



National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

Denitrification in shallow groundwater at dairy farms in the sand region of the Netherlands

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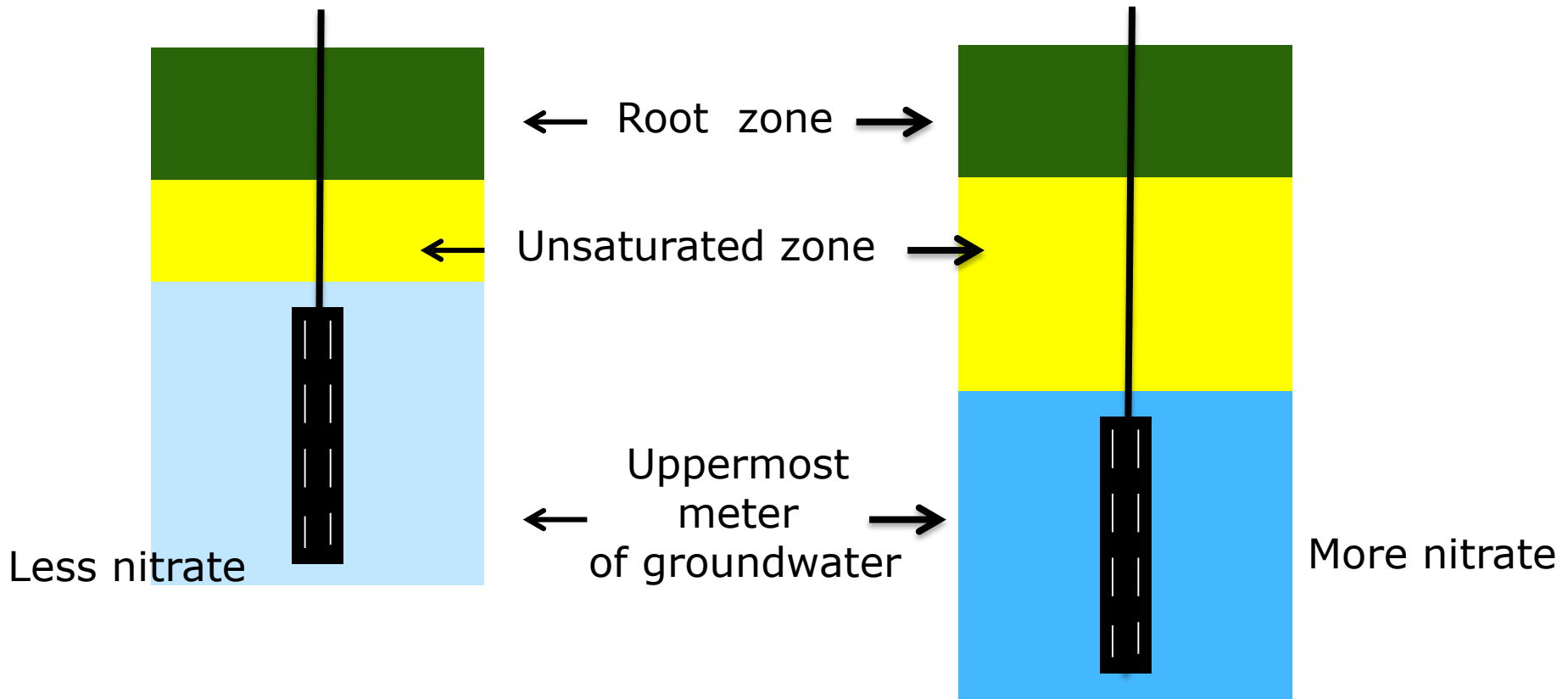


1. Introduction

- About 50% of nitrogen application is used by grassland on sandy soils; 50% of nitrogen surplus or less leaches; This “less” depends on the groundwater table.
- The Netherlands have shallow groundwater tables; mostly < 2m below surface level. The critical nitrogen surplus for exceeding 50 mg/l in the upper groundwater depends on this groundwater table.
- Critical nitrogen surpluses are based presently on an out of date soil map for groundwater tables and on field research results of 1988.
- There is more recent information available to calculate critical nitrogen surpluses.

