Challenges in establishing FRL with limited data for a highly diverse and fragmented forest area

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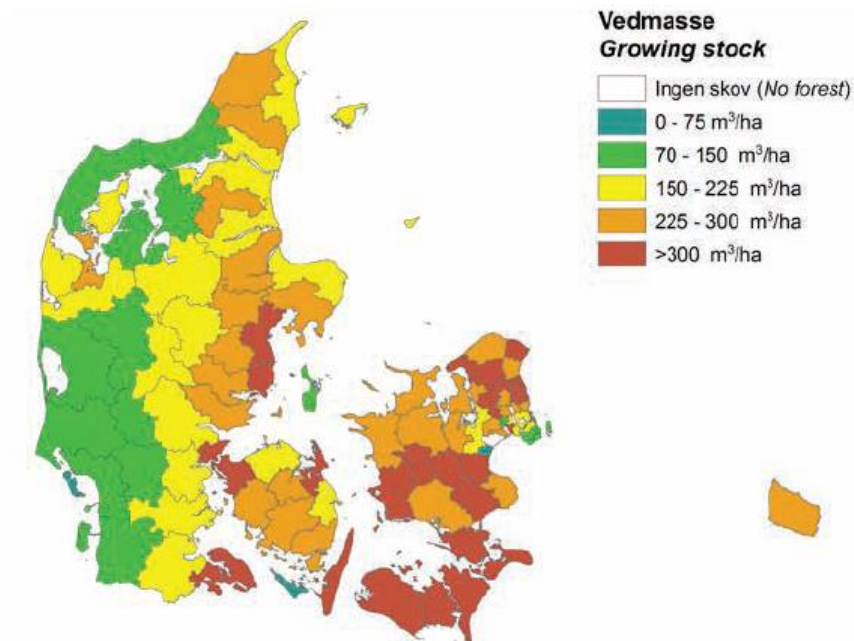2018.05.17

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Outline

1. Forest Reference Level - setting the scene
2. Limitation of data
3. Diversity of the forest area
4. Differences in old and new forests
5. Implications for FRL - the need for sufficient data to produce a valid prediction
6. Preliminary results
7. Challenges in establishing FRL

Vedmasse
Growing stock

	Ingen skov (*No forest*)
	0 - 75 m³/ha
	70 - 150 m³/ha
	150 - 225 m³/ha
	225 - 300 m³/ha
	>300 m³/ha

Forest Reference Level - setting the scene

Some key points:

Reference periode: 2000-2009

Forest management area AND afforestation > 20 year

Constant rate of assortement - use wood/energy wood.

Include HWP

Business as usual - yet including some adopted policies (from when?) and sustainable forest management

Limitation of data

National Forest Inventory - Denmark:

Starting date: 2002

Grid density: 1 plot per 100 ha

Inventory cycle: 5 years (continous with partial replacement)

Plots per inventory cycle: approx 9.500 plots

Permanent plots: 1/3 - approx 3.100 plots

Number of remeasured plots within the reference periode: approx 1.900 plots (3/5 of a second rotation)

We try to include NFI data including data from 2017 - ie after the reference periode ....

Diversity of the forest area

Forest area (2016): 625.000 ha

Result of afforestation over 200 years

Highly manipulated - 57 species recorded

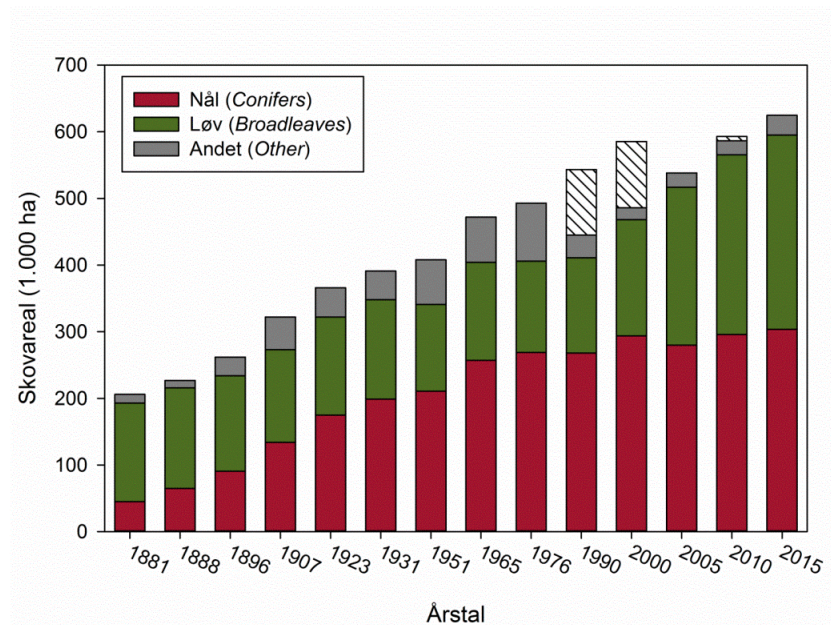Number of forest owners: 23.000 - 80 % of area private

