Session: C1 Poster: M235A

The Asian-Australian Monsoon: Intraseasonal to seasonal prediction using multi coupled models in APCC/CliPAS and ENSEMBLES project

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The monsoon precipitation is a principal atmospheric heat source that drives tropical and extratropical circulation and has profound impacts on agricultural planning and water resource management. Thus, reliable prediction of the seasonal variation in monsoon system is one of the most important and challenging tasks in climate system. This study strives to evaluate the state-of-the-art coupled models' performance on intraseasonal-to-seasonal prediction for Asian-Australian monsoon (A-AM) variability. Two hindcast datasets are used for the evaluation. Frist, the one-month lead multi-model ensemble (MME) prediction for seasonal anomalies in the A-AM region was assessed for the 25 years of 1981-2005 using eleven coupled models which have participated in the Asia-Pacific Economic Cooperation Climate Center/Climate Prediction and Its Application to Society (APCC/CliPAS) and ENSEMBLE-based predictions of climate changes and their impactS (ENSEMBLE) project. Second, nine models' ISO hindcast dataset were made which covers the last 20 years from 1989 to 2008 initiated every 1st day of each calendar with integration length of 45 days. Although the ENSO, a dominant predictability source of global seasonal prediction, is reasonably well predicted, the seasonal prediction over Monsoon region is very poor, particularly during boreal summer over land. Such poor predictions may be related to poor representation of land surface processes in the models and uncertainty of initial conditions over the land. Correction of the inherent bias in the mean state and annual cycle is critical for improving the long-lead seasonal prediction of precipitation. Predictable mode analysis (PMA) for the seasonal precipitation over the A-AM region reveals that the first three to four leading modes of the observed seasonal precipitation are potentially predictable accounting for about 50 to 60 % of the observed total variability. On the other hand, the one-month lead MME prediction tends to capture about 15 to 30 % of the observed total variability depending on season over the region of interest. The dynamical intraseasonal prediction, particularly the MJO prediction, has been improved in recent years. It is shown that a reliable MJO (MISO) prediction with correlation skill of 0.5 can be made with the CliPAS ISO MME system for more than 25 (20) days, which is longer than any of statistical models. It is also worth mentioning that the models better simulating the seasonal mean tend to make a better prediction of intraseasonal activity, indicating the seasonal mean is somewhat related to the intraseasonal activity over the season, particularly in the Monsoon region.