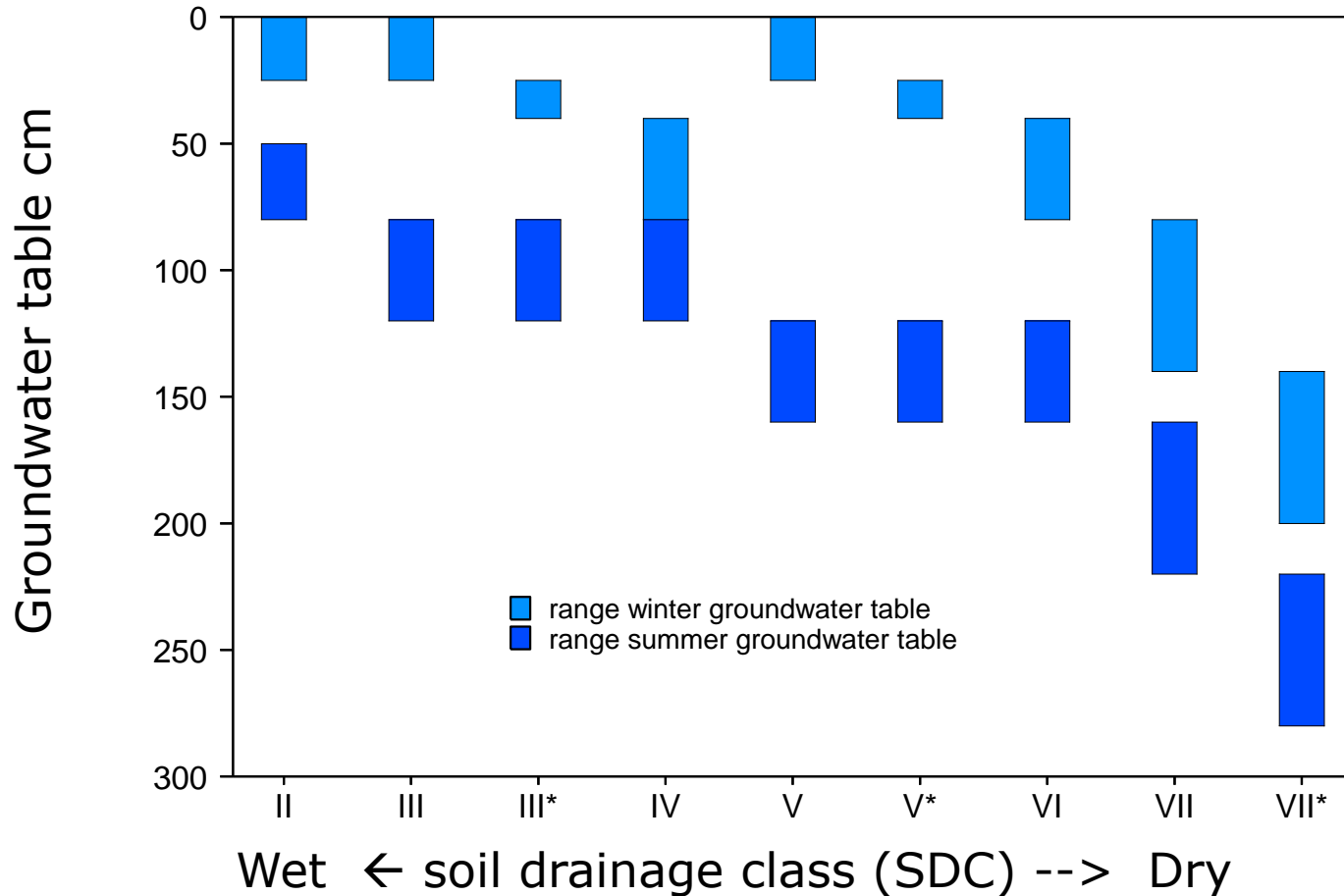


Sampling uppermost meter of groundwater





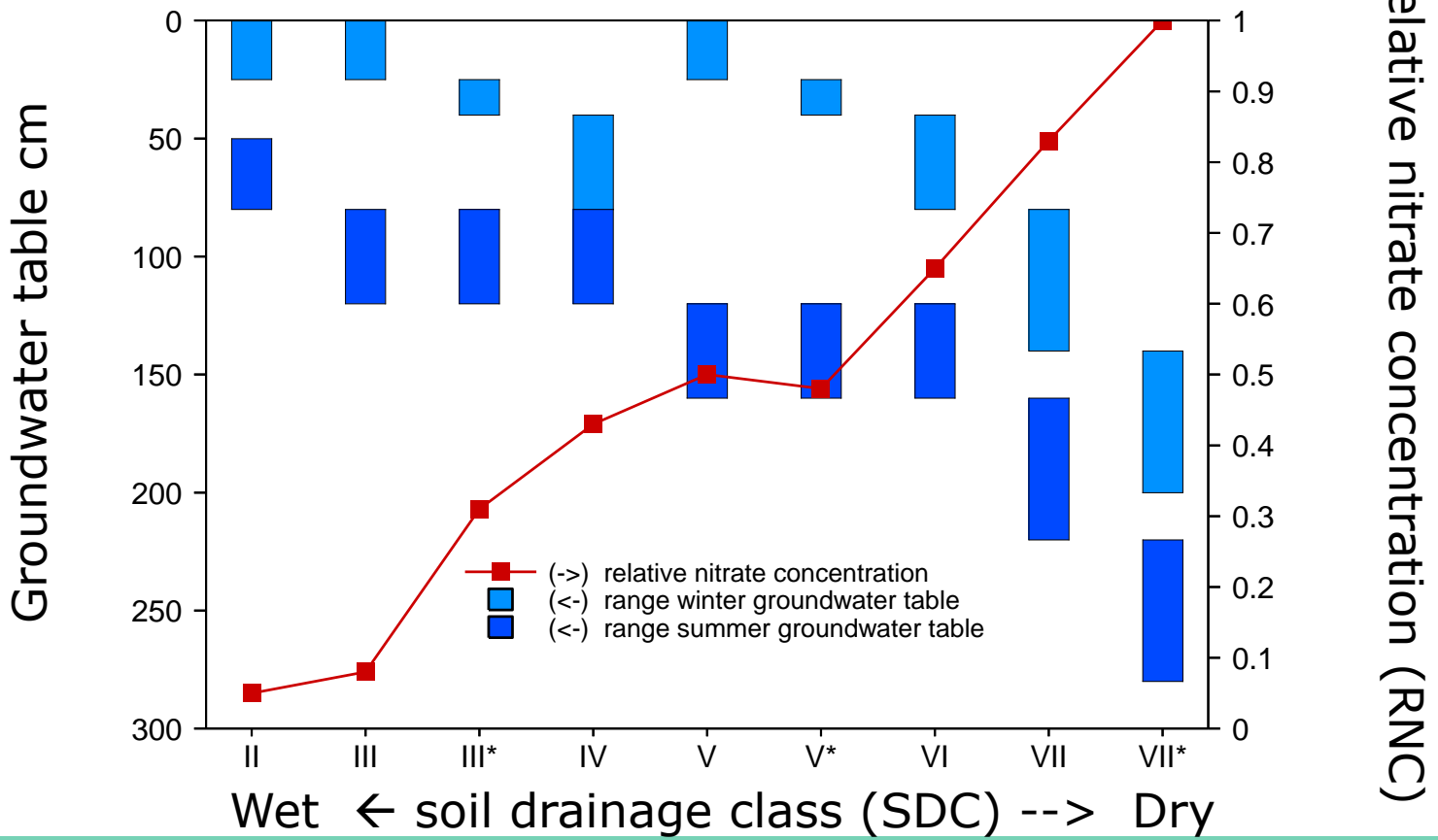
Soil Drainage Class (SDC)





Relative Nitrate Concentration (RNC) and SDC

$$RNC[SDC_i] = NO_3[SDC_i] / NO_3[SDC_{VII^*}]$$





2. Research goal

We want to show that:

RNCs of 1988 cannot be applied with soil map SDCs because present groundwater tables are lower than indicated by the soil map SDCs

Stated otherwise:

Nitrate concentrations calculated with soil map SDCs and 1988 RNCs will be lower than in reality.



