ECN

Energy research Centre of the Netherlands

cost

Dutch activities in ammonia emission research

COST729 MC 23-25 April, Lisboa

A. Bleeker & J.W. Erisman

Main ammonia activities

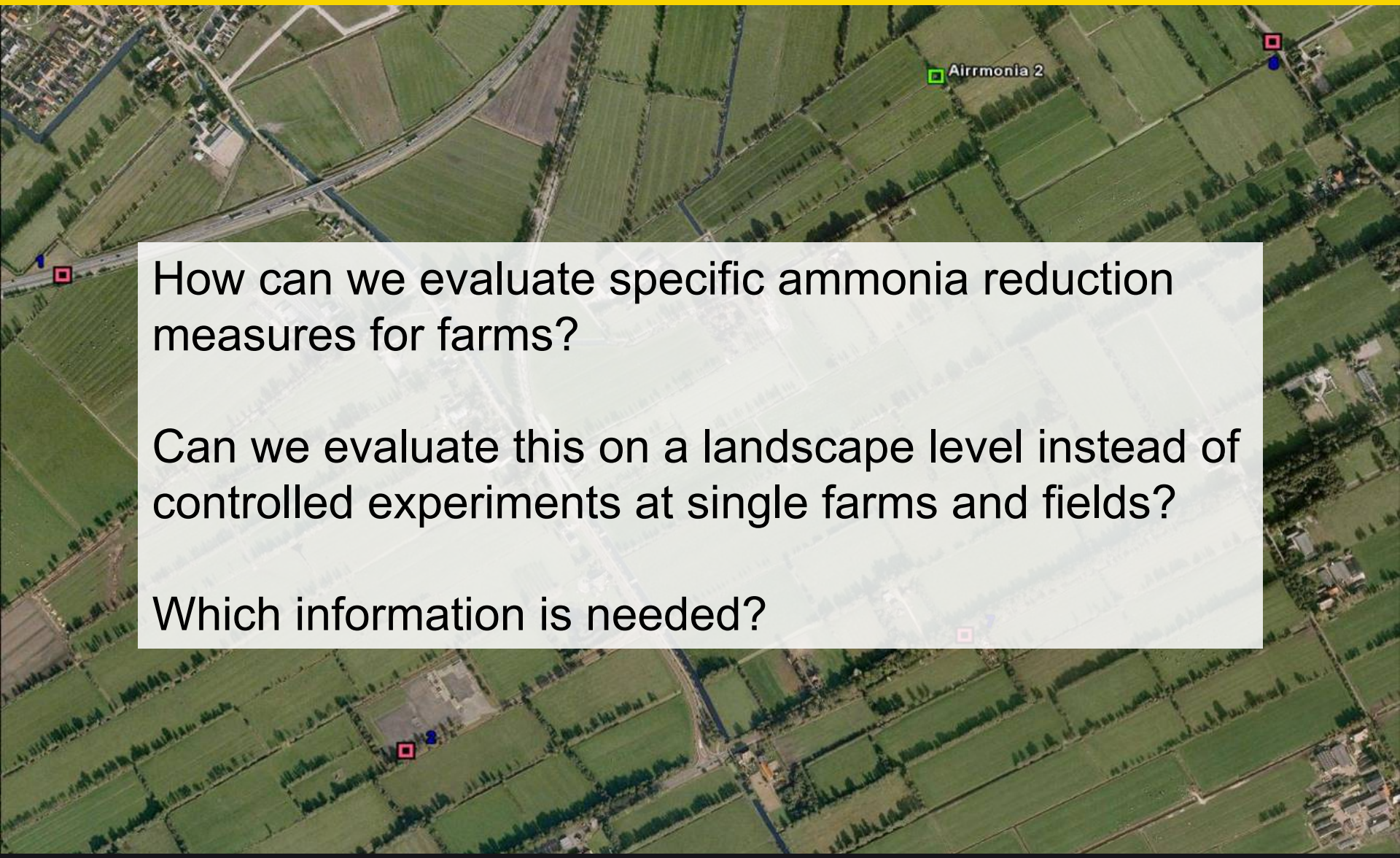
- Trend measurements of NH_3/NH_4 in different regions
  - Concentrations
    - Netherlands – 8 sites (RIVM – national monitoring network)
    - Two regions in North and South – multiple passive sampler sites
  - Rain Water
    - Netherland – 15 sites (RIVM – national monitoring network)
  - Aerosol
    - Netherland – 5 sites (RIVM – national monitoring network)
  - Throughfall
    - Netherland – 5 sites (ECN)
- Emission research related to:
  - 'ammonia gap'
  - setting region specific targets
- Relation between N-flux and GHG emissions

NitroEurope IP

Noardelike Fryske Wâlden

rivm Rijksinstituut voor Volksgezondheid en Milieu

ALTERRA WAGENINGEN UR



How can we evaluate specific ammonia reduction measures for farms?

Can we evaluate this on a landscape level instead of controlled experiments at single farms and fields?

Which information is needed?

Evaluation of reduction measure ?

Aim Dutch Policy:

- Reduction NH_3 emissions from each individual source (housing, storage, **fields**)

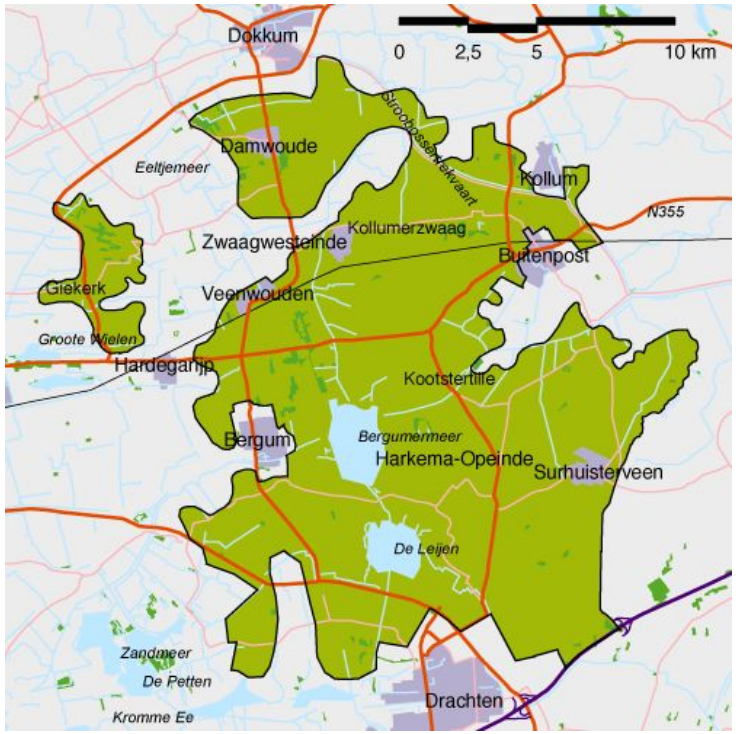
Reduction measures for **field** sources:

- **Manure application** by “low emission” application techniques.
  - Shallow injection in “trenches”
    (80% reduction / 10% volatilization ???)

- Is this right and are there no other measures possible?
  - Broadcast spreading and low N-feeding?
    (also 80% reduction, similar to injection???)

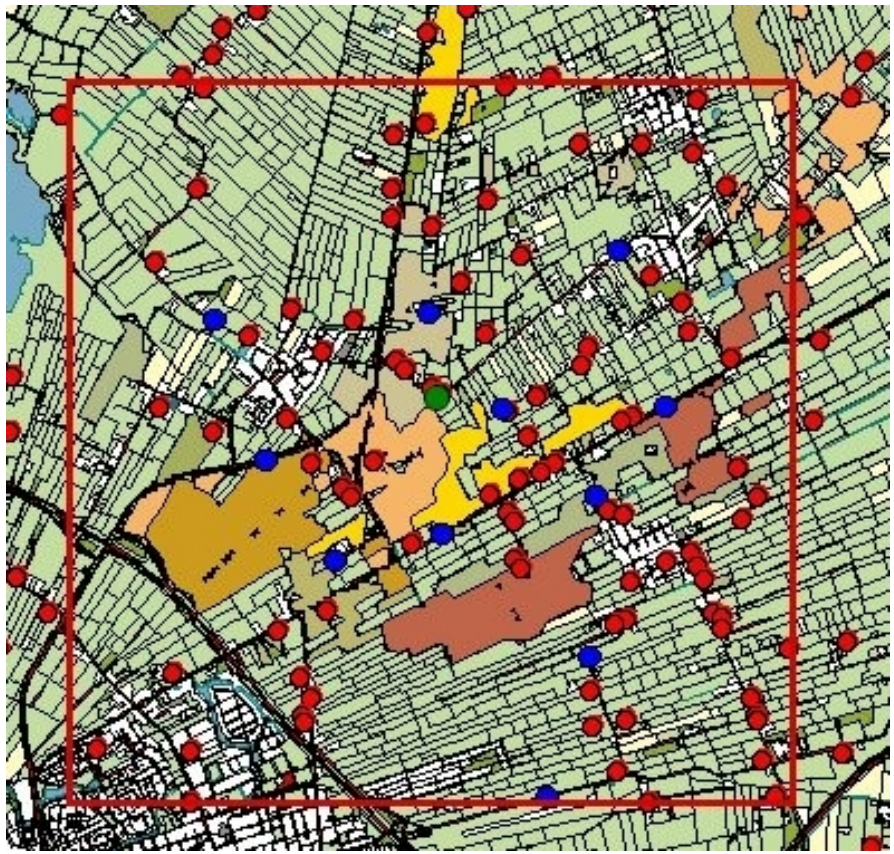
Research Location

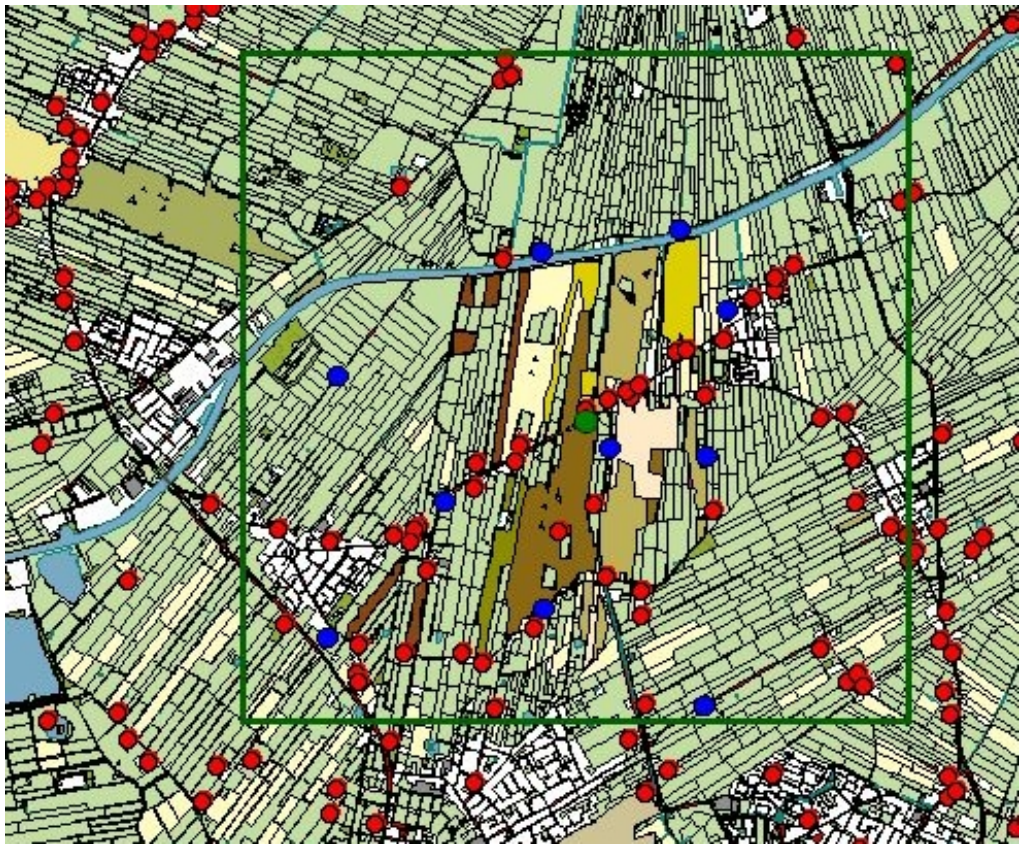
Noardlyke Fryske Wâlden



Noardelike Fryske Wâlden

Research Location





Reference Area:

Shallow Injection

Alternative Area:

Broadcast Appl.

Approach: Source – Receptor coupling

Sources:

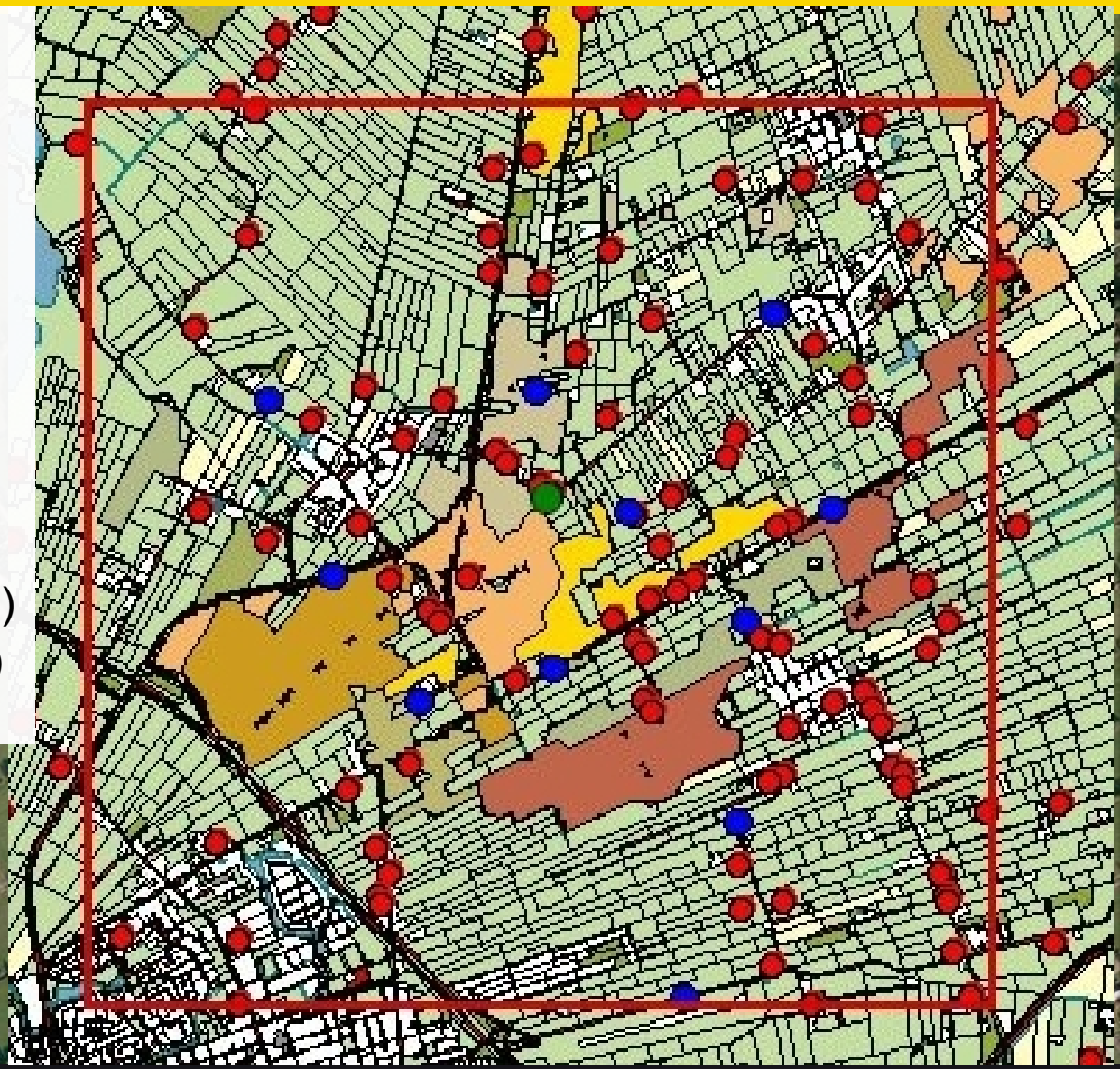
- Farm Housing (red dot)
- Fields (Manure Application & Grazing)

Receptors:

- Airrmonia (green dot)
- Passive samplers (blue)

Coupling: (2 steps)

- Emission model (Huijsmans)
- Dispersion model (OPS-ST)



Step 1: (First) Emission determination

Housing:

- Farm database (GIAB)

- Livestock categories
- Livestock numbers
- Stable type

Fields:

- Field database (BRP)
- Farm management
  "(Grassland calender)"

- NH_3 emission from emission & excretion factors.

