Geophysical Research Abstracts
Vol. 13, EGU2011-10670, 2011
EGU General Assembly 2011

Analyzing ICESat/GLAS derived terrain roughness parameter using airborne LiDAR data

Markus Hollaus (1), Norbert Pfeifer (1), Andreas Roncat (1), and Hieu Van Duong (2)

(1) Institute of Photogrammetry and Remote Sensing (I.P.F.), Vienna University of Technology, Vienna, Austria (mh, np, ar@ipf.tuwien.ac.at / 0043-1-58801-12299), (2) Natural Resource Ecology Laboratory, Colorado State University (hieu.duong@colostate.edu)

The worldwide elevation database of the full-waveform Geoscience Laser Altimeter System (GLAS) onboard the ICESat satellite is commonly used for change detection of ice sheet mass balance, forest canopy height estimation or the derivation of terrain models of remote areas. The elliptical GLAS laser footprint varies in size as a function of laser geometry and has approximately a footprint diameter of 70 m in average. For each illuminated footprint the backscattered laser echoes contain information about the topography (i.e. terrain slope and roughness), the vertical distribution of vegetation and the reflectivity at the wavelength of 1064 nm. To understand the backscattered LiDAR signal, which is a convolution of the above mentioned surface characteristics, several LiDAR models have studied their influences. Most of these studies have not modeled the ground roughness explicitly, due to increased simulation time and or missing appropriate reference data.

The overall aim of this contribution is to gain insight in the possibility of using spaceborne laser altimetry for geomorphological analyses in alpine regions. Especially with future missions (LIST from NASA, but also projects at ESA), which target denser coverage with smaller footprints the possibilities of analyzing land topography will increase. For the current analyses high point density airborne LiDAR data sets are used as reference to parameterize the terrain slope and roughness. A Gaussian decomposition of the ICESat/GLAS full-waveforms is applied to derive in addition to the range, the echo width and the amplitude of each detectable echo. The received terrain echoes are broadened with respect to the transmitted laser pulses due to terrain slope and roughness, as well as ground vegetation. Using airborne LiDAR data a high precision terrain model is determined and the average terrain slope is calculated for each ICESat/GLAS footprint. The terrain roughness is parameterized by the standard deviation of detrended terrain points. The derived surface parameters are used as reference for analyzing the effects of the individual terrain characteristics on the derived ICESat/GLAS terrain echo widths. The analyses are done for different test sites in Austria. It is expected that the increased knowledge about the interaction of ICESat/GLAS laser beam with the terrain surface can improve the descriptions of the terrain returns, especially in alpine regions.