Integrating ecosystem extent and condition accounts in an urban context:

Conceptual issues and illustrations from the URBAN EEA project

Research area no 1: Spatial units

London Group, Dublin, 1- 4 October 2018

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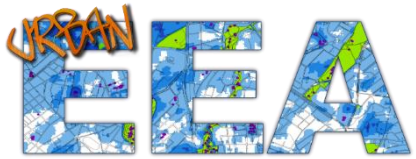

Statistics Norway
Statistisk sentralbyrå

NINA
Norwegian Institute for Nature Research

AHO
Arkitektur- og designhøgskolen i Oslo
The Oslo School of Architecture and Design

Outline of presentation

- Conceptual issues of spatial units in the SEEA-EEA:
  - We reconsider a crucial issue: *Do we need fixed spatial units in ecosystem accounting?*
  - We discuss: *Is a more flexible use of spatial units easier to deal with, in order to obtain different purposes of analysis?*
  - *We need flexible use of spatial units in order to link extent and condition variables, by introducing an element of condition parameters in the extent account.*
  - We raise a basic question: *What do we need the spatial units for?*
- What is the purpose of the extent and condition accounts, for different types of analysis?
- How can we broaden the information basis in the ecosystem extent account, in order to have a description of a natural blue-green mosaic?
- How can we obtain yearly land use accounts in compilation of national statistics, based on satellite data, using the high accuracy of administrative data and maps of land use and land cover maps to create algorithms of automatic correction and classification of satellite data?
- Conclusions and research agenda.

Do we need fixed spatial units in ecosystem accounting?

"Ecosystem accounting requires the delineation of areas within a country into contiguous, mutually exclusive units, covered by a specific ecosystem, i.e. a combination of biotic and abiotic components and other characteristics that function together, and are relatively homogenous. Each of these units comprises an ecosystem asset, and form the conceptual base for accounting, in terms of stocks and flows, and the integration of relevant statistics. The stocks are represented by the ecosystem assets, and the flows by the ecosystem services derived from these stocks. Each ecosystem asset therefore generates a specific basket of ecosystem services."

SEEA Discussion paper on spatial units for the Forum of Experts in SEEA Experimental Ecosystem Accounting 2018. *Version: 8 June 2018. Prepared by: SEEA EEA Revision Working Group 1 on spatial units (led by Sjoerd Schenau, Statistics Netherlands),* 18 - 20 June 2018, Glen Cove, New York.

Is a more flexible use of spatial units easier to deal with, in order to obtain different purposes of analysis?

- Statistical units are typically strictly defined as f. ex.
  - Persons, households
  - Companies, industries, sectors
  - Properties, defined with borders
- Nature and ecosystems are not like that. The borders are diffuse, and although researchers try to describe an ecological system as a geographical unit, they know that this unit is linked to other units in a complicated ecological and spatial web that makes it difficult to treat it as a specific unit, and ecologically, the connections are more important than the borders.
- There is no practical statistical unit that can be defined as an ecosystem asset, and you would never compile an account for ecosystem assets *per se*, "Generally, ecosystem accounts will be compiled and presented for areas of different ecosystem types rather than for individual ecosystem assets." (Sjoerd, ref)

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What do we need the spatial units for?

- To have a common reference for data collection. But we do not need that. We can geo-reference all observations and thus retain their actual accuracy, for different types of analysis.
- To aggregate information for analysis. But we can do that on an ad hoc basis, i.e. relative to the purpose of analysis, depending on data quality and type of analysis.
- To have reporting units. But given a flexible data structure, we can choose whatever statistical reporting units which are of professional or political interest, given the purpose of analysis.

Ecosystem types, land cover and land use are very important elements in a classification approach, but maybe property rights are even more important?

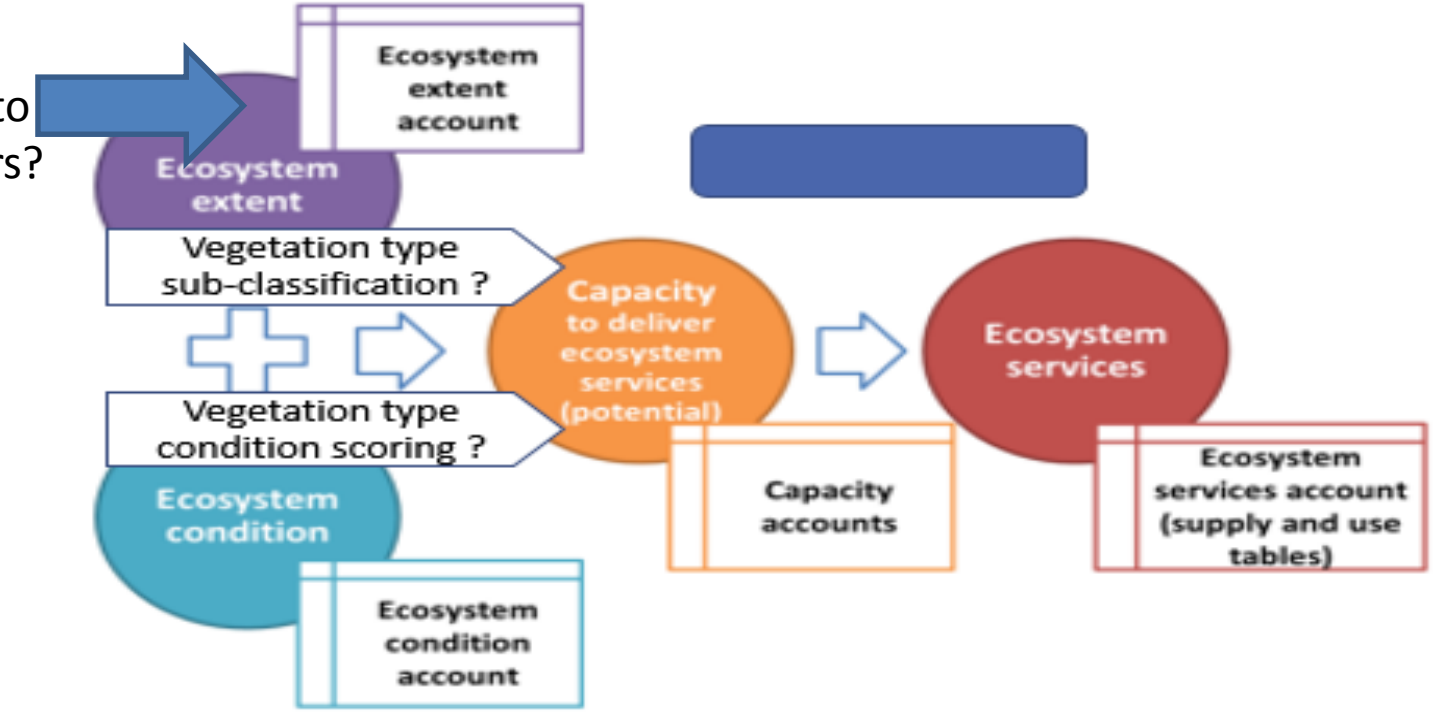
- Broad classes of ecosystem types, land cover types, and land use types seem to be accepted by everybody as a back-bone of a classification system.
- But in most situations the legal right to land is more important in policy matters. This means that property borders and cadaster elements are very important for classifying nature, especially in an urban context where the extent of remaining nature in and between built-up areas is very small and under development pressure.
- But is it a problem to distinguish between different land use and land cover types on a property segment? In principle not. Today with high-resolution satellite photos and sophisticated interpretation methods, we may track land cover and land use within a property.

What is the purpose of the extent and condition accounts?

- One important issue is to keep track of the changes in the natural environment. We can do that through surveying programs, but in ecosystem accounting we are able to analyze trade-offs between ecosystem services, in physical or monetary values, and for instance biodiversity that is the basis for a number of ecosystem services.
- Another important issue is how to distribute the different ecosystem services in the geographical space, f. ex. as basis for local nature management, and how to assess the distribution of the benefits of ecosystem services to different user groups.

