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Soil formation and biological soil crust development in glacier forelands of Svalbard (High Arctic)

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Over the last decades, a progressive glacier melting has been detected induced by climate change which cause a rapid enlargement of ice-free areas in glacier forelands in Arctic, Antarctic and Alpine regions. These recently deglaciated areas represent highly dynamic environments in terms of vegetation development and soil formation. Tundra plant communities of glacier forelands mainly consist of cryptogamic species forming biological soil crusts (BSCs) on the surface. These BSCs are known to promote the accumulation of aeolian particles and organic material being relevant to soil formation. It is important to understand both BSC development and soil formation in glacier forelands as fundamental to future development of mature tundra which contributes to an increase in soil organic carbon (SOC) and nitrogen (N) stocks in soil. The heterogeneous terrain of glacier forelands affects the spatial variation in both soil and vegetation characteristics which are additionally influenced by the distance to the glacier terminus. This study focuses on the spatial variation in soil and BSC characteristics in Arctic glacier forelands of Svalbard using multi-scale contextual soil mapping (CSM) and Euclidean distance fields (EDF). The data set comprises of soil (SOC, N, texture) and BSC characteristics (species composition, percent cover) from 168 sampling locations as well as terrain covariates (elevation, slope, aspect, curvature) at several scales using CSM and spatial covariates (EDF). Random forests (RF) are used to analyse the relationships between the covariates and soil and BSC characteristics, respectively.

Preliminary results show a good quality of the RF models (R^2/RMSE) which is similar for SOC (0.41/6.19) and N (0.44/0.22). Elevation, curvature and slope at large scales are the most important covariates to explain the spatial variation in SOC and N. On large scales, these covariates represent the distance to the glacier terminus and generally explain the increase in SOC and N with increasing distance from the glacier terminus. Additionally, elevation at small scales represents relevant issues of predominant geomorphologic features signature (e.g. moraine topography) to soil formation and BSC development. Analyses of the spatial variation and interrelationships of soil and BSC characteristics are still ongoing and further results will be

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