Integrated analysis of the effects of agricultural management on environmental quality at landscape scale

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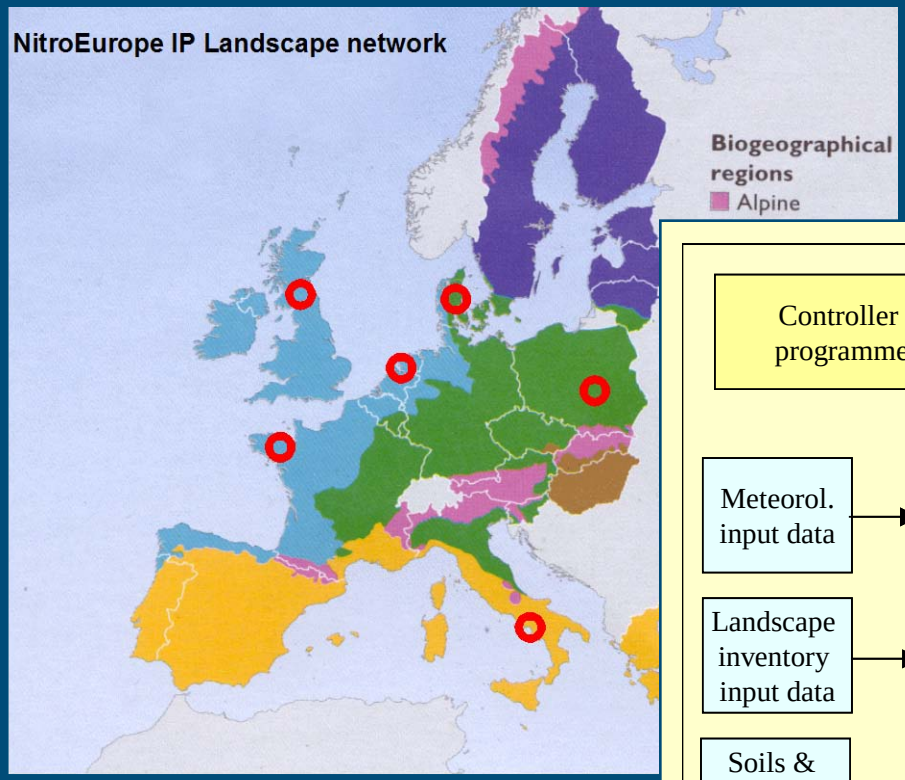
Outline

- Introduction
- Current emission and deposition status
- Validation of ammonia deposition calculations
- Quantification of the effect of measures
- Conclusions

One of the six NEU Landscapes



Controller programme

Local and regional atmospheric dispersion

Nested atmospheric model

Meteorol. input data

Landscape inventory input data

Soils & hydrology input data

Output maps datasets & scenarios

Landscape database & GIS

Emission / deposition

Farm management model

Non-agric sources

Forest & shrubland

Grass fields

Arable fields

Farm buildings & manure stores

Multi-ecosystem model

Leaching / uptake

Distributed hydrological model

Lateral transfer in catchments

Model data exchange

N & C flux

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Environmental ambitions Noordelijke Friese Wouden

Aim study

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Noordelijke Friese Wouden (NFW)

- Farmers joined in an environmental cooperative
- Agreement with government to achieve environmental targets at landscape level
- Targets to be reached in 5 -10 years
- Freedom regarding measures as long as the environmental targets are attained

Environmental ambitions NFW related to N

Ground- and surface water

- NO_3 ground water < 50 mg l^{-1}
- N in surface water < 2.2 mg l^{-1}

- Nature
  - Emission ceiling of 2 kton NH_3-N derived from the NEC of NH_3 and the present ratio of NFW versus national emissions (2010)
  - Only 10% exceedance of critical N loads per nature target type; 90% protection of nature (2030)

Aim study

- A model (INITIATOR2) based integrated assessment of the
  - Environmental status of the NFW area for the year 2004/7
  - Impacts of alternative management measures on the environmental status

- NitroEurope-IP task
  - Deliver detailed agricultural input data for NITROSCAPE
  - Model comparison (INITIATOR2–INTEGRATOR–NITROSCAPE)

