PEATLANDS OF CANADA DATABASE AND MAPS (Version 3)

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1. INTRODUCTION

Peatlands, which are dominant features of the Canadian landscape, cover approximately 1136 x 10^3 km^2, or 13% of the land area. These peatlands are essential to the global environment because they retain, purify and deliver fresh water, store carbon, absorb pollutants and support numerous species of plants and wildlife, many of them identified as endangered. Under current scenarios of increasing greenhouse gases, the expected increases in global temperatures have the potential to affect peatlands in many areas. Most of the peatlands (97%) occur in the Boreal Peatland Region (64%) and Subarctic Peatland Region (33%). Because of the large area they cover and their high organic carbon content, these peatlands contain approximately 147 Gt soil carbon, which is about 59% of the organic carbon stored in all Canadian soils.

2. CONTENTS OF CD

This third version of the peatland database and accompanying maps is organized into the 5 sections described below:

01_DATA: folder containing the digital GIS peatland database in ESRI® shapefile format (found in the 01_1_Shp subdirectory) and in ARC/INFO export (.e00) format (found in 01_2_ArcInfo Export subdirectory). Please note, the shapefile does not contain the peatlands layer table used to calculate carbon content and mass. The file "peat032005lyr.dbf", found in the 01_1_shp folder, is the layer table in dBase format.

02_PUBMAP: folder containing the published maps. There is one sub-directory of poster-sized maps (02_1_Poster sized maps) with the original rasterized ESRI plot files (.rtl) and the same files converted to pdf format. A second sub-directory (02_2_Page sized maps) provides the poster maps reduced to page-size in a .jpg format.

03_METADATA: folder with documentation in pdf format.

04_APPS: application software folder with software ArcExplorer® which allows the user to visualize shapefiles.

05_STATISTICS: folder with statistics related to area of peatland by peatland type, SOC masses and SOC contents by peatland type, and administrative provinces and ecoclimatic regions. Statistics were calculated after projecting the data in a Lambert Azimuthal equal area projection with the specifications below.

Radius of sphere of reference is 6370997.
Longitude of center of projection is -91 degrees, 52 minutes, 0 seconds.
Latitude of center of projection is 63 degrees, 0 minutes, 0 seconds.
False easting is 0 meters.
False northing is 0 meters.

3. PROJECTION PARAMETERS OF SHAPEFILE

Lambert Conformal Projection
Datum is Nad27
Spheroid is Clarke 1866
Units METERS
1st standard parallel is 49 degrees, 0 minutes, 0 seconds
2nd standard parallel is 77 degrees, 0 minutes, 0 seconds
Central Meridian is -91 degrees, 52 minutes, 0 seconds
Latitude of Projection's Origin is 0 degrees, 0 minutes, 0 seconds
False Easting is 0 meters
False Northing is 0 meters

4. PEAT DEFINITIONS

Peat is material consisting largely of organic residues originating under more or less water-saturated conditions through the incomplete decomposition of plant and animal constituents. It forms as a result of anaerobic conditions, low temperatures, and other complex causes.

Peatlands (formerly referred to as organic terrain or muskeg) are wetlands with massive deposits of peat that are at least 40 cm thick (National Wetlands Working Group, 1988). Each of the four classes of peat - bog, fen, swamp or marsh - may take several to numerous forms depending on the climate, hydrology, presence or absence of permafrost, form and composition of underlying surficial materials.

Bogs are peatlands having the water table at or near the surface (National Wetlands Working Group, 1988). Since the bog surface, which may be either raised or level with the surrounding terrain, is virtually unaffected by nutrient rich groundwater from the surrounding mineral soils, it is generally acid and low in nutrients. The dominant materials are weakly to moderately decomposed sphagnum and woody peat, underlain at times by sedge peat. Bogs, which may be treed or treeless, are usually covered with Sphagnum spp. and ericaceous shrubs.

Fens are peatlands usually having the water table at or just above the surface (National Wetlands Working Group, 1988). The waters are nutrient-rich and originate from mineral soils. The dominant materials are moderately to well-decomposed sedge and/or brown moss peat of variable thickness. The vegetation consists predominately of sedges, grasses, reeds, brown mosses, with some shrubs, and, at times, a sparse tree layer.

