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Seasonality of surface stirring by geostrophic flows in the Bay of Bengal

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Stirring of passive tracers in the Bay of Bengal driven by altimetry derived daily geostrophic surface currents, is studied on subseasonal timescales. To begin with, Hovmöller plots, wavenumber-frequency diagrams and power spectra confirm the multiscale nature of the flow. Advection of latitudinal and longitudinal bands highlights the chaotic nature of stirring in the Bay via repeated straining and filamentation of the tracer field. An immediate finding is that stirring is local, i.e. of the scale of the eddies, and does not span the entire basin. Further, stirring rates are enhanced along the coast of the Bay and are relatively higher in the pre- and post-monsoonal seasons. Indeed, Finite Time Lyapunov Exponent (FTLE) and Finite Size Lyapunov Exponent (FSLE) maps in all the seasons are patchy with minima scattered through the interior of the Bay. Further, these maps bring out a seasonal cycle wherein rapid stirring progressively moves from the northern to southern Bay during pre- and post-monsoonal periods, respectively. The non-uniform stirring of the Bay is reflected in long tailed probability density functions of FTLEs, that become more stretched for longer time intervals. Quantitatively, advection for a week shows the mean FTLE lies between 0.13±0.07 day^{-1}, while extremes reach almost 0.6 day^{-1} . Averaged over the Bay, Relative dispersion initially grows exponentially, followed by a power-law at scales between approximately 100 and 250 km, which finally transitions to an eddy-diffusive regime. Quantitatively, below 250 km, a scale dependent diffusion coefficient is extracted that behaves as a power-law with cluster size, while above 250 km, eddy-diffusivities range from 6×10^3 - 1.6×10^4 m^2s^{-1} in different regions of the Bay. These estimates provide a useful guide for resolution dependent diffusivities in numerical models that hope to properly represent surface stirring in the Bay.