# Session IV
# Future visions in habitat monitoring

09:00 – Introduction (Håkan Olsson, SLU)

09:10 – Use of remote sensing in habitat monitoring
(Håkan Olsson, SLU)
09:20 – After-LIFE (Hans Gardfjell & Åsa Hagner, MOTH)

09:50 – COFFEE

10:20 – 10.40 Future visions from Swedish EPA
(Johan Abenius, Swedish EPA)

10:50 – Panel discussion

11:50 – 12:00 Closing

# A few words about
# Use of remote sensing in habitat monitoring

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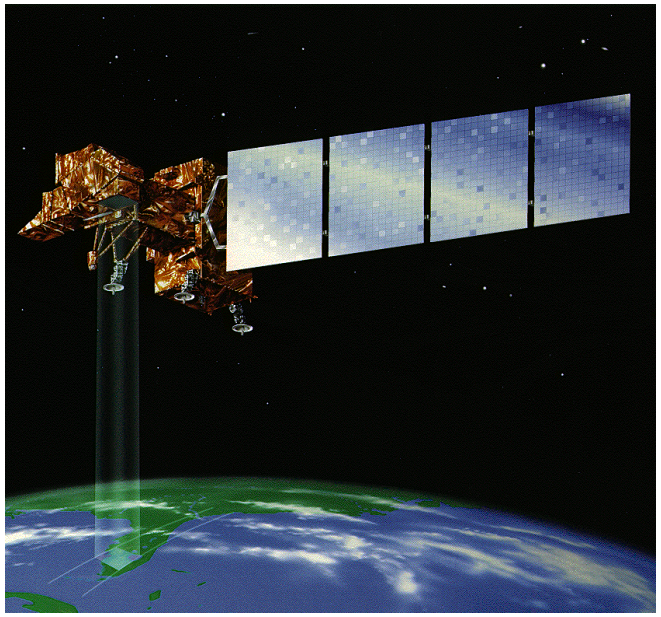
# Platforms and sensors

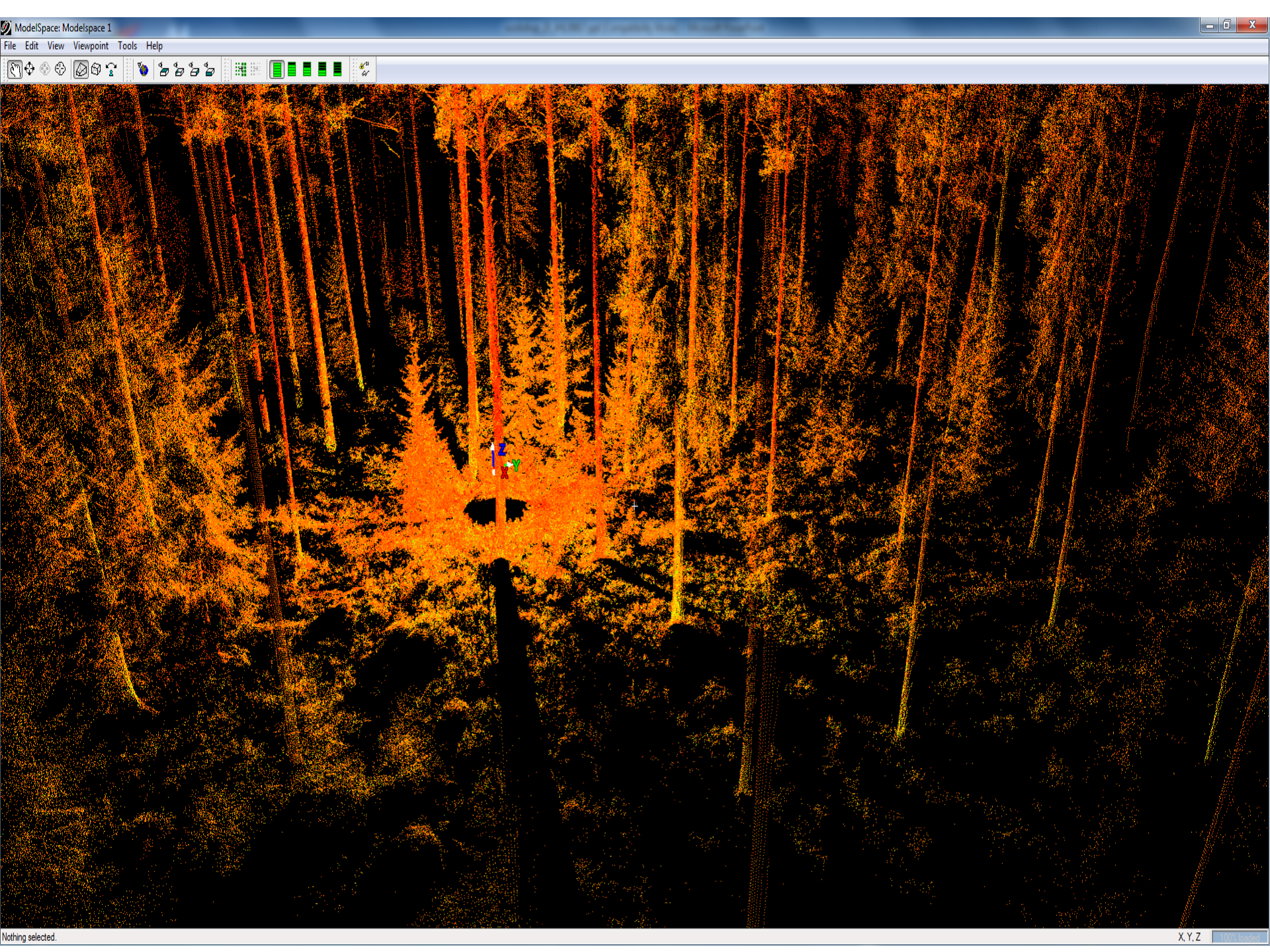


Satellite data
(**optical**, radar, future also lidar points)

Airborne sensors (digital **air photos**, **laser scanning**, hyperspectral scanners, radar)

UAV
(**cameras**,
Laser)

Terrester and
mobile sensors
**(laser scanners**,
cameras)


ModelSpace: Modelspace 1
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Z
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Nothing selected.
X, Y, Z

