MODELLING RIVER WATER QUALITY FROM DIFFUSE SOURCES AT THE CATCHMENT SCALE

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River pollution from non-point sources, such as agricultural activities and surface runoff is actually one of the major threats to surface and groundwater quality at the catchment scale. Agriculture water pollution is becoming a major concern not only in developed regions such as the European Union (EU) but also in many developing countries. The intensification of agricultural practices, in particular the growing use of fertilisers and pesticides, and the specialisation and concentration of crop and livestock production, has had an increasing impact on water quality. The main agricultural water pollutants are nitrates, phosphorus, and pesticides. Rising nitrate concentrations threaten the quality of drinking water, while high pesticide use contributes substantially to indirect emissions of toxic substances. Increasing levels of nitrates and phosphorus in surface waters reduce their ability to support plant and animal life and make them less attractive for recreation. Controlling water pollution from agriculture is made difficult by its particular nature. In most circumstances, agricultural pollution occurs over a wide area, and its sources are diffuse and difficult to identify.

In this paper the first results on river water quality simulation, obtained by a European funded research project called RIVERTWIN are presented. The research team at the Aristotle University of Thessaloniki is responsible for modelling surface water quality from diffuse sources at the basin scale. The main objective of the project is the development and application in different river basins of an integrated water resources management model, including the surface water quality simulation component. Two different mathematical models were used, i.e. the MONERIS and QUAL2K models and applied in two river basins having different climatic conditions have been studied.

The Neckar Basin is located in the South-West of Germany and bordered by low mountain ranges in the west and South East part (Black Forest, Swabian Alb). Being the third largest tributary of the Rhine River, the Neckar, 367km long, drains a catchment of more than 13.000 km^2. Climate in the Neckar catchment is semi humid and temperate. Average annual precipitation is 950 mm and average daily temperature in the catchment is 8.7°C Results of numerical simulation together with comparison with available data are reported for the case of the Neckar River Basin, Germany. The second river basin is the Oueme basin is located in the Republic of Benin. It has an extension of about 50.000 km^2 and its major part is located within the country borders. The climate is of the monsoon type, which is characteristic for the large sub-humid Savannah zones of the world. In third world countries such as Benin, the disposal of the urban wastes is a major problem.

The MONERIS (MOdelling Nutrient Emissions in RIver Systems) model is a conceptual, quasi-static model developed to estimate annual emissions of nitrogen and phosphorus from various sources on a subcatchment scale and the resulting loads at the subcatchment outlet (Behrendt et al. 2000a, b; Behrendt, 1993).

The conceptual representation of a stream used in the QUAL2K model is that of an element that has been divided into a number of unequally spaced reaches or computational steps equivalent to finite difference elements (Brown et al., 1987).

Some of the model outputs and comparison with available data are plotted in the graphs below (Figs 1 and 2).

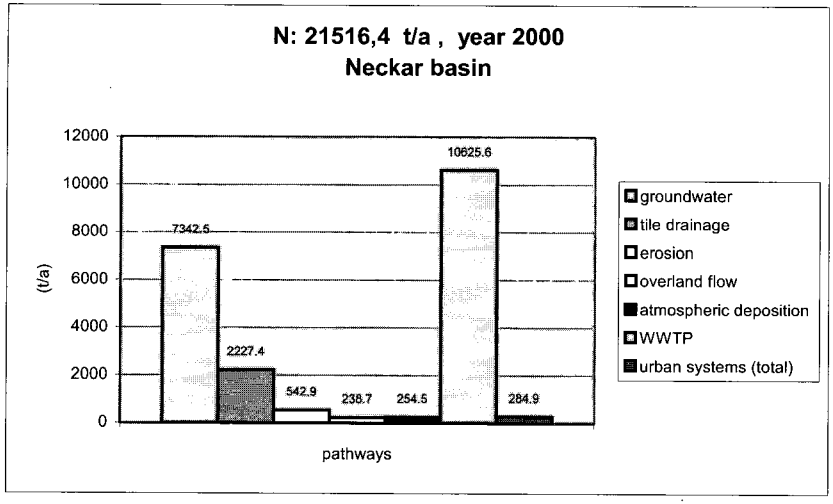

Fig. 1 Nitrogen emissions at the outlet of the Neckar basin for the reference year 2000.

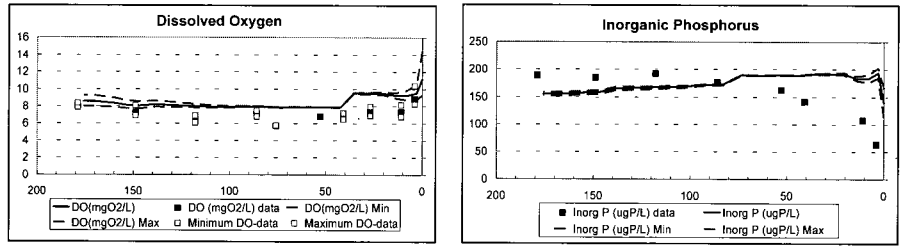

Fig. 2 Comparison between QUAL2K simulation and available data.

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