Controls on pCO$_2$ variation at a sustained observatory (PAP-SO) in the northeast Atlantic Ocean

S. Hartman$^1$, R.S. Lampitt$^1$, D. Turk$^2$, Z.P. Jiang$^1$, H. Frigstad$^3$, D.J. Hydes$^1$, U. Schuster$^4$

1 National Oceanography Centre, Southampton (UK); 2 Dalhousie University (Canada); 3University of Bergen (Norway); 4 University of East Anglia (UK).

**Introduction**

The northeast Atlantic is a significant oceanic CO$_2$ sink region. However the sink has been shown to vary from year to year (1-3 mol C m$^{-2}$ yr$^{-1}$). This variability has been attributed to changes in wintertime mixing and stratification (Schuster & Watson, 2007). To understand both the physical and biological causes for this variability we require a wide range of measurements as offered by time series studies.

**Time series**

Fixed-point deep ocean observatories are an integral part of monitoring the marine environment, producing high resolution, long-term time-series data sets of climatically and ecologically relevant variables.

The Porcupine Abyssal Plain Sustained Observatory (PAP-SO) in the Northeast Atlantic (49°N, 16.5°W; water depth ~ 4800 m) has produced in situ time-series datasets from the euphotic zone to the seabed for the past 20 years. A mooring with autonomous sensors has been in place since 2002 producing high-resolution, year-round physical and biogeochemical measurements. The main objectives are to understand the system & to monitor changes in key variables.

**PAP-SO data**

The PAP-SO is in a region where surface ‘mixed’ layer depth changes from 25m in the summer to > 400m in winter. Inter-annual changes in the winter mixing depth can result in large (x2) changes in surface concentrations of nutrients (Hartman et al., 2010). PAP-SO data details processes and time scales (from diurnal to inter annual) and related variations in pCO$_2$. Physical and biological processes control seasonal pCO$_2$ variability, and therefore annual fluxes.

Through collaboration with the UK Met Office since 2010 (Hartman et al., 2012) we have contemporaneous atmospheric and ocean datasets from PAP so we can investigate the effect of the relatively high wind measurements on pCO$_2$ data in the region.

**Data comparison**

PAP-SO pCO$_2$ data (measured at 30m) shows a persistent under-saturation throughout the year. The region is an oceanic CO$_2$ sink (~1.0 mol CO$_2$ m$^{-2}$ yr$^{-1}$). This figure is lower than previously calculated by Kortzinger et al., 2008 (average of ~3.2 mol CO$_2$ m$^{-2}$ yr$^{-1}$ in ve NAO years 2003-2005). This is a significant sink compared with subtropical time series sites such as ESTOC (near the Canary Islands, 29.17°N, 15.50°W), which is an overall annual CO$_2$ source region (0.05 mol CO$_2$ m$^{-2}$ yr$^{-1}$, Gonzalez-Davila et al., 2003).

**References**


