Distinguishing between the effects of fertilizer policy and weather variations on nitrate concentrations and loads to surface water in the Netherlands

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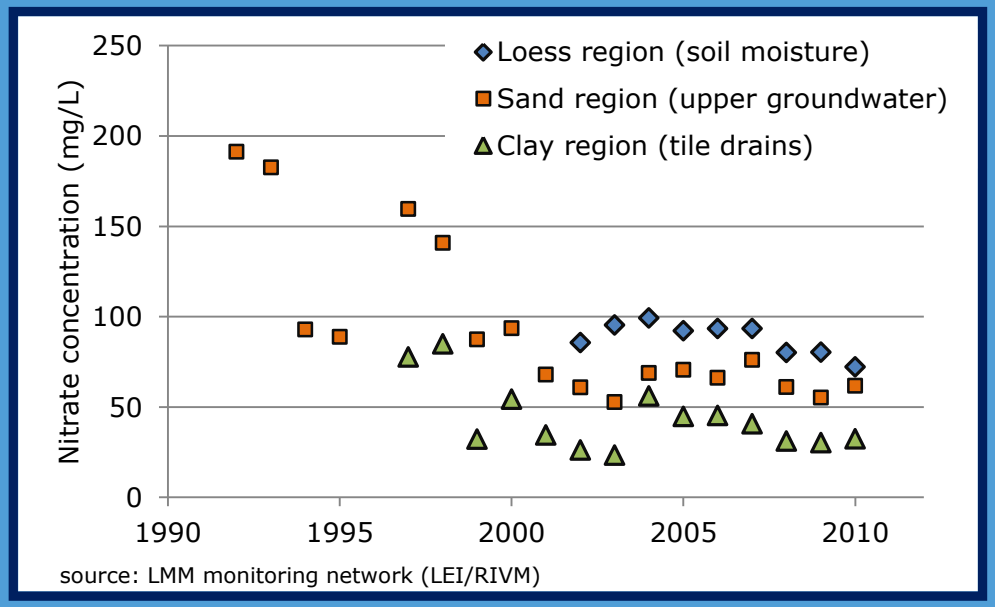
Introduction

