SOLAS Australia

Southern ocean foraminifera are showing reduced calcification

New Australian research has shown that the shell weights of foraminifera in the modern ocean are significantly lighter (by 30-35%) than those in the sediments laid down throughout the Holocene. This may have implications for marine ecosystems and the drawdown of atmospheric carbon dioxide by the oceans. See Moy, A.D., et al. (2009). Nat. Geosci. 2: 276-280.

Renewed focus on aerosol and climate

Australia is adjacent to some major sources and sinks of aerosol, as well as being affected by biomass burning, wind-blown dust, anthropogenic aerosol and vegetation and soil interactions within the continent. A major review of current knowledge and future research priorities has been published recently (Rotstayn, L.D., et al. (2009). Int. J. Climatol. 29: 461-479).

New findings in Southern Ocean biogeochemistry

Australia kept a strong focus on the Southern Ocean in 2009. Ongoing programs include ocean-atmosphere carbon fluxes (program led by Bronte Tilbrook), carbon fluxes to the deep ocean (program led by Tom Trull), cycling of micronutrients (led by Ed Butler), ocean acidification, productivity and iron limitation.

Clean air research and monitoring

Volatile organic compounds (VOCs) are now being measured at the Cape Grim Baseline Air Pollution Station. This work has helped to raise the profile of VOCs in the clean marine boundary layer, and highlight the importance of the ocean as the source of a large suite of trace gases.

Equipment and information integration

As part of the new Integrated Marine Observation System (IMOS, http://imos.org.au/about.html), the Southern Ocean Time Series set of moored instruments will collect observations of ocean-atmosphere physical, chemical and biological properties in the Sub-Antarctic Zone.

New research vessel

The national science organisation CSIRO has announced $120m in funding for a new marine research vessel to replace the Southern Surveyor.

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Air-Sea CO_2 fluxes in the Benguela region

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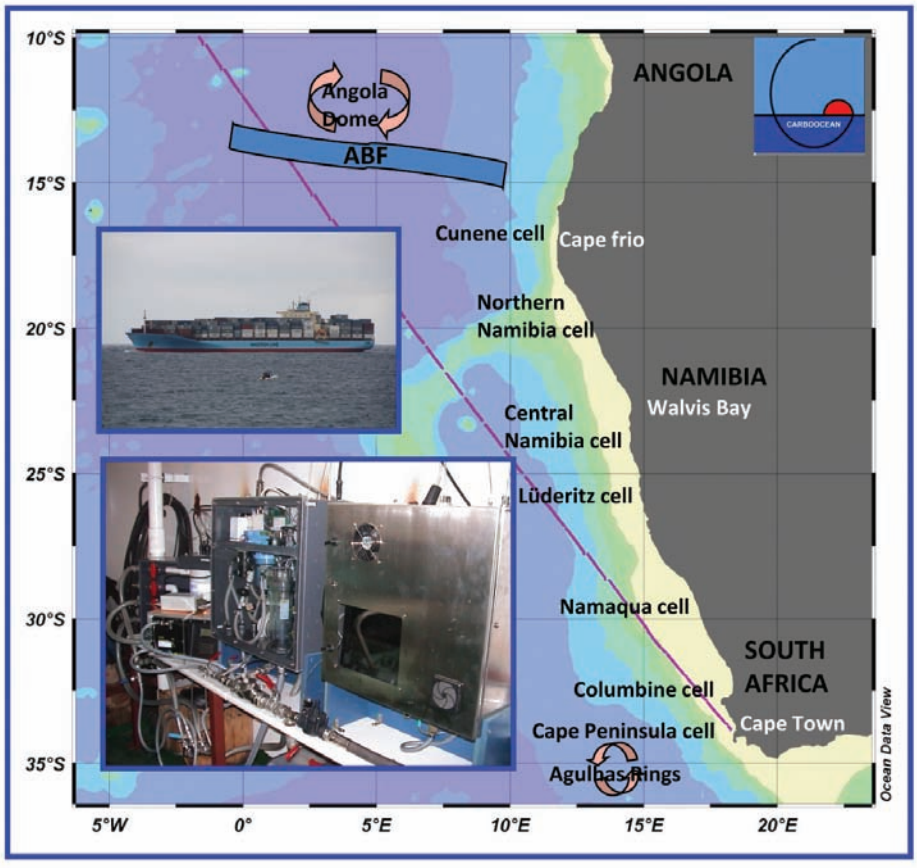
Knowledge of the magnitude and direction of air-sea CO_2 exchange in Eastern Boundary Upwelling Systems (EBUS) is essential for an understanding of the role played by these productive regions on the global carbon cycle. These upwelling systems are regions of active physical and bio-geo-chemical processes that affect the chemistry of the carbon (Monteiro, 2009). In the framework of the CARBOOCEAN project the Grupo de Investigación de Química Marina (QUIMA-ULPGC group) studied the air-sea fluxes of CO_2 in the eastern boundary upwelling system of the South Atlantic region during the period 2005-2008. 28 cruises using volunteer observing ships (VOS) from the Mediterranean Shipping Company were carried out. The VOS line crossed the region from west to east (Figure 1), approaching the coast along the Southern latitudes. The studies showed a complex pattern for the fugacity of CO_2 (fCO_2) distribution linked to temperature variability and ocean circulation, the highest variability being observed associated with the most significant upwelling cells (Santana-Casiano et al., 2009; González-Dávila et al., 2010).



