
Carbon budget of Finnish forests 1920-2000

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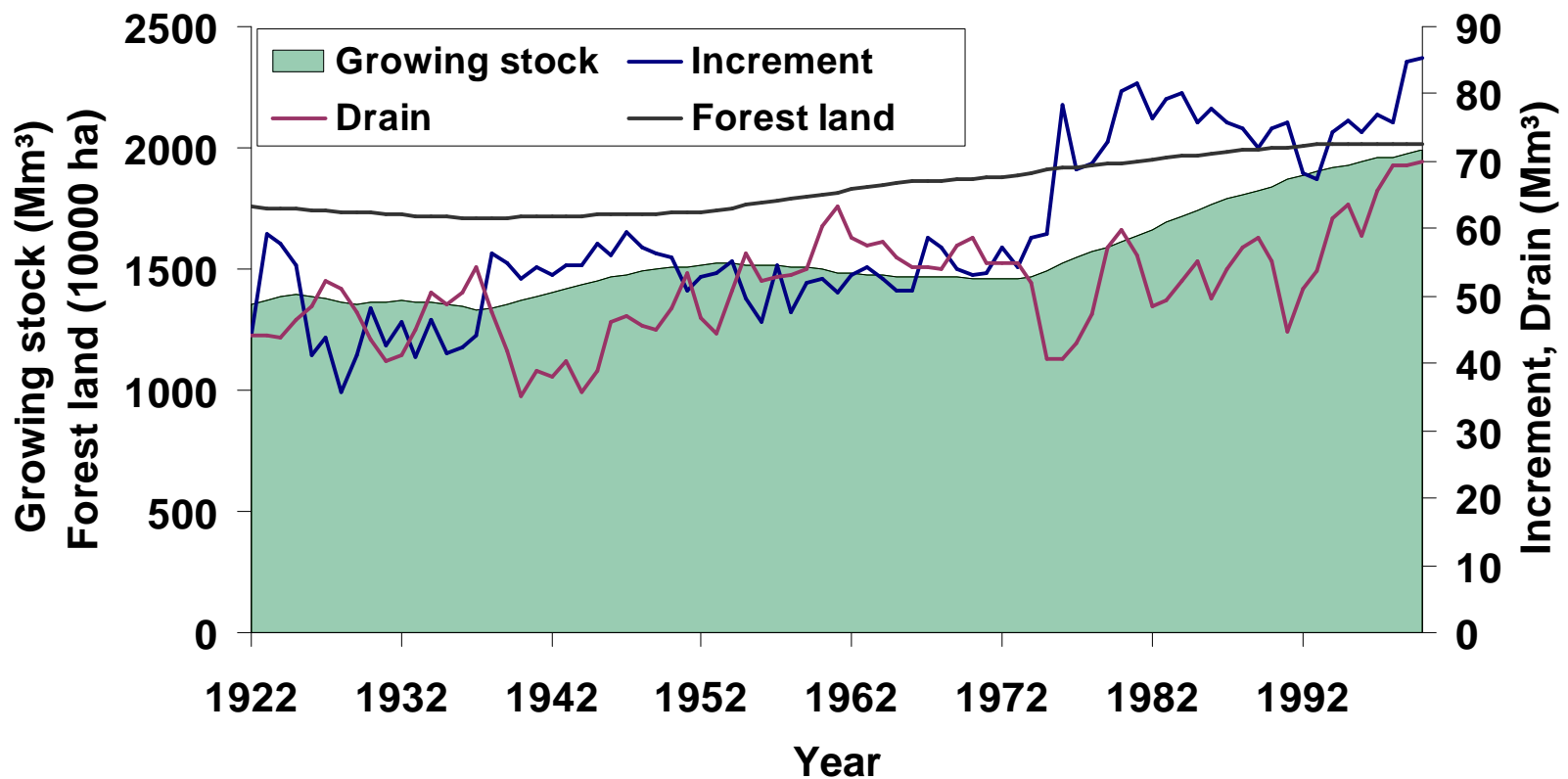
Project and research team

- "Integrated method to estimate the carbon budget of forests"
 - SUNARE research programme of the Academy of Finland 1/2001 – 5/2004
- European Forest Institute (EFI)
 - Jari Liski, Thies Eggers, Taru Palosuo
- Finnish Forest Research Institute (Metla)
 - Raisa Mäkipää, Aleksi Lehtonen, Petteri Muukkonen, Mikko Peltoniemi, Risto Sievänen

