Models simulate nitrate dynamics in Garonne, Southwest France

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The over-enrichment of fresh, transitional, and marine waters with nitrogen (N) can lead to problems associated with eutrophication, such as a change in species composition of aquatic plants and nuisance algal blooms. In this context, dynamic models of flow and water quality are required to aid the implementation of the Water Framework Directive and to understand the impacts of environmental change.

Scientists from CNRS in Toulouse (France) and the University of Reading (U.K.) described the spatially and temporally complex flow and N dynamics of a major European watershed, the Garonne (62,700 km2) located in southwest France, using multivariate analysis before applying the linked rainfall-runoff HBV and the Integrated Catchment Model of Nitrogen (INCA-N) models to simulate daily flow and N dynamics.

This is the first application of the linked HBV and INCA-N models to a major European river system commensurate with the largest basins to be managed under the Water Framework Directive. Results from the study were published in the November-December 2008 issue of the *Journal of Environmental Quality*.

The spatial and temporal dynamics in the stream water NO3-N concentrations in the Garonne watershed were first described and related to variations in climate, land management, and effluent point-sources using multivariate statistics (PCA, RDA).

Building on this, INCA-N simulations were in accordance with expected flow and seasonal N patterns. In the low and mid reaches of the Garonne, the NO3-N concentrations exhibited a clear seasonal pattern with a peak concentration coinciding with fertilizer applications; that is, results highlighted that 75% of the NO3-N river load in the lowlands came from arable farming. In the upper reaches, climate controls on flow were the most important in determining the NO3-N concentrations which exhibited dilution patterns during high spring flows.

This study reinforces the interest of using semi-distributed models that represent key hydrological pathways, the spatial variations in inputs to land cover types, and a representation of the terrestrial and aquatic biochemical cycles. Thus, semi-distributed models can be used successfully to simulate the seasonal and decadal flow and water quality dynamics from mountainous headwaters to the lowlands in the largest European catchments, at large spatial (>300 km2) and temporal (≥ monthly) scales using available national datasets.

View the abstract of this study at jeq.scijournals.org/cgi/content/abstract/37/6/2155 .

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