waterschap limburg
Rijkswaterstaat
Ministry of Infrastructure and the Environment
Deltares
Enabling Delta Life

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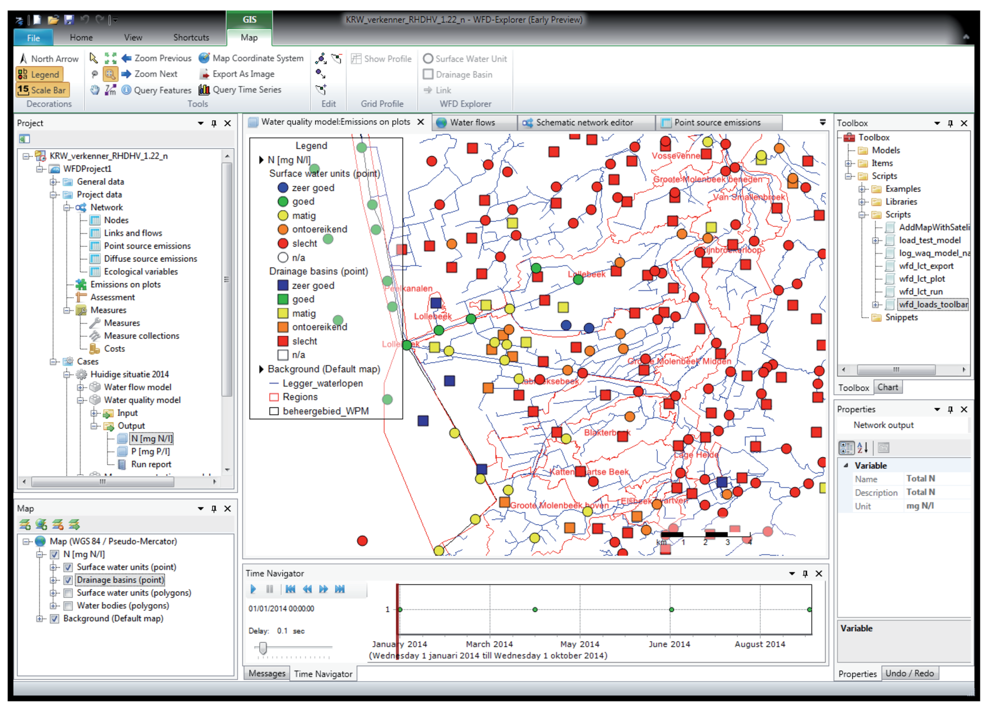
Tracing the origin of nutrients, pesticides and heavy metal loads in a river basin

Introduction

Water managers are responsible for the implementation of the Water Framework Directive (WFD). Insight in the source, origin and distribution of WFD pollutants (nutrients, pesticides, heavy metals) will support the planning and execution of appropriate mitigation measures. Together with Waterboard Limburg, Deltares developed a tracer module for the WFD Explorer allowing the user to define the emission source (e.g. WWTP's, industry, atmospheric deposition, agriculture, etc.) and geographic origin to be distinguished in the mass balance.



< Fig. 1 Schematic overview of nodes in the Delta Shell[4] Environment of the WFD Explorer (above) and in the Groote Molenbeek (below).

The WFD Explorer computes transport and decay of nutrient loads throughout a catchment[1] [2]. A typical WFD-Explorer schematization consists of a network of drainage basin (□) and surface water units (●). Seasonal steady state simulations yield nutrient concentrations in each node as well as water fluxes between connected nodes[3] (Fig. 1).
For each combination of substance, emission type and origin area, a unique tracer is created (Fig. 2). The sum of all emissions of a given substance is equal to the total of all its tracer emissions.