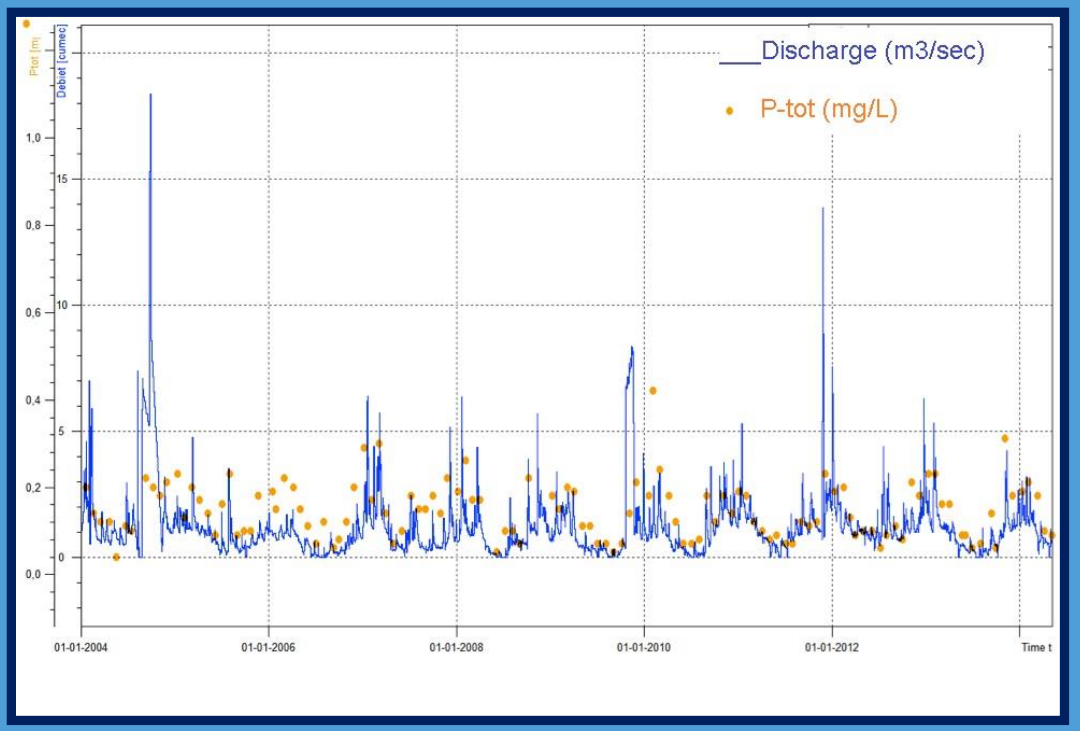
Monitoring data

Questions:

Can we reveal trends?

Can trends be attributed to fertilizer policy?





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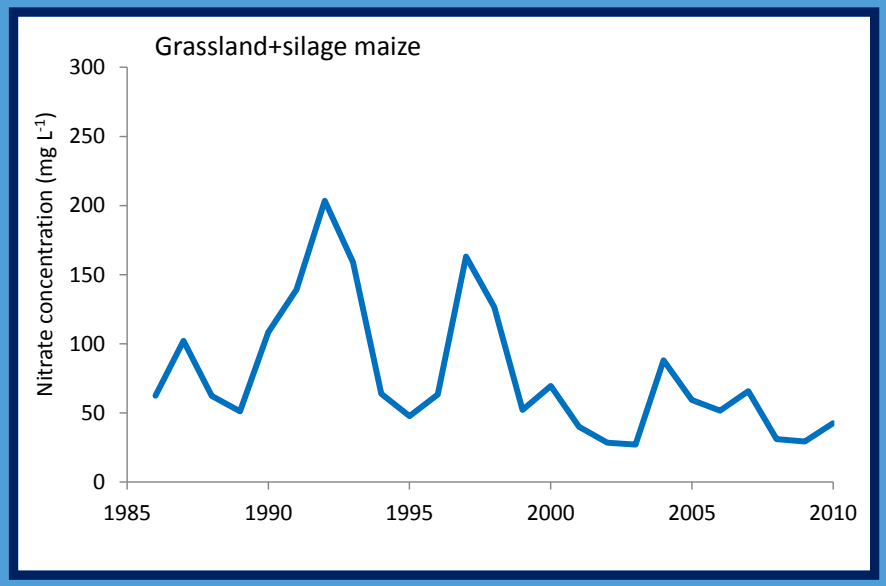
Introduction

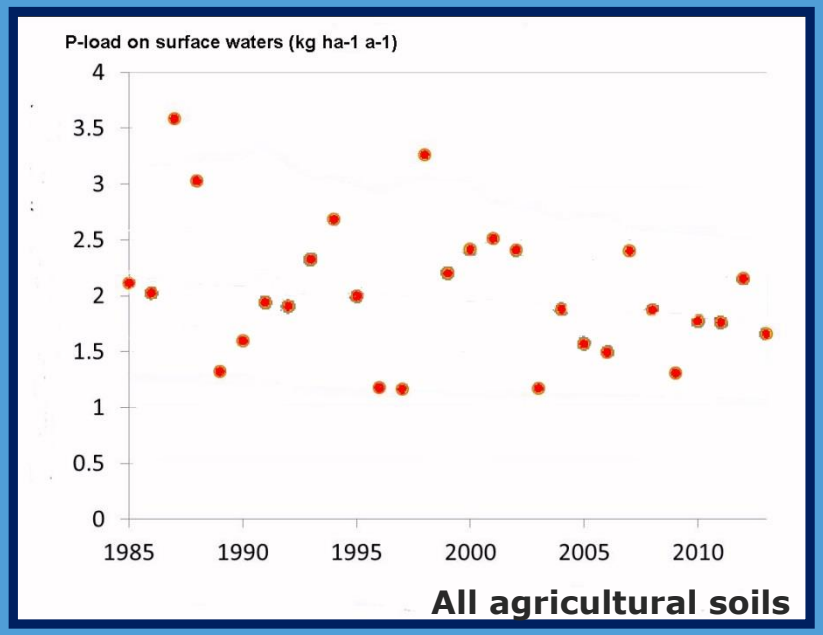
Results of dynamic models

Questions:

Can we reveal trends?

