Comparison of biogeochemical models of different complexity in the Arabian Sea Oxygen Minimum Zone.

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Résumé

The degree of deoxygenation and extent of the Oxygen Minimum Zone (OMZ) in the Arabian Sea have been shown to vary over short time scales, e.g. in response to recent multi-decadale climate warming. Over longer glacial-interglacial time scales, variations in OMZ intensity are also reported and are thought to be of prime importance for global biogeochemical elemental budgets, particularly for carbon and nitrogen. Despite global climate settings that are greatly different, both time scale cases are linked by the fundamental processes behind the formation and sustainability of the oxygen deficit. These processes involve the oceanic circulation and ventilation and the biogeochemical activity, both at the surface ocean, i.e. mostly the primary production, and at depth, i.e. remineralization and various nitrogen loss processes. Therefore, the efforts to develop biogeochemical models focused on processes in OMZ context will benefit from case studies over both present and past ocean conditions. This study is the first step of a modelling effort based on a comparison of biogeochemical models of different complexity, including the oxygen, coupled to a regional ocean circulation model (ROMS), and applied to the northern Indian Ocean. The regional configuration of the Arabian Sea is appropriate for sensitivity studies: the southern oceanic boundary will serve to evaluate the impact of changes in the oceanic ventilation, and the variations in the atmospheric forcing will be related to the primary production response. The first results will compare the biogeochemical models in their ability to reproduce and sustain the OMZ, and their response under different and extreme climate settings. We try to present comparisons based on different appropriate metrics, and we discuss the potential of improvement of each biogeochemical model. One set of simulations will compare results of a fully prognostic circulation versus a strongly constrained circulation by imposing a short restoring time scale for temperature and salinity fields toward climatological fields. This approach helps to estimate what is the room for improvement of the biogeochemical models themselves versus the error due to the weaknesses of the circulation model only.

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