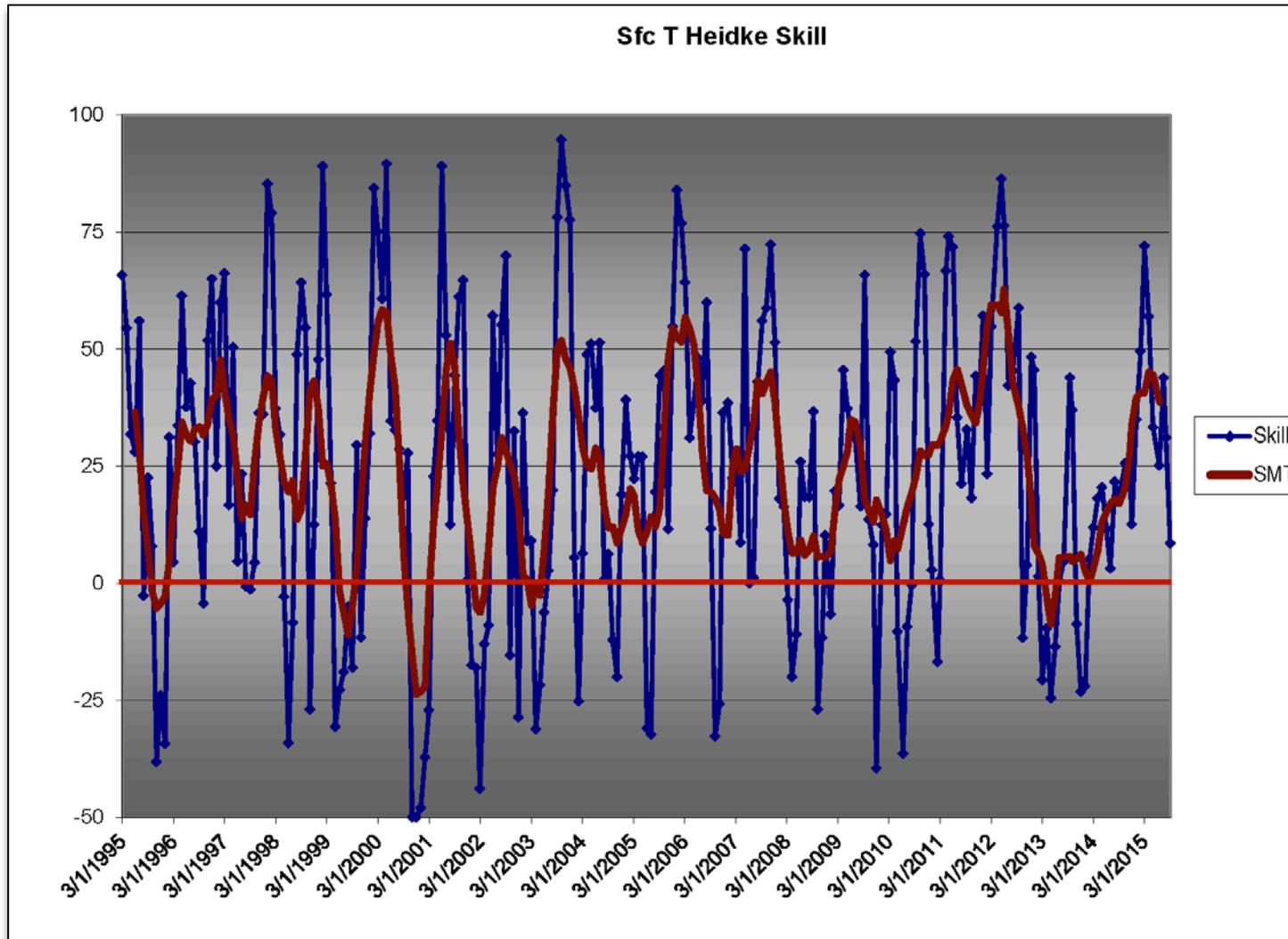


Approaches for estimating seasonal predictability: Where are we with current estimates?

