

B-4 Feedback of Global Warming in Siberian Permafrost Area

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The climate change caused by the increase of green house gases, such as CO₂, CH₄ and CFC's, is expected most notably in arctic or boreal area. The effect will be remarkable in Siberia, where the ground is permafrost and the vegetation over it is fragile. The increase of wetland and the decrease of Taiga forest due to the melting permafrost is expected at the first stage, but desertification is afraid to occur after because of small precipitation there. This change will cause the increase of methane and carbon dioxide emission, which will be a positive feedback to Global Warming. On the contrary, there is a possibility that forest area may increase to northwards as the result of warm climate, which leads to increase of uptake of carbon dioxide, negative feedback to GW. The research to evaluate this feedback effect is the final goal of this long term research project.

As the first stage, we need to understand the present situation concerning the emission rate of CH₄ in wetlands, and the carbon budget in the Taiga forest. The evaluation of the present carbon stock in Taiga and Tundra is an important data to estimate the future. Second is to understand the mechanism of methane emission and carbon budget and to know the factors to control them. The parametrization of the methane emission and the carbon budget through these basic research is necessary to evaluate the feedback to GW, which is the final stage of this research.

In 1991, the master plan of this research project has been discussed not only among the Japanese participants, but also with Russian scientific organizations and scientists. The counterpart organizations are as follows; NIES vs. CAO in the field of atmospheric measurement on aircraft, NIES, Hokkaido Univ.(HU, Institute of Low Temperature Science) and Tokyo Institute of Technology vs. Institute of Microbiology (in West Siberia) and Permafrost Institute (in East Siberia) in the emission measurements on the ground. NIES, IFFP and HU vs. Institute of Biology in Yakutsk, Institute of Forestry and Center for Ecology and Productivity of Forests.

In 1992, the research fields have been established for individual research activities; West Siberia for atmospheric research, Yakutsk and Tiksi for ground base measurements of atmosphere-biosphere-geosphere interactions which includes the ground base atmospheric monitoring and the emission measurement of methane, and the biomass and primary productivity research, and ecological survey. Preliminary results to validate the methodology of research in Siberia have been obtained.

In 1993, some preliminary but important results have been obtained which may orientate the direction of research activity. Following the some of them in shortest description: The flux of methane has been found to be very dependent on the ground conditions in several scale from 1m to 1km scale on the ground, and several tens km scale in the air. The large scale gradient of CO₂ in the free troposphere has been found decreasing to the west, in the direction of global circulation. The percentage of leaves on the tree in permafrost area is small and that of roots is large in comparison with Japanese. The ice in the permafrost contains a lot of methane in its bubble and it may be emitted to the atmosphere from the thawing permafrost at the cliff.