Emissions. atmospheric concentrations and bulk deposition of reduced nitrogen in Hesse. Germany – steps towards a comprehensive treatment of reactive nitrogen in the atmosphere

Report from a construction site

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We felt that the chain

| Emission | → | Trans-mission | → | Deposition | → | Effects |

needs more attention for reduced nitrogen!

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Project Partners

- Hessian Agency for the Environment and Geology (HLUG) (money, sampling)

- Federal Ministry for Food, Agriculture and Consumer Protection (BMELV) (money)

- Federal Environmental Agency (UBA) (money)

- Association for Technology and Structures in Agriculture (KTBL) (survey of agricultural activities)

- Justus Liebig University, Giessen, Institute of Plant Ecology (SVAT model)

- Energy Research Centre of the Netherlands, Petten (ECN) (transmission model)

- Institute of Agroecology, Federal Agricultural Research Centre (the rest)

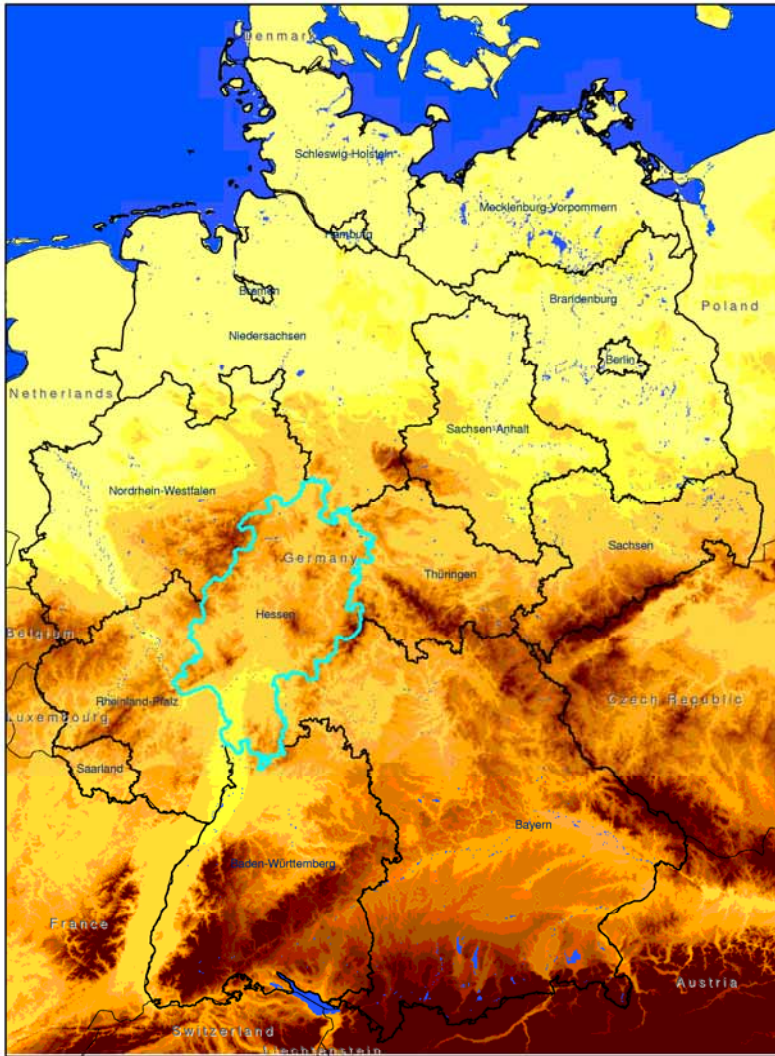**FAL**
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Primary goal:

Establish a methodology which gets close to
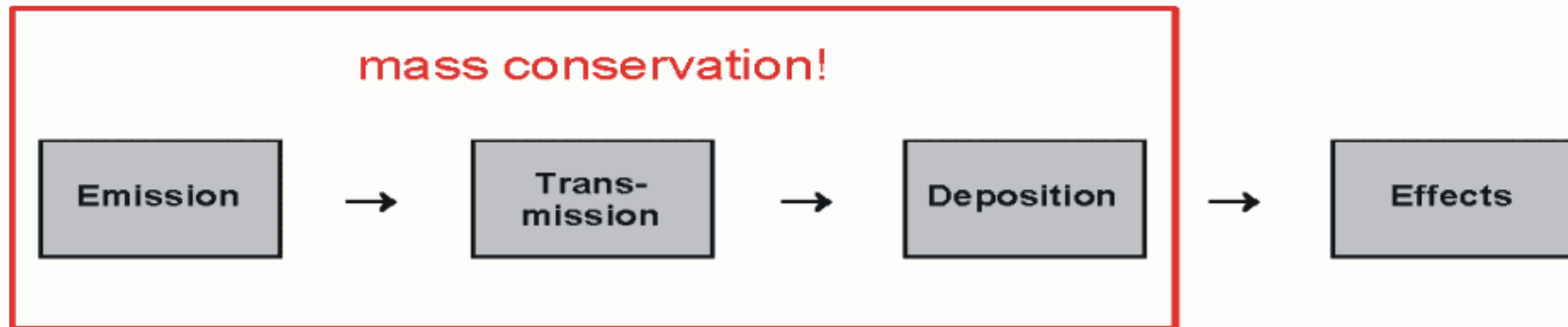
for reduced nitrogen.
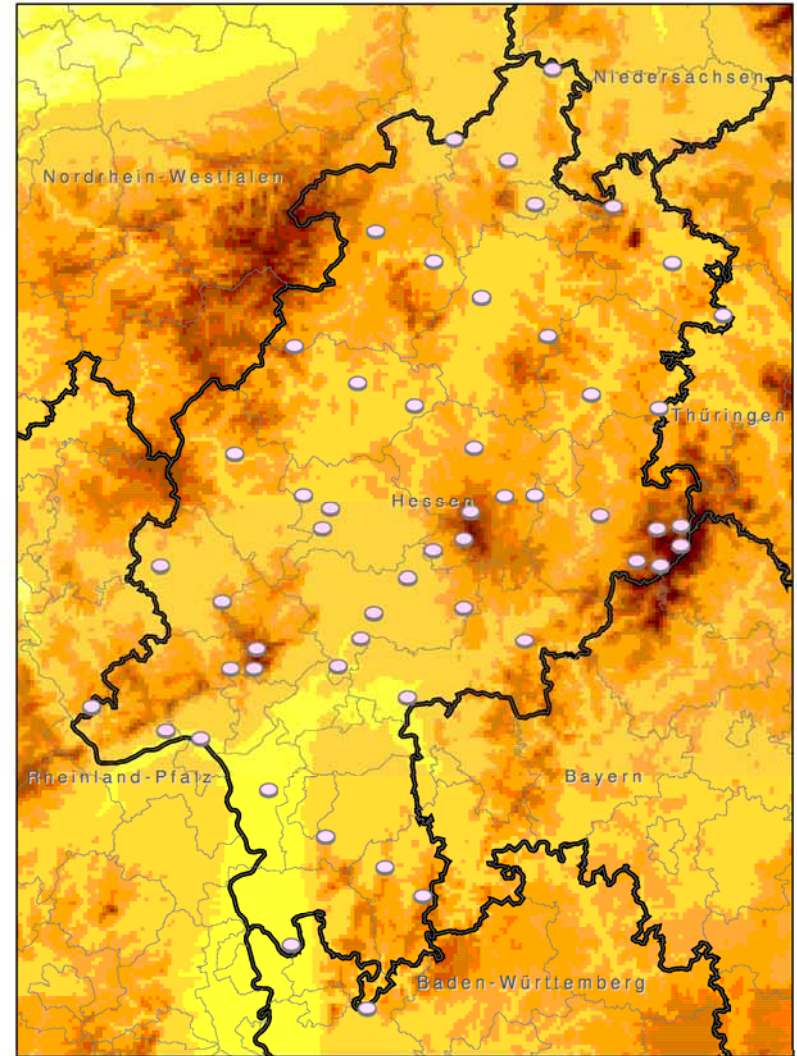
What goes in must come out!

