The GWB BE-Meuse-RWM040 “Chalk of the Geer basin”: delayed effect for nitrate in deep, old groundwater

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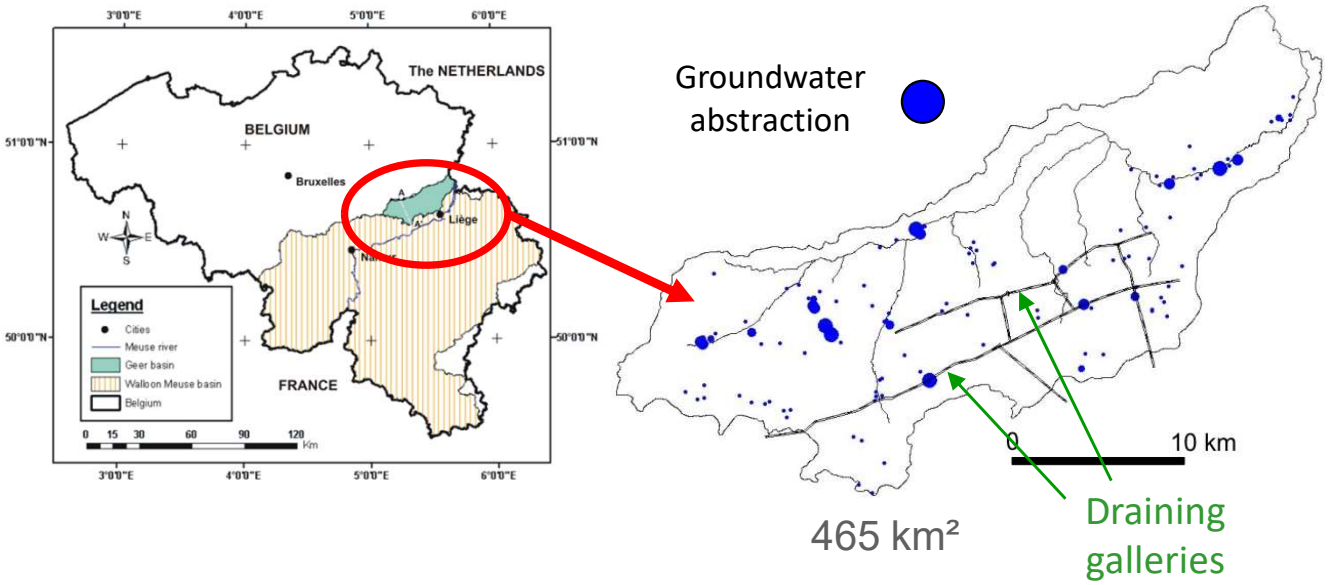
GWB BE-Meuse-RWM040

"Chalk of the Geer basin"



Groundwater abstraction
30 millions m³/year of drinking water to supply approx. 600,000 people in the region of Liège

