Estimation of the vertical eddy diffusion coefficient of heat in the Gulf of Trieste (Northern Adriatic)

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Vertical eddy diffusion coefficient of heat (VEDCH) has been computed from a least squares trigonometric fit of temperatures at four levels of the water column from January 1986 to September 1989. This coefficient is supposed to be in the form of a constant and a time and depth function. In climatological time scales, the constant coefficient is sufficient for the description of the annual temperature changes in the lower part of the water column. For the upper part of the column, the possible range of values of the coefficient for the shallow Gulf of Trieste were estimated.

The solution of the diffusion equation of heat can be proposed, where the only source term of heat is due to irradiance absorption varying through the year, and where the VEDCH is supposed to be dependent on the vertical gradient of temperature, annual surface irradiance, and on the absorption coefficient estimated from the Secchi disc measurements. The temperature measurements done for several years at the fixed station, one mile from the coast at the entrance of the Gulf of Trieste were then fitted with the form of the solution of the diffusion equation, where the trigonometric time dependency was assumed (Fig. 1). Annual variation of VEDCH was estimated from annual irradiance cycle, from measurements of Secchi disc depth and from phase shift changes with depth of trigonometric fits of temperature measurements. The method was in principle already discussed by Fjeldstad (1933). This can also be the base for other estimations of vertical turbulent diffusion parameters, like the coefficient of turbulent diffusion of nutrients.

VEDCH at the entrance of the Gulf of Trieste has values from $1.7 - 2.5 * 10^{-4}$ m^2/s, the variations being naturally the greatest at the surface. VEDCH for the upper part of the water column reaches its minimum in the summer, when a strong temperature stratification is present. In the lower part of the water column,

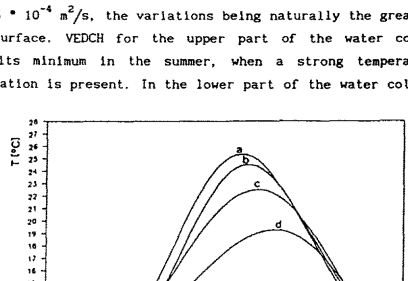

Figure 1

Trigonometric fits of temperatures taken from four depths at the station F(45°32.33'N, 13°33.10'E) at the entrance of the gulf of Triestefrom January 1986 to September 1989 for: a) 0 m, b) 5 m, c) 10 m, d) 21 m depths (bottom).

the annual variations of VEDCH are almost negligible and VEDCH has bigger values from those at the surface, about $2.5 * 10^{-4}$ m^2/s.

The above result was obtained from a simple one-dimensional diffusion model of heat, by using a hypothetical solution for temperature and a hypothetical form of VEDCH, which was depended only on the temperature stratification for simplicity. The solution has been adapted to the least squares fits trigonometric solutions of temperature at the four depths. The effect of salinity stratification at the surface (Stravisi, 1983), which reduces the VEDCH at the surface during the season, and the surface fluxes of heat and advection (Stravisi and Crisciani, 1986) still remains to be considered and was discussed in Malačič (1990).

References

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