Assessing the Fidelity of Predictability Estimates

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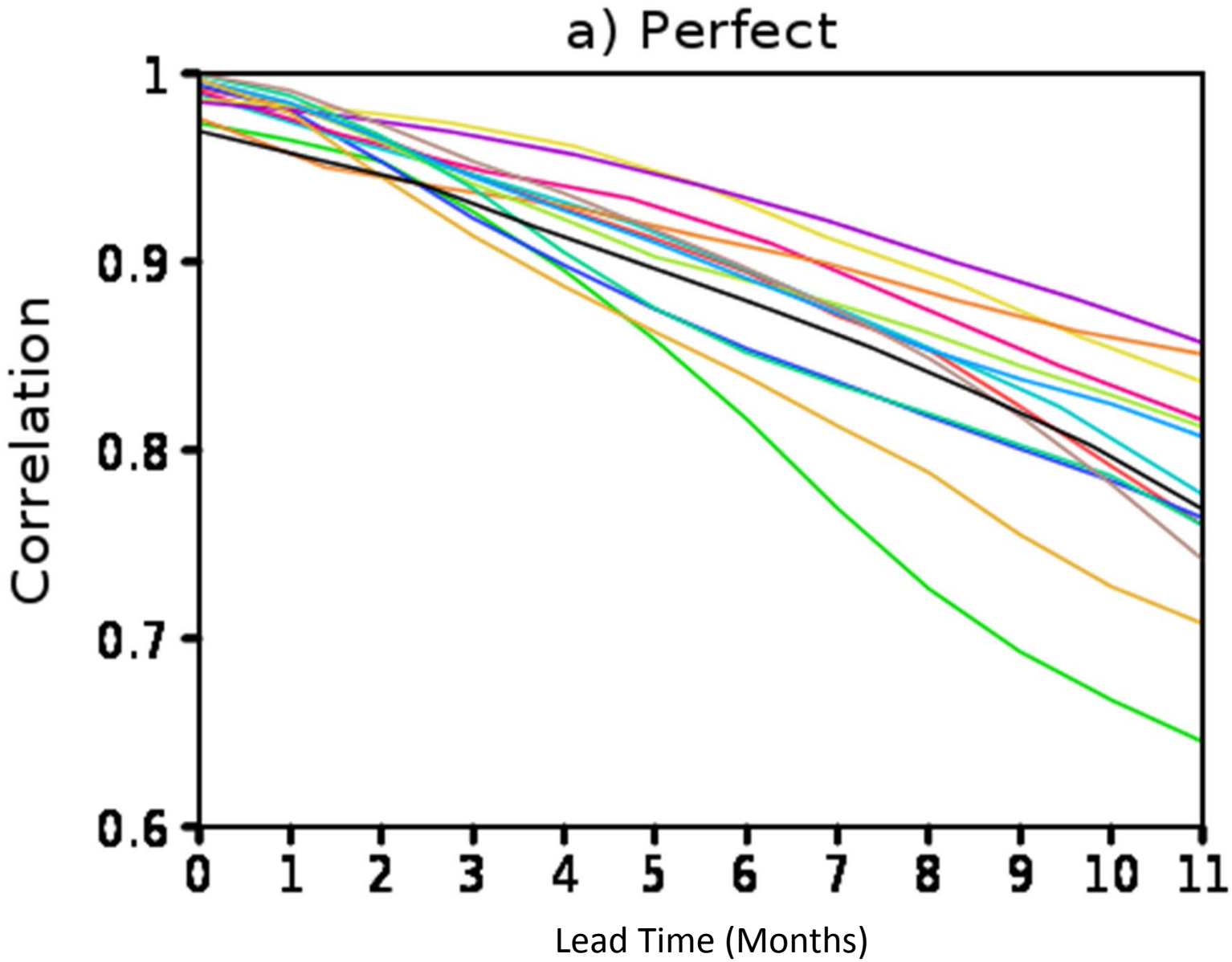
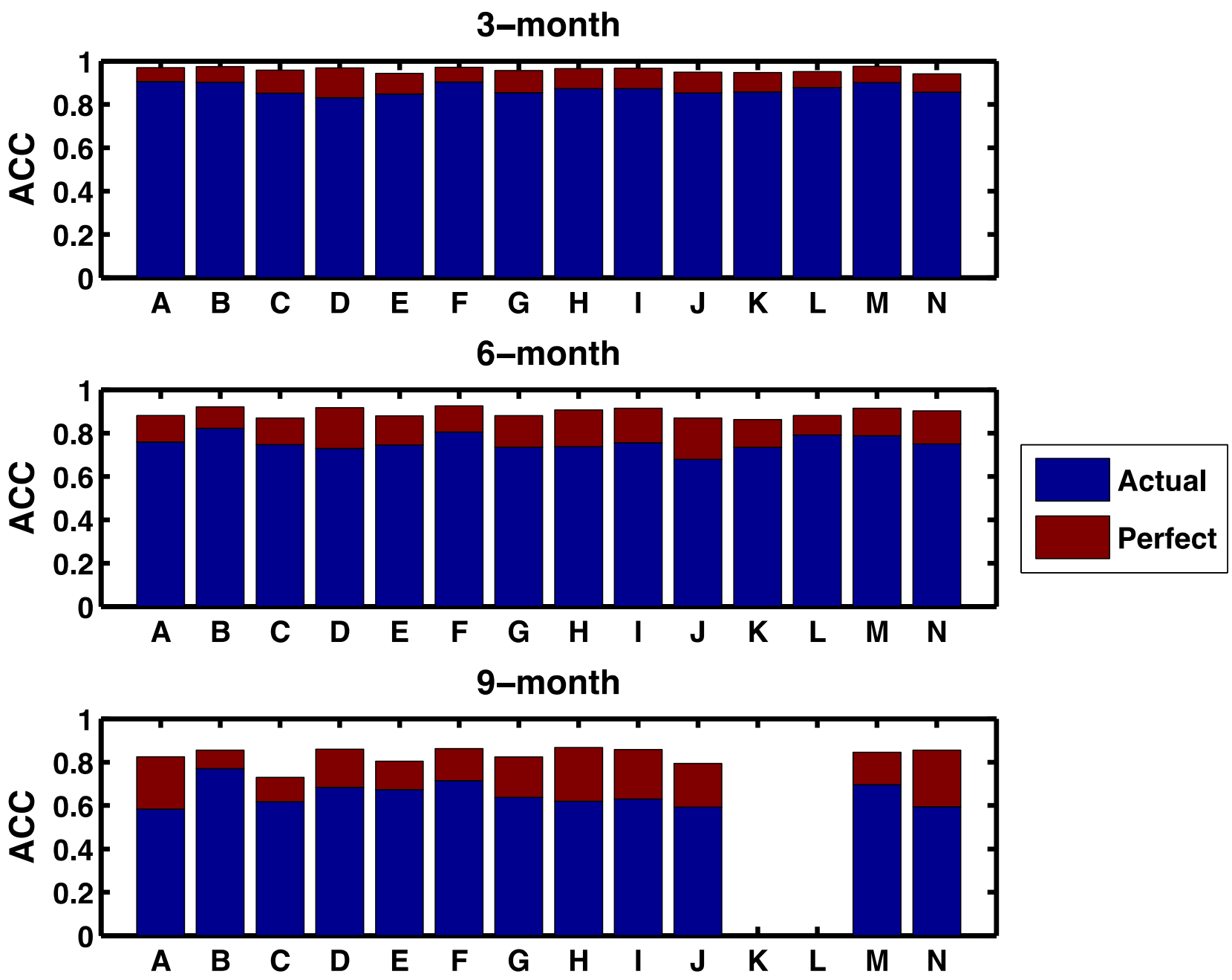
No matter how good our forecast systems become, we will always have a limit to our ability to make predictions due to initial condition uncertainty

