Calculating nitrate leaching at field scale - using detailed soil data

ALECTIA AQUA

Head of department, agronomist
Christian Thirup, ALECTIA A/S,
cth@alectia.com

AGWAPLAN Conference 14.-15. January 2009

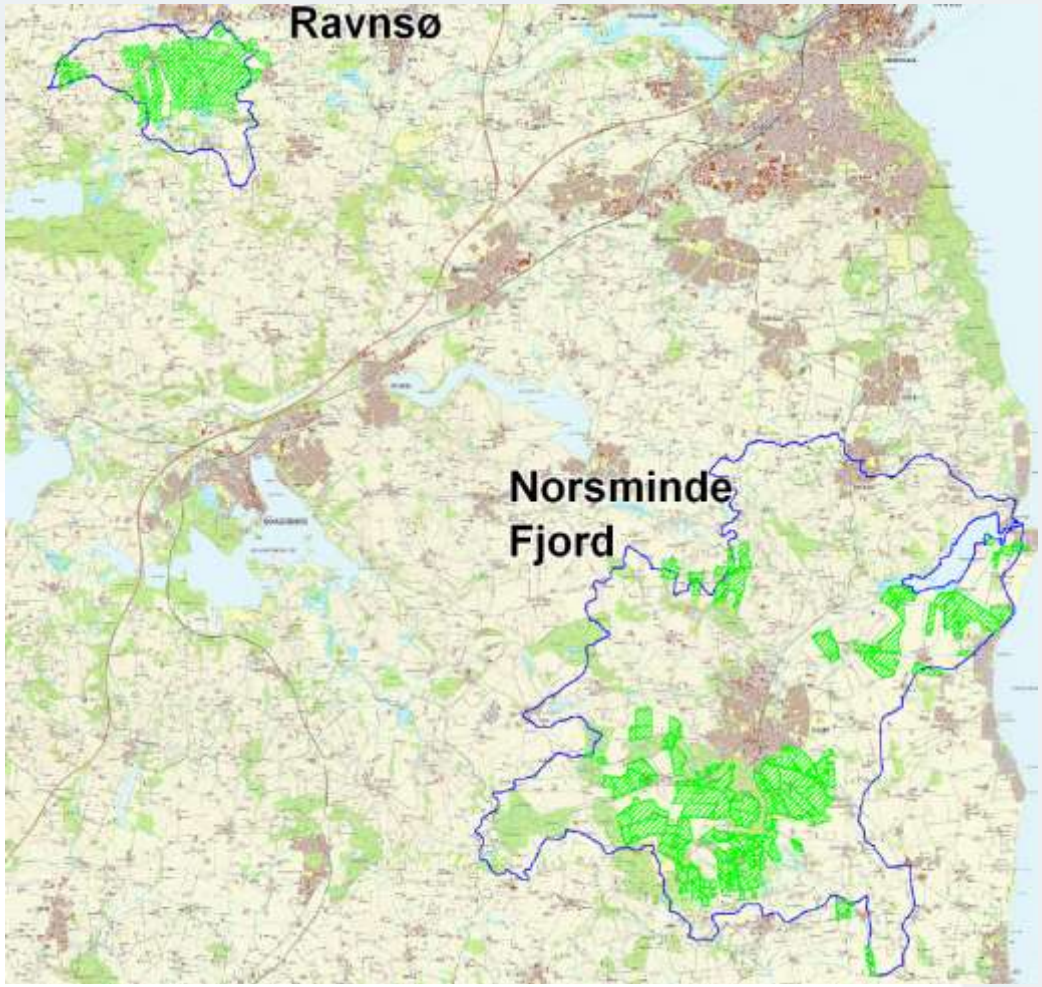
Purpose

To quantify the area distributed nitrate leaching before project start (2005).

Norsminde Fjord

Catchments

- Norsminde Fjord
- Lake Ravn (Ravnsø)
- 16 farms
- 1.728 ha
- (1.272 ha in rotation)

