

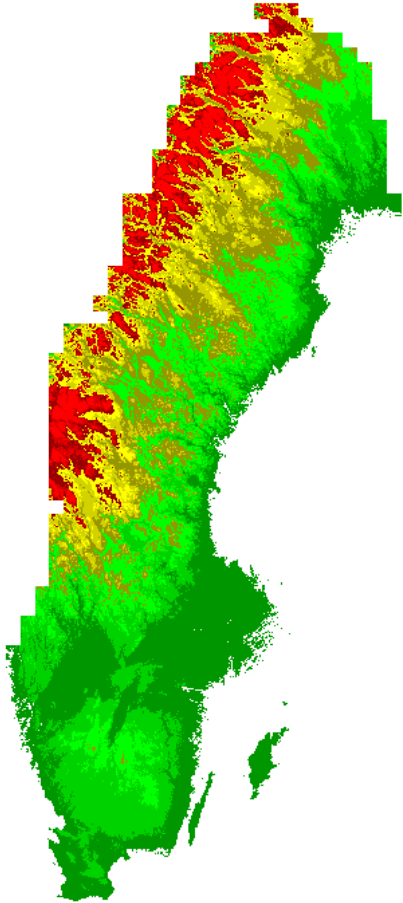


# 3D DATA DEVELOPMENTS AT LANTMÄTERIET, SWEDEN

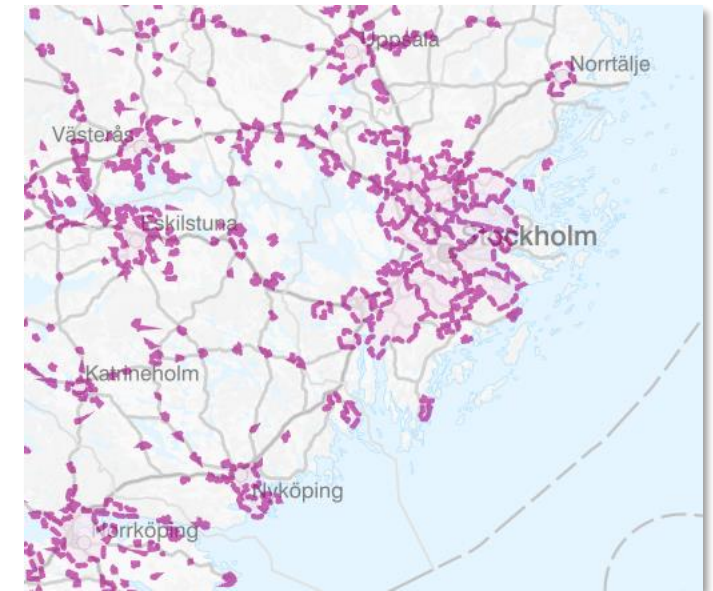
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WORKSHOP STATE-OF-THE-ART 3D MAPPING AT NATIONAL AND REGIONAL MAPPING AGENCIES,  
22/23 January 2025, IGN, Paris  
Helen Eriksson, Erik Nilsson & Thomas Lithén

