

IBFRA Insight Process:

Sustainable boreal forest management – Challenges and opportunities for climate change mitigation: Preliminary results

Presentation given April 2020 by process leader

Peter Högberg (Sweden)

Team of scientists from USA, Canada, Norway, Sweden, Finland, Russia and IIASA (Austria).



How can forestry in the boreal region contribute to climate change mitigation?

- By enhancing the C stock in forest ecosystems
- By providing raw material for long-lived C-containing products
- By providing raw material for products substituting fossil C, concrete, energy-intensive products such as steel, etc.

Data on changes in tree C stocks 1990-2017

Long-term data, high resolution

Norway, Sweden, Finland



Photo: B. Hånell

Lower resolution

Alaska, Canada, Russia



Photo: Google Earth

Basic data on forest area and forest C stocks in living tree biomass as per country/state. Note: there were no major changes in forest area 1990-2017

Country/ State	Forest area, km ²	C stock in living trees in million metric tonnes, Mt (as of 2015-2017, but 2009 in Alaska)	Average C stock in living trees per area, t C ha ⁻¹ (as of 2015-2017)
Alaska	233 000*	810*	35*
Canada	1 600 000**	7 680**	48**
Norway	120 000	490	41
Sweden	280 000	1 160	41
Finland	220 000	670	30
Russia	8 110 000*	30 090*	37*

* Boreal forest only

** Managed boreal forests, there is an additional 75 % of non-managed boreal forest in Canada

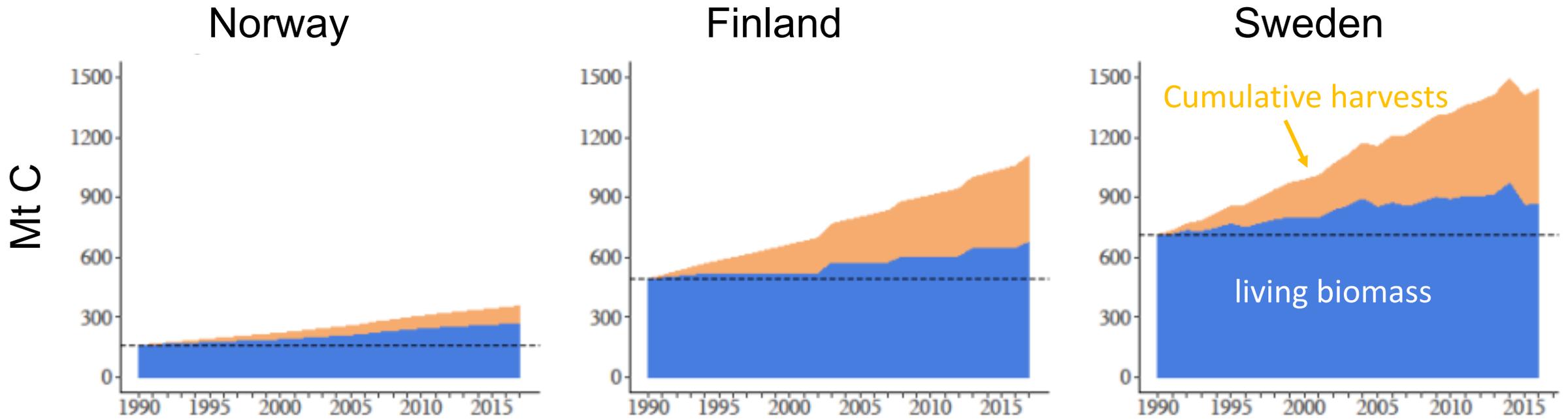
Basic data on forest C stocks and wood harvests as per country/state.