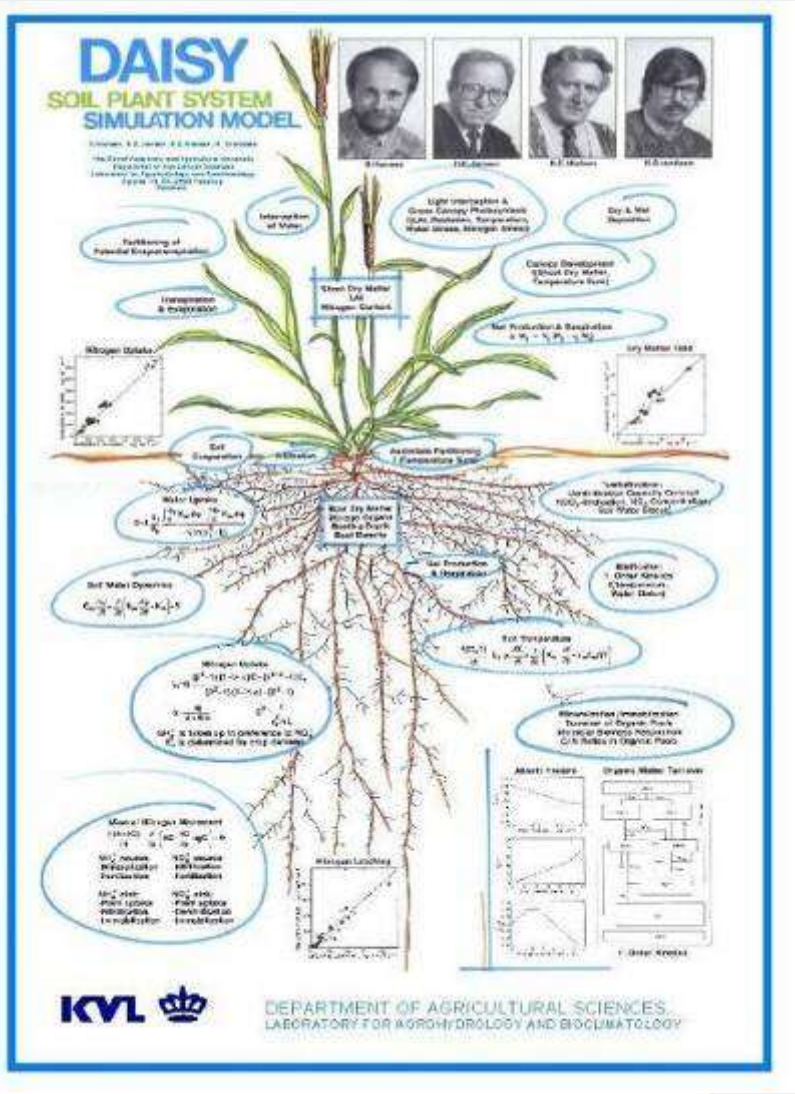


Daisy-model

- Soil Plant System Simulation Model
- Mechanistic, dynamic
- Physical and biological processes in an agricultural field
- Traces the fate of:
  - Water
  - Carbon
  - Nitrogen

- Input data:
  - Management
  - Soil quality
  - Daily weather data

- Developed at Copenhagen University, LIFE (former KVL)



Management data

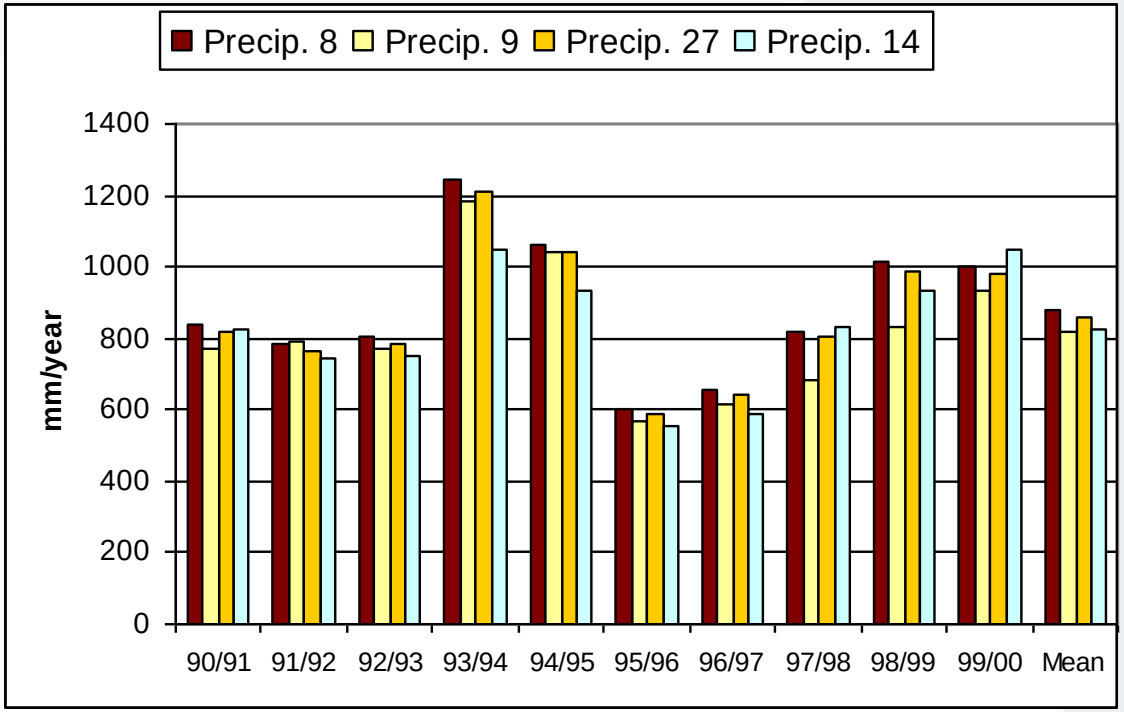
- Agricultural practice in 2005
- Crops and yields
- Crop rotation (2001-2005)
- Fertilizers and animal manure
- Straw incorporation
- Irrigation
- Drainage conditions