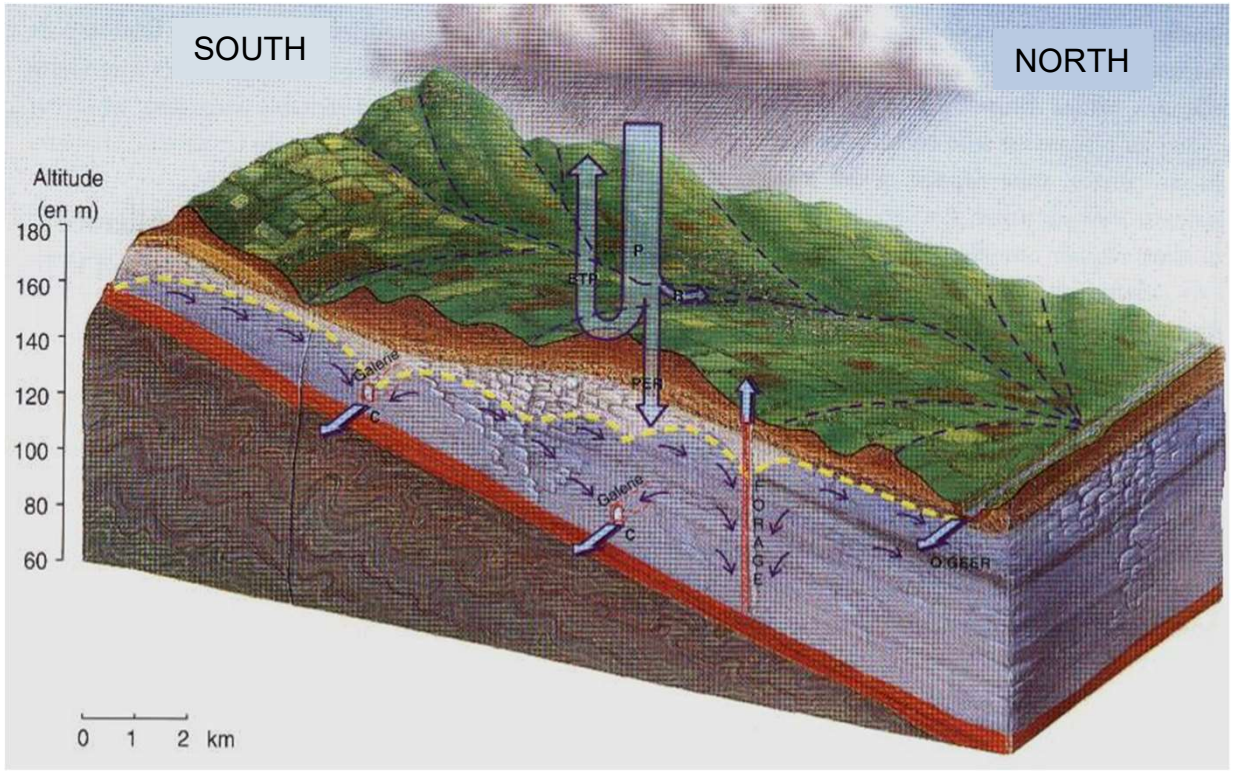


Image adapted from Programme Action Hesbaye

Geology

- soils and loess deposits
- residual flint conglomerate and locally sands
- fractured, dual-porosity chalk (aquifer reservoir)
- clay (aquifer base)