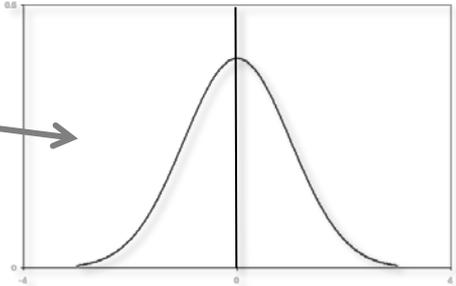
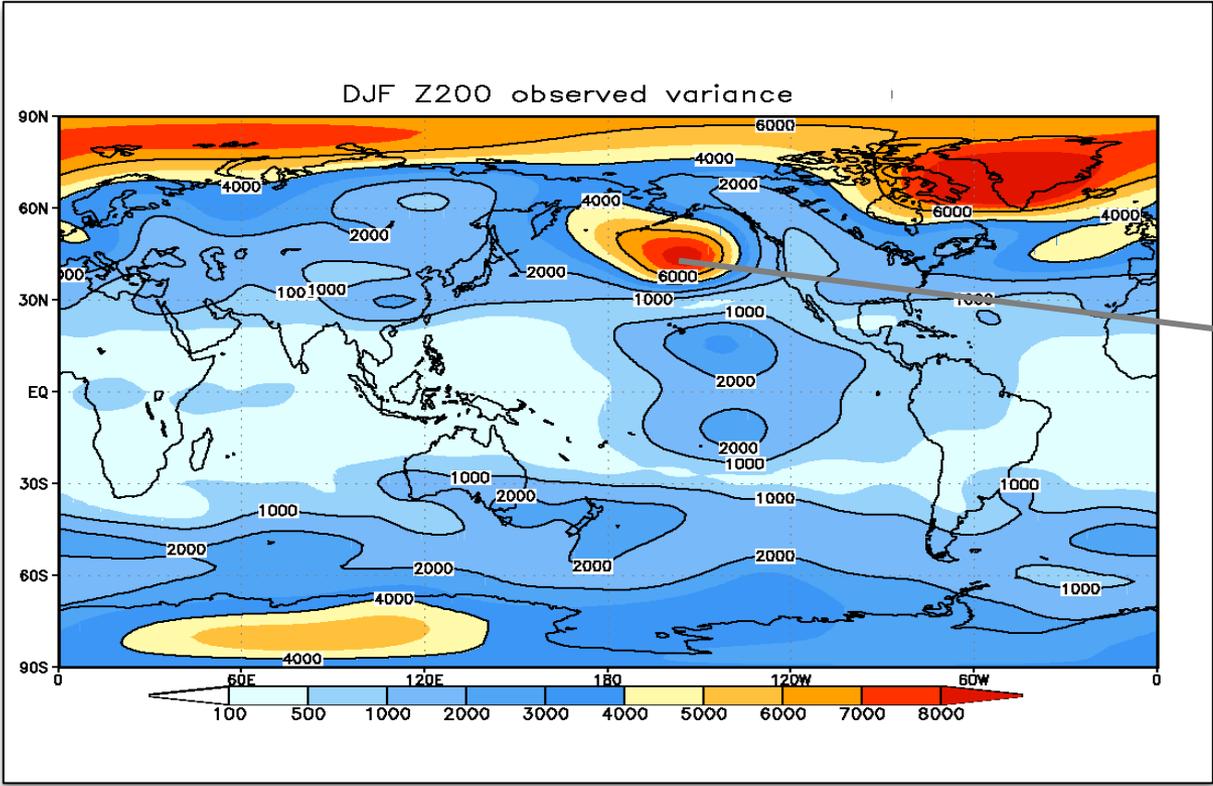
Arun Kumar

Martin Hoerling

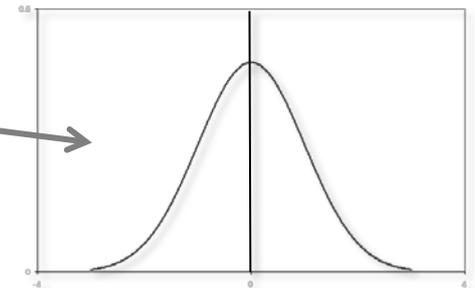
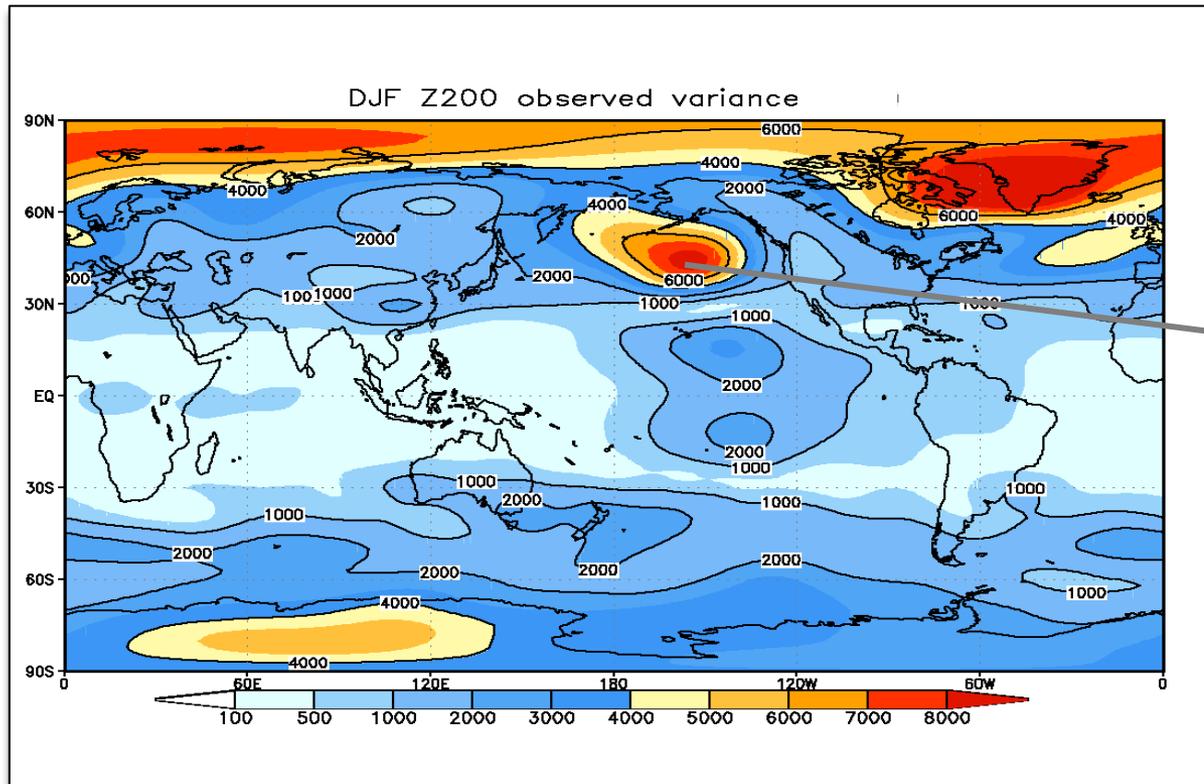
Skill of CPC's US Seasonal Surface Temperature Outlook



What is the average predictability in nature?