Current (year 2004/2007) emission and deposition status

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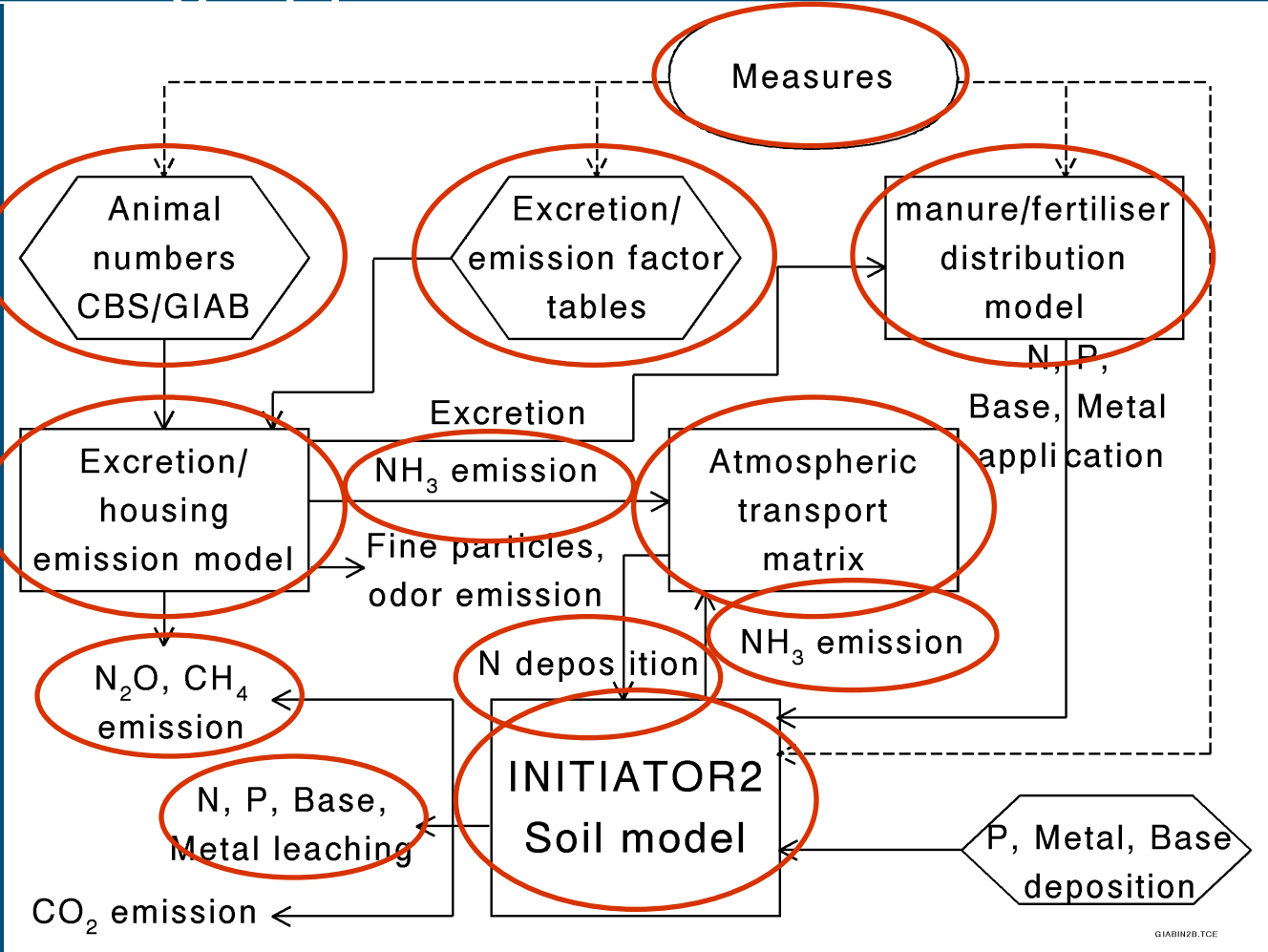
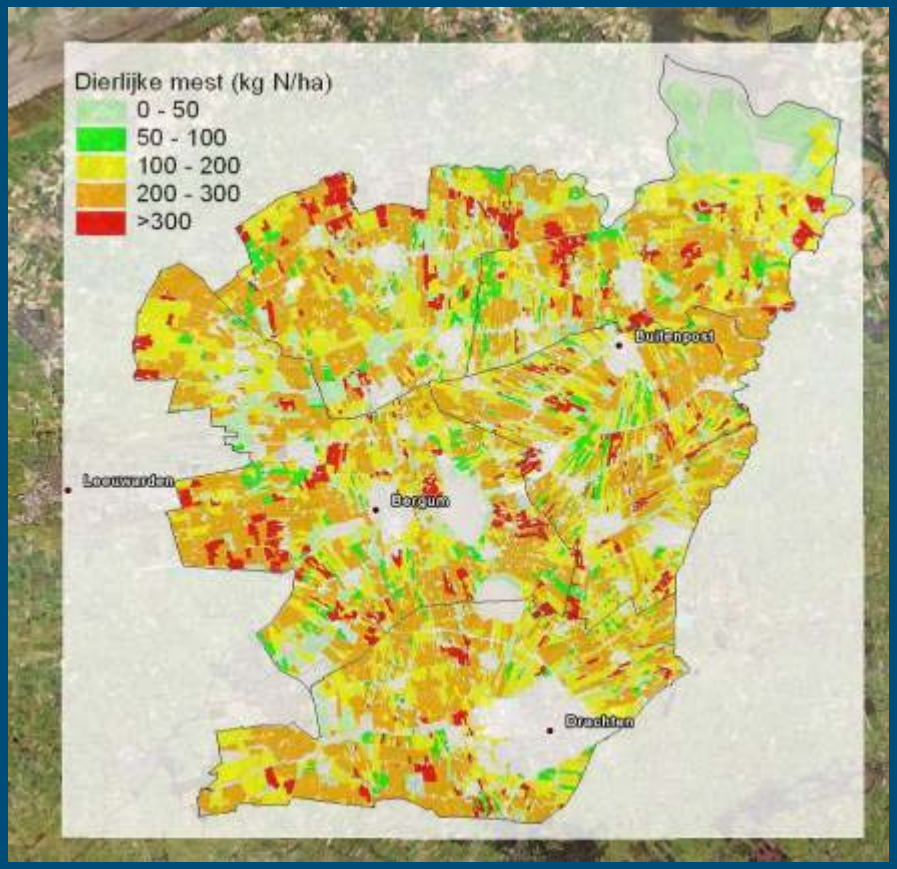
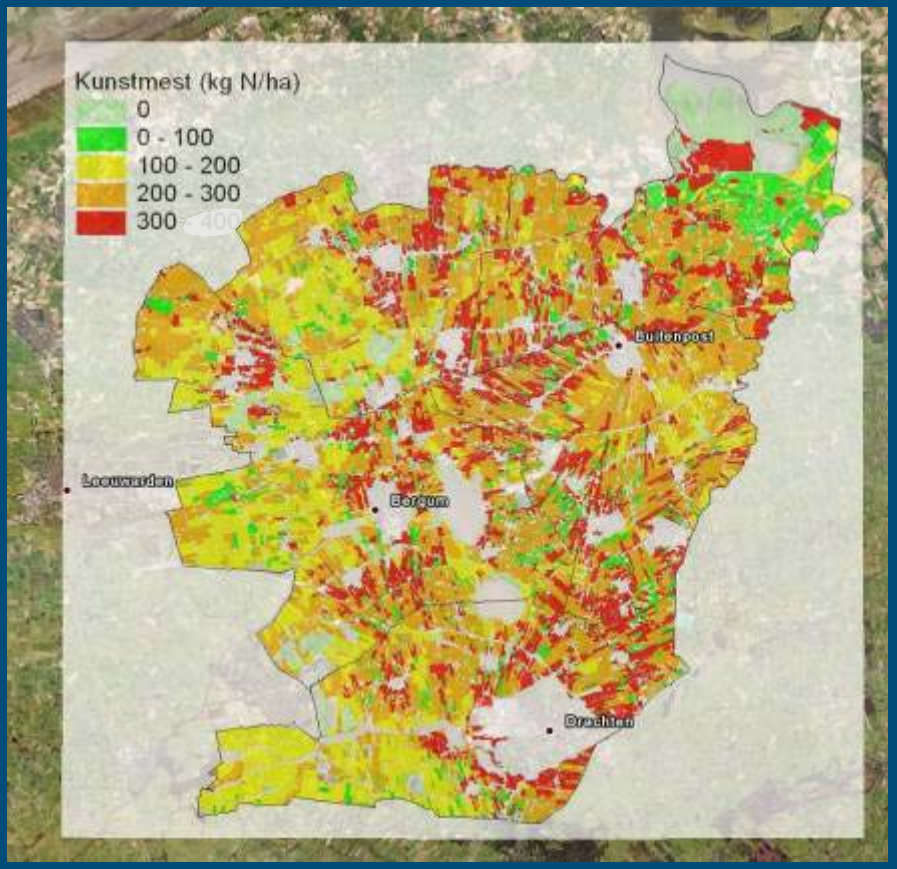
Modelling approach: flowchart of INITIATOR2