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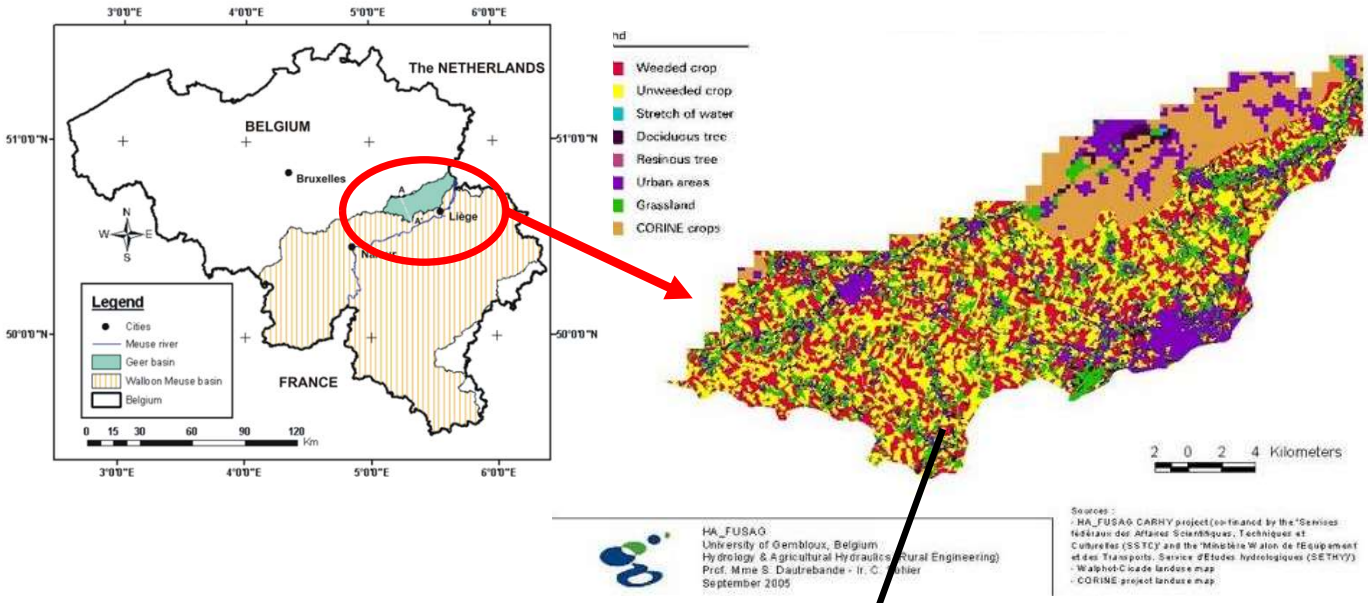
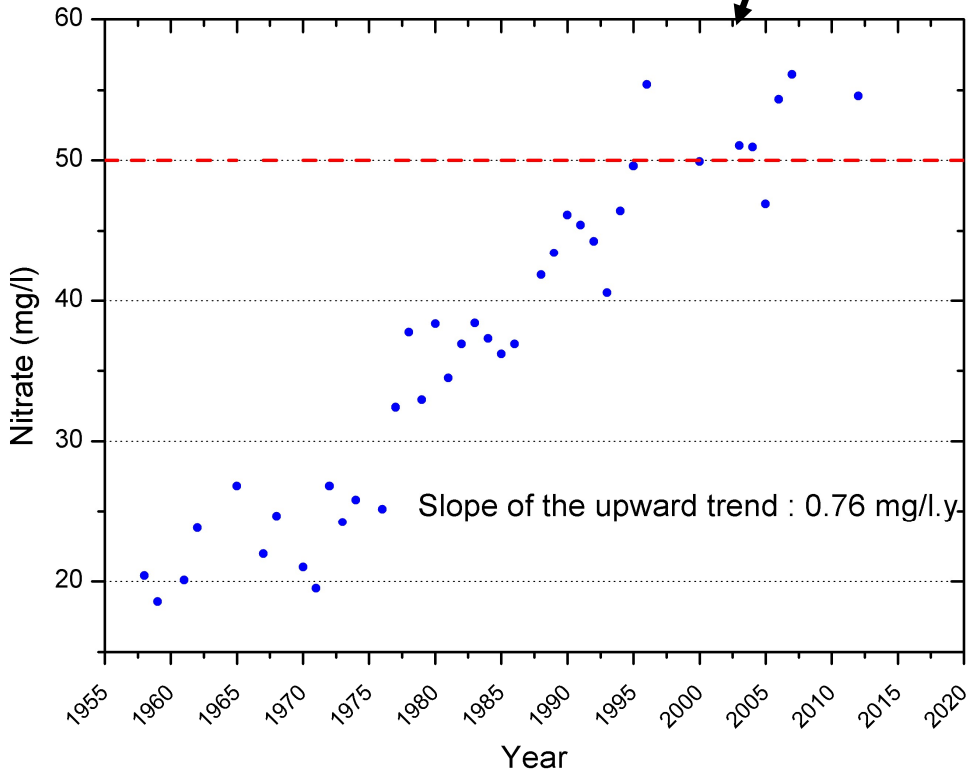


Intensive agriculture (65% of the basin)



Groundwater quality

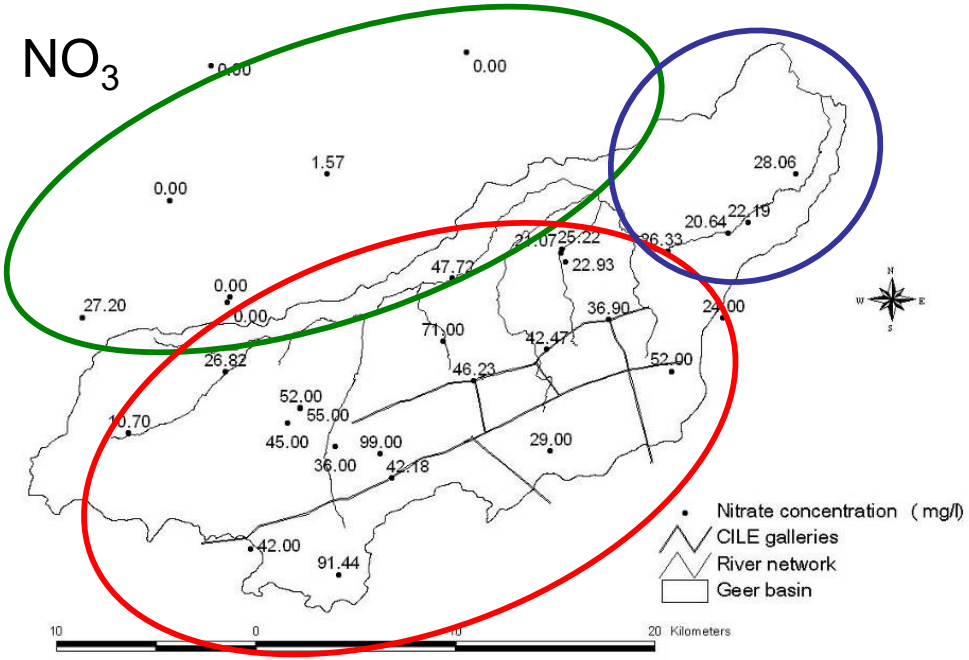
nitrate concentrations close to and even above the 50mg/L NO_3 threshold

