Why measure CO_2 flux

At the sea surface, CO_2 is exchanged between ocean and atmosphere. Accurate measurements of this air-sea CO_2 flux are essential to improve our understanding of the role of the oceans in mitigating anthropogenic climate change. To date the oceans have absorbed around 25% of all human generated CO_2, which has helped to slow the impact of climate change on land, but is fundamentally changing the chemistry of the ocean.

AMT4CO2flux

AMT has measured CO_2 concentrations in both the ocean and atmosphere for over a decade, however direct estimates of the flux of the gas between the ocean and atmosphere have not been possible until now. The AMT4CO2flux project is working to develop a processing chain for satellite products and uncertainties for the air-sea flux of carbon dioxide and ocean acidification parameters. This will provide monthly measurements which will then be used in estimating global carbon budgets.

This builds upon the AMT4OceanSatFlux and AMT4SentinelFRM programmes which measured CO_2 exchange and made fiducial reference measurements to calibrate and ensure the quality of satellite data. This enables us to use the data from the satellites with greater confidence. With it we can address large scale issues and scientific questions on the effects of climate change.

Contact

AMT4CO2Flux Project Office
Plymouth Marine Laboratory
Plymouth, PL1 3DH, UK
www.amt4co2flux.org
email: comms.amt4satflux@pml.ac.uk
tel: +44 (0)1752 633100

What is ocean acidification?

The long-term absorption of atmospheric CO_2 by the ocean is causing a gradual decrease in the pH of the oceans, a phenomenon called ocean acidification. This is having an adverse effect on many important marine species such as corals, oysters, crabs and plankton, and due to the unparalleled rate of acidification the organisms may not have time to evolve mechanisms to cope with the changing ocean chemistry.

What is AMT?

AMT, or the Atlantic Meridional Transect, is a multidisciplinary programme which undertakes biological, chemical and physical oceanographic research during an annual voyage between the UK and the South Atlantic. The transect covers a vast range of environments from productive coastal and eutrophic regions to desert-like gyres in the centre of the ocean, areas rarely accessed by research ships.

AMT was heralded as one of NASA SeaWiFS ten greatest highlights since it provides an ocean observing platform providing vital calibration and validation data to support ocean satellite missions.

Partners and funding

esa

The AMT4CO2Flux consortium is funded by the European Space Agency.

Plymouth Marine Laboratory leads the consortium with three partners as subcontractors: the University of Southampton, the Institut Français de Recherche pour l'Exploitation de la Mer, Plouzane, France (IFREMER) and University of Exeter.

