Forest management cools the Earth! Did it? Will it?

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Switching the focus towards forest management

Forest management







Picture credit: S. Luyssaert, M. Saarinen, TVEnergy, Ake Nilsson

Switching the focus towards forest management

Forest management







Afforestation and reforestation





Picture credit: S. Luyssaert, M. Saarinen, TVEnergy, Ake Nilsson

Land cover and land management equally important







Luyssaert et al. 2014 Picture credit: C. Thomas

How does land management affect the climate?

The basics of the radiative balance



The basics of climate change



Climate mitigation – A carbon perspective



Climate mitigation – An Earth system perspective



Climate mitigation – An Earth system perspective



Forest management and changes in albedo





Mitchell et al 2004, Anderson et al 2011, Halim et al., 2019, Picture credit: Canadian Forest Service

Climate mitigation – An Earth system perspective



Forest management and changes in transpiration





Hassler et al 2018, Picture credit: https://biologyreader.com/transpiration-in-plants.html

Forest management and changes in roughness





---- Low density

---- Medium density

----• High density

Miri et al., 2017, Picture credit: M. Saarinen

Forest management and changes in turbulent fluxes



Picture credit:biocycle.atmos.colostate.edu

Climate mitigation – An Earth system perspective



Land-atmosphere interaction: BVOCs



Guenther et al. 1994

From theory and observations to continental applications

Climate models



Bonan and Doney, 2018

Adjusting the model to the question at hand





Hydraulic architecture

Forest management

Effects of 250-years of forest management



Naudts et al. 2016

	TOA due to GHG (Wm-2)	TOA due to surface (Wm-2)	∆Ta summer (K)	ΔAtmospheric carbon (Pg C)
Global				
GHG emissions	2.98	0.00	1.71	247
European				
Land-use change	0.01	0.11	0.12	1.2
Land-cover change	-0.01	0.12	0.02	-0.7
Forest management	0.02	-0.01	0.10	1.9
Species conversion	-0.01	0.00	0.08	-0.6
Wood extraction	0.03	-0.01	0.02	2.7

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Paris agreement

Biophysical effects and biogeochemical effects were of the same magnitude resulting in no net effect.

Article 2

Hold [...] global average temperature to well below 2 °C above pre-industrial [...]

Article 5

[...] conserve and enhance,[...] sinks and reservoirs of greenhouse gases [...], including forests.

Article 7

[...] reduce the need for additional adaptation efforts.

So, can forest management help us achieve the Paris agreement?

UNFCCC, 2015









In locations with a substantial snow season, deciduous trees help to cool the local climate.

Need to account for all processes, not one is clearly more important.

Climate mitigation – An Earth system perspective



The missing piece



Kalliokoski et al., 2020

Forest management cools the Earth! Did it? Will it?

- When managing the carbon balance of a forest, unintended but unavoidable changes in surface properties and behaviour occur.
 These should be accounted for when assessing the climate impact of forest management.
- Forest may cool the Earth, i.e., tropical afforestation but there is little evidence European forest management did and will.

Problem or opportunity?

- Is the effort and risk worth the potential climate impact or should we focus our efforts on the sustained provision of ecosystem services, hence, forest stability?
- Instead of maximizing the sink, forest management could maximize the provision of ecosystem services while minimizing the GHG emissions.