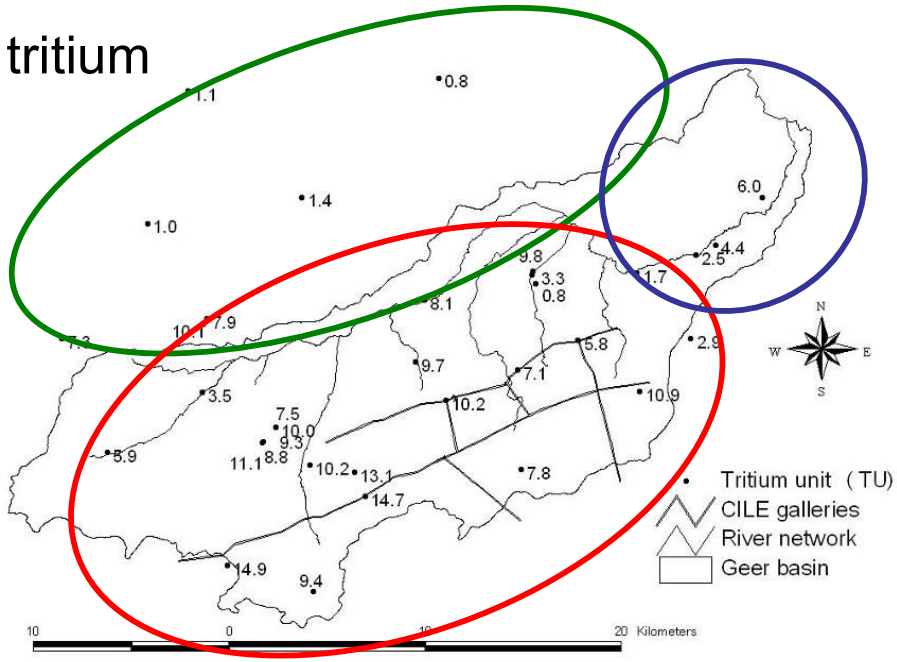
To face this problem, different measures taken:

- GWB BE-Meuse-RWM040 classified in 1994 as vulnerable to NO_3 in the sense of the EU Nitrate Directive (91/676/CEE)
- Action programme in accordance with the Code of Good Agricultural Practice
- Investigations on fate and management of NO_3 in the basin (Programme Action Hesbaye (Dautrebande et al. 1996, Hallet, 1998…)
- More recently, NO_3 treatment plant built by CILE (water company)

Despite these efforts, key remaining questions:

- Any natural mechanisms contributing to delay groundwater quality improvement in response to the applied measures?
- How long do we have to wait until NO_3 trend reversal is observed in groundwater of the Geer basin?





