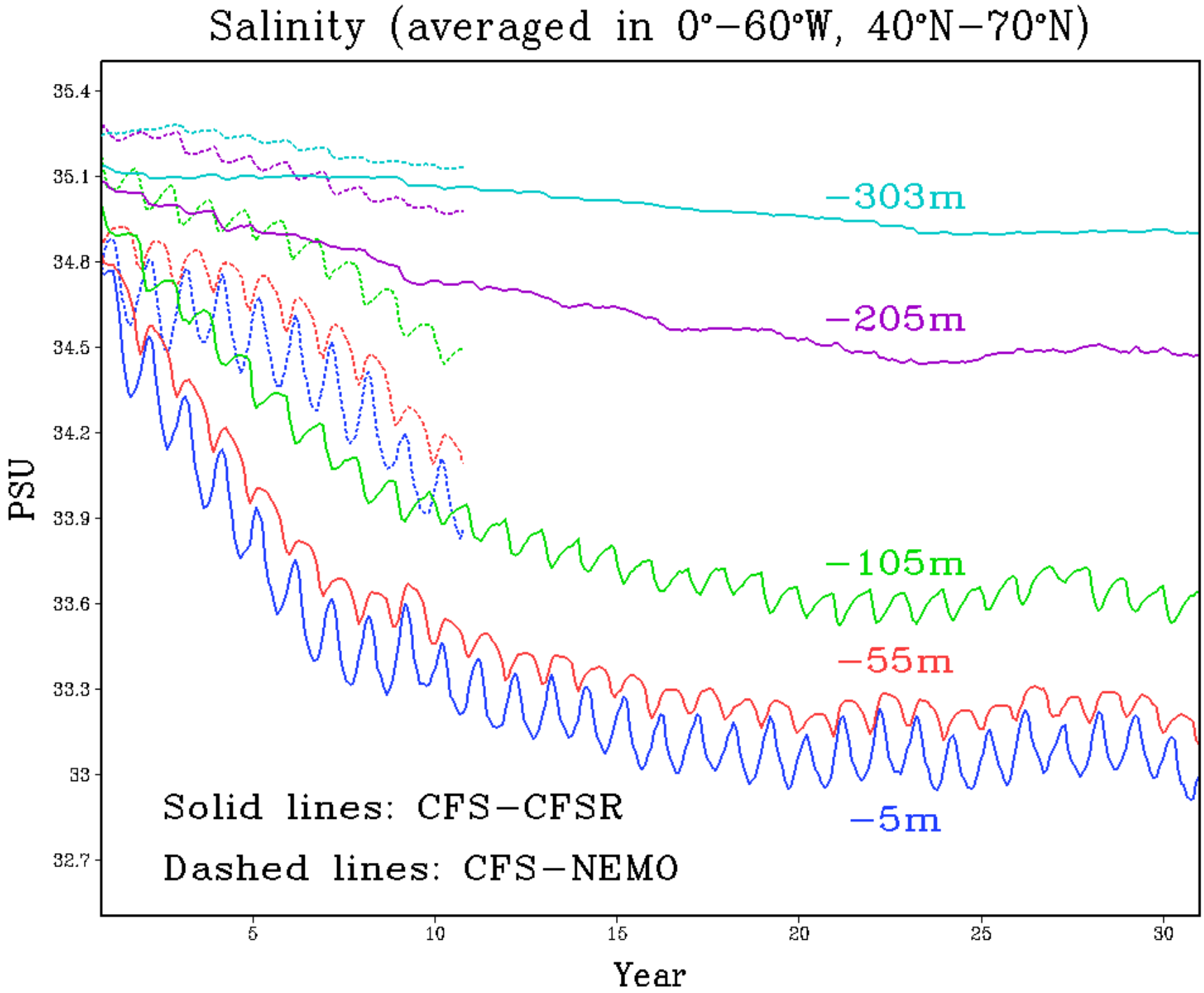
Sea Ice/AMOC Biases (courtesy of Bohua Huang)

