Carbon dioxide balances of tropical and temperate forests

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Terrestrial ecosystems function as a large carbon sink as a whole in the global carbon balance. The carbon balance of individual ecosystem varies temporally and spatially, depending on endogenous factors and the environment. To investigate vegetation functions for the global carbon cycles, the carbon dioxide (CO_2) exchange of terrestrial ecosystems with the atmosphere (CO_2 flux) has been measured since the mid-1990's using the eddy covariance technique over various ecosystems.

We have measured CO_2 flux above tropical peat swamp forests in Central Kalimantan, Indonesia since 2001 and a larch forest in Hokkaido, Japan since 2000. The former forests are growing on tropical peatlands with different disturbance levels: an undisturbed evergreen swamp forest, a drained swamp forest and a drained cutover. Peat swamp forest was deforested and drained to develop farmland on a large scale in this area during the 1990's. Although peat swamp forest occupies a small portion of the total area of tropical forest, it has become a great concern of not only researchers but also policymakers from the viewpoint of carbon balance, because underling tropical peat stores huge carbon as soil organic matter. Recently, the carbon pool in tropical peat has become more vulnerable and has a high potential to switch to a large carbon source in the near future under the conditions of climate change and large-scale disturbances by human activities, such as land-use change and fires.

The latter forest is a larch plantation established in the mid-1950's. Larch forest is widely distributed over temperate and boreal regions in East Asia. The larch plantation, however, was seriously destroyed by strong wind from a typhoon in 2004. Typhoon is an important disturbance factor for forest ecosystems in East Asia, which are damaged extensively and intensively. CO_2 flux has been continuously measured even after the typhoon disturbance.

I will mainly talk about the CO_2 balance of the tropical peat swamp forests and the larch forest as the representative of tropical and temperate forests, respectively, using our data. Topics include seasonal variations, interannual variations, controlling factors and disturbance effects.