The extent and condition account can form a basis to analyze the capacity (potential) for different ecosystem services

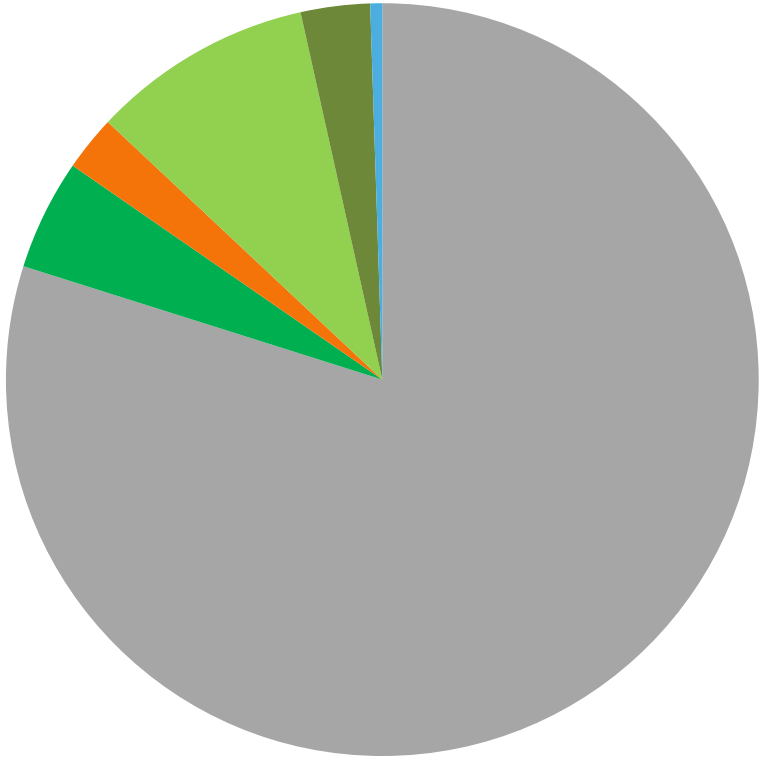
Is it possible to have some information in the extent accounts that facilitates links to condition parameters?

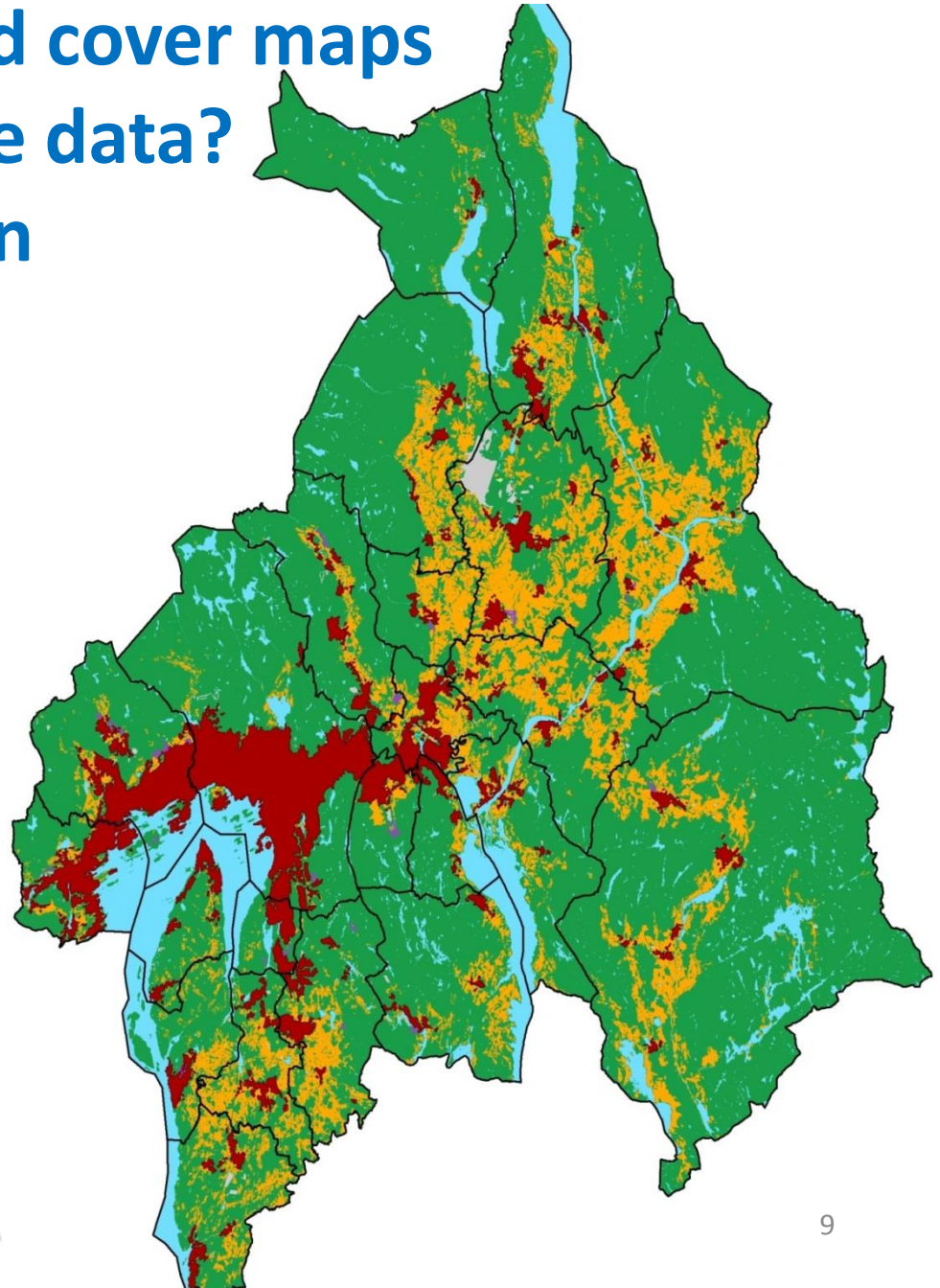


Source: adapted from European Commission (2018) Mapping and Assessment of Ecosystems and their Services. An analytical framework for mapping and assessment of ecosystem condition in the EU. Discussion Paper - Final Version January 2018.

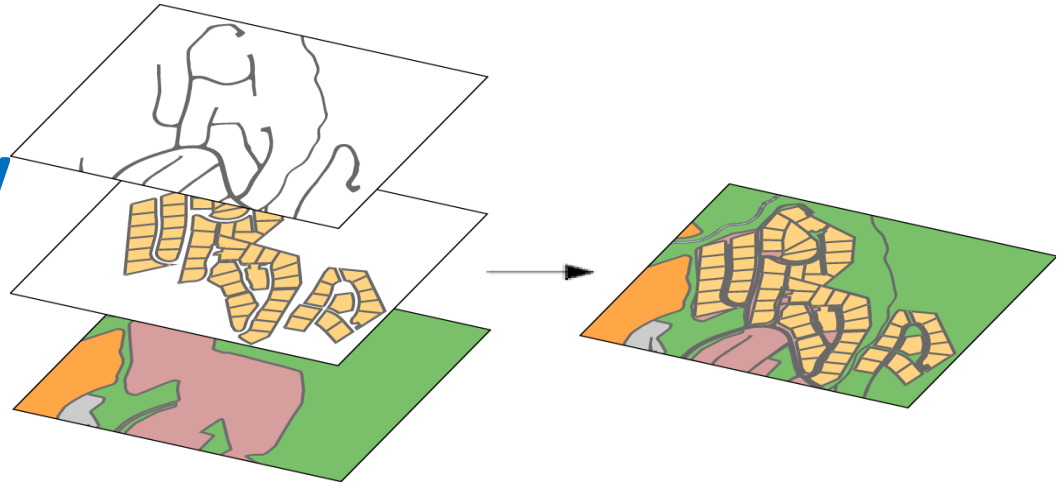
Maes J, Teller A, Erhard M, Grizzetti B, Barredo JI, Paracchini ML, Condé S, Somma F, Orgiazzi A, Jones A, Zulian A, Vallecilo S, Petersen JE, Marquardt D, Kovacevic V, Abdul Malak D, Marin AI, Czúcz B, Mauri A, Loffler P, Bastrup-Birk A, Biala K, Christiansen T, Werner B (2018) *Mapping and Assessment of Ecosystems and their Services: An analytical framework for ecosystem condition*. Publications office of the European Union, Luxembourg.

