

WATERPEAT MID TERM REPORT – MESERET MENBERU

1. PEAT HYDRAULIC AND PHYSICAL PROPERTIES DATABASE

1.1. Objectives of the study

1. To test applicability of the van Genuchten soil water retention curve model (mostly applied to other soil types) for peat soils subjected to different land management regimes and quantify the corresponding van Genuchten model parameters.
2. To parametrize the hydraulic and physical properties of peat soils under different land use management regimes, which are not properly documented in the literature.

1.2. Materials and Methods

Peat properties data used for this study were collected from an ongoing and past research projects at the Water, Energy and Environmental Engineering Research Unit, University of Oulu, Finland. The peat properties database included (in total 3073 samples from 59 study sites) data on saturated hydraulic conductivity (K_{sat} , $n = 2077$), unsaturated hydraulic conductivity (K , $n = 22$), bulk density (BD , $n = 439$), porosity ($n = 444$), specific yield (S_y , $n = 284$), and soil water retention curve (SWRC, $n = 284$) for different peat layers, determined in field and/or laboratory studies.

The van Genuchten-Mualem soil water retention curve model and several other machine learning algorithms (e.g., K-nearest neighbours, principal component analysis, Random forest) were used to study the hydraulic and physical properties of peat soils as a function of three distinct peat layers (top, middle and bottom layers) for each land use of different management regimes.

1.3. Results

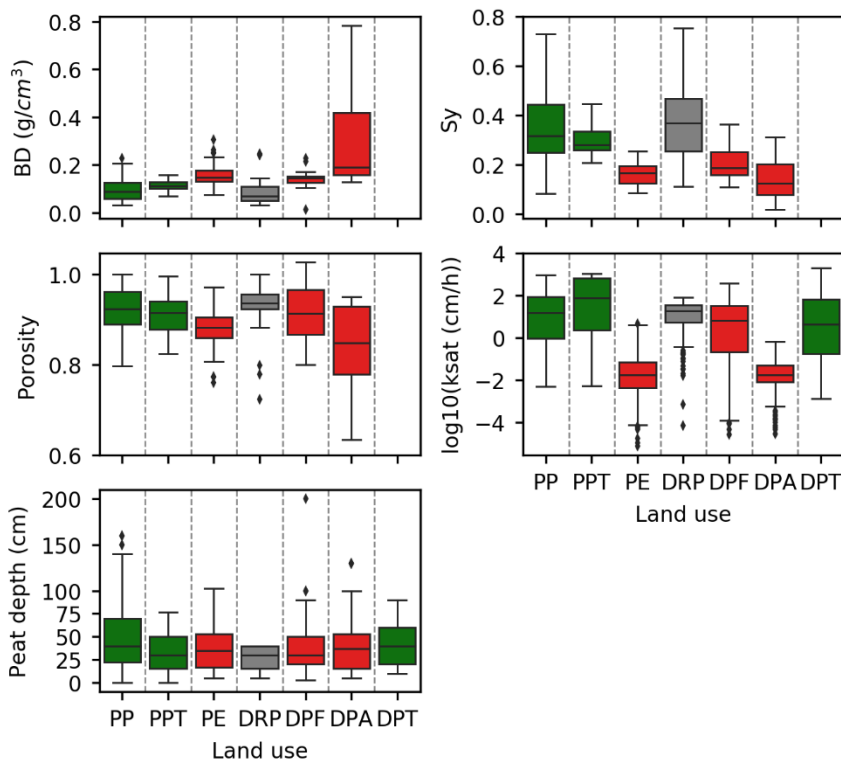


Figure 1. Mean bulk density, porosity, specific yield and saturated hydraulic conductivity (log scale) for each peatland land use management regime. PP = pristine peatland, PPT = pristine treatment peatland, DPT = drained treatment peatland, DRP = drained restored peatland, DPF = forestry-drained peatland, DPA = drained peatland for agriculture and PE = peat extraction site.