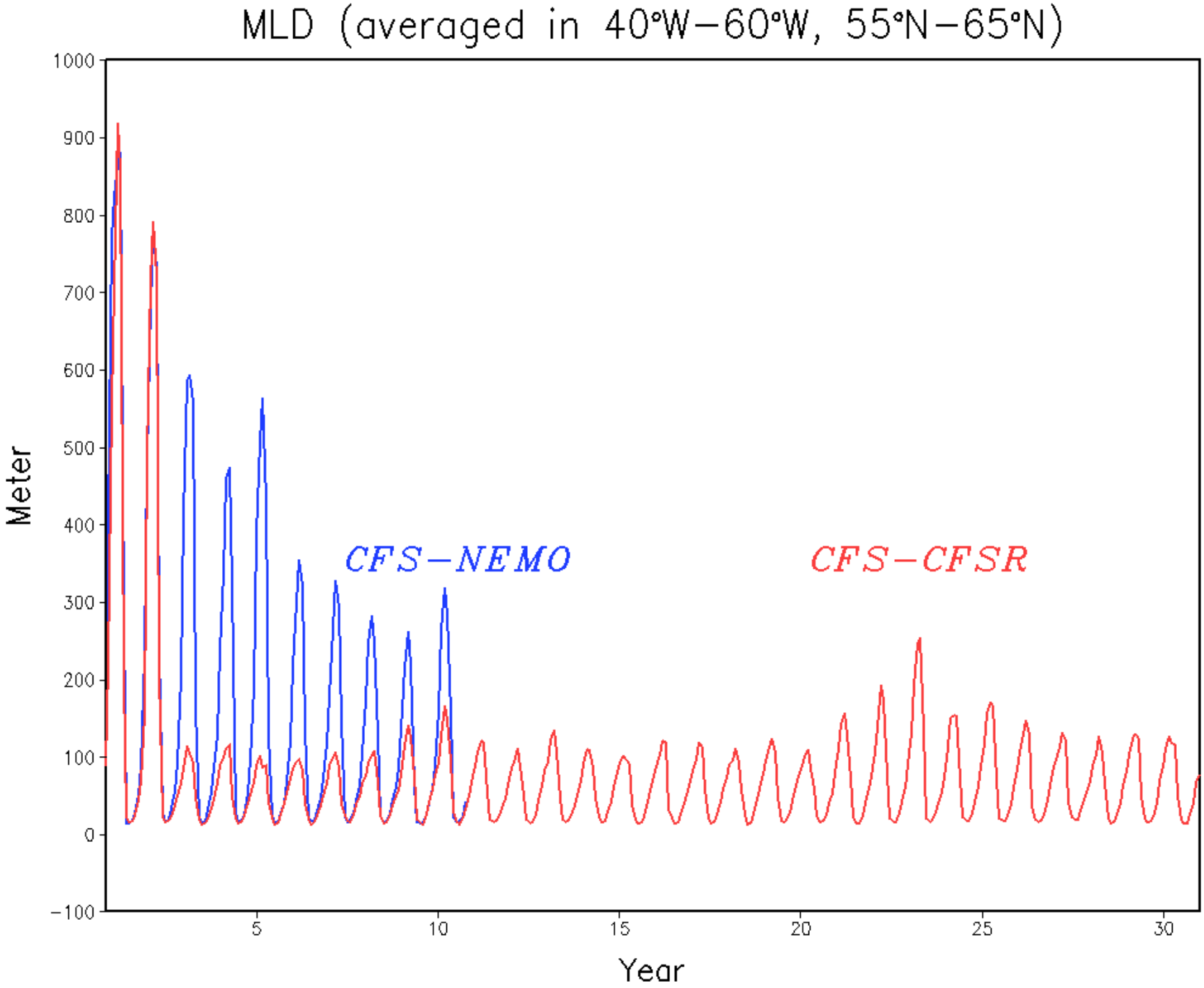
AMOC (Sv), CFS_v2, Control, 30-yr



Sea Ice, CFS−CFSR




Salinity (averaged in 0°–60°W, 40°N–70°N)
PSU
35.4
35.1
34.8
34.5
34.2
33.9
33.6
33.3
33
32.7
5
10
15
20
25
30
Year
–303m
–205m
–105m
–55m
–5m
Solid lines: CFS–CFSR
Dashed lines: CFS–NEMO


MLD (averaged in 40°W–60°W, 55°N–65°N)
Meter
Year
CFS–NEMO
CFS–CFSR
1000
900
800
700
600
500
400
300
200
100
0
−100
5
10
15
20
25
30