- Manure / Fertiliser application
- Grazing
  (amount, timing, N-content)

- NH_3 emission from emission model & meteo conditions

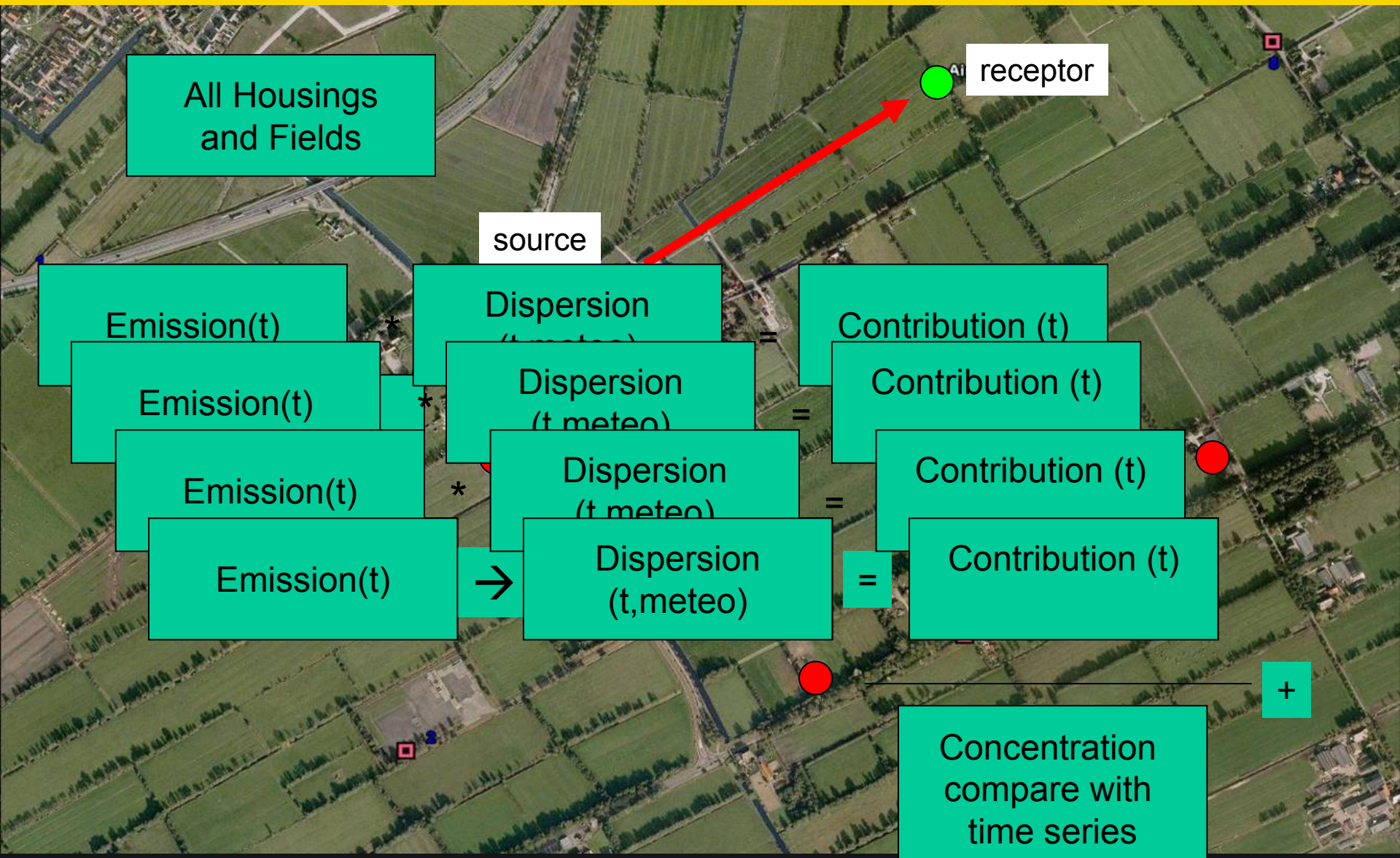
Emission factors

- Much discussed in the context of ‘ammonia gap’
  - Initially difference between emission / concentration trends
  - Later difference between modelled / measured concentrations
- Indications that difference is caused by:
  - Wrong emission factors (spreading of manure)
  - Problems with dry deposition modelling (e.g. issues like compensation point)

Research on emission factors

- Measurement campaigns to get better insight in the open field emissions after manure application
- Involved parties:
  - ECN, RIVM, TNO, WUR
- Comparison between:
  - WUR Emission model results
  - Measurements
    - TDL (ECN)
    - Lidar (RIVM)

Step 2: Dispersion



Compare with receptor NH_3

Airrmonia

Passive Sampler

‘Field’ emission model (Huijsmans)

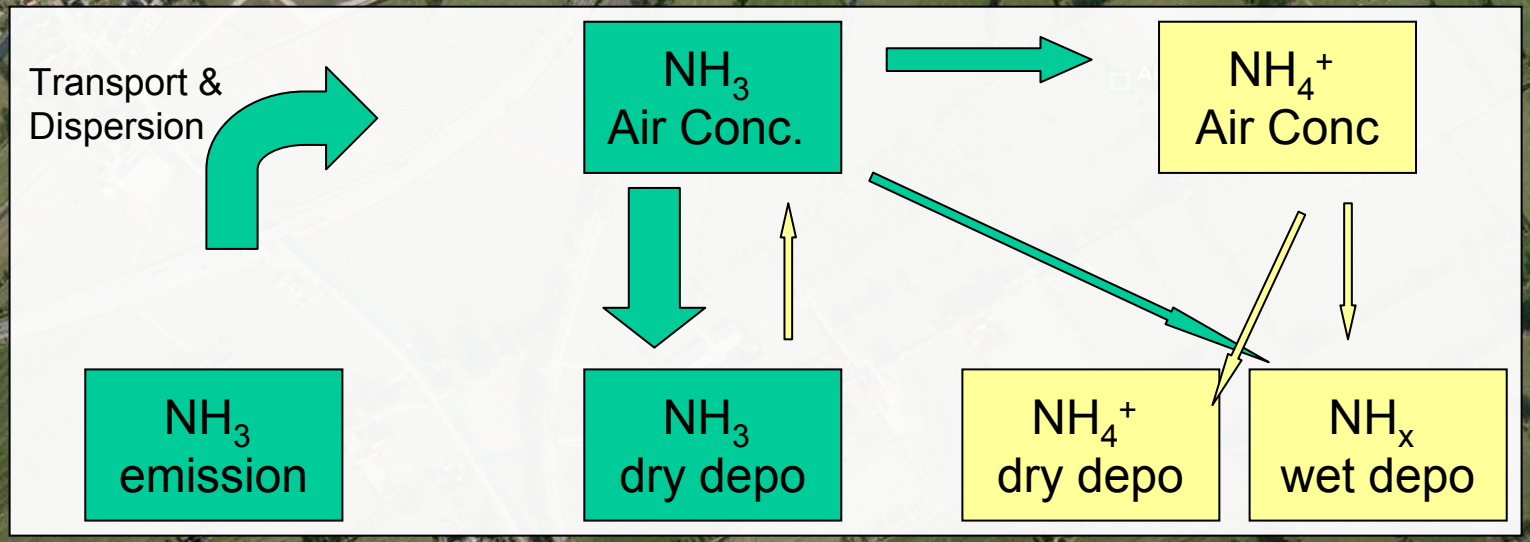
Regression model:
For specific application on grassland fields

Volatilization dependent on:
1. Manure properties (TAN content: NH_4^+ +NH_3)
2. Application rate
3. Weather conditions (T, RH, U, R_s)

for shallow injection:

$$\ln z_t = \alpha 0 + \alpha_t \ln(t) + \alpha_1 \mathit{TAN} + \alpha_2 \mathit{rate} + \alpha_3 \mathit{wind} + \alpha_4 \mathit{radiation} + \alpha_5 \mathit{temp}$$

Dispersion model (OPS-ST)

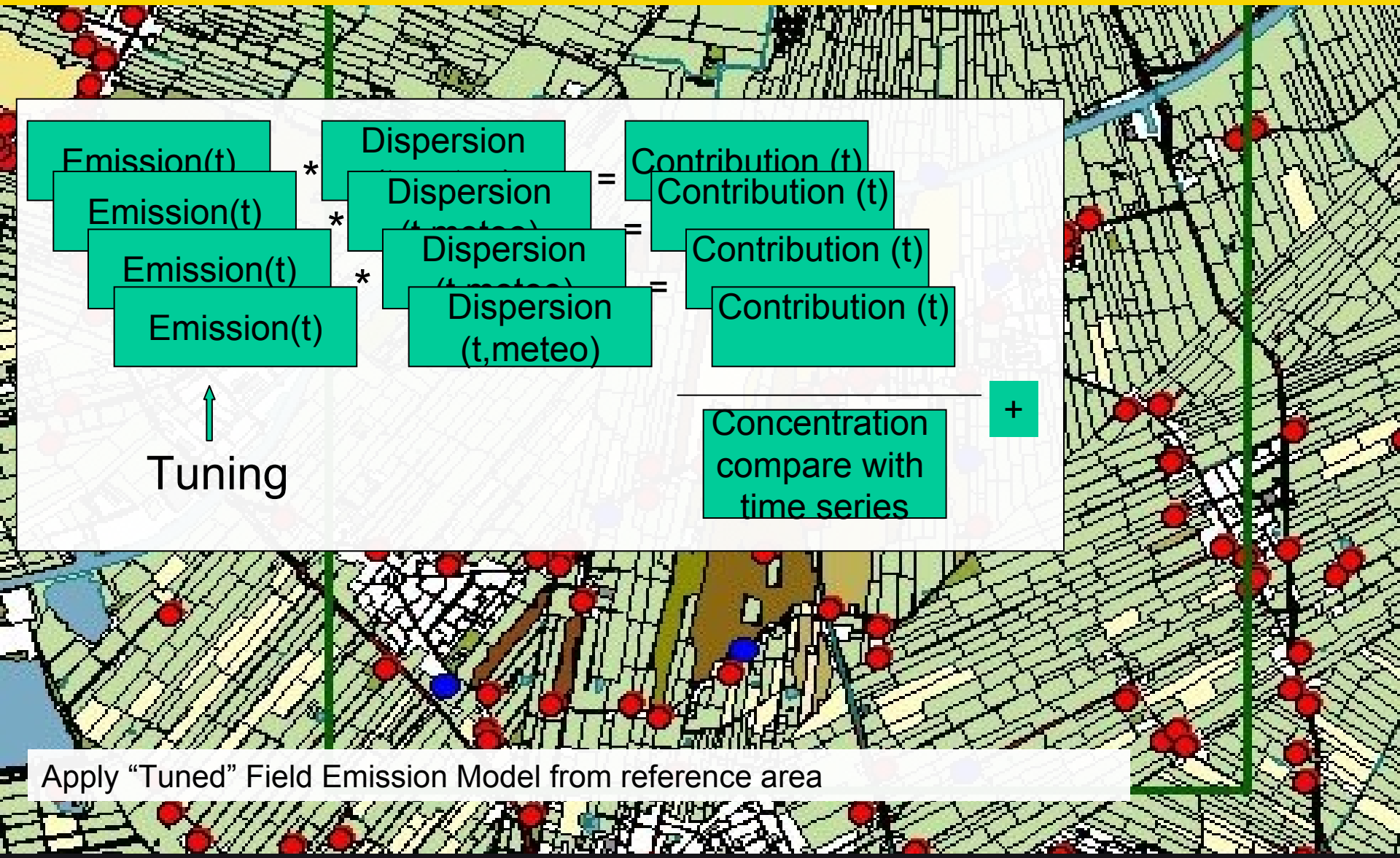


Analytical model:

Dispersion from a source by Gaussian Plume model
Dispersion and Transport are function of height and transport distance

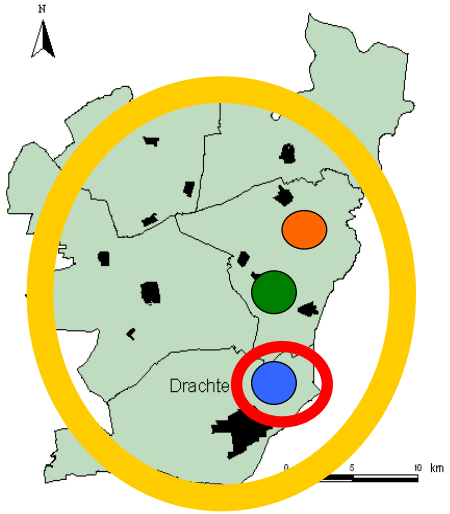
Needs: U,Udir,T … → Emission height & Turbulence important

Result: “Tuned” Field emission model



Apply “Tuned” Field Emission Model from reference area

Overview

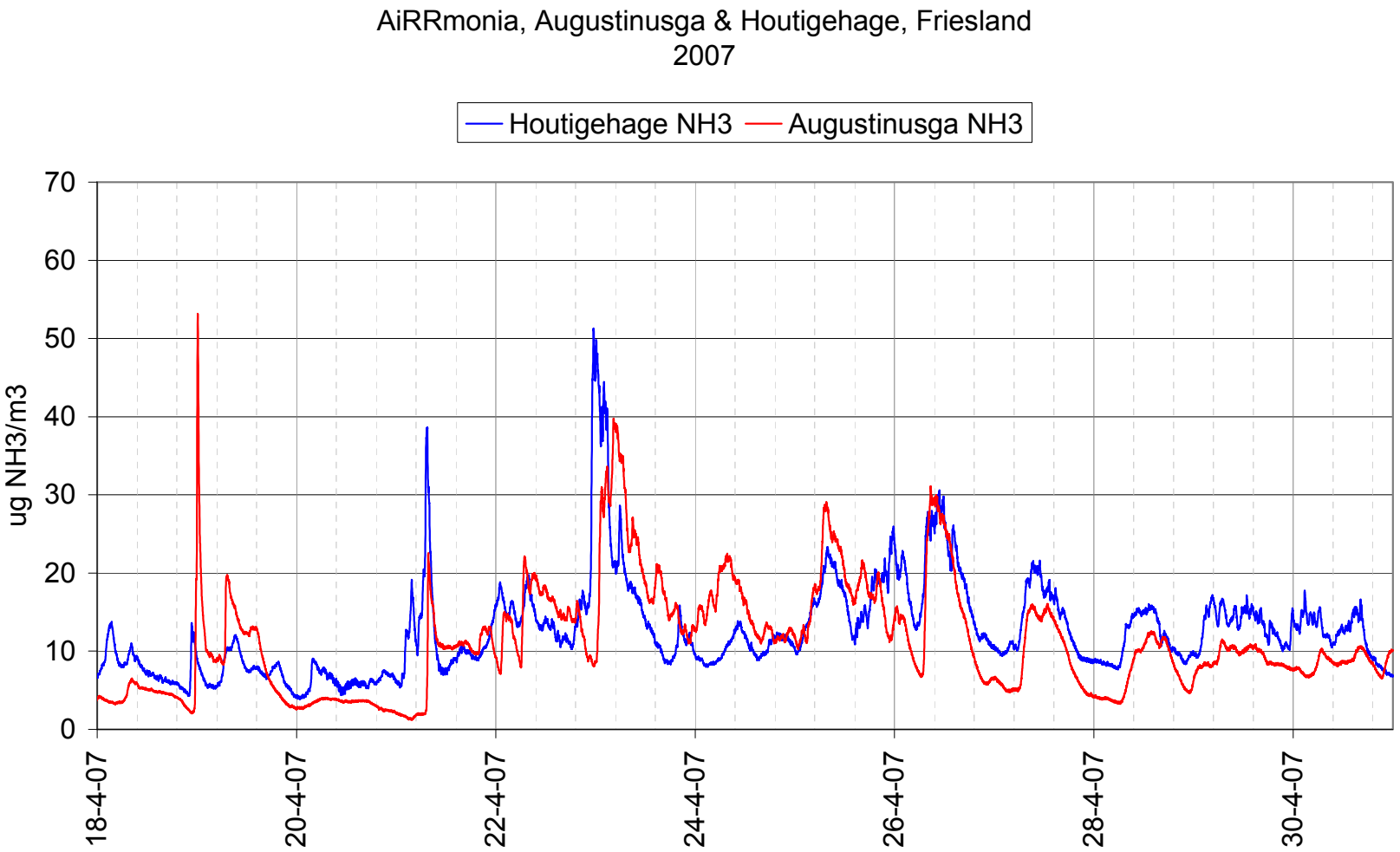


- Spatial and Temporal monitoring of Ammonia
  - Passive samplers (*monthly & spatial*)
    - 10 * Sand area alternative spreading
    - 10 * Sand area normal spreading
    - 10 * Clay area alternative spreading
    - 30 * NFW total area
    - Nitro Europe Landscape scale

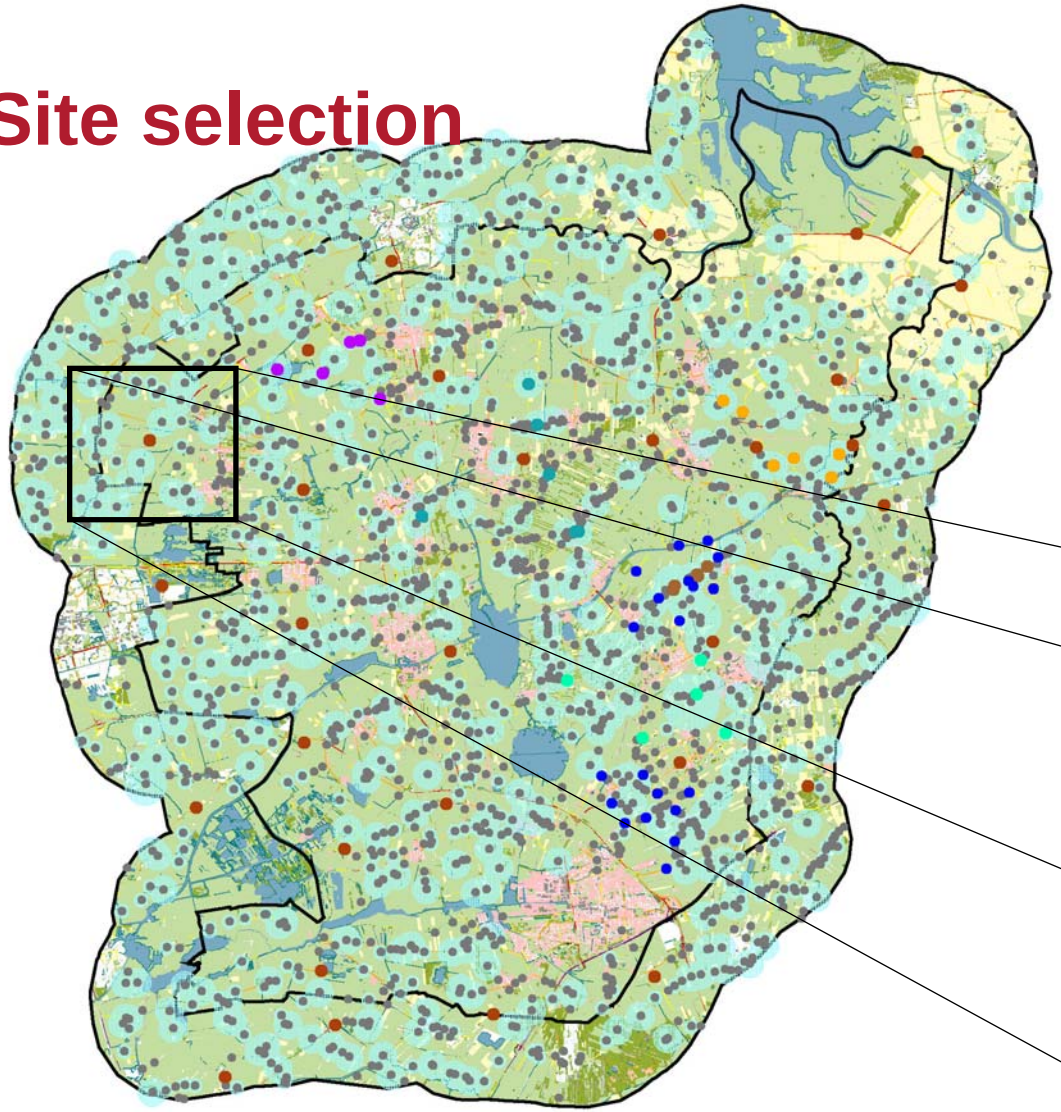
  - *Airrmonia* (*half hourly; so larger temporal distribution*)
    - Sand area alternative spreading
    - Sand area normal spreading

