Biomass and Vegetation Structure Estimates from Combined LiDAR, SAR, and InSAR Observations Over the Harvard Forest

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The Harvard Forest, a 1200 hectare upland region in Western Massachusetts, consists of Red Oak, Red Maple, White Pine and Eastern Hemlock was heavily forested in the early 20th century. It was donated in 1907 to Harvard University to study sustainable forestry and has been the subject of multiple research projects ranging from the small scale to regional. One of NASA's BigFoot sites for linking *in situ* measurements, remote sensing and models for validating MODIS products related to the terrestrial carbon cycle, in the past decade, the area has been measured for biomass and structural characteristics (McKain, 2005). Among the characteristics of the region are a mean vegetation height of 24 m, a mean basal area of 40 m^2/ha, some 1000 trees/ha, and a carbon content ranging between 100 and 120 Mg/ha.

In addition to its vegetation characteristics, there is a wealth of remote sensing data collected over the Harvard Forest. In particular, full waveform LiDAR data from NASA Goddard's Laser Vegetation Imaging Sensor (LVIS) and L-band satellite data from the Japanese Aerospace Agency's ALOS/PALSAR. In July of 2003, LVIS data were used for determining the true ground elevation and the vertical extent of the canopy over the LiDAR coverage area (9 km x 30 km). Used in combination with the BigFoot ground validation data, the LVIS observations have been converted into estimates of biomass. Additionally, through a coordinated effort with the Japanese Space Agency (JAXA) and the Kyoto and Carbon Cycle Initiative, the Harvard Forest has been imaged by eight fully polarimetric overpasses, and six dual-pol observations since the launch of the ALOS satellite in 2006. The depth of dual- and quad-pol SAR observations over the Harvard Forest and LVIS derived biomass allow for algorithm development and testing of the seasonal dependence for remote sensing derived observations of the physical characteristics for the region.

In this paper, we present the results of the LVIS derived biomass map over the Harvard region as well as those exploring the relationships between the lidar observations and the SAR and InSAR L-band data collected by ALOS/PALSAR.

McKain, K., "Carbon Accumulation at the Harvard Forest: A Comparison of Methods for Measuring Tree Biomass for Regional Extrapolation of the Eddy-Flux Tower Footprint," Mt. Holyoke College Honor's thesis, 2005.