Assessing land nitrogen budgets for Danish agriculture

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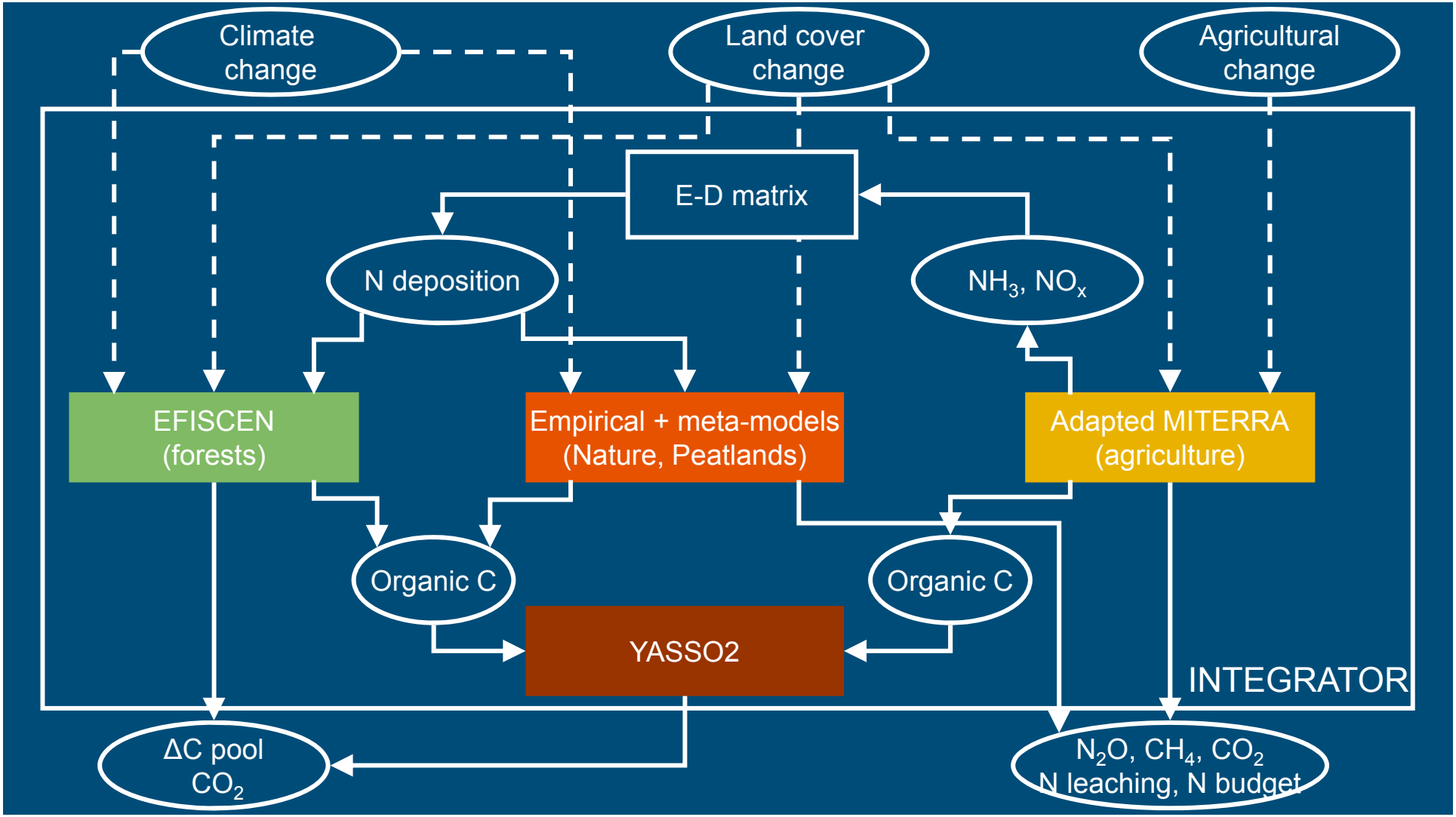
The INTEGRATOR model