Sources: BGR (1998); Corine Land Cover
GIS&Mapping 06/2005:
Thomas Gauger

0 25 50   100   150   200
Kilometers

Sources: BGR (1998); FAL-AOE; HLFUG
GIS&Mapping 06/2005:
Thomas Gauger

0 5 10   20   30   40
Kilometers

First steps

Emission	→	Trans-mission	→	Deposition	→	Effects

create an adequate emission inventory

gather appropriate data sets

First steps

Emission → Trans-mission → Deposition → Effects

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measure NH$_3$ concentrations for validation

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First steps

Emission → Trans-mission → Deposition → Effects

create an adequate emission inventory

gather appropriate data sets

measure NH$_3$ concentrations for validation

measure bulk deposition adequately

create adequate SVAT model

measure relevant concentrations of gases and particles

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Model used: GAS-EM

Type: mass flow model
(animal numbers, feed, performance, grazing time and intensity, housing type, storage type, application type, incorporation time)

Resolution: districts, 1 a

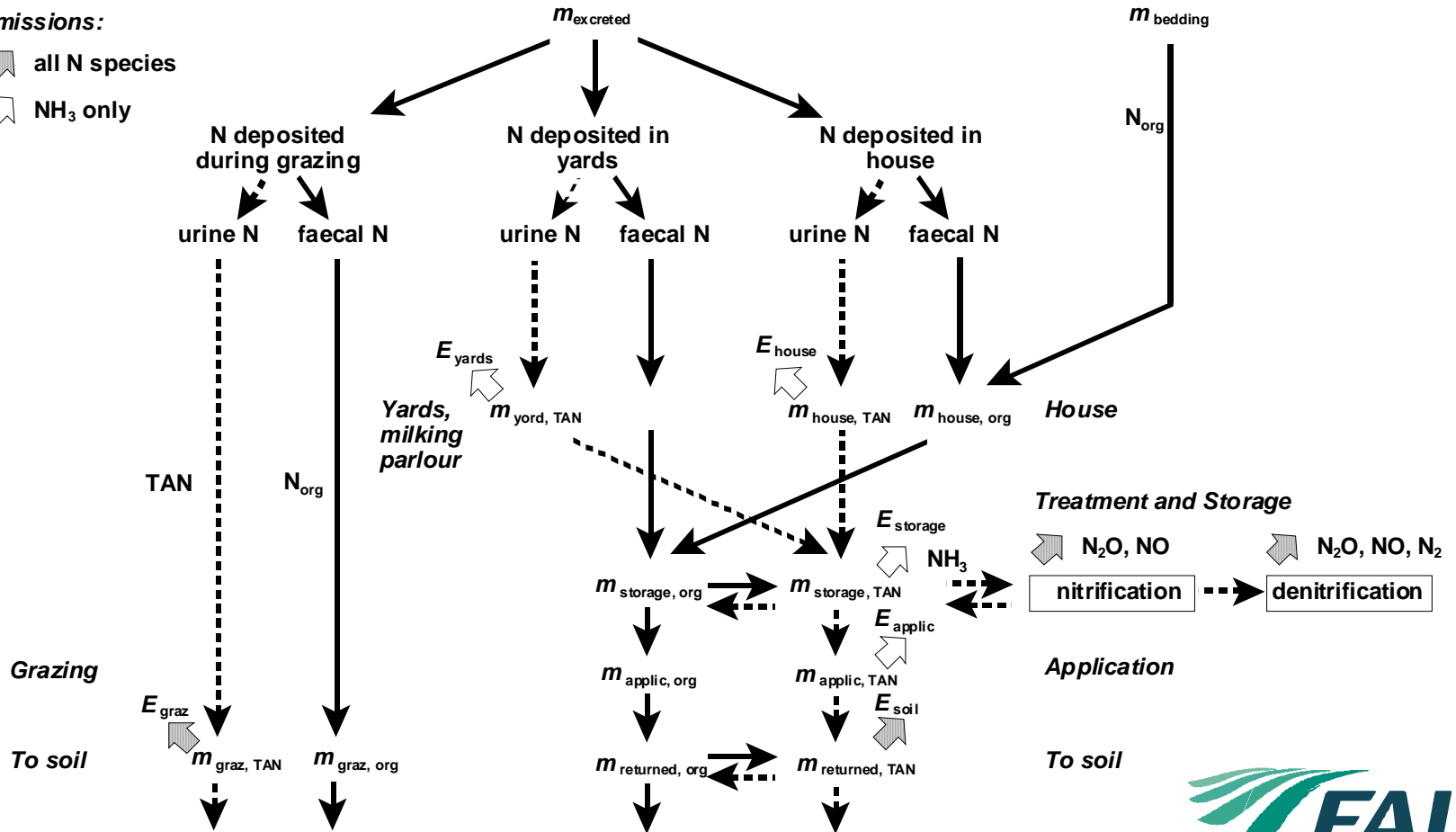Emissions: NH_3, N_2O, NO, N_2, CH_4, NMVOC, PM