- Data collected by agric. advisor:
  - Fertilizer plans
  - Field plans
  - Rotation plans etc.

Lake Ravn

Weather data

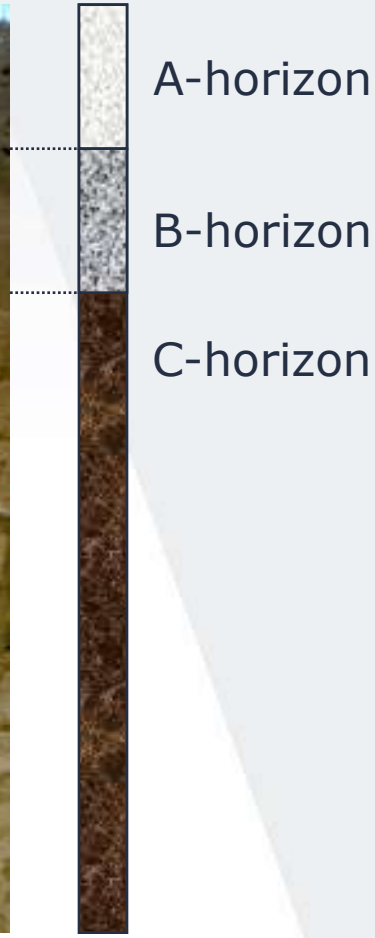
- 10 years weather data – daily values
- Temperature
- Global radiation
- Precipitation



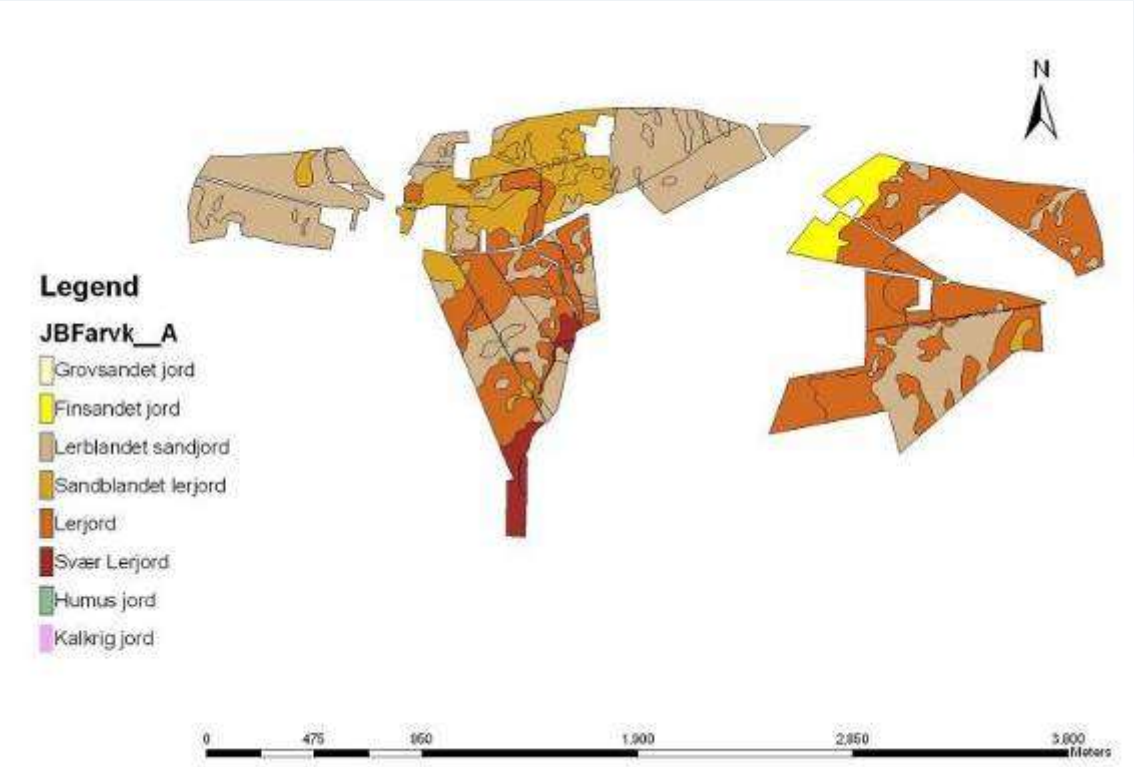
(1st April – 31. March)

