

Comparing Niño 3.4 evolution in NMME forecasts and observations

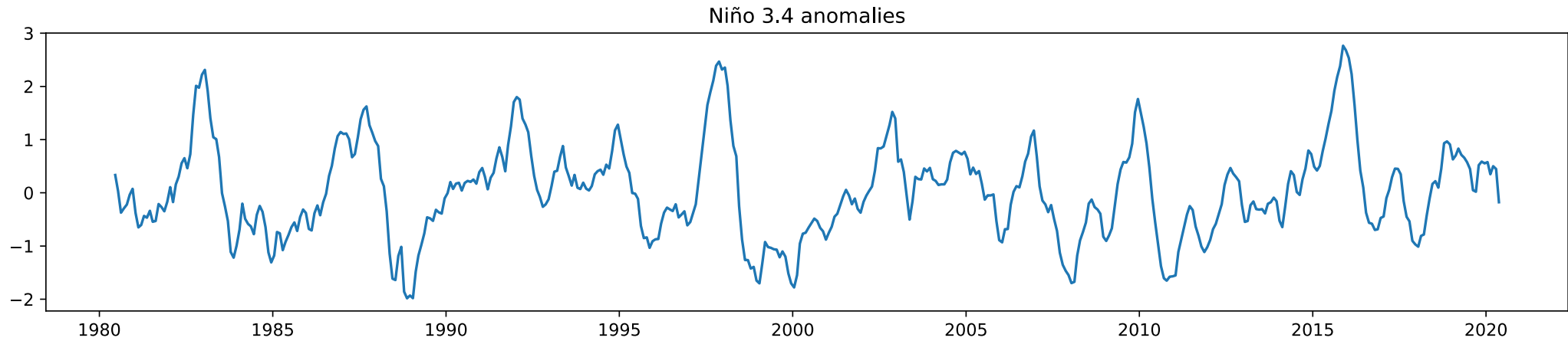
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Overview

- Q: How similar is the evolution of Niño 3.4 in models and observations?
 - Comparing anomalies (not climatology)
 - Comparing 12-month trajectories (not long free runs)
 - Comparing model and observed *variability* (not skill)
- Use EOFs *in time* (not space) of Niño 3.4 to address the question (newish?)
- 2 EOFs (in time) of observed Niño 3.4 capture:
 - > 94% of the variability
 - Seasonality of variance
 - Lag correlations
- Application to NMME forecasts
 - Visual comparison of EOF time patterns
 - Models with good EOFs tend to have higher skill
 - Correction method: 2 model EOFs to predict 2 obs. EOFs

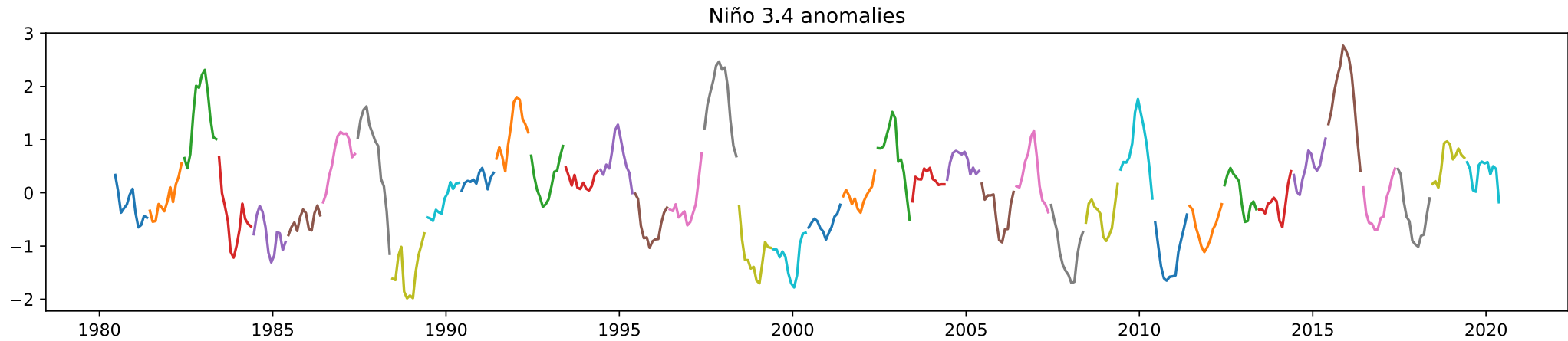
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A: Apply EOF analysis (PCA) to 12-month segments



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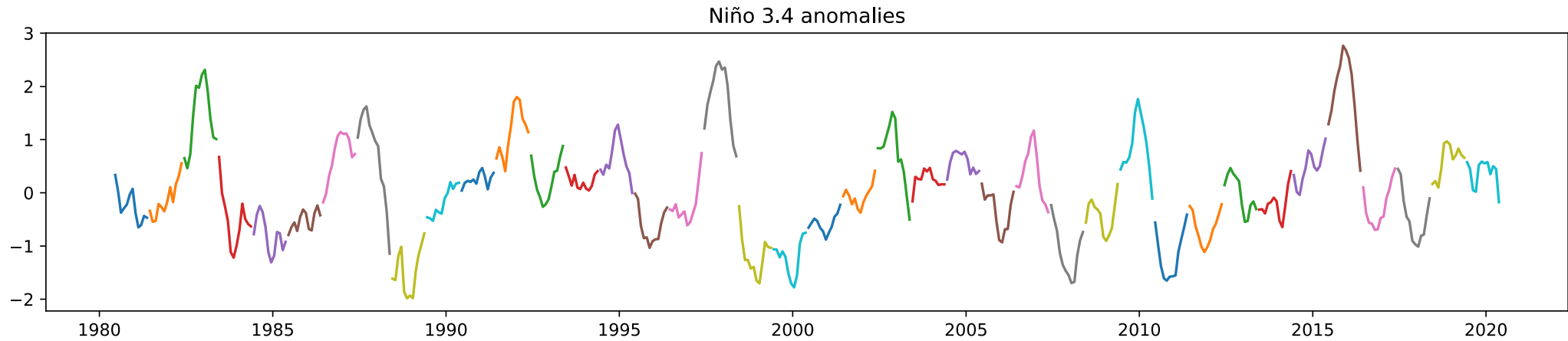
A: Apply EOF analysis (PCA) to 12-month segments



EOFs depend
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Here the
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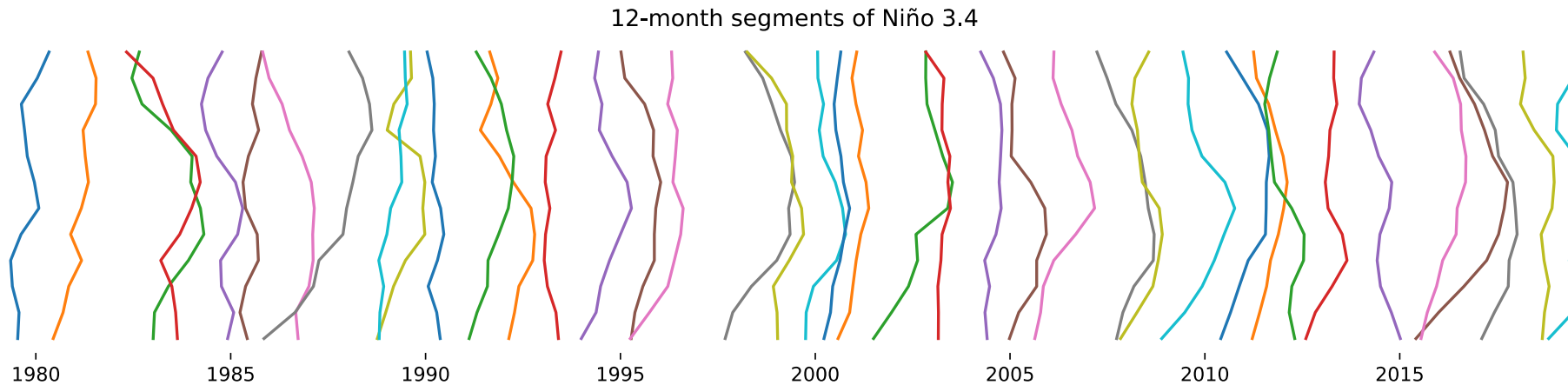
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J-
J-
A-
S-
O-
N-
D-
J-
F-
M-
A-
M-