N application by manure and fertilizer 2004



N in Animal manure



N in Fertilizer

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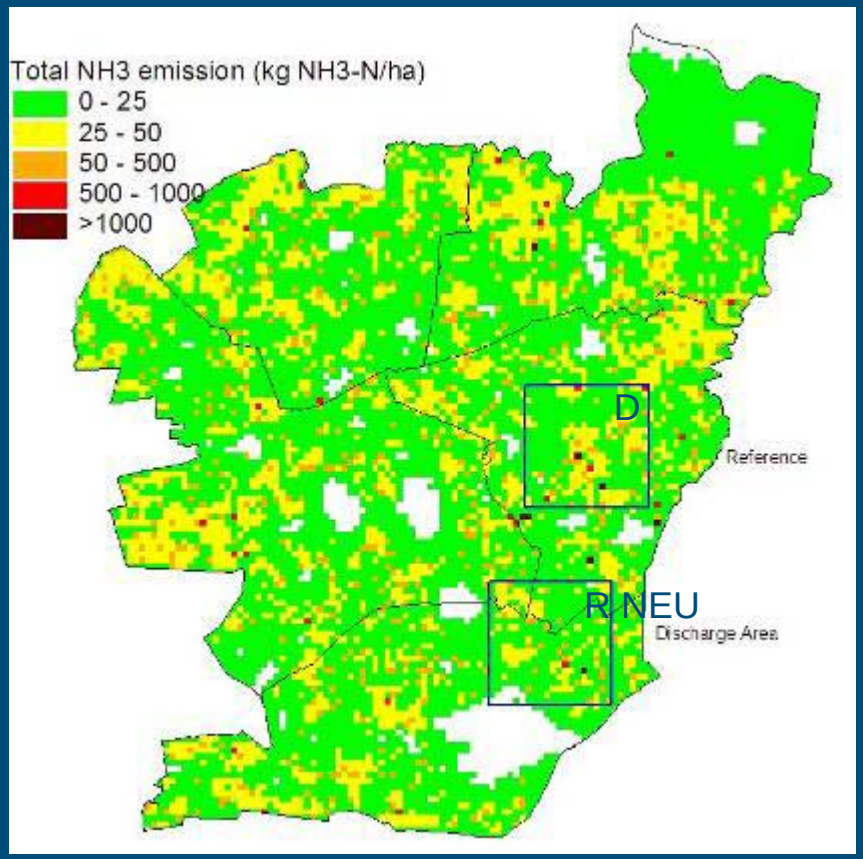
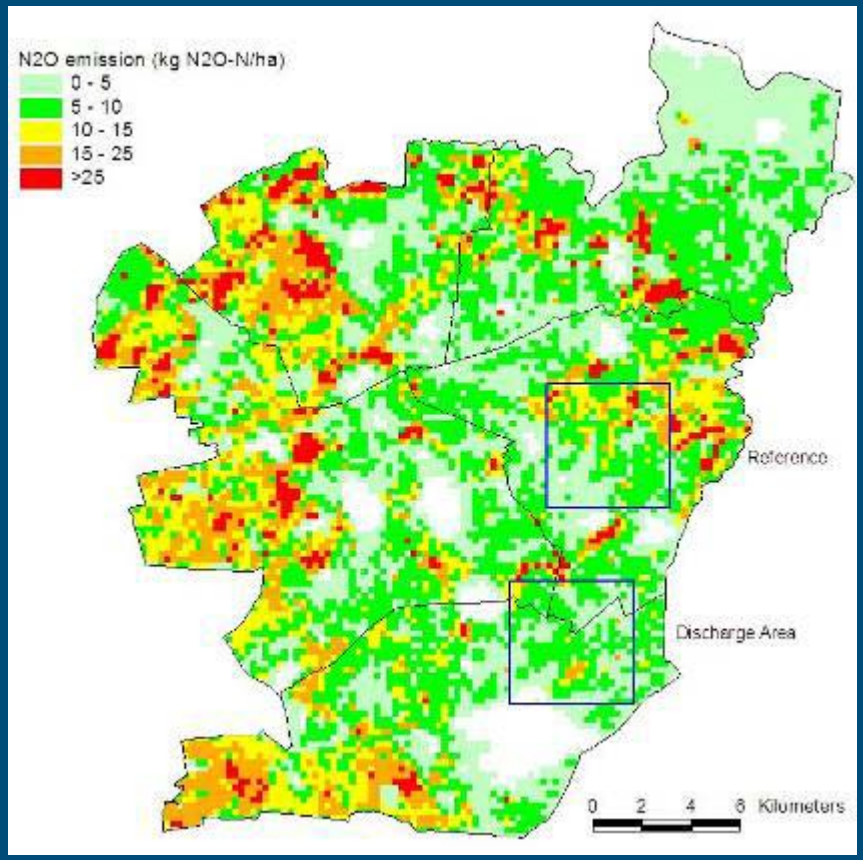
Emission of ammonia and nitrous oxide 2004



NH_3 emission (kg NH_3-N ha^{-1})



N_2O emission (kg N_2O-N ha^{-1})

