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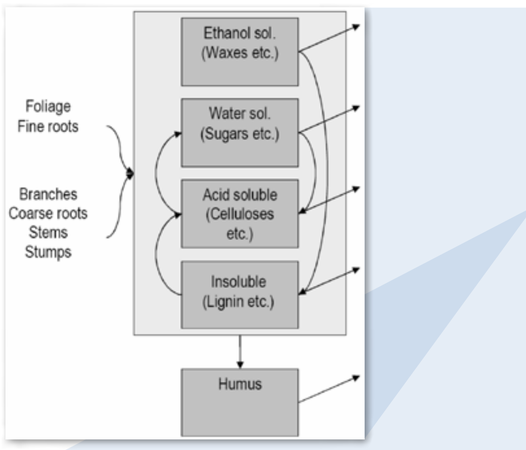
Integrating ecosystem models with spatial analysis of ecosystem services

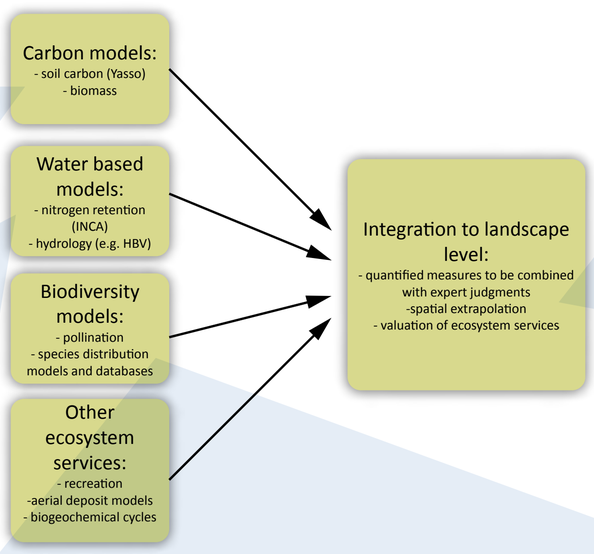
Assessments of ecosystem services is often based on landcover data, stocks of provisioning services, or indicators showing status and trends of certain ecosystem properties. The problem with such approaches is that they are often static, qualitative or semi-quantitative, and they don't take into account trade-offs. Uncertainty analysis is often lacking from ecosystem service assessments. Dynamic ecosystem processes (associated especially with regulating and maintenance services) and models are seldom integrated with spatial analysis, or only a one particular process is focused. However, there is an increasing need for innovative quantification methods and integration of several dynamic ecosystem models to evaluate ecosystem services on different landscape scales, and under varying land-use forms.

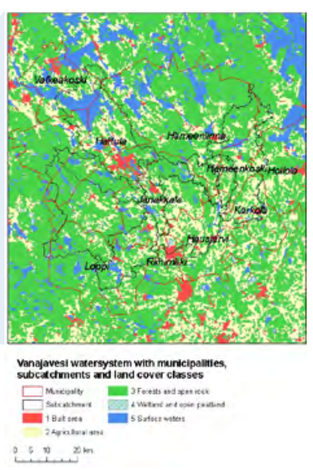
This poster is a brief presentation of the models used in SYKE. We have investigated

- what kind of biodiversity and landcover databases, and remote sensing and GIS databases are available in our case study area in Finland,
- what kind of ecosystem models are available,
- what kind of challenges the integration of various models and linking them with spatial data might face.

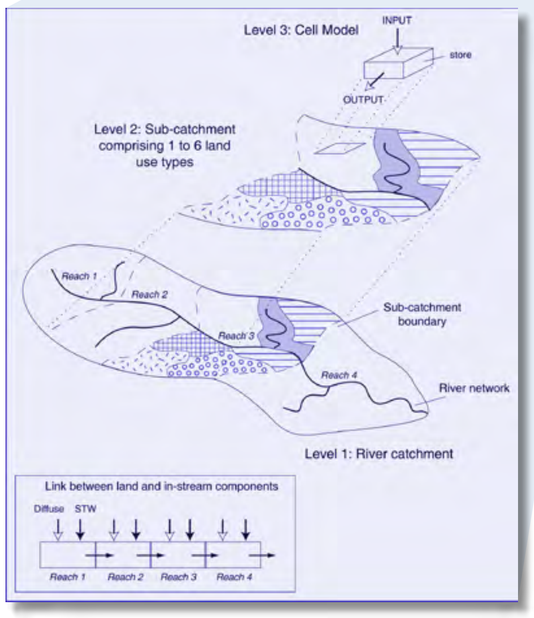
Fig. 2. Model integration approach was tested in Vanajavesi basin. View from Lammi LTER site..







