CLIMES-Modeling ecosystem functions in Lake Vanaja watershed: What data is available? What data is needed?

Katri Rankinen

Maria Holmberg

Jari Liski et al.

Content

- CLIMES project

- Model description including one example

- Data available and data needs

- Conclusions

CLIMES Impacts of climate change on multiple ecosystem services

- CLIMES is a three-year project, funded by the Academy of Finland and the Chinese Academy of Sciences for the period 1.1.2012 to 31.12.2014.

- The project seeks to increase the process understanding and develop the methodologies in the context of climate change impacts and adaptation options for spatially explicit values of services across landscapes.

SYKE

Main task of CLIMES

- Analyze the impacts of changes in key climate drivers on water resources at different spatial scales.

- Study the contribution of river networks, lakes and wetlands to the purification of water.

- Study the impacts of climate and land-use change on soil and ecosystem carbon sequestration processes.

- Develop methodologies for spatial extrapolation, modelling and valuation of the different ecosystem services.

- Enhance cooperation and integration of knowledge between ecosystem researchers in China and Finland.

WP1 Water based services

Work package 1 analyses the impacts of changes in key climate drivers on water resources at different spatial scales. The climate effect on erosion processes is of special interest in Yanhe basin, while nitrogen loading is of concern in Vanajavesi. Physical and statistical models will be used and their performance compared at the different study areas. The models to be studied include HBV, INCA, RUSLE.

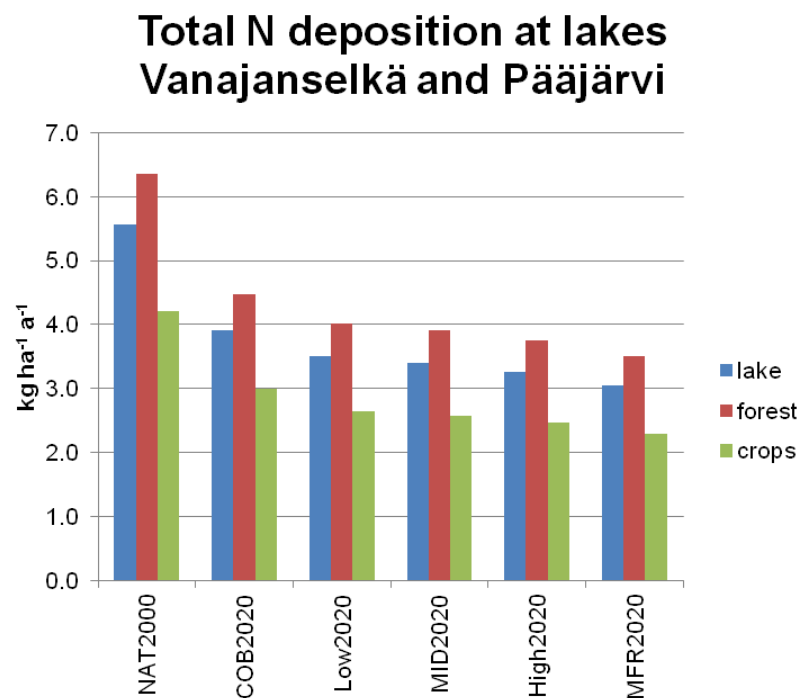## WP2 Carbon sequestration services

Workpackage 2 studies the impacts of climate and land-use change on soil and ecosystem carbon sequestration process at different spatial scales. Yasso07 soil carbon model will be used in the analysis.

WP3 Spatial extrapolation and ecosystem service valuation

Workpackage 3 integrates the results of WP1 and WP2 and develops methodologies for spatial extrapolation and integrated modelling of the ecosystem services. This includes the valuation of ecosystem services and their interactions in terms of trade offs and synergies.
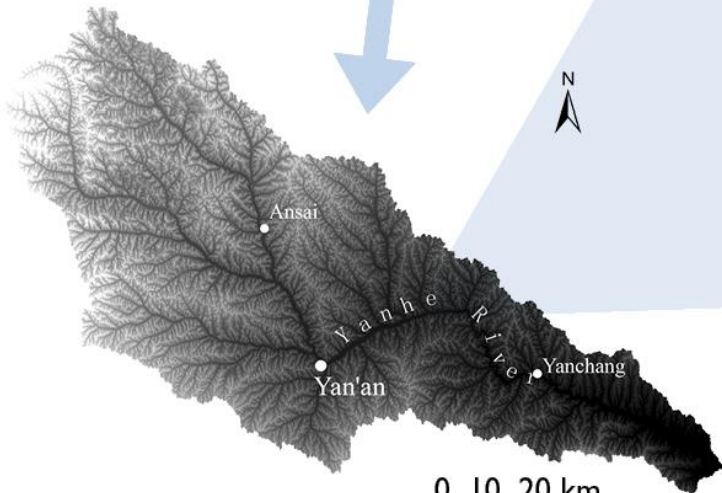
SYKE

