

National Land Cover Data (CadasterENV) for Urban mapping and Monitoring

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Contribution from:

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Overview

1. CadasterENV Sweden
2. Mapping method, process and challenges
3. User examples



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CadasterENV Sweden

- National mapping
- Funded by ESA (DUE)
- Nov 2012- Oct/Nov 2015
- Swedish Users



CadasterENV Sweden

Develop and implement a system for:

- Map LC in two different scales
- Detect and monitoring changes
- According to the Swedish users requirements

Scale levels:

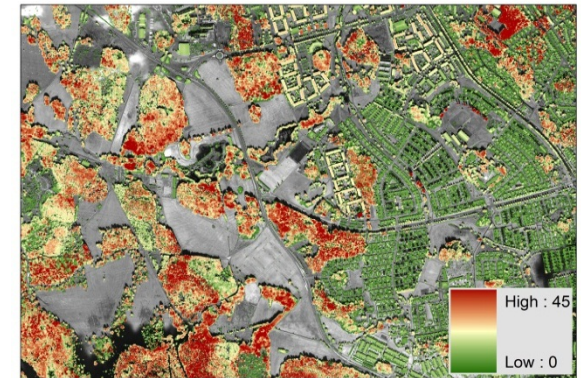
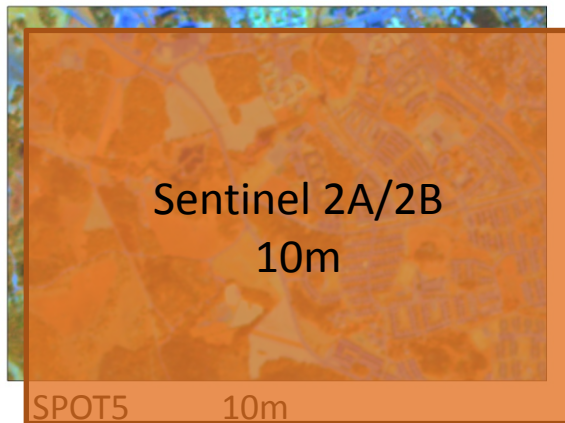
- **10 meters** resolution to map LC and identify changes at a national level (HR)
- **2 meters** resolution with focus on LC and changes within urban areas for local and regional planning (VHR)



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Input data today ... onwards



→ Sentinel 2A/2B
= increased opportunities to obtain cloud-free scenes

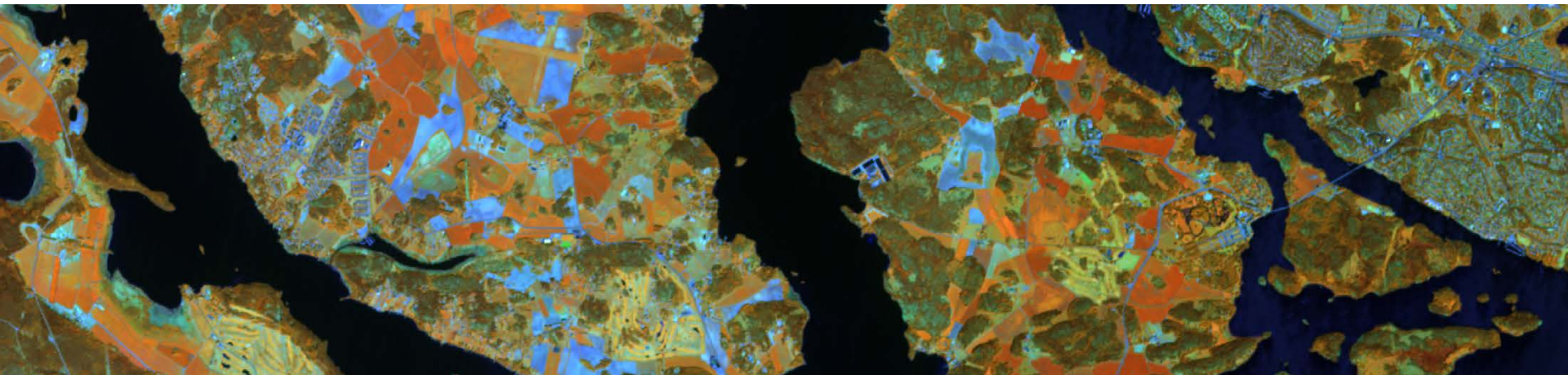


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General user needs

- Homogeneous and nationwide land cover data
- A possibility to update LC data on a regular basis
- Reasonable production costs on a national level
- INSPIRE compatible



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Thematic LC core need

- The land cover shall be mapped but not valued (map what you see regardless of the context of the area, e.g. map buildings and artificial surfaces but don't categorize them as spares or dense urban areas)



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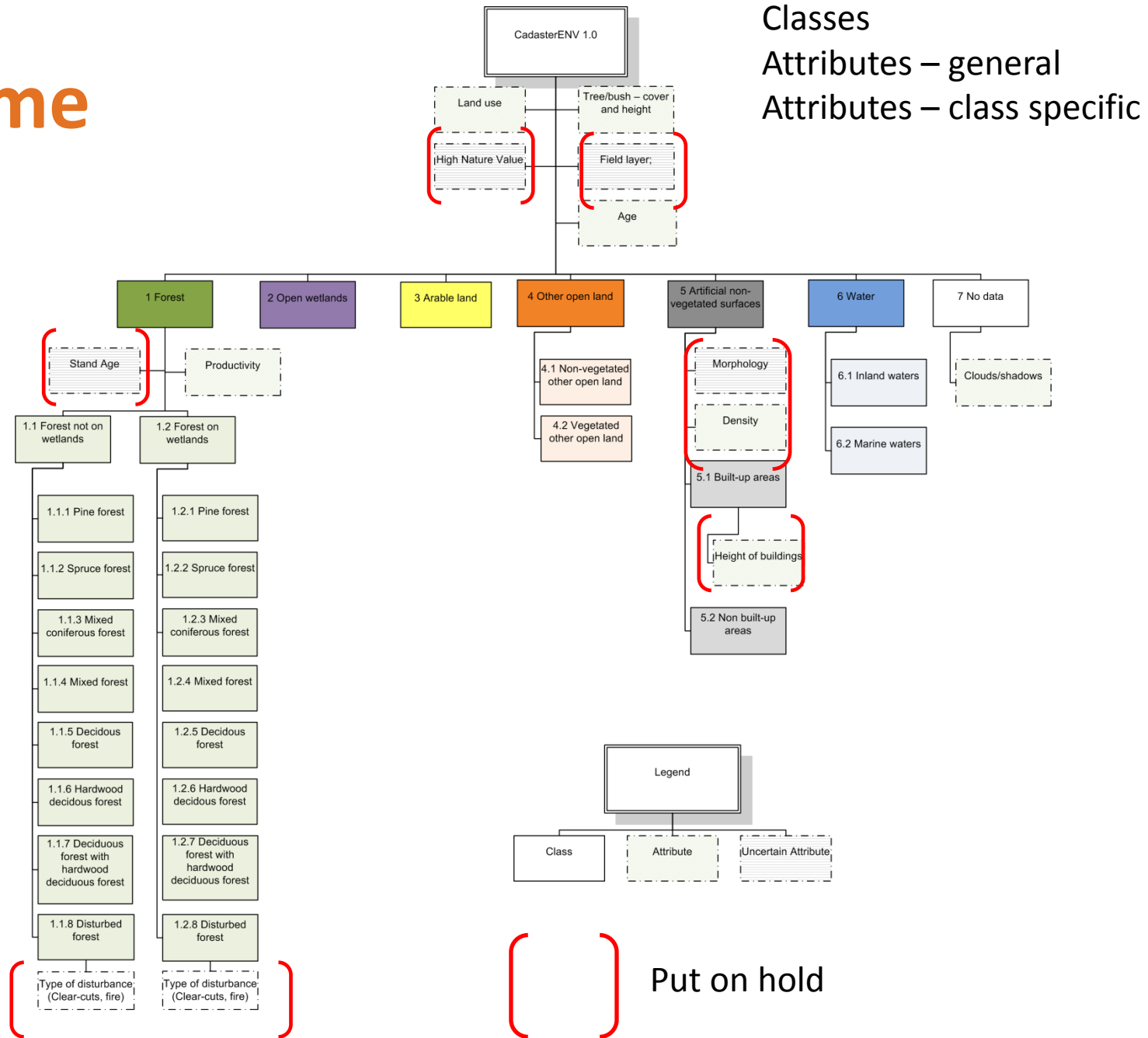