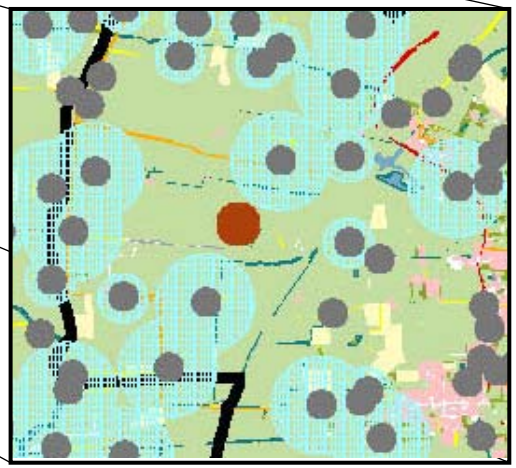
  - Campaign with measurements car (TDL)
    - Spatial variation in short periods

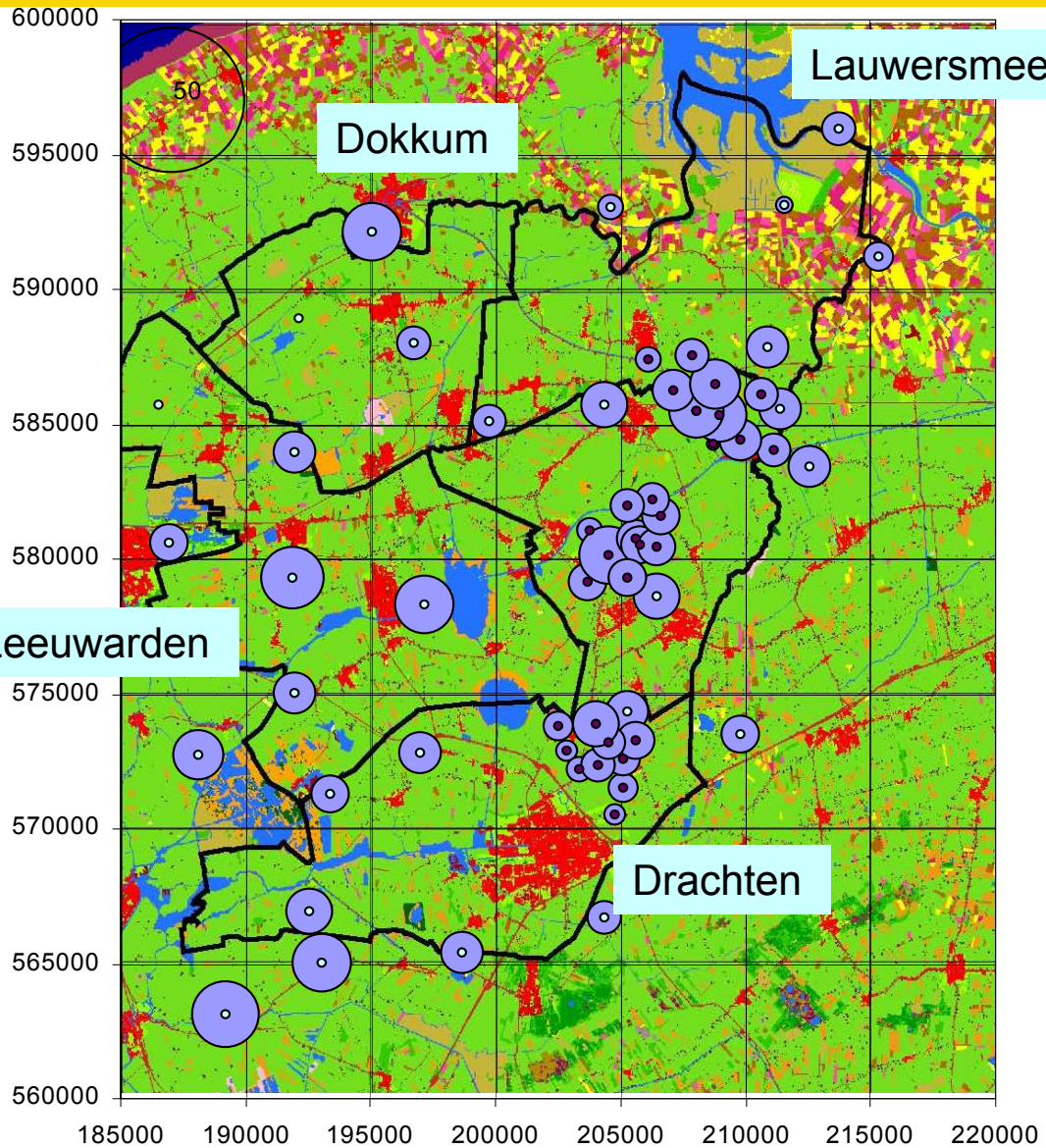
Measurements: Airrmonia



Site selection

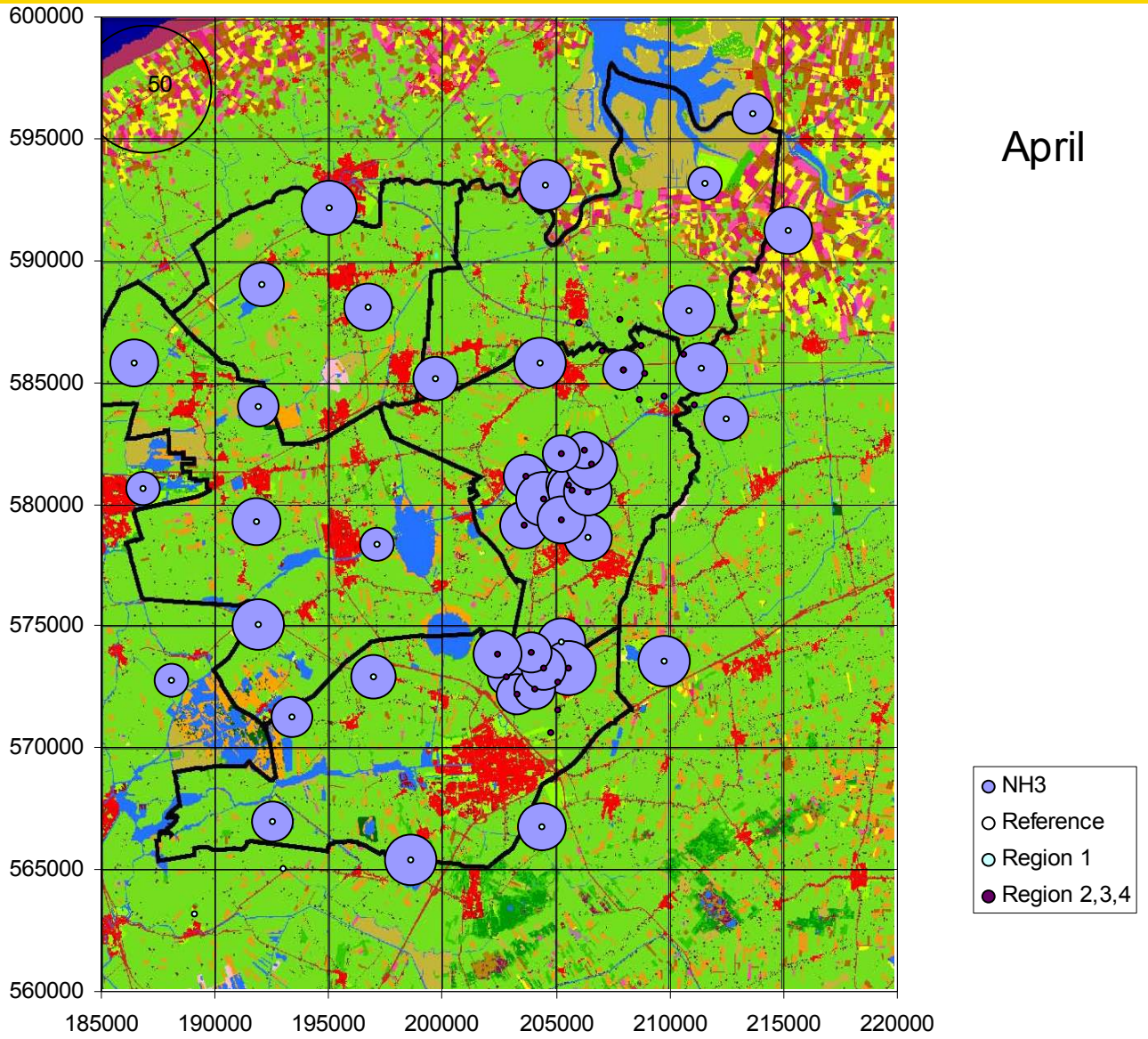






3MG

December



3MG

April 2006

9 °C

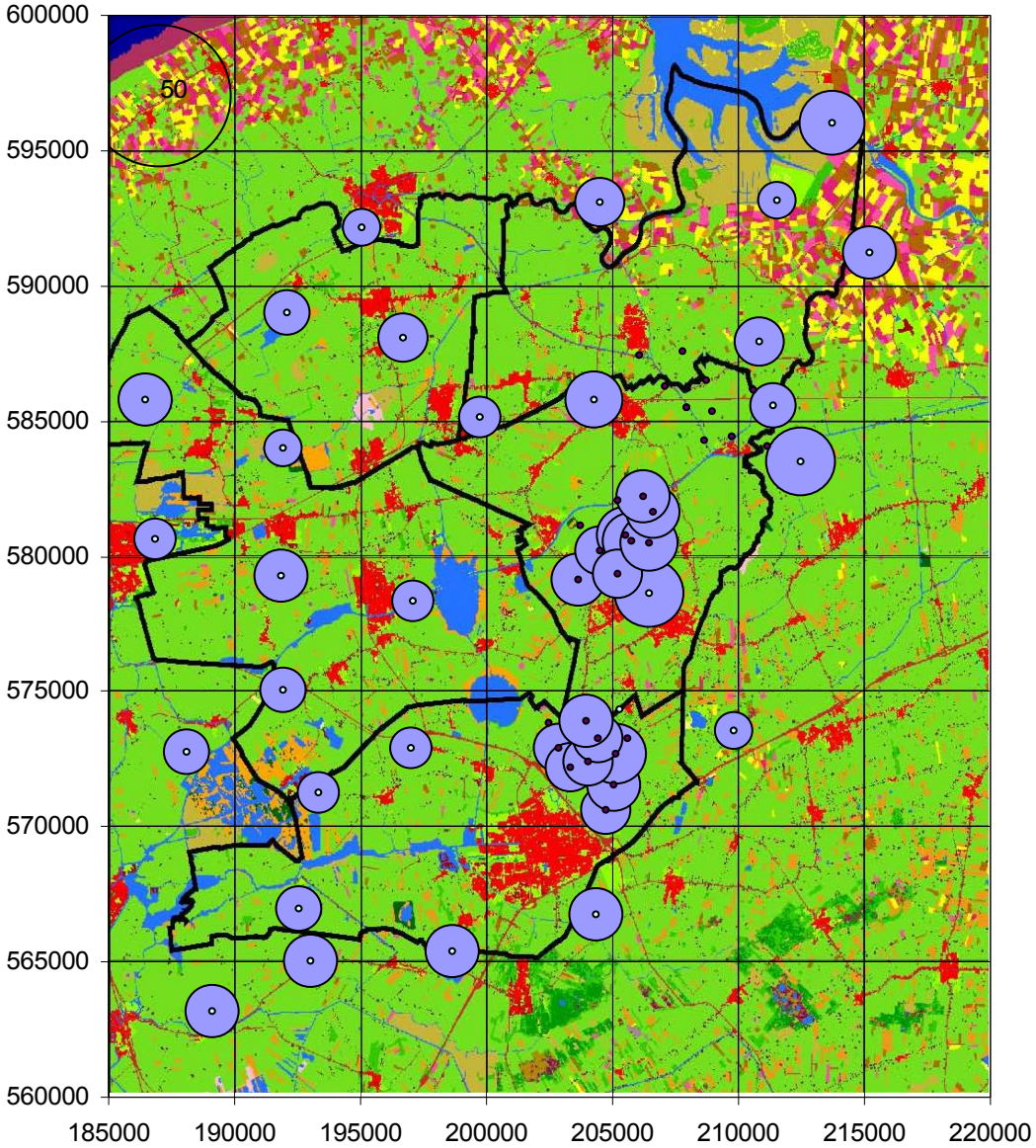
norm=8.3

37 mm

norm=44

3MG

May 2006



14.5 °C

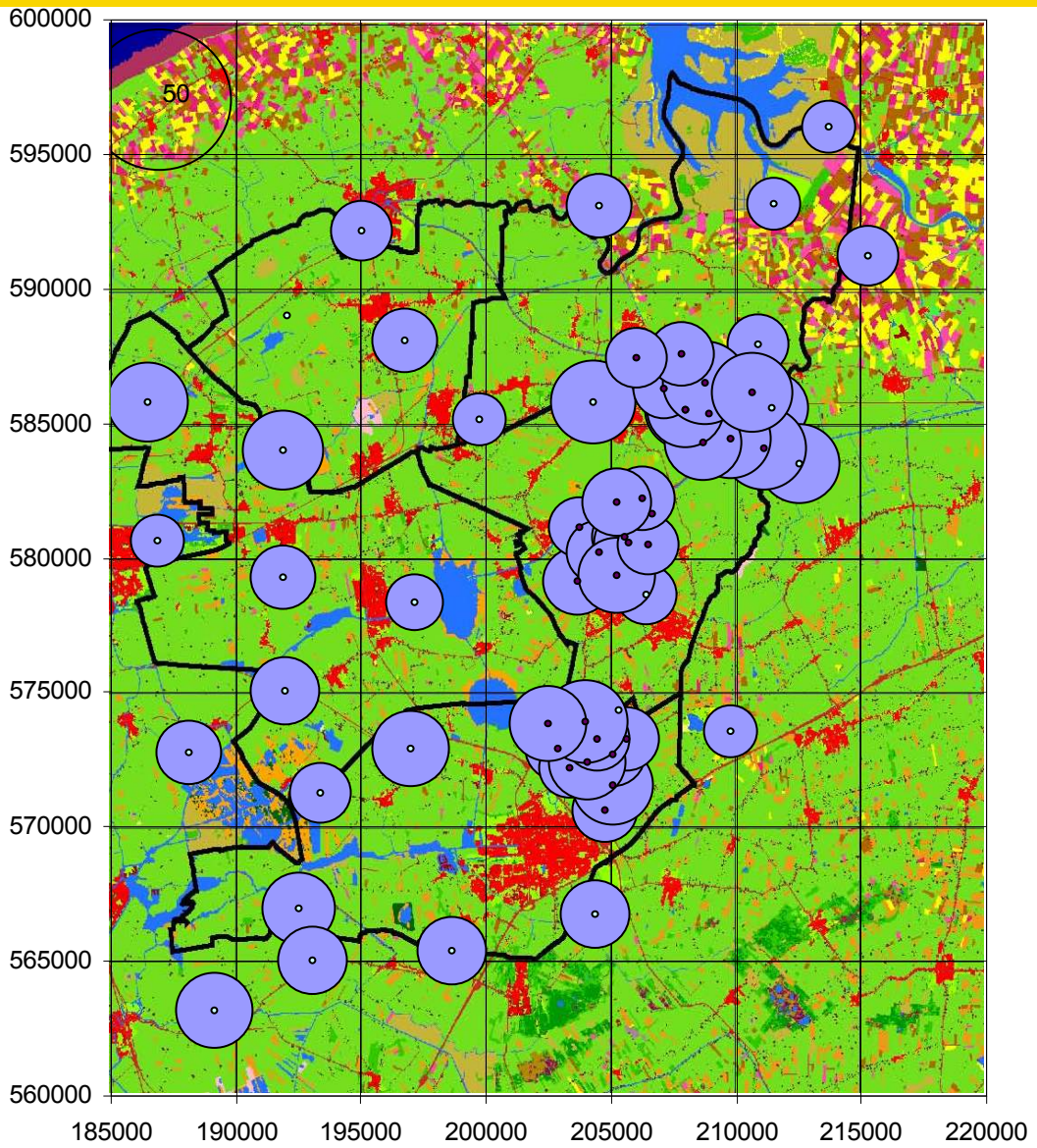
