Assessment of Atmospheric Nitrogen deposition using a combination of measurements and model calculations

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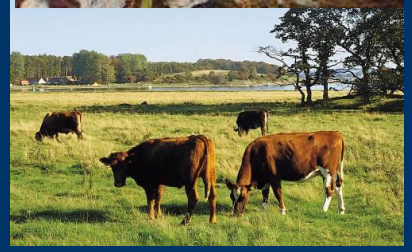
Role in COST Action: WG Leader



Reactive N compounds are increasing in the environment

Un-reactive N is N_2 (78% of earth's atmosphere)

Reactive N includes all biologically, chemically & physically active N compounds in the atmosphere and biosphere of the Earth

N controls productivity of most ecosystems

Nature converts N_2 to reactive N by biological nitrogen fixation (BNF)

Humans convert N_2 to reactive N by fossil fuel combustion, the Haber Bosch process, & cultivation induced BNF.

Humans create more than created by natural terrestrial processes.

Nosengo, N., 2003, Fertilized to death, *Nature, 425, 894-895.*

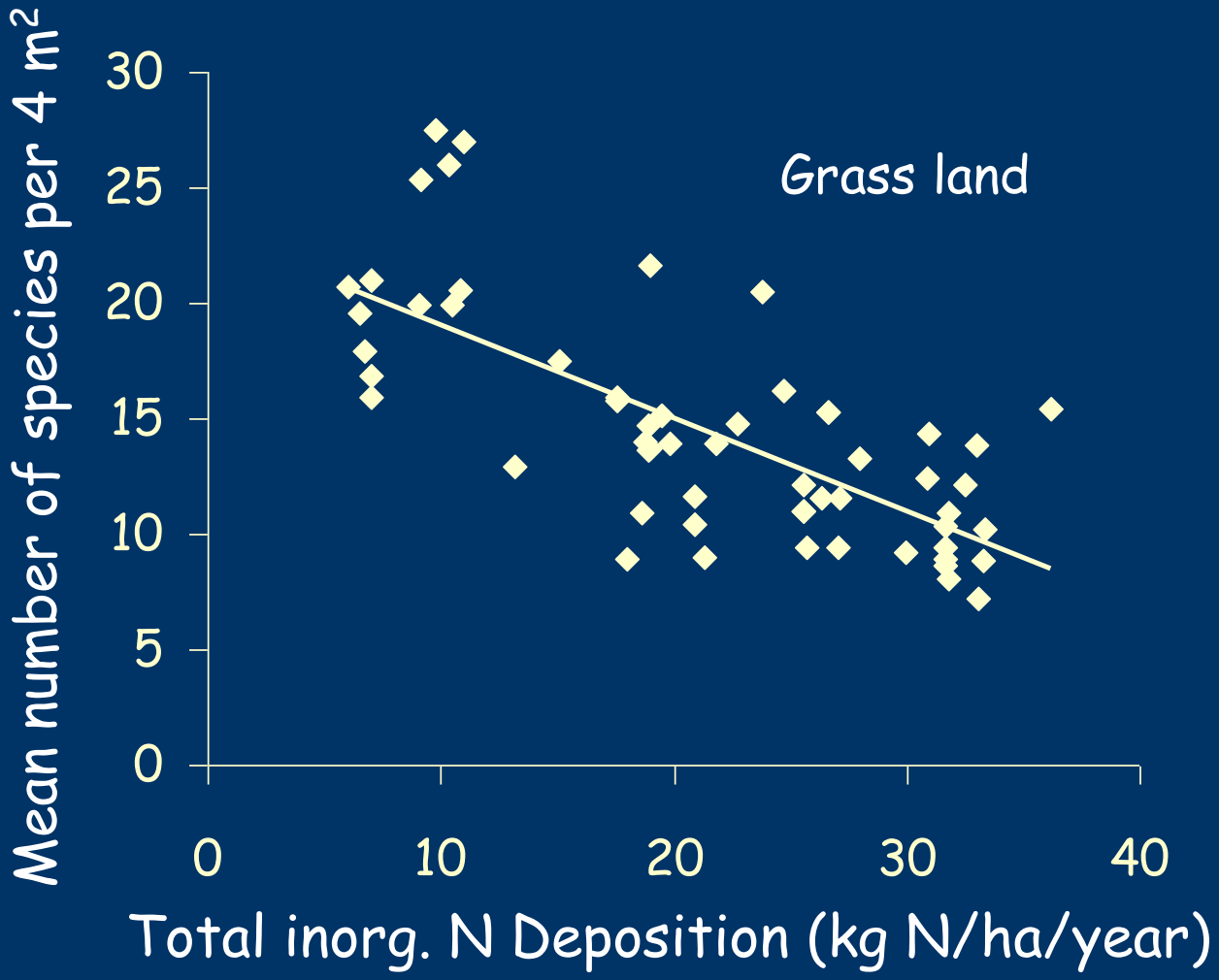
Marine Ecosystems
- Atm. nitrogen deposition