Year considered: 2003

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The general procedure

Emissions:

all N species

NH_3 only

$m_{excreted}$

$m_{bedding}$

N_{org}

N deposited during grazing

N deposited in yards

N deposited in house

urine N faecal N

urine N faecal N

urine N faecal N

E_{yards}

E_{house}

Yards, milking parlour

$m_{yord, TAN}$

$m_{house, TAN}$ $m_{house, org}$ *House*

TAN N_{org}

Treatment and Storage

$E_{storage}$

NH_3

N_2O, NO N_2O, NO, N_2

$m_{storage, org}$ $m_{storage, TAN}$

nitrification denitrification

E_{applic}

Grazing

$m_{applic, org}$ $m_{applic, TAN}$

Application

E_{graz}

E_{soil}

To soil $m_{graz, TAN}$ $m_{graz, org}$

$m_{returned, org}$ $m_{returned, TAN}$

To soil

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Emission explained (emission densities in kg ha^{-1} a^{-1} NH$_3$, results for 2003)
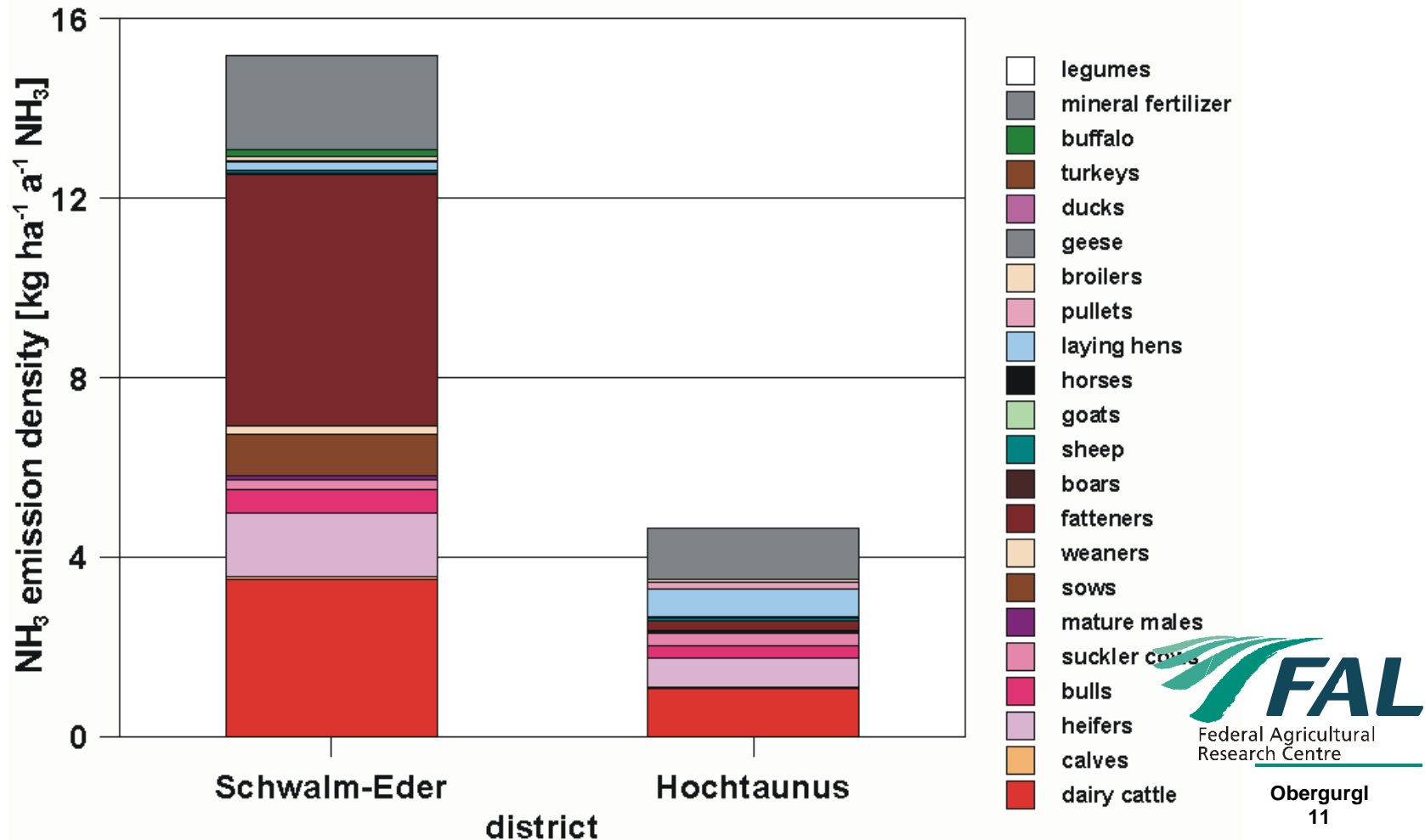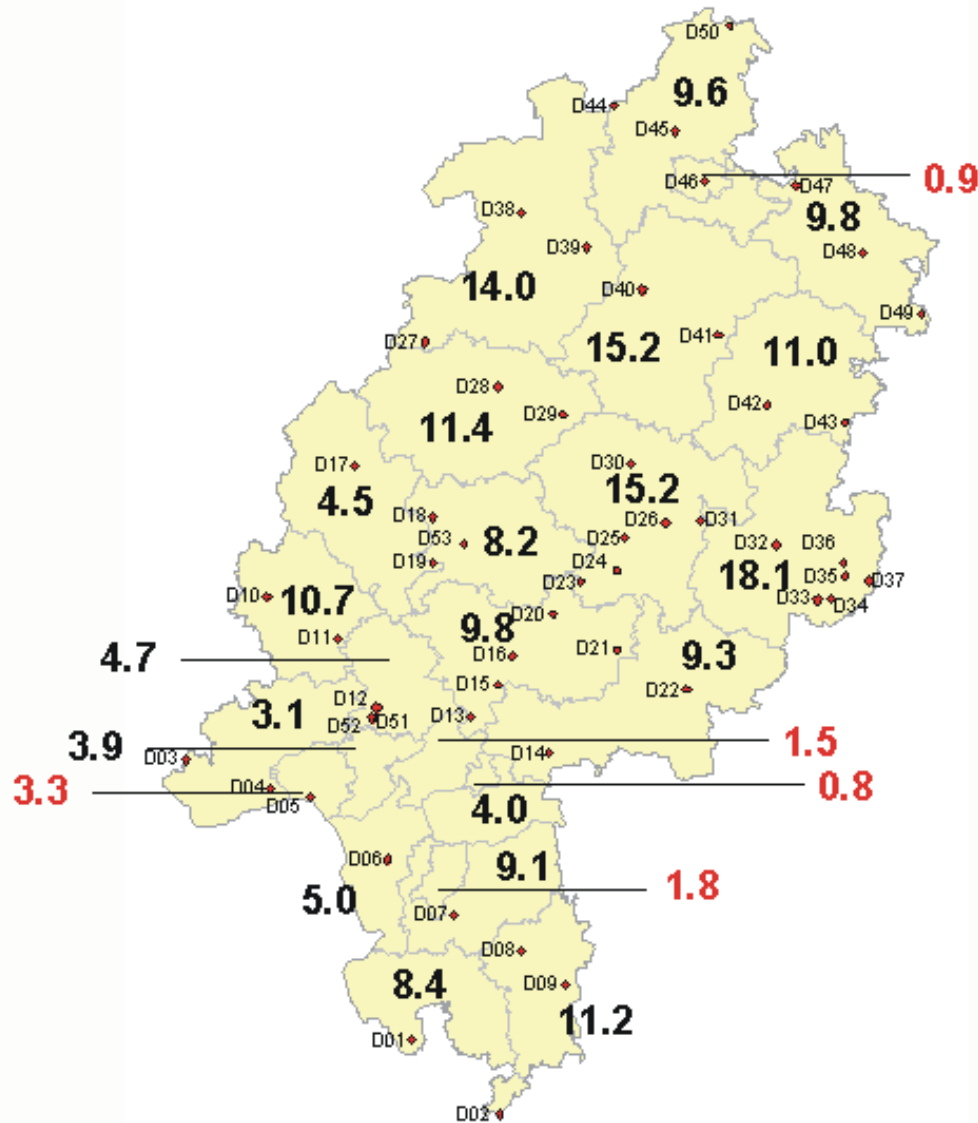
Emission densities in kg ha^{-1} a^{-1} NH$_3$

