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Data analytics in deriving atmospheric modes

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Data analysis is an integral part of research in Atmospheric science. The tropical atmosphere is largely governed by spatially propagating disturbances and several natural oscillatory modes exist in the atmosphere which determines the frequency and distribution of precipitation and weather conditions. For example, the Kelvin, Rossby and gravity waves are the normal modes of the tropical atmosphere, each one exhibiting a unique spatial and temporal relationship and having different propagation characteristics. The Madden Julian Oscillation (MJO) is a tropical oscillatory mode which play a dominant role in organizing tropical convection and govern the tropical precipitation variability in the intraseasonal timescale. The El Nino Southern Oscillation (ENSO) and the Indian Ocean dipole (IOD) are coupled ocean atmosphere modes in the interannual timescale which govern the atmospheric processes ranging from cyclones to monsoons. Spatio temporal filtering is integral to most of the approaches due to the different timescales of the modes and methods like empirical orthogonal functions (EOF) and K-mean clustering based analysis are used to derive the structures. However, such practices are not directly applicable for real-time monitoring of the modes and often projection based methods are used in real time. Predictability assessment of the modes are made through ensemble forecasts and error growth estimation methods. Atmospheric modes like the MJO and the ENSO are also act as diabatic heat sources in the atmosphere and their influence extends to far off regions through atmospheric teleconnection patterns. Statistical approaches and Bayesian approaches are commonly used to bring out the atmospheric teleconnection patterns and remote influences of the atmospheric modes.

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