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Open Access Earth System Science Data Discussions

A peat-depth database for Canada (PDD-Can-1)

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Abstract

Canadian peatlands hold an estimated ~25% of the world's peatland carbon (C) stock. However, a more accurate calculation of C stock requires high-quality empirical datasets to refine numerical techniques, perform validation steps, and calculate the resulting uncertainties in prediction. Here, we present two databases (i) a compilation of 88,763 survey points of basal peat-depth across Canada, extracted from 844 publications (government reports, environmental impact assessments and scholarly journals), and (ii) a compilation of 436,923 survey points containing no peat. Many of these peat-depth survey points were digitized here for the first time. We showcase the peat-depth data by presenting a timeline of peat studies over the past ~100 years and discuss the motivation behind much of this peatland work across the country. Measurements of peat-depth across Canada range from 0-1200 cm and from relatively shallow wetlands in the Arctic tundra to deep fens and bogs in the southern temperate forests. Importantly, our compilation includes peat-depth measurements from regional soil or surficial

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material surveys, largely from environmental impact assessments. These datasets tend toward shallower peats in the range of 50-100 cm, and therefore represent transition areas, regions of shallow peat and/or forested peatlands that were not previously widely documented. There are five data-quality considerations: (i) some data have low precision geographic (latitude and longitude) coordinates; (ii) across the database, there are apparent issues with rounding, vague methodology and unclear definition of the mineral-peat interface; (iii) some peat-depth data were measured 100+ years ago, so there may be mismatches between the present-day condition of the peatland and the original measurements; (iv) there are notable spatial gaps and biases across Canada, including few data from the Hudson Bay Lowlands, overall sparse coverage north of ~55° and a patchwork of peat-depth data that is sometimes abruptly truncated at provincial/territorial borders; (v) we do not include a classification of peat-depth data into fens or bogs because this information is lacking in the original data or was unreliable. We finish by discussing potential uses for these databases along with future improvements. The databases are available at https://doi.org/10.5281/zenodo.17409850 (Dalton et al., 2025).

1 Introduction

Peatlands are long-term sinks for atmospheric carbon dioxide (CO_2). Accordingly, the documentation and management of these globally critical ecosystems have been identified as important for limiting the effects of climate change (United Nations Environment Programme, 2019; United Nations Framework Convention on Climate Change, 2016). Canadian peatlands (covering ~13 % of the landscape; Melton et al., 2022; Tarnocai et al., 2011) represent ~25% of the world's peatland carbon (C) stock (Hugelius et al., 2020; Xu et al., 2018). There has been

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recent interest in quantifying C stocks at a national scale (Sothe et al., 2022), and, more broadly, in peatlands across the globe (Hugelius et al., 2020; Widyastuti et al., 2025; Xu et al., 2018). However, despite many peatland projects taking place across the country, there have been few attempts to compile large-scale empirical datasets of peat depths across Canada. This work is sorely needed, since such empirical datasets are the foundation of any successful numerical modelling work and are critical for performing validation steps and calculating the resulting uncertainties in prediction. Moreover, the value of the C storage in peatlands will help supporting conservation strategies as nature-based solution to fight climate change.

Here, we present the first national-scale compilation of peat-depth measurements for Canada, extracted from government reports, environmental impact assessments and scholarly journals. We also present a large database of 'no peat' sites, which is useful for validating and training data-driven models. Our work comes at a time of increased application of numerical techniques for mapping peatlands (Minasny et al., 2019), especially the integration of large-scale datasets to predict the presence of peat on the landscape (i.e. peat covariates including climate, soil structure, vegetation/biomass, and geomorphology). Empirical measurements of peat depth are critical for calculating C stocks, and previously a lack of field data and large-scale peat-depth datasets limited the accuracy of carbon stock estimation (Hugelius et al., 2020). Our work is complementary to a peat profile dataset that was recently published for Canada (Bauer et al., 2024), which offers information about peat decomposition, bulk density and hydrological parameters at ~1200 sites across the country.

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2 Methods

We compiled available measurements of peat depth from across Canada. This included data from fens, bogs, and muskegs in forested and non-forested locations. The vast majority of compiled data did not contain estimates of carbon content, so we could not follow a strict definition of peat (ie. an accumulation of dead organic material having >30% carbon by dry weight; see Joosten and Clarke, 2002). Instead, depth data were compiled when they explicitly identified peat, bog, fen, muskeg, or soil horizons that specifically mentioned peat (ie. O and LFH horizons). A key requirement was that measurements reflected undisturbed (natural) peat conditions.

2.1 Literature review

We performed an extensive search for any observational data relating to peat depth. Documents reviewed included government reports, academic journals and peatland inventories. As a starting point, we searched scholarly databases (Google Scholar, Web of Science, Scopus, ResearchGate) for any datasets that met the following criteria: (soil OR peat OR peatland OR bog OR fen OR muskeg) and (Canada OR <any province or territory>). We then used the same search terms in the Government of Canada's Open Science and Technology Repository database (https://ostrnrcan-dostrncan.canada.ca/home), which houses scientific and technical publications from the Geological Survey of Canada along with the Canada Forestry Service. The same search terms were used to scan for relevant documents in each of the 13 provincial/territorial geological surveys, or their equivalents (e.g. the Nova Scotia Geoscience and Mines Branch; https://novascotia.ca/natr/meb/). Finally, an extensive search was conducted into environmental impact assessments, both at the national level (Canadian Impact Assessment Registry; https://iaac-aeic.gc.ca/050/evaluations/index?culture=en-CA) and at the 13 provincial/territorial levels (ie. Nunavut Impact Review Board; https://www.nirb.ca/).

The resulting database contains the site name, geographic coordinates, peat-depth measurement, data source and any relevant notes (SITE_NAME, LATITUDE_DD, LONGITUDE_DD, PEAT_DEPTH_CM, REFERENCE, NOTES). A significant portion of this work was spent digitizing provincial peatland survey maps, notably from Nova Scotia, Ontario and Saskatchewan. These survey maps were commonly hand-drawn with often hundreds of survey points and corresponding peat depths indicated on the map. In each case, we uploaded images containing peat-depth data into ArcGIS pro and georeferenced them to match present-day geographic coordinates. This commonly involved aligning the outline of the hand-drawn peatland map with the boundary of the peatland as shown in present-day satellite imagery. Next, we extracted the geographic coordinates (latitude and longitude) for each survey point along with the related measurement of peat depth. There were undoubtedly some uncertainties introduced in this digitization process, especially in the precision of the geographic coordinates because data were extracted from hand-drawn maps that were created before the availability of aerial imagery (for example, some earliest peatland maps date to the 1910s). However, these uncertainties are negligible on the Canada-wide scale, likely not amounting errors greater than 10m in any direction. Many of the pre-1970s data were in imperial units (feet) and we converted them to metric (cm).

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2.2 Quality control

Care was taken to compile accurate peat-depth measurements and any suspected quality control issues are noted in our database. Some datasets that ostensibly document peat depths were ultimately removed from our database because we questioned their accuracy. Notably, provincial well logs from British Columbia, contain lithology records (https://apps.nrs.gov.bc.ca/gwells/) that commonly noted surficial peat. However, we did not incorporate this data as we suspect the lithology data does not represent 'undisturbed conditions'. Another subset of sites excluded were ~275,000 seismic drillers' log records from the Northwest Territories and the Yukon, which described lithology (Smith, 2011). Upon investigation, many instances of extremely deep peat (>1200 cm) corresponded to apparent upland areas when cross-referenced with satellite imagery. Conversely, areas appearing to be large peatlands sometimes had no associated peat in the dataset. We further learned that the accuracy of these lithological logs was variable, and highly dependent on the skills of the geologist writing the log (Smith, 2011). Thus, we excluded these data from our compilation. More details about the seismic drillers' log record is provided in Appendix A.