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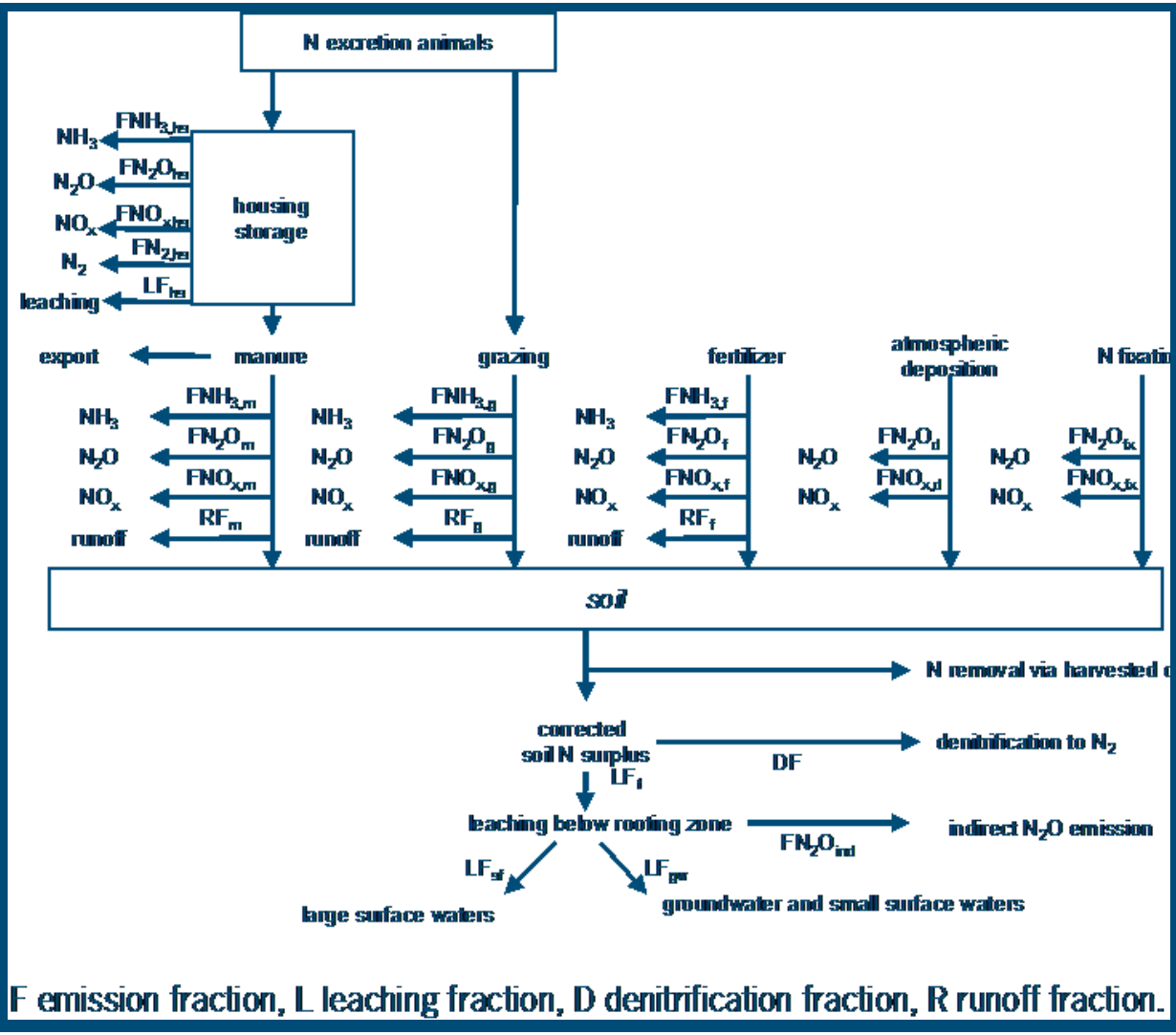
The MITERRA model: Schematic overview



