PREDICTABLE SKILL AND ITS ASSOCIATED SEA-SURFACE TEMPERATURE VARIABILITY IN AN ENSEMBLE CLIMATE SIMULATION

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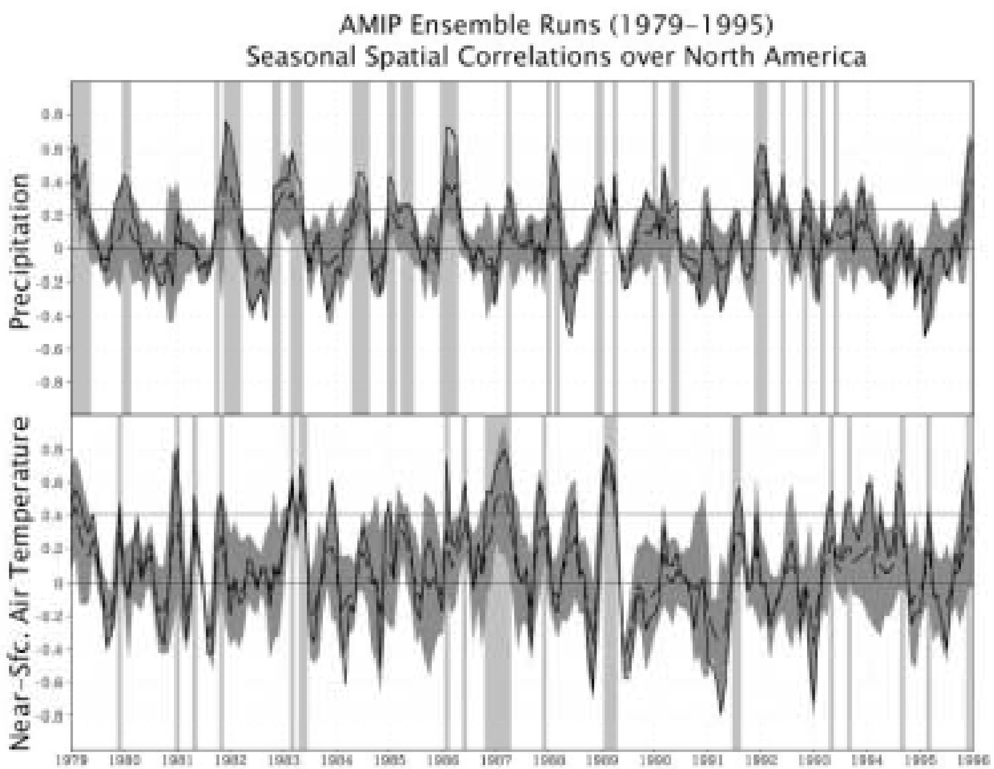
The performance of an ensemble climate-simulation at simulating near-surface air temperature (T_a) and precipitation over North America (NA) is assessed. The ensemble climate-simulation was constructed with the Center for Ocean Land Atmosphere (COLA) atmospheric general circulation model (AGCM) in conjunction with the Atmospheric Model Intercomparison Project II (AMIP II). To diagnose the ensemble simulation, a measure of "predictable skill" is formalized. This diagnostic is based upon the statistical significance of spatial correlation for a given region (for this analysis, North America) between the ensemble mean and observed anomalies

Figure 1



(shown as solid curves in Fig. 1), and the inter-member scatter of the spatial correlation (dark-gray shaded timeseries envelopes in Fig. 1). Using this measure, epochs of predictable skill are identified (denoted as the light-gray, boxed periods in Fig. 1). Through a point-wise correlation technique, spatial patterns of contemporaneous sea-surface temperature (SST) variability are also constructed.

Spatially coherent patterns of SST variability are found to be associated with predictable skill. These patterns are, not surprisingly, primarily related to the El Nino Southern Oscillation (ENSO). One of the strongest ENSO associations to predictable skill (for the COLA AGCM) is found in sub-tropical regions of the western Pacific (WSTPAC). Moreover, skill in North American precipitation is seen to be associated with inter El Nino variability and East Indian Ocean (EIND) variability. In addition, a strong contemporaneous association of T_a predictable skill with sub-tropical Atlantic (STATL) SST variability is found. Complementary simulations are then performed with the COLA AGCM to verify and assess these associations between predictable skill and SST variability.

In our preliminary numerical experiments, we focus on three regions of SST variability that have been associated to predictable skill. These regions are: STATL, WSTPAC, and EIND (Fig. 2, light contours denote the contemporaneous correlation of SST to the NINO3.4 index). For each region, a point-wise regression of SST to the area-averaged SST of that region is performed. The regression is then superposed on the SST annual cycle. The AGCM is then run for the AMIP period with the constructed SST forcing. The impact of the experimental SST forcing on model skill is assessed against the ensemble control-run's skill. Not surprisingly, none of the experimental runs are able to reproduce all the predictable skill of the control run. However, some notable skill results are found (though not shown for brevity). The EIND SST-forcing reproduces nearly all the precipitation skill in the 1981/82 epoch of the control. Contrastingly, for the 1982/83 El Nino, only the WSTPAC SST-forcing is able to reproduce a portion of the control run's skill in precipitation and T_a. The strong 1986/87 skillful epoch (during an El Nino) for T_a (Fig .1) is partially reproduced by both the TATL and WSTPAC SST-forcings. The results indicate that ensembles of these experimental SST-forcing runs are needed to provide a more robust diagnosis of the impact on skill (and are currently underway). Further analysis regarding these experimental ensemble runs and mechanistic diagnoses of the SST impact will be provided.

Figure 2