Remote Sensing of Environmental Variables for National Biodiversity Indicator Systems

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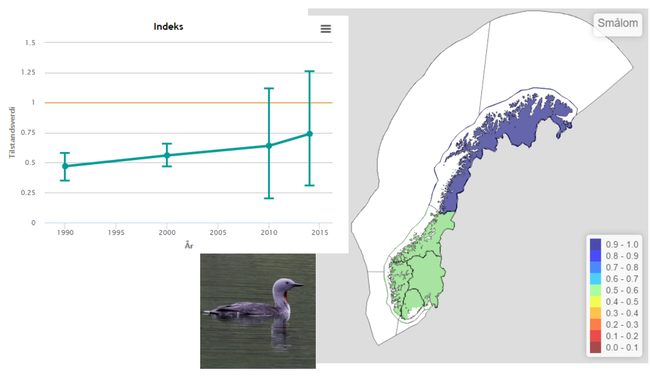
The Nature Index (NI)

The Nature Index (NI) is a general, integrated framework, designed to synthesize and communicate the current knowledge of the state and trends of biodiversity. It has been developed and applied as a National Biodiversity Indicator System in Norway. However, the methodological and technical concept of the NI is about to be exported to other countries, like Bulgaria, India and Costa Rica.

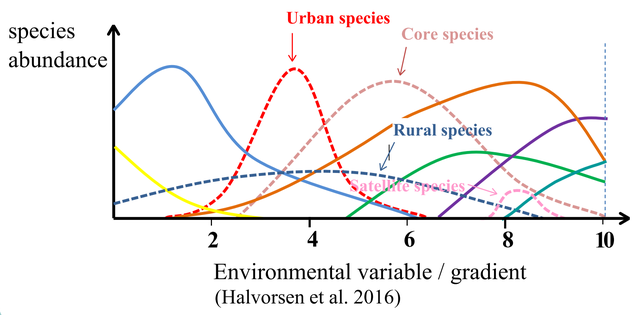


The NI integrates data analytics with expert judgement, but deliberately excludes indicators of pressure (e.g. human activities). In Norway the NI is applied at municipal level and above, which provides a challenge for utilizing it for policy design and management actions.

Nature in Norway (NiN)

Nature in Norway (NiN) is a system to describe – but not value - the manifold in Norwegian Nature. The system focuses on species response to environmental variables and gradual transitions in nature at different spatial and temporal scales. In NiN habitat types are standardized based on species response to environmental variables. Furthermore, the latter can be used to describe habitat types in more detail. In total, NiN lists and makes use of 57 different, but interrelated environmental variables.

As such, the NiN system overlaps to some degree with the concept of Essential Biodiversity Variables (EBV) promoted by the GEO BON community.



(Halvorsen et al. 2016)

