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Changes in net primary production along primary succession on a High Arctic glacier foreland in Ny-Alesund, Svalbard

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In the High Arctic, glacial retreat exposes new ground surfaces and provides plants and microorganisms with new habitats. There, we can observe various plant communities ranging from pioneer to later successional species along a primary successional gradient within a glacier foreland. Understanding the contribution of each ecosystem component to carbon flow and changes in the pattern of carbon flow along primary succession is important for considering the response of the Arctic terrestrial ecosystem to climate change. In this study, as part of a study on the terrestrial carbon cycling in a glacier foreland in Ny-Alesund, Svalbard, we aimed to: 1) estimate the net primary production (NPP) of dominant vegetation types; 2) to clarify the spatial distributions of the NPP along the primary succession after glacial retreat; and 3) evaluate the contribution of each vegetation type to ecosystem carbon stock.

This study was conducted at the front of Austre Broggerbreen near Ny-Alesund, northwestern Spitsbergen, Svalbard (79 N). Three about 1.8 km line transects were extended in parallel from old well-vegetated area to newly deglaciated area and 15 plots (4 m * 4 m) were placed on each transect with 120 m intervals. Coverage (%) of vascular plants, moss, lichen, and biological soil crusts (BSC, soil-surface community that consists of various organisms such as cyanobacteria, algae, lichen and fungi) were recorded in all plots. Aboveground part of all plants, organic soil layer, and mineral soil layers (0-1, 1-3.5, 5-7.5, 10-12.5 cm in depth) were collected at 1-5 points per each plot. Carbon contents of all samples were determined to calculate the carbon stock at each plot. Stand-based NPP (NPP per unit area fully covered by each species/complex) of two vascular plants (Saxifragaoppositifolia and Salixpolaris), moss (Sanioniauncinata), lichen (Cetrarielladelisei) and BSC were estimated using previously reported models for estimating the NPP and the meteorological data. Ground-based NPP (NPP per unit ground surface area) at each study plot was obtained by multiplying the stand based NPP by coverage (%).

Stand-based NPP during the snow-free season varied depending on the vegetation type according to the following order: Sal.polaris > Sax.oppositifolia > moss > lichen > BSC. However, important contributor to ground-based NPP changed greatly along the primary succession: NPP of Sal. polaris was much larger than that of other producers in the later stages of primary succession; in contrast, NPP of non-vascular plants were comparable with or greater than NPP of vascular plants in the early stages of succession. In this presentation, we will discuss about relationship between special distribution of ground-based NPP and ecosystem carbon stock in the High Arctic glacier foreland.

Keywords: Net primary production, High Arctic, Glacier foreland, Carbon stock, Primary succession