3. Available new data and modelling

Data

334 dairy farms which were sampled
1913 times totally, during 1992-2014

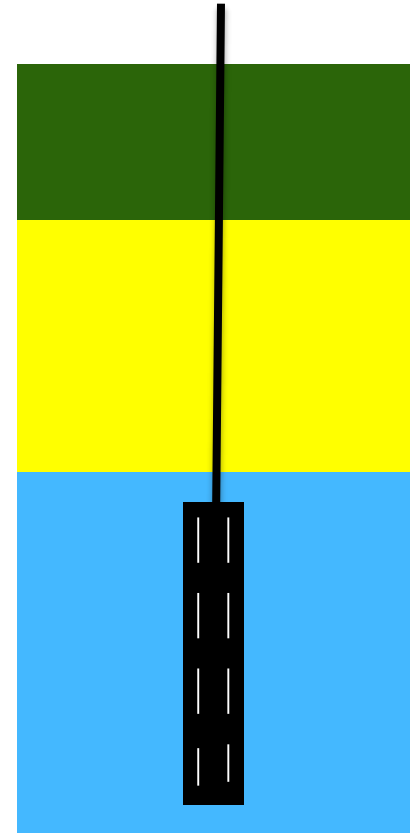
Modelling (statistical approach)

Dependant variable :

Nitrate (measured)* groundwater recharge (calculated)

Independent variables:

Sampling year, sampling month, SDC



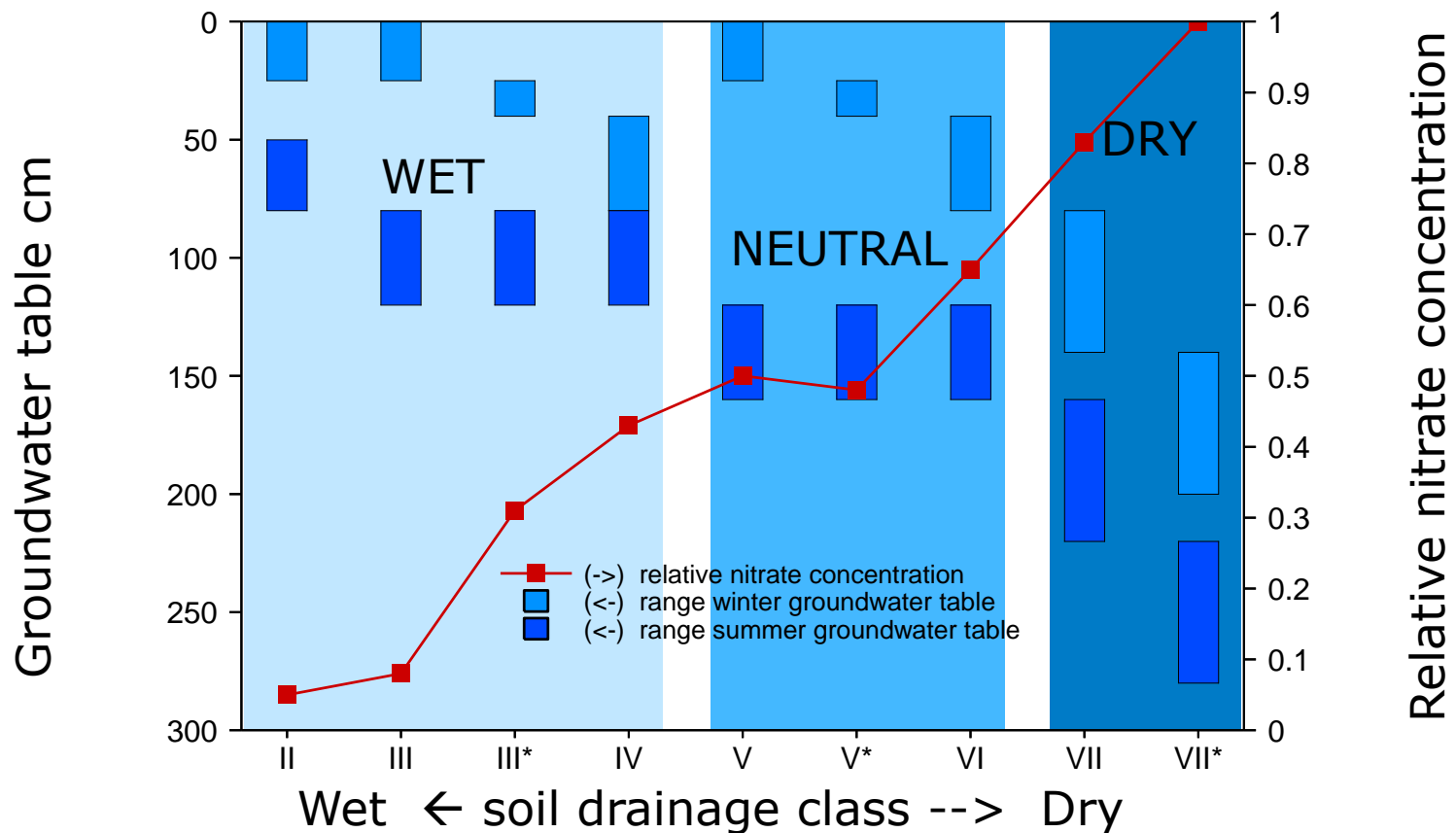


4. Limitations for comparison

1. 1988: only grassland was sampled on dairy farms
Now: both grassland and silage maize ($\approx 20\%$) are sampled
2. 1988: grazing N and N application was known per SDC
Now: we must assume that there is no relation between SDC, grazing and N-application
3. 1988: each groundwater sample could be related to field SDC
Now: groundwater samples are farm mean samples, which can only be related to a distribution of map SDCs and not to an individual field SDC.
Because of map-errors effects of SDC on nitrate is less.

