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Evaluation of Storm Drain Groundwater and Nutritional Capacity Using QUAL 2Kw

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Commentary

The quantity and quality of water in two of the four main drainage canals in the plain of Chryssoupolis in Kavala, North Greece, are investigated. Agriculture is practised extensively in the area. Nestos River provides irrigation water via a network of irrigation canals. The four main drainage canals collect drainage water and irrigation return flows, which discharge into the Thracian Sea and the North Aegean. A monitoring programme was designed in the four canals to monitor flow and the main constituents of drainage water. The primary pollutants were nitrate, phosphorus, and suspended solids. The trophic state of the canals and its seasonal variation were assessed using the collected data, and the limiting nutrient was identified. In two of the four canals, QUAL 2Kw was also used to model flow and water quality. The calibration and verification of QUAL 2Kw were carried out using the collected field data in order to identify pollution sources and propose future management actions to improve the quality of drainage canal water. The findings demonstrated that QUAL 2Kw is an effective tool for simulating water quality in rivers and canals, as well as quantifying the effects of non-point source pollution from agricultural areas.

The degradation of surface water quality is mostly due to anthropogenic factors, such as urbanization, and industrial and agricultural activities. The construction of wastewater treatment plants to control point-source pollution has highlighted non-point source pollution as the primary cause of poor water quality of aquatic systems. The most important non-point source polluter is agriculture, which enriches streams, rivers, lakes and the coastal areas with nutrients (nitrogen and phosphorus), sediments and pesticide residues. One result is the eutrophication of surface water bodies. For the purpose of this study, a data collection network was designed in the four main drainage canals to measure discharge and water quality variables at approximately 7 to 15-day time intervals. In each canal, three monitoring and sampling stations were defined; Flow was measured using a Vale port model 801 flow meter. Temperature (T), dissolved oxygen (DO), electrical conductivity (EC) and pH were measured in situ. Samples were analysed in the laboratory, in order to determine the concentrations of BOD and COD, total suspended solids. As in the case of discharge, it was necessary to add extra amounts of ammonium and nitrate nitrogen, and phosphorus from non-point sources, in order to minimize the error between the measured values in the field and those estimated by the model. The addition of nitrate and ammonium nitrogen and inorganic phosphorus was in concentration units (μg/L). In terms of water quality, drainage canal monitoring showed increased nutrient concentrations downstream of intensively cultivated areas, leading to water pollution. The present study showed that the model QUAL2Kw can simulate flow and water quality parameters in the drainage canals of Chryssoupolis plain. Based on the calibration of the model for cultivation and non-cultivation periods, loads of nutrients (N, P) entering into the canals from non-point sources were estimated. The cultivation season loads of nitrogen and phosphorus entering into the canal are multiples of the loads entering during the non-cultivation season. Also, it was found that certain canal reaches accept larger loads, something that helps in identifying pollutant sources and in taking appropriate best management measures to reduce pollution. This can be done with appropriate guidance to farmers for proper crop fertilization. Other management measures may also include the installation of riparian vegetation and buffer strips along the canals. These have been found very effective in preventing non-point source pollution from agricultural areas from entering canals and rivers. Finally, the use of constructed wetlands for the treatment of agricultural runoff could improve the quality of water discharged into canals and coastal lagoons, since they are very efficient and inexpensive solutions to reduce nutrients.

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