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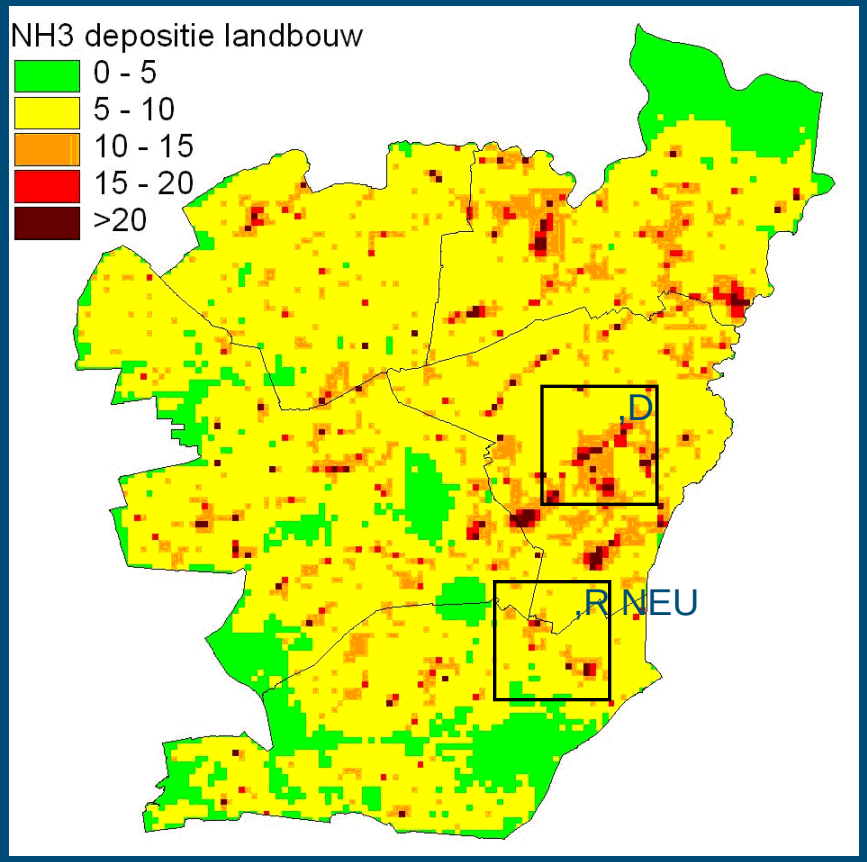
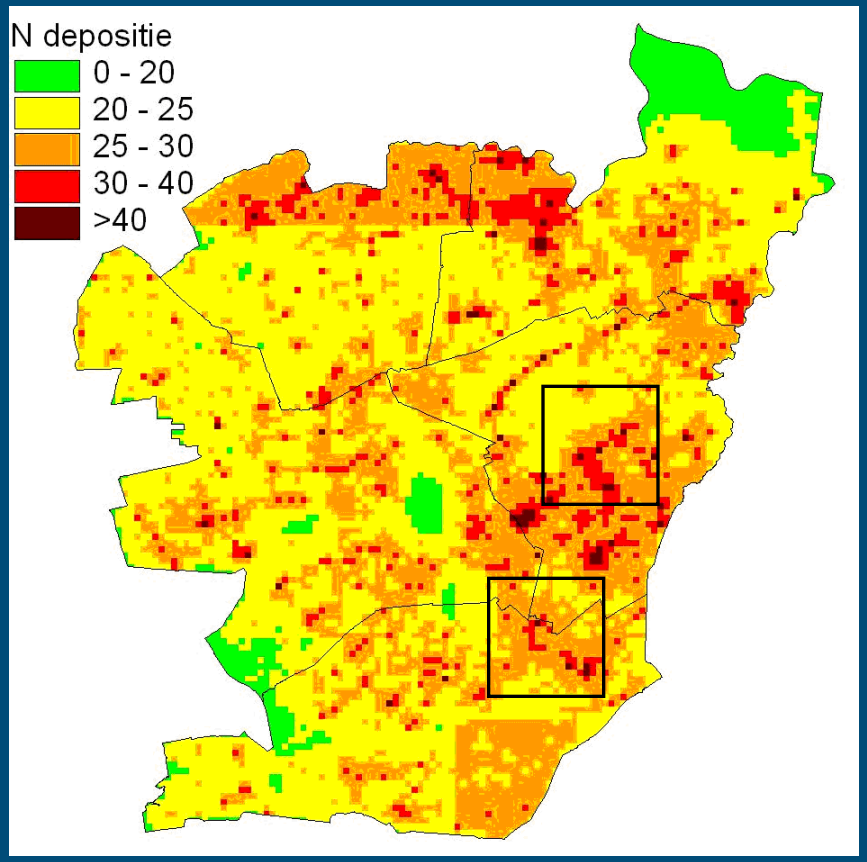
Deposition of ammonia and total N 2004



NH_3 deposition (kg NH_3-N ha^{-1})



Total N deposition (kg N ha^{-1})

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Origin of N deposition in the NFW in 2004

Sources	N deposition	
	(kg N ha^{-1} jr^{-1})	(%)
NO_x + NH_3 import (background)	17.5	69
NH_3 Housing NFW	2,7	11
NH_3 Application NFW	4,2	20
NH_3 Total NFW	7,9	31
Total	24.4	100

