



## Chapter (Refereed)

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# Continental Scale Modelling of Water Quality in Rivers

*Richard Williams<sup>\*1</sup>, Anja Voss<sup>\*\*</sup>, Virginie Keller<sup>\*</sup>, Ilona Bärlund<sup>\*\*</sup>, Olli Malve<sup>†</sup> and Frank Voss<sup>\*\*</sup>*

*\* Centre for Ecology and Hydrology, UK*

*\*\* CESR, Universität Kassel, Germany*

*† Finnish Environment Institute (SYKE)*

*<sup>1</sup> Centre for Ecology and Hydrology, Wallingford, Oxfordshire, OX10 9AU, UK.  
Telephone: +44 (0)1491 692398 Fax: +44 (0)1491 692424  
email: rjw@ceh.ac.uk*

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## **ABSTRACT**

Global and continental scale modelling has been confined to water quantity (e.g. WaterGAP - Water Global Assessment and Prognosis (Alcamo et al. 2003), GWAVA - Global Water Availability Assessment (Meigh et al, 1999)). Here we describe an approach to include water quality at these scales within the WaterGAP model. The application is to the pan-European area and is being carried out within the EU-funded SCENES Project which has the principal goal of developing new scenarios of the future of freshwater resources in Europe.

The model operates on 5x5 arc-minute grid squares. Water flows in and between grid cells are provided by WaterGAP. The water quality loadings into the river system comprise point sources (domestic effluent, manufacturing discharges and urban runoff) and diffuse sources (runoff from land and scattered settlements not connected to the public sewerage system). Point source loadings are calculated for each country using easily available datasets. For example, the domestic load is a per capita emission factor times by country population multiplied by the percentage of the population connected to the sewerage system, which is then reduced by the amount removed in each of three types of sewage treatment (primary, secondary and tertiary). Data on the amount treated in different types of sewage works is set for each country, while the amount removed by treatment types will vary with the water quality variable being modelled. Country level data is converted to grid square data required by the model, according to the population in each grid square. Diffuse

sources from land are calculated by regression models based on runoff and land use (e.g. numbers of livestock) for each model grid square.

The modelling system has currently been set up to simulate biochemical oxygen demand (BOD) and total dissolved solids. The model was tested against measured longitudinal profiles and time series data for BOD on contrasting rivers e.g. the River Thames (UK) driven by domestic loading and the River Ebro (Spain) with a high share of discharges from livestock farming. Further developments will see the inclusion of total nitrogen (TN), total phosphorus (TP) and dissolved oxygen.

Within the SCENES project a set of future scenarios reflecting different outlooks on Europe has been developed, called “Economy First”, “Fortress Europe”, “Sustainability Eventually” and “Policy Rules”. An Expert Panel was used to suggest what these futures would mean for drivers of water quantity and water quality across pan-Europe. We have projected how changes in percentage population connected to sewers, the level of sewage treatment and population would change loadings from domestic effluent for TN, TP and BOD. In time, these will be used to predict future water quality in European rivers.

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