Sites with vague terms like "organic soil" or "permafrost" or "overburden" were excluded from the database, since it was not clear if they represent peat or non-peat conditions. For a similar reason, grouped descriptions involving peat were excluded since it was not possible to discern the peat depth (e.g. "178 cm of muskeg, wet clay, shale"). Moreover, imprecise peat-depth measurements were excluded (e.g. "about two meters of peat"). This led to the exclusion of extensive survey data from Ducks Unlimited Canada because they measure

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only the uppermost 50 or 100 cm of peat (Smith et al., 2007). Many survey points from environmental impact assessments were also omitted from this compilation when they indicated peat depths of >220cm, which meant the peat depth exceeded the length of the sampling rods.

2.3 Compiling no peat dataset

A database of 'no peat' survey points was compiled in parallel to the work described above. In some cases, these data represent the uplands around the periphery of peatlands. However, another significant source of 'no peat' data was soil surveys related to environmental impact assessments, along with geological bedrock maps across Canada. To find further expand our 'no peat' database, we performed a similar search in scholarly databases and government reports as described above, focusing instead on non-peat datasets (ie. bedrock outcrops, mineral soils).

3 Overview of peat-depth database

Our peat-depth database contains 88,763 survey points from 844 publications across Canada (Fig. 1; Dalton et al., 2025, Supplemental Table 1). The database shows that peat has accumulated in varying depths across the country, ranging from shallow <50 cm (27.5% of the database), to polygon-patterned wetlands in the Arctic tundra (200-300 cm of peat; Ellis and Rochefort, 2004) to deep fens and bogs in the temperate forests farther south (ie. many peatlands in New Brunswick exceeding 800-cm depth; Thibault, 1992).. Four sources contributed almost half (48.5%) of the peat-depth survey points:

i) the New Brunswick Peatland Database, which is a digitized copy of ~20,000 measurements of peat depth in eastern Canada, which were originally sampled in the 1970s and 1980s (Thibault, 1992)

ii) a digital borehole geotechnical database for the Mackenzie Valley/Delta region, which provided 8097 measurements of peat-depth for northwestern Canada (Smith et al., 2005) . This dataset was compiled from borehole records spanning the 1970s onward and was collected in preparation for pipeline and highway construction.

iii) Soil surveys in the province of Quebec, largely south of 50N, conducted by the Ministère des Forêts, de la Faune et des Parcs (MFFP).

iv) 86 peatland isopach maps collected during an inventory campaign in the 1970s and 1980s by the Nova Scotia Department of Mines and Energy.

Despite wide coverage of peat-depth data across Canada, measurements tend to be concentrated along the periphery of the Canadian Shield, with a relative scarcity of data in the northern area compared to the south (Fig. 1). This aligns well with the concentration of bogs and fens in this area (Tarnocai et al., 2005; Tarnocai et al., 2011). However, there is a noticeable shortage of field data from the Hudson Bay Lowlands, which is a globally significant peatland region but difficult to access (Li et al., 2025; Packalen et al., 2016).

4 Timeline of peat investigations across Canada

We categorized a total of 77,818 (85.6% of the dataset) measurements of peat-depth by year of publication. The resulting timeline (Fig. 3) provides insight into the motivation behind

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much of this peat-depth work and showcases the variety of data that are contained in the peat-depth database. Three distinct periods of peat-depth data are apparent on the timeline, each of which are discussed below, and the corresponding data are mapped in Figs 4, 5 and 6. For practical reasons, only a small fraction of the peat-depth database is shown/discussed here. The full dataset is in Dalton et al., 2025, Supplemental Table 1.

4.1 First peatland investigations (1905-1930)

The first period of peat-depth measurements in Canada was published between 1905 and 1930 (Fig. 4), largely by the Canadian Geological Survey (then known as the Department of Mines). During that time, peatlands were inventoried to determine their suitability as supplementary fuel sources to meet the needs of a growing population and industry, particularly in Ontario and Quebec (Haanel, 1926). This resulted in over 13,000 measurements of peat-depth being documented in a span of 20 years (Figs. 3,4). Most of these early peatland surveys were conducted by S. Aleph von Anrep and Erik Nyström, who focused on gridded probing of peatlands to ascertain the extent, depth and humification properties, often at ~150-m spacing intervals. These researchers studied tens of peatlands each summer during this time, often sampling hundreds of survey points at each peatland. An overview of the systematic sampling pattern is shown for three bogs in Figure 4A, B and C. In each case, the color gradient (light to darker colors) shows that peat-depth increases toward the center of the peatland. Notably large datasets from this interval include the Rondeau peat bog (615 survey points; Anrep, 1910), the Alfred peat bog (412 survey points; Nyström and Anrep, 1909), and the Welland bog (427 survey points; shown in Fig. 4B; Nyström and Anrep, 1909), all of which are

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located in Ontario. Also, the Lanoraie peat bog (512 survey points; Anrep, 1914) in Quebec. This early peatland work is even more impressive considering all data and maps were hand-drawn from the vantage-point of the ground since this work pre-dated aerial imagery. Many of these maps are presented here in digitized form for the first time.

4.2 The 1970s Energy Crisis (1970-1990)

The second period of peat-depth data collection corresponds to the period following the 1970s Energy Crisis (Figs. 3,5). During that time, oil shortages caused the Canadian governments (provincial and federal) to consider peatlands as potential fuel sources as an alternative to petroleum. Accordingly, peatland surveys were commissioned by the Geological Survey of Canada, along with numerous provinces, notably Ontario, New Brunswick, Saskatchewan and Nova Scotia (Fig. 5). This second period of peatland studies yielded at least 34,000 measurements of peat-depth (Figs. 3,5). The protocol for peatland surveying was largely similar to the first investigations in the early 1900s (gridded probing at regular intervals; occasional measurement of humification). An overview of a typical sampling pattern is shown for three bogs in Figure 5A, B and C. Notably large datasets from this interval include Peatland X97-1G (427 survey points; Nova Scotia; Nova Scotia Department of Mines and Energy, 1984), Dryden Lac Seul 52K-82 (389 survey points; Ontario; Monenco Ontario Limited, 1986) and 42H-177D (274 survey points; Ontario; Geo-analysis Ltd., 1986). An extensive survey of peatlands in New Brunswick contained >20,000 measurements taken in the 1970s and 1980s (Thibault, 1992). Many of the peatland inventories from this interval were conducted by private companies that were commissioned by the government.

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Another source of peat-depth data unrelated to the 1970s Energy Crisis is apparent on Fig. 5. Following the advent of radiocarbon dating in the 1940-1950s (Libby et al., 1949; Suess, 1954), basal peat from across Canada were submitted for radiocarbon dating to understand the timing of ice sheet retreat and other ecological processes. We compiled numerous single-point peat-depth measurements from radiocarbon reports (Dyck et al., 1966; Lowdon et al., 1969; Lowdon et al., 1972).

4.3 Environmental Impact Assessments (2005-present-day)

A third period of peat-depth measurements in Canada relates to the collection and digitization of data in environmental impact assessments (Fig. 3, 6). Across Canada, proposed development projects were required to complete increasingly rigorous assessments from the 1970s onward. Broadly, the purpose of that work was to document baseline environmental conditions, track disturbance, and evaluate the potential effects of the proposed development on the landscape. Starting in the mid-2000s, data pertaining to these environmental impact assessments were increasingly archived online, resulting in >28,000 measurements to our peat-depth database (Fig. 3). In some cases, peatlands and/or wetlands were explicitly inventoried as part of the assessment work. For example, a wetland survey related to a proposed wind project in Nova Scotia yielded 22 peat-depth measurements (Strum Consulting, 2023), and a similar wetland baseline report documented peat depth across 34 sites in British Columbia (proposed gold mine; Rescan, 2013). However, overwhelmingly, peat-depth data were extracted from the regional soil and/or borehole survey component of environmental impact assessments (ie. 3142 measurements of peat-depth as part of a seismic survey in Alberta; BlackPearl Resources Inc.,

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2013). In other cases, peat depth was documented as part of broad assessments of terrestrial resources (1252 measurements of peat-depth; Cenovis FCCL Ltd., 2010). As a result of different survey approaches, peat-depth data from these assessments come into a variety of sampling strategies. They can either span long distances (see Fig. 6A, where >8000 boreholes stretch along ~1000km of the MacKenzie River; Smith et al., 2005), or they were arranged in closely-spaced transects (see Fig. 6B, where >3000 peat-depth measurements are spaced at 20-m intervals in a seismic survey; BlackPearl Resources Inc., 2013). In other cases, peat-depth measurements were sporadically sampled across the area of interest (Fig. 6C).

