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Living vs. dead moss in Antarctica – how vegetation and seabirds determine soil organic matter distribution and composition

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The soil carbon accrual in Maritime Antarctica is a unique process due to the harsh environmental conditions and very low carbon input, that is locally restricted (bird colonies and few vegetation patches, without roots). Especially ornithogenic soils of this region receive high doses of bioavailable C, N and P, which affects vegetation distribution and productivity. A higher vegetation productivity, together with nutrient availability directly affect soil pedogenesis due to increased mineral weathering and soil organic matter contents. The aim of this work was to study broad soil biogeochemical processes of sites differently affected by the nutrient and organic carbon input from seabird rookeries. With ongoing climate change it is assumed that the underlying processes will be altered substantially. By studying soil transects on Deception Island (South Shetland Islands) we aimed to gain a better knowledge of the feedbacks between climate, nutrient cycling, vegetation patterns and soil biogeochemical processes in Maritime Antarctica. To this end we sampled three spatially separated sites on Deception Island (Penguin Colony, Fumarole Bay, Lago Escondido) that are distributed along a transect from higher to lower ornithogenic influence, respectively. At the sampling sites patches below living and dead moss were sampled. Bulk soil samples from 4 replicated subplots per site were taken from three layers at 0 – 2 cm (including dead mosses); 2 – 3 cm, and 3 – 10 cm depth at corresponding spots under living and dead Polytrichastrum alpinum, accounting for a total of 72 bulk soil samples. Besides C and N contents, we also fractionated the topsoils according to density and particle size in order to differentiate soil organic matter accrual processes between the sites. Using a principal component analysis, we could clearly discriminate between the three sites, with the Penguin Colony having a major correlation with C and N, and both the Fumarole Bay and Lago Escondido having a high correlation with pH. These results are in accordance with Location being the main effect and the Location x Vegetation interaction in an ANOVA, where significant C and N differences were demonstrated in relation to the intensity of seabird influence. Beside the clear local effect of the input of C and N by seabirds, we were able to also demonstrate distinct effects of dead moss cover on soil organic matter stocks and composition. With respect to the ongoing climate change and alterations in vegetation distribution in Antarctica our data highlight the intricate connection between vegetation status and soil chemical and biological development and function.