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Vegetation Mapping at the Tundra-Taiga Region in the Northwest Territories, Canada, and Indigenous Use

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Arctic landscapes are very sensitive to warming with changes happening much faster than in other regions. The investigation on circumarctic Arctic vegetation change is carried out in the framework of the Federal Ministry of Research, Technology and Space (BMFTR) funded project SQUEEZE (Protection of the Disappearing Arctic Tundra: Potential, Planning, and Communication) in a large consortium. This study presented here focusses on the region close to Inuvik in the Mackenzie delta area in northwest Canada, which holds many different habitat types important to Indigenous peoples. The habitat diversity is important for ecosystem health and should be monitored as well as protected. In the region north of Inuvik, habitats range from tundra with low shrub structure, over forest tundra with sparse spruce forests, to taiga with dense needleleaf forests south of Inuvik and wetlands, lakes and river floodplains distributed over the area. These environments can be used for hunting, fishing, foraging of food, medicinal plants, firewood and construction material or as grazing grounds for caribou. However, those regions are facing changes due to climate change. Most dominant processes are increased permafrost thaw, shrubification of the tundra, northward shift of the treeline, more fires and pests in forests and changed waterways.

Remote sensing offers valuable insights into the current state of this region and can help to track changes. Airborne remote sensing provides high resolution and allows to cover large areas. The airborne data used in this work was acquired with the AWI Perma-X flight campaign in the summers 2023 and 2025. We use the Modular Airborne Camera System-Polar (MACS-Polar) optical data. The MACS-Polar camera was developed by the German Aerospace Centre (DLR, Adlershof) specifically for challenging, contrasting light conditions in the polar region. MACS images were processed to four-band (visible and near-infrared, VNIR) orthomosaics and digital surface models with spatial resolution of 15 cm and 3D point clouds with point densities of up to 25 points per m^2. Features of the VNIR images as well as structural features of the surface will be used to classify the habitat types. The analysis of the data for the years 2023 and 2025 in this work allows for tracking of changes between the years. The outcomes are classified maps of habitats, such as wetland,

tundra, forest tundra and different forest types, in the area around Inuvik. Those will be made publicly available to the Indigenous communities in northwest Canada. MACS optical orthomosaics can be challenging because of changing illumination during flight times and the data derivation from Structure from Motion can hold inaccuracies. However, the resulting maps of the current state of vegetation structure are valuable products. Future work can build upon those by looking at longer timescales and upscaling with Sentinel-2 satellite data.