Spatial distribution of nitrate content

S : NO3 =~ 30 – 90 mg/L

NE : NO3 =~ 20 – 25 mg/L

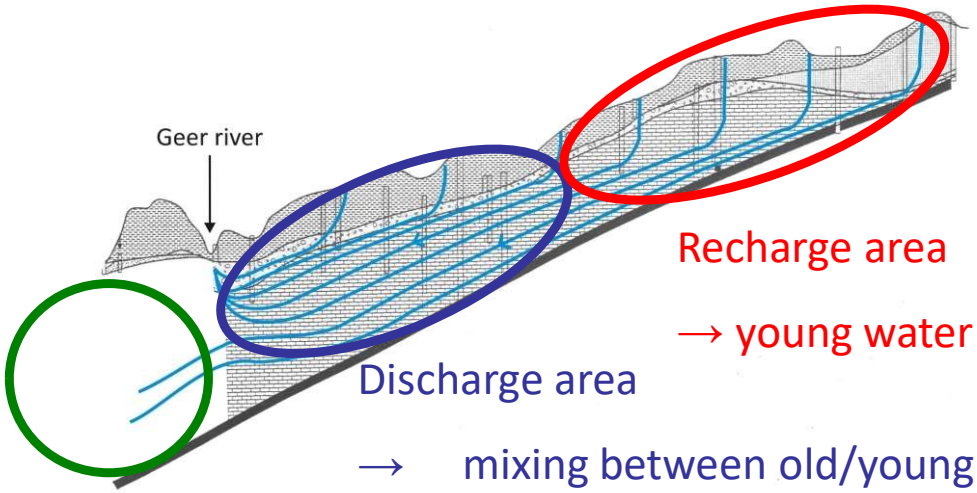
N : NO3 =~ 0 mg/L

Spatial distribution of tritium content

S : UT =~ 10, young water

NE : UT =~ 5, mixing between old/young

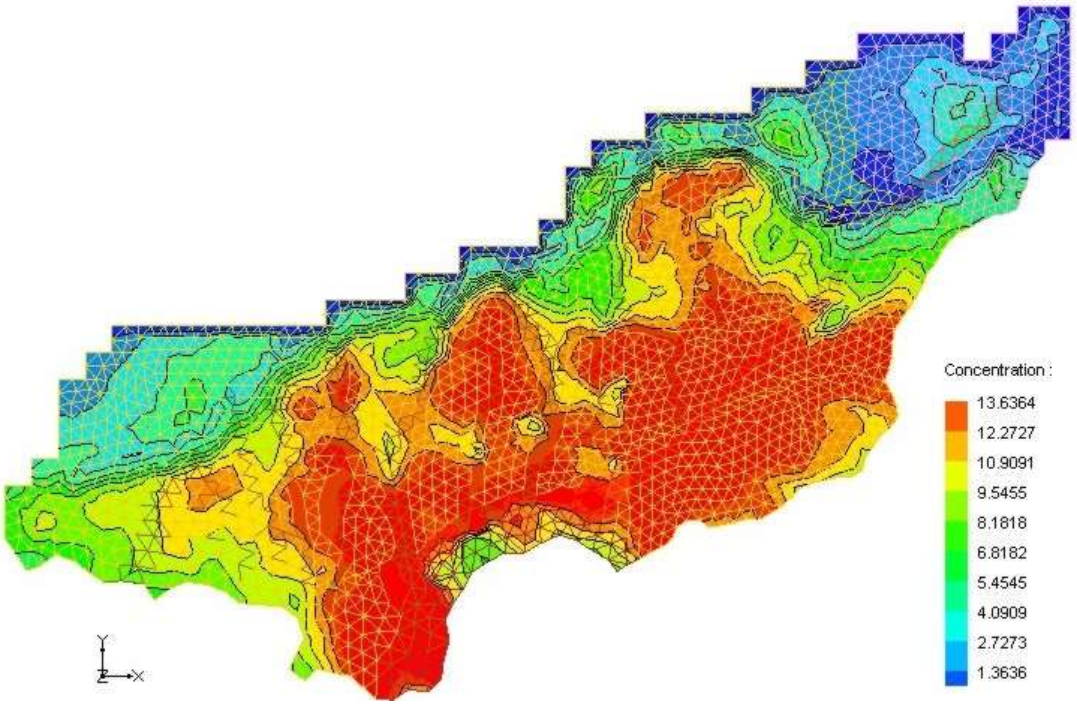
N : UT =~ 1, old water

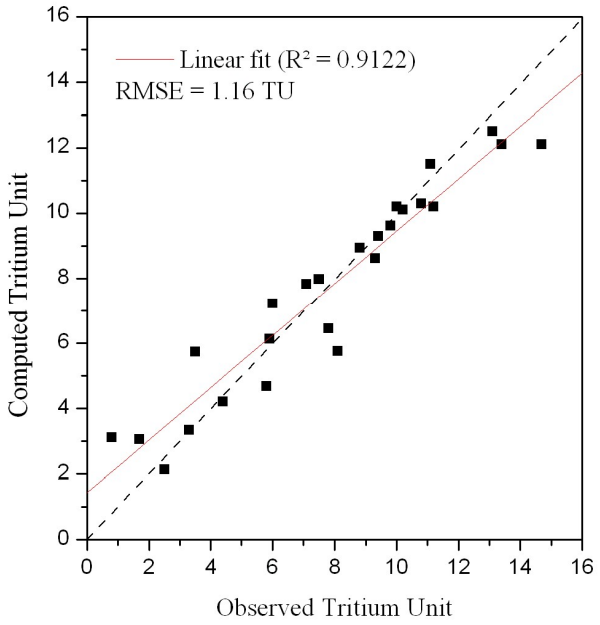