Can trends be attributed to fertilizer policy?





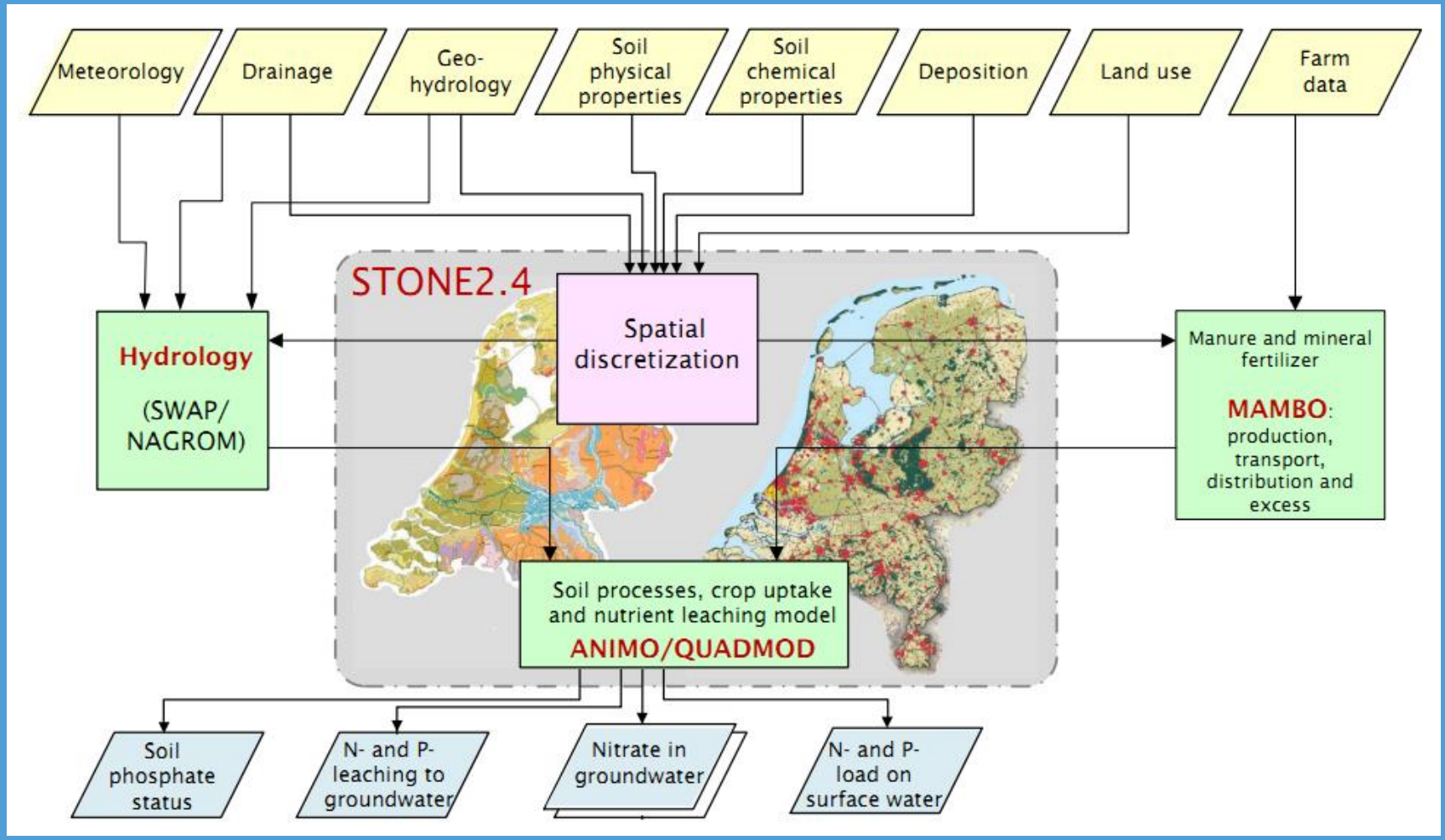
Questions

- Can we distinguish the trends and the weather induced variation in model predictions?
- Can the trend be attributed to the **actual** policy of fertilization restrictions?
- What are the delay times for effects of fertilization restrictions?

Methods

- Modelling of nitrate in groundwater and N- and P-transport to surface waters
- Exclude the effects of weather variation by repeated runs with different sequences of meteorological time series
- Evaluate soil nitrogen balances
- Simulate the age of upper groundwater and discharge water

Nation wide application of a distributed fertilizer / soil / leaching model