PML | Plymouth Marine Laboratory

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amt4CO2flux

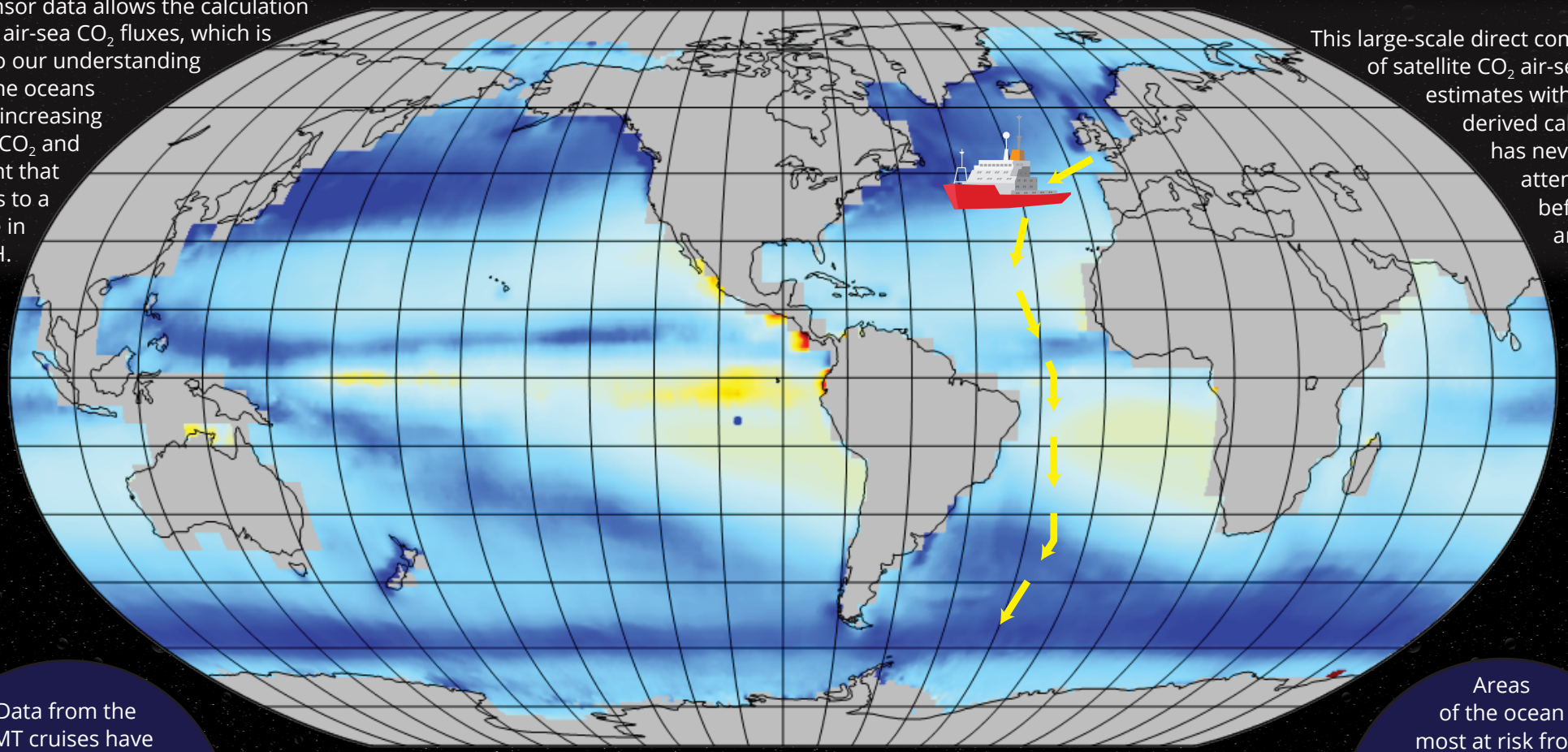
Measuring CO_2 exchange from space and sea

Global estimates of CO_2 flux

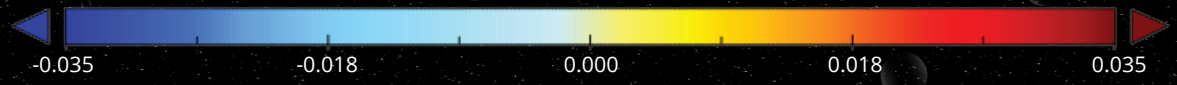
Global estimates of CO_2 flux are calculated using the FluxEngine, an Open Source Python toolbox for calculating air-sea CO_2 fluxes from model, *in situ* and Earth observation data. These satellite estimates are compared and contrasted with direct measurements of the CO_2 flux calculated using *in situ* measurements.

Multi-sensor data allows the calculation of global air-sea CO_2 fluxes, which is central to our understanding of how the oceans regulate increasing levels of CO_2 and the extent that this leads to a decrease in ocean pH.

This large-scale direct comparison of satellite CO_2 air-sea flux estimates with *in situ* derived calculations has never been attempted before anywhere in the world.



CO_2 flux (Tg C m^{-2} $month^{-1}$)



AMT cruises provide data from more than CTD casts, optics casts, surface optical deployments, radiosonde balloon launches and tens of thousands of underway measurements for the validation and development of satellite products.

Data from the AMT cruises have shown the Atlantic Ocean from the Equator to 8°S to be acting as net source of CO_2, whereas the rest of the South Atlantic is acting as net sink of the gas.

Areas of the ocean most at risk from acidification are identified using satellite data to estimate pH and aragonite saturation state, the chemical many marine animals need to build their skeletons and shells.