



Estimation of carbon stocks and stock changes in soil, litter and deadwood in Swiss forests with Yasso07

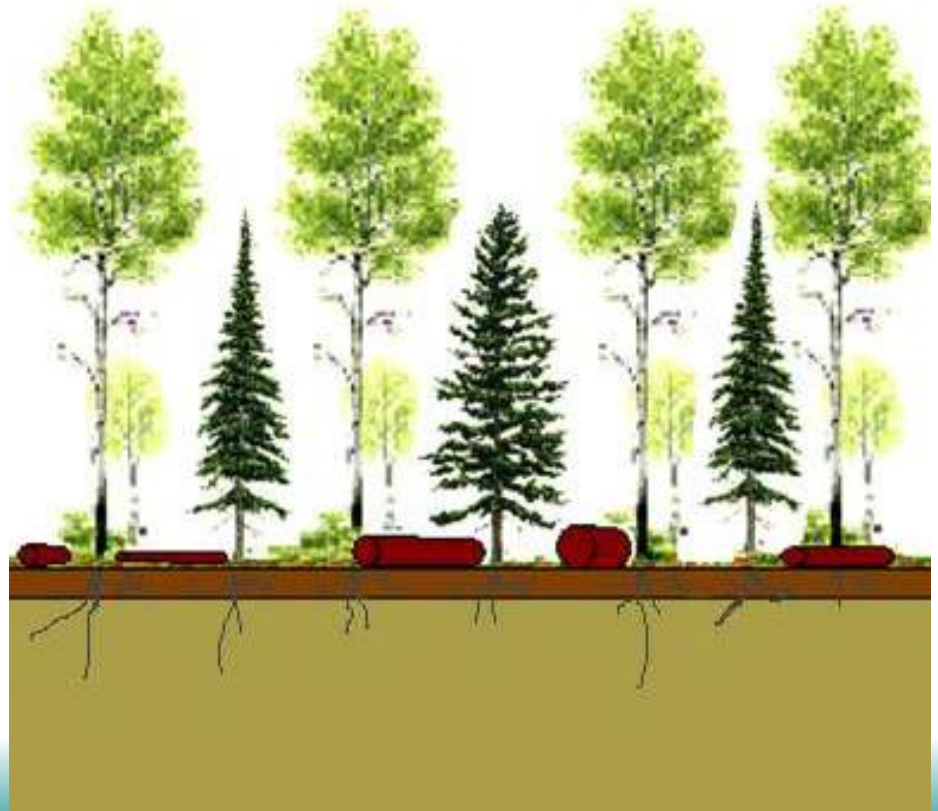
Markus Didion, WSL

JRC LULUCF workshop

Ispra, 27 Feb – 1 March 2013

Overview

- Model of carbon cycling Yasso07
- Implementation to Swiss forests
- Validation of results
- Conclusions and Challenges

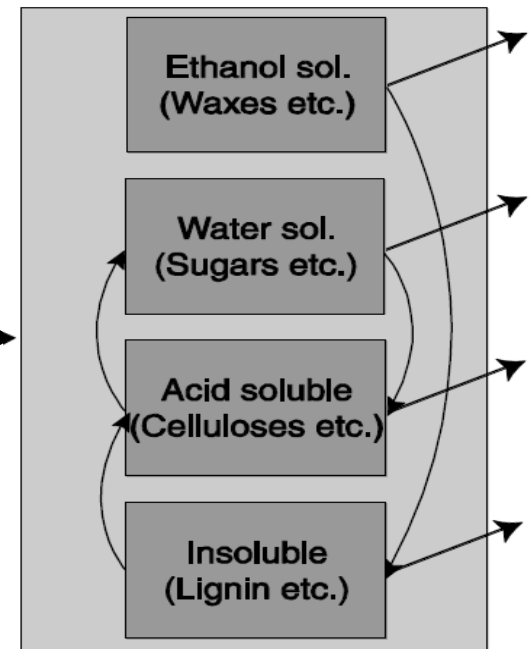


Yasso07 (Tuomi et al. 2009; 2011)

- Model of litter decomposition and soil carbon cycle
 - Annual decomposition as a function of
 - T, T-amplitude and P
 - Litter quality and dbh

C-inputs

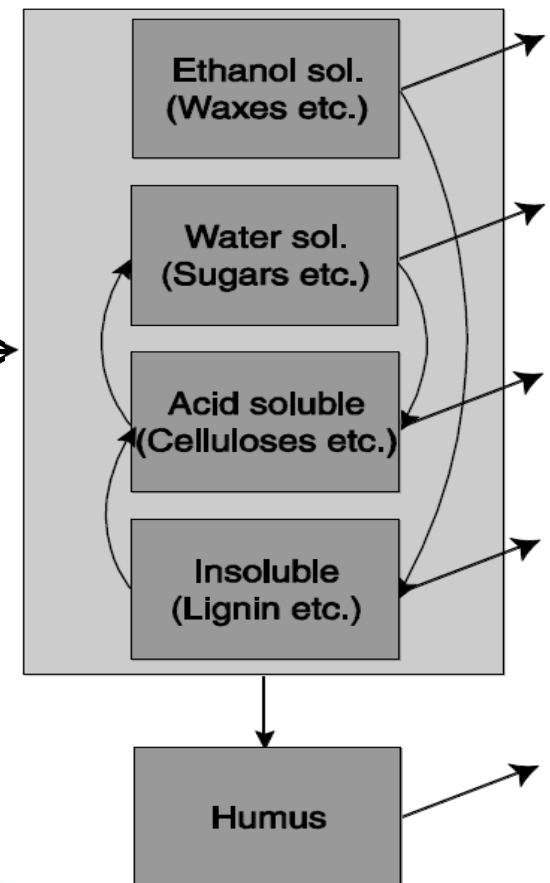
(litter, deadwood) →



Yasso07 (Tuomi et al. 2009; 2011)

- Model of litter decomposition and soil carbon cycle
 - C cycling between compartments and more stable humus

C-inputs
(litter, deadwood) →



Yasso07 (Tuomi et al. 2009; 2011)

- Model of litter decomposition and soil carbon cycle
- Generality and low data requirements

Yasso07 (Tuomi et al. 2009; 2011)

