Methods for regional scale farming systems modelling and uncertainty assessment

- cases of production, N-losses and greenhouse gas emissions

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FACCE www.Macsur.eu Midterm Scientific Conference. Cross-theme session 1.6.2: Uncertainty. Sardinia, Italy April 1-4 2014.

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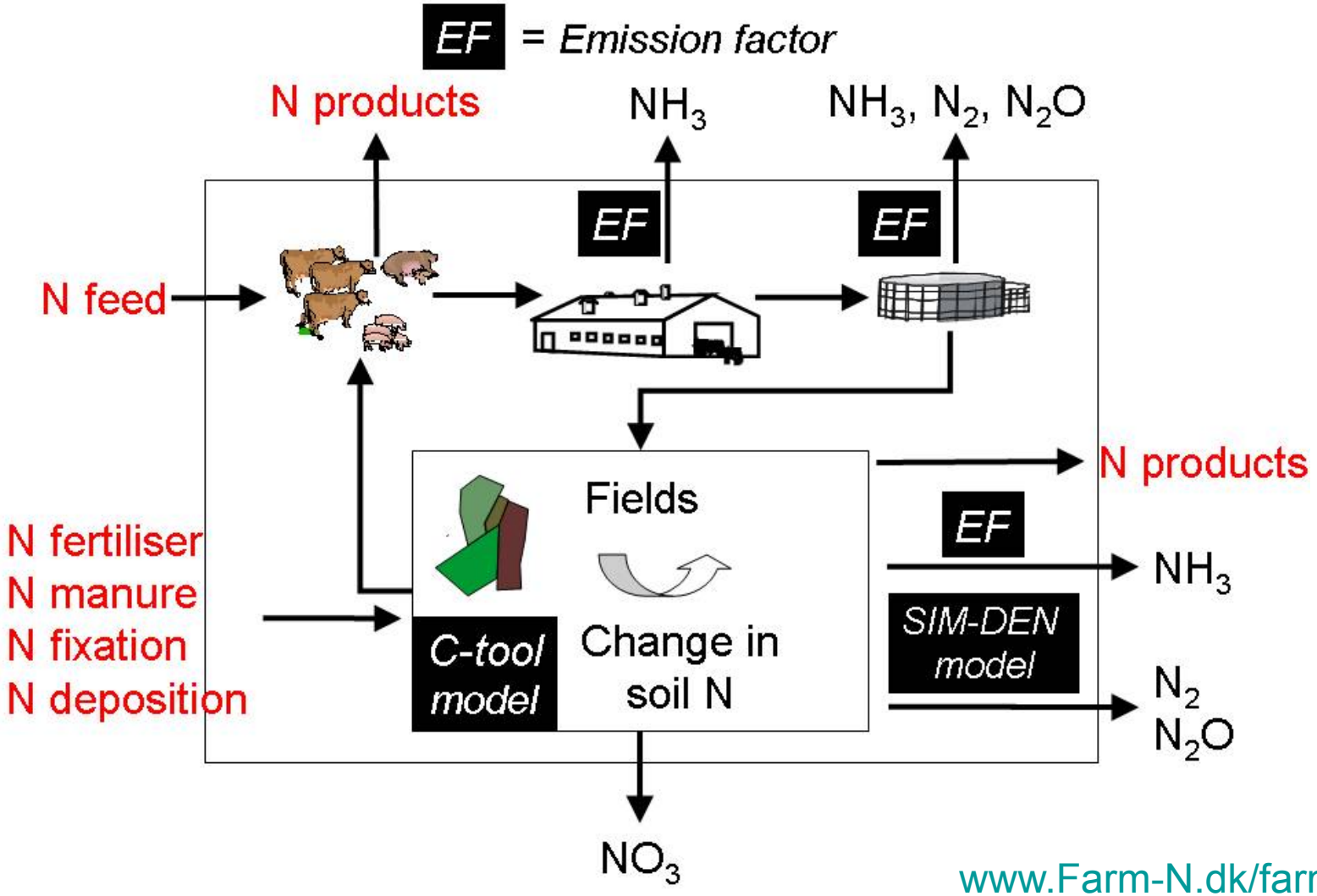
Program

- **Farm modelling**
- **Results from case study landscapes**
  - Spatial heterogeneity
  - Temporal heterogeneity
- **Perspectives for future research**