Repeated runs, move the years of a 30 year time serie

Fertilization, deposition, crop offtake

	1981	**1982**	**1983**	**.**	**.**	**2008**	**2009**	**2010**

Meteorological series (Precipitation, evapotranspiration, temperature)

1	1981	1982	1983	.	.	2008	2009	2010
2	2010	1981	1982		.	2007	2008	2009
.	.	.	.	.	.	.	.	.
28	1984	1985	1986	.	.	1981	1982	1983
29	1983	1984	1985	.	.	2010	1981	1982
30	1982	1983	1984	.	.	2009	2010	1981

Resulting set of 30 predictions for each year:

	1981	**1982**	**1983**	**.**	**.**	**2008**	**2009**	**2010**

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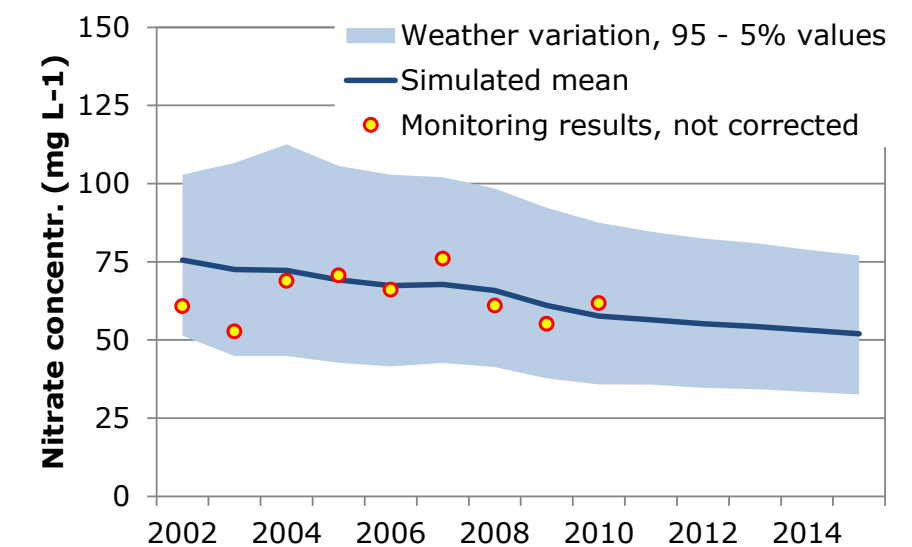
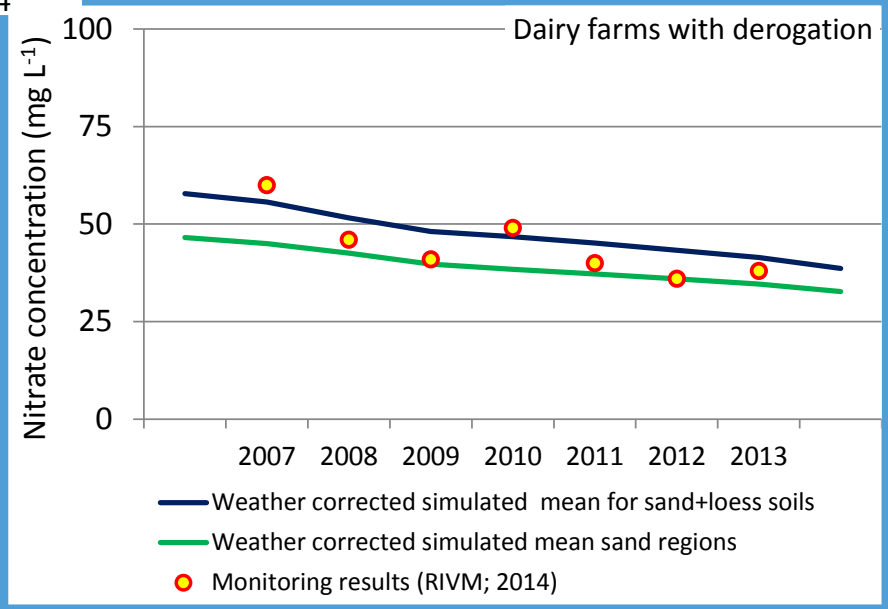
Results





