# Sea Surface Height Anomaly and Upper Ocean Temperature over the Indian Ocean during Contrasting Monsoons

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Dynamics of Atmospheres and Oceans, 75, 1-21.

**Abstract:** Recent research emphasizes the importance of the oceanic feedback to monsoon rainfall over the Asian landmass. In this study, we investigate the differences in the sea surface height anomaly (SSHA) and upper ocean temperature over the tropical Indian Ocean during multiple strong and weak monsoons. Analysis of satellite derived SSHA, sea surface temperature (SST) and ocean reanalysis data reveals that patterns of SSHA, SST, ocean temperature, upper ocean heat content (UOHC) and propagations of Kelvin and Rossby waves differ during strong and weak monsoon years. During strong monsoons positive SSH, SST and UOHC anomalies develop over large parts of north Indian Ocean whereas during weak monsoons much of the north Indian Ocean is covered with negative anomalies. These patterns can be used as a standard tool for evaluating the performance of coupled and ocean models in simulating & forecasting strong and weak monsoons. The rainfall over central India is found to be significantly correlated with SSHA over the regions (Arabian Sea and West central Indian Ocean and Bay of Bengal) where SSHA is positively large during strong monsoons. The SST-SSHA correlation is also very strong over the same area. The study reveals that much convection takes place over these regions during strong monsoons. In contrast during weak monsoons, convection takes place over eastern equatorial region. These changes in SST are largely influenced by oceanic Kelvin and Rossby waves. The Rossby waves initiated in spring at the eastern boundary propagate sub-surface heat content in the ocean influencing SST in summer. The SST anomalies modulate the Hadley circulation and the moisture transport thereby contributing to rainfall over central India. Therefore oceanic Kelvin and Rossby waves influence the rainfall over central India.
**Keywords:** Sea surface height anomaly, Monsoon rainfall, Kelvin waves and Rossby waves, Indian Ocean dynamics, Sea surface temperature & Ocean atmosphere coupling.