Is it possible to combine land use and land cover maps and blue-green factors from satellite data? Examples from the Oslo region

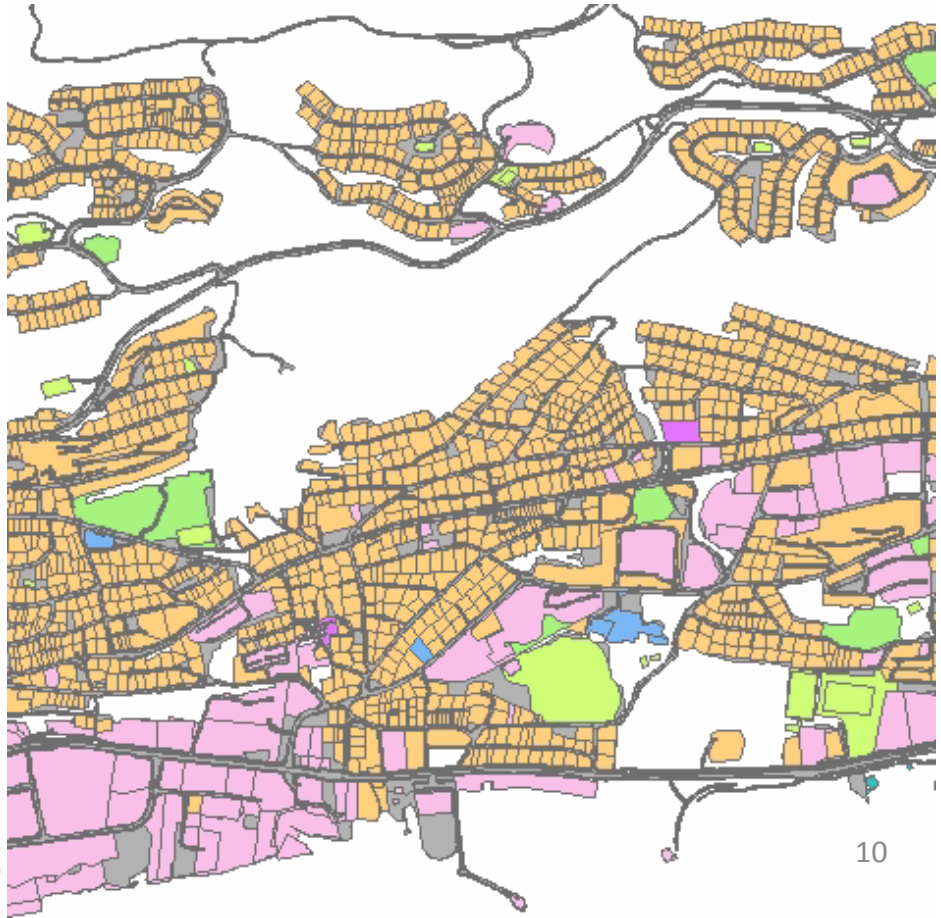




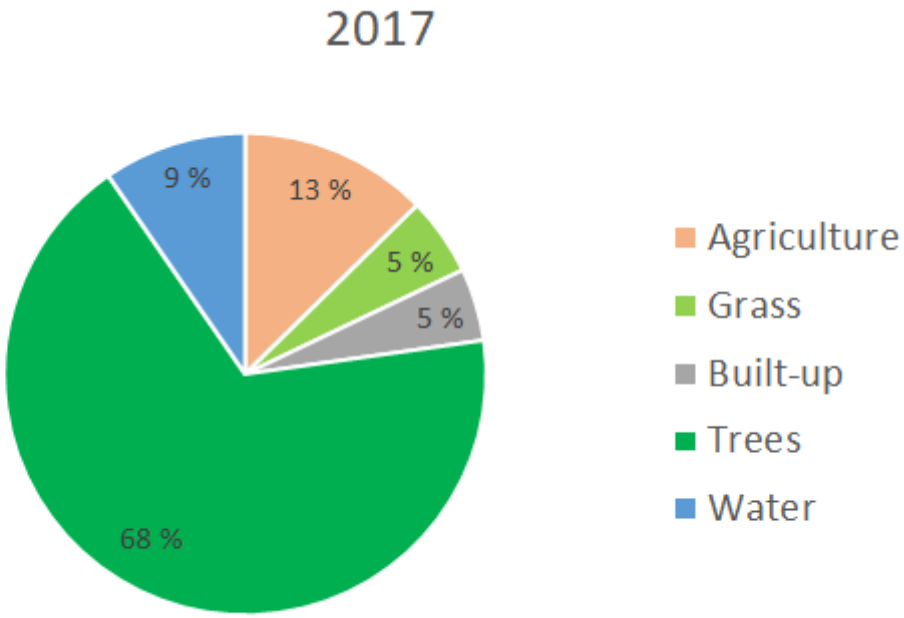
Land use map from Statistics Norway



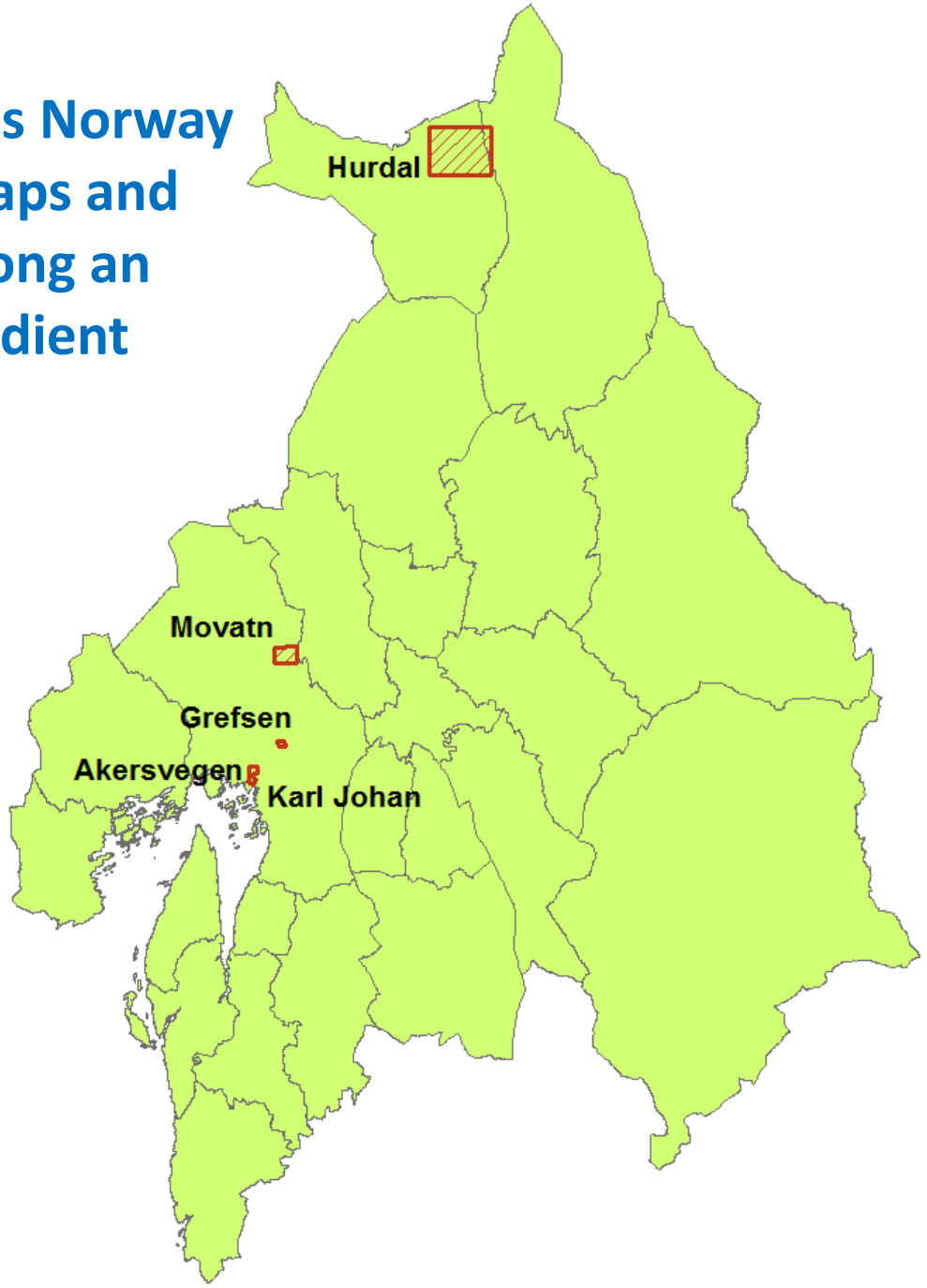
- Based on many map layers from different sources. F. ex
  - **Cadastre** (*matrikkelen*): national register of properties and buildings
  - **FKB** (*Felles Kartdata Base*): Collection of accurate land use maps (1:5000), **AR5**: Accurate land cover map (1:5000)
  - Roads, harbours, employes, residents
- **Main principle:**
  - Use best possible data where available
  - Supplemented by simpler data
  - Compiled in hierarchy
- **Result:** Land use/cover map. Both as updated and detailed as possible, geographically and in characteristics (50 classes of built-up areas, 64 in total)
- Basis for land use statistics. Produced every year



