

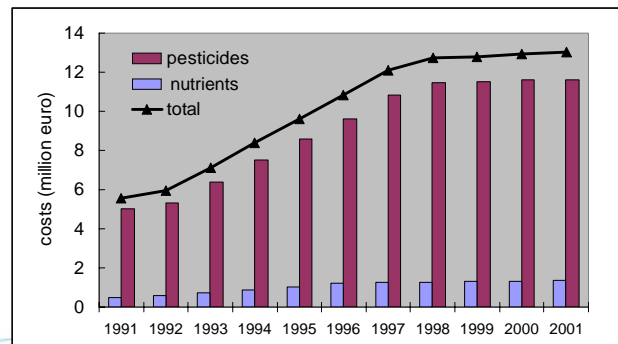
Modelling the fate of pesticides in large rivers with drinking water abstractions

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Introduction

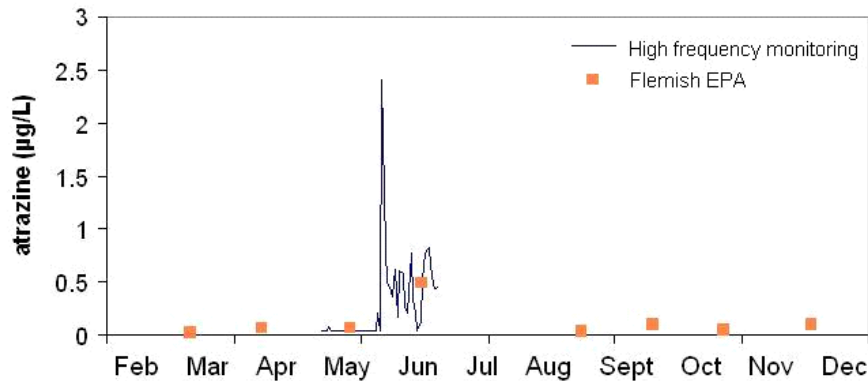
- » European drinking water standard for individual pesticides = $0.1 \mu\text{g.L}^{-1}$
- » **Pesticide peak concentrations** above standard occur, even in large river systems
- » **Drinking water abstraction** from large river systems
 - » High purification **costs**
 - » Adapted water **intake**
 - » **Buffering** capacity



Source: Flemish EA, MIRA report, 2007, Background document plant protection products (dutch)

Monitoring = knowledge, but...

- » usually once or twice a month

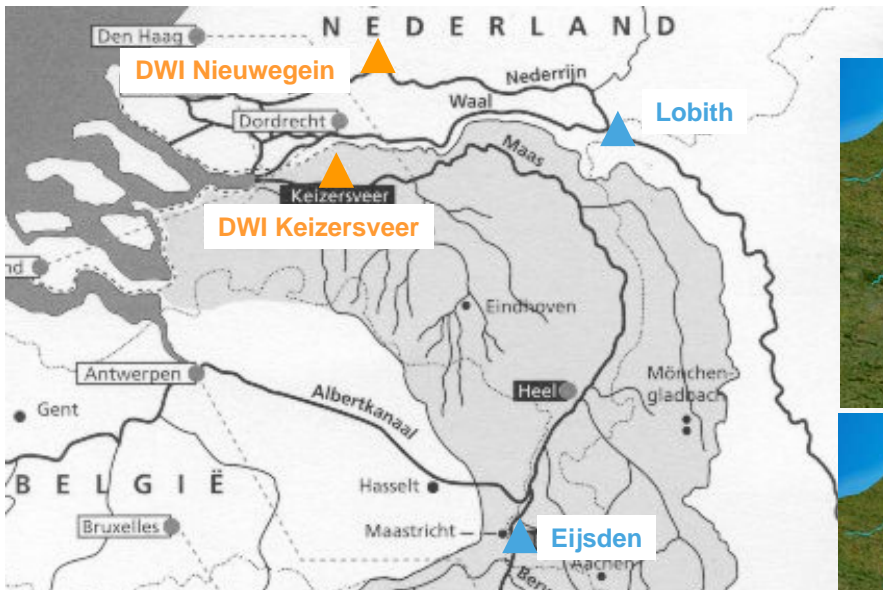


- » due to **scarcity in monitoring data**, knowledge on fate & sources of pesticides in large river basins is often limited
- » Application of a **modelling approach** to fill the monitoring gaps