Main methodologies

- Field measurements on soils, vegetation, water
- INCA catchment-model system
- YASSO model for soil carbon
- JSBACH land-biosphere model
- National databases of critical loads for air pollutants
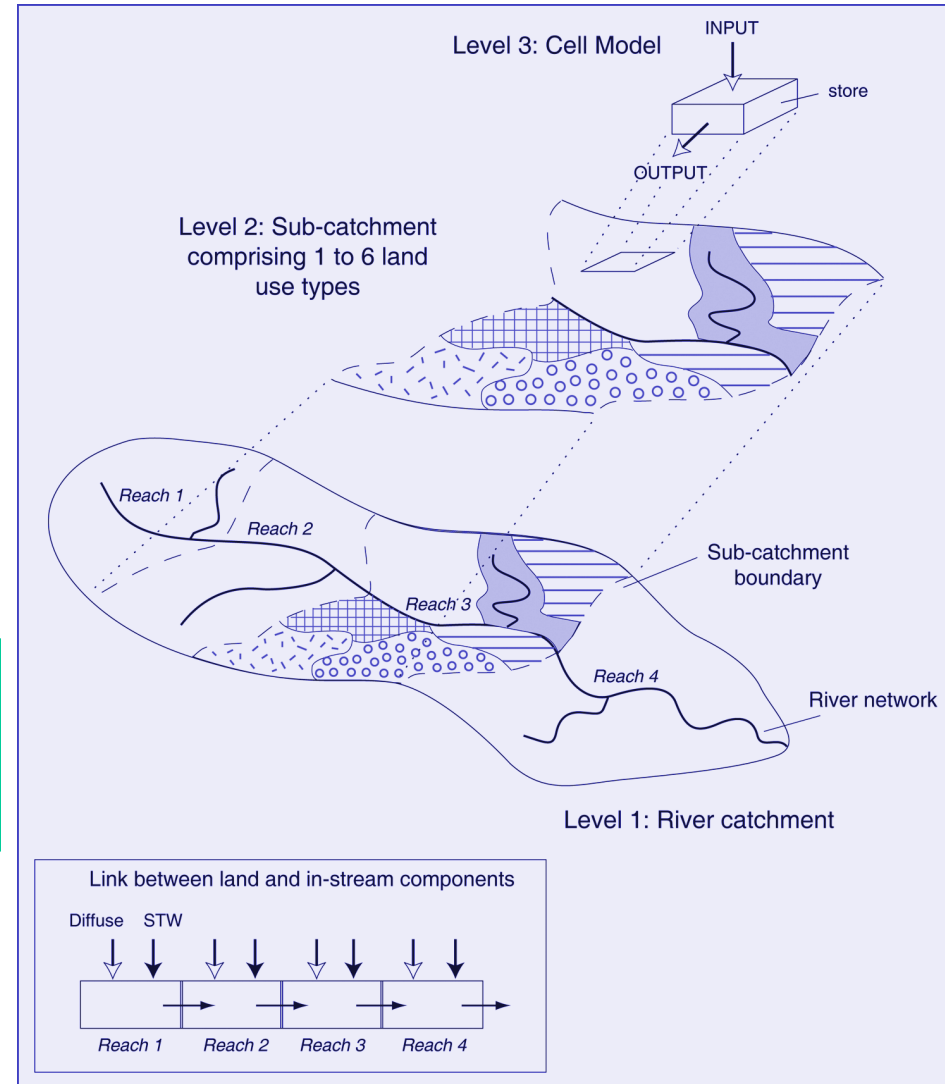- Deposition data and models

