



SCIENCE AND  
EDUCATION **FOR**  
**SUSTAINABLE**  
**LIFE**



SWEDISH NATIONAL  
FOREST INVENTORY

100

SLU SWEDISH NATIONAL  
FOREST INVENTORY  
1923-2023

# Digitalisation of the Swedish National Forest Inventory — Accessibility and Applications

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SCALE-UP Training session on digitalisation Session 2. 2024-02-06

- Short background of the Swedish NFI
- Technical development
- Accessibility
- Applications combining remote-sensing and NFI-data

# Humans have been influencing the Swedish forest for a long time

## Food, heating and shelter

- Slash and burn agriculture
- Forest grazing
- Fuelwood
- Houses



## Manufacturing industry

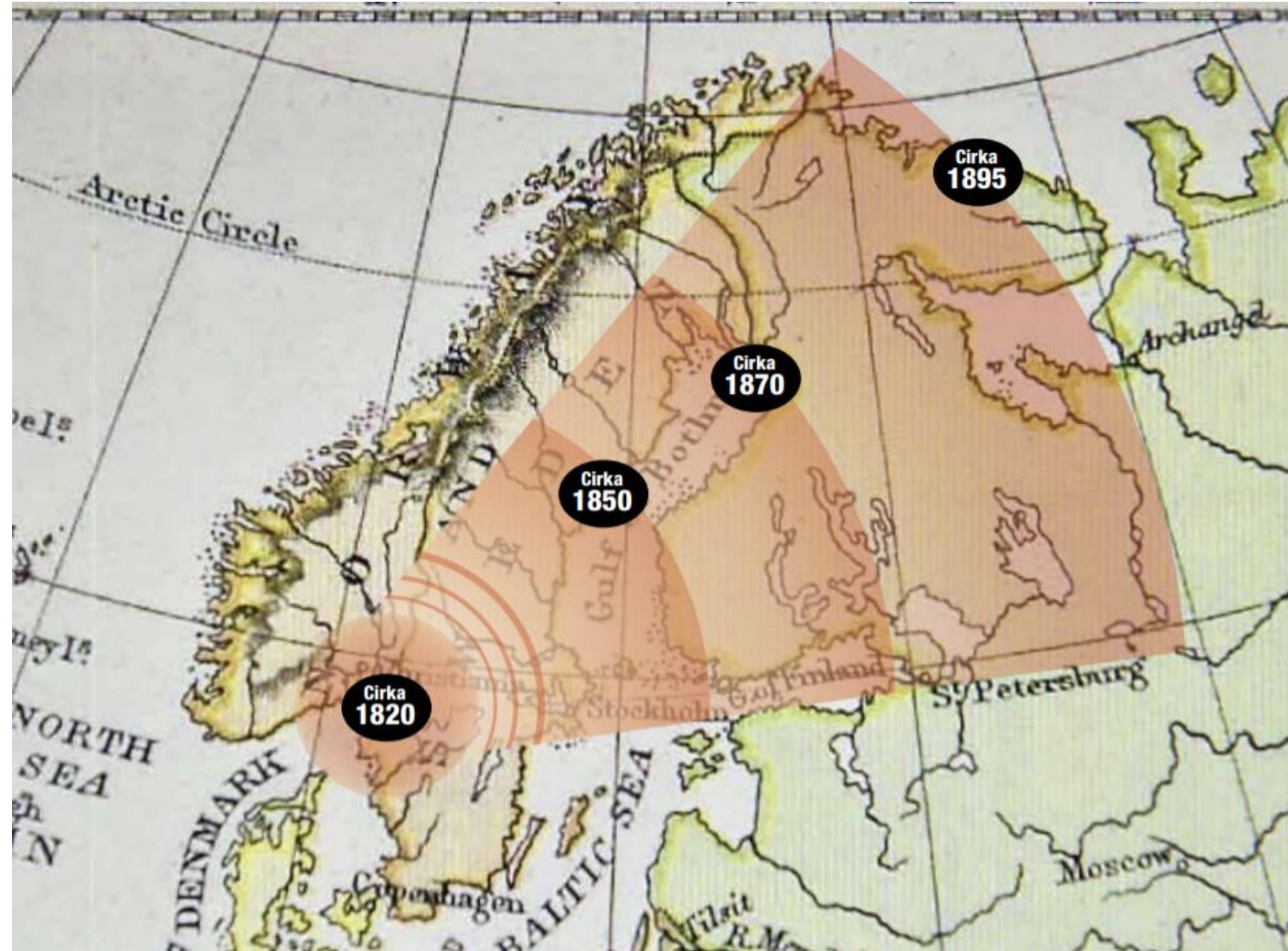
- Mining & Metals
- Glassworks
- Potash, charcoal, pitch and tar
- Forest Industry



## Forest industry

Around 1870, Sweden was the world's leading exporter of sawn timber.