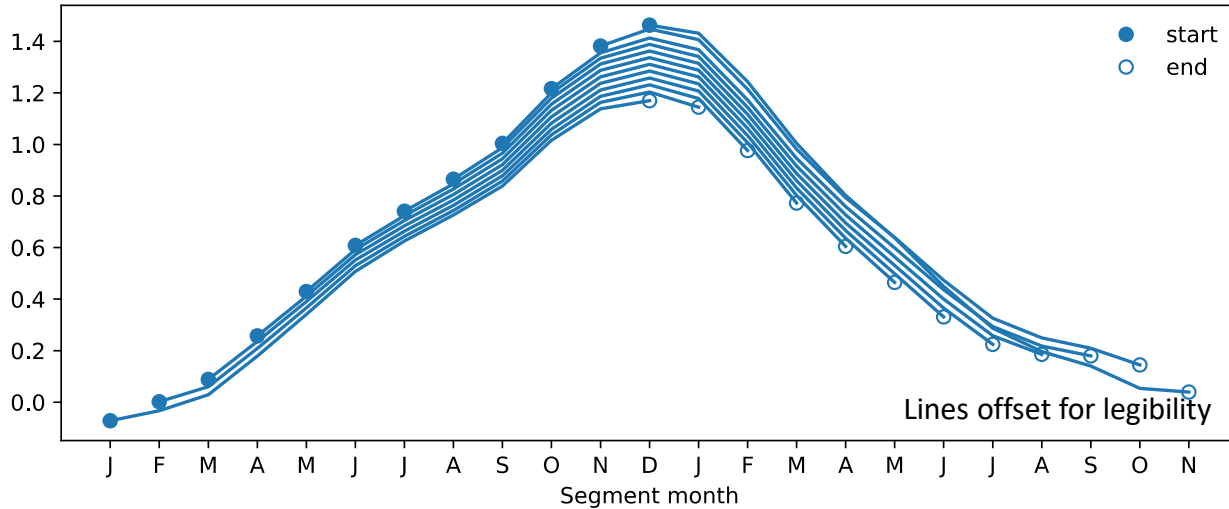


12 x 40 data matrix

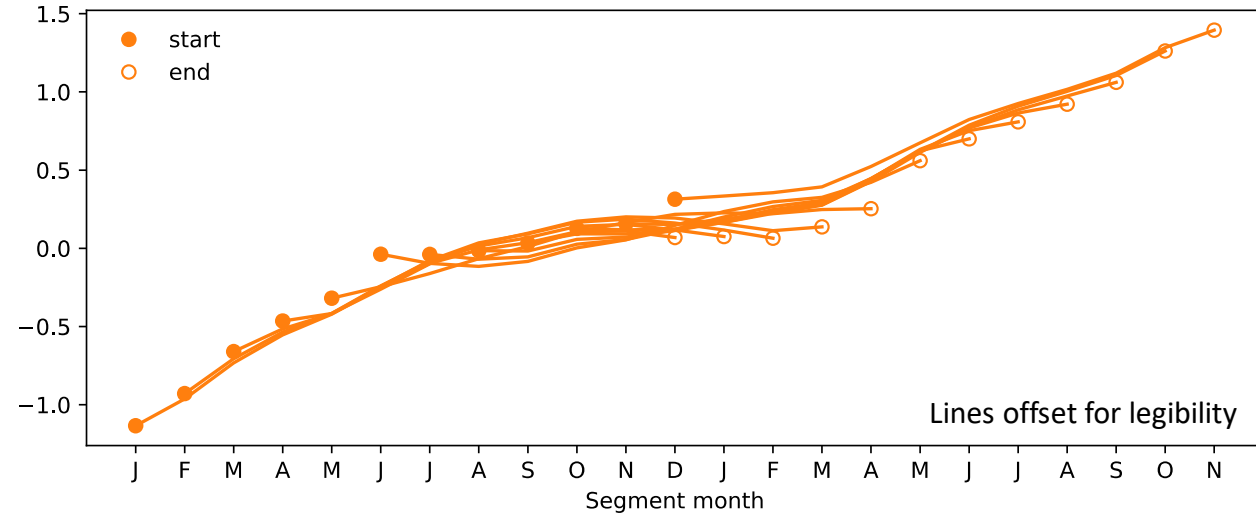
Q: What do the first 2 EOFs look like?
 A: EOF1 = event, EOF2 = transitions

EOFs depend on segment start month. Here we show all.

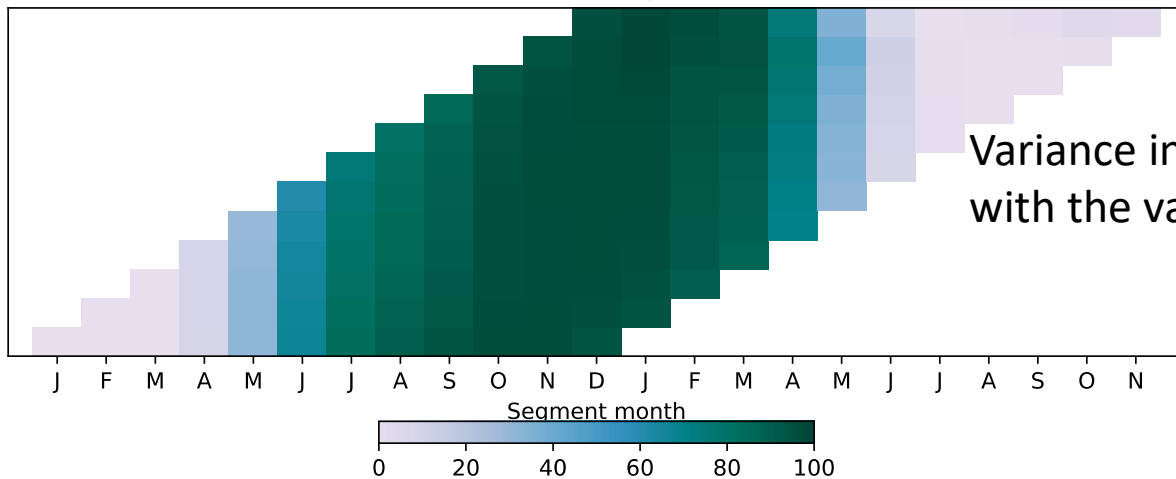
Nino 3.4 EOF1



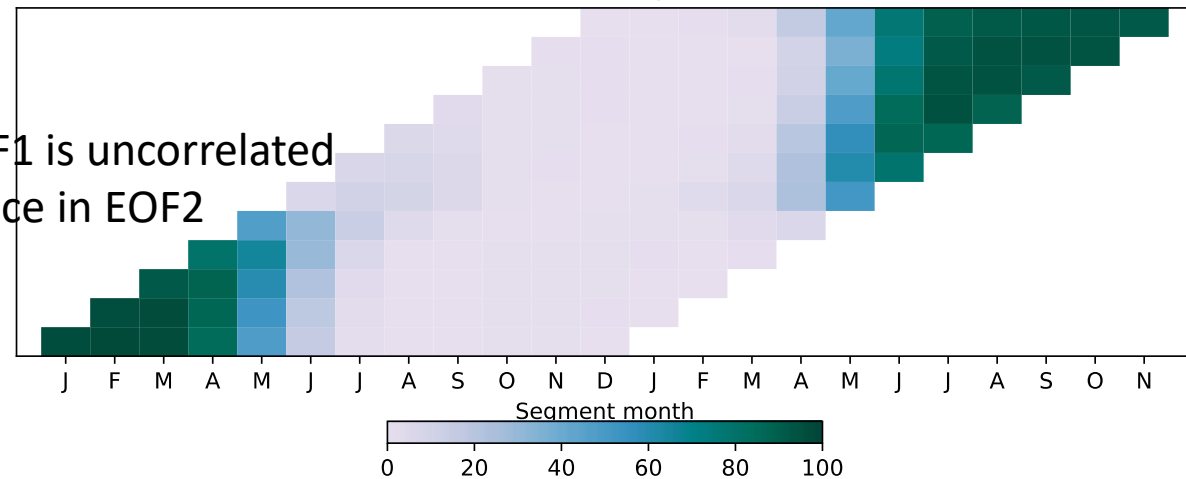
Nino 3.4 EOF2



Nino 3.4 EOF1 fraction of explained variance [%]