User requirements

Identifier	Description	User	Prio
	URBAN		
RB-1	The actual land cover shall be mapped (regardless of whether it is inside of urban areas or not).	SCB	1
RB-2	The same land cover classes shall be used for vegetated areas within urban areas as well as outside.	SCB,SBA, CAB, Lantm, SEPA	1
RB-3	Impervious surfaces shall be mapped similarly regardless of whether they are within or outside urban boundaries.	SCB	1
RB-4	Impervious areas shall be separated in built-up and non-built up areas	SCB, CAB	1
RB-5	The definition of sparse and dense urban structure from SMD shall be used	SCB	1
RB-6	Mapping should not be based on existing urban boundaries.	SCB	1
RB-7	Extractions and dump areas.	SEPA, SCB	2
RB-8	Golf courses		2
RB-9	Morphology (structure) of buildings	SCB, CAB	1
RB-10	Height of buildings	SCB, CAB	1
RB-11	Update frequency 5 years	SCB, SEPA	

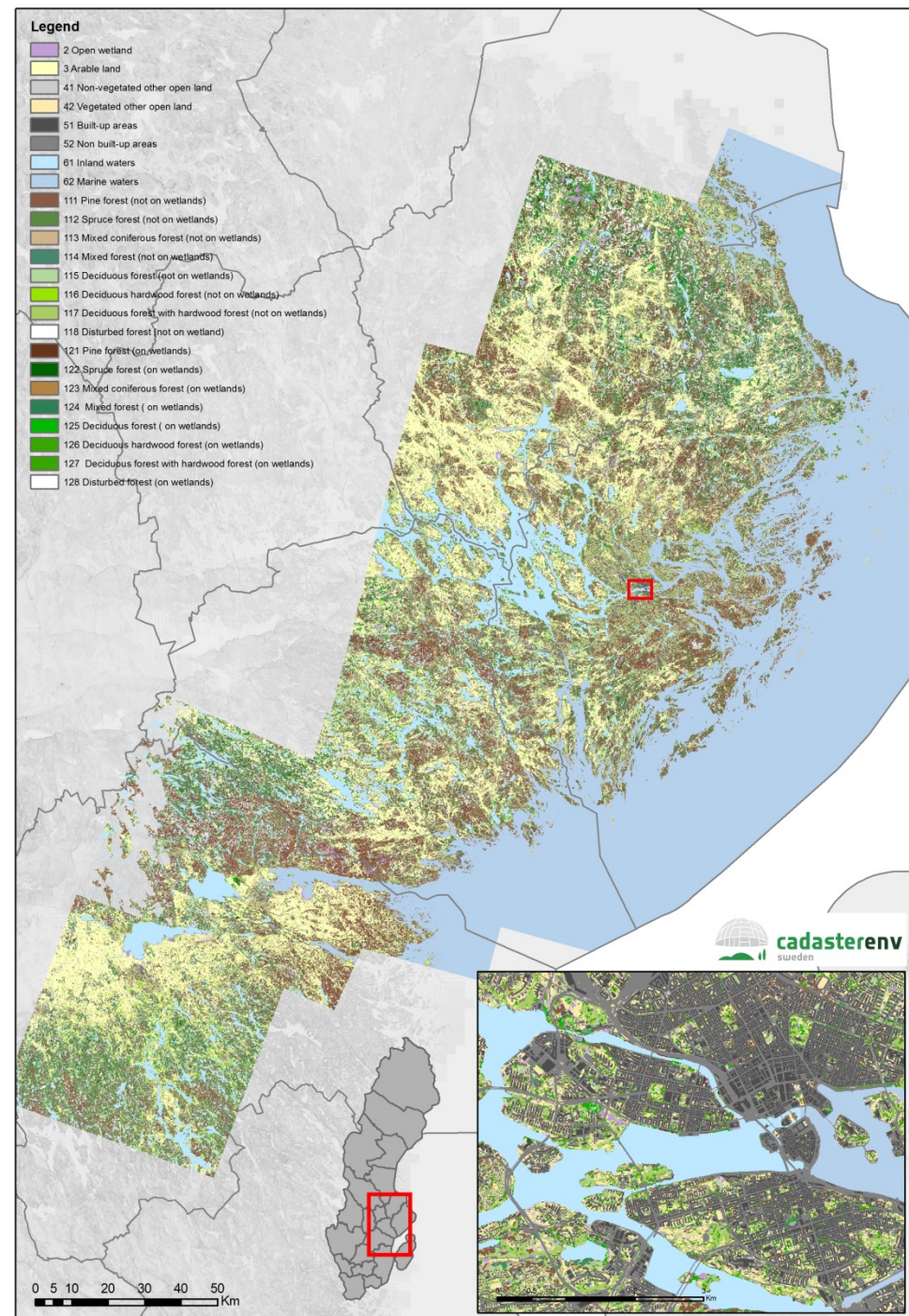
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	FOREST		
RB-100	Forest classes from KNAS	CAB, SEPA	1
RB-101	Forest definitions shall be adapted to FAD	SCB, SBA, CAB, Lantm, SEPA	1
RB-102	Non-productive forests shall be classified according to forest type	CAB, SEPA	2
RB-103	Native age groups	CAB	1
RB-104	An improved delineation of forest on wetlands	CAB, SEPA	1
RB-105	Field layers, especially tichen-rich shall be mapped	CAB, SEPA	2
RB-106	Field layers with heath vegetation, herbs and grass are also of interest to map.	CAB	2
RB-107	Barren forest areas shall be distinguished from clearings	CAB	2
RB-108	Savon-felled forest areas to be distinguished from clearings.	CAB	2
RB-109	Other disturbed forest due to screw and flooding to be distinguished from clearings.	CAB	2
RB-110	Differentiate dense, sparse, within spruce and open forests	CAB	2
RB-111	Specify type of deciduous forest (e.g. open and mixed) within the class Mixed forest. Find and classify deciduous forest within the deciduous forest also when the deciduous forest doesn't reach 30% of the crown cover.	CAB	2
RB-112	Find older forests on sand / gravel / ridge (N2000 9060)	CAB	2
RB-113	Find nutritious spruce and non-nutritious pine on sand	CAB	2
RB-114	Land elevation forests are of interest to map	CAB	2
RB-115	Update frequency 5-10 years	SEPA	1
RB-116	The Swedish definition of non-productive forest shall be followed	SEPA, CAB	1
	AGRICULTURAL AREAS		
RB-200	Open agricultural areas shall be distinguished from wooded agricultural lands.	SBA, CAB, SEPA	1
RB-201	Definition of wooded pastures shall be based on FAD (> 10%)	SBA, CAB, SEPA	1
RB-202	Coverage of 5-10% shall be mapped as "Other wooded land" according to FAD	SEPA, CAB	1
RB-203	Identify wooded agricultural land of high conservation value	CAB, SEPA	1
RB-204	Grasslands outside LPS shall be separated from other subgroups of "other open land"	SBA, CAB, SEPA	2
RB-205	Distinguish permanent lands from temporary lands	SBA	2
RB-206	Constructed wetlands	SBA	2
RB-207	Map larger landscape elements as attributes	SBA, SEPA	2
RB-208	Update frequency of agricultural land should be 5 years	SBA	1
RB-209	Store information on nature values as an attribute		2
RB-210	Encroachment of shrubs/trees. The signal from the "Change Alert" shall be stored as an attribute	SCB, SBA, CAB, Lantm, SEPA	1
RB-211	Identify non-acceptable geometric accuracy of the LPS (Land Parcel Identification System)	SBA	1
RB-212	Use LPS for better delineation	SEPA	3
RB-213	Assess land outside LPS shall be mapped	SBA	1
RB-214	Define wooded pastures and shrublands in accordance to the Swedish Board of Agriculture's directive SVEP 2011:7	SBA	2
	WETLANDS		
RB-300	Improved delineation for wetlands, both between open wetland and open non-wetland and between forested wetland and forested non-wetland.	SCB, CAB, Lantm, SEPA	1
RB-301	Fresh water shall be distinguished from oceans	SCB, CAB, Lantm, SEPA	1
RB-302	Traditionally managed wetlands	SEPA	1
RB-303	Incorporate SMI (when digitized)	CAB, SEPA	1
RB-304	Classify according to hydro-topographic units bog, fen, mixed mire.	CAB	1
RB-305	Classify according to field layer (grass, moss etc)	CAB	2
	WATER		
RB-400	Fresh water shall be distinguished from oceans	SCB, CAB, Lantm, SEPA	1
RB-401	Distinguish different types of lakes	CAB	2
RB-402	Reed (10 m width)	CAB, SEPA	2
RB-403	Lower water vegetation (water lilies, pondweed etc)	CAB	2
	OTHER		
RB-500	Substrate areas and heathland	CAB, SEPA, SBA	2
RB-501	Sand environments	CAB	2
RB-502	Power line corridors	CAB	2
RB-503	Power line corridors with grass	CAB	2
RB-504	Accuracy of each class for different parts of the country	CAB	1
RB-505	Compatibility between Cadaster classification system, CLC and KNAS	SEPA	1
RB-506	Classify according to field layer (grass, herbs, heath etc)	CAB	2
	LC		
RB-600	Other yearly updated data (e.g. LPS) can be used for a yearly update of the LC	CAB, SEPA	1
RB-601	Where and when to update the LC must be decided from class to class and region to region		1
RB-602	Changes between main class groups	SCB, SBA, CAB, Lantm, SEPA	1
RB-603	Changes of bush/tree cover (priority in LPS areas)	SBA	1
RB-604	Plugging of ditches on wetland		1
RB-605	New buildings	SCB	1
RB-606	Gate layer (e.g. tichen - not tichen)	SEPA, CAB	1
RB-607	Mixed Forest/Deciduous forest to increased coniferous part	SEPA, CAB	1
RB-608	Mixed Forest to increased deciduous part	SCB	1
RB-609	Changes between different coniferous classes (e.g. pine to mixed coniferous forest)	CAB	1