Higly fragmented forest areas: 1/3 core forest (100 m limit)

Data from one NFI cycle:

112.000 diameters

25.000 heights

And other data

Differences in old and new forests

Old forests - before 1990

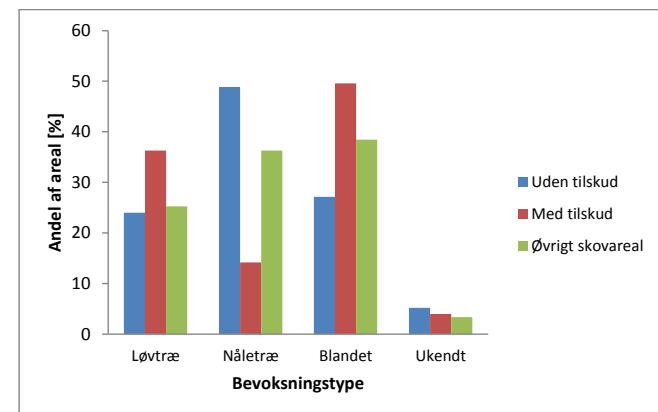Intensive management in 90 % - exstensive in 10 %

Many excotic species used

Highly manipulated

Models of growth and management exist based on experiments

New forests - after 1990

- New species compositions

- New soil types

- New forest owners

- New forest management

Figur 1. Skovrejsningsarealet fordelt til bevoksningstype for skovrejsningstyperne.
Fordelingen for det øvrige skovareal (skov etableret før 1990) er indsat som reference.
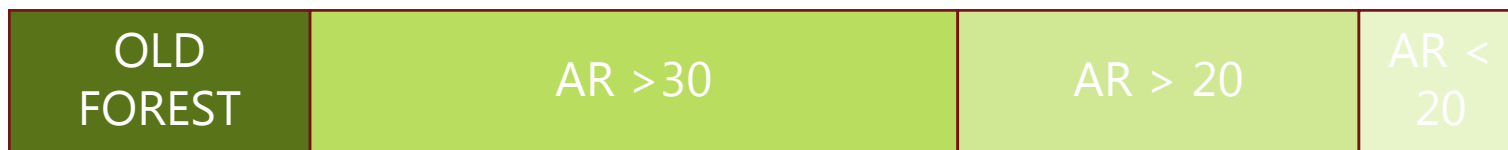
Implications for FRL