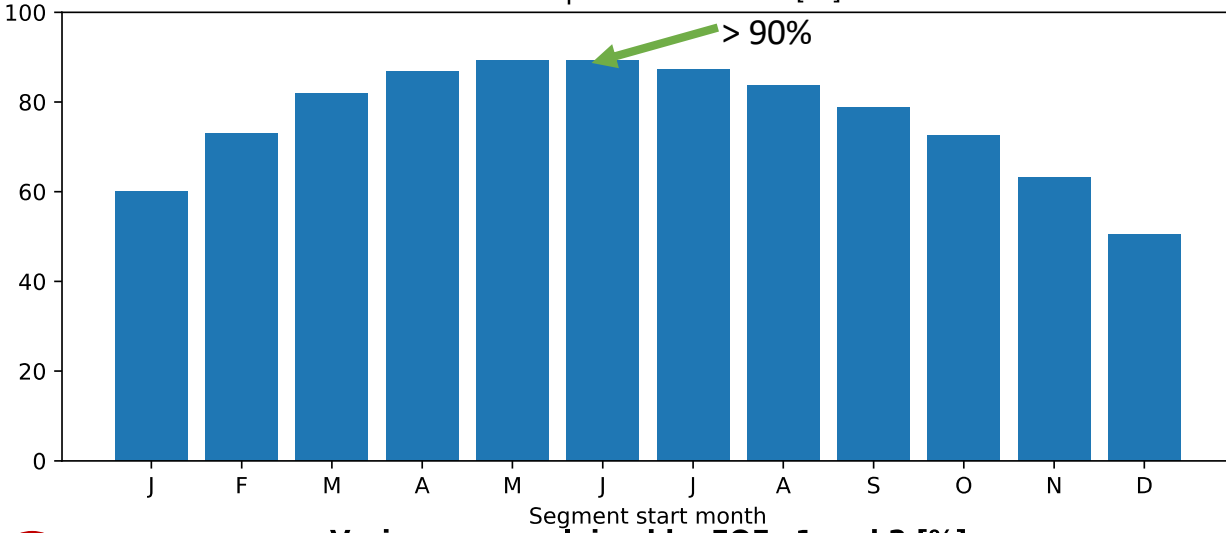
Nino 3.4 EOF2 fraction of explained variance [%]



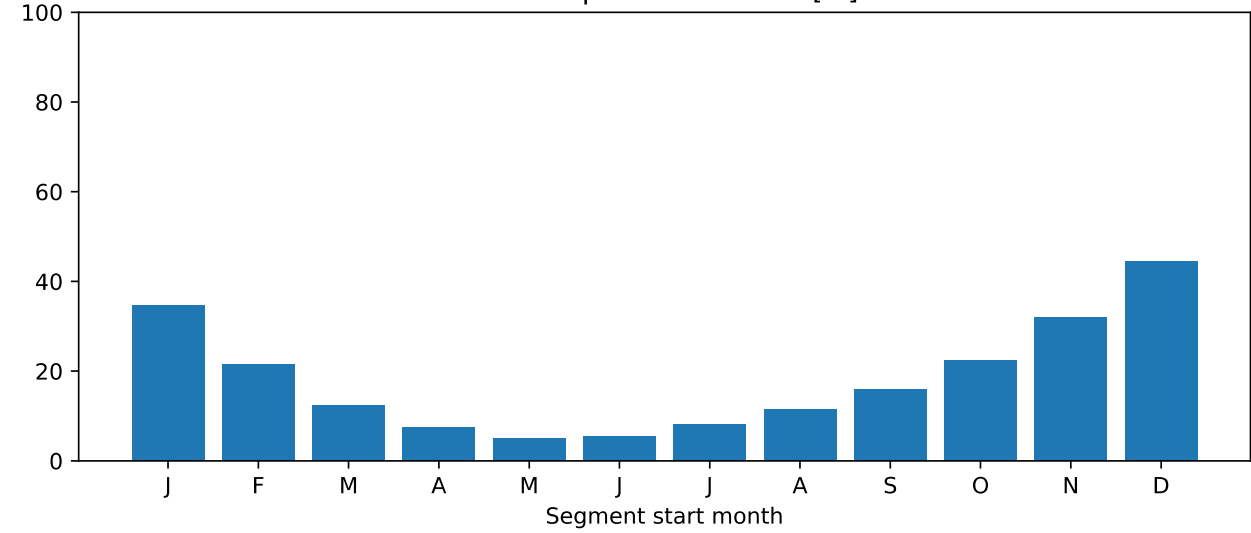
Q: Are 2 EOFs enough?

A: Yes

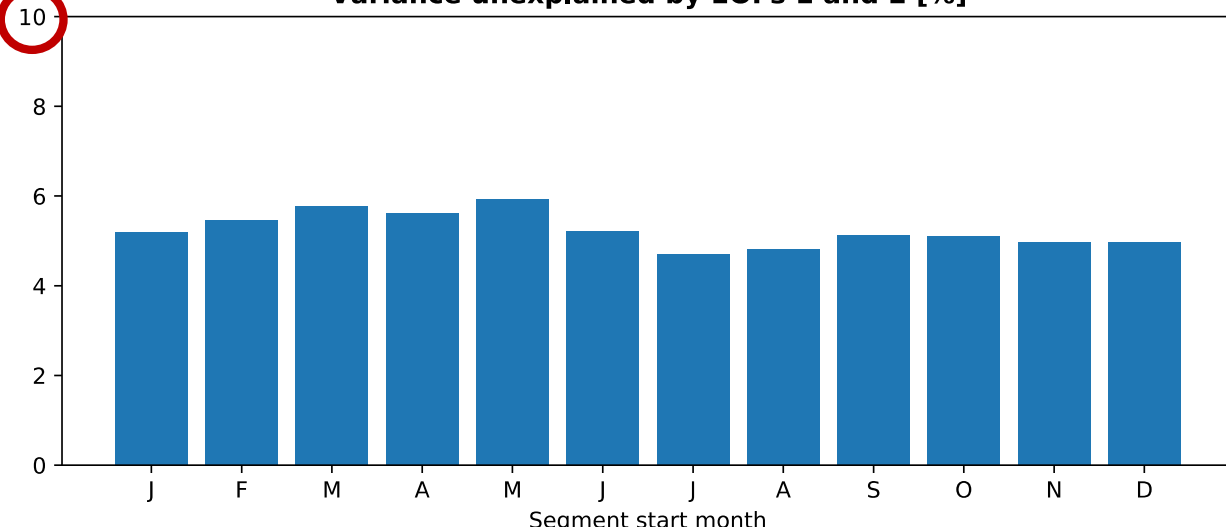
EOF1 explained variance [%]



EOF2 explained variance [%]



