Exploring the dynamics of the Oxygen Minimum Zones in the Arabian Sea and the Bay of Bengal

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More than half of total global Oxygen Minimum Zone (OMZ) area is located in the northern Indian Ocean of the Arabian Sea and Bay of Bengal because of the conjunction of elevated biological production rates and weak intermediate ocean ventilation. Yet, the dynamics of the OMZs in the Arabian Sea and in the Bay of Bengal display fundamental differences in terms of the intensity of the OMZ and the nitrogen cycle that remains poorly understood. Here we use an eddy-resolving ocean physical-biogeochemical coupled model to explore the role of eddy-activity, biological production, and time scales of water ventilation in generating and maintaining the contrasting features of the OMZs in the Arabian Sea and Bay of Bengal. The model results are compared to the observed hydrography, plankton, and dissolved oxygen and nitrate concentrations from several global ocean databases. The model is able to properly reproduce the dynamics of seasonal plankton blooms in both the Arabian Sea and the Bay of Bengal. Furthermore, the model captures well the contrasting distributions of the observed nitrate and oxygen between the two seas, and in particular, simulates water column denitrification exclusively in the Arabian Sea. We investigate the contrasts in eddy-activity, production rates and ventilation timescales between the Arabian Sea and the Bay of Bengal and quantify their respective contributions to the observed differences in oxygen and nitrogen cycle in the two seas.