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Atmospheric Long Range Transport of pollutants to the North Western Mediterranean

Marta ALARCON*, Antonio CRUZADO* and Sergio ALONSO**

*Centre d'Estudis Avançats de Blanes, Blanes (Spain)

**Department of Physics, Group of Geophysical Fluid Dynamics, Balears Islands University (Spain)

Large quantities of substances of natural or anthropogenic origin enter the marine environment through the atmosphere, from both coastal and distant sources. This is especially true for semienclosed seas such as the Mediterranean Sea. Preliminary estimations of the fluxes of substances such as Hg, Cd, Pb and Cr, confirm that the atmospheric transport for these substances is, at least, comparable in magnitude to the riverine inputs (MED POL, 1989).

In a recent study (Alarcon and Cruzado, 1990) the nutrient fluxes (nitrate, nitrite, ammonia, phosphate and silicate) indicate that the deposition amounts are of the same order of magnitude to that of the vertical diffusive fluxes from deep waters into the photic zone. Therefore the atmosphere could be an important source of nutrients for the marine productivity, mainly in oligotrophic waters, as is the greatest part of the Mediterranean Sea.

The meteorology of the Mediterranean region is particularly variable both spatially and temporally, and this variability is due, partly, to the hilly orography. The topography behind the coastline around all the Mediterranean is complex. This can interact with the long range atmospheric flux inside the boundary layer influencing the horizontal transport and the vertical mixing of the substances by complex mechanisms.

At first, the knowledge of the deposition processes of the aerosol particles, combined with transport models should allow an evaluation of the net transfer rate from air to sea of particulate matter.

Computation of air parcel trajectories is a very powerful tool to estimate the long-range transport of substances. In this study we have computerized an isentropic method due to Petersen and Uccellini (1979) to simulate long- distance transport of substances.

The isentropic approximation reduces a tridimensional trajectory computation to a bidimensional problem. The air parcel moves above isentropic surfaces. Although only the horizontal components of the wind are used, the vertical velocity of the particle is not ignored. It is implicitly taken into account through the contour and the temporal variation of the isentropic surface.

Trajectories are computed applying an explicit system of equation based in the theory of the "discrete model" developed by Greenspan (1972), to the atmospheric equations of the movement. Trajectories are constructed in an isentropic framework, from the movement equations, where the pressure fields are represen- ted by the Montgomerystream fuction, CpT+gz.

The model calculates parcel positions in time steps of 900 s. A trajectory segment is integrated by 48 time steps. Acceleration is computed from the gradient of the Montgomery streamfunction, and then velocity and position are interpolated for the next time step. The process is repeted for the succesive time steps to complete a 12 hours trajectory segment.

The stability of this process is discussed by Petersen and Uccellini (1979), and conclude that this explicit method is stable for time increments between 300 and 1800 s.

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