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Aims

- Inter comparison of N budgets for Denmark for the year 2000 based on INTEGRATOR, using :
  - downscaled European (e.g. livestock) data
  - detailed Danish data
- N budgets for DK for the years 1990-2010 with detailed Danish data

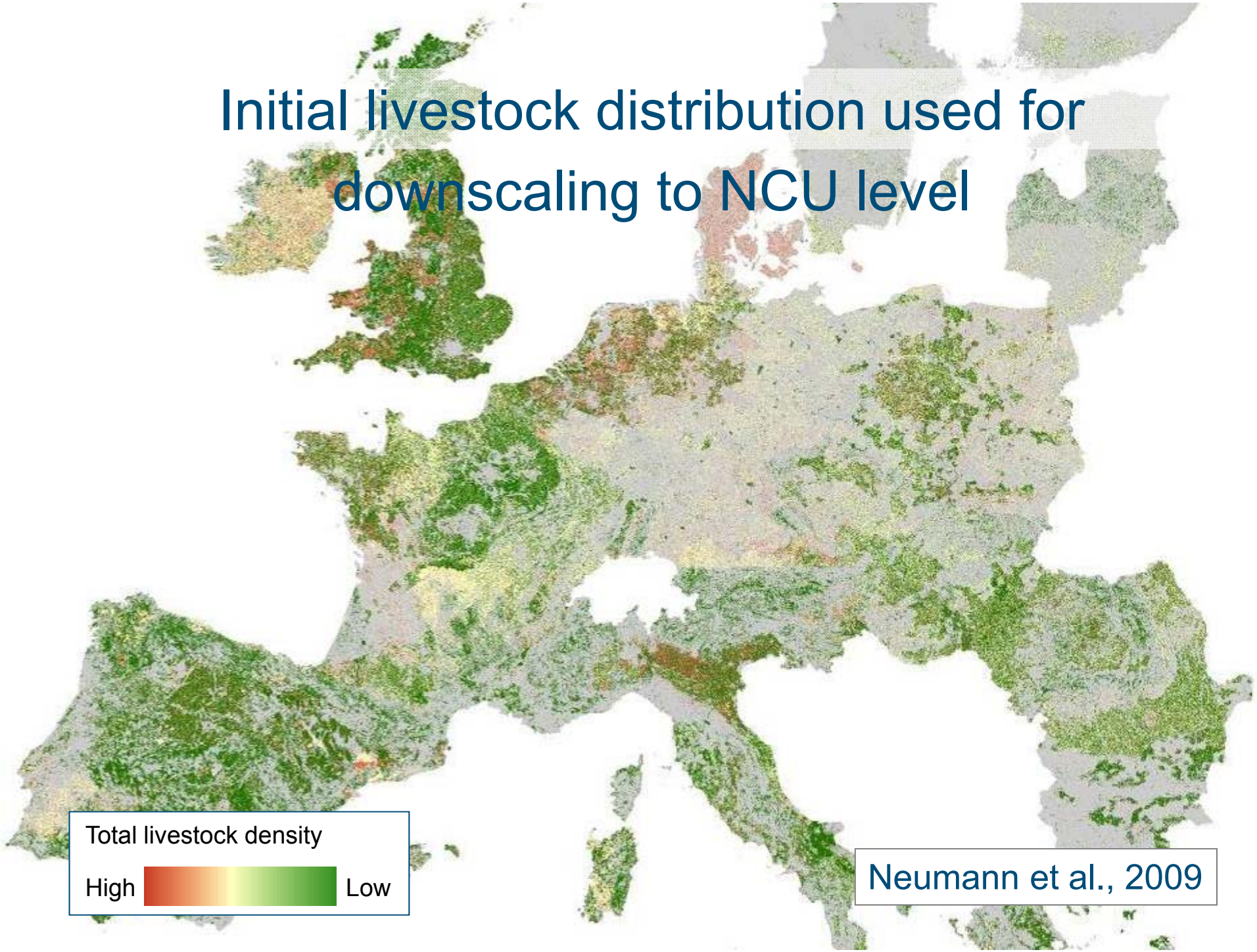
Spatial scale - NitroEurope Classification Units (NCUs)