5 Survey points containing no peat

We also compiled 436,923 survey points containing no peat (Dalton et al., 2025, Supplemental Table 2) from 848 sources across Canada (Fig. 7). The largest dataset that we imported was 36,325 ecological observation points from Quebec (https://www.donneesquebec.ca/recherche/dataset/points-observation-ecologique). We also imported 19,436 survey points from kimberlite anomaly and drill hole data in Nunavut (Tremblay, 2025); 12,761 survey points from the Canadian Rock Physical Property Database (Enkin, 2018) and 8,415 sites from the National Pedon Database (NPDB; https://sis.agr.gc.ca/cansis/nsdb/npdb/index.html). Other large datasets included surficial geology surveys from Nunavut (8250 data points; Kerr, 2022); surficial deposits of southern Ontario (7093 sites; Ontario Geological Survey, 2010), and a digital borehole geotechnical database for the Mackenzie Valley/Delta region (n=3923 data points; Smith et al., 2005). In all

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the aforementioned cases, the lack of peat was inferred, for example, by the presence of non-peat material at the surface (notably: till, bedrock, boulders or mineral soils)

6 Discussion

Our compilation of peat-depth data from 88,763 survey points across Canada (Dalton et al., 2025, Supplemental Table 1) and our dataset of 436,923 no peat survey points (Dalton et al., 2025, Supplemental Table 2) represents a significant contribution toward mapping Canadian peatland depths. Our work is complementary to a recent peat profile database (Bauer et al., 2024), and together, these datasets can be used to calculate peatland C stocks at a national scale. Globally, our work in compiling this Canada-wide database is paralleled only by the NatureScot Peatland Action database which contains 90,000+ individual survey points of peat depth across Scotland (https://map.environment.gov.scot/Soil_maps/?layer=15) as well as a recent global peatland database with 204,000+ measurements of peat depth (Peat-DBase v.1; Skye et al., 2025).

Our compilation of peat-depth data is also useful because of the spatial distribution of data across Canada. Because many of our depth measurements originated from peatland inventories, our dataset captures transitions from the deepest sections of bog andfens to increasingly shallow peats along their periphery and surrounding upland areas. Many of these depth measurements fall in the range of 200-400 cm (Fig. 2). However, importantly, our compilation also includes peat-depth measurements from regional soil or surficial material surveys, largely from EIAs. These datasets tend toward shallower peats in the range of 50-100 cm (Fig. 8). These data are a critical component of this work because they represent the areas of shallow peat and/or forested peatlands that were not previously widely documented. This adds significant nuance to our understanding of peat formation and distribution across the country, which has the potential to add important refinements to peatland models (Bona et al., 2020).

6.1 Data considerations

Our databases report the original geographic (latitude and longitude) coordinates. In many cases, especially environmental impact assessments, these data are highly precise owing to the use of GPS. However, our databases also include peat-depth measurements from the early 1900s that were digitized by overlaying archived maps into ArcGIS. Every effort was made to ensure robust data digitization, but in these cases, the apparently high precisions are an artifact of georeferencing the datapoints in ArcGIS. In some datasets obtained pre-GPS, the coordinates are rounded (49.40 and -54.05) and should be considered of low precision. We retained the originally derived coordinates in our databases, which may require additional screening depending on the spatial resolution in predictive work.

There are also difficult-to-quantify uncertainties in the peat-depth data. While not explicitly mentioned in the respective reports, many of these measurements appeared to be rounded to the nearest 10-cm interval. This was particularly noticeable in peatland survey maps (see, for example Fig 4A-C). This approach was likely adopted to streamline fieldwork and to facilitate hundreds of peat-depth measurements across a single peatland. We also suspect that rounding occurred in cases where imperial (“inches”) measurements used pre-1970. This ‘rounding’ was also apparent in environmental impact assessments but was here likely the

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result of peat depths not being the primary purpose of the work. Across the peat-depth database, it is also unclear what constitutes a 'surface' of the peat, and there is also a lack of consistent rules for defining the exact limit between organic and mineral soil. In most cases, peatland surveys were conducted with peat probes and the peat depth was determined by the resistance of the probe to the underlying mineral soil. However, uncertainties can be raised when there is obstruction due to a woody layer within the peat or when the mineral contact is diffuse (organo-mineral substrate) so peat depth is misinterpreted. Finally, for the measurements taken in the early 1900s, there have been 100+ years of peat accumulation, or loss, not accounted for in our database. In other cases, there might have been major changes to peatland (i.e. mining) since recording the peat depth. These uncertainties in peat-depth should all be taken into account by users of these data.

Users of this peat-depth database should take note of the spatial gaps and biases across Canada. Notably, measurements of peat depth tend to be sparse north of ~55° because of the logistics and costs in sampling these remotes areas (Fig. 1). This spatial bias is apparent when viewing peat-depth measurements across Quebec, which show a northern limit at roughly 50°, corresponding to the northernmost extent of most roads (Fig. 1). When present, peat-depth data north of ~55° are often only by single-point surveys, compared to large systematic inventories of peatland further south. This is unfortunate because we know that peatlands, ranging from thin lenses to thicker bogs and fens are present and sometimes widespread north of ~55° as surficial geology maps (derived from field studies as well as remote-sensing work) indicate their presence (ie. large swaths of peatlands identified, but not surveyed, in northern Alberta; Plouffe et al., 2006). Peat-depth data are also noticeably sparse in the Hudson Bay

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Lowlands, which is one of the largest peatland complexes in the world (Li et al., 2025; Packalen et al., 2016). Given the importance of northern peatlands in the global carbon cycle (Harris et al., 2022; Hugelius et al., 2020), it would be valuable to increase surveys in that area.

Political boundaries (especially those separating the country into 13 provinces and territories; Fig. 1) also influence the acquisition and/or availability of peatland data. Some jurisdictions did not commission large peatlands inventories in the early 1900s, nor again in the 1970-1980s (for example, Prince Edward Island, Nunavut). In other cases, peatland inventories were limited largely to spatial mapping and not depth measurements (Newfoundland and Labrador Geological Survey, 2022). The availability of peat-depth data from environmental impact assessment is equally variable across Canada. In some cases, soil surveys that can contain peat-depth data are either not widely required as part of the reporting process or they are not available online (i.e. Ontario, Saskatchewan). Throughout the compilation of our peat-depth database, we encountered several reports that ostensibly contained data that were not readily accessible (e.g. non-functional online links). At the opposite end of the spectrum some jurisdictions provide all documents relating to environmental impact assessments on frequently updated websites (i.e. Alberta, British Columbia). The above mentioned political and legislative boundaries across Canada results in a patchwork of peat-depth data that sometimes are abruptly truncated.

A final consideration for those using the peat-depth database is that we did not attempt to classify the data into fens or bogs. This decision was made to preserve the integrity of the database and not introduce errors. A key concern was mislabelling: many peatlands that were deemed bogs in the early 1900s have since been discovered as having some fen components.

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Notable examples include Alfred Bog and Mer Bleue Bog in Ontario (Riley and Michaud, 1987). Moreover, major sources of peat-depth data across the country (notably, shallow peats that were documented in soil surveys conducted as part of environmental impact assessments) do not distinguish between fen and bog. Users requiring this information should consult with independently derived categories of peatlands. For example, the Canadian Model for Peatlands (CaMP) distinguishes between 3 categories of peatland across the country (Webster et al., 2018) and 11 categories are presented in Bona et al. (2020).