LC scheme



LC Deliverables

- 24 thematic classes
 - Level 1-3
 - HR/VHR
 - Raster 2/10 m
- Attributes as separate layers
 - Land use
 - Object height
 - 0,5-5 m
 - >5 m
 - Object cover
 - 0,5-5 m
 - >5 m
 - Forest Productivity
 - Age

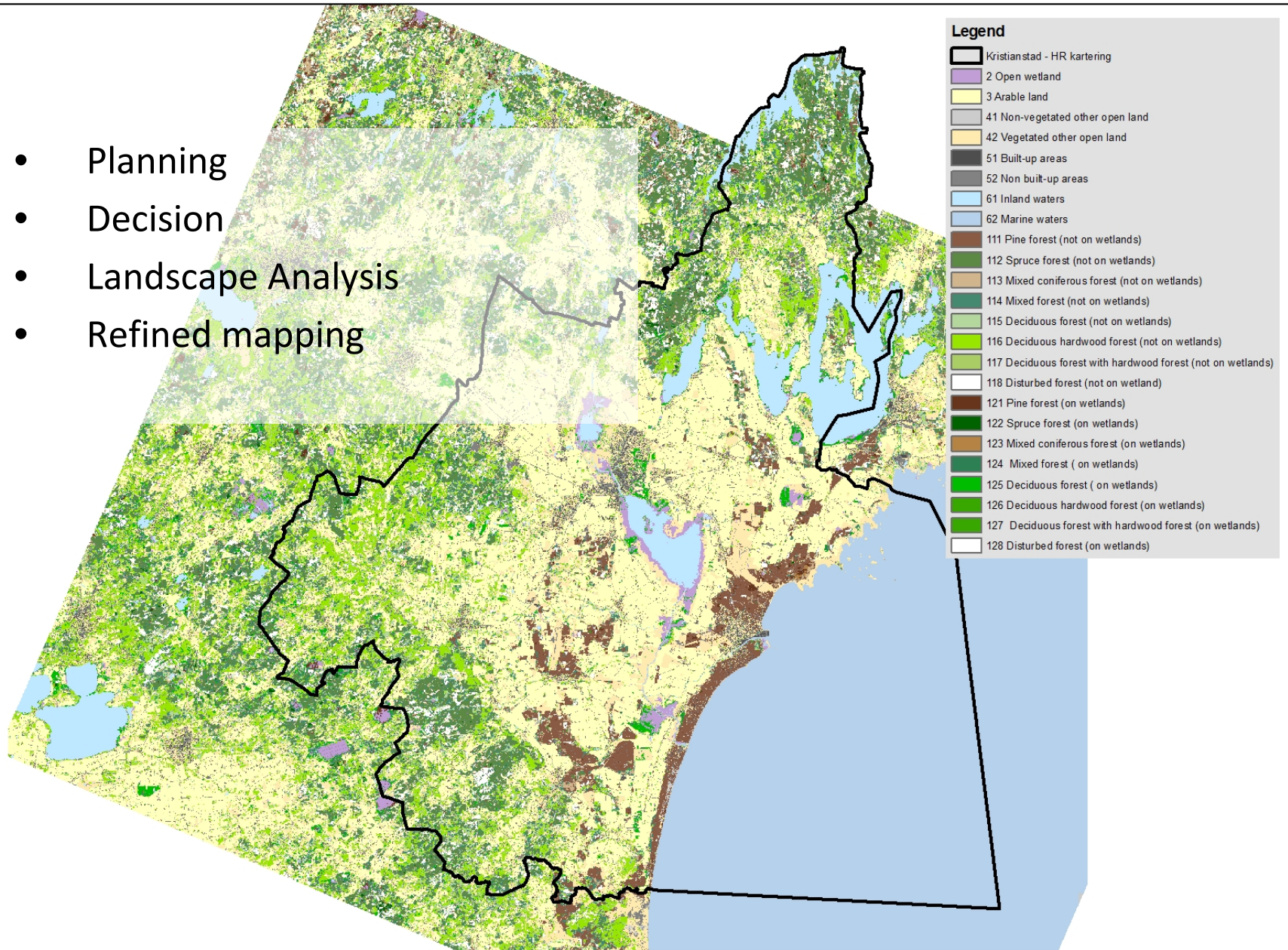




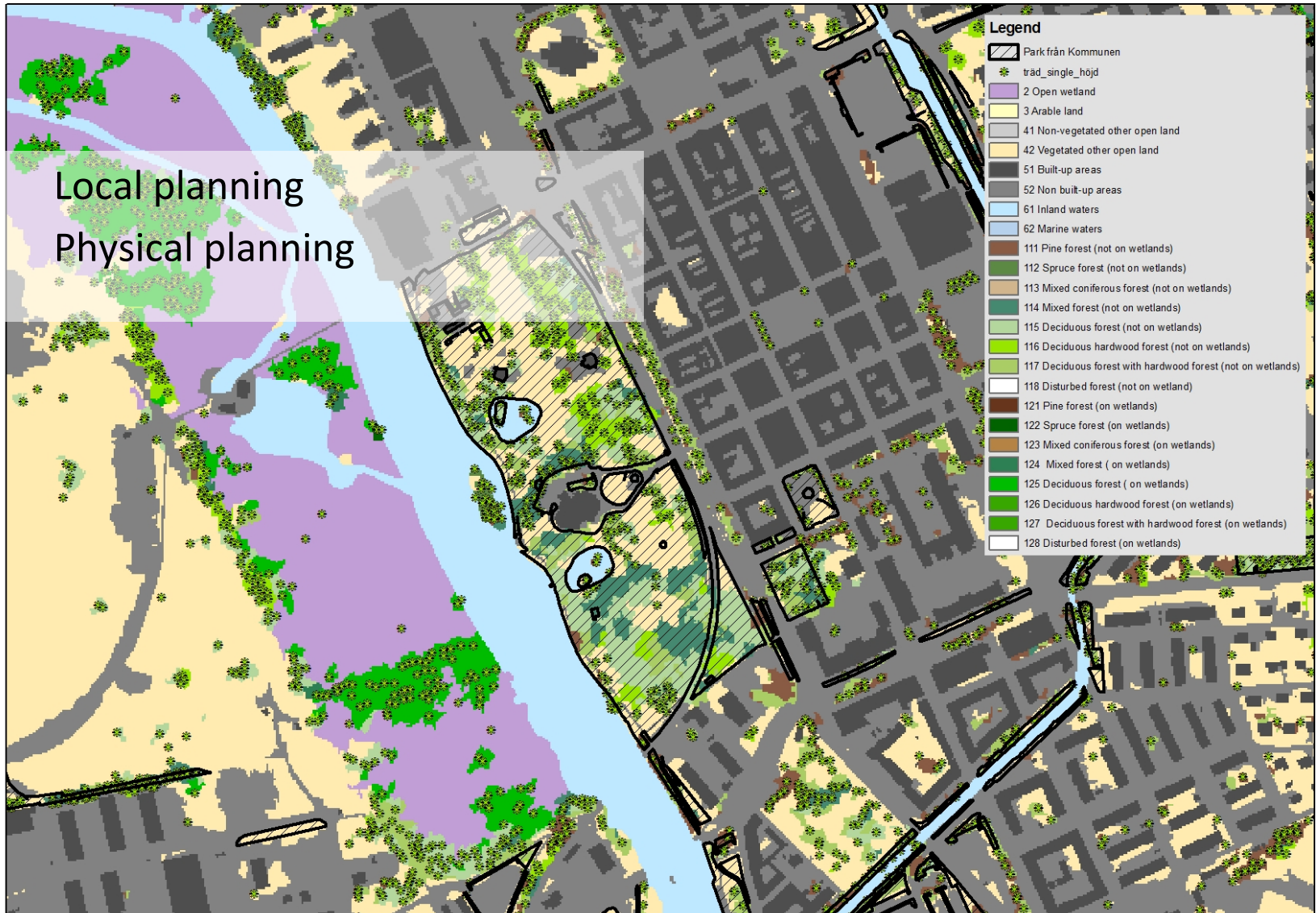
Legend

- 2 Open wetland
- 3 Arable land
- 41 Non-vegetated other open land
- 42 Vegetated other open land
- 51 Built-up areas
- 52 Non built-up areas
- 61 Inland waters
- 62 Marine water
- 111 Pine forest (not on wetlands)
- 112 Spruce forest (not on wetlands)
- 113 Mixed coniferous forest (not on wetlands)
- 114 Mixed forest (not on wetlands)
- 115 Deciduous forest (not on wetlands)