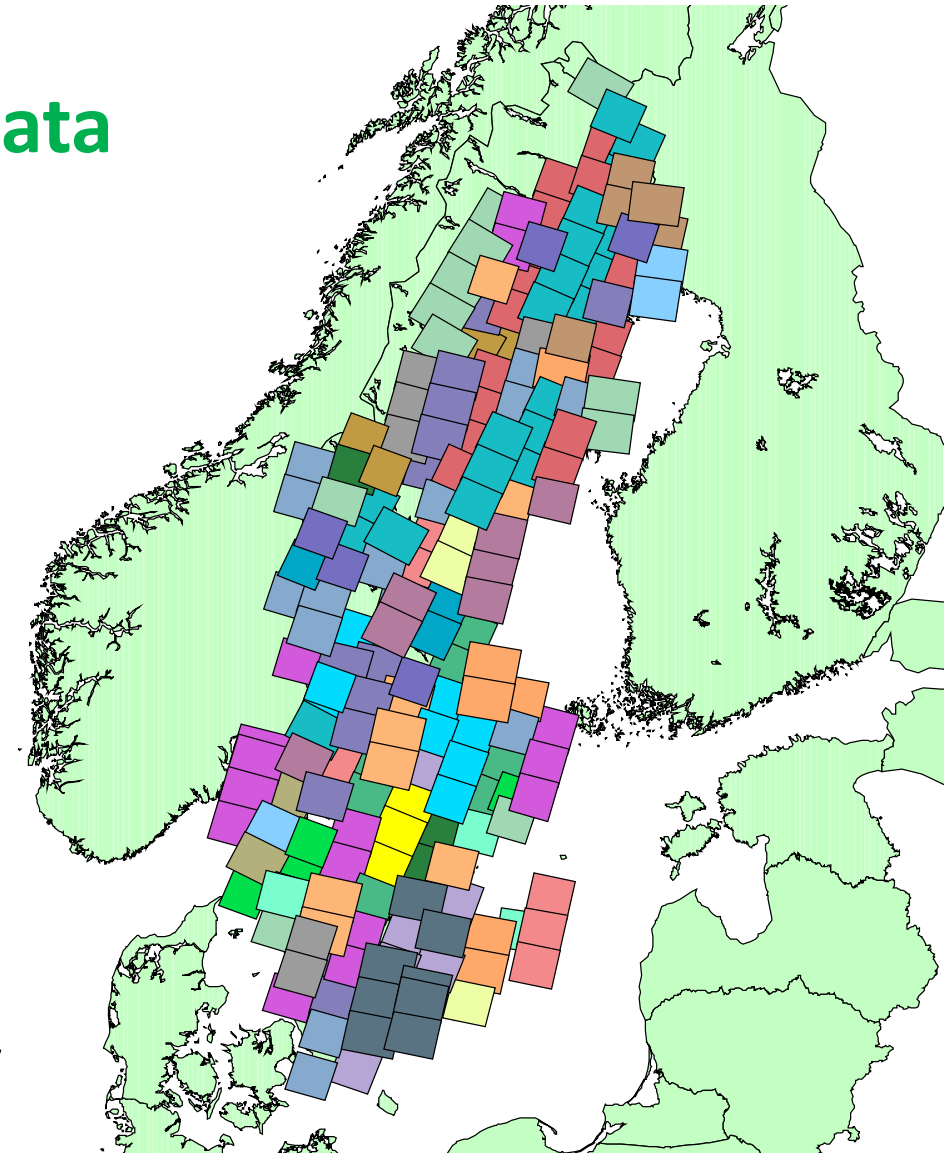
# Yearly coverage with optical satellite data

- Will improve further with Sentinel 2 next year

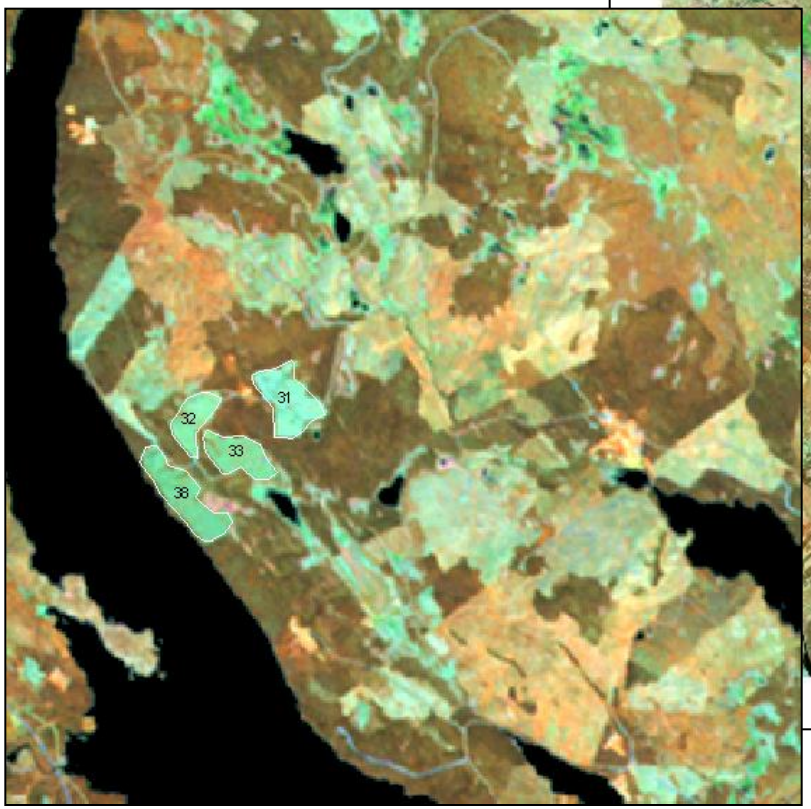
Good for broad species compositions

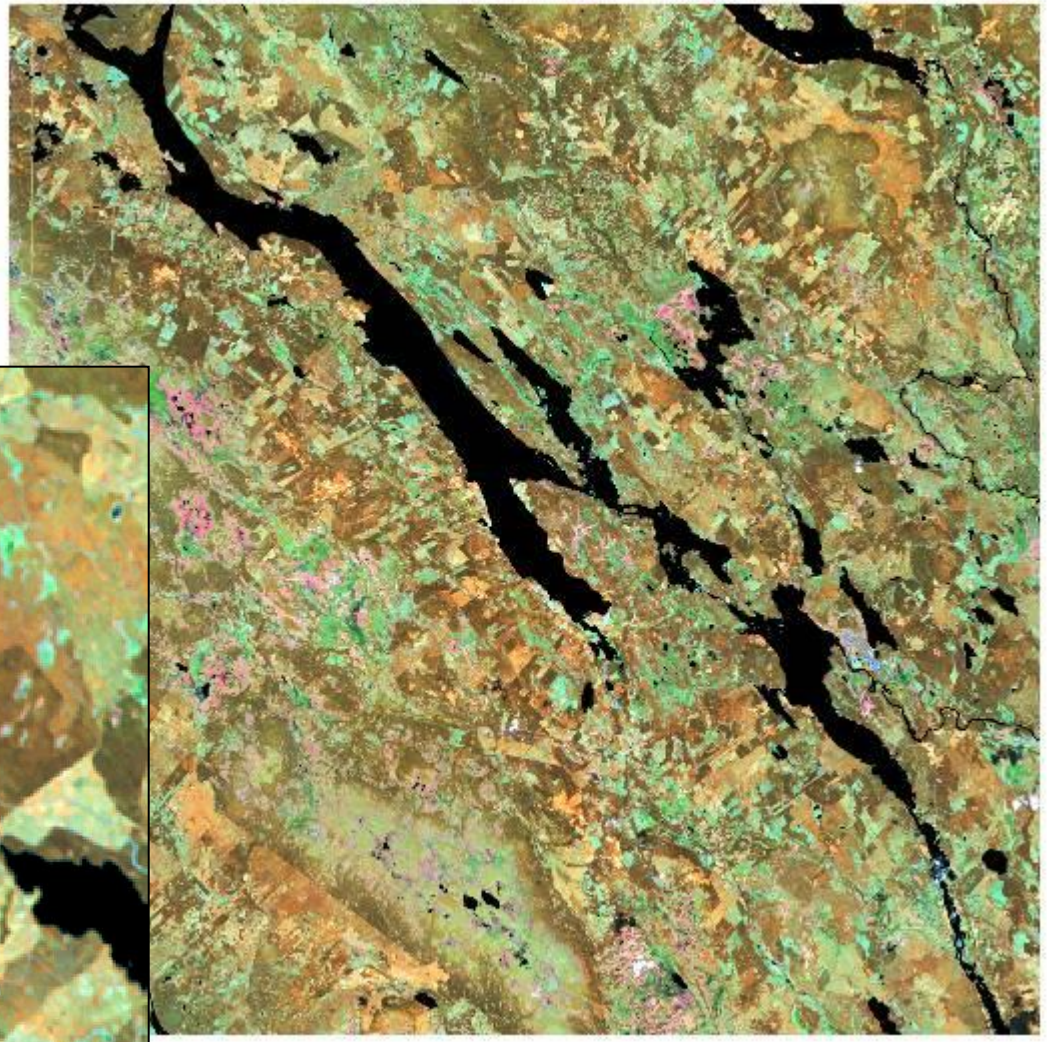
and for defining a change strata for identifying **habitat loss**

