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Arabian Sea is getting less productive

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We show that the longitude dependent increase in the Arabian Sea SST over the last 15 years had only minor and non-significant effects on the phytoplankton biomass of the western basin whereas the eastern basin showed a significant decrease in surface chlorophyll a. The monthly average wind velocity integrated over either of these basins showed a significant decrease over the same period of time. This suggests that the increase in temperature and decrease in primary production are likely related to a decreased winter—North East Monsoon— mixing along the eastern basin, resulting in more intense stratification and a decreased nutrient injection in the upper water column. The western basin remained relatively immune to the change since most of its primary production is related to upwelled water during the South West Monsoon.

We subdivided the Arabian Sea into 61 2-degrees region covering all marine areas between 54-76º E and 10-25º N. For each region, satellite derived (9-km spatial resolution SeaWIFS) Level-3 data for chlorophyll a concentration were used to retrieve monthly average time series (1997-2009). Monthly average temperature time series were extracted from the Hadley Center sea surface temperature dataset for the 1991-2009 period. Trend analysis was performed on both (temperature and chlorophyll a) using the Mann-Kendall test modified for seasonal data sets.

The trend analysis revealed that there was an overall warming up of the whole Arabian Sea with most of the significant slope values in its central part and eastern margin. No 2º regions showed any cooling trend. This is in agreement with the recent oceanic heat analysis carried out on the world oceans. In terms of surface chlorophyll a, the western basin was characterized by an overall non-significant increase in surface phytoplankton. Two 2º regions offshore the islands of Socotra (Yemen) and Masirah (Oman) had p-values of 0.07. On the other hand, the eastern margin of the basin had three 2º regions with significant negative trend: i.e an overall decline in chlorophyll a over the 1997-2009 time series and another three had marginally significant decreasing trend ($p < 0.08$). These observations at finer scale reconcile somewhat the contradictory analysis presented for a single 5º region in the south-west Arabian Sea and showing an increase in surface chlorophyll a with a study focusing on the Western Arabian Sea and showing no such increase over the same time period.

The zonal component (E-W) of the wind velocity showed a significant negative trend in the 1990-2010 period in both western and eastern basins, although the slope was slightly steeper in the Eastern Basin (-0.027m/s/year) than in the western basin (-0.024m/s/year). In the Western basin where the nutrient input driving primary production lies in upwelled water along the margin of the basin, the overall warming up of the ocean and the decrease in wind velocity had apparently no significant effect on primary production. On the other hand, in the Eastern basin, dominated by convective nutrient input during the winter monsoon, the overall decrease in wind velocity resulted in a decreased convective cooling, increased stratification and decreased primary production.