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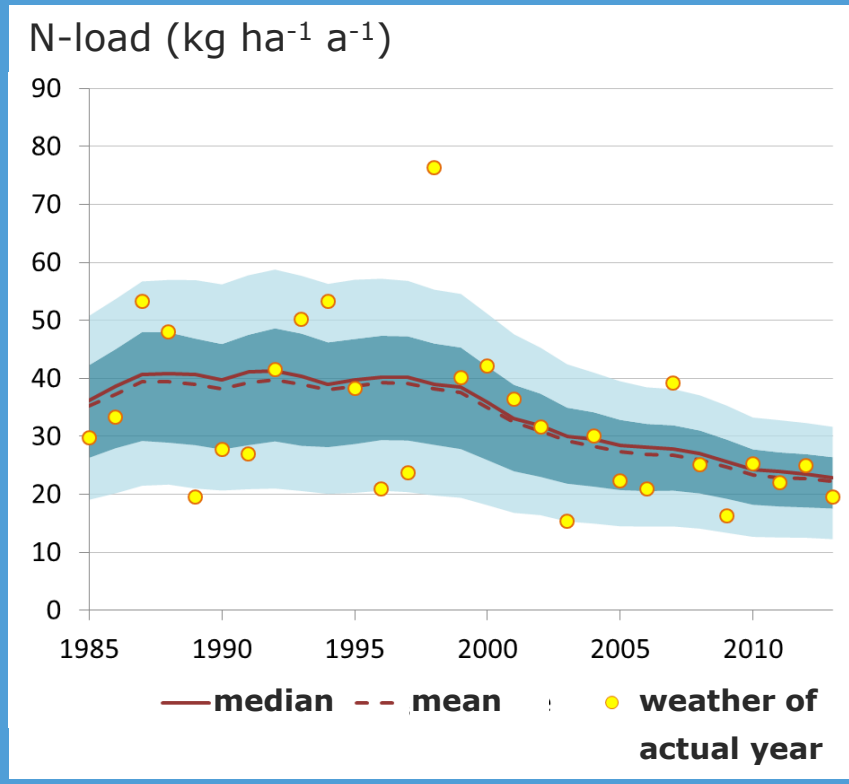
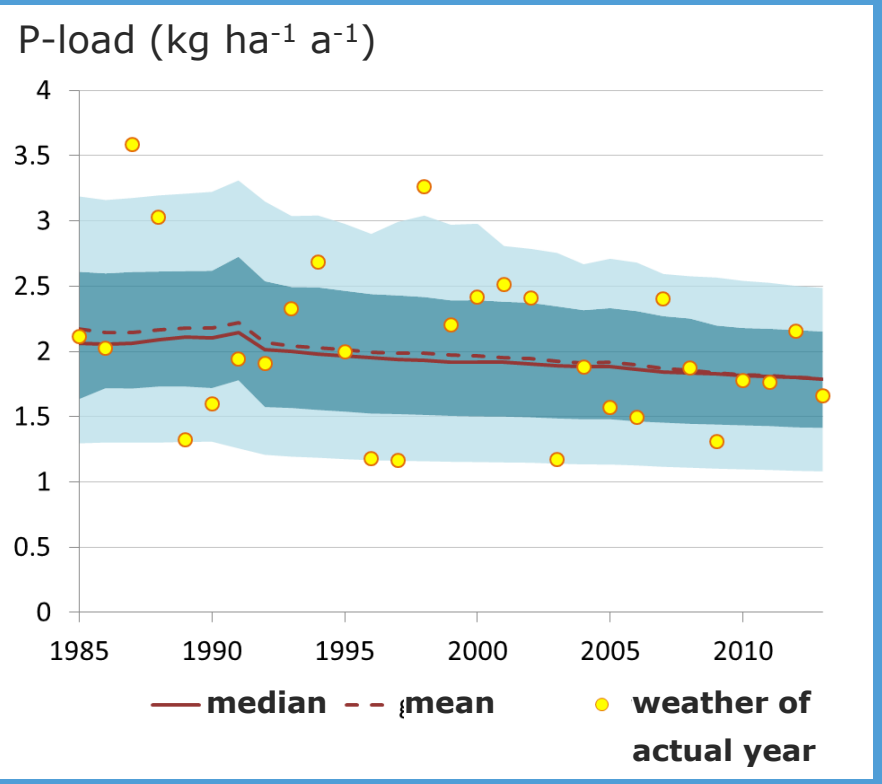
Results: N- and P-load on surface waters