What is the average predictability in nature?



Predictability → How much one can narrow the choice of outcomes before the beginning of the season?

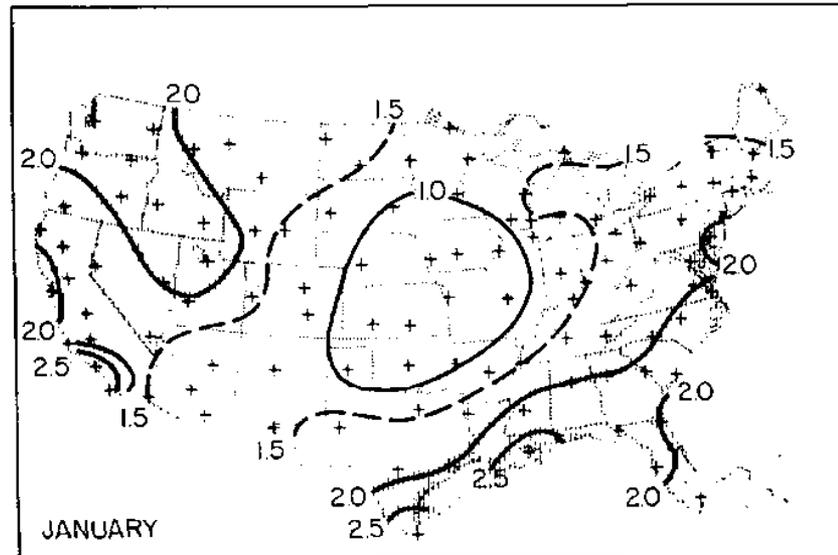
- Various reasons that allow one to narrow the choice of future outcomes
 - Initial conditions
 - Boundary conditions
 - External conditions (e.g., volcanic aerosols, CO₂)
- And their influence depends on the lead time

- Some other reasons why one wants to assess/estimate predictability?
 - Managing expectations; How much better can predictions become?
 - Improving models to harvest sources of predictability
 - Where to place limited resources (ensemble size, model resolution, analysis, perturbations,...)

Methods for Estimating Predictability

- Observational data
 - Daily time-series
 - Predictor – Predictand relationships
 - Analogs
- Simple; unbiased, but non-linearity is hard to incorporate

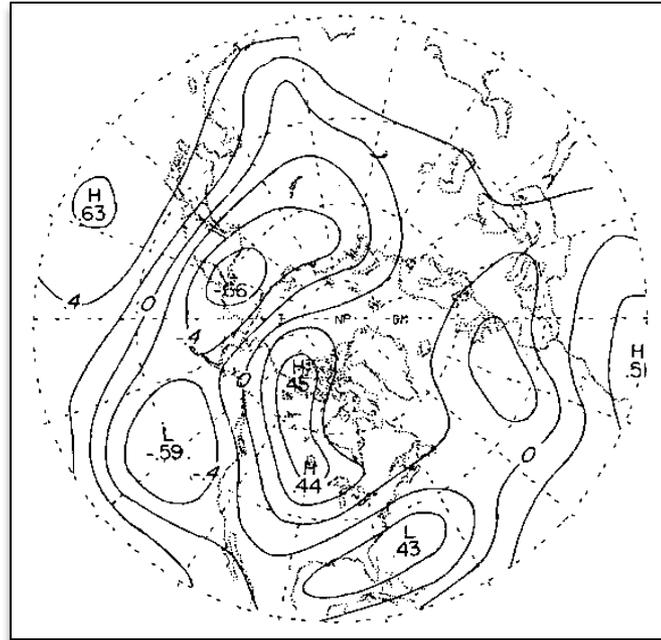
R. Madden, 1976: Estimates of natural variability
time-averaged sea-level pressure. *MWR*



% of predictable variance
Surface Temperature

...We argue that this [time-averaged temperature] variability is essentially unpredictable and places important limitations on our ability to make long-range predictions...

