Estimation of stand volume of conifer forest: A Bayesian approach based on satellite-based estimate and forest register data

Abstract

This paper highlights some problems underlying the gathering of stand volume information by forest register and the estimation of stand volume using satellite data. It was found that volume information from the forest register (V_{reg}) underestimates the actual stand volume. Satellite data is a promising source for estimating stand volume on a large-area basis, but stand volume estimation remote sensing still suffers from the problem of large variations due to unwanted noise. We present a Bayesian approach that combines stand volume estimates from remotely sensed data (Landsat-TM) and forest register. Pure Sugi (Cryptomeria japonica D.Don) forest stands were delineated using orthophotographs and forest information such as compartments, sub-compartments and roads from a Geographic Information System (GIS) database. Pattern decomposition method (PDM) was used to derive remote sensing indices (vegetation, soil, and water indices), which were used for estimating stand age. Stand volume was indirectly estimated from remotely-sensed data (V_{RS}) through the use of stand age. A Bayesian estimate of stand volume by age class (V_B) was performed by assuming the V_{reg} and V_{RS} as a priori probability distribution and random sample distribution, respectively. The Bayesian approach was found to improve the volume estimate from the forest register. In this way, the widely available forest register can be effectively used together with remote sensing data for estimating stand volume, an approach that is potentially useful for monitoring stand volume on a regional or national scale.