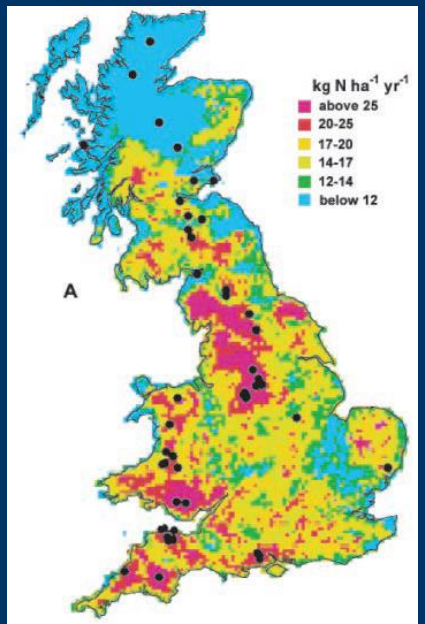
- Eutrophication in coastal waters
- Algal blooming limited by nitrogen
- Turnovers inner DK waters
- Atmosphere contributes about 30%

Terrestrial ecosystems
- Critical loads (CL)

- CL exceeded >40% Europe EEA (2010)
- CL exceeded >70% DK Bach (2005)
- Preindustrial loads about 10% of 1990ties Alveteg et al. (1998)
- Background > Cl for sensitive ecosystems

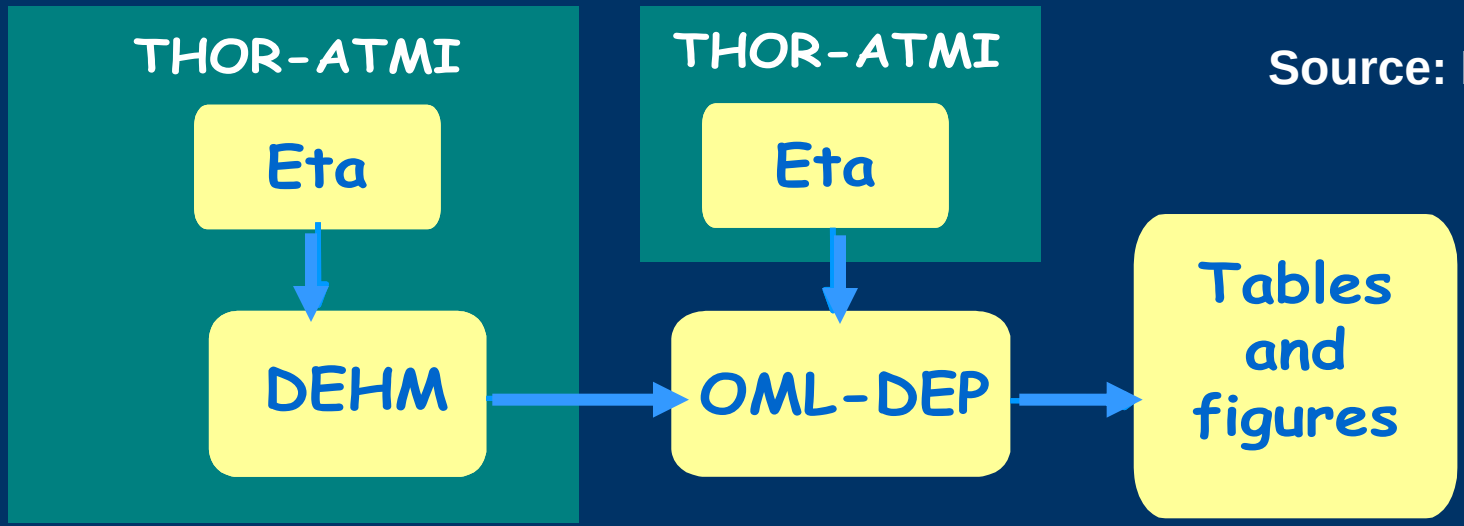
Atmospheric N deposition affects biodiversity