Farm modelling



www.Farm-N.dk/farmNtool

EU farm study case landscapes
- *farm N surplus*

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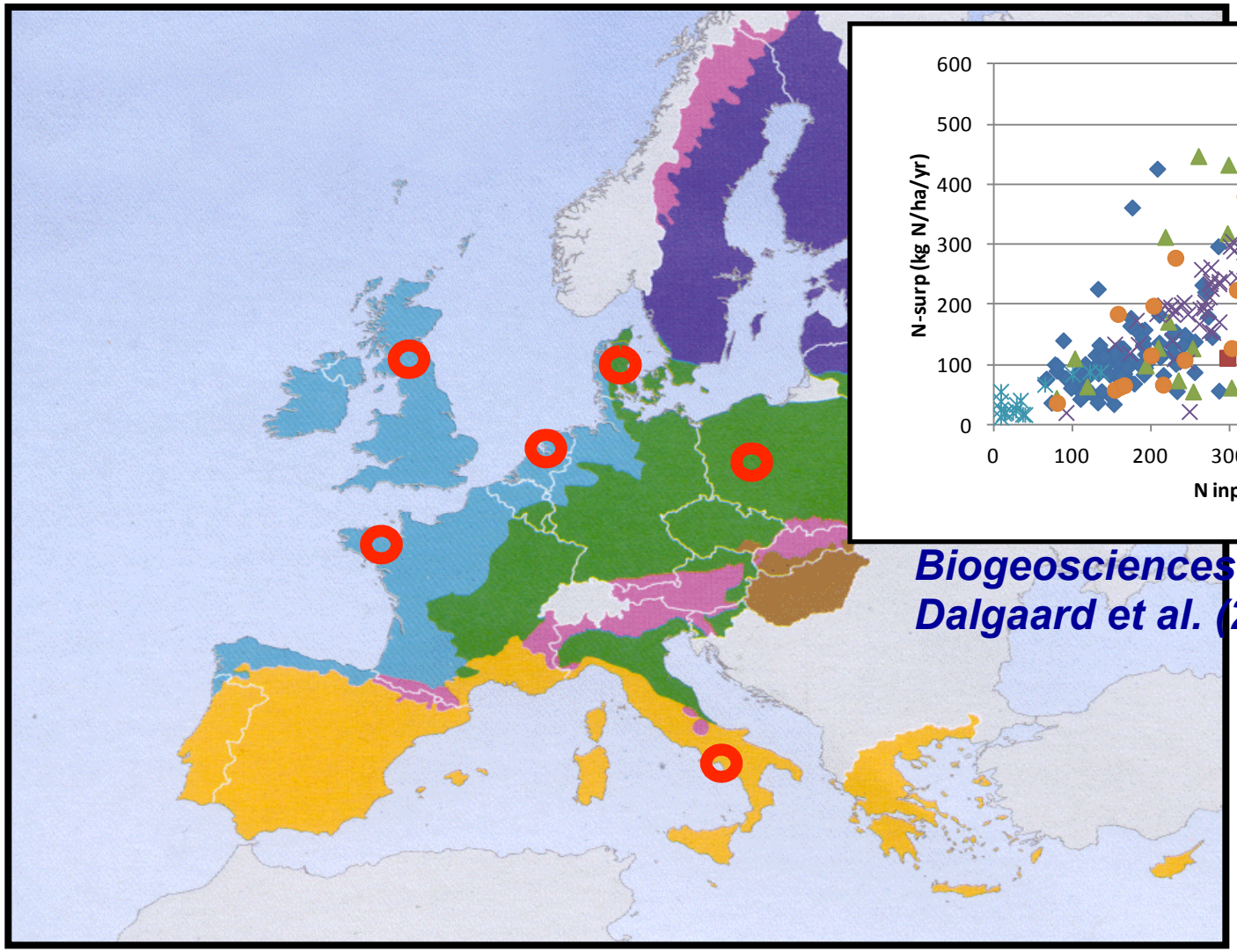
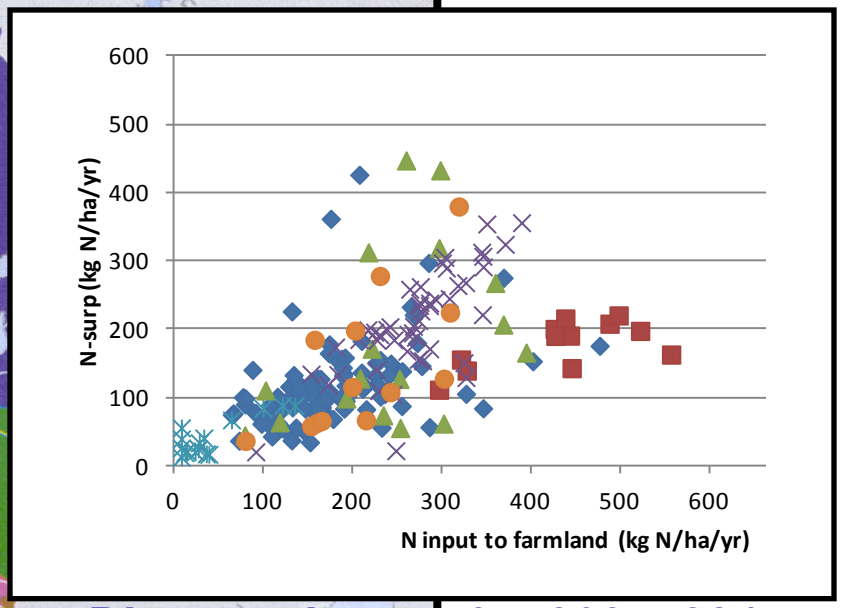
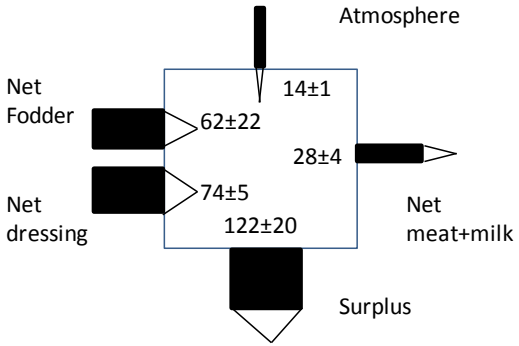




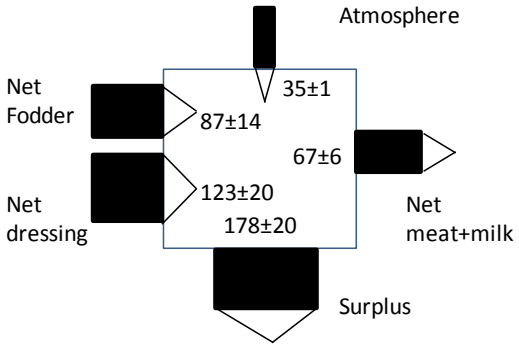
Biogeosciences 9, 5303–5321
Dalgaard et al. (2012)