(Yearly land use change is only about 0.1 % of the land area)



Landsat-5 TM 1992-06-11
Vilhelmina



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Landsat-5 TM 2004-06-03
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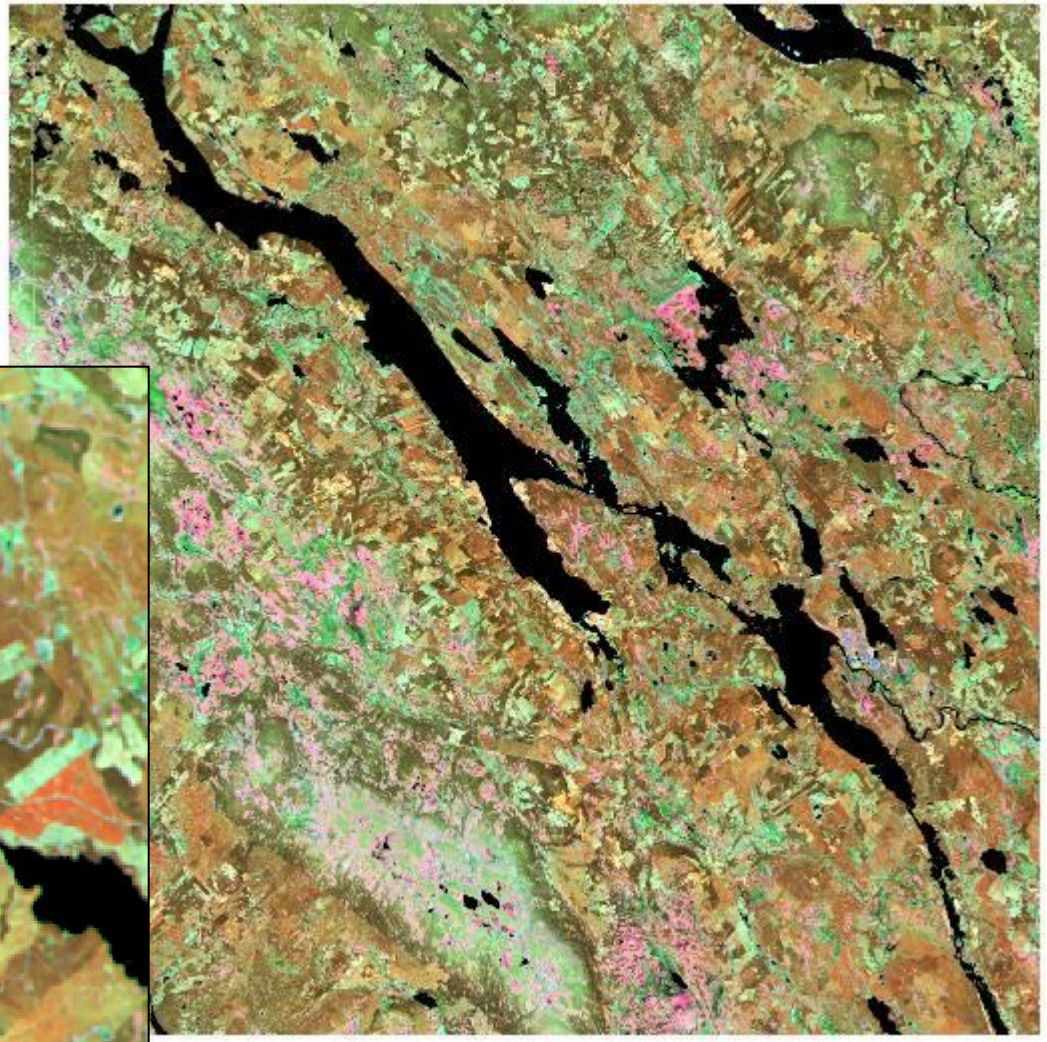

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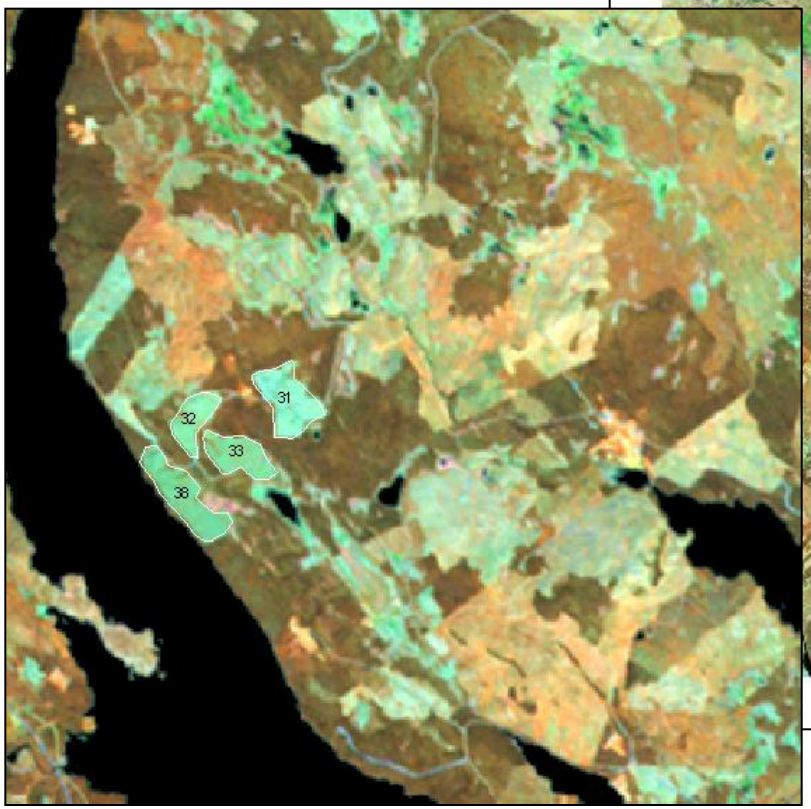