What is that limit?

How close are current prediction systems to that limit?

Nino3.4


a) Perfect
Correlation
1
0.9
0.8
0.7
0.6
0
1
2
3
4
5
6
7
8
9
10
11
Lead Time (Months)


3−month
6−month
9−month
ACC
0
0.2
0.4
0.6
0.8
1
A
B
C
D
E
F
G
H
I
J
K
L
M
N
Actual
Perfect

How do we know which of these estimates of predictability is most representative of the predictability of the true climate system?

Metrics for assessing fidelity of predictability estimates

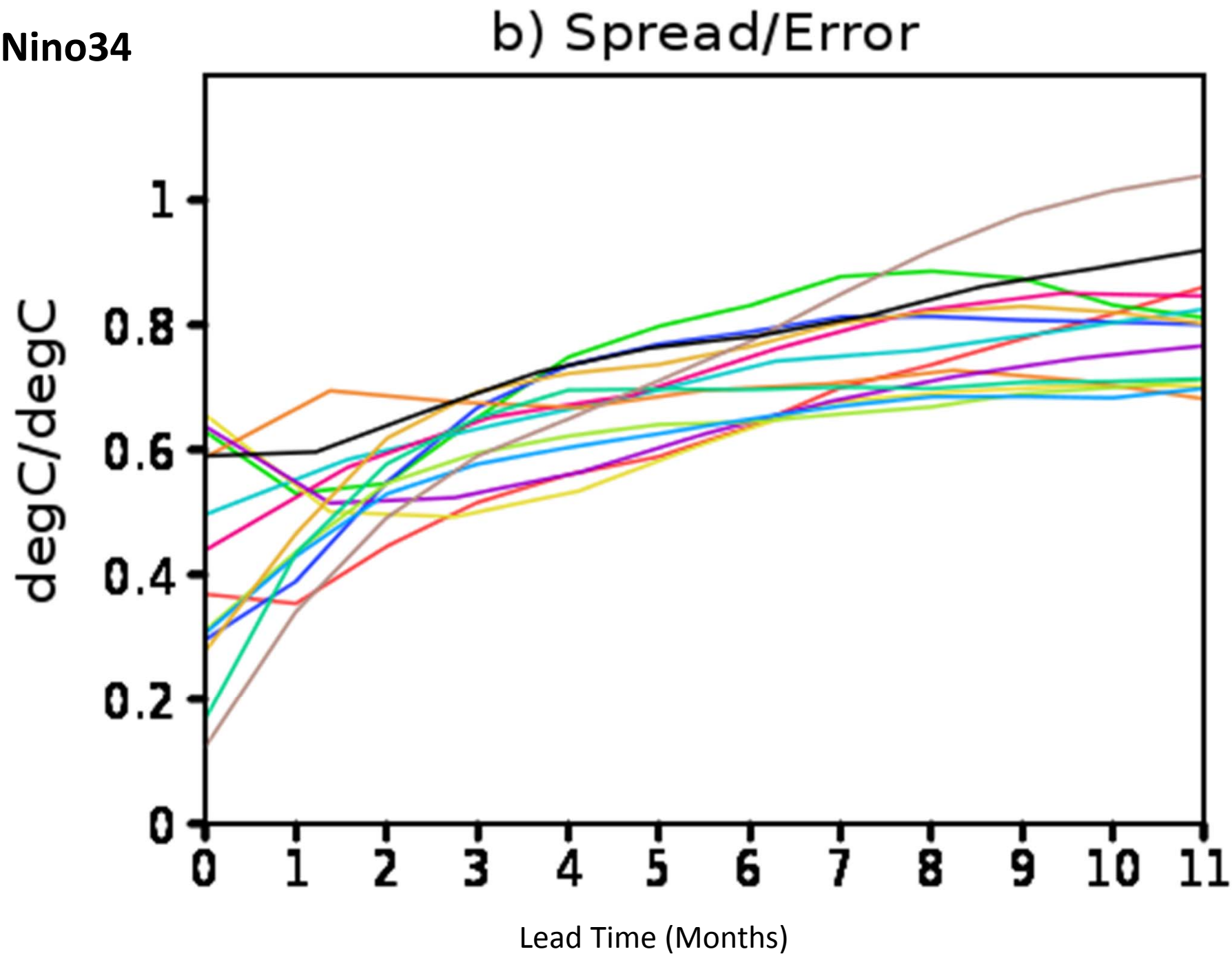
1. **Spread/Error Ratio**
   - For a perfect model, SE should be ~1
   - S<E under-dispersive; over-estimates predictability

2. **Autocorrelation**
   - Measure of persistence
   - If model is more persistent than observations, then it would better predict itself than it should, so predictability would be too high

