Centre for Observation of Air-Sea Interactions and Fluxes

The Centre for Observation of Air-Sea Interactions and Fluxes (CASIX) studies the interactions between the sea and the atmosphere and aims to make climate change predictions as precise as possible. The primary goal is to accurately measure the transport of carbon dioxide (CO_2) between the sea and the air on a global scale. CASIX will accelerate the use of new Earth Observation satellite data to further the understanding of marine biogeochemistry in the Earth System. CASIX links Natural Environment Research Council (NERC) Centres, university groups and the Met Office to model ocean circulation and the ocean carbon cycle.

Why air-sea interaction and fluxes?

The interaction of the atmosphere and ocean has a profound effect on our climate. The oceans absorb a large part of the CO_2 added to the atmosphere, moderating climate change. By improving our measurements of the ocean CO_2 budget we can better estimate the terrestrial fraction of the global CO_2 budget.

The promise of new observing techniques

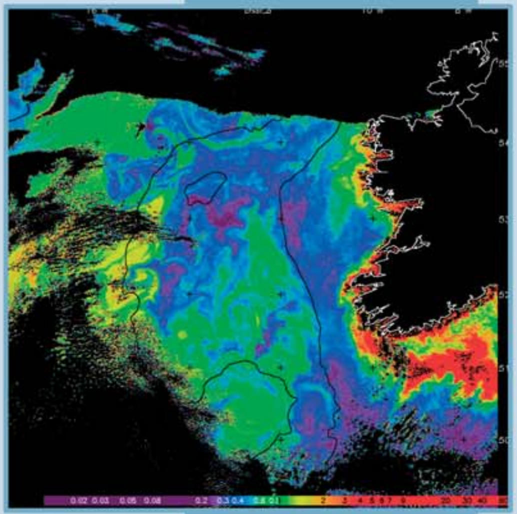
New sensors in new satellites: ENVISAT, Aqua and other new Earth Observation satellites herald a new era in marine Earth Observation. Satellite-borne instruments provide high-precision, high-resolution data of atmosphere, ocean boundary layer properties and ocean biogeochemical variables daily, globally, and long-term. The mission of CASIX is to maximise the use of these data.

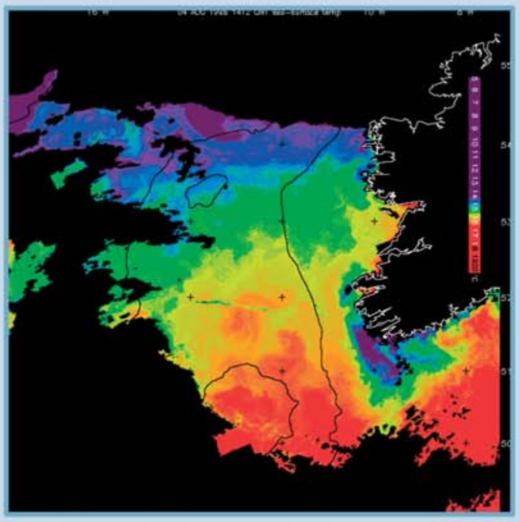
Air-sea exchange

Wind stress, wave breaking and slicks damping turbulence and ripples on the sea surface all affect the transport of CO_2 between the air and sea. These processes are closely linked to the 'roughness' of the sea surface, which can be measured by satellite radars and microwave radiometers.