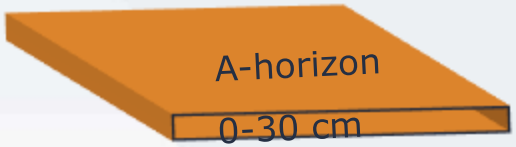
Soil data

- Horizons
- Texture
- Organic content
- Hydraulic parameters
  - HYPRESS-model
    - Retension
    - Conductivity
- Drainage
- Groundwater level
- Root depth

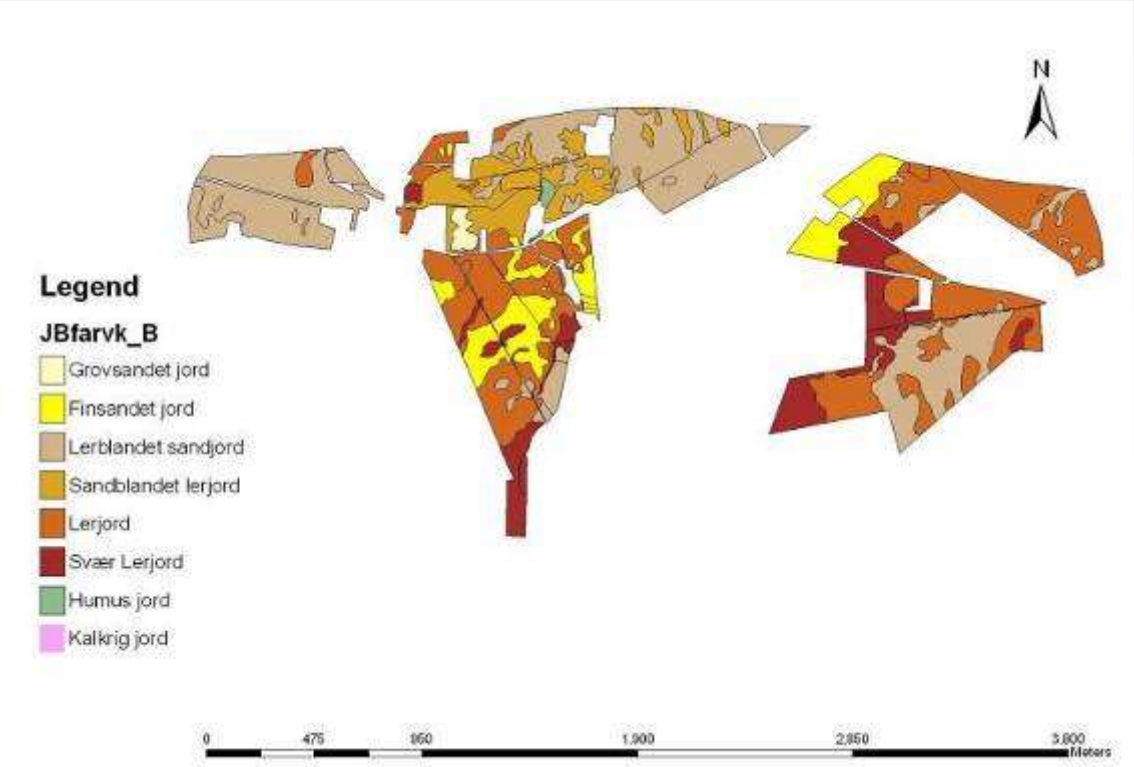


