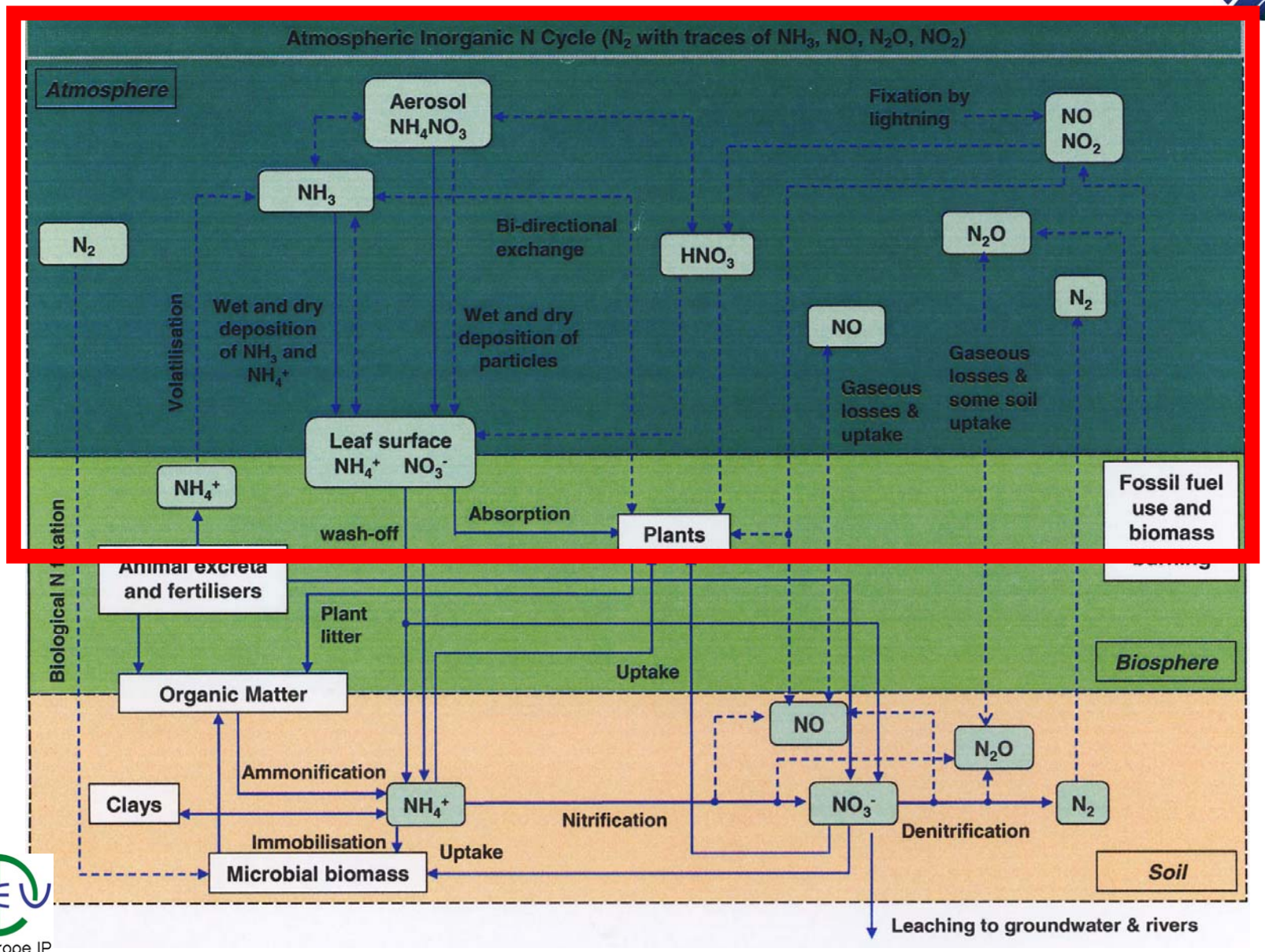
Norwegian Meteorological Institute
met.no

Nitrogen modelling in EMEP/MSC-W

Hilde Fagerli and many more..

TFIAM/COST729/NinE, Laxenburg, 28-30th November, 2007

Schematic N cycle



EMEP Unified Model

NitroEurope IP

EMEP Unified Chemical transport model

Air concentrations of
NO, NO2, NH3, NH4+, NO3-,HNO3
Reduced and oxidized
nitrogen deposition

