El Niño in the Climate Forecasting System: T62 *vs.* T126 or *Dance, Dance, Resolution!!!*

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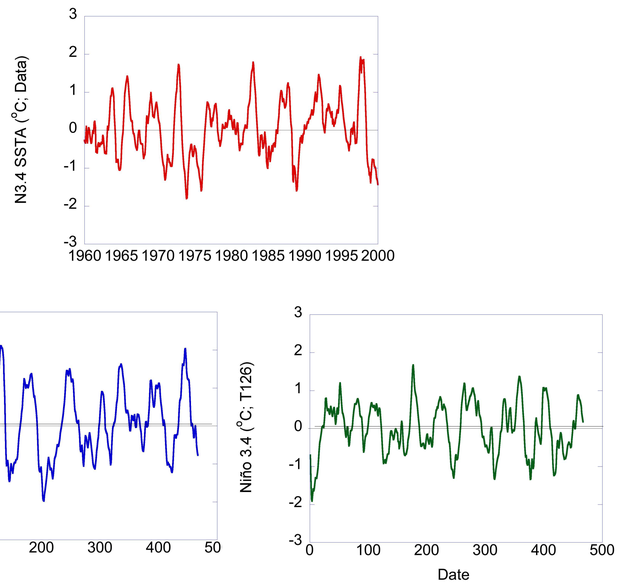
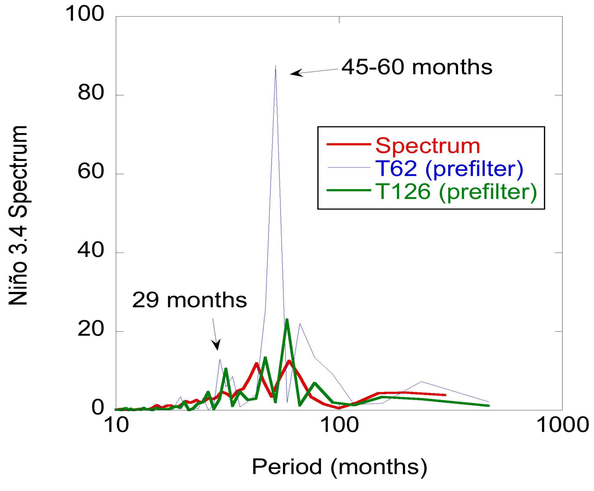
Does increasing the resolution of the CFS's atmospheric component affect the model's El Niño? ***Yes!***

To see this, we prepare CFS output as we do COADS data: project SSTs onto a $4° \times 10°$ grid, subject to a 3-month running mean, and then project onto 20 leading EOFs.

The Niño 3.4 SSTA time series: COADS(top; red), T62(left; blue), T126 (right, green).

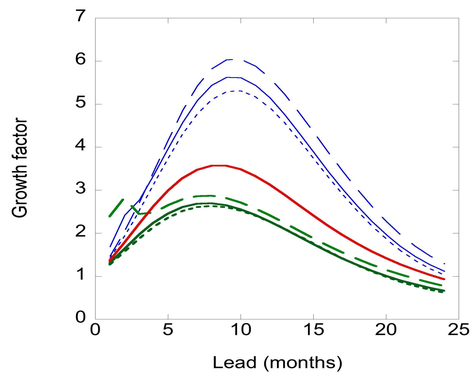


Niño 3.4 spectra: Red: COADS. Blue: T62. Green: T126.

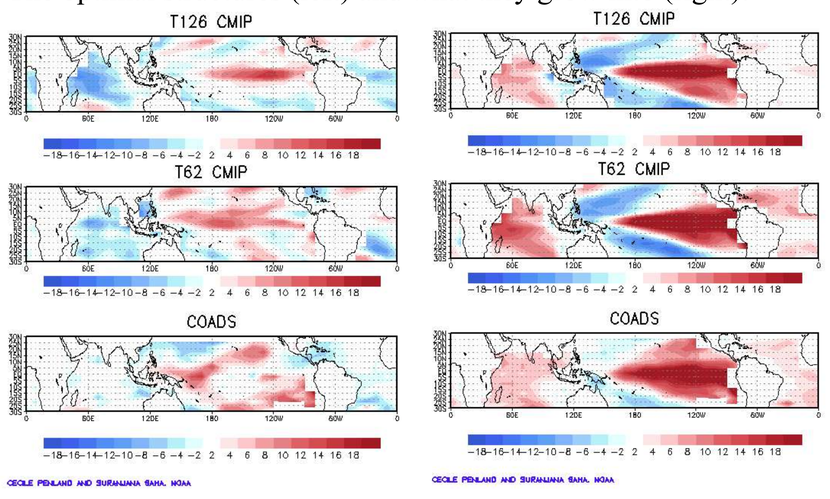


Linear Inverse Modeling (LIM) uses a combination of lagged and contemporaneous covariance matrices to provide the best-fit linear operator to the multivariate SSTA field. If the system is linear, then this operator does not strongly depend on the lag at which it was estimated.

