Project acronym: GLARE

**Project title:** GLacier Aerodynamic Roughness Estimation

Project leader:  Mark Smith, University of Leeds

Discipline: Earth Sciences & Environment
Station(s): Tarfala Research Station (Sweden)

The proposed research seeks to better understand the link between ice surface topographic variability and the ice aerodynamic roughness ($z_0$), through the application of high resolution survey techniques (Terrestrial Laser Scanning and Structure-from-Motion) and validation of novel roughness metrics designed to capture the relevant components of topographic variability for $z_0$ estimation. $z_0$ remains a major uncertainty when determining turbulent heat fluxes over glacier surfaces, which are forecast to become more significant in a warmer, wetter climate. We will validate $z_0$ estimates using wind tower data collected over 3 glaciers in Tarfala valley, northern Sweden and upscale these estimates using glacier-scale high-resolution 3D surveys.

Outputs from this research will allow distributed representation of $z_0$ in glacier melt models as required to accurately predict glacier responses to future climate warming. We will also investigate the potential for $z_0$ to be estimated directly from the ArcticDEM, a 2 m resolution Digital Elevation Model (DEM) that will soon provide coverage of the entire Arctic. In future, we plan to obtain similar data from a number of climatically different sites across the Arctic to investigate potential feedbacks between climate warming-driven melt and ice surface roughness through its key influence on nonradiative energy fluxes.