- 116 Deciduous hardwood forest (not on wetlands)
- 117 Deciduous forest with hardwood forest (not on wetlands)
- 118 Disturbed forest (not on wetland)
- Forest on wetlands

- Planning
- Decision
- Landscape Analysis
- Refined mapping



- Local planning
- Physical planning

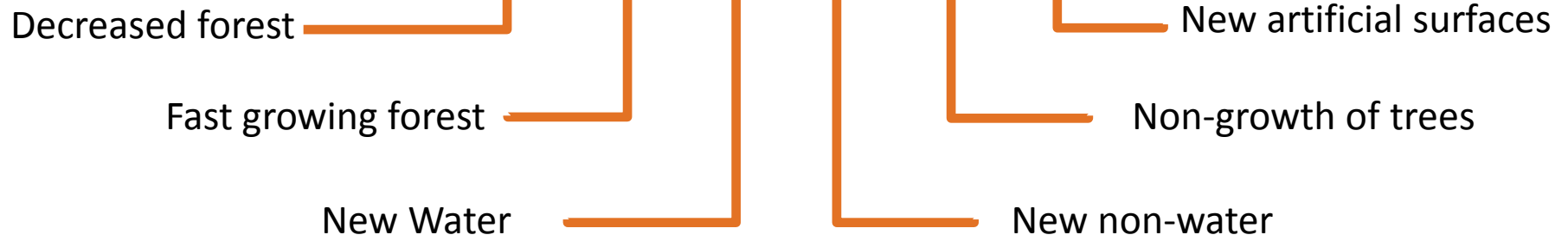




Legend

träd_single_höjd

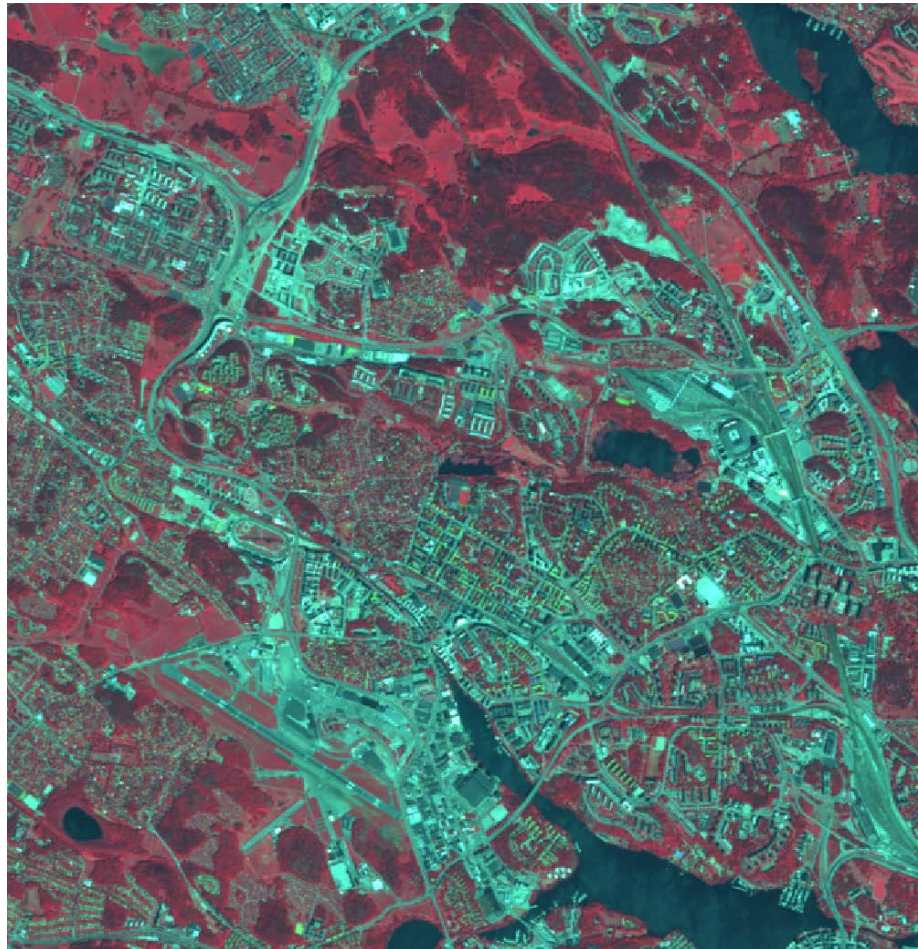
Toolbox



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Toolbox



2014



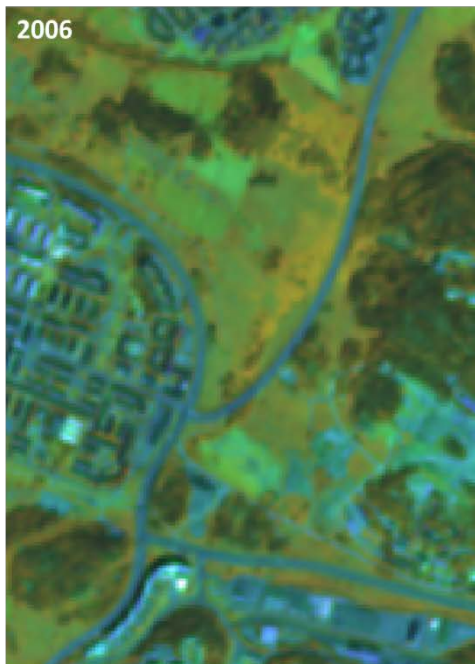
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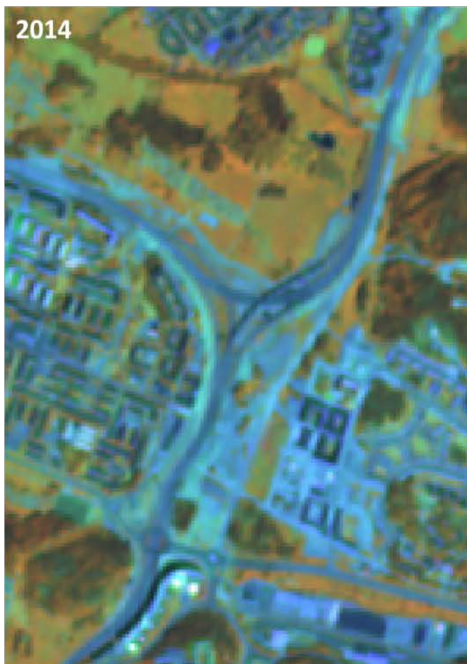
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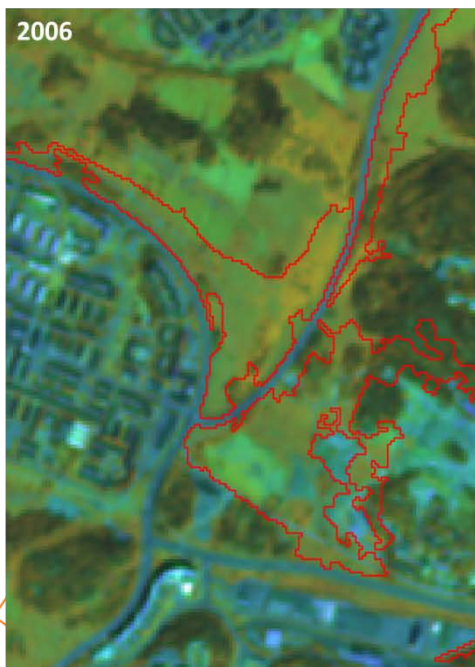
2006



