# Peat Mapping with Heterogeneous Features and Graph Neural Networks

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*Published in:*
Soil Mapping for a Sustainable Future

*Publication date:*
2023

*Document Version*
Early version, also known as pre-print

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**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**

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**[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).**