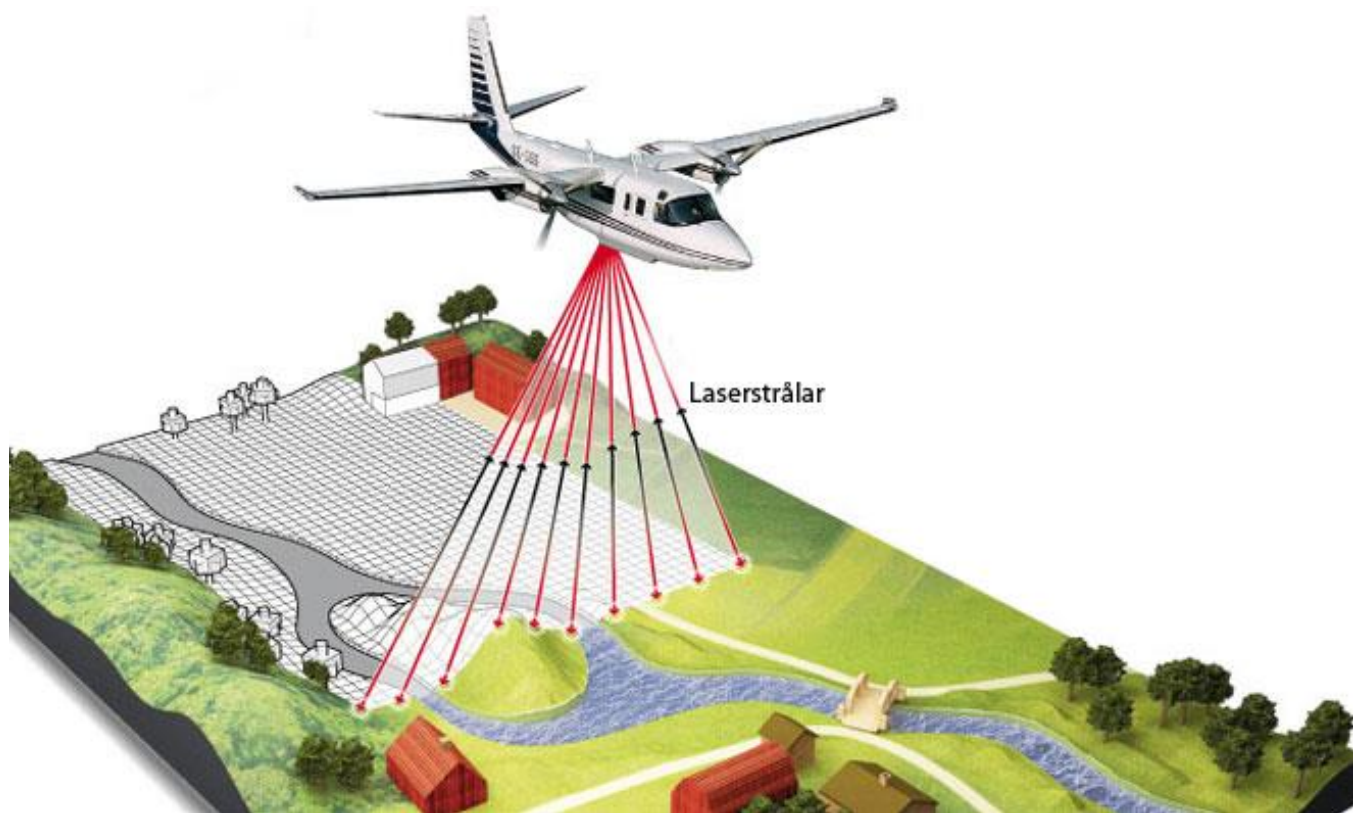
# SOME FACTS ABOUT SWEDEN



- **about 450 000 km<sup>2</sup>**
  - 4 300 km coastal length - the mainland and sea islands
  - 65% of the area is productive forest
  - 290 municipalities
- **about 10 million buildings**
  - 95% of Sweden's area is updated by Lantmäteriet, comprising about 25% of the stock
  - 5% of Sweden's area is updated by municipalities, comprising about 75% of the stock



# 3D DATA PRODUCTS AT LANTMÄTERIET



- Lidar-data
- DTM from lidar-data
- DSM from image-matching
- (flight obstacles)
- (buildings)

# 3D DATA PRODUCTS AT LANTMÄTERIET

## Lidar

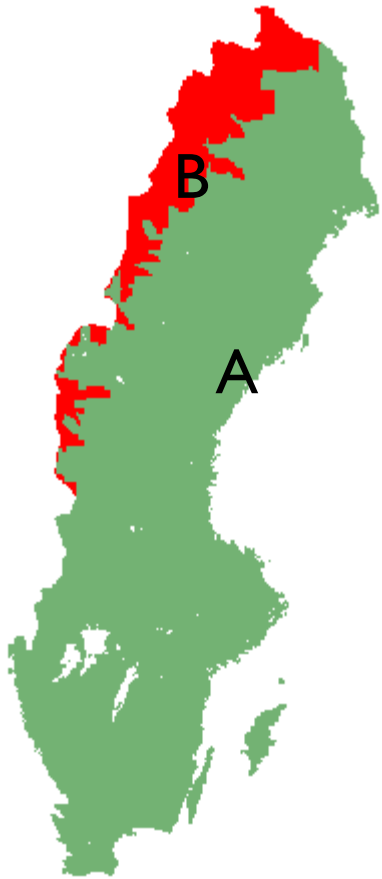
- A Point cloud 1-2 points/m<sup>2</sup>. Updated every 6-7 year.
- B Point cloud 0,5 points/m<sup>2</sup>. Collected 2009-2019.  
No planned updates.

