



Aalborg Universitet

AALBORG UNIVERSITY
DENMARK

Peat Mapping with Heterogeneous Features and Graph Neural Networks

Philipsen, Mark Philip; Beucher, Amélie; Greve, Mogens Humlekrog; Moeslund, Thomas B.

Published in:
Soil Mapping for a Sustainable Future

Publication date:
2023

Document Version
Early version, also known as pre-print

[Link to publication from Aalborg University](#)

Citation for published version (APA):
Philipsen, M. P., Beucher, A., Greve, M. H., & Moeslund, T. B. (2023). Peat Mapping with Heterogeneous Features and Graph Neural Networks. In *Soil Mapping for a Sustainable Future: 2nd joint Workshop of the IUSS Working Groups Digital Soil Mapping and Global Soil Map* (pp. 29). Article 56

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal -

Take down policy

If you believe that this document breaches copyright please contact us at vbn@aub.aau.dk providing details, and we will remove access to the work immediately and investigate your claim.

Please choose for which type of presentation you wish to submit your abstract:

Oral presentation

Short oral presentation

Poster presentation

Title: Peat Mapping with Heterogeneous Features and Graph Neural Networks

Authors

Mark P. Philipsen ¹, Amélie M. Beucher ², Mogens H. Greve ², Thomas B. Moeslund ¹

Affiliations

[1] Visual Analysis and Perception Group, Department of Architecture, Design and Media Technology, Aalborg University - Denmark

[2] Soil Physics and Hydropedology section, Department of Agroecology, Aarhus University – Denmark

Corresponding author email: mpph@create.aau.dk

Abstract (maximum 2000 characters including spaces):

Depending on their state and use, peatlands may either release or sequester significant amounts of carbon. Current estimates of the condition and extent of peatlands are subject to a high degree of uncertainty [1]. To ensure an effective and targeted effort in preserving and restoring peatlands, detailed, accurate, and up-to-date models of peatlands are needed.

The best models are achieved through a mix of available data sources, whether in situ, proximal, or remote measurements [1]. The main challenge in building models, that incorporate data from different sources, is fusing data with varying availability and density such that it can be ingested by point-based models such as Random Forest or grid-based models such as Convolutional Neural Networks. We propose to bypass this problem by connecting each measurement in a graph, retaining the original resolution and density. By utilising Graph Neural Networks (GNNs), features are efficiently aggregated spatially through neighbouring nodes in the graph. The flexibility of Heterogeneous GNNs, in particular, makes the model robust to missing modalities or holes in the graph. We demonstrate our method for a 10-ha field located in Jutland, Denmark, modelling peat depth with data from multiple geophysical sensors, remote sensing modalities, and maps.

The benefits of the method include: (1) Faithful spatial aggregation of features, (2) arbitrary output resolution due to the graph existing in a continuous space, (3) no need for laborious, error prone, and inefficient interpolation of feature maps.

So far, GNNs have seen extremely limited use in soil mapping. One example is its use for modelling soil moisture by capturing the important spatio-temporal correlations that influence soil moisture

levels [2]. We are excited about future improvements to our method and its application to more study areas and nation scale models.

References

[1] Minasny, Budiman, Örjan Berglund, John Connolly, Carolyn Hedley, Folkert de Vries, Alessandro Gimona, Bas Kempen et al. "Digital mapping of peatlands–A critical review." Earth-Science Reviews 196 (2019): 102870.

[2] Vyas, Anoushka, and Sambaran Bandyopadhyay. "Dynamic Structure Learning through Graph Neural Network for Forecasting Soil Moisture in Precision Agriculture." Proceedings of the Thirty-First International Joint Conference on Artificial Intelligence (IJCAI-22).