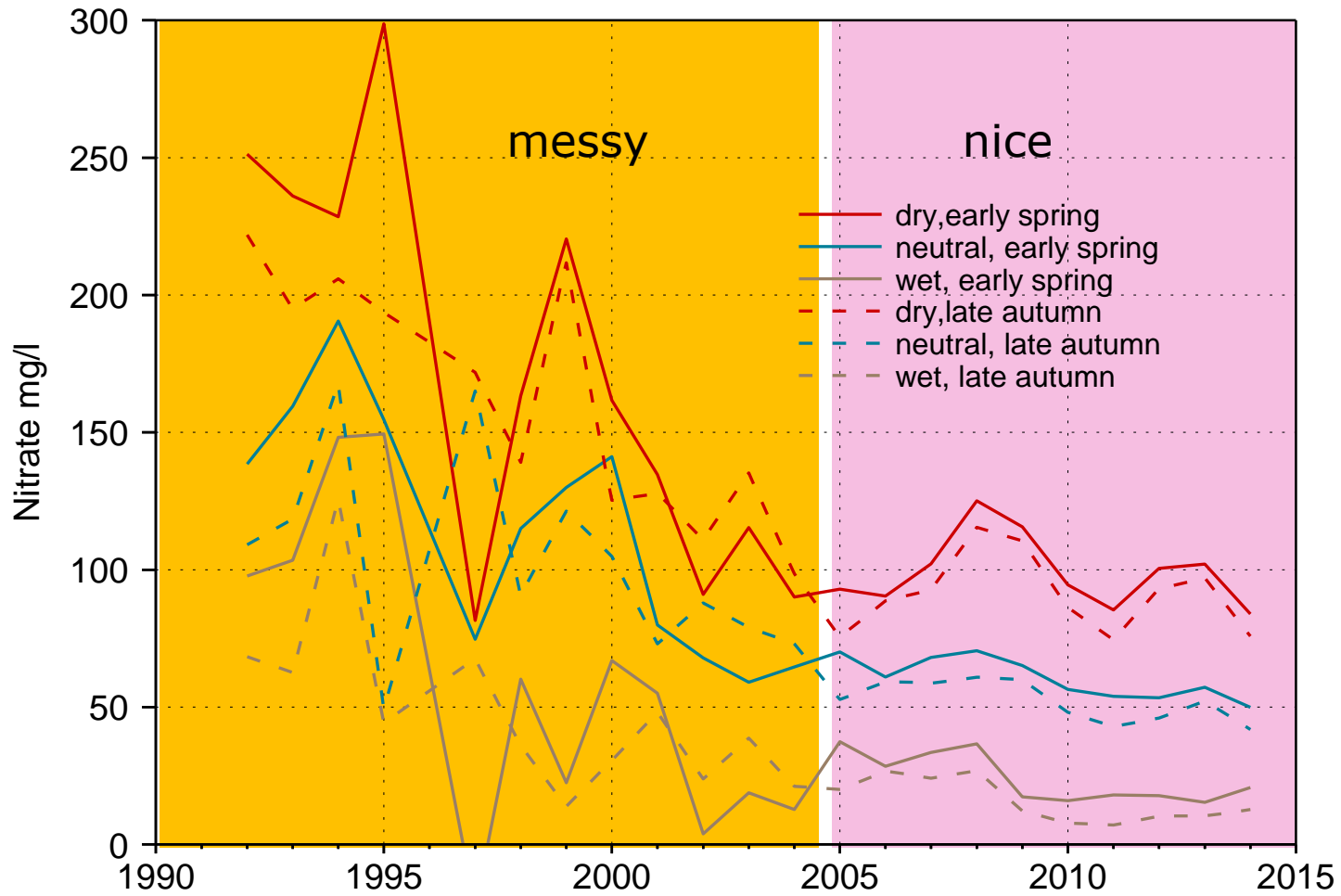


Clustering soil drainage classes (SDCc)





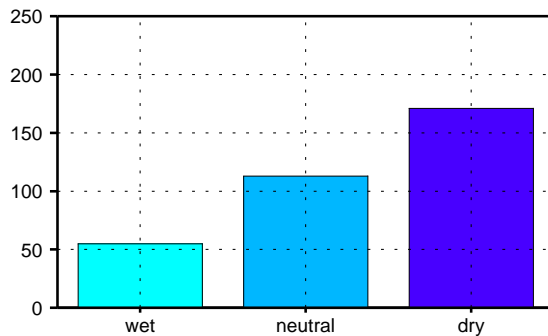
5. Results: Annual Nitrate concentrations per clustered SDC