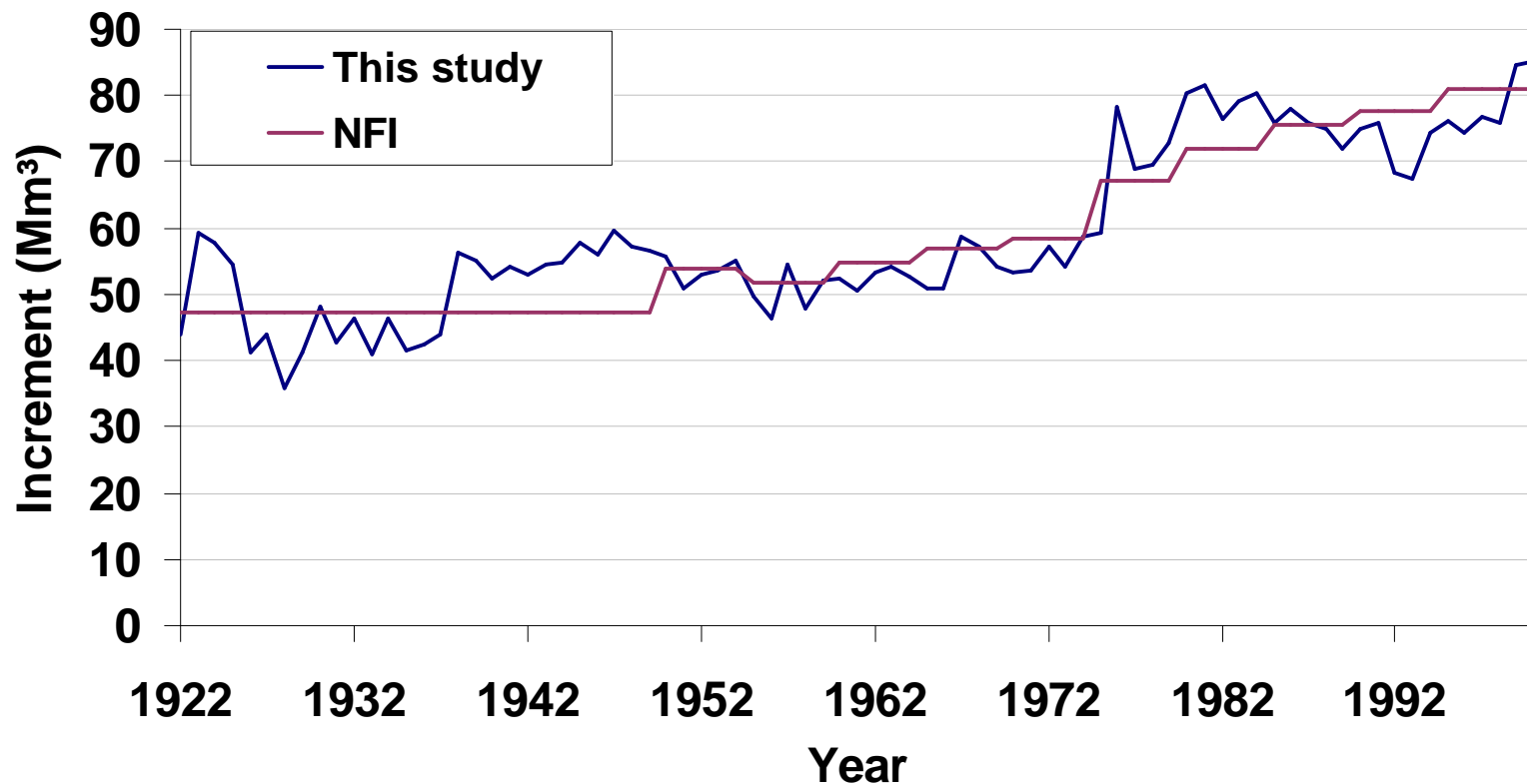
Outline

- Carbon budget of Finnish forests 1920-2000
- Integrated method to estimate the carbon budget of forests

