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A Comparison of Aerodynamic Roughness and Surface Roughness Measurements Derived from Terrestrial Laser Scanning Over Ice and Sandar Surfaces

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Surface roughness influences aerodynamic roughness which is a key component required for energy balance models in glacial and snow environments and sediment transport models in aeolian environments. However, quantifying surface roughness at high spatial resolution has often proven difficult in the past. Terrestrial laser scanning (TLS) is an innovative, non-invasive surveying technique that produces accurate high resolution point clouds of topographic data. This study assesses the potential of using TLS to improve the parameterisation of small scale surface roughness by comparing measurements with aerodynamic roughness measurements derived from vertical wind profiles. Over the course of a ten day period terrestrial laser scanning was employed on varying surfaces (rock covered ice, ash covered ice, an active sandur and an inactive sandur) in Svinafell, Austur-Skaftafells, Iceland. Two methods were used to quantify surface roughness from the TLS data. The first method used high resolution DEMs (5 cm grid cells) and surface roughness was estimated based on the standard deviation of elevations in a moving window of surrounding grid cells. The second method quantified surface roughness by fitting Gaussian curves along points on a transect. The validity of these techniques and the degree to which TLS offers a substantive improvement to quantifying surface roughness is assessed through comparisons with aerodynamic roughness measurements taken from the same sites.