21 APRIL 1999: OCEAN-ATMOSPHERE INTERACTIONS NEAR COASTS

Professor P S Liss, University of East Anglia: An introduction to air-sea gas exchange

"Only Connect....." (Howards End, EM Forster, 1910) The theme of this talk will echo the sentiment of the above quotation, i.e. that the ocean and atmosphere are intimately connected by the exchanges which occur between them across the air-sea interface. Such transfers are of several types - I will concentrate on exchange of gases and will illustrate the theme by the following four examples from our recent work:

1. Iron induced increase in marine biological activity and its effect on carbon dioxide and dimethyl sulphide in the atmosphere.
2. Natural surfactants in the oceans and their possible role in air-sea gas exchange.
3. Seaweed and the chemistry of the troposphere.
4. The formation of volatile selenium compounds in the oceans and the global cycling of this element.

Dr W Oost, KNMI, Holland: Micro-meteorology and measurement of air-sea fluxes of CO2 at a coastal site

The oceans absorb an estimated 2.0q 0.8 gigaton carbon per year. A significant contribution to the 40% uncertainty in this value is the fact that most of our knowledge in this field is based on methods that require measurement times well in excess of the time scale on which the flux varies due to e.g. wind speed variations. Micro meteorological measurements need only 20 minutes, but have until recently produced unrealistic k-values. During the 1996 ASGAMAGE experiment both types of methods were used - and the results turned out to be comparable. But ASGAMAGE provided more: modelling results indicating concentration gradients close to the water surface. And more or less the ultimate Micro meteorological heresy: counter gradient heat fluxes.

Dr D K Woolf, Southampton Oceanography Centre: Turbulence in coastal waters and air-sea exchange coefficients

Air-sea exchange coefficients are usually parameterized in terms of wind speed or wind stress, but the air-sea exchange of poorly soluble gases and marine aerosol production are governed by turbulent processes in the surface water. The linkage of the wind to the stirring of surface waters is examined. In most circumstances, there will be a fair but inexact relationship between wind and sub-surface turbulence. One obvious exception is a surf zone, which will be a strong source of aerosol and a site of rapid air-sea exchange irrespective of the wind. Air-sea exchange will also exceed predictions from the wind speed where the principal source of turbulence is flow (e.g., tide or river) over the bottom.

Dr R Upstill-Goddard, University of Newcastle: Gas exchange in coastal waters of the southern north sea determined with multiple tracer releases

Air-sea gas transfer velocities derived from tracer release experiments in the southern North Sea during 1996 are described. "Dual-tracer" measurements involve the simultaneous release of gaseous 3He and SF6, with subsequent measurement of the time-dependent change in their ratio in surface water. We also report on the use of non-volatile tracers, spores of the bacterium Bacillus globigii var. Niger and two rhodamine dyes (WT and sulphono-G), in the same experiments. These conservative tracers correct for dispersive dilution of the gaseous tracers, provide additional transfer velocity determinations, and facilitate estimates of the Schmidt number dependence of gas transfer in a field situation. The results are reviewed briefly in the light of previous dual tracer experiments, in order to further evaluate published parameterisations of gas transfer with wind speed.

Professor C Murrell, Warwick University: The bacterioneuston and air-sea gas exchange

There are a number of interesting biogenic gases that are produced and/or consumed in the marine environment. The surface micro layer of the sea is the interface between a gaseous and an aqueous environment and it has been suggested that this is an important environmental niche where microorganisms may thrive. Methane is an important greenhouse gas and the bacteria that oxidise methane in terrestrial and marine environments are well-characterised. We are investigating the marine air-water interface as a habitat for these methanotrophic bacteria by sampling the sea-surface micro layer using hydrophobic membranes and analysis using a combination of conventional and molecular microbiological techniques. The strategy adopted and recent results obtained will be presented.