norm=12.7

88 mm

norm=57

3MG

June 2006



16.7 °C

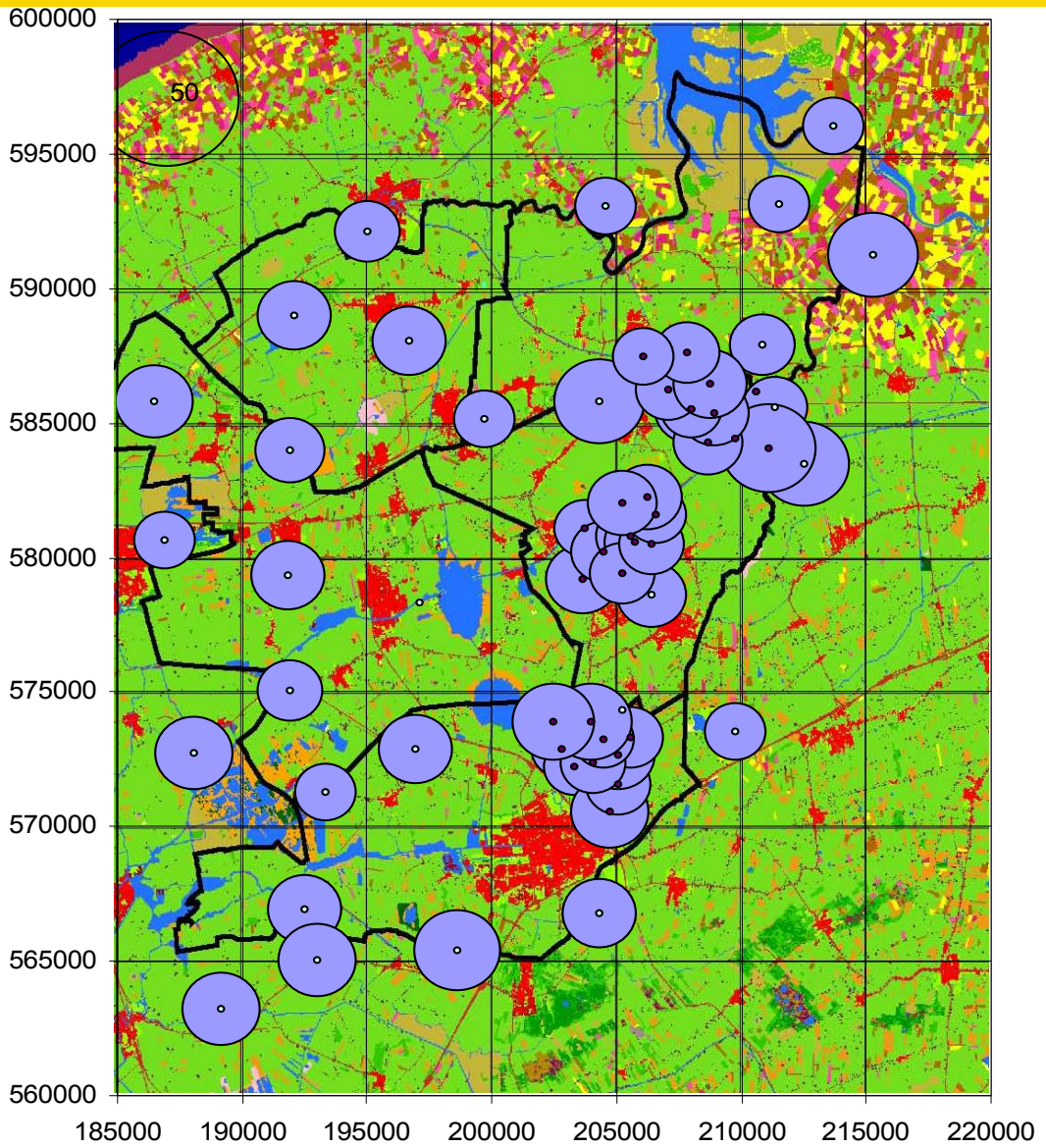
Norm=15.2

28 mm

Norm=71

3MG

July 2006



22.3 °C

norm=17.4

29 mm

norm=70

3MG

August 2006

"Natste oogstmaand

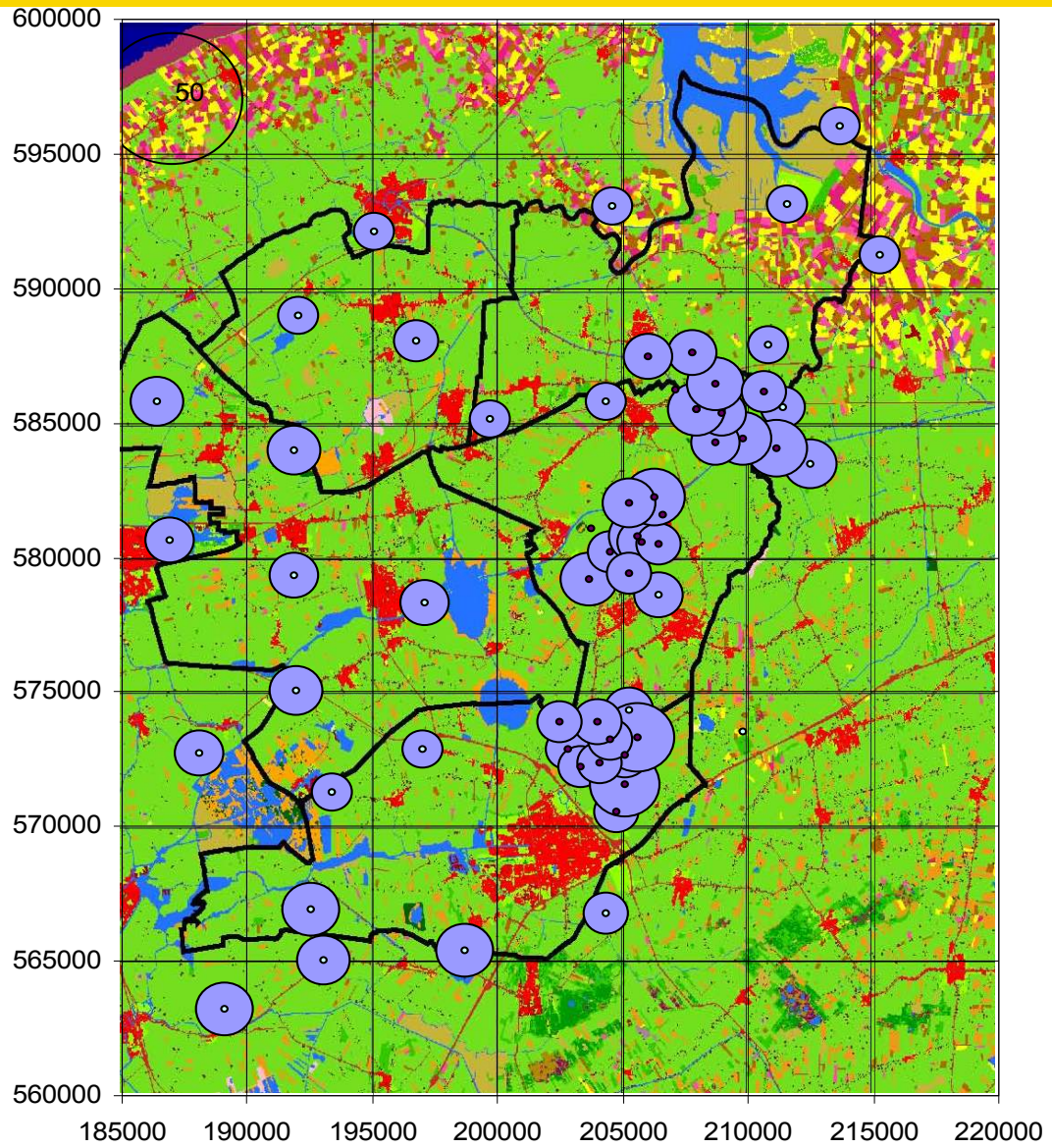
in 100 jaar"

16.4 °C

norm=17.2

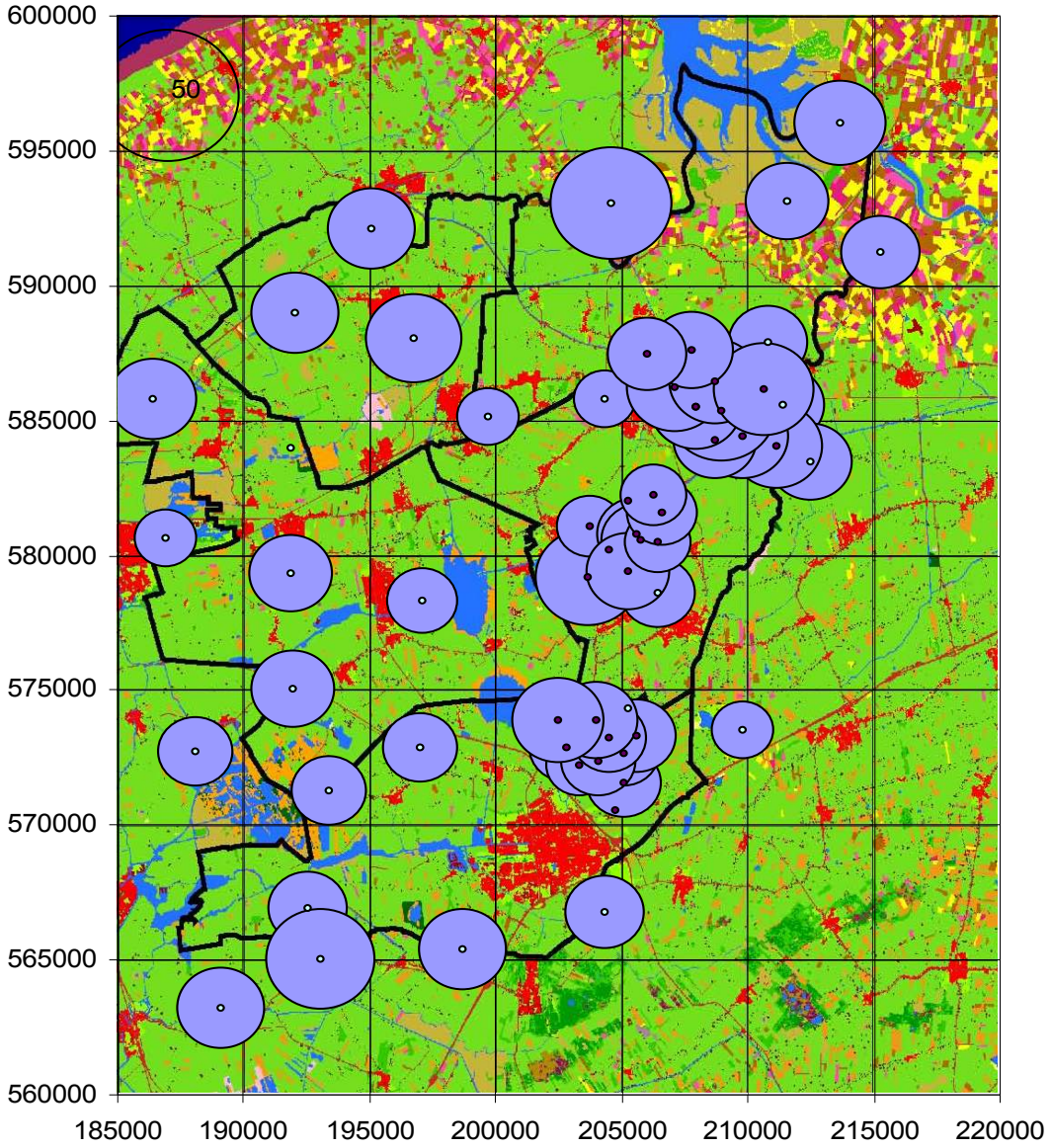
184 mm

norm=62



3MG

September 2006



"Warmest in 300 jaar"

