ISSN 1946-7664. MCFNS 2015
Vol. 7, Issue 2, pp. 66–80
Mathematical and Computational Forestry & Natural-Resource Sciences
AVAILABLE ONLINE AT HTTP://MCFNS.COM
Submitted: Sep. 10, 2015
Accepted: Sep. 27, 2015
Published: Sep. 30, 2015
Last Correction: Oct. 1, 2015

EVALUATING DIFFERENT MODELS TO PREDICT BIOMASS INCREMENT FROM MULTI-TEMPORAL LIDAR SAMPLING AND REMEASURED FIELD INVENTORY DATA IN SOUTH-CENTRAL ALASKA

H. Temesgen[1], J. Strunk[2], H.-E. Andersen[3], J. Flewelling[4]

[1] *Dept. For. Eng., Resources and Management, Oregon State University, Corvallis, OR, USA*
[2] *Washington State Department of Natural Resources, Seattle, WA, USA*
[3] *USDA Forest Service, Pacific Northwest Research Station, Seattle, WA, USA*
[4] *Seattle Biometrics, Seattle, WA, USA*

Abstract. We evaluated two sets of equations for their predictive abilities for estimating biomass increment using successively acquired airborne lidar and ground data collected on western lowlands of the Kenai Peninsula in south-central Alaska. The first set included three base equations for estimating biomass increment as a function of lidar metrics, and the remaining equations enhanced the three base equations by considering the hierarchical structure of the data.

It is shown that the mixed effect framework substantially improved the accuracy and precision of biomass increment prediction over a model without the plot effects that assume the observations are independent for the area covered by two lidar acquisitions, 5 years apart from one another. On the average, root mean square error values were reduced by 19.8% by using a plot-level random coefficient model that account for the impacts of site (biophysical factors) on biomass increment on the western Kenai Peninsula.

Mixed effect models are effective statistical tools, but their effective application requires some sample growth data. As such, we recommend two models for estimating biomass increment on the Kenai Peninsula. If a subsample of ground data is available to predict the plot random intercept, the enhanced model is suggested. In the absence of ground data, an alternative model a model without the plot effects is suggested. Model coefficients are documented to facilitate development of a multi-part estimation strategy which includes both decay and increment.

Keywords: LiDAR, Mixed model, Alaska, Pacific Northwest

1 Introduction

Information on forest biomass and its increment is increasingly being used to guide the location of new biomass processing plants (Andersen et al. 2011), quantify wildlife habitat capability (Hyde et al. 2006), model carbon balance and storage (Gough et al. 2008), determine the components of forest fuels (Andersen et al. 2005), predict the effect of climate change on forest productivity (Latta et al. 2009), and develop forest restoration thinning and fire hazard management plans (Edmons et al. 2000, Temesgen et al. 2007) and greenhouse gas policy analysis (Baker et al. 2010).

Performing field measurement to quantify biomass increment is time- and labor- intensive. Yet, there is a need for accurate and up-to-date information on biomass increment for sustainable forest management. Conventionally, biomass increment models have used only ground attributes as predictor variables. Recent studies, however, indicate that lidar may offer a quicker and more cost-effective method of data collection with the potential not only to provide predictions for current status but