Horel and Wallace, 1981: Planetary-scale atmospheric phenomenon associated with southern oscillation, *MWR*



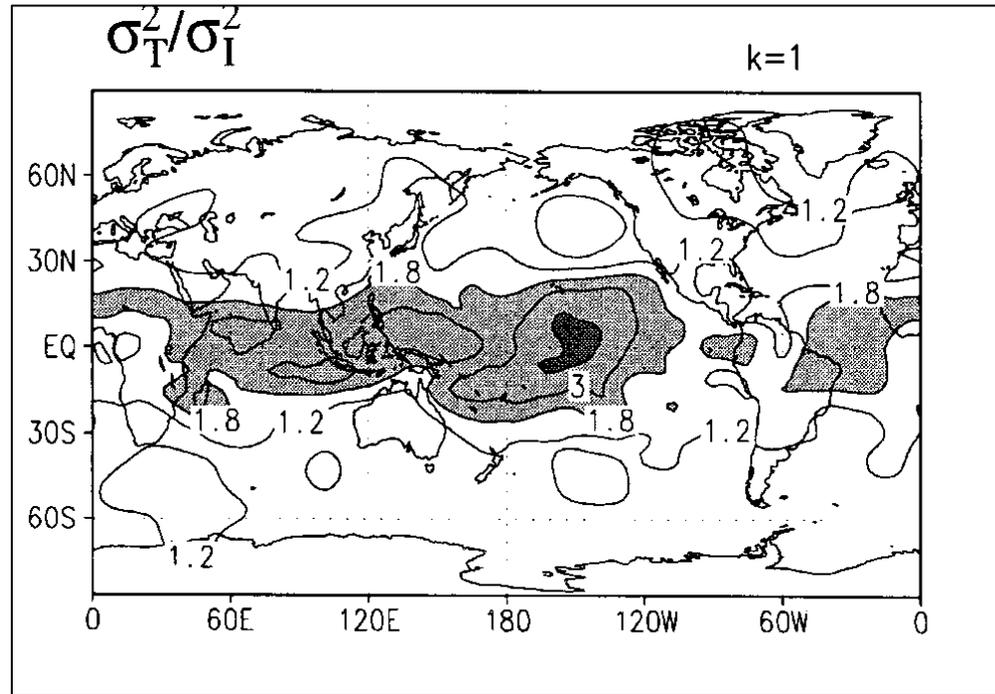
DJF Z700 Correlation with SST index

...If the strength of the correlations is limited by the high level noise inherent in seasonal averages due to the presence of weather fluctuations...then prospects of (seasonal predictions) are not encouraging. On the other hand, if patterns constitute blurred images resulting from ... superposition of shaper patterns...then there is hope for (skillful SI predictions)

Methods for estimating predictability

- Models
 - Ensemble with specified boundary forcings (AMIP)
 - Initialized AGCM predictions with specified boundary forcings
 - Initialized coupled predictions
 - Ensemble based on multiple models

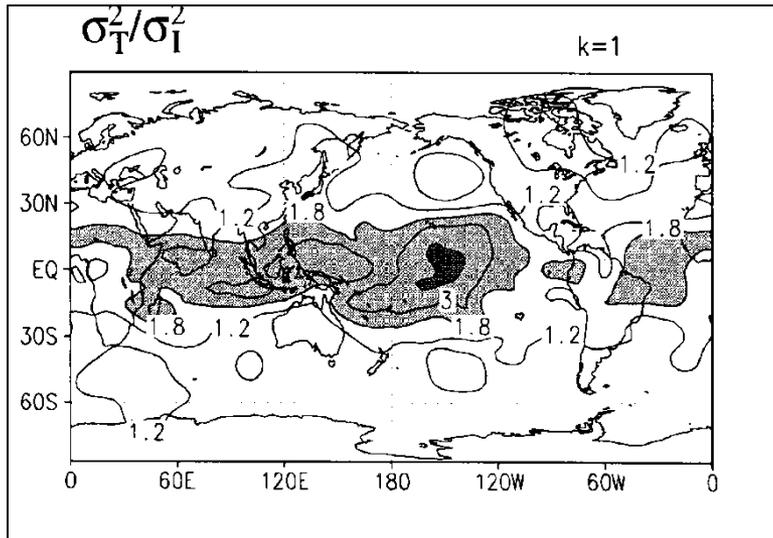
Estimate of Predictability : 1995



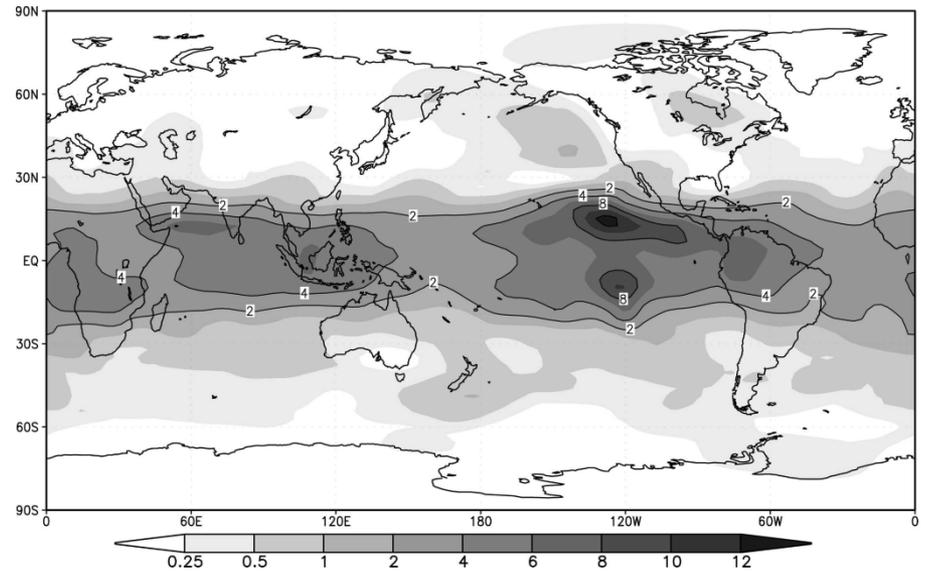
Kumar and Hoerling, 1995: Prospects and limitations of atmospheric GCM climate predictions. *BAMS*