Forest balance in Finland



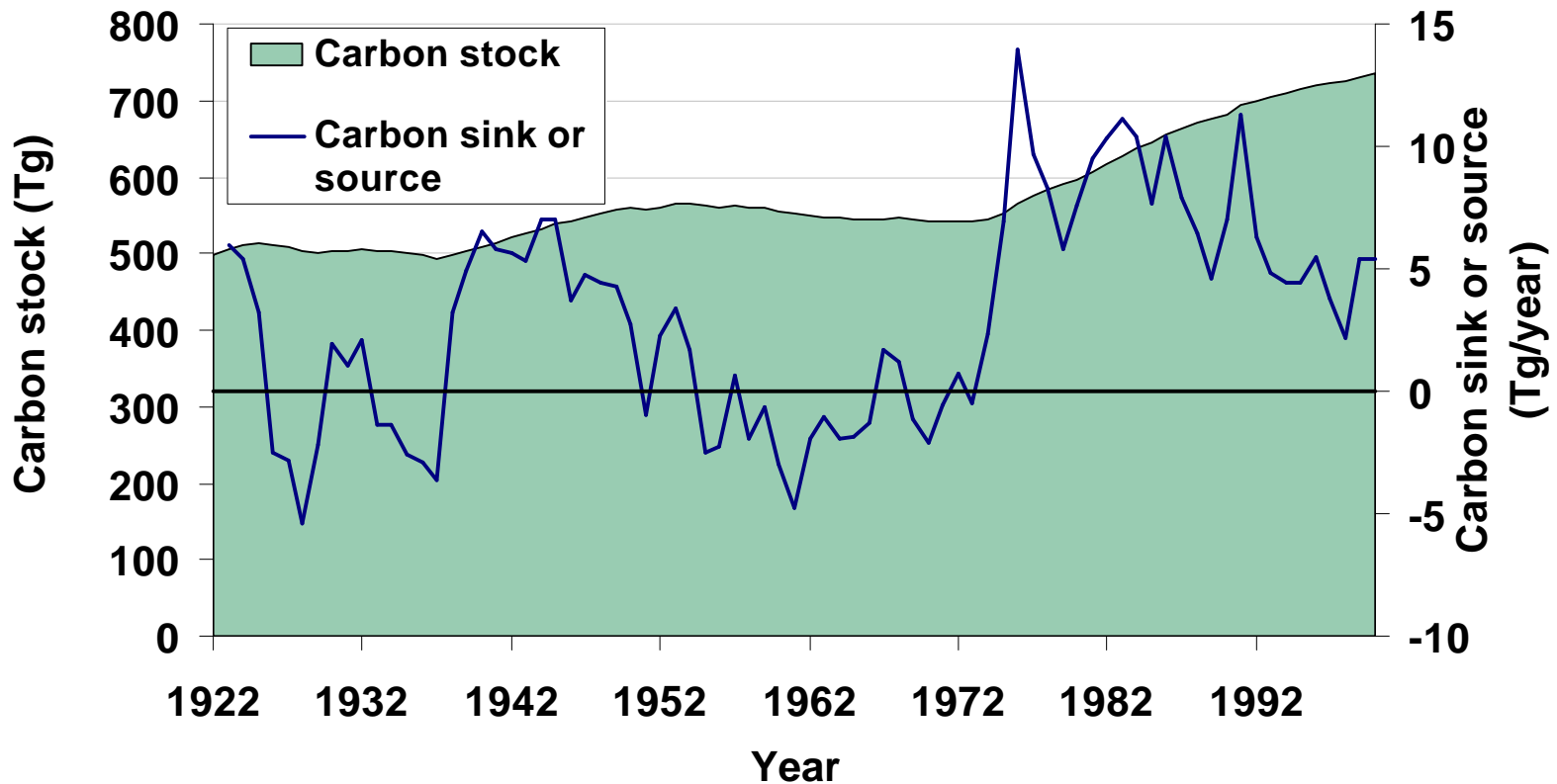
Growth estimates for Finnish forests



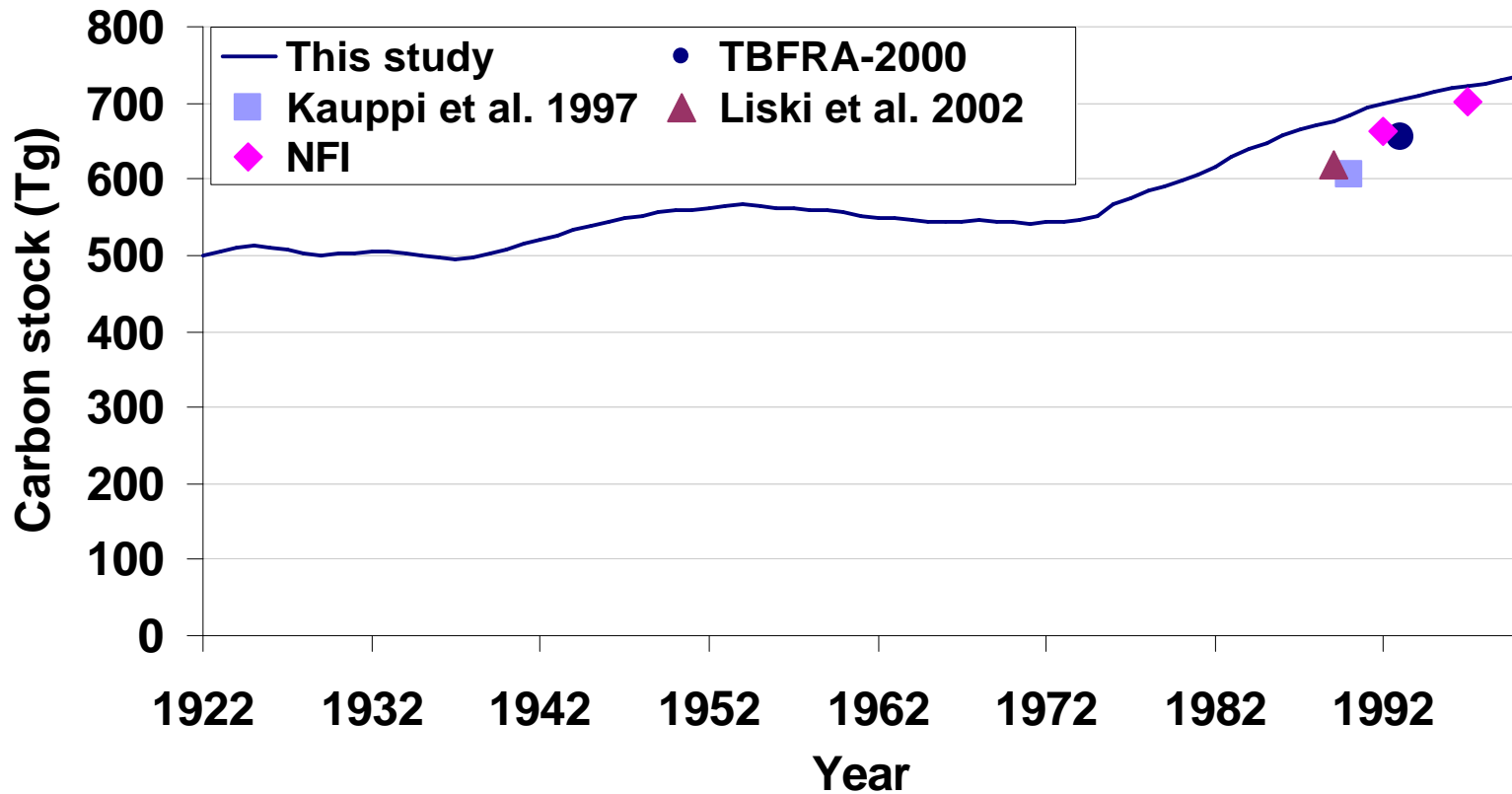
Tree carbon method

- $0.5 * BEF * \text{stemwood volume}$
- $BEF = f(\text{tree species, stand age})$