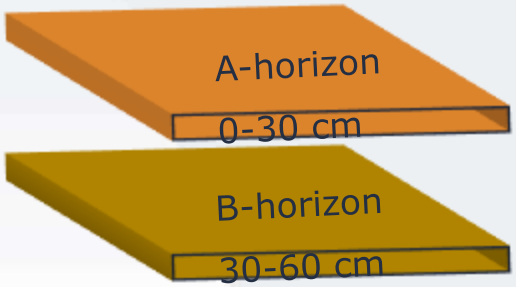
Soiltexture in the A-horizon



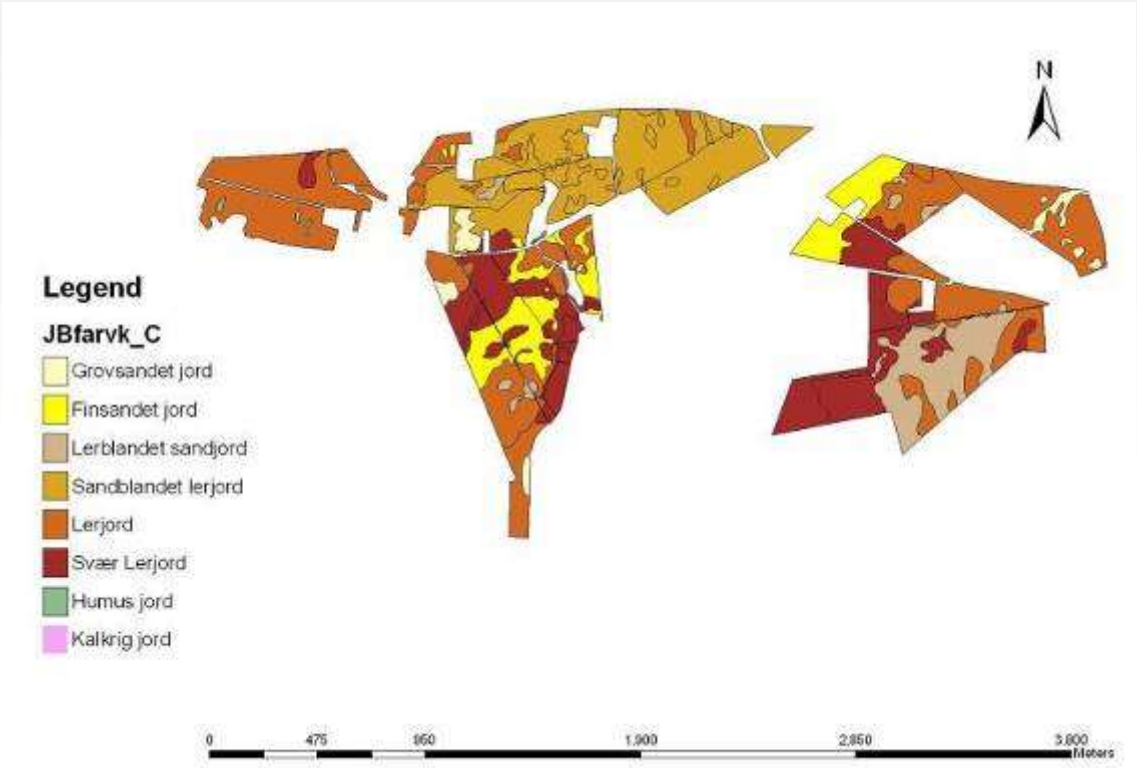


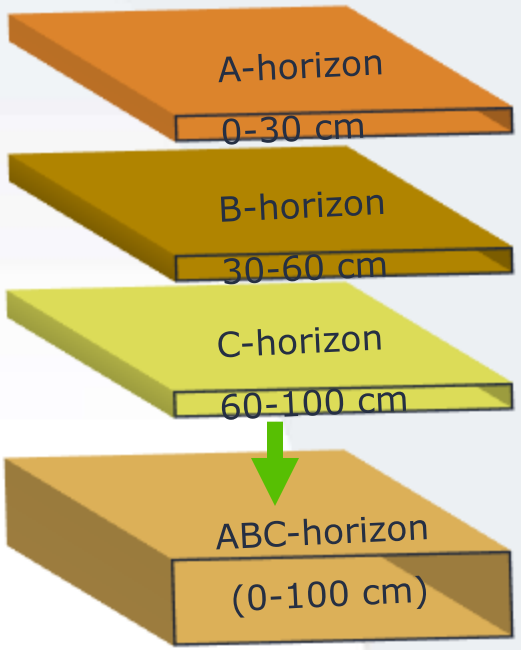
Soiltexture in the B-horison





Soiltexture in the C-horison

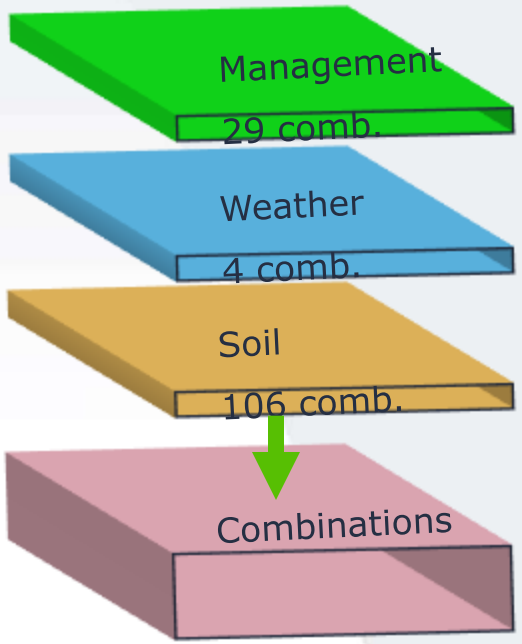




106 combinations

Modelling