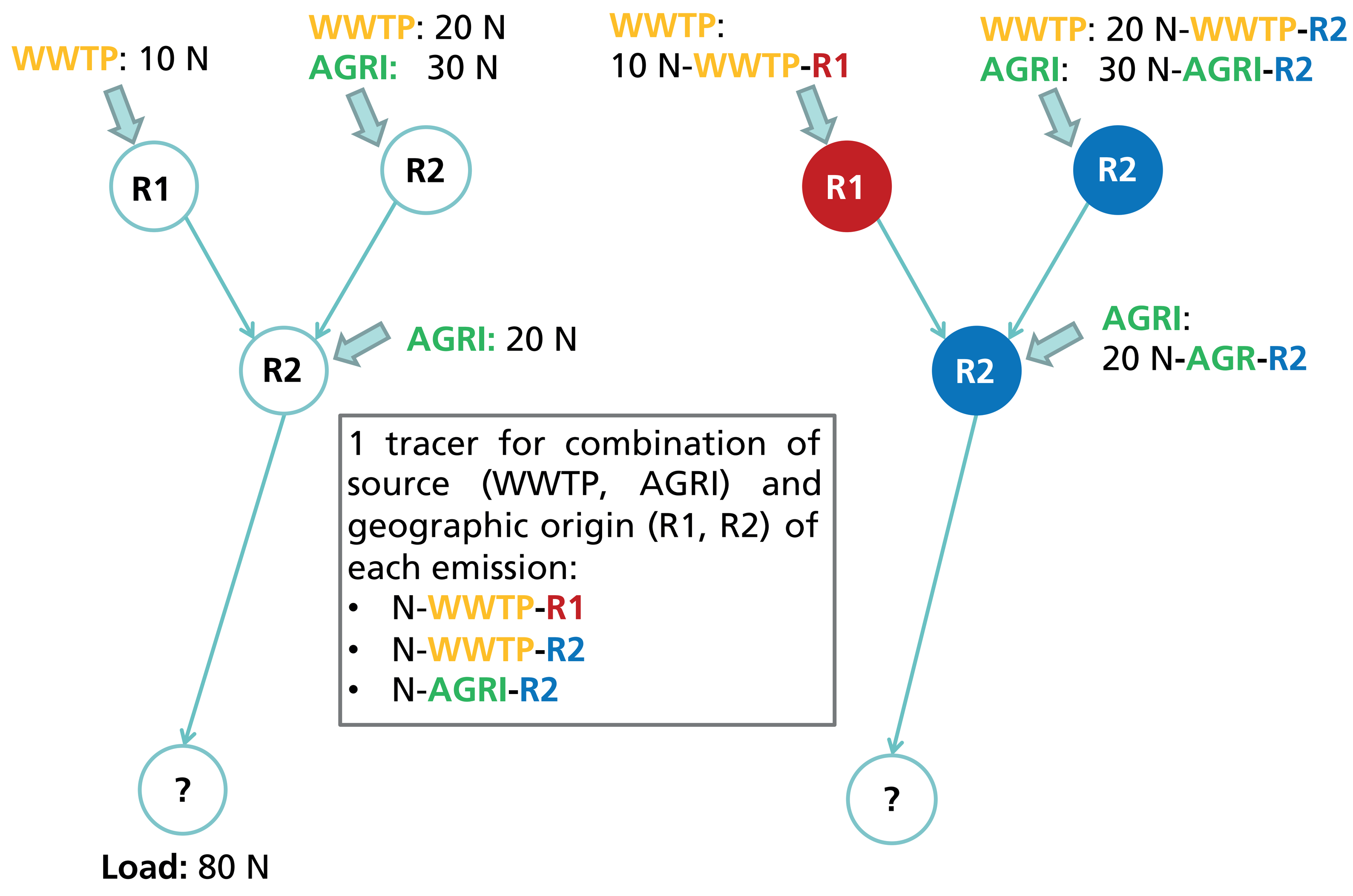


Fig. 2 Illustration of nutrient loads (left) converted to tracer loads for each emission source (WWTP, Agriculture) and origin (Region 1, Region 2) (right).

Load:
- 10 N-WWTP-R1
- 20 N-WWTP-R2
- 50 N-AGR-R2

Pilot 1: national scale – heavy metals [5]

Fig. 3 presents the origin and emission type of mercury in 3 selected Dutch national water bodies based on WFD-Explorer tracer calculations summarized for the years 2012 -2015. At loc. A, Hg input is mainly caused by WWTP's, input from abroad is limited (<5%). At loc. C 95% of Hg originates from abroad. Downstream loc. B is receives Hg pollution from several Dutch sub-basins but contributions from other countries dominate the Hg loads. Often water issues cannot be solved entirely in a small region but require an integral river basin approach to choose more appropriate measures.