NitroEurope IP

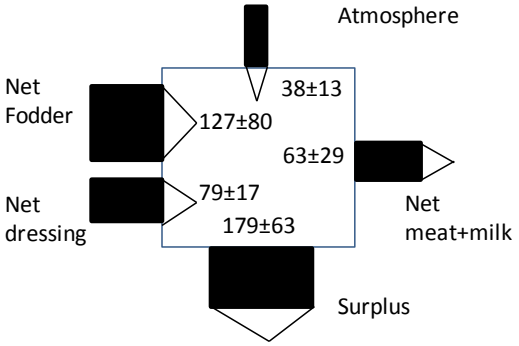
Turew, PL (100 farms)



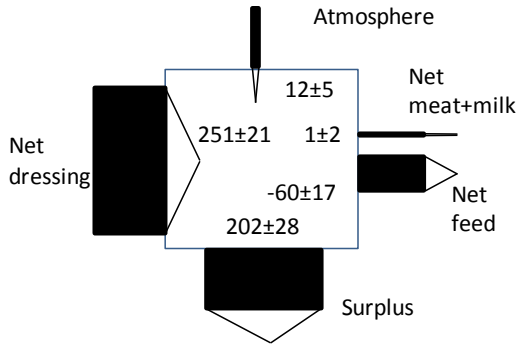
NFW, NL (12 farms)



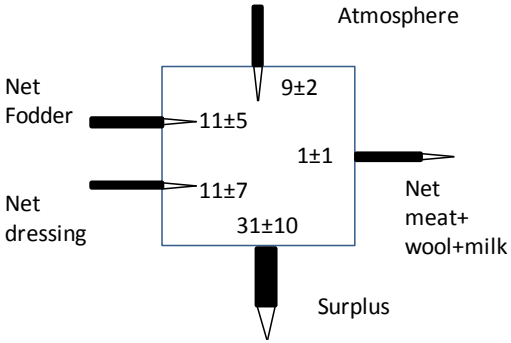
Naizin , FR (17 farms)



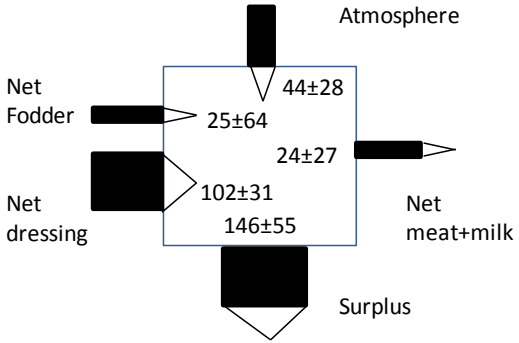
Piana del Sele, IT(53 farms)



South Scotland, UK (25 farms*)



Bjerringbro ,DK (13 farms)



Regio-nal he-tero-geneity and uncer-tainty diffe-rences

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Farm study case landscapes in Denmark

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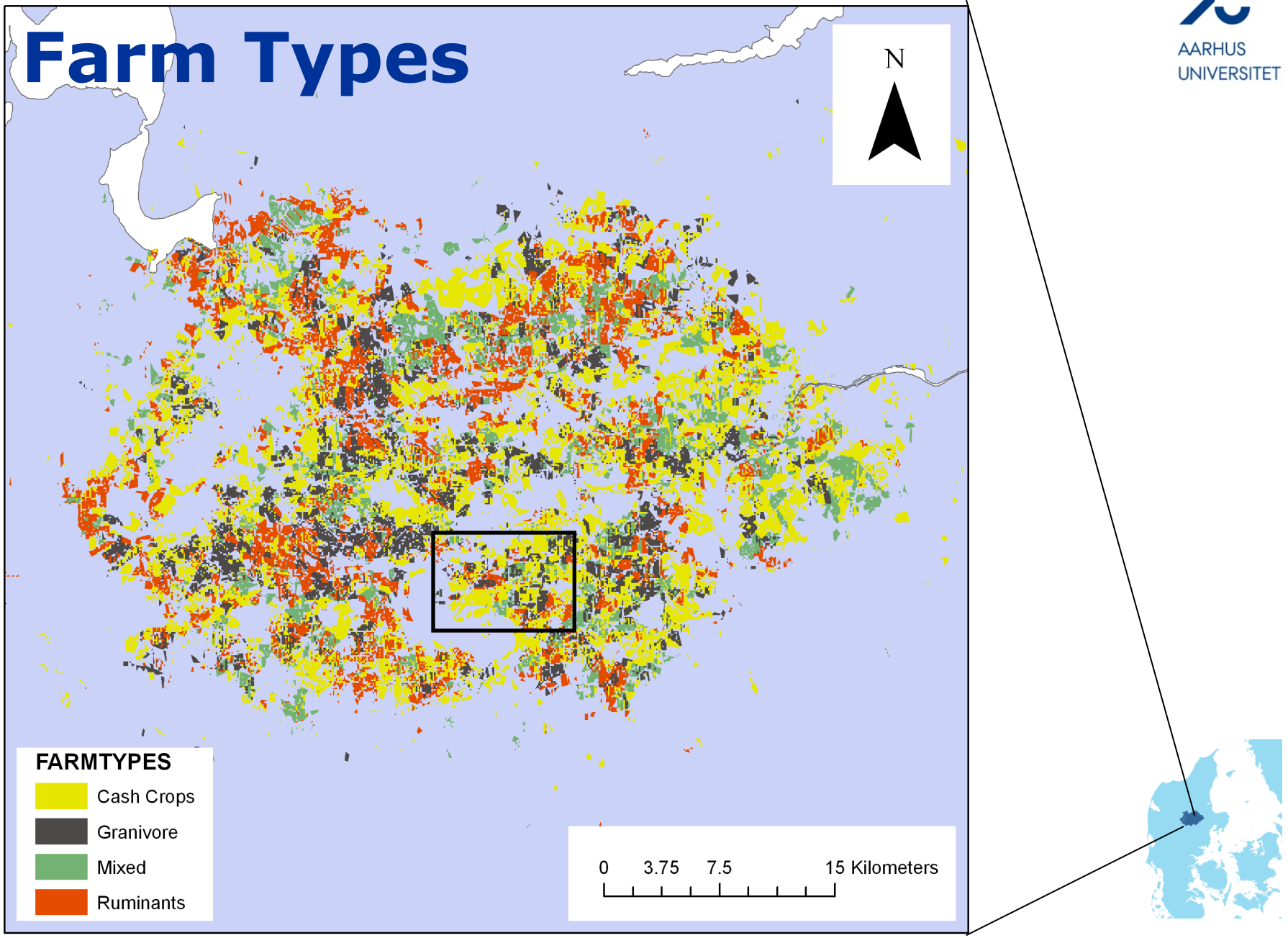
dNmark
research alliance

