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Development of Above Ground Biomass estimation method using satellite data in Japan

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As a measurement method of Forest Above Ground Biomass, getting basic information of tree category, height and DBH from fieldwork, then calculate the volume, multiply expansion factor and wood density to get the result is widely used. This method can measure the forest above ground biomass correctly, however it is hard for us to make wall-to-wall map when monitoring large area of land. Satellite Remote Sensing is an effective way to estimate large area of forest distribution. In this study, our purpose is to investigate forest above ground biomass in the whole terrestrial land of Japan using ground truth data (fieldwork data from forest above ground biomass) and satellite data. We mainly used MODIS reflectance data from 2000 to 2009, Land Surface Reflectance data, Vegetation Index, LAI then using Random Forest method to estimate biomass.

We divided ground truth data to two groups, one group (90%) used as building Random Forest learning model. After the learning model was built, another group of data (10%) was used for estimating above ground biomass. Then we did the regression analysis between the estimation result and ground truth data. Accuracy assessment was carried out by calculation of coefficient of determination and RMSE from regression analysis. The results showed R2 is 0.6, RMSE is 26.37 (t ha-1). Estimation accuracy from deciduous forest and evergreen forest, R2 is 0.4 and 0.53, RMSE is 24.29 (t ha-1) and 27.34 (t ha-1), respectively. Evergreen forest showed an higher accuracy. Also, we found out that low biomass (<100 t ha-1) and high biomass (>200 t ha-1) showed bigger estimation error. We compared the estimation result (acquired from forest above ground biomass of whole Japan) to prefectural data and forest registration, the comparison results showed coefficient of determination is 0.95, slope is 1.68 times, which is much lower than verification result (1.86 times) from Forestry and Forest Products Research Institute.

In this study, we confirmed that combine satellite data and fieldwork data, using Random Forest machine learning model, the large area of forest above ground biomass can be effectively estimated. In future study, compare the Random Forest to other models then get more accurate estimation is one of our goals. Also, carbon emission from deforestation, typhoon and other disturbance caused forest biomass change should be considered as well.

Keywords: Satellite data, MODIS, Above Ground Biomass, RandomForest