Seasonal prediction of North Pacific SSTs and PDO in the NCEP CFS Hindcasts

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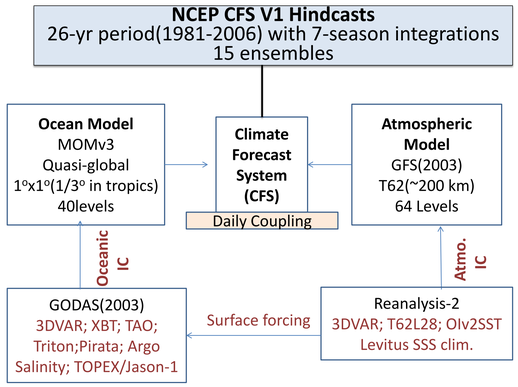
Summary:

Seasonal prediction skill of North Pacific SST anomalies and the PDO in the NCEP CFS v1 hindcasts is assessed. The central North Pacific SST experiences a faster drop in prediction skill for forecasts initialized from Nov to Feb than those from May to Aug, a similar feature to the "spring barrier" in the ENSO forecasts. Seasonal prediction skill in the central North Pacific mainly results from skillful prediction of ENSO via the atmosphere bridge. The PDO is more (less) skillful than the persistence at all lead time during ENSO (neutral) years. Results suggest that improvement of ENSO prediction and reduction in model biases near the western boundary will improve the PDO and North Pacific SST predictions.

Reference:

Wen,Caihong, Y.Xue and A.Kumar: Seasonal prediction of North Pacific SSTs and PDO in the NCEP CFS Hindcasts. J. Climate (submitted).

Forecast Model and Data



Observation: ERSST.v3b
PDO index : Projections of SSTA onto the 1st EOF of North Pacific(20°N – 60°N) SSTA from ErSST.v3b

Skill assessment of SST predictions

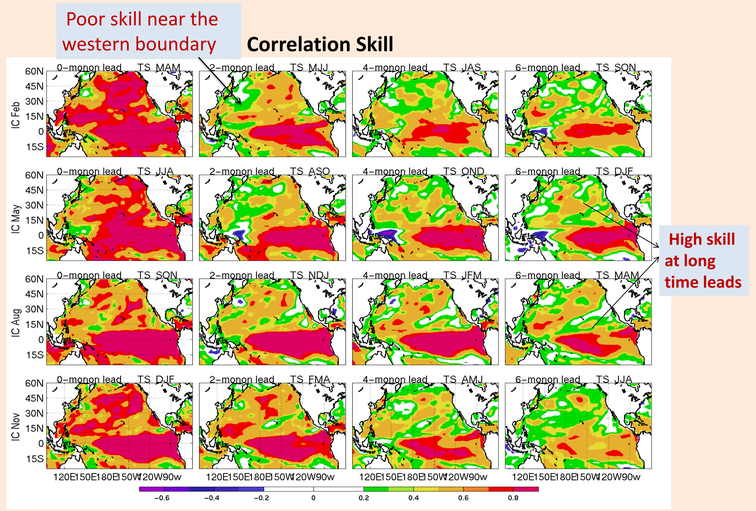


Figure Correlation skill of seasonal mean SST for CFS 0-, 2- , 4-, 6-month lead predictions (from left to right). From top to bottom the months for initial conditions are February, May, August and November. The target season (TS) and lead time are labeled on the top of each panel.

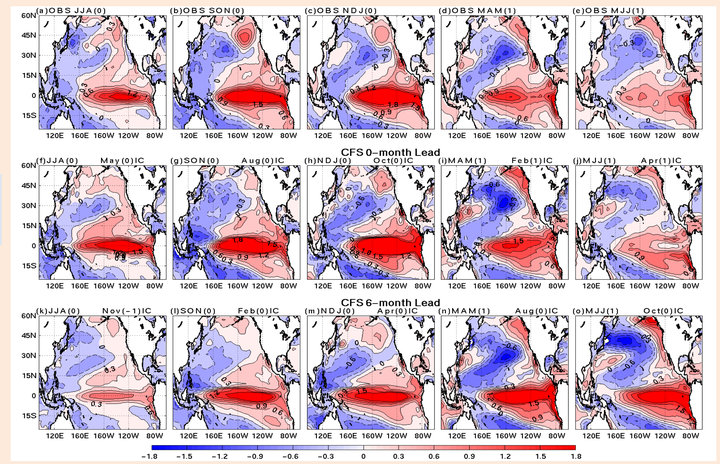
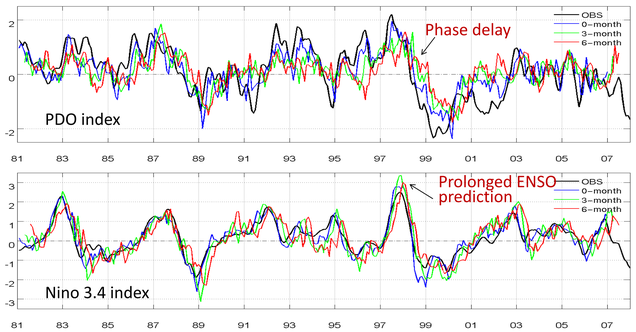
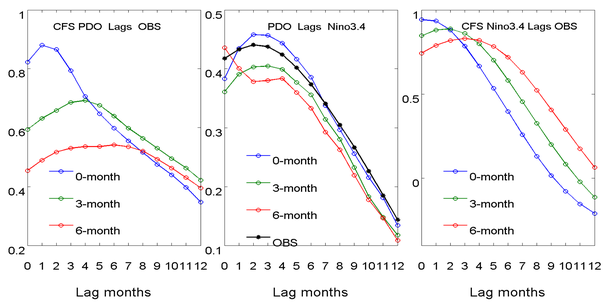


Figure 8. Composite of El Nino minus La Nina events during JJA(0),SON(0),NDJ(0),MAM(1), and MJJ(1) (from left to right panels) derived from observation((a)-(e)), CFS 0-month((f)-(j)), and 6-month lead((k)-(o)) predictions, where 0 indicates the ENSO year and 1 indicates the year following the peak phase of ENSO. Contour interval is 0.3 °C. For the predictions, initial start month (IC) for each case is also labeled on the top of panel.