January 1983 – 1993; 9 member ensemble; 200 mb Z

Estimate of Predictability : 2007

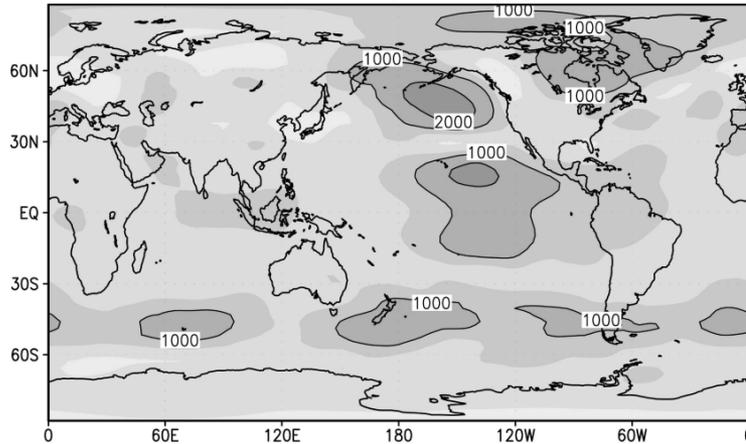


Jan; 1983 - 1993 ; 200 mb Z

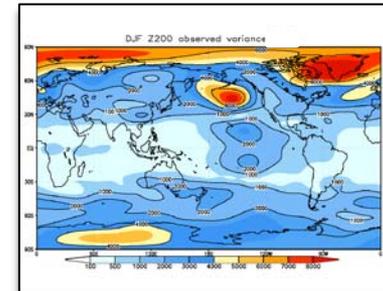


DJF; 1950 - 2000 ; 200 mb Z

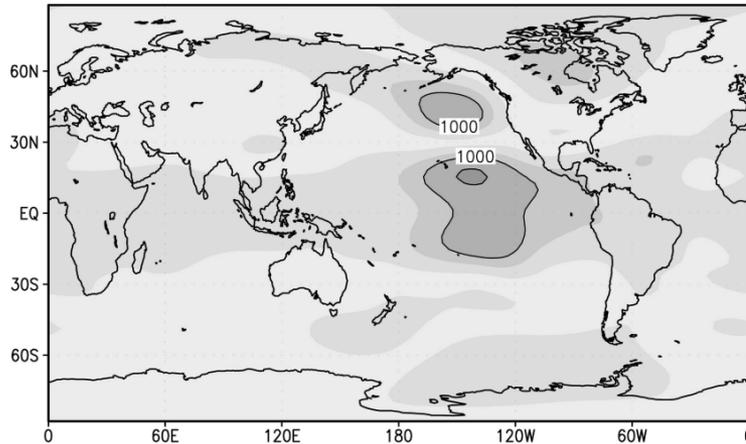
Estimate of Predictability : 2007



