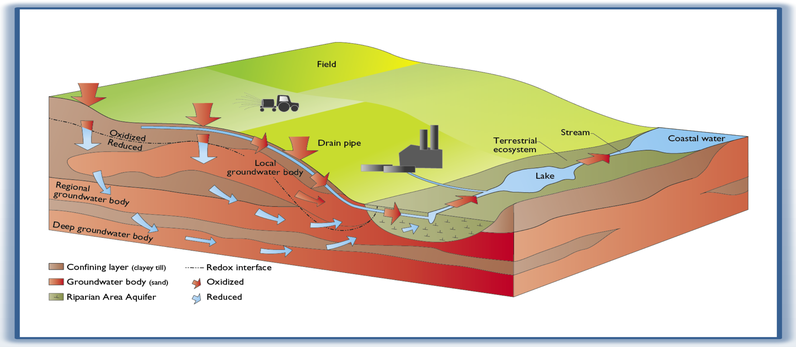
Nitrate reduction in groundwater as a measure for reducing nitrate load to surface waters

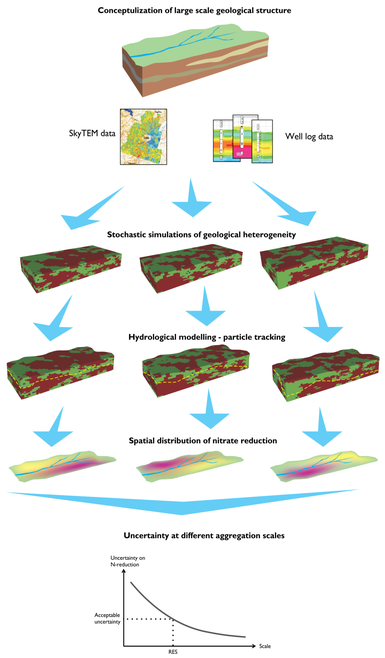
- 2/3 of the nitrate leaching from the root zone is reduced naturally, through denitrification, in the subsurface before reaching the streams.
- No tools have proven efficient in identifying the robust areas with high denitrification and distinguish these from the vulnerable areas, where none of leached nitrate disappears before reaching the surface waters.
- The overall objective of the NiCA project is to develop a framework for assessing nitrate reduction in the subsurface and to assess to which spatial scale modelling tools have predictive capabilities for identifying robust and vulnerable areas



Key elements in new framework

Six steps:

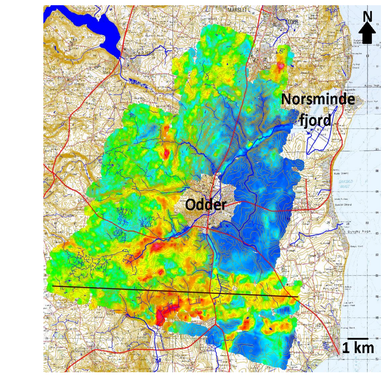
- **Airborne geophysical mapping with high spatial resolution**: more details – see box to the right
- **Geological modelling with focus on geological uncertainty**: using stochastic methods for establishing a number of plausible geological realisations
- **Characterisation of redox interface in the saturated zone:** describing the location of the redox interface at local scale using field data and modelling studies
- **Hydrological modelling with particle tracking:** establishing coupled surface-groundwater models for each of the geological realisations and calculating the fraction of flow (particles) passing the redox interface.
- **Assessing the scale of potential predictive capability -(RES):** aggregating nitrate reduction fractions from one model cell to many cells and thus establishing a relationship between aggregation length scale and uncertainty. The smallest scale, at which the uncertainty is below a given acceptable level, is denoted **the Representative Elementary Scale**
- **Testing the concept in water resource management:** assessing the economic effects of differentiated agricultural regulation in a stakeholder process

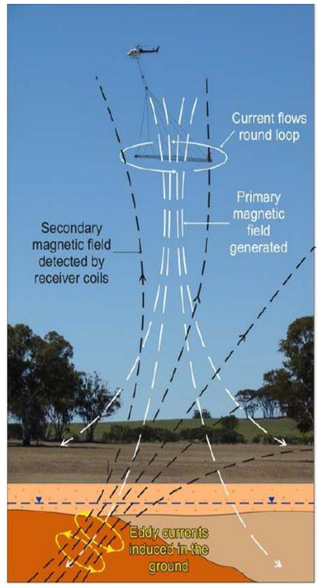


Geophysical data

A new airborne system using Transient Electromagnetic Method has been developed (**MiniSkyTEM**).

The system has a penetration depth in the order of 100 m. In the upper 30 m a spatial resolution of 1.5 – 3 m vertically and 30 – 50 m horizontally can be obtained

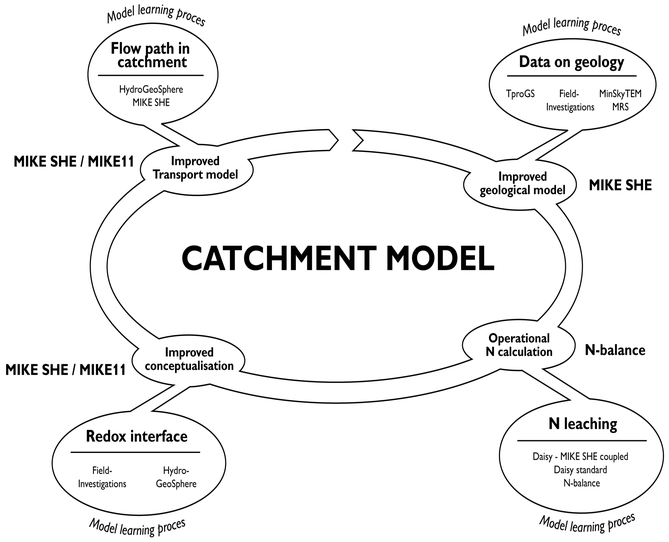




The figure to the left shows the resistivity in the depth interval 15-20 m below surface and a profile south of the town of Odder.

Modelling tools and learning processes

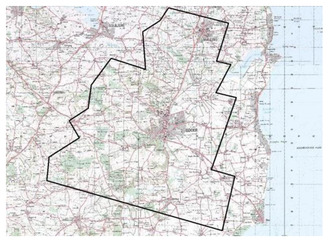
The figure below demonstrate the role of the various modelling tools in the main modelling process as well as the various supporting and learning modelling studies.



Study sites

Lillebæk: 4.7 km²

Norsminde: 101 km²



Catchment characteristics:

- Soils dominated by glacial clayey tills
- Stream discharge highly dominated by drain flow
- High nitrate load from agriculture

SkyTEM mapping:

- 2,000 km line surveys resulting in more than 100,000 soundings

Partners

- **Geological Survey of Denmark and Greenland**
- **Department of Geography and Geology, University of Copenhagen**
- **Department of Geosciences, Aarhus University**
- **Aarhus Geophysics**
- **Knowledge Center for Agriculture**
- **Institute of Food and Resource Economics, University of Copenhagen**
- **Department of Geology and Geological Engineering, Laval University, Quebec**
- **Alectia A/S**
- **Municipality of Aarhus**
- **Municipality of Odder**
- **SkyTEM Surveys Aps**
- **DHI**

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NiCA Research project
NITRATE REDUCTION IN GEOLOGICALLY HETEROGENEOUS CATCHMENTS

For more info:
WWW.NITRAT.DK