- Polygons of clusters of 1 km x 1 km pixels. NCU is unique combination of :
  - administrative unit (Nomenclature of Territorial Units NUTS2 and NUTS3)
  - soil mapping units (SMU; Soil Geographic Database SGDB classification)
  - slope class (Catchment Characterisation and Modelling Digital Elevation Model, CCM 250 DEM)
- 142 NCUs in Denmark (~40k in all Europe)

Current status

- Standard INTEGRATOR application:
  - March 2013: Animal numbers at NUTS2 level, no manure distribution across NUTS2 regions
  - October 2013: INTEGRATOR application for EU 27 using new 1km x 1km data on animal numbers and new fertilizer and manure distribution model
- INTEGRATOR application for Denmark using:
  - INTEGRATOR data structure but using Danish agricultural data and based on an overlay of municipalities with NCUs

Initial livestock distribution used for downscaling to NCU level



Manure distribution at NCU level

- Apply manure in NCU where it is produced until reaching the maximum permissible application rate
- Excess manure is distributed over the surrounding NCUs that have a capacity to receive manure
- Distribution of excess is weighted with 1/D, with D is the distance to the centre point of the NCU
- If a excess manure exists after redistribution over NUTS2 within the country, the excess is equally applied over all NCUs within the NUTS2 were the excess occurs

Disaggregated agricultural N budget for Denmark

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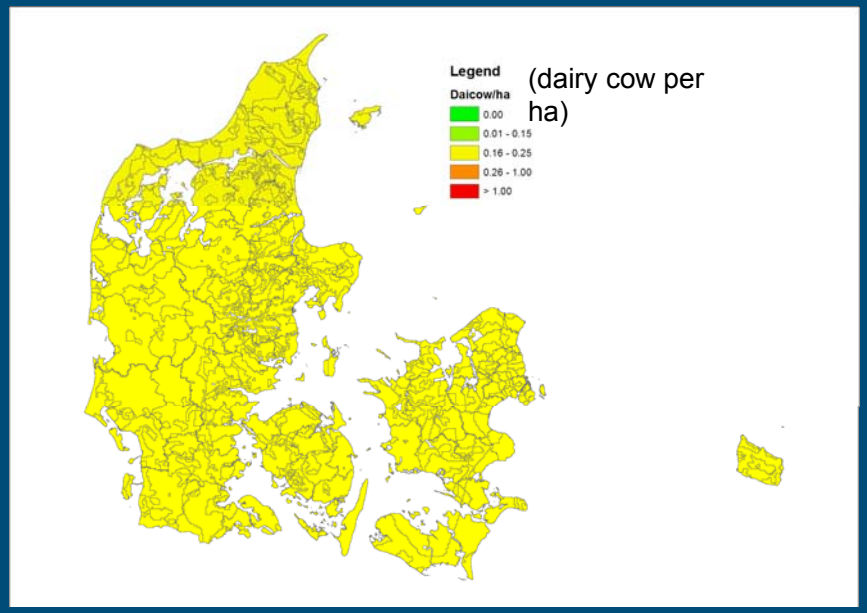
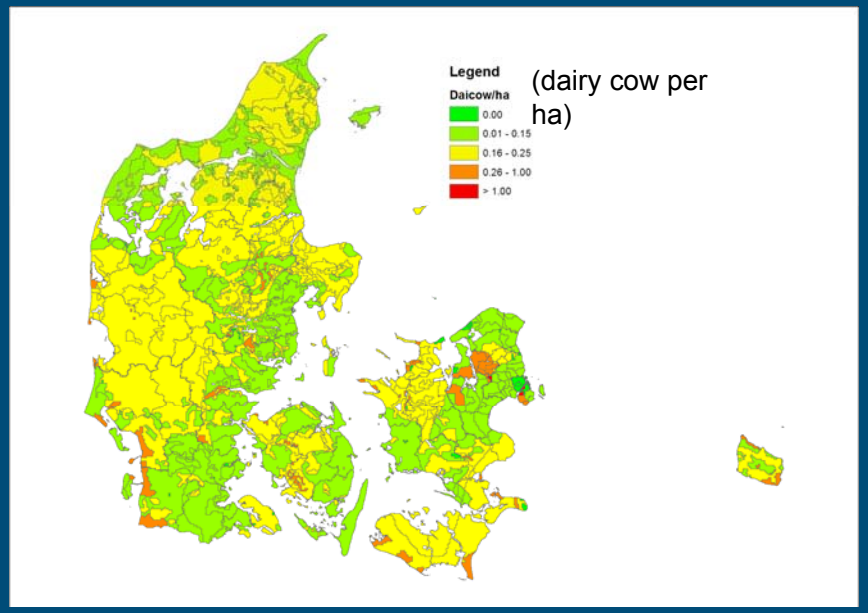
Animal stocking density 2000