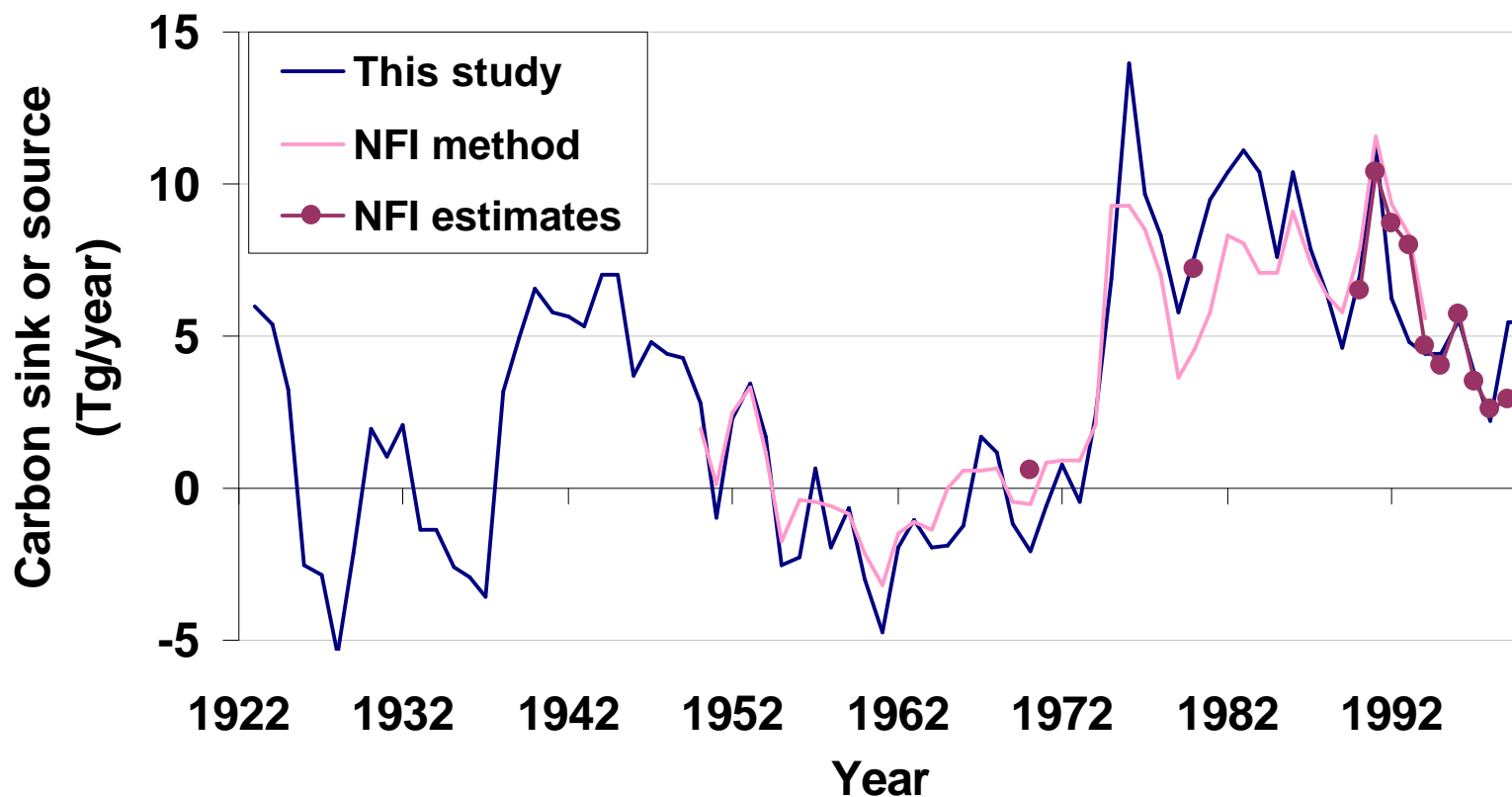
Carbon stock and carbon sink of trees



Estimates for the carbon stock of trees



Estimates for the carbon sink of trees



Soil carbon method

Litter production

turnover rate * biomass

foliage, branches, stem,
coarse roots, fine roots

Decomposition, soil carbon