6.2 Uses for Canada's peat-depth database

High-quality empirical databases are the foundation for complex numerical techniques that have been increasingly employed to map peatlands globally (Hugelius et al., 2020; Melton et al., 2022; Xu et al., 2018). Databases such as ours can be used for training computational techniques, performing validation steps, and calculating the resulting uncertainties in prediction. It can also be used for identifying hot spots of C stocks for conservation purposes in nature-based climate solution to fight climate change. Our database of 88,763 peat-depth survey points across Canada (Dalton et al., 2025, Supplemental Table 1) and our database of 436,923 no peat survey points (Dalton et al., 2025, Supplemental Table 2) would significantly increase the empirical data that forms the foundation of this work, resulting in undoubtably smaller uncertainties in the next iteration of models. The inclusion of shallow peat from environmental impact assessments is also highlight relevant for future iteration of the Canadian model for peatlands (CaMP), which allows for peatlands to be integrated into national greenhouse gas reporting (Bona et al., 2020).

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6.3 Future improvements

In completing this work, we became aware of several relevant sources of peat-depth data that were not feasible to include here. Notably, for Ontario, where several peatland reconnaissance open files were not accessible online (OF-5543, 5489, 5487, 5448, 5450, 5488, 5541). Another likely source of peat depth data are technical documents related to utility corridors, bridge construction and/or highway alignment. It is standard practice in this field of engineering to conduct extensive terrain surveys at regularly spaced intervals along the entire length of the proposed road/corridor (for example, an international standard which specifies the classification of soil for the purposes of highway construction; ASTM International, 2015). We were able to secure hundreds of peat-depth survey points from technical documents of recent infrastructure projects (Golder Associates Inc., 2010; KGS Groups, 2011; SNC Lavalin, 2008). However, many of the existing utility corridors and/or highways were built prior to the 2000s, and as such have not been digitized. Instead, they are archived in paper form at the respective government offices. This is likely a significant untapped source of peat-depth data, especially given the widespread nature of highways and utility corridors across Canada.

Changes to fieldwork protocols would also extend the areal coverage of this database. It would be highly beneficial for peatland and/or soil surveys work to use longer probes to measure the entire depth of peat instead of only measuring the uppermost 50 or 100 cm (Smith et al., 2007). There are also some newer technologies that can be employed to determine peat depth. For example, ground penetrating radar shows promise as an effective indicator of peat depth (Parry et al., 2014; Proulx-McInnis et al., 2013).

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We also noticed that basic details on peat-depth were missing (or, published very sparingly) from otherwise extensive interdisciplinary peatland studies. Without drawing attention to specific studies, we note that there are several cases of this in the database. Many, likely hundreds, of peatland publications were omitted from our compilation because no measurements of peat depth were reported. This is surprising because depth probing is frequently one of the first reconnaissance tools used when studying peatlands for a variety of purposes (vegetation surveys, hydrological studies, and monitoring greenhouse gas emissions). Anecdotally, many of the researchers 'know' the depth of their peatlands, but this knowledge is not documented in the resulting publication. As a result of these omissions, we need to turn to numerical techniques to approximate the peat depth in these areas. To address this issue, it would be useful if basic peat-depth data were included in publications, perhaps in supplementary material. This issue is pervasive across environmental impact assessments, academic research and government publications.

7 Conclusions

Extensive empirical databases are the foundation of any successful numerical modelling work and are therefore critical for accurately mapping northern peatlands and calculating their C stocks. We present a peat-depth database containing 88,763 survey points from 844 publications across Canada, along with a database of 436,923 survey points containing no peat. Our approach for compiling this dataset involved an extensive literature review and a quality control process to limit errors in the database. We also digitized numerous maps here for the first time, making these data accessible to future workers. Our database includes data from

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peatland surveys as well as more shallow peats that were opportunistically recorded as part of regional soil or surficial material surveys, largely from environmental impact assessments. These peat-depth data add significant nuance to our knowledge on shallow peats, notably highlighting transition zones and/or forested peatlands that were not previously widely documented. We also identified research gaps and biases, notably, that peat-depth measurements tend to be very sparse north of ~55°, and political boundaries heavily influence the presence and/or availability of peat-depth data. This empirical database will be of value for numerical efforts to study peatlands, notably mapping extent and calculating C stocks and to support decision making about conservation of C most important hot spots.

8 Acknowledgements

We thank the following individuals who provided peat-depth data and/or helpful discussions related to this work: Daniel Aydalla, Kelly Bona, Frédéric Caron, Lee Fedorchuk, Nicolas Perciballi, Justin Yu, and Jade Skye. This research is part of the Can-Peat: Canadian peatlands as nature-based climate solutions (https://uwaterloo.ca/can-peat). This project was undertaken with the financial support of the Government of Canada.

Data availability

The databases are available at https://doi.org/10.5281/zenodo.17409850 (Dalton et al., 2025):

Supplemental Table 1. The vetted peat-depth database containing 88,763 survey points, from 844 publications across Canada. (dataset content)

Supplemental Table 2. A compilation of 436,923 survey points not containing peat (0 cm peat)(dataset content)

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Author contributions

Data collection and analysis by A.S.D. with input and guidance from M.G. and J.R.M. Manuscript was prepared by A.S.D. with contributions from all co-authors. All authors read and approved of the final manuscript.

Competing interests

The authors declare no competing interests.

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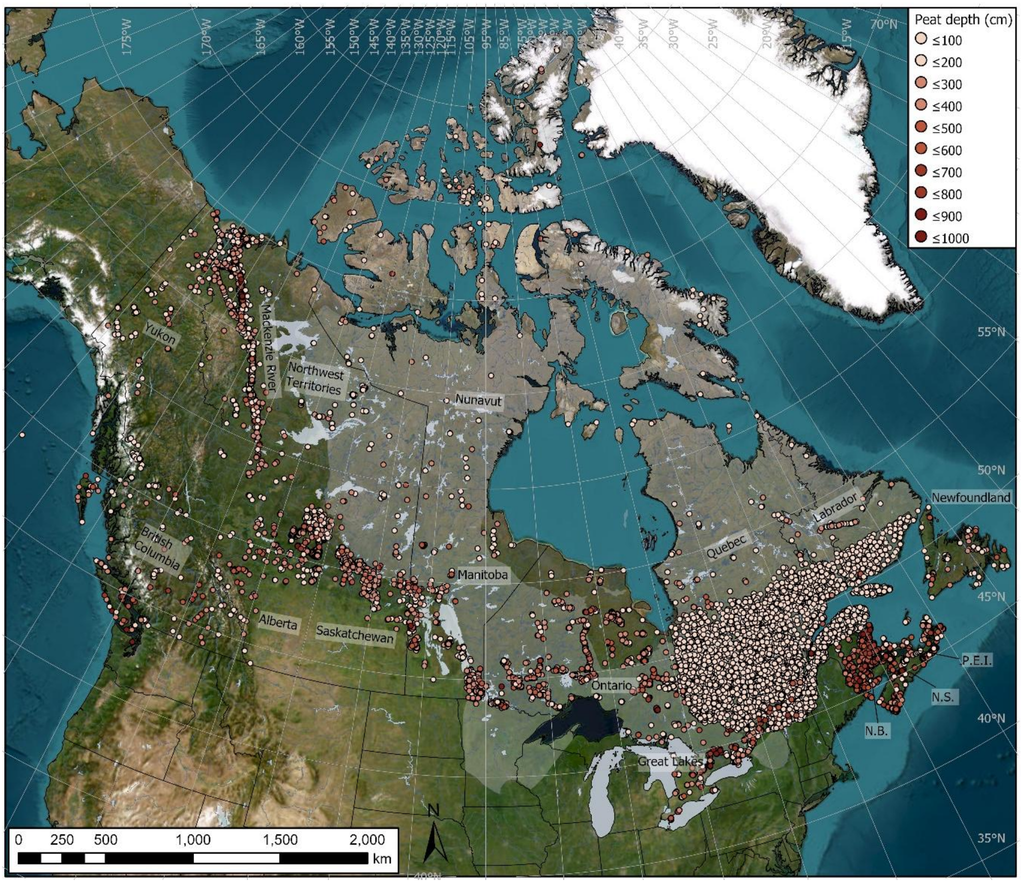

Figure 1. The vetted peat-depth database containing 88,763 survey points, from 844 publications across Canada (Dalton et al., 2025, Supplemental Table 1). Shaded grey area represents the Canadian Shield, a broad region of Precambrian granite that covers much of Canada. Note that measurements of peat depth tend to be very sparse north of ~55° because of the logistic costs to survey these remotes areas. N.B.: New Brunswick; N.S.: Nova Scotia; P.E.I.: Prince Edward Island. Basemap source: Esri, Vantor, Earthstar Geographics, and the GIS User Community. Powered by Esri.