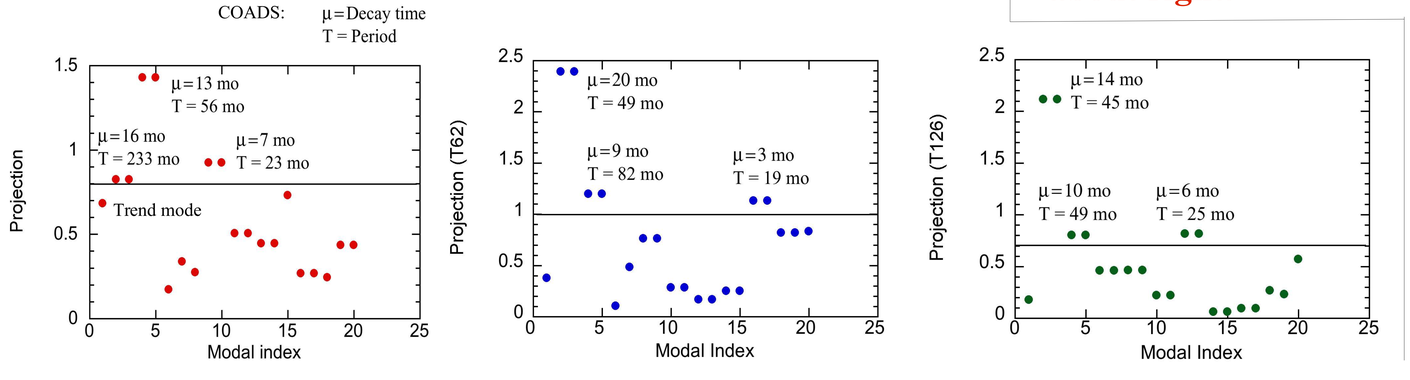
We estimate the leading eigenvalue of the corresponding right singular vector as a function of lead time for operators estimated with lags of 3 months (dotted lines), 4 months (solid lines) and 5 months (dashed lines). Blue: T62. Green: T126. Red: COADS, estimated with a lag $\tau_0 = 4$ months. This eigenvalue represents the field variance growth factor over a specified lead time, given the right singular vector ("***optimal structure***") as an initial condition of the linear model, and this curve is called a ***Maximum Amplification Curve***.



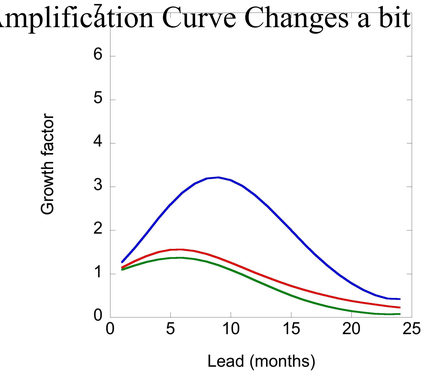
The optimal structures (left) and what they grow into (right):



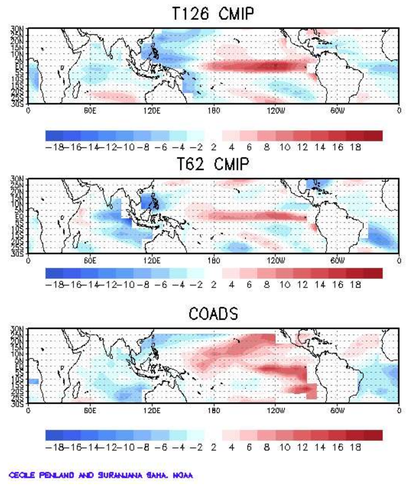
In both models and data, the optimal structure is dominated by 3 normal mode pairs. Unfortunately, the data optimal is contaminated by a trend.



If we reconstruct the SSTA data using *only* the 3 leading normal mode pairs, the Maximum Amplification Curve Changes a bit



and so do the optimal structures. Now, the models agree somewhat better with the observations, but there are still differences. Not shown: the optimals still grow into El Niños and the character of the Niño 3.4 spectra don't change a lot.



Conclusion:

The resolution of the atmospheric component of the model matters a lot! The T126 does get the El Niño spectrum about right.

Speculation:

Should we trust process studies using models whose atmospheres don't vary enough?