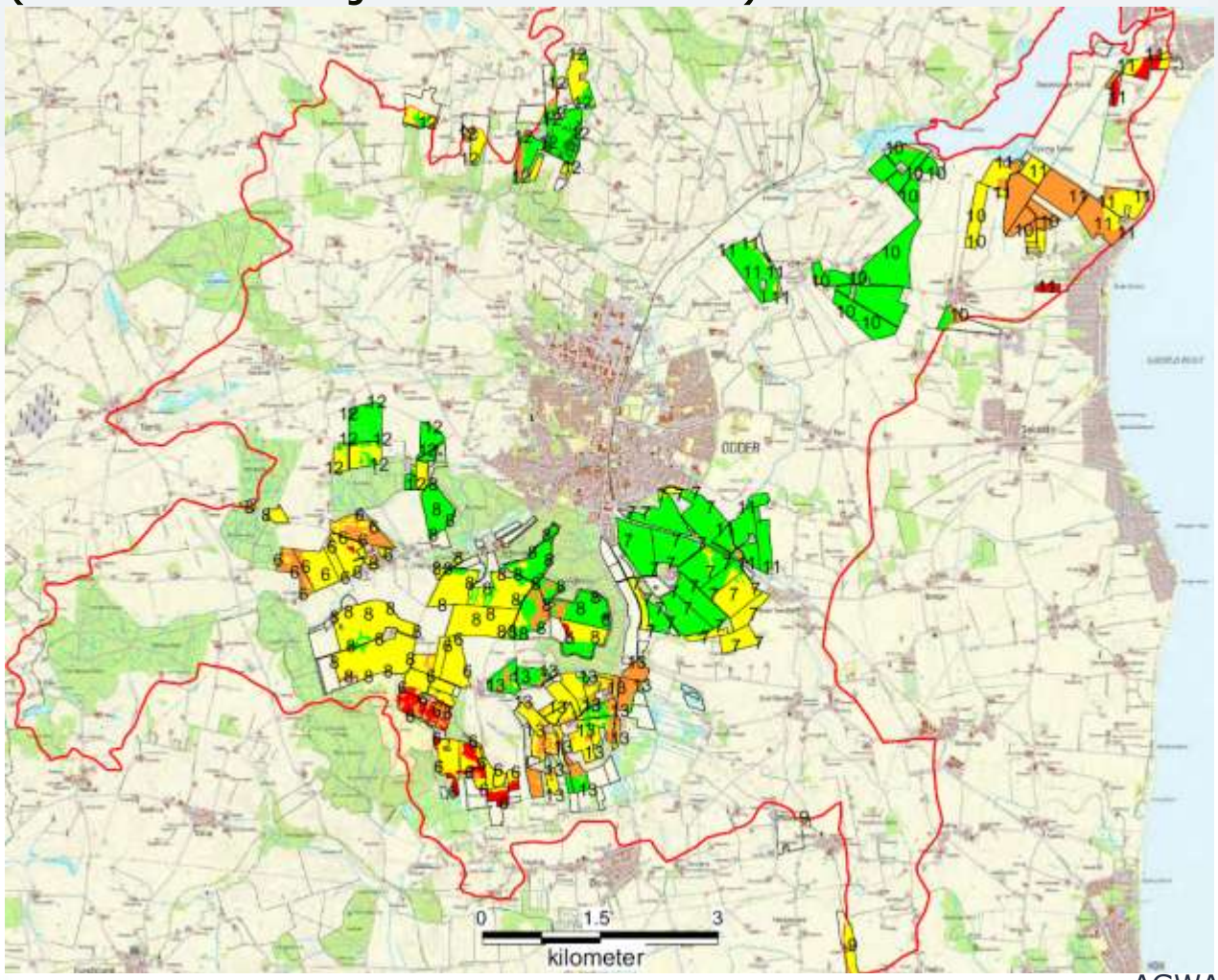
- DaisyGIS (geo-refer combinations)
- Setup according to ”Daisy Standardisation”
- Modelling-period:
  - 10 years
  - + 10 years warmup-period
- Calibration:
  - Harvest yield
  - Drainage
  - Development in soil organic matter



