



National Institute for Public Health  
and the Environment (RIVM)  
*Ministry of Health, Welfare and Sport*  
The Netherlands

# Effectiveness of two decades of policy measures to reduce ammonia emissions in the Netherlands

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Roy Wichink Kruit, INI2016, Melbourne, Australia, Dec 7, 2016



## Why?

Acidification (together with SO<sub>2</sub>)



Eutrophication





## Why?

Loss of biodiversity – rare species extinct





# Why?

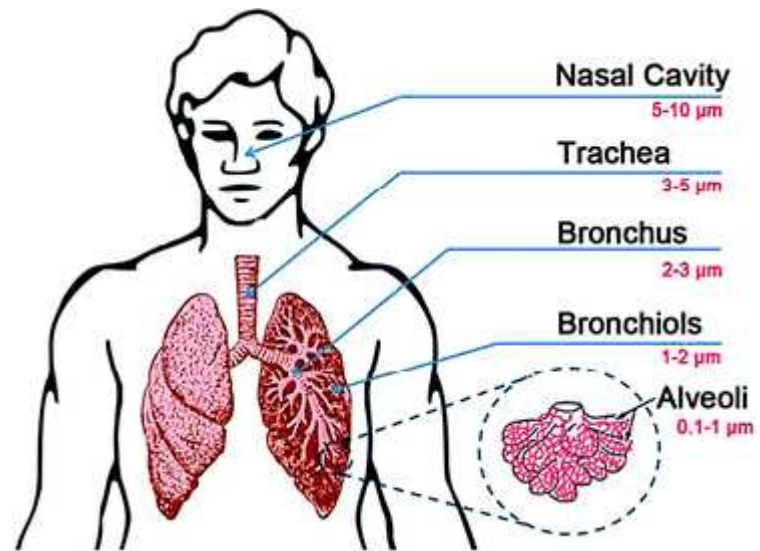
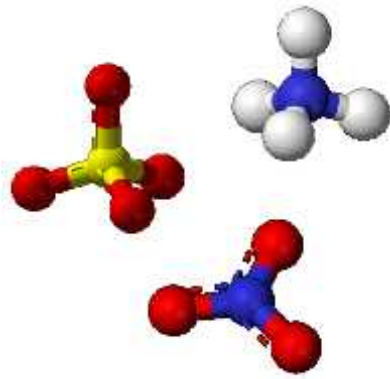
## Nitrogen Use Efficiency





# Why?

Health impact





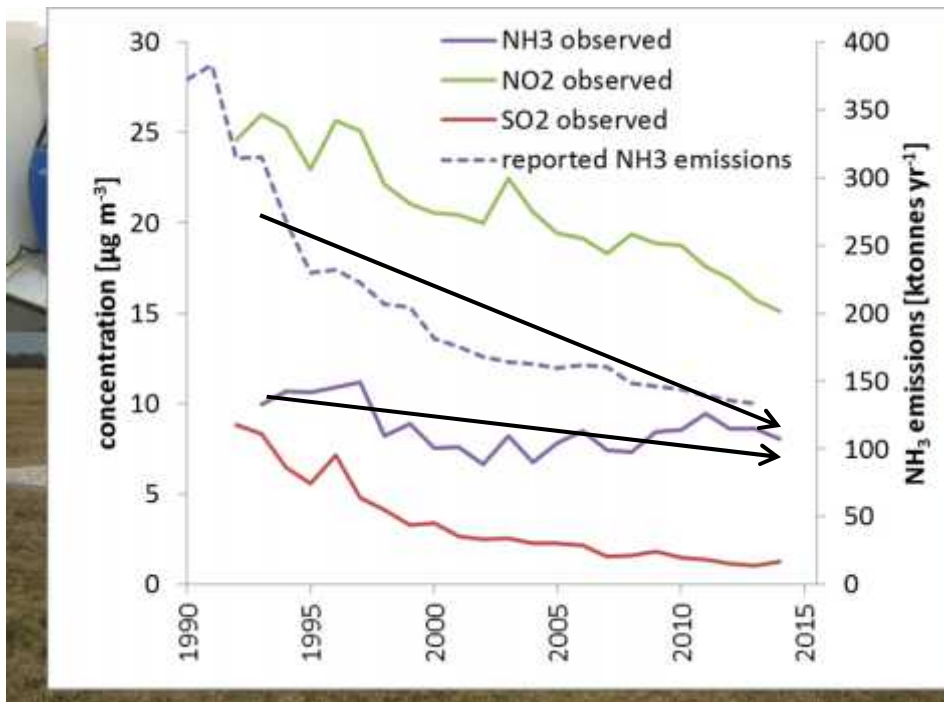
## Emission reduction measures

- Coverage of animal manure storage basins
- Prohibition of application of manure in winter
- Obligatory incorporation of manure in the soil after application
- Low emission manure application techniques
- Changes in animal diet (reduce TAN content of manure)
- Air scrubbers for chicken and pig farms





## Reported emissions and observed concentrations



58% emission reduction since 1993  
Observations at 8 monitoring stations

'only' 22% reduction in observed concentrations

Observed concentrations are affected by emissions, but also:

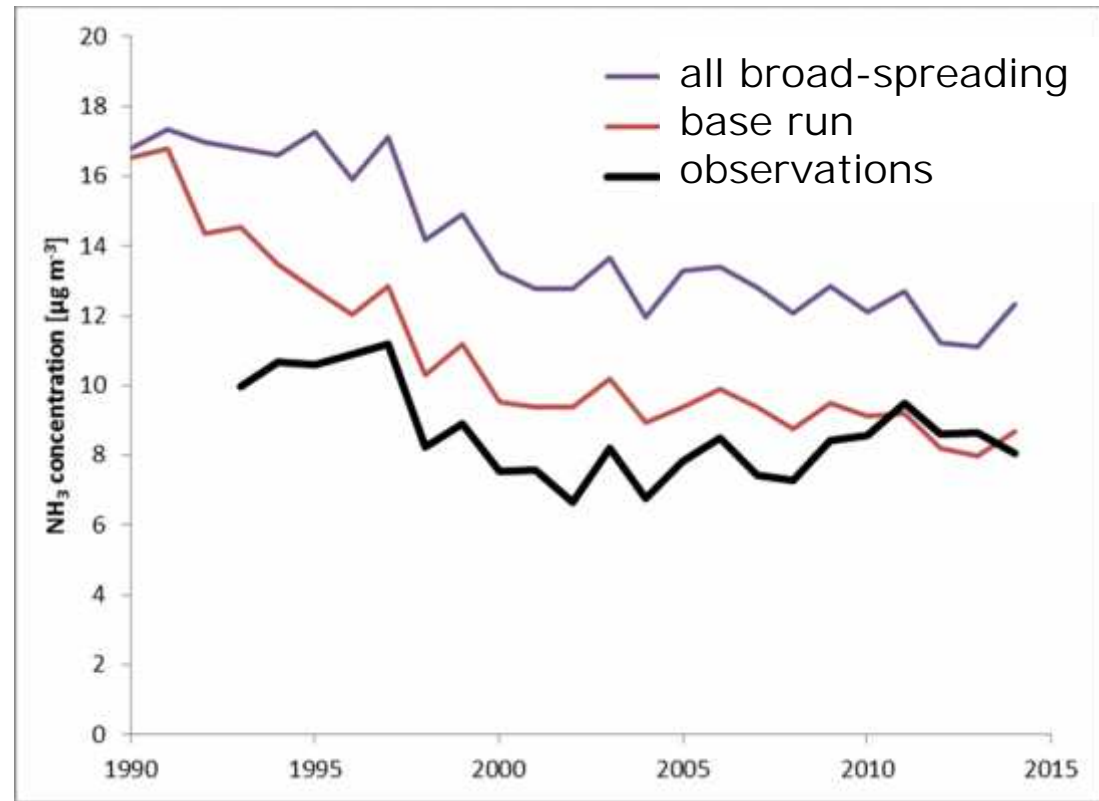
- chemistry
- deposition
- meteorology



## Model runs

Base run (OPS model)

Effect of all manure application assumed to be above-ground broad-spreading







## Sensitivity runs

(process included – process constant or excluded)

Chemistry

(chemical conditions of 2012)

Codeposition of  $\text{NH}_3$  and  $\text{SO}_2$

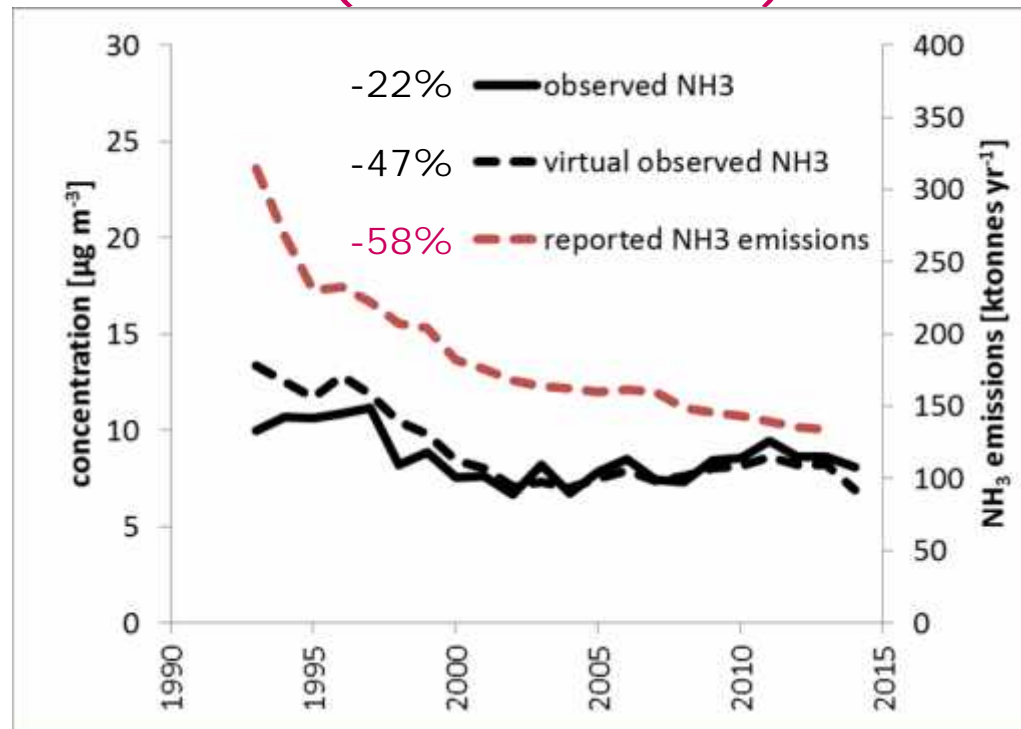
(codeposition excluded)

Meteorology

(average meteo 1995-2004)



## Virtual observed ('unaffected') concentration





## Conclusions

Mitigation measures (successfully) reduced ammonia concentrations in the Netherlands

The Dutch trend in ammonia concentrations is dominated by changes in emissions

Changes in the chemical climate only partly affect the Dutch trend in ammonia

Meteorology did not significantly affect the trend in ammonia between 1993 and 2014

There is still an unexplained difference in trends in recent years!



## Questions?

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Or see you around at INI2016!



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