

Seasonal to Decadal Scale Climate Prediction

Presented by

Xiaosong Yang

Geophysical Fluid Dynamics Laboratory Review

May 20 – May 22, 2014



Predictability analysis

GOALS:

- Using statistical optimization approach to extract most predictable information in model hindcasts on different time scale (e.g., seasonal, decadal)
- Understand the mechanisms responsible for that predictability.

EXAMPLES:

- Decadal prediction of SST (CM2.1)
- Seasonal prediction of mid-latitude storms (FLOR)

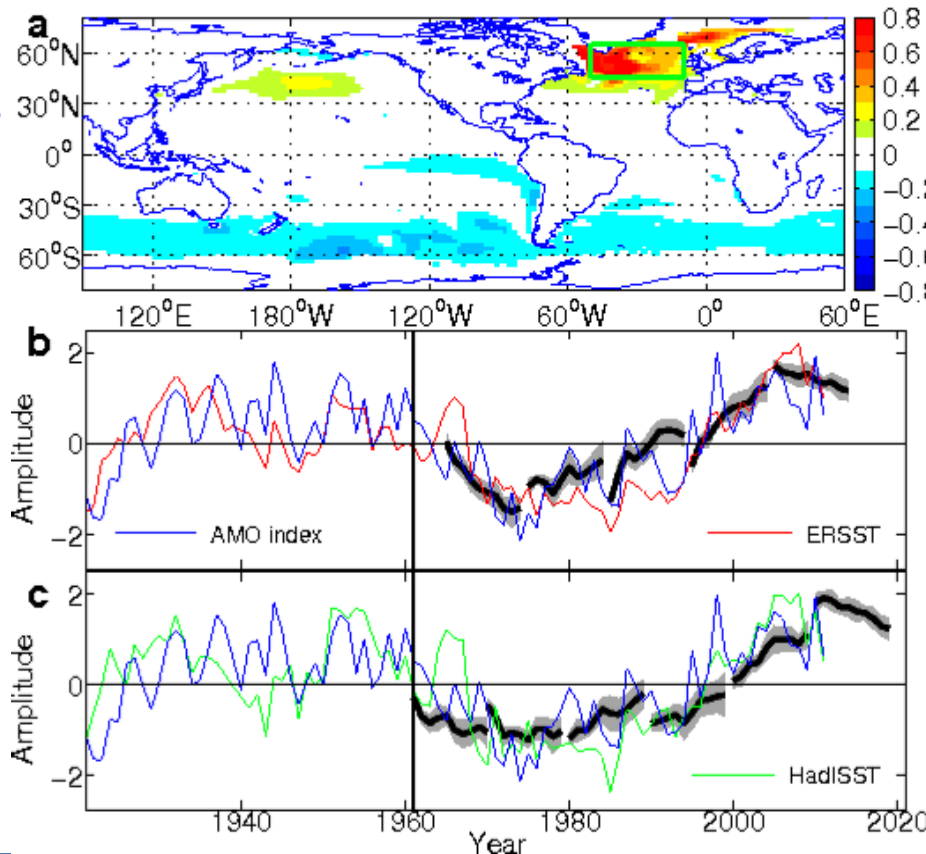
CMIP5 Decadal prediction: predictable AMO-like internal SST pattern