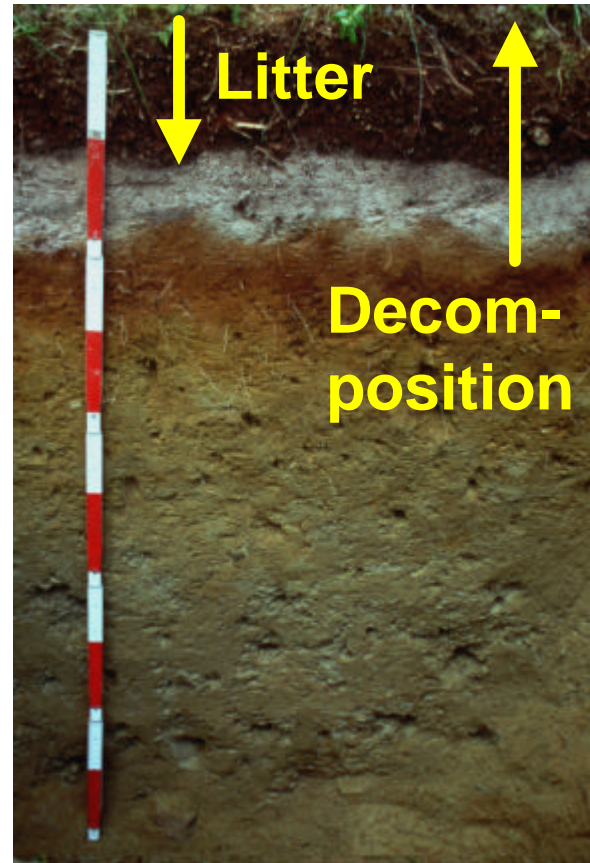
dynamic soil carbon model
Yasso

input information

litter production

climate

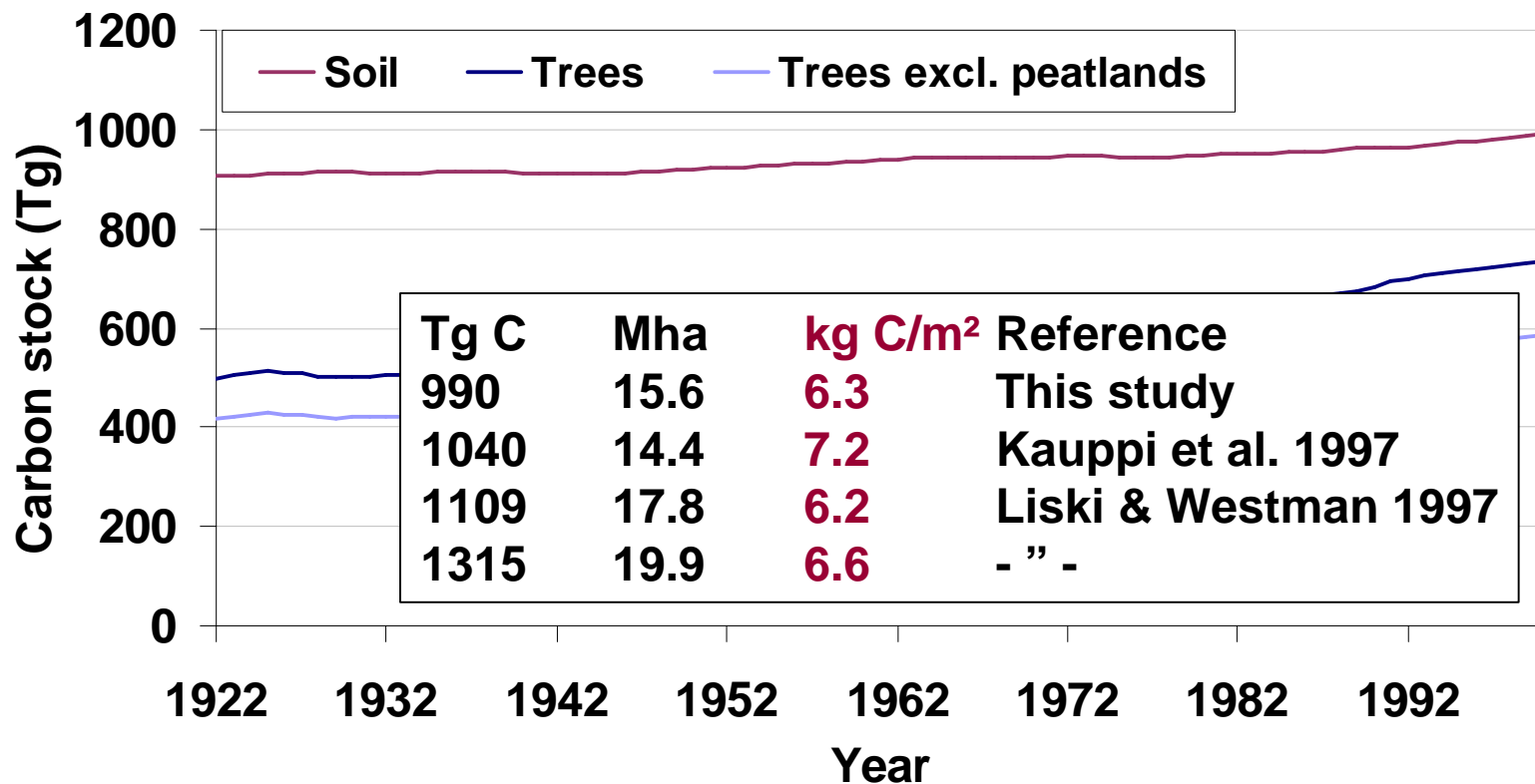
soil carbon initially



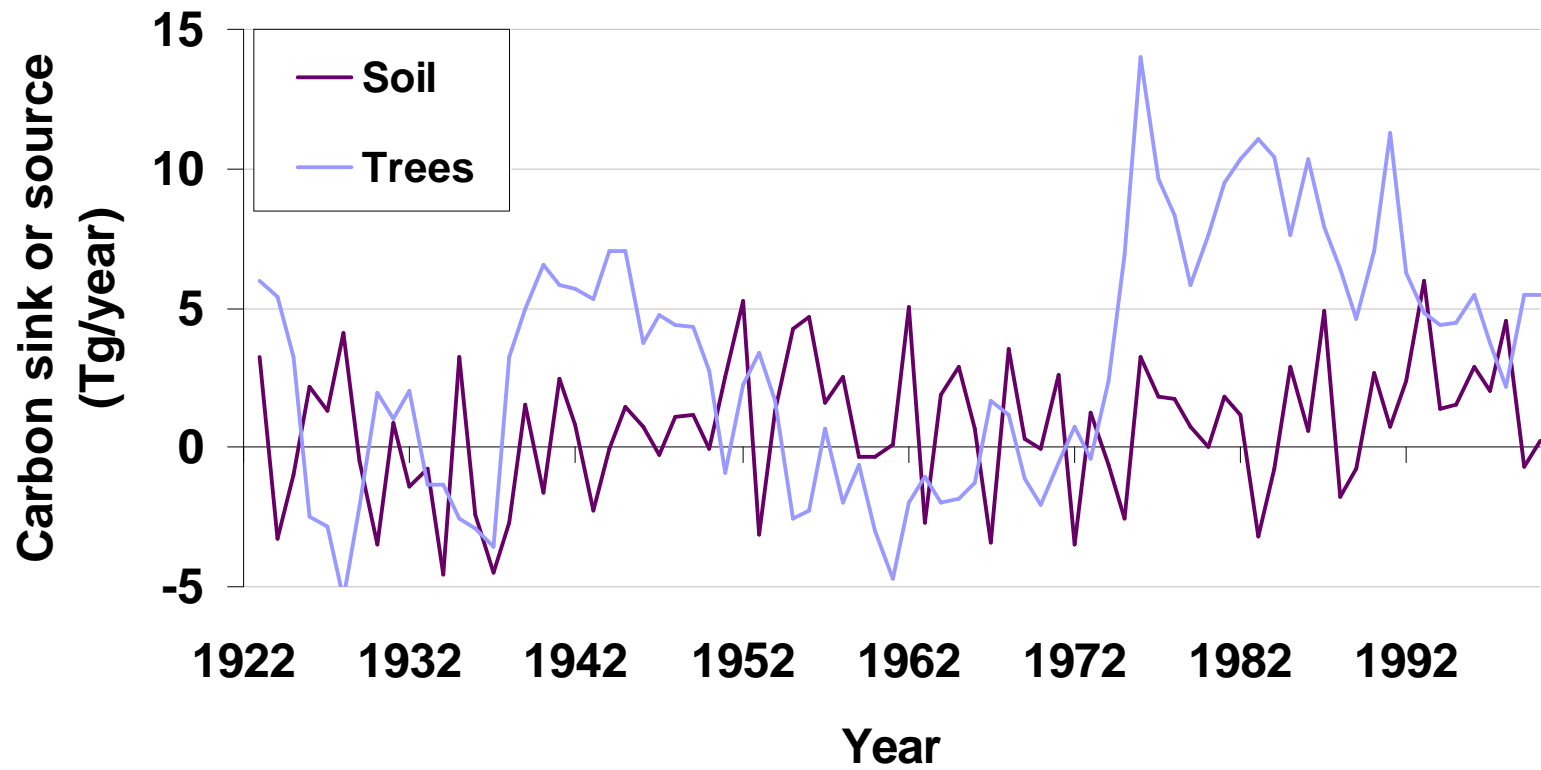
Soil carbon estimates

- Organic layer + 1 m mineral soil
- Cover upland forest soils only!
- Peatlands not included