17.9 °C

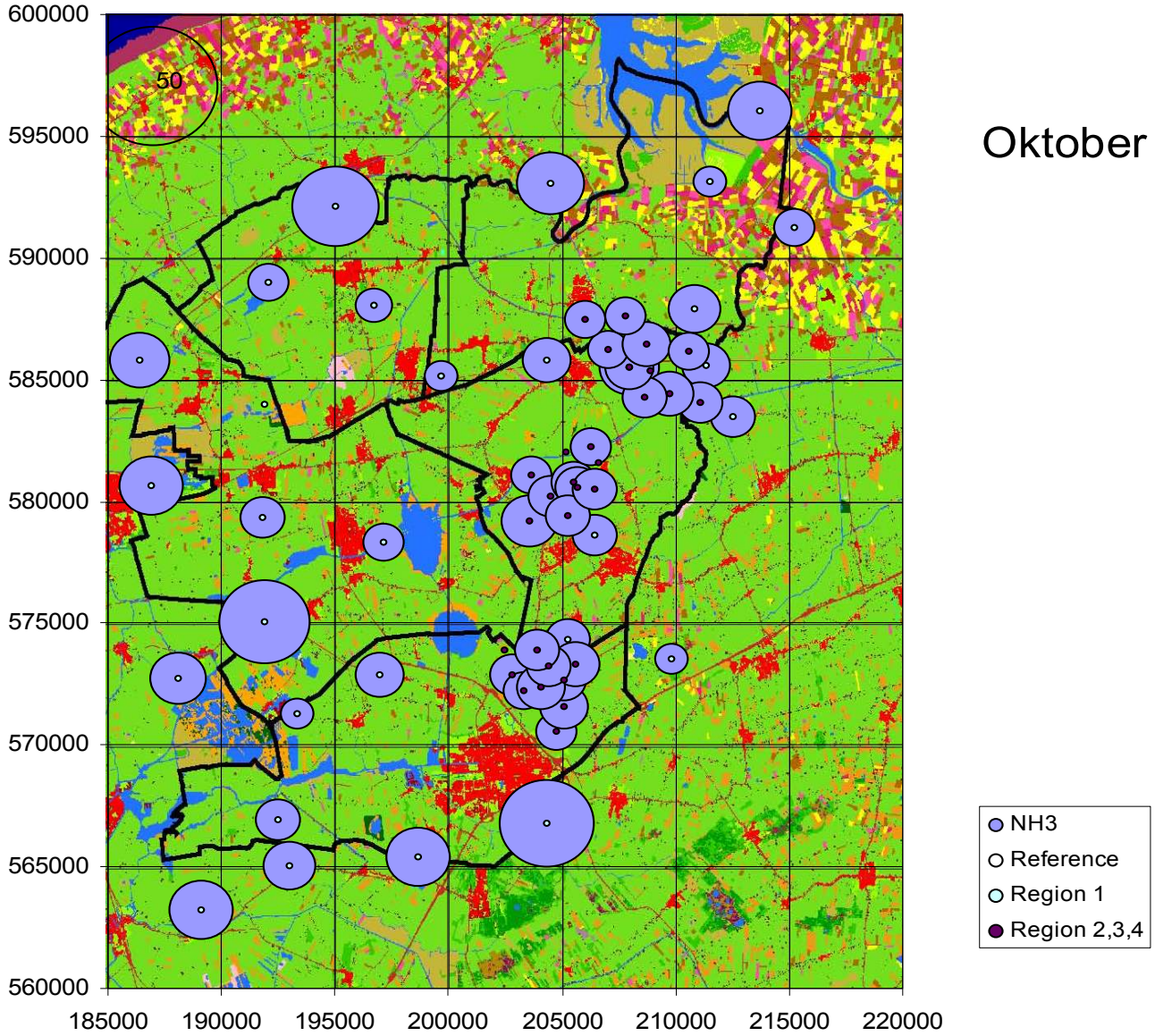
norm=14.2

12 mm

norm=75

3MG

Oktober 2006



13.6 °C

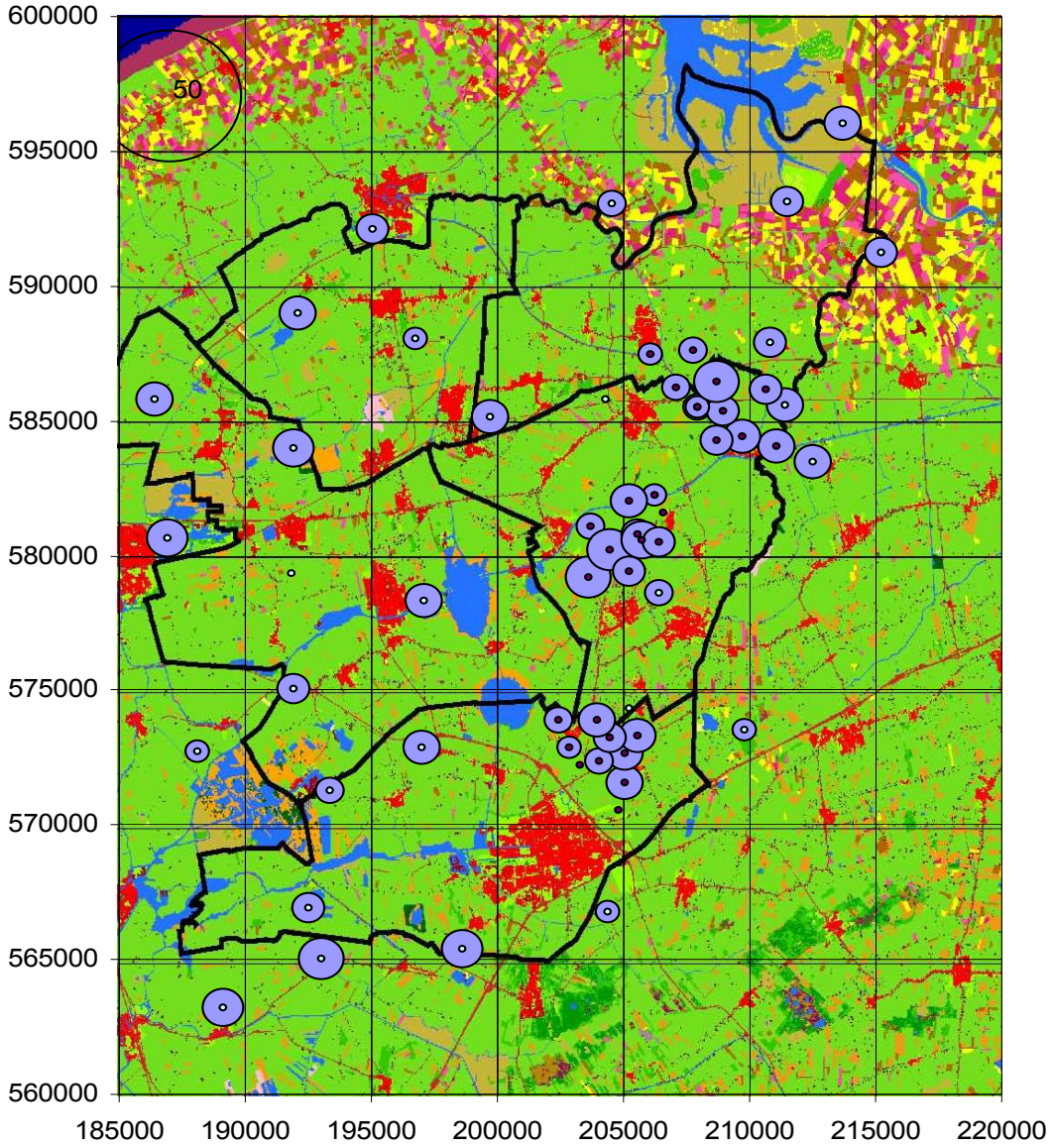
norm=10.3

91 mm

norm=78

3MG

November 2006



9.2 °C

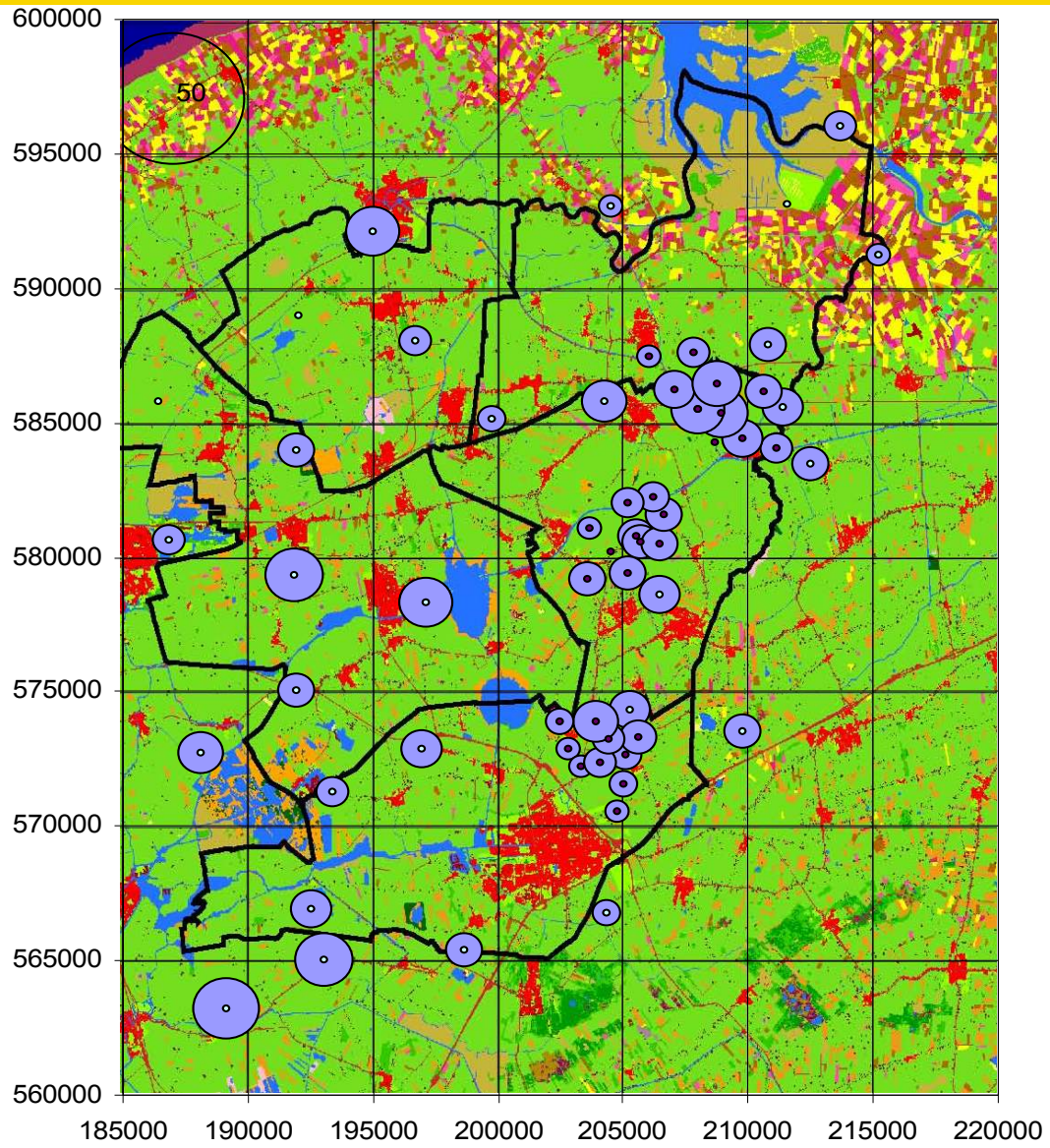
norm=6.2

78 mm

norm=82

3MG

December 2006



6.5 °C

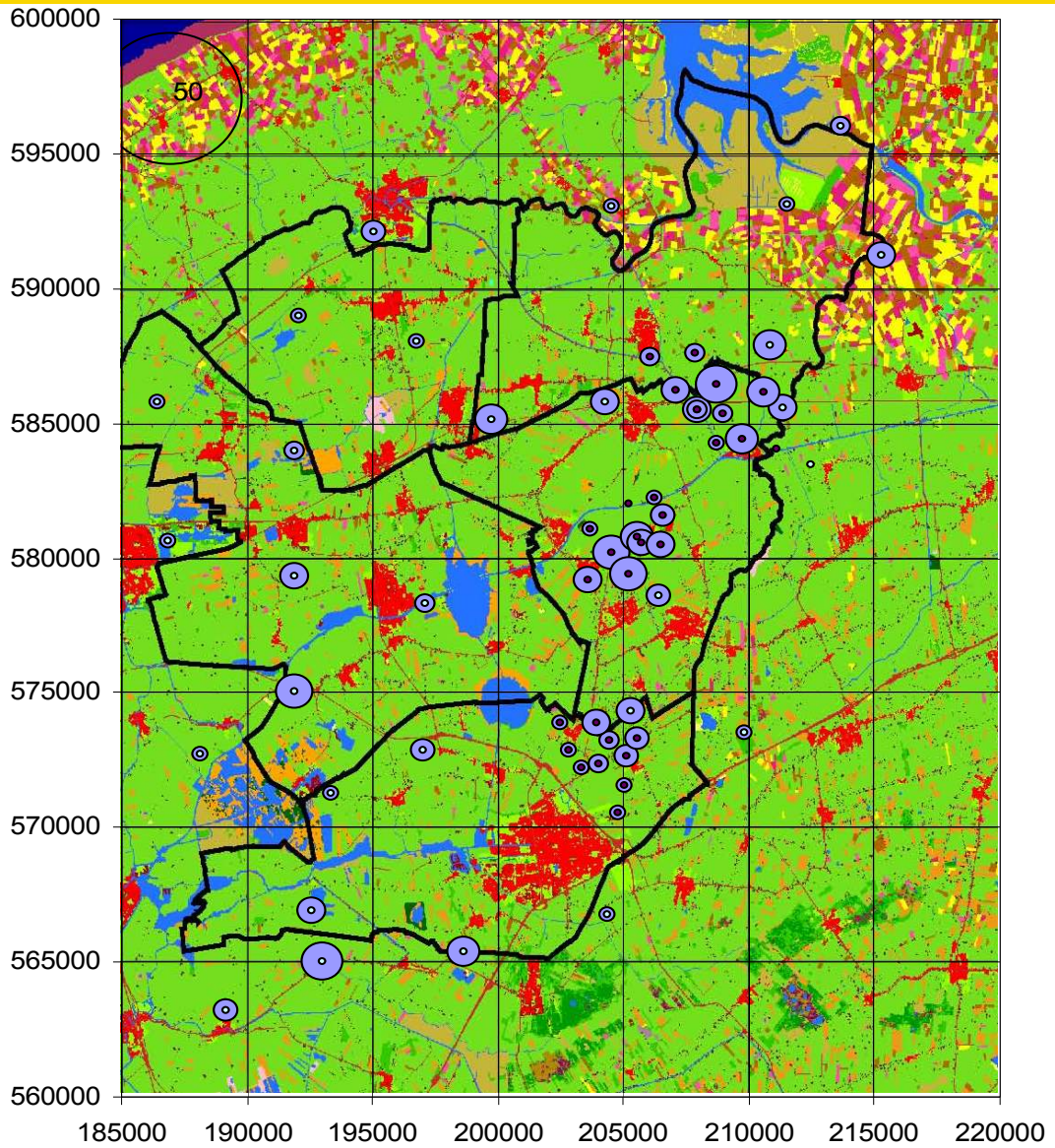
norm=4

80 mm

norm=79

3MG

January 2007



7.1 °C

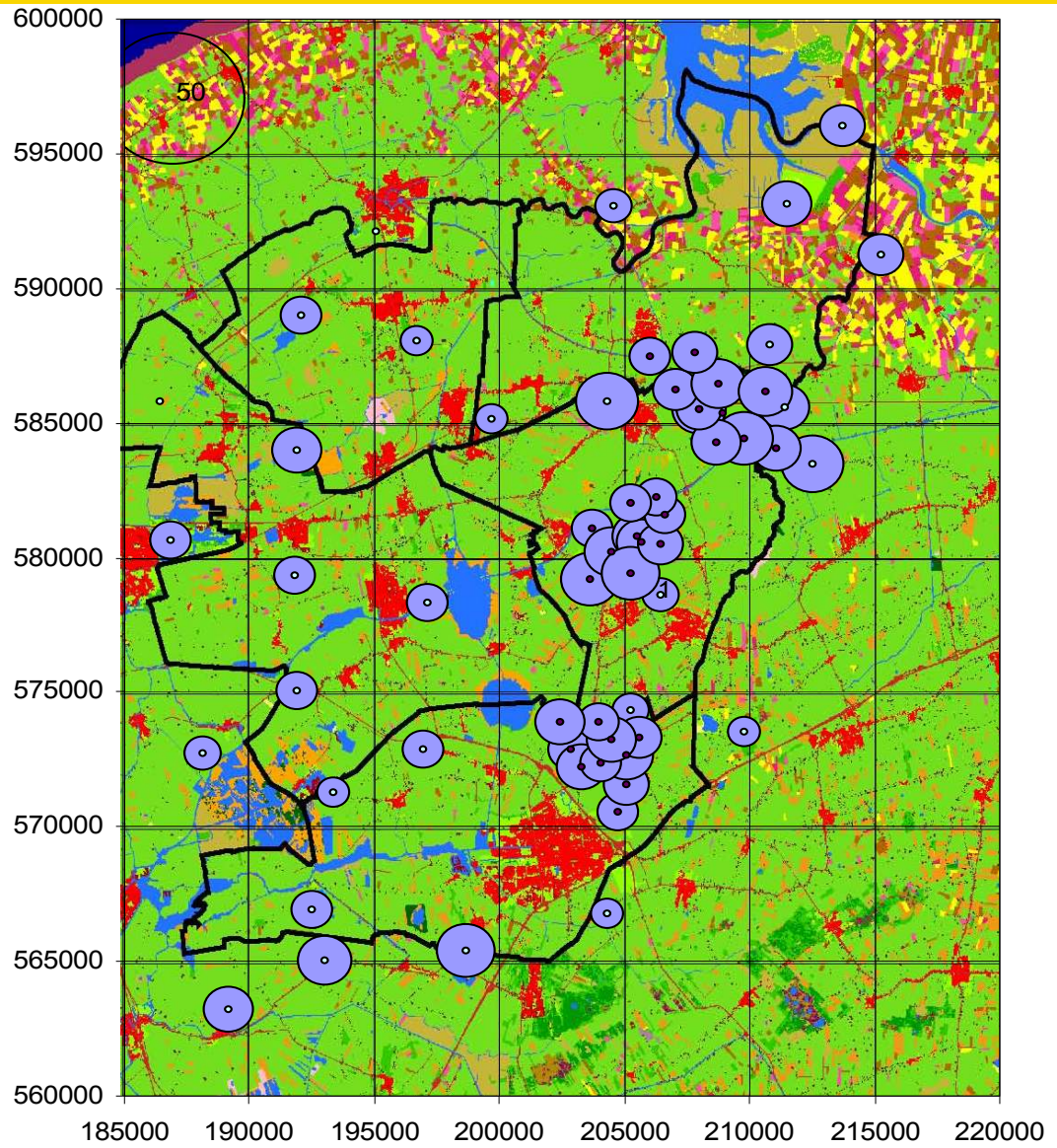
norm=2.8

113 mm

norm=69

3MG

February 2007



6 °C

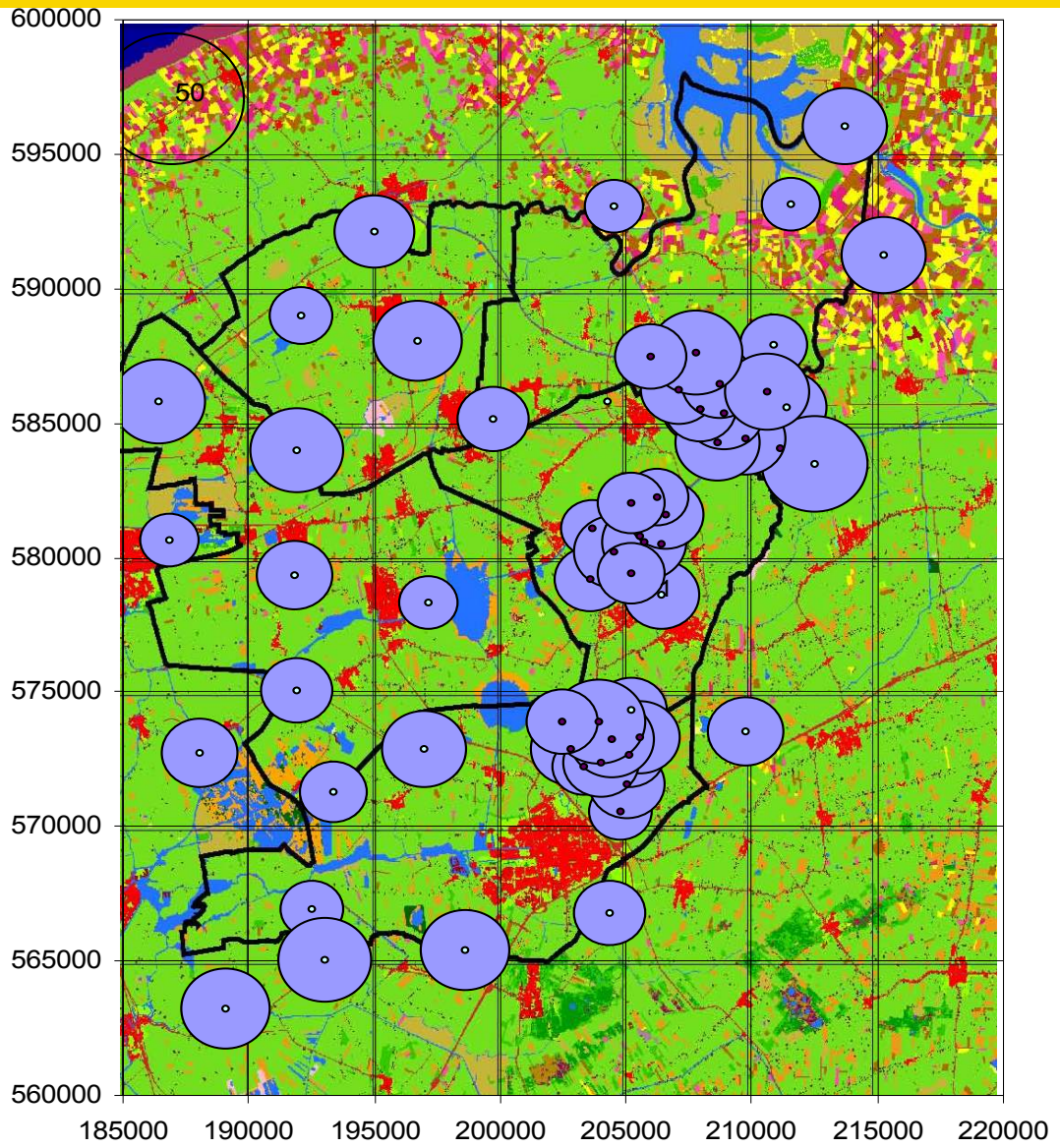
norm=3

78 mm

norm=47

3MG

March 2007



8 °C

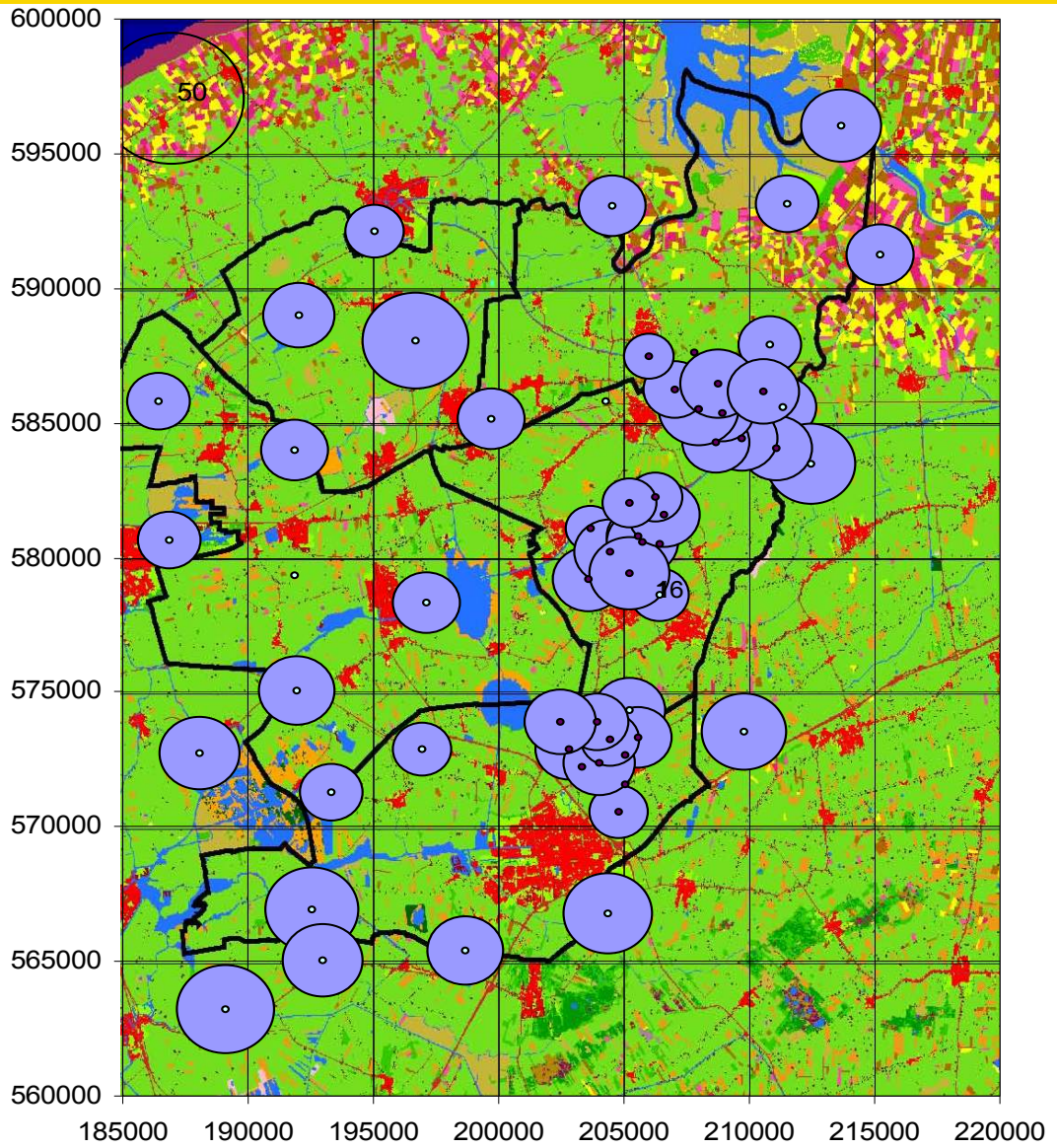
norm=5.8

69 mm

norm=65

3MG

April 2007



"Warm en dry"