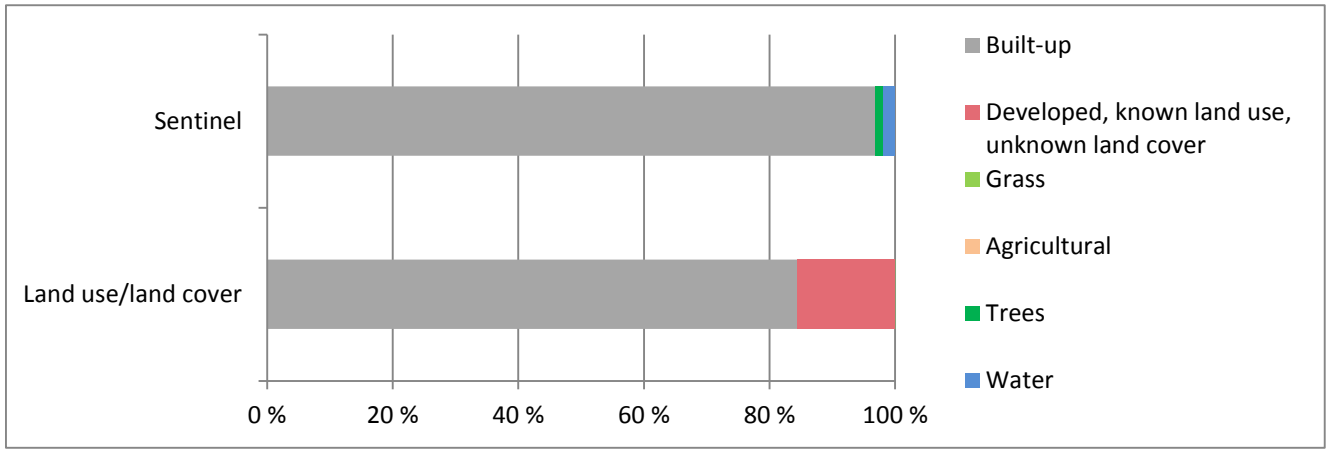
Satellite data – Sentinel-2 10m resolution



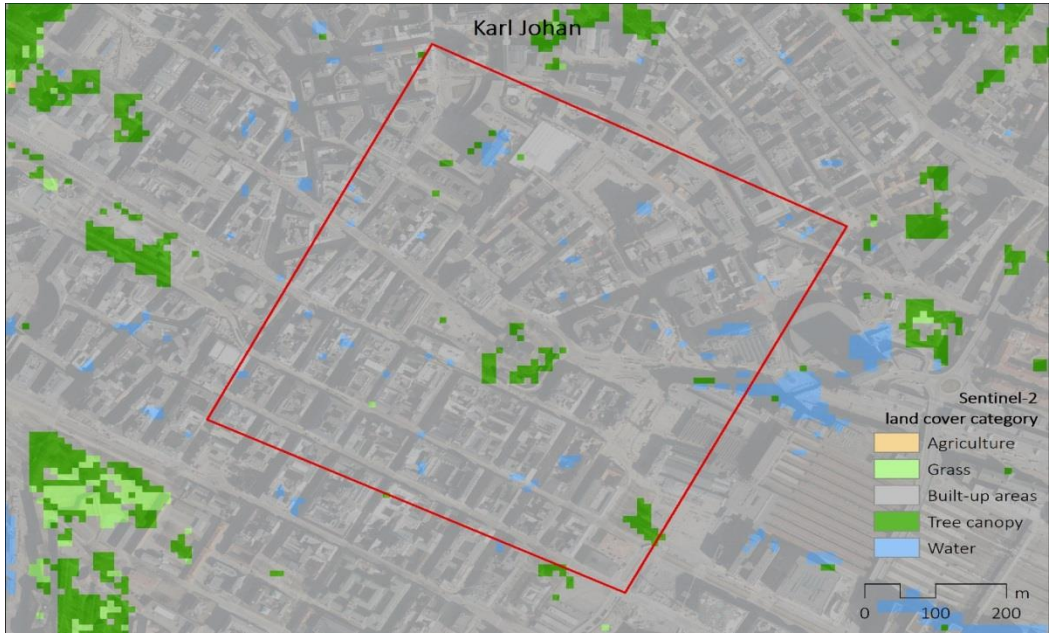
Comparing Statistics Norway (SSB) land use maps and satellite data along an urban-rural gradient