Aim

- » Develop methodology to :
 - » Generate model input data from monitoring data
 - » Investigate combined effects of variable discharge and dynamic upstream pesticide concentrations on water quality at the intake
 - » Estimate the contribution from different subbasins
 - » Estimate the potential impact of degradation processes in the river
 - » Optimize monitoring strategies

Meuse & Rhine examples

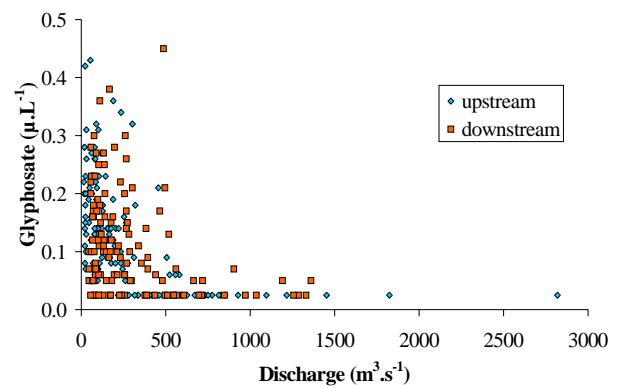
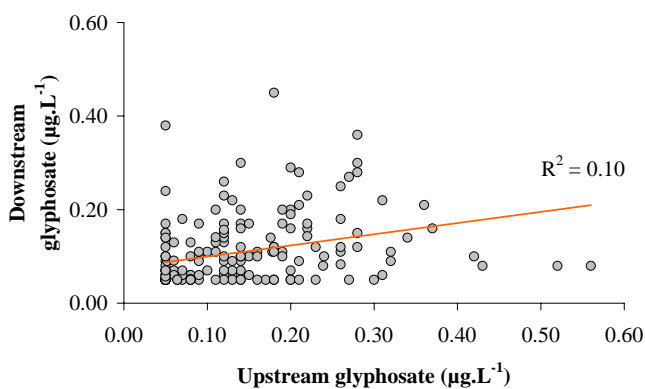


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Data analysis

» Relation between upstream and downstream (DWI) pesticide concentration?

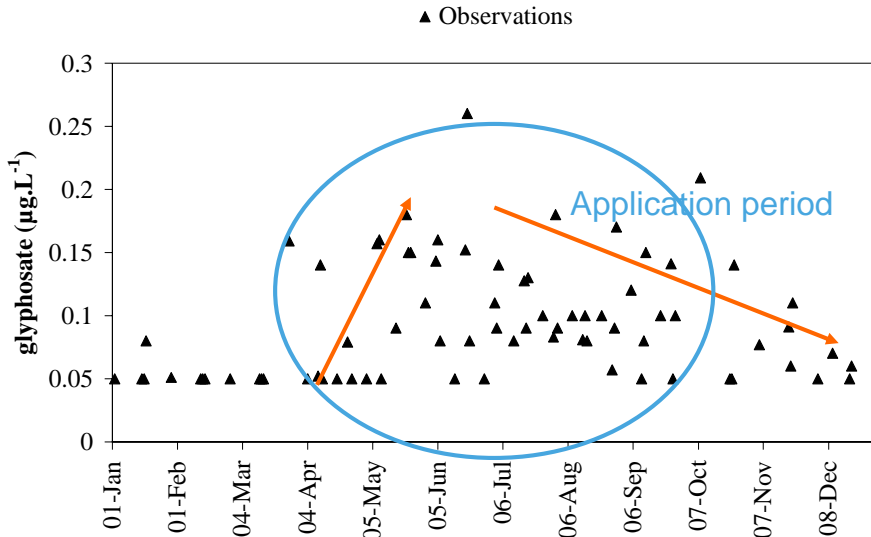
» Relation between pesticide concentration and river discharge?