Total forests for reporting

Area

OLD FOREST	AR >30	AR > 20	AR < 20

Stock

OLD FOREST	AR >30	AR > 20	<

Changes

OLD FOREST	AR >30	AR > 20	AR < 20

Implications for FRL

Total forests for reporting

Area

OLD FOREST	AR >30	AR > 20	AR < 20

FRL- all AR   FRL>30   FRL>20

Stock

OLD FOREST	AR >30	AR > 20	<

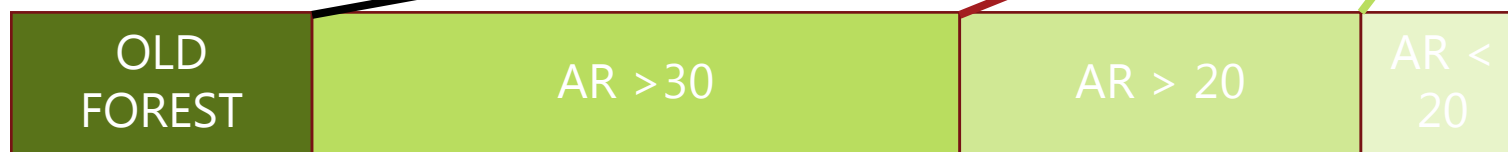Changes

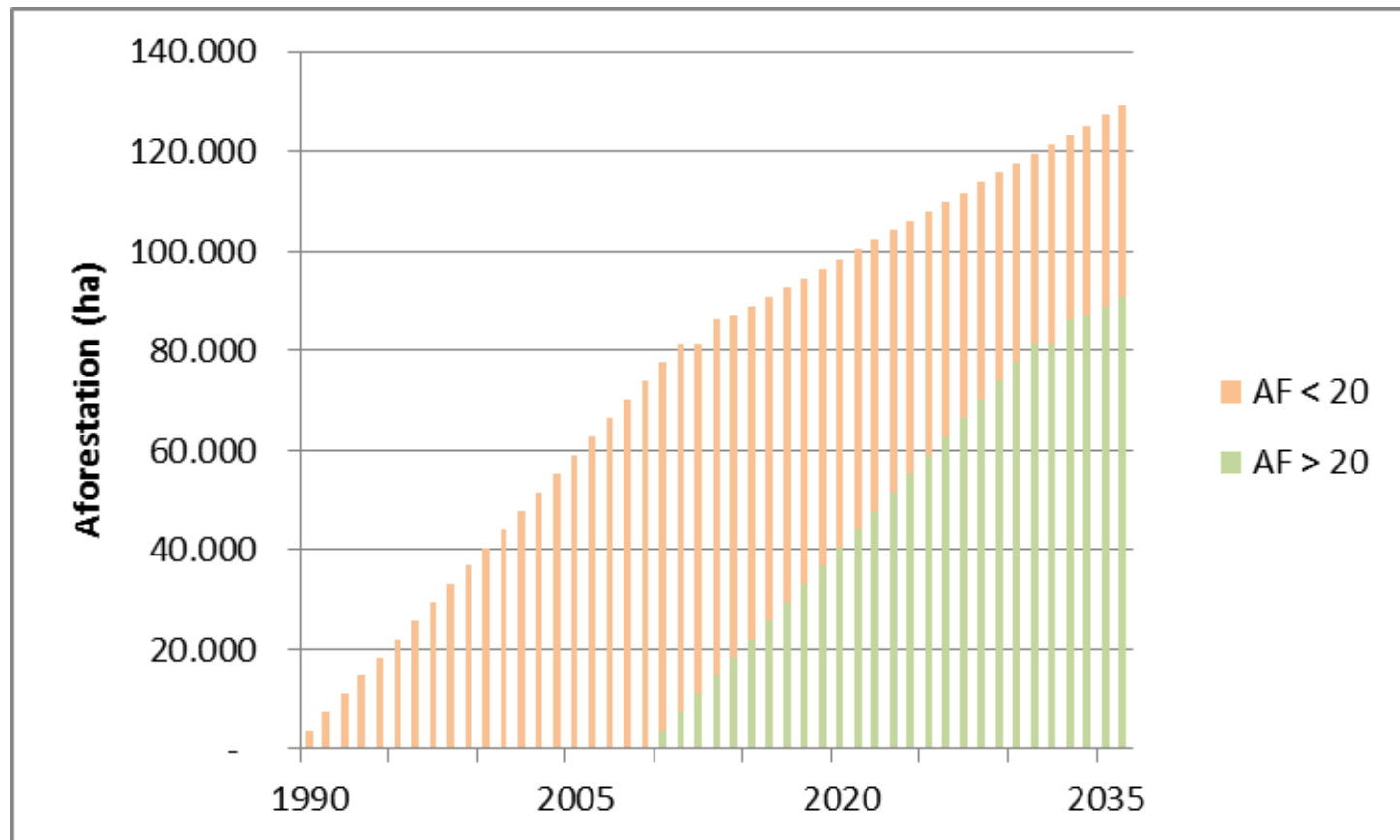| OLD FOREST	AR >30	AR > 20	AR < 20

Implications for FRL

Afforestation - transfer to FRL (green label) by age 20

(indication of the changing additional area included in FRL over time - how to include?)

Implications for FRL
# Reference Level - Danish case

Tabel 6 - 1,900 ha/yr afforestation (declining rate - but included in FRL)

New Reference Level 20 yr	2015-2020	2021-2025	2026-2030	2031-2035
FRF: Forest before 1990 **I (kt CO2/yr)**	228	428	548	328
Afforestation > 20 yr **II (kt CO2/yr)**	-617	-705	-852	-907
FRL - All forest > 20 yr **I + II (kt CO2/yr)**	**-389**	**-277**	**-304**	**-578**
Forest <20 and deforestation: **(III+IV) (kt CO2/yr)**	-37	-49	-17	11
HWP (kt CO2/yr)	-61	-20	-20	-20
Total Forest **I+II+III-IV (kt CO2/yr)**	**-426**	**-326**	**-321**	**-568**

Preliminary results

What are we doing?