Modeling nitrate trends in groundwater

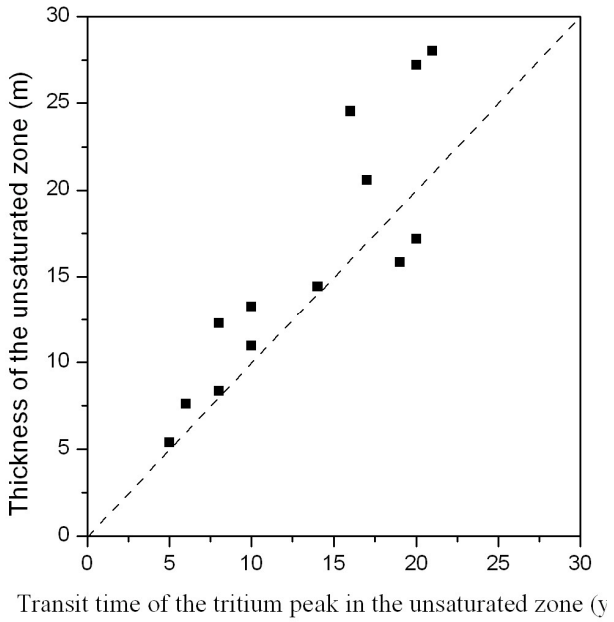
SUFT3D variably saturated GW flow and transport finite element model (Orban 2006)

Calibration with ^{3}H data measured in 2004

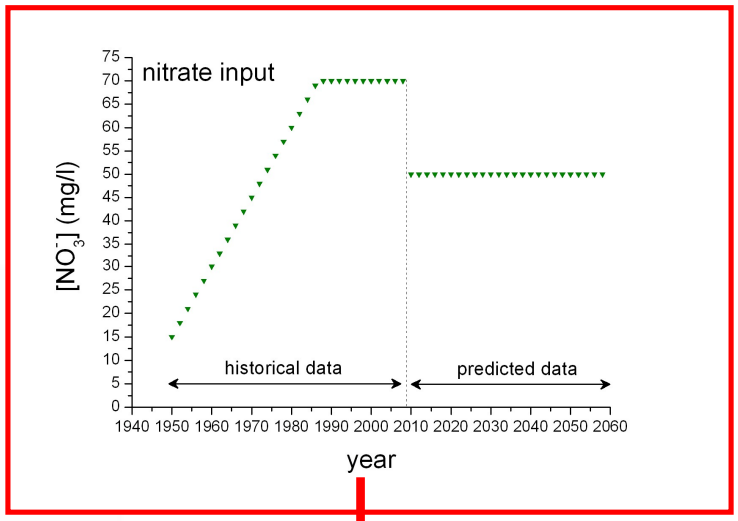


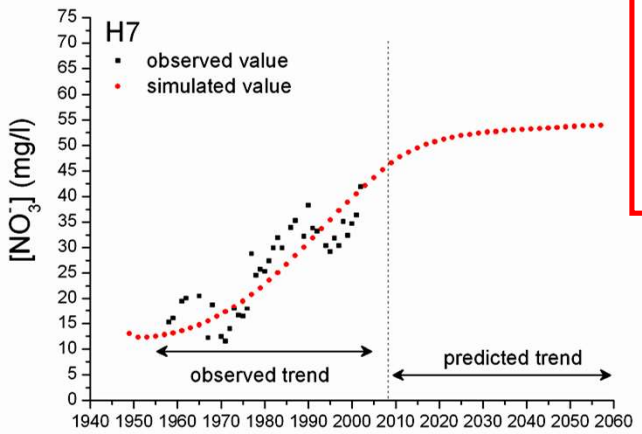


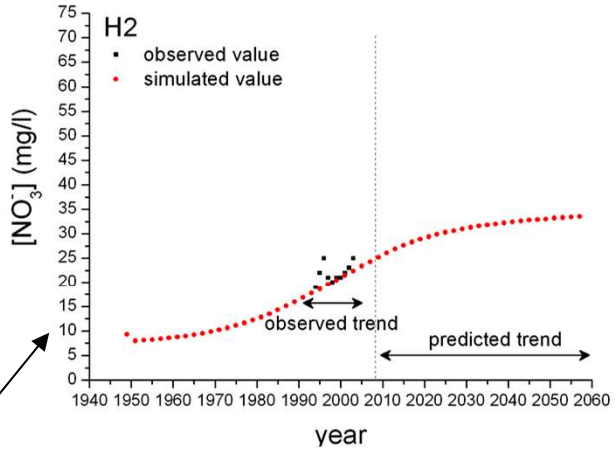
Mean observed velocity across the unsaturated zone=~ 1m/y