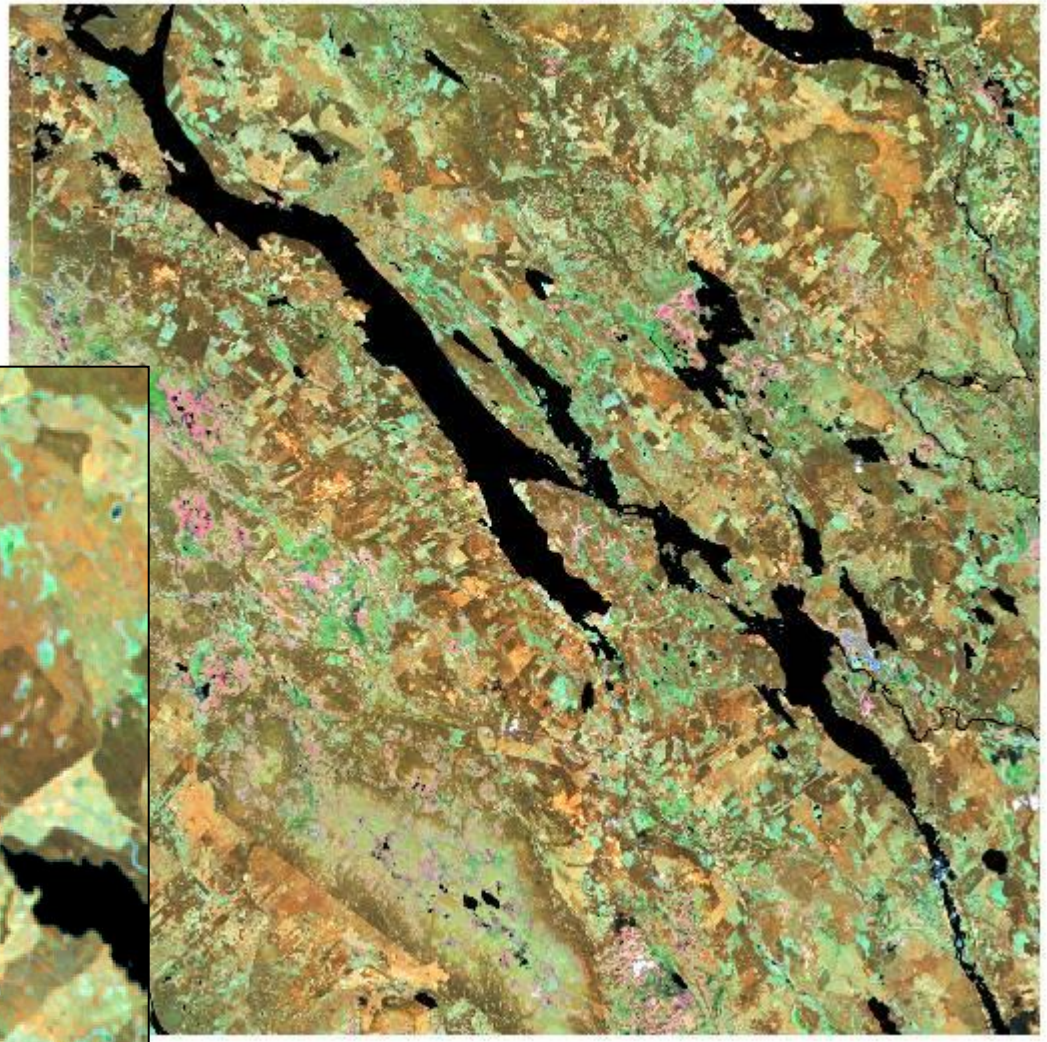

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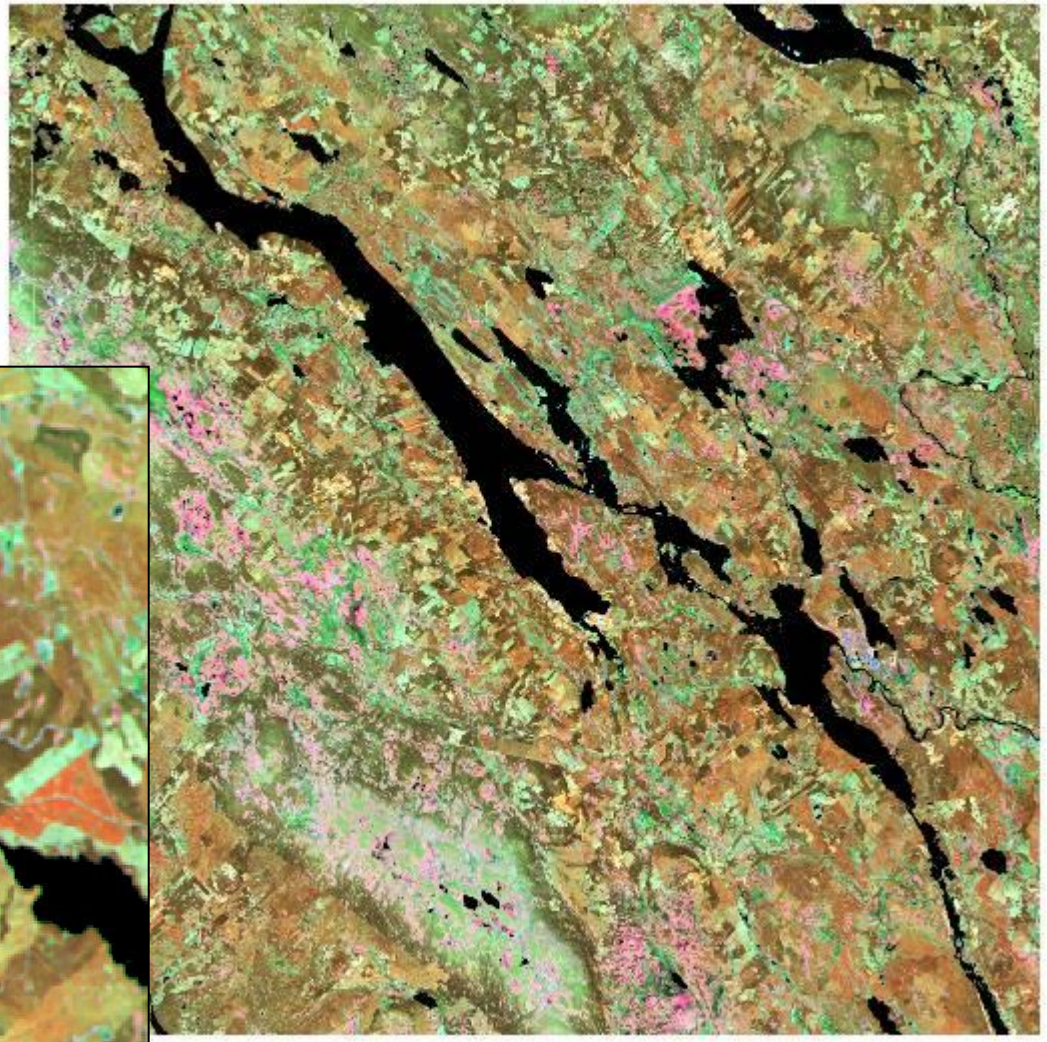

