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Distinguishing Different Types of ENSO Influences on the Indian Summer Monsoon Variability

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The year-to-year variability of the Indian summer monsoon (ISM) is related to many factors, one of which is El Niño-Southern Oscillation (ENSO). There has been extensive study about the influence of ENSO on the ISM variability. The present talk will separate different types of ENSO influences on the ISM variability based on observations: anomalous ISM only due to the influence of preceding winter (December-February; DJF) eastern equatorial Pacific (EEP) sea surface temperature (SST) anomalies (DJF-only cases), only due to the influence of concurrent summer (June-September; JJAS) EEP SST anomalies (JJAS-only cases), and due to the influence of both preceding winter and concurrent summer EEP SST anomalies (DJF&JJAS cases). The speaker will present the processes connecting ENSO to the ISM corresponding to the different types of ENSO-ISM relationship.

In the DJF-only cases, preceding winter EEP SST anomalies induce North Indian Ocean (NIO) SST anomalies through air-sea interaction processes in the tropical Indian Ocean. ENSO-induced anomalous lower-level moisture convergence over the western Indian Ocean alters surface air humidity there. Both processes favor anomalous ISM. The meridional thermal contrast over South Asia is not a factor in this type of cases. In the JJAS-only cases, anomalous ISM is directly induced by ENSO through large-scale circulation changes and associated anomalous vertical motion. The meridional thermal contrast may contribute to anomalous ISM as well. The NIO SST anomalies are mainly response to anomalous ISM in this type of cases. In the DJF&JJAS cases, preceding winter EEP SST anomalies induce NIO SST anomalies and change surface air humidity over the western Indian Ocean. Concurrent summer EEP SST anomalies induce large-scale vertical motion anomalies over South Asia. Together, they lead to an anomalous ISM. The anomalous meridional thermal contrast may contribute to anomalous ISM in late summer in this type of cases.

The contemporaneous correlation between ISM and EEP SST may be contributed by preceding winter SST anomalies in the DJF&JJAS cases. In comparison, there are more DJF&JJAS cases before than after the late 1970s due to the change in the periodicity and timing of decay of ENSO. This suggests that the observed weakening in the ISM-ENSO relationship in the late 1970s may be related to the change in ENSO characteristics.