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Estimating nitrate emissions to surface water at regional and national scale: comparison of models using detailed regional and national-wide databases (France)

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The European Union (EU) Water Framework Directive (WFD) requires River Basin District managers to carry out an analysis of nutrient pressures and impacts, in order to evaluate the risk of water bodies failing to reach "good ecological status" and to identify those catchments where prioritized nonpoint-source control measures should be implemented.

A model has been developed to estimate nitrate nonpoint-source emissions to surface water, using readily available data in France. It was inspired from US model SPARROW (Smith al., 1997) and European model GREEN (Grizzetti et al., 2008), i.e. statistical approaches consisting of linking nitrogen sources and catchments' land and rivers characteristics.

The N-nitrate load (L) at the outlet of a catchment is expressed as:

L= R*(B*Lsgw+Ldgw+PS)-denitlake

Where denitlake is a denitrification factor for lakes and reservoirs, Lsgw is the shallow groundwater discharge to streams (derived from the base flow index and N surplus in kgN.ha-1.yr-1), Ldgw is the deep groundwater discharge to streams (derived from total runoff, the base flow index and deep groundwater N concentration), PS is point sources from domestic and industrial origin (kgN.ha-1.yr-1) and R and B are the river system and basin reduction factor, respectively.

Besides calibrating and evaluating the model at a national scale, its predictive quality was compared with those of regionalized models in Brittany (Western France) and in the Seine river basin (Paris basin), where detailed regional databases are available. The national-scale model proved to provide robust predictions in most conditions encountered in France, as it fitted observed N-nitrate load with an efficiency of 0.69. Regionalization of the model reduced the standard error in the prediction of N-nitrate loads by about 19

Hence, the development of regionalized models should be advocated only after the trade-off between improvement of fit and degradation of parameters' estimation has come under scrutiny.

References

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