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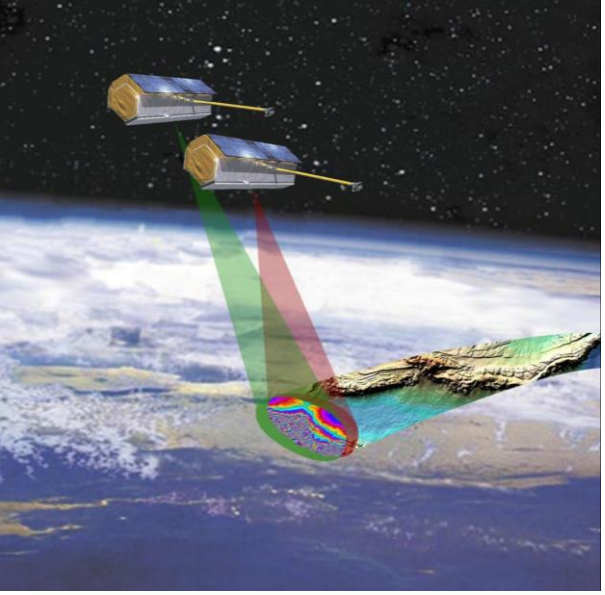
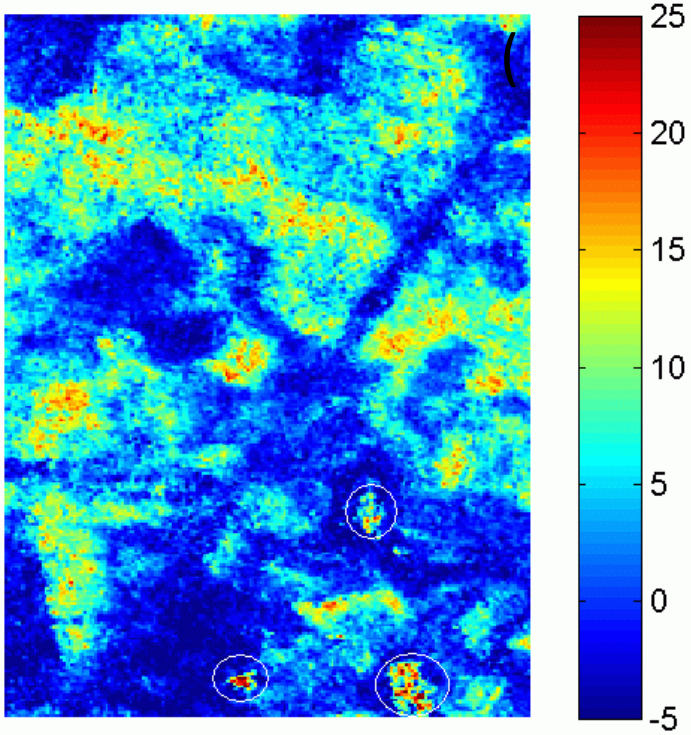


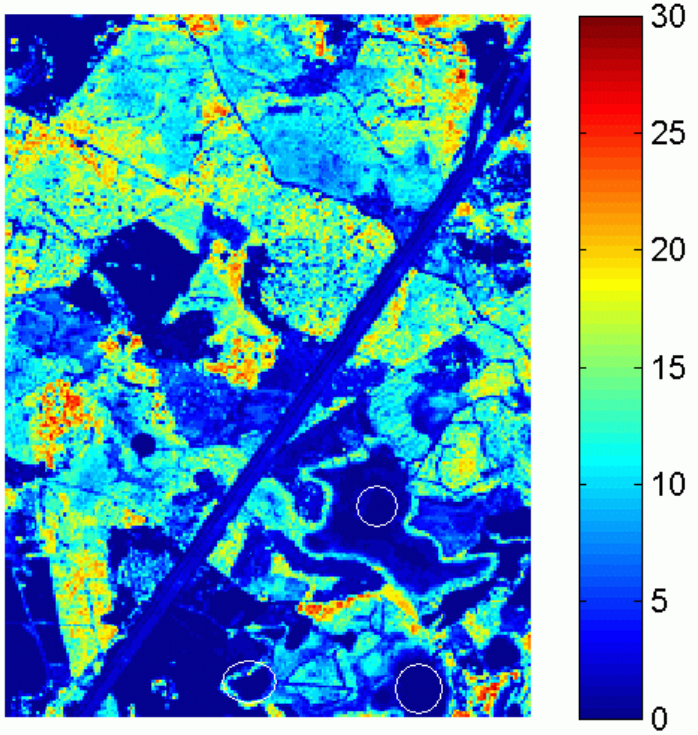
## Example of satellite technology: currently in the research phase

Interferrometric radar from TanDEM-X can measure canoy hight above DEM as accurate as airborne lidar data

FROM TANDEM-X (december acquisition, $H_{amb}$=189m)



