Forecasting Forecast Skill: Can an ENSO Conditional Skill Mask Improve Seasonal Predictions?

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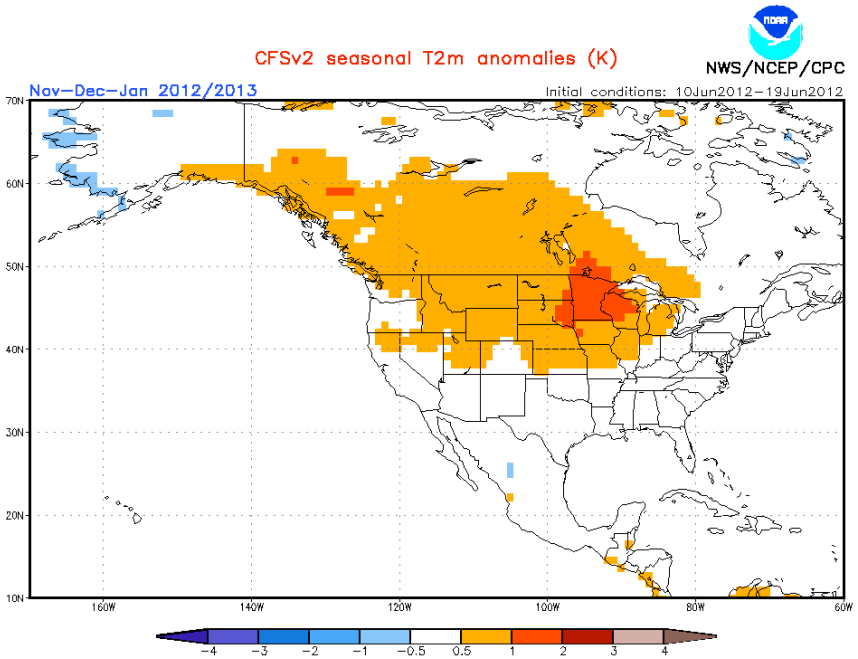
What is a Skill Mask?

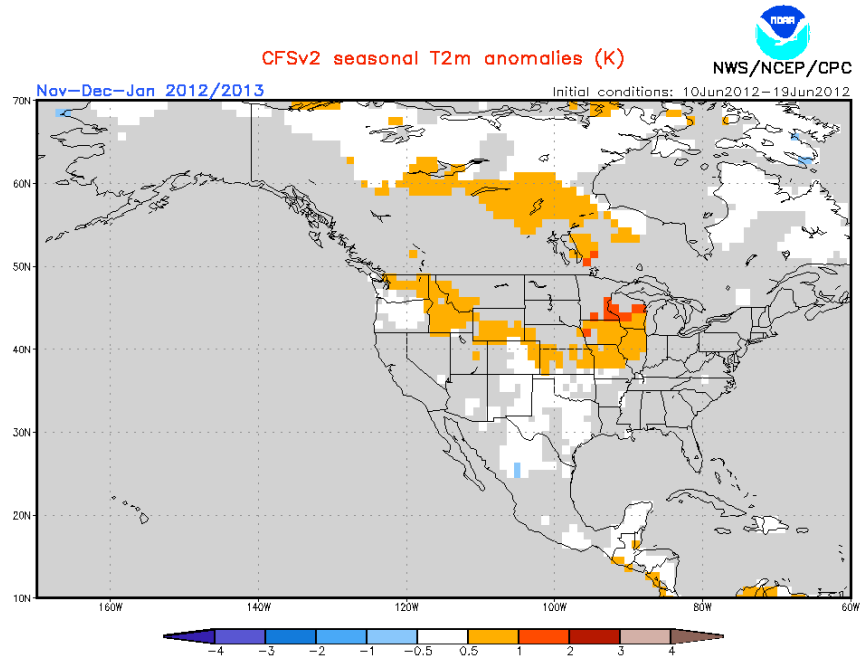
A simple model for forecasting forecast skill

ICs: 20120609 -20120619

CFSv2 T2M Forecast



CFSv2 Forecast w/Skill Mask Applied



(Areas of expected skill less than 0.3 are shaded in grey.)

- Skill Mask is Determined from Re-forecasts
- Average anomaly correlation skill over 1982-2009
- Function of initial month and lead-time
- *Average* AC skill < 0.3 is considered not skillful

From NOAA/NWS/NCEP/CPC (http://www.cpc.ncep.noaa.gov/products/people/wwang/cfsv2fcst/)