I.C.: 1Jan., 1961-2012 from ECDA

Internal: Hindcasts – Forced Response

Leading
predictable
pattern

Time
Series



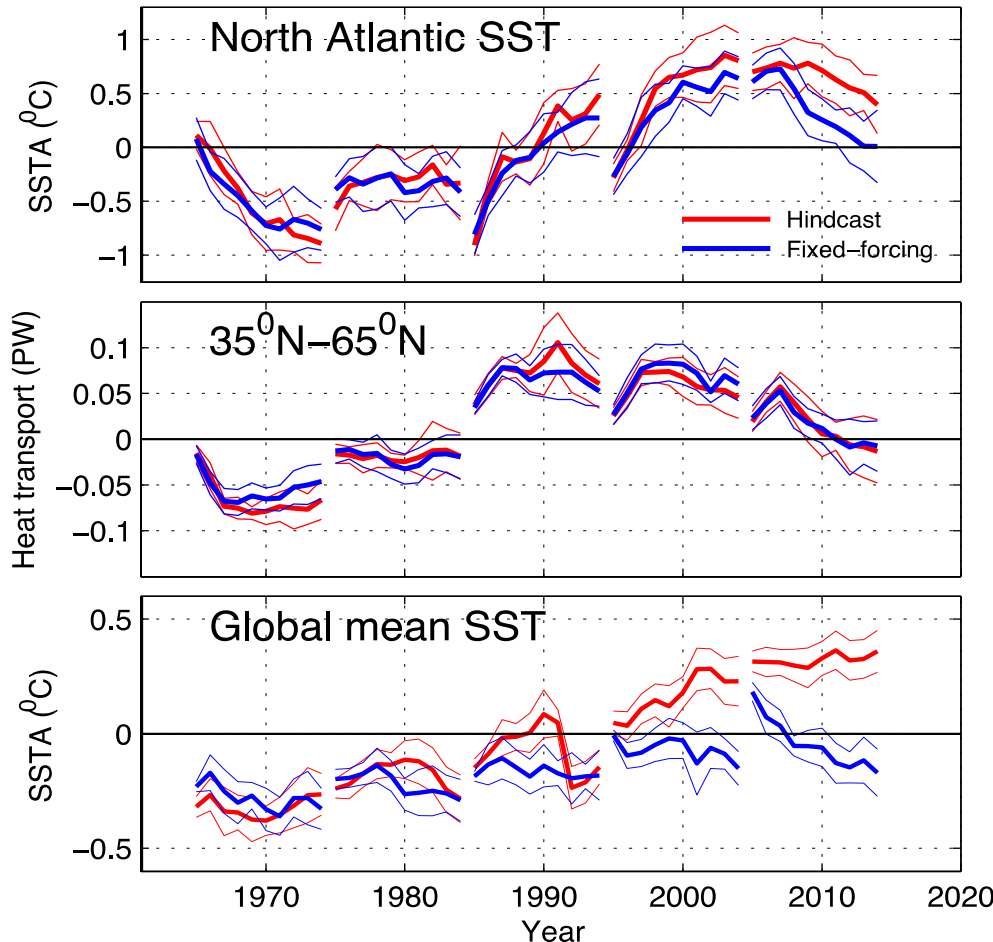
- An inter-hemisphere dipole pattern
- Time series well correlated with AMO index
- Hindcasts following observations

CM2.1

Yang et al. (2013, J. Clim.)

Global mean SST are controlled by radiative forcing, while predicting North Atlantic SST mainly originates from the internal processes

Forcing values = 1961 conditions, Same I. C.



