Project Database of ICP Forests
PROJECT DESCRIPTION

PROJECT INFORMATION

Project title: Analysis of across-site variability of carbon-flux and -pool relations derived from chamber and eddy covariance based measurements as affected by climate, vegetation and other factors

Project ID: 6

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This is a synthesis project, which aims to answer the following questions:

1. Does soil organic matter residence time in forested ecosystems, derived from carbon flux and stock data, vary spatially across climate zones and vegetation type?

2. What environmental and physiological factors can explain some of this spatial variability (considering: climate, edaphic conditions, and foliage properties).

The goal of our study is to derive, as an overall ecosystem diagnostic, the relationships between carbon fluxes and pools within the whole ecosystem and possibly within different compartments (e.g. organic soil layer and mineral soil). We hope to substantially improve the study by Sanderman et al (2003), where eddy flux measurements were used to derive mean soil organic carbon turnover times (MTO), which were then related to variability in mean annual air temperature and precipitation. In that study, MTO was derived for about 20 forested sites, as the ratio between total annual soil heterotrophic respiration (Rh) and soil organic carbon content (SOC), assuming steady state conditions. Rh was derived from tower-based eddy covariance measurements, while SOC was derived from global soil maps. However, since the publication of that paper, monitoring of soil respiration and of its components across the globe has increased. At many flux sites (http://www.fluxnet.ornl.gov), soil respiration is now often monitored with chambers. At some of these sites, soil heterotrophic respiration is also measured, directly or indirectly (i.e. via trenching or girdling experiments). Furthermore, at some sites, the soils have been analyzed for soil carbon content. This new set of data allowed us to test the relationships observed by Sanderman et al (2003) on a larger spatial scale. We used the data to compute soil organic carbon residence times from tower and chamber-based flux measurements for over 100 forested sites, globally. We then used multivariable regression analysis and mixed-effect modeling to show differences in the response of turnover times to mean annual temperature between different climate zones and also between forests of different leaf habit.

However, based on the method proposed by Sanderman et al (2003), it is also possible to compute these turnover times (MTO) from the input fluxes (i.e. total annual detrital carbon into the system). If we assume that most of the annual carbon input in forested ecosystems comes from litterfall input, we could compute MTO using annual litterfall fluxes. This would then provide us with an alternative estimate of MTO, one unrelated to the estimate based on tower and chamber flux measurements. We are very much interested to find out if the MTO values estimated from the litter-fall approach would result in the same general patterns and relationship as we observed with tower-based estimates. For this we need a dataset that spans several climate zones and also vegetation types (i.e. deciduous vs evergreen forests; needle-leaf vs broadleaf forests). This is why we are approaching the ICP Forests project for your data.

The results of our study will benefit those trying to create and improve models on soil carbon dynamics, by providing empirical constraints on the models. This synthesis would also add to our understanding of spatial variability of SOC dynamics and controls, helping to improve and/or direct future studies on soil carbon cycling.

Reference: Sanderman J., Amundson R.G., Baldocchi D. (2003) Application of eddy covariance measurements to the temperature dependence of soil organic matter mean residence time. *Global Biogeochemical Cycles*, 17: doi: 10.1029/2001GB001833.