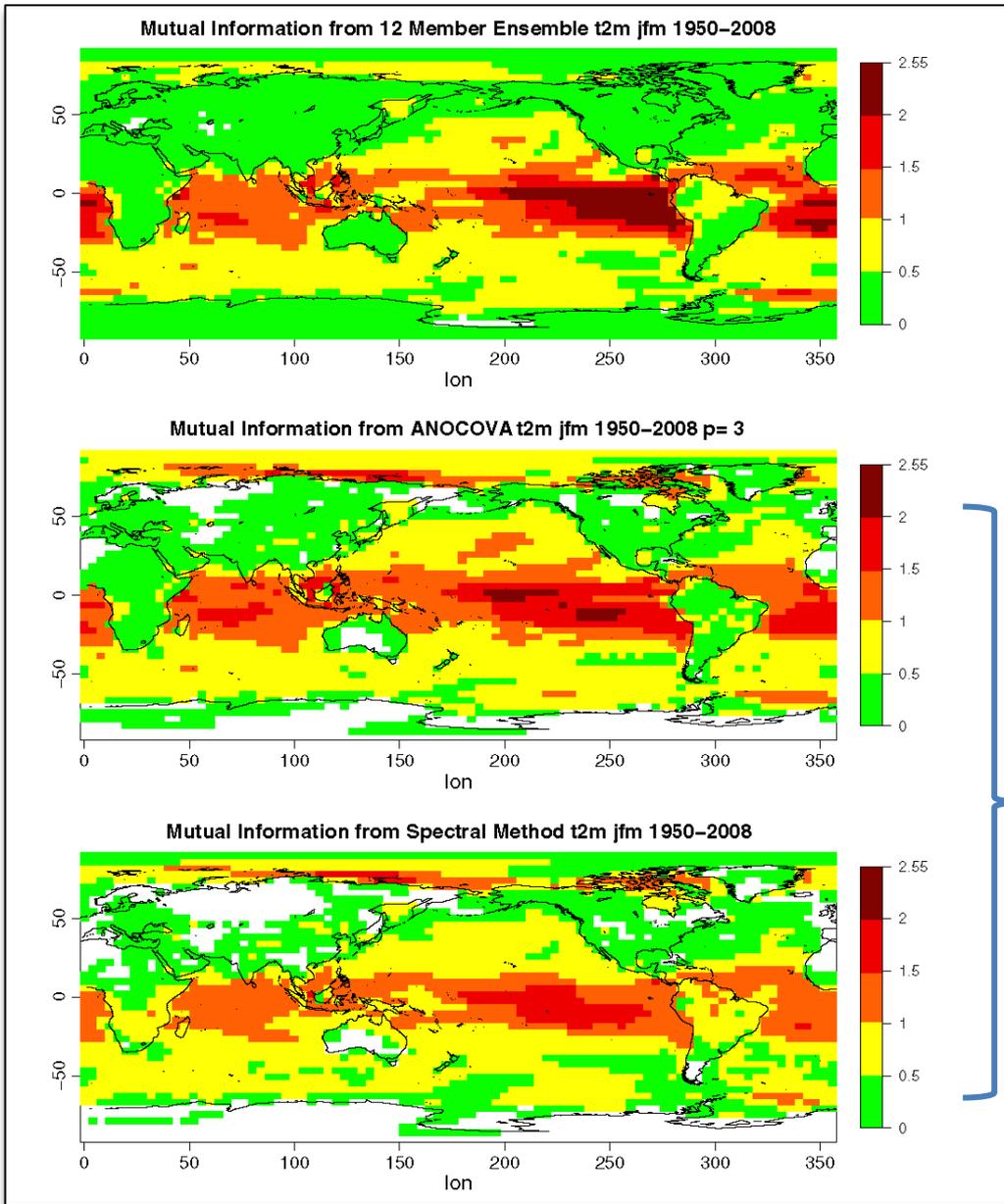
Ensemble mean
variability



Linear: Variance
Accounted for by Nino3.4



DJF; 1950 – 2000 ; 200 mb Z

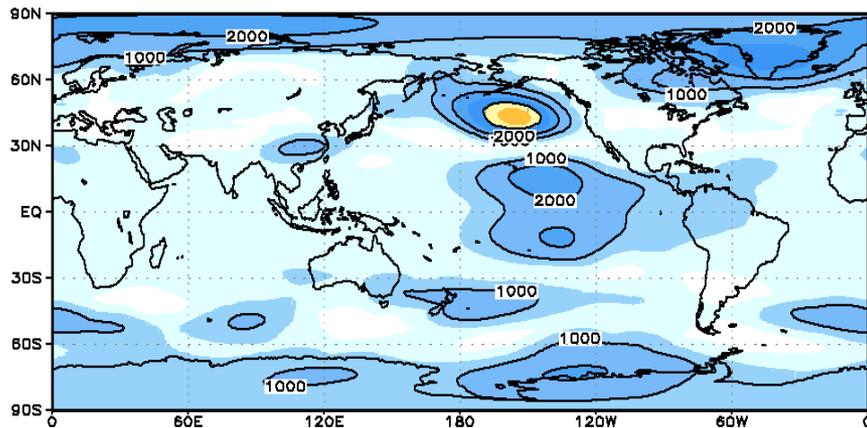


Ensemble Based

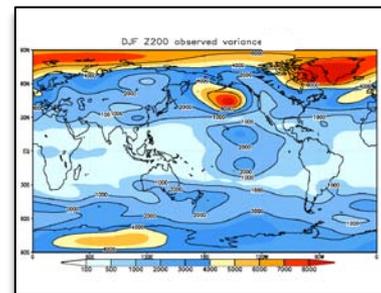
Based on Daily Data from Model Simulations