Λ Figure 1 : The QUIMA VOS cruise track and the main upwelling cells in the Angola-Benguela region.

Figure 2 shows the average fluxes of CO_2 (FCO_2), for the years 2006 and 2007 and for three years from July 2005 to June 2008 computed considering the Wanninkhof (1992) parameterisation (The Nightingale et al. (2000) parameterisation is also shown in brackets in the text below). Fluxes for the year 2006 and 2007 were similar, except in the areas where seasonal upwelling was present, indicating an important inter-annual variability in the upwelling intensity. In Northern Namibia (14°S-19°S) the area acted as a slight source of CO_2, with values of 0.40 (0.28) mol m^{-2} yr^{-1} in 2006 and 0.26 (0.21) mol m^{-2} yr^{-1} in 2007. South of 20°S, the area was a net sink of CO_2. From 20°S to 24°S, the ocean was ingassing -0.34 (-0.30) and -0.56 (-0.45) mol m^{-2} yr^{-1} in 2006 and 2007, respectively. In the Lüderitz region (25°S to 28°S) the FCO_2 values increased to -0.97 (-0.80) mol m^{-2} yr^{-1} in 2006 and to -1.22 (-0.97) mol m^{-2} yr^{-1} in 2007. From 29°S to 32°S, both years presented similar ingassing values of -1.80 (-1.50) mol m^{-2} yr^{-1}. South of 32°S, the area acted as a sink of CO_2 but with a value of only -1.17 (-1.03) mol m^{-2} yr^{-1} in 2006, as compared to a value of -3.24 (-2.65) mol m^{-2} yr^{-1} in 2007. An increase in both ΔfCO_2 and wind speed controlled the differences between the two years considered. However, three years of data collection for a highly variable area can only provide a rough estimate of the trends and more studies should be carried out.

A new VII Framework European project for the CO_2 community, CARBOCHANGE, is now starting and within this project a new collaboration with the Maersk Shipping Company has been opened, re-initializing the QUIMA VOS line in July 2010 on board LARS Maersk.