## DTM

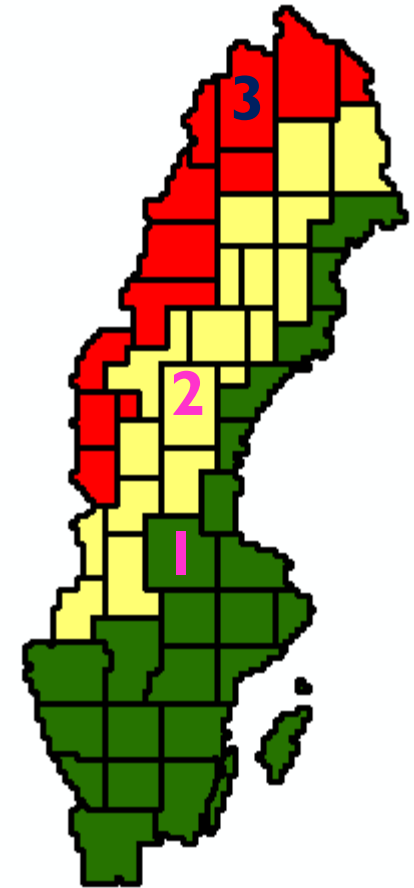
- 1m grid
- Mainly updated using Lidar data as above

## DSM and true ortho from image matching

- 1 Every second year 0,25m/pixel
- 2 Every fourth year 0,5m/pixel
- 3 Every 6-10 year 0,5m/pixel



LIDAR and DTM



DSM and true ortho

# WORKFLOW TO GENERATE AND UPDATE 3D PRODUCTS

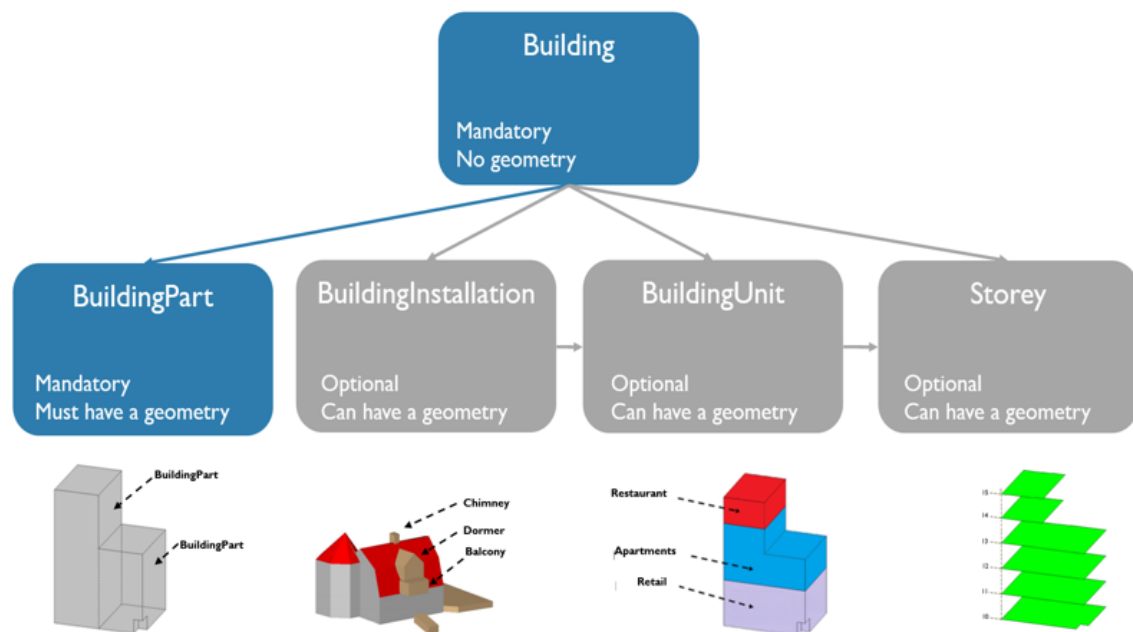
- Lidar-data and DTM is updated every seventh year
  - Some open areas are updated using the DSM from image matching
- Flight obstacles by using 2D-data, DTM, Lidar-data and sometimes photogrammetric 3D-mapping
- Planning for 3D-Buildings LOD2 by
  - photogrammetry in-house and
  - co-operation with municipalities – photogrammetry or LIDAR-data+footprints