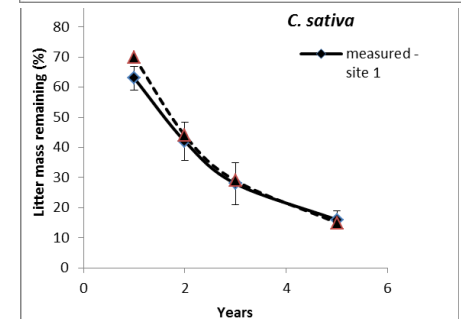
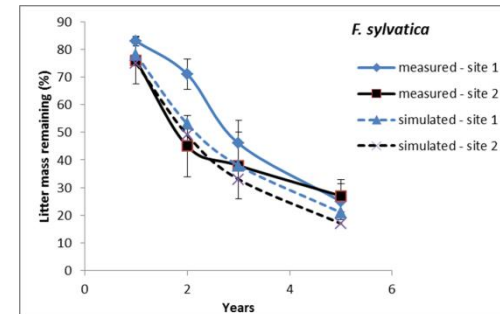
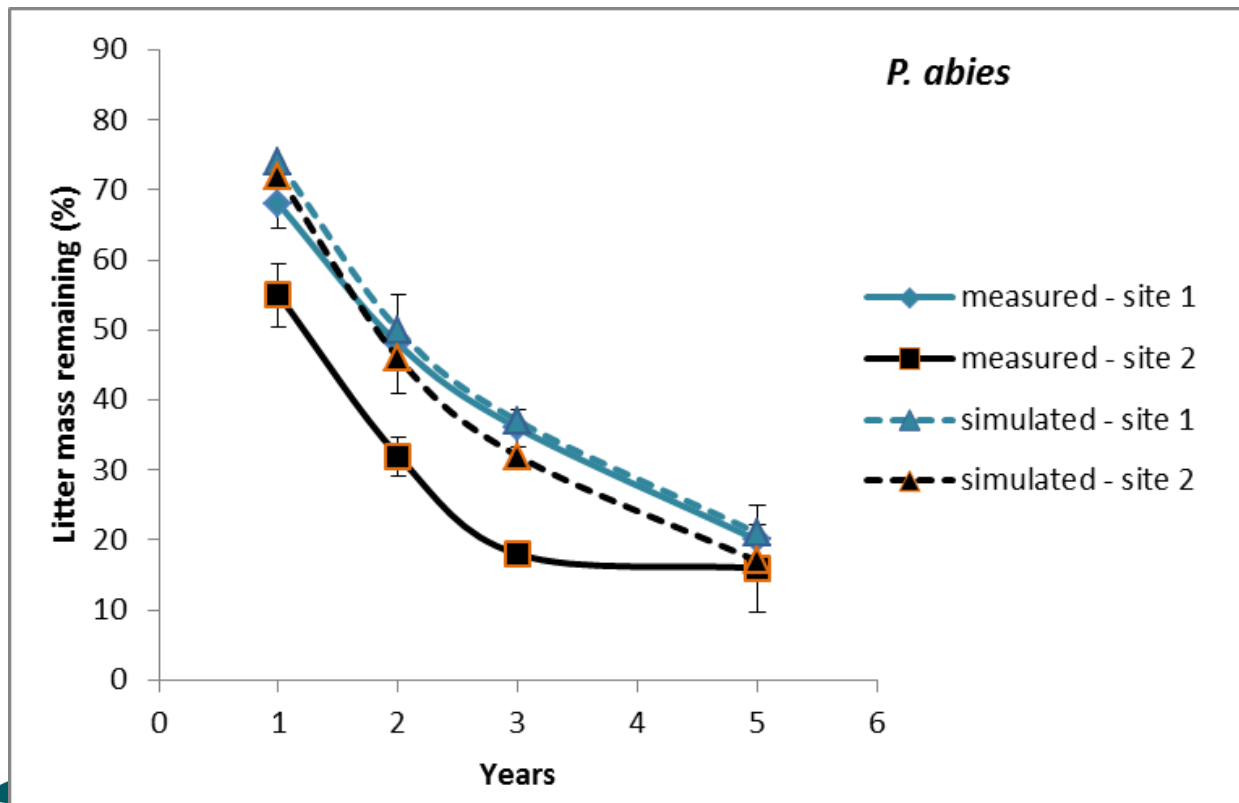
- Model of litter decomposition and soil carbon cycle
- Generality and low data requirements
- Parameter estimation
 - Database of litter decomposition measurements
 - Independent parameter sets (Tuomi et al. 2009, 2011; Rantakari et al. 2012)

Yasso07 (Tuomi et al. 2009; 2011)

- Model of litter decomposition and soil carbon cycle
- Generality and low data requirements
- Parameter estimation
 - Database of litter decomposition measurements
 - Independent parameter sets
- Application
 - stock and stock change of organic C on mineral soils
 - GHGI: Finland, Norway, Austria, Belgium
 - Research: forest and agric. Sites (e.g. de Wit et al. 2006; Luyssaert et al. 2010.; Karhu et al. 2012)

Yasso07 - implementation for Swiss forests

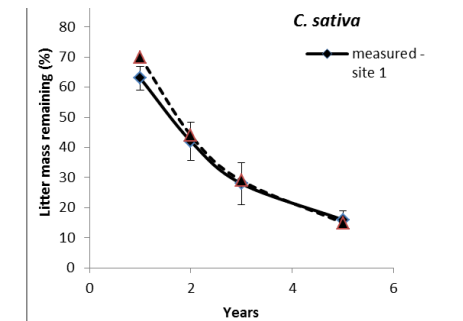
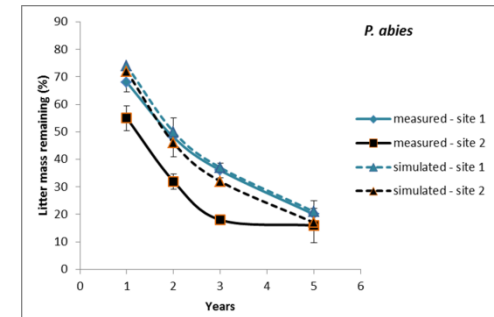
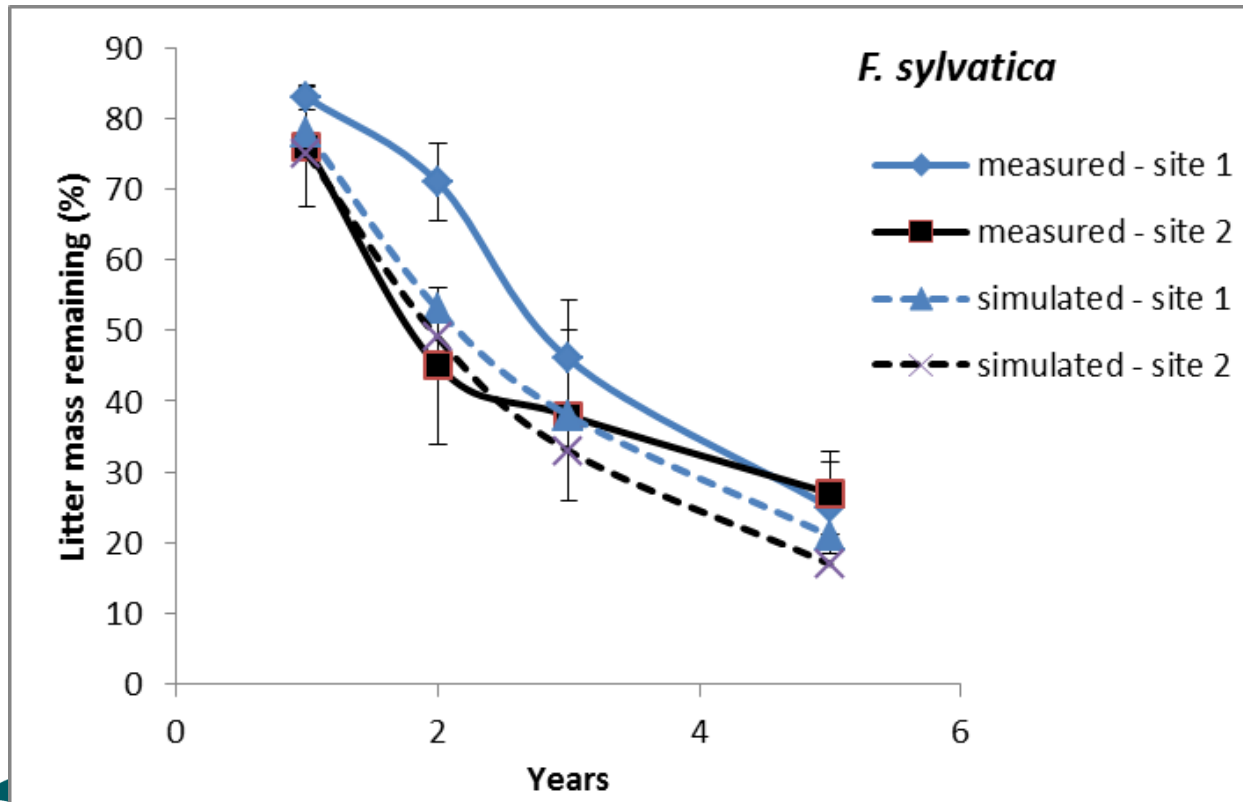
- Model parameters – validation