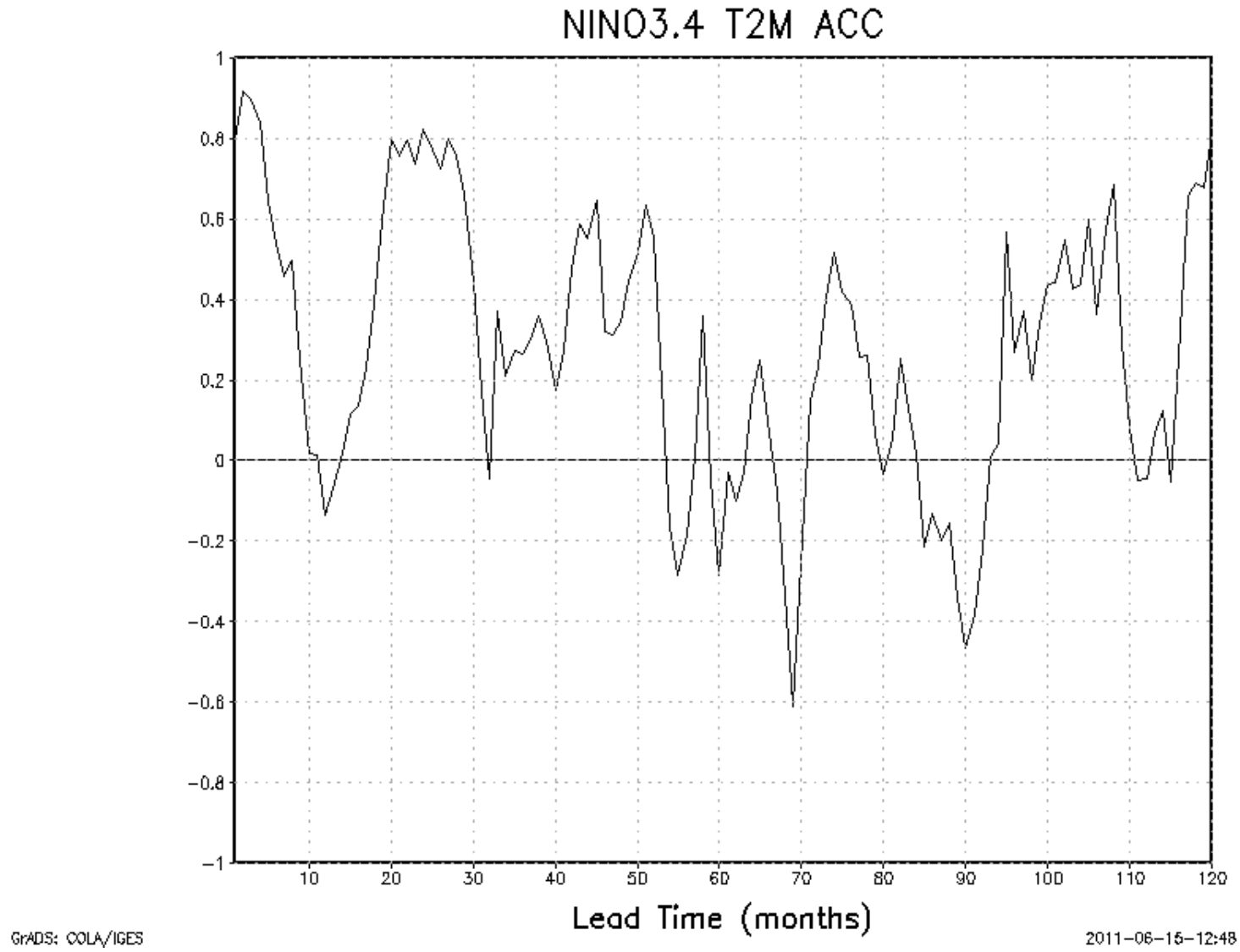
Future Plans

- Tune sea ice to reduce high latitude drifts by increasing albedo, hopefully improve AMOC
- Run again
- Anomaly initialization
- Run again
- …

Possible Issue

- **Initial state choice**
  - Limited number of initial years may lead to biased evaluations (e.g. suppose all initial years chosen are incipient El Nino. Then a model with a tropical warming bias will appear to make better forecasts than a model with no bias.)
  - Suggest that a better experimental design for the same cost would be to sample the initial states more thoroughly with fewer ensemble members.

NINO 3.4 SSTA Correlation



Implications for Bias Correction?

- Construct a set of almost perfect decadal forecasts of global mean surface air temperature (e.g. reanalysis).
- Initialize one set every year from 1960 to 1999
- Initialize another set every 5 years from 1960 to 1995.
- Compute "drift" of each set of forecasts
  - This "drift" to be subtracted from forecast mean and used for bias correction of predictions of future.
  - Green curve (from 5 year interval between ic's will introduce noise into the predictions.

Drift of Perfect Decadal Forecasts of Global Mean Surface Air Temperature