13.2 °C

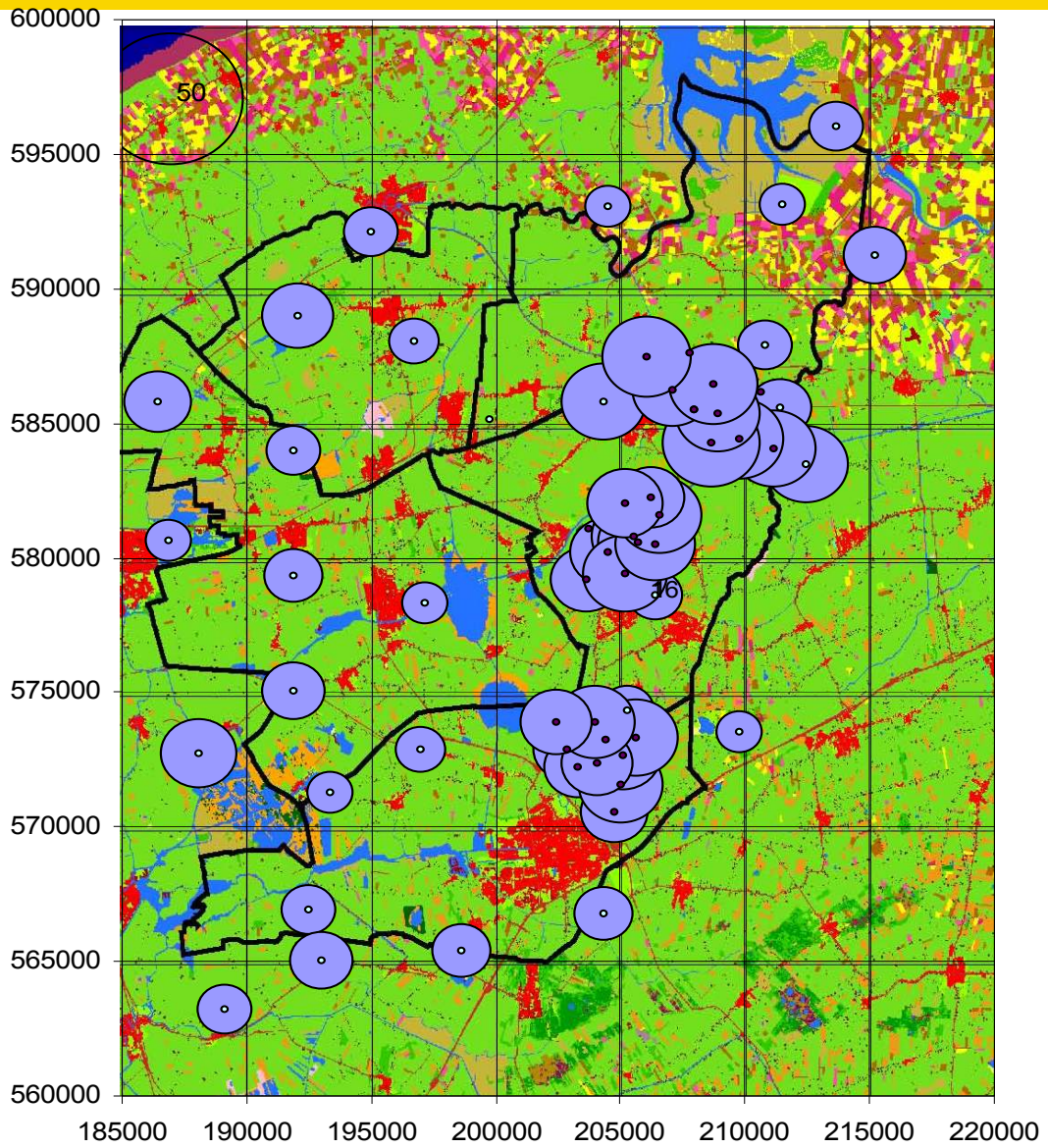
norm=8.3

0.4 mm

norm=44

3MG

May 2007



Wet

14.1 °C

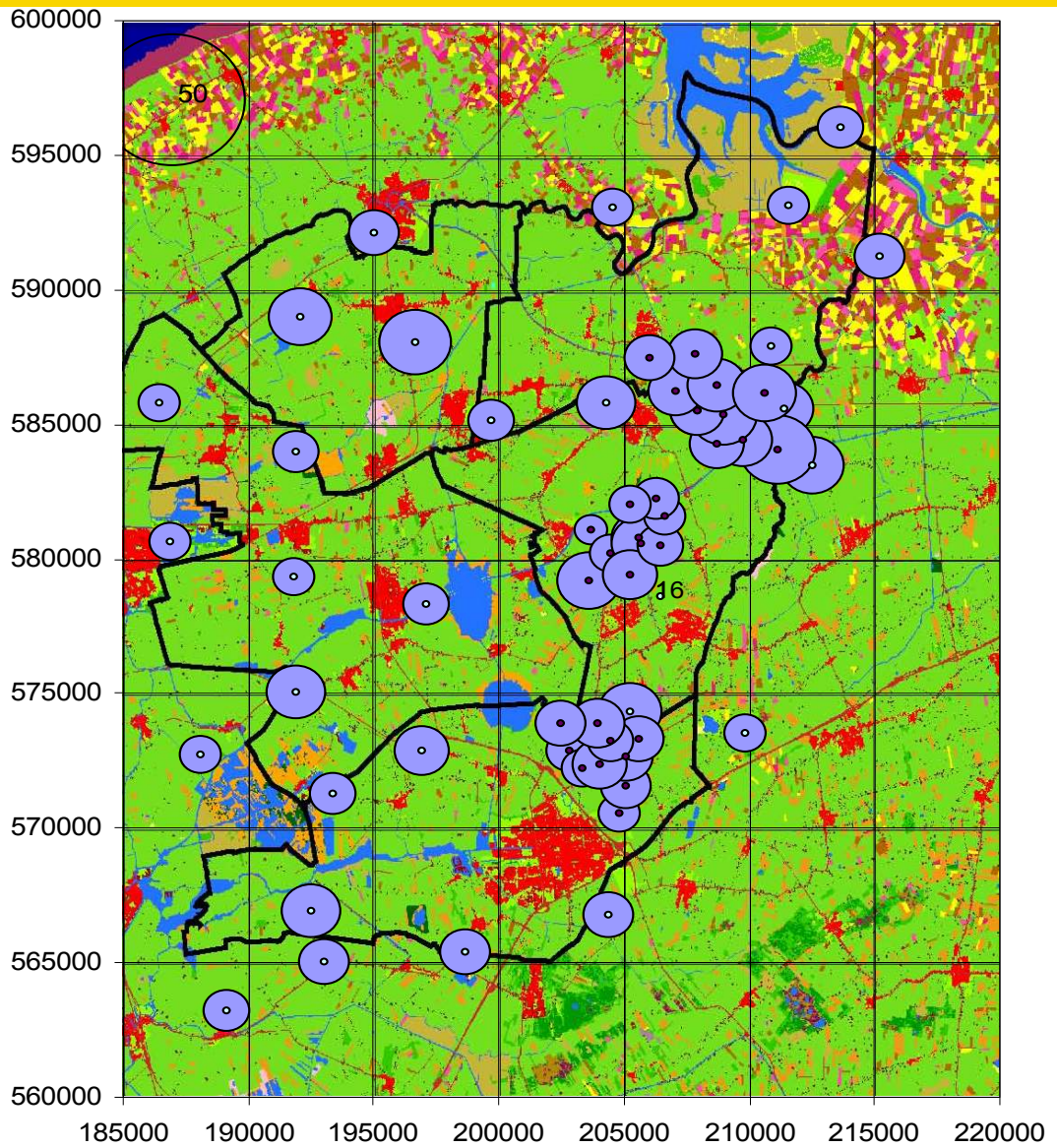
norm=12.7

104 mm

norm=57

3MG

June 2007



17.5 °C

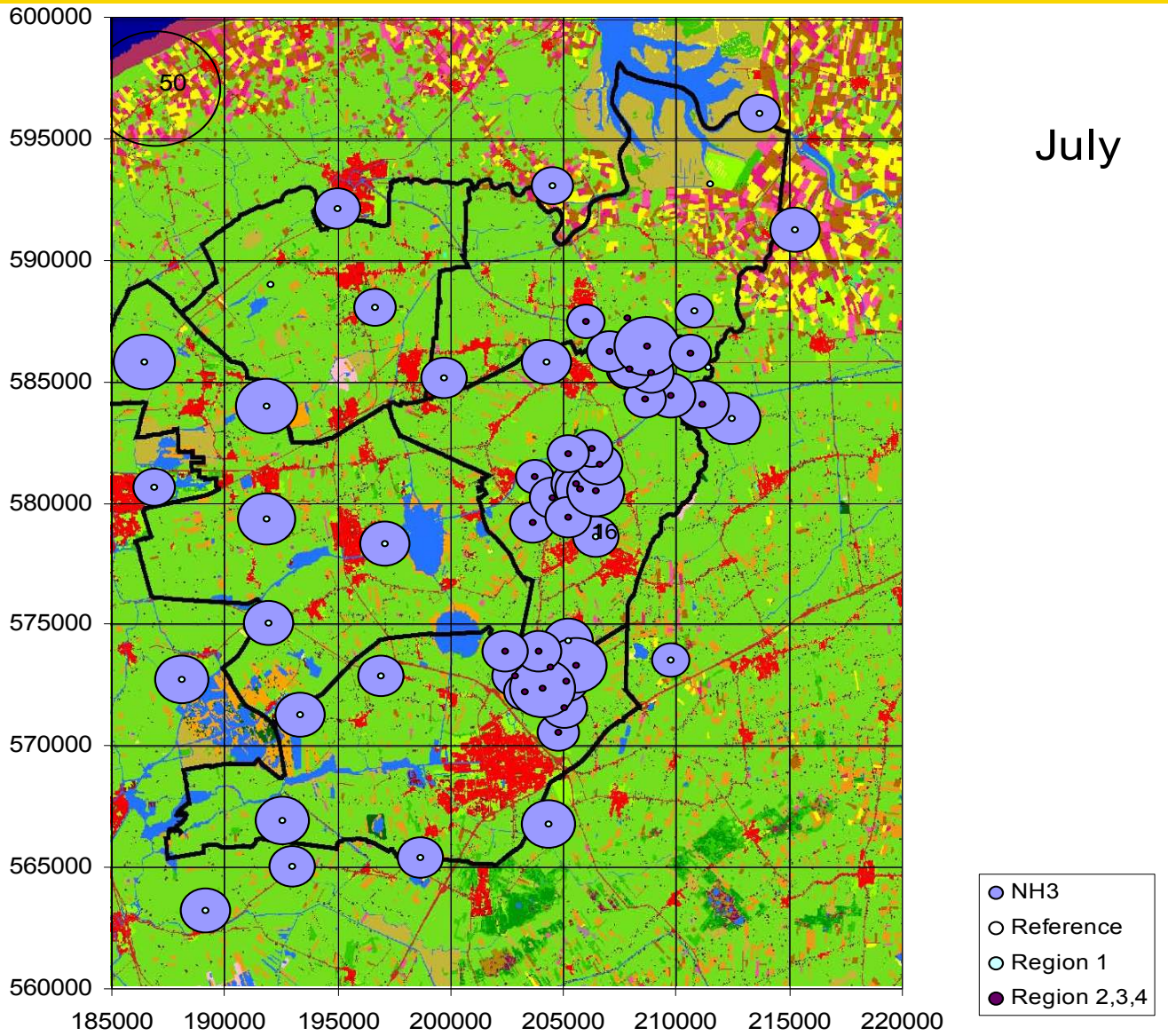
norm=15.5

95 mm

norm=71

3MG

July 2007



Verry wet

17.0 °C

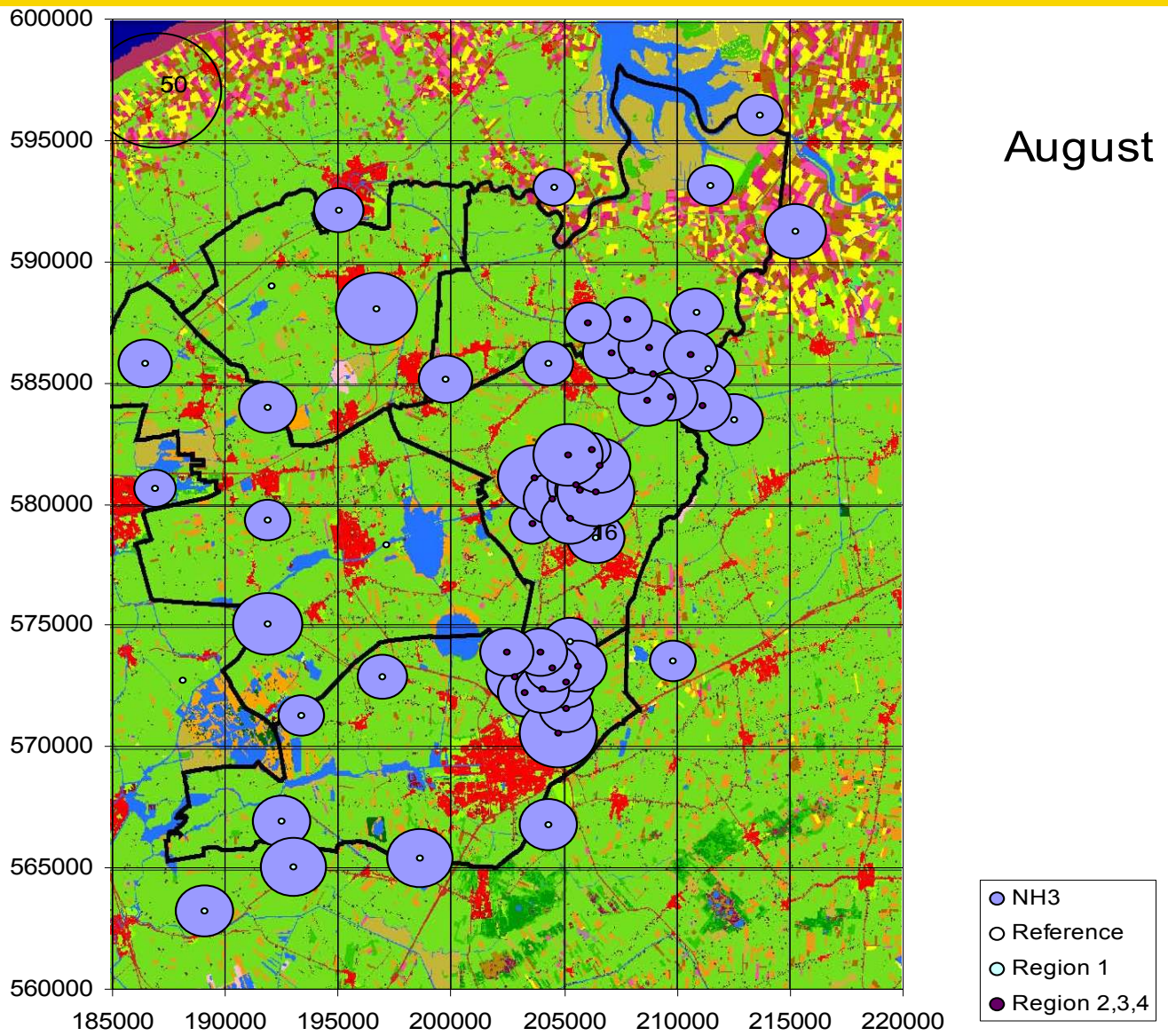
norm=17.4

155 mm

norm=70

3MG

August 2007



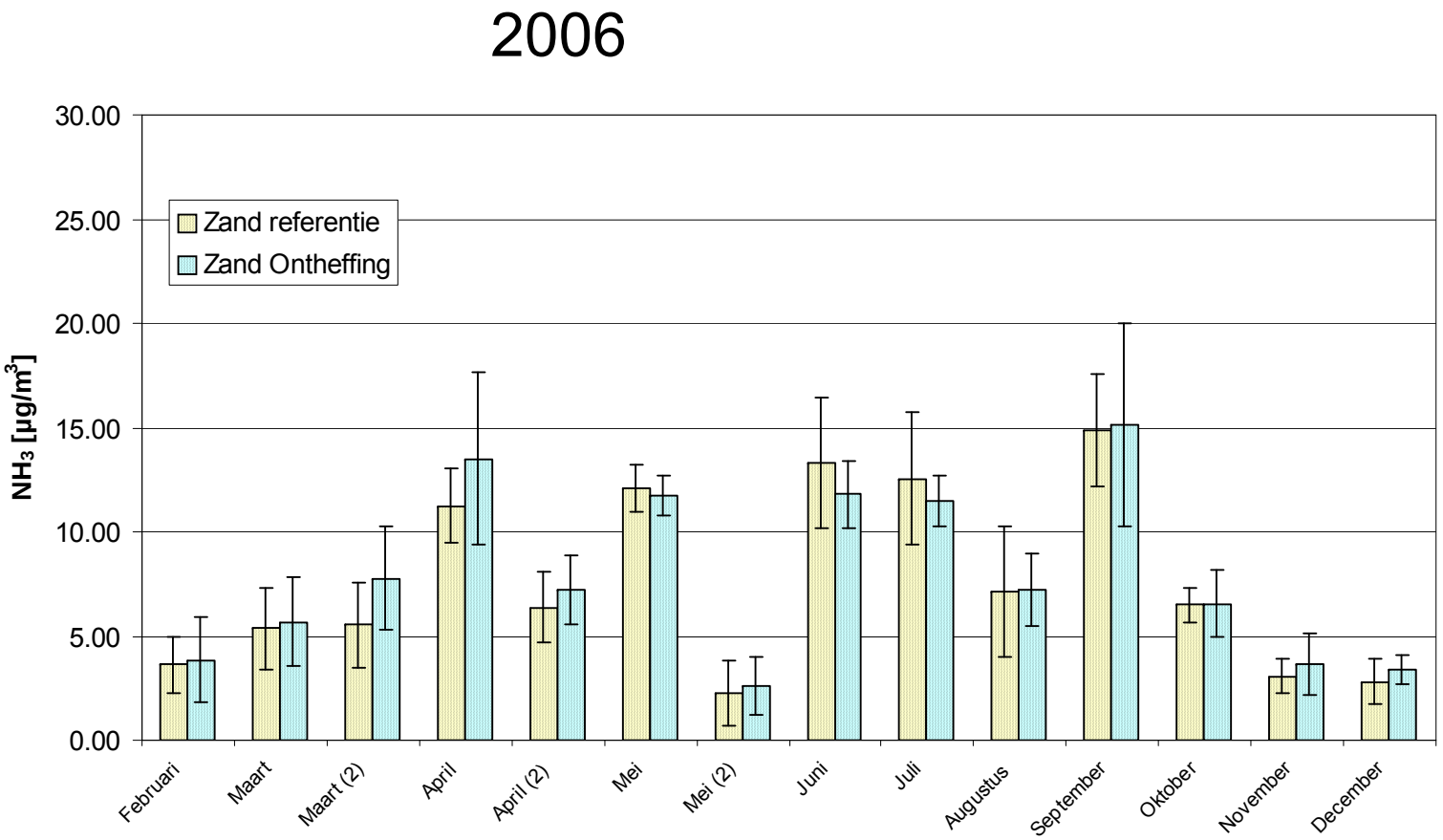
17.1 °C

norm=17.2

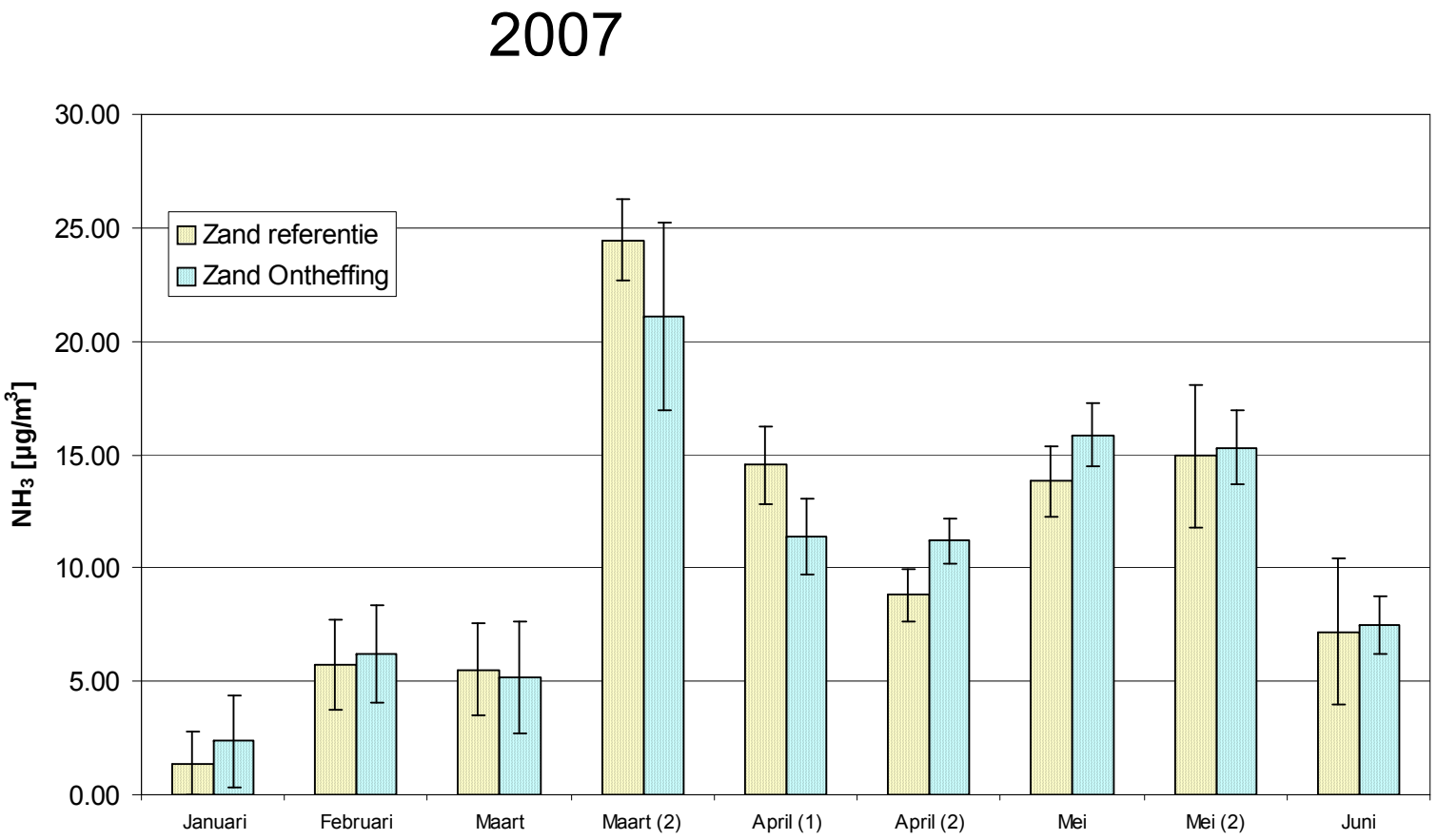
52 mm

norm=62

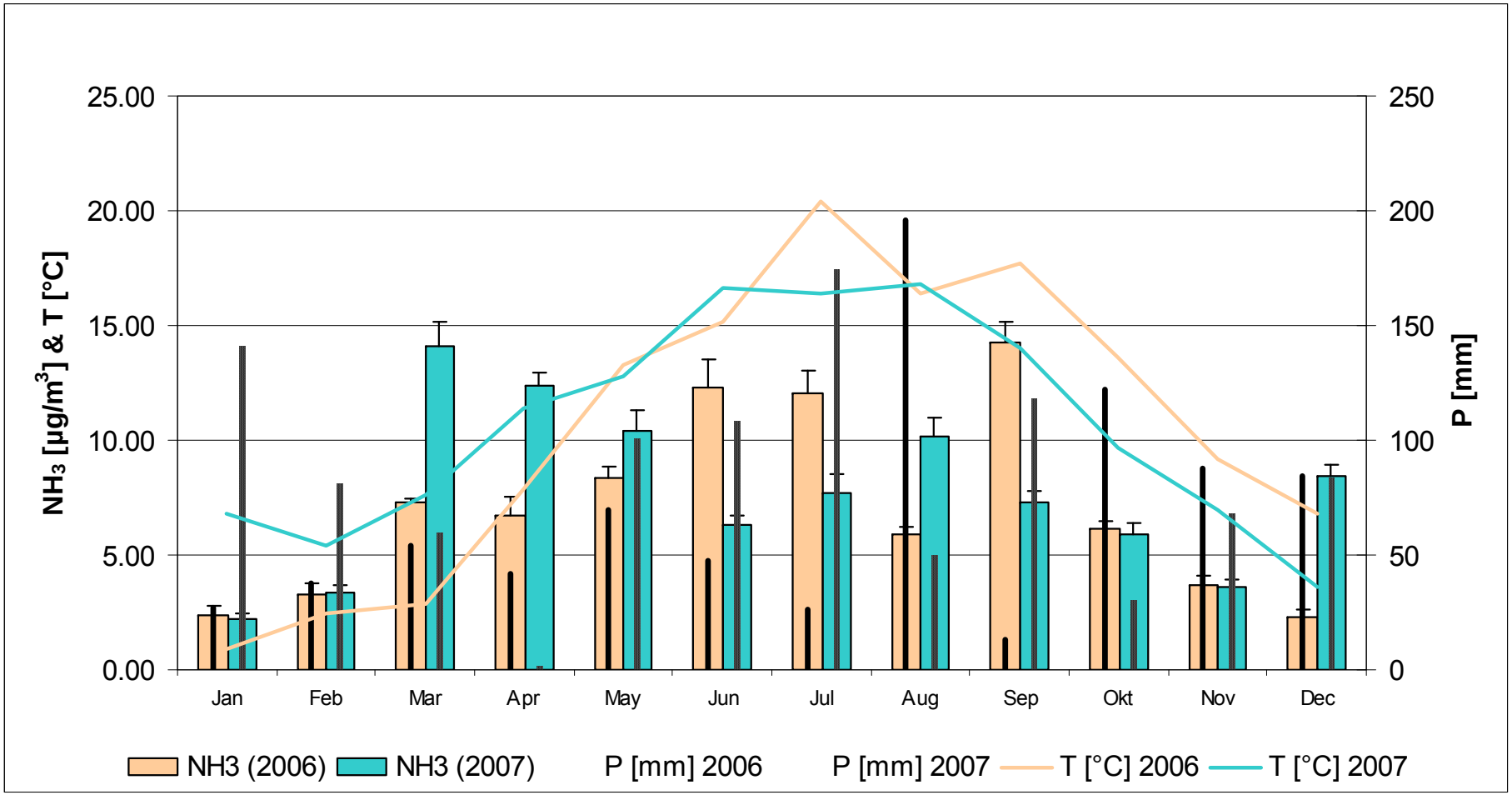
Mean concentrations in each area



Mean concentrations in each area



Measurements: Passive Samplers



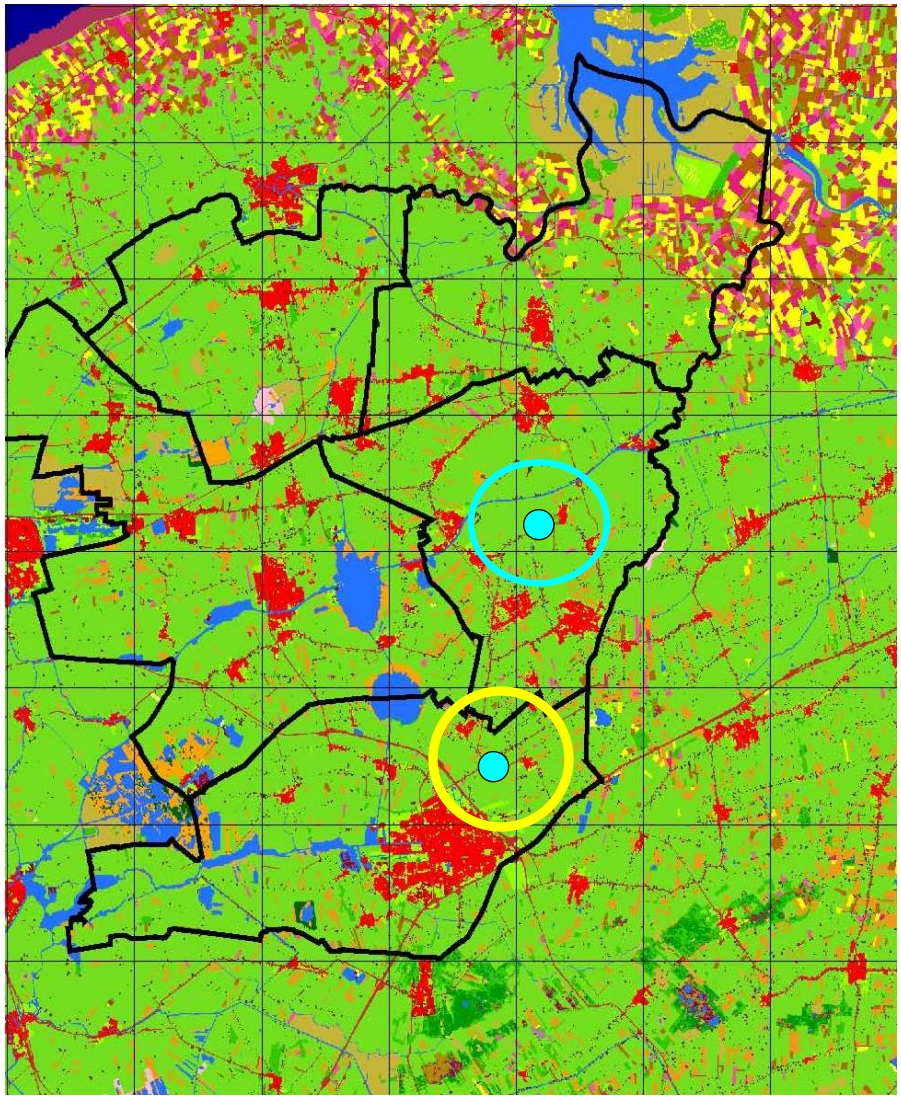
Using the passive sampler data