Nitrate and Water Balance

	Norsminde Fjord	Lake Ravn
Area (ha)	1272	456
N-supply (kg N/ha/yr.):		
- fertilizer	158	187
- deposition	16	16
- atm. N-fixation	6	12
- seed	4	4
Total	184	219
N-removal (kg N/ha/yr.)		
- volatilization	4	6
- leaching	43	56
- denitrification	21	25
- harvest	120	138
Total removal	188	224
Change in soil-N (kg N/ha/yr.)	-4	-5
Water Balance (mm/yr.)		
- precipitation	853	830
- evaporation	530	520
- percolation (matrix)	201	232
- drainage	122	78
Nitrate concentration (mg NO_3/l)	**Approx. 58**	**Approx. 80**

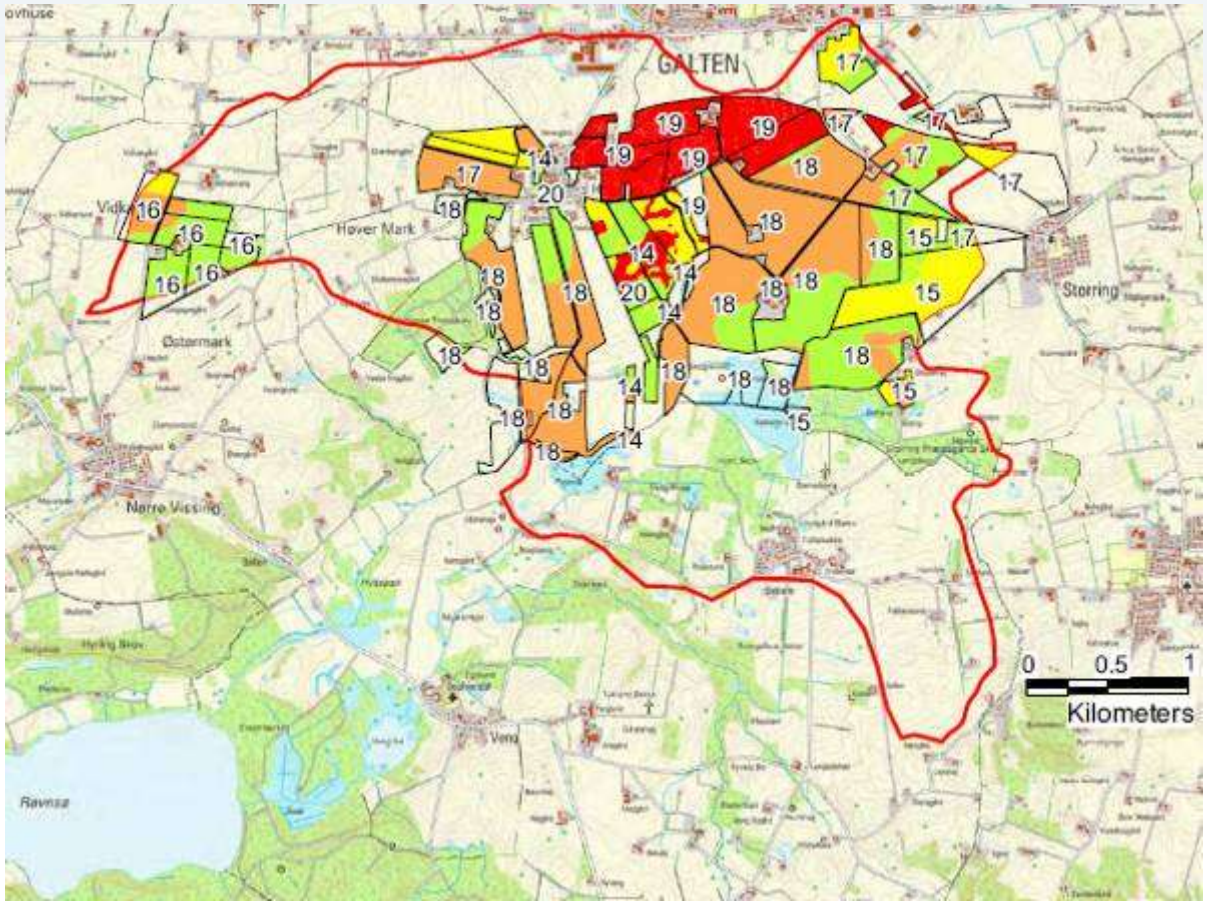
Area distributet nitrate leaching
(Norsminde Fjord catchment)