Data from Weggler 2011

Yasso07 - implementation for Swiss forests

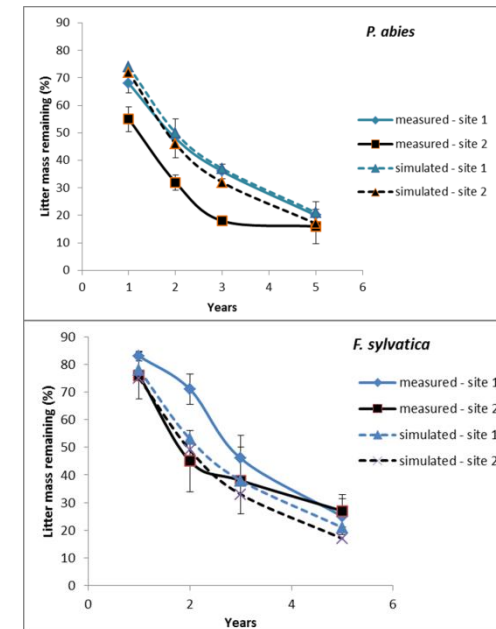
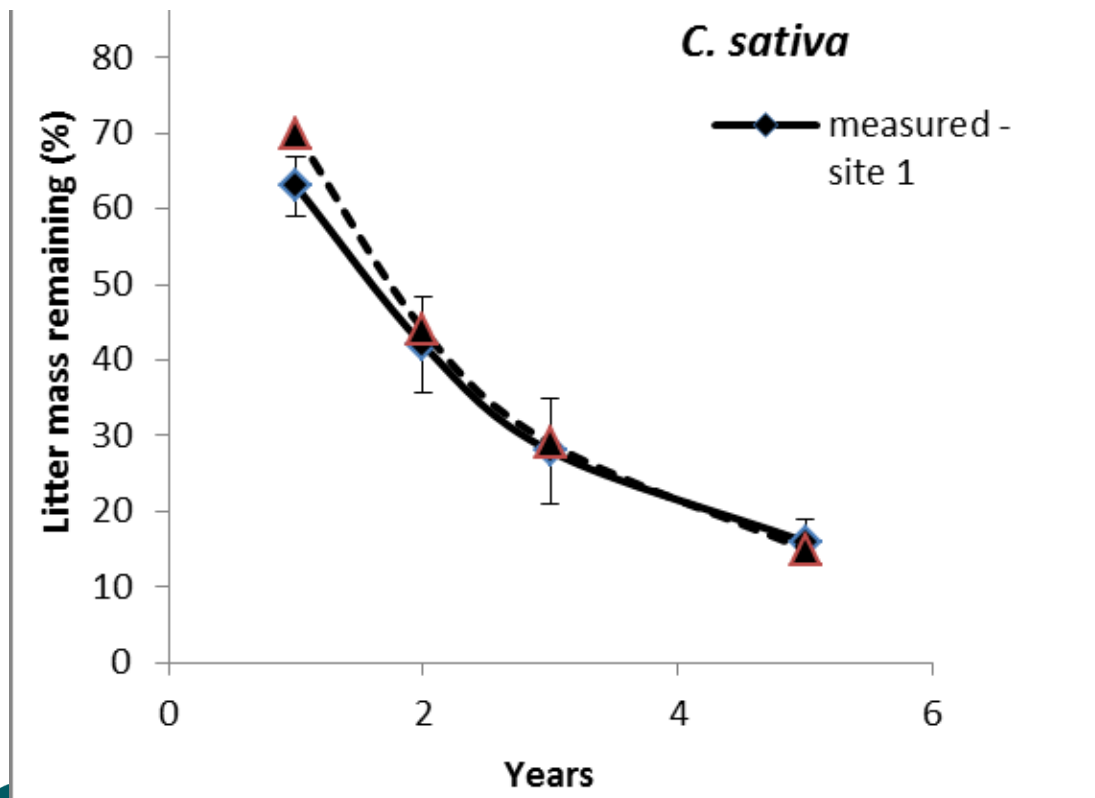
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Data from Weggler 2011

Yasso07 - implementation for Swiss forests

- Model parameters – validation



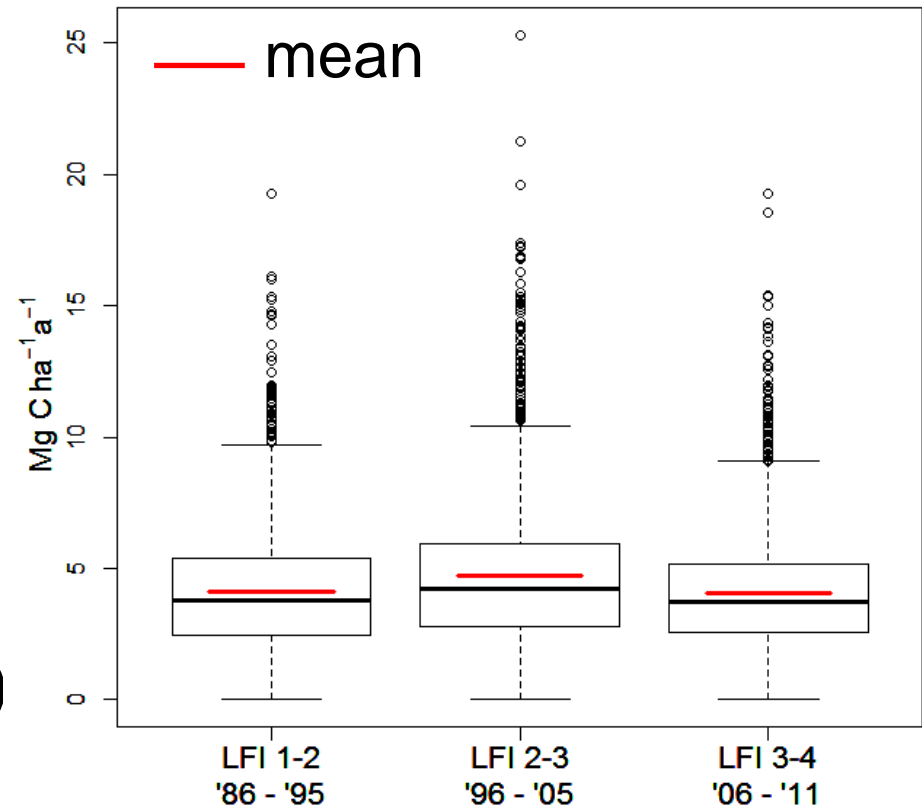
Yasso07 - implementation for Swiss forests

- Model parameters

- C-Inputs (mass)

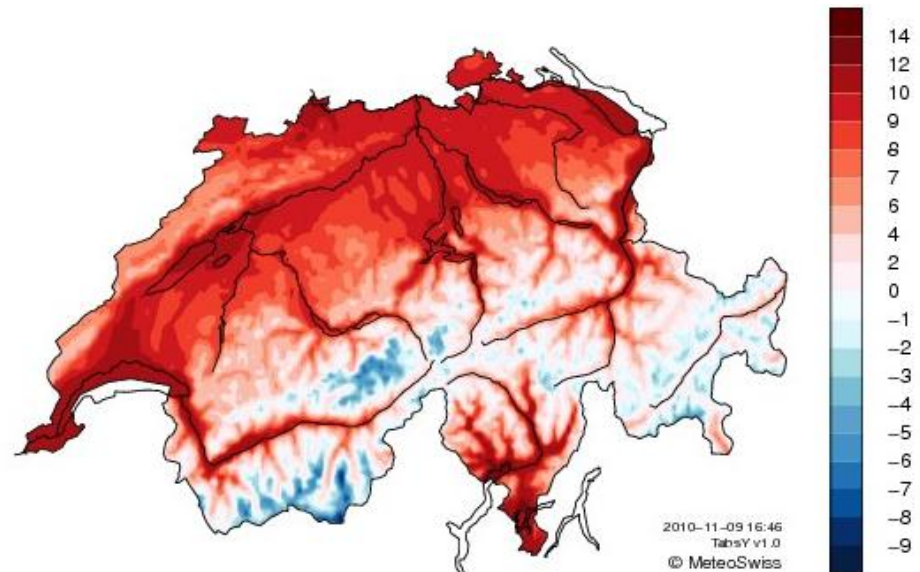
National forest inventory
(LFI) since 1985