- Single tree analysis
  - Growth of diameter and height
  - Mortality - harvest and natural competition

- Plot level analysis
  - Growth of diameter and volume
  - Probability of harvest, mortality and final felling

- Transition models based on trees and plots
  - Diameter, age and volumes
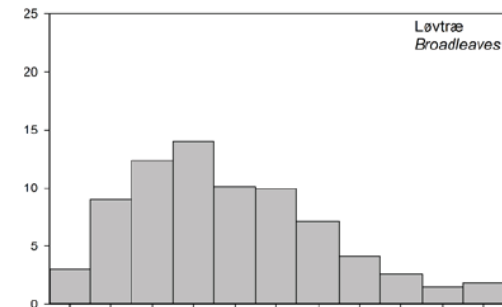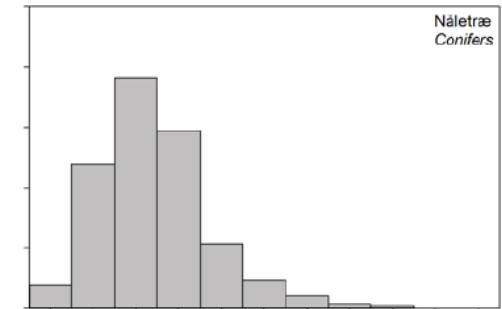
Diameter distribution
- broadleaved and conifers

Stratification by species, species groups and growth regions

Preliminary results

How are we doing?

- Single tree analysis
  - Growth models are not converging or producing biologically inlogical predictions
  - Mortality - to rare an occurence for a short period to produce a valid model
  - No reproduction of observed data

- Plot level analysis
  - Growth models are not converging
  - Probability of harvest, mortality and final felling - are to rare to model - so the models produce biologically inlogical resullts - eg markedly dropping of forest carbon pool
  - No reproduction of observed data

- Transition models based on trees and plots
  - Depend on single tree and plot level analysis
  - Still in development

Stratification by species, species groups and growth regions or less detail, causes either to crude models or models resulting in biologically inlogical model results

Preliminary results

Uncertainties in FRL and monitoring due to:

- Rate of afforestation
- Mixed effects of global environmental and climate change effects
- Reporting interval

- Estimats of change
    - Uncertainty 60-86 % - if based on annual reporting
    - Uncertainty 15 % - if based on 5 year reporting
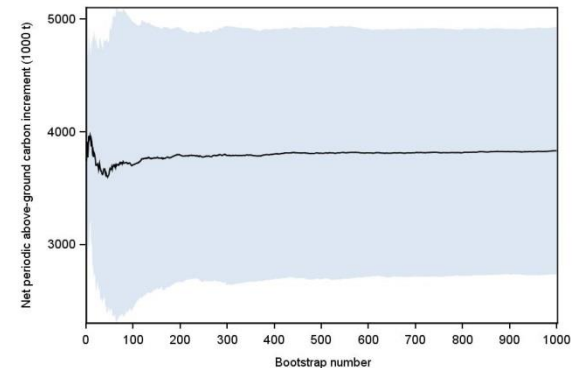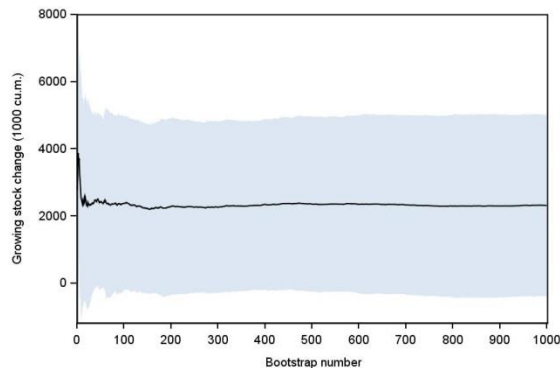
Challenges in establishing FRL

We have limited data - can we include more data?

1. More data from the NFI to estimate models?
2. Previous surveys? (different definitions)
3. Data from experimental plots on forest management? (1852-2017)
4. Data from afforestation - and growth of these based on other data?

Reference period of 10 years for forestry is equivalent to setting ¼ lap in the first exercise session in Monaco F1 as the base for the final starting grid! Unless you include data outside the reference periode.