Data & Methodology

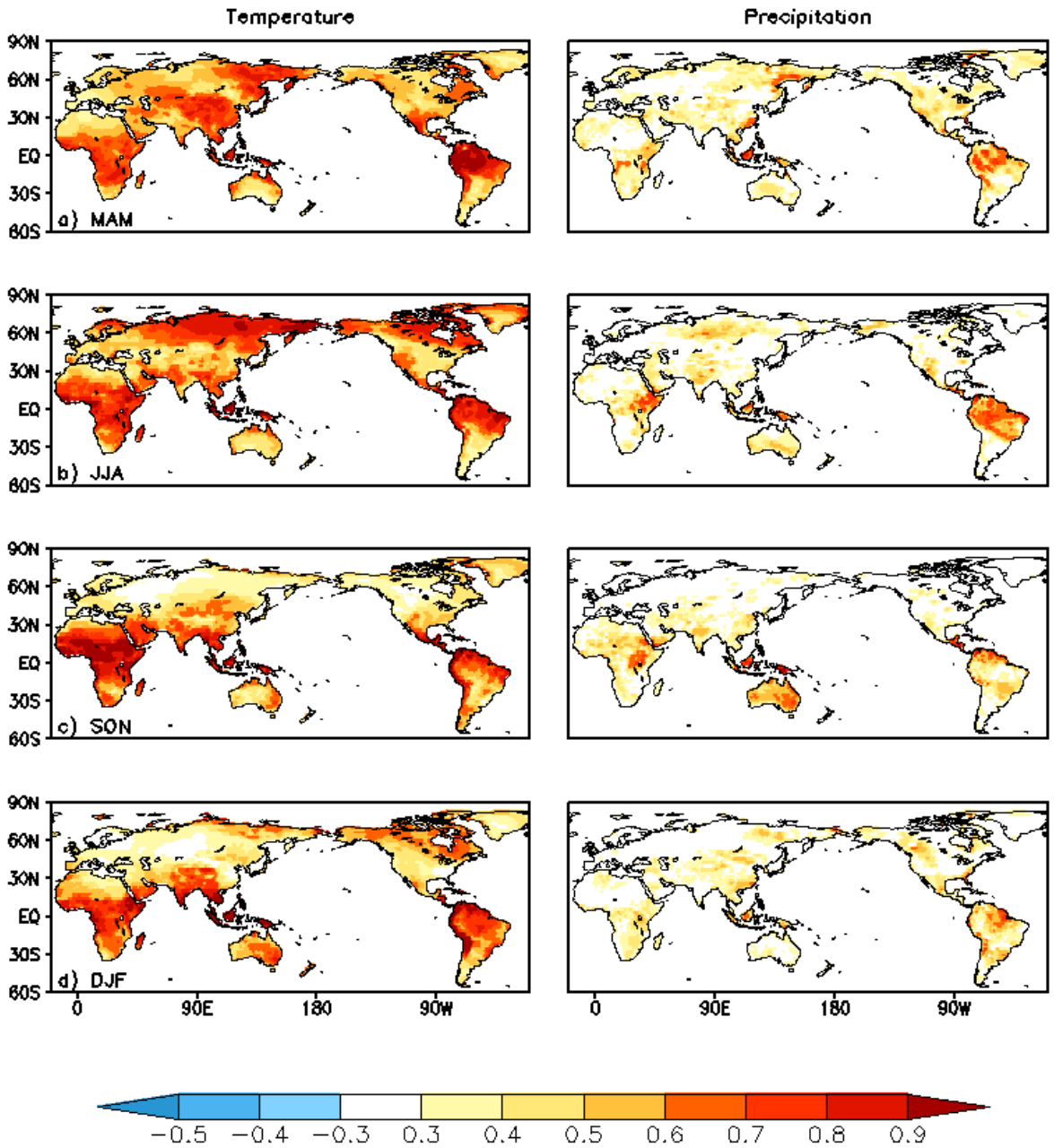
Data

- CFSv2 Re-forecasts (24 ensemble members per month, 1982-2009)
- 0, 3, 6-month leads
- U.S. 2m Temperature & Precipitation