# TESTS WITH DATA COLLECTION FOR 3D MAPS



# NEW NATIONAL SPECIFICATION FOR BUILDINGS

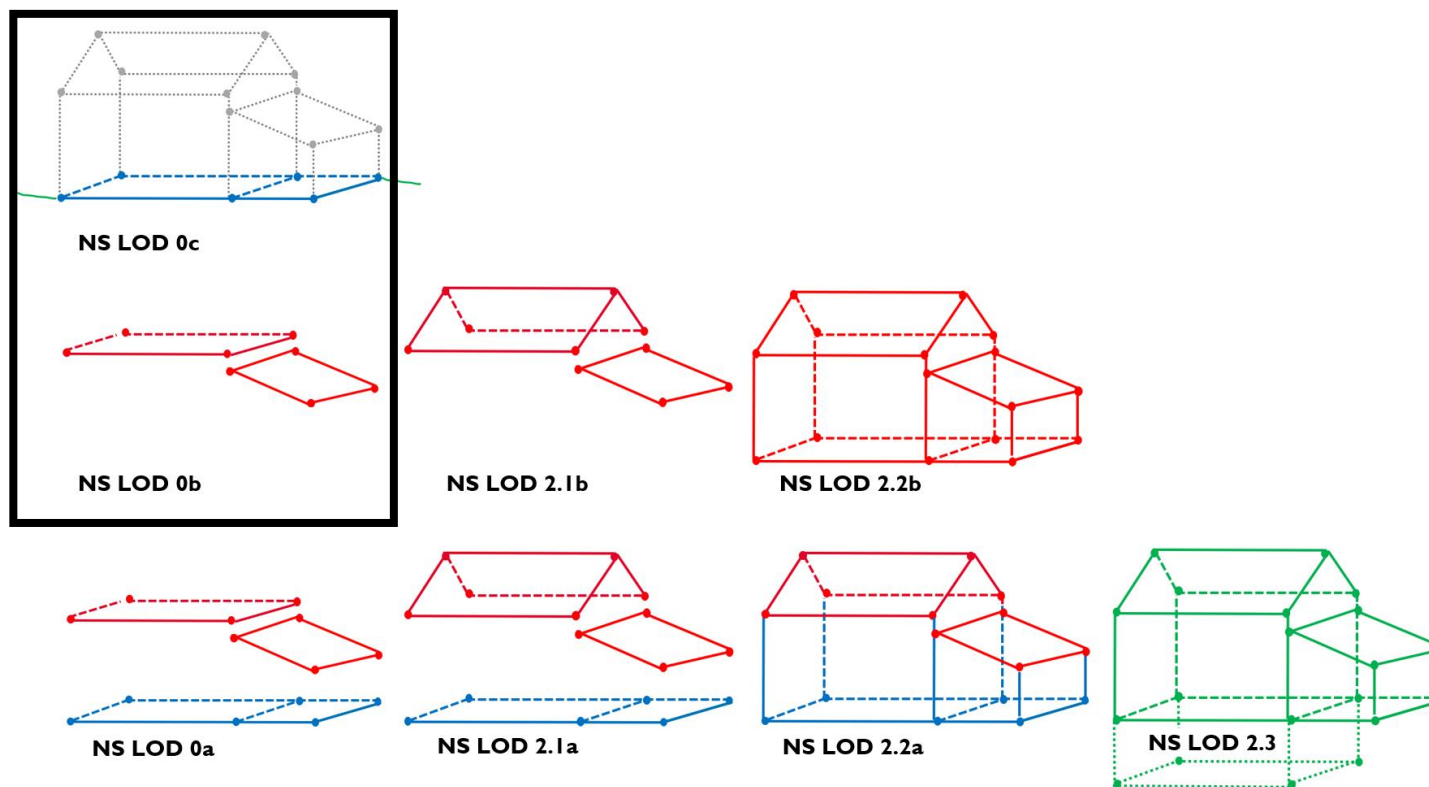
- Developed in co-operation with the Swedish National Board of Housing, Building and Planning
- Has a structure similar to CityGML 3.0
  - Includes more attributes and metadata about the geometries



- Building information can be stored and provided via a national platform
  - The platform is not used yet for building information
  - Consultants are using building information from a test environment