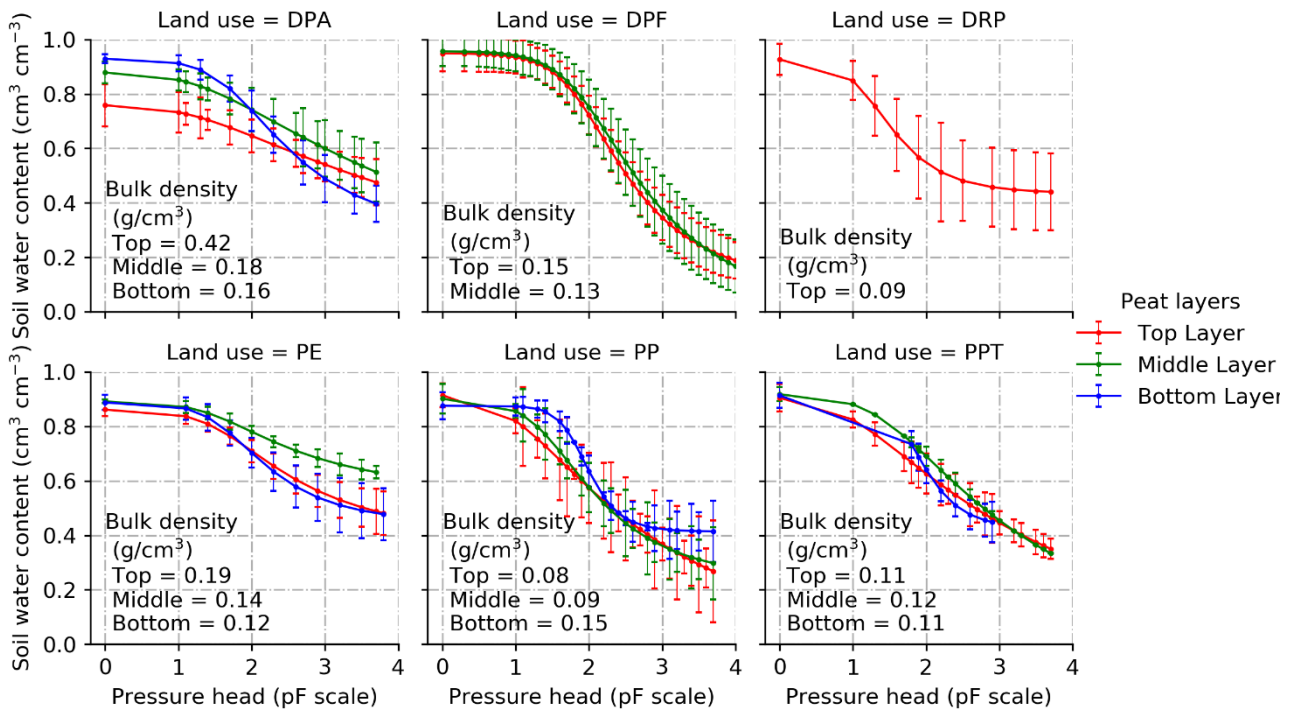


Figure 2. Fitted soil water retention curve for each land use across different layers and their corresponding bulk density values, error bars show the standard deviation.

The outcome of this research is currently under review at *Water Resources Research* journal with title “Hydraulic and physical properties of managed and intact peatlands: Application of the van Genuchten-Mualem models to peat soils”.



Water Resources Research

Hydraulic and physical properties of managed and intact peatlands: Application of the van Genuchten-Mualem models to peat soils

***** **Under Review** *****

2. A systematic review of previously published research work on peatland restoration and used methods for different purposes

2.1. Objectives of the study

A review of mitigation measures on peatland management options and use of peatlands as buffer zones to retain water and reduce negative environmental impacts is being conducted. The review focuses on mitigation measures on peat-dominated catchment and the use of peatlands, e.g., as buffer zones, to reduce negative environmental impacts from the following perspective:

- Leaching (total phosphorus, total nitrogen and dissolved organic carbon)
- Hydrology (retain water using water table and runoff as proxy)
- Green House Gases emissions (CH₄, N₂O and CO₂)