regional distribution (2003)

(red: urban districts)

KAPS Denuder filter equipment at Linden (NH_3, HNO_3, SO_2, NH_4, NO_3, SO_4)

all other sites
IVL passiv samplers (NH_3)

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Weekly means (days and nights, two replicates) at Linden

Mean concentrations ($\mu g\ m^{-3}$)

	2002	2003	2004
NH_3	2.4	2.7	2.0
HNO_3	0.9	1.0	1.0
SO_2	2.1	1.7	2.1
NH_4	2.2	1.6	2.4
NO_3	0.9	0.8	1.0
SO_4	1.3	0.9	1.1
Cl	0.7	0.6	1.4

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Annual variation of NH_3 and NH_4-N concentrations

NH$_3$

NH$_4$-N
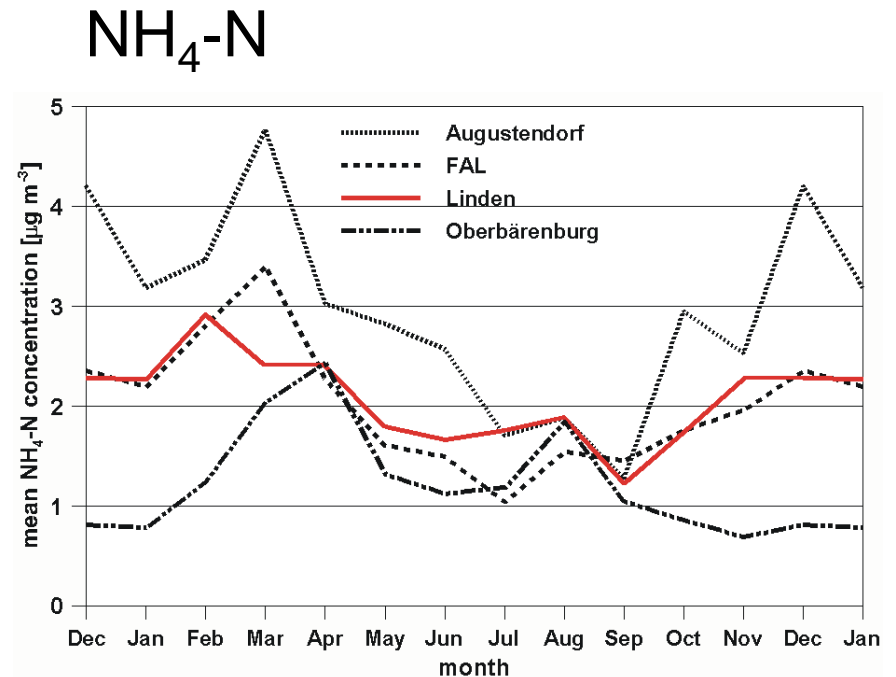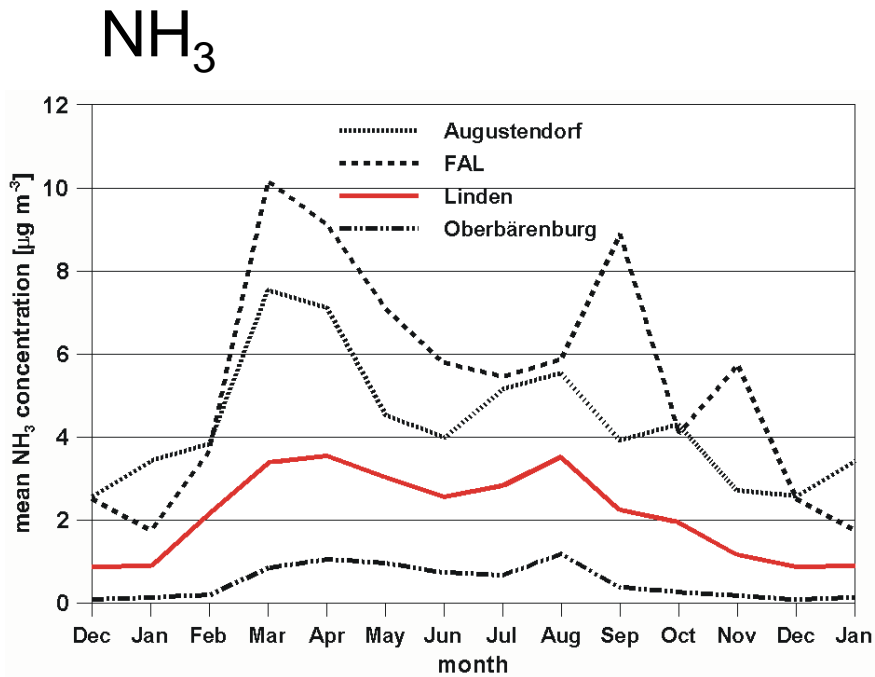
Mean concentrations obtained using passive samplers
(μg m^{-3} NH$_3$)