Marshes are mineral lands or peatlands periodically inundated by standing or slowly moving water (National Wetlands Working Group, 1988). Surface water levels may fluctuate seasonally,

with declining levels exposing drawdown zones of matted vegetation or mudflats. The nutrient-rich waters vary from fresh to highly saline. The substratum usually consists of mineral material, although occasionally it consists of well-decomposed peat. Marshes characteristically show zonal or mosaic surface patterns composed of pools or channels interspersed with clumps of emergent sedges, grasses, rushes and reeds that border grassy meadows and peripheral bands of shrubs or trees. Submerged and floating aquatics flourish in areas of open water.

Swamps are mineral wetlands or peatlands with standing water or water gently flowing through pools or channels (National Wetlands Working Group, 1988). The water table is usually at or near the surface. Pronounced internal water movement from the margin or other mineral sources results in nutrient rich waters. Peat, when present, is primarily well decomposed wood underlain, at times, by sedge peat. Vegetation is characterized by a dense cover of deciduous or coniferous trees or shrubs, herbs and mosses.

5. CARBON VARIABLE DEFINITIONS

Information on soil carbon data for Canadian soils is provided by Soil Carbon Data Base Working Group (1993). Total carbon content of the polygon (kg/m^2), 'TOCC', is a measure of the average amount of soil organic carbon of the total depth of the soil (all three layers of data recorded in the Peatlands Layer Table, see section 8) found in the land area of a soil landscape polygon. Soil landscape polygons represent particular soil and landform features and are the most detailed spatial entities within the ecological hierarchy employed in Canada (National Soil Database, 1996).

Surface carbon content of the polygon (kg/m^2), 'SOCC', is a measure of the average amount of soil organic carbon of the active layer of the soil (0-30 cm) found in the land area of a soil landscape polygon.

From 0-100 cm depth, carbon content of the polygon (kg/m^2), 'MOCC', is a measure of the average amount of soil organic carbon of the top 100 cm of soil found in the land area of a soil landscape polygon.

6. PEATLAND DEVELOPMENT

The distribution of peatlands is determined by the climate and by the morphology of the land surface (National Wetlands Working Group, 1988). Climate determines the amount of water received and retained while the morphology of the land influences the distribution of the water and, thus, the location of peatlands. Peatlands develop initially when areas of high water table are infilled with peat-forming vegetation such as that found in fens and bogs. Bogs are dependant upon rainfall for water (ombrotrophic), while fens can also obtain water that originates from the surrounding (adjacent) mineral terrain (minerotrophic).

Canadian peatlands, developed during the Holocene epoch, are most extensive in poorly-drained areas of glaciomarine and glaciolacustrine silt and clay and of fine-grained tills in the Hudson Bay Lowlands, in the Mackenzie River valley region, and in northern Alberta and northern Manitoba. They are also common in topographic depressions in the rugged Precambrian Shield terrain in central Canada.

7. DATABASE COMPILATION

The current Peatlands of Canada Database was developed in 2005 (Tarnocai et al., 2005) by updating the 2000 version of the database (Tarnocai et al., 2000) using new spatial and site data together with updated information from the peatland component of the Soil Organic Carbon Database (Tarnocai and Lacelle, 1996). Although all these databases were developed in an ARC/INFO environment, the current version differs from the earlier versions in that it contains an expanded polygon attribute table and a peat layer table. Since this peat layer table includes all the data necessary to calculate carbon content, this latest version of the database provides the means for generating peatlands maps not only to estimate peatland areas but also to determine the relationship between the amounts of organic carbon and the various peatland classes and regions.

The Soil Landscapes of Canada database was the primary source of information for the Atlantic Provinces, Quebec, Ontario, the Yukon, and parts of British Columbia, the Northwest Territories and Nunavut. Information for the Prairie Provinces was obtained primarily from Vitt et al. (1995), Halsey and Vitt (1997), Halsey et al. (1997), and Vitt et al. (2000). It should be noted that, for purposes of consistency with other sources of data, some units categorized in the Prairie Provinces as non-patterned wooded fen have been designated bogs in this compilation. The Mackenzie River Valley area in the western Northwest Territories was mapped on the basis of peatland information obtained from Geological Survey of Canada surficial geology maps (Geological Survey of Canada, B-series and Open File Maps. 1973-1980). Because peatland data for the Prairie Provinces and Mackenzie River valley were generated at a larger scale than that of the SLC landscape polygons, these data sets were resampled to a comparable scale using the SLC polygon structure. Peatland areas in the southern Arctic islands, Great Slave Lake area and eastern Nunavut were delineated on the basis of new air photo interpretations and archived field data. Coastal British Columbia (Tarnocai et al., 2004a) and Southern Ontario (Tarnocai et al., 2004b) were updated using detailed survey data. Carbon layer data were assembled from the Soil Organic Carbon Database of Canada (Tarnocai and Lacelle, 1996). When data were not available from the Soil Organic Carbon Database, regional site data (Tarnocai and Lacelle, 2001) was used. When no other data were available, data were interpolated using the previous two sources by wetland region, frozen indicator and peatland type.