- Fine roots
- Foliage litter
- Fine deadwood (DBH)
- Coarse deadwood (DBH)



Yasso07 - implementation for Swiss forests

- Model parameters
- C-inputs
- Temperature, T-amplitude and precipitation
 - Meteo Swiss
 - Annual data
 - 2km grid

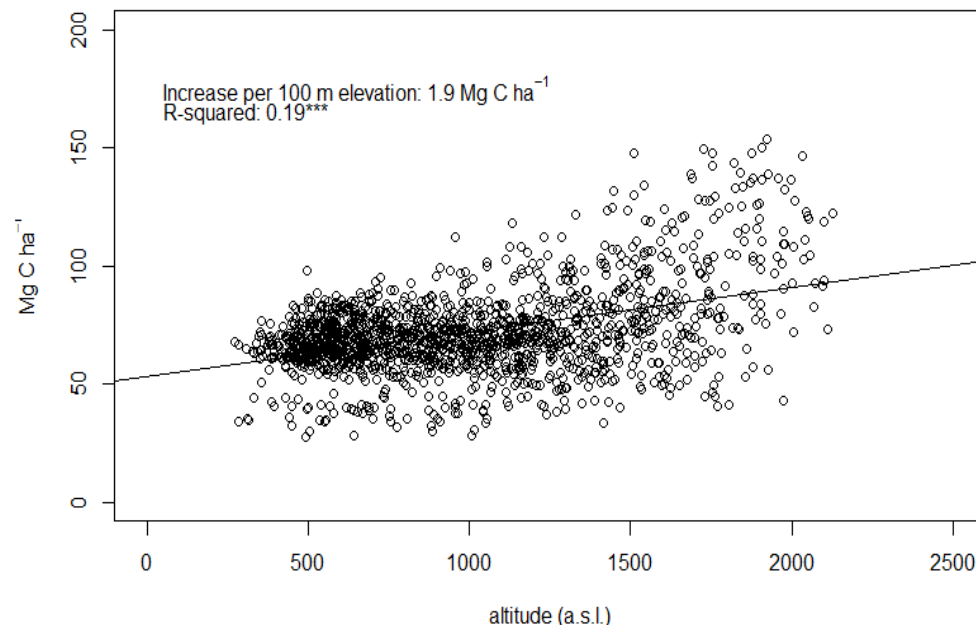


Yasso07 - implementation for Swiss forests

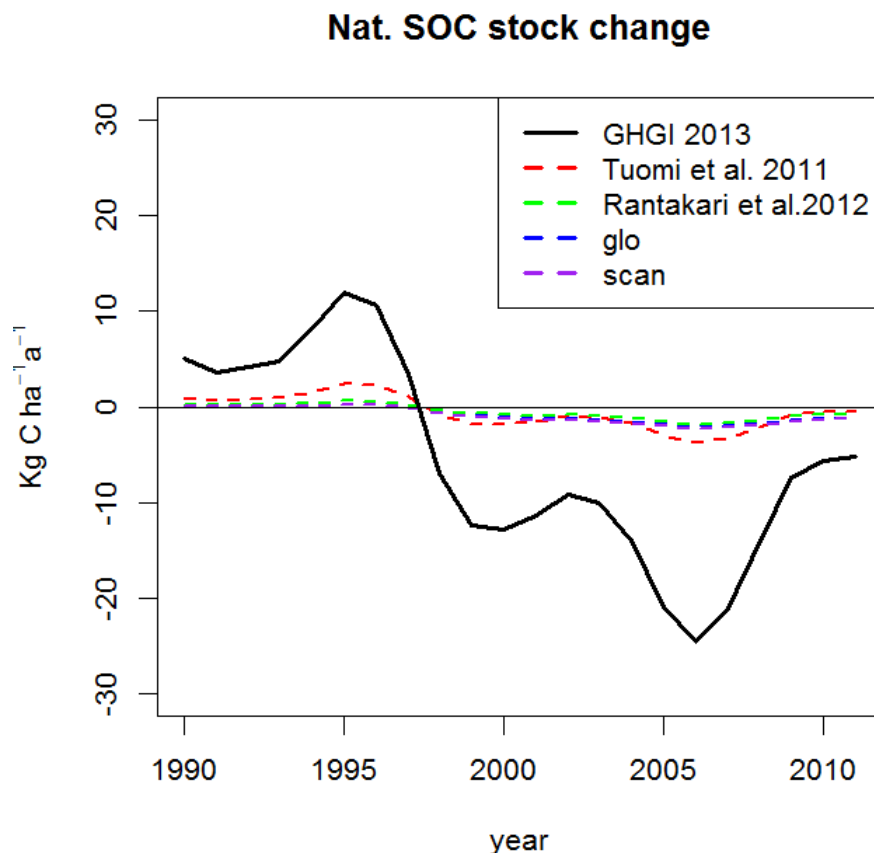
- Model parameters
 - C-inputs
 - Temperature, T-amplitude and precipitation
 - Site-specific simulation
- C stock in soil, litter and deadwood

Results – C stocks

- Soil C stocks generally underestimated
- Elevation gradient reproduced
 - SOC: $1.9 \text{ Mg C ha}^{-1} 100 \text{ m}^{-1}$ vs. 2.3 (Hagedorn et al. 2010)

