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Effect of land-use change on nutrient pollution in estuaries

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Water quality issues remain one of the most complex and poorly understood problems in terms of aquatic management; it is the aim of this study to develop a better understanding of the processes involved in the generation, transport and fate of nutrients in rivers, estuarine and coastal waters. This study introduces a linked modelling approach which is able to predict the impact of alternative land use management strategies on the water quality of receiving waters. A concept for the assessment of nutrient loads is proposed on a catchment scale using geographic and land-use information. River runoff and transport is modelled considering the fluvial retention time with an implemented water quality submodel. It accounts for the biochemical reactions along the river course and is based on the “QUAL2” standard. In a third step, the discharges and concentrations of nutrients from the rivers are linked to the 2D finite volume model “HEMAT” which incorporates the transport by tidal currents. In addition, the above river water quality model was adapted to represent the conditions in estuarine and coastal waters. The impact of land use changes on the nutrient concentrations in the receiving waters was investigated by running the modelling tool for a range of land-use and hydrological scenarios with reduced nutrient input rates and for dry and wet weather conditions. The relationship between land use and nutrient concentrations in the rivers was modelled using export coefficients. Two types of land use were used: (i) Areas of intensive land use and (ii) areas with near to no nutrient outputs. To integrate economical and ecological effects of different land use strategies an input-output analysis approach was used. The method of input-output analysis was used to link the export coefficient based land-use model with the hydrodynamic model and infor-

mation on the agricultural yields of different types of land use. From the qualitative input-output graph a quantitative input-output matrix was derived. With this information, the requirements for land-use changes and appropriate compensatory measures or subsidies for the agricultural sector can be determined by selecting the desired standards of water quality in the coastal waters. The linked model developed and applied in this study provides a decision support tool to assist materially in understanding and minimising nutrient problems in view of a sustainable estuarine and costal management.