

The impact of coastal upwelling on the air-sea exchange of climatically important gases (ICON)

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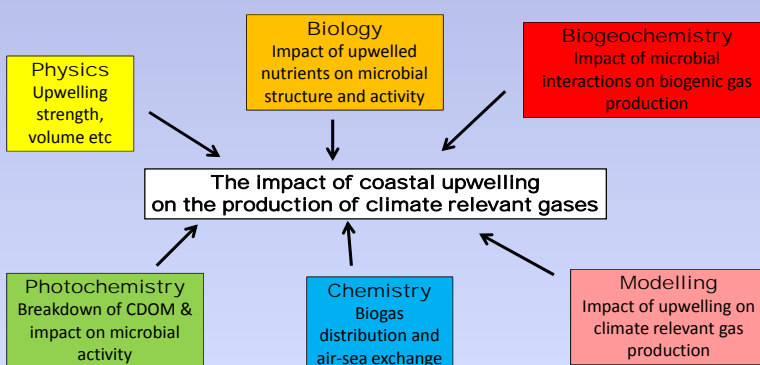
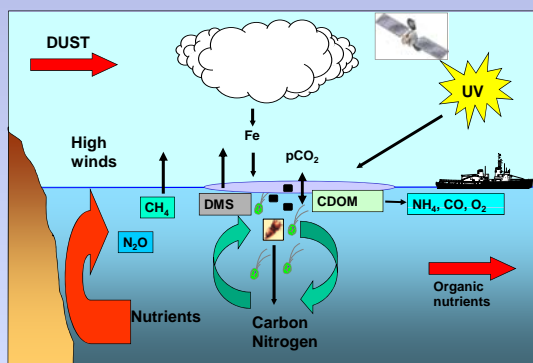
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The chemical and particle fluxes associated with coastal upwelling regions significantly influence atmospheric chemistry and oceanic biogeochemistry. These highly productive ocean systems are, however, largely neglected in budgets of climate relevant gases. The intensity of coastal upwellings is regulated by surface wind and ocean current patterns yet the response of coastal upwelling systems to potential climatic shifts, and the impact this might have on air-sea gas exchange is unclear.

Upwelling enhances emission of the greenhouse gases N₂O and CH₄, accounting for a significant proportion of the total marine N₂O source. However the relative fate of the upwelled N₂O between the physical processes of air-sea exchange and dilution and biological consumption has not been examined. Similarly, discrimination between the upwelling supply of N₂O and indirect sources such as near surface nitrification and diffusion across the pycnocline have only been examined within models.

Offshore export, which is greatest in upwelling regions where filaments occur, provides an important pathway for the transfer of carbon and dissolved nutrients. Upwelled coloured dissolved organic material (CDOM) impacts the optical properties of the seawater, affecting nitrogen and carbon cycling, while light absorption by CDOM influences nutrient cycling and trace gas production.



Interpretation of the limited biogeochemical data available for coastal upwellings is hindered by their complex heterogeneity, and so requires a co-ordinated programme that is hydrodynamically constrained. This SOLAS (Surface Ocean, Lower Atmosphere Study) project will address this challenge by determining the relative contributions of physical supply, photochemistry and biological activity to the air-sea exchange of O₂, CO₂, N₂O, CH₄ and DMS within a tracer (SF₆) labelled Lagrangian experiment in a coastal upwelling system.

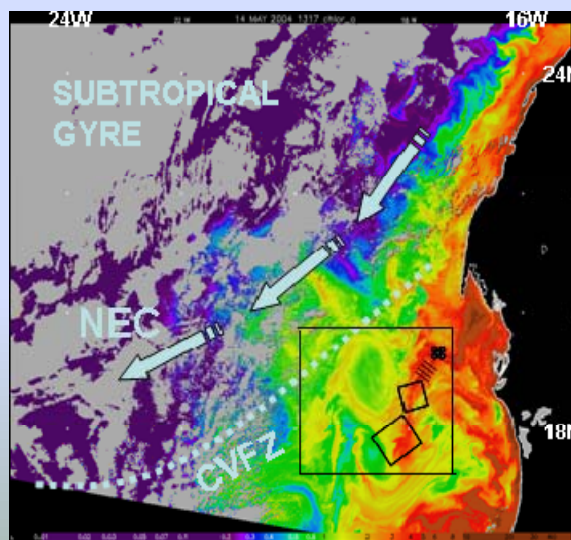
The specific objectives of this project are to determine :

- 1) the role of upwelling in the supply, loss and air-sea exchange of climate relevant gases
- 2) the photochemical and biological fate of upwelled and newly produced CDOM, and its role in air-sea exchange of climate relevant gases
- 3) the impact of upwelling on the spatial and temporal variability in plankton community structure and activity and resultant influence on biogenic gas flux.

The Northwest African site was chosen due to its intense coastal upwelling, its potential influence on open ocean biogeochemistry and its location near to the SOLAS atmospheric sampling station on Cape Verde.

Determination of hydrodynamic properties and the concentration of SF₆ will enable the quantification of upwelling dispersion and transport. Measurements of N₂O, pCO₂, CH₄, DMS, O₂ and CO with ³He derived transfer velocities will constrain air-sea fluxes. Stable isotopes will be used to quantify the upwelling source of N₂O and CH₄. Incubation experiments will link CDOM photobleaching with the photochemical transformation of NH₄⁺, CO and O₂. We will determine the role of viral, algal, bacterial and zooplankton interactions which contribute to the production, transformation, release and destruction of O₂, pCO₂, DMS and N₂O. The collated dataset will inform ongoing modelling exercises.

The fieldwork will take place in April – May 2009 and involve >30 scientific staff from 6 research establishments. Further information including a cruise diary will be available at <http://web.pml.ac.uk/solas/icon/icon.htm>



SeaWiFS image processed by the NERC Earth Observation Data Acquisition and Analysis Service