Improved biomass estimation of individual trees using a new method and multiple remote sensing data

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Abstract: Forest attribute inventory information and measurements are critical to forest management. Biomass as an important biophysical parameter appropriate for assessing a diversity of natural characteristics, from tree health, forest regeneration, biological balance, energy conversion. And accurate estimation of aboveground biomass has gained importance in the context of the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. Remote sensing has demonstrated potential in measuring forest biomass. In order to improve forest biomass estimation of individual trees for old-growth forest in the Akazawa Forest Reserve in central Japan, this study analyzed texture measures derived from multiple remote sensing data using the ITC (Individual Tree Crown) method. After satellite data and LiDAR data preprocessing, tree tops, tree species, crown area and height were calculated. The relationships between the crown area and DBH and between height and DBH were analyzed using linear regression. Then biomass estimation models of individual trees were developed by expanding coefficient method. This method was verified against the survey data from old–growth *Chamaecyparis obtusa* stand composed of various cover types. For *Chamaecyparis obtusa*, the accuracy of biomass estimation was higher than 84 %. For *Chamaecyparis pisifera*, the accuracy of biomass estimation was less than 60 %, because *Chamaecyparis pisifera* was sometimes misidentified as *Chamaecyparis obtusa*, and crown area of *Chamaecyparis pisifera* was underestimated in the high-density stand. For *Thujopsis dolabrata*, the accuracy of biomass estimation ranged from 22.4 % to 78.9 %, and it is from 63.4 % to 84.6 % for broad-leaved trees, because many of these were understory. The results of biomass estimation revealed that estimation of old-growth forest biomass based on high resolution satellite data can be validated for estimating biomass at the individual tree level, improved by developing and applying forest stratum–specific models with the ITC-survey data as a bridging reference in addition to spectral information. This

approach is useful for biomass estimation on either the individual trees or the total canopy layer of forest.

Keywords: biomass estimation; ITC (Individual Tree Crown) method; high resolution satellite data; LiDAR data; old-growth forest;