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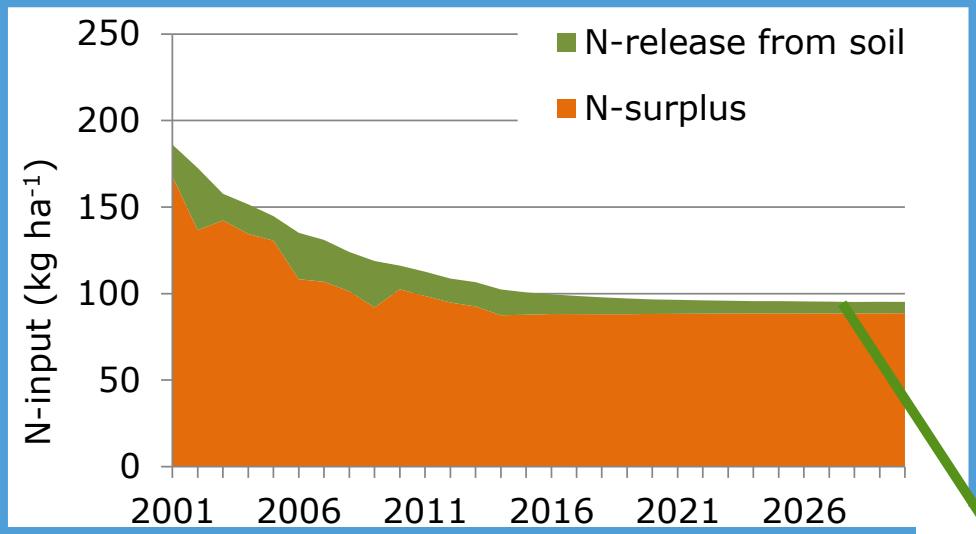
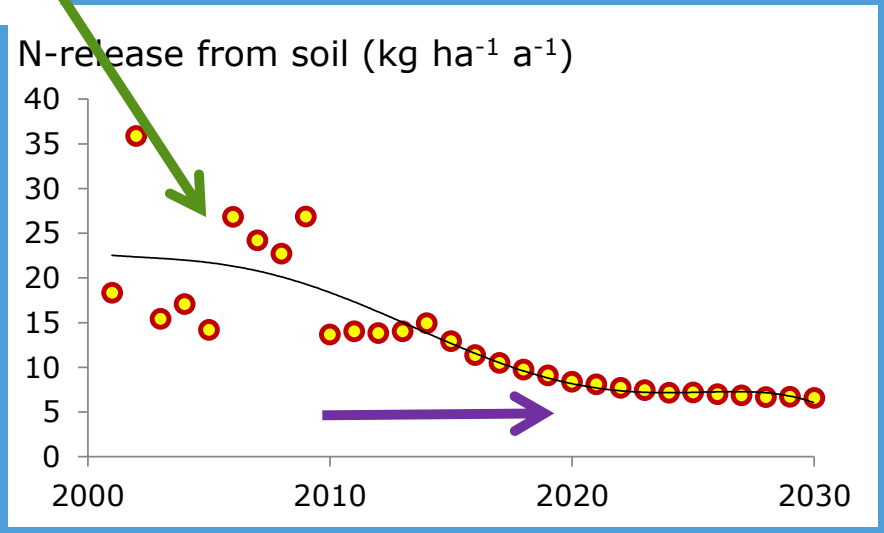
Results