## The "Timber frontier"



## Concerns about the state of the forest in the late 1800's:

*Is there enough timber for the growing forest industry?*

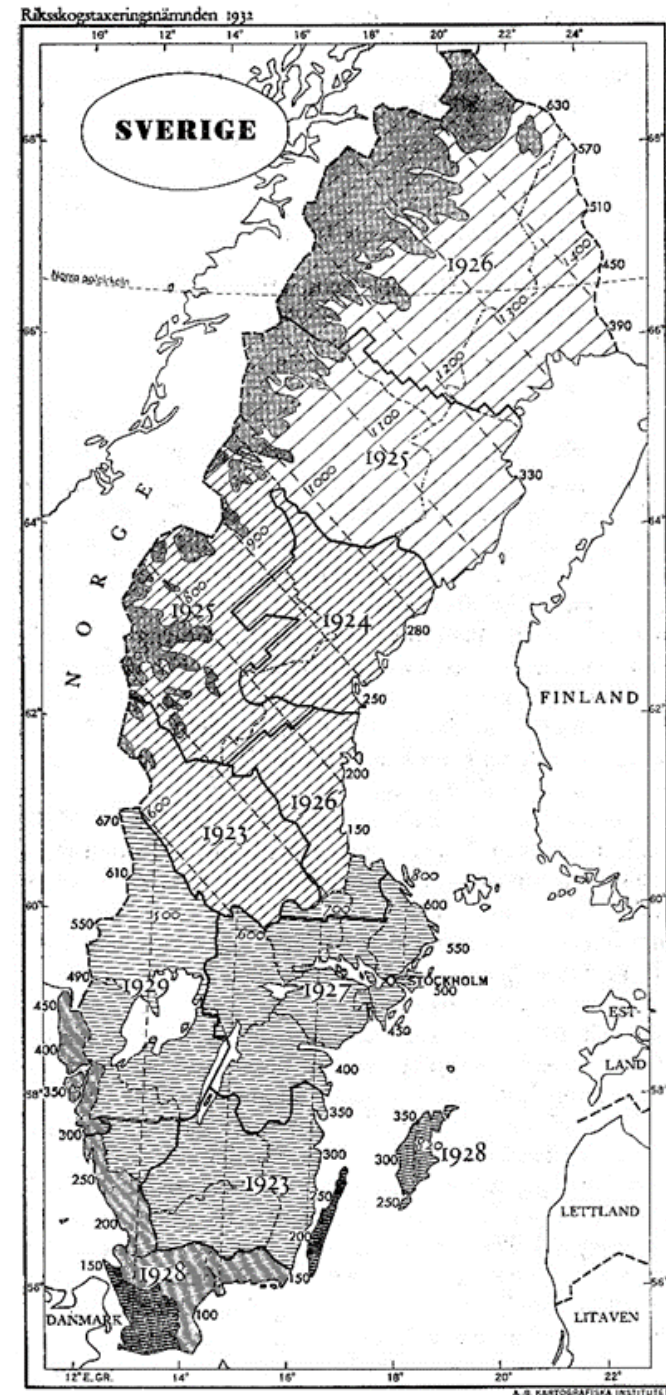


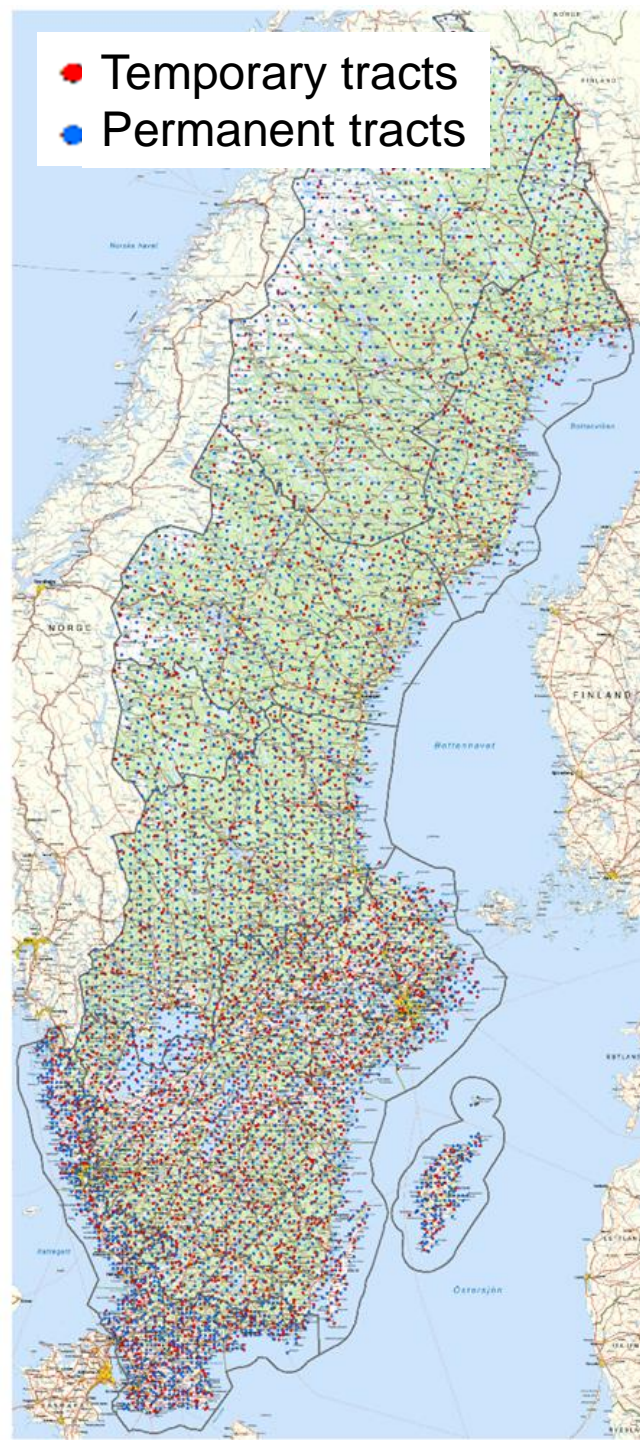
# Something had to be done

- Forest Law on reforestation in 1903
- The Swedish NFI starts in 1923



Fotograf: Okänd. Bild från Malin Bergmans fotoalbum, dotter till jagledaren Erik Thorell.