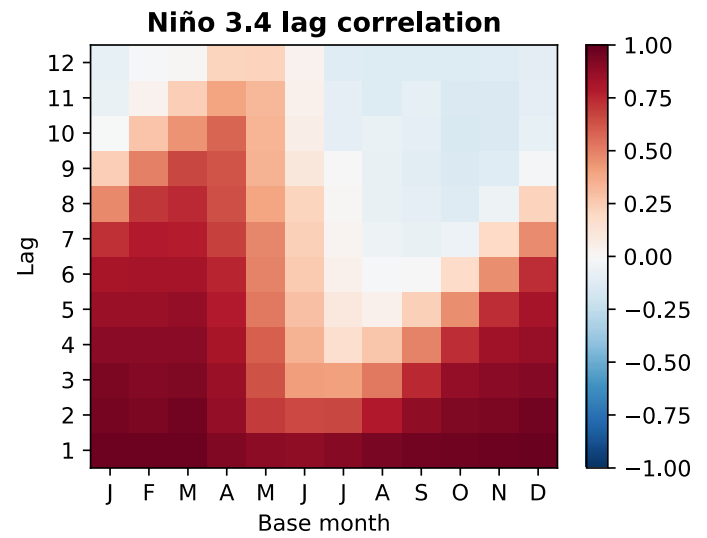
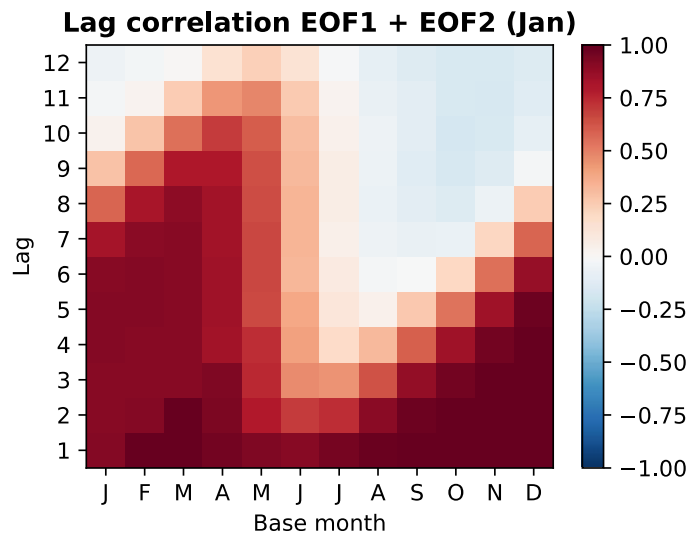
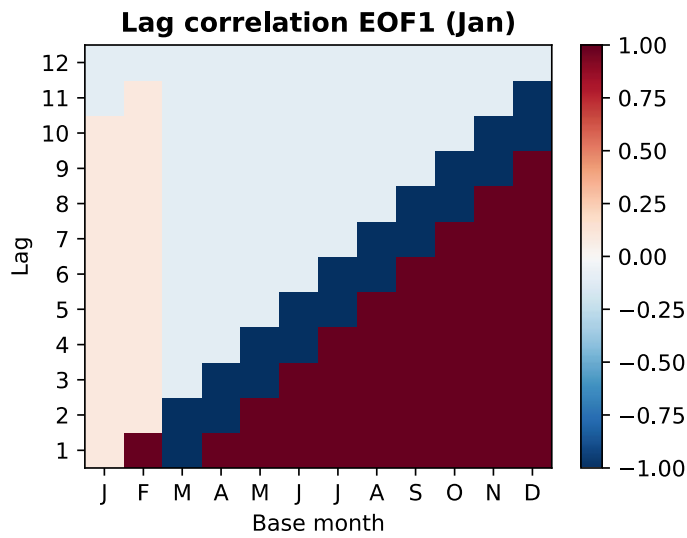
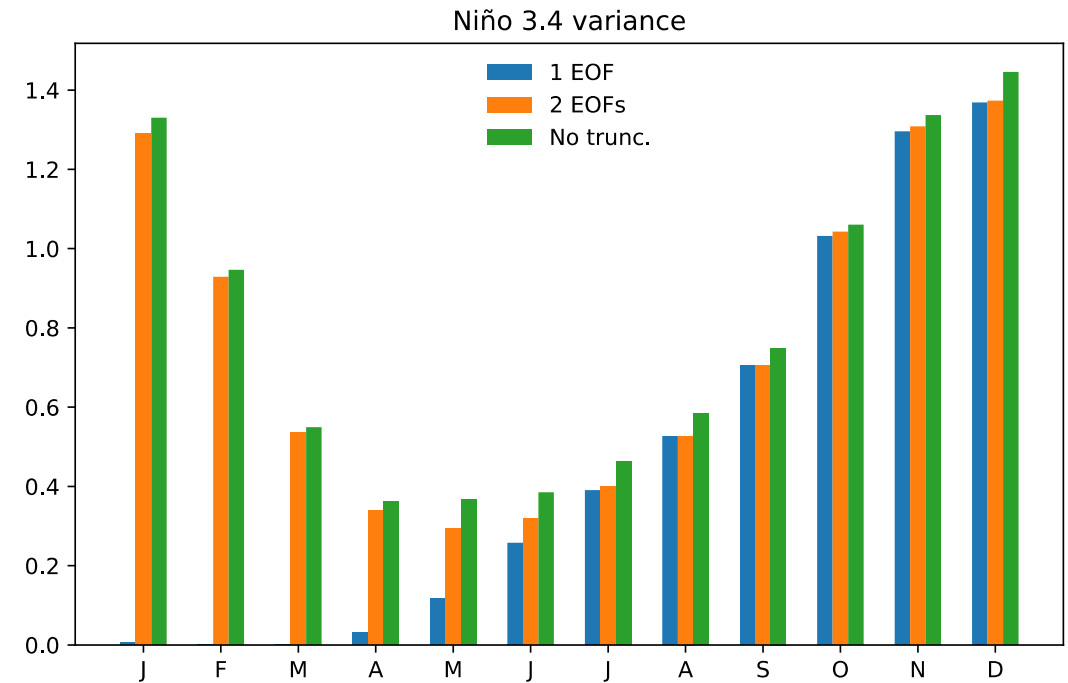
Variance unexplained by EOFs 1 and 2 [%]



>94 % of variance explained for all segment start months

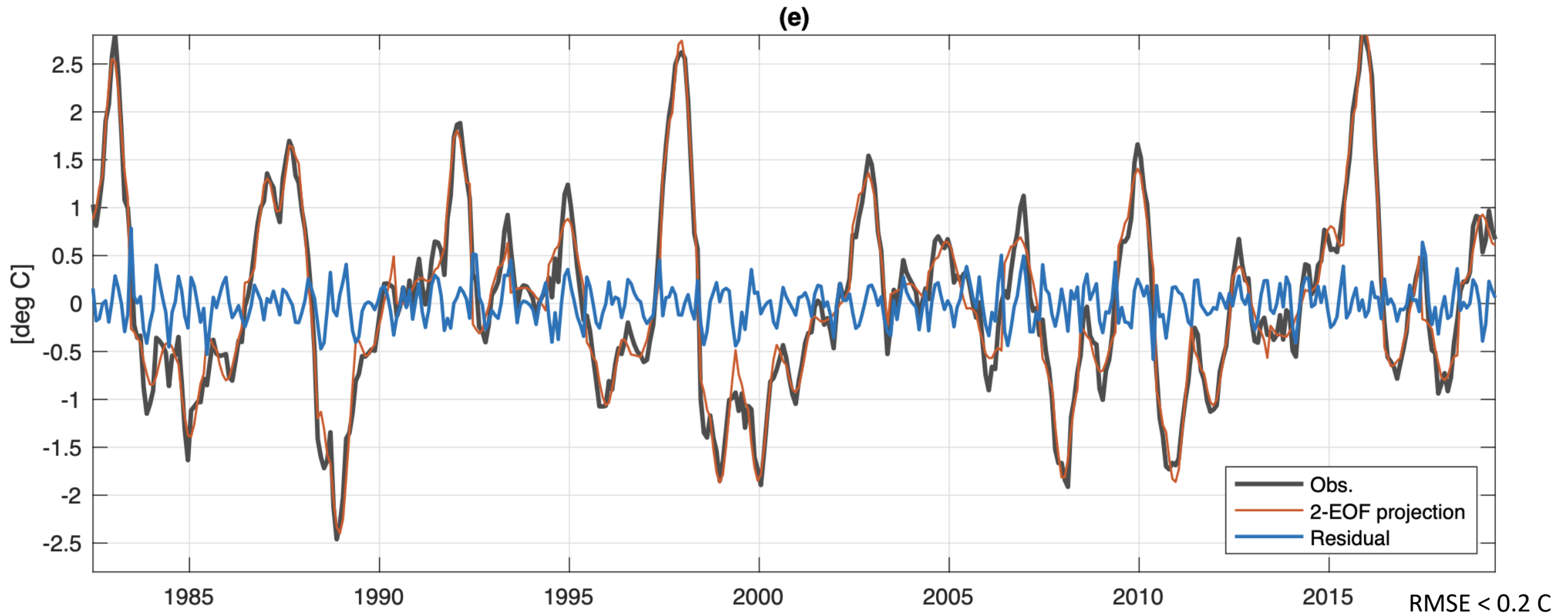
Q: Are 2 EOFs enough?
 A: Yes (and 1 is not)