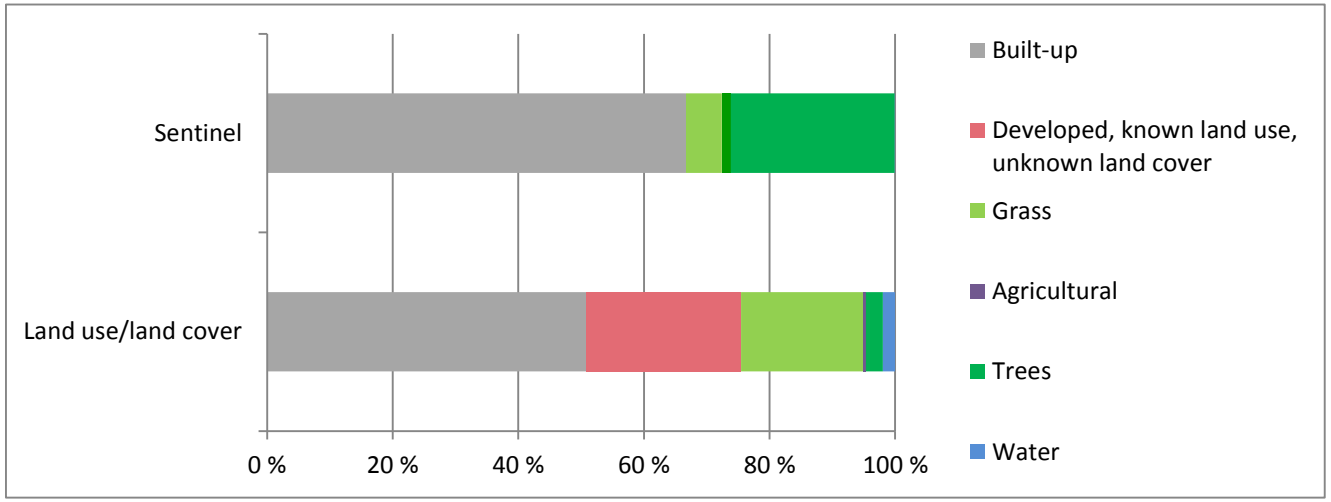
Karl Johan - the city-center of Oslo

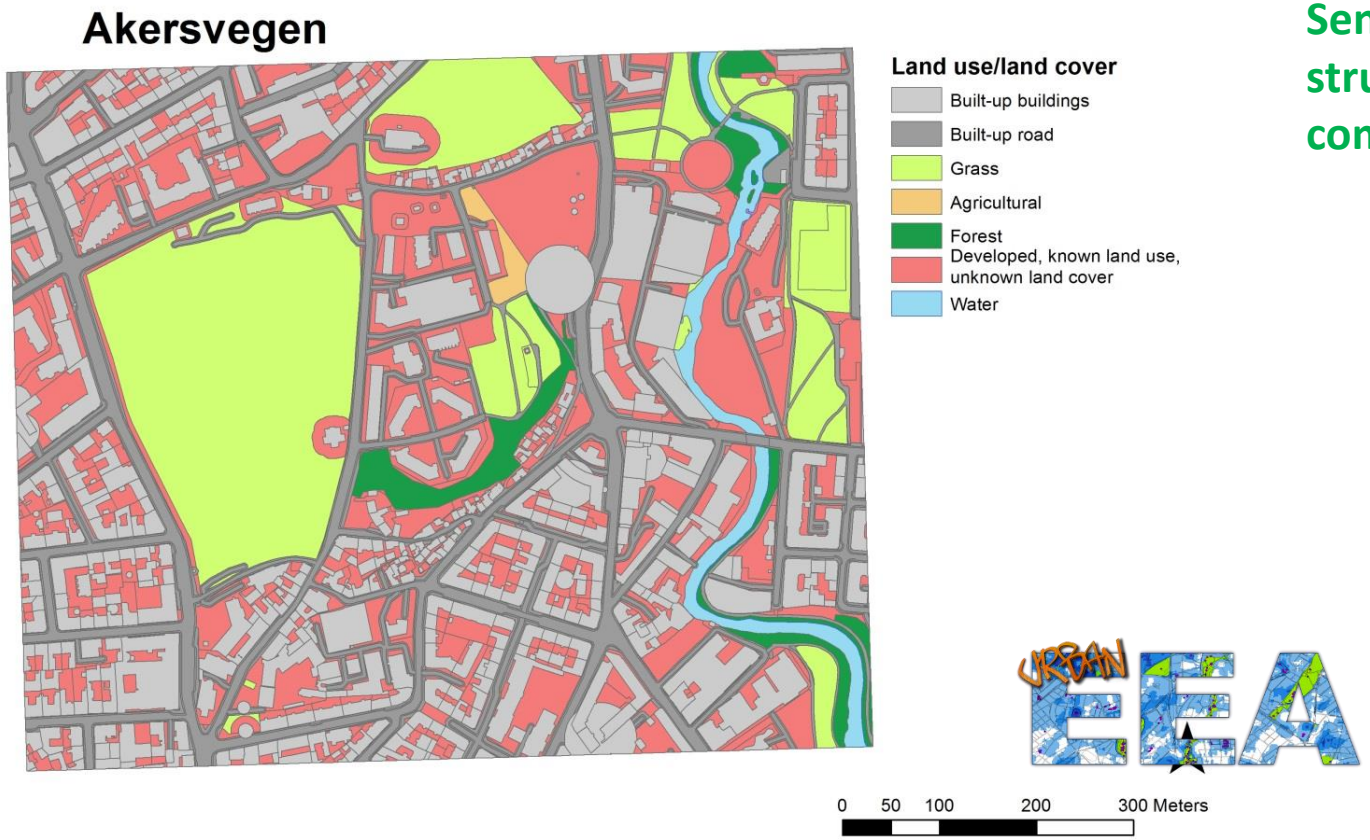


Sentinel gives better representation of green structure even in densely built-up urban areas, compared to land use/land cover maps.