- Get the spatial information
- Are there hot-spots

Continuous concentration data at 2 locations

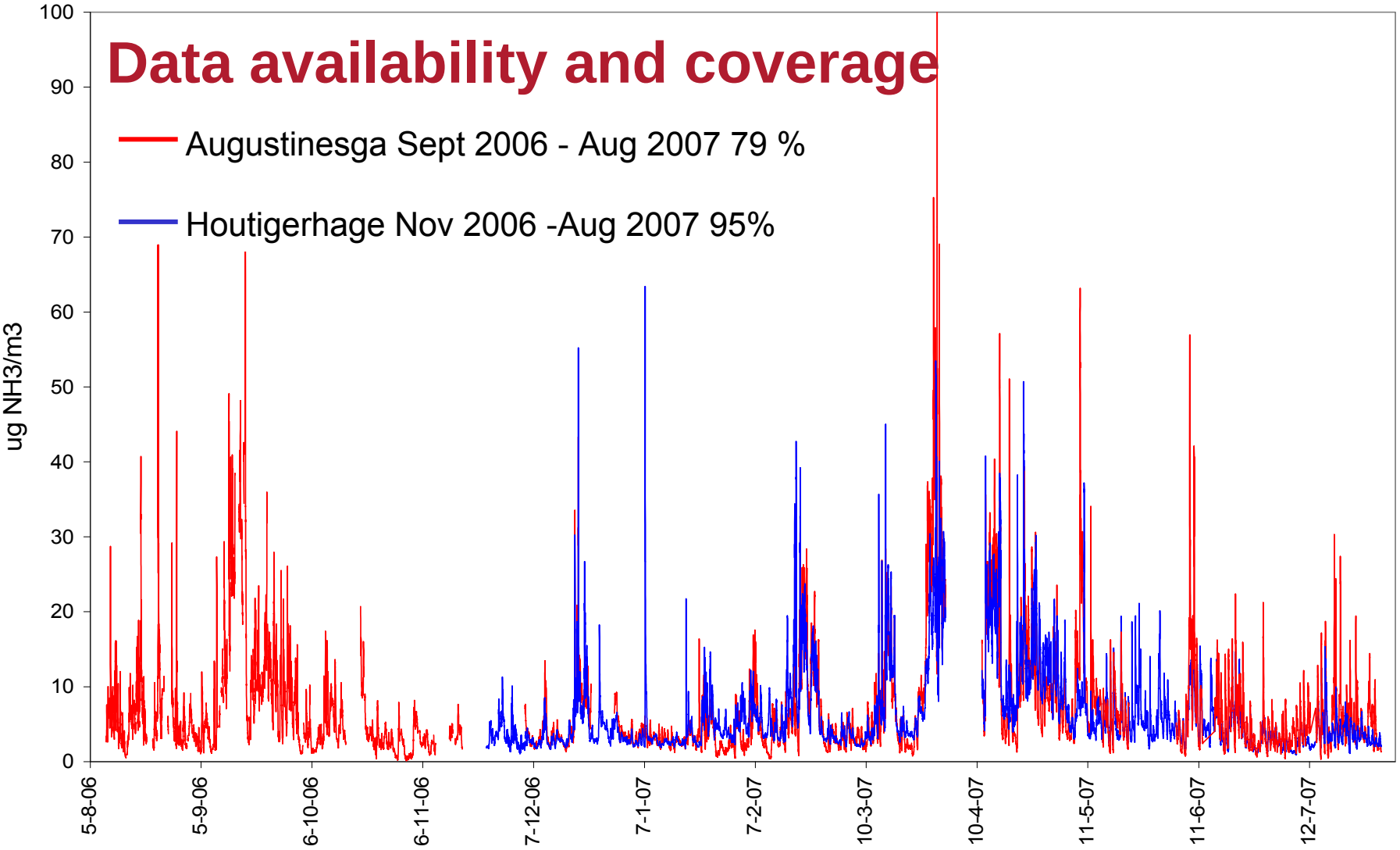
Location:
Wetterskip
Pumping station

Continuous monitoring stations



10 km

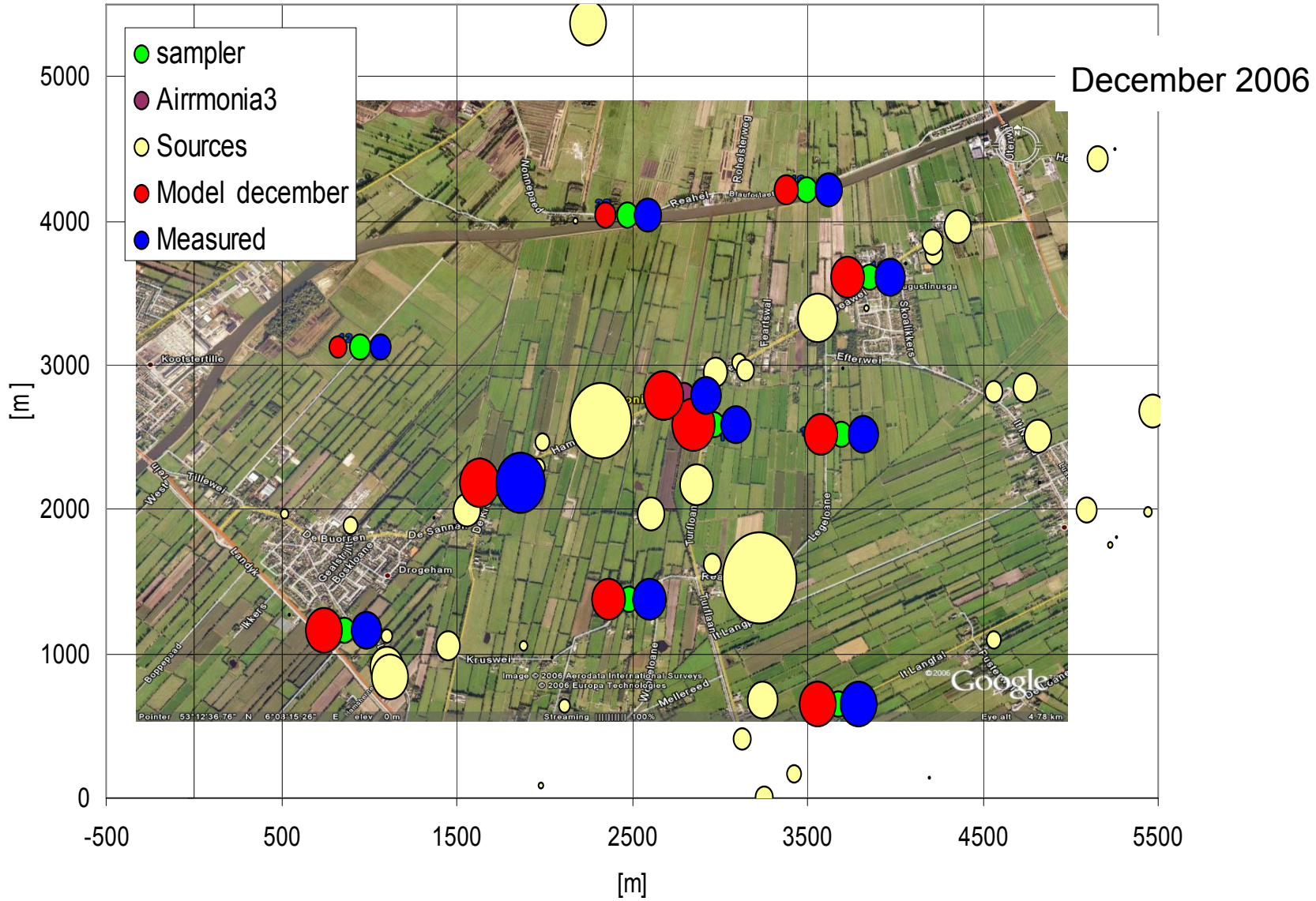
Data availability and coverage



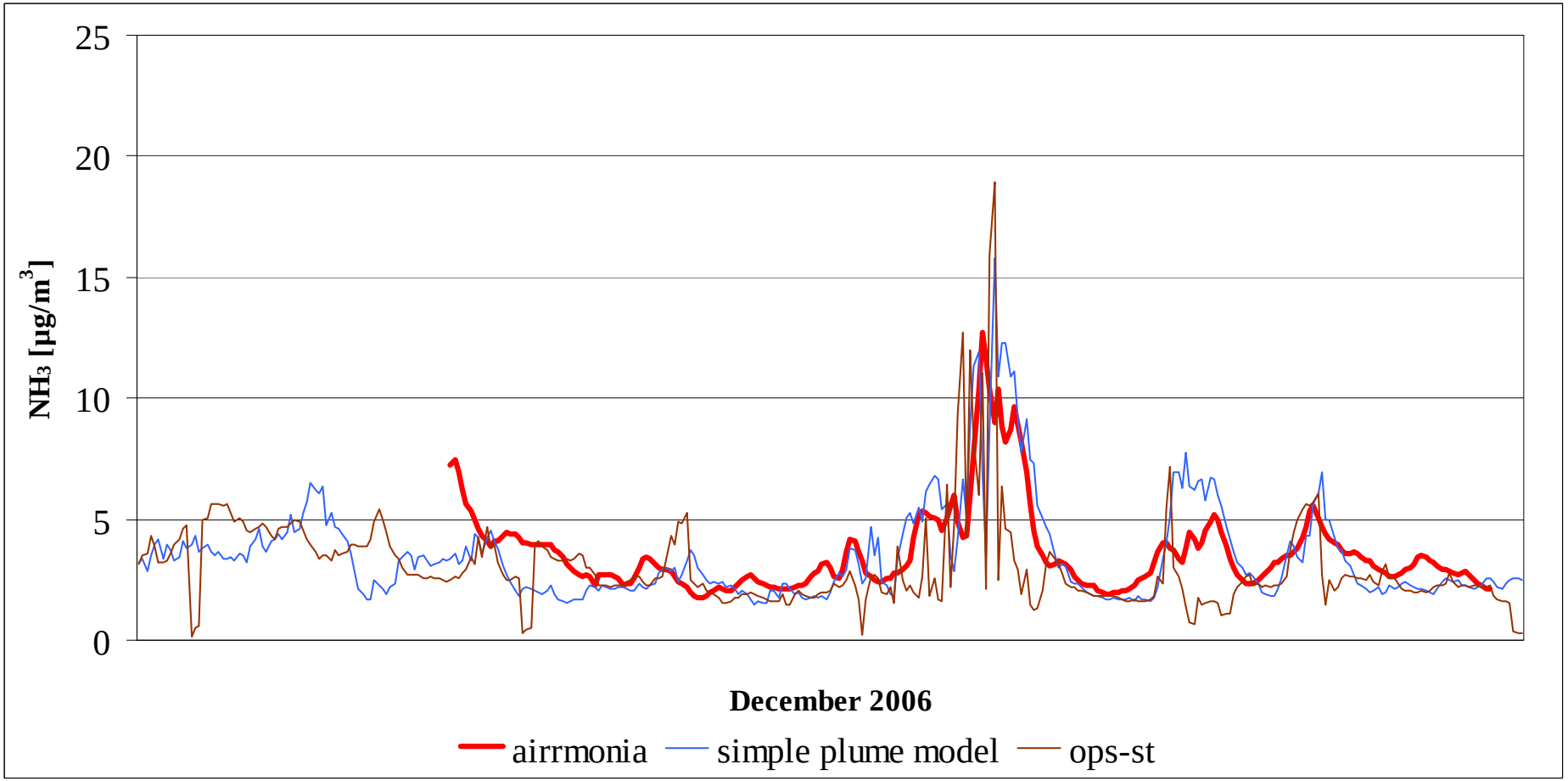
Using the Airrmonia data

- High temporal resolution
- Check on combination of emission and meteo data
- Check models that will also be used for all passive sampler locations

Results: Test for Housing Emission

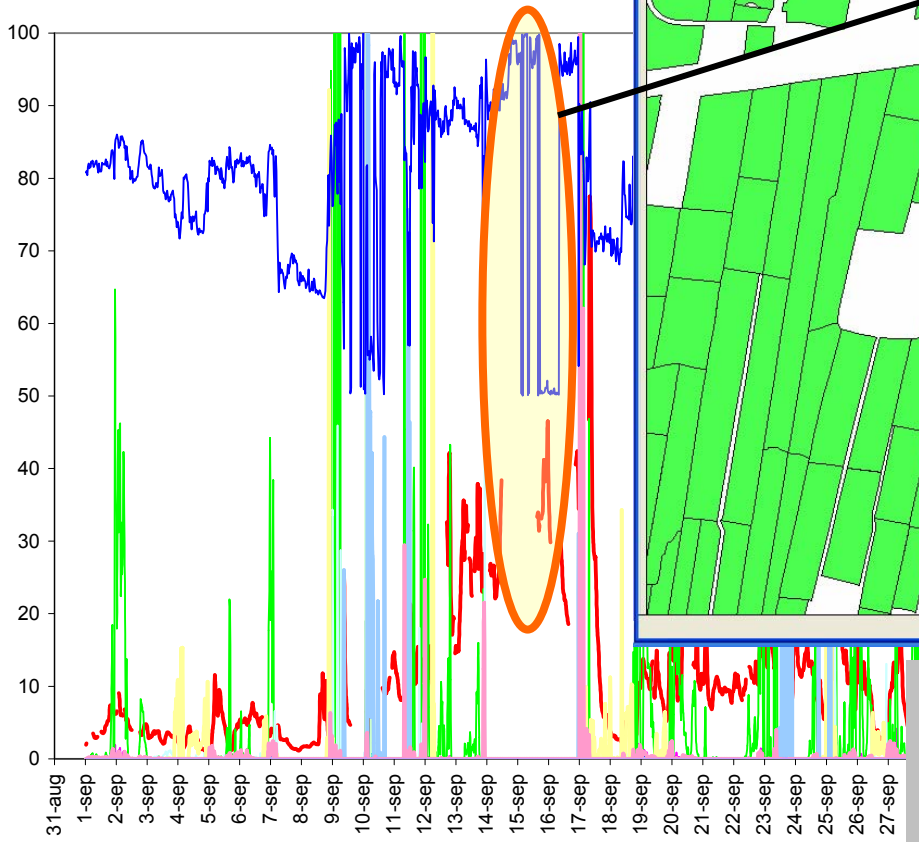


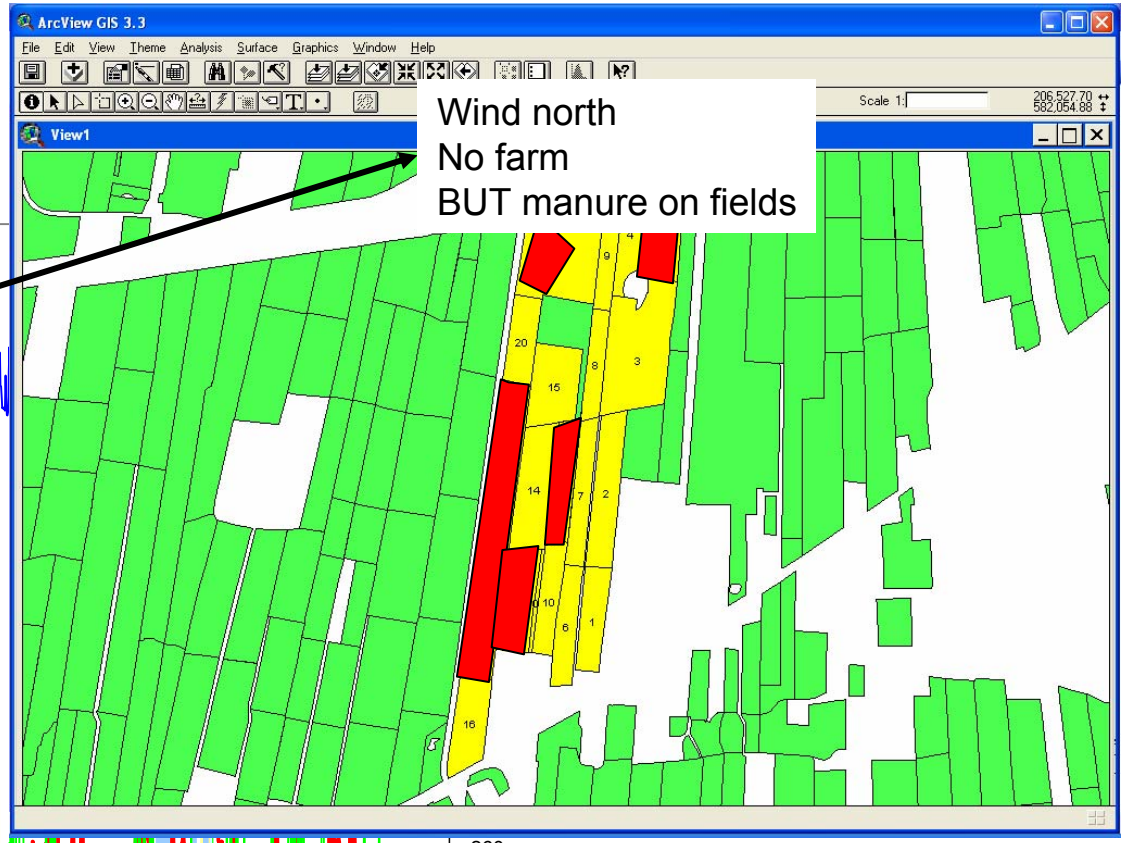
Results: Test for Housing Emission



Results: Test for Fields as well