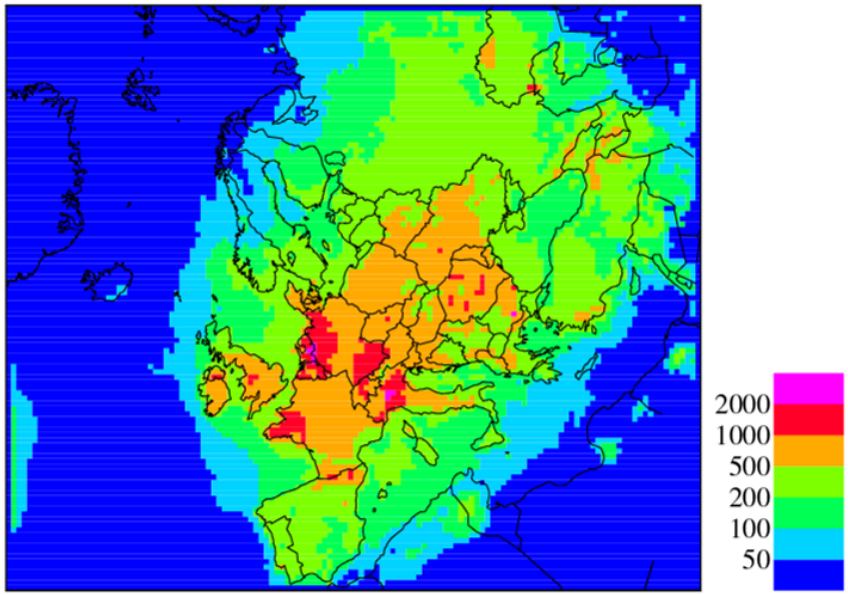
↑

Chemistry
Dry/Wet removal

↑ ↑

Emissions 50*50km

Meteorology 50*50km

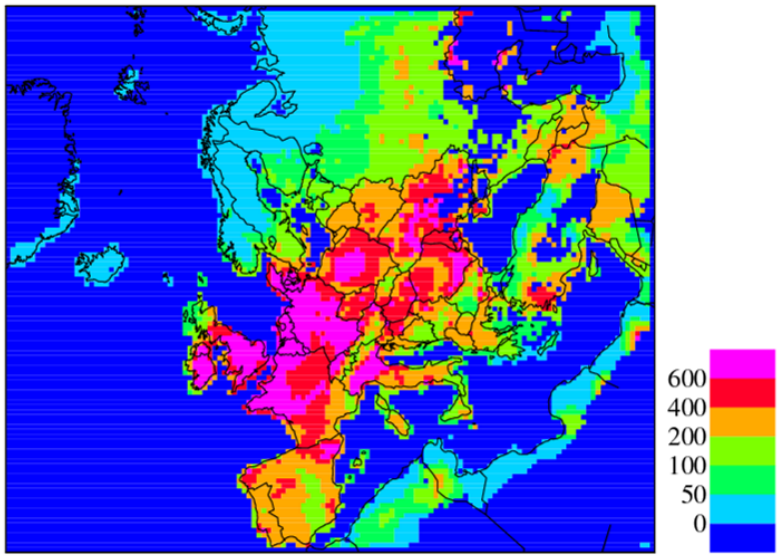


Deposition of reduced N (mg(N)/m2), 2005

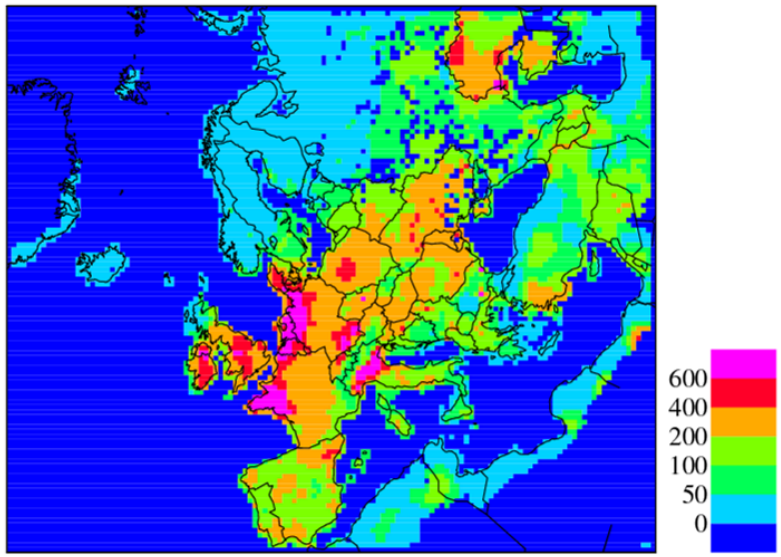
‘Main products’

- Every year (based on reported emissions):
  - Concentrations (and indicators)(NO,NO2,NH3,NH4+,NO3-,HNO3..)
  - Deposition maps (ecosystem specific), 50km*50km, ox. N, red. N
  - Source-receptor matrices
  - Scenario runs
  - *Comparison model-observations, both ways*

Ecosystem specific depositions



RDN to deciduous forest
(mgN/m2 forest area)

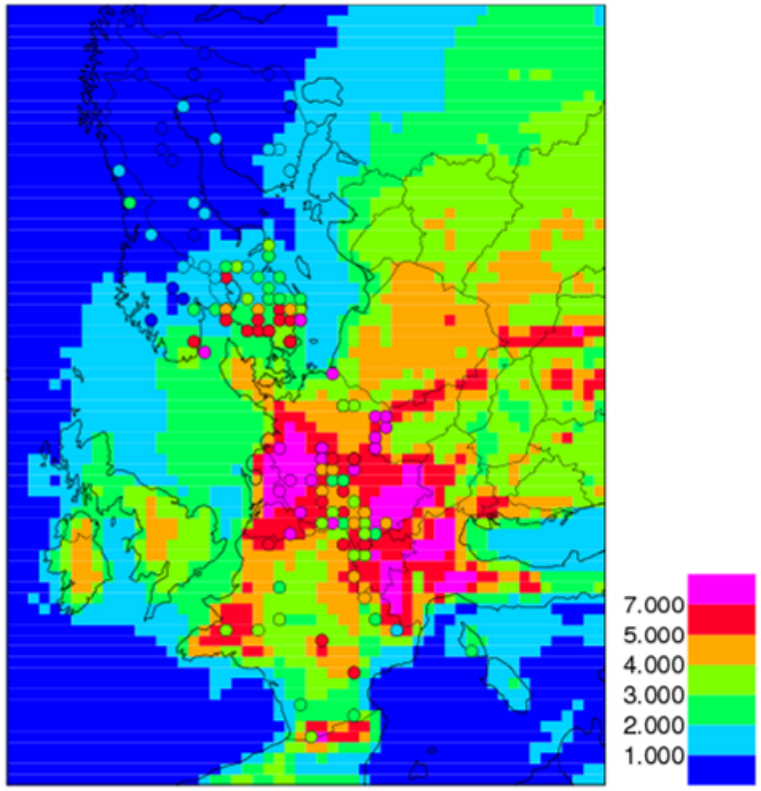


RDN to seminatural land
(mgN/m2 SN area)