Country/State	Carbon stock in living biomass, Mt C	Carbon removed by harvests, Mt C per year	% carbon removed by harvests per year
Alaska	810	0*	0*
Canada	7680	24	0.3
Russia	30900	37	0.1
Nordic countries**	2450	52	2.1

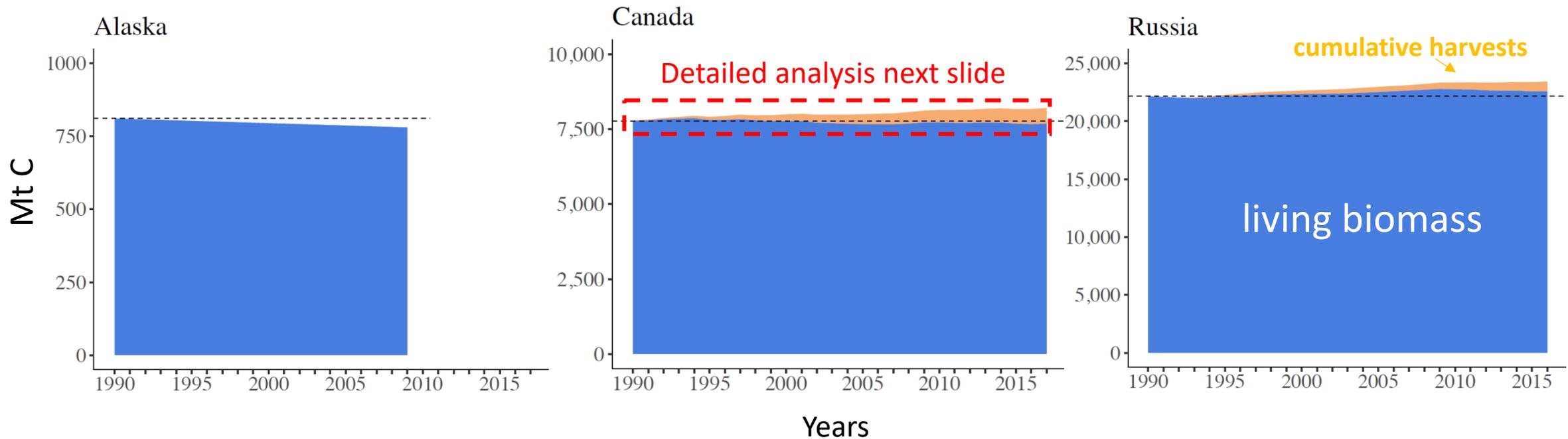
*no harvesting for industrial purposes (which occurs in the maritime forests of Alaska)

**Norway, Sweden and Finland combined

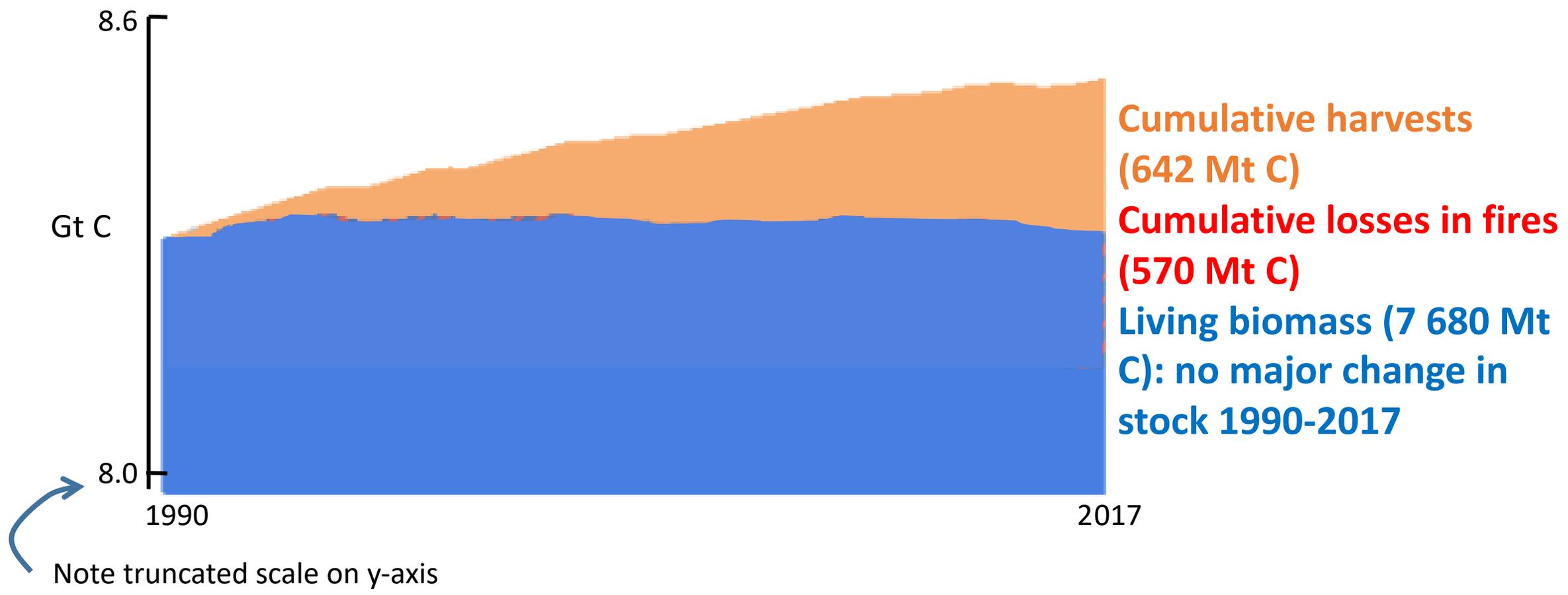
Changes in tree C stocks and cumulative harvests 1990-2017: Countries with forest management for wood harvests on ca. 55-75 % of forest land. Fires are effectively suppressed.