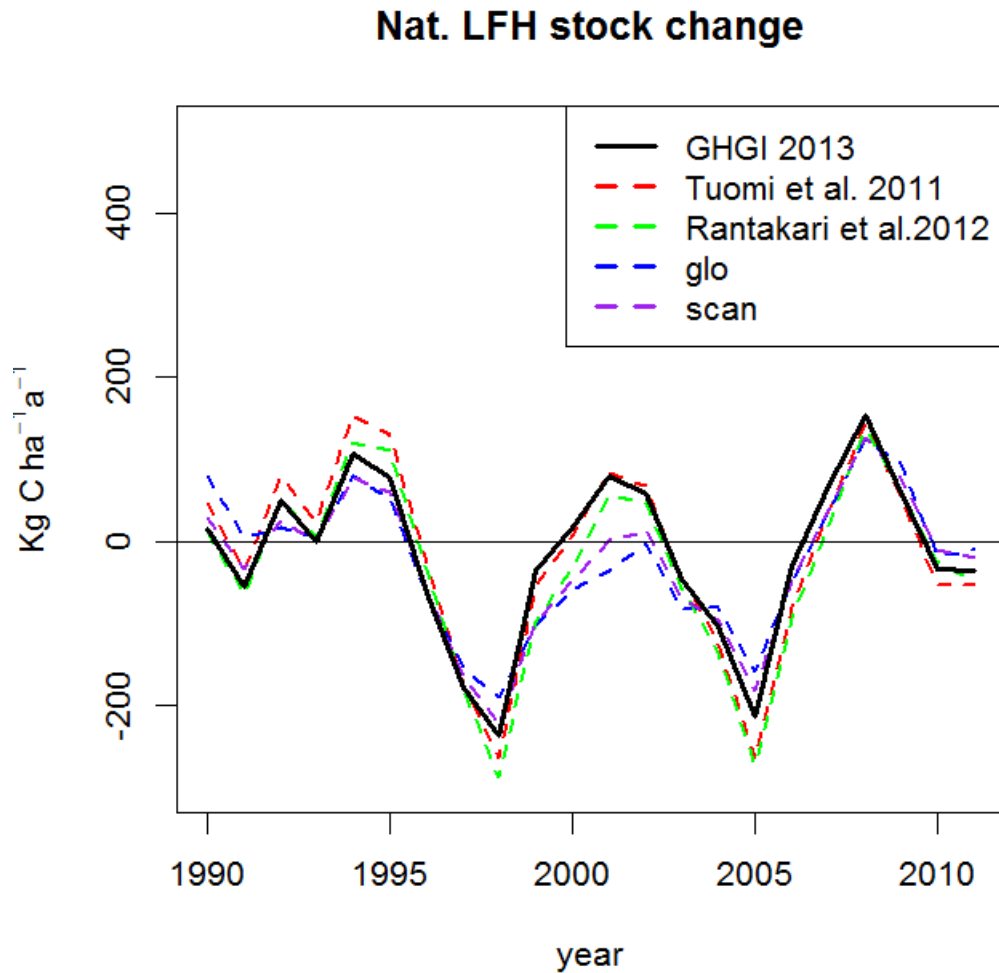


Validation C stock change - soil

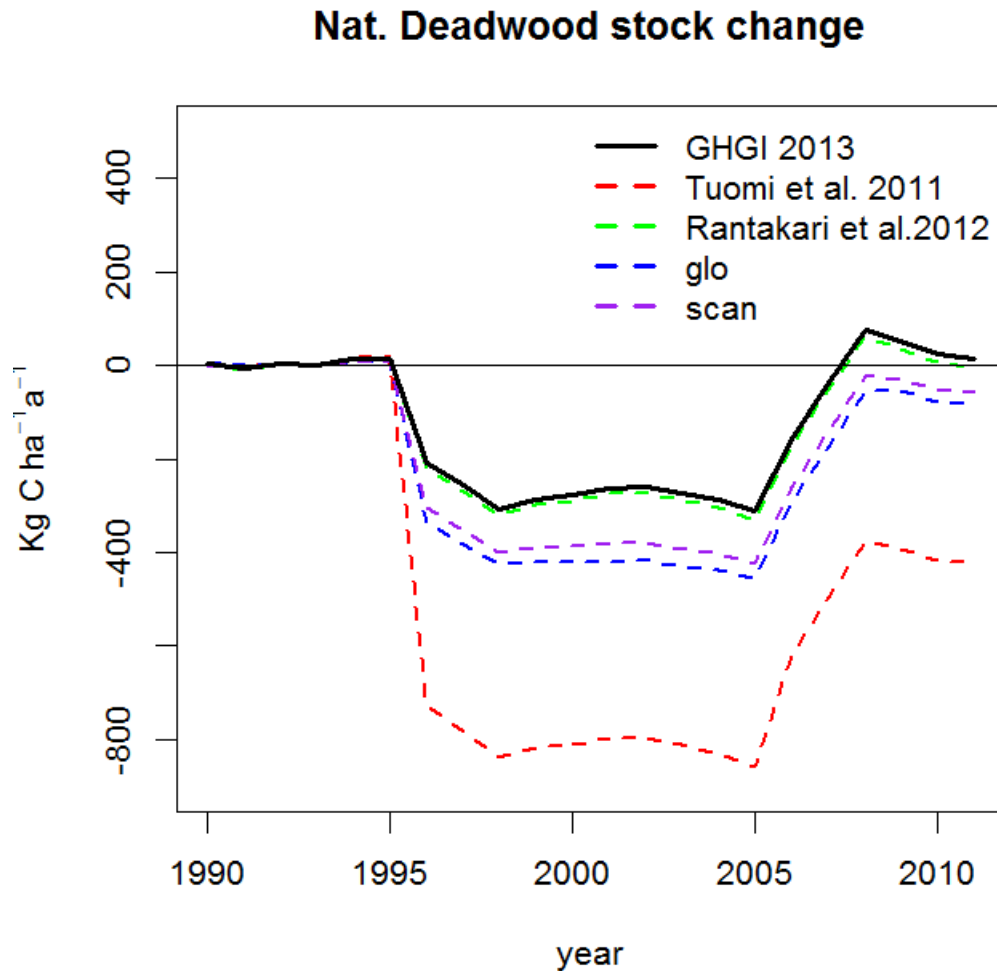


- Consistent with data from 28 soil monitoring sites (Keller et al. 2006)

Validation C stock change - litter



Validation C stock change - deadwood



Net CSC 2009 - 2010

Country	Net CSC in soil [Mg C ha ⁻¹ a ⁻¹]	Net CSC in dead organic matter [Mg C ha ⁻¹ a ⁻¹]
Austria ¹	0.19	-0.06
EU15 ¹	-0.05	-0.03
Finland ¹	-0.09	Not given
Liechtenstein ¹	-0.01	0.00
Norway ¹	-0.12	-0.08
Switzerland - recalculated	-0.006	-0.01

¹ Country data from Tab. 5.2a in UNFCCC 2012. Synthesis and Assessment Report on the GHG Inventories submitted in 2012

Conclusions

- Improvement in accuracy of stock change estimates – robust validation, cf. Rantakari et al. 2011
- Transparent and comparable
- Low data requirements allow site-specific simulation increasing accuracy (Palosuo et al. 2012)
- Potential application to non-forest sites and for LUC assessment (e.g. GHGI Norway; Karhu et al. 2007)

Challenges

- Historical stocks and legacy effect
 - Underestimation of soil C stocks
- Accuracy of pools
- Improve validation of stock changes
- Uncertainty propagation

