Full details

All details held on the selected case study are shown below.

Went live on	Title	Reference
28 Jul 2011	Understanding complex interactions between ocean and atmosphere	SID0344

Synopsis

Sea and air interact in many different ways, exchanging, for example, heat, CO2 and momentum. Continuous and sustained measurements of these `fluxes' are being taken at sea, providing a more detailed understanding of the Earth's climate.

Description

The exchange of gases between the oceans and the atmosphere has a significant impact on the climate and weather. Knowledge of the complex processes involved is necessary for a better understanding of climate change.

Scientists at the National Oceanography Centre (NOC) in Southampton, have been determining the rate at which the ocean and the atmosphere exchange heat, carbon dioxide and momentum. The project, entitled High Wind Air-Sea Exchanges (HiWASE), was carried out as part of NERC's UK Surface Ocean-Lower Atmosphere Study (UK SOLAS).

'The behaviour of these exchanges or 'fluxes' is complicated and affected by many different processes,' says Dr Margaret Yelland, the principal investigator for the research. 'For example, CO2 flux depends on the: speed of the wind; air and sea temperature; humidity; state of the sea; breaking waves and whitecaps; and concentrations of CO2 in the water and air. All of these need to be measured to understand what's occurring.'

From 2006 until 2009, measuring equipment was deployed on board the Polarfront, a dedicated Norwegian weather ship. It was stationed in the open ocean of the North Atlantic and was regularly exposed to high wind speeds that increased flux rates. Using an autonomous system called 'Autoflux', the scientists made nearly 4,000 flux measurements.

'Our results during the three-year period included measurements made at higher mean wind speeds than had previously been achieved,' Yelland says. 'Filling this knowledge gap was important because wind speeds like those experienced in the North Atlantic are expected to have a large effect on the global flux of CO2.'

The results gave some support to the hypothesis that bubbles in whitecaps may play a significant role in exchange of CO2 and other climatically important gases.

'The HiWASE dataset from the Polarfront represented a breakthrough of international importance,' says Dr Phil Williamson, Science Coordinator of the UK SOLAS programme. 'Whilst we have known for 20 years that CO2 flux is faster under high wind speeds, we now know how much faster. This matters for global models of climate change; it makes a big difference whether a third, a quarter or a fifth of the extra CO2 released by human activities ends up in the ocean.'

Polarfront was withdrawn from service in December 2009. In place of HiWASE, a new project, the Waves, Aerosols and Gas Exchange Study (WAGES), began in May 2010. Autoflux was installed on the RRS James Clark Ross, operated by NERC's British Antarctic Survey. WAGES is a three-year joint project between NOC and the University of Leeds. It is being led by Yelland and Professor Meric Srokosz with Dr Ian Brooks at the University of Leeds.

A number of additions have supplemented data from Autoflux. From summer 2010, a commercial wave radar system was added to the onboard equipment to provide data on wave direction. Digital cameras were also installed to take images of whitecap coverage and an aerial camera system will be flown for additional coverage of breaking waves.

'The exciting thing about WAGES is that it is obtaining data over the entire length of the Atlantic under a vast range of different conditions,' Yelland says. 'Measurements will be taken in sea-ice covered areas of the Antarctic and Arctic, the extreme seas of the Southern Ocean, the high temperatures of the equatorial Atlantic, and during the fierce storms of the North Atlantic.'

On 13 March 2011, team members joined the RRS James Clark Ross in the Falkland Islands. They were at sea for about three weeks before docking in Punta Arenas in Chile. The ship was operating in the Weddell Sea and waters between Chile and the Antarctic Peninsula, where weather and wave conditions can be fierce.

References and links

Hyperlinks

1. British Antarctic Survey - RSS James Clark Ross - Research Ship
2. British Oceanographic Data Centre - UK Surface Ocean - Lower Atmosphere Study (UK SOLAS)

	3. British Oceanographic Data Centre - Project 14: High wind air-sea exchanges (HiWASE) 4. NERC - SOLAS 5. National Oceanography Centre, Southampton - Measuring air-sea exchange of carbon dioxide in the open ocean 6. National Oceanography Centre, Southampton - Ocean Observing and Climate: High Wind Air-Sea Exchanges (HiWASE) 7. National Oceanography Centre, Southampton - Dr Margaret Yelland 8. National Oceanography Centre, Southampton - Study begins on air-sea exchanges and their influence on climate 9. University of Leeds - WAVES, AEROSOLS AND GAS EXCHANGES (WAGES)

Impacts	
Key outputs	Database - Improved understanding of the processes driving air-sea gas exchanges.

Research and funding	
Funding type	Research Programme

Researchers at Universities		
Grant reference	NE/G000123/1	
Investigator	Dr MJ Yelland	National Oceanography Centre, Science and Technology

Research and Collaborative Centres	
Centre	National Oceanography Centre, Southampton

Classification	
Science themes	Climate system, Earth systems science
Science areas	Atmospheric, Marine, Polar
Policy areas	Climate/environmental change and impacts, Natural processes

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