Changes in tree C stocks and cumulative harvests 1990-2009(-17):
Countries/states with no, or relatively low level of wood harvests and
where fires cause large C losses. Note different scales on y-axes!

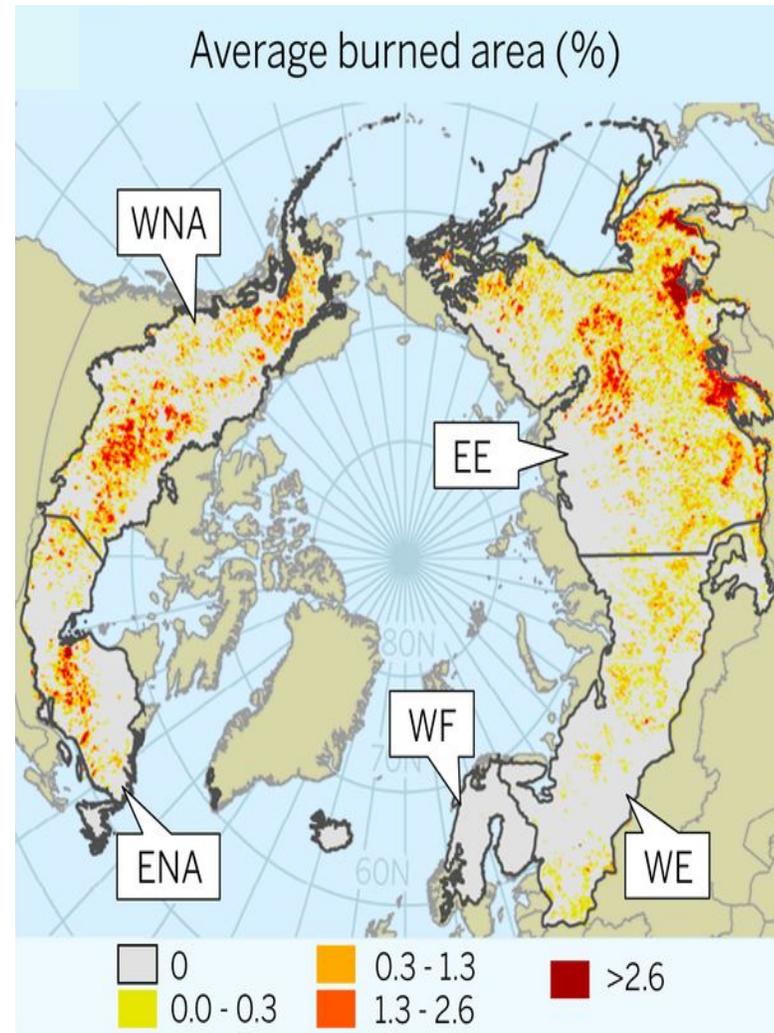


Detailed analysis of impacts of wood harvests and fire on living biomass C in Canadian managed boreal forests 1990-2017.