all data, 2002 to 2004

(1,4): 2004 only

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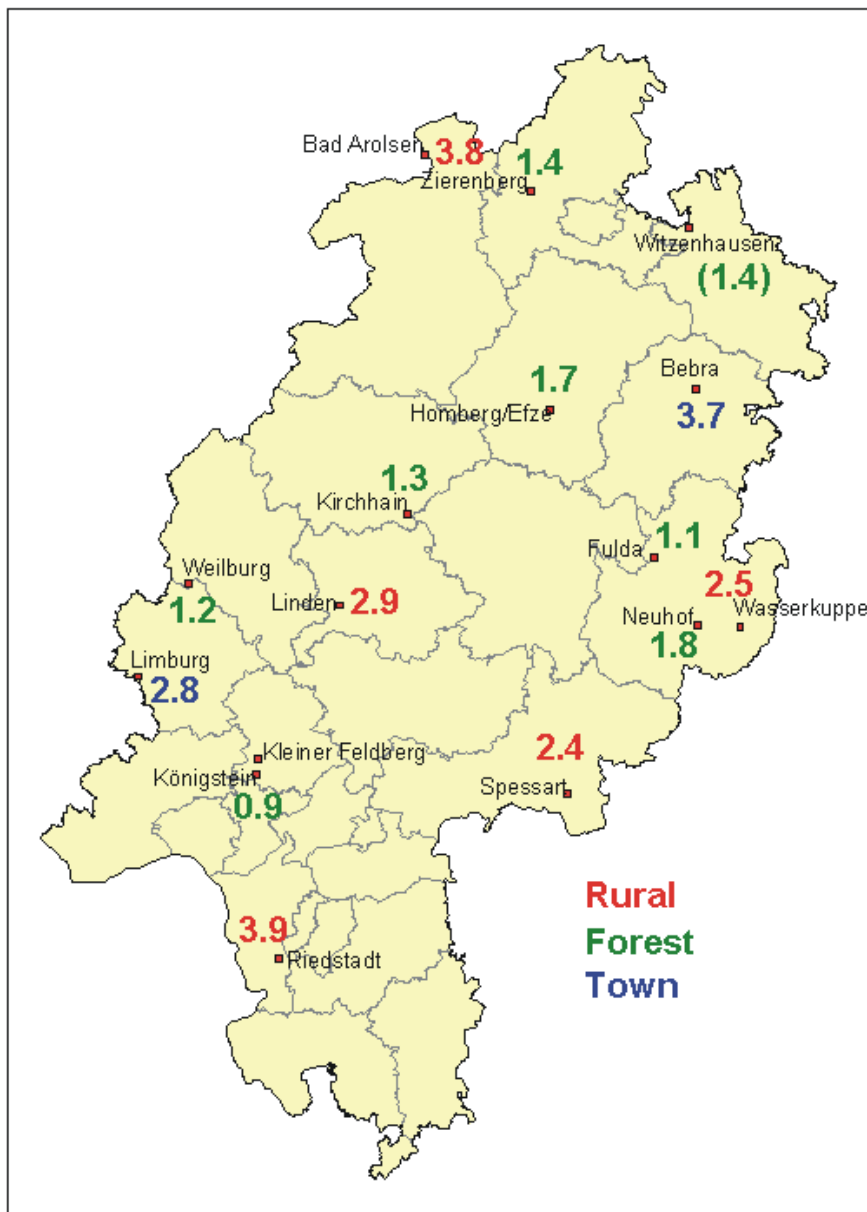
Three pairs of stabilized samplers at each location

