SAPWOOD PROPORTION AND NITROGEN CONTENT IN BOREAL AND TEMPERATE TREE SPECIES

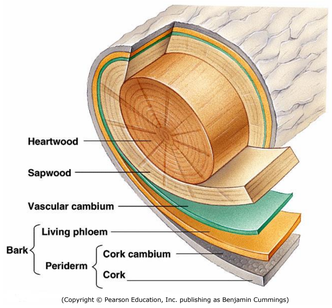
Martin Thurner[1] (martin.thurner@senckenberg.de), Christian Beer[2], Thomas Hickler[1,3]

BiK F | Biodiversität und Klima Forschungszentrum

SENCKENBERG world of biodiversity

BACKGROUND

- **Maintenance respiration depends on** temperature, plant **biomass and on nitrogen content**
- **Information on biomass** and N content **in tree compartments required**
- **Sapwood** (= living tissue) **contributes to plant respiration**, but not heartwood
- **Spatial estimates** of stem (+ branch, root and foliage) biomass available, but **required for sapwood biomass**



(Copyright © Pearson Education, Inc. publishing as Benjamin Cummings)

CONCLUSIONS

(1) Plant respiration will be **derived from** spatial estimates of tree compartment **biomass**, temperature **and** plant trait data (**N content, respiration rates**)

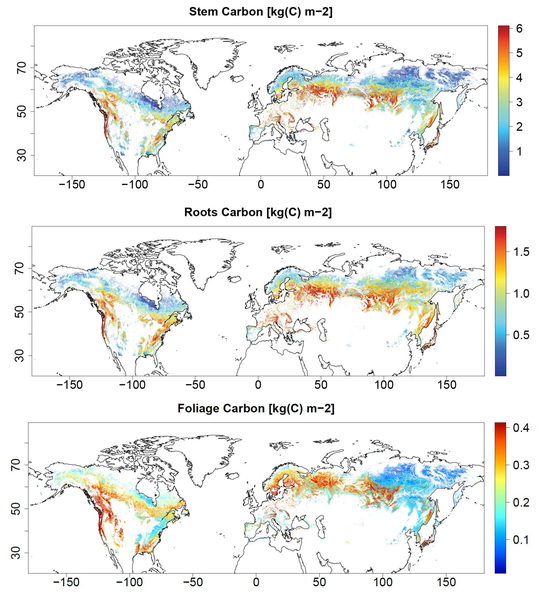
(2) Changes in tree species distribution (by forest management or climate change) can strongly **affect sapwood biomass (and thus R_a)** even if stem biomass remains unchanged

(3) N content varies strongly **between** tree **compartments** and tree species

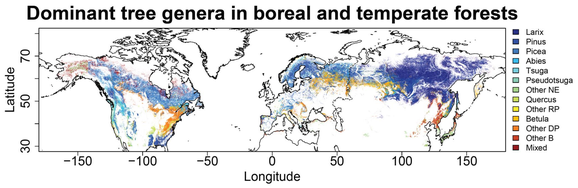
Tree Compartment Biomass based on Satellite Radar Remote Sensing[1,2]

(can be requested at https://www.bgc-jena.mpg.de/geodb/)

- ENVISAT/ASAR C-band radar (2010)
- 0.01° (≈ 1 km) resolution
- Growing stock volume converted to carbon density (using data on wood density and biomass allometry)



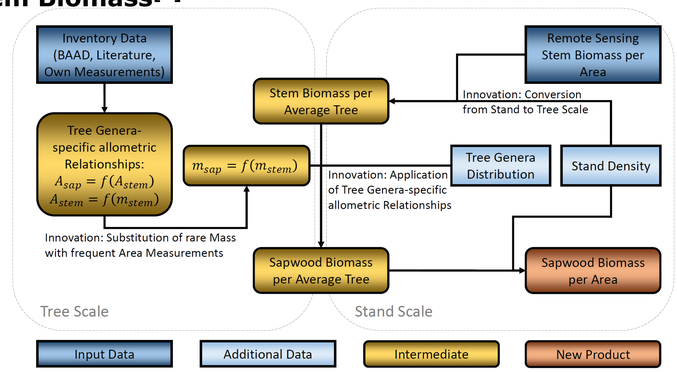
Dominant tree genera in boreal and temperate forests