Average burned area per year across the boreal forests 1997-2014. Note low frequency of fire in the Nordic countries (WF) as compared to the vast areas of un-managed or less intensely managed forests in Alaska, Canada and Russia. Source: Gauthier et al. (2015) *Science*

In Sweden 1996-2018, which includes major fire years like 2014 and 2018, the average area burned was 0.01 % per year.



Conclusions about changes in tree C stocks

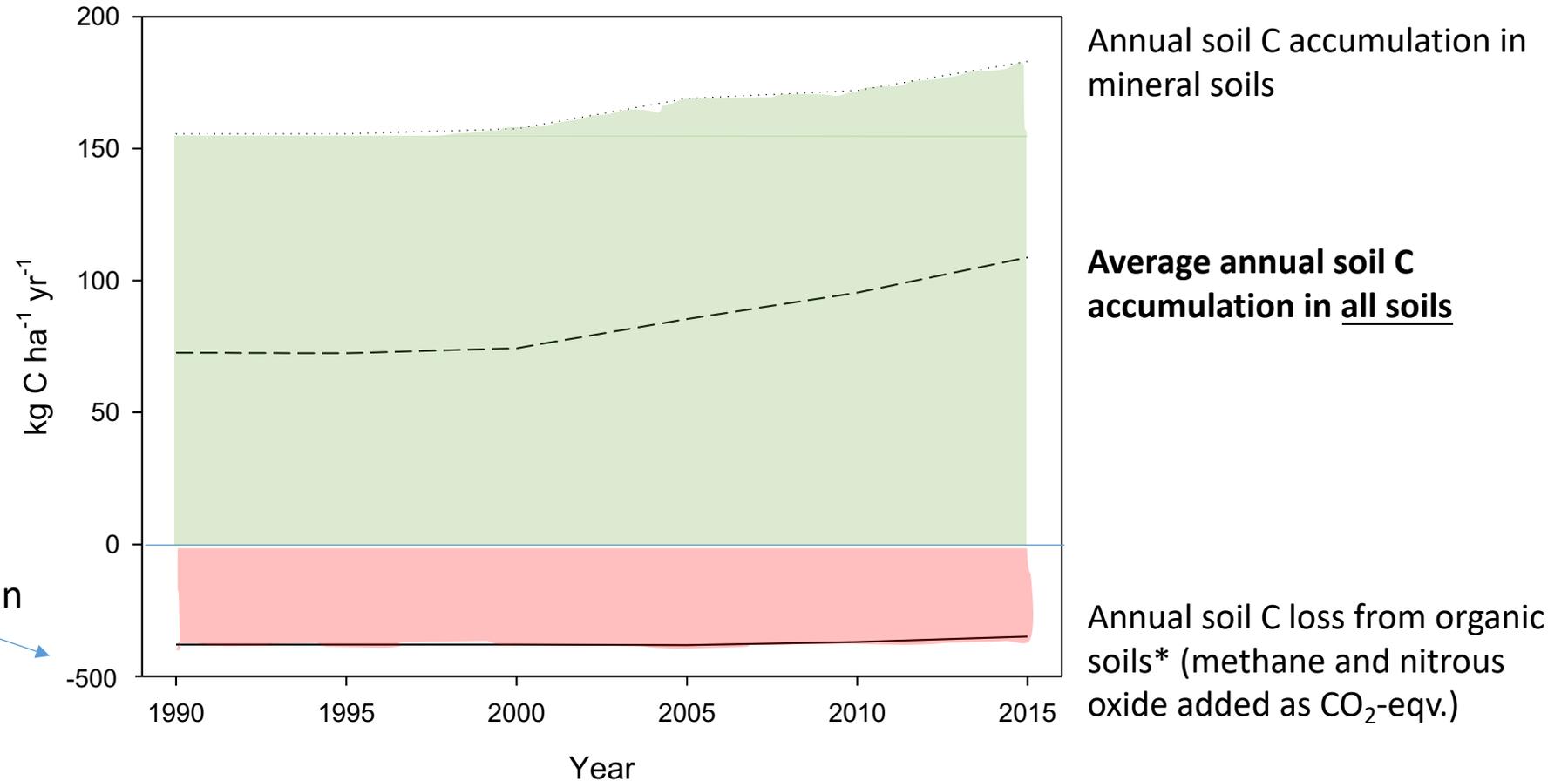
- In the three countries/states (Alaska, Canada, Russia) with low levels of management for wood harvests, changes in tree C stocks are small. Fires have a large influence on the C balance.
- In the three countries (Norway, Sweden, Finland) with a high level of management for wood harvests (mainly rotational silviculture), the tree C stocks increased by 20-55 % during the studied period. Fires are effectively suppressed.
- In Norway, Sweden and Finland, the cumulative harvests during the same period amounted to the equivalent of 55-88 % of the initial C stock in 1990.