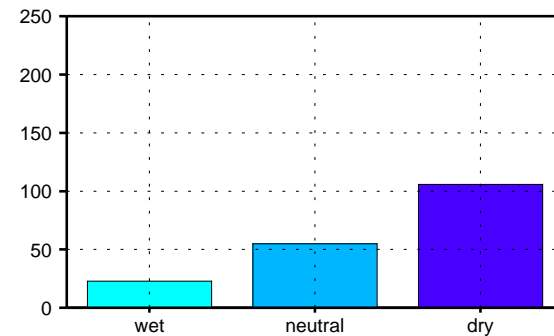


Nitrate concentration per SDCc and period

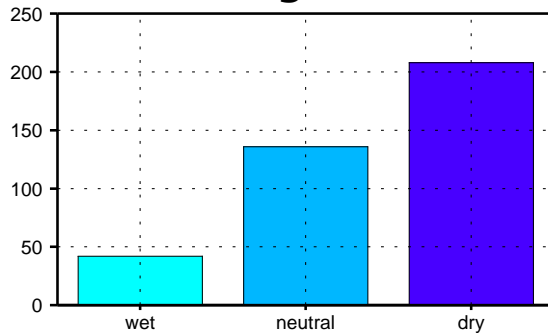
1992-2004



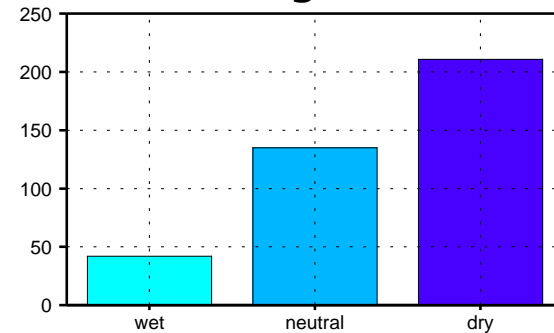
2005-2014



According 1988

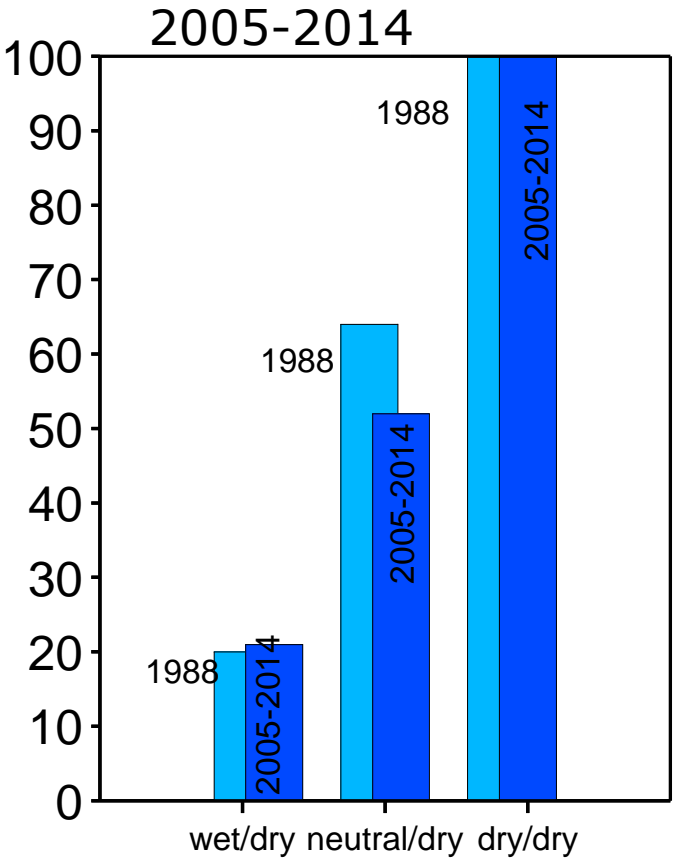
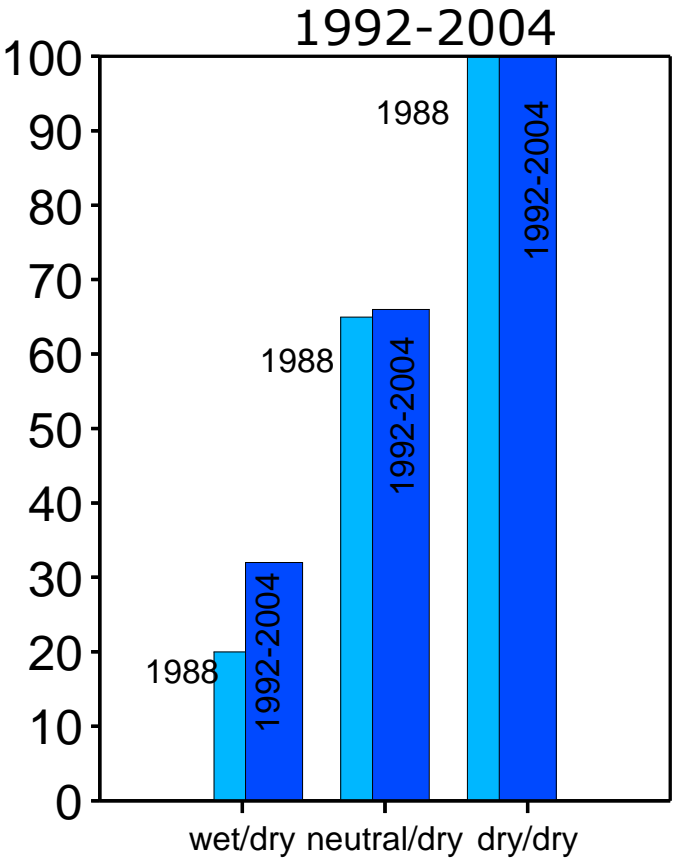


According to 1988





Relative nitrate concentrations (RNCs) for SDCc





6. Conclusions

Nitrate leaching can safely be calculated with soil map SDCs and 1988 RNCs

There are no reasons found to criticise the application of the 1988 RNCs with out of date soil map SDCs

Nitrate concentrations calculated with soil map SDCs and 1988 RNCs will not be lower than in reality



Alternative hypothesis:

Concept of relative differences in nitrate leaching between soil-drainage classes is not valid.

Denitrification per soil drainage class decreases less than nitrate leaching



Nitrate concentration per SDC per period

Period	SDC	Wet	Neutral	Dry
1992-2004		55	113	171
<i>According to 1988*</i>		42	136	208
2004-2015		23	55	106
<i>According to 1988*</i>		42	135	211

* Calculated with 1988 mean nitrate concentrations per SDC



Nitrate Leaching Ratios per SDCc and per period

Nitrate Leaching Ratios

Period	Wet/Dry	1988	Neutral/Dry	1988
	Now		Now	
1992-2004	32% (5)	20%	66% (6)	65%
2005-2014	21% (4)	20%	52% (5)	64%



Limitation 5: nitrate leaching \neq nitrate concentration