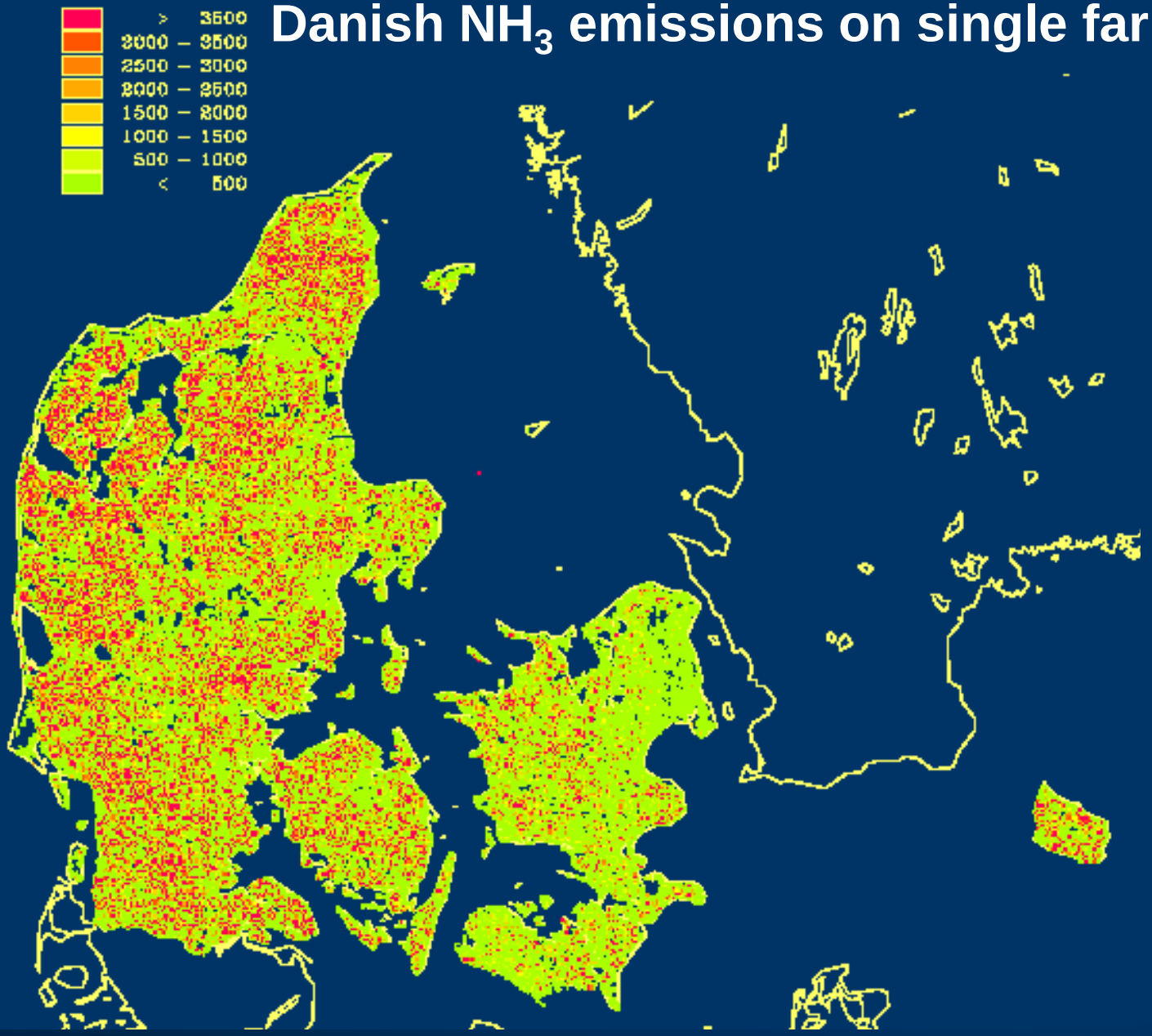
Stevens et al. (2004) Science, 303, 1875