See also: www.dNmark.org


Farm Types
N
FARMTYPES
Cash Crops
Granivore
Mixed
Ruminants
0 3.75 7.5 15 Kilometers
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Simulated farm N-balances

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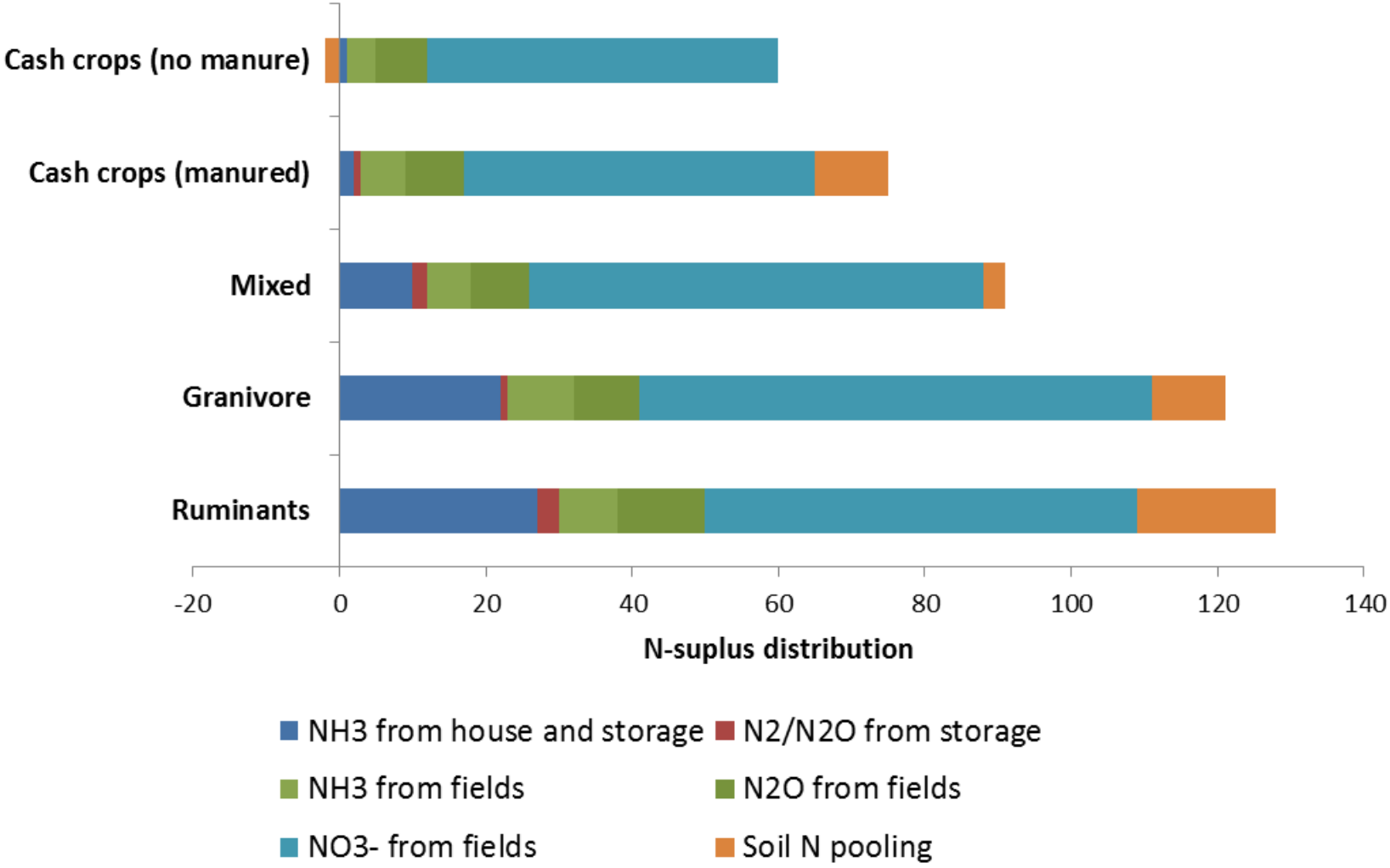