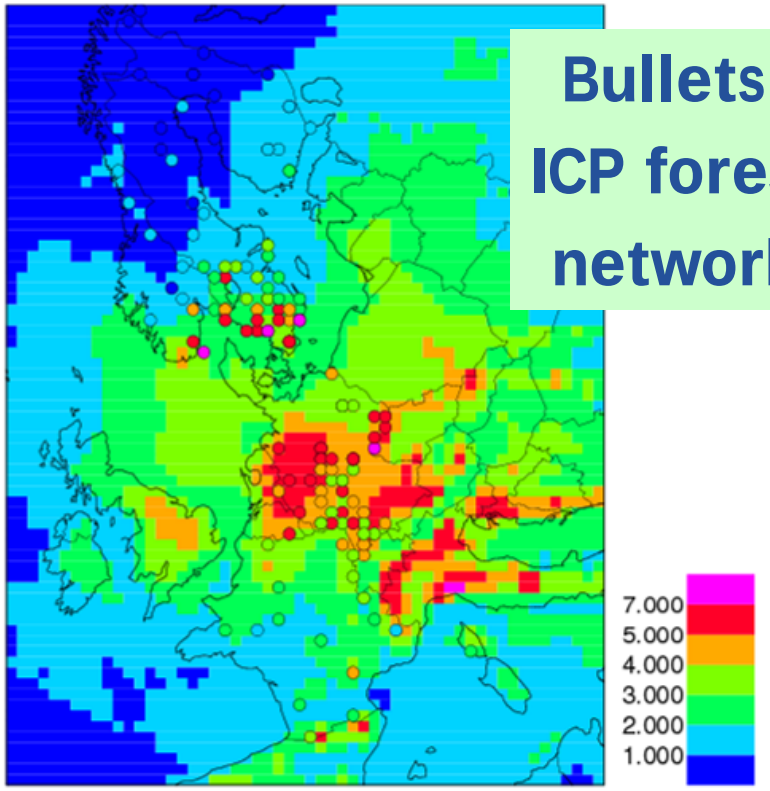
‘Main products’

- Every year (based on reported emissions):
  - Concentrations (and indicators)(NO,NO2,NH3,NH4+,NO3-,HNO3..)
  - Deposition maps (ecosystem specific), 50km*50km, ox. N, red. N
  - Source-receptor matrices
  - Scenario runs
  - *Comparison model-observations, both ways*

Which results can be verified?



Reduced nitrogen wet deposition, 1997



Oxidized nitrogen wet deposition, 1997

Bullets: ICP forest network

- Most data for central, west and north Europe
- Dry deposition of N: little data

Air concentrations

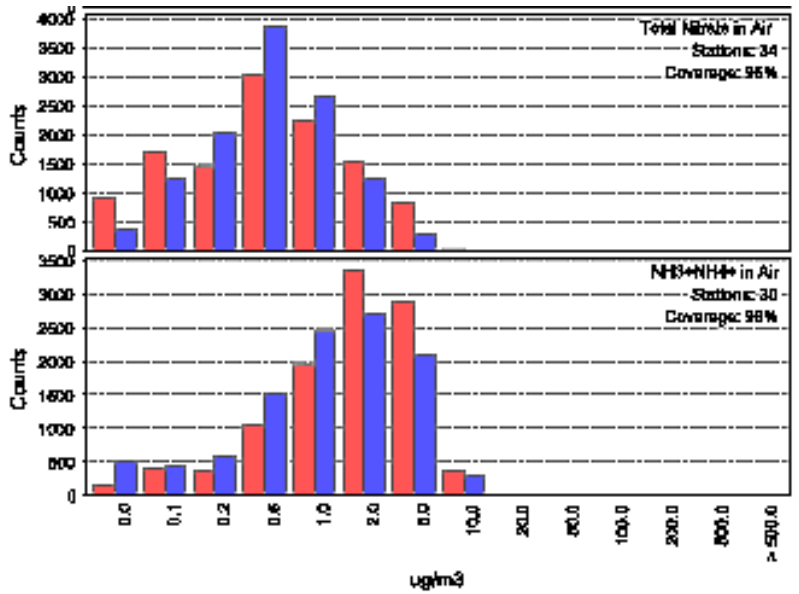
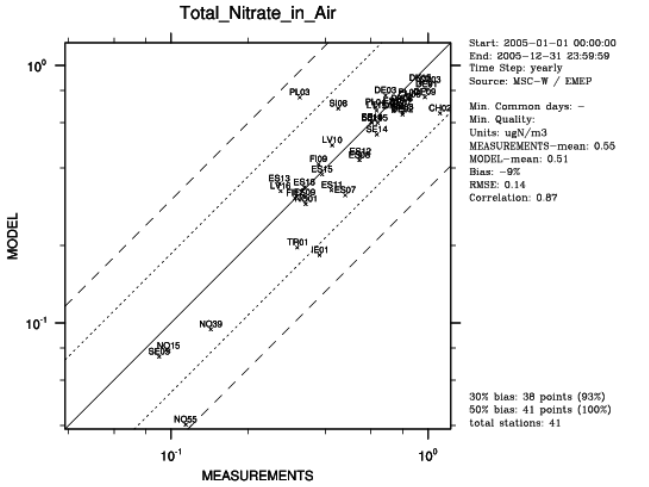
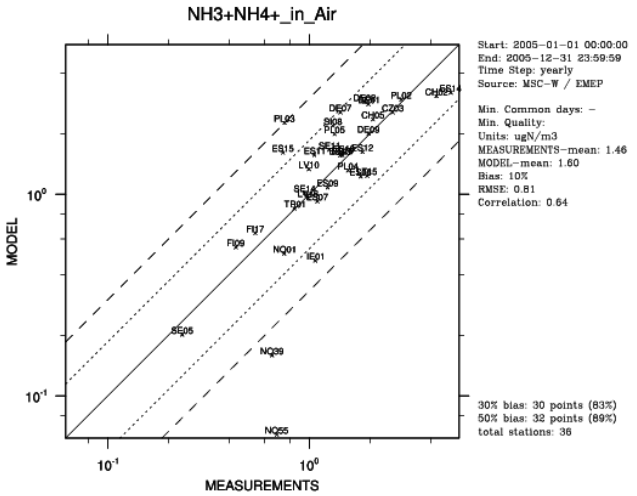