Danish Ammonia Modelling System (DAMOS)

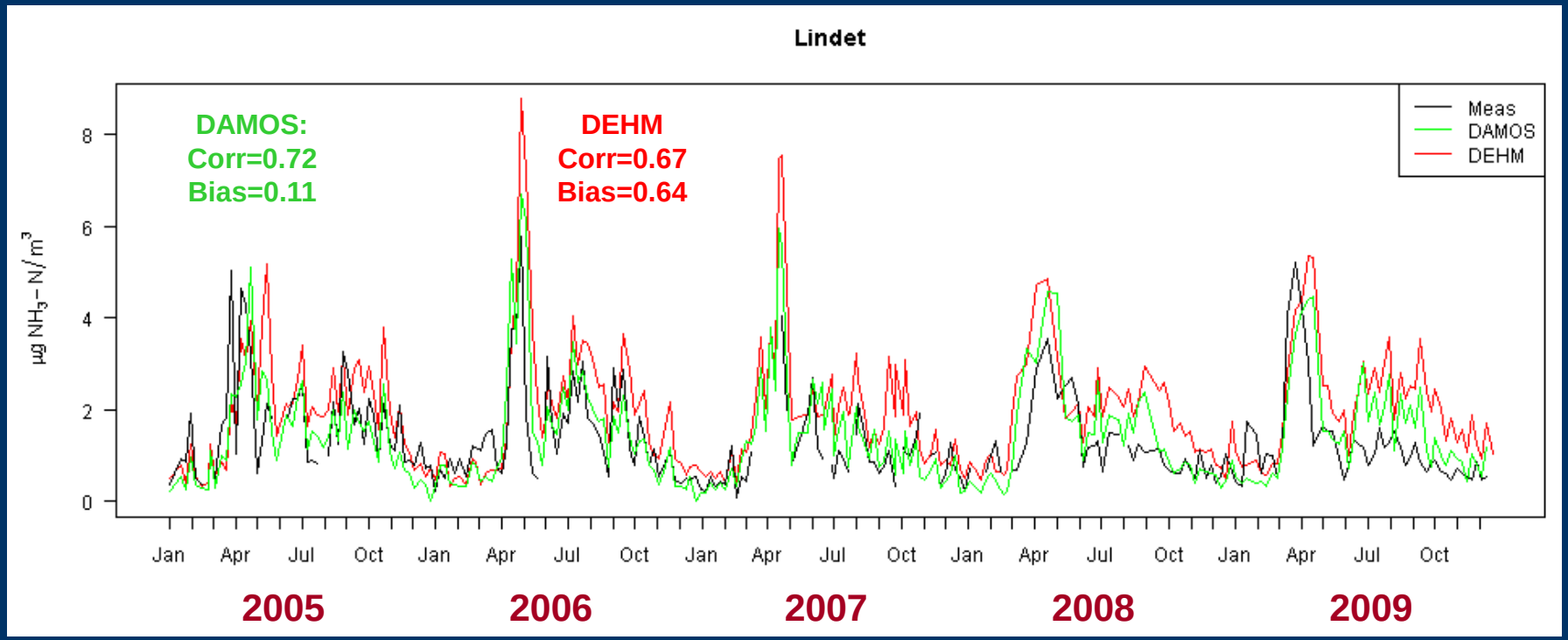


Source: NERI 2005

Danish NH_3 emissions on single farm level



Weekly NH_3 concentration at Lindet.[5]