Uncertainty assessment

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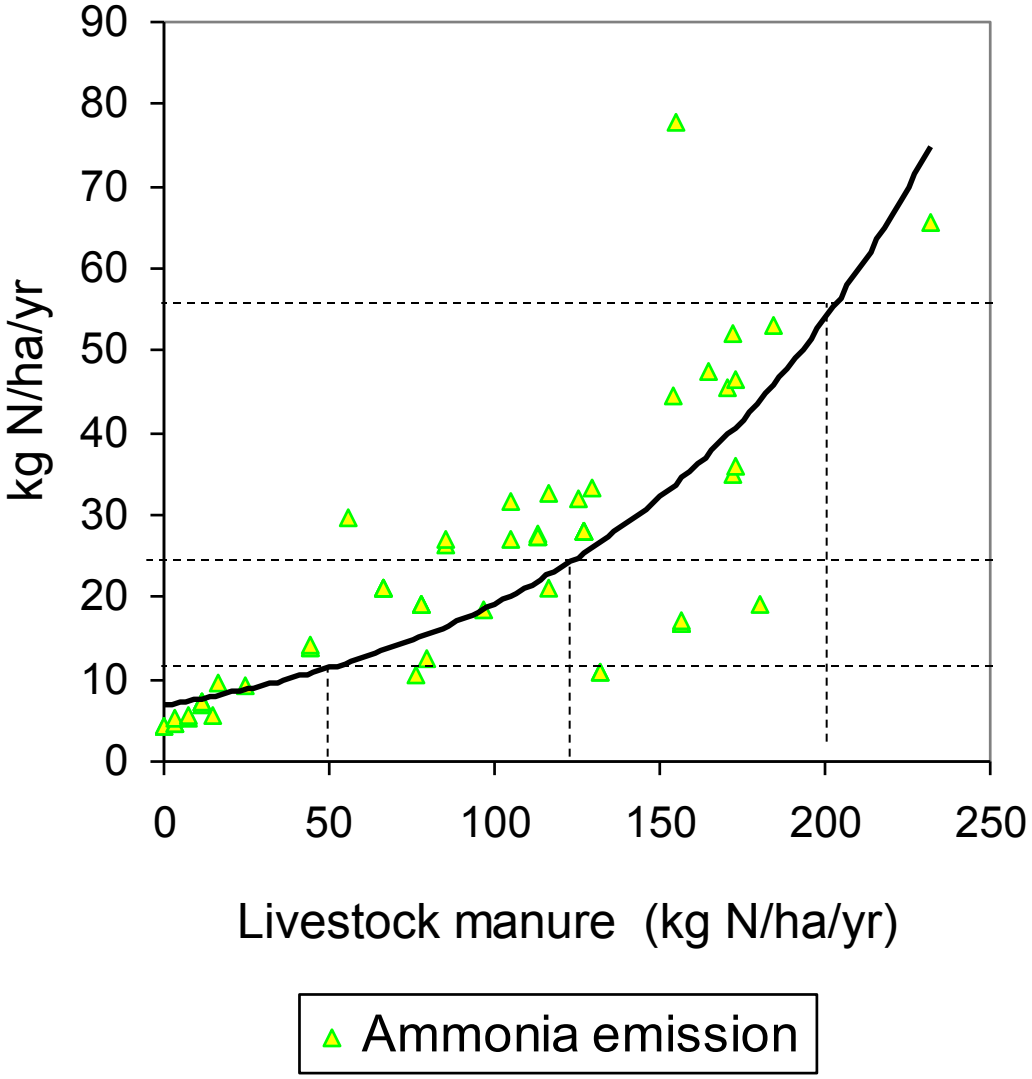
Farm Type	Ruminants	Granivore	Mixed	Cash crops (manured)	Cash crops (no manure)	Average
	kg N ha^{-1}	kg N ha^{-1}	kg N ha^{-1}	kg N ha^{-1}	kg N ha^{-1}	kg N ha^{-1}
N-surplus	128 ±13	123 ±14	91 ±7	77 ±11	59 ±1	100 ±8
NH_3 from house+storage	27 ±6	22 ±12	10 ±4	2 ±0	1 ±1	14 ±4
N_2/N_2O from storage	3 ±2	1 ±2	2 ±1	1 ±0	0 ±0	2 ±1
NH_3 from fields	8 ±1	9 ±3	6 ±1	6 ±3	4 ±0	8 ±1
N_2O from fields	12 ±1	9 ±1	8 ±0	8 ±1	7 ±0	9 ±1
NO_3^- from fields	59 ±2	70 ±7	62 ±5	48 ±2	48 ±1	58 ±3
Soil N pooling	19 ±5	10 ±2	3 ±1	10 ±7	-2 ±1	10 ±3

Environmetal Pollution 159: 3183-3192.
Dalgaard et al. (2011)