- Regions with high skills have a seasonal dependence. Similar to the "Spring barrier" feature in the tropics, the central North Pacific SST experience a faster drop in skill for forecasts initialized from Nov to Feb than those from May to Aug.
- Central North Pacific where ENSO-related SST anomalies are strongest coincides with locations of high prediction skill in the North Pacific. It indicates the skill of central North Pacific mainly comes from the skillful prediction of ENSO via the atmosphere bridge.
- Prolonged ENSO peak phase into late spring in conjunction with seasonal mixed layer variation, give rise to delay shift of maximum SST response in the North Pacific.



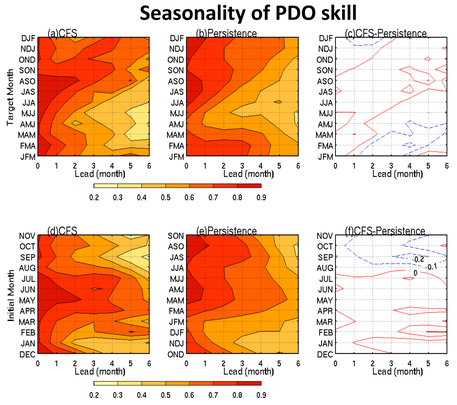
Lag correlation



Lag shift of predicted PDO is associated with the lag shift of predicted Nino 3.4

Skill assessment of PDO predictions

Seasonality of PDO skill



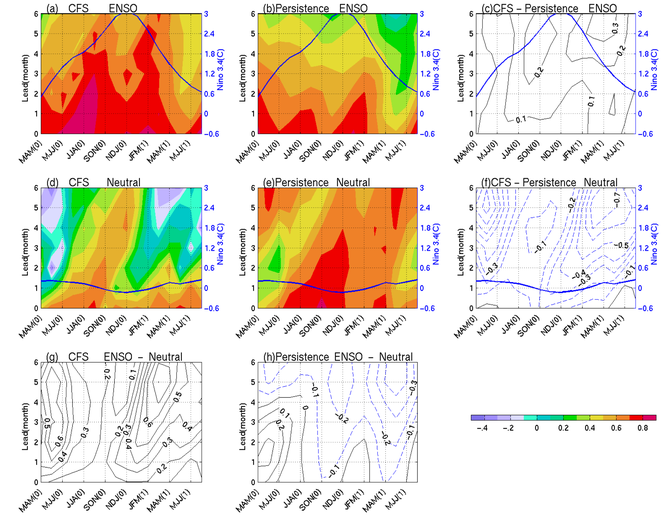


Figure Variation of correlation coefficient of PDO index (shading) during ENSO years and ENSO-neutral years. (0) indicates the year in which the event develops and (1) indicates the year following the peak phase of ENSO. (a), (b) and (c) are CFS prediction, persistence, CFS prediction minus persistence for ENSO events respectively. (d)-(f) as the same in (a)-(c), but for ENSO-neutral years. (g) Correlation coefficient for ENSO events minus ENSO-neutral years . (h) as in (g), but for persistence. In (a)-(f), the blue line is the composite Nino 3.4 anomalies .

- CFS PDO skill is significantly higher at all leads during ENSO events than that during neutral years .
- CFS PDO skill is much lower than the persistence during ENSO-neutral conditions and vise versa.
- CFS PDO skill exhibits two maximums with significant high skill beyond 6-month lead (one at ASO(0)-SON(0); one at JFM(1)-MAM(1)).

PDO skill and ENSO skill weaken since early 2000s

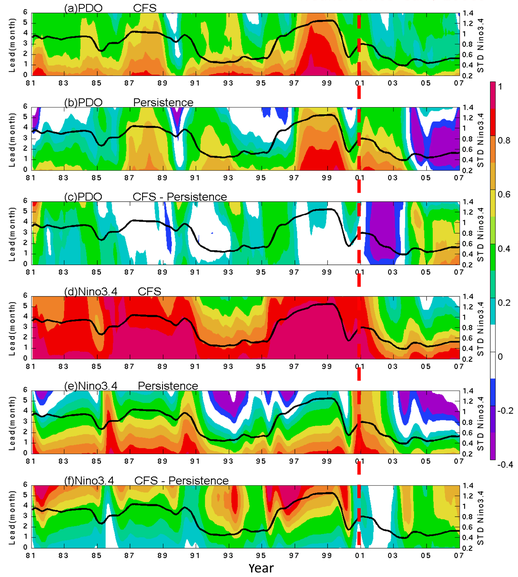


Figure 4-year sliding window correlation skill of PDO and Nino 3.4 prediction. The superimposed black solid line on each panel presents standard deviation of the observed Nino 3.4 SST Both the correlation and standard deviation are calculated based on seasonal mean for 4-year sliding window.