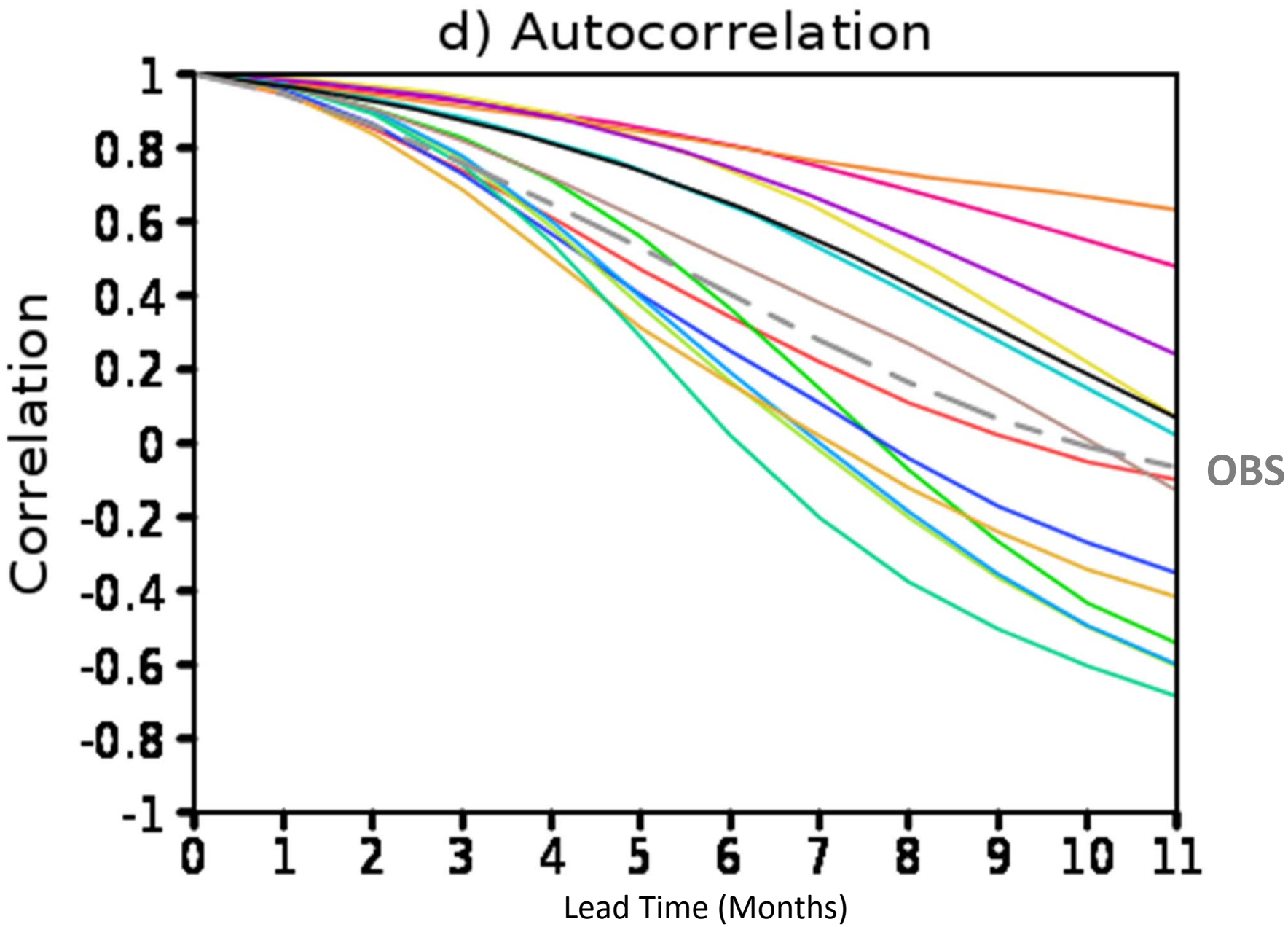
3. **Actual Skill**
   - Model with highest skill is closest to observations

Pegion & Sardeshmukh 2011, MWR & Kumar et al. 2014, MWR

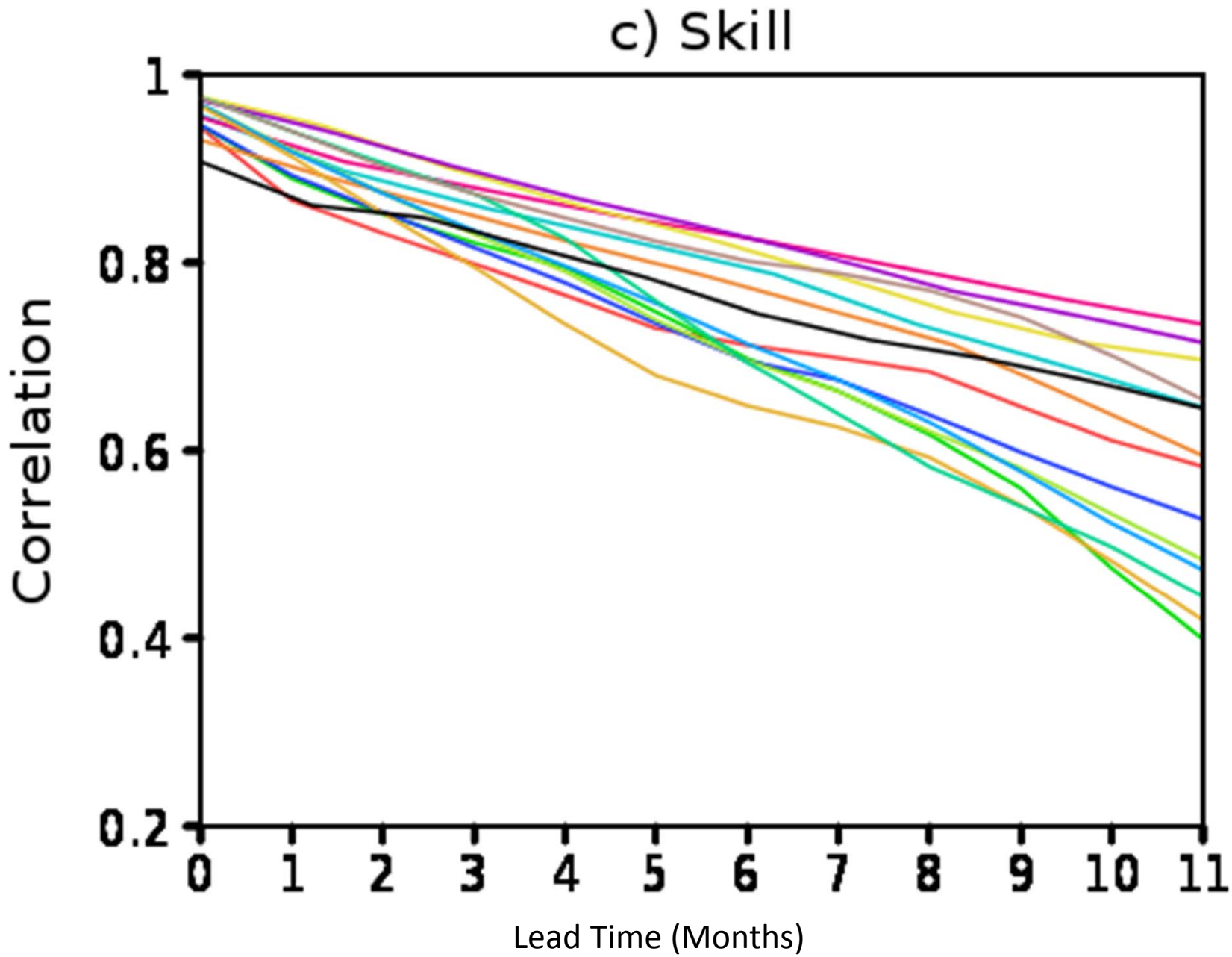
Nino34


b) Spread/Error
degC/degC
0
0.2
0.4
0.6
0.8
1
0
1
2
3
4
5
6
7
8
9
10
11
Lead Time (Months)