Farms heterogenuity:
Ammonia emission example



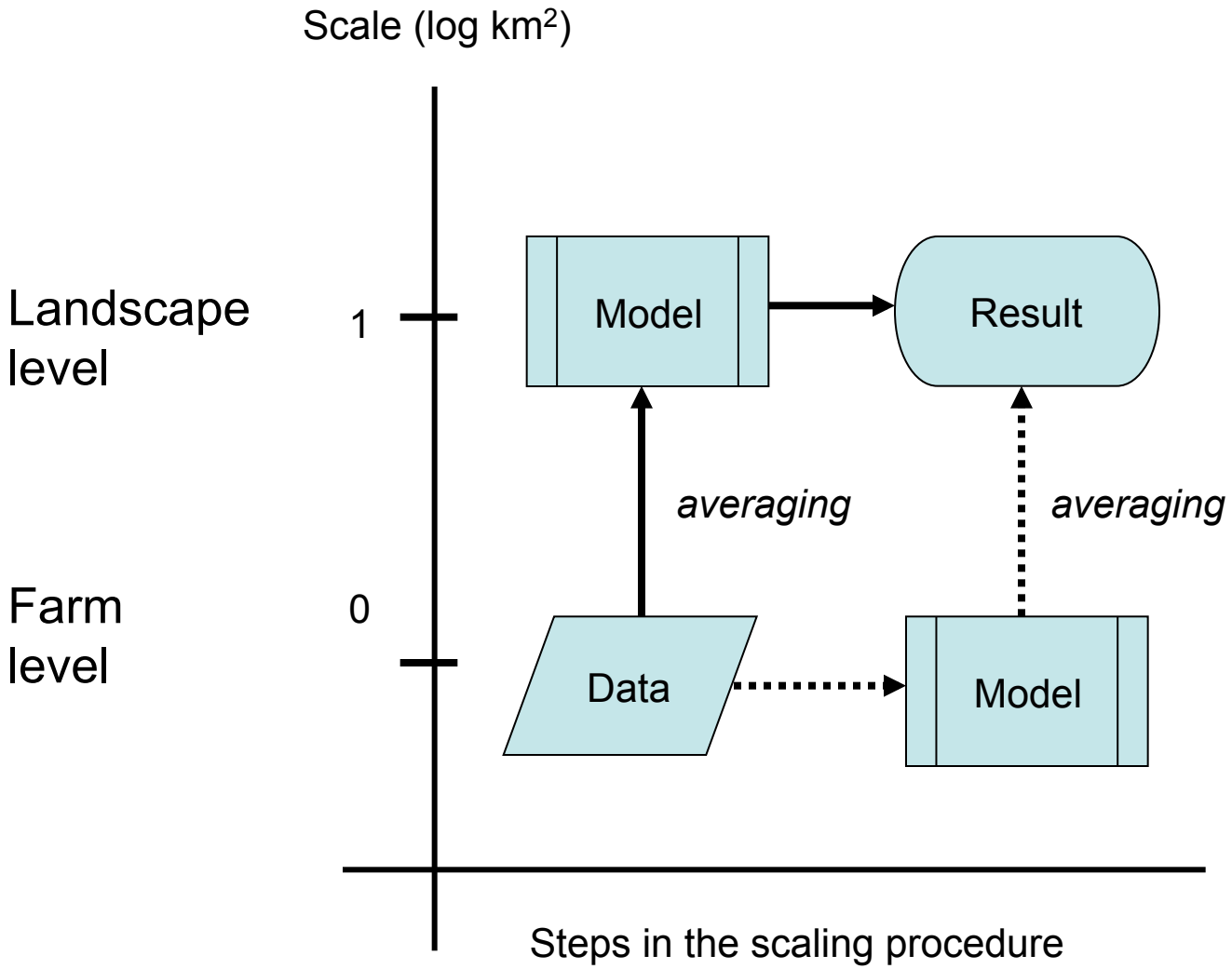
(55+12)/2= 33½

≠

26

Env Pol 159: 3183-3192.
Dalgaard et al. (2011)

Accounting effects of non-linearities and hetrogeneity



Env Pol 159: 3183-3192.

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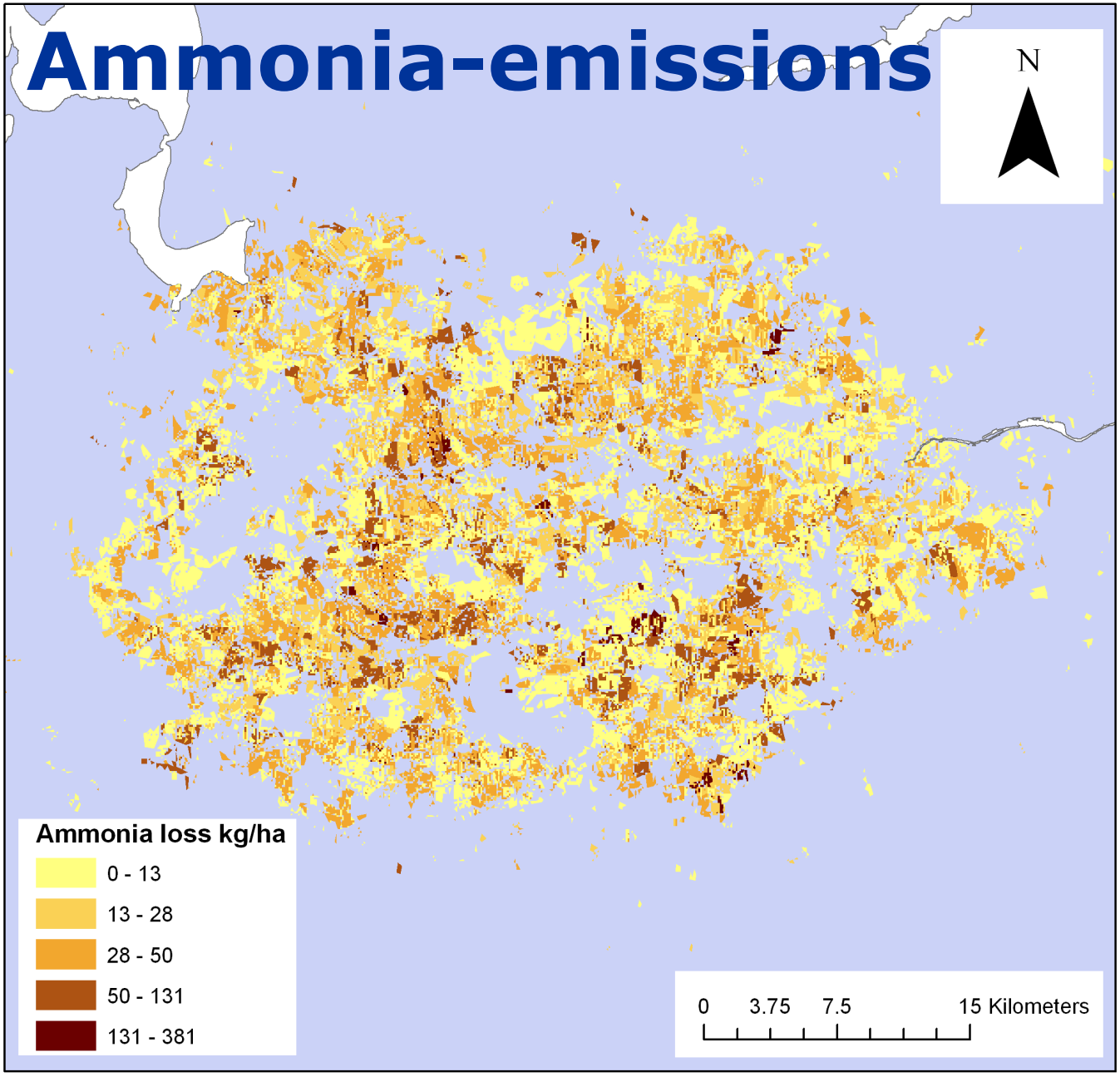
Ammonia-emissions