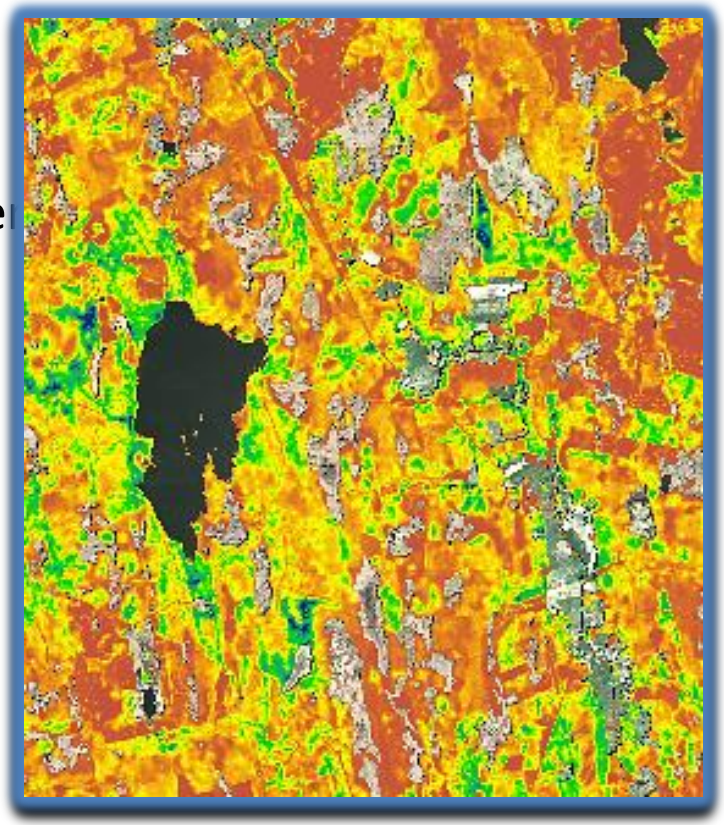

FROM LIDAR

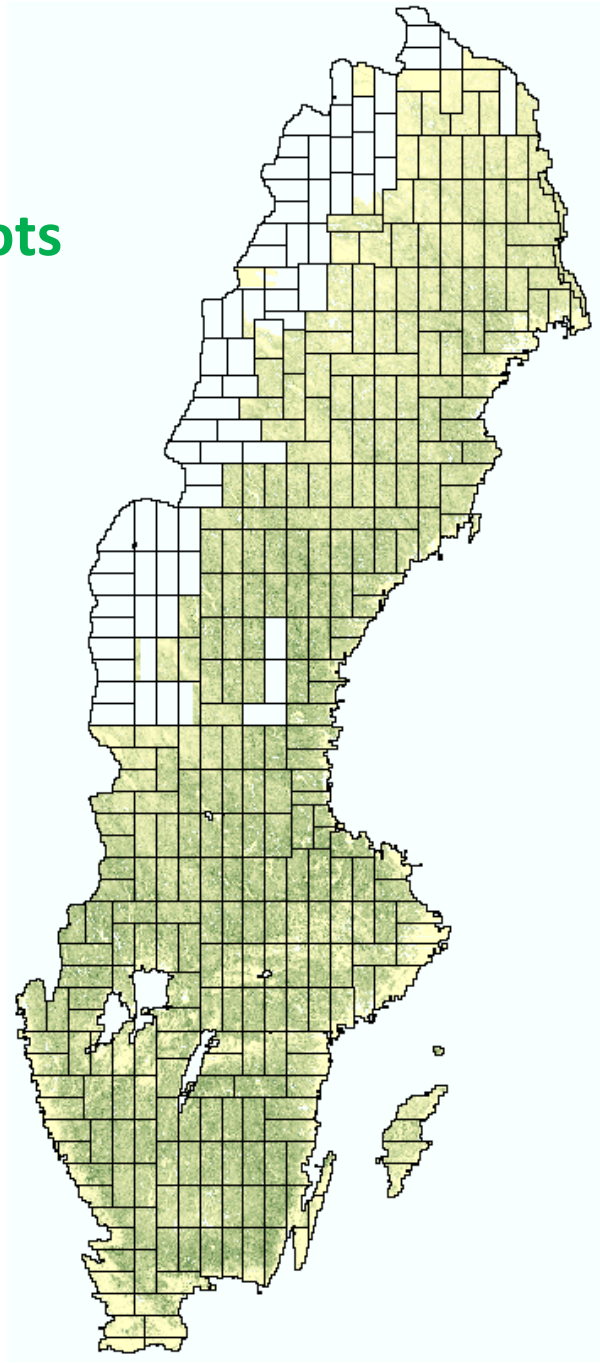


## Nationwide forest database 12,5 m grid size, made from airborne laser scanner data, trained with National Forest Inventory field plots

<u>Estimated variables</u>

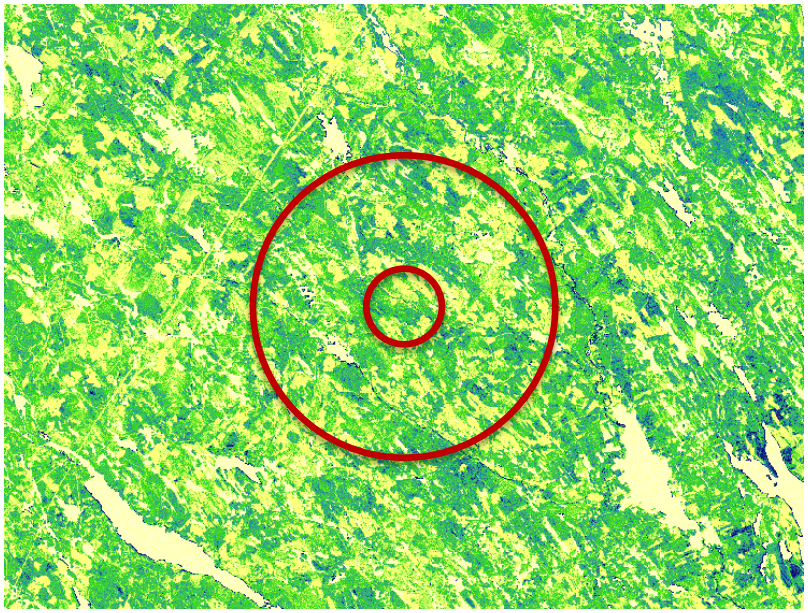
- Mean tree height
- Mean stem diameter
- Basal area
- Stem volume
- Biomass

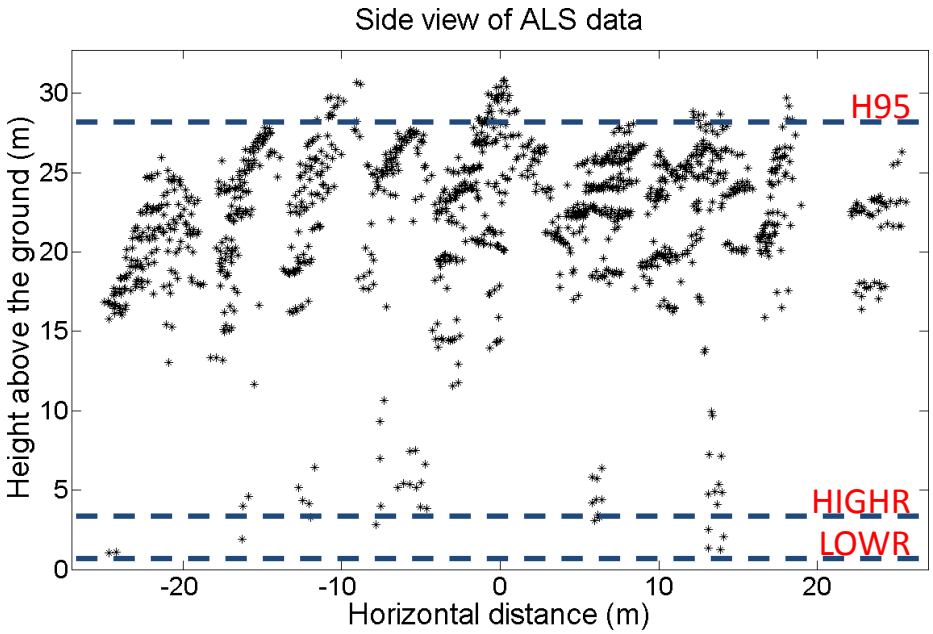




# Example of use of surrounding information in 50 m or 200 m radius obtained from remote sensing, used in bird habitat study

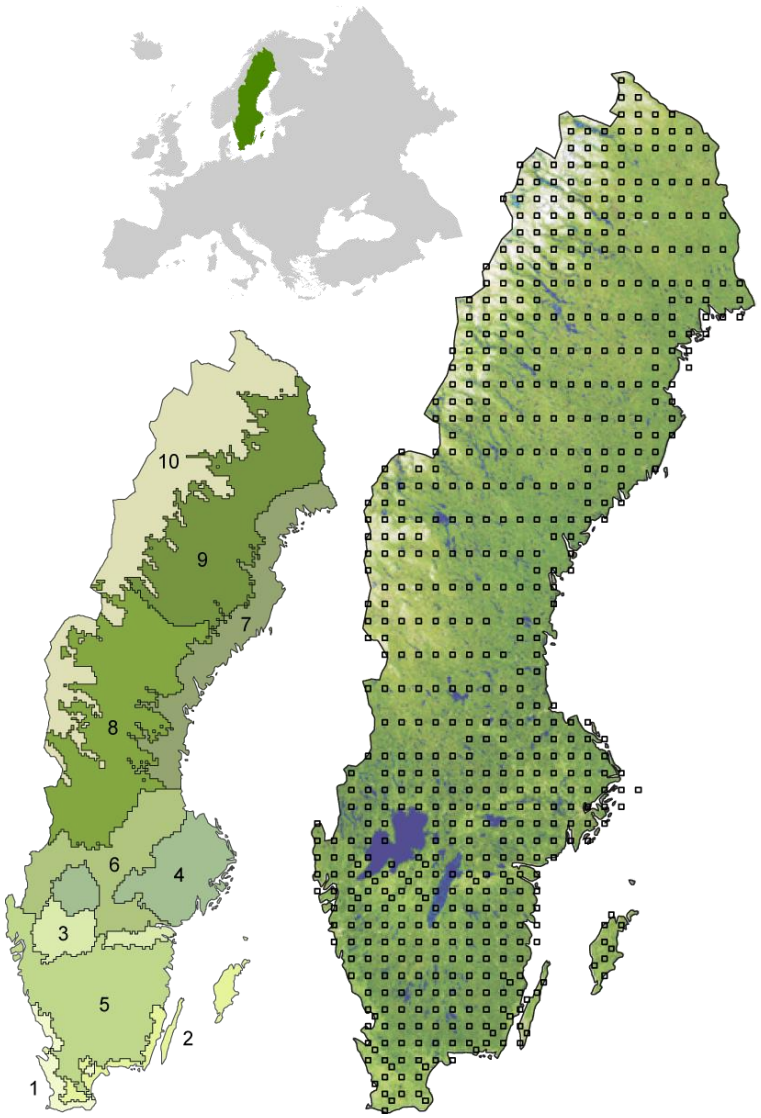
From satellite remote sensing data:
tree species, tree age etc, estimated from SPOT trained with NFI plots