North Atlantic SST:
Multidecadal variations

North Atlantic heat
transport: No change

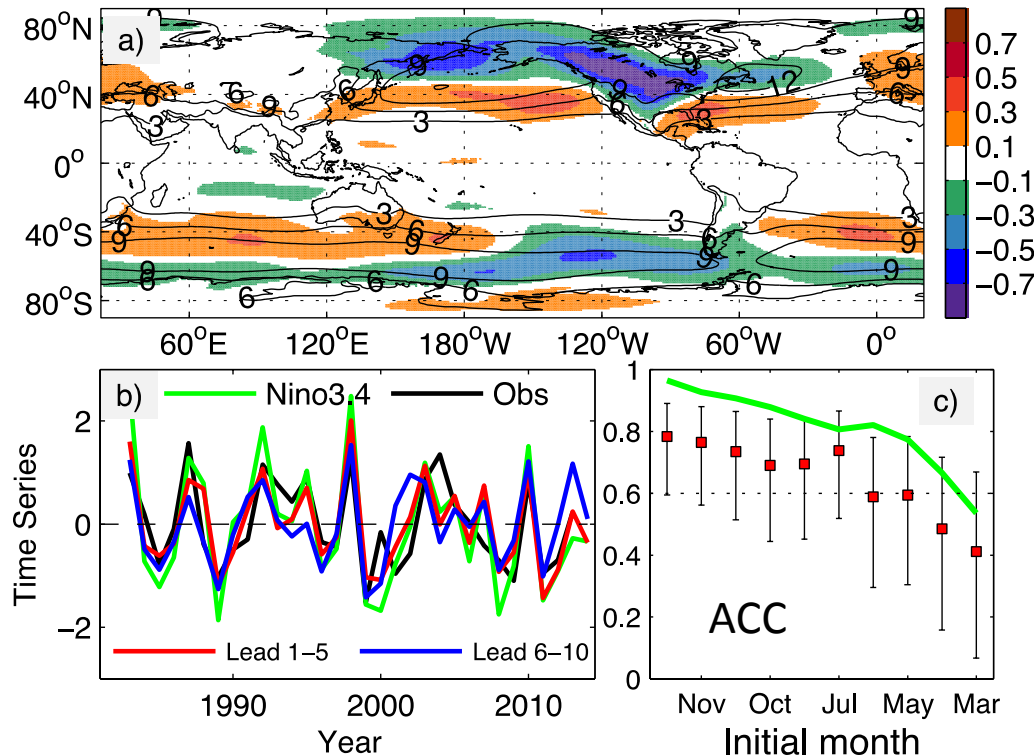
Global mean SST: Fast
Cooling

Seasonal prediction

- **Traditional seasonal prediction products**
 - Seasonal mean precipitation, surface temperature (first moment)
 - Predictability analysis of land temperature and precipitation (Liwei's poster)
- **Higher order products (second moment)**
 - mid-latitude storm tracks (Variance statistics)
 - Cause extreme weather and climate events
 - Useful information for the seasonal prediction
 - Are they predictable?

Leading Predictable pattern of storm tracks is ENSO-related, and is predictable up to 9 month lead time.

Storm track: std(6-hour filtered SLP)



Storm reduction over most North America

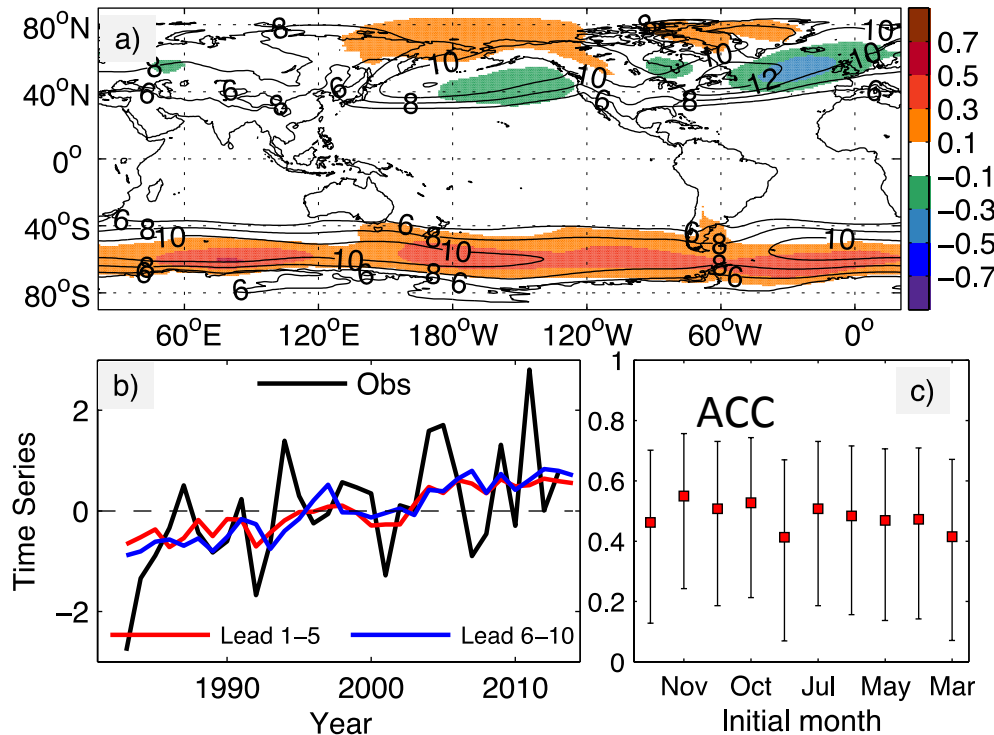
Time series highly correlated with NINO3.4

