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Understanding the trends and controlling factors of Indian Ocean acidification

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The Indian Ocean (IO) is witnessing acidification of its surface waters as a consequence of the continuous rising of atmospheric CO_2 concentration thus disrupting the biological and chemical balance of the ecosystem in the region. The basin wide spatial variability of biogeochemical properties induces spatial variability of surface water pH. This study investigates the seasonality and trends of surface pH over the IO bioprovinces and regionally assesses the individual contribution of the factors affecting its variability. Simulations from global ocean models (OTTM and ROMS) coupled with suitable biogeochemical modules were validated with pH observations over the basin, and used to discern the regional response of pH seasonality (1990-2010) and trend (1961-2010) to changes in ocean temperature (SST), Dissolved Inorganic Carbon (DIC), Total Alkalinity (ALK) and Salinity (S). DIC and SST are the major contributors to the seasonal variability of pH in almost all bioprovinces consistent in both model simulations. The acidification in IO basin of 0.0675 units during 1961-2010 is attributed to 69.28% contribution of DIC followed by 13.82% contribution of SST. For most of the regions DIC remains a dominant contributor to changing trend in pH except for the Northern Bay of Bengal and Around India (NBoB-AI) region, wherein pH trend is dominated by ALK (55.6%) and SST (16.8%). The interdependence of SST and S over ALK is significant in modifying the carbonate chemistry and biogeochemical dynamics of NBoB-AI and a part of tropical, subtropical IO. The strong negative correlation between SST and pH infers the increasing risk of acidification in the bioprovinces with the rising SST.

This study is an attempt to identify the regional influencers of pH variability so that adequate mitigation action can be planned and the acidification can be decelerated in near future.