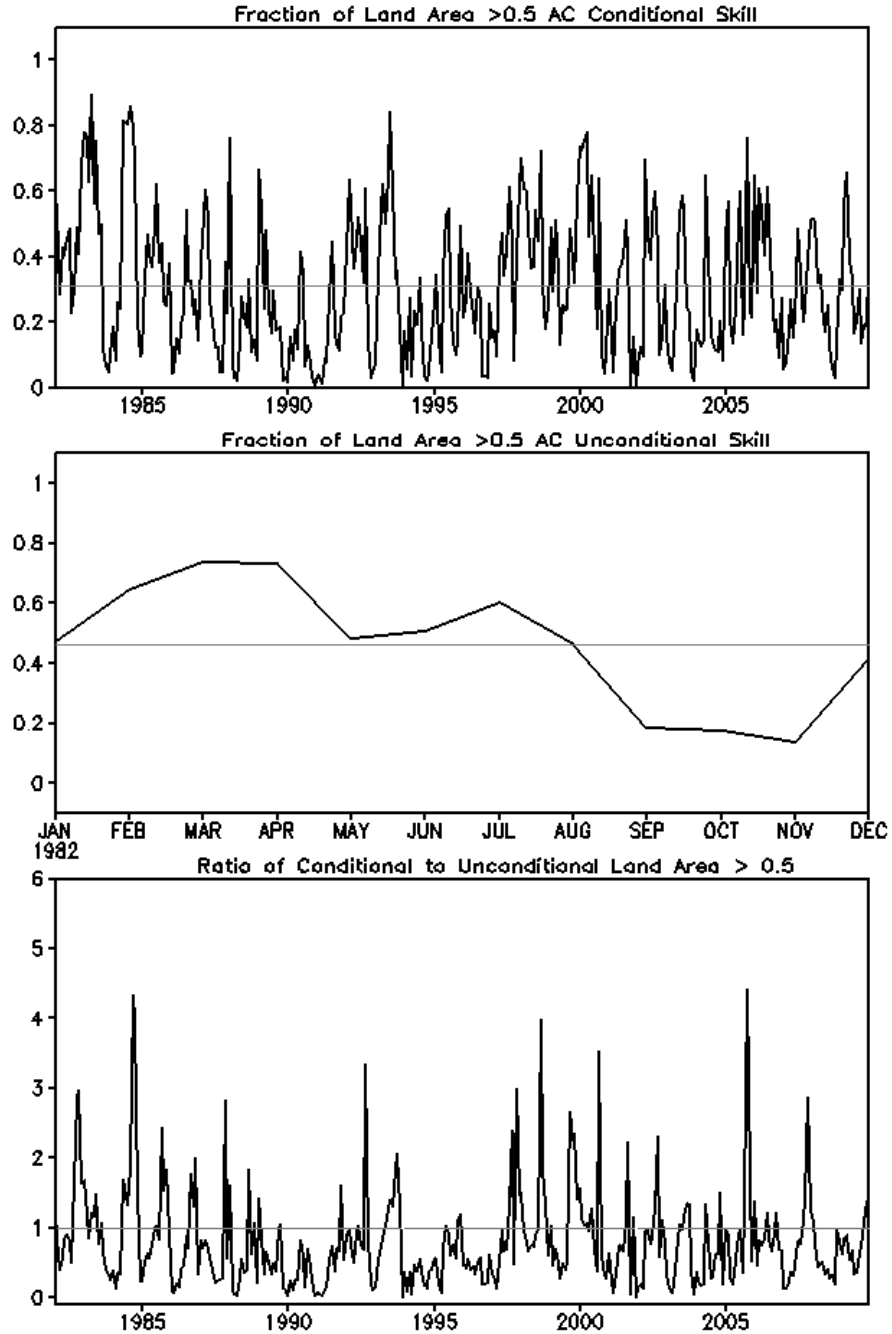
Perfect Model Approach

- Withhold one ensemble member as “truth” and determine forecast using the other 23 members. Repeat for all members.

"Unconditional" or Average Correlation Skill
0-month lead CFSv2 Perfect Model Forecasts (1982-2009)



Conditional (Year-to-Year) Perfect Model Skill over U.S.



Can we Predict the Skill Associated with the ENSO Signal?

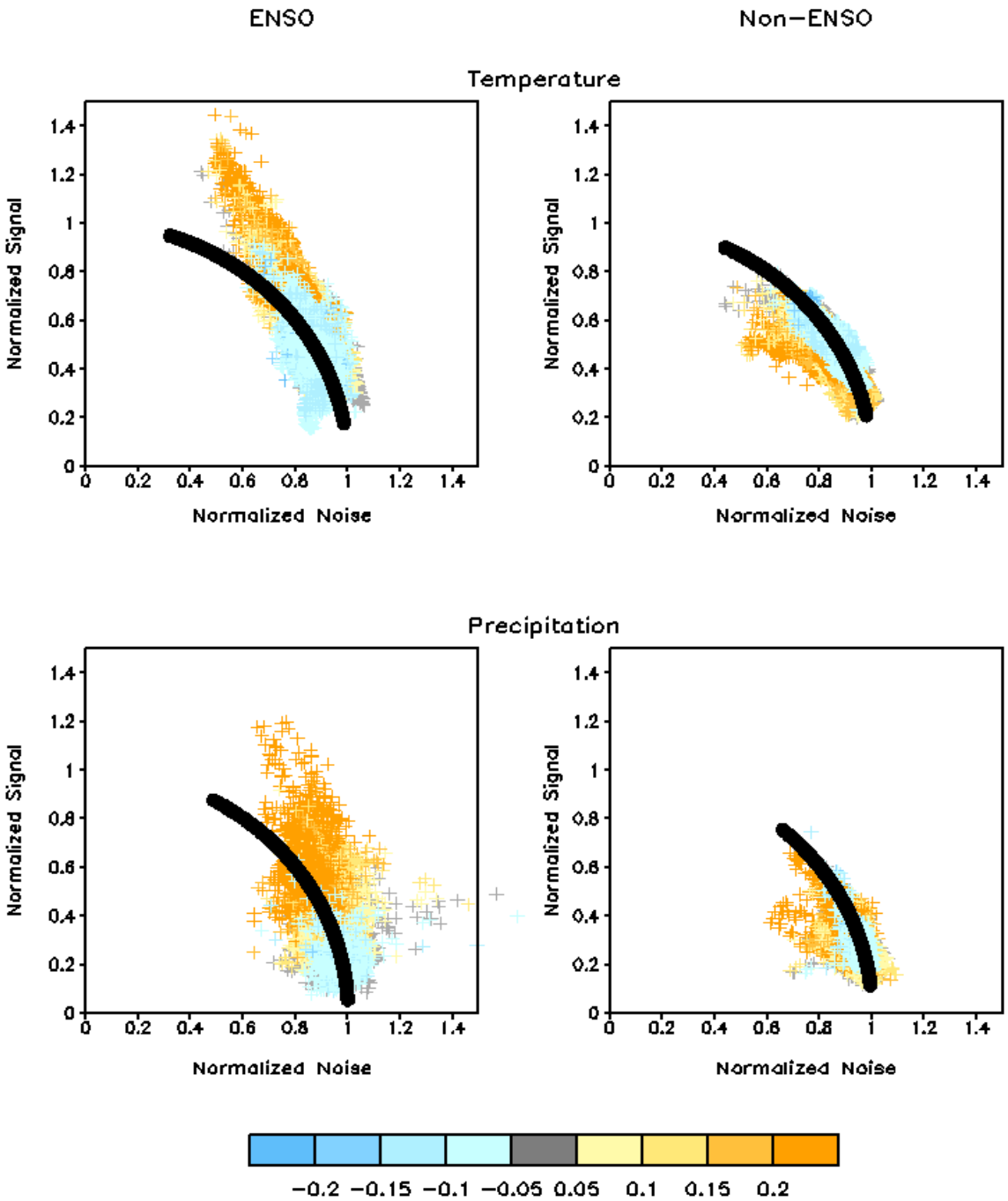
$$y(seas, year) = m(seas) * x(seas, year) + b(seas)$$

Forecast Skill (Anomaly Correlation)