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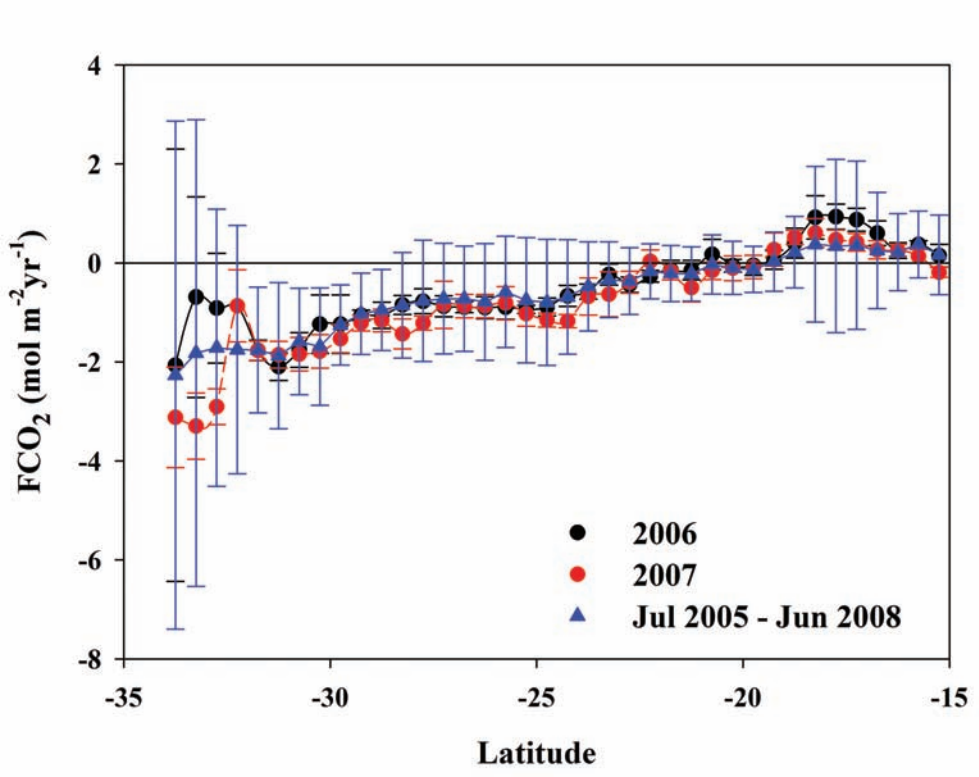

Λ Figure 2 : The average fluxes of CO_2, along the VOS line for the year 2006 (10 cruises) and 2007 (11 cruises) as well as for three years from July 2005 to June 2008.

SOLAS UK

Although the UK SOLAS coordinated programme has ended (see Special Report p33), UK research addressing SOLAS goals continues. National contributions to the international SOLAS effort are funded by a wider range of means and it will mostly be up to researchers themselves to develop collaborative links.

One major development is the recent launch of the UK Ocean Acidification Research Programme (UKOARP), co-funded by the Natural Environment Research Council (NERC), the Department for Environment, Food and Rural Affairs (Defra) and the Department of Energy and Climate Change (DECC). UKOARP is based on consortium projects, and initial awards tackle the following questions:

- How much variability is there in oceanic CO_2 uptake and what are the trends for the future? (Andrew Watson, UEA)
- What are the impacts of ocean acidification on key benthic ecosystems, communities, and, species? (Stephen Widdicombe, PML)
- How will ocean acidification affect the biology of surface ocean communities and biogeochemistry, and how that might feedback to climate? (Toby Tyrrell, NOC)
- What are the potential impacts of ocean acidification that might amplify rising CO_2 and climate change? (Andy Ridgwell, Bristol)
- How will ocean acidification impact ecosystems and chemical cycling in UK and Arctic regional seas? (Jerry Blackford, PML)
- What were the effects of rapid ocean acidification events in the Earth's past? (Paul Pearson, Cardiff).

These projects are supported by a national analytical facility led by Eric Achterberg (NOC). For details on UKOARP see www.oceanacidification.org.uk

Another current UK activity is the Waves, Aerosols and Gas Exchange Study (WAGES), led by Ian Brooks (Leeds), Margaret Yelland and Meric Srokosz (NOC). The AutoFlux instrumentation that was on the Norwegian weathership MV Polarfront is now on RRS James Clark Ross, with an initial shake-down cruise at the Porcupine Abyssal Plain deep water observatory. See http://homepages.see.leeds.ac.uk/~lecimb/WAGES/index.html

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