2014



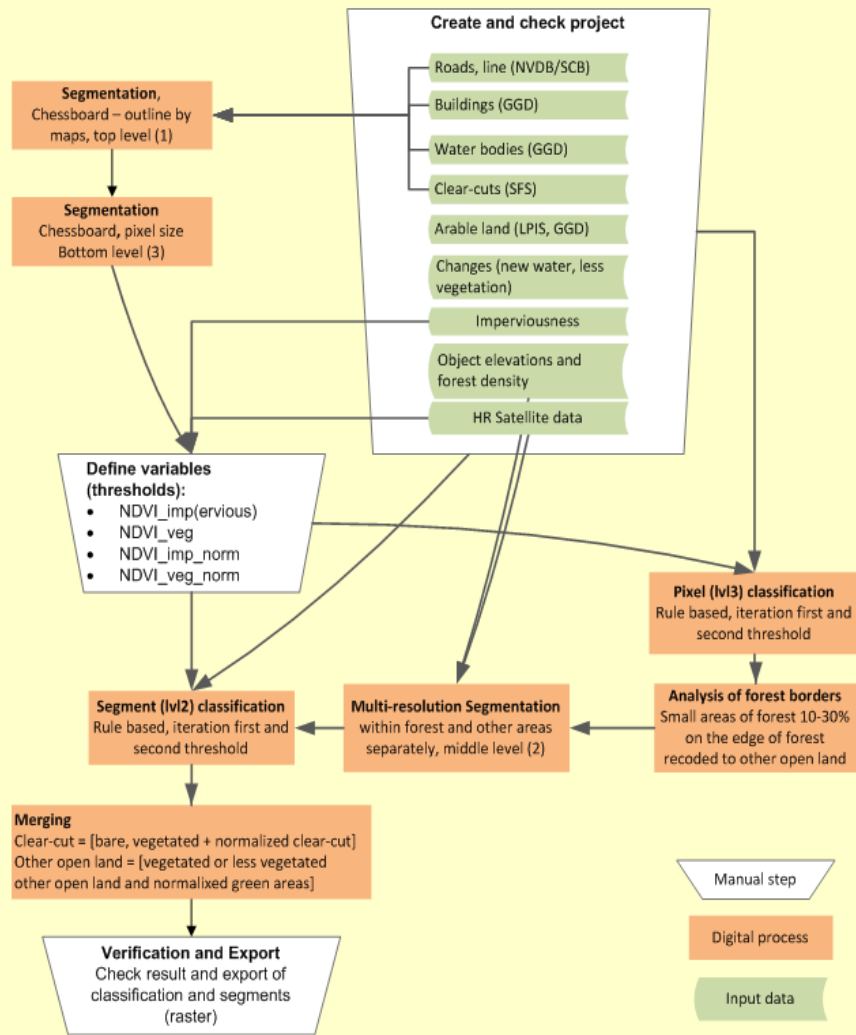
2006



2014



Pre-classification overview HR

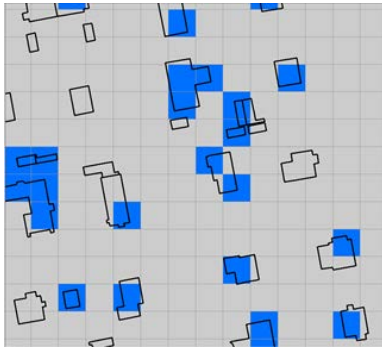


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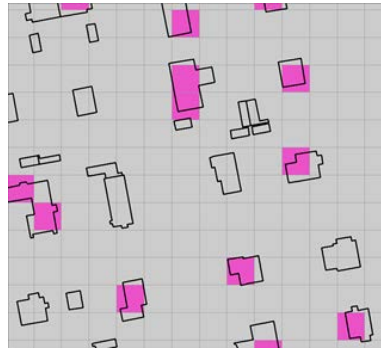


Vector to raster conversion

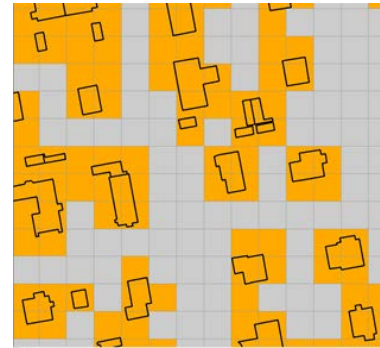
Statistical correct and/or visually appealing...



Centroid



Maximum area



Existing



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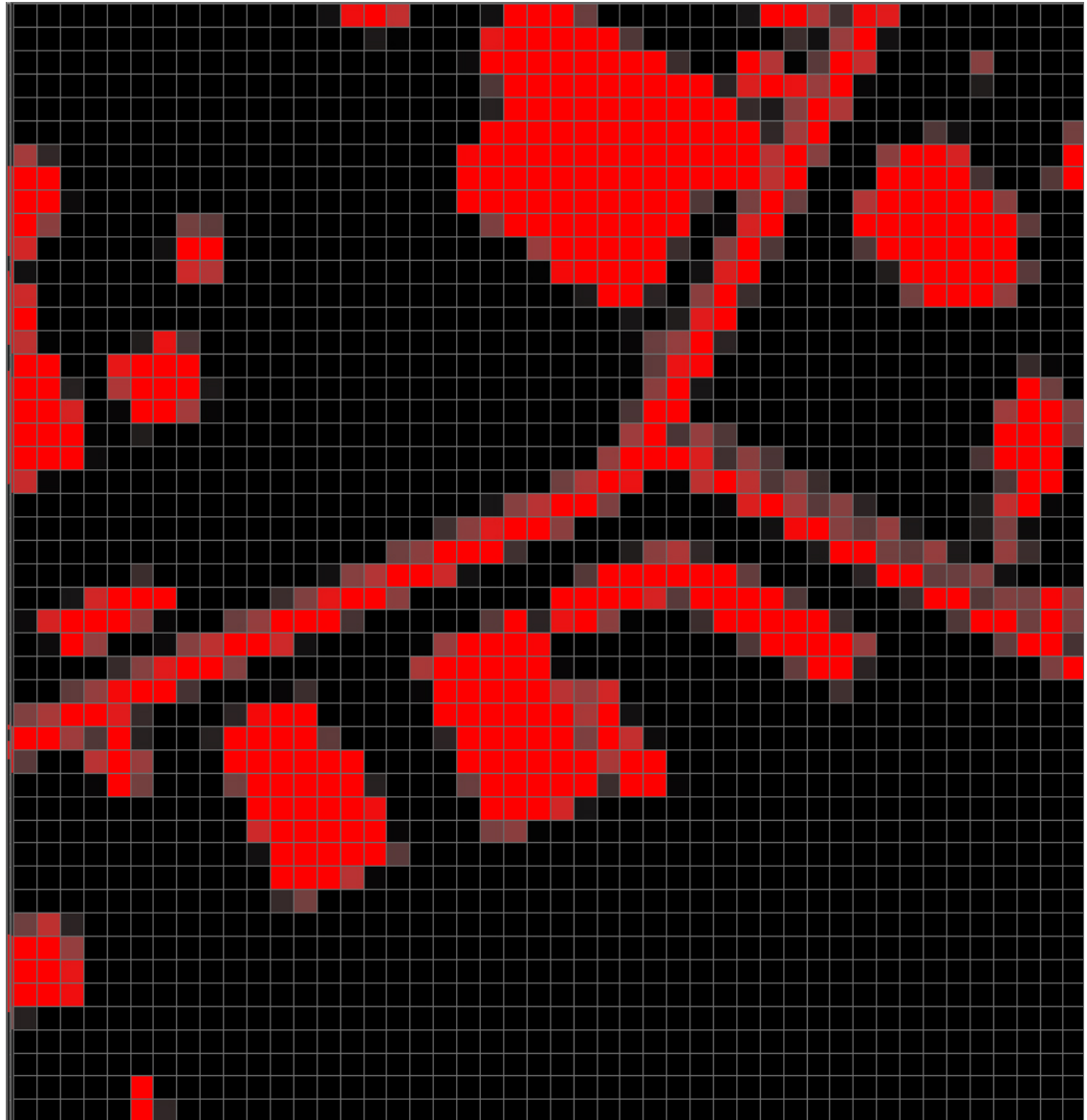


Imperviousness (percentage)

Buildings

Roads

10x10 meter



Green vs impervious: mixels -> vegetation?