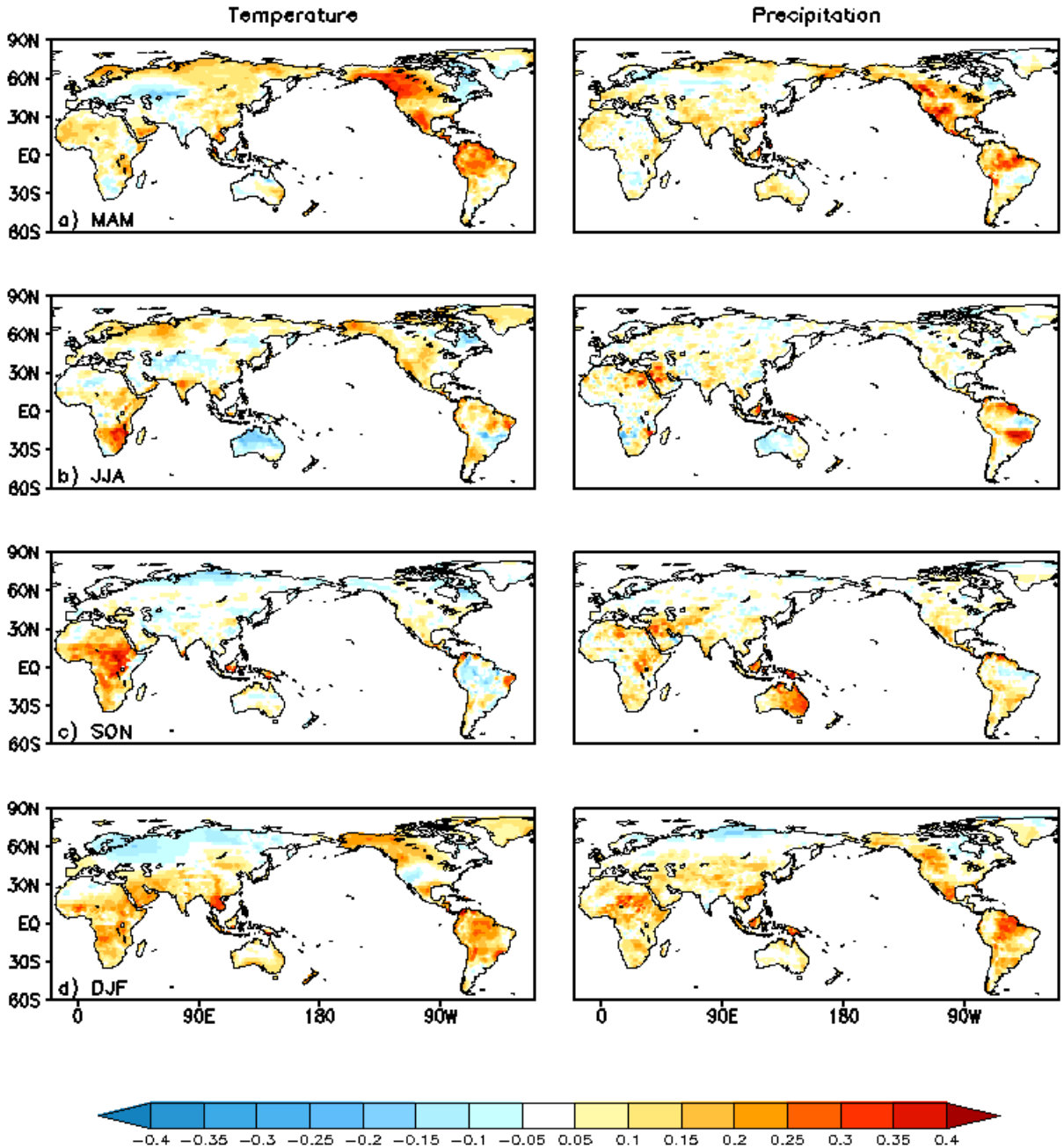
Relationship between ENSO & skill

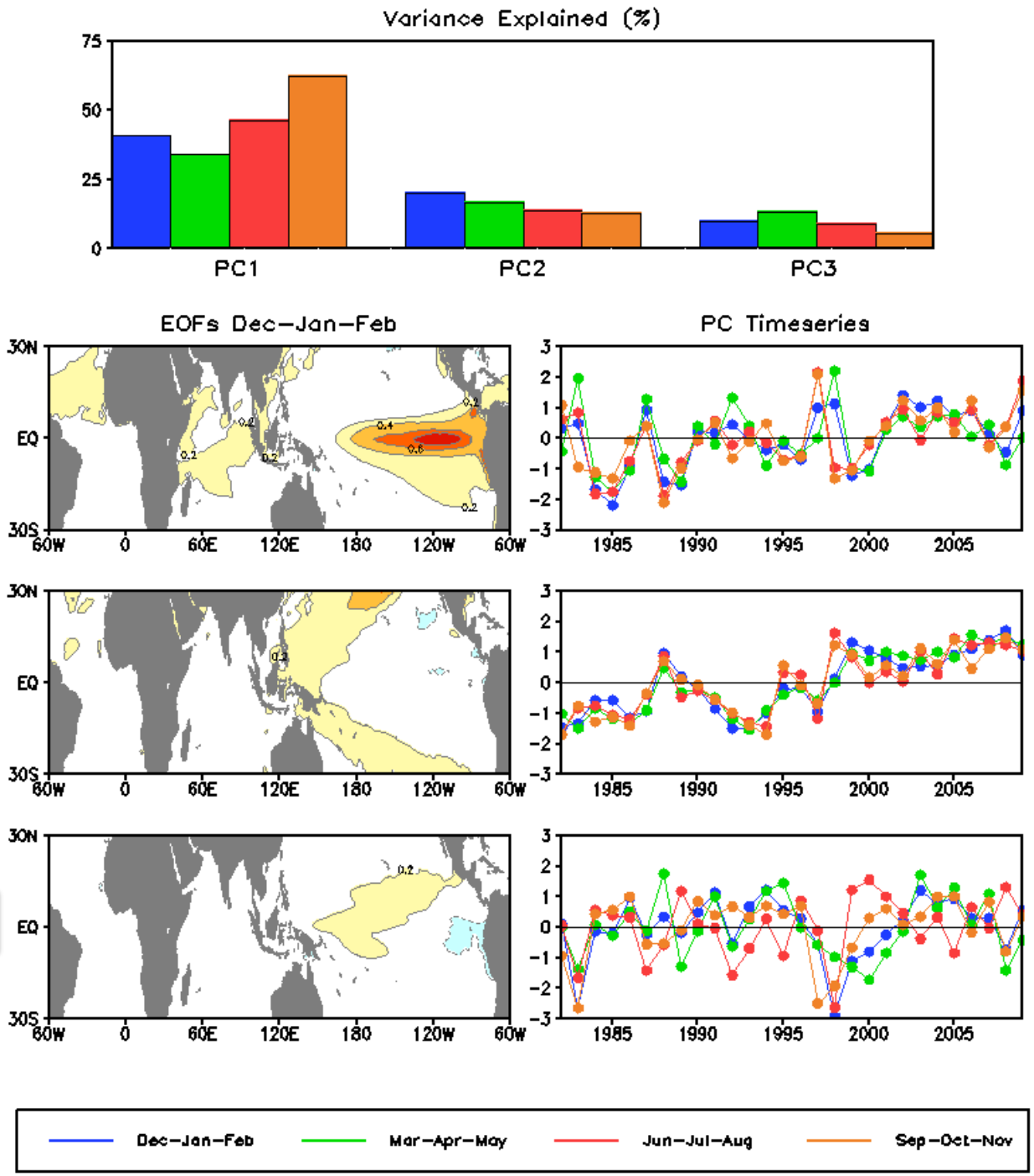
Index of ENSO
- **ABS(Nino3.4)**
- **ABS(PCs)**