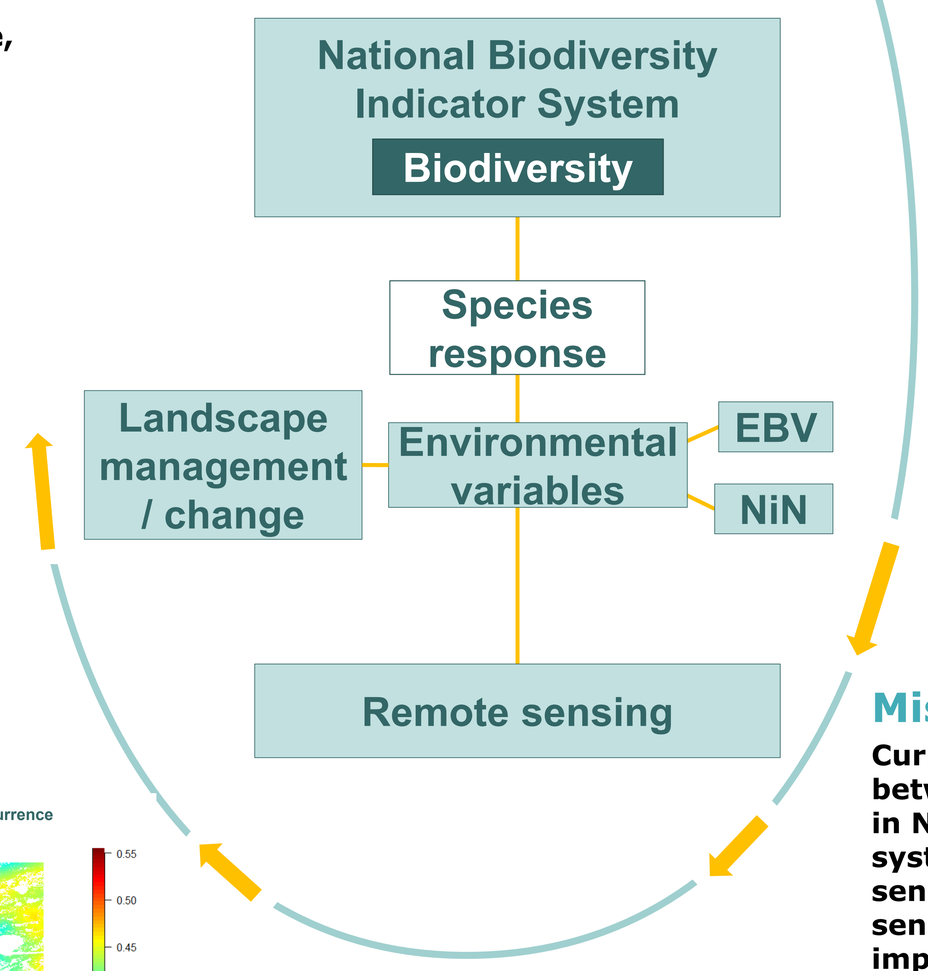
Remote sensing – a basis for gluing things together?

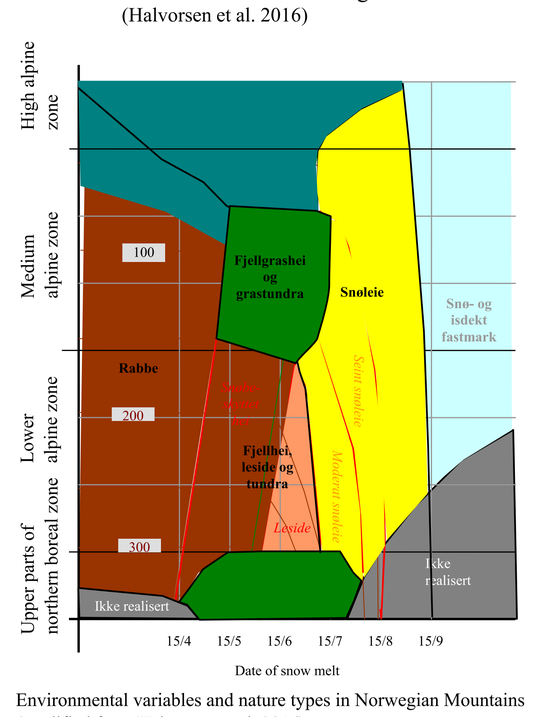
A hypothesis for future research and development is that remote sensing can improve

- **the management relevance of a National Biodiversity Indicator System like the NI through modeling of environmental variables and**
- **it`s data base by means of tracking biodiversity indicators.**

Thus it can be seen as a basis for linking activities on biodiversity monitoring, research on ecosystem response, and environmental policies.

Integration – the next step in future development?

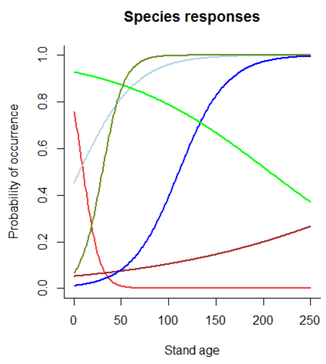


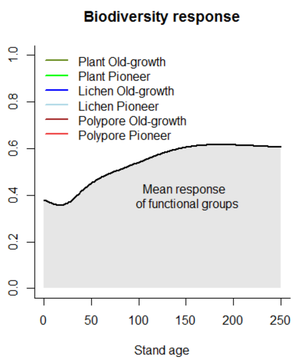


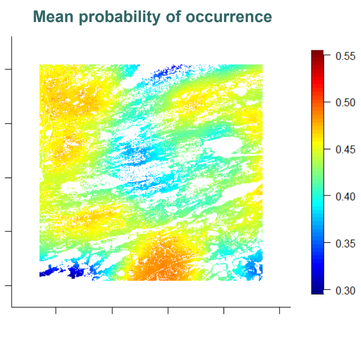
Environmental variables and nature types in Norwegian Mountains (modified from Halvorsen et al. 2016)

