Carbon Balance of Larch Forests: Estimated by Using Multichannel Automated Chamber Approach

Naishen Liang[1]

[1] CGER, NIES

Forests worldwide contain about 45% of the global stock of carbon, the large part of which is found in forest soils. They impact upon the natural cycle of carbon, nitrogen and water, and they influence the radiation balance of the planet. Larch forest widely distributes throughout the North Hemisphere (e.g., occupying larger than 40% of Russian forests), thus is global important of forested biome. However, the carbon budget of larch forest ecosystems has received little attention. We routinely measure net ecosystem exchange (NEE) with eddy covariance at the larch forests of Tomakomai and Teshio in Hokkaido as well as at the north-foot of Mt. Fuji (Fuji-Hokuroku), Japan, and northeastern China (Laoshan). In addition, we partition component CO_2 fluxes, i.e., by utilizing a 24-automated-chamber system for canopy foliage photosynthesis, a 24-automated-chamber system for aboveground woody tissue respiration, and a 24-automated-chamber system for the understory carbon budget (i.e., 8 chambers for soil-CO_2 efflux, 8 chambers for heterotrophic respiration, and 8 chambers for photosynthesis of understory vegetation). For a 50-year-old larch forest atTomakomai, three year (2001-2003) averaged NEE was -186 and -500 gC m^{-2} yr^{-1} measured by the closed-path and open-path eddy system, respectively (Hirata et al. 2007). With continuous measurements by the automated chamber approaches in 2003, soil-CO_2 efflux was averaged to 959 g C m^{-2} yr^{-1}, heterotrophic respiration was about 547 g C m^{-2} yr^{-1} that accounted 57% of soil-CO_2 efflux, net CO_2 exchange of understory vegetation was about -39 g C m^{-2} yr^{-1}, aboveground woody tissue respiration was bout 75 g C m^{-2} yr^{-1}, and net photosynthesis and respiration of the canopy foliage was -1165 and 110 g C m^{-2} yr^{-1}, respectively. During the non-growing season, NEE of larch forest is the sum of aboveground woody tissue respiration and soil-CO_2 efflux. Aboveground woody tissue respiration contributed only 4.5% of NEE during the non-growing season. By the chamber approaches, averaged GPP, NPP (net primary production, the balance of GPP and autotrophic respiration), NEP (net ecosystem production) and ecosystem respiration was estimated to be about 1275, 677, 165 and 1145 g C m^{-2} yr^{-1}, respectively. The contribution of canopy foliage respiration, aboveground woody tissue respiration, root respiration and heterotrophic respiration to GPP was 8.6%, 5.9%, 32.4% and 42.9%, respectively.