Skill is comparable with predicting ENSO

FLOR

Yang et al. (2014, J. Clim., Submitted)

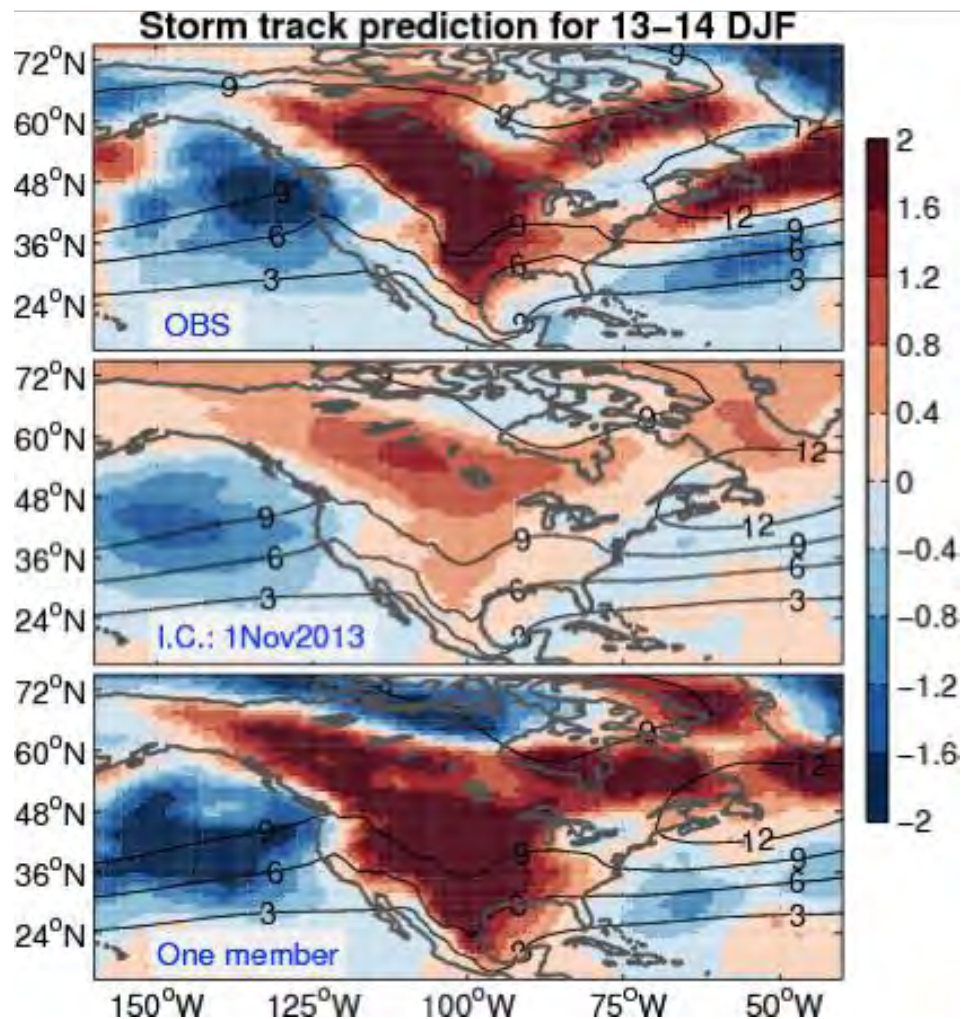
Both radiative forcing and multi-decadal variability also contributes to the seasonal predictability