Matches the seasonal
 variance and lag correlation

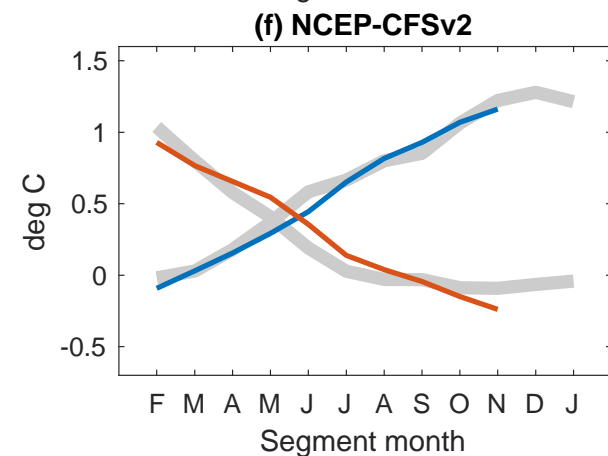
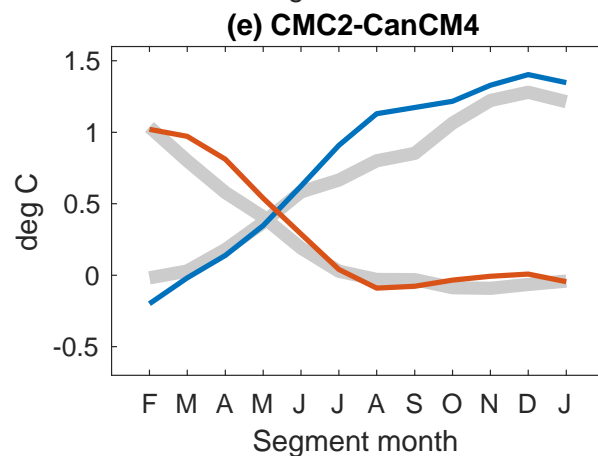
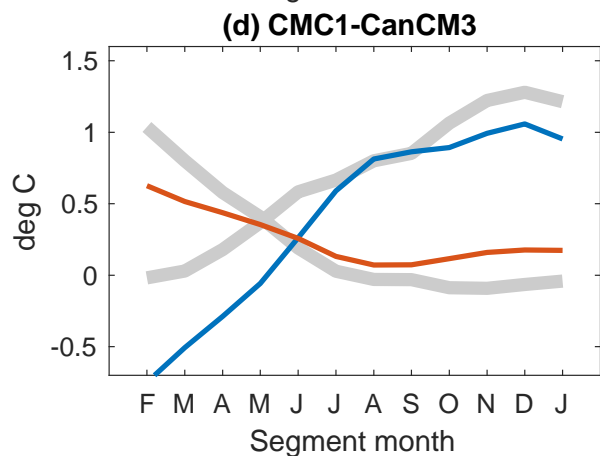
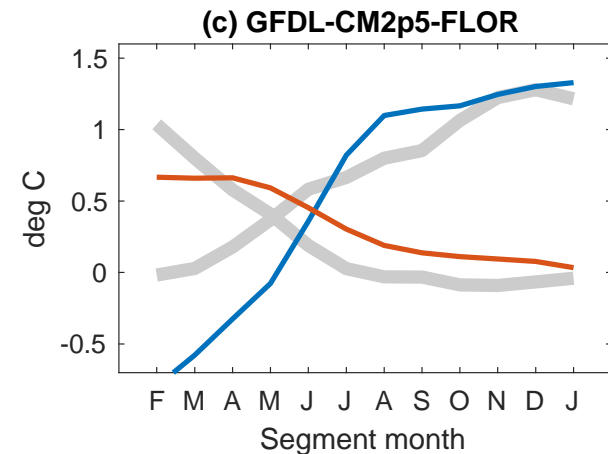
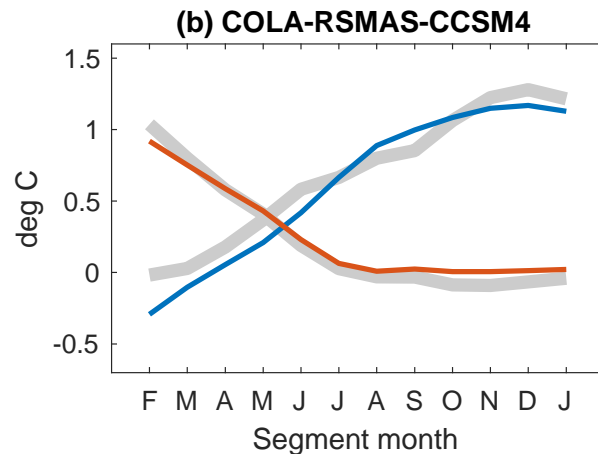
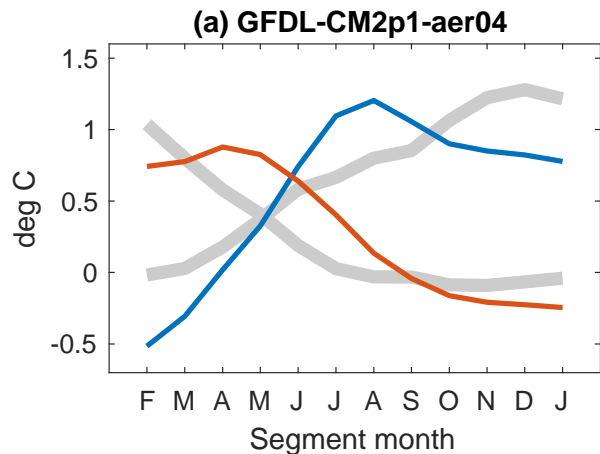


Q: Are 2 EOFs enough?

