B05-P04

REGIONAL CO2 UPTAKE ESTIMATION APPLYING THE LIGHT USE EFFICIENCY MODEL WITH MODIS AND FIELD DATA TO EXAMINE WILDFIRE EFFECTS IN ALASKAN BOREAL FOREST

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Wildfire is a major disturbance in boreal forest, which affects CO_2 exchange for a long period. We applied the light use efficiency model with a specific parameterization for burned forests to evaluate the effect of wildfire on regional CO_2 uptake in Alaskan boreal forest. A scheme to calculate the regional CO_2 uptake was developed by a synthesis of field observations, climate reanalysis data, fire history database, and MODIS data.

CO_2 exchange measurements have been conducted at two burned sites with different years elapsed after wild fire (2010 and 2004 burn sites) by eddy covariance observation systems over three growing seasons. Photosynthetically active radiation (PAR) absorption and other vegetation properties such as leaf area index and vegetation indexes were measured at the both sites. These data were used to parameterize the light use efficiency model for burned forests. As MOIDIS FPAR (fraction of absorbed PAR by vegetation) is known to be overestimated in burned forests from ground-based studies, we build up an empirical scheme to evaluate FPAR from a vegetation index obtained from satellite.

The parameterized model reproduced the seasonal variations in gross primary production (GPP) well for the both burned sites. The obtained maximum light use efficiencies for the both sites were similar to each other, implying that the variation of GPP after wildfire could be estimated with the variation of FPAR only. Hence, averaged maximum light use efficiency from two burned sites were used to estimate GPP for burned forests in the regional estimation.

GPP distribution was calculated for early recovery stage of burned forests for 2011, where burned area during 1992-2011 was assumed as the early recovery stage. The calculated GPP distribution reflected the spatial variation of temperature and PAR. The effect of wildfire on the regional GPP in black spruce forest was evaluated by replacing MODIS GPP with calculated GPP in burned forest in this study. The total GPP was overestimated by about 8% when the effect of burned area was not considered in the light use efficiency model. The results show reasonable performances of developed satellite-based model, and it is important to account for the effect of wildfire for accurate estimation of regional GPP.

The study was supported by IARC-JAXA Information System (IJIS) project (2008-2013).