

Mapping northern wetland extent and methane emission potential using Arctic DEM and Sentinel-1

Martin Karlson, David Bastviken, and Magnus Gålfalk

Linköping University, Department of Environmental Change, Linköping, Sweden

Wetlands, including inland waters, in northern areas are among the largest natural sources of the greenhouse gas methane (CH_4), but wetland extent, structure, and associated emissions remain highly uncertain. Wetland structure and plant species composition is closely connected to topography, so the lack of a digital elevation model (DEM) with sufficient spatial resolution and coverage has been a major limitation for regional scale wetland mapping efforts. Consequently, the release of a new Arctic DEM by the Polar Geospatial Institute in 2017 potentially offers major improvements in the mapping of northern wetlands.

This study presents a method for wetland mapping on a regional scale based on a combination of synthetic aperture radar (SAR; Sentinel-1) and topographic predictor variables derived from high resolution (5 m) DEM data. The potential of the Arctic DEM is also evaluated through a comparison with a LiDAR derived DEM. A 25 000 km² area located in the northwest of Sweden is used as a pilot study site. We present a two-level classification approach where wetlands are first separated from other land cover and then characterized by spatial moisture patterns to assess prevalence of vegetation types with different CH_4 emission potential.

The results show that the inclusion of topographic predictor variables is crucial when delineating wetlands (level-1), with classification accuracy > 90% for both Arctic DEM and LiDAR DEMs. In addition, the combination of SAR time series and the Wetness index enables detailed characterization of moisture patterns in the wetland areas, which can be linked to CH_4 emission potential. Our study shows that the availability of a pan-Arctic DEM opens up for large improvements in regional scale wetland mapping. This is a key step in reducing uncertainties in the regional CH_4 budget.