2.2. Materials, methods and progress

A systematic review is being conducted using several published works, in total 303 published articles have been selected from different databases (Google Scholar, ScienceDirect, ISI Web of Science, ResearchGate, Springer, Scopus, Wiley Online Library, Georef and Geobase) and gone through an initial review process. From this 303 initially added and further reviewed articles, a total of 186 have fulfilled the initial screening, and second stage review process and are almost ready for

further analysis. Currently, further cleaning of the data entries is being carried out to prepare the database for analysis. The articles that passed the second review process (188 unique articles) included study sites from different countries (

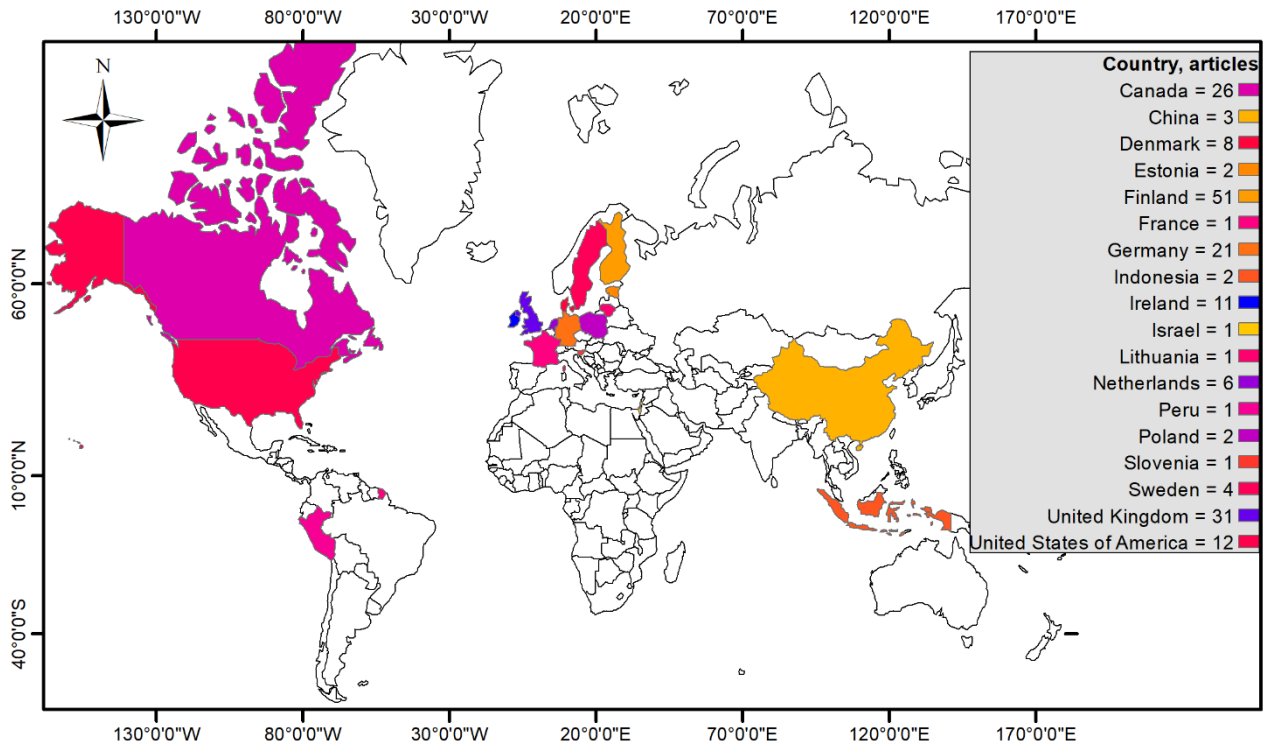


Figure 3), mainly in Europe and North America due to the prevalence of peat soils in these regions.