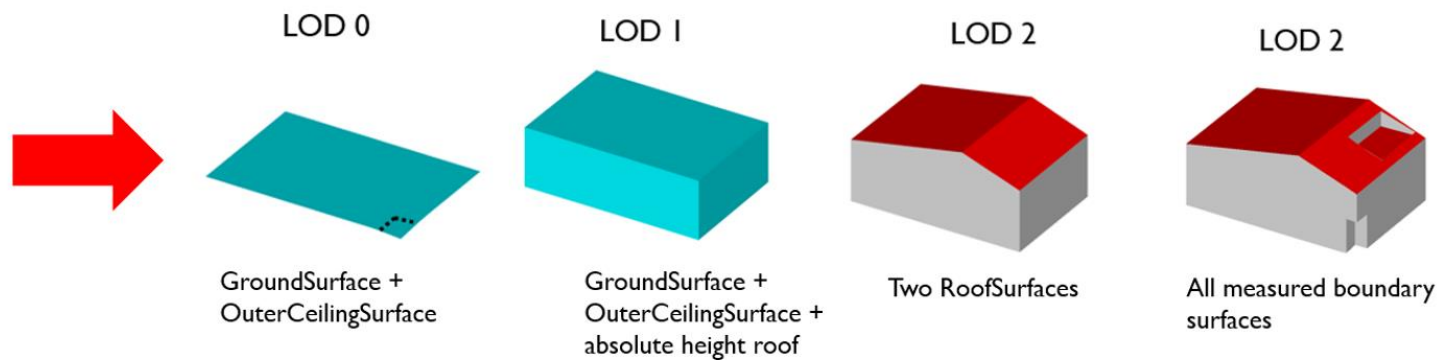
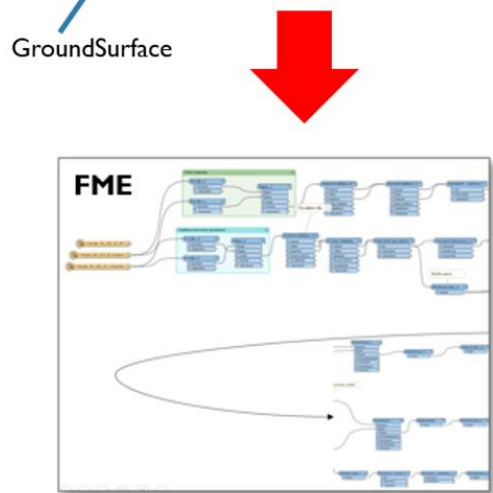
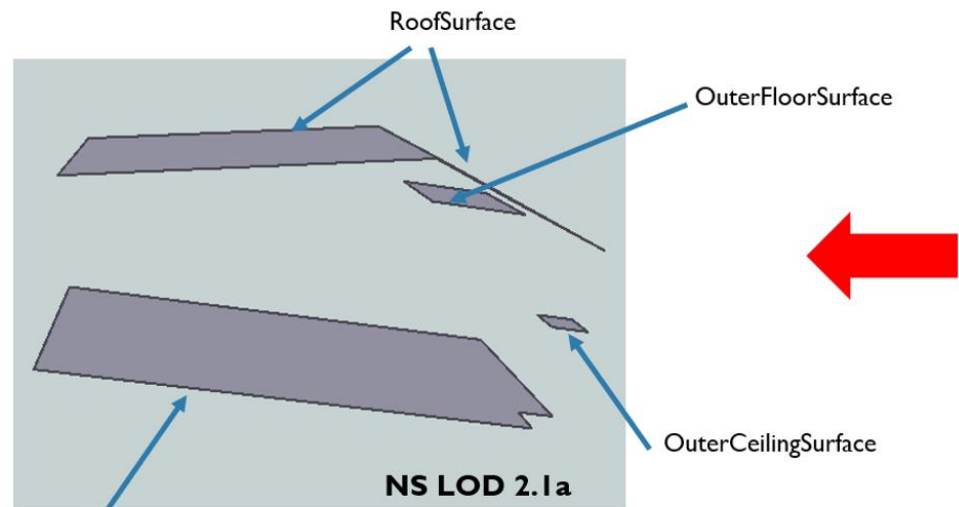
# LEVEL OF DETAIL

The building specification uses its own LOD concept called NS LOD.  
NS LOD is based on the principles of CityGML with certain additions and simplifications.





# CONVERSION TO CITYGML



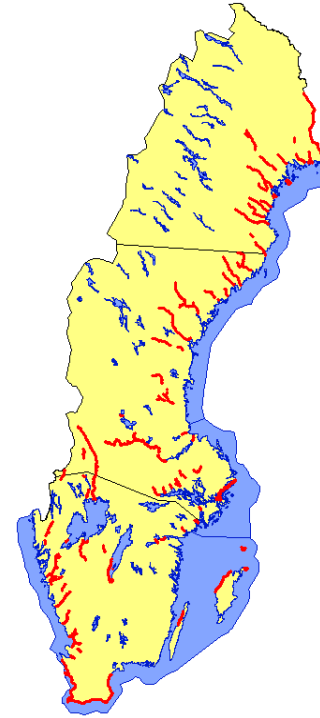
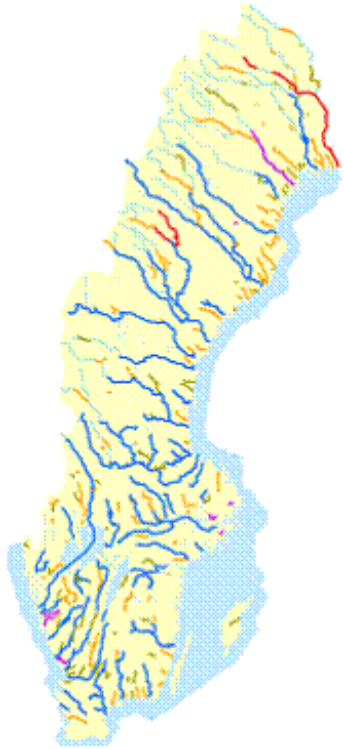
# APPLICATIONS USING OUR 3D DATA

