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Monitoring permafrost patterned ground with small-format aerial photography - classification and upscaling of a polygon landscape on Samoilov Island, Lena Delta, Siberia

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Accurate land cover products like vegetation cover or surface water extent of arctic wetlands are needed to obtain reliable inputs for modeling the surface - atmosphere exchange, specifically the exchange of trace gases and energy. Using satellite sensor imagery for land cover is inevitably restricted to sensor spatial resolution. Data is therefore especially needed on smaller scales to close the gap between satellite observations and plot-scale measurements. We use small-format aerial photography (SFAP) to monitor the permafrost patterned ground on Samoilov Island in the Lena Delta, Northern Siberia. SFAP presents a low-cost, efficient method to acquire high-resolution aerial images with the help of balloons or kites. Depending on camera type and flying height we are able to obtain resolutions of up to 7 mm per pixel. Images are mosaicked and orthorectified in a GIS for the areas of interest. Remote sensing analyses allow for example high-resolution land cover classification like vegetation cover as well as the tracking of landscape changes over the years like coastal erosion or the formation and shrinkage of lakes. Moreover, stereo images can be obtained and used for the production of detailed digital elevation models (DEM). The landscape of Samoilov Island is shaped disctinctly by the microtopography of the wet polygonal tundra. The development of low-centered ice-wedge polygons results in a prominent microrelief with the alternation of depressed polygon centers and elevated polygon rims with elevation differences of up to 0.5 m over a few meters distance. In the depressed polygon

centers, drainage is strongly impeded due to the underlying permafrost resulting in water-saturated soils or small ponds. This heterogeneous microrelief is clearly not represented with sufficient resolution in satellite images with resolutions between 15 and 30 m. It is, however, the most important factor for small-scale differences in vegetation type and of soil moisture, and is therefore a major variable when considering heat and trace gas fluxes on the meso-scale, i.e. ranging from a few to a few hundred meters. Due to their spatial resolution satellite classification result in a strongly filtered and generalized land cover product. With its highly detailed mapping of landscape and landscape change SFAP offers a valuable tool for the quantification of surface characteristics on small scales and upscaling them to large-scale satellite sensor information. SFAP can contribute to the ongoing focus on land atmosphere exchange, specifically on the prediction of the sensitivity of heat and water budget components of these northern permafrost landscapes.