- 
- Temporary tracts
  - Permanent tracts

# The Swedish NFI-sample (2018-2022)

## Covering

- All Sweden
- All landuse-classes
- All owner and management categories

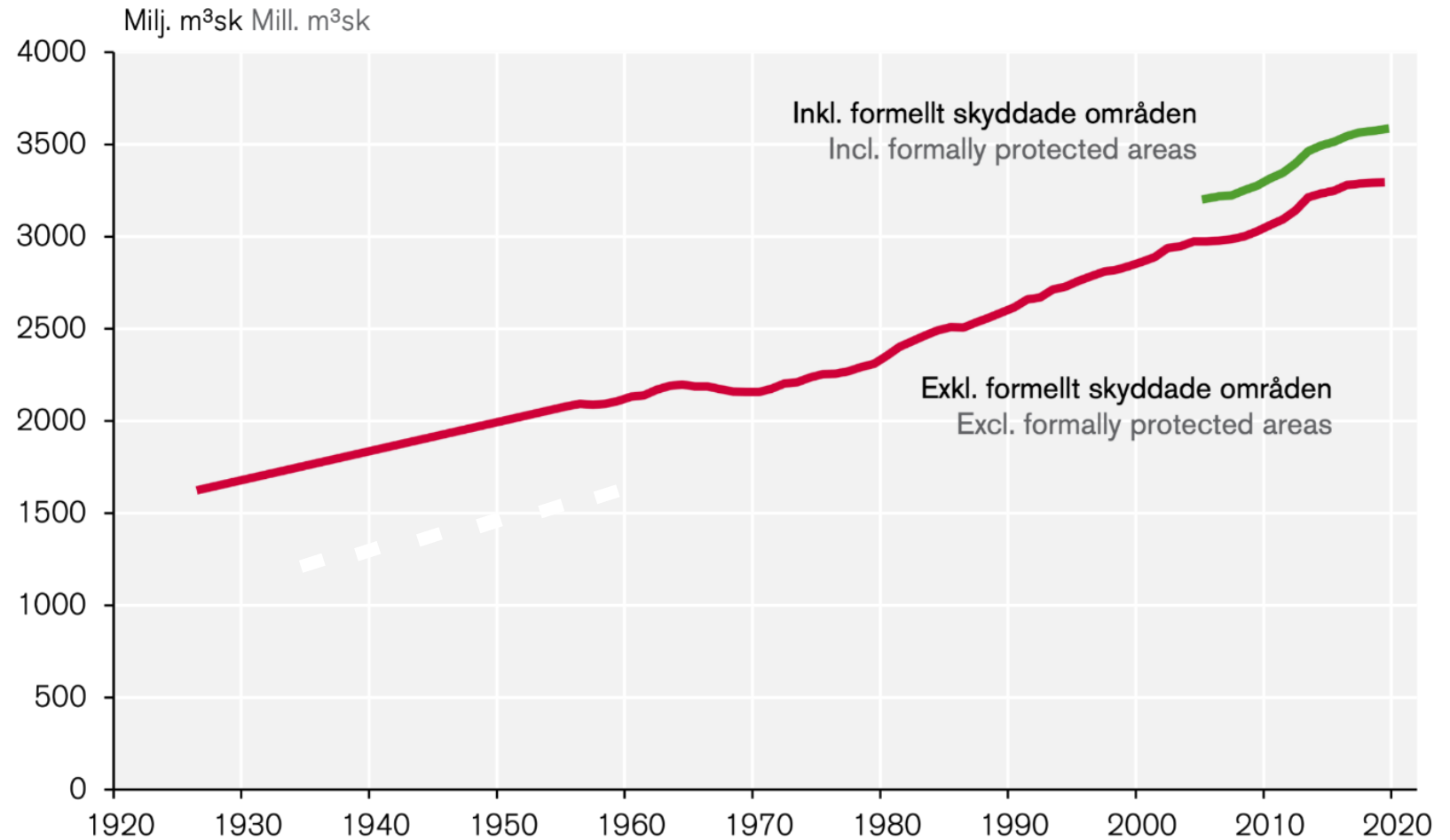
## Annual field measurements

- 16 field teams, 3 persons per team
- 20 000 sample plots
- 120 000 measured trees (living, dead, stumps)
- 6 000 bore-cores measured in microscope