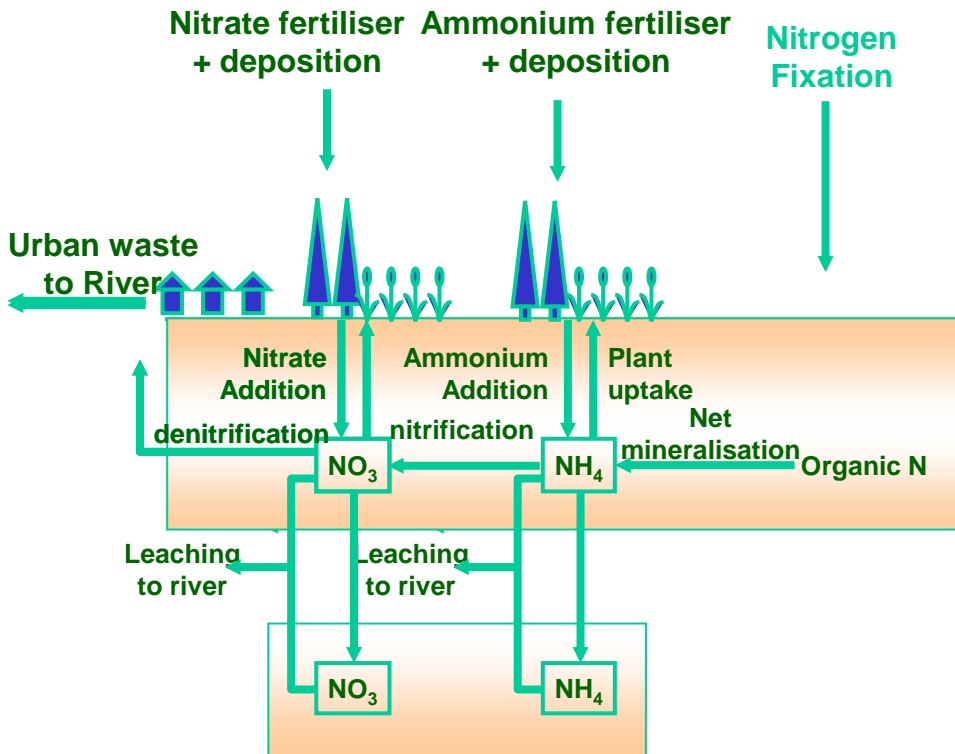### Total N deposition at lakes Vanajanselkä and Pääjärvi

Chart: Total N deposition at lakes Vanajanselkä and Pääjärvi ($kg\,ha^{-1}\,a^{-1}$), categories NAT2000, COB2020, Low2020, MID2020, High2020, MFR2020 with series lake, forest, crops.

FINLAND

Vanajavesi

M. Forsius

SYKE

Yan´an

Xi´an

0   500 1,000   2,000 km

Ansai

Yanhe River

Yan'an   Yanchang

N

0 10 20 km

A. Akujärvi

INCA Integrated Nutrients in CAtchments

Catchment data

Main crops in 2007

- 1 Winter Cereal
- 2 Spring Cereal
- 3 Beets
- 4 Grass
- 5 Garden
- 94 Fallow
- NoData

SCA timeseries from agri. and con. areas from 2005 Lepsamaenjoki

Discharge

$R^2=0.756$
N-S=0.647

Nitrate as Nitrogen

$R^2=0.410$

N retention as Ecosystem Service in two small catchments in Finland

Methods

- Nutrient export from two agricultural catchment was modelled by a dynamic, semi-distributed model

- Valuation was based on replacement cost: average cost of kg N retained by artificial water protection wetland

