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Freshwater transport in the Bay of Bengal and its modulation by eddies and the Indian Ocean Dipole

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The large freshwater input from rivers and rain and energetic monsoon circulation conspire to create strong horizontal salinity gradients in the Bay of Bengal (BoB). Since salinity acts as a barrier to the vertical mixing of heat and nutrients in this basin, this peculiar salinity distribution has strong implications for air-sea interactions below tropical cyclones and productivity in this basin. In this work, we use a Lagrangian method together with altimeter-derived currents to investigate how horizontal circulation spreads riverine and rain inputs horizontally in the BoB. The comparison between the computed Lagrangian trajectories and drifting buoys indicates that the satellite-derived currents are reasonably accurate in the BoB. Our results reveal that the Ganges-Brahmaputra waters are transported southward by the East India Coastal Current (EICC) along the coast of India after the monsoon and largely contribute to a low-salinity water tongue hugging the coast nicknamed the "river in the sea". Mesoscale eddies provide the main source of stirring to export freshwater from this "river in the sea" toward the basin interior. During positive IOD events, coastal upwelling Kelvin wave supress the southward EICC and associated freshwater transport, resulting in saltier along the coast of India and fresher in the northern BoB. The spreading of the Irrawaddy freshwater is largely controlled by the mesoscale field, with a weaker impact of the mean circulation. During positive IOD years, though, the anomalous anticyclonic circulation yields more Irrawaddy freshwater in the Andaman Sea, and less in the northern BoB and east coast of India. Finally, cumulative monthly maps of advected freshwater thickness from the Ganges, Irrawaddy and rainfall are compared with the observed maps of satellite-derived salinity and allows discussing the respective influence of each these fresh water sources on the horizontal distribution of the BoB freshening.