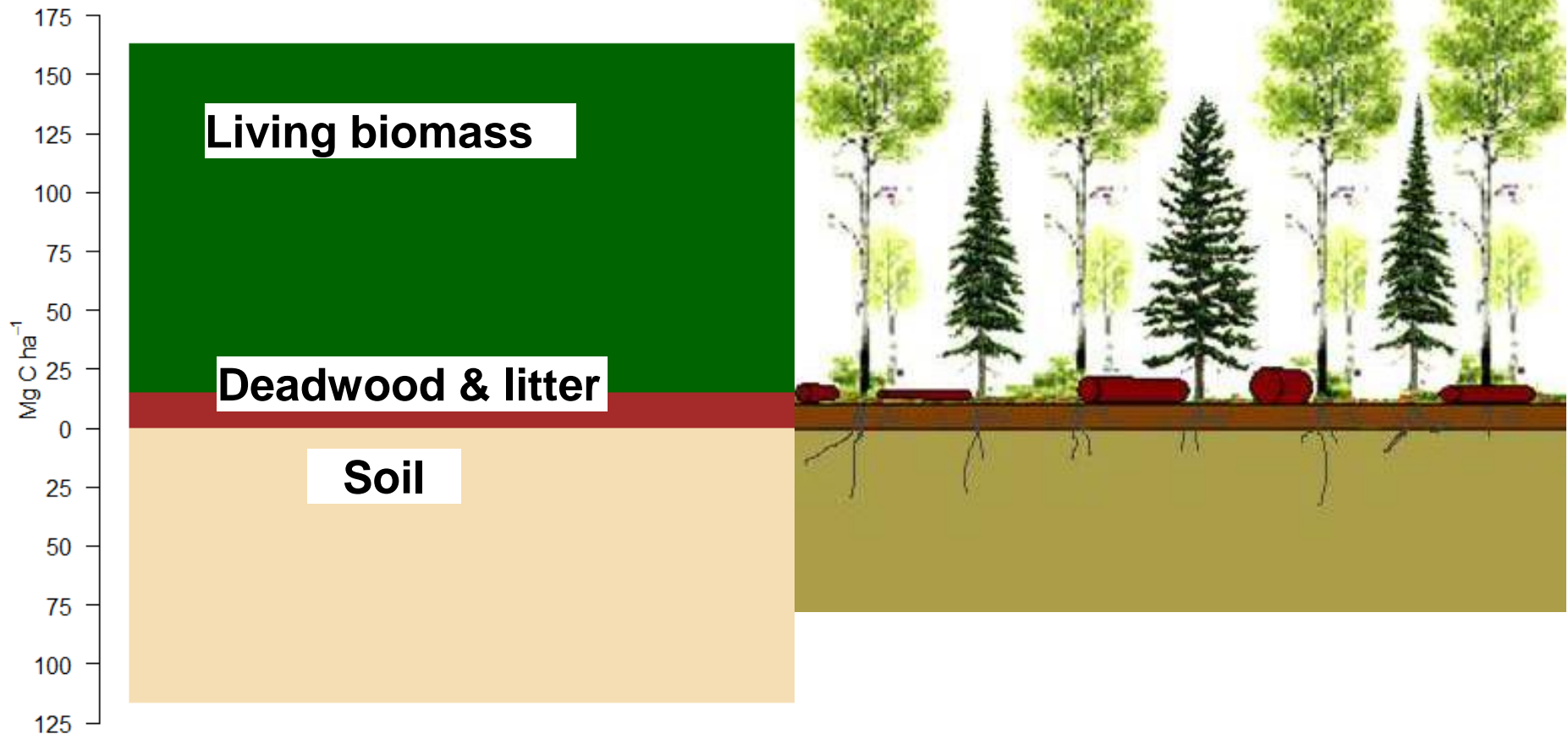
Acknowledgements

- E. Thuerig, E. Kaufmann, NFI team, WSL
- Swiss Federal Office for the Environment



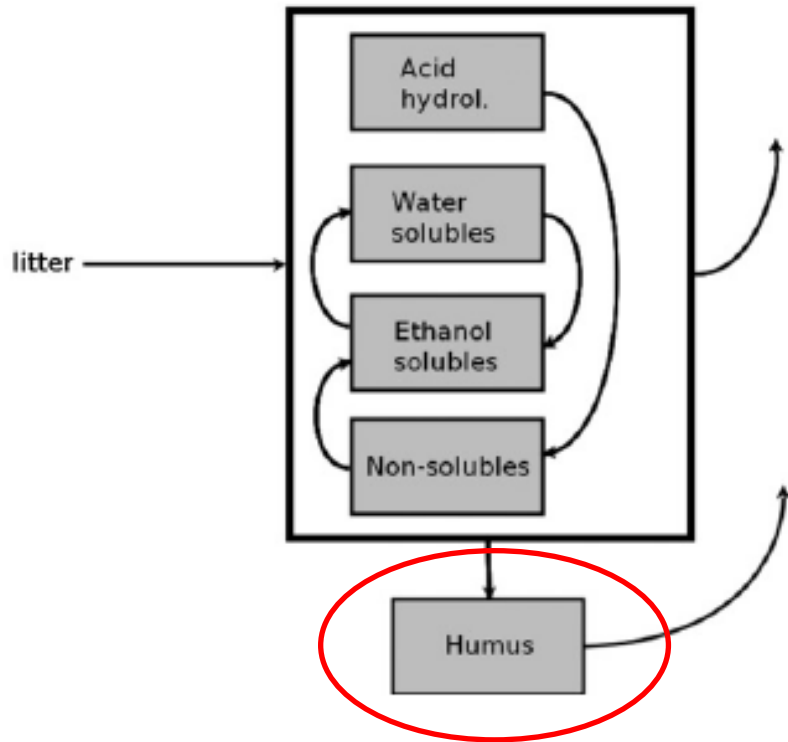
Additional material

C stocks in Swiss forests



after Fig. 10, BAFU 2007. CO₂-Effekte der Schweizer Wald- und Holzwirtschaft

Identification of pools



From Tuomi et al.
2011

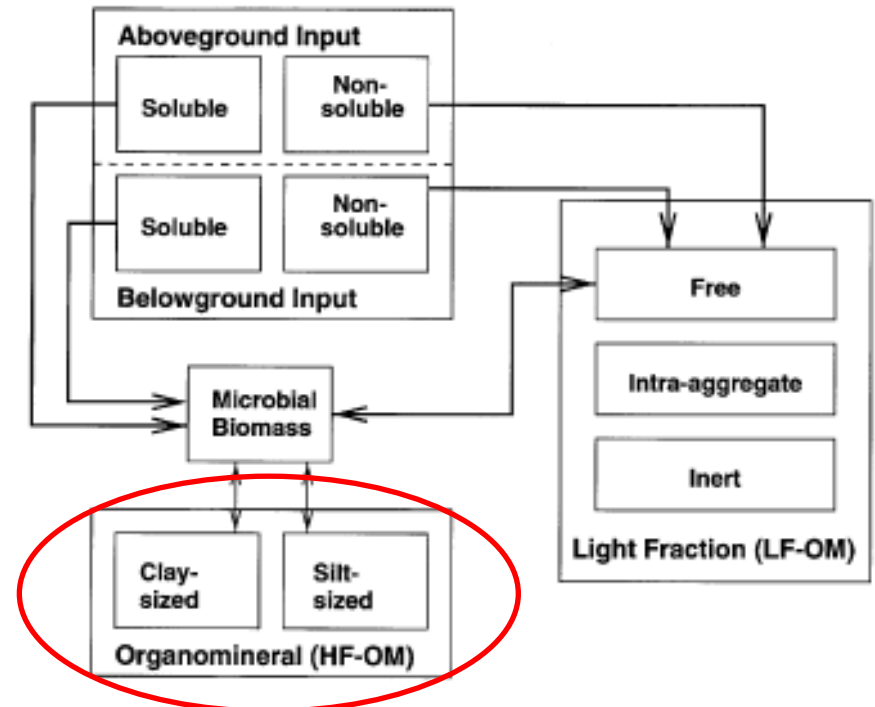
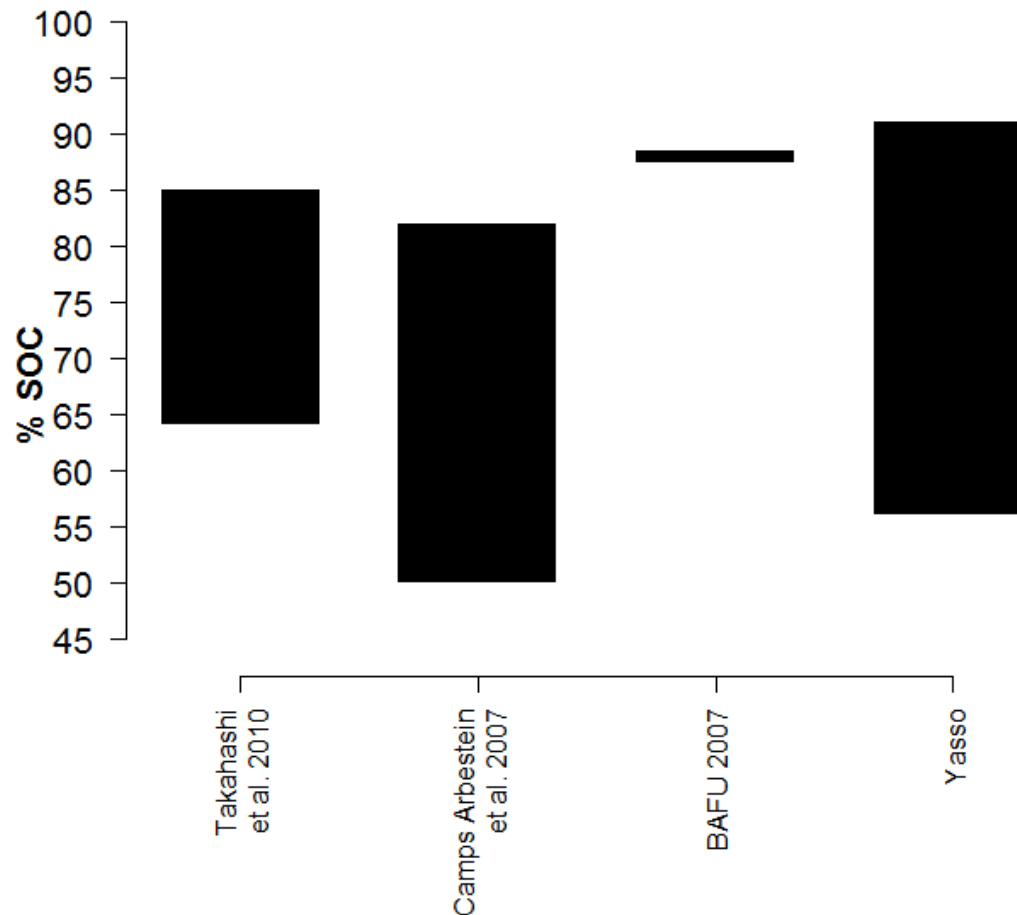