Vanajavesi basin, Finland *(60°40'– 61°20'N , 24°10'– 25°20'E) and its two key study areas in the Lammi LTER site are located in the southern boreal region. The whole catchment area of Lake Vanajanselkä is 2700 km² and that of Lake Pääjärvi 220 km². The surface area of Lake Vanajanselkä is 103 km² and Lake Pääjärvi 13.4 km².*



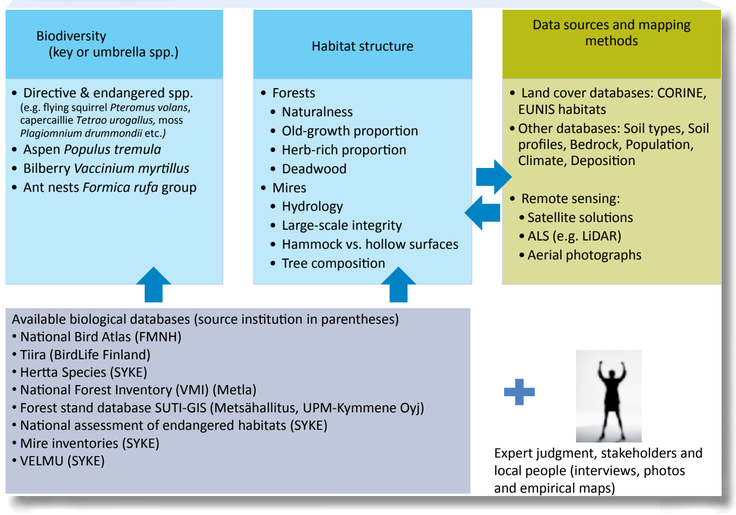


Fig. 1. Integration of the ecosystem models in Finland.

Model	Target	Input data	Output data
Yasso07	Soil carbon	Quantity of litter input: e.g. based on biomass estimates Chemical quality of litter input: databases or local Climate: local data or global databases	Variables: soil carbon stock, change in soil carbon stock, carbon flux out of soil Estimates: maximum likelihood value and probability density
INCA-N	N retention	Water quality data, land use data, climate data: i.e. daily actual precipitation (mm day-1), hydrologically effective rainfall (mm day-1), soil moisture deficit (mm) and air temperature (°C).	Retention of nitrogen in the watershed: daily estimates of discharge, and stream water quality concentrations and fluxes, at discrete points along a river's main channel Emissions of the greenhouse gas nitrous oxide (N_2O)

Table 1. Data requirements for Yasso07 and INCA models.

We have tested the integration approach of models related to carbon, water and biodiversity (Fig. 1). Flow charts and needs for input data are identified for Yasso07 and INCA models below. In addition, we have assessed how ecosystem models presenting several ecosystem processes, such as carbon sequestration, water cycling, N retention, biodiversity interactions, could be linked with landcover data (CORINE, EUNIS biotope classification data) on regional scale. We have used various areal boundaries to compile spatially explicit data: those are watersheds, administrative units, protected areas, built areas and recreational areas.

Harmonization of the methodologies as well as automated input data acquisition seemed to be among the main challenges of the integration. It may be too optimistic to assume the current models to be truly integrated in one platform – instead of that individual models can be run separately for certain landscape and the results could be linked with GIS in spatial overlay analysis, and for further valuation and land use optimisation.

SYKE Ecosystem Service Research Programme

The SYKE ecosystem services research analyses how the multiple ecosystem services and the benefits they generate can be identified and valued, what crucial ecosystem functions and biodiversity lie behind ecosystem services, what impacts environmental change, natural resource use and land use have on ecosystem services, and how ecosystems and their services can be governed in a sustainable fashion.

Our multidisciplinary research enables process elaborate based analyses and supports sophisticated management and protection of ecosystem services. The research is organised under two partly overlapping themes:

- Models of ecosystem functions and biodiversity for ecosystem service provision
- Ecosystem services governance and decisions with multiple values

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