monthly sampling 2002 to 2004

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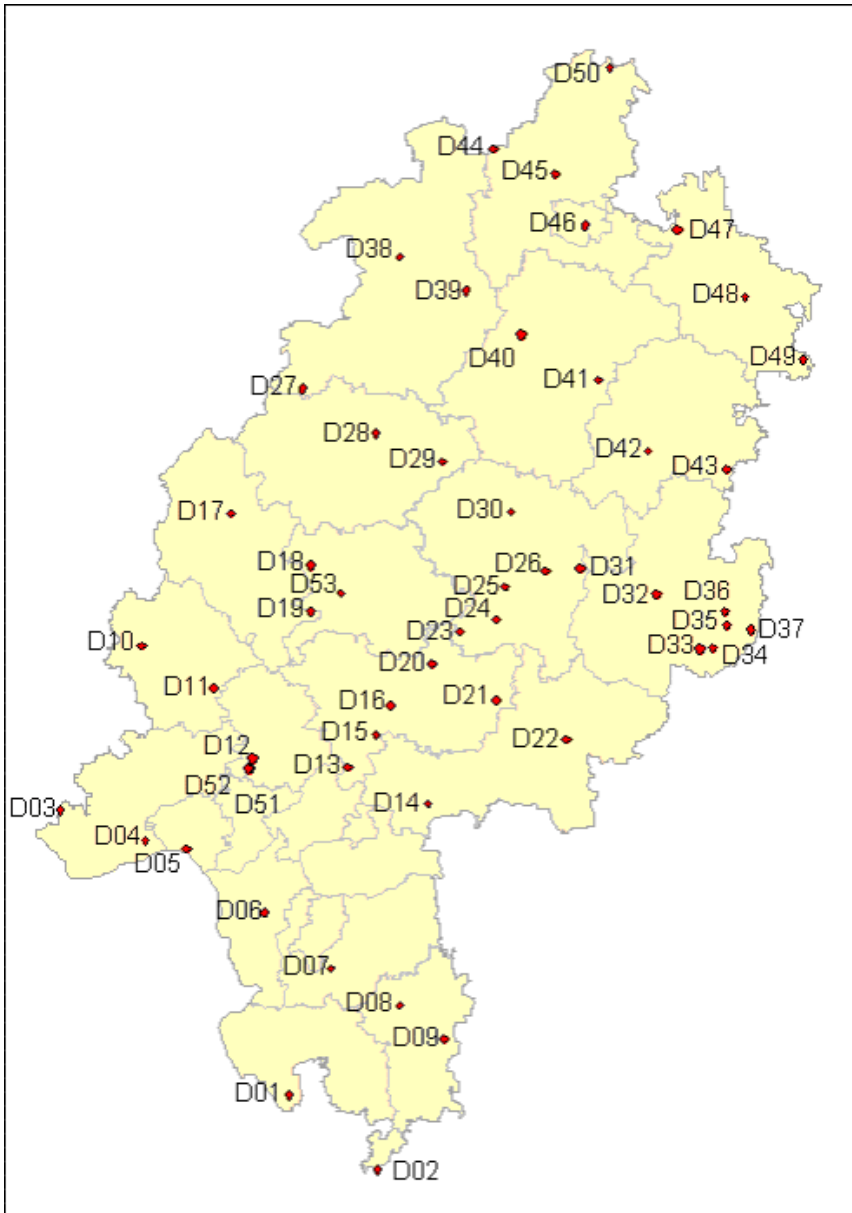
NH4-N bulk deposition
(kg ha^{-1} a^{-1} NH$_4$-N)