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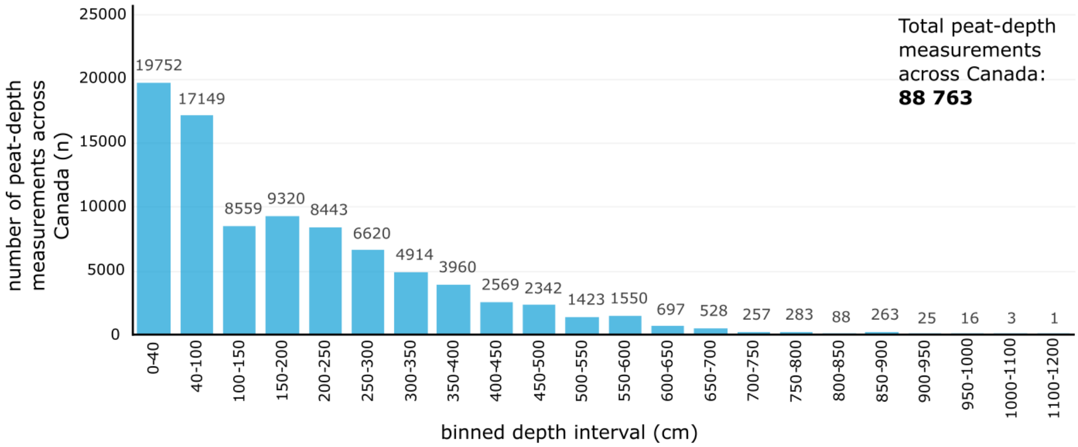

Figure 2. Binned peat depth measurement across Canada. The first bin (shallow peat; 0-40cm) comprises 22% of the dataset, and is below the traditional minimum depth for a peatland in Canada. Note the change in bin size at 1000.

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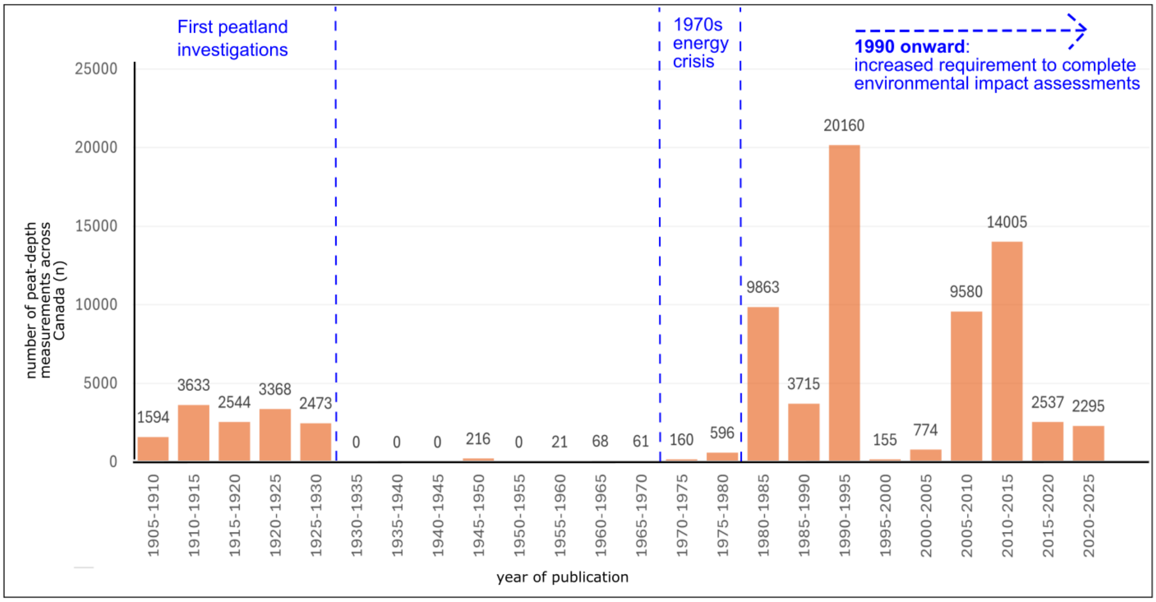

Figure 3. Timeline showing the gradual accumulation of peat-depth data across Canada since the early 1900s. The year of publication often lags the sample collection by 1-2 years. Three distinct periods of peat-depth data are apparent on the timeline (outlined in blue). Data corresponding to each wave is mapped in Figs 4, 5 and 6.

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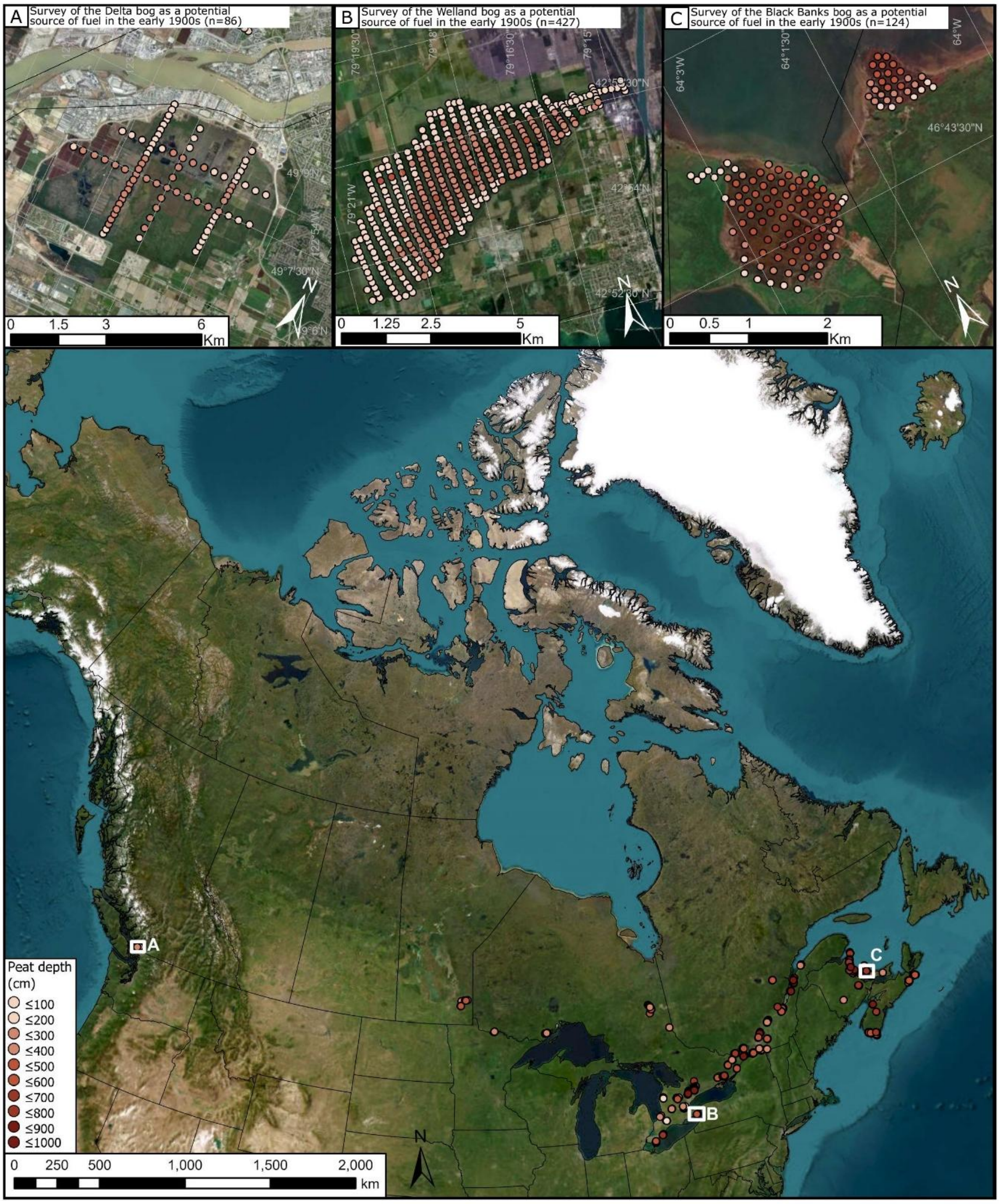

Figure 4. Peat-depth data that were published between 1905 and 1930. Most data on this map were collected by the Canadian Geological Survey (then known as the Department of Mines) as means of using peat for supplementary fuel sources. Sub-panels A, B, C show examples of peat-depth data collected during this interval. Basemap source: Esri, Vantor, Earthstar Geographics, and the GIS User Community. Powered by Esri.