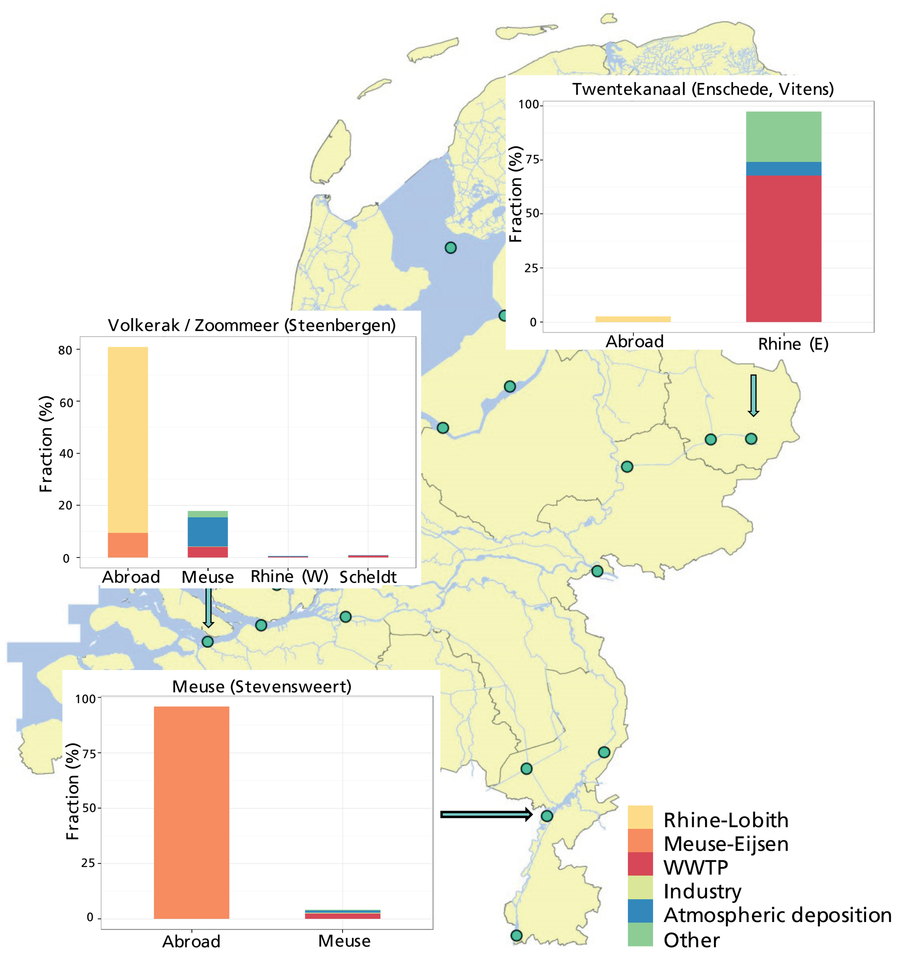


Fig. 3 Mercury fractions (%) for 3 different locations in the Netherlands differentiated by origin (abroad or NL) and emission type.

Pilot 2: regional scale - phosphorus [6]

Fig. 4 presents the phosphorus fractions of the Groote Molenbeek (78 km²) and their geographic origin for the years 2008-2014. We only differentiated the emission type of phosphorus loads originating from the management area of Waterboard Limburg ("WL"). The main sources sources of phosphorus pollution in the Groote Molenbeek are diffuse agricultural pollution, UWWTP and contributions from trans-boundary tributaries of the Meuse catchment.

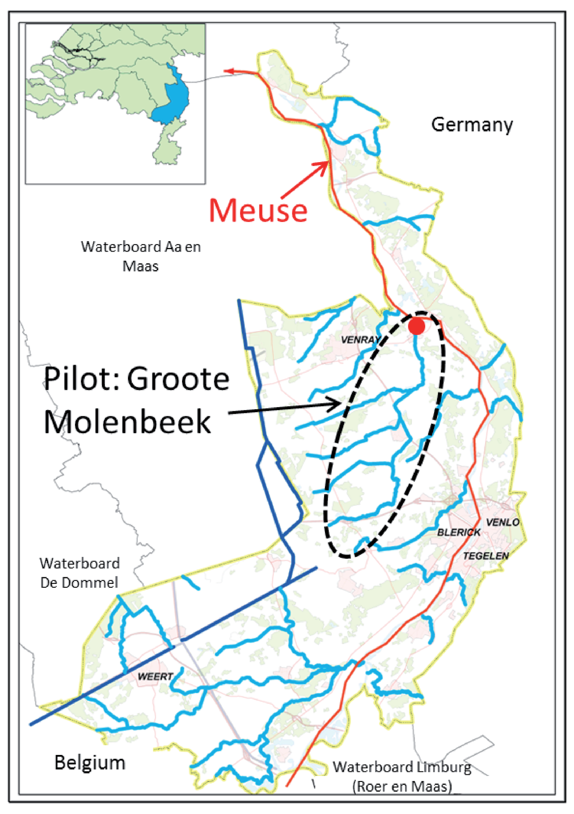


Fig.4 River basin Groote Molenbeek (left) and preliminary model results (right) for phosphorus fractions at most downstream point (●).

References

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