2002 to 2004

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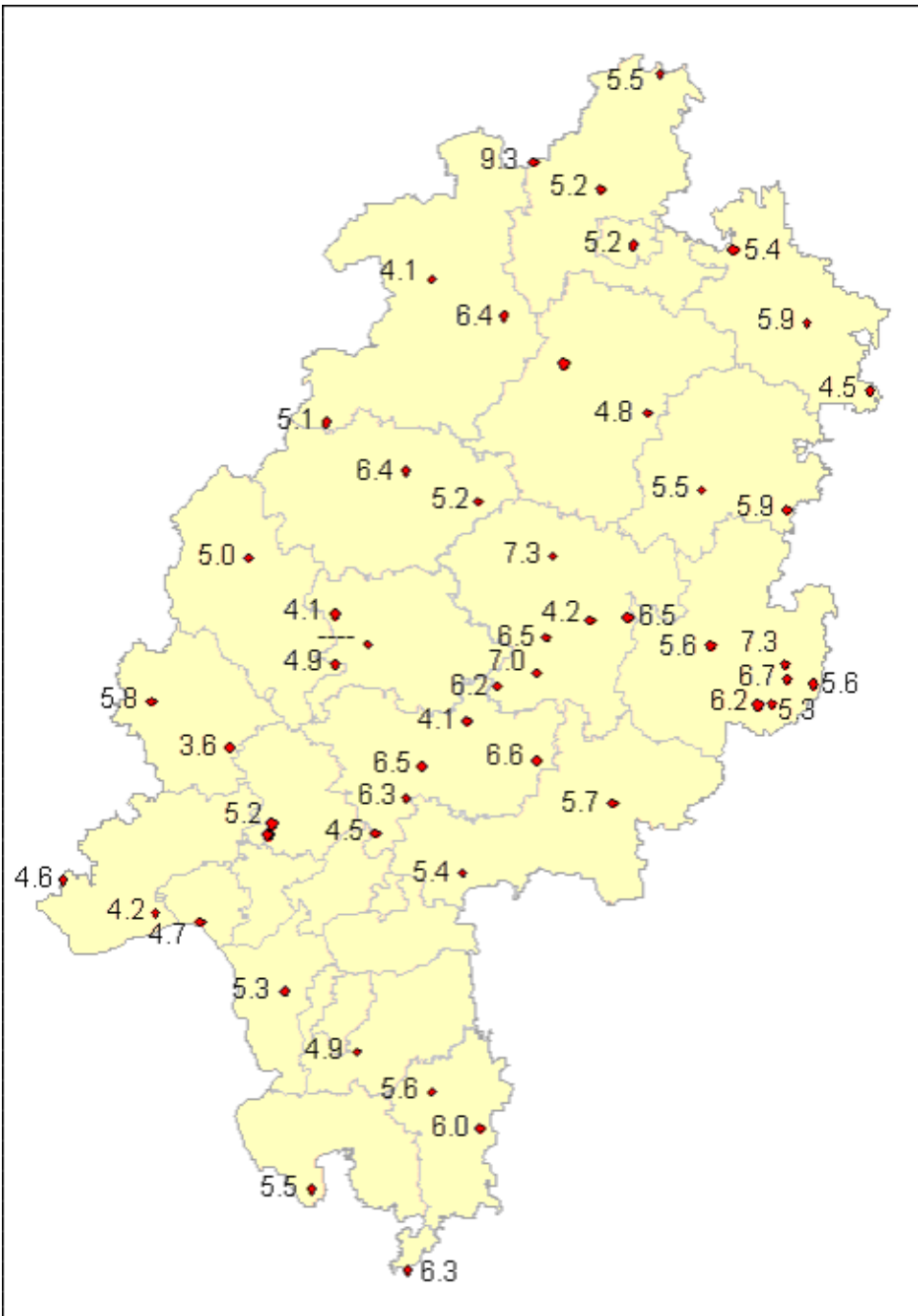
precipitation and deposition
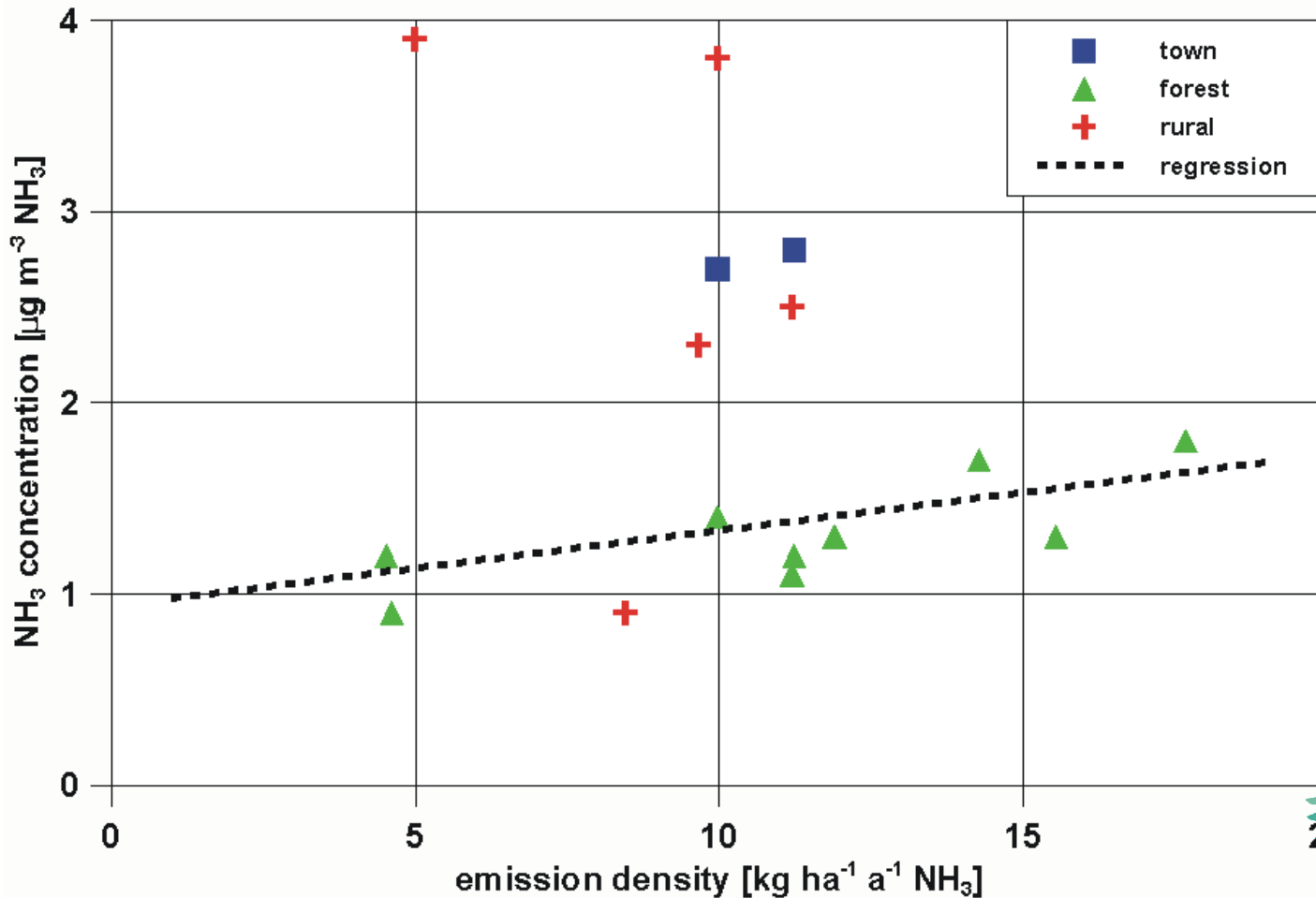