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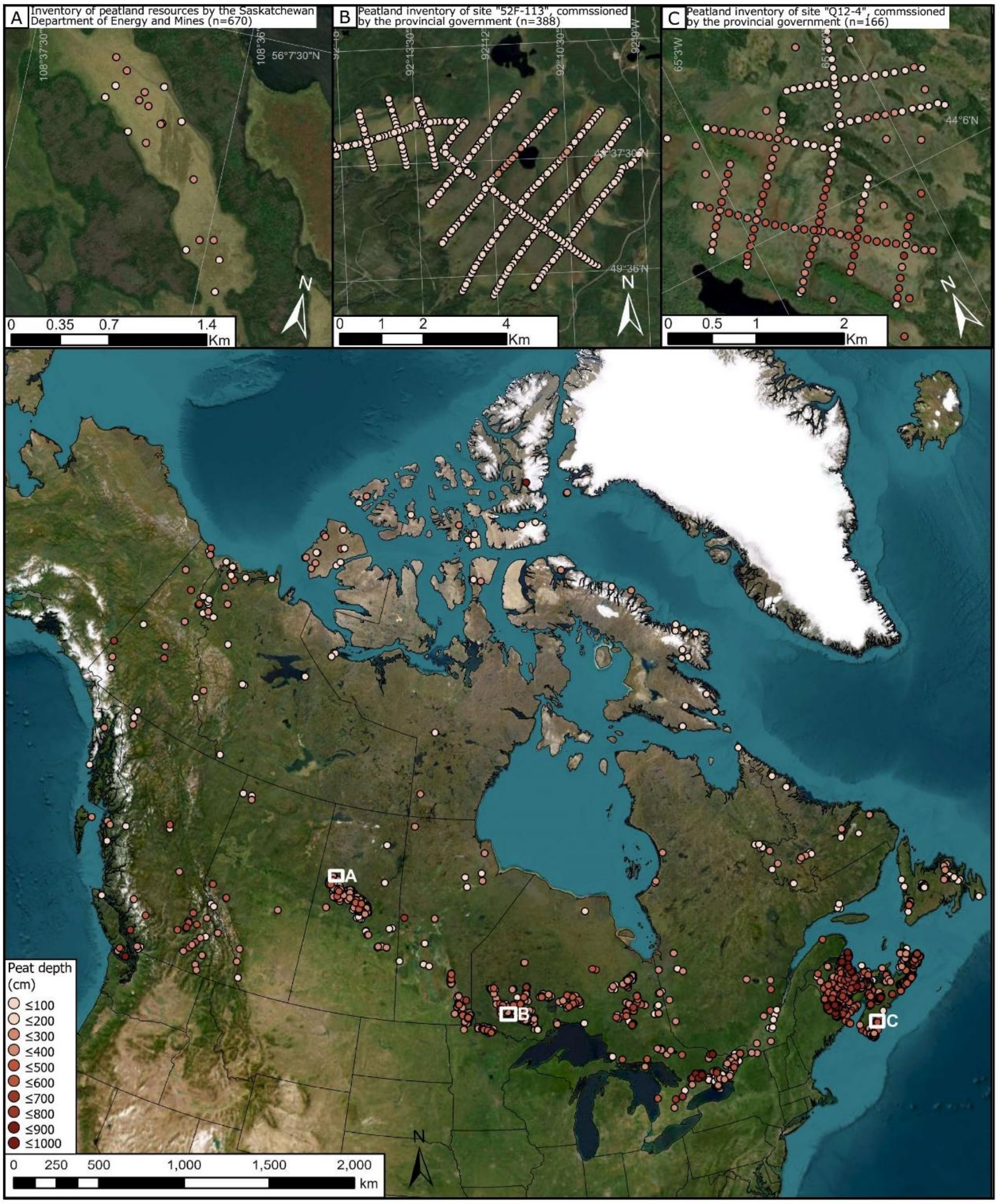

Figure 5. Peat-depth data that were published between 1979 and 1990. Many of these investigations were conducted to explore peatlands as an alternative fuel source during the 1970s Energy Crisis. Sub-panels A, B, C show examples of peat-depth data collected during this interval. Basemap source: Esri, Vantor, Earthstar Geographics, and the GIS User Community. Powered by Esri.

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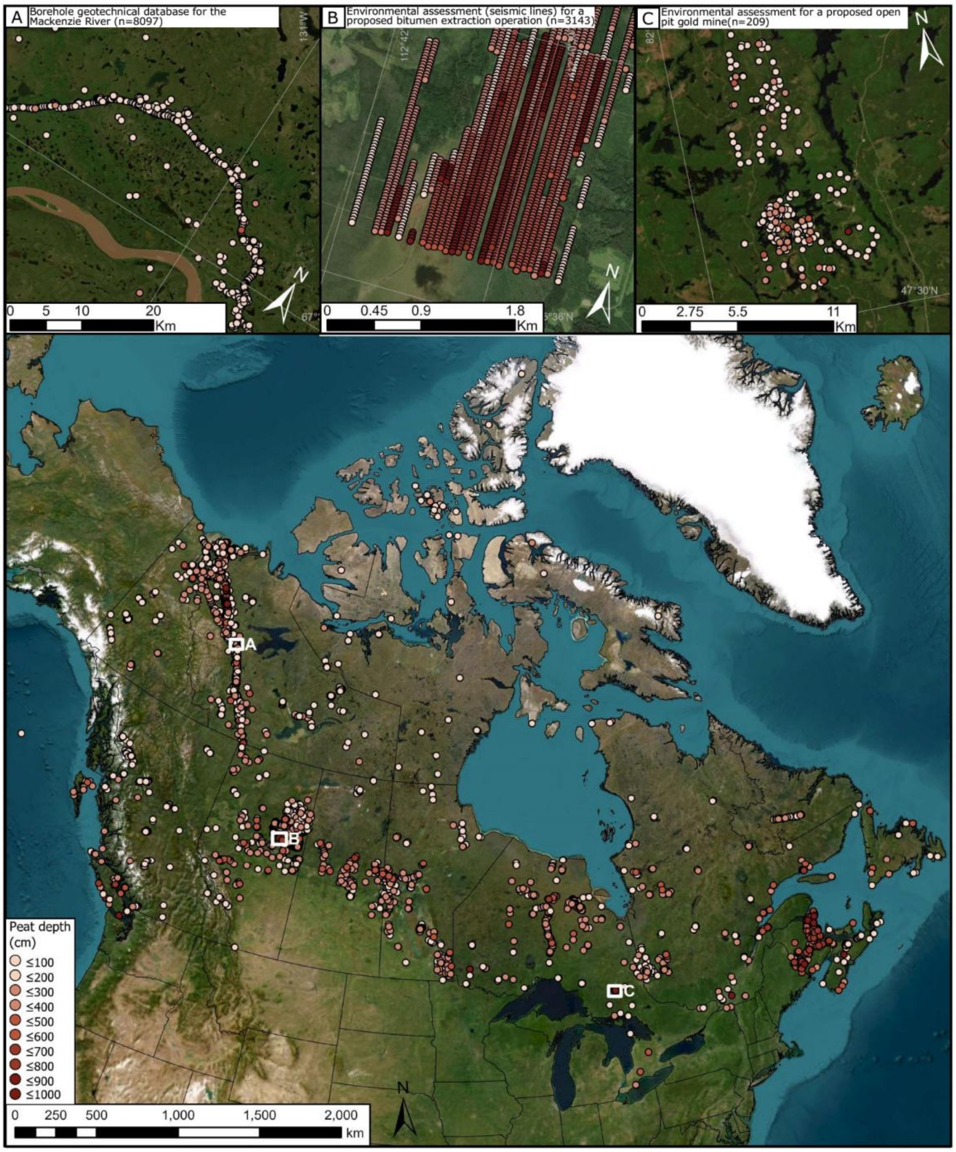

Figure 6. Peat-depth data that were published between 2005 and present-day, many of which are derived from environmental assessments. Sub-panels A, B, C show examples of peat-depth data collected during this interval. Basemap source: Esri, Vantor, Earthstar Geographics, and the GIS User Community. Powered by Esri.