Strengthening of vegetation content in mixed pixels



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Kartdagarna 2014



User Examples



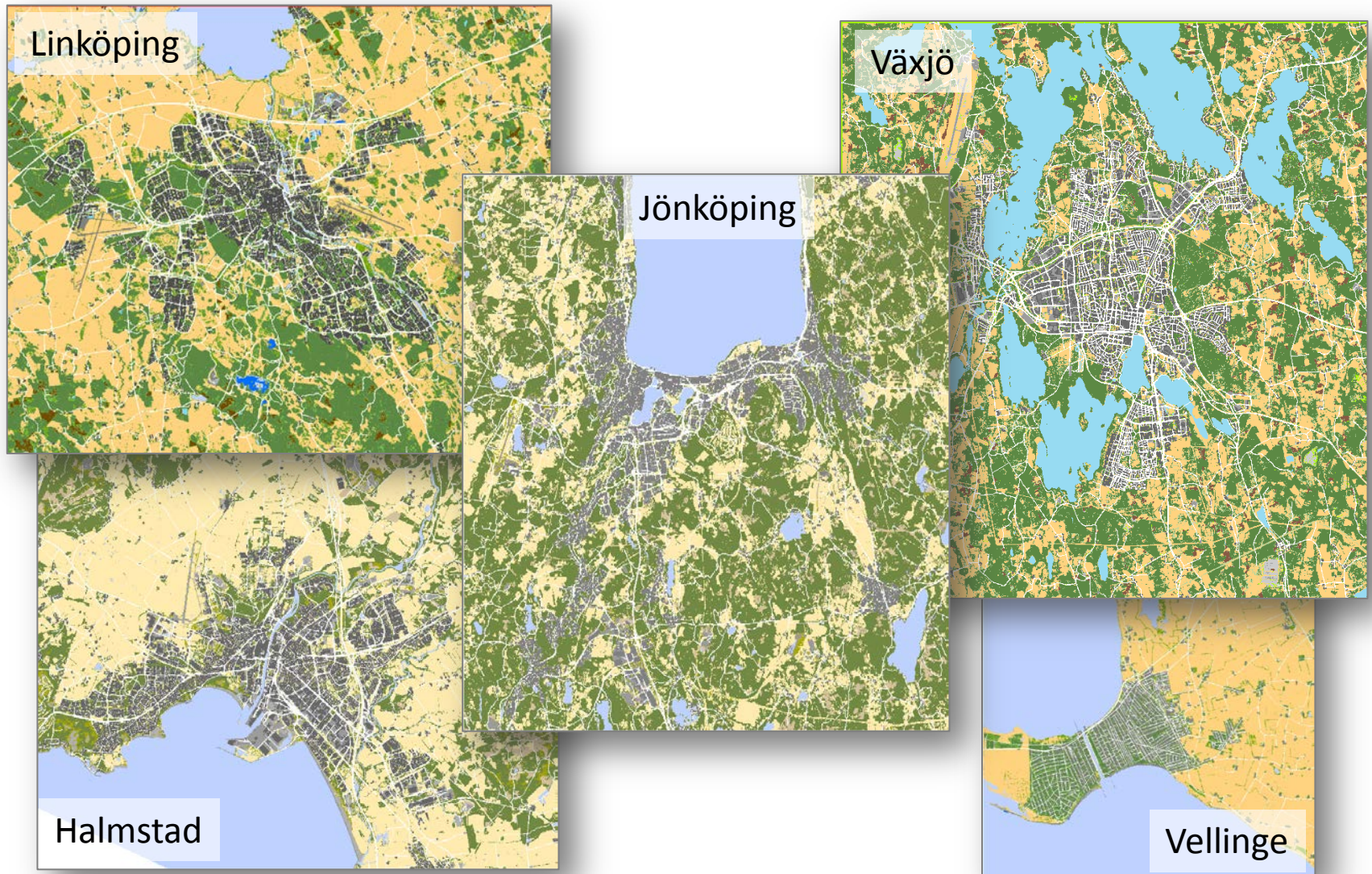
How green are our cities?

- Cities > 30 000 citizens
- Follow the result of planning policy (eg densification)
- Indicators of human health, living environment and quality of life (nationally and internationally)
- Basis for analyzing climate change and climate adaptation
- Basis for the quantification of ecosystem services

Stefan Svanström & Jerker Moström
Statistics Sweden

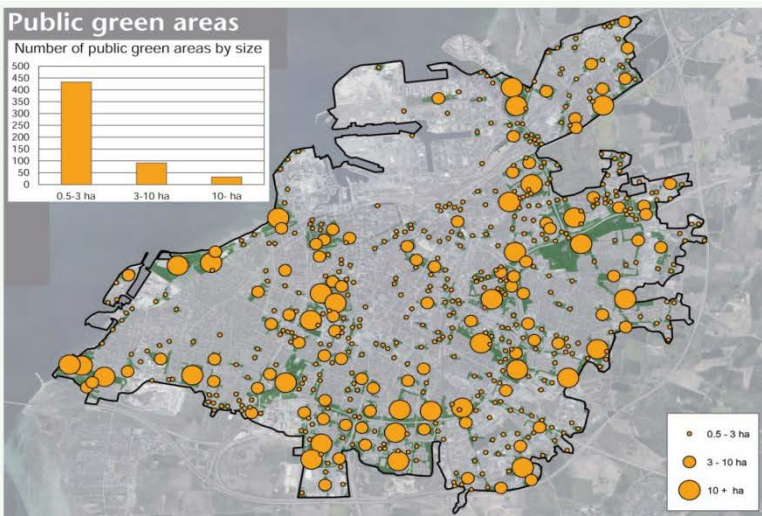
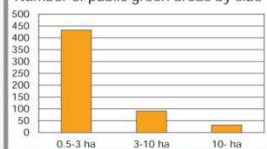


Mapped all urban areas > 30 000 citizens



Public green areas

Number of public green areas by size

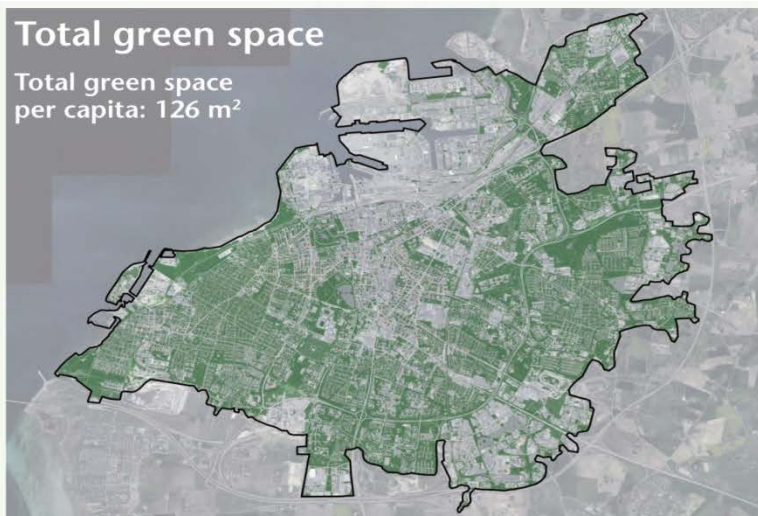


© Statistics Sweden and Lantmäteriet

Footnote: A public green area is defined as an area of contiguous green space of at least 0.5 hectares which is available for the public.

Total green space

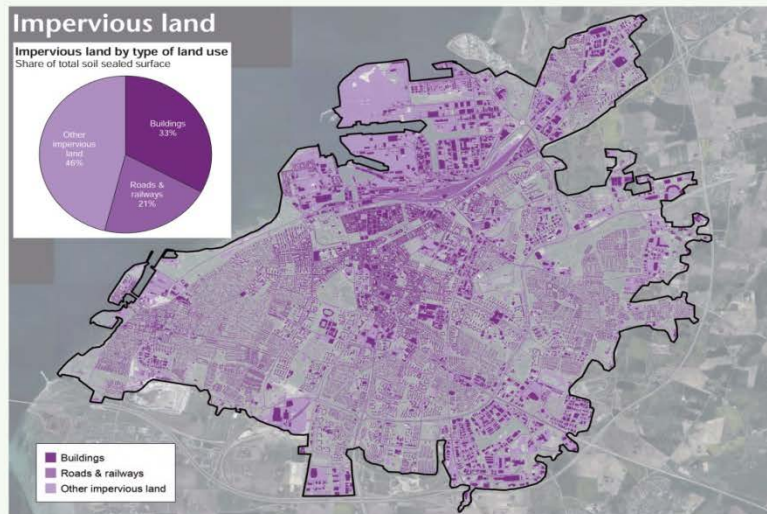
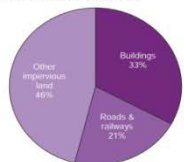
Total green space
per capita: 126 m²



