

B-4 Study on the Interaction between Atmosphere and Biosphere for Establishing Methods of Evaluating Carbon Dioxide Absorption by Forest (Final Report)

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We study the interaction between the atmosphere and the biosphere in order to establish methods of evaluating quantitatively carbon dioxide absorption by forest ecosystems. The methods cover many varieties from soil organic carbon storage in a forest to carbon dioxide absorption estimate on a continental scale.

This project consists of the following 7 sub-themes.

- B-4.1 Estimation for storage and changes in carbon accumulated in larch ecosystems
- B-4.2 Modeling of the carbon cycle in forest ecosystems through field measurements
- B-4.3 Improvement of carbon budget evaluation at forest ecosystem by means of micrometeorological methods
- B-4.4 Aircraft observation of areal carbon absorption
- B-4.5 Altitude distribution of CO₂ over forest and sink source evaluation
- B-4.6 Estimation of carbon sink distribution using inverse and forward models
- B-4.7 Carbon storage in biomass and productivity of larch forests in Northeastern Asia

Larch forest ecosystem is widespread biome in northeastern Eurasian continent. In order to estimate carbon dioxide flux in the future, the long-term ecological research site for tower monitoring with two towers (40 m and 25 m) was established in larch plantation forests at Tomakomai in Hokkaido. In the larch forest site, carbon storage in aboveground of larch and soil organic carbon storage was estimated, and needle photosynthetic rate of a sunny crown was measured in situ with special references to needle morphology, namely long-shoot needle and short-shoot needle. Open-top-chamber techniques to measure the CO₂ efflux from soil were examined. Daily and seasonal changes in soil respiration of a cool temperate forest were measured using the open-flow infra-red gas analyzer method. Development of eddy correlation measurement techniques to determine accurate CO₂ flux at various ecosystems was made with examining current correction methods and their application manners using flux data obtained from rice paddy, wet land, and the larch forest site. The tower site of Northeast Forestry University located in the Heilongjiang Province of China was investigated as a candidate site of our successive research.

The relation between local circulation and Net Ecosystem Exchange (NEE) measured on the top of 27 m tower at a hill top of Takayama site was investigated by an additional small tower in a small valley near the 27 m tower for the quantitative evaluation of NEE. The altitude distribution measurements of CO₂ over forest by use of a model unmanned aircraft and a tethered balloon were carried out over the Tomakomai site in summer. Aircraft (manned) observation technique of trace gases in the atmosphere by simultaneous measurements of the concentration of the trace gases and the velocity vector was developed, and was used over the Tomakomai site in summer. Methods of estimating carbon sink distribution from carbon dioxide measurements on a continental scale and meteorological data using tracer transport models were carried by development of a global tracer transport model, an inverse model trajectory model, a local CO₂ circulation model, and a mechanistic global land ecosystem model.