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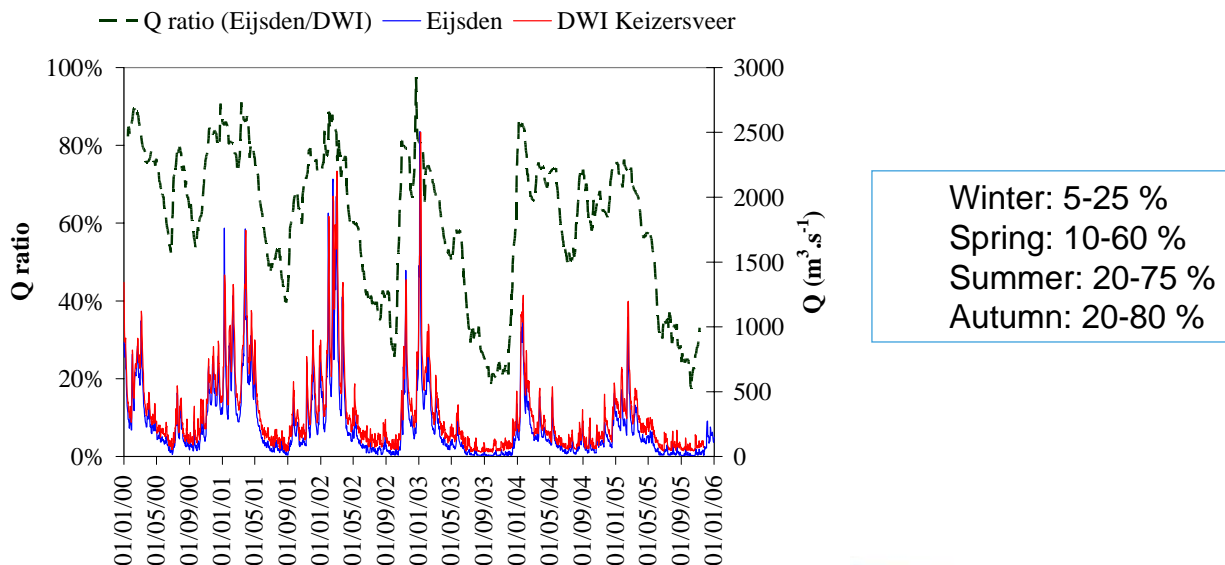
Data analysis

» Seasonal trends?



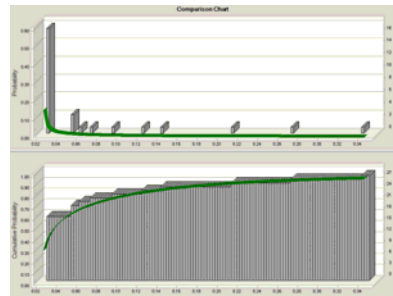
Data analysis

» Contribution of subbasins to main river discharge?



