Improving spatial distribution of growing stock volume using MODIS satellite imageries and geospatial information

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Abstract: In South Korea, where more than 63% of the country is covered by forest, accurate estimation of carbon stock is essential for understanding the carbon cycle. However, current estimates of Korean growing stock volume (GSV) are mostly derived from expensive field data. Techniques that allow reducing the amount of ground data with reliable accuracy would decrease the cost and time required for such analyses. The goal of this research was to test the Convolutional Neural Networks (CNNs) algorithm fed with a portion of the national forest inventory (NFI) data to predict the carbon stock for the entire country using satellite imagery and auxiliary information. Spatial distribution of the GSV of South Korean forests was predicted by the CNNs algorithm, which is a type of deep learning. NFI data were randomly sampled for training from 90 to 10%, in 10% increments. We estimated the rest of the area using satellite imagery and geo-spatial information. Based on the analysis, the accuracy of the total GSV using the NFI data was 98% (total GSV 713.25 Mm^3) when trained over 20%. However, when using 10% for training and 90% for validation, the estimated total GSV was 563.44 Mm^3 and the accuracy was reduced. Consequently, we found that the error rate of total GSV was less than 5% when using over 17% of NFI data for training. The error of GSV estimation in hotspots and coldspots, distributed in the class of small wood (0–16 cm), were 86.46 and 77.33%, respectively. This demonstrates that the tree was too small to be reflected from stand level forests in the two-dimensional satellite imageries.

Keywords: convolutional neural networks (CNNs), growing stock volume (GSV) estimation, spatial distribution of GSV, satellite imageries, geo-spatial information