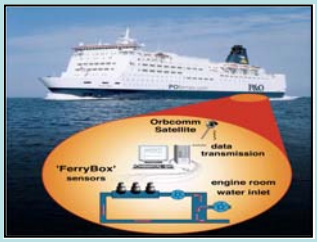
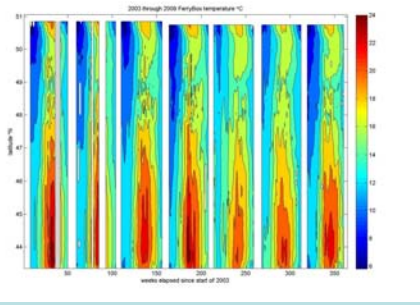
FerryBox and acidification

The P&O MV Pride of Bilbao FerryBox contributes to understanding in key policy areas particularly acidification and eutrophication.
Here we present findings related to acidification, both with unexpected results showing how important it is to go out and see the world as it really is. The work is funded by DEFRA (DEFRApH), the EU EPOCA & CarboOcean and NERC. P&O provide NERC with > 300 days ship time per year at no cost - providing an un-aliased monitoring platform.

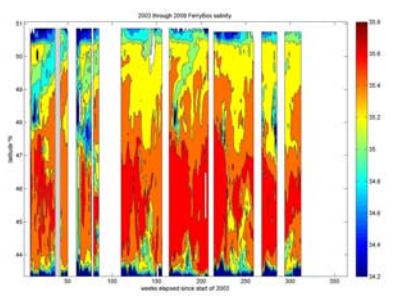


Underpinning Hydrographic Data - high quality data is not only essential for the interpretation of other observation but revealing in its own right



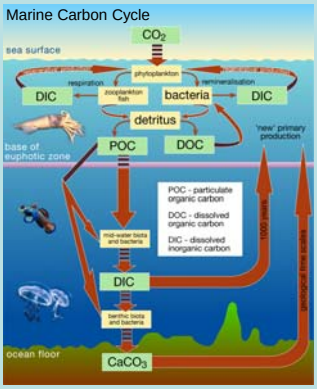
With 7 years of data so far inter-annual changes in basic conditions can be assessed. These have proved of value to the development of the DEFRA - Charting Progress 2 document.

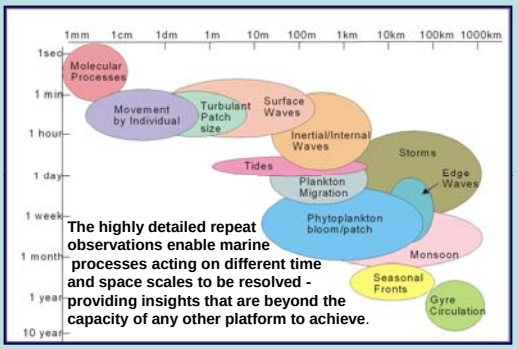
Our salinity data identified for the first time that the French rivers Loire and Gironde contribute substantially to the fresh water in the English Channel in some years - Kelly-Gerreyn, B.A., et al (2006) Continental Shelf Research 26,1241–1257



The MV Pride of Bilbao system provides not only continuous autonomous measurements sent back to project web page in real time (www.noc.soton.ac.uk/ops/ferrybox_index.php) but also facilities for the regular collection of water samples for experimental work and testing of equipment.

The latest development has been to install a robotic sampler for the collection of pigment samples in conjunction with the EU-Protool project.

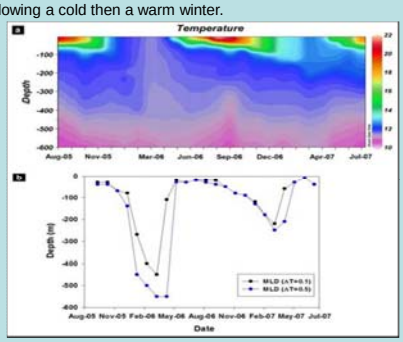




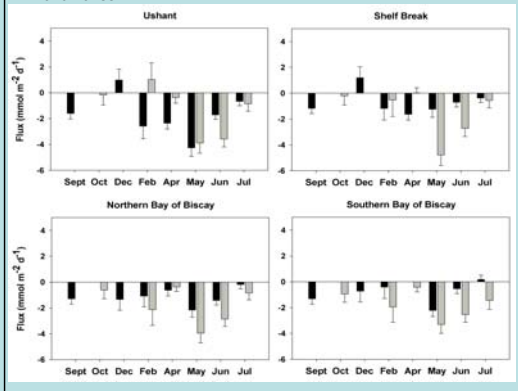
The highly detailed repeat observations enable marine processes acting on different time and space scales to be resolved - providing insights that are beyond the capacity of any other platform to achieve.