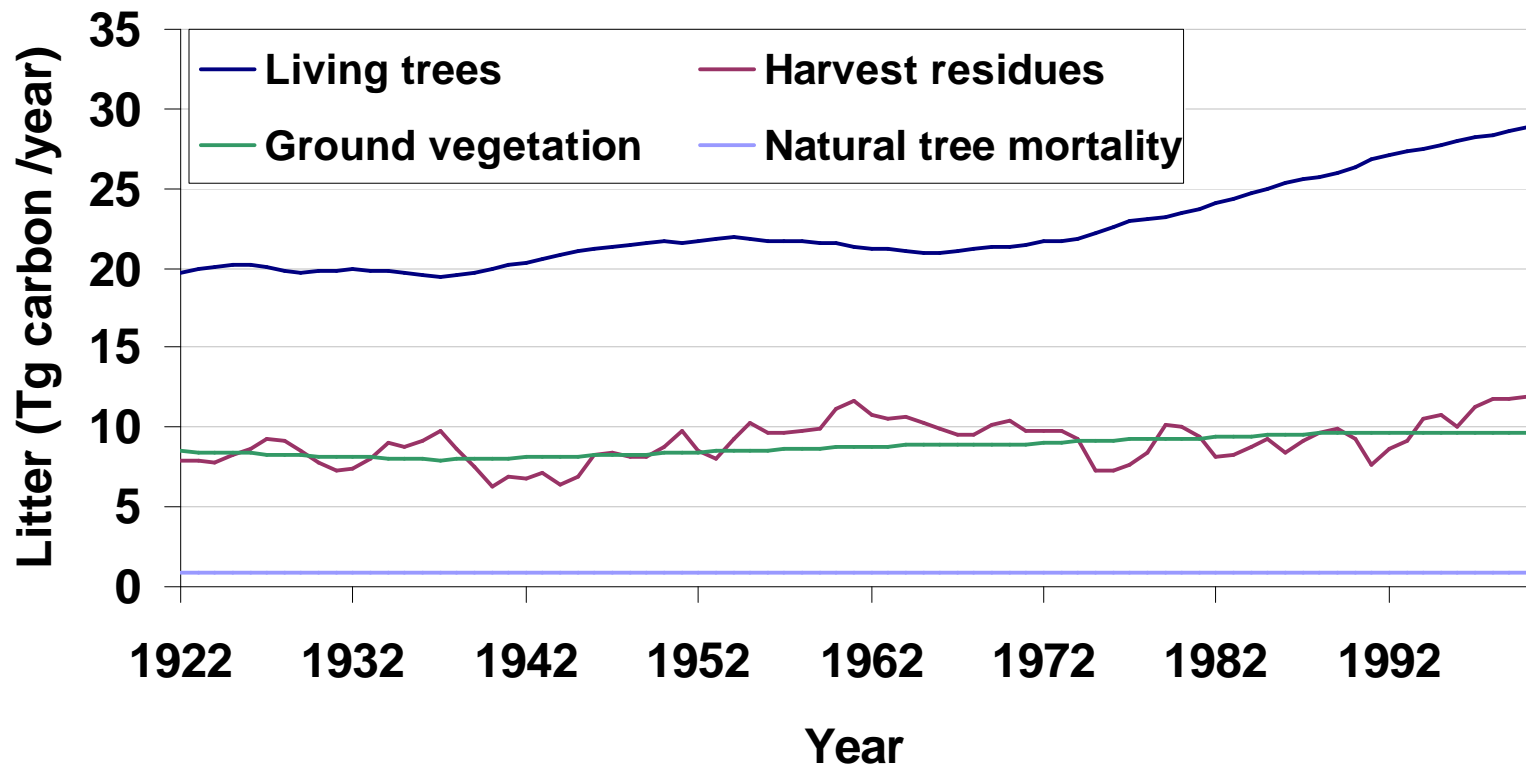
Carbon stock of soil



Carbon balance of soil

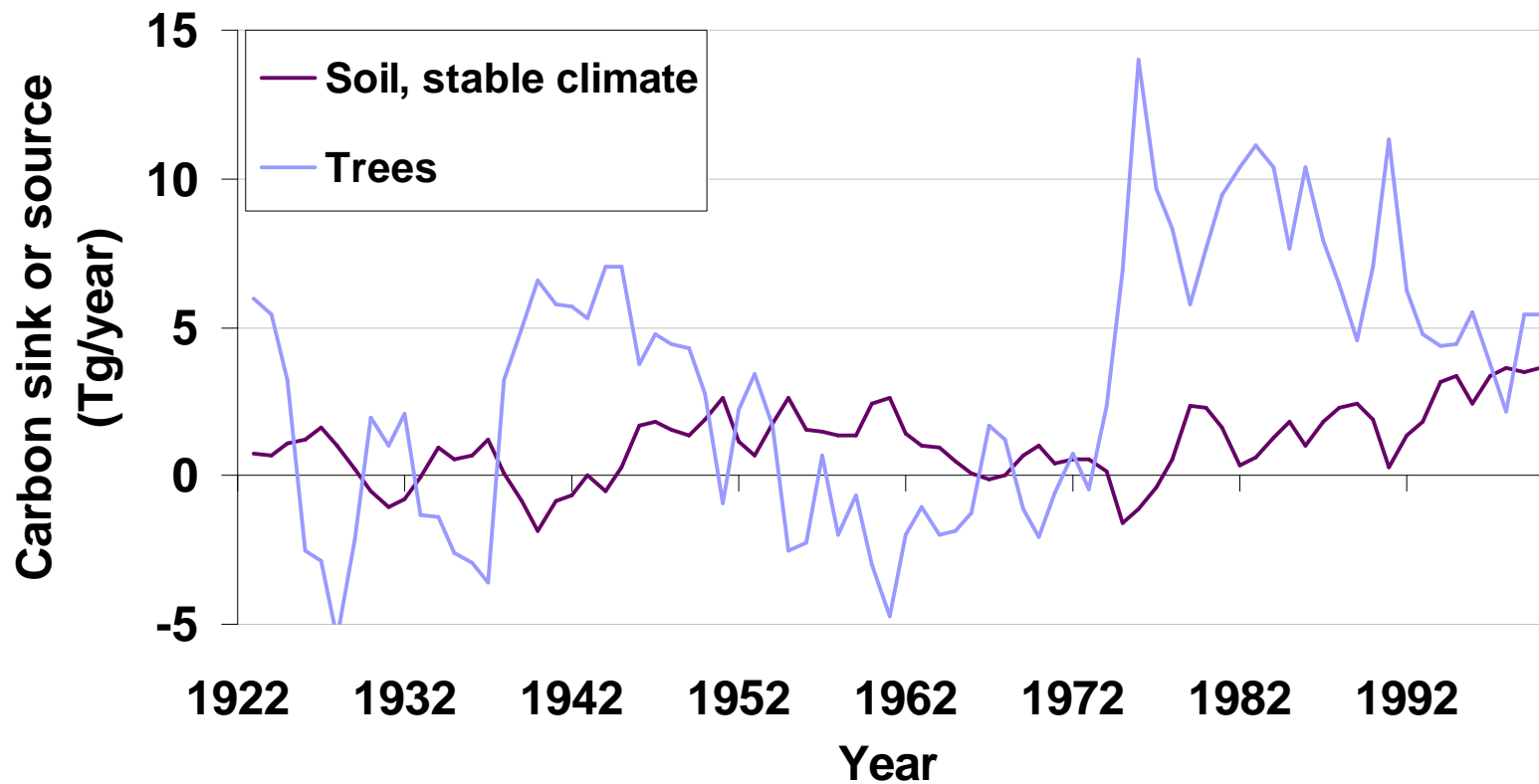


Litter production

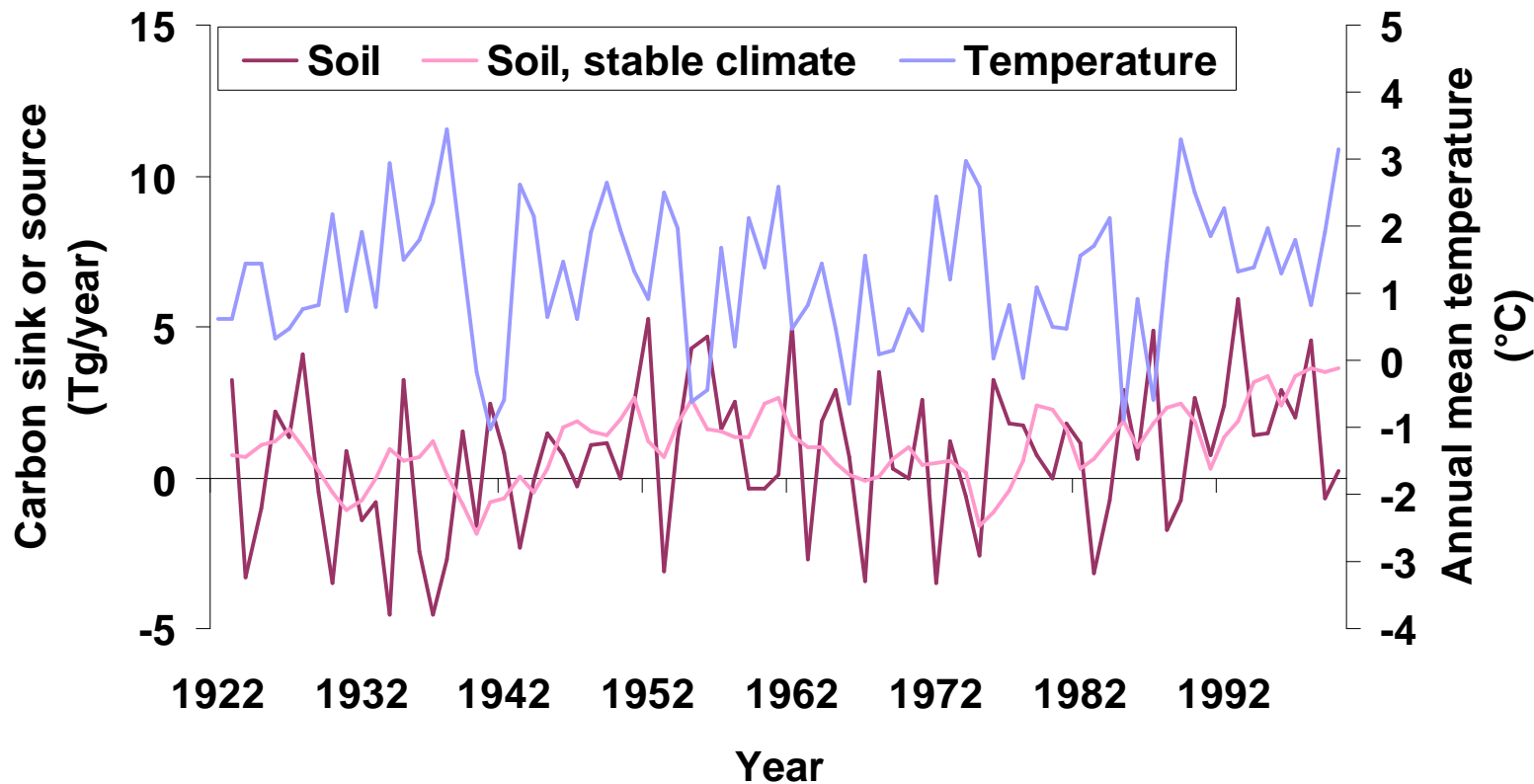


Carbon balance of soil

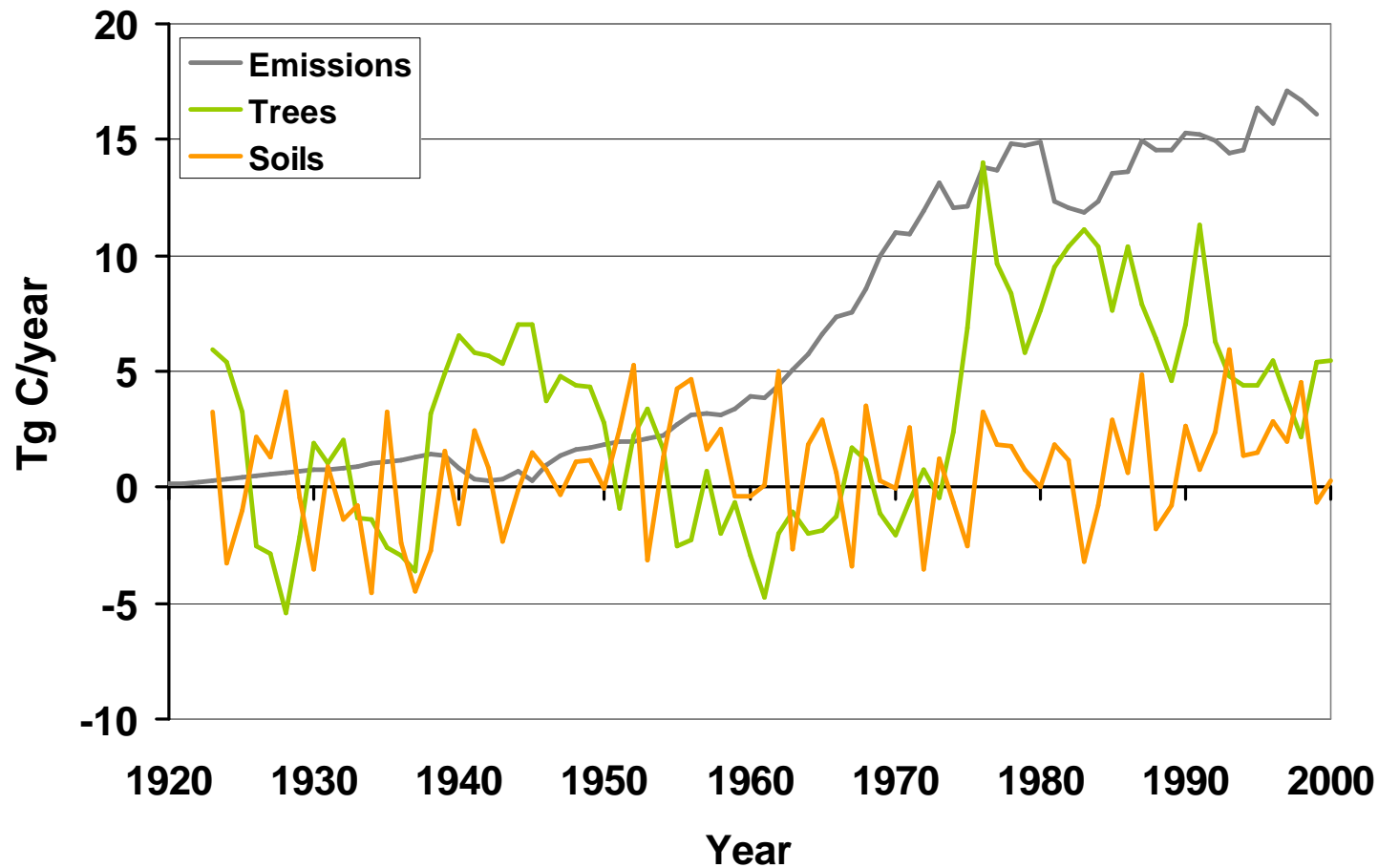
- assuming constant climate



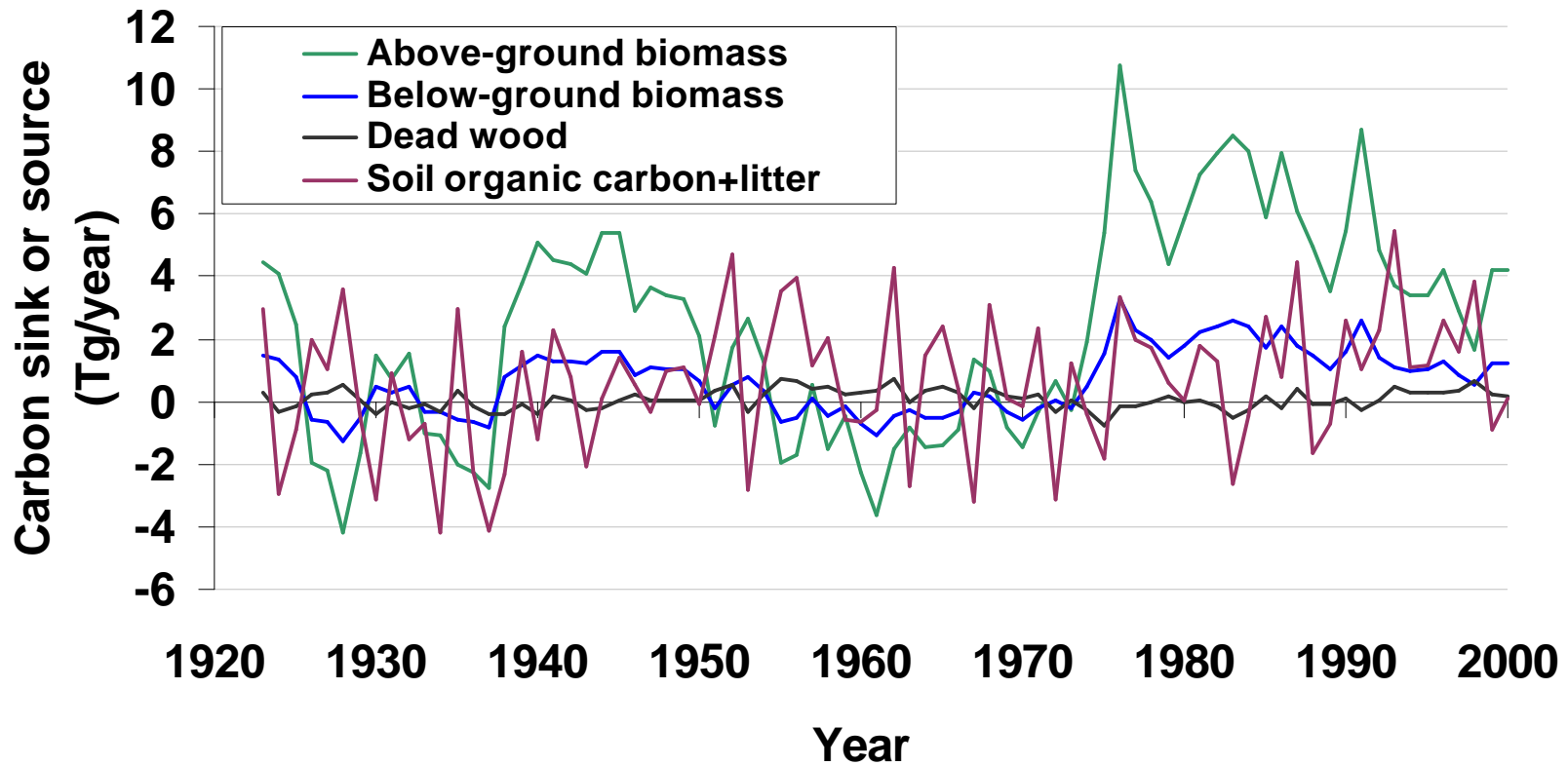
Carbon balance of soil



Fossil carbon emissions and forest carbon sinks



Carbon pools to be reported according to IPCC GPG



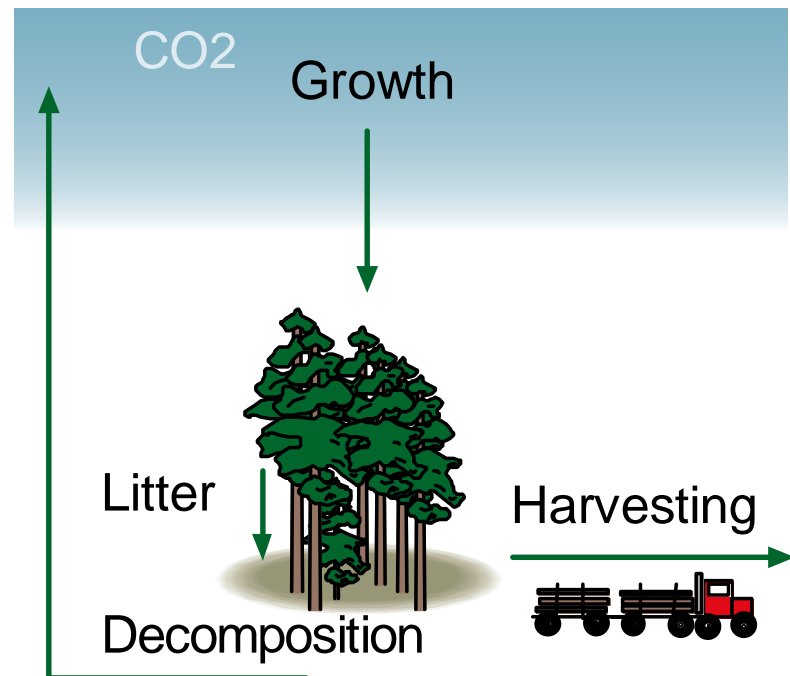
Integrated method

Input

Forest inventory information
Climate information

Output

Carbon stocks and stock changes
biomass, dead wood, litter, soil carbon
Carbon fluxes
NPP, Rh, NEP, NBP



Applicability of the Integrated method

- Suitable for analyses at various spatial scales
 - from stands to region
- Useful components