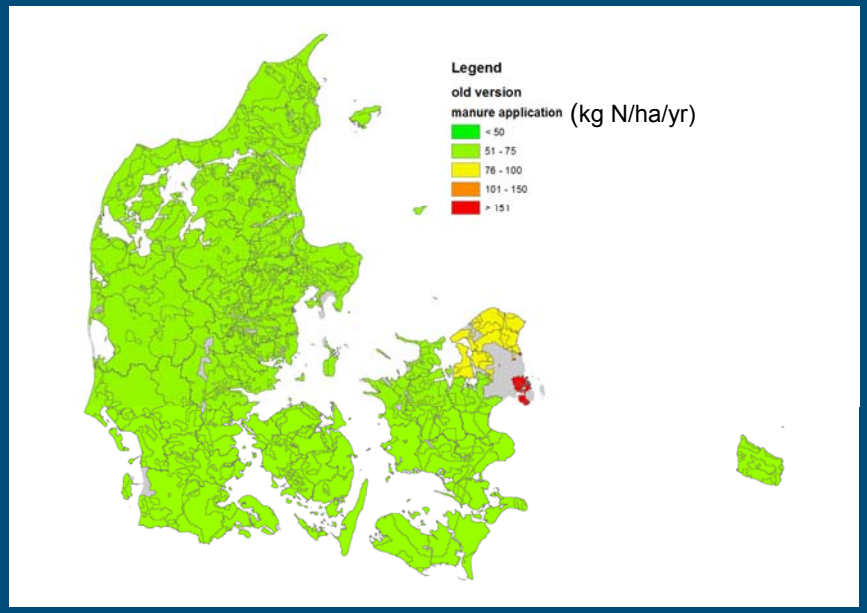


Old version: at NUTS level

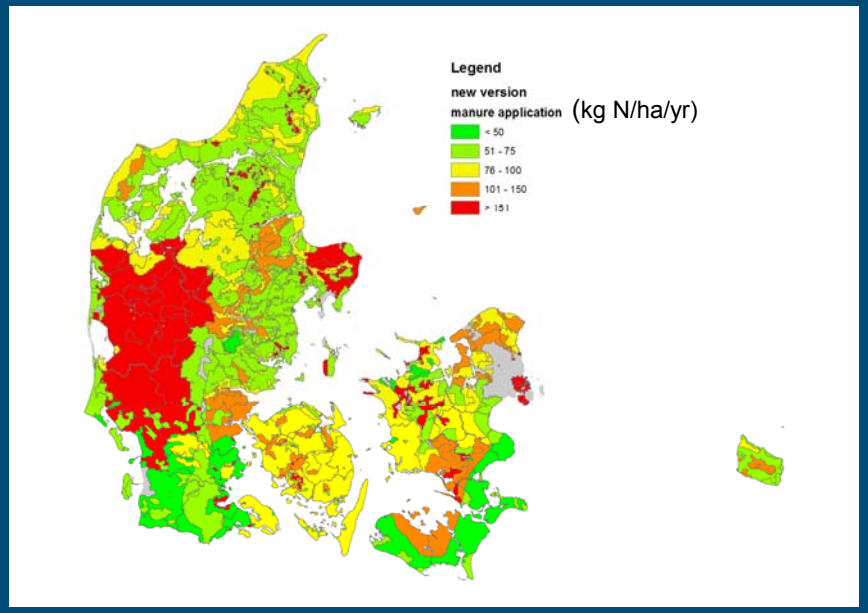


New version: at NCU level

Manure application arable land



Old version: at NUTS level