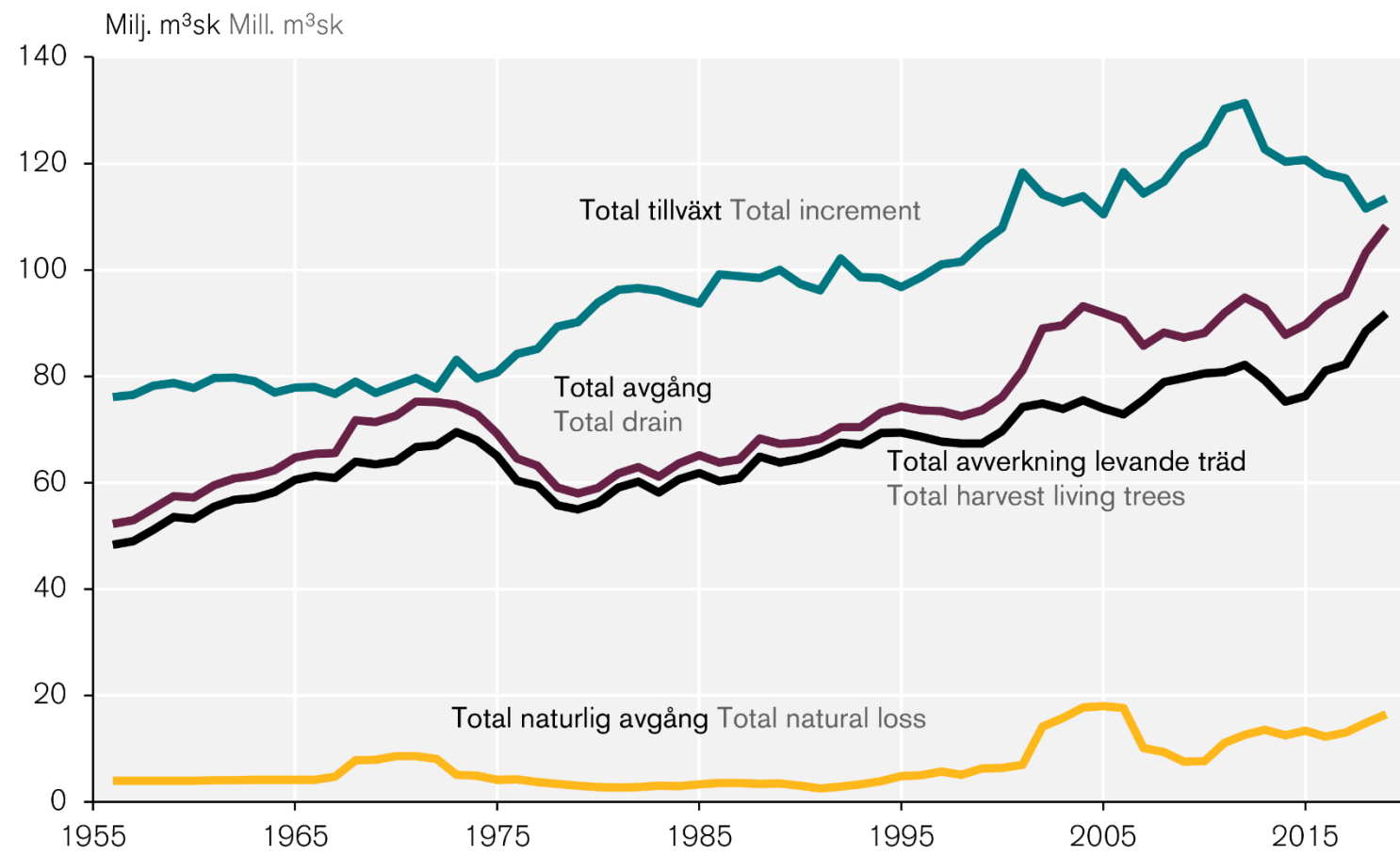


# A continuously increasing tree-volume in Swedish forests

Standing volume more than doubled since 1923 as an effect of high forest production ambitions in line with forest policy



# Increment, logging and natural mortality



Total annual increment (including increment of felled trees), total annual loss, total annual felling of living trees and total annual natural loss. Swedish NF1 1953–2022.



# Digitalisation in the Swedish NFI

## Data collection

PROVYTIPROTOKOLL

Yrkes beaktning: Detta protokoll används för att registrera skogsdata från provytan. Det är viktigt att fylla i alla fält och göra tydliga anteckningar.

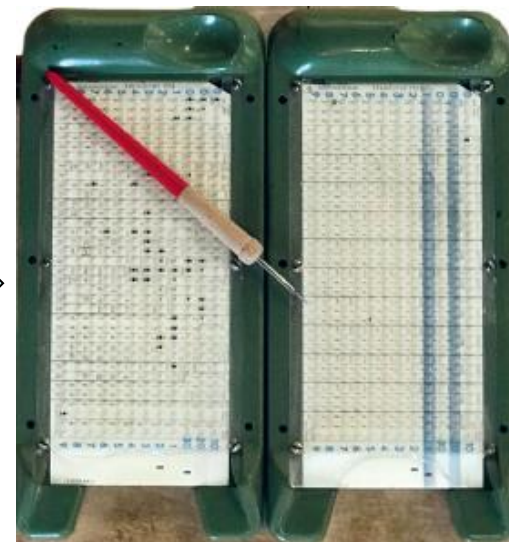
Skogsgrupp:  1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35  36  37  38  39  40  41  42  43  44  45  46  47  48  49  50  51  52  53  54  55  56  57  58  59  60  61  62  63  64  65  66  67  68  69  70  71  72  73  74  75  76  77  78  79  80  81  82  83  84  85  86  87  88  89  90  91  92  93  94  95  96  97  98  99  100

Årsklass:  1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35  36  37  38  39  40  41  42  43  44  45  46  47  48  49  50  51  52  53  54  55  56  57  58  59  60  61  62  63  64  65  66  67  68  69  70  71  72  73  74  75  76  77  78  79  80  81  82  83  84  85  86  87  88  89  90  91  92  93  94  95  96  97  98  99  100

Växtslag:  1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35  36  37  38  39  40  41  42  43  44  45  46  47  48  49  50  51  52  53  54  55  56  57  58  59  60  61  62  63  64  65  66  67  68  69  70  71  72  73  74  75  76  77  78  79  80  81  82  83  84  85  86  87  88  89  90  91  92  93  94  95  96  97  98  99  100

Stamlista

Träd	Art	Storlek	Ålder	Överlevnad	Övrigt
1	B	10	10	1	
2	B	10	10	1	
3	B	10	10	1	
4	B	10	10	1	
5	B	10	10	1	
6	B	10	10	1	
7	B	10	10	1	
8	B	10	10	1	
9	B	10	10	1	
10	B	10	10	1	