Nino34


d) Autocorrelation
Correlation
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
1
2
3
4
5
6
7
8
9
10
11
Lead Time (Months)
OBS

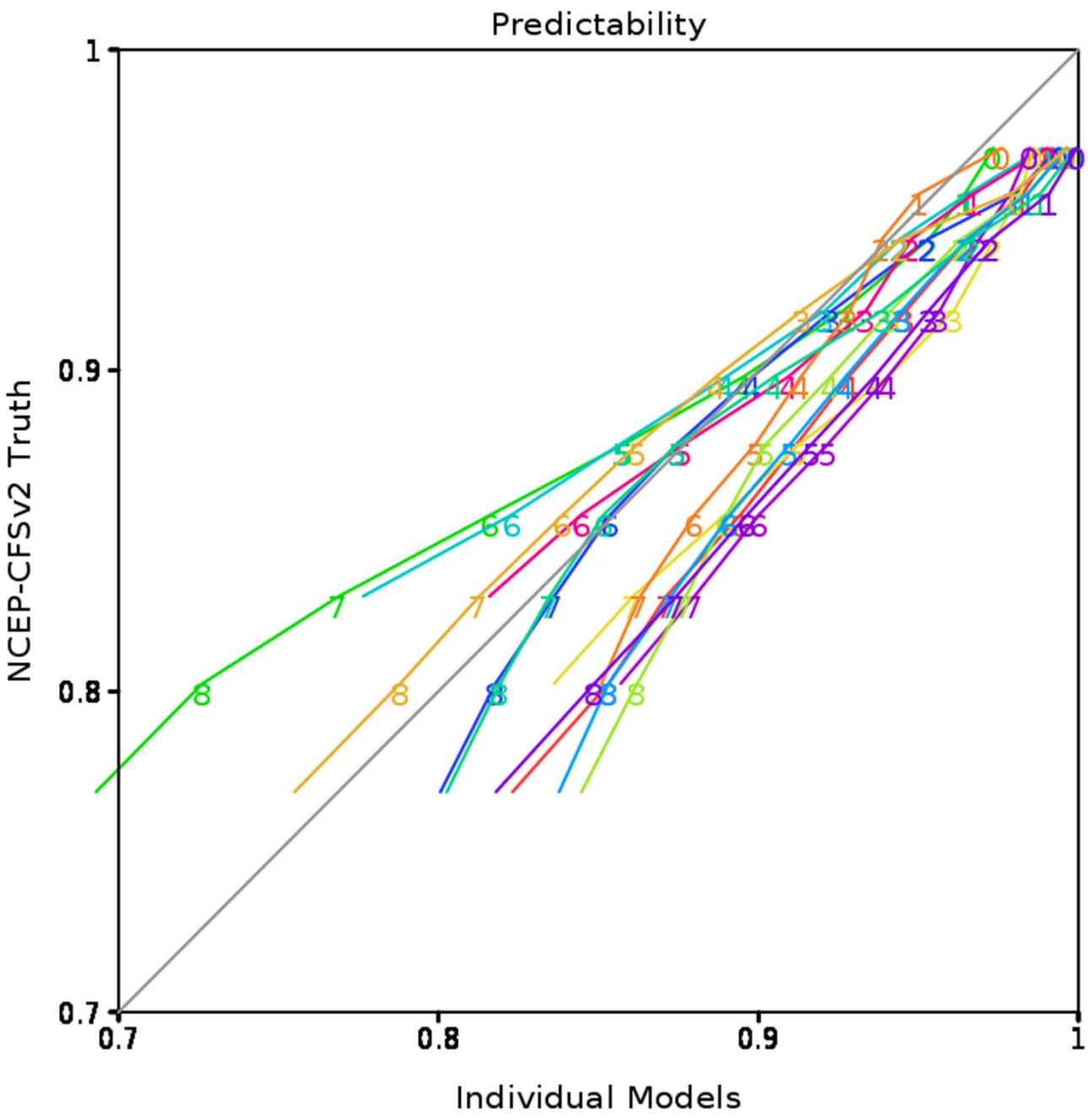
Nino34


c) Skill
Correlation
1
0.8
0.6
0.4
0.2
0
1
2
3
4
5
6
7
8
9
10
11
Lead Time (Months)

