Are we near the limit of tropical SST predictability?

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The predictability of seasonal anomalies worldwide is largely due to the predictability of tropical sea surface temperature (SST) anomalies. Despite incorporating several decades of model improvements, however, the tropical SST forecast skill of the operational North American Multi-Model Ensemble (NMME) system, which combines forecasts from eight state-of-the-art coupled nonlinear atmosphere-ocean models, remains close both regionally and temporally to that of a vastly simpler Linear Inverse Model (LIM) derived from the observed covariances of SST, sea surface height (SSH), and wind fields. This closeness suggests that the predictable SST dynamics are essentially linear. The fact that the regionally and temporally varying potential forecast skill estimated using the LIM's forecast signal to noise ratios also closely tracks the NMME and LIM skill, and is only slightly higher, suggests that the scope for further skill improvements may be small.

There is one notable exception to the above conclusion. There is a potential for substantial skill improvement in the western Pacific, where the NMME skill is much lower than the LIM skill. This is mainly because the NMME component models typically predict ENSO anomalies of the same sign across the entire equatorial Pacific, instead of opposite signs as observed in the central and western Pacific. A corresponding error is also seen in the tropical precipitation forecasts. Both errors develop in the first few months of the forecast, and rapidly approach the systematic errors of ENSO patterns in each component model.