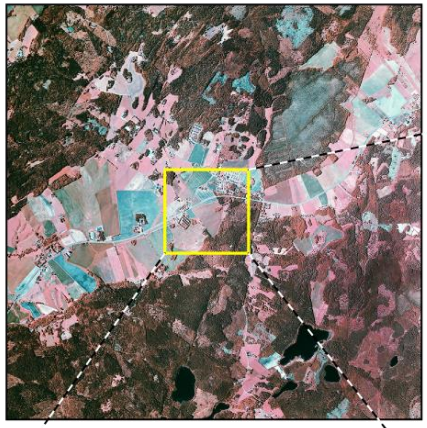

From laser scanner data:
metrics describing the height and density of the vegetation in 10×10 m raster cells

# NILS squares could be a resource for measuring landscape composition over time with different spatial criteria's

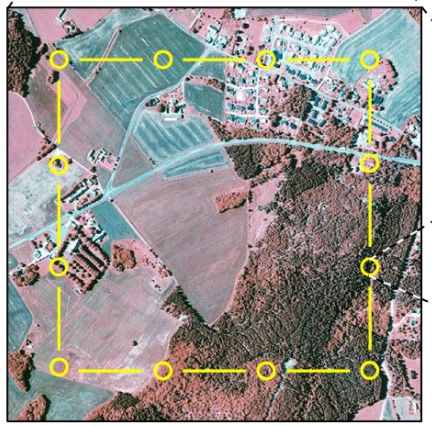



**10 geographical strata** **631 sample units**

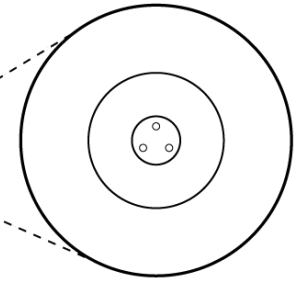
**Sample unit**
25 km² square



**Aerial photo interpretation**
1 km² square
- Polygons
- Lines
- Points



**Field inventory**
1 km² square
- Circular sample plots
- Sample lines



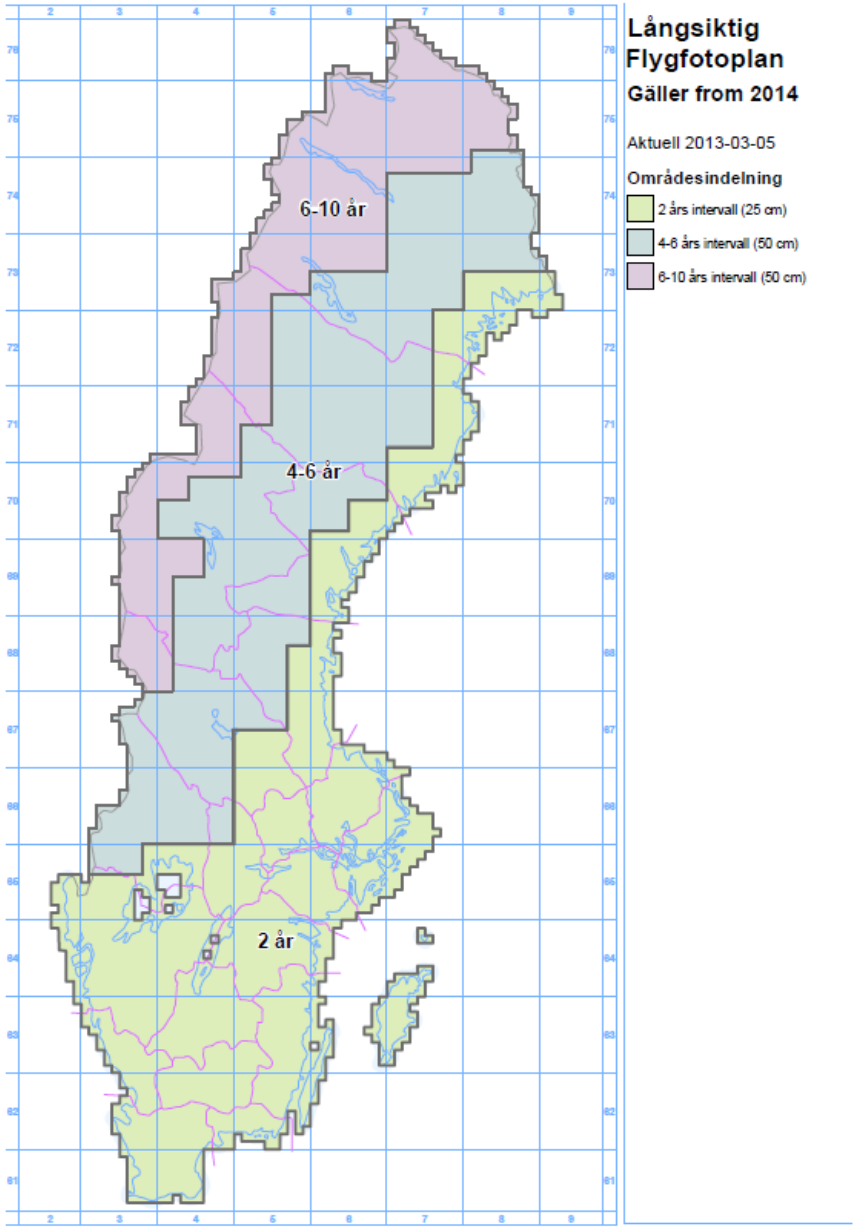
**Circular sample plots**
- 20 m radius
- 10 m radius
- 3,5 m radius
- 0,28 m radius