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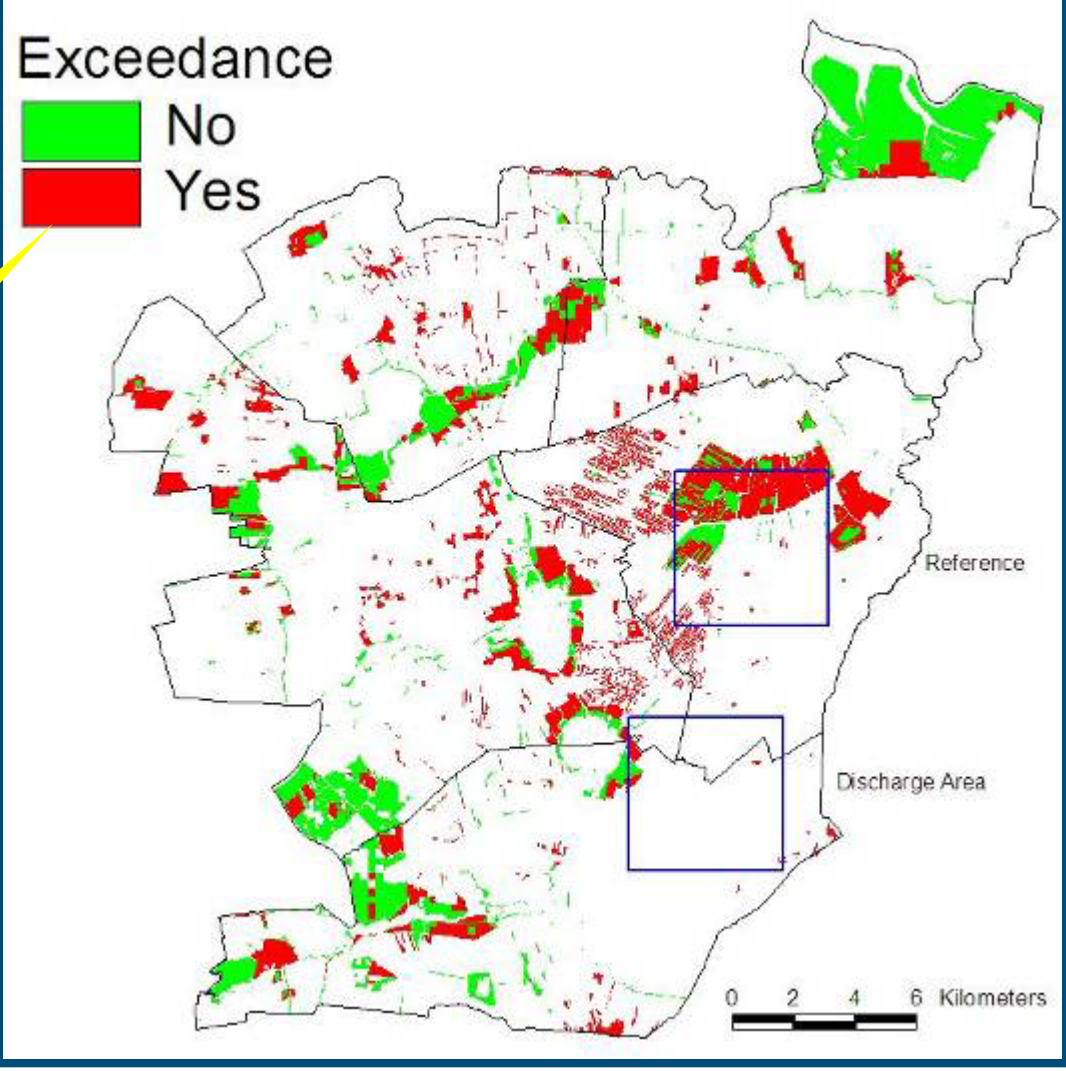
Exceedance critical N loads

39%



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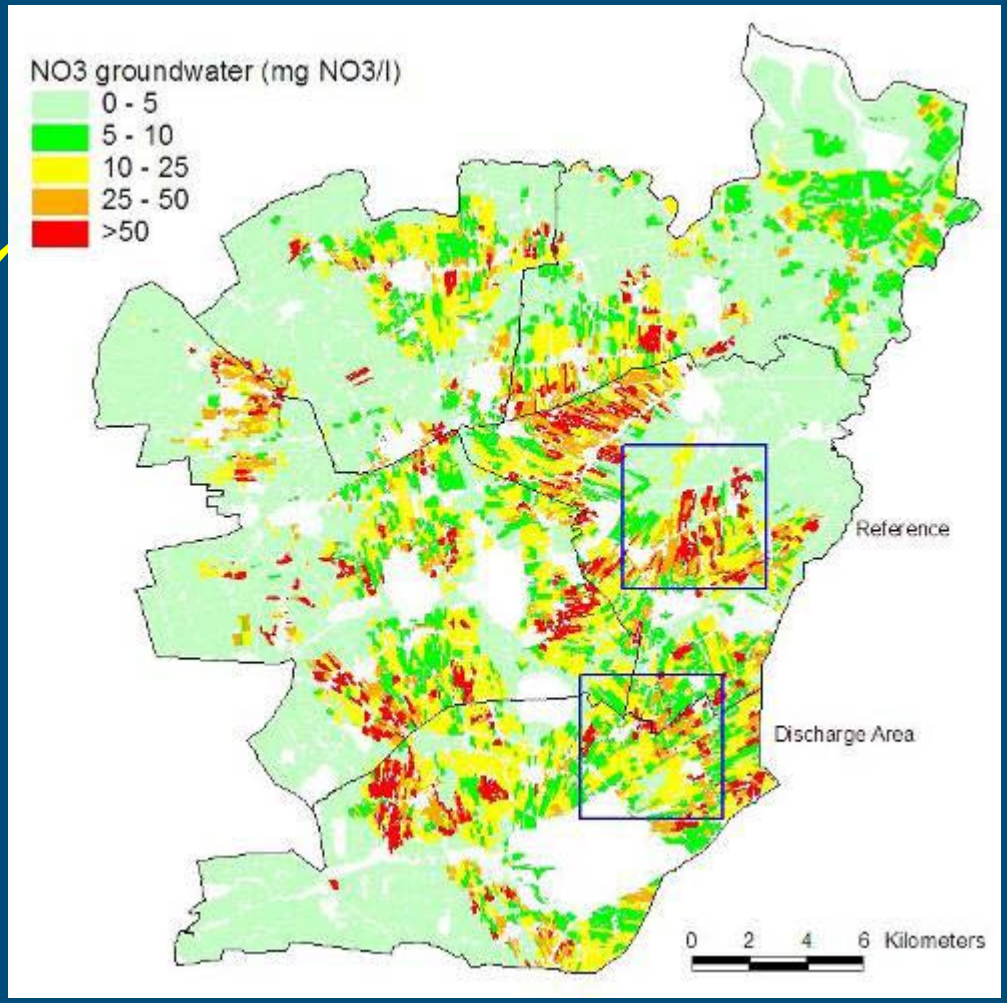
N concentrations in groundwater

