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Impact of horizontal salinity gradients on the Bay of Bengal circulation and mesoscale variability

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The large fresh water influx from major rivers and monsoonal rainfall make the Bay of Bengal (BoB) one of the freshest region in the tropical oceans. The potential influence of the resulting horizontal salinity gradients on the surface circulation in the BoB has however not yet been thoroughly assessed, because of the poor observational coverage and lack of realistic simulations of salinity spatio-temporal variations. In this study, we use high-resolution (1/4° and 1/12°) regional ocean circulation model simulations to assess the impact of horizontal salinity distribution on the BoB circulation. These simulations realistically simulate the main features of the BoB dynamics and salinity distribution, including the East India Coastal current (EICC) and the intense mesoscale activity. They also simulate the narrow strip of very fresh water that hugs the east coast of India after the monsoon (nicknamed the "river in the sea") as a result of the southward transport of the Ganges-Brahmaputra river plume by the EICC. By switching off the impact of salinity in the on-line calculation of the horizontal pressure gradients in these simulations, we demonstrate that the cross-shore salinity gradients associated with the "river in the sea" contribute to about 40% of EICC intensity after the summer monsoon, hence sustaining the southward advection of fresh waters in a positive feedback loop. Since salinity contributes both to the barotropic shear associated with the EICC and to baroclinic pressure gradients, it also contributes to enhance mesoscale variability by up to 30% in the western BoB.