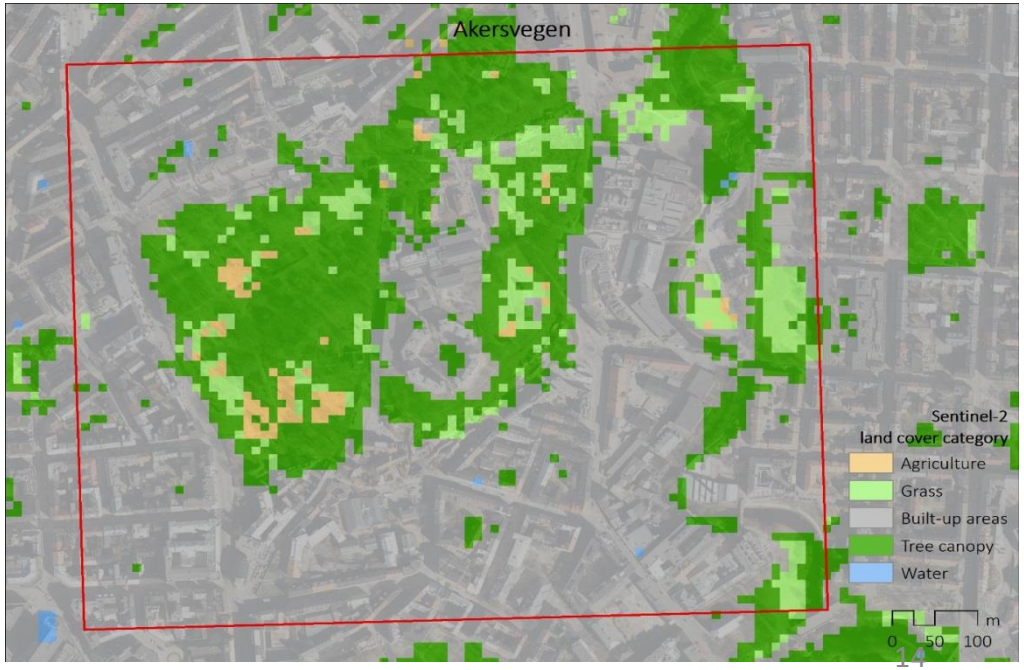


Akersveien, location of Statistics Norway, just outside the city-center of Oslo

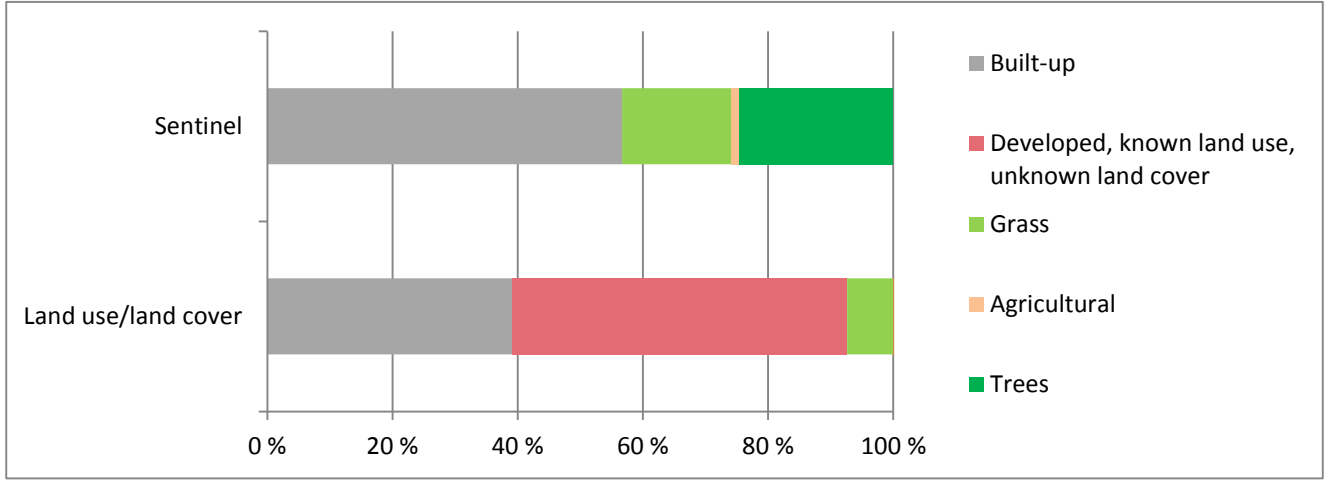




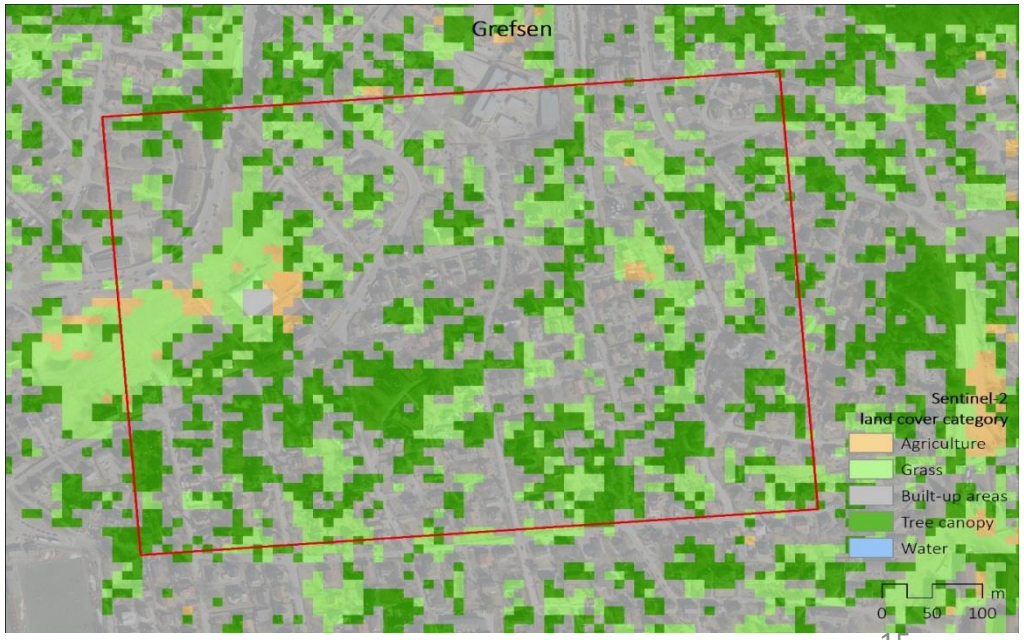
Sentinel gives better representation of green structure in built-up urban areas, compared to land use/land cover maps.



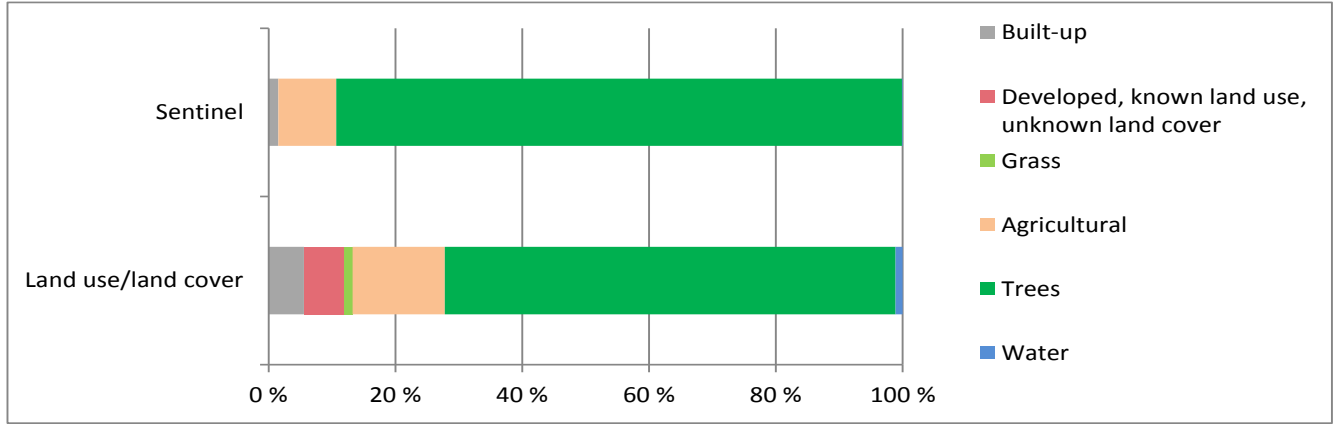
Grefsen - a suburb in Oslo that could be densified

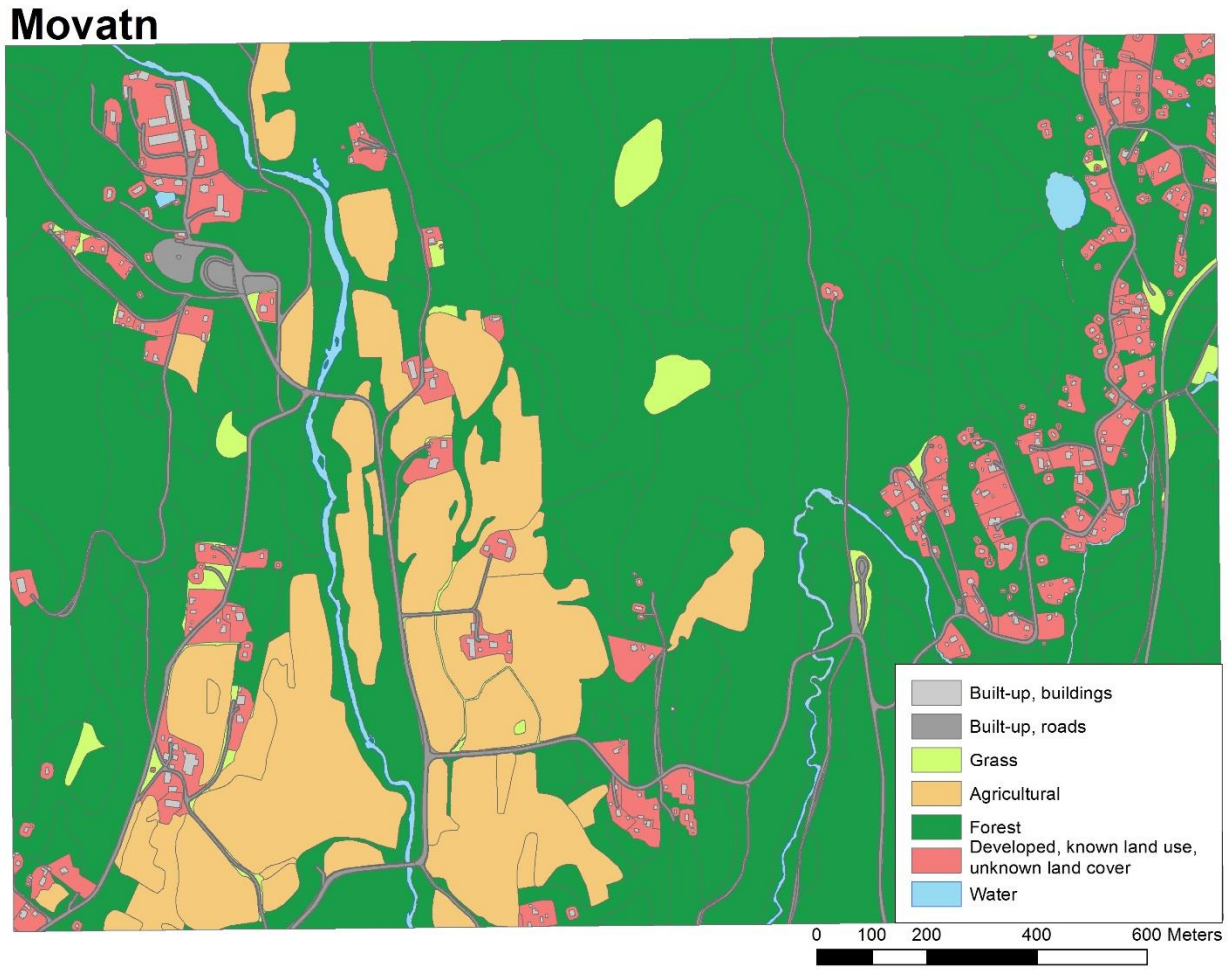


Sentinel gives better representation of green structure in built-up suburban areas, such as gardens, compared to land use/land cover maps.