Modelling approach

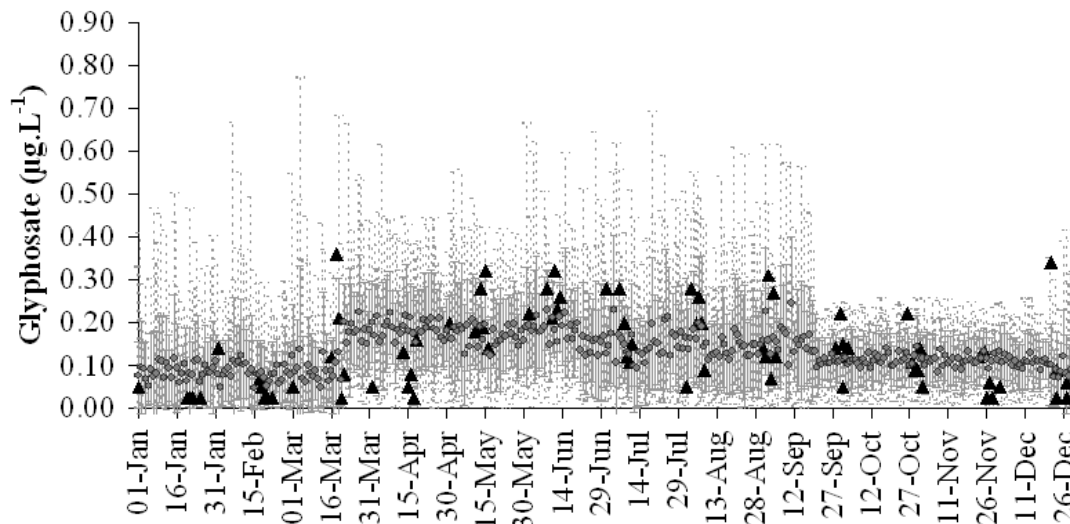
- » From low frequency monitoring data to **representative dataseries with daily pesticide concentrations**
 - » Observed seasonal trends in pesticide concentration ranges
 - » Frequency distribution of monitoring data
- » Generation of pesticide concentration scenarios
 - » Monitoring data
 - » Seasonal groups
 - » Histogram per season
 - » Sampling from frequency distribution per season → **scenarios**