Fig.1 Mineralization and transfer of organic matter in soil (Christensen 1996).

Identification of pools

- Validation

- Ratio SOC to total C (soil, litter, deadwood)



Identification of pools - Validation

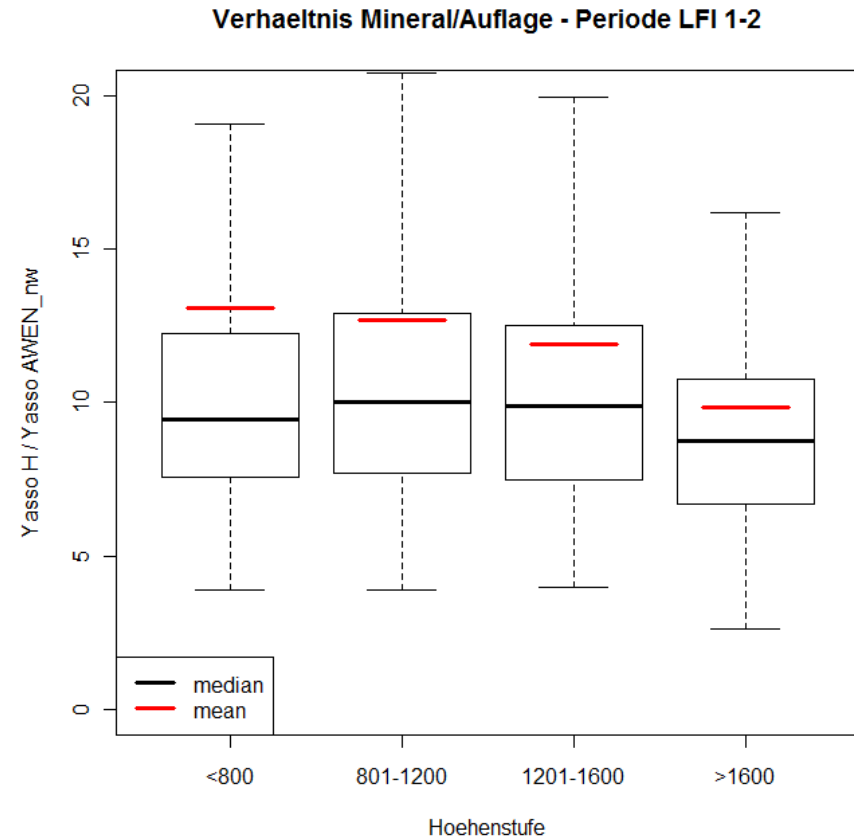
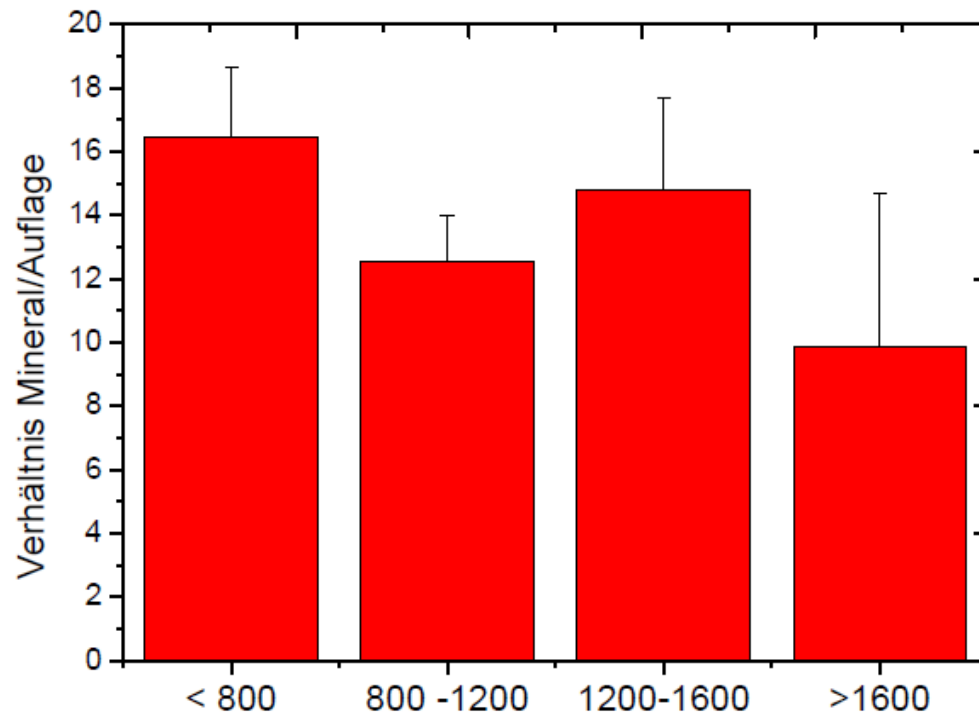
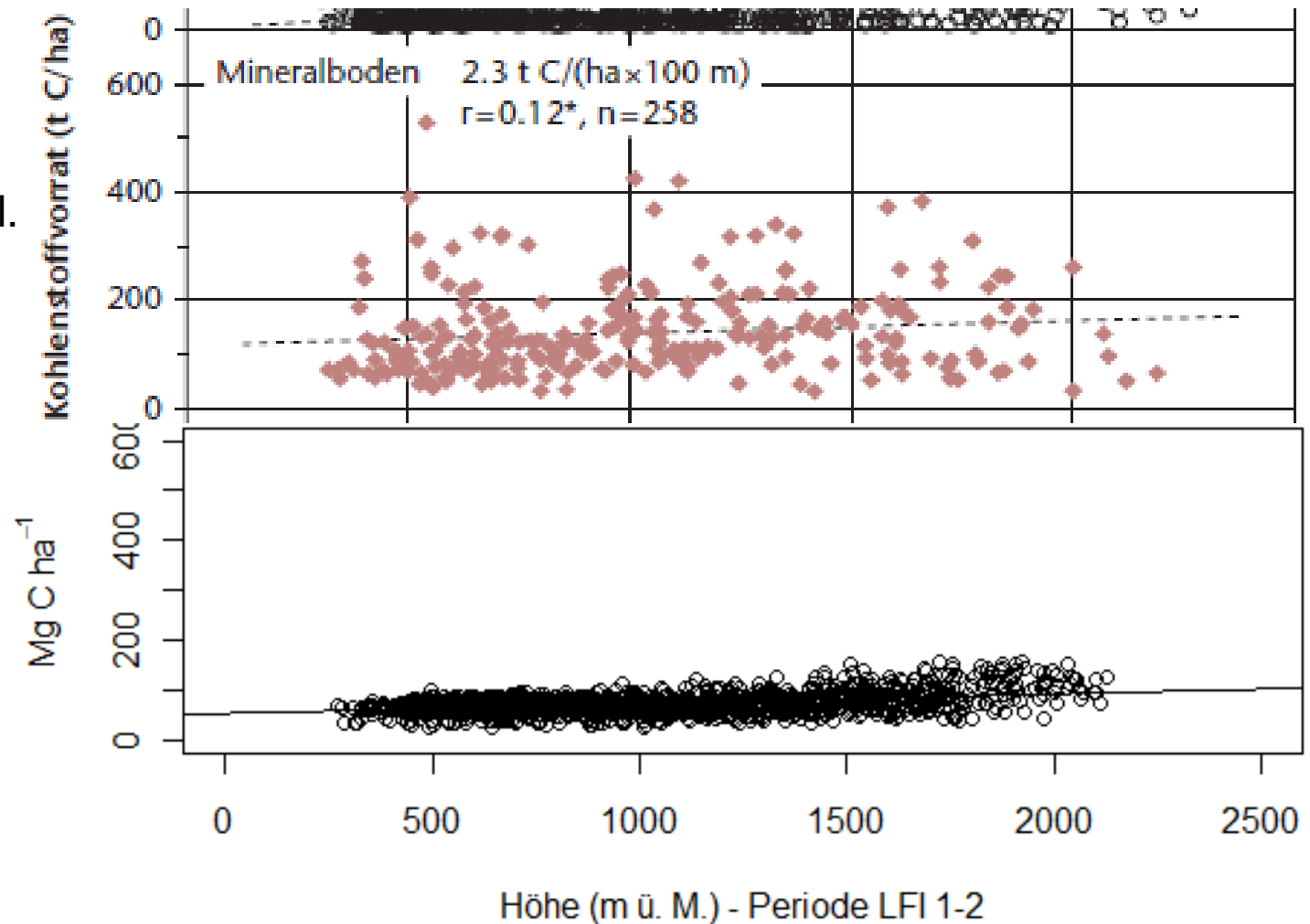