delay time > 10 years

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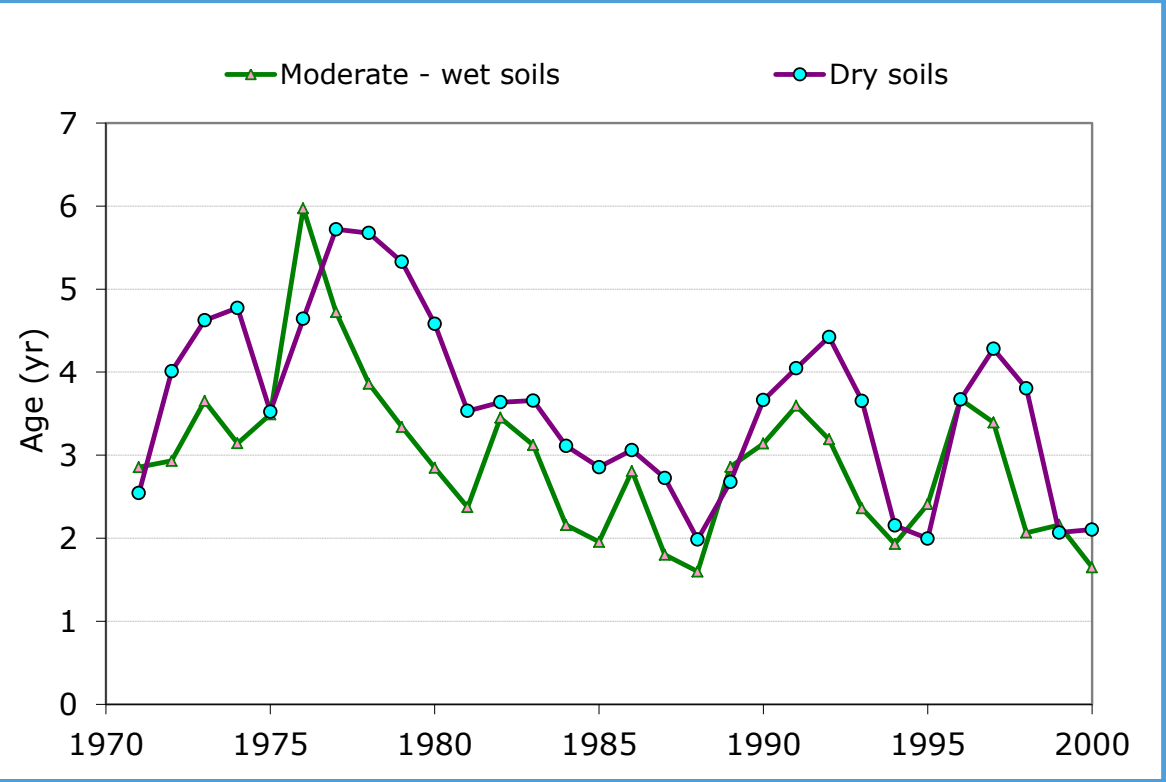
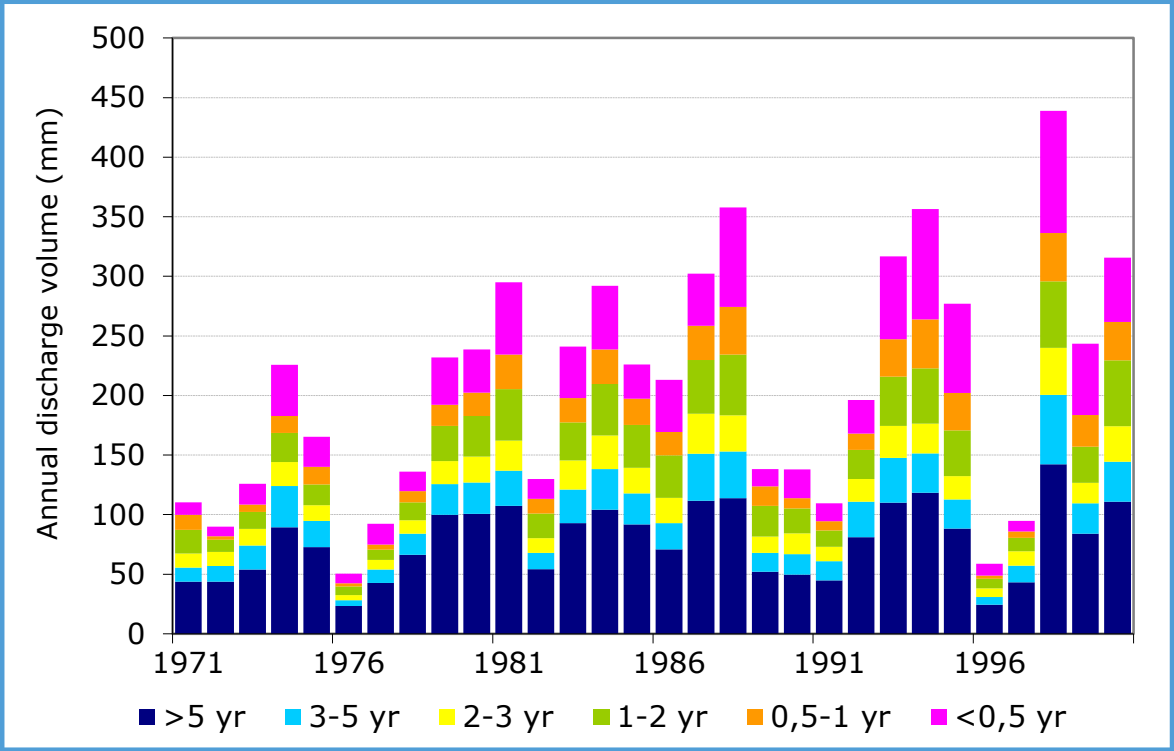
Age of 1m upper groundwater



Average delay time: 2 - 4 years

- Tracer simulation: D_2O; subject to evaporation and plant uptake
- Field averaged, lateral flow to field ditches accounted for

Age distribution of water discharged to surface waters



Average delay time: 2 - 3 years

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Conclusions

Can we distinguish the trends and the weather induced variation in model predictions?

Repeated model runs with moved meteorological inputs provides helpful information on trends, variation and exceedance values

Can the trend be attributed to the **actual** policy of fertilization restrictions?

A particular delay time should be accounted for

What are the delay times for effects of fertilization restrictions?

- *Hydrological response time: 2 – 4 year*
- *Response time of crop – soil system > 10 years, but smaller proportions*