

Effect of land-use and climate changes on carbon budget in Borneo Island using VISIT model

Minaco Adachi^{1*}, ITO, Akihiko¹, TAKEUCHI, Wataru², YAMAGATA, Yoshiki¹

¹NIES, ²University of Tokyo

More reliable estimation of carbon budget in forest ecosystems including the impact of deforestation is an important goal for environmental researchers. Carbon emission from land-use change accounts for about 20% of the total anthropogenic emissions worldwide. Especially, evaluation of carbon emission due to land-use change in tropical region is a very important task for management activities related to the Reducing Emissions from Deforestation and Forest Degradation (REDD+) initiative. In previous regional-scale studies, many models have been applied to the deforestation impacts specifically in Amazonian forests, whereas only a few studies have investigated the impacts of land-use change occurring in Southeast Asia. In the present study, we estimated the carbon budget of Borneo Island in Southeast Asia using remote sensing data and a process-based terrestrial ecosystem model (VISIT), aiming at evaluating the differences of carbon budget between land-use and climate change.

To develop a broad-scale system of forest carbon monitoring, we used time-series data of forest coverage derived from satellite remote-sensing images to track a transition through forest disturbance history. We found that the active radar sensor PALSAR (Phased-Array L-Band Synthetic Aperture Radar) onboard the ALOS satellite is especially advantageous for monitoring tropical forest cover under clouds, and that temporal changes in forest coverage could be also detected using MODIS (MODerate resolution Imaging Spectroradiometer) data during the period from 2002 to 2008. Then, by applying the VISIT model to every grid point, we estimated the atmosphere-ecosystem exchange and internal dynamics of carbon at 1km resolution.

When the effect of land-use change was neglected, gross primary production (GPP), aboveground biomass, and soil respiration rate were overestimated by about 10 to 20% for the whole of Borneo Island. The difference of GPP between 1986 (a warm and wet year) and 1999 (a cool and dry year) was $3.01 \text{ tC ha}^{-1} \text{ yr}^{-1}$. On the other hand, when the land-use impact was included, GPP was estimated smaller by 3.33 to 5.15 tC ha^{-1} compared with estimates of the no-deforestation case. These results suggested that the effect of land-use change on carbon budget in the study area would be larger than that of climate variability, and that land management is very important for mitigation of global warming by reducing carbon emission. Additionally, we mention our preliminary estimation of the carbon budget under the future climate scenarios in Borneo Island.