Field forms 1923-

Punch-cards 1966-

Field computers 1983-

# Digitalisation in the Swedish NFI

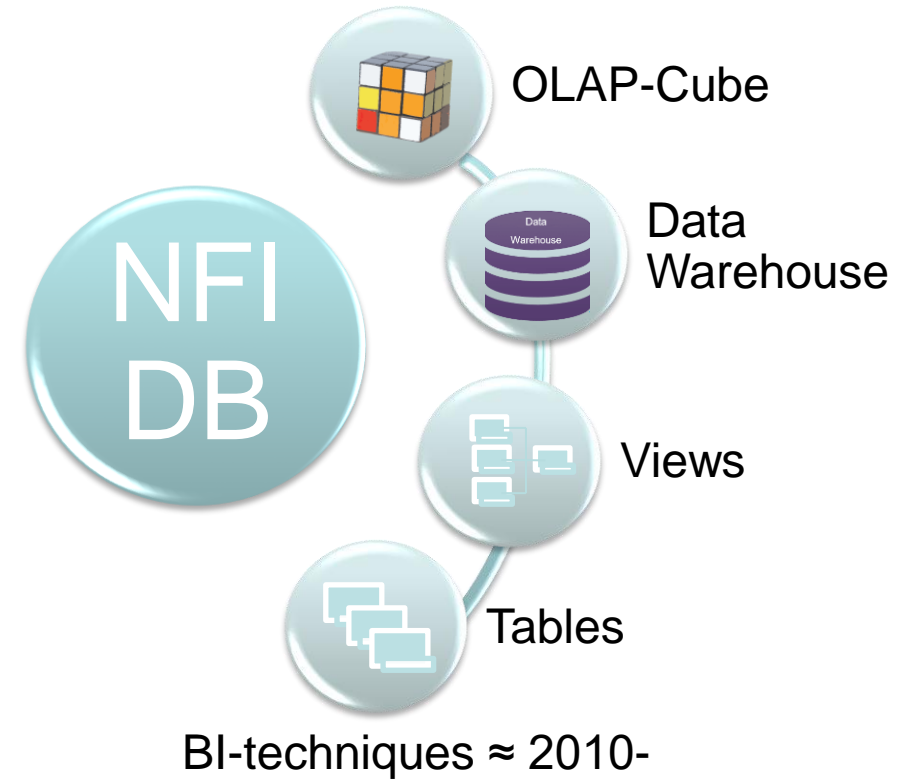
## Production of statistics



Manual calculators 1923-



IBM 1401 ≈ 1960-



# Accessibility of NFI-data and statistics

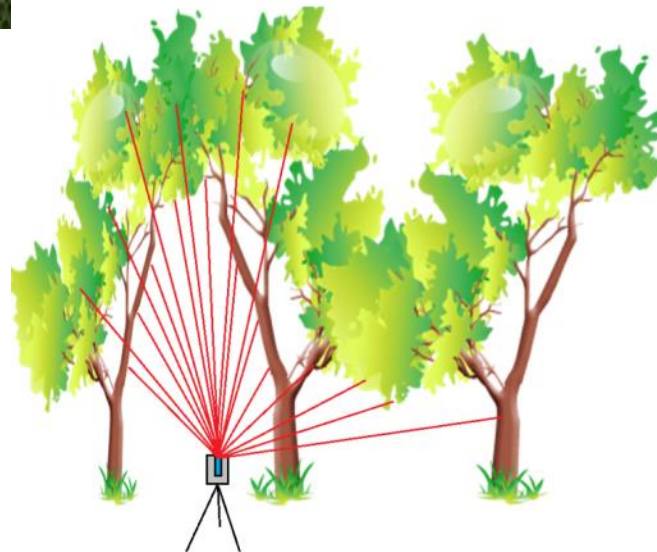
Free download from the NFI website

- [Statistics archive from 1923](#) (Digitalisation of old field-forms)
- [Web-based interactive estimation tool](#) (data from 1983)
- [Free download of plotdata](#) (selection)
- [Free download of tree-data](#) (selection)