- PRESS2 project

SYKE

Value of N retained in catchments

Total value €/km² catchment area
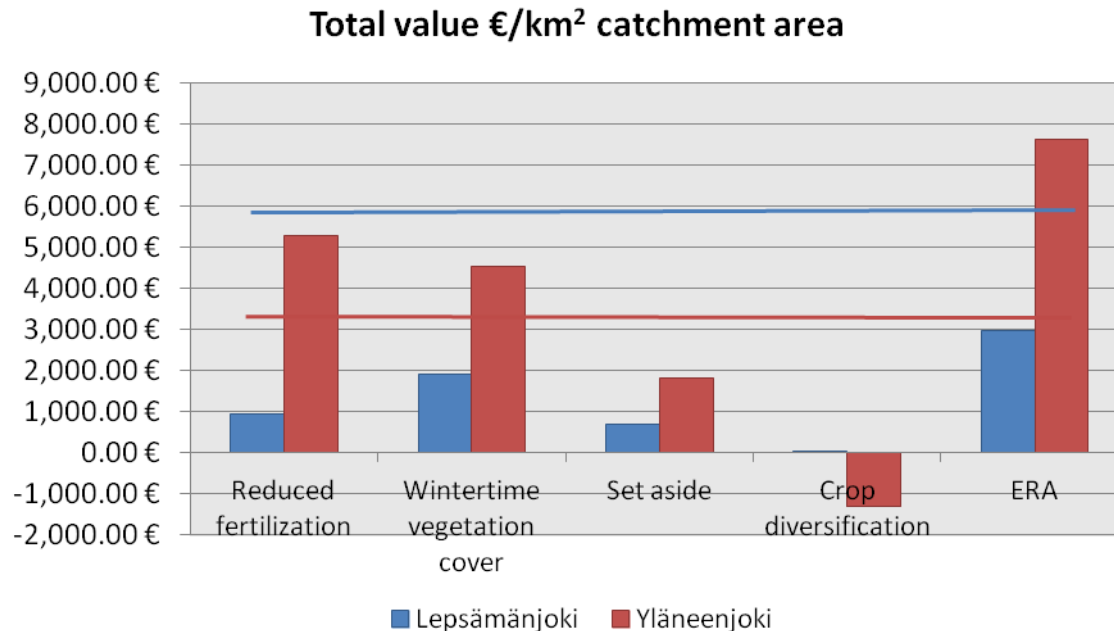
- Allows comparison between scenarios
- Allows comparison between catchments
- Can be used to study trade-offs e.g. Biodiversity vs. Water protection
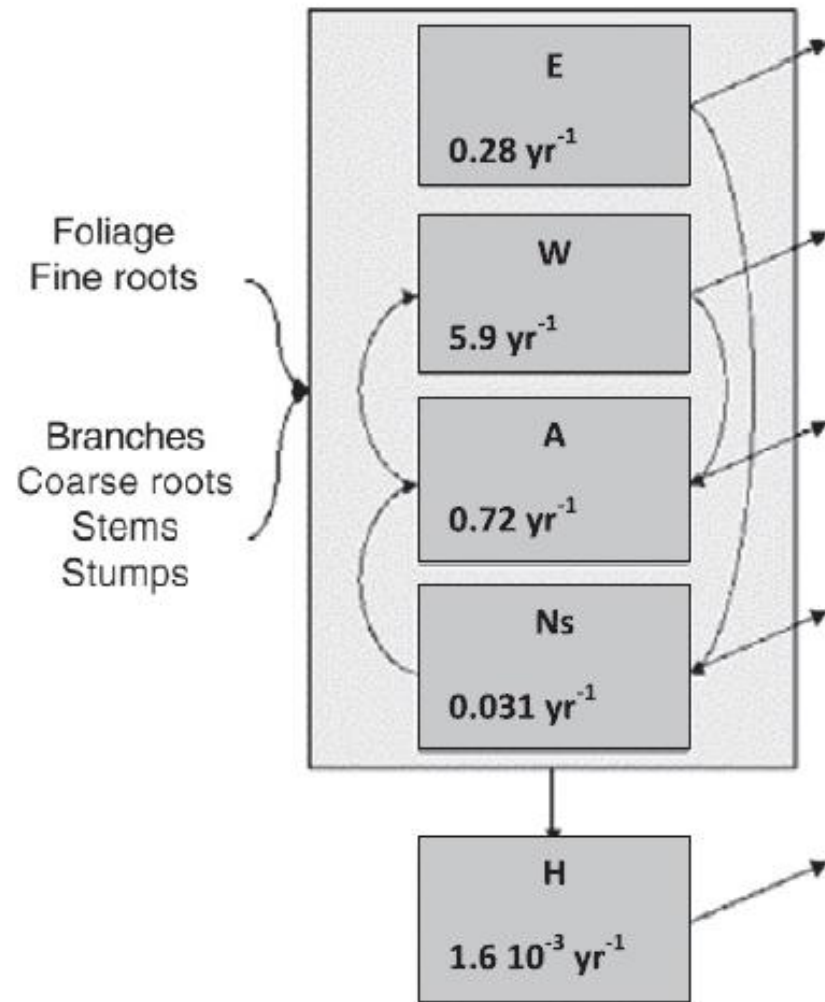
SYKE