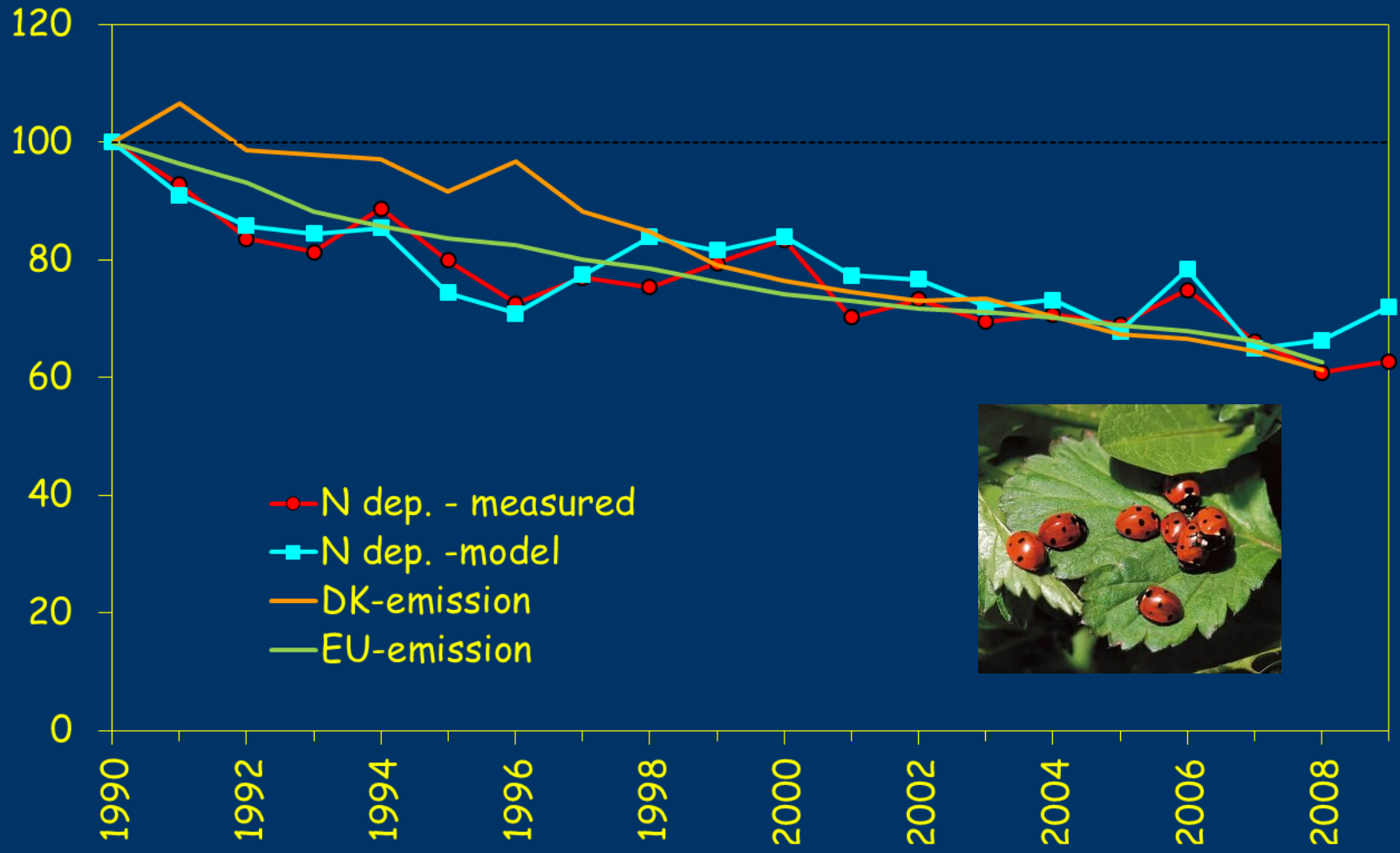


- Strong seasonal cycle captured by both DAMOS and DEHM[5]
- Overestimating some spring peaks[5]
- Week-to-week variability also captured[5]
- DAMOS closer to measured level[5]