Deposition: $R^2 = 0.08$; concentration: $R^2 = 0.2$
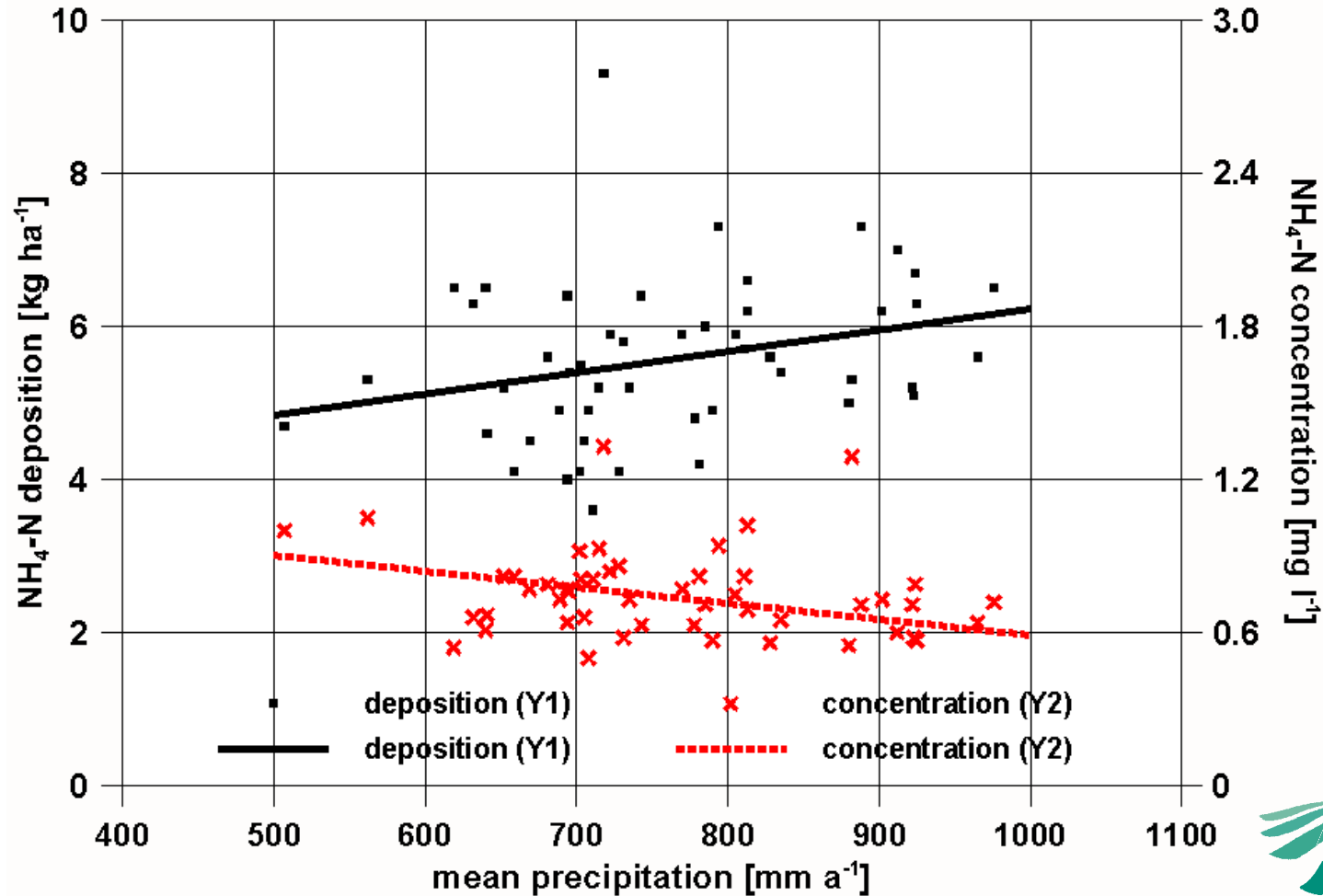
(1) emission and deposition (related to districts, 2003)
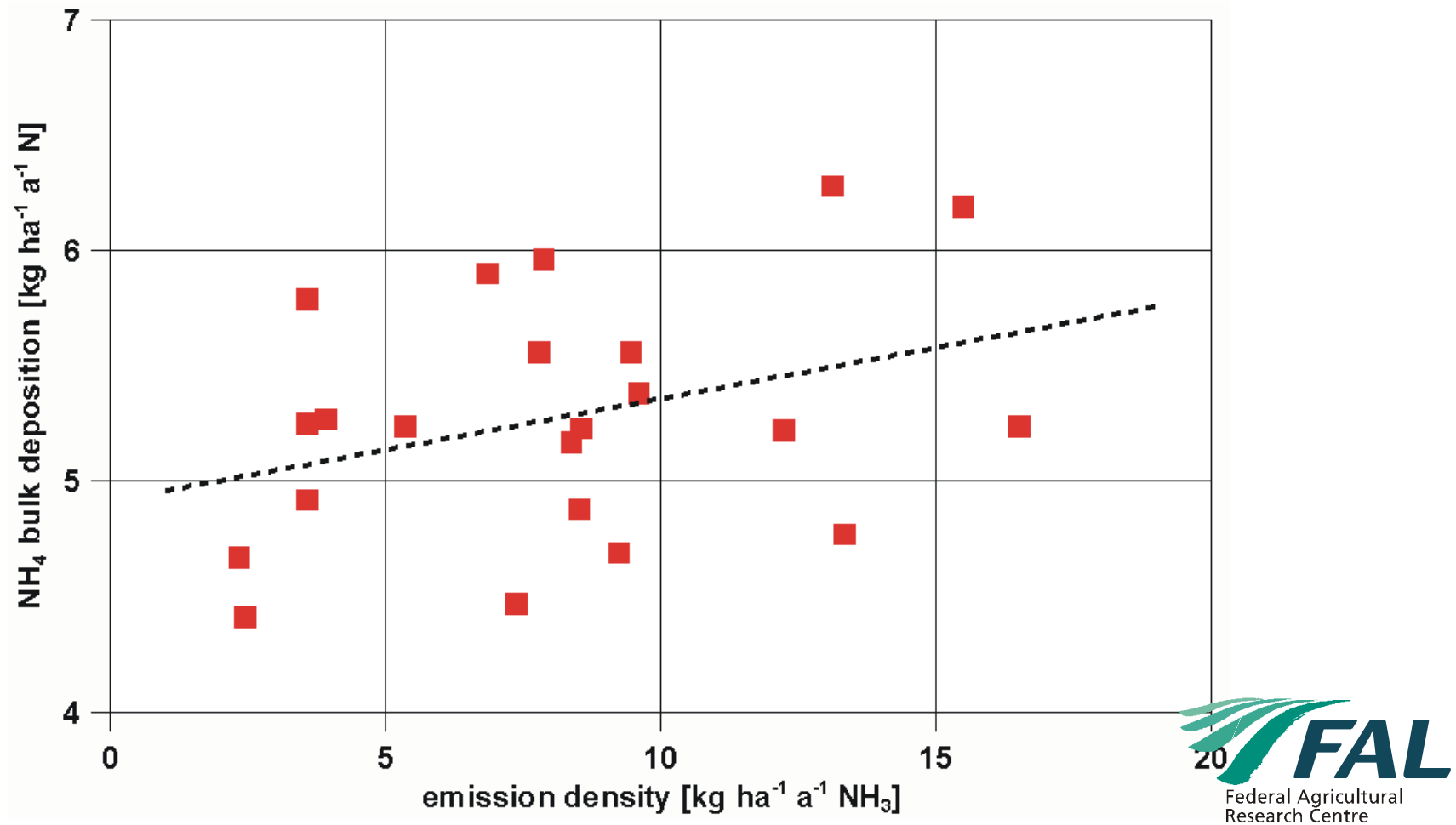
Deposition: $R^2 = 0.15$

(2) emission and concentration (related to districts, 2003)

Concentration: $R^2 = 0.58$

- write a detailed report

- give the data to the modellers

  (and watch them play and relax)

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Thank you for your attention

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