Skill during ENSO neutral


ENSO
Non−ENSO
Temperature
Precipitation
Normalized Signal
Normalized Noise
0
0.2
0.4
0.6
0.8
1
1.2
1.4
−0.2 −0.15 −0.1 −0.05 0.05 0.1 0.15 0.2

Regression between Conditional Skill and Normalized ABS(NINO34) (units: correlation/factor of std)
0-month lead



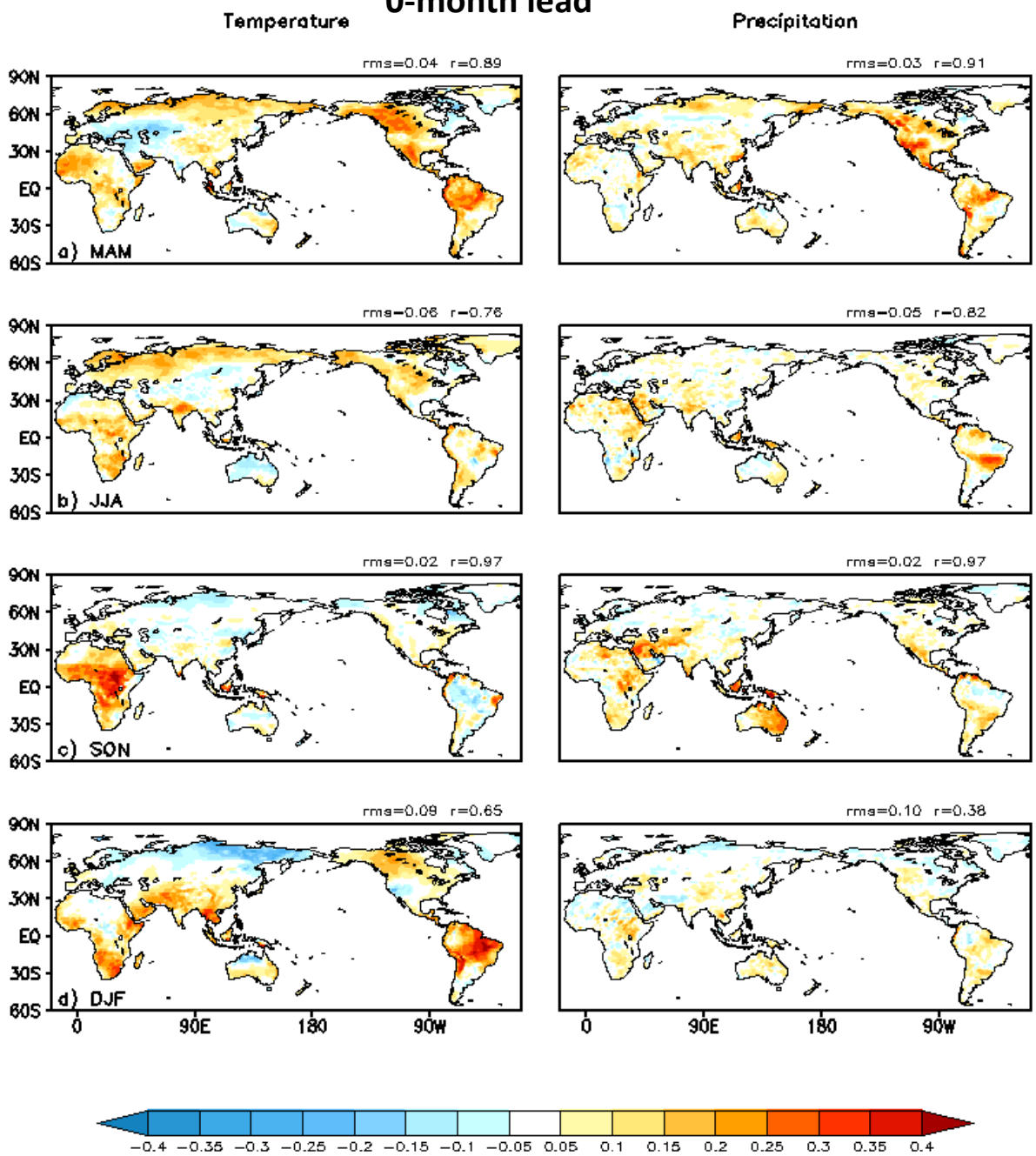


"Canonical ENSO"

