RISE OF EFFLUENT FROM AN UNDERWATER SEWAGE DIFFUSER IN THE SOUTHERN PART OF THE GULF OF TRIESTE (NORTHERN ADRIATIC) DURING THE BORA EVENT

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Abstract

Initial dilution and rise of effluent from diffusers of a submarine sewage outfall for the town of Piran (15000 PE) is simulated with a numerical model. CTD vertical profiles conducted during the 'Bora' wind in autumn of 1997 were re-analysed by calculating the overturning length scale. The tail of the patch of the overturning length scale is roughly elongated in the direction of the inflow into the Gulf of Trieste, and the height of its peak coincides with the height of the peak of bacteria, as well as with the height of a plume predicted by the numerical model.

Keywords: overturning length scale, sewage dilution

The sewage outfall for the town of Piran accounts for only 7% of the sewage load that arrives in the Gulf of Trieste (1). The statistics of the analysis of eight dominant nutrient compounds during 1997-1999 showed that only ammonia followed the increase of bacteria (2) in a layer of neutral buoyancy, with a correlation factor of 0.58. There was no significant correlation between bacteria and the fluorescence signal, nor with dissolved oxygen, both being recorded with the multiparameter CTD probe. The initial rise and dilution was modeled numerically with a calibrated model (3), that was previously applied in the planning of future discharges (4).

Vertical CTD profiles conducted during the survey that took place on the autumn morning of 26 September 1997, during the 'Bora' wind, were re-analysed by calculating the overturning length scale. The Bora wind forced the convection, as well as the horizontal circulation. The overturning length scale was calculated from temperature, salinity and from density vertical profiles that were obtained with a fine-scale CTD probe that retrieves the data with a vertical resolution of 2.5 cm during the free-fall. Results of the numerical model for the initial rise of effluent were compared with the vertical distribution of faecal coliforms at the central position of the near-field, as well as with the distribution of the overturning length scale.

The distribution of the overturning length scale was affected by the forced convection that originated at the sea-surface. However, there are indications that there was a core of turbulent effluent at the pycnocline above the bottom boundary layer, where a local maximum of the overturning length scale was found. The depth of the subsurface local peak of the overturning length scale, that is calculated from the density profile in the center of the sewage near-field, matches with the depth of the peak of faecal coliforms, and with the height of the simulated plume rise. The 3D space distribution of the overturning length scale indicates a spread of a structure with enhanced overturning activity below the surface mixed layer over an area of 1 km^2, and could be attributed to an effluent that erupts turbulently from diffusers.

Wind and current-meter observations during winter 2002-2003 have shown that a wind driven circulation during the Bora has an outflow current in a thin surface layer in the direction of the wind. Below is an inflow of the water mass in the Gulf of Trieste, that governs the transport of the water mass through the water column. The distribution of the overturning length scale confirms that the effluent, which remains well below the surface spreads in this direction of the inflow.

References

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