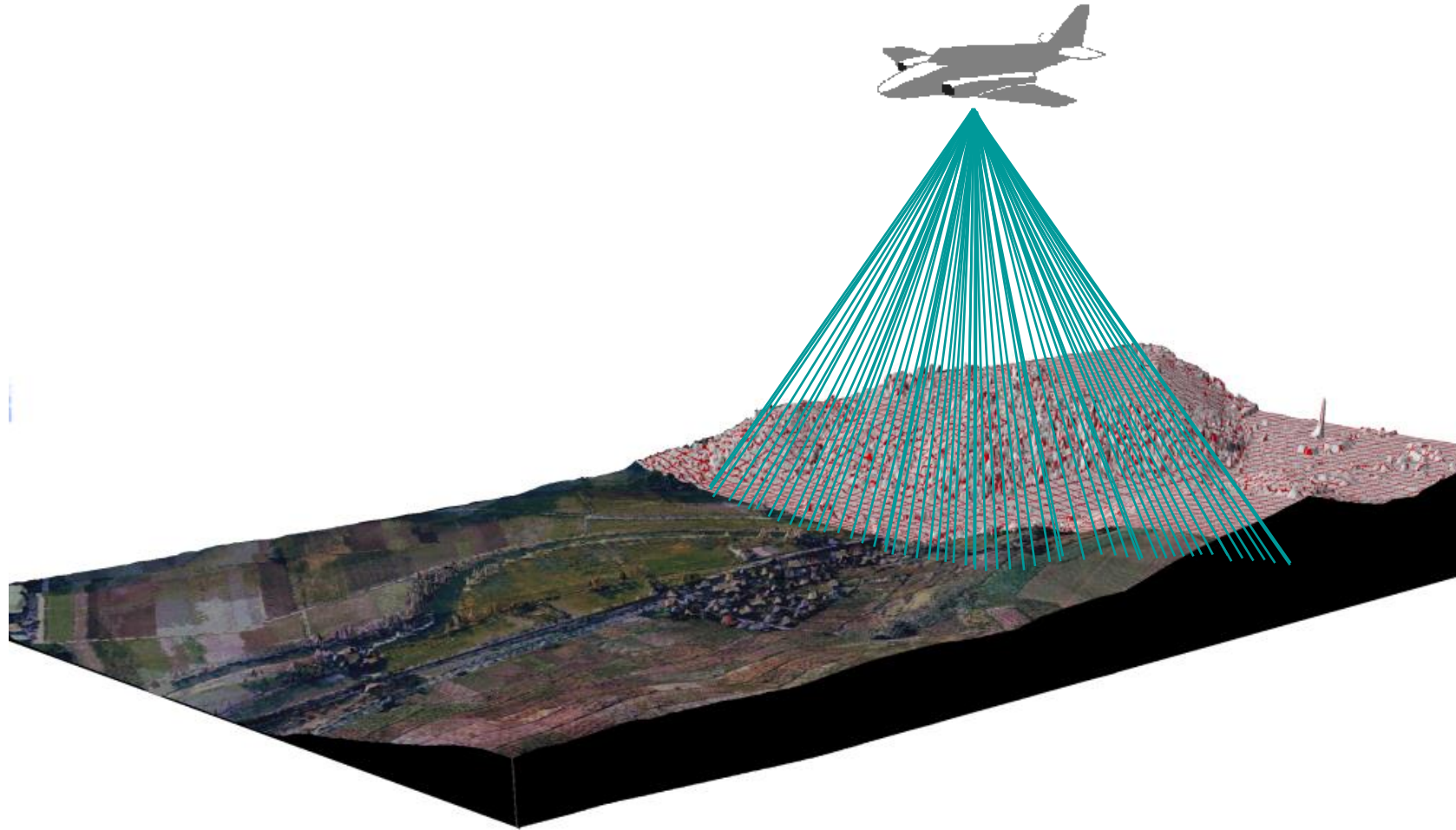
# Remote Sensing Platforms



Terrestrial laser scanning

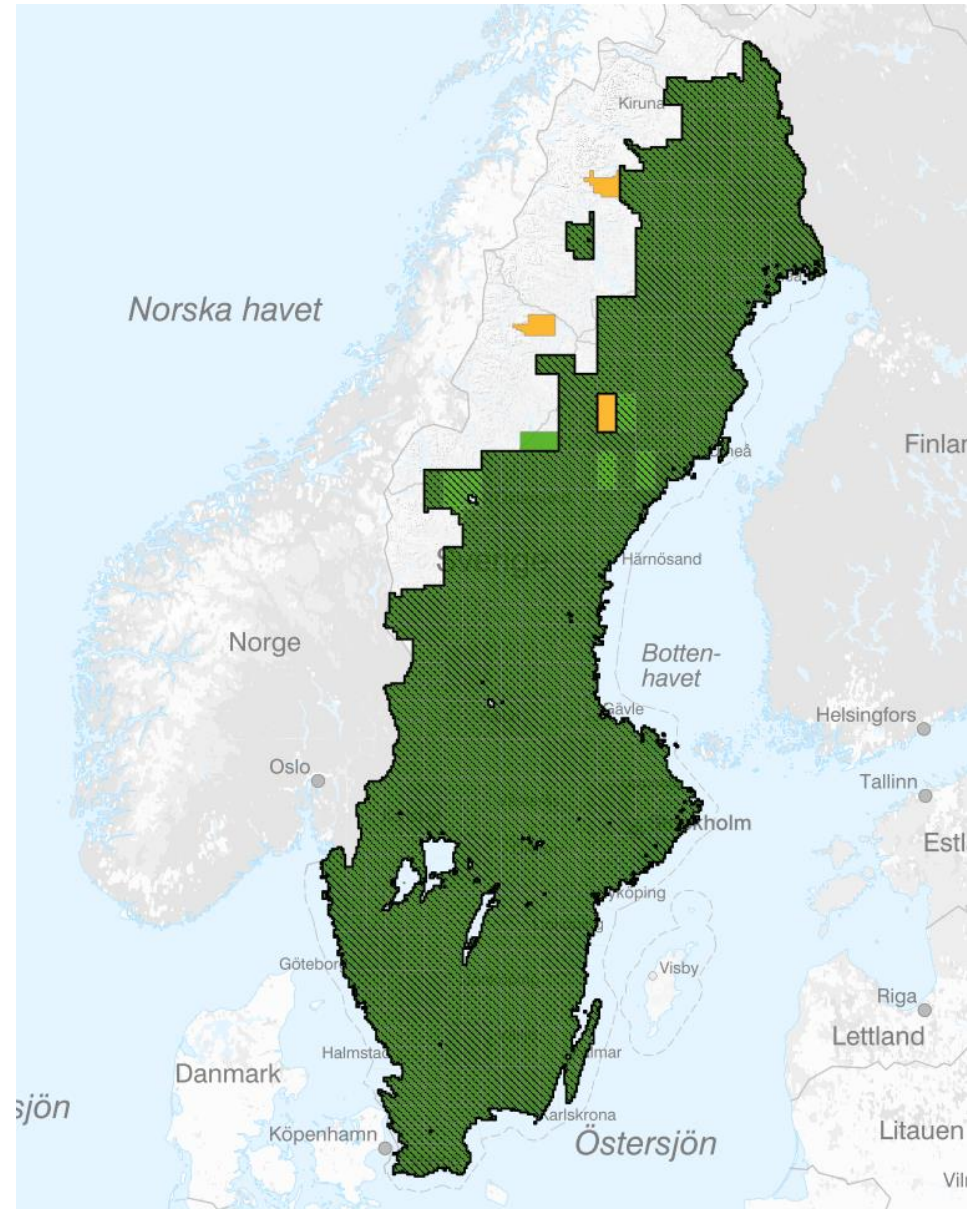


# The example of Airborne Laser Scanning (ALS)



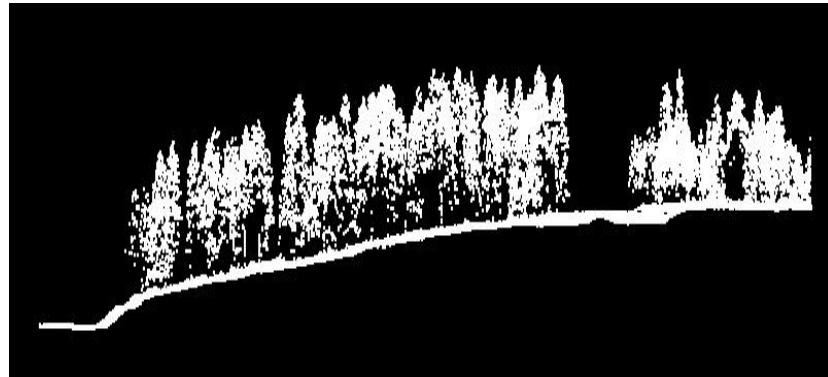
# Swedish National Laser Scanning campaign #2