Spatial hetero-geneity effects the total emission

Env Pol 159: 3183-3192.

Temporal heterogeneity
example: pig farming in DK and DE

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		Bjerringbro, Denmark		Brandenburg, Germany	
Crop Rotation	Field area	Fertilisation Organic	Fertilisation Inorganic	Fertilisation Organic	Fertilisation Inorganic
Unit	(ha)	(kg N ha^{-1})	(kg N ha^{-1})	(kg N ha^{-1})	(kg N ha^{-1})
Set aside	42	0	0	0	0
Set aside	42	0	0	0	0
Winter wheat	42	150	54	150	72
Winter rape	42	150	59	150	77
Winter wheat	42	150	27	150	45
Winter wheat	42	150	54	150	72
Winter barley	42	118	63	118	79
Winter rye	42	102	45	102	58
Winter rape	42	150	59	150	77
Winter wheat	42	150	27	150	45
Winter wheat	42	150	54	150	72
Winter barley	42	118	63	118	79
Set aside	42	0	0	0	0
	546	58283	21009	58283	28378

Temporal heterogeneity example

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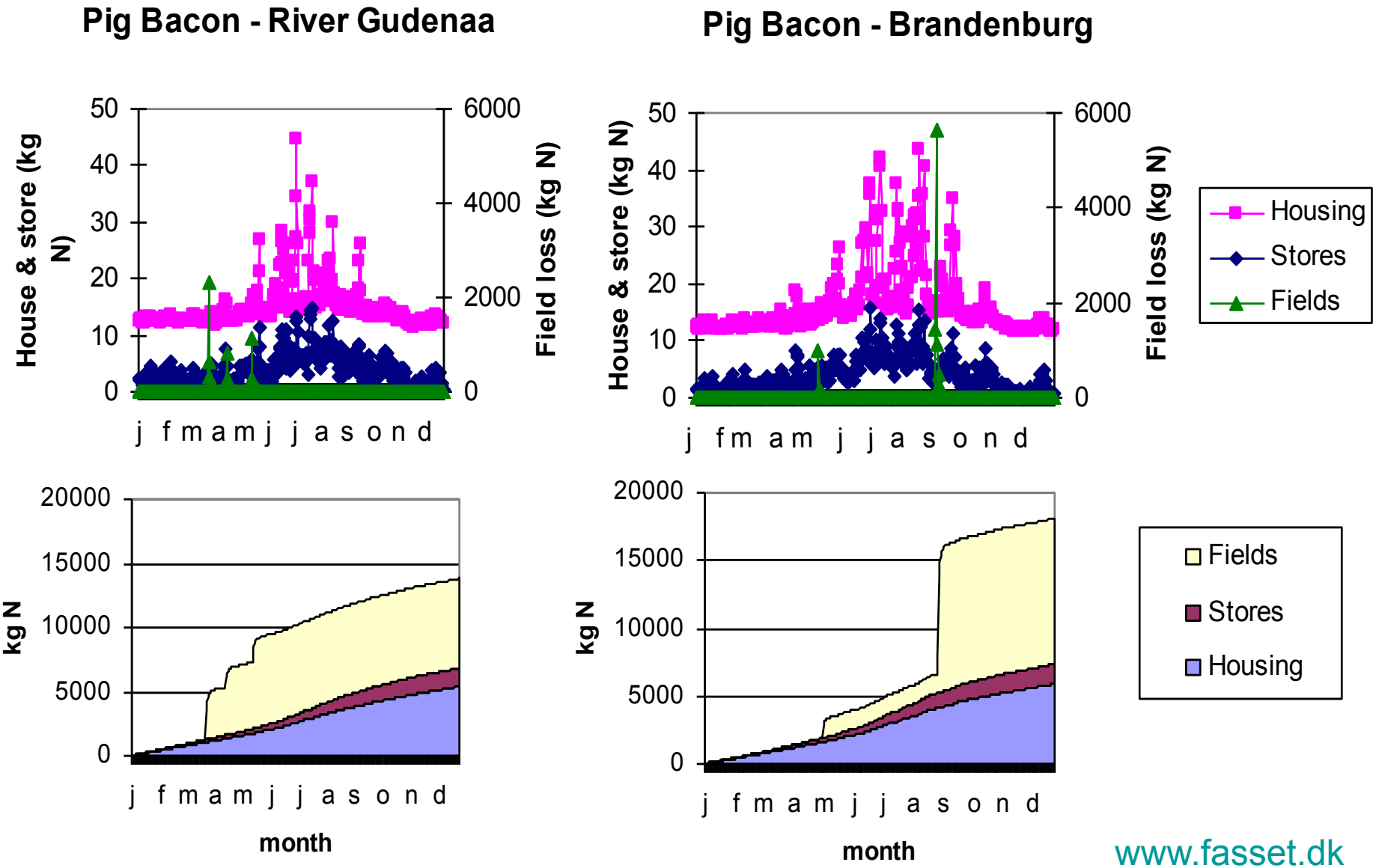

www.fasset.dk

Conclusions

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- **Taking into account spatial and temporal heterogeneity is important when modelling and upscaling farm N-losses and GHG-emissions**
- **Future research studies should therefore be developed to being able to taking these effects into account**
- **This is an important point for the www.macsur.eu farm and regional model development, and the inclusion of regional pilot studies.**

The regional scale study problem

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Top down information

from national/regional statistics, Corine Land Cover etc.