Calculation of Carbon Content and Masses

The soil organic carbon contents (OCC) were calculated using the information in the Peat Layer Table of the Peatlands of Canada Database (see digital database format section of this documentation). Data on peat thickness (T), bulk density (BD) and organic carbon (C%) obtained from peat cores were entered in three layers based on information in the database. The first layer

represents the uppermost 0 to 25 cm for fens and marshes and 0 to 50 cm for bogs and swamps. The second layer is the remaining basal peat and the third is the organic-rich mineral layer underlying the basal peat. The OCC was then calculated for each layer using the formula OCC = C% x BD x T. For the surface organic carbon content (SOCC) T = 30 cm, for 0-100 cm (MOCC) T = 100, and for the total organic carbon content (TOCC) T is the total depth of the three layers. Each of these values was aggregated for each peat polygon in the database. In respect to the statistics calculated and reported on this CD, the organic carbon mass (OCM) of each polygon was calculated by multiplying the OCC by the area of each peatland class in the polygon.

8. DIGITAL DATABASE FORMAT

The Peatlands of Canada Database consists of an ArcGIS® compatible spatial cover and associated attribute files. The attributes associated with the shapefile "peat032005" consists of the distribution of peatland classes within the polygon, their percent distribution and the soil organic carbon contents (OCC) of each polygon. The peatlands layer table (peat032005lyr.dbf) is a file which holds the peatlands layer information needed to calculate soil organic carbon. There are a maximum of three layers per soil. See Section 7, calculation of carbon content and masses for a more in depth analysis of this file.

Shapefile attributes:

Area of polygon (m2)	AREA
Polygon number	POLYGON_ID
Peatland Region*	PEATLANDRE
Land (%)	LAND_PCT
Fresh Water (%)	H2OFRESH_P
Ocean Water (%)	H2OOCEAN_P
Rockland (%)	ROCKLAND_P
Glaciers (%)	GLACIER_PC
Total peatland (%)	PEATLAND_P
Bog (%)	BOG_PCT
Fen (%)	FEN_PCT
Swamp (%)	SWAMP_PCT
Marsh (%)	MARCH_PCT
Perennially frozen peatland (%)	PEATLANDFR
Unfrozen peatland (%)	PEATLANDUN
Total organic carbon content (kg m^{-2})	TOCC
One metre organic carbon content (kg m^{-2})	MOCC
Surface organic carbon content (kg m^{-2})	SOCC

*National Wetland Working Group, 1986

Peat Layer Table:

Polygon number	POLYGON_ID
Peatland Class	PEATCLASS
Layer number	LAYERNO
Layer Designation	LAYER
Layer Thickness (cm)	THICK
Layer Thickness Data Indicator*	THICK_ME
Bulk Density (gm/cm^3)	BDENS
Bulk Density Data Indicator*	BDENS_ME
Organic Carbon (%)	OCARB
Organic Carbon Data Indicator*	OCARB-ME

* Measured (m) or estimated (e) indicator

9. ACKNOWLEDGEMENTS

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10. RECOMMENDED CITATION

For database:
Tarnocai, C., I.M. Kettles and B. Lacelle. 2011. Peatlands of Canada; Geological Survey of Canada, Open File 6561 (digital database); CD-ROM.

For maps:
Tarnocai, C., I.M. Kettles and B. Lacelle. 2011. Peatlands of Canada. Geological Survey of Canada, Open File 6561 (map, scale 1:6 500 000); CD-ROM

Tarnocai, C., Kettles, I. M. and Lacelle, B. 2011.
Soil Organic Carbon Content of Canadian Peatlands.
Geological Survey of Canada 6561 (map, scale 1: 7 500 000); CD-ROM

Tarnocai, C., Kettles, I. M. and Lacelle, B. 2011.
Soil Organic Carbon Mass of Canadian Peatlands.
Geological Survey of Canada 6561 (scale 1: 7 500 000); CD-ROM

11. PREVIOUS VERSIONS AND CITATIONS

This release replaces the following:

For database:
Tarnocai, C., Kettles, I.M., and Lacelle, B., 2002. Peatlands of Canada database, Geological Survey of Canada Open File 4002 (digital database).

