



## **Potential impact of the May Southern Hemisphere annular mode on the Indian summer monsoon rainfall**

Juan Dou, Zhiwei Wu, and Yefan Zhou

Earth System Modeling Center, Nanjing University of Information Science and Technology (NUIST), Nanjing, China(zhiweiwu@nuist.edu.cn)

El Niño-Southern Oscillation (ENSO) is probably a most important external forcing to Indian summer monsoon (ISM) rainfall (ISMR), yet the observed ENSO-ISMR relationship has become weak in recent years. It's essential to explore other predominant modes of variability which can contribute to the ISMR. As the leading mode of the variability in Southern Hemisphere (SH) extratropical atmospheric circulation, the SH annular mode (SAM) has potential influence both on the northern and southern hemispheric climate. The present study investigates the relationship between the SAM and ISMR. It is found that the May SAM exhibits a significant positive correlation with the monsoon precipitation over the Indian sub-continent and the adjacent areas in June/July (JJ). Observational and numerical evidences indicate that the May SAM anomaly can trigger a South Indian Ocean dipole (SIOD) sea surface temperature anomaly (SSTA) through air-sea interactions. The SIOD SSTA persisting into the following months of JJ excites abnormal meridional circulation and modulates the low-level cross-equatorial flow. Accordingly, the ascending (or descending) motion and water vapor transportation are enhanced (or suppressed), which favors more (or less) precipitation over the Indian sub-continent and the adjacent areas. In fact, the SIOD SSTA plays an "ocean bridge" role to "prolong" the influence of the May SAM to the subsequent season and in turn impacts on the ISMR. Moreover, an empirical model is established to forecast the JJ ISMR strength based on the ENSO, Indian Ocean Dipole (IOD) and May SAM. The hindcast is carried out for the period 1979–2014, and performs better than the multimodel ensemble mean (MME) obtained from the Development of a European MME system for seasonal to interannual prediction (DEMETER) project. Since all these predictors can be monitored in real time before the early boreal summer, the empirical model might provide a practical real-time forecast tool for predicting ISMR variations.