Figure 30: Frequency analysis of air concentrations in the European Community (Model, Observations)





NH_3: model
Versus obs

Green: model

Red: obs

Overestimate NH_3 in forest areas; low NH_3 emissions

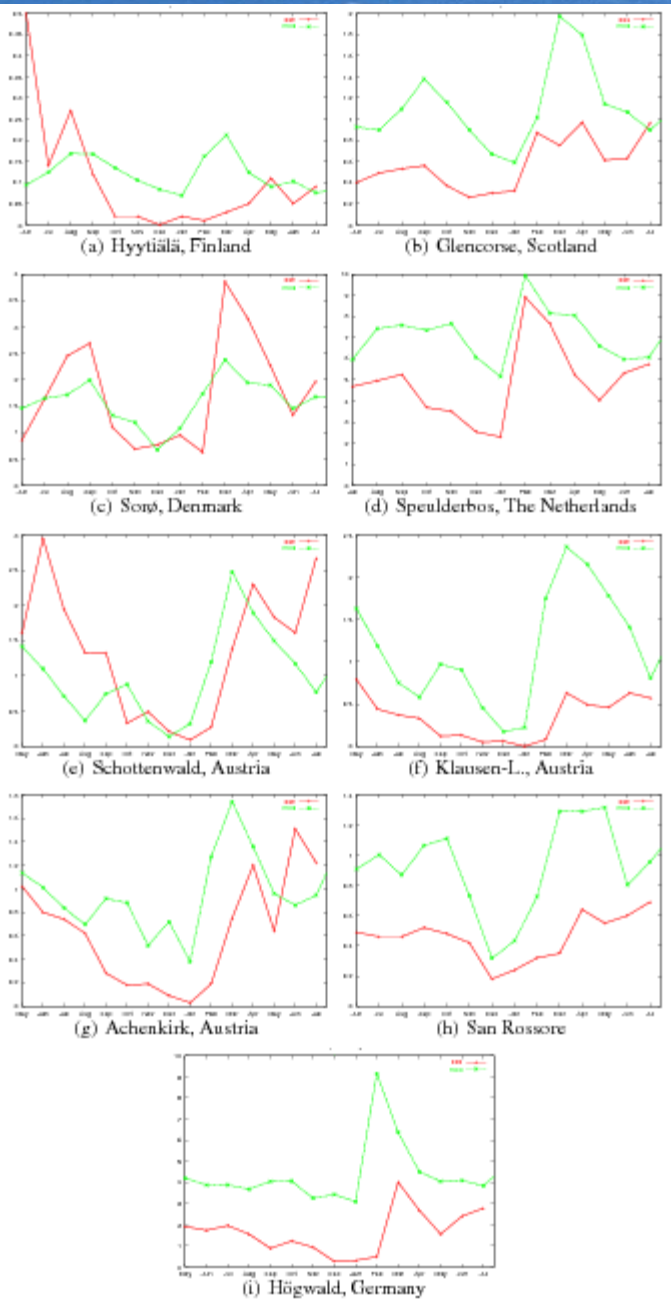


Figure 1.10: Comparison of modelled versus observed monthly-average NH_3 ($\mu g\ m^{-3}$) at NOFRETETE sites for May/June 2002 to June/July 2003. Figures a)-d) are reprinted from Simpson et al. (2006a).