- 1:st Campaign 2009-2016
- 2:nd campaign 2018-
  - Financed by Government and Industry

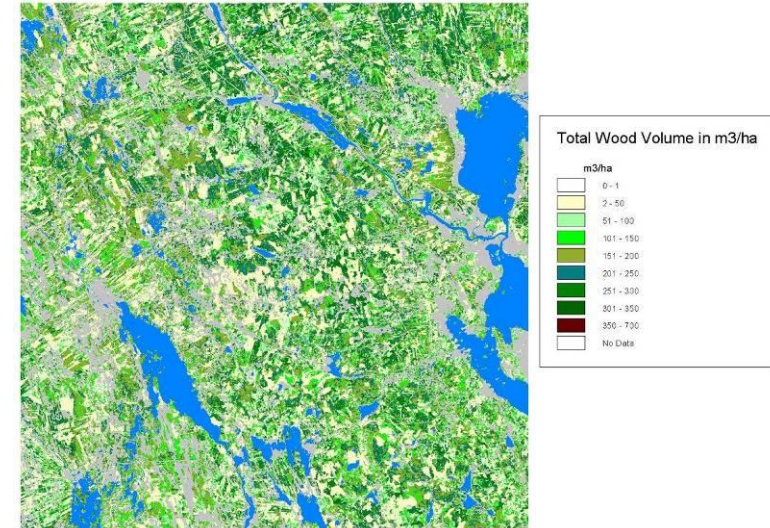




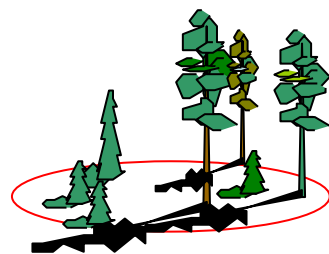
# Combination of ALS-data and NFI-data



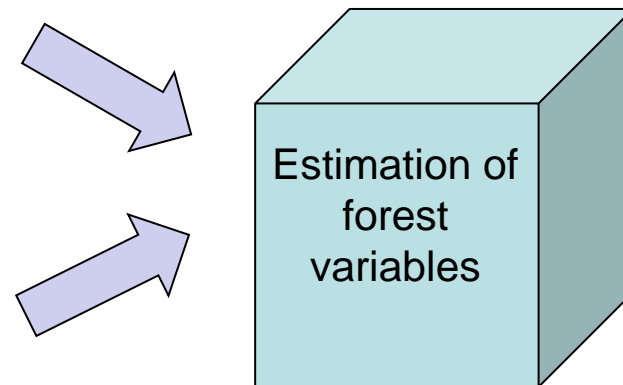
Laserdata from the National ALS-campaign



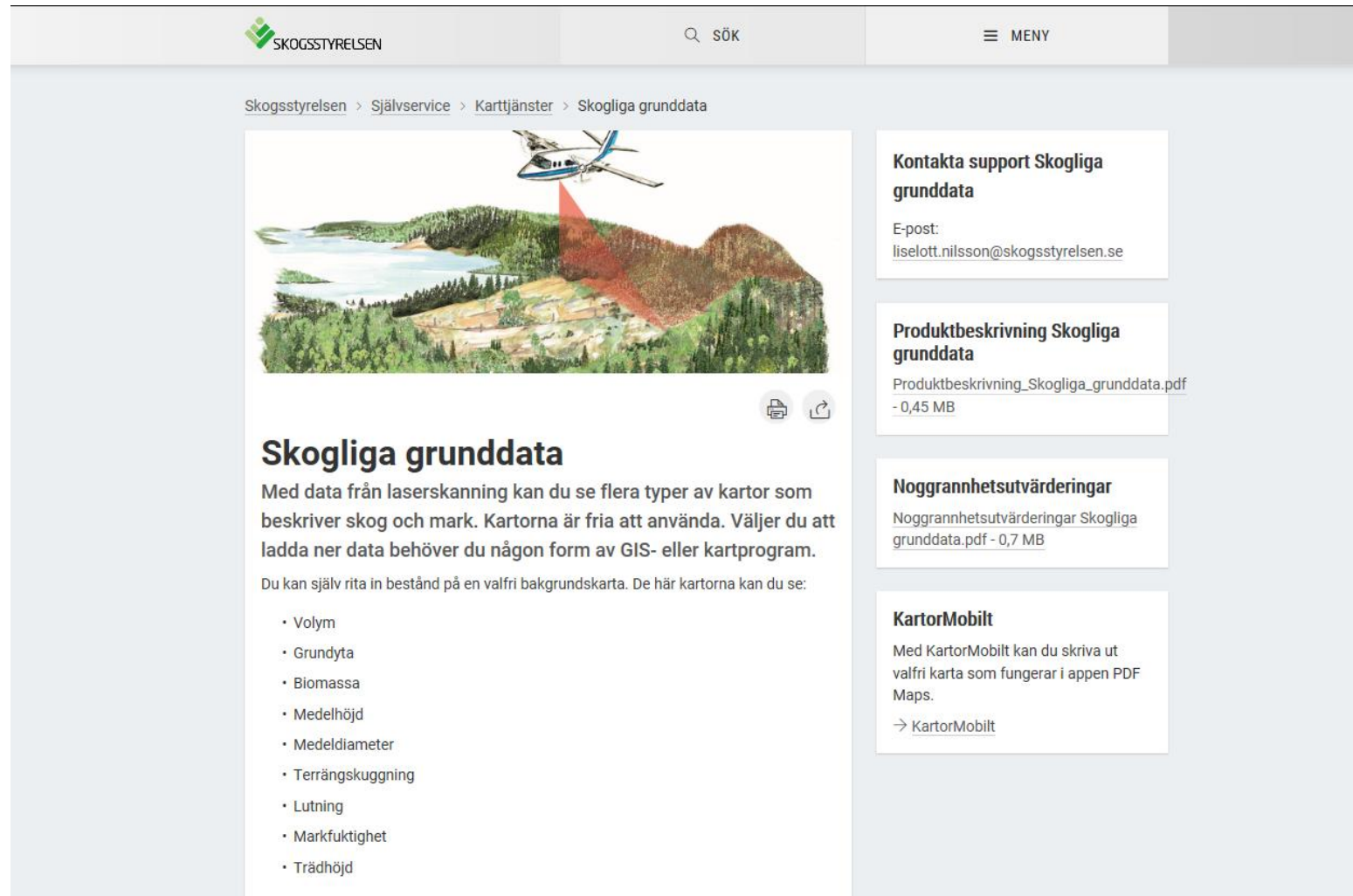
National raster database with estimated forest variables for 12 x 12 m pixels



