27. Use of remote sensing for estimating global warming potential at permafrost area in East-Siberia

Sonoko D. Kimura [1], Gen Takao [2], Keiji Kushida [3], Fumiaki Takakai [4], Takahiro Koide [4] and Ryusuke Hatano [5]

[1] Graduate School of Bio-Application and Systems Engineering (BASE), Tokyo University of Agriculture and Technology, Koganei, Tokyo, 184-8588 Japan
[2] Institute of Low Temperature Science, Hokkaido University 060-0819 Japan
[3] Hokkaido Research Center, Forestry and Forest Products Research Institute, Sapporo, Hokkaido, 062-8516 Japan
[4] Research Group of Regional Environment, Graduate School of Agriculture Hokkaido University, Sapporo, Hokkaido, 060-8589 Japan
[5] Field Science Center for Northern Biosphere, Hokkaido University, Sapporo, Hokkaido, 060-0811 Japan

Abstract

Russia's boreal forests cover about 9.0 10^6 km^2 and is estimated to hold 21-37% of the world's terrestrial carbon in the forests and soils. However, this area is susceptive to fire due to the dry climate with only 150 mm annual precipitation in some region.

To evaluate the influence of fire in Russia, satellite remote sensing method appears to be the only practical method to create maps of the soil type, land cover, vegetation volume and elevation for its vast and remote nature. Recently, several studies have used satellite imagery to measure burned area in individual Russian regions. For example, the burned area in Russia during 1996 and 2002 was supposed to have an average of 7.7 10^4 km^2 per year, ranging from 1.5 10^4 km^2 in 1997 to 12.1 10^4 km^2 in 2002. The estimated total carbon release was 39–55 Mt C in the 2001 equal to 11-17% of that year's fossil fuel carbon emissions in Russia. More detail studies at smaller scales have been conducted, too. The interpretation method of the maps in those studies tend to be site specific, which provides advantage in a precise description of the studied area, but also disadvantage in a restriction of the application of this method to another area.

Not only is the temporal release of stored carbon of concern, but also the long term disturbance of the ecosystem. Once burned, the disturbance return interval ranges typically from 50–240 years, with an average of approximately 100 years. On permafrost area, CH_4 gas production is stimulated by the change in soil moisture. Land cover change can also enhance the emission of N_2O. These gasses have different radiative properties, which is expressed in CO_2 equivalent and defined as global warming potential (GWP) by the IPCC.

Thus, the change from carbon sink to green house gas source due to fire must be evaluated at middle to large spatial scale, taking into account the CO_2 emission as well as CH_4 and N_2O emission. The objective of this study was to classify the land cover of an area near Yakutsk and to evaluate the influence of fire on the GWP. Using Landsat TM data from August 2002, around 25% of the studied area was found to be burned in summer 2002. By comparing the land cover in 1999 and 2002, the burned surface biomass can be estimated. The GWP before and after burning was calculated by combining ground monitoring and literature data with the created land cover maps.