Ecoservice – linkages between forest structure variables and biodiversity indicators

In the Ecoservice project (Research Council of Norway 2014-2016, lead by NIBIO), NINA carries out empirical studies of species responses to forest management regimes and forest structure (e.g. stand age). Based on the identified responses of species and functional groups, aggregated biodiversity indicators are being developed (such as the mean probability of occurrence illustrated below) and mapped based on the underlying forest structure variables measured by remote sensing. The final aim is to analyze tradeoffs between biodiversity, climate regulation and forestry production for spatially explicit forest management strategies.







Missing links?

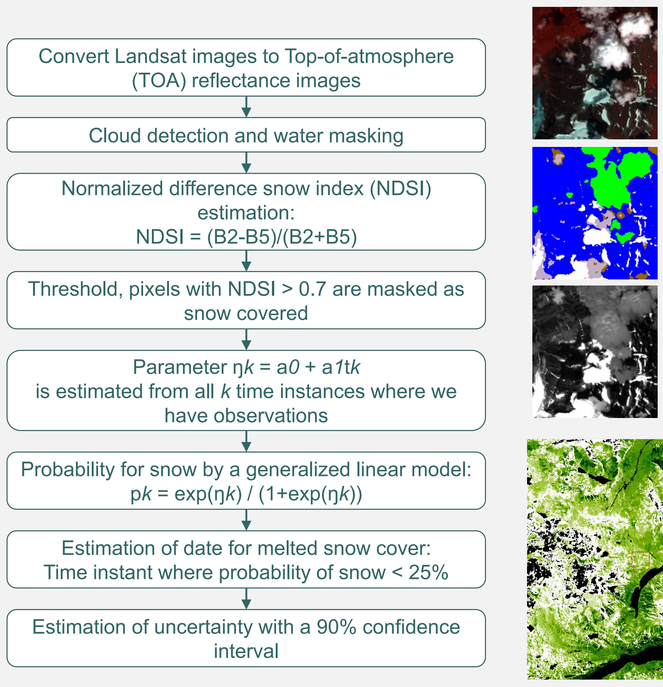
Currently there are no explicit links between the Nature Index and Nature in Norway, and neither of the two systems makes use of remotely sensed data sources. However, remote sensing holds the potential of both improving the data availability and fostering the development of new linkages between the two systems. Thus it may help to improve the policy relevance of the NI. NINA and its partners NIBIO and NR are working on two projects which can contribute in that direction:

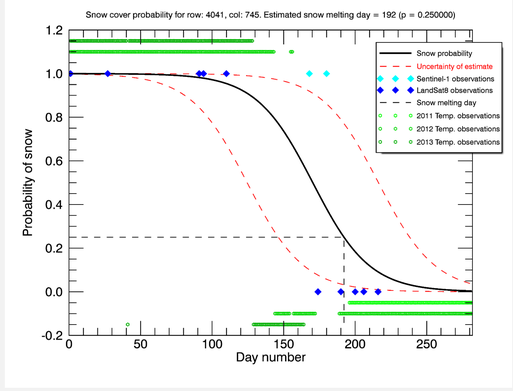
Sentinel4Nature – remote sensing of environmental gradients

Main objective of the Sentinel4Nature project (ESA, 2014-2017) is to develop and advance a novel approach to remote sensing, which focuses on monitoring basic environmental gradients. In the project the suitability of remote sensing for estimating environmental variables from NiN is assessed and for selected cases (see below) models are being developed. Expected benefits of the gradient based approach are:

- **Early warnings: Usually, characteristics of relevant gradients change before vegetation patterns change**
- **Environmental gradients can further describe the quality of nature types**
- **Information on environmental gradients has a broader scope of possible applications**
- **Monitoring of environmental gradients will to identify reasons for or drivers of change**

http://www.nina.no/Forskning/Prosjekter/Sentinel4Nature





Probability map showing the day the snow is melting:

- Green = early in the season
- White = late in the season

Uncertainty map:

- White = low uncertainty
- Pink = High uncertainty