A NUMERICAL NITROGEN TRANSPORT MODEL FOR CARMARTHEN BAY, WALES, UK

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The control of nitrogen pollution in coastal waters is a major concern within a sustainable catchment management. The two-dimensional finite volume numerical model HEMAT 2D (Namin et al., 2002) was set up for the Bristol Channel to investigate nitrogen pathways for Carmarthen Bay, Wales, UK. The numerical model implied the momentum and mass conservation equations and the advective-diffusion transport equations. The water quality model at the current stage calculated the four nitrogen fractions organic nitrogen, ammonia, nitrate and nitrite and the concentration of algal biomass.

The model was based on an unstructured triangular grid which was largely refined within the Carmarthen Bay area. The mesh sizes were gradually reduced from 3km in the Bristol Channel down to 75m in the estuaries of Carmarthen Bay.

The nitrogen inputs from rivers and sewage treatment works were modelled as source points within the grid. The available field data provided by the Environment Agency Wales contained river samples and discharges measured at discrete time steps within the computational period. This data was then used as a boundary condition for the model. In addition, intensive survey data has been collected during two one week periods which ideally featured stable weather conditions. This data was used as a time series for verification of the predicted results.

The hydrodynamics were calibrated using measured tidal current and water level data at Rhossili and Tenby. The boundary conditions were set as a time series of water levels at the western boundary and a flow velocity time series at the eastern boundary.

Comparison of calculated and measured results showed an accurate prediction of water levels and tidal current velocities. Errors were attributed mainly to an insufficient spatial resolution of the available bathymetry and subsequently uncertainties in the interpolation of the bathymetry data to the grid cells.

The nitrogen model was based upon the standard QUAL2E formulae (U.S. Environmental Protection Agency, 1987) and used rate and temperature correction coefficients from literature. Nevertheless the presented model showed reasonably good agreement with the measured data (see Fig. 1 for the location at Rhossili). The order magnitude and bandwidth of the concentrations of all four nitrogen components is representing the measured data. Only the base level concentrations of organic, ammonia and nitrate nitrogen were overestimated to a small extend. Future work on HEMAT 2D will focus on a sensitivity analysis of rate coefficients. It will involve additional analysis of nitrogen and algal samples and the interactions with bottom and suspended sediment.

On a larger scale, the aim is to develop HEMAT 2D as a tool for the quantification of

sustainable catchment management strategies that accurately predicts the impact of alternative land use practices on the water quality of receiving estuarine and coastal waters.

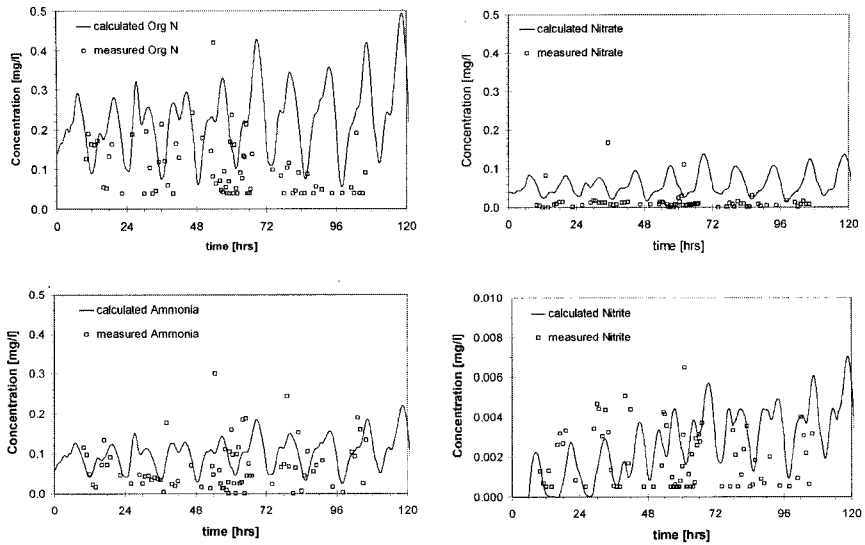

Fig.1 Measured and predicted nitrogen concentrations at Rhossili

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