Fig. 5-25 in Moeri 2007

Identification of pools

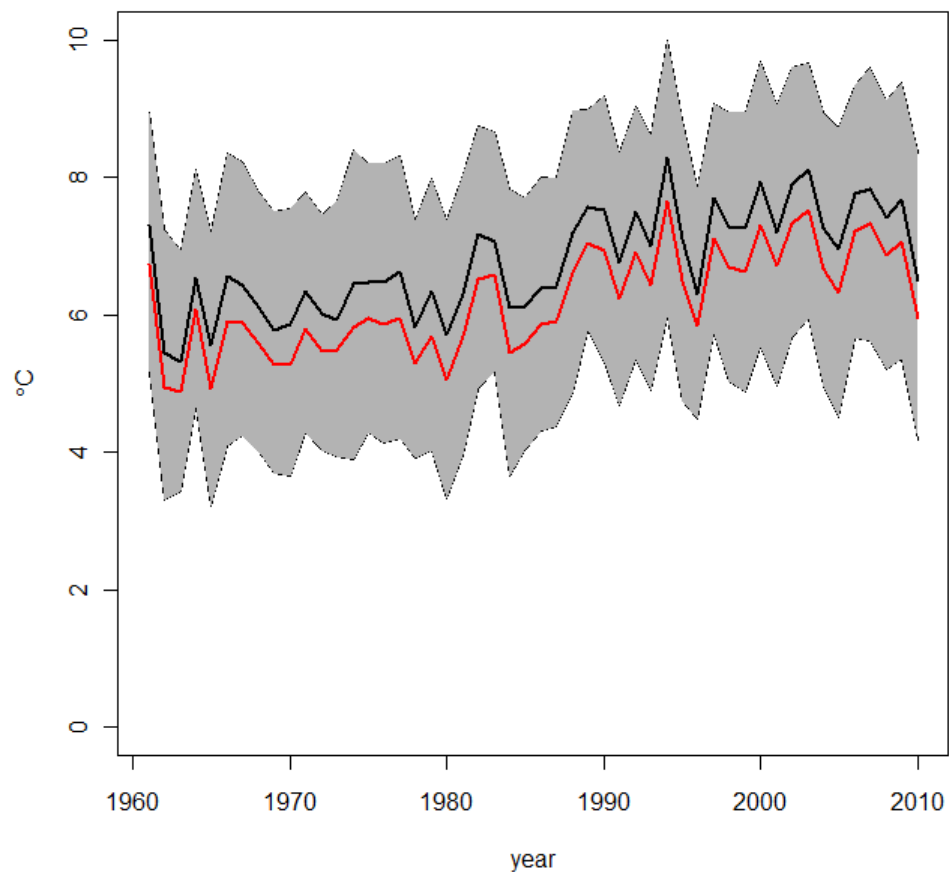
- Validation

Fig. 3 in
Hagedorn et al.
2010

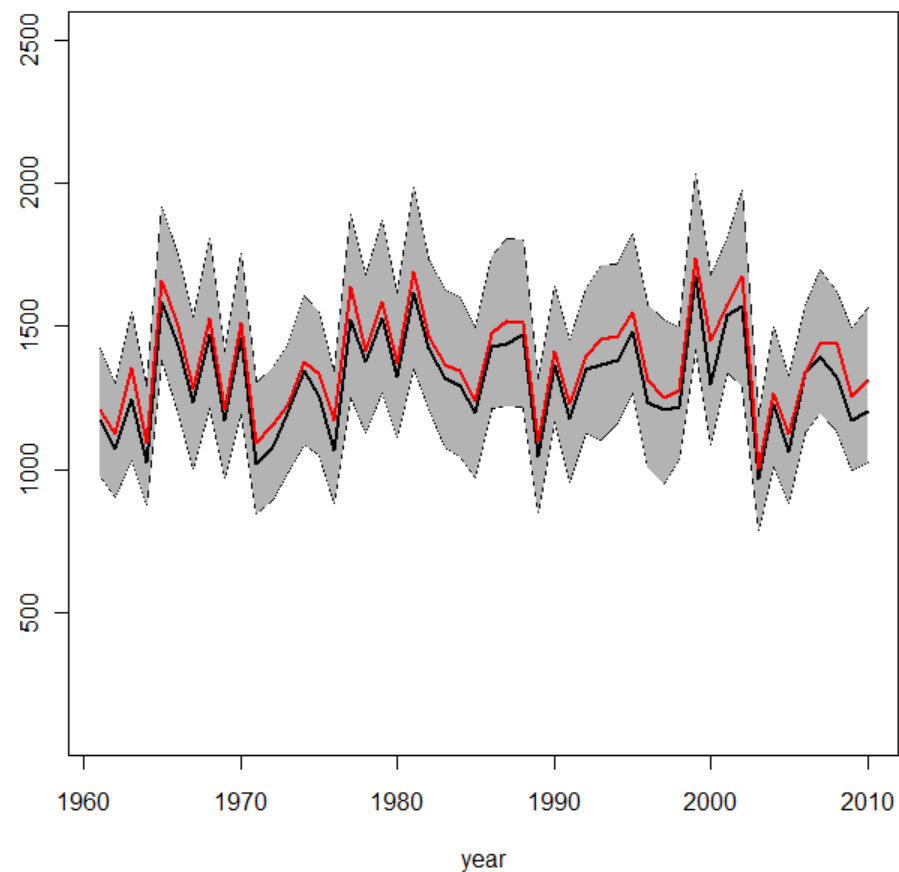


Climate

Temperature - 2km (MeteoCH)
mean, 25, 50, 75%iles



Precipitation - 2km (MeteoCH)
mean, 25, 50, 75%iles



C-inputs

- LFI 1-4
 - 1.4 km Netz: 4726 (LFI 1-3), 1548 (LFI 4)
Probeflaeichen
produktiver Wald