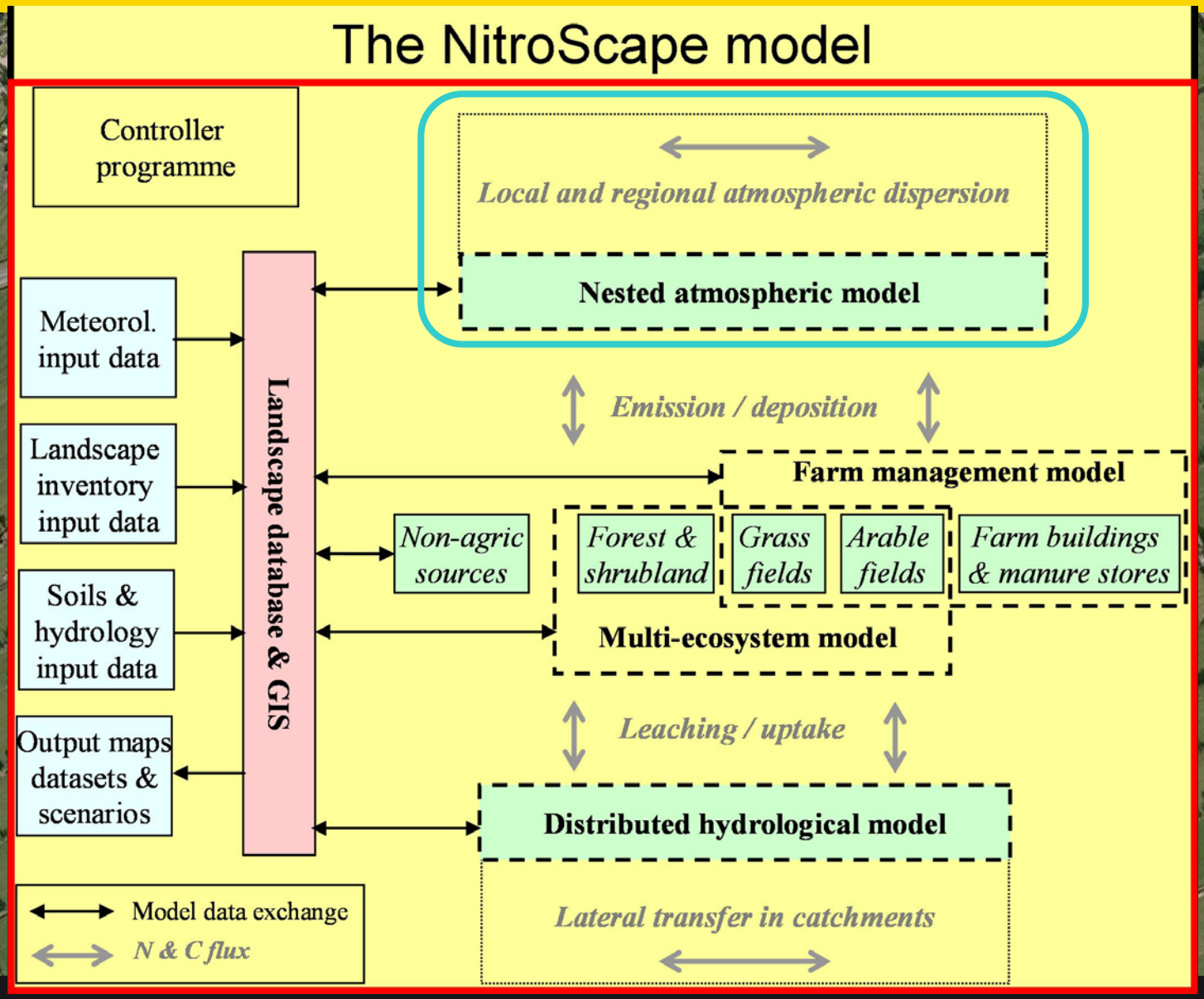
September





5	grasland	1.532	middag: 12.00-18.(	14-9-2006
11	grasland	1.169	morgen: 07.00-12.	14-9-2006
13	grasland	1.491	morgen: 07.00-12.	14-9-2006
19	grasland	1.27	morgen: 07.00-12.	14-9-2006
1203	grasland	1.109667	morgen: 07.00-12.	14-9-2006
17	grasland	1.588	morgen: 07.00-12.	15-9-2006
18	grasland	1.186	morgen: 07.00-12.	15-9-2006

The NitroScape model



Status of the projects

- Finalizing stages
  - Emission factor work
  - Comparison of spreading/feeding measures
  - Verification measurements NitroEurope
- Possible extension
  - Overall NFW work with respect to determining landscape scale targets
  - Combining NH_3 and GHG measurements

Thank you for your attention!