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# Uncertainty of soil carbon sink estimate - case Finnish GHG inventory

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## Background

- The National Forest Inventories (NFI) serve often as a basis to estimate carbon stock change of tree biomass.
- According to the Kyoto protocol, countries are obliged to report carbon stock changes of biomass, litter, dead wood and soils. Countries may omit a pool from the reporting, if they provide transparent and verifiable information that the pool in question is not loosing carbon.
- The objective here was to quantify the uncertainty of the model based estimate for soil carbon sink of mineral soils in Finland.

## Material and methods

- The carbon stock change of mineral soil carbon (including litter, dead wood and soil organic matter) pool of forest land mineral soils were estimated with Yasso07 soil carbon model (Tuomi et al. 2011).
- Yasso07 needs input information about initial carbon stock of soils and thereafter time series of litter input (living trees, harvesting residues, natural mortality and understorey vegetation) and weather data (Liski et al. 2006).
- Here we applied both constant (average 1971-2010) and annual weather data with Yasso07 model.
- The parameter uncertainties and variance-covariance matrices of biomass models were utilised to estimate both the uncertainty of biomass due to sampling and due to parameter uncertainty. Also the correlation between biomass components were assessed and utilized (Repola 2008 and 2009).
- The uncertainty of litter turnoverrates were assumed to be similar to that reported by Peltoniemi et al. (2006). The uncertainty of understorey vegetation litter input was assessed by simulating model predictions, using parameter uncertainties and variance-covariance matrices (Muukkonen et al. 2006).
- The uncertainty of Yasso07 model was included by simulating parameter combinations that were obtained as a results of model calibration (Tuomi et al. 2011).

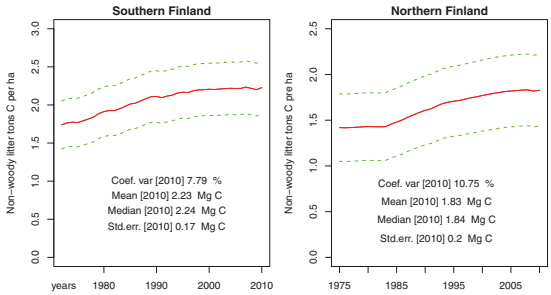


**Figure 1.** The non-woody litter (foliage, fineroot and understorey) estimate and its uncertainty for Southern- and Northern Finland.

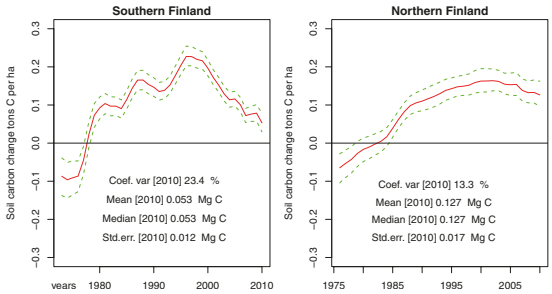


**Figure 2.** Soil carbon stock change estimate and its uncertainty for Southern- and Northern Finland obtained with average 1971-2010 weather data.

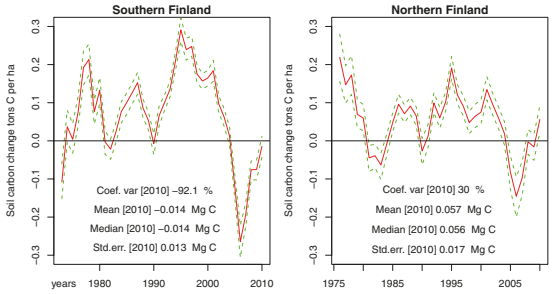


**Figure 3.** Soil carbon stock change estimate and its uncertainty for Southern- and Northern Finland obtained with annual weather data.

## Results

- The uncertainty of litter input is remarkable, especially that of fine root, leaves and understorey vegetation (Fig 1).
- According to the results Finnish mineral soils have been a sink of carbon constantly if we assume constant climate (i.e. temperature does not impact decompostion), (Fig 2).
- Results are opposite when we apply annual weather data with Yasso07 and during warm and moist years soils are loosing carbon (Fig 3).
- The coefficient of variation of soil carbon stock change varied between 10% to 25% between years.

## Conclusions

The uncertainty of modeled soil carbon stock change was influenced by:

- Sampling error of biomass – influencing litter input trend variation and further the variation of the modeled soil carbon stock change.
- The correlation of errors between different biomass components.
- The uncertainty of non-woody litter (fineroots, foliage and understorey vegetation) due to high litter input and substantial uncertainties.

According to the results the uncertainty of annual soil carbon stock change was between 10% and 25% (CV), while the choice of applied weather data is more critical and may result either soil carbon sinks or sources.

## References

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