New version: at NCU level

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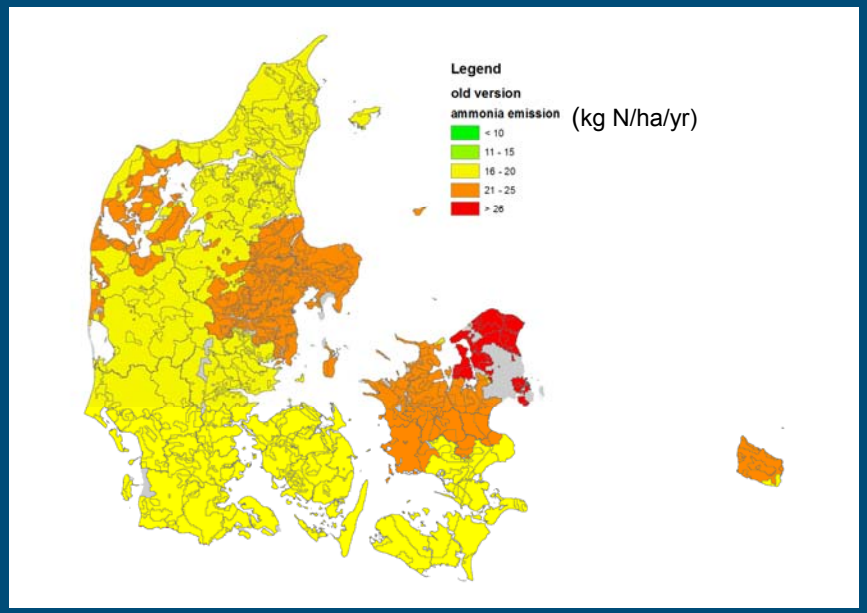
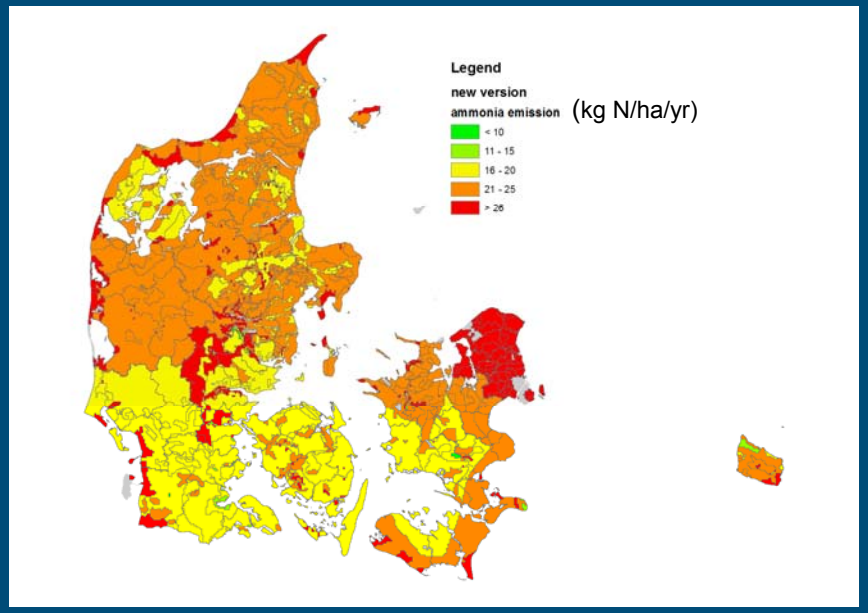
Total ammonia emission arable land