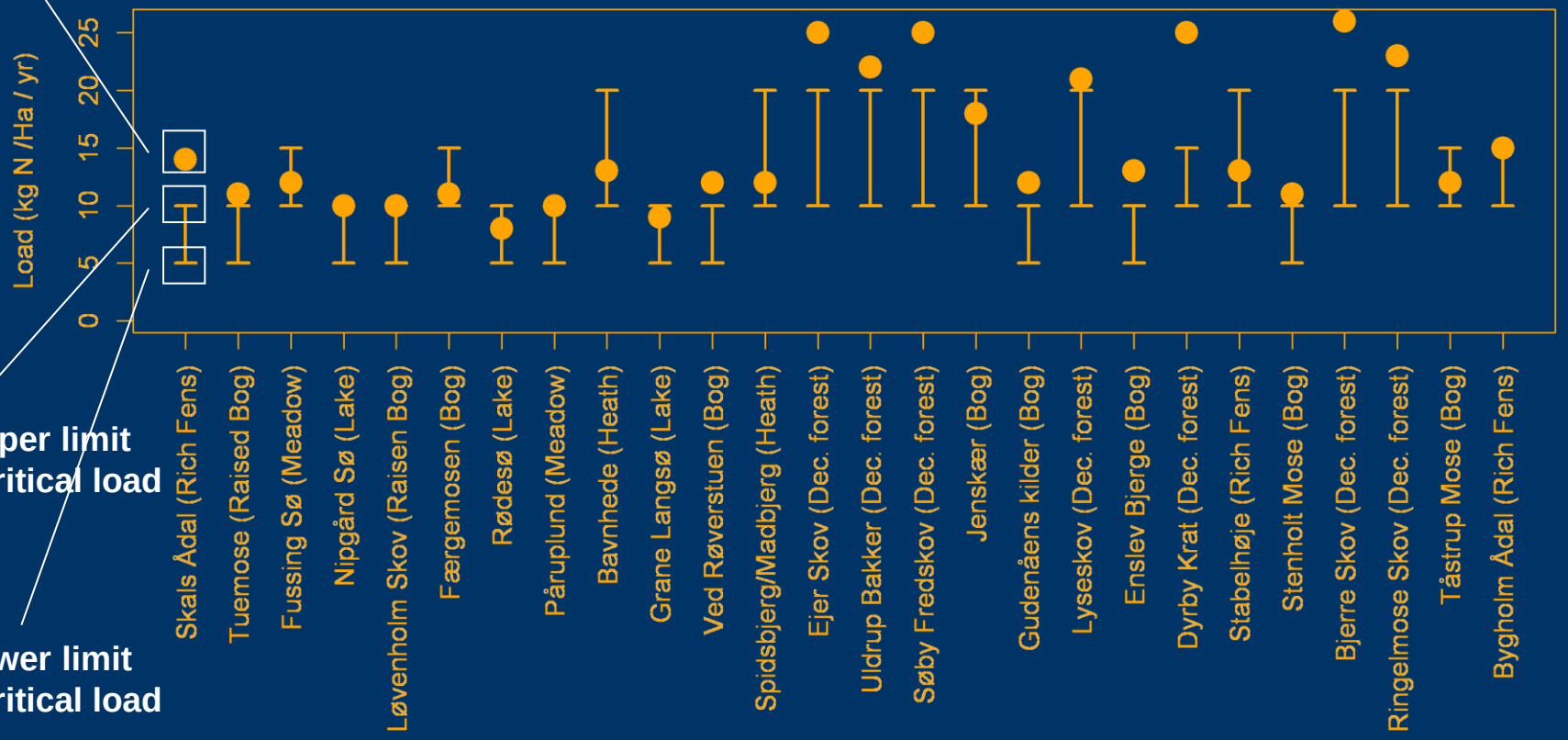
[5] Geels et al, (2012) Improved modelling of atmospheric ammonia over Denmark using the coupled modelling system DAMOS: Biogeosciences, 9, 2625-2647.

