CARBON FLUXES AND CLIMATE IN THE EQUATORIAL PACIFIC

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In the tropical Pacific, carbon fluxes within the ocean and between the sea and the atmosphere, are closely linked to the geographical extension of the equatorial upwelling. This oceanographic phenomenon is due to the divergence of equatorial surface currents which generates vertical transport of deep and cold waters, with rather high carbon dioxide (CO_2) and nutrients (e.g. nitrate, phosphate, silicate,...) concentrations, to the surface. It yields a double effect on the superficial and lighted surface layer : (1) export of CO_2 from the sea to the atmosphere because of differences in partial pressures between the two, the ocean being considered as a "source" ; (2) increase of CO_2 uptake by oceanic primary production (i.e. plant photosynthesis), thanks to the presence of nutrients in the lighted layer, a process known as the "biological pump" and the ocean being considered as a carbon "sink". From present carbon budget estimates, it appears the equatorial upwelling is a "source" of CO_2, in spite of its enhanced primary production.

On a global scale, the Pacific equatorial upwelling covers most of the total "source" area on Earth, but it varies interannually in association with the El Nino-Southern Oscillation (ENSO) events. Thus, during El Nino periods, geographical extension of the upwelling is minimum ; so is CO_2 export from the ocean. This case has been observed during the 1991-1995 period on atmospheric records. On the contrary, during La Nina periods (e.g. the 1996 year), extension of the upwelling is maximum, leading to a greater CO_2 export flux to the atmosphere.

An important international research effort has been made in the 1990-1996 period in the frame of JGOFS (Joint Global Ocean Flux Study). Its purpose was to determine the main processes taking place in the biological pump and air-sea exchanges. However, the geographical extension of the upwelling, which can be tracked by pigment concentrations, has been poorly surveyed, mainly because of the lack of satellite devoted to oceanic primary production. NASA SeaWifs satellite, which is just about to be launched, should fill this gap.

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ABSTRACTS

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