Delsole, Kumar, Jha, 2013, *GRL*

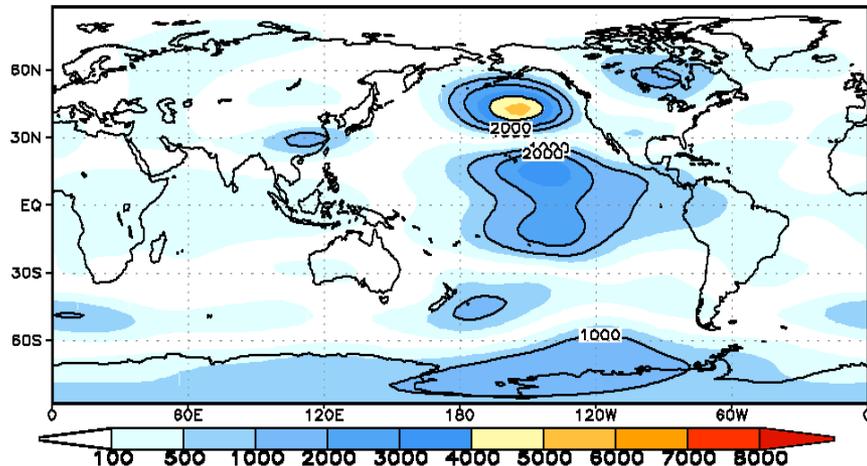
Estimate of Predictability : 2015



Ensemble mean
variability

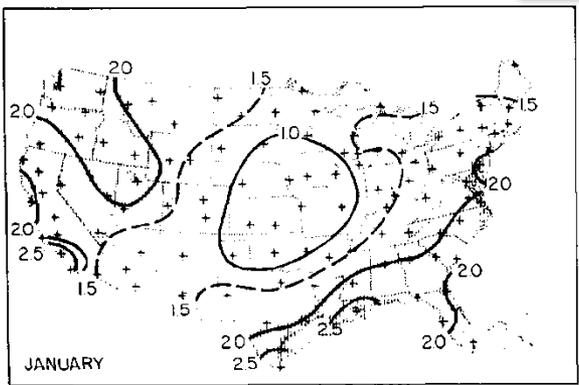


Linear: Variance
Accounted by Nino3.4

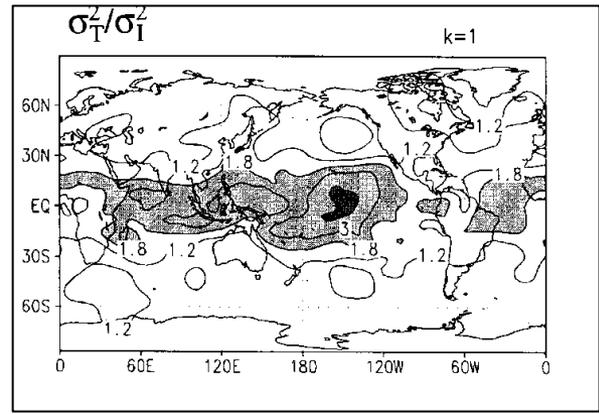
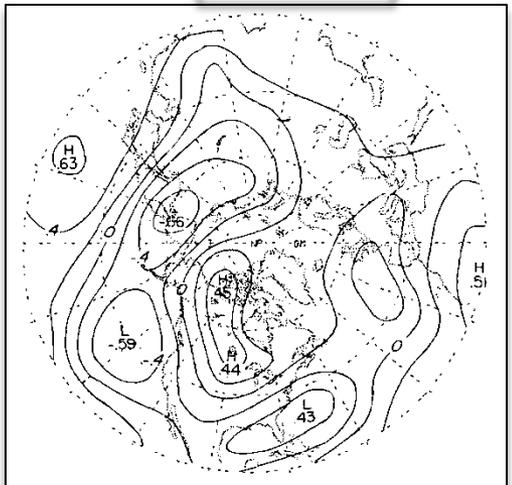


DJF; 1982 - 2010; 200 mb Z

1976

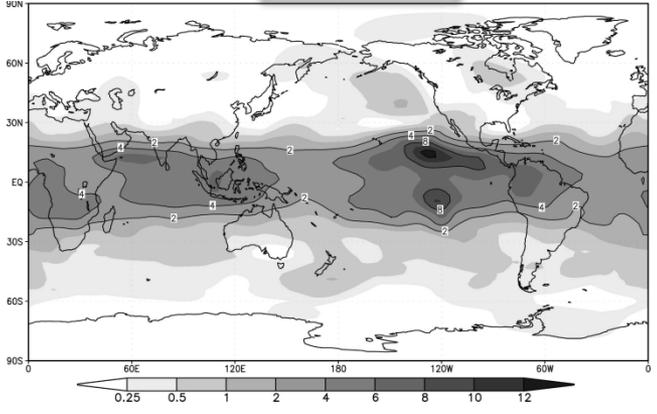


1981



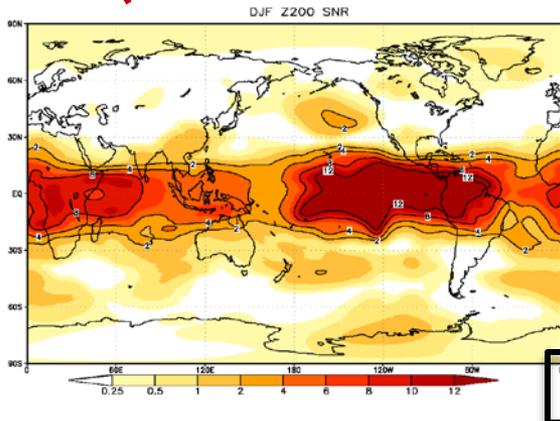
1995

2007



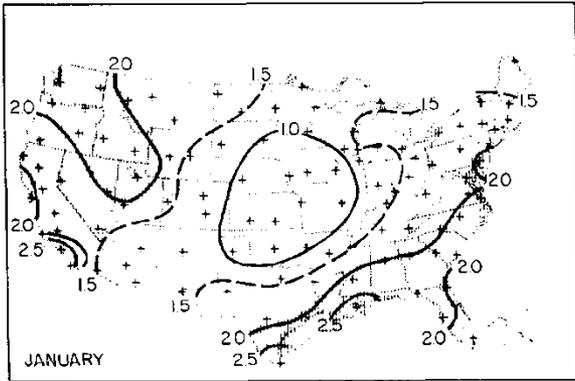
?