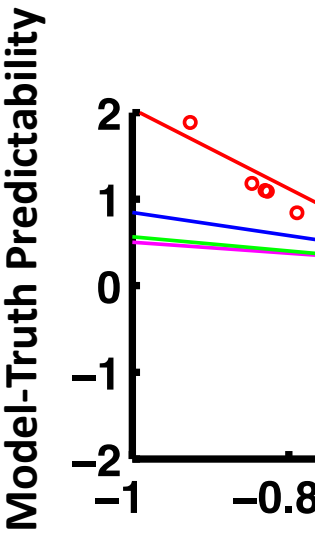
Methodology

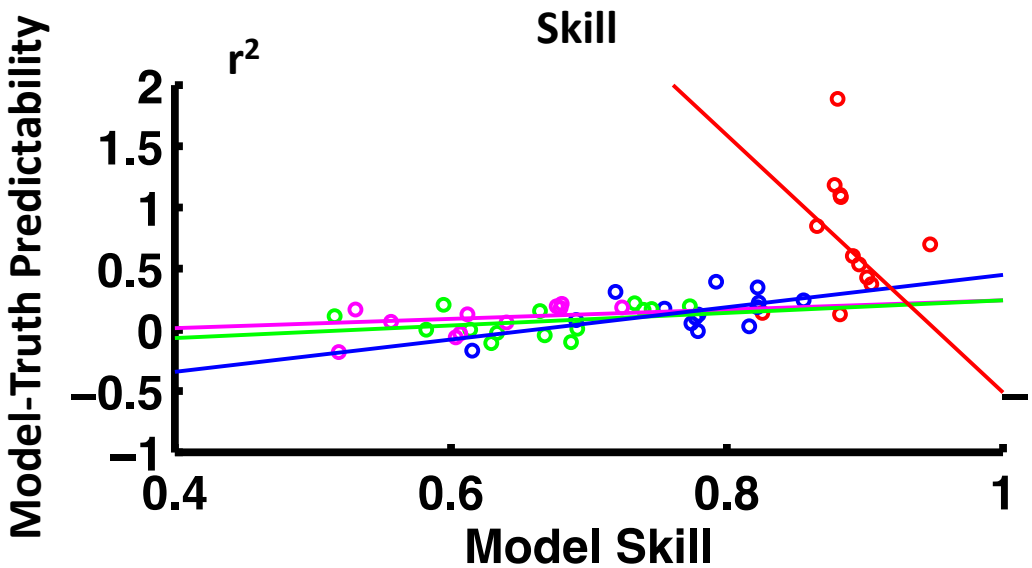
- NMME
- idealized framework: choose each model in turn as the "truth"
- test whether the three metrics tell us how well a model estimates the predictability of the "truth"