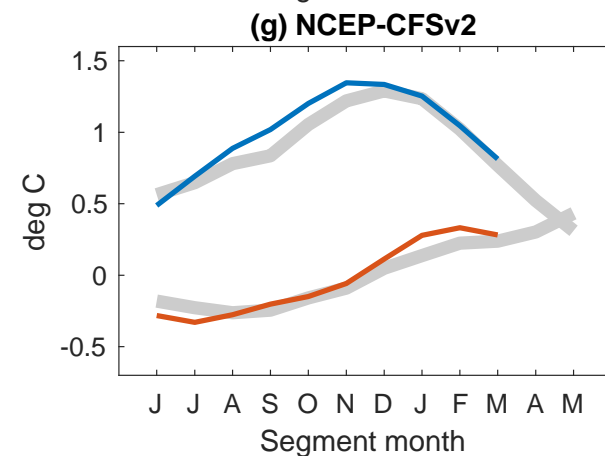
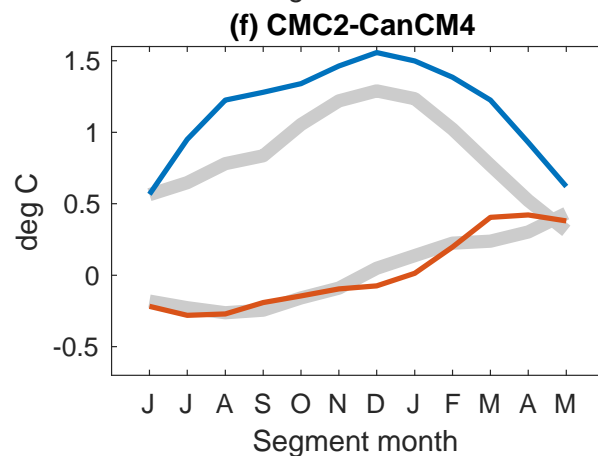
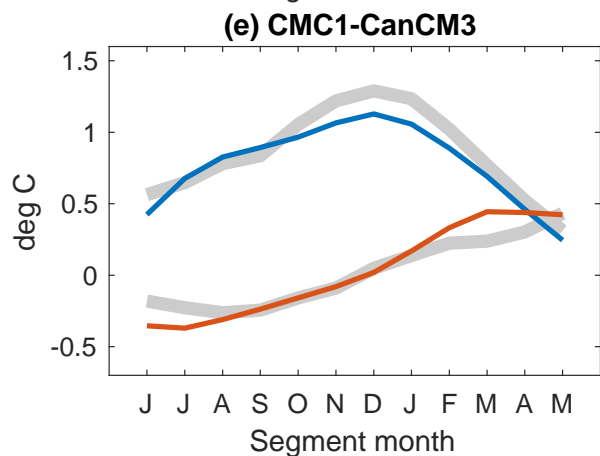
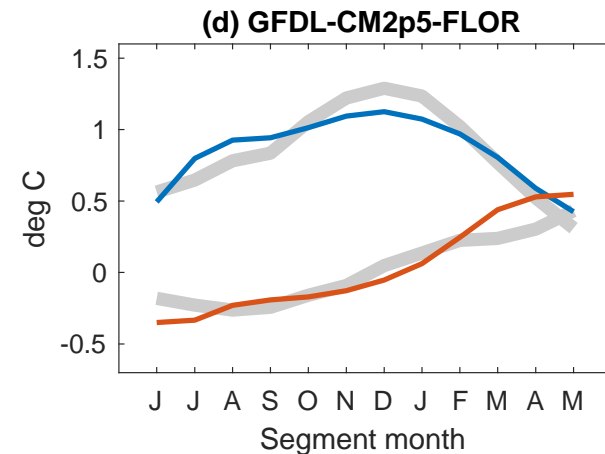
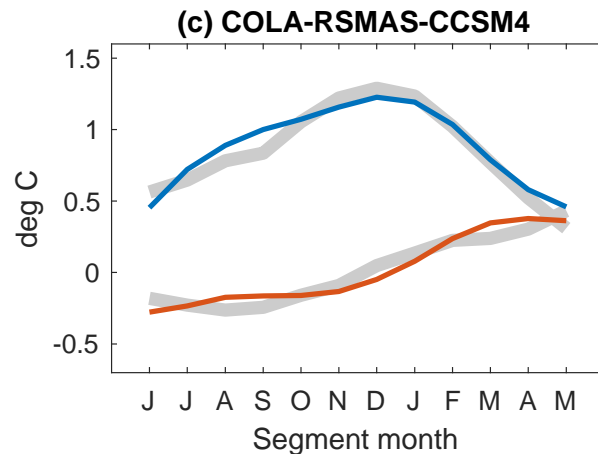
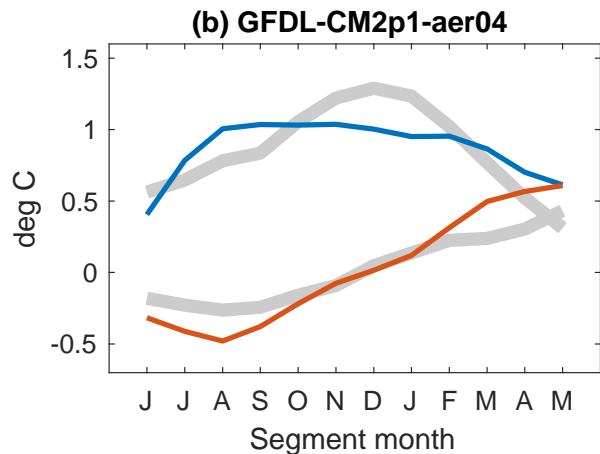
A: Yes



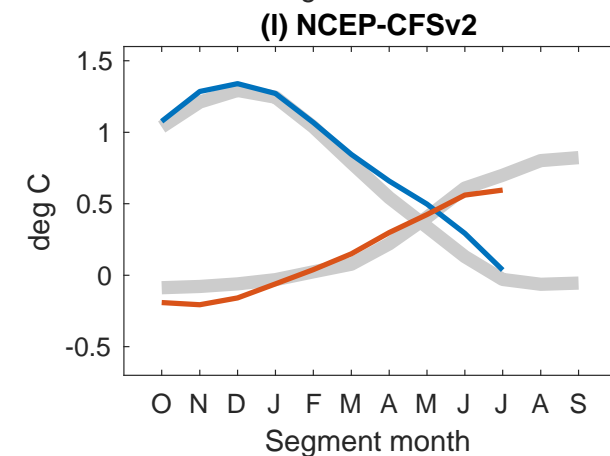
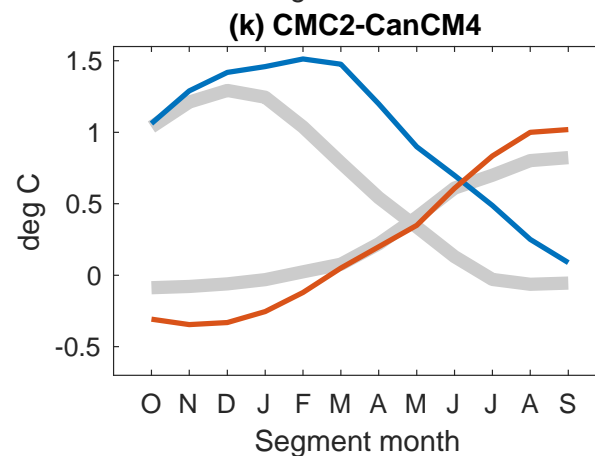
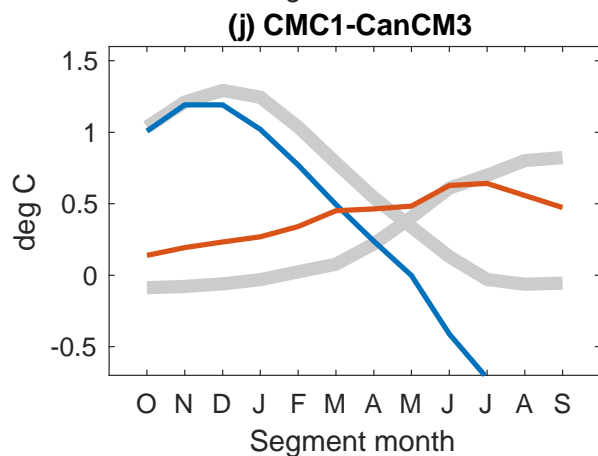
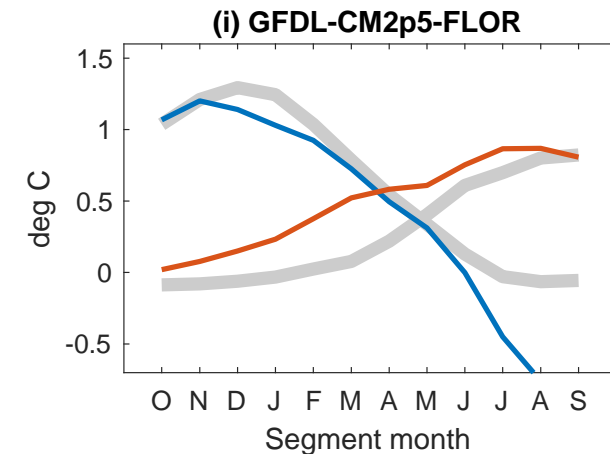
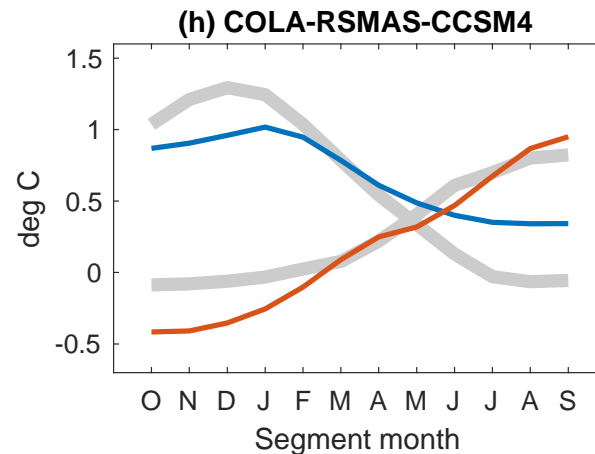
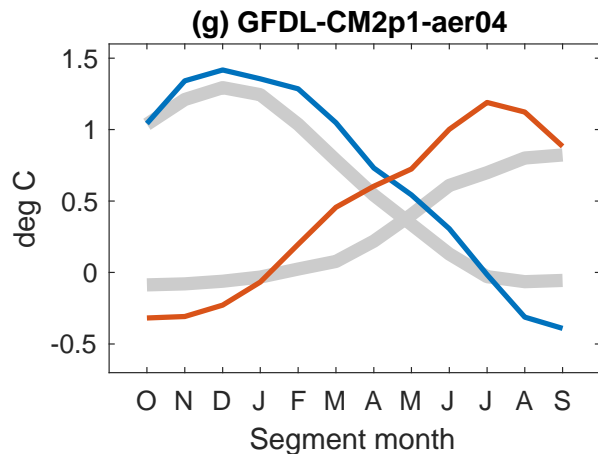
Back to forecasts. Compare EOF of forecasts and observations. Feb starts



