Evaluation of carbon dioxide release ability from the forest surface by using the carbon isotopic ratio

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1. Introduction

Forest in a high latitude district in the Northern Hemisphere is one of the important release source and absorption sink of atmospheric CO_2 in the global carbon. We have to estimate the forest's ability of absorption and release of CO_2 quantitatively while the global warming advances. In this study, quantity evaluation of flux and carbon isotope ratio ($^{14}C/^{12}C$) of CO_2 released from forest floor is aimed, and the observation in the mountainous district forest and analysis by laboratory experiments and by a numerical model have been undergone.

2. Methods

The observation site was in a Japanese larch forest in Inabu, Toyota, Aichi Pref. (35.2N, 137.4E, 1010 m a.s.l., 23 m mean tree height). The observation period was from May 2004 to November 2006. The soil respiration (the phenomenon that CO_2 is released from soil surface) was measured by a closed chamber method in ten spots in the site. For carbon isotope ratio analysis, soil respiration CO_2 were sampled samples with a 144 L volume chamber. An NDIR gas analyzer (LI-820, Li-Cor) was adopted for CO_2 mixing ratios. The carbon isotopic ratios of soil respiration CO_2 were measured by a Tandetron AMS and an isotopic ratio mass spectrometer (Finnigan MAT252, Thermo Electron).

Dependancies of CO_2 production of soil on environmental factors such as soil temperature were measured by the laboratory experiments. Their results were introduced into the numerical model which described the CO_2 one dimension transportation for each carbon isotope used CO_2 to calculate CO_2 flux from the forest surface and its carbon isotopic ratio.

3. Results and Discussions

As a result of soil respiration measurement, there was correlation with soil temperature. In addition, the carbon isotopic ratio of soil respiration CO_2 showed a seasonal and diurnal variation and increased for the high temperature period. The change of CO_2 production profile by soil temperature would result in this variation, because soil has a profile of radiocarbon isotopic ratio ($^{14}C/^{12}C$) with its maximum in topsoil,.

As a result of model calculation, the tendency that ($^{14}C/^{12}C$) of soil respiration CO_2 increased for the high temperature period was obtained as well as the result of the observation.