Model input vs. Observations

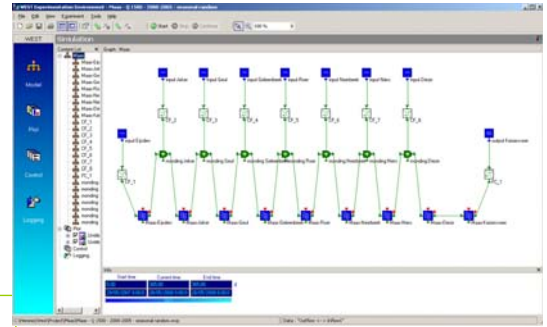
20 generated concentration scenarios

• Model input ▲ Observations

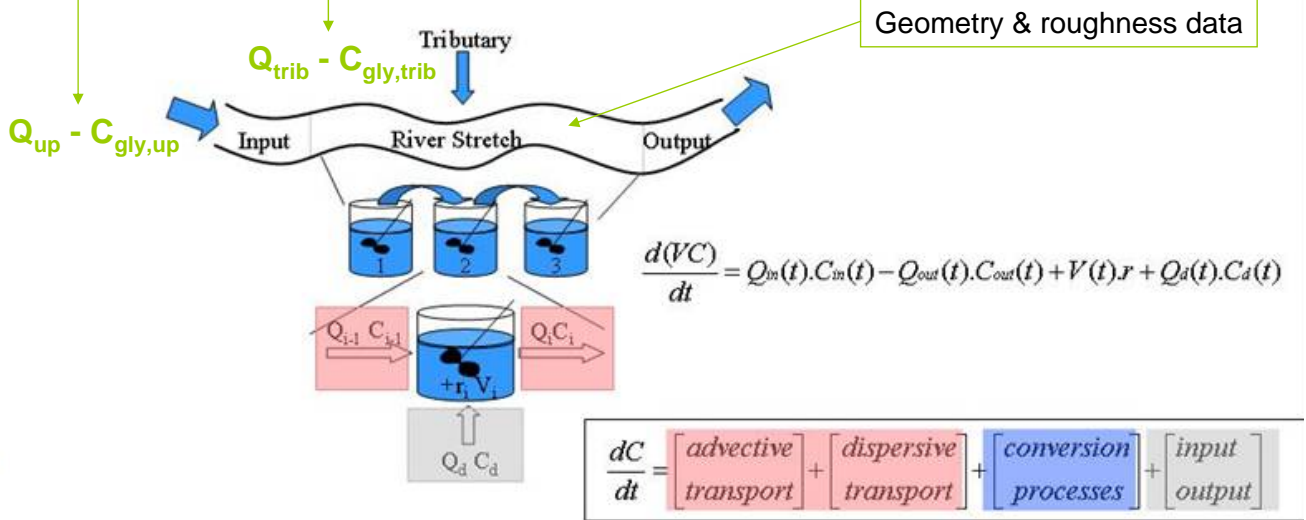


River Water Quality Model

- » River = cascade of continuously mixed reactors
- » Input data & boundary

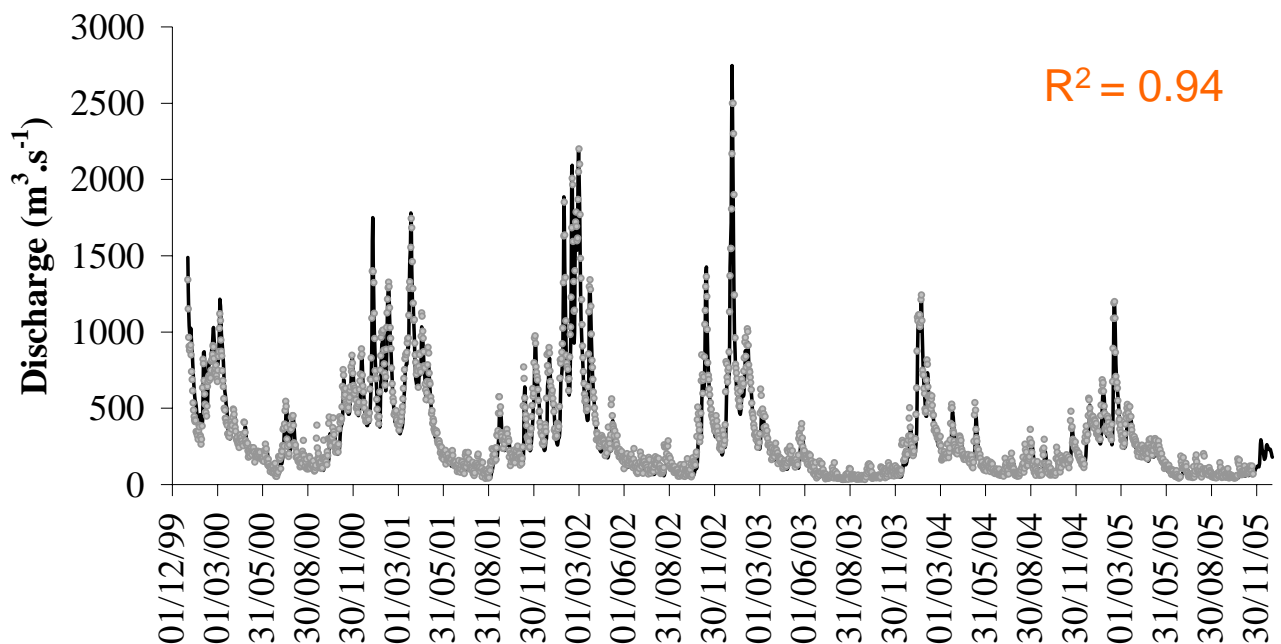


Mean daily discharge (measured)
Generated dataseries with daily pesticide concentrations