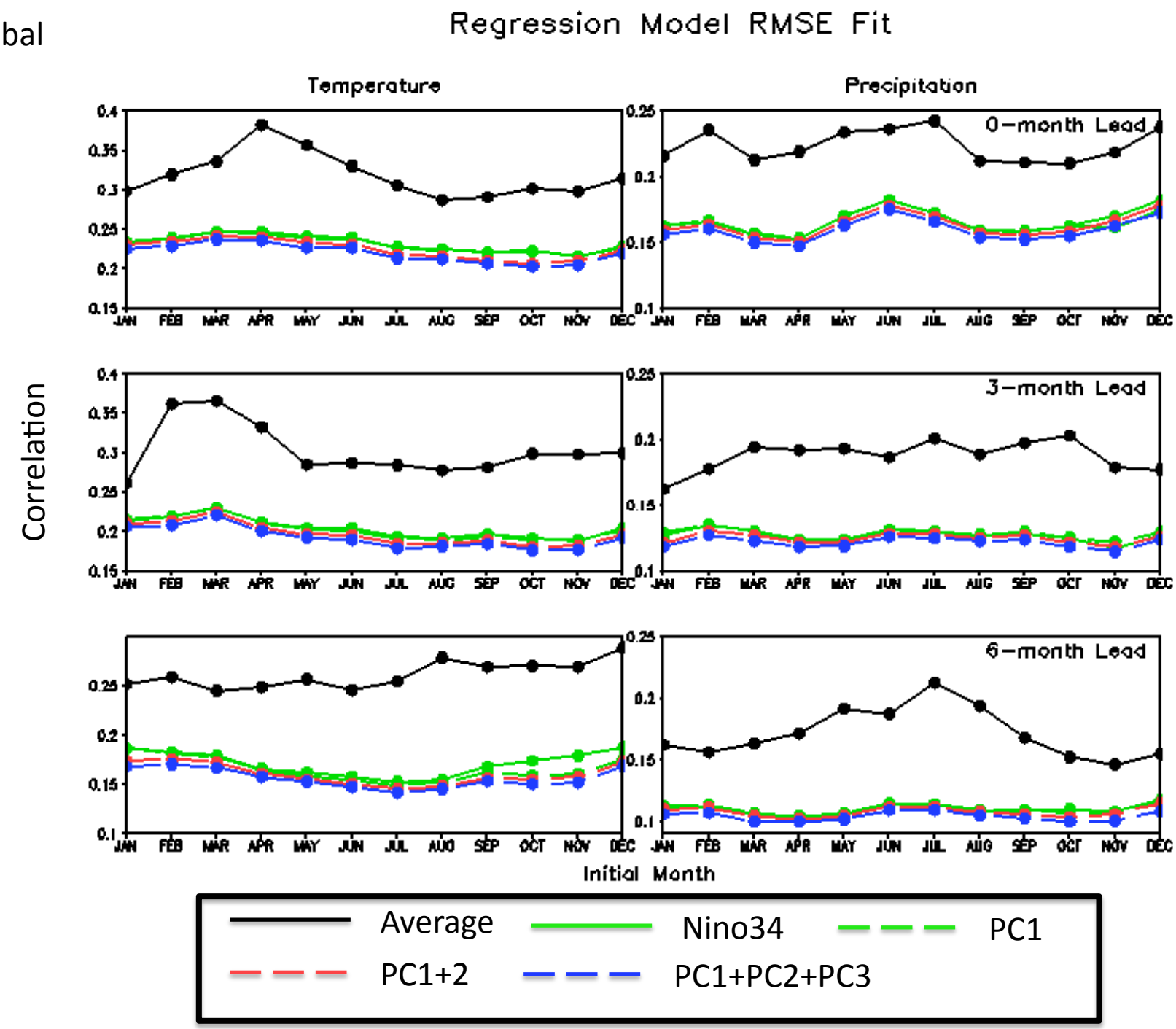
"Trend and/or decadal variability"

"Central Pacific ENSO"