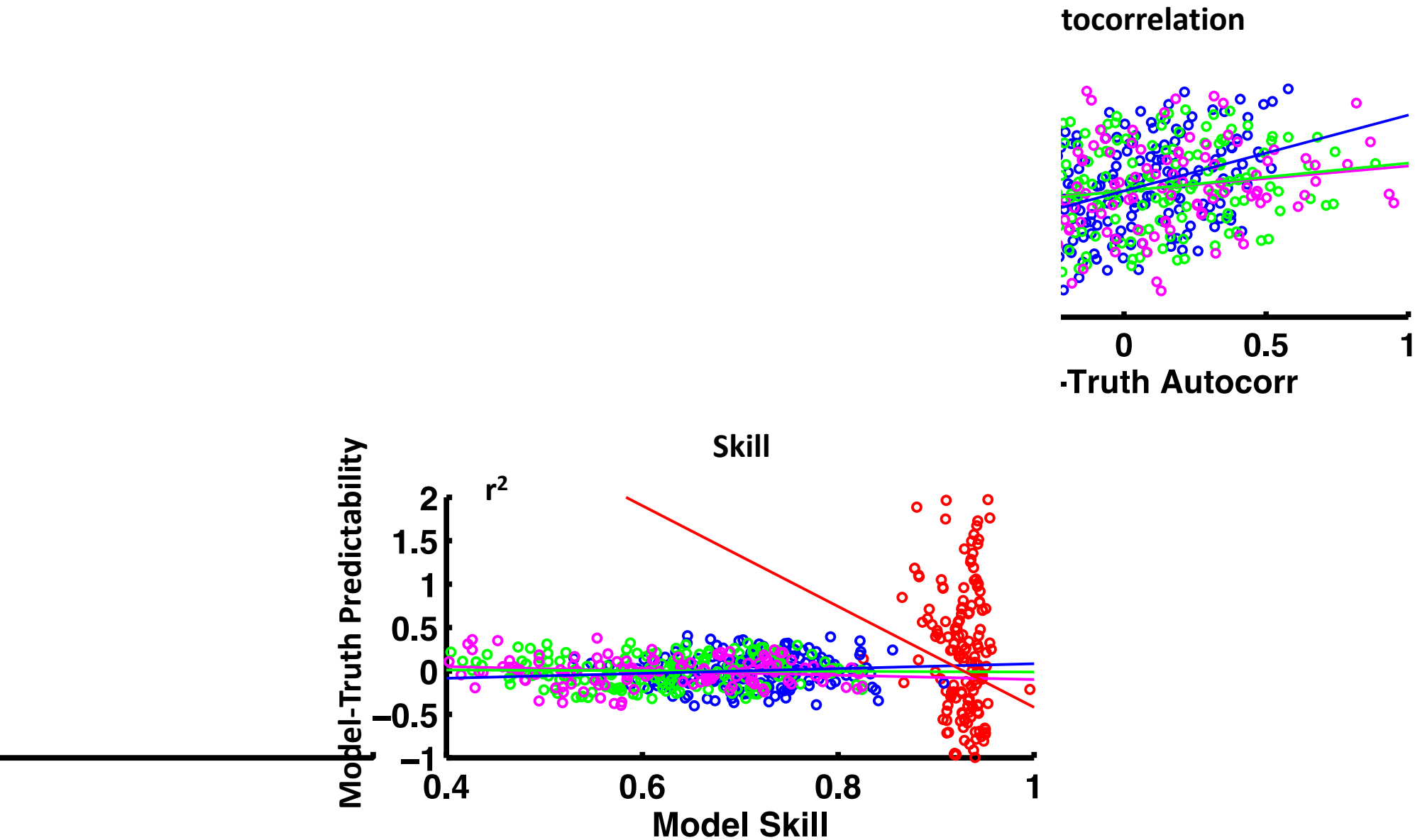
Nino34


Predictability
NCEP-CFSv2 Truth
Individual Models
0.7
0.8
0.9
1

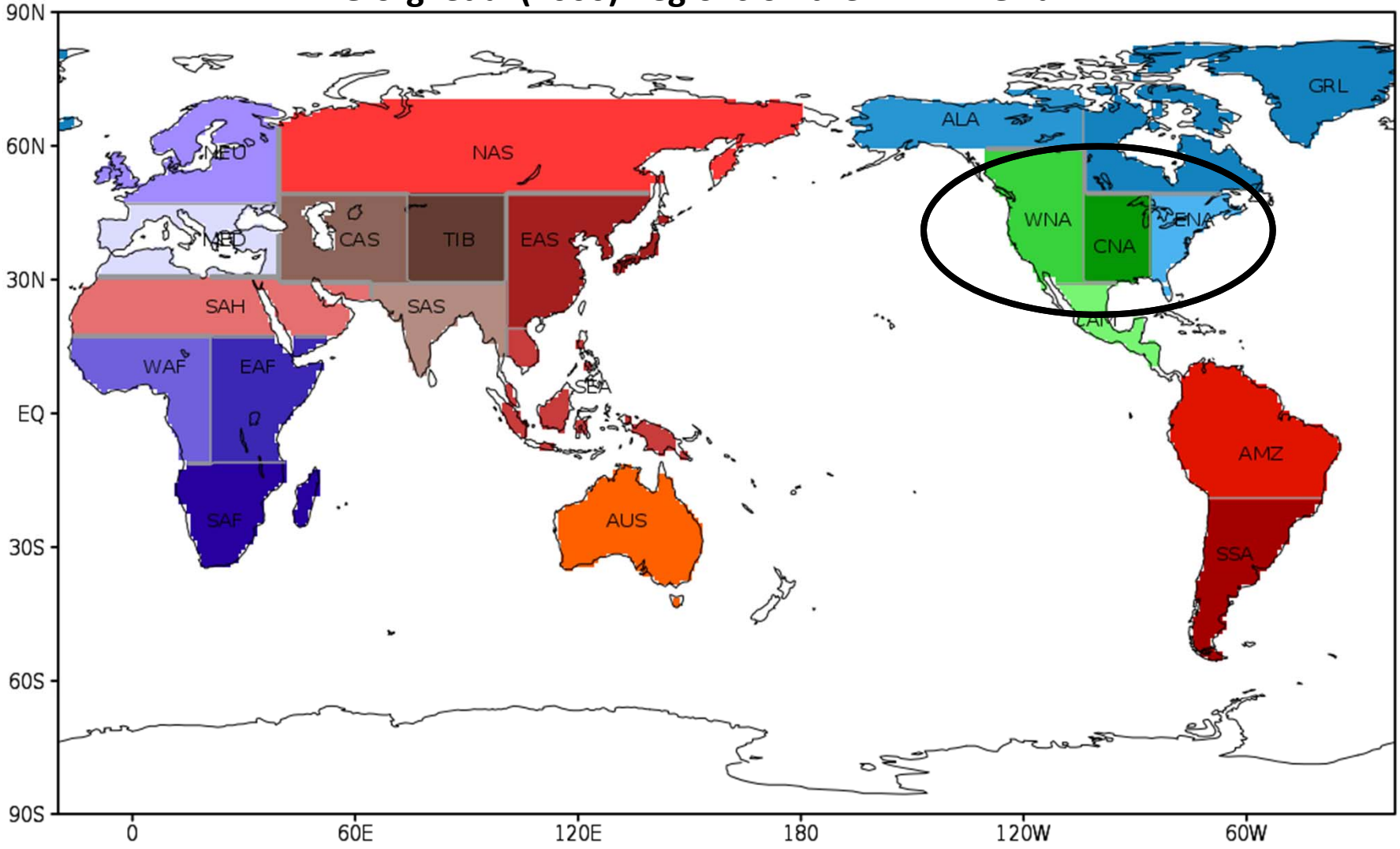
Nino34


Model-Truth Predictability
2
1
0
−1
−2
−1
−0.8

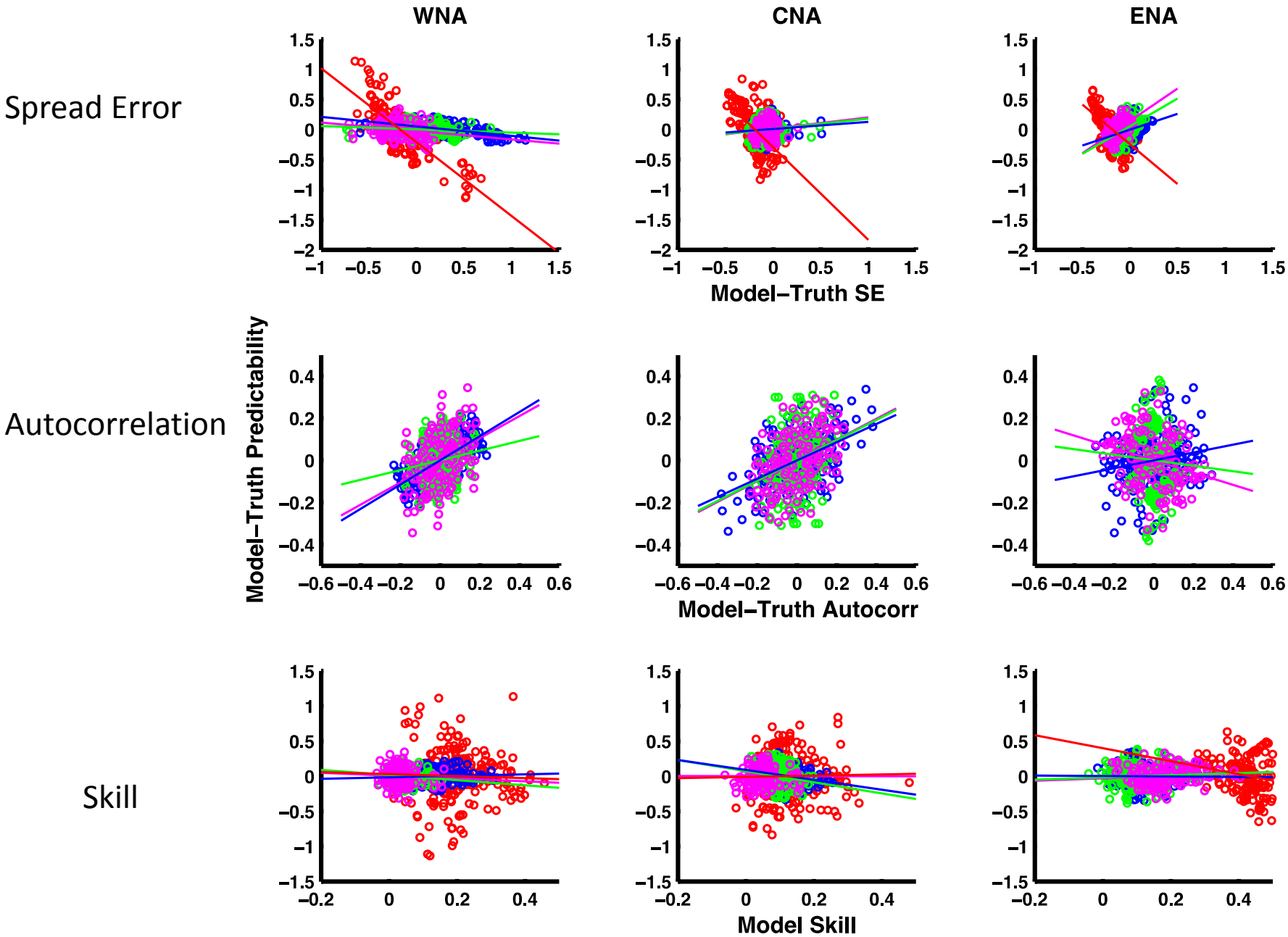

Skill
r²
Model-Truth Predictability
2
1.5
1
0.5
0
−0.5
−1
0.4
0.6
0.8
1
Model Skill


tocorrelation
0
0.5
1
-Truth Autocorr
Skill
r2
2
1.5
1
0.5
0
−0.5
−1
0.4
0.6
0.8
1
Model-Truth Predictability
Model Skill