Trend-like time series

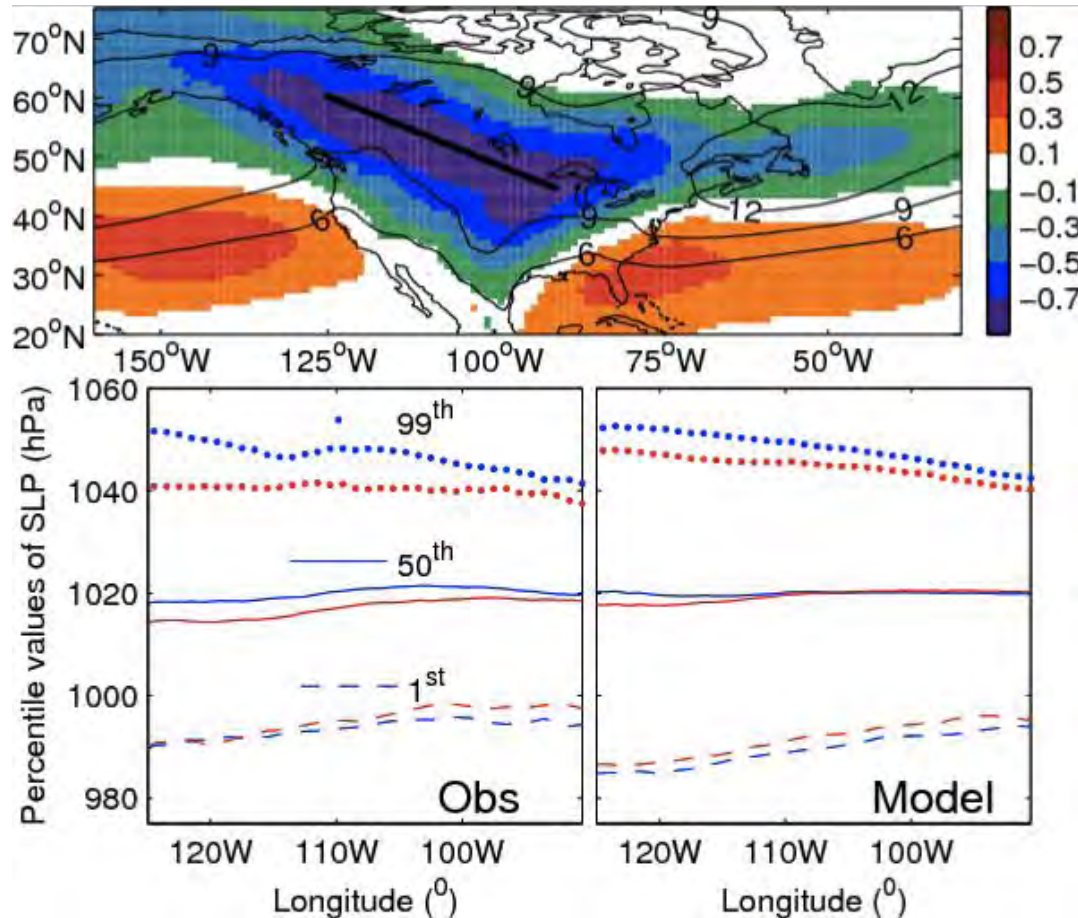
- Poleward expansion and strengthening of the SH storm tracks
- Consistent with CMIP5 projection (Chang et al. 2012)
- Weakening of North Atlantic storm tracks (AMO-phase, Zhang and Delworth, 2007)

Storm track prediction for 2014 winter (non-ENSO year)



Skill is limited to 1-2 months lead time

The model could predict the storm extreme changes associated with ENSO



Blue: La Niña composite Red: El Niño composite

During **El Niño** years:

Reduced storm tracks →
Reduced both anticyclones and cyclones → Smaller 99th percentile value and larger 1st percentile value (Narrower distribution width)

Vice versa for **La Niña** years

Model agrees well with Obs

Summary

- AMO-like internal multi-decadal pattern may be predictable multi-years in advance.
- ENSO-related mid-latitude storm track pattern is predictable up to 9 month lead.
- The multidecadal trend (radiative forcing) also contributes to the seasonal prediction of storm tracks.
- The FLOR model could reproduce the observed storm extreme changes associated with ENSO.
- Potential opportunity of providing extreme storm information in seasonal prediction.