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Seasonal to decadal pH and fCO_2 changes in the subtropical, sub-antarctic and polar waters of the SW Indian ocean

A. Lourantou, C. Lo Monaco, C. Brunet, C. Ridame, and N. Metzl
LOCEAN, IPSL, CNRS, Université Pierre et Marie Curie, Paris, France

Human-induced CO_2 emissions are constantly increasing and the role of the ocean carbon sink becomes crucial for the global carbon budget (Peters et al., 2011). The Southern Ocean is a key area of carbon sink (Takahashi et al. 2009) and thus more susceptible to pH changes, according to model predictions (Orr et al., 2005; McNeil & Matear, 2008). Little is known from in situ observations. The SW Indian Ocean is being regularly visited in the framework of the OISO (Océan Indien Service d'Observation) program. This extended area is annually a carbon sink (Metzl, 2009; Lourantou and Metzl, 2011).

Here we examine three distinct stations located south of the Polar Front (50°S, KERFIX station), in the frontal zone (40°S) and in the Subtropical Zone (30°S). These stations differ by their hydrological properties, their potential in assimilating atmospheric CO_2 and their associated nutritional and ecosystem regime, from a HNLC -High Nutrient Low Chlorophyll- area (50°S), to a region of formation of Subantarctic Mode Waters (40°S), and oligotrophic waters in the north (30°S). By using CARINA (Key et al., 2010) and SOCAT (Pfeil et al., in prep.) databases, for the water column and surface waters, respectively, and the addition of recent OISO data, we computed the evolution of pH along depth and time (from 1978- 2010) at these stations.

We present: (i) the temporal evolution of the rate of change of computed pH and fCO_2 at the 3 stations from surface to deep waters; (ii) a comparison with anthropogenic carbon estimates, Cant (Touratier et al., 2007) and the change in measured Dissolved Inorganic Carbon, DIC; (iii) a comparison with the evolution of chlorophyll a concentrations. Based on these results, we discuss the dominant mechanisms responsible for the changes in pH observed at different depths and latitudes. For KERFIX station we also assess the distinction between seasonality and decadal evolution of biogeochemical parameters.

Our first results point towards a decrease of surface waters pH of -0.002units.yr-1 for all 3 stations, compatible with earlier estimates at stations BATS, ESTOC and ALOHA (Bates, 2007; Santana-Casiano et al., 2007; Dore et al., 2009). Deeper in the water column, the evolution of the rate of change for both pH and fCO_2 are far from being homogeneous, while the pattern differs among the stations.

This research brings more into light the ocean acidification issue upstream of the ecosystem approach. This is crucial for the comprehension of the processes driving the changes in seawater pH.

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