For example:

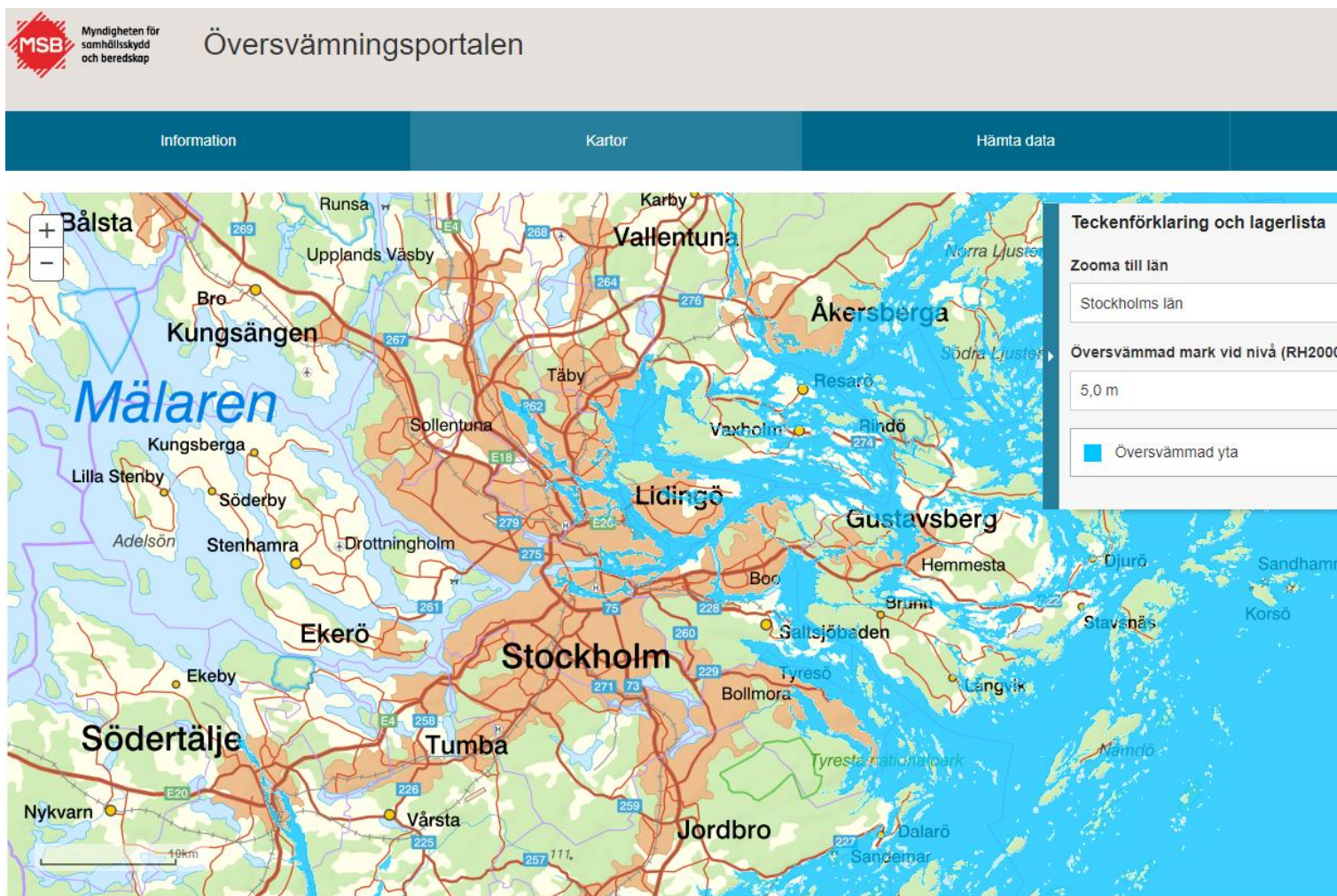
- Climate change adaption
- Forest basic data
- Planning of infrastructure



