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Soil formation along a glacier forefield (Dammaglacier, Switzerland)

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The Dammaglacier is currently receding due to global warming such as the most Swiss glaciers. In the beginning, the forefield of receding glaciers is vegetation-free and greater distances from the glacier termini correspond to longer periods of both, ice-free exposure and vegetation cover. A preliminary investigation (four sampling spots) revealed heterogeneous site conditions which are typical on glacier forefields and shown by several soil parameters (e. g. proportions of rock fragments, texture). Therefore, additional twenty-three sites with increasing distance from the glacier were sampled (mineral soils and organic surface layers) in three replicates for studying initial soil and humus development in a successional chronosequence (circa 20 – 150 years after glacier retreat). In addition, undisturbed samples were collected for bulk density measurement. Organic surface layers (above Cv-material) occur only 40 – 50 years after glacier retreat. Their thicknesses increase with time since deglaciation and increasing vegetation cover. This also applies to Ai horizons which can be found on sites older than 70 years of ice-free exposure. With increasing distance from the glacier endpoint, the accumulation of organic matter in organic surface layers and the mineral soil is shown by mean increases of organic carbon stocks. Besides the higher input of plant material, this may result from the growing potential for soil organic matter stabilization which is indicated by increasing proportions of clay and oxalate soluble Fe. Solid state CPMAS 13C NMR spectroscopy revealed that the ratio of alkyl C to O/N-alkyl C of organic surface layers points to different plant input and reflects the change of plant communities along the glacier forefield. Organic surface layers and Ai horizons from sites around 70 years of ice-free exposure have similar C distributions among spectral regions of 13C NMR spectroscopy. In contrast, older sites (120 – 150 years ice-free) show increasing proportions of carboxyl C and alkyl C, similar proportions of aromatic C and decreasing proportions of O/N-alkyl C from organic surface layers to Ai horizons. This may indicate higher decomposition degrees of organic matter at older sites due to higher microbial activity.