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Signature of ENSO and NAO signals in the Indian Subcontinent monsoon system

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South Asian monsoon is believed to be one of the possible drivers of global climate system. We spectrally analyzed here different sets of recently published climate indicator time series to search for statistically significant modes and teleconnection among ENSO, NAO and Indian subcontinent. In particular we examine: (1) updated Indian Rainfall (IRF) time series of the whole country (2) coral growth rate time series from the Arabian sea, and (3) NINO3 temperature record to investigate the signature of ENSO response in the Indian monsoon. Multiple spectral analyses (e.g. multi-taper method (MTM), maximum entropy method (MEM), Wavelet and cross spectra) reveal coherent cyclic and non-stationary modes in these records.

MTM analysis of IRF time series resolves statistically significant variability (>90% C.I)

(i) at multi-decadal (66-70 year) scales related to the well-known global temperature variability of internal atmospheric-ocean origin

(ii) relatively weak signal at 13 and 22 years (solar cycles) and

(iii) the 2.5 to 7.5 year cycles associated with ENSO frequency band.

The MTM spectra of coral growth rate record also reveal statistically significant periodicities (>90% C.I.) within 1.8-4.2 ENSO frequency band, and a relatively weak signal at 12.8 years. MEM analysis confirms the stability of above spectral peaks. Wavelet spectral analyses of the above time series reveal non-stationary "localized modes" of ENSO evolution corresponding to 2-7 years and higher, order terms. Similar spectral longer climate indicator records also reveal higher order cyclic pattern seemingly related to the persistent solar cycles. Although matching periodicities are present in these records, coherency analysis exhibits statistically significant spectral peaks (>80% CI) only at some selected periods suggesting possible role of ENSO and NAO dynamics in organizing the subtle Indian monsoon at these frequencies. These results may provide significant implication for the modeling of Indian monsoon.

Keywords: Indian rainfall, NINO3 temperature variability, Coral growth rate, ENSO, Spectral analyses.