Development of the Forest Degradation Index and the Carbon Emission Estimation Method using PALSAR Data

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[Abstract]

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REDD (Reducing Emissions from Deforestation in Developing Countries) has been drawing international attention in Post-Kyoto climate negotiations. PALSAR is an active microwave sensor and expected to monitor tropical forest with overcoming the cloud problem. Since feasibility of operational application of PALSAR data for detecting forest degradation and estimating greenhouse gasses (GHG) emissions was still unclear, we set two test sites in a tropical seasonal forest in Cambodia and a drained peat swamp forest in the central Kalimantan, Indonesia and have developed a technique using PALSAR to give a new tool to monitor changes in GHG emissions in degrading forest. We classified a few forest types and non-forest areas using PALSAR data similarly with Landsat/TM imagery. Backscattering coefficient (σ0) of HV has an exponential relationship with above ground biomass (AGB). However, σ0 was saturated after 100 Mg ha^{-1} of AGB. When AGB was mapped using HV, AGB in high biomass forest could be overestimated. A correction method of HVσ0 was proposed and AGB was devised using the corrected HV. The AGB overestimation was reduced greatly and forest monitoring using PALSAR was sufficiently achieved. Regarding biomass carbon, we applied the PLASAR interferometry technique for forest height estimation. Since overstory height can be a parameter for estimating ecosystem carbon stock of various plant communities, we developed generic equations containing the parameter for overstory height. We then showed the capability of measuring the forest height of 15-20 m using PALSAR where the truth height was around 20 m. We have applied the PLASAR interferometry technique for monitoring the subsidence of the peat land and then estimated the GHG emissions and confirmed that the InSAR measurement for the subsidence well coincided with the long-term ground based measurement of subsidence and succeeded in calculating the GHG emission of 13.0 M ton-C y^{-1} at the central Kalimantan for around 70 km square area. Higher subsidence rate was observed in the year and/or location of deeper groundwater table. The ground based measurement revealed CO_2 emissions from biomass were important in the seasonal forest, while in the drained peat swamp forest, CO_2 emissions from soil organic matter were important. CO_2 emission from the drained swamp peat was highest

at 80 cm of water table depth. N_2O emission was correlated with the CO_2 emission. Drastic N_2O emission occurrence was suggested when fertilizer and ash were supplied to the top soil.