© Statistics Sweden and Lantmäteriet

Impervious land

Impervious land by type of land use
Share of total soil sealed surface



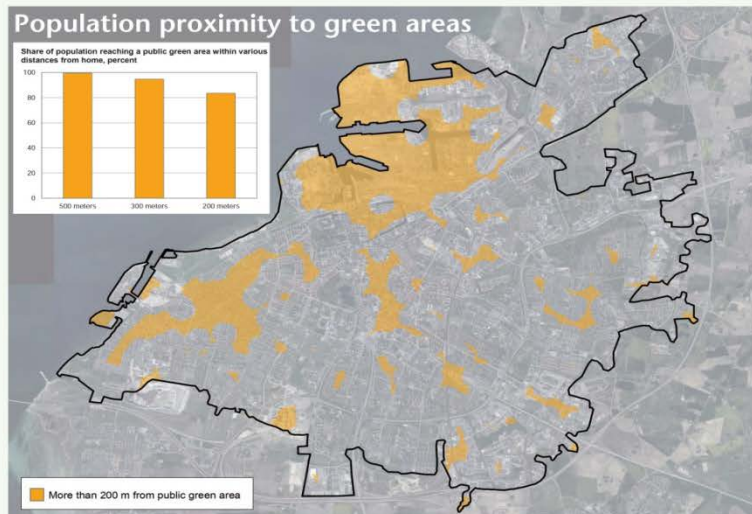
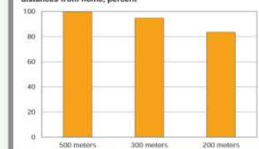
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For questions and further information, please contact:

Jerker Moström at Statistics Sweden, jerker.mostrom@scb.se

Population proximity to green areas

Share of population reaching a public green area within various
distances from home, percent



© Statistics Sweden and Lantmäteriet

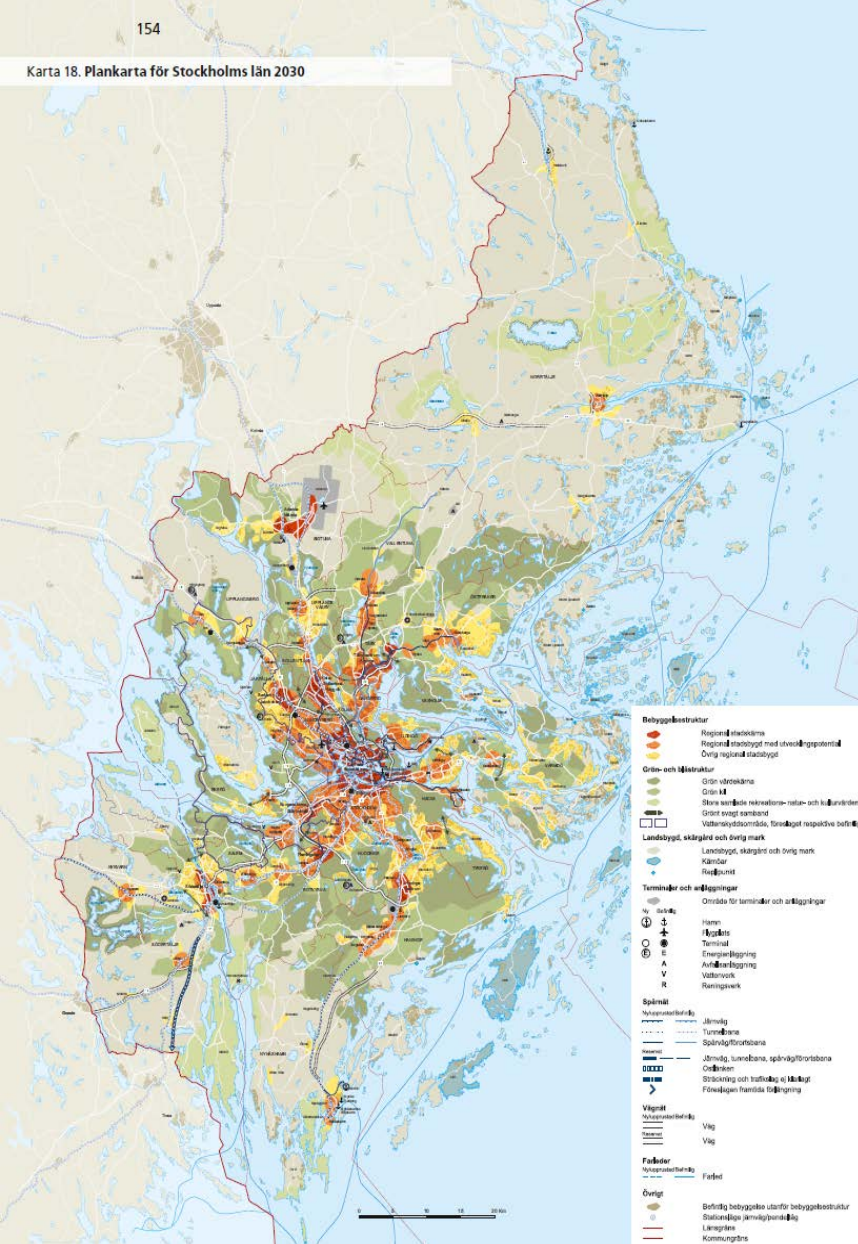
Repeatability

- Every 5th year!
 - Based on 10 meter satellite data, height information and ancillary map data
 - Cloud free data, time for registration
 - Sentinel-2
- Changes
 - Arable land
 - Exploitations
 - Water – new/ disappeared/water vegetation



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Stockholm County in 2030, Regional Development Plan, Stockholm County Council

The Challenge

In Stockholm County we need to build over 20 000 new homes per year and provide all the connecting infrastructure in a long-term sustainable way

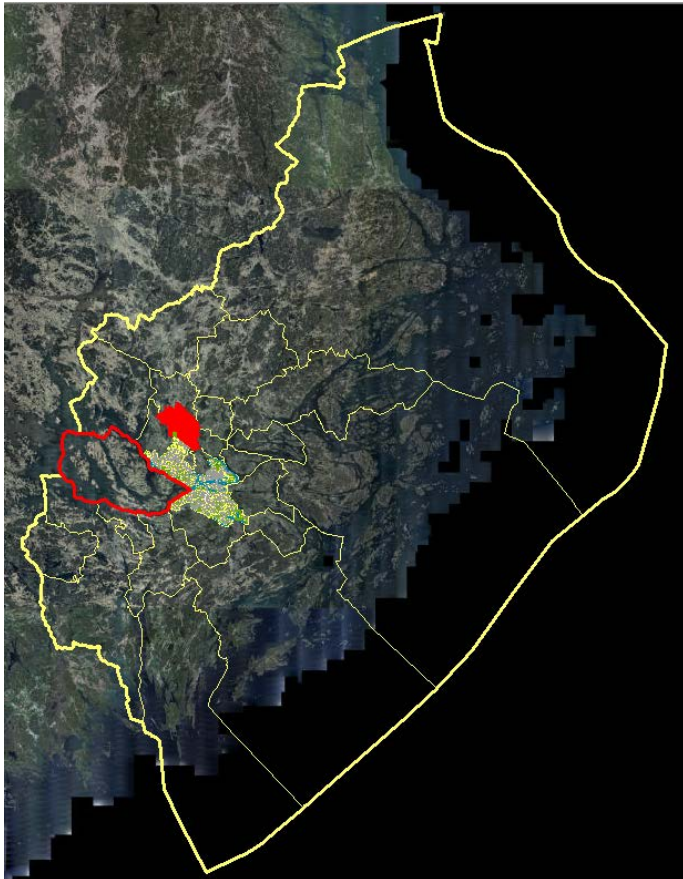
... without increasing fragmentation (for animals and plants)