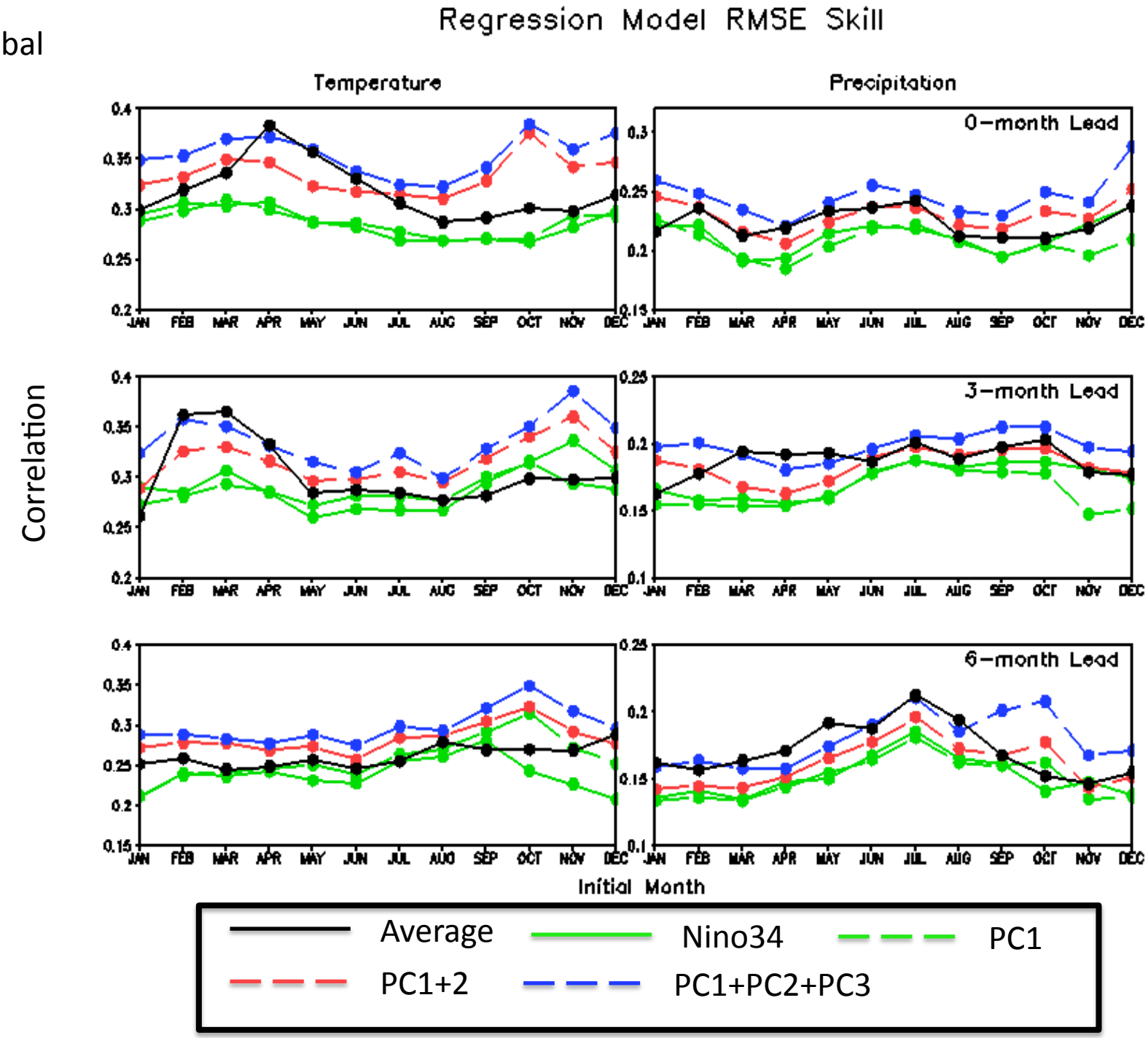
Regression between Conditional Skill and Normalized ABS(PC1) (units: correlation/factor of std)
0-month lead



Global


Regression Model RMSE Fit
Temperature
Precipitation
0-month Lead
3-month Lead
6-month Lead
Correlation
Initial Month
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
Average
Nino34
PC1
PC1+2
PC1+PC2+PC3

