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Ventilation pathways and timescales of the oxygen minimum zone in the Arabian Sea

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In oxygen minimum zones (OMZs) the lack of oxygen affects marine life. One of the most intense but least understood OMZs in the world is located in the Arabian Sea in a depth range between 300 to 1000 m. Within the last decades observations suggest a decreasing oxygen trend. Thus an improved understanding of the crucial processes is necessary for a reliable assessment of the future development of the Arabian Sea OMZ.
This study uses a combination of observational data as well as reanalysis velocity fields from the dynamic ocean model Hycom (Hybrid Coordinate Ocean Model) to explore the ventilation and dynamics of the Arabian Sea OMZ. Our results show that the OMZ features a strong seasonal cycle with regional differences that is correlated with the monsoon system:
In the eastern basin, the OMZ is strongest during the winter monsoon with a core thickness of 1000 m depth and oxygen values of less than 5 mol/l. Ventilation during that phase is dominated by Persian Gulf water, that clockwise circles the perimeter of the basin and enters the OMZ from the north. During the summer monsoon ventilation from the southeast leads to higher oxygen values indicating a reverse flow in the intermediate layer compared to the surface currents.
The seasonal cycle in the western basin has the same seasonality as the one in the eastern basin with a core thickness of 900 m during the winter monsoon. The oxygen supply during the summer monsoon is weaker compared to the eastern basin and correlates with the ventilation of Persian Gulf (Red Sea) water during the summer monsoon (autumn inter-monsoon) phase.
As the interior exchange between the eastern and western basin is weak, the more pronounced OMZ in the eastern basin is explained by prolonged ventilation time scales. For the eastern (western) basin Persian Gulf water needs 2-3 (1-2) years and Red Sea water 7-8 (3-4) years to ventilate the OMZ.