... and keep and increase the ecosystem services

We need to plan for a functional Green infrastructure

Klara Tullback & Helle Skånes
Stockholm County , SU

Documented need for a county wide and detailed biotope database



 Sollentuna pilot, 2015

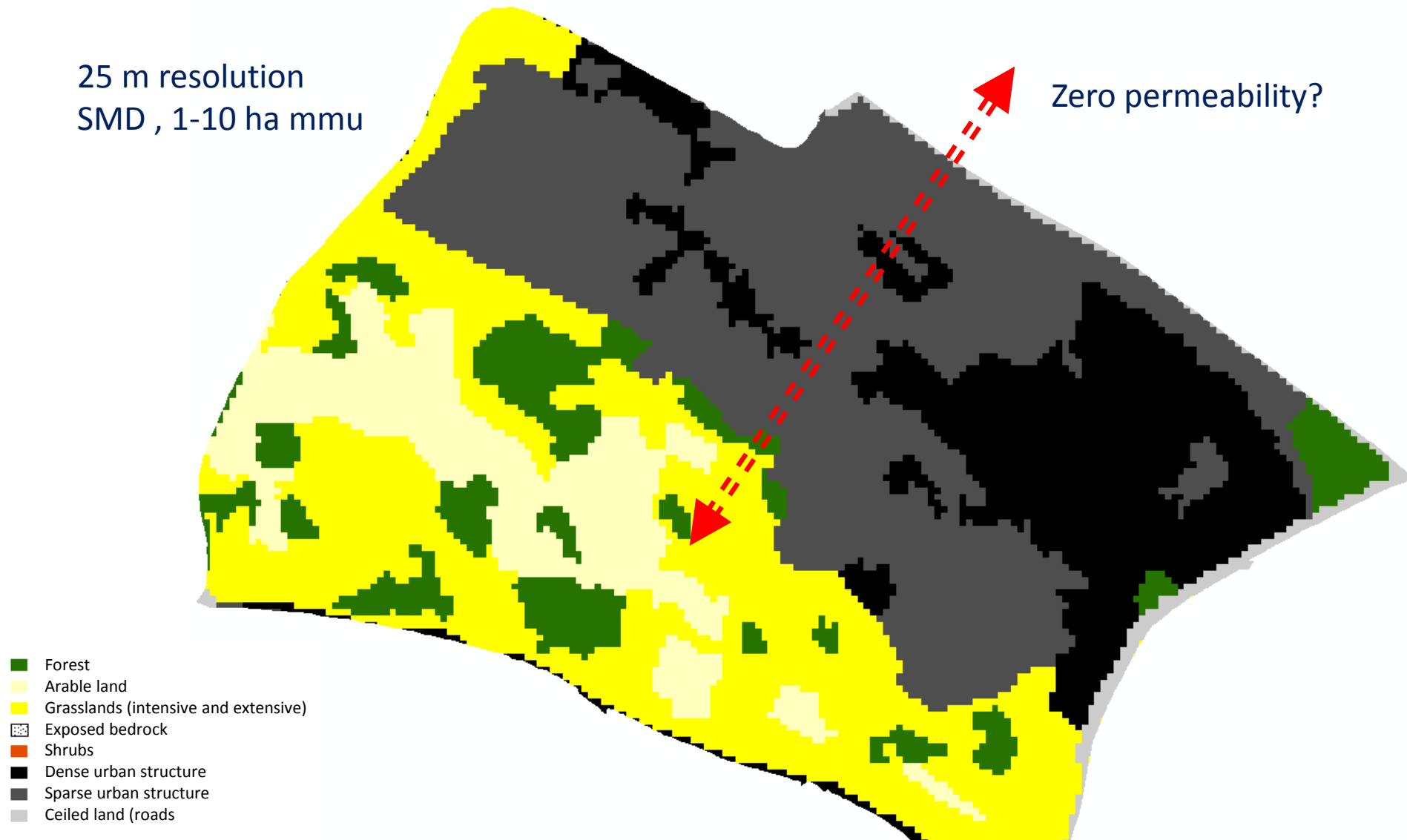
 Ekerö pilot, 2016

- **High resolution biotope data** is needed within nature conservation and urban planning for:
 - Contextual **planning** and sustainable city development
 - Modelling potential species distribution and **ecosystem services**
 - **Protection/management/monitoring** of green spaces
- Current biotope database, is done by conventional air photo interpretation.
 - The need is to cover the entire county (potentially beyond).
 - Conventional method (air photo interpret. only) is not efficient
- We should combine several techniques: map data, satellite, LiDAR. etc. classifications **and** visual air photo interpretation!
- The aim is to create:
 - **A robust method for an improved coherent, spatially complete biotope database covering large areas in a cost efficient way**
 - Not the most detailed biotope database ever!

Spatial resolution matters - Swedish land cover data (national) SMD

25 m resolution
SMD , 1-10 ha mmu

Zero permeability?



Aggregated for comparison and readability

Spatial resolution matters - Stockholm's current biotope database

Vector data
0.1-0.5 ha mmu

Some permeability

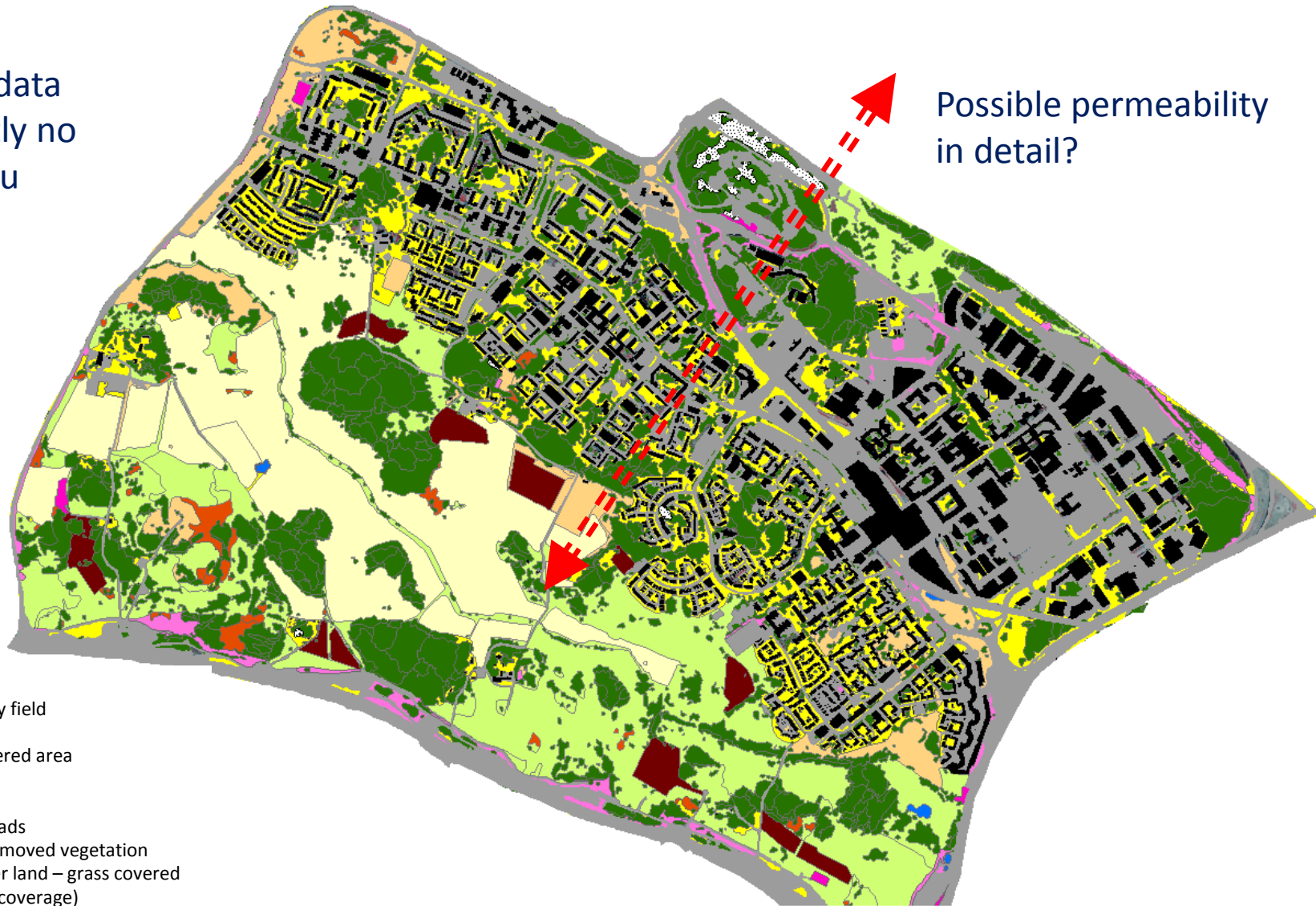


Aggregated for comparison and readability

Spatial resolution matters - New prototype biotope database (county - country) with CadasterENV

Vector data
Currently no
set mmu

Possible permeability
in detail?



Aggregated for comparison and readability

Continuation

The objective is a homogenous, nationwide LC mapping system with an effective method for updating and maintenance

- National coverage HR (10 m raster)
- VHR coverage larger cities (2 m raster)
- Update every 5th year

More information :
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