Examples:

1) MEA-scope

2) NitroEurope

… MACSUR?

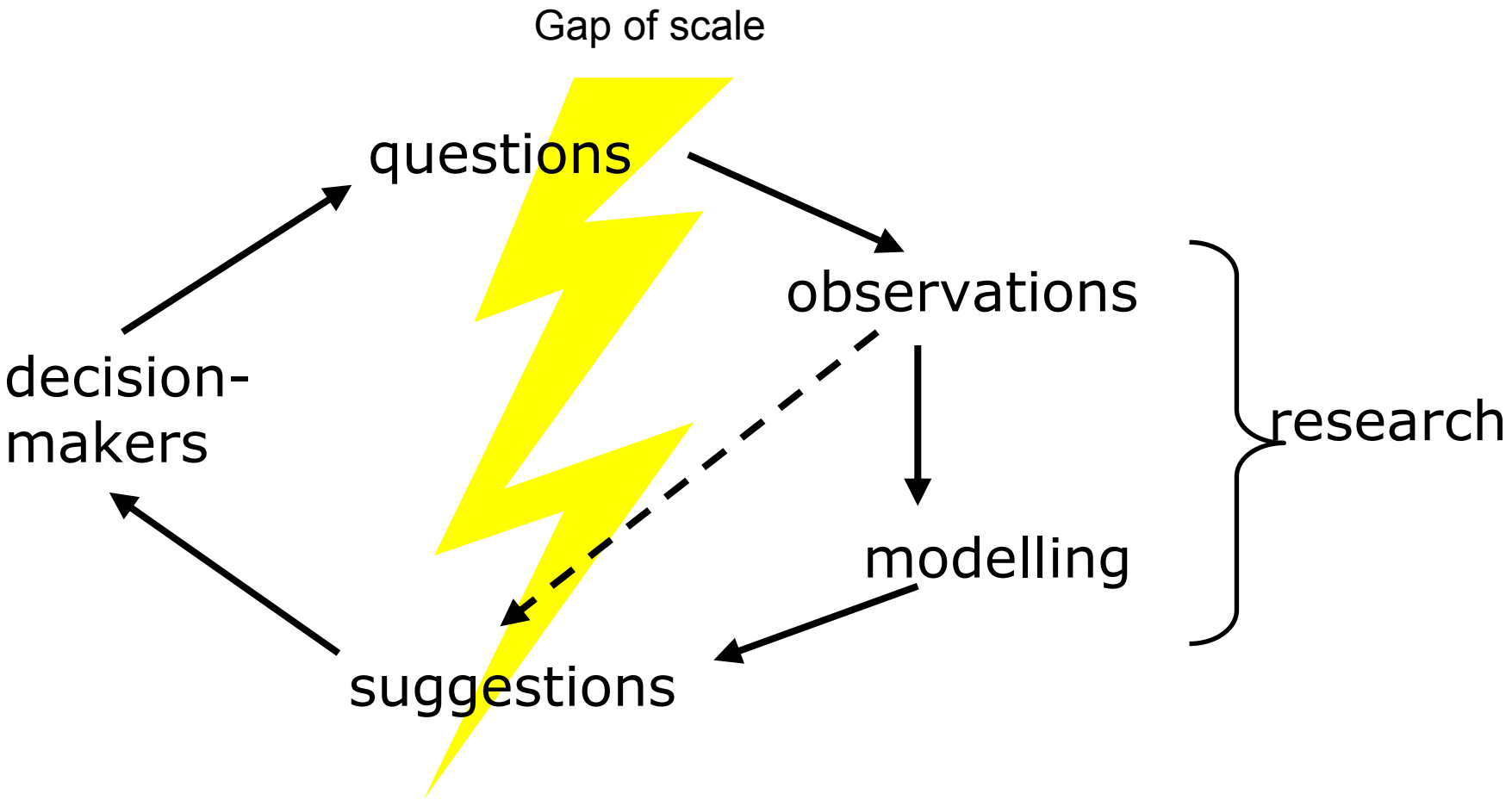
≈ 500 km^2 landscapes

≈ 25 km^2 landscapes

Bottom-up information

from local farm surveys, plot experiments, digital EU farm registers, local GIS-maps (LPIS, soil maps…) etc.

Future research needs



Farm type differences in the Danish landscape

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	Ruminants	Granivore	Mixed	Cash Crops	
				> 10 kg manure-N/ha	< 10 kg manure-N/ha
	(n=14)	(n=13)	(n=11)	(n=23)	(n=7)
Manure-N produced (kg N ab store ha-1 yr-1)	175 ±35	136 ±23	61 ±12	9 ±2	4 ±3
Manure-N spread (kg N ha-1 yr-1)	147 ±18	125 ±18	58 ±11	59 ±28	3 ±2
Fertiliser-N spread (kg N ha-1 yr-1)	30 ±14	44 ±11	97 ±10	86 ±22	130 ±14
Area with sandy soils (% of total area)	50	49	50	45	47

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