Geophysical Research Abstracts, Vol. 7, 07537, 2005
SRef-ID: 1607-7962/gra/EGU05-A-07537

Non-point source nitrogen transport modeling by continuous Montecarlo geomorphic approaches

G. Botter, T. Settin, A. Alvaro, M. Marani and A. Rinaldo

University of Padova, Dept. IMAGE and International Center for Hydrology "D. Tonini", Padova, Italy (botter@idra.unipd.it / Fax: +39 049 8275446 / Phone: +39 049 8275445)

The circulation of solutes in the hydrologic cycle is affected by chemical sorption processes occurring between the hydrologic carrier and immobile phases of the hillslopes, where solutes are usually stored and transformed. Transport is therefore strictly related to the dynamics driving the water carrier throughout the basin. A continuous Lagrangian model for both the hydrologic flow and the transport of solutes has been applied to an agricultural basin of 53 km^2 located in North-Eastern Italy, providing an estimation of nitrates loads to a very fragile aquatic eco-system. It is seen, both observationally and theoretically, that annual catchment loads are largely generated by a few floods, thereby requiring a model of detailed (as opposed to integral) response of the catchment in nitrate release to intense rainfall events. Coupling of flow and transport in the hydrologic response is thus necessary. The geomorphic approach employed makes complete use of the residence time distribution of the water carrier, which is deduced on the basis of the spatial distribution of the drainage paths available for hydrologic runoff. The nitrate transport through the hydrologic response is modelled by a Mass Response Function model, thus assuming that mass exchange processes occurring within any hydrologic unit are solely controlled by the time available for the sorption phenomena, which is in turn determined by the underlying residence time distributions. The model also includes a distributed description of soil properties and of nitrogen sources (which are related to soil coverage and pedology), and long-term processes (e.g. evapotranspiration, plant-uptake, denitrification) affecting the water and/or the nitrate mass balance within the soils. The predictive capability of the model has been already assessed, where both discharge and nitrate concentration measurements have been properly simulated, leading to a robust estimation of the chemical and dynamical parameters for the catchment at hand. The evolution of land

use (e.g. of agricultural activities vs. urban developments) during the last decades has surely increased the anthropogenic pressure on the environment in many rural basins of Northern Italy and throughout Europe. As a consequence, the hydraulic properties of the soils have changed in time and the nutrient load of anthropogenic origin prone to the flushing through the hydrologic runoff have also significantly increased. The long-term impact due to the persistence of current level of anthropogenic pressures may be estimated by coupling the transport model to a stochastic rainfall generator. A seasonally variable Bartlett-Lewis rainfall model (whose parameters have been deduced on the basis of the observed rainfall) has been employed in order to achieve, via Montecarlo techniques, rainfall series to be used as inputs to the transport module. This allowed the estimation of the return period of the maximum discharge and of the solute load transferred from the basin soils to the water body. In this context, future scenarios (including land use variations, different fertilization strategies and possible climatic changes) may be considered in a stochastic framework, and their impact on the return period of the discharge and of the solute response may be singled out, with relevant implications for catchment management practice.