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The dynamics of the Southwest Monsoon Current in the Bay of Bengal

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The Indian monsoon provides 80% of the annual rainfall total for over a billion people, and prediction of its variability is crucial to Indian agriculture. The high stratification of the Bay of Bengal, and thus the air-sea interaction that influences monsoon rainfall, is driven by the salinity difference between the fresh surface waters of the northern Bay and the supply of warm, salty water by the Southwest Monsoon Current (SMC). However, observations of this current during the monsoon are sparse. Using data from high-resolution in-situ measurements along an E-W section in the southern Bay of Bengal at 8°N and numerical model data, we constrain the location, strength, vertical extent and evolution of the SMC during July 2016 to a high degree of accuracy.

We find that the total northward transport during July 2016 was stable at 21 ± 4 Sv (1 Sv = 10^6 m^3 s^{-1}), associated with a surface velocity of approximately 0.5 m s^{-1} and northward flow down to 500 m. Comparison with climatology suggests the observed SMC was close to the average annual maximum strength. We show how the SMC strength and location is driven by the complex interplay between local and remote forcing. Low sea surface height in the Sri Lanka Dome is formed to the west of the SMC by local wind stress curl while high sea surface height to the east of the SMC in the form of propagating Rossby waves can be traced back to the seasonal westerly wind burst at the equator. The exact timing of these features determines the strength of the SMC and various modes of climatic variability will influence the SMC strength and location on time scales from weeks to years. In 2016, although strong local forcing over the Sri Lanka Dome was present early in the season and the downwelling Rossby wave signal was also unusually strong, the Rossby wave arrived later than usual, resulting in a relatively modest SMC. Further, idealised 1-D ocean model experiments show that the subsurface water masses advected by the SMC can significantly alter the evolution of mixed layer temperature and salinity, suggesting that the SMC influences the sea surface temperature variability across the Bay at intraseasonal time scales.