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Biogeochemistry of the Benguela upwelling system

Our project will focus on the biogeochemistry of the Benguela upwelling system (BUS). There are three major oxygen minimum zones (OMZ) in the world ocean - all located in equatorial or coastal upwelling areas, among them the Benguela region. OMZ, in general, play a key role in the nitrogen budget of the world ocean. In low oxygenated water denitrifying organisms use nitrogen compounds to remineralize organic matter, a process which leads to a loss of bioavailable nitrogen. This might affect the global primary production being closely linked to the biological carbon pump. Furthermore, upwelling areas are known to be pronounced sources for nitrous oxide, a climate relevant gas. Therefore, the development of the OMZ and the nitrogen related processes within them are key questions for the oceanic carbon storage and marine emissions of biogenic greenhouse gases in a future changing climate.

In this project we apply a global version of the ocean biogeochemistry model MPOIM/HAMOCC with a stretched grid configuration enabling higher horizontal resolution in the region of interest. Studies have shown that the presence of mesoscale eddies increases oxygen ventilation of mid-ocean depth and, thus, affects the expansion of the OMZ. Nitrogen related processes such as stepwise nitrate reduction, denitrification, anammox, and nitrification will be treated explicitly based on the introduction of two prognostic tracers, ammonium and nitrite. This allows us to resolve concurrent processes of denitrification and nitrification as well as nitrous oxide production and consumption in suboxic water. This model configuration of the Benguela upwelling system combines the advantages of a high resolution regional model and of a dynamical consistent global model without any regional boundary artefacts.

We will derive a nitrogen and carbon budget for present day and we analyse the interannual variability of sea-air emissions of carbon and nitrous oxide by forcing the model with reanalysis data (NCEP, ERA). Our project contributes to CliSAP RA-B3: Marine and coastal systems.