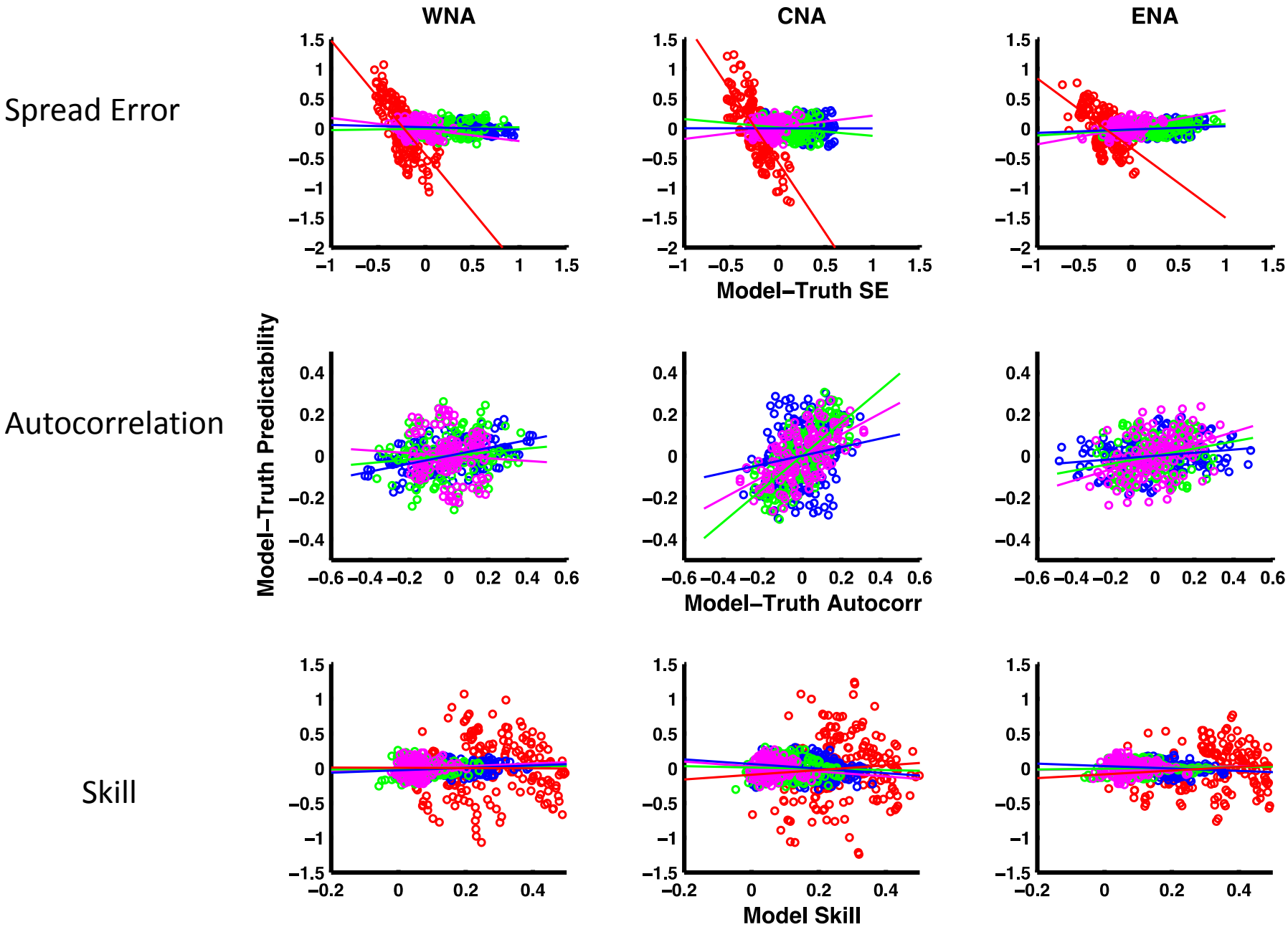
Giorgi et al (2000) Regions on the NMME Grid



2m Temperature



Precipitation



Summary

☑Spread-Error Ratio

- But only at short lead-times
- Perhaps useful for weather and subseasonal timescales? (Future work)

