B2 Estimation and Prediction of the Budgets of Greenhouse Gases in Western Siberia

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We have been working on the methane and carbon dioxide budget of Siberian ecosystems for nine years. The processes related to the production and consumption of the greenhouse gases has been studied as well as the total budgets. In the latest six years, we focused to the methane production in Bakchar wetland near Plotnikovo, West Siberian Lowland, and the carbon budget in the forest on permafrost at Tura, along Yenisei River.

West Siberian Lowland is the world largest wetland that is believed to be a substantial natural source of atmospheric methane. The microbial communities inhabiting wetland are important for biological carbon cycle, and the emission of methane or carbon dioxide is expected to increase under the global worm climate here. In order predict the future emission, it is important to elucidate the mechanisms controlling methane cycle: the relationship between physicochemical soil properties and methanogenic activity. The methane emission measurement in full season for several years is necessary to elucidate the relationship between the climatic parameter and the methane emission.

The methane emission rate has been evaluated by several methods. The fundamental method is so called chamber method to observe the integration rate of the emitted methane in a box. New methane sensor system has been developed and the full season observation comes to be possible with occasional maintenance. The methane emission starts immediately after the thawing of snow, increases until the middle of August, and ends at the freezing time, at the begging of October. The emission rate is found not parallel with the soil temperature, little water level dependent, and strongly dependent on the wetland ecosystem structure.

We developed a method to identify wetlands using dataset of global vegetation index with the resolution of 1km provided by US Geological Survey. With this dataset, the distribution of wetlands in a large area can be determined. We also developed the scaling procedure to extrapolate high-resolution data from SPOT/HRV and LANDSAT/TM to the larger scale.

We estimated photosynthesis and respiration rate, soil respiration, allocation ratio to root system, tree density and mortality, and soil nitrogen mineralization in *Larix gmelinii* stands in a permafrost region. Photosynthetic arte and soil respiration rate during the growing season varied due to spatially heterogeneous environment. In the larch tree, the dry matter allocation to the root system was about 30-50% of total plant weight. Relationship between the tree density and mortality did not agree with that

predicted by the self-thinning processes through the competition for light among trees. It is likely to be due to a unique mechanism of tree mortality in continuous permafrost region. Soil nitrogen availability was as low as 0.4gN/me or less.

We carried out a theoretical analysis of the dependencies of tree growth and survival on the maximum tree size is highly sensitive to the environmental productivity. The low productivity in the higher latitude regions not only limits the rate of growth of trees, but also the size a tree can attain. The model also suggests that the size a tree reaches under favorable conditions may cause negative carbon balance if the environmental productivity decreases with time. We suspect that this is the case in the sparse old larch forest on permafrost regions, where soil conditions is favorable during several decades after forest fire but becomes less favorable with time.

All the reports on this project have been published in series of "Symposium on the Joint Siberian Permafrost Studies between Japan and Russia", which is written in English, consist of 9 volume, and total page of 1,846. All the volumes except vol.1 are available.