FOREST HEIGHT MAPPING BASED ON LIDAR AND SAR DATA

Z. Zhang [a, b], Guoqing Sun [c], W. Ni [b], Z. Guo [b], and L. Zhang [a]

[a] Remote Sensing and GIS Research Center, Beijing Normal University, Beijing, china, lwzzzy@gmail.com

[b] State Key Laboratory of Remote Sensing, Institute of Remote Sensing Applications, Chinese Academy of Sciences, P. O. Box 9718, Beijing, 100101, China

[c] Dept. of Geography and ESSIC, University of Maryland, College Park, MD USA

1. INTRODUCTION

Researches have shown that 3D vegetation structure exerts a strong influence on radiation transmission and changes radiation and energy balance at the land surface. Vegetation spatial structure including plant height, biomass, vertical and horizontal heterogeneity, is an important factor influencing the exchanges of matter and energy between the landscape and atmosphere, and the biodiversity of ecosystems. Boreal Forest is one of the largest ecosystems on the Earth, and it plays an important part in environment and economy. Estimation of boreal forest canopy height is an extremely urgent research because it is essential for understanding ecosystems changing by human activities and climate change. Lidar with capabilities of recording the time-varying return signals provide the vegetation height, ground surface height, and the vertical distribution of vegetated surfaces intercepted by laser pulses. On the other side, radars have the capability responding to the amount of water in forest canopy, as well as its spatial structure. Data from these sensors contain information relevant to different aspects of the biophysical properties of the vegetation canopy.

2. DATA AND TEST SITES

The data from Geoscience Laser Altimeter System (GLAS) onboard ICESat and L-band PALSAR on ALOS were used in this study [1]. The complementary of lidar (GLAS) and radar (PALSAR) data in forest structural parameter estimation was investigated over a test site, Changbai Mountain, Northern China. GLA14 data of GLAS were acquired since Jan 1, 2003. PALSAR InSAR and dual-polarized data were acquired in 2007 and Changbai Mountain Natural Preserve (42.8°N, 128.5°E) and nearby Lushuihe Bureau of Forestry (42.5°N, 127.8°E) in Northern China provide ideal test site for forest structure studies. The broadleaf-korean pine (Pinus koraiensis) mixed forest is the most diversified forest in species and ecosystem, and the most productive one in various resources in northern China.

3. METHODS

The processing of field sampling data, forest stem map, lidar data, PALSAR and InSAR data were described in this paper [2]. Several methods for constructing canopy scattering phase center were adopted [3] [4] [5]. The method for forest height estimation based on lidar data at lidar footprints were developed, and was validated using field measurements and forest inventory data [6]. Then, these height data were used as ground truth for development of a forest retrieval model using SAR data only. This model was applied to the entire SAR image, and the results were assessed using large-scale forest inventory data.

4. RESULTS

The result showed that canopy heights predicted by GLAS waveform data and field measuring data have a nice relationship. A map of forest canopy height in Changbai Mountain was constructed by the results. This paper will report the methods and results in detail.

5. REFERENCES

[1] Harding, D. J., Carabajal, C. C, "ICESat waveform measurements of within footprint topographic relief and vegetation vertical structure, "*Geophysical Research Letters*, 32. L21S10.doi: 10/1029/2005GL023471

[2] Lefsky, M. A., Harding, D. J., Keller, M., Cogen, W. B., Carabajal, C. C, Espirito-Santo, F. D., et al.. "Estimates of forest canopy height and aboveground biomass using ICESat," *Geophysical Research Letters*. 32(22).2005

[3] Josef Kellndorfer, Wayne Walker, Leland Pierce, Craig Dobson, Jo Ann Fites, Carolyn Hunsaker, John Vona, Michael Clutter, et al., "Vegetation height estimation from Shuttle Radar Topography Mission and National Elevation Datasets," *Remote Sensing of Environment*, 93(3), pp.338-358, 2004

[4] Sun, G., Ranson, K.J., Masek, J., Z. Guo, Y. Pang, A. Fu, D. Wang et al., "Estimation of tree height and forest biomass from GLAS data," *Journal of Forest Planning*, 13, pp.157-164., 2008

[5] Clare S. Rowland and Heiko Balzter, "Data Fusion for Reconstruction of a DTM, Under a Woodland Canopy, From Airborne L-band InSAR," *IEEE Transactions on Geoscience and Remote Sensing*, 45(5), pp. 1154-1163, 2007

[6] Sun, G., Ranson, K. J., Kimes, D. S., Blair, J. B., Kovacs, K., "Forest vertical structure from GLAS: An evaluation using LVIS and SRTM data," *Remote Sensing of Environment*, 112(15), pp.107-117, 2008