☒Autocorrelation

Not robust across regions or lead-times

☒ Skill

Nothing useful here

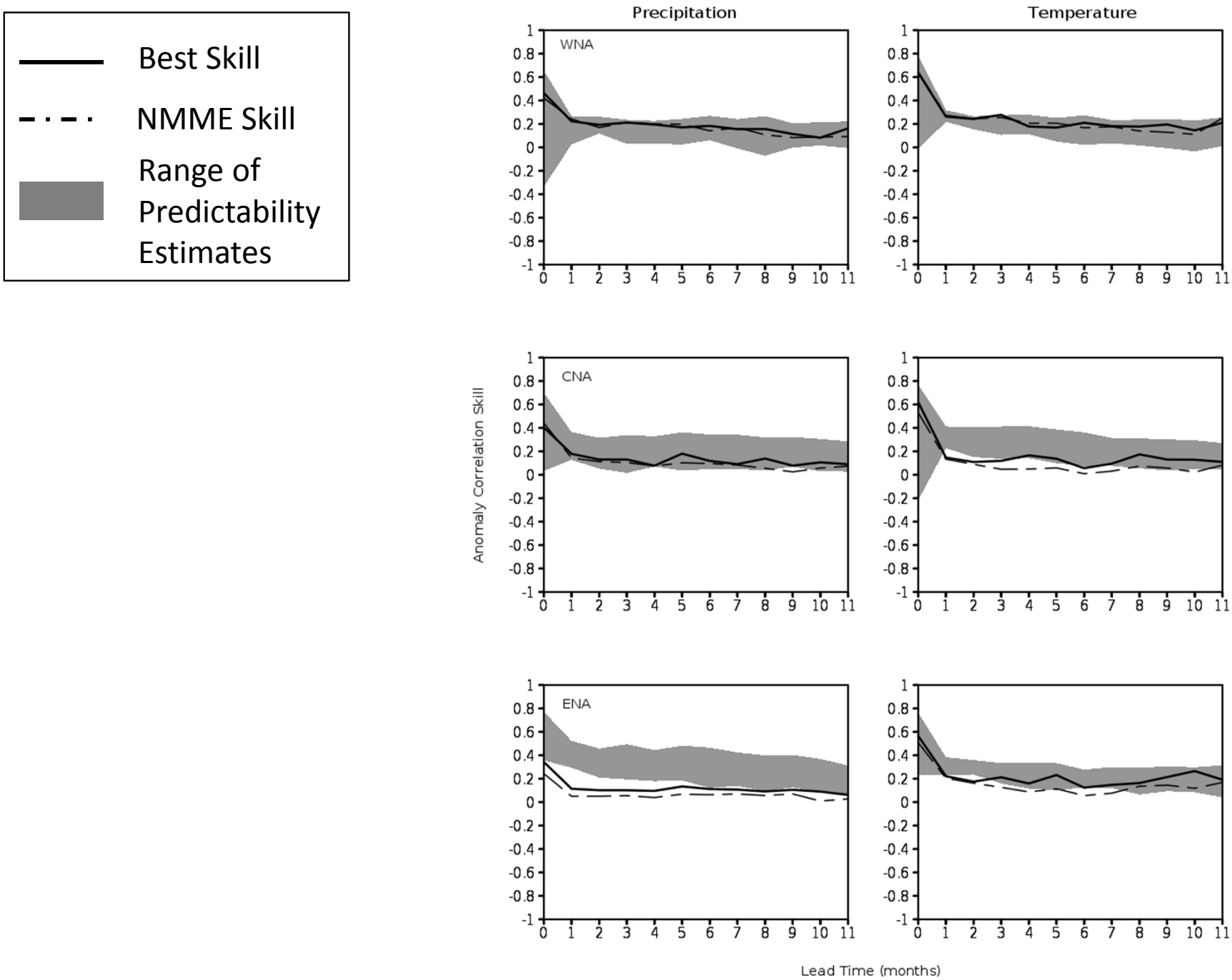
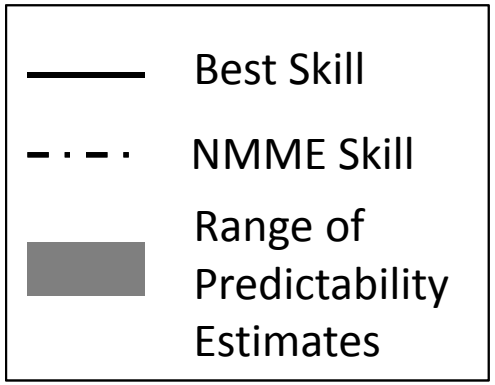
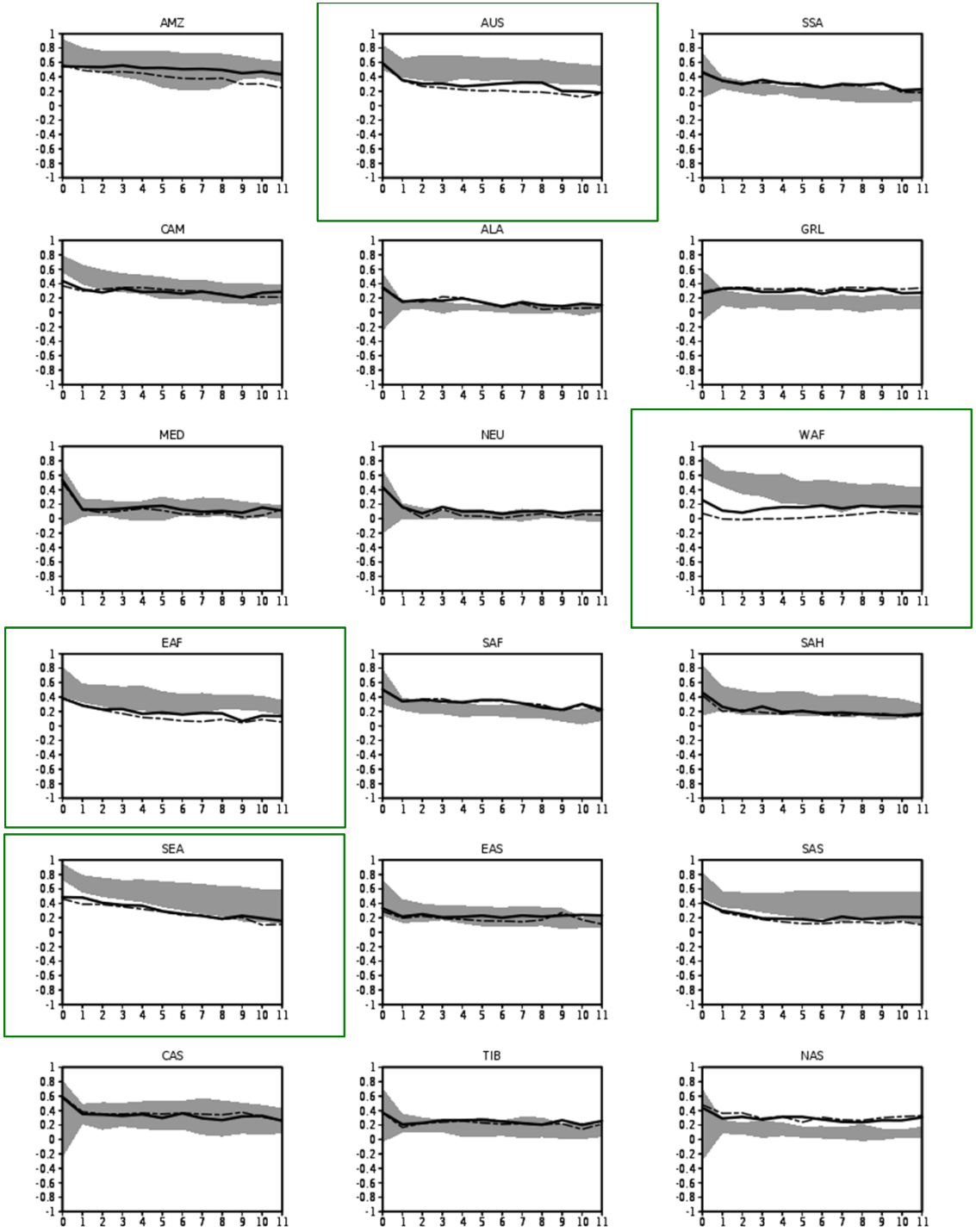
Conclusions

No matter how good our forecast systems become, we will always have a limit to our ability to make predictions due to initial condition uncertainty

What is that limit?

How close are current prediction systems to that limit?

Perhaps the best we can do is to provide a range of predictability estimates


Best Skill
NMME Skill
Range of Predictability Estimates
Precipitation
Temperature
WNA
CNA
ENA
Anomaly Correlation Skill
Lead Time (months)

Precipitation