NFI-data as training data (groundtruth)



# Data are distributed freely over internet




SKOGSSTYRELSEN

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MENY

Skogsstyrelsen > Självservice > Karttjänster > Skogliga grunddata



**Skogliga grunddata**

Med data från laserskanning kan du se flera typer av kartor som beskriver skog och mark. Kartorna är fria att använda. Väljer du att ladda ner data behöver du någon form av GIS- eller kartprogram.

Du kan själv rita in bestånd på en valfri bakgrundskarta. De här kartorna kan du se:

- Volym
- Grundyta
- Biomassa
- Medelhöjd
- Medeldiameter
- Terrängskuggning
- Lutning
- Markfuktighet
- Trädhöjd

**Kontakta support Skogliga grunddata**

E-post: [liselott.nilsson@skogsstyrelsen.se](mailto:liselott.nilsson@skogsstyrelsen.se)

**Produktbeskrivning Skogliga grunddata**

[Produktbeskrivning\\_Skogliga\\_grunddata.pdf](#)  
- 0,45 MB

**Noggrannhetsutvärderingar**

[Noggrannhetsutvärderingar Skogliga grunddata.pdf](#) - 0,7 MB

**KartorMobilt**

Med KartorMobilt kan du skriva ut valfri karta som fungerar i appen PDF Maps.

→ [KartorMobilt](#)

Interface only in Swedish

# What happens without ground-truth?

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Article | [Published: 01 July 2020](#)


## Abrupt increase in harvested forest area over Europe after 2015

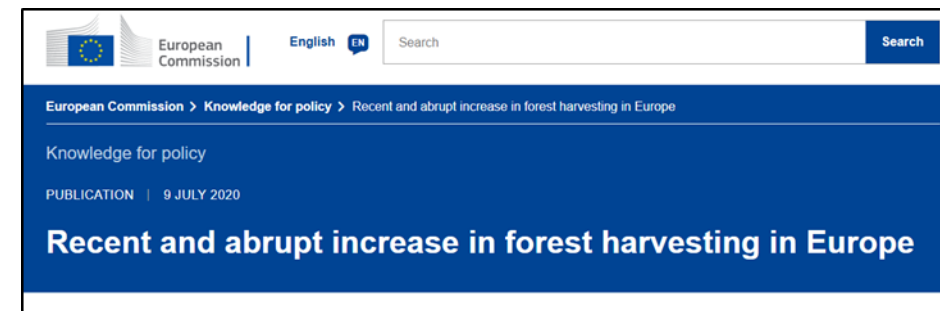
[Guido Ceccherini](#) , [Gregory Duveiller](#), [Giacomo Grassi](#), [Guido Lemoine](#), [Valerio Avitabile](#), [Roberto Pilli](#) & [Alessandro Cescatti](#)

[Nature](#) 583, 72–77 (2020) | [Cite this article](#)

28k Accesses | 183 Citations | 1060 Altmetric | [Metrics](#)

 [Matters Arising](#) to this article was published on 28 April 2021


 [Matters Arising](#) to this article was published on 28 April 2021



# Using data from permanent plots from the NFIs of the Nordic countries this could be proven as incorrect

Opinion Paper | [Open access](#) | [Published: 22 February 2022](#)

## Harvested area did not increase abruptly—how advancements in satellite-based mapping led to erroneous conclusions

[Johannes Breidenbach](#) , [David Ellison](#), [Hans Petersson](#), [Kari T. Korhonen](#), [Helena M. Henttonen](#), [Jörgen Wallerman](#), [Jonas Fridman](#), [Terje Gobakken](#), [Rasmus Astrup](#) & [Erik Næsset](#)

*Annals of Forest Science* **79**, Article number: 2 (2022) | [Cite this article](#)

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### Abstract

#### Key message

Using satellite-based maps, Ceccherini et al. (Nature 583:72-77, 2020) report abruptly increasing harvested area estimates in several EU countries beginning in 2015. Using more than 120,000 National Forest Inventory observations to analyze the satellite-based map, we show that it is not harvested area but the map's ability to detect harvested areas that abruptly increases after 2015 in Finland and Sweden.

Conclusion:

”Remote sensing is insane without groundtruth”

**Thanks for your attention!**

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<https://www.slu.se/en/Collaborative-Centres-and-Projects/the-swedish-national-forest-inventory//>