Geophysical Research Abstracts
Vol. 16, EGU2014-13548, 2014
EGU General Assembly 2014

Estimating needle litterfall in Scots pine based on photosynthesis and stand structural development

Boris Ťupek (1,2), Liisa Kulmala (1), Mikko Peltoniemi (1), and Aleksi Lehtonen (1)

(1) Finnish Forest Research Institute, Vantaa, Finland (boris.tupek@metla.fi), (2) University of Helsinki, Dept. Forest Sciences, Helsinki, Finland

Needle leaf litter modelled with constant foliar biomass turnover rates or with constant proportion of gross primary production (GPP) may underestimate the climate change driven impacts on ecosystem carbon balance. Changing climate may have adverse effects e.g. on the timing of the needle leaf development and shedding quantity, which means litter-induced variation may become more pronounced.

In this study, we investigated whether the meteorological conditions, GPP, and fraction of absorbed photosynthetically active radiation (f_{APAR}) can be used to predict more precisely trends and inter-annual variation of needle litterfall. Mutual dependence of these factors would imply mechanistic linkages between precise estimation of leaf litter and precise estimates of GPP, which is driven by f_{APAR}. The f_{APAR} depends on the quantity of active foliage in canopy that depends on carbon allocation to the foliage.

The needle litterfall, needle cohort counts, and basic tree measurements were conducted between 1992 and 2012 on 7 Scots pine stands across Finland. Meteorological conditions for each stand were available from the nearest weather station. The GPP was estimated with a semi-empirical ecosystem model calibrated to Finnish environment given meteorological conditions and f_{APAR} as inputs. The f_{APAR} depended on the modelled foliage and measured litterfall. Litterfall was estimated as a difference between two f_{APAR} estimates. First based on allometric foliage models and second based on allometric foliage models scaled annually with the needle growth model. We tested our predictions against data from two FLUXNET eddy covariance sites Hyytiälä and Sodankylä located in southern and northern Finland.

We found that the non-functional longevity of the needle lifespan (sum of the period when GPP is close to zero) was strongly correlated with the mean annual GPP level, and could be used for estimating the mean number of the needle cohorts. The inter-annual variation of the number of needle cohorts which correlated with the needle litterfall was function of the GPP variation. Our results show that if structural changes are accounted for in GPP estimation, then both GPP and litterfall predictions are more precise.