YASSO

Fig. 1. Flow chart of the Yasso07 soil carbon model, modified from Tuomi et al. (2011b). The boxes represent soil carbon compartments, and the arrows represent carbon fluxes. The numbers inside the boxes are decomposition rates of the different compartments (yr^{-1}). E = ethanol solubles, W = water solubles, A = acid-hydrolysable compounds, Ns = non-soluble, non-hydrolysable compounds, H = humus.
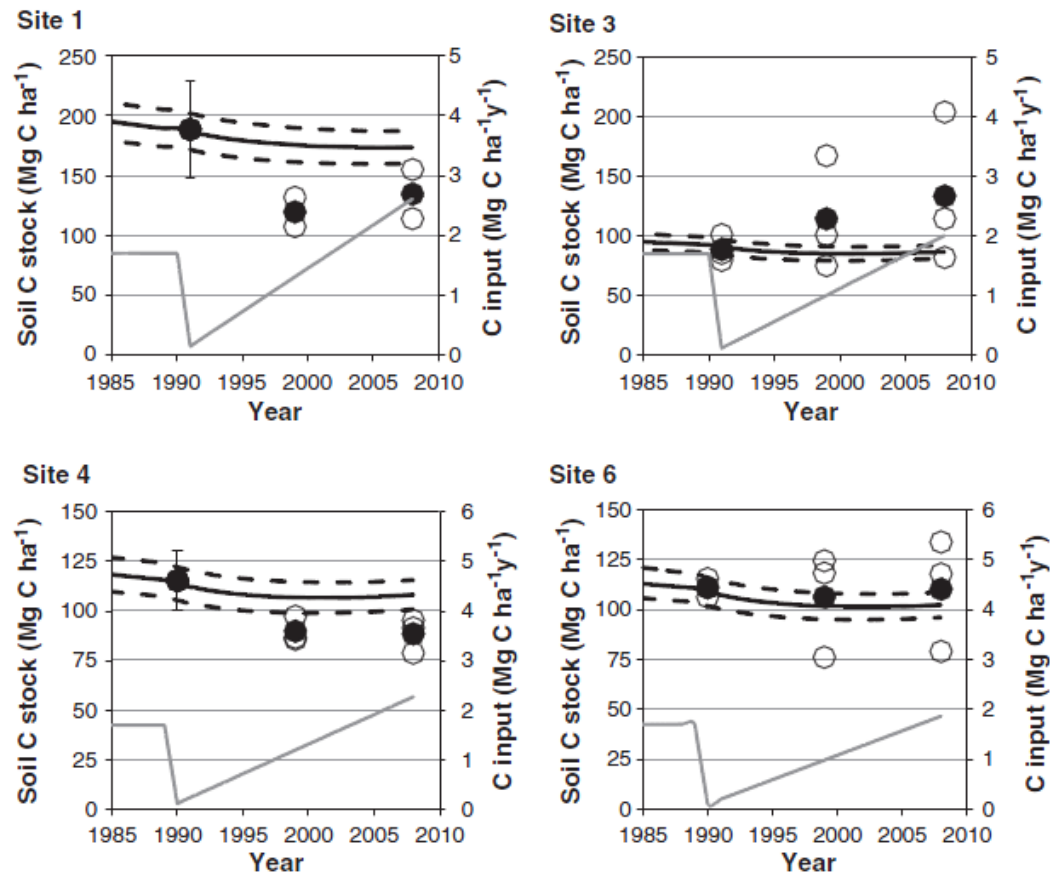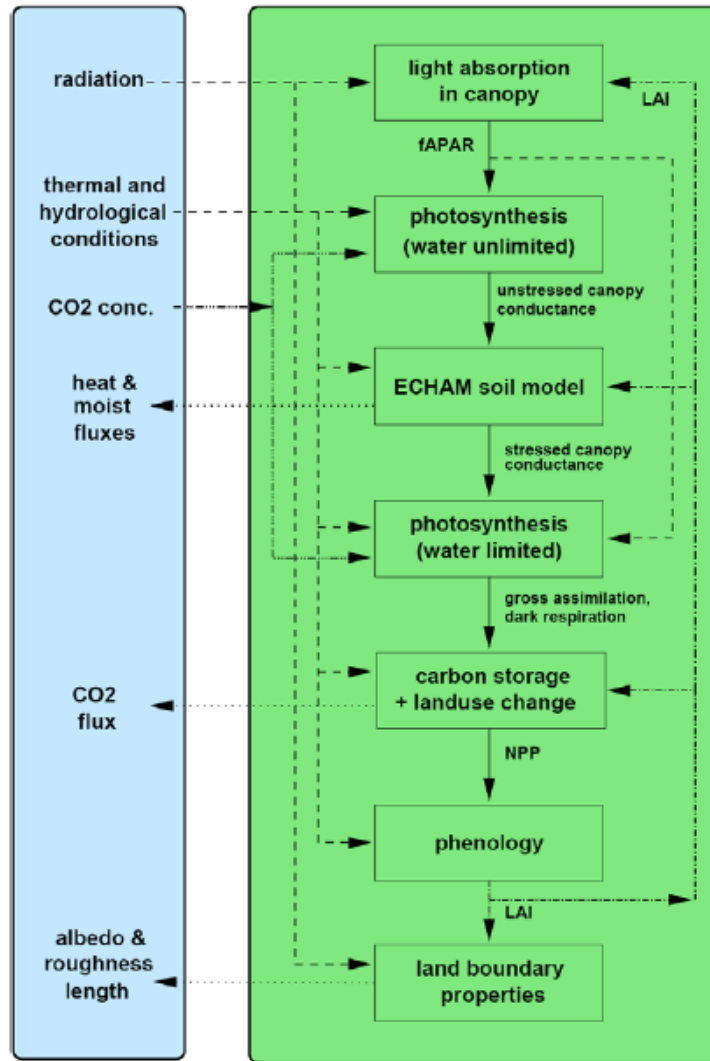
YASSO