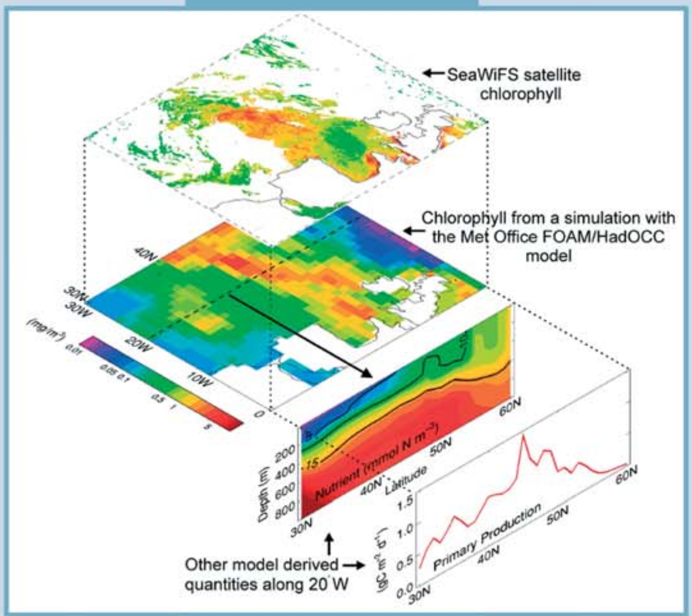
Sea surface roughness consists of a hierarchy of smaller waves upon larger waves. Different sensors give subtly different measures of this roughness.

Natural slicks and oil spills, as shown in the SAR image left, have a smoother structure than the surrounding ocean and can be detected using Synthetic Aperture Radar.





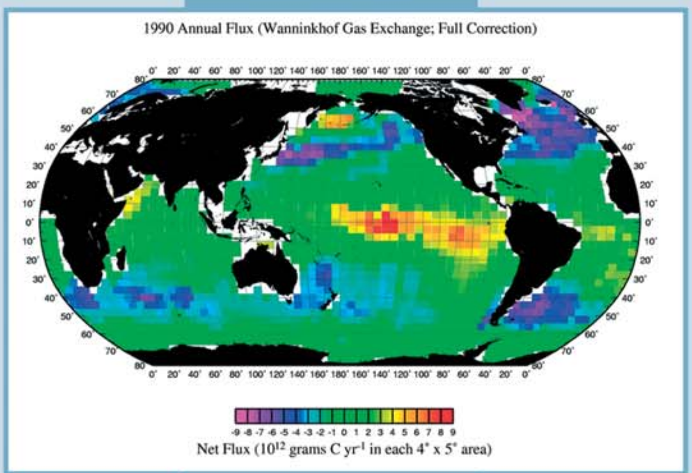
Measurements of ocean colour (far left: pseudo-colour map of chlorophyll), provided by NASA-SeaWiFS or Envisat's MERIS, provide information on marine biogeochemistry. Simultaneous sea surface temperature measurements (left) from NOAA-AVHRR or Envisat's AATSR provide information on the physical background to the biogeochemistry.



The central role of modelling

Modelling both the open ocean and shelf seas is at the heart of CASIX. Only by assimilating Earth Observation data into models can we use these data effectively. Earth Observation data (both for assimilation and for validation) are vital to developing reliable models that can describe the complex physical and biogeochemical interactions involved in marine carbon cycling.

Left: SeaWiFS satellite chlorophyll data overlaid on the output of the Met Office Forecast Ocean Assimilation Model coupled to the Hadley Centre Ocean Carbon Cycle model. The model captures spring bloom chlorophyll in early March 2000 in the North Atlantic, west of Europe. The model can fill in the data gaps created by clouds and estimate variables (eg nutrients and primary production) within the ocean interior.



Global air-sea fluxes of carbon dioxide

The aim of CASIX is to produce estimates of the transport of CO_2 between the air and sea, with much higher spatial and temporal resolution than previous estimates or than can be achieved realistically by directly sampling the upper ocean CO_2. Crucially these estimates must be accompanied by genuine estimates of their uncertainty. Developing tools for estimating uncertainties will be a major activity. CASIX will improve current coarse resolution (4° x 5°) global pCO_2 climatology (left) to 0.11° x 0.11° (12 x 12 km) over the North Atlantic.

CASIX aims to exploit Earth Observation data for:

- New algorithms for air-sea exchange coefficients
- New techniques to estimate primary production
- Improved process models of biogeochemical fluxes
- A full analysis of uncertainties in carbon fluxes

NATURAL ENVIRONMENT RESEARCH COUNCIL

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