 - BEFs (stemwood to biomass)
 - Litter production
 - Ground vegetation
 - Soil carbon model Yasso

Reliability of Integrated method results

Trees

BEFs accompanied with uncertainty estimates

Soil and litter

most uncertain components, uncertainty being
quantified

litter production of foliage, fine roots and ground
vegetation, important but uncertain

initial soil carbon

climate dependence of decomposition

Tests and uncertainty analyses

What's new on trees

- Carbon stock of trees 8 % larger
 - More accurate, stand-age-specific BEFs
- Carbon sink of trees more variable between years
 - Annual growth index
 - More accurate BEFs

What's new on soils

- Changes in soil carbon estimated
- Soil contributes significantly to the carbon balance of Finnish forests
- Carbon balance of soil highly variable
 - Long-term trends depend on litter production of living trees
 - Year-to-year variation depends on climatic conditions and harvests

What's new on method 1/2

- Complete carbon budget of forests based on inventory data
- Carbon stock and the carbon sink of trees more accurately estimated

What's new on method 2/2

- Soil carbon estimates integrated to trees
 - Based on basic forest inventory and climate information
 - "Transparent and verifiable information"?
 - Verifying the sign of these estimates less laborious and less expensive than a pure soil carbon inventory?
 - Help to design effective soil carbon inventories
 - Useful with scenarios (use of forests, climate)

Acknowledgements

- Martti Aarne, Juha Heikkinen,
Helena Henttonen, Antti Ihalainen,
Annikki Mäkelä, Elina Mäki-Simola,
Yrjö Sevola, Petteri Vanninen,
Pekka Tamminen, Tarja Tuomainen