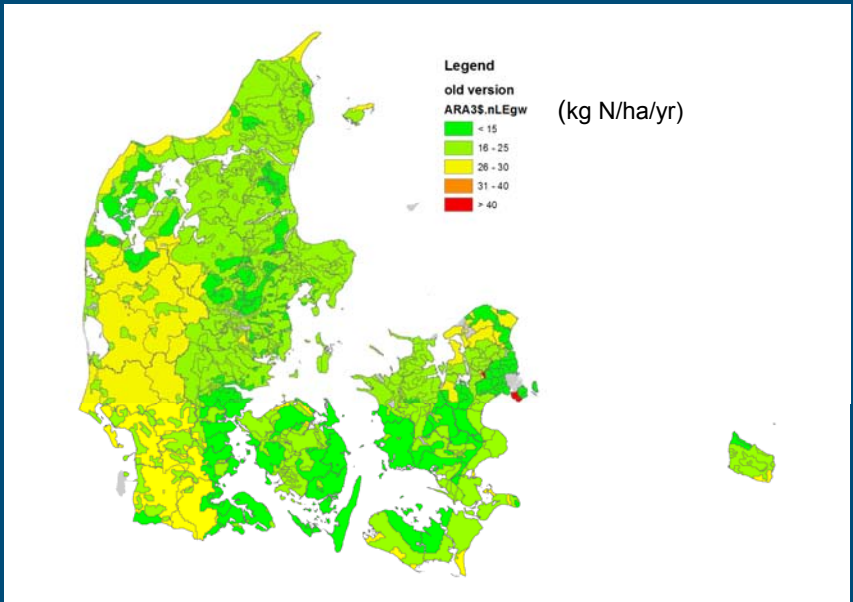


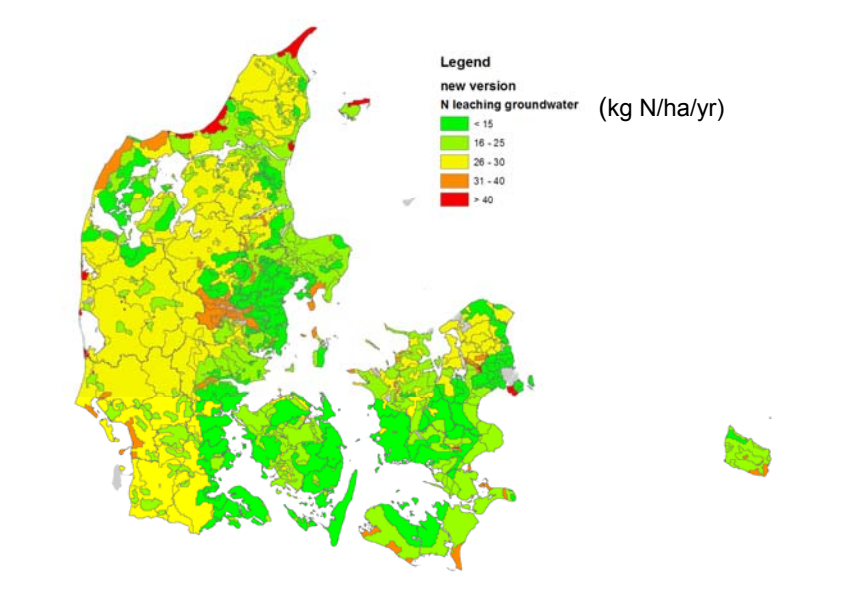
Old version: at NUTS level



New version: at NCU level

Nitrate leaching flux to groundwater for arable land





Old version: at NUTS level

New version: at NCU level

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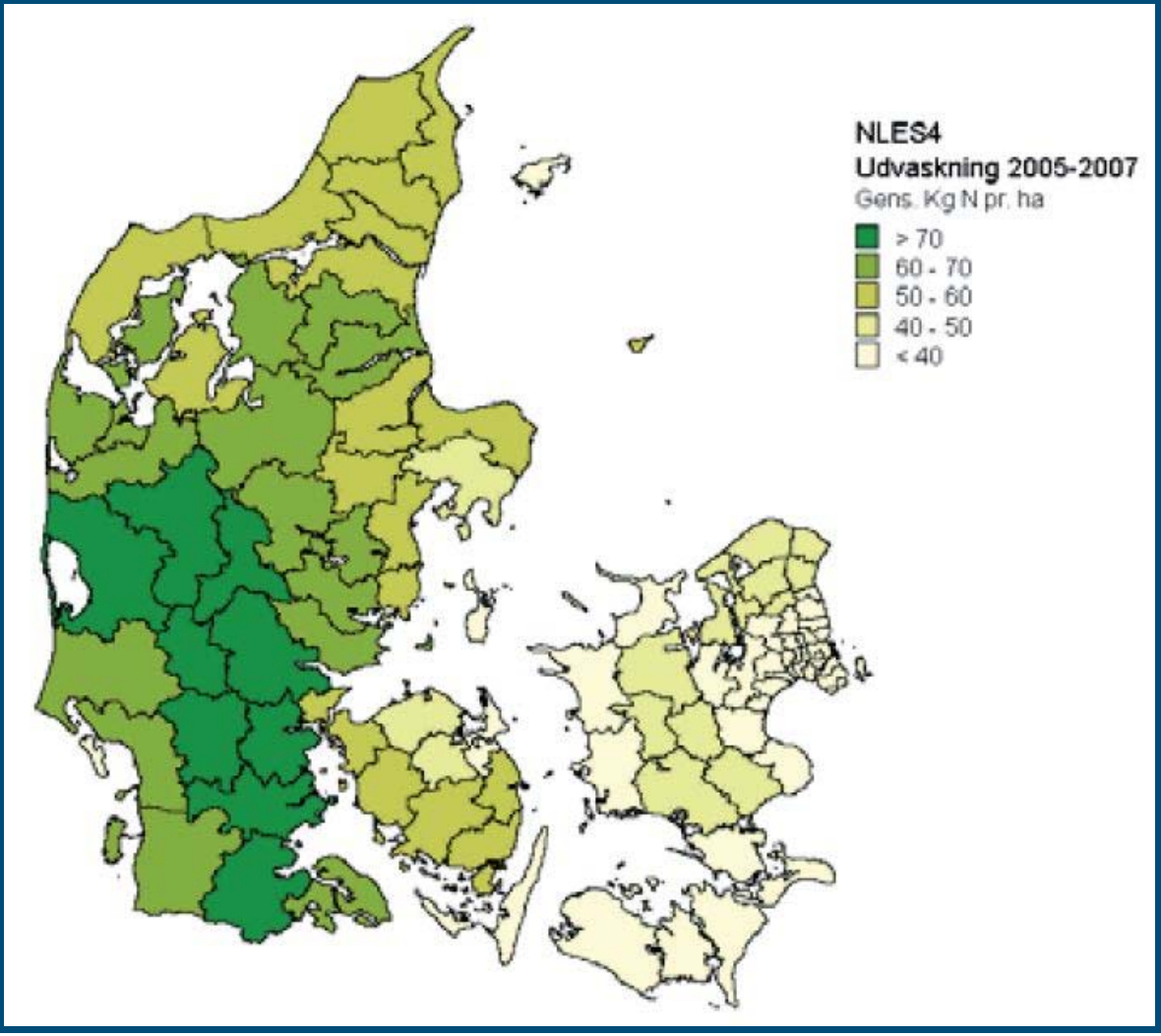
Nitrate leaching (NLES)



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Planning next period

- NCUs with DK data on animal numbers and cropping areas are available

- Planned in 2013 and begin 2014
  - Linking INTEGRATOR with DK data on animal numbers and cropping areas
  - Downscaling national housing system, manure storage and manure application to the NCU level?
  - Model application and comparison

Downscaling stocking density

- Livestock units (LU) downscaled to NCU (i) within each NUTS (j) using weighing factor for each of the six animal categories in INTEGRATOR (k):
  - $ANk(NCU)_{i,j} = fw_{k,i,j} \times AN_k(NUTS)j$
  - $fw_{k,i,j} = \frac{LU_k(NCU_{i,j})}{\sum_i LU_k(NCU_{i,j})}$
- Weighing factors based on 1×1 km cell livestock densities