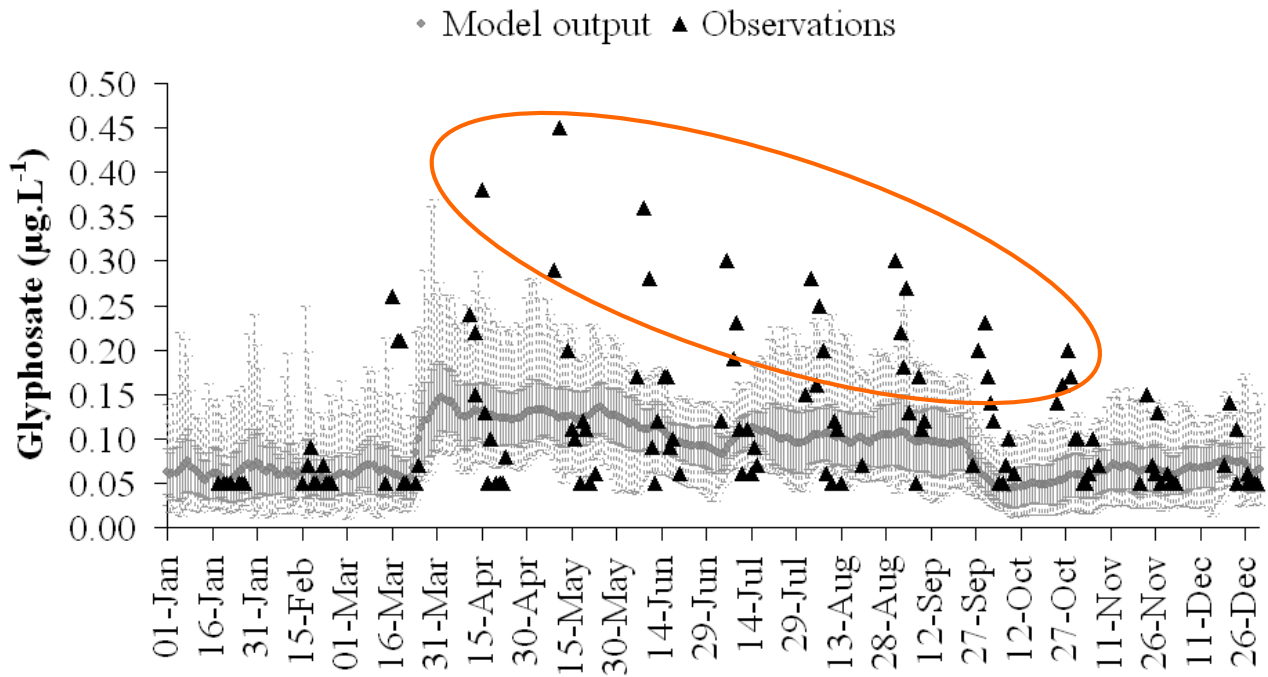
Hydrodynamics

— Model • Measurements



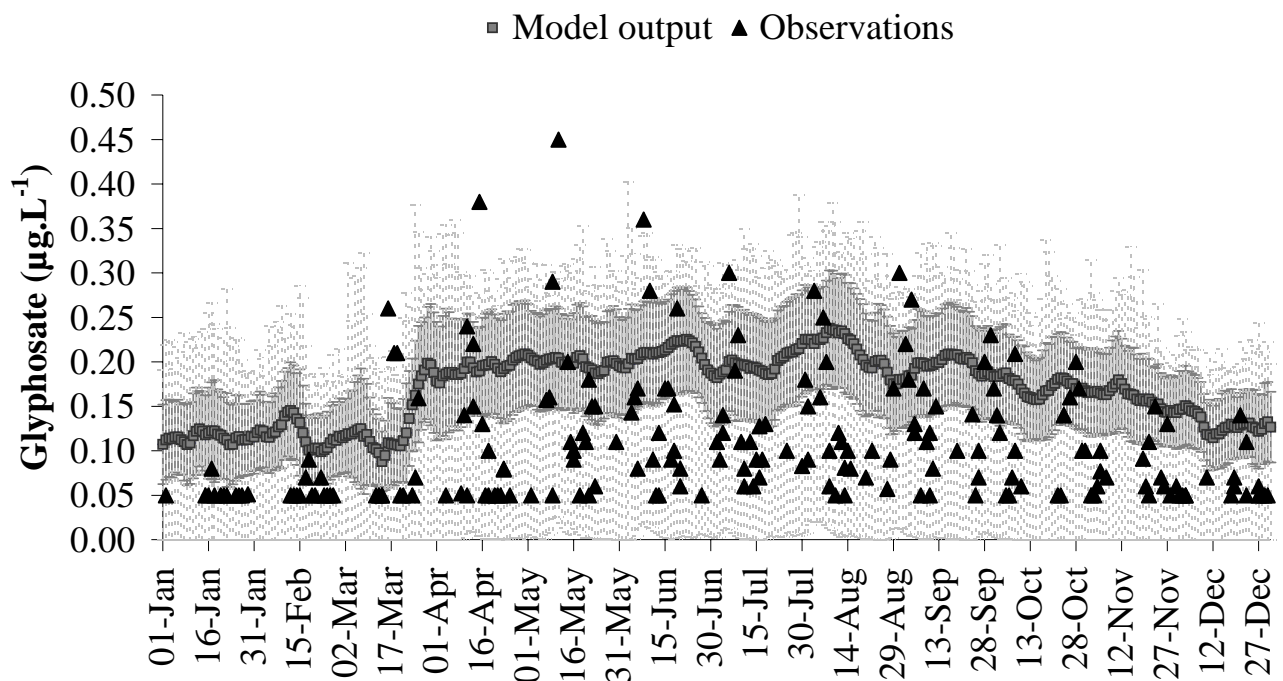
Model output vs. Observations

No input from tributaries ($C_{gly,trib} = 0$)



Model output vs. Observations

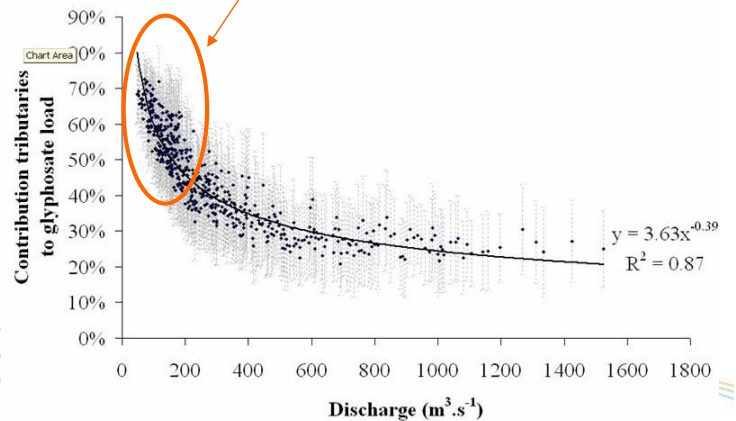
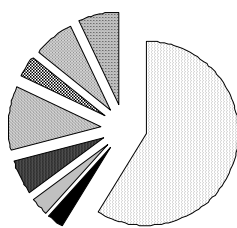
Including input from tributaries (scenarios)



Contribution of tributaries to pesticide load in main river at DWI

- » For the Meuse example: based on the data for 2006-2008, the average contribution of the **7 tributaries** is estimated at **45% ± 17%**
- » **Impact of tributaries** is enhanced during summer when **discharge in the main river** is low
 - » Tributaries account for >50% of the glyphosate load at the DWI when discharge in the river Meuse is below 150 m³.s⁻¹

Glyphosate supply to the river Meuse



Conclusions

- » In order reduce pesticide concentrations in large rivers with drinking water abstraction, **management on basin scale** (WFD) is needed, a.o. because of transboundary fluxes
- » Contribution of subbasins strongly dependent on discharge ratio
 - ➔ Understanding of river **hydrodynamics** is very important
- » Use of river **models** provides **useful** complementary information and insights, especially when monitoring data are scarce
- » The results can be used to found **targeted decision** making on measures and river management
 - » Focus on particular sub basins
 - » Focus on particular users
- » Way ahead ➔ including **land use & land properties** (GIS data) in the modelling approach and analysis



Acknowledgments

- » RIWA Maas glyphosate data
- » Rijkswaterstaat discharge and geometry data