NH_3/NH_4^+ : SCALE

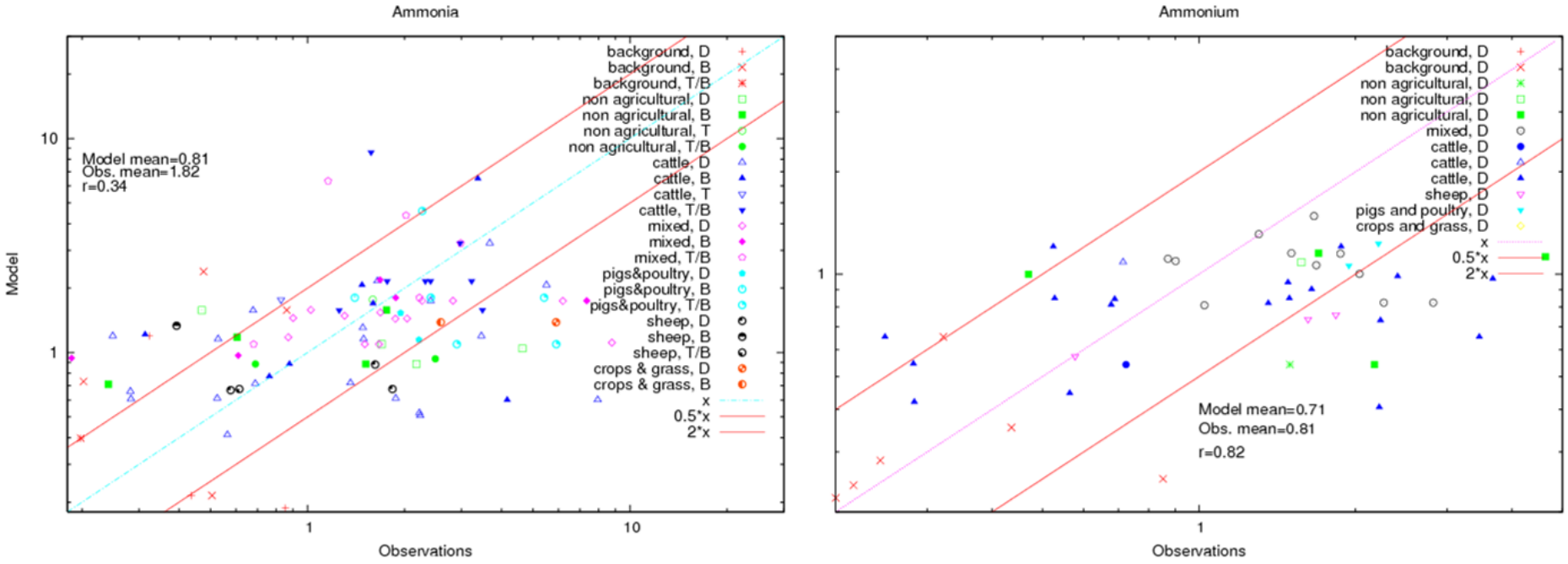


Fig: Comparison of measurements from the UK National Ammonia Monitoring Network and model results for ammonia and ammonium measurements for 2005. D = Denuder, T = Diffusion Tube, B = ALPHA Sampler

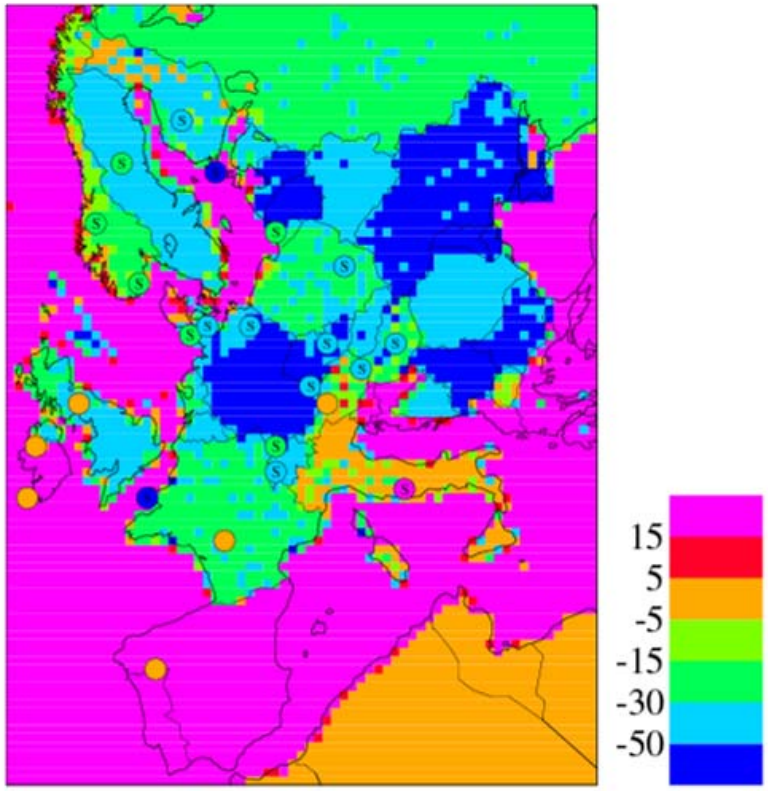
NH_3: cannot capture large spatial gradients (overestimate low, underestimate high concentration

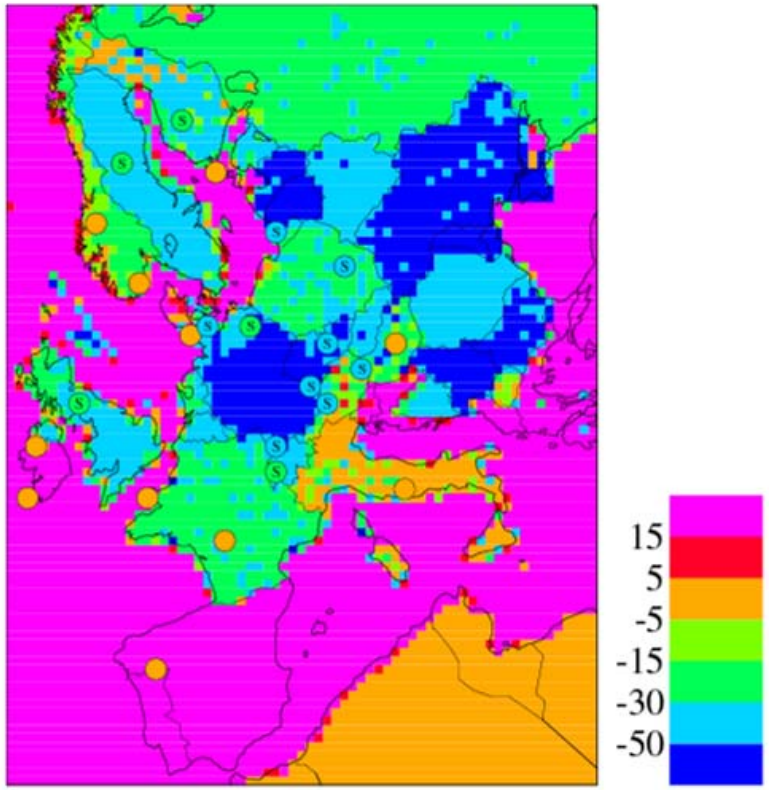
NH_4^+: overestimated in cold seasons

Scenarios: respons to emission changes

- Cannot verify future… but past

Changes ((1980-2002)/1980*-100%) in NOx emissions (field) versus trends in obs(1)/mod(2) concentrations of oxidized N in precipitation (bullets in color) S marks statistically significant trend.