6%



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Validation NH_3 deposition

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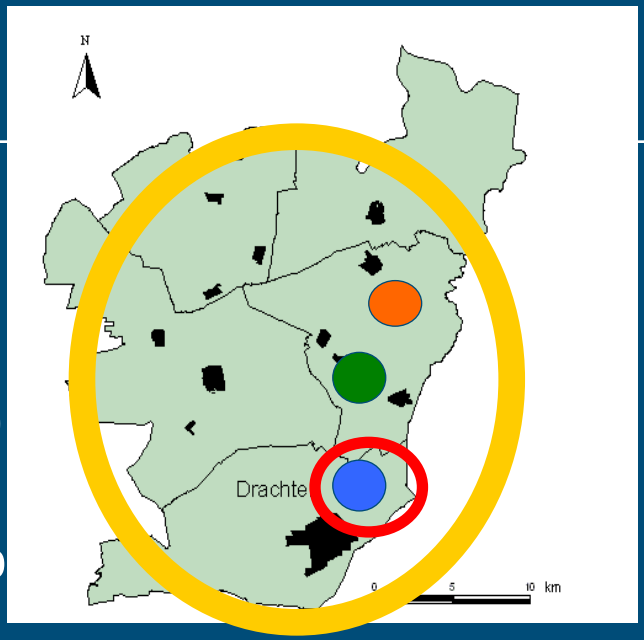
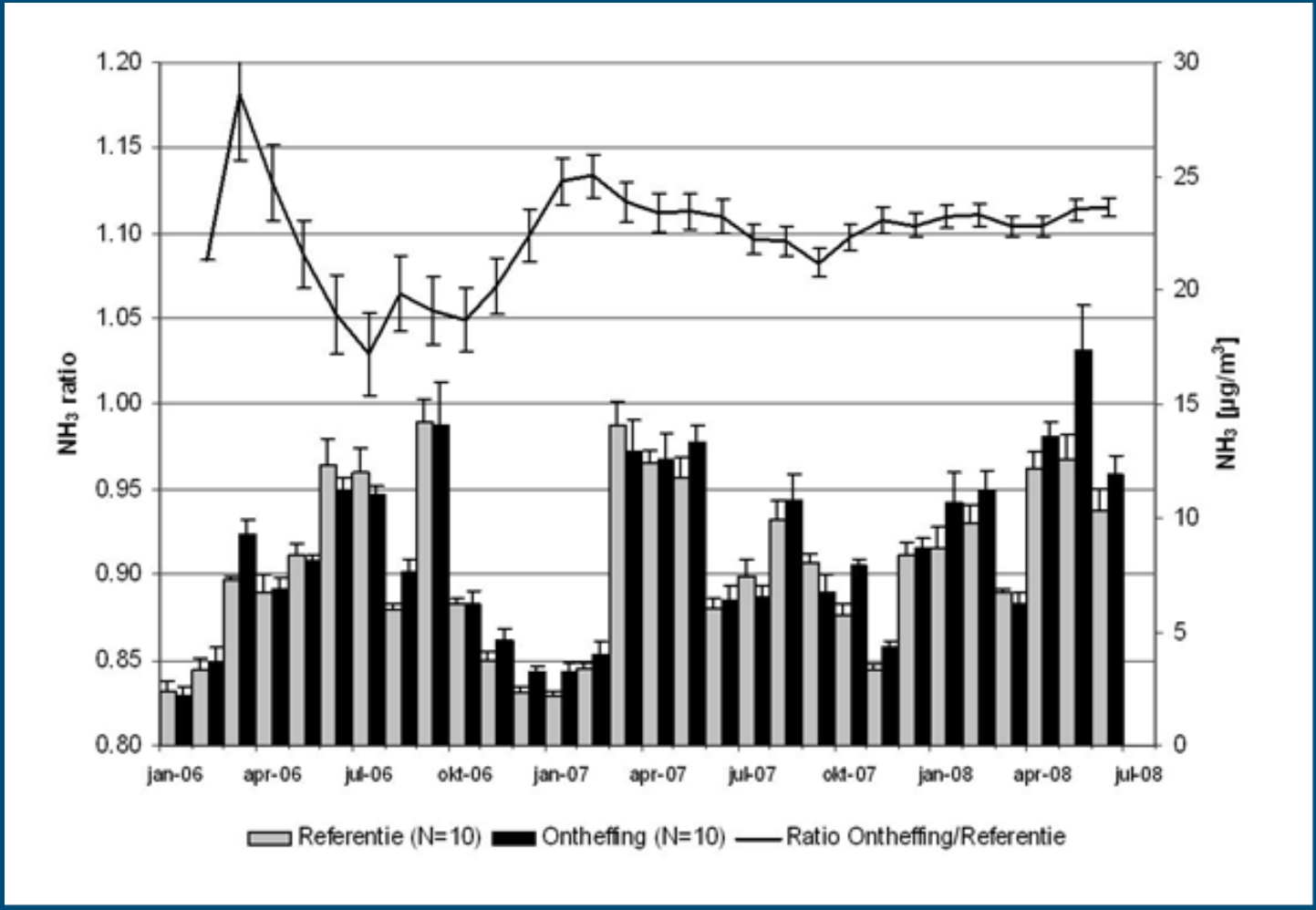
NH_3 measurements



- Passive samplers (*Monthly*)
  - 10 × Sand area & above ground appl. (D)
  - 10 × Sand area with injection (R)
  - 10 × Clay area & above ground applicatio
  - 30 × NFW total region (3MG)
  - Nitro Europe Landscape scale area (R)
- Intensive measurements, Airmonia (*30 min*)
  - In time: continuous 1/2 hour at 2 locations
  - In space: 1 day campaigns mobile measurements