Global

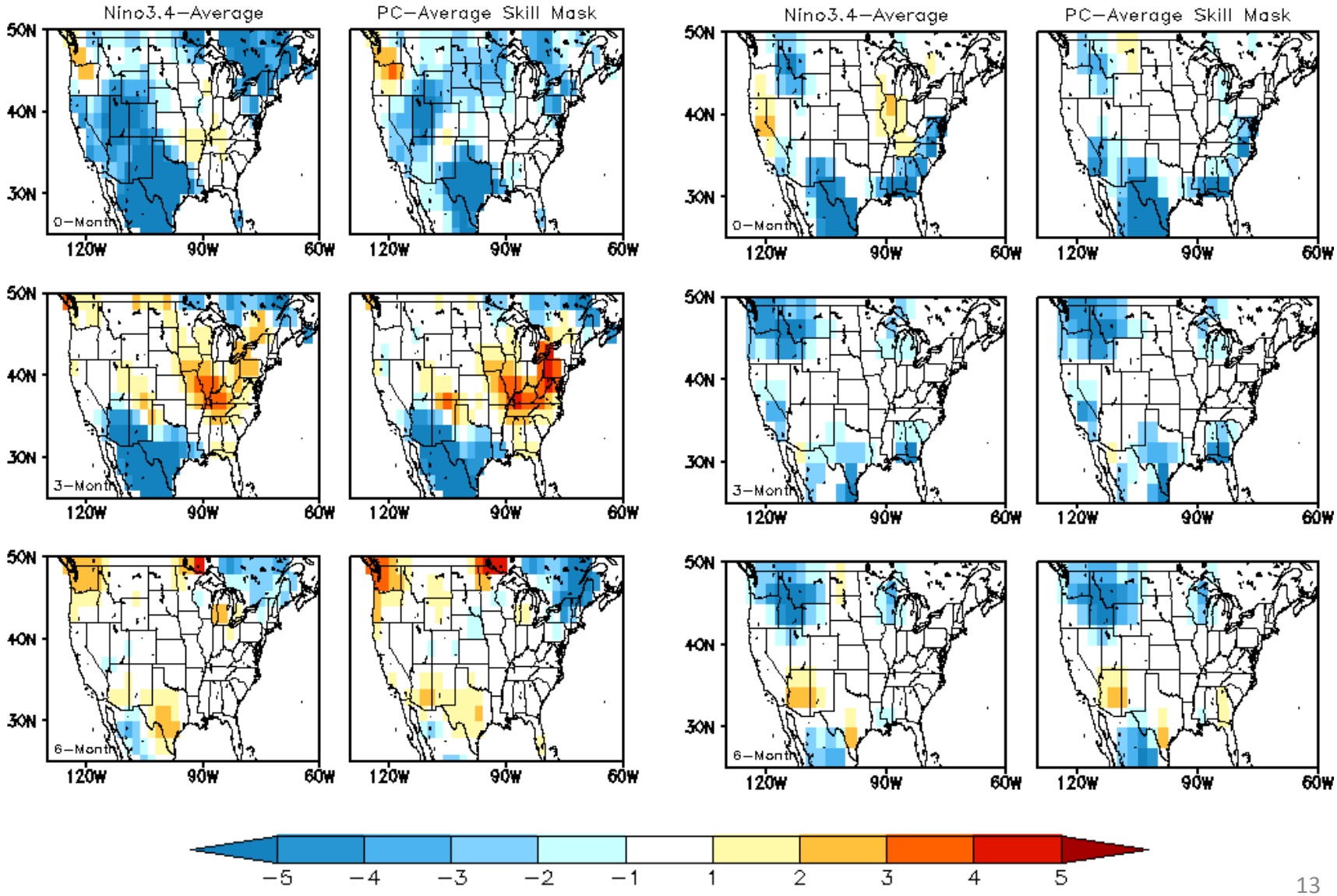

Regression Model RMSE Skill
Temperature
Precipitation
0-month Lead
3-month Lead
6-month Lead
Correlation
Initial Month
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
Average
Nino34
PC1
PC1+2
PC1+PC2+PC3

Do ENSO-Conditional Masks Improve on Average Mask? No!

Differences in Modified Heidke Skill Score Winter
(Verified against obs)

Temperature

Precipitation



Average Mask is better

ENSO-mask is better

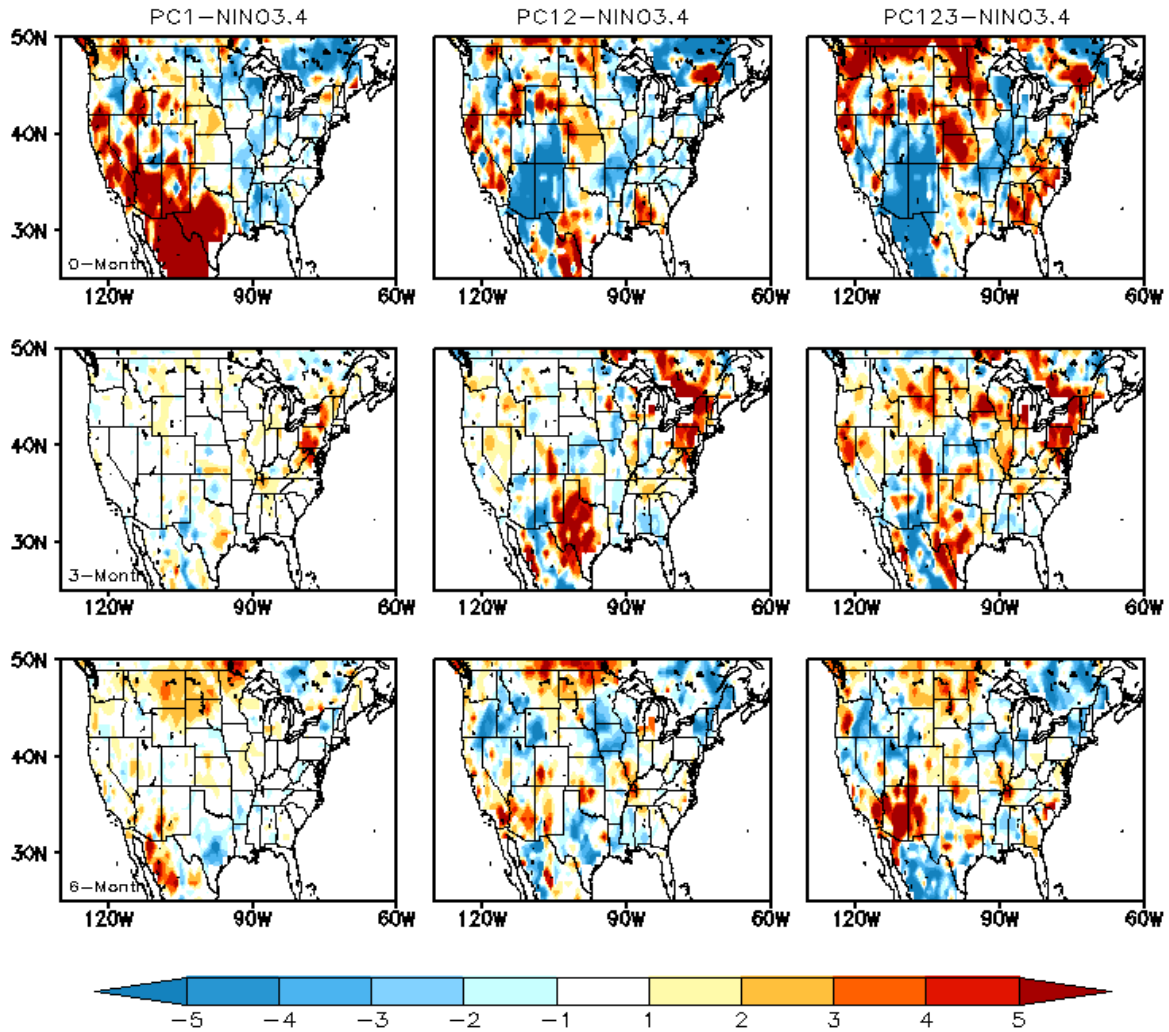
Does including Additional PCs improve Skill over Nino3.4 as Predictor? Not systematically.

Temperature Heidke Skill Score Differences Winter (Perfect Model)

0-month

3-month

6-month



Nino3.4 is better predictor **PCs are better predictor**

Conclusions

1. Including additional PCs that represent the trend and/or decadal variability, as well as central Pacific variability of tropical Pacific SSTs does not offer any systematic improvements over Nino3.4 in the ability to predict forecast skill associated with ENSO.

2. The ENSO conditional skill mask does not improve upon the average skill mask.

3. This is due to the fact that there are many more “equal chances” forecasts using the conditional masks than using the average mask (not shown).

It is hard to skillfully forecast the forecast!