Carbon cycle studies based on CO2 flux measurements at larch forest ecosystems in China and Japan

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We present several main results of a joint research program which started in 2001 with a collaboration of Hokkaido University, Northeast Forestry University of China, Forestry and Forest Products Research Institute, and National Institute of Advanced Industrial Science and Technology (AIST) of Japan based on field measurements in a larch forest ecosystem in northeast part of China. The forest was 40-year-old larch plantation dominated by *Larix gmelinii*, with canopy height about 17 m (Wang W. *et al*., 2005).

A long-term observation of energy, water vapor, and CO_2 fluxes as well as meteorological components has been carried out since 2002 by AIST and Northeast Forestry University. The data accumulated so far showed that the annual carbon uptake in the larch forest was estimated to be 1.0-1.5 ton-C/hectare. The dependence of gross primary production on the environmental variables such as photosynthetically photon flux density and the air temperature was investigated, and the dependence was quite similar to that obtained in the larch forest in northern Japan (Hokkaido) (Wang H. *et al*., 2005).

Since 2005, a collaborative study has been conducted among several research institutes in Asia in order to compare the CO_2 uptake by Asian forest ecosystems distributed in different climatic zone. The dataset was acquired from more than ten forest ecosystems in sub-arctic, temperate, and tropical region. The results showed that the gross primary production of larch forests reached maximum value during the early stage of the growing period in June (temperate larch forests) or in July (sub-arctic larch forests). The result also showed that the maximum value of gross primary production of a temperate larch forest was higher than other forest ecosystems distributed from sub-arctic to tropics (Hirata *et al*., 2008; Saigusa *et al*., 2008). These results suggest that the productivity of larch forests are quite high just after the leaf expansion and could be sensitive to a year-to-year change in the timing of leaf expansion and meteorological conditions in the early spring and in the beginning of growing period.

Future tasks will be that (1) we need to continue the long-term measurements and to compile the dataset into a database with standardized quality control; (2) it is urgently necessary to initiate and promote joint studies among principle investigators of larch forest sites based on data exchange and synthetic analyses; (3) and we need to establish a new technique to integrate field measurements, satellite remote sensing, and ecosystem modeling. The technique is indispensable to estimate carbon, water, and energy budgets in the larch forests in northeastern Eurasia, and also to interpret the mechanism of year-to-year change in the budgets and the role of the ecosystems on the interaction between northern terrestrial ecosystems and the atmosphere.

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