Contrasting effects of temperature and winter mixing on the seasonal and inter-annual variability of the carbonate system in the Northeast Atlantic Ocean

Future climate change resulting from increasing atmospheric CO_2 concentrations is expected to interact with the oceans. Shallower winter mixing and a reduction in primary production are expected to decrease the oceans ability to absorb CO_2. Between 2005 and 2007 we were able to make an actual comparison of what happened to the carbonate system following a cold then a warm winter.

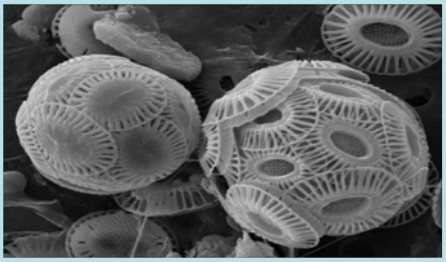


During the colder winter of 2005/2006, the maximum depth of the mixed layer reached up to 650 meters in the Bay of Biscay, whilst during the warmer (by 2.6 ± 0.5 ºC) winter of 2006/2007 the mixed layer depth reached only 300 meters (see Argo float data above). The inter-annual differences in late winter concentrations of nitrate (2.8 ± 1.1 µM) with higher concentrations at the end of the colder winter (2005/2006), led to higher productivity measured as higher oxygen anomalies. However in contrast to model predictions, the calculated air-sea CO_2 fluxes (see fig. below) showed an increased oceanic CO_2 uptake in the Bay of Biscay following the warmer winter of 2006/2007 associated with favorable wind speeds and cooler sea surface temperature in 2006/2007.
Dumousseaud, C, et al (2009) Biogeosciences Discussions 6, 9701-9735.



Calculated monthly air-sea CO2 fluxes (mmol m^{-2} d^{-1}; negative values indicate a net flux into the sea) for region in and adjacent to the Bay of Biscay 2005/2006 (dark grey) and 2006/2007 (light grey).

Over-calcified coccolithophores at low $CaCO_3$ saturation / low pH during winter in the Bay of Biscay



Coccolithophore phytoplankton play a major role in the ocean carbon cycle and affect ocean albedo. They provide 60 % of the calcite rain to the sea bed. If, in an acid ocean they don't grow, the export of detritus will be severely reduced. Laboratory experiments offer equivocal support for this view. Sampling from the ferry allows sampling in-situ at different periods of the natural cycle in pH. The results reveal an unexpected and distinct seasonality in the *Emiliania huxleyi* morphotypes present. In the Bay of Biscay there is a shift from almost 100% normally-calcified in summer (right above), to almost 100% over-calcified in winter (left above). Because winter is also the time of year when the calcite saturation state of seawater is lowest, this natural pattern does not support the idea of reduced coccolithophore calcification in a higher CO_2 world.
Tyrrell, T., et al (2010) BO51A-02 AGU Ocean Sciences

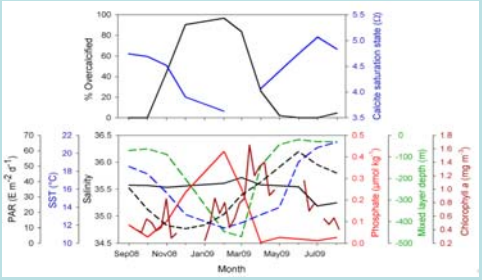


Figure above shows a comparison of the seasonal changes in the % of *Emiliania huxleyi* cells that are over-calcified (black line, left axis) against the saturation state of surface seawater with respect to calcite (blue line, right axis). All points represent averages over the Bay of Biscay part of the route (44 - 46 ºN).

The work presented here is a joint effort of many people and several groups across NOCS using the Pride of Bilbao as a common research platform. Contributors to the work include H. Smith, T. Tyrrell, A. Charalampopoulou, C. Dumousseaud, O. Legge, S. Birchenough, L. Pettit, R. Garley, S. Hartman, M. Hartman, E. Achterberg, D.J. Hydes, B. Kelly-Gerreyn, D. Smythe-Wright, S. Boswell, J. Campbell, K. Saw and U. Schuster (UEA).

Work is carried out in close co-operation with other UK and international groups through DEFRApH, EPOCA, CarboOcean. UK-Ocean Acidification funding will fund the fitting of a PML- Dartcom pCO_2 system when work moves to the Brittany Ferries MV Cap Finisterre on the retirement of the MV Pride of Bilbao at the end of September.

Very many thanks to P&O Ferries

Oceans 2025

Presented by David Hydes

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