What about soil C?

Annual C balance of Swedish forest soils 1990-2015 (data from the Swedish Forest Soil Survey)



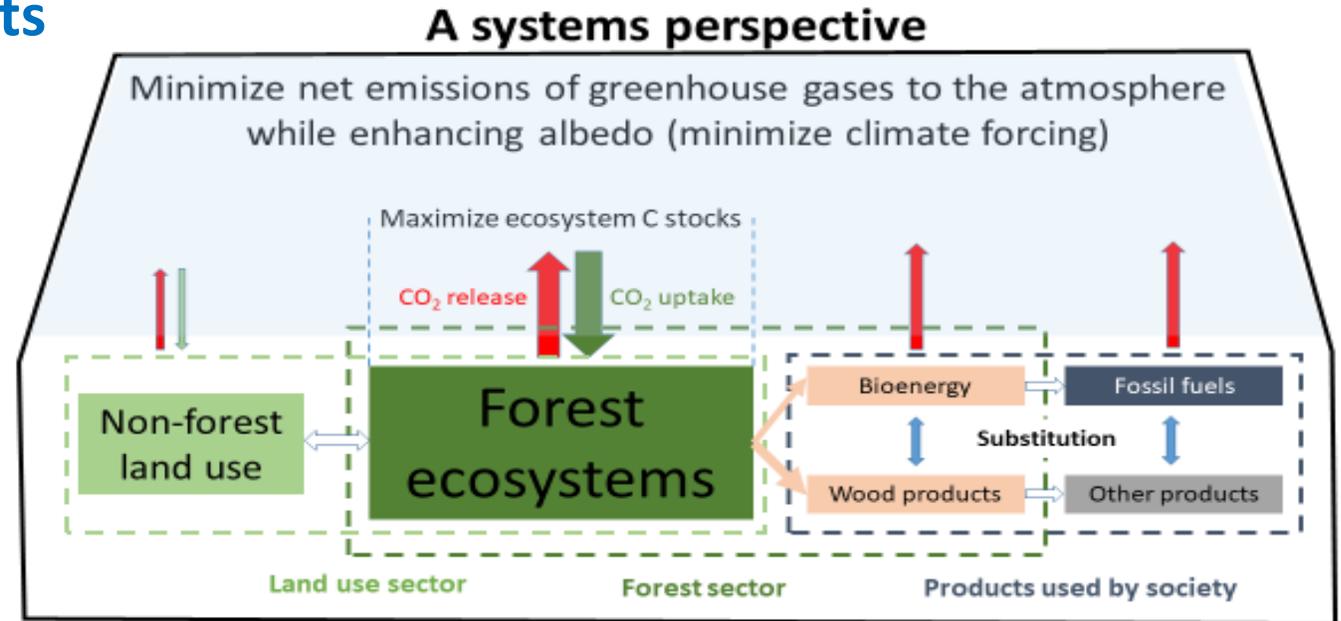
Note change in scale!



Organic soils are soils where the superficial organic layer is >0.3 m.
They comprise 14 % of the forest land.

What about harvested wood products (HWPs)?