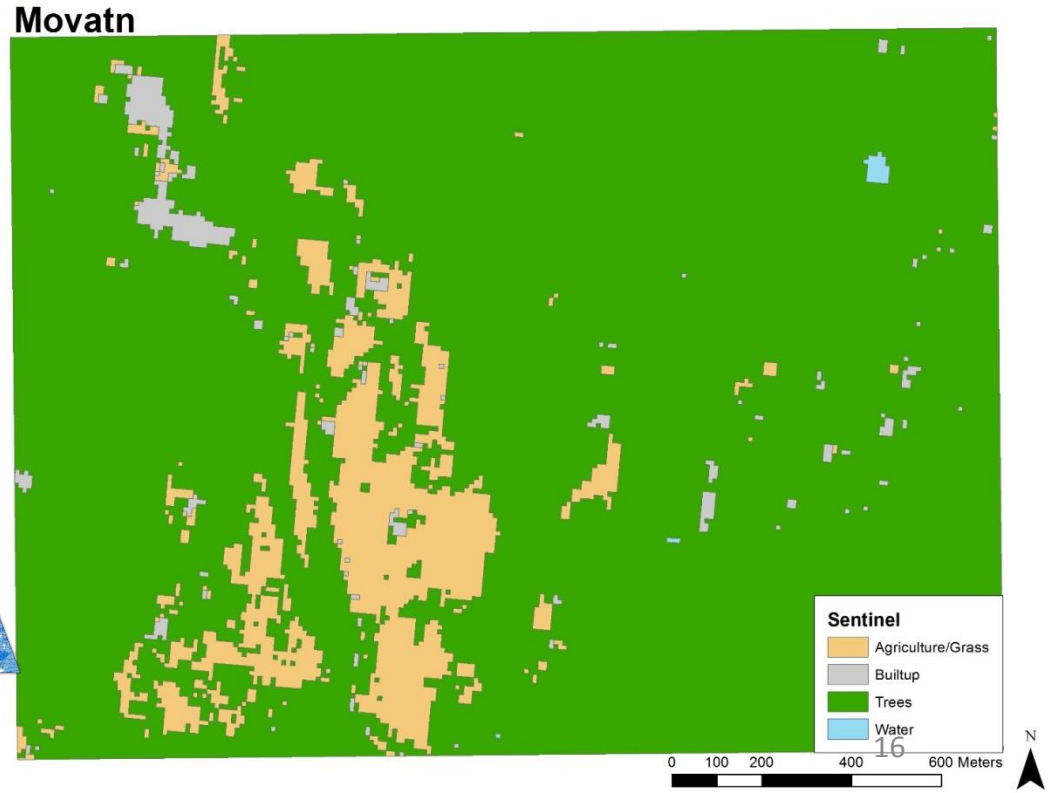


Movatn – nature recreation and residential area, non-urban but still close to Oslo

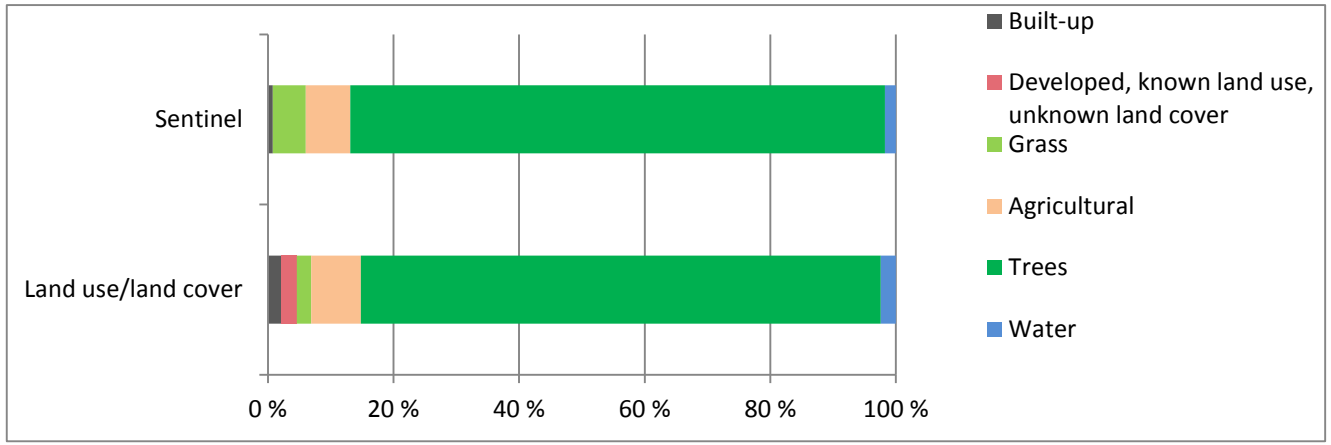




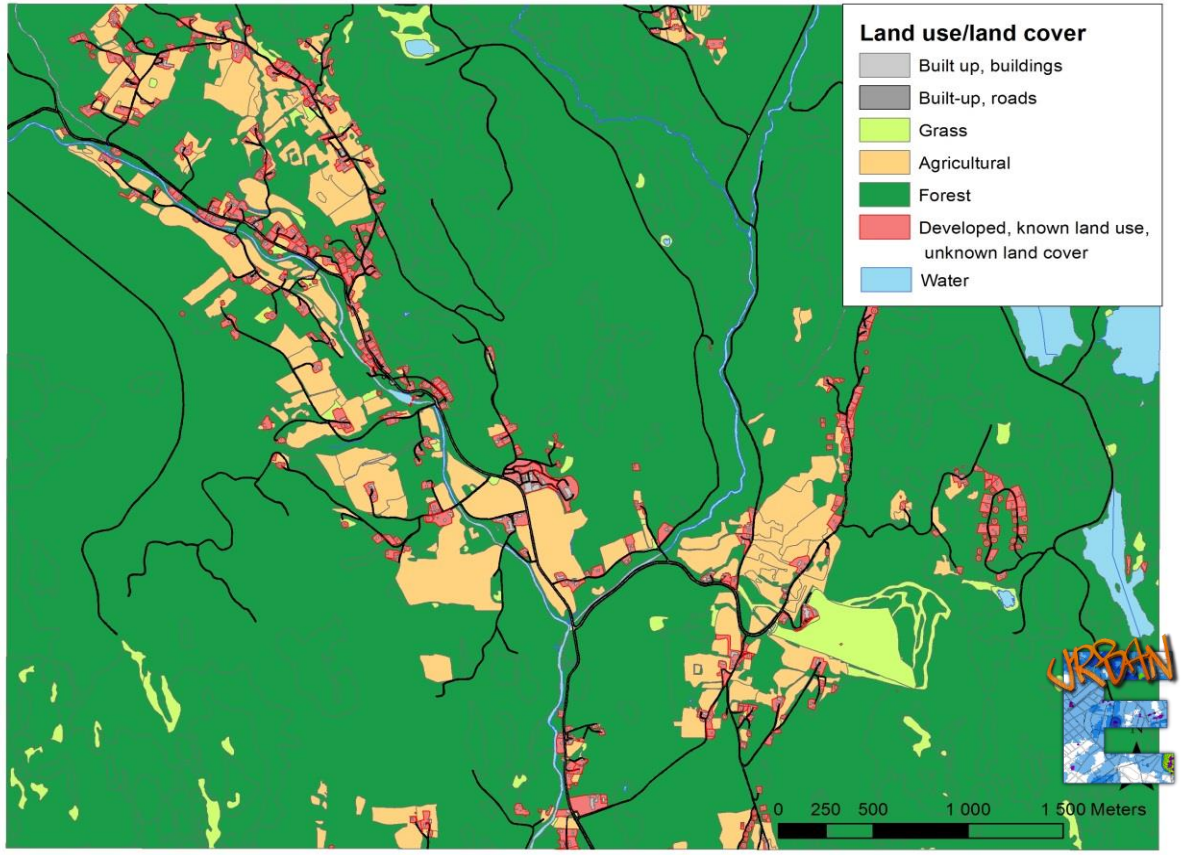
Sentinel gives better representation of green structure, but land use/land cover maps give better information about where people lives