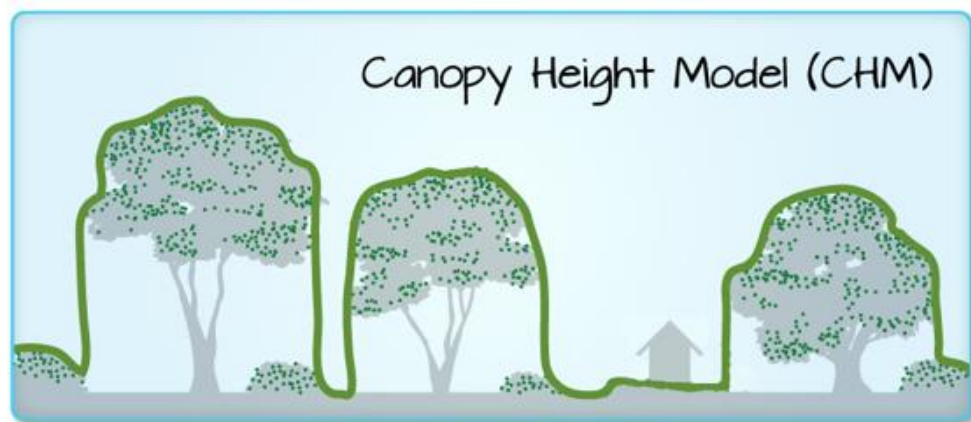
# CLIMATE CHANGE ADAPTION



# ANALYSIS IN 3D, PRESENTATION IN 2D



# FOREST BASIC DATA



**DSM** (Digital Surface Model)

**-DTM** (Digital Terrain Model)

**CHM** (Canopy Height Model)

neon

Figurkälla: earthdatascience.org och Andreas Berg (2023)



# INTEGRATE OTHER DATA INTO OUR 3D MODELS

- Today we integrate other data in 2D, but not yet in 3D.  
For example:
  - Buildings
  - Road and railroad network
  - Power lines
  - ...



# DIGITAL TWIN RELATED WORK

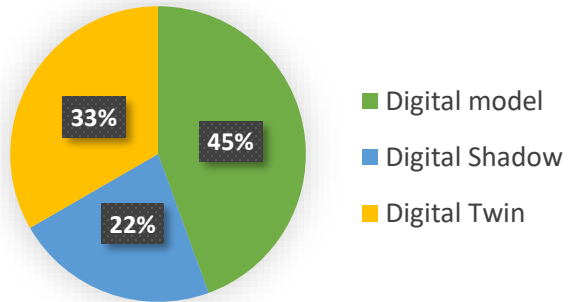
- Lantmäteriet has a cross-functional group for digital twins:
  - Builds knowledge about Digital Twins
  - Participates in some National Digital Twin activities
  - Participates in the Nordic Land Mapping Network ad-hoc group on digital twins
- Lantmäteriet will primarily coordinate the supply of basic public geodata for various usages, including digital twins
  - Lantmäteriet will not currently lead the development or be responsible for digital twins, but will closely monitor and participate in the development



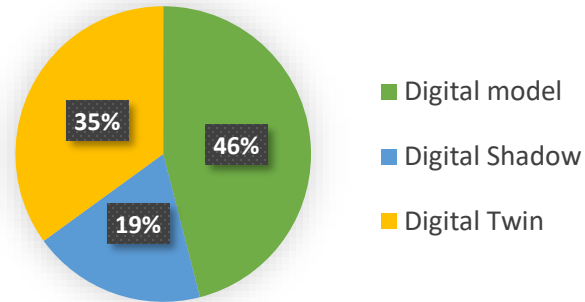
# RESULTS FROM A NORDIC DT QUESTIONNAIRE

What is the the technological level of your Digital Twin

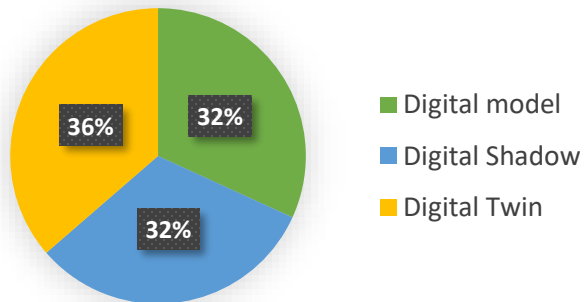
## Sweden



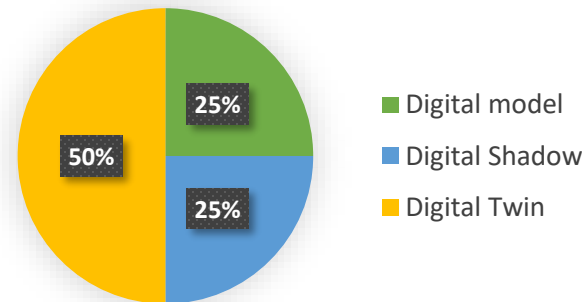
## Denmark



## Finland



## Iceland



	Data flow from physical object to digital object	Data flow from digital object to physical object
Digital Model	Manual	Manual
Digital Shadow	Automatic	Manual
Digital Twin	Automatic	Automatic

