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Water Quality Assessment in the Vouga Catchment (Portugal) through the Integration of Hydrologic Modeling, Economic Valuation, and Optimization Methods

Daniel Hawtree (1), Stefan Julich (1), João Rocha (2), Peter Roebeling (2), and Karl-Heinz Feger (1)

(1) Institute of Soil Science & Site Ecology, Technische Universität Dresden, Tharandt, Germany, (2) Centre for Environmental and Marine Studies (CESAM), University of Aveiro, Aveiro, Portugal

Hydrologic model assessments of the impacts of land-cover / use change (LCLUC) are fundamental for the development of catchment management plans, which are increasingly needed for meeting water quality standards (i.e. Water Framework Directive). These assessments can be difficult to conduct at the spatial scale required for such plans, due to data limitations and the challenge of up-scaling from field / small scale studies to larger regions. Furthermore, such hydrologic assessments are of limited practical use if the financial impacts of any potential land-cover / management changes on local stakeholders are adequately quantified and taken into planning consideration.

To address these challenges, this study presents an approach that integrates hydrologic modeling, economic valuation, and landscape optimization methods. This approach is applied to the Vouga catchment, a large (2,298 km^2) mixed land-use catchment in north-central Portugal. The Vouga has high nutrient (nitrogen and phosphorus) impacts in a number of reaches, which have negative impacts on downstream wetlands and groundwater supplies.

To examine potential improvements to water quality, the Soil and Water Assessment Tool (SWAT) was calibrated over a five period (2002 - 2007) to establish the baseline hydrologic and nutrient fluxes. This calibration relies upon the up-scaling of findings from previous field studies (on vegetation and soils), hydrologic assessments, and modeling studies. The agricultural income for local stakeholders was estimated from existing land-cover and management approaches is made, to establish the baseline financial conditions. An optimization algorithm is then applied to the baseline scenario using both the biophysical and financial information, which seeks to determine various (most) optimal states. The preliminary results from this work are presented, and the advantages and challenges of using such an approach for scenario analysis for catchment management are discussed