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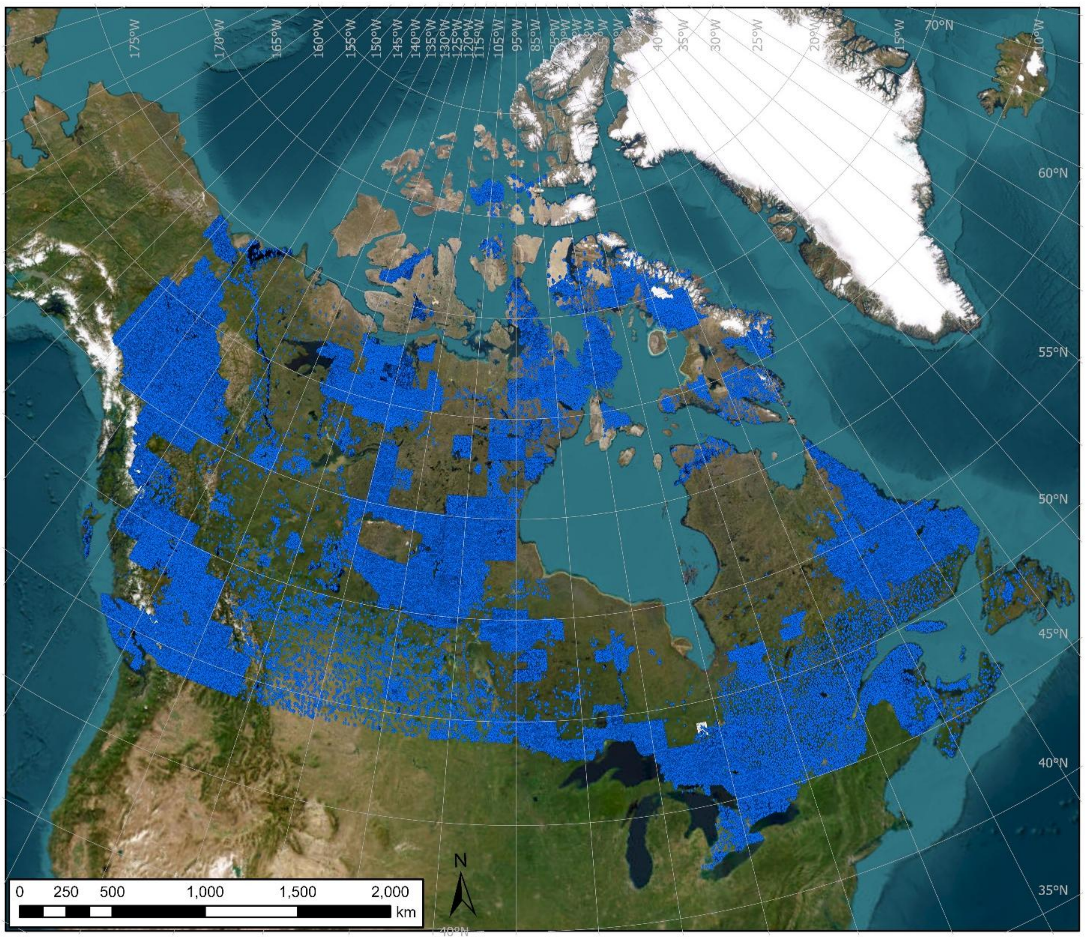

Figure 7. Our compilation of 436,923 survey points not containing peat (Dalton et al., 2025, Supplemental Table 2). Basemap source: Esri, Vantor, Earthstar Geographics, and the GIS User Community. Powered by Esri.

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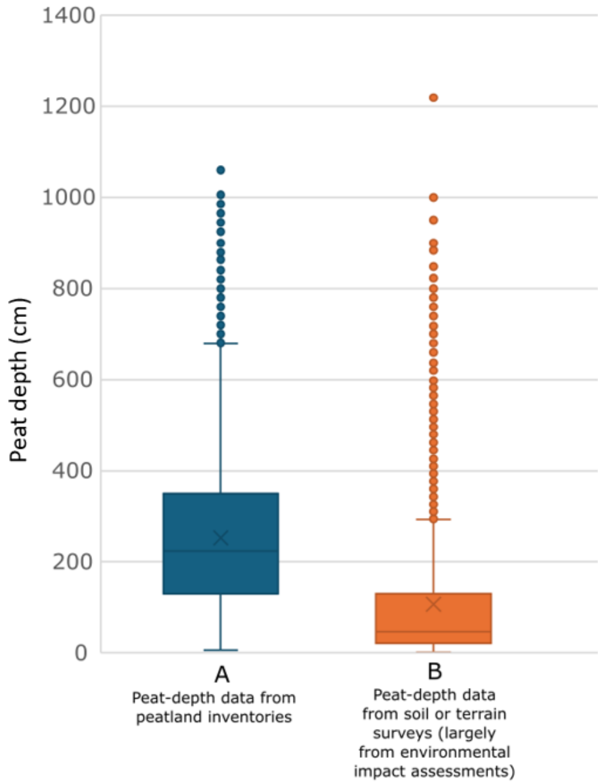

Figure 8. Boxplots summarizing two categories of peat-depth data: A) cases where peatlands were intentionally sampled (notably as part of large peatlands inventories in the early 1900s, and again between 1970-1980). B) peat data that were opportunistically recorded as part of regional soil or surficial material surveys, largely from environmental impact assessments starting in the mid-1990s. Peat-depth data from EIAs are significantly shifted toward more shallow peat and therefore add critical information about shallow peat and/or forested peatlands that were not previously widely documented.

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Appendix A: Justification for excluding peat-depth data from a compilation of seismic shothole drillers' logs from the Northwest Territories and northern Yukon

While compiling peat-depth data across Canada, we found a compilation of seismic shothole drillers' logs from the Northwest Territories and northern Yukon (Smith and Lesk-Winfield, 2010). This dataset contains >275,000 digitized drilling log records from petroleum exploration and seismic acquisition companies, resulting in what appears to be a highly detailed lithological dataset across the Mackenzie River basin (Fig. A1). In most cases, sediment descriptions and the thickness of each unit are fully documented.

We queried this dataset for any sites containing surficial peat and found 13,014 survey points (Figure A1). However, we began to suspect these data may not be reliable given the haphazard distribution of peat depths across the dataset, with large clusters of data in the range of 50-100 cm, 150-200 cm and 300-350 cm (Fig. A2). This dataset also apparently contained 16 sites with >1000 cm of peat, which made it the single largest contributor of deep peat measurements in our entire Canada-wide compilation. Moreover, our 'visual check' showed that many instances of extremely deep peat (>1200 cm) were associated with apparent upland areas on the map (Fig. A3). Contrastingly, areas that appeared to be peatlands were sometimes associated with no peat (Fig. A3).

Reading further into the development of this database, we found that Smith (2011) urged caution because of some inconsistencies in lithographic notation. The main purpose of

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the shothole driller logs was to document the depth to bedrock, and overlying sediments were identified somewhat haphazard depending on the expertise of the person writing the log (Smith, 2011). In order to avoid introducing errors into our peat-depth dataset, we chose to omit data from the compilation of seismic shothole drillers' logs from the Northwest Territories and northern Yukon. Future work may make this dataset useable for peat-dept work; for example, a study into the methods of each exploration company may make it possible to determine which companies reported peat-depth accurately.