Tarnocai, C., Kettles, I.M. and Lacelle, B., 2005. Peatlands of Canada. Agriculture and Agri-Food Canada, Research Branch, Ottawa, (digital database)

For maps:
Tarnocai, C., Kettles, I.M., and Lacelle, B., 2000. Peatlands of Canada. Geological Survey of Canada Open File 3834, Scale 1:6 500 000.

Tarnocai, C., Kettles, I.M. and Lacelle, B., 2005. Peatlands of Canada. Agriculture and Agri-Food Canada, Research Branch, Ottawa, (1:6 500 000 scale map).

Tarnocai, C., and Lacelle, B., 2005. Soil Organic Carbon Content of Canadian Peatlands. Agriculture and Agri-Food Canada, Research Branch, Ottawa, ON. (1:7 500 000 scale map)

Tarnocai, C., and Lacelle, B., 2005. Soil Organic Carbon Mass of Canadian Peatlands. Agriculture and Agri-Food Canada, Research Branch, Ottawa, ON. (1:7 500 000 scale map)

12. REFERENCES

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National Wetlands Working Group, 1988. Wetlands of Canada; Canada Committee on Ecological Land Classification, Environment Canada, Ecological Land Classification Series, No. 24, 454 p.

Soil Carbon Data Base Working Group, 1993. Soil carbon data for Canadian soils; Centre for Land and Biological Resources Research , Research Branch, Agriculture Canada, Ottawa, 137 p.

Tarnocai, C., 1989. Peat resources in Canada; *in* Quaternary Geology of Canada and Greenland, (ed.) R.J. Fulton; Geological Survey of Canada, Geology of Canada, No. 1, Chapter 11, p. 676-684.

Tarnocai, C., and Lacelle, B., 1996. The soil organic carbon digital database of Canada; Research Branch, Agriculture and Agri-Food Canada, Ottawa, Ontario.

Tarnocai, C., Kettles, I.M., and Lacelle, B., 2000. Peatlands of Canada; Geological Survey of Canada, Open File 3834, 1 CD ROM.

Tarnocai, C., and Lacelle, B., 2001. Wetlands of Canada database; Research Branch, Agriculture and Agri-Food Canada, Ottawa, Ontario (digital database).

Tarnocai, C., and Lacelle, B., 2005. Soil organic carbon content of Canadian peatlands; Agriculture and Agri-Food Canada, Research Branch, Ottawa, ON. (1:7 500 000 scale map)

Tarnocai, C., and Lacelle, B., 2005. Soil organic carbon mass of Canadian peatlands; Agriculture and Agri-Food Canada, Research Branch, Ottawa, ON. (1:7 500 000 scale map)

Tarnocai, C., Kettles, I.M., and Lacelle, B., 2002. Peatlands of Canada database, Geological Survey of Canada Open File 4002 (digital database).

Tarnocai, C., Hohban, L. and Lacelle, B., 2004a. Peatlands of coastal British Columbia; Research Branch, Agriculture and Agri-Food Canada, Ottawa, Ontario.

Tarnocai, C., Hohban, L. and Lacelle, B., 2004b. Peatlands of southern Ontario; Research Branch, Agriculture and Agri-Food Canada, Ottawa, Ontario.

Tarnocai, C., Kettles, I.M. and Lacelle, B., 2005. Peatlands of Canada database; Research Branch, Agriculture and Agri-Food Canada, Ottawa, Ontario (digital database).

Vitt, D.H., Halsey, L.A., Thormann, M.N., and Martin, T., 1995. Peatland inventory of Alberta;

Prepared for the Alberta Task Force and Alberta Environmental Protection Agency.

Vitt, D.H., Halsey, L.A., Bauer, I.E., and Campbell, C., 2000. Spatial and temporal trends in carbon storage of peatlands of continental western Canada through the Holocene; Canadian Journal of Earth Sciences, v. 37, no. 5, p. 683-693.