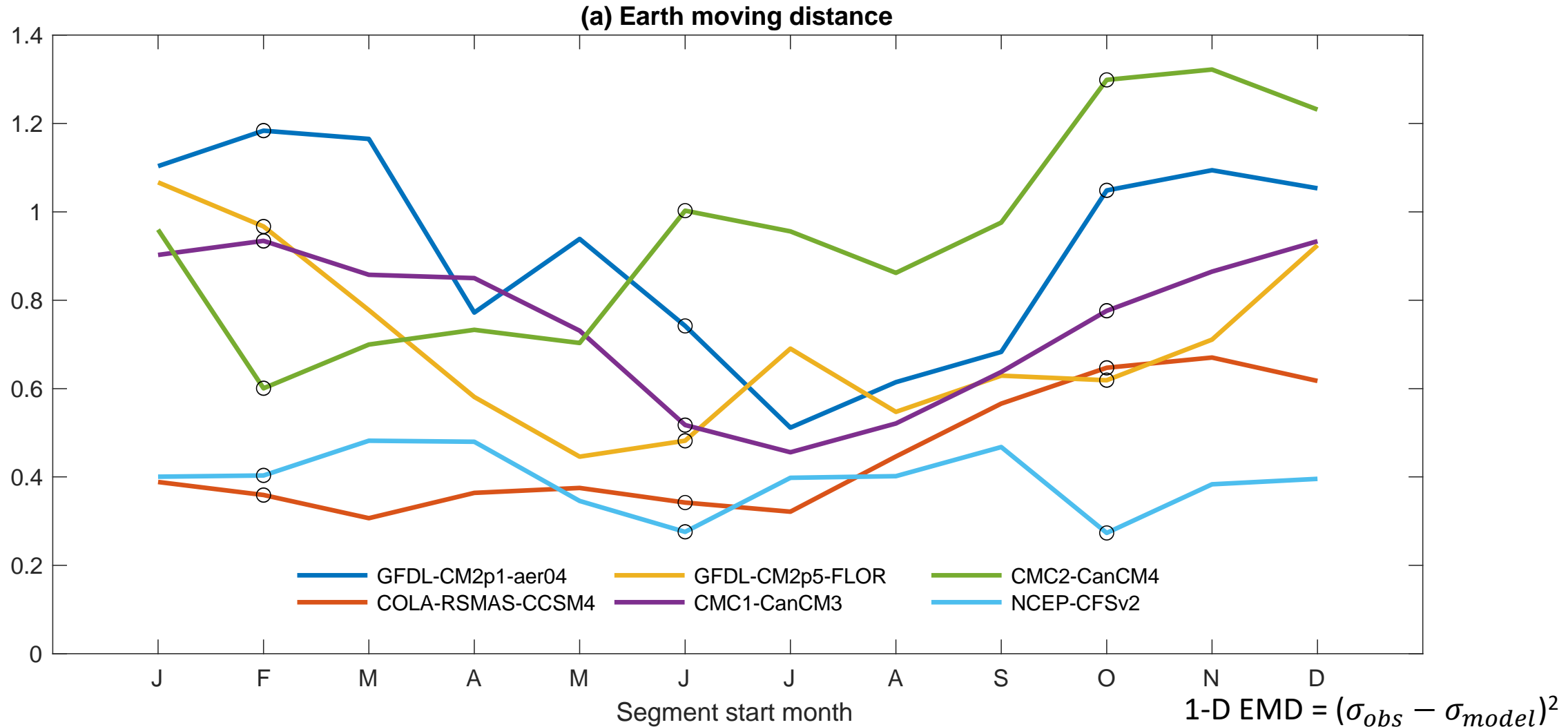
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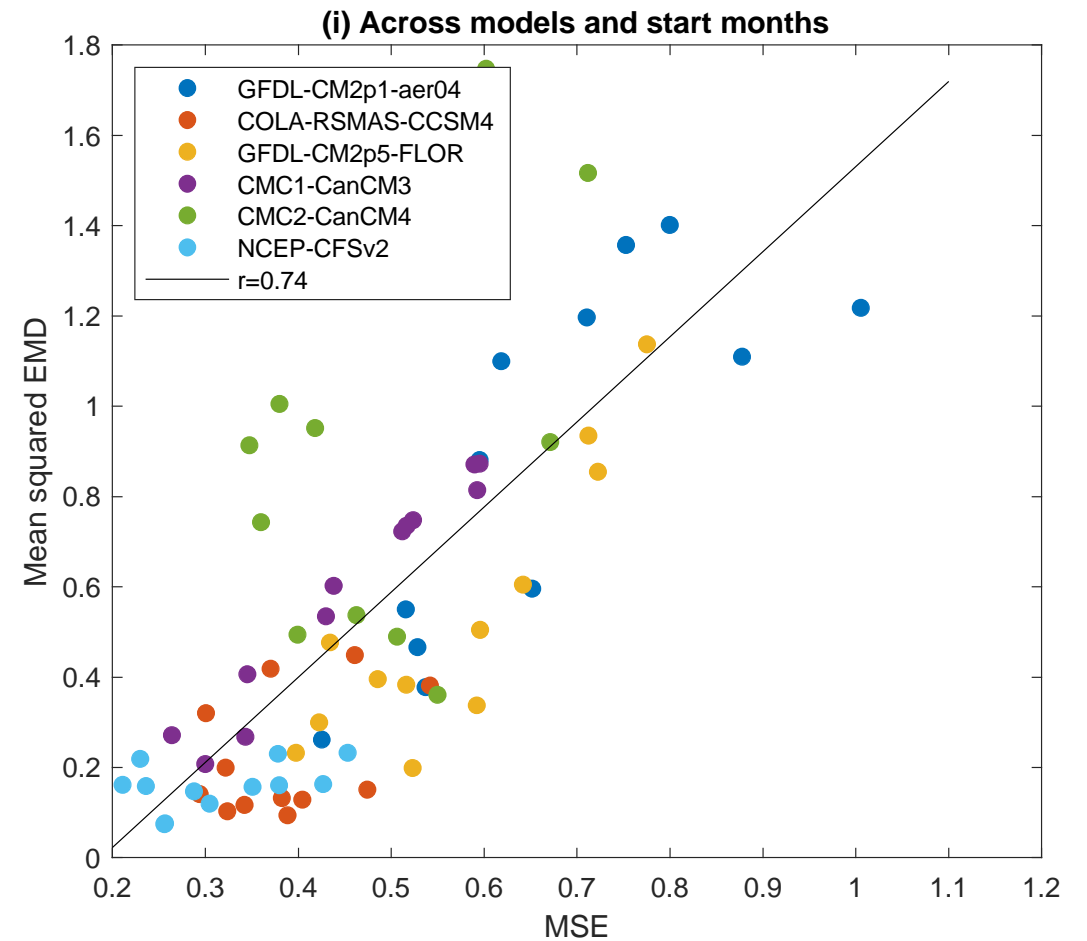
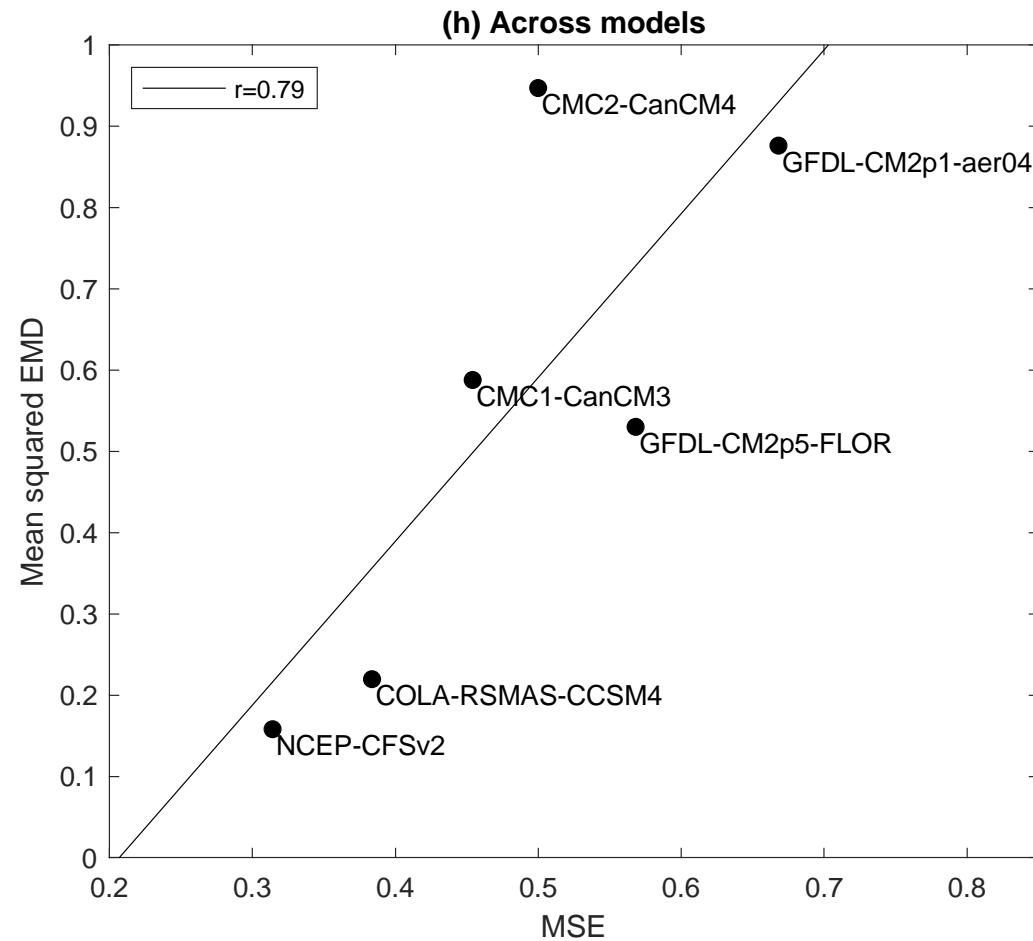
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“Earth mover’s distance” measures difference between 2 model and observation EOFs