Measurements; Monthly average NH_3 concentration



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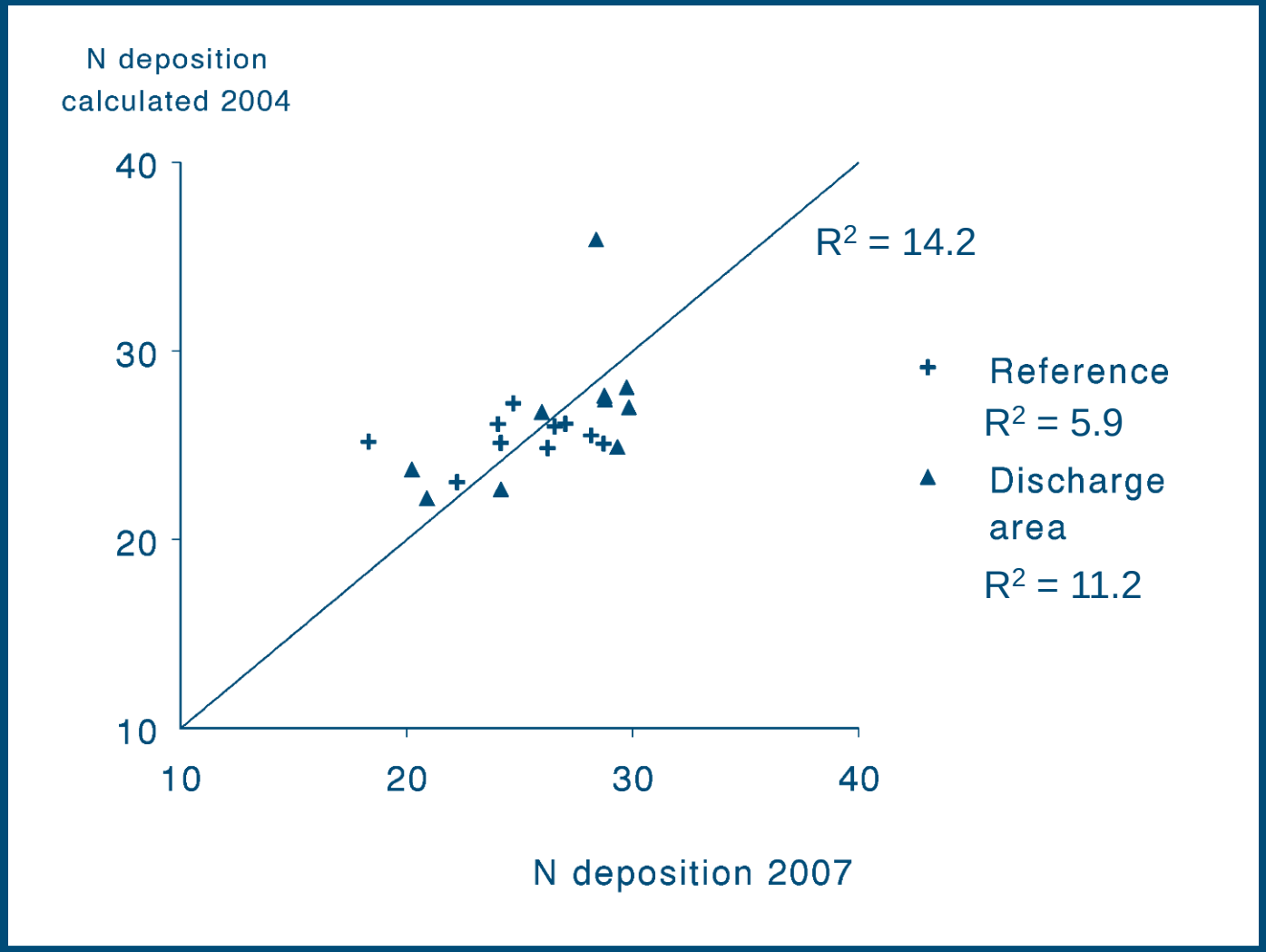
Comparison with observations



Average NH_3 deposition (kg NH_3-N ha^{-1})

Area	Observed 2006	Observed 2007	Modelled 2004
Reference	24.9	25.0	25.4
Discharge	27.1	26.6	26.6
All	26.0	25.8	26.0

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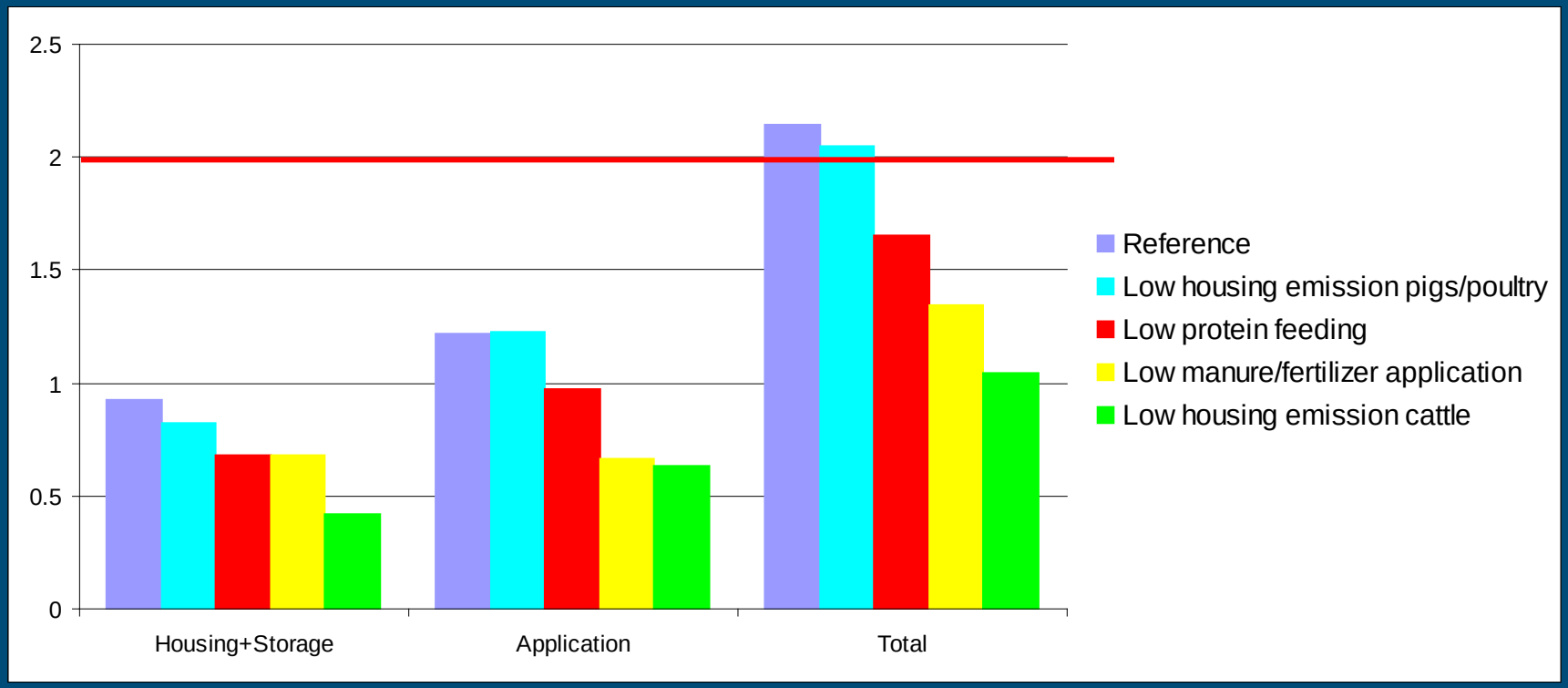
Evaluated measures