- Increases in the C stocks in ecosystems plus HWP pools represent a net removal from the atmosphere.
- Additional mitigation benefits are achieved through substitution (i.e. avoided emissions in other sectors through the use of wood products and bioenergy).
- Substitution not yet assessed here, but I will show some preliminary results for Canada.

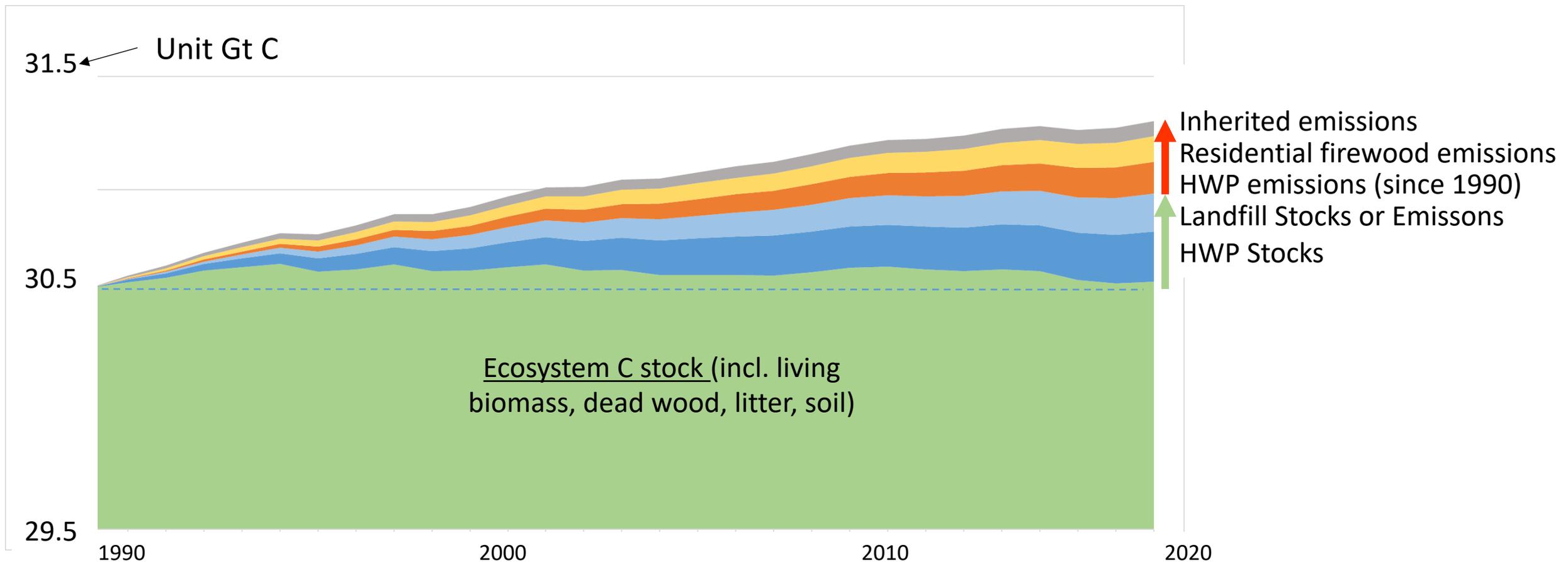


Lemprière et al. 2013



Ecosystem and HWP C stocks 1990-2017: boreal Canada

- Sum of ecosystem C stocks plus HWP in 2017 is 410 Mt C greater than in 1990.
- If landfills C stocks are reported as stored (167 Mt C) and
- subtracting "Inherited emissions" from pre-1990 harvest (66 Mt C)



Final remarks

- Objectives of the Paris Agreement cannot be achieved without a contribution of land sector C sinks.
- Deforestation rates in boreal countries are very low.
- Forest management for wood production can increase C sinks.
- Large potential to increase C sinks in boreal countries with low management intensity – but these are also at risk from climate change.
- Changes in HWP product use towards more long-lived products and higher substitution benefits also offer large mitigation benefits.

In this Insight Process, we have focussed on the role of forestry in mitigating climate change. IBFRA will also address other aspects of sustainable forest management.