long-term trends in N deposition & emissions

Source: ENVS 2008



DAMOS: N dep. Udvalgte Naturområder under Miljøcenter Aarhus

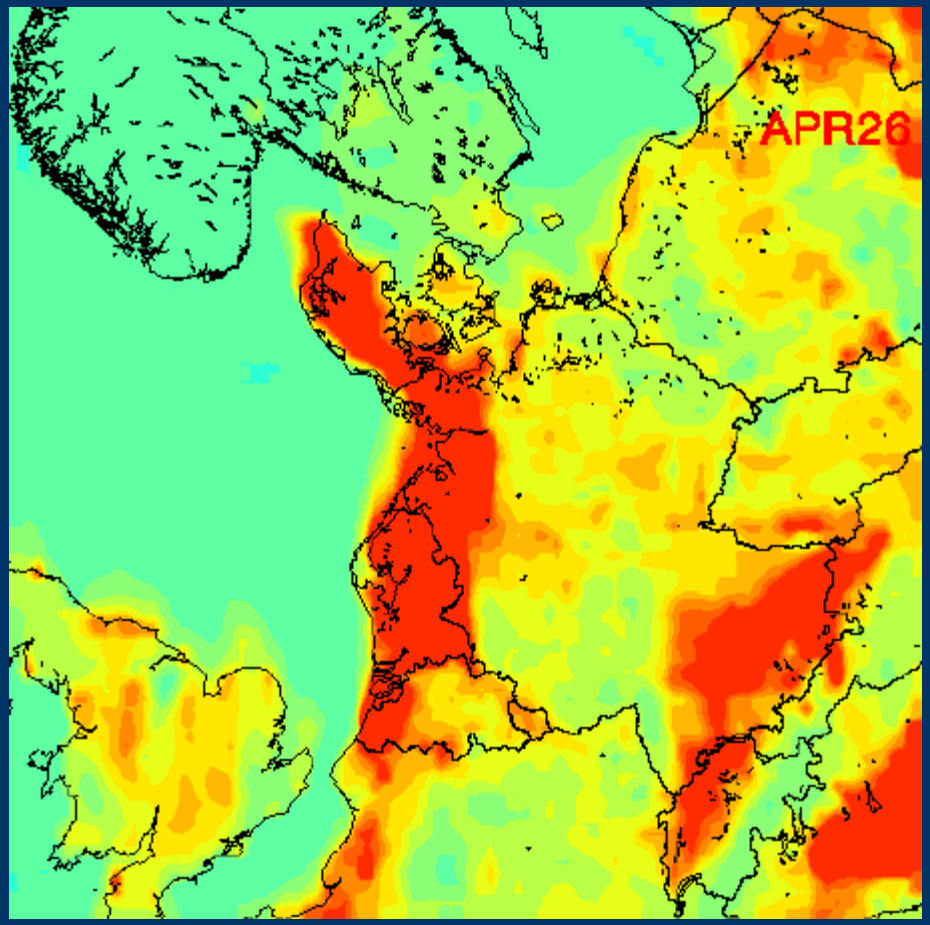


Upper limit of critical load

Lower limit of critical load

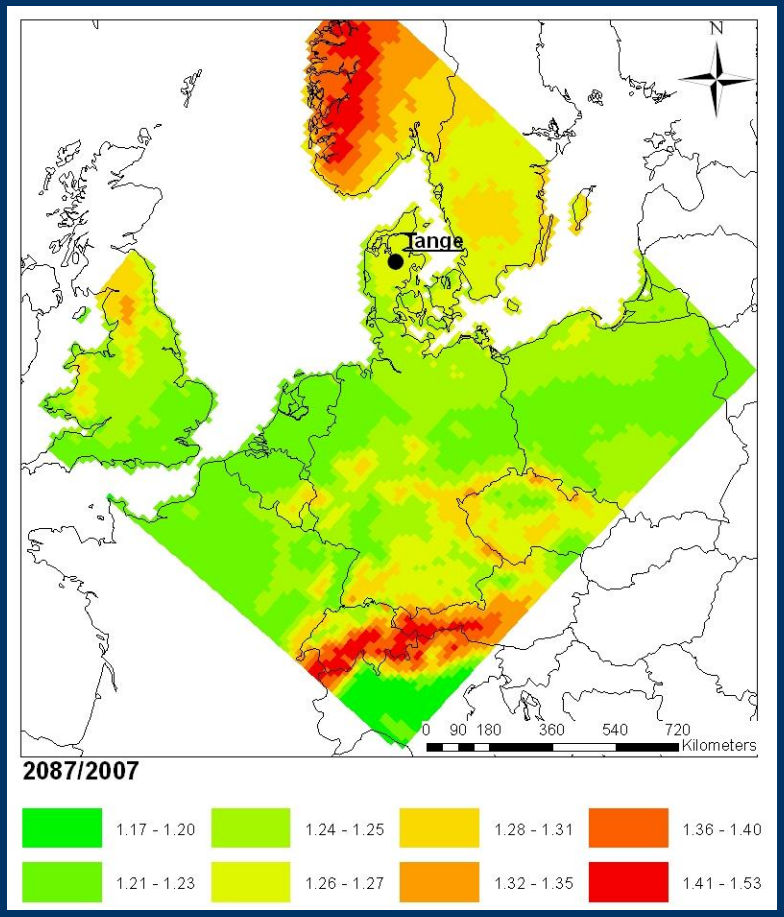
Photo: Henriette Bjerregaard, MC Aarhus

Simulations of NH_3 concentrations performed with DEHM

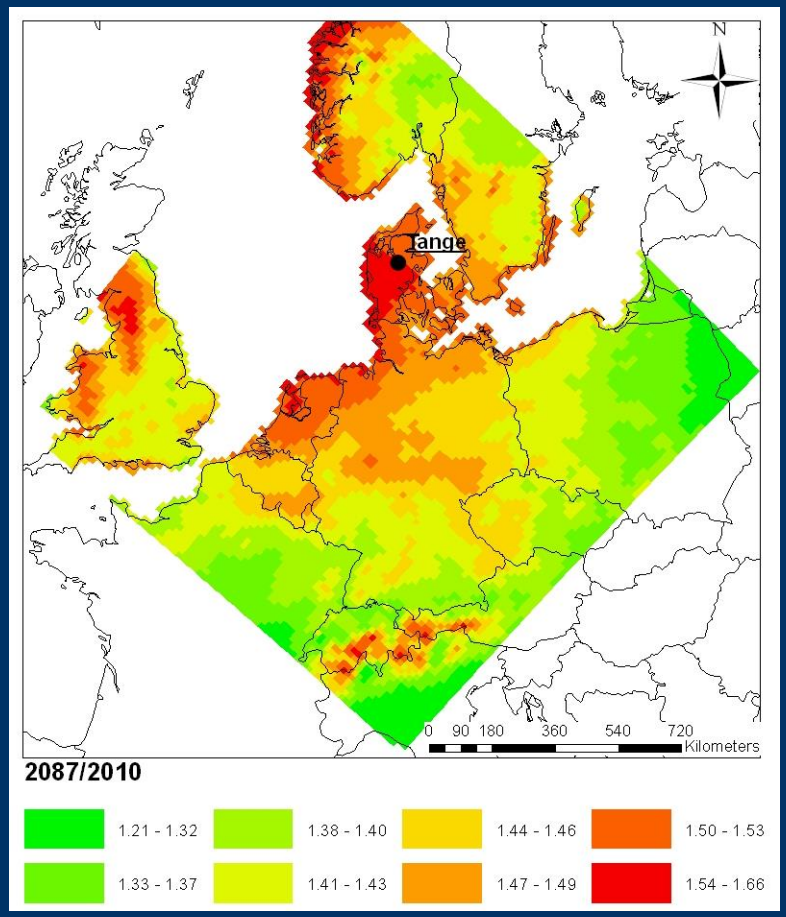


The climate "penalty" on NH_3 emissions

(standard Danish storage moved to other locations).



2087 relative to 2007



2087 relative to 2010

Conclusions

- - Measurements provide information about levels and trends at monitoring sites
- - In DK background loads lead to exceedances of critical loads
- - High temporal and spatial resolution emission inventories is a must for proper assessment of loads
- - DAMOS system combines a LRT-model and a local scale model to provide high resolution mapping of loads

Conclusions

- Emissions can vary with 20% by changing geographical location within a country due to overall variations in climate.
- Warmer years give higher NH_3 emissions than colder years. Annual variations in overall climate can at specific locations cause uncertainties in the range of 20%.
- Climate change will in general increase the emissions with 0-40%, in central to northern Europe – so yes the increase in emissions might hinder mitigations effects….