Source: *Digital Twin in Services and Industrial Product Service Systems: Review and Analysis*  
<https://www.sciencedirect.com/science/article/pii/S2212827119302525?via%3Dihub>

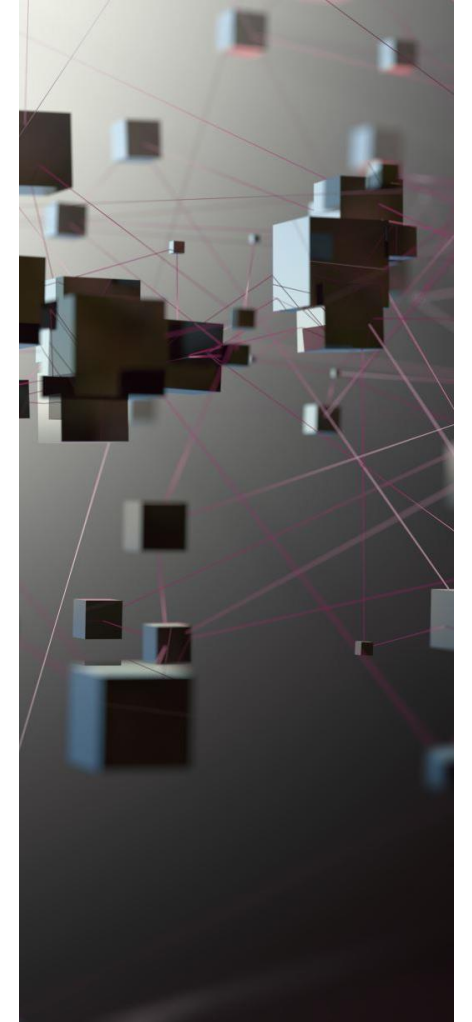
### Number of answers:

Sweden: 9  
 Finland: 21  
 Denmark: 56  
 Iceland: 5



# PAINS AND CHALLENGES PRODUCING & DELIVERING 3D DATA

- To solve the financing for 3D development
- To get access to more accurate data (Lidar + Footprints)
- The transition to 3D for data collection, storage and data provision
- The management of versions and history (both for 3D and future digital twins)
- The management of 3D-geometries in our cadaster



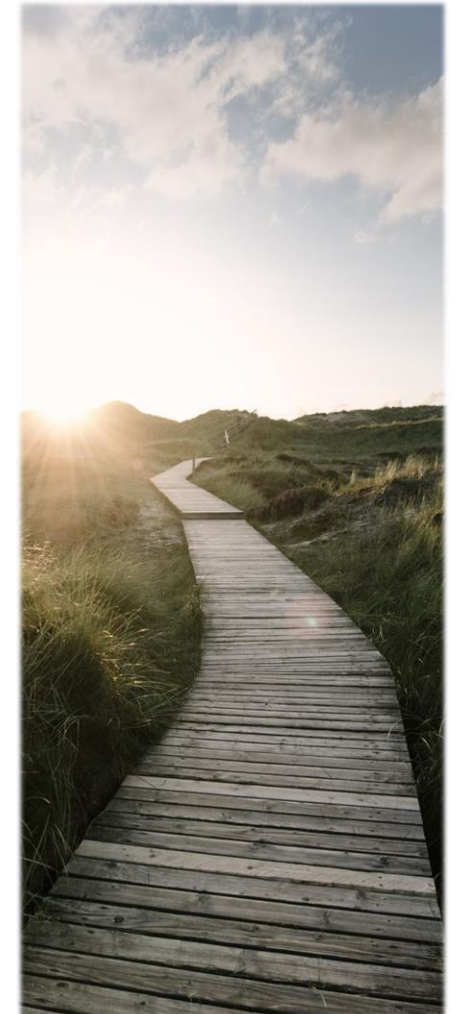
# FUTURE PLANS FOR LANTMÄTERIET

For 3D:

- We seek funding and collaboration to implement our test results in 3D on a larger scale for buildings, masts, bridges, vegetation, etc.

For digital twins:

- Follow the development and gradually adapt our data collection, storage and data provision to better fit the requirements from digital twins, AI, etc.



# PROPOSED RESEARCH QUESTION

How should NMCA data look like and how should the data be provided to best support Digital Twins, AI etc. in the future?





**THANK YOU FOR LISTENING!**