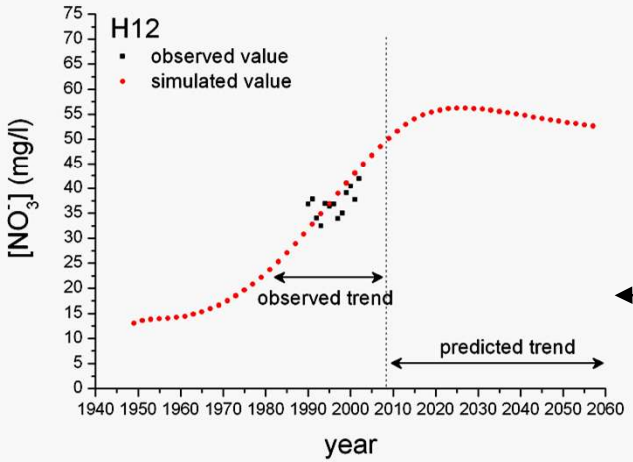


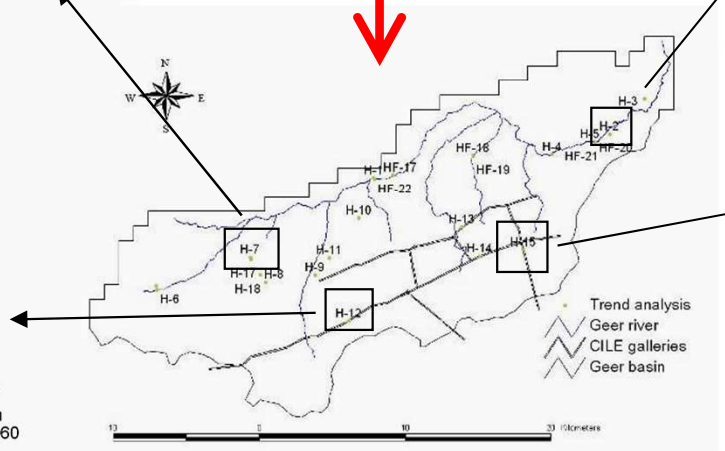
Modeling nitrate trends in groundwater

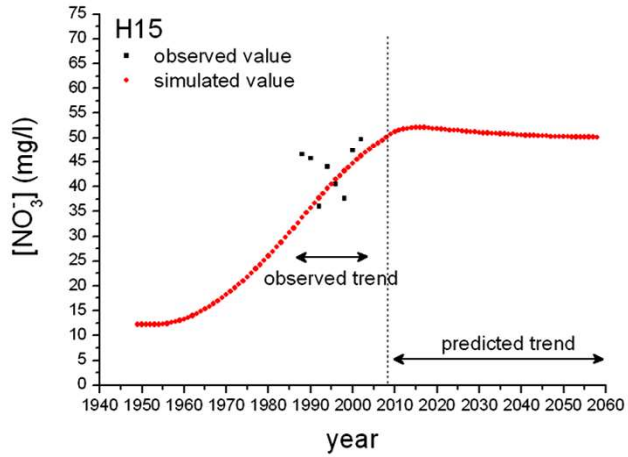












Conclusions and lessons learned

In the Geer basin, spatial distribution of NO_3 strongly linked to hydrodynamic conditions and groundwater mixing

Good description of regional hydrodynamic conditions is essential

Strong correspondence between NO_3 and ^3H patterns in GW

Combined NO_3 – gw age dating tracers useful to distinguish between NO_3 pollution corresponding to very different time scales

NO_3 trend assessment indicative as a first warning
However regional GW flow and transport models are essential for reliable prediction of future NO_3 concentrations in GW

Observations and modelling results indicate that Article 4(4) can be used to extend the time to achieve good chemical status in the GWB BE-Meuse-RWM040 “Chalk of the Geer basin”