IF we are to produce a valid FRL to give the basis for including Forests sinks accurately in the mitigation of the climate change, we are in for a busy year! Good ideas and sound solutions are welcome!

AND - don't forget the requirement to be consistent with the reporting

Thank you
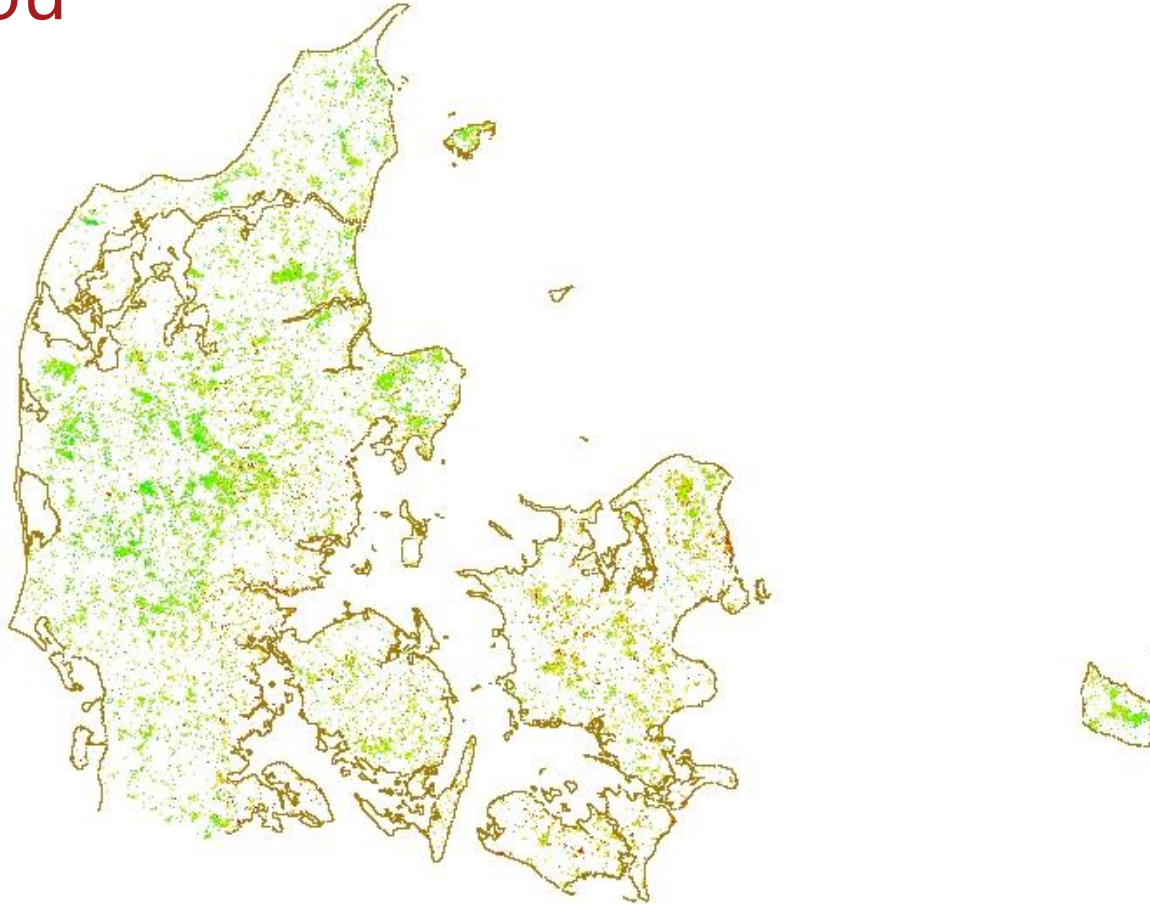
References:
Identifying potential uncertainties associated with forecasting and monitoring carbon sequestration in forests and harvested woodproducts / Johannsen, V. K., Nord-Larsen, T., Vesterdal, L., Suadicani, K., & Callesen, I. Department of Geosciences and Natural Resource Management, University of Copenhagen. (IGN Report / Department of Geosciences and Natural Resource Management, June 2017)
Skove og plantager 2016 / Thomas Nord-Larsen, Vivian Kvist Johannsen, Marie Frost Arndal, Torben Riis-Nielsen, Iben Margrete Thomsen, Kjell Suadicani og Bruno Bilde Jørgensen / Institut for Geovidenskab og Naturforvaltning, Københavns Universitet, Frederiksberg. 104 s. ill.