Nitratkoncentration
(mg NO3/l)

- 100 til 125
- 75 til 100
- 50 til 75
- 25 til 50
- 0 til 25

Area distributet nitrate leaching
(Lake Ravn catchment)

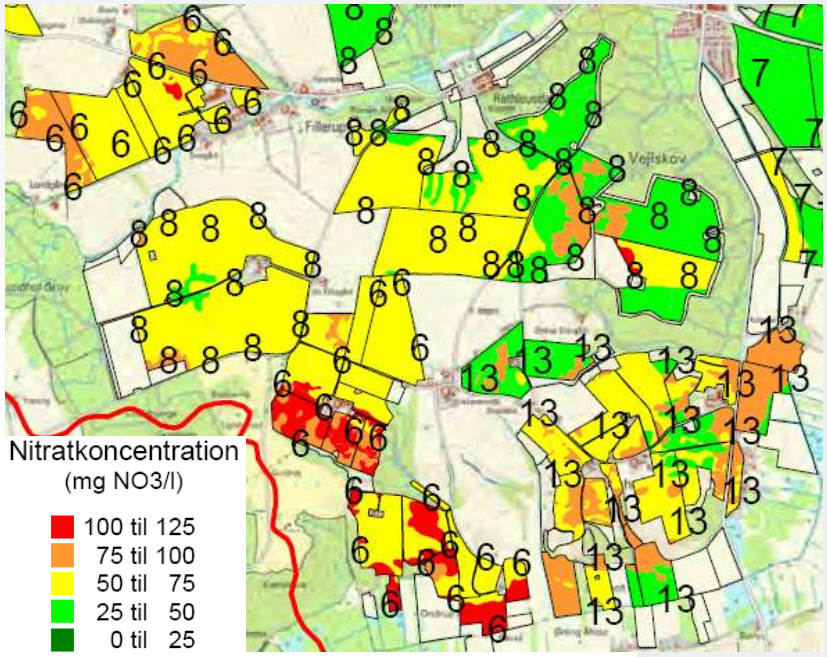


Nitratkoncentration
(mg NO3/l)

- 100 til 125
- 75 til 100
- 50 til 75
- 25 til 50
- 0 til 25

Conclusions

- It's possible to use detailed soil data to calculate the area distributed nitrate leaching at catchment scale.
- Nitrate leaching depends very much of soil types. That means that the detailed soil mapping results in a much more precise picture of the area distributed nitrate leaching.
- This method is much cheaper than the costs of doing efforts at the wrong places.
- A good basis for advising farmers



Perspectives

- Efforts must be made where the effect is cheapest (cost effectiveness)
- Mapping the area distributed nitrate reduction between fields and recipient – (where does efforts have the highest effect on the recipient?)
- Where do we get the best and cheapest effect – at the field or just before the recipient?
  - Change in farming practice
  - Cleaning of drain water

References

- DHI, KVL, DJF, Watertech, LR (2004): Standardopstillinger til Daisymodellen, Vejledning og baggrund. Homepage: http://www.dhigroup.com/~/media/293EA9DD6A214A438BA2919DF759E822.ashx

- Hansen, S, Jensen, HE, Nielsen, NE, Svendsen, H (1990): DAISY – a soil plant atmosphere system model. NPO-forskning fra Miljøstyrelsen, A10, Miljøministeriet.

- Hansen, S (2002): Daisy, a flexible Soil-Plant-Atmosphere system Model. Homepage of the Daisy model. http://code.google.com/p/daisy-model/

- Watertech A/S (2007): Nitratudvaskning i oplandet til Norsminde Fjord og Ravnsø. Indgår i AGWAPLAN projektet. Udarbejdet for Miljøcenter Århus.

ALECTIA

AQUA