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Challenges of scaling up carbon balances in fragmented Arctic landscapes

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Peatland landscapes such as northern fens are fragmented and patchy in terms of their vegetation, land cover and hydrology. Such heterogeneity leads to variation in biogeochemical cycles of e.g. carbon, nitrogen and water among different land cover types and atmosphere. Thus, there is an urgent need to classify vegetation and land cover accurately. There have been contrasting claims on the spatial resolution requirements for mapping the mosaic-like patterns in treeless northern landscapes such as tundra and peatlands. Some have argued that Landsat-scale resolution (ca. 30 m) is sufficient (Bartsch et al. 2016, Treat et al. 2018). However, according to others, a very-high spatial resolution (of the order of <5 m) is needed for constructing realistic maps of tundra and peatland vegetation (Virtanen and Ek 2014, Siewert et al. 2015, Räsänen et al. 2018). Moreover, recent studies suggest that a centimeter-level spatial resolution, obtained only with unmanned aerial vehicles, should be used for an accurate characterization of patchy landscapes (Palace et al. 2018).

We present here a case study highlighting the impact of the choice of the spatial and spectral resolution, dataset combination used as source data in classification, and classification technique on the accuracy of land cover classification in a patchy subarctic landscape. This study will also shed light on the importance of accurate land cover characterization in interpreting chamber and eddy covariance carbon dioxide and methane fluxes measurements with footprint modelling, upscaling the carbon balance to the catchment scale and in process-based biogeochemical modeling.

The study area is located in Kaamanen, northern Finland (69.14°N, 27.27°E; 155 m a.s.l.) in a northern boreal vegetation zone and subarctic climate zone. The main research area is dominated by a treeless mesotrophic patterned fen, characterized by a strong pattern of strings with dwarf shrub vegetation, and flarks with sedge and brown moss vegetation. The catchment area includes also upland pine forests, shrub-dominated pine peatland, and some streams and lakes. Measurements of CO_2 and CH4 exchange conducted in 2017 and 2018 using eddy covariance and manual chamber methods at representative land cover types will be used in this study.

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