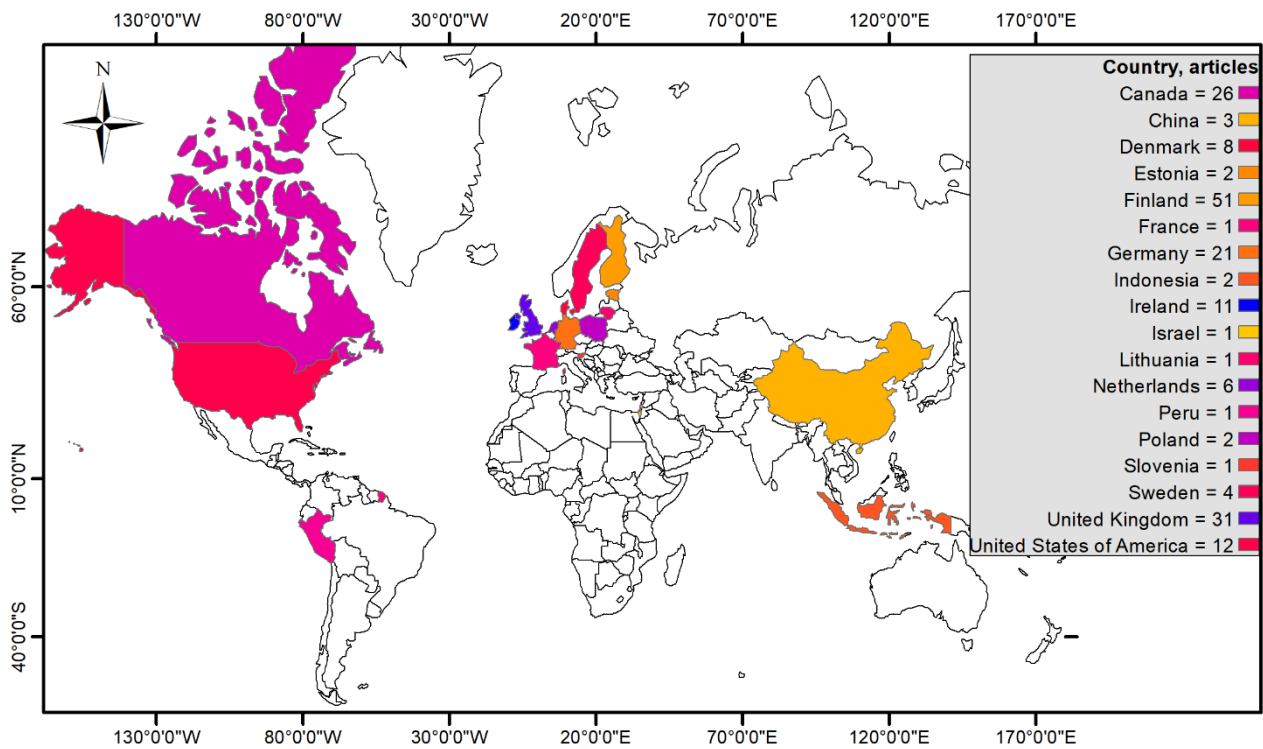


Figure 3. Global distribution of study sites (coloured) included in the 186 articles included in this systematic review, most of the study sites are in North America and Europe, where peat-dominated catchments are typically common.

2.3. Results

Data cleaning, statistical analysis and writing of the article is in progress.