Models with smaller EMD have lower MSE



Use EOFs to correct forecasts

Linear regression (by start month) with

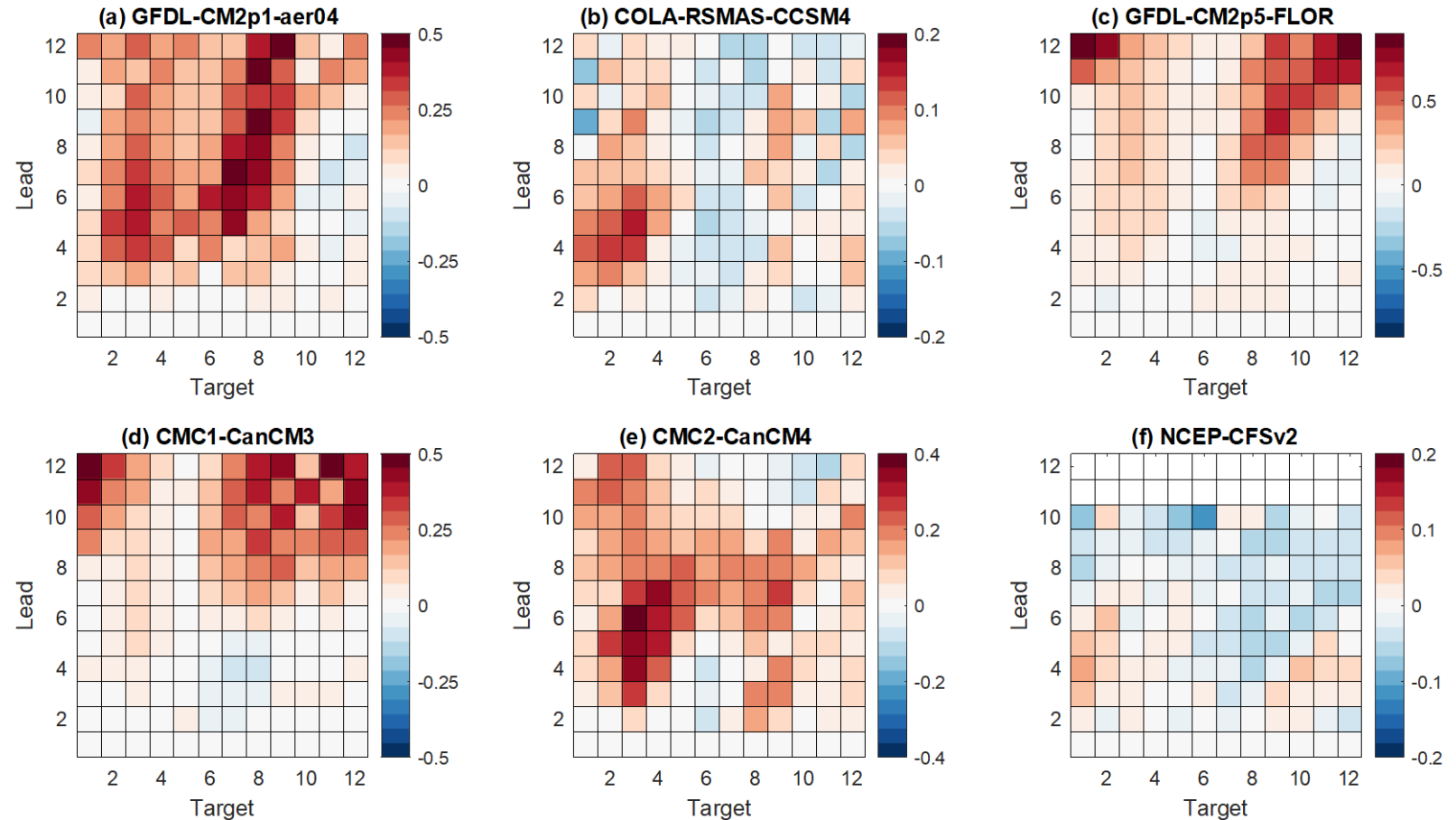
- 2 model EOFs as predictors
- 2 obs. EOFs as predictands
 - Consistent across leads
- Leave-out-5-year cross validation

The complete forecast trajectory is corrected

Benefits vary by model

More improvement at longer leads.

Reduction in MSE



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