2025

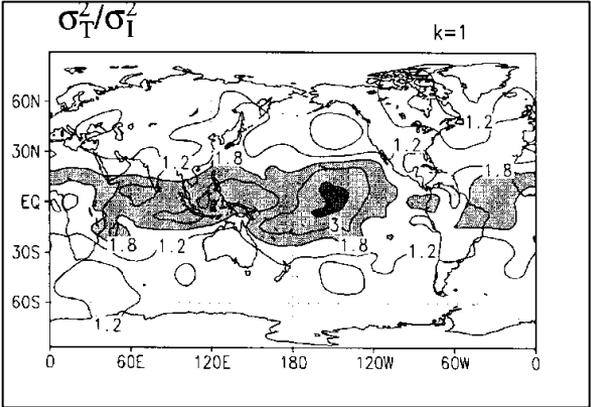
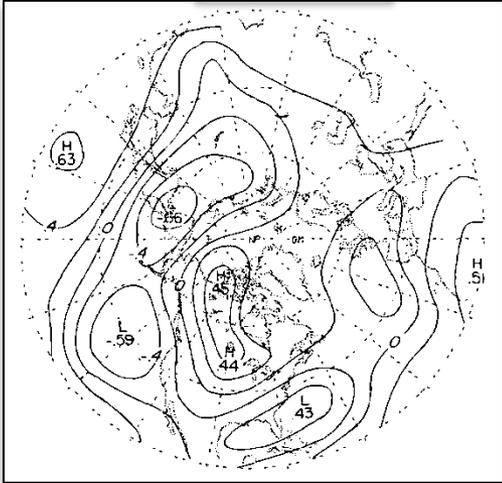


2015

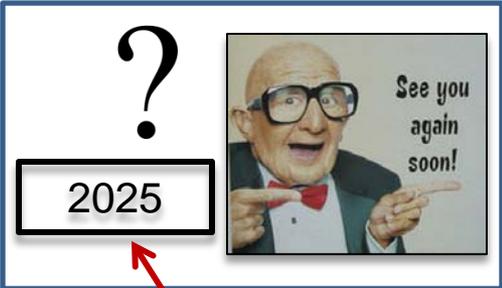
1976



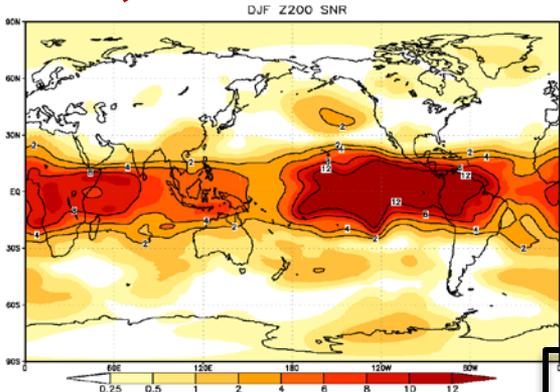
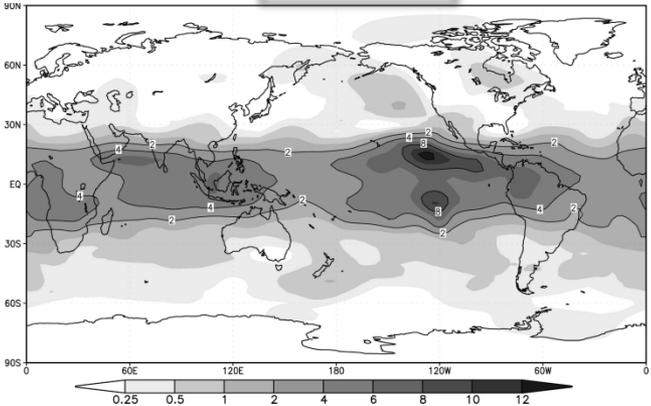
1981



1995



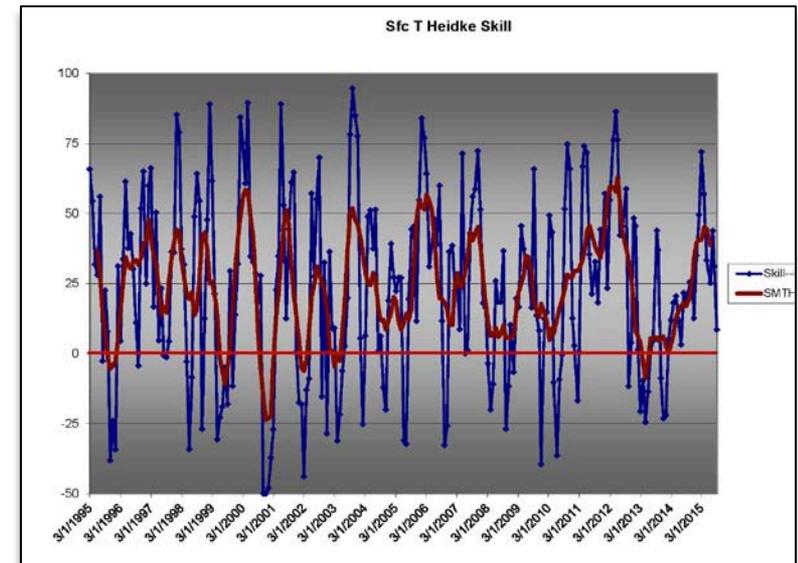
2007



2015

Seasonal-Climate Forecasts Improving Ever So Slowly

“There are seasons, places, and situations in which skill is very, very good,” says climatologist and study co-author recently retired from the National Weather Service (NWS). But even many people in the field “don’t appreciate how little there is to work with. **There is really no evidence here that there are any other silver bullets**” waiting to be found.



Thanks!