Fig. 3. Measured and modelled C stocks of the afforested sites planted with pine (first y-axis). C input used in modelling is presented on the second y-axis. Figures present measured values (open circles), measured mean (black circles), modelled mean (black line), 95% confidence limits of the modelled mean (dotted lines), C input (grey line). Error bars for 1990/1991 measurements represent standard deviation.

The Land/Vegetation Model JSBACH


lowest layer of atmosphere

JSBACH

radiation

thermal and
hydrological
conditions

CO2 conc.

heat &
moist
fluxes

CO2
flux

albedo &
roughness
length

light absorption
in canopy

LAI

fAPAR

photosynthesis
(water unlimited)

unstressed canopy
conductance

ECHAM soil model

stressed canopy
conductance

photosynthesis
(water limited)

gross assimilation,
dark respiration

carbon storage
+ landuse change

NPP

phenology

LAI

land boundary
properties

JSBACH = **J**ena **S**cheme for **B**iosphere-**A**tmosphere **C**oupling in **H**amburg

SYKE

Catchment data

- Borders
- DEM/slope
- Water courses
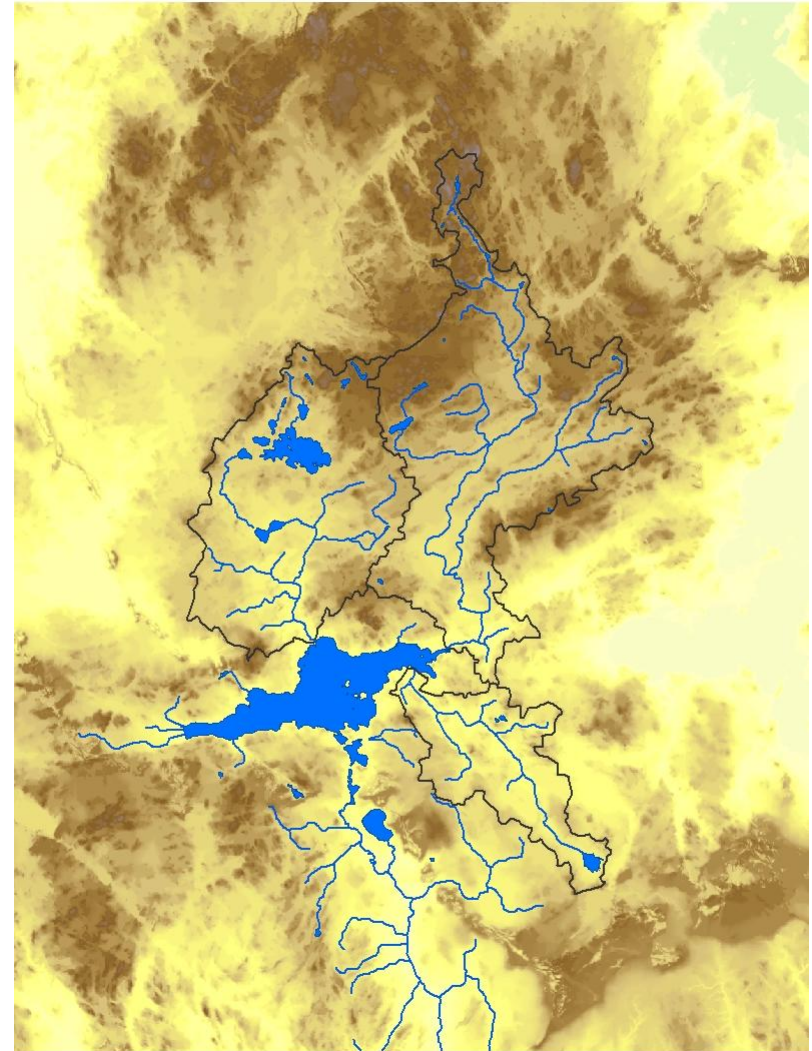
Land use/cover

- CORINE2000/2006
- Slices
  - No forest areas
- SLAM 1995
  - Old but good classification of forests
- Field parcel register
  - Field areas and crops in 2008 and 2011

SYKE

Soil types

- Soil types 200/85/25
  - Geological classification at 1 m depth
  - Soil texture and organic matter content
- Soil profile classification
  - WRB World Reference Base for Soil Classification

SYKE
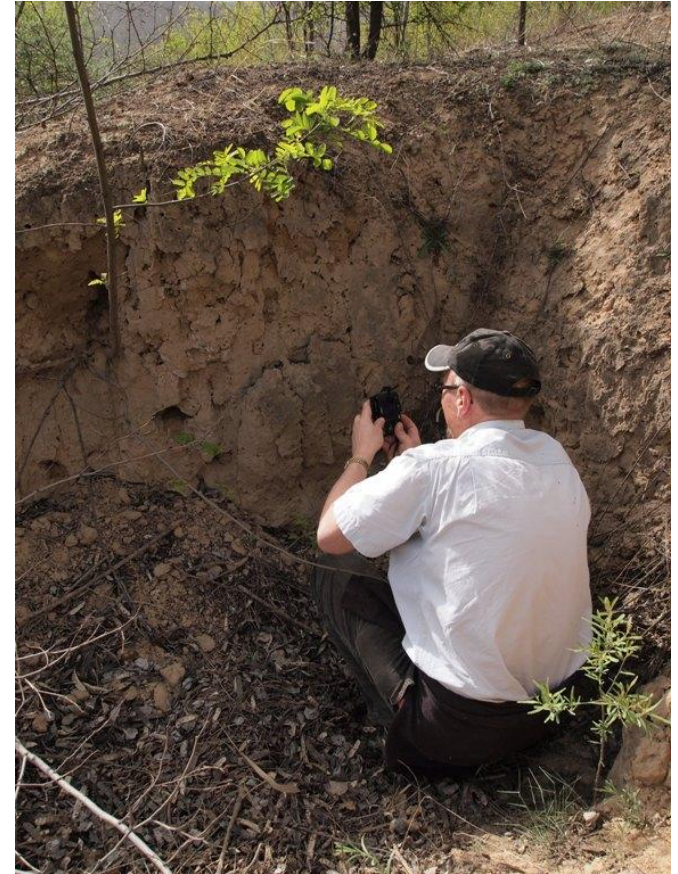
Conclusions

- Good data available:
  - Including snow melt and phenology
- Concerns:
  - DEM
  - Forest classification
  - Field parcels
- Is there something available we do not even understand to ask for?

SYKE

Thank you!