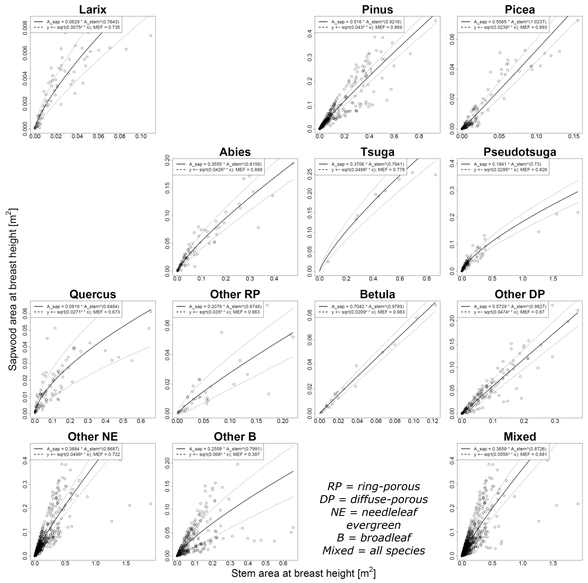


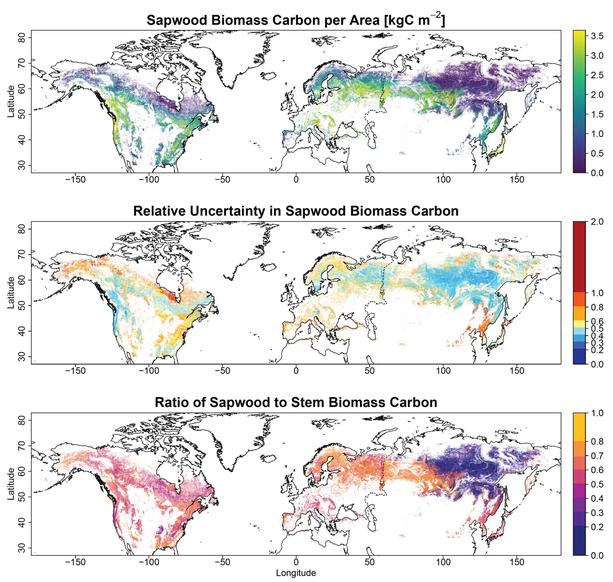
Derivation of Sapwood Biomass from Stem Biomass[3]

(can be downloaded at https://bolin.su.se/data/thurner-2020)

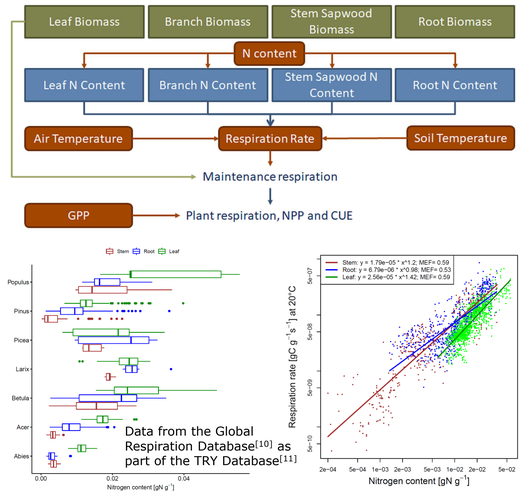
- **Innovation 1: Use of measurements[4] of sapwood area and stem cross-sectional area** instead of rare sapwood mass measurements, **together with theory on biomass allometry**
- **Innovation 2: Application of a global tree density product[5]** to bridge the gap between inventory measurements at tree level and satellite observations at forest stand scale
- **Innovation 3: Application of a map of dominant tree genera[6-9]** allows accounting for most of the variation in sapwood-to-stem proportion



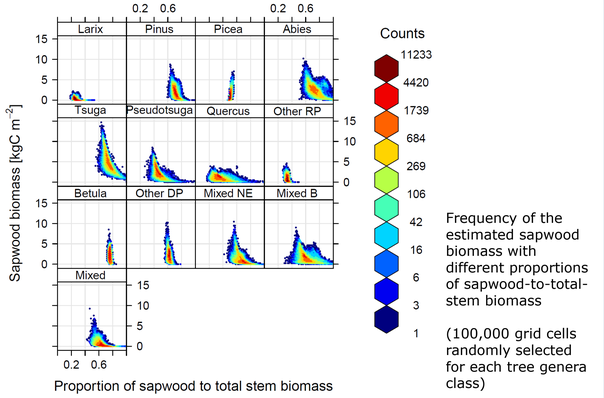




Towards Estimating Plant Respiration



Data from the Global Respiration Database[10] as part of the TRY Database[11]



Frequency of the estimated sapwood biomass with different proportions of sapwood-to-total-stem biomass

(100,000 grid cells randomly selected for each tree genera class)

AFFILIATIONS:

1 Senckenberg Biodiversity and Climate Research Centre (SBiK-F), Frankfurt am Main, Germany
2 Department of Earth Sciences, Universität Hamburg, Germany
3 Department of Physical Geography, Goethe University, Frankfurt am Main, Germany

REFERENCES:

[1] Thurner et al. 2014, Global Ecology and Biogeography, 23, 297-310.
[2] Santoro et al. 2015, Remote Sensing of Environment, 168, 316-334.
[3] Thurner et al. 2019, Global Ecology and Biogeography, 28, 640-660.
[4] Falster et al. 2015, Ecology, 96, 1445.
[5] Crowther et al. 2015, Nature, 525, 201-205.
[6] Schepaschenko et al. 2011, Journal of Land Use Science, 6, 245-259.
[7] Brus et al. 2012, European Journal of Forest Research, 131, 145-157.
[8] Wilson et al. 2012, Forest Ecology and Management, 271, 182-198.
[9] Beaudoin et al. 2018, Canadian Journal of Forest Research, 48, 85-93.
[10] Reich et al. 2008, Ecology Letters, 11, 793-801.
[11] Kattge et al. 2011, Global Change Biology, 17, 2905-2935.