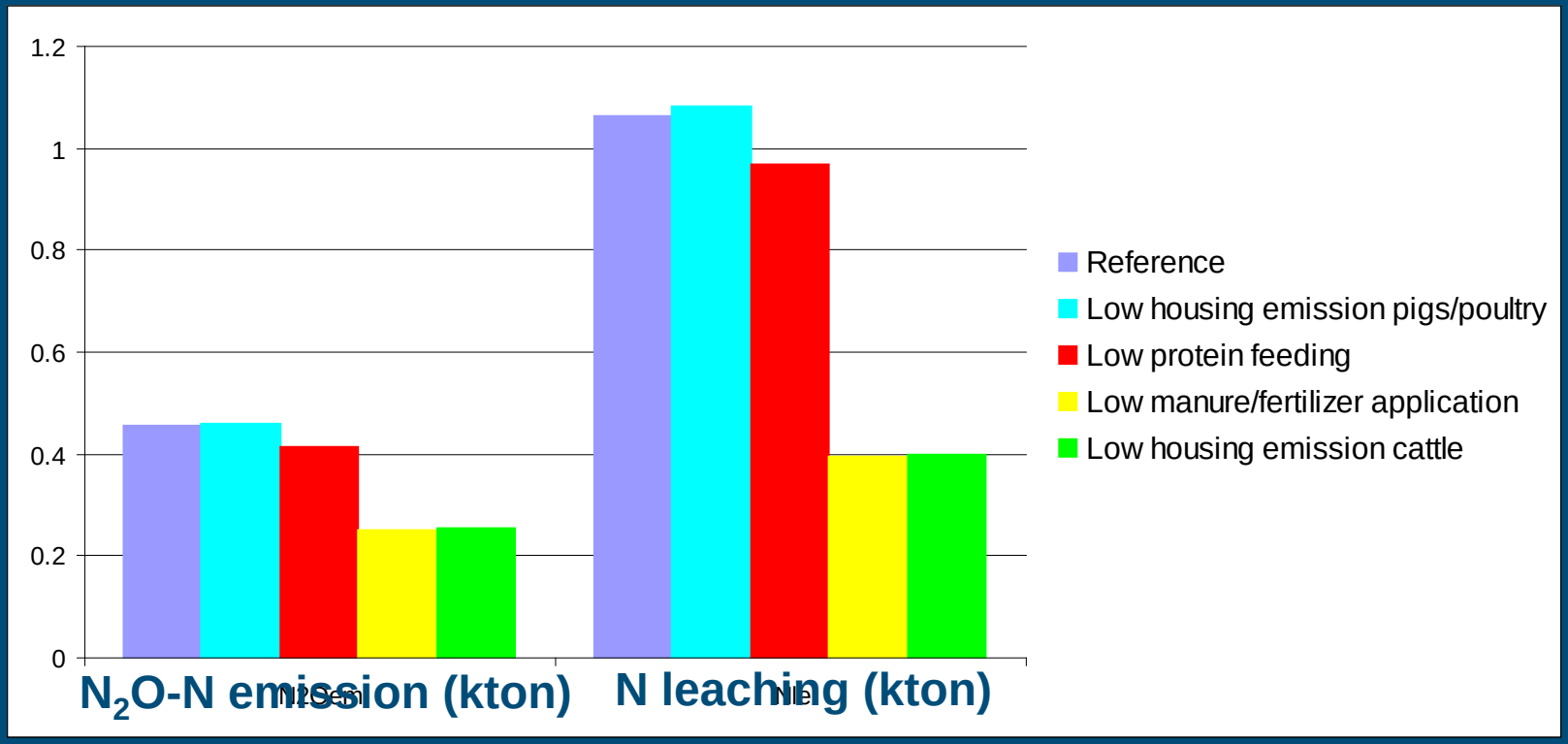
0	Reference (2004/2007)
1	Emission reduction from poultry and pig housing system by using air washers (incl IPPC en AmvB)
2	Low protein feeding
3	Reducing fertilizer/Manure amount
4	Emission reduction from dairy housing systems

Effects of measures on NH_3



NH_3 emission in kton NH_3-N

Effects of measures on N_2O and N_{le}



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Effects on the exceedance of critical N loads

	Deposition N Mol N /ha	Exceedance %
Present situation	1687	39.1
Low housing emission pigs/poultry	1677	39.1
Low protein feeding	1618	38.9
Low manure/fertilizer application	1567	38.1
Low housing emission cattle	1542	37.2
NH_3 emission NFW = 0	1340	**15.4**

Effects on NH_3 and N_2O emissions and NO_3 leaching

Aspect	Present (=2004)	All measures
NH_3 emission (kton N)	2.1	0.8
N_2O emission (kton N)	0.46	0.27
Exceedance NO_3 limit (%)	5.7	0.27

Conclusions

- Present situation:
  - NH_3 emissions exceed NFW target for 2010: 7%
  - Area exceeding NO_3 concentration: 6%
- Measured and estimated NH_3 deposition in same range; averages nearly equal.
- Low emission from housing systems largely reduces NH_3 emissions but slightly increase N_2O emissions and N leaching (pollution swapping)
- Low protein feeding and reduced fertilizer and manure application leads to a reduction in NH_3 and N_2O emissions and N leaching/runoff to ground and surface water

Thank you

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