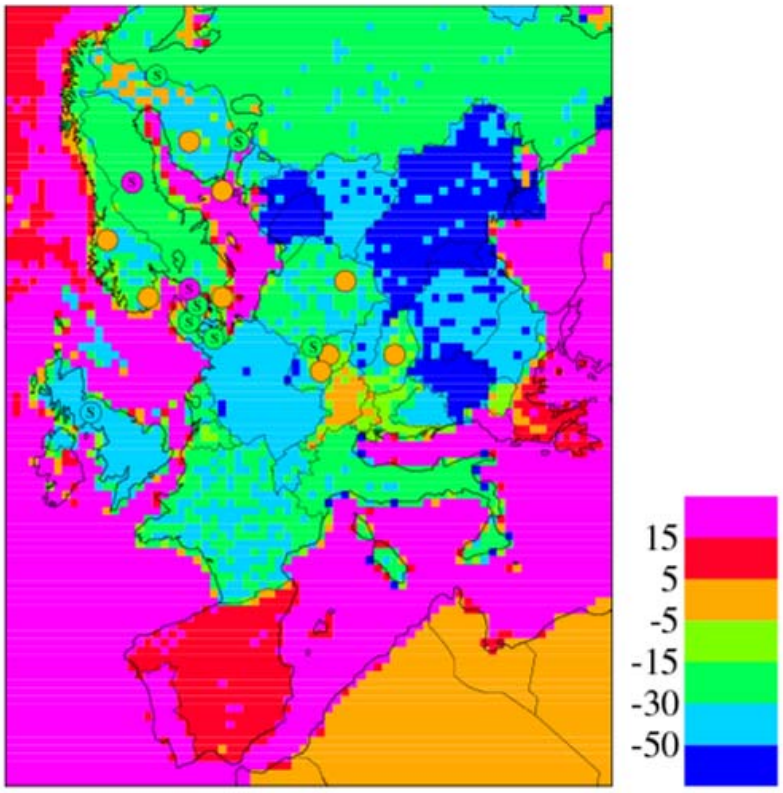


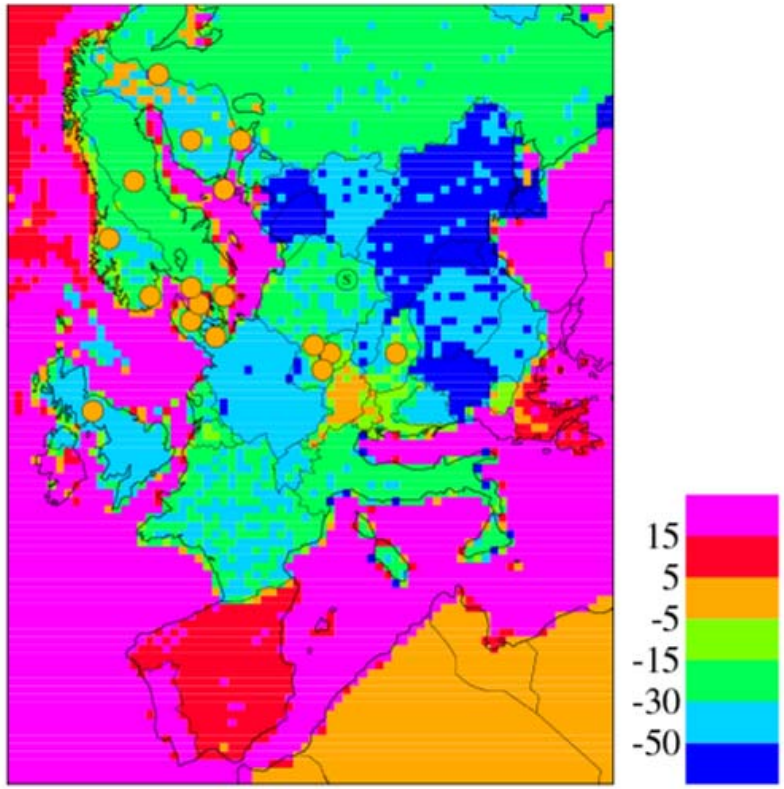


OBS

MOD

Changes ((1990-2002)/1990*-100%) in NOx emissions (field) versus trends in obs.(1)/mod.(2) concentrations of oxidized N in air (bullets in color) S marks statistically significant trend.