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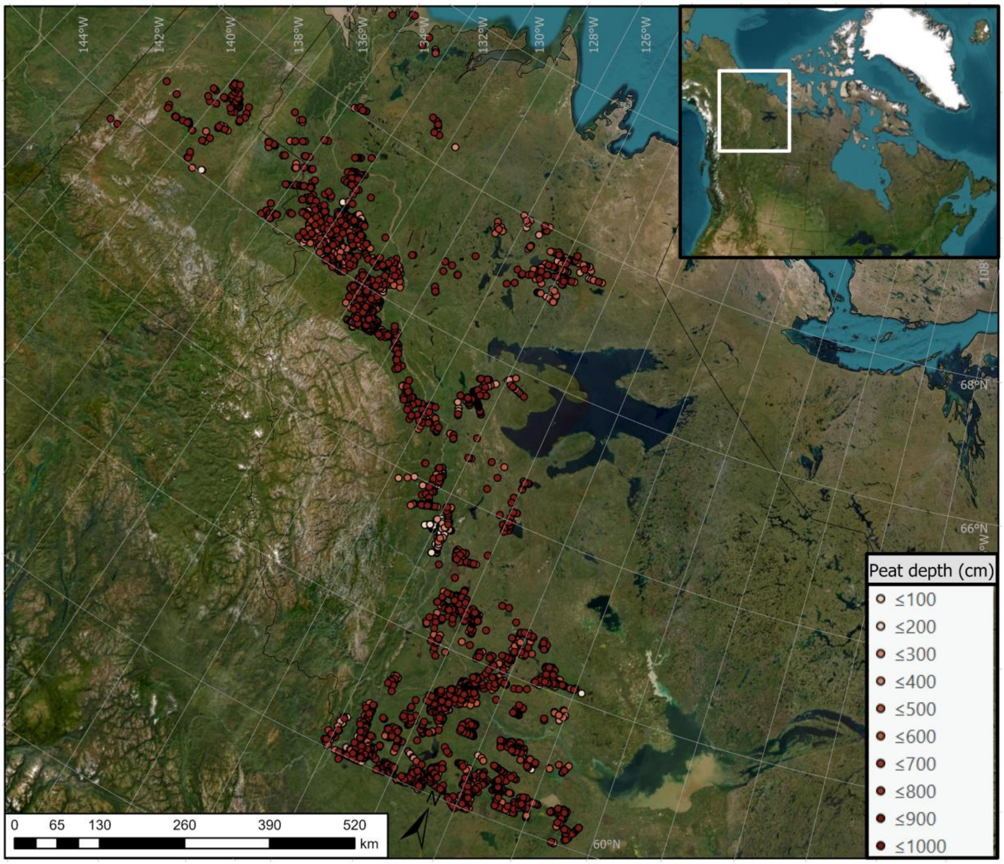

Fig. A1. Sites purportedly containing surficial peat from seismic shothole drillers' logs from the Northwest Territories and northern Yukon (n = 13,014 sites). Inset map shows the location in Canada. Note the large amount of sites showing peat depths in the range of >500cm, which is unusually deep for this region. Basemap source: Esri, Vantor, Earthstar Geographics, and the GIS User Community. Powered by Esri.

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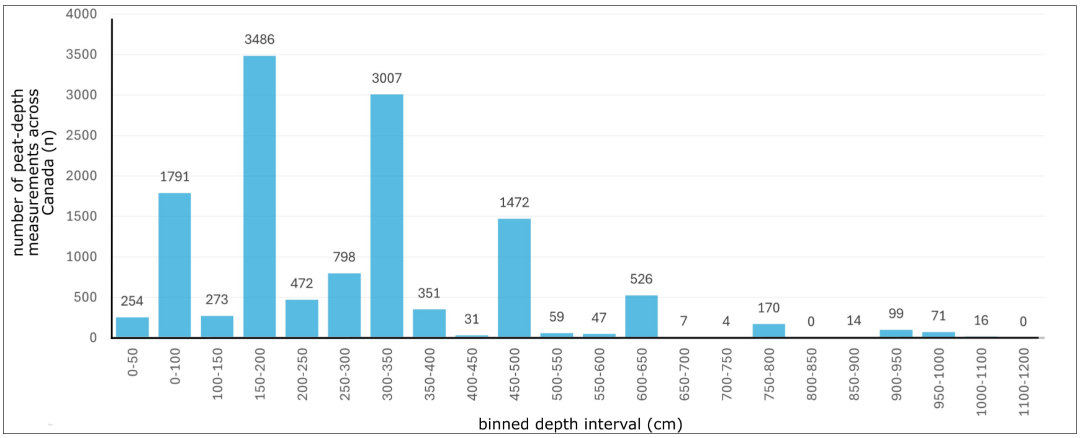

Fig A2. Graph showing the depth intervals of surficial peat from seismic shothole drillers' logs from the Northwest Territories and northern Yukon (n = 13,014 sites).

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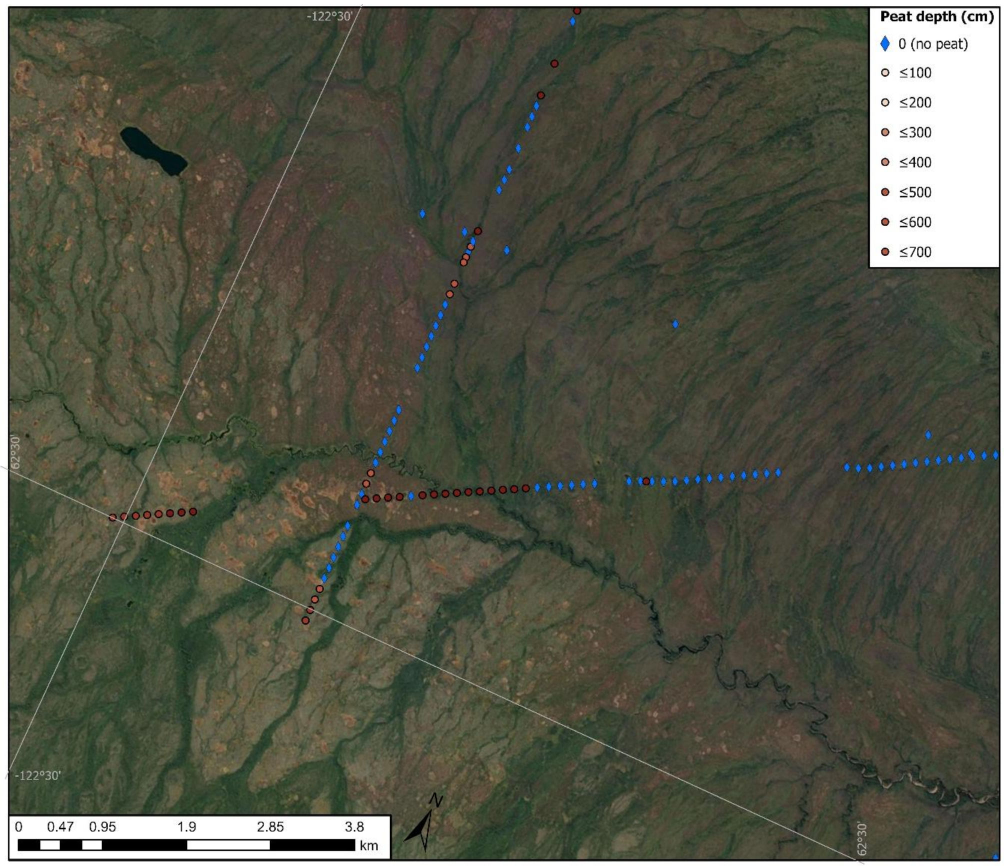

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684 **Fig A3.** A regional look at the peat sites in the seismic shothole drillers' logs from the
685 Northwest Territories and northern Yukon (n = 13,014 sites). Many sites in this region have very
686 thick peat deposits (>500cm) but they are adjacent to sites with no peat (blue diamonds). This
687 signifies the inconsistent nature of reporting peat in this dataset, which is a key reason for not
688 using it in our work. Basemap source: Esri, Vantor, Earthstar Geographics, and the GIS User
689 Community. Powered by Esri.

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