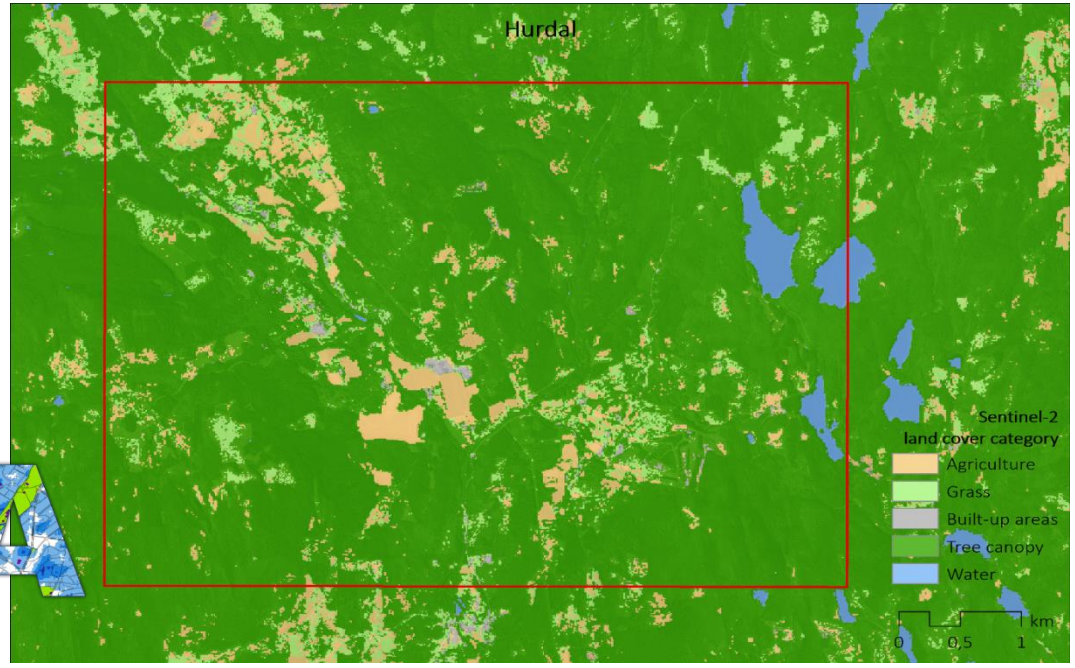
Hurdal – rural area in the greater Oslo region



Hurdal- Ødemarken



Both Sentinel and land use maps give good information about green areas, but land use/land cover maps give bett information about roads and settlements.



Land use/land cover maps are excellent sources of information, but satellite data tell more about variation in nature, vegetation and the blue-green structure.

- The problem with satellite data is that the built-up areas are not so easy to classify and describe, and still they are the most predominant feature in an urban context.
- The urban land use maps are excellent sources of information and allow us to describe the detailed use of a property, but they do not tell us very much about the blue-green structure.
- Moving along a gradient from the city center and outwards, it is obvious that the two data-sources complement each other, as seen in the previous examples. The challenge is to combine them.

Principle for combination
Intersection of Sentinel-2 landcover classification and SSB Land Use:

Green line shows property borders

Principle for combination

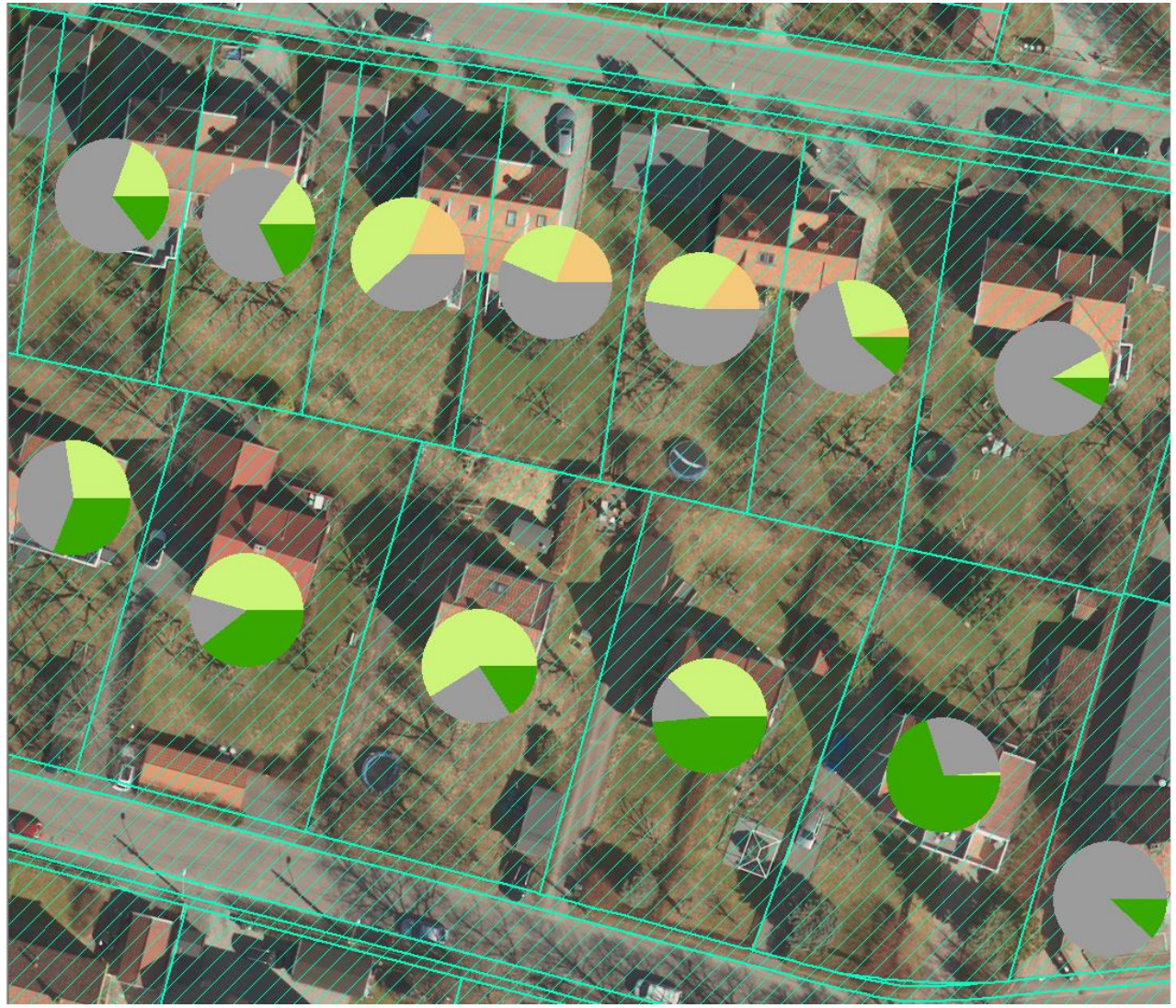
Intersection of Sentinel-2 landcover classification and SSB Land Use:

- **Sentinel-2 landcover classification**
  - Raster map
  - 10m resolution
  - 5 classes:

Agriculture
Grass
Built-up
Tree canopy
Water

Proportion of Sentinel-2 classes visualized using cartodiagram
Intersection of Sentinel-2 landcover classification and SSB Land Use:

- Agriculture
- Grass
- Built-up
- Tree canopy
- Water



Proportion of Sentinel-2 green classes visualized using choropleth Intersection of Sentinel-2 landcover classification and SSB Land use:

TREES + GRASS [%]

- 0 - 20 %
- 21 - 40 %
- 41 - 60 %
- 61 - 80 %
- 81 - 100 %

Conclusions and research agenda

- A fixed spatial unit in ecosystem accounting seems to be unnecessary, and data should as a rule be kept in their original (geo-referenced) form in order to be used in a flexible way, depending on purpose.
- There is need for flexible use of spatial units in order to link extent and condition variables, by introducing an element of condition parameters in the extent account.
- In urban areas an extent account based on cadastral units, showing land use and land cover, and adding on information from detailed satellite data to grasp the blue-green mosaic structure, seems to offer a large potential. The crucial question is if it will give us better models for ecosystem services like recreation, pollination and biodiversity.
- Another challenge is to compile yearly land use accounts (you know, most of the accounts we have seen so far have had a span of 10 years to make changes visible and valid). The idea in our research project URBAN-EEA is to use the high accuracy of map and administrative data, combined with satellite data, which are much more updated, to detect and correct lags.
- Then it is possible to create algorithms of automatic correction and classification of satellite data based upon defining categories of change patterns on aerial photos.