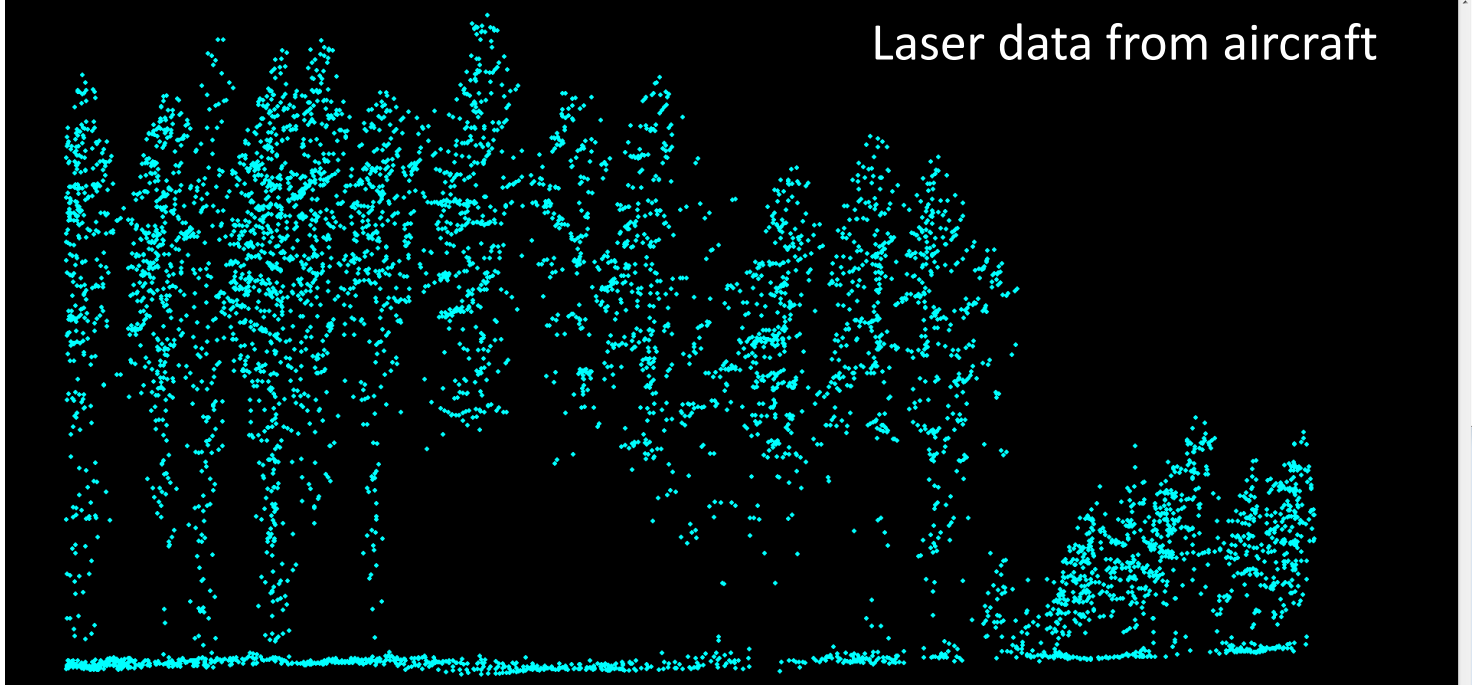
# Digital aerial photographs are acquired for 1/3 of Sweden yearly

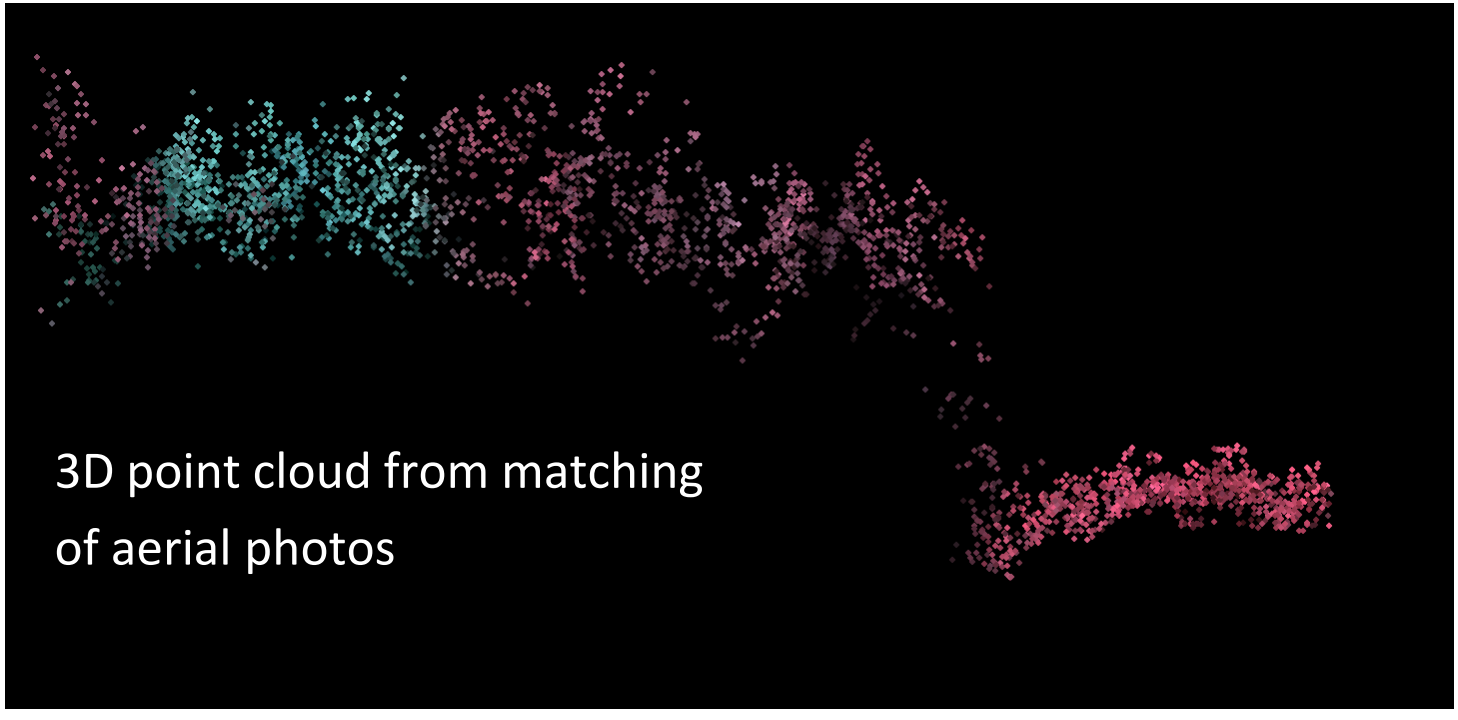
Aerial photos are good for:

- Visual interpretation, e.g. land use rather than land cover

- Automated measurements of vegetation heights over DEM (check correlations between height and variables of interest to monitor)




Laser data from aircraft


3D point cloud from matching
of aerial photos

## Examples of sampling schemes for utilising the correlation between remote sensing data and field data for improved estimates

Multi phase sampling

Multi stage sampling

Pre-stratification

Model based estimates

Model assisted estimates

Post-stratification

# Example, double sampling for regression

$$\bar{y}_{lr} = \bar{y} + b\,(\bar{x}' - \bar{x})$$

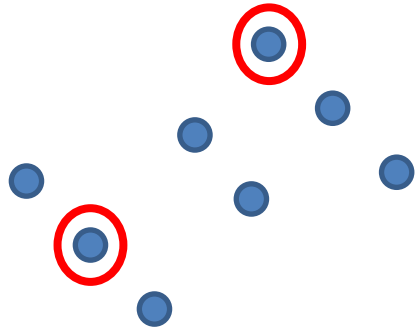
Estimate from field data, calibrated →

Values measured in field = "second phase" →

Regression coeffecient for second phase X, Y →

Mean of large remote sensing sample →

Remote sensing sample for second phase →



Example:
If the correlation between Remote sensing based samples ($x_i$ ) and the field samples ($y_i$ ) is 0.7, must a field sample be more than 6 times more expensive than a remote sensing based sample in order to motivate the double sampling

# Some conclusions

- Habitats are generally species specific,
  - But land cover and other information could be used for modelling habitats for species or groups of species

- Habitats should generally be assessed by field visits, but remote sensing data could in combination with field data provide:
  - Data about habitat loss
  - Wall-to wall data and the spatial context to sample points
  - Increased accuracy of statistical estimates and/or reduced number of needed field samples in case there is a correlation

- Correlations with tree height should be evaluated

- Examples of sufficiently mature remote sensing techniques are optical satellite data, digital air photos, laserscanning from aircraft or ground.


Thank you!
Questions?