15th FEFCO

Forest Ecosystem Function Colloquium (FEFCO) は、地域や地球全体のレベルで森林生態系の機能とその持続的活用法を統合的に理解することを目的とし、研究者間の学術交流を推進します。

第15回森林生態系機能コロキウムは、フィンランド　ヘルシンキ大学から来日される Jukka Pumpanen博士に講演していただきます。どなたでも参加できます。京都大学農学研究科森林利用学研究室がホストを務めます。

15th FEFCO
2014/12/2 16:00 - 17:30
Faculty of Agriculture Main Building, S128
Dr. Jukka Pumpanen
Feedback mechanisms between below-ground carbon allocation, soil organic matter turnover and carbon fluxes

The feedback effects resulting from the increasing atmospheric CO_2 concentration on the biomass production of terrestrial ecosystems and soil organic matter (SOM) decomposition are one of the biggest uncertainties in the predictions of future climate. It has been suggested that root exudates and other easily decomposable carbon could enhance the decomposition of old SOM and turnover rates of nitrogen in the rhizosphere with possible growth enhancing feedback in vegetation. We are studying the feedback mechanisms between the assimilation of CO_2 and decomposition of SOM and the effects of different environmental factors (such as precipitation, temperature, drought and fire) on them in multiple scales using detailed laboratory measurements and long term field experiments. In our recent paper by Lindén et al. (2014), we observed that living rhizosphere and belowground carbon input of easily decomposable C play an important role in the decomposition of SOM. We also observed that the increased amount of easily available carbon in the soil was reflected to the photosynthesis, probably through sink limitation. In a fire chronosequence study by Köster et al. (2014), we studied in a pristine sub-arctic forest, the turnover rate and recovery of soil C stocks after forest fires, and observed, that the turnover rate of soil carbon was substantially affected by the age of the forest. The turnover rate was also positively correlated with the amount of ectomycorrhizal biomass in the soil indicating that the ectomycorrhizal (ECM) fungi are an important driver of the SOM decomposition in boreal forest soil, and that the faster turnover rate of soil carbon in old forests compared to young forest stands is related to the increasing below ground carbon allocation which is due to higher nitrogen demand in old vs. young forests. The estimation of below ground carbon allocation without disturbing the ecosystem is difficult by using conventional girdling and trenching techniques. We have developed a novel method for separating these two flux components (Pumpanen et al. 2014). The method enables continuous monitoring of soil CO_2 effluxes and separation of the two flux components in an undisturbed manner, unlike the traditional flux partitioning methods such as girdling and trenching. With the method we were able to estimate the annual contribution of the autotrophic component in soil respiration and its seasonal variation and connect it to the seasonal variation in gross primary productivity of the forest. The enhanced decomposition of SOM resulted from the belowground carbon allocation to root exudates and ECM symbiosis may also significantly affect the transport of terrestrial carbon to the rivers, estuaries and the coastal ocean, a process with unknown contribution to the global and regional carbon balances. We studied in a recent paper by Pumpanen et al. (2014) how the short and long-term changes in precipitation, soil temperature, soil water content and net ecosystem exchange (NEE) are reflected to DOC concentrations and runoff DOC fluxes in two small forested upland catchments in Southern Finland. The DOC flux was to a large extent determined by the amount of precipitation, but the previous year's NEE and litter production had also a small but significant effect on runoff DOC fluxes. Another possible explanation for the increasing DOC concentrations in the runoff could be the increasing soil temperature which could affect the decomposition of SOM, but it may also increase the belowground carbon sink and thus increase the primary productivity of the forest in the long run (Pumpanen et al. 2012).

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