Estimating forest biomass in mixed broad-leaved forests of the Italian pre-Alps

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Abstract

Estimation of forest biomass for inventorying carbon stocks has gained importance as a result of the Climate Convention and the Kyoto Protocol. Estimation of forest biomass on the regional and global scale is therefore of great importance. Many studies have demonstrated that lidar is an accurate tool for estimating forest biomass. However, results vary with forest types, terrain conditions and the quality of the lidar data. In Italy many regional governments are acquiring low density lidar data for topographic and bathimetric mapping. We examine whether this type of data are useful for measuring forest attributes, such as biomass.

In this study, we investigated the utility of low density lidar data (< 2 points m^2) for estimating forest biomass in the mountainous forests of northern Italy.

As a first study site we selected a 2x2 km area in the Valsassina mountains in Lombardia. The region is characterized by mixed and broad-leaved forests with variable stand densities and tree species compositions. The site is representative for the entire Pre-Alps region in terms of type of forest and geomorphology. The main forest types are coppice management with plantations of chestnut (*Castanea sativa*), beech (*Fagus sylvatica*), birch (*Betulla pendula*), linden (*Tilia cordata*), ash (*Fraxinus excelsior*), poplar (*Populus tremula*) and natural stands of oak (*Quercus spp*).

We collected field data for 27 randomly located circular plots (radius=10m) in May 2008. In each plot we measured and determined tree height, DBH and tree species for trees with a DBH greater than 5cm. We used allometric equations to calculate total aboveground tree biomass and subsequently plot-level biomass (Mg ha^{-1}). Lidar data was collected in June 2004. The objectives of this work were: (i) to develop models of forest biomass from plot-level lidar height metrics and (ii) to understand if low density lidar is accurate enough in high slopes to produce a map of forest biomass for the region.

Our results indicate that low density lidar can be used to estimate forest biomass in our study region with acceptable accuracies. The best height results show a R^2 from final model 0.87 and the RMSE 1.02 m (8,3% of the mean). The best biomass model explained 59% (R^2) of the variance in the field biomass. Leave-one-out cross validation yielded an RMSE of 30,6 Mg ha^{-1} (20,9% of the mean).