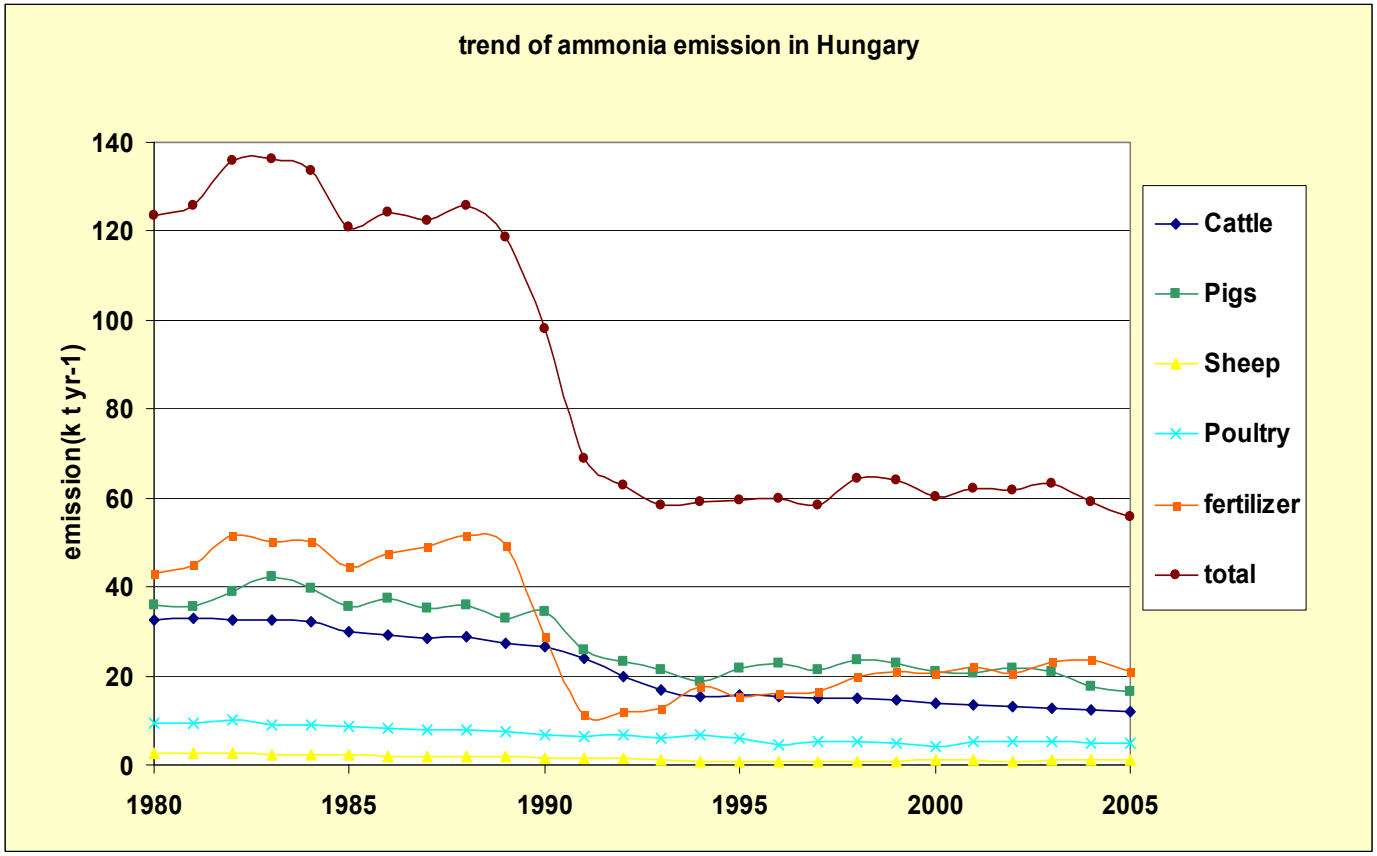




OBS

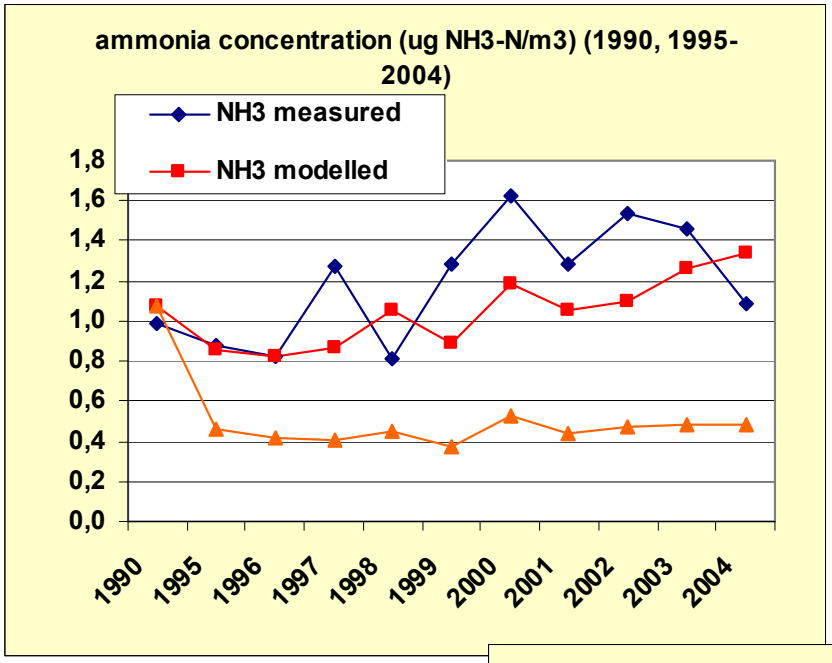
MOD

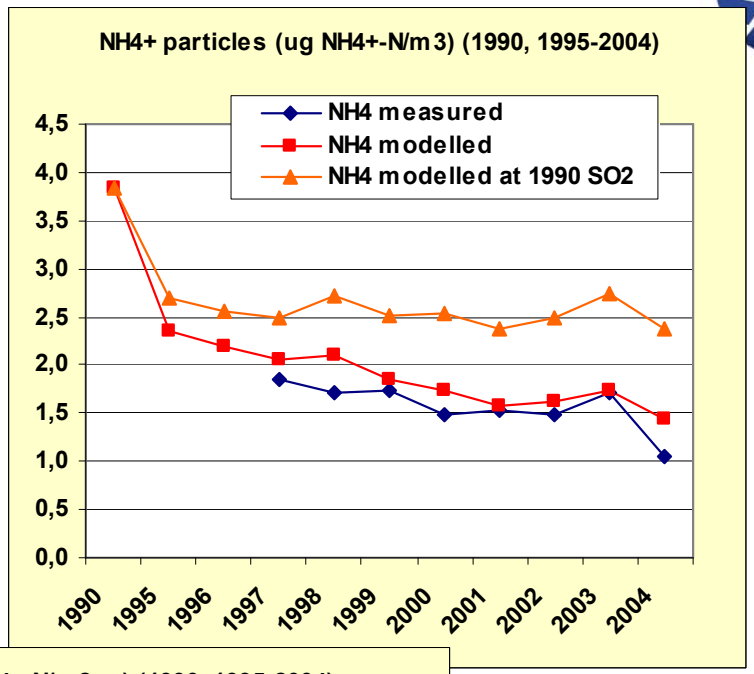
Non-linear response to emission changes

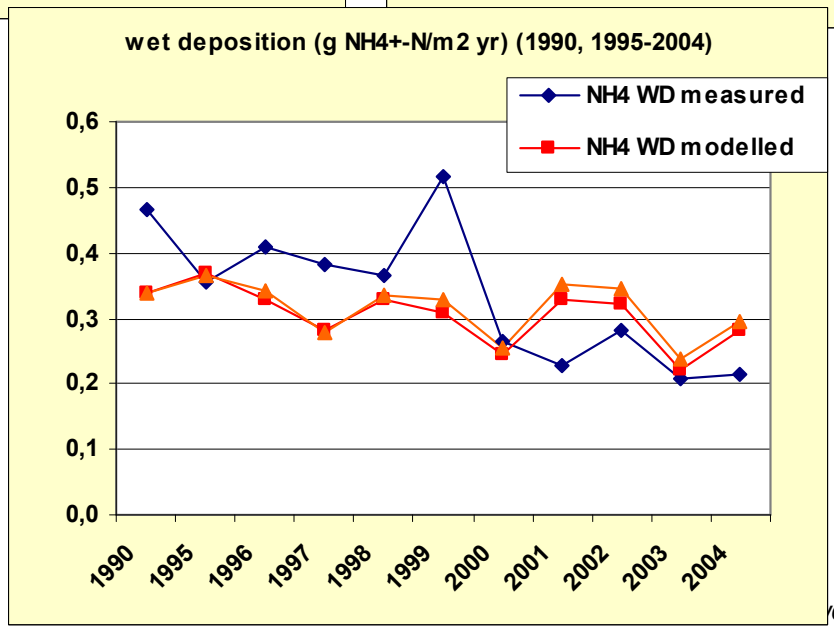


Courtesy L. Horvath

Trends, K-puszta: cont.







Courtesy L. Horvath

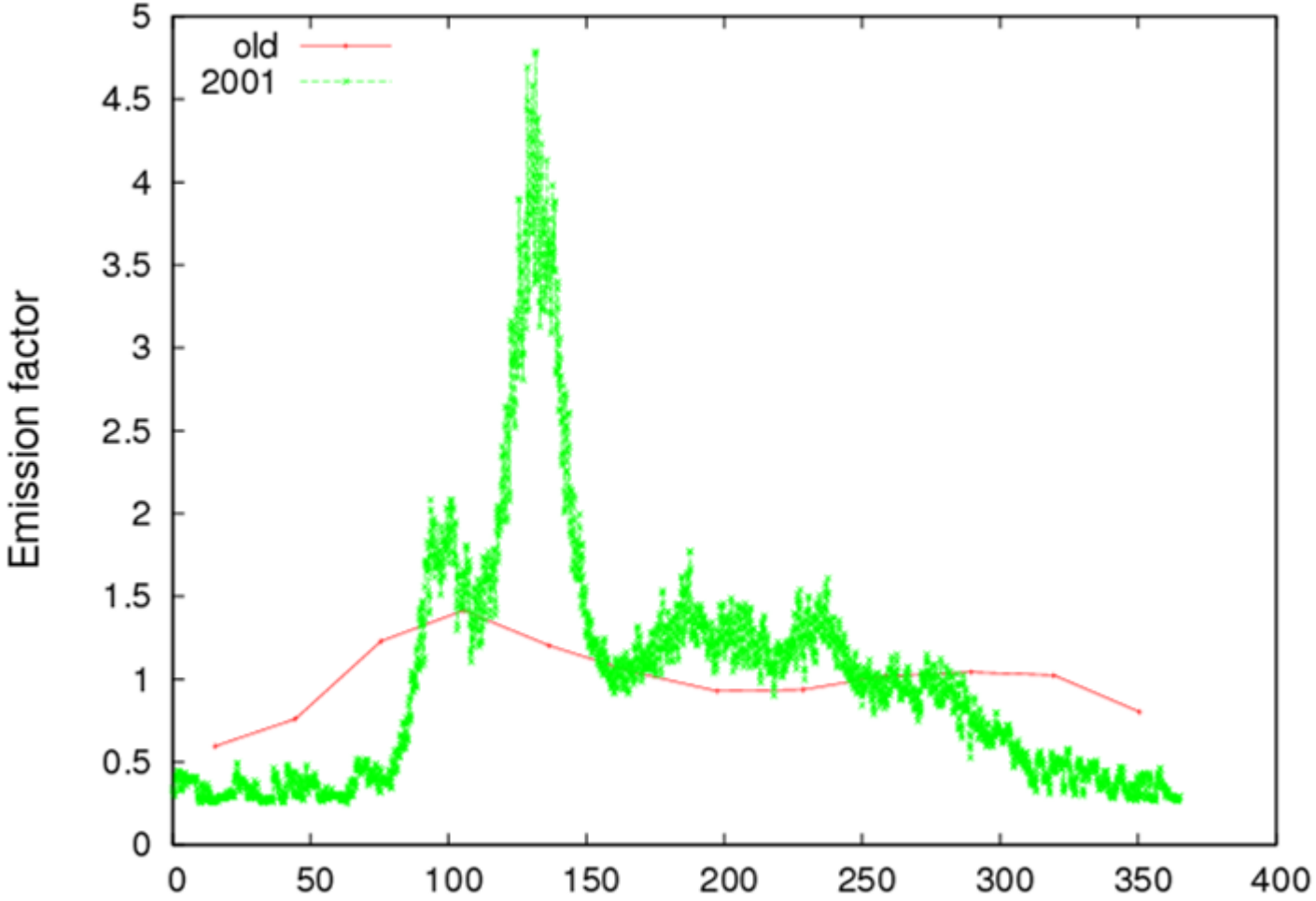
Plans/Projects

- Extended area, finer scale model
  - Need finer scale emissions
- Dynamic ammonia emission modelling

Implementation of dynamic NH_3 emission module (for Denmark)

- Used for seasonal variation (total emission kept)
- Depend on:
  - Meteorology (temp, wind)
  - Info about agr. practice
  - Simple crop growth model
  - 15 additive functions (+traffic,industri)

- Main idea: Splitting emission into main groups with similar behaviour with unique parameterisation
- From: Skjøth et al, 2004 & Gyldenkærne et al., 2005



Tange, Denmark

Ammonia in Air