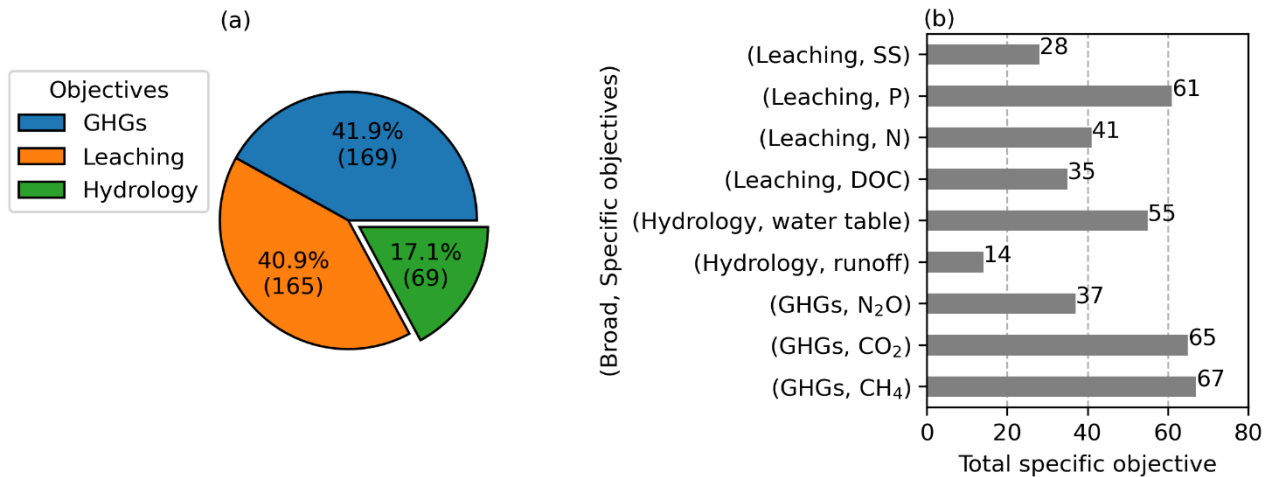


Figure 4. Total study counts based on broad (a) and specific objectives (b) of the papers included in this systematic review, one unique article could have more than one objective counts.

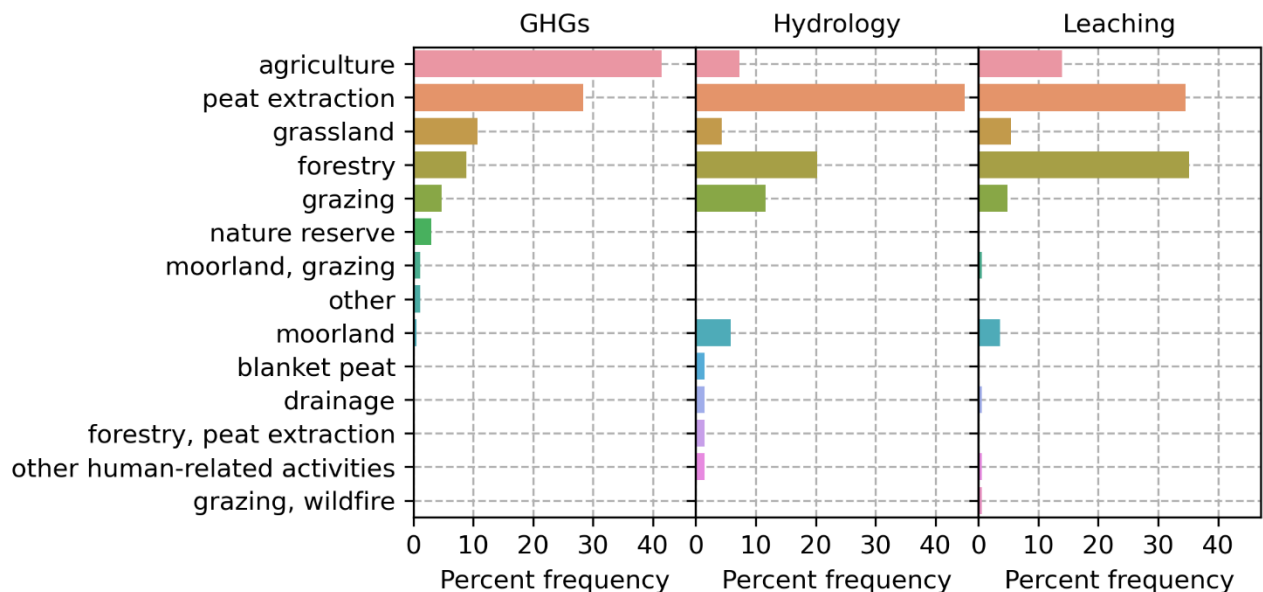


Figure 5. The dominant land uses types of the study sites included in this systematic review for each broad objective (Green House Gases, Hydrology and Leaching papers).

3. List of project persons

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