Circum-Arctic Map of Permafrost and Ground Ice Conditions

Summary

The Circum-Arctic permafrost and ground ice map is available via ftp in ESRI Shapefile format and Equal-Area Scalable Earth Grid (EASE-Grid) format. See the Format section for an explanation of the files provided via ftp.

The circumpolar permafrost and ground ice data contribute to a unified international data set that depicts the distribution and properties of permafrost and ground ice in the Northern Hemisphere (20°N to 90°N). The re-gridded data set shows discontinuous, sporadic, or isolated permafrost boundaries. Permafrost extent is estimated in percent area (90-100%, 50-90%, 10-50%, <10%, and no permafrost). Relative abundance of ground ice in the upper 20 m is estimated in percent volume (>20%, 10-20%, <10%, and 0%). The data set also contains relative abundance of ice wedges, massive ice bodies and pingos, ranges of permafrost temperatures (deg. C) and thicknesses (m), and the location of subsea and relict permafrost, and unfrozen layers. Data are gridded at 12.5 km, 25 km, and 0.5 degree resolution.

Permafrost, or permanently frozen ground, is ground (soil, sediment, or rock) that remains at or below 0°C for at least two years (Permafrost Subcommittee, 1988). It occurs both on land and beneath offshore arctic continental shelves, and underlies about 22% of the Earth's land surface. Permafrost thicknesses range from less than 1 m to greater than 1000 m.

For more information on the creation of the original map, see Heginbottom et al. (1993).

Citing These Data:

Brown, J., O.J. Ferrians, Jr., J.A. Heginbottom, and E.S. Melnikov. 1998, revised February 2001. *Circum-arctic map of permafrost and ground ice conditions.* Boulder, CO: National Snow and Ice Data Center/World Data Center for Glaciology. Digital media.

Overview Table

Category	Description
Data format	ESRI Shapefiles and EASE-Grid
Spatial coverage	25°N - 90°N, 180°W-180°E
Grid type and size	Lambert Azimuthal projection, EASE-Grid

File naming convention	*.avl = legend *.dbf = attribute data *.prj = projection info *.shp = feature geometry *.shx = feature geometry index *.byte = binary raster files *.hdr = header files used to bring the binary raster files into a GIS program
File size	94 bytes - 20.2 MB
Parameter(s)	discontinuous, sporadic, or isolated permafrost boundaries permafrost extent relative abundance of ground ice in the upper 20 m relative abundance of ice wedges, massive ice bodies and pingos ranges of permafrost temperatures (deg. C) and thicknesses (m) location of subsea and relict permafrost and unfrozen layers
Procedures for obtaining data	Data are available via FTP

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2. Detailed Data Description:

Format:

The Circum-Arctic permafrost and ground ice map data set contains the following files:

permaice.avl = ESRI Shaprefile legend file for permaice coverage based on NUM_CODE field in the polygon attribute table
permaice.dbf = attribute data
permaice.prj = projection info
permaice.shp = feature geometry
permaice.shx = feature geometry index
subsea.avl: ESRI Shapefile legend file for subsea coverage
subsea.dbf = attribute data
subsea.prj = projection info
subsea.shp = feature geometry
subsea.shx = feature geometry index
treeline.avl: ESRI Shapefile legend for treeline map
treeline.dbf = attribute data
treeline.prj = projection info
treeline.shp = feature geometry
treeline.shx = feature geometry index
llipa.byte = binary raster file, 0.5 degree by 0.5 degree version
llipa.hdr = header file used to bring the binary raster files into a GIS program
nhipa.byte = binary raster file, 2.5 km by 12.5 km EASE-Grid version
nhipa.hdr = header file
nlipa.byte = binary raster file, 25 km by 25 km EASE-Grid version
nlipa.hdr = header file
readpf.f = fortran program

Each datum within a file is a single byte. Numerical data values are listed below.

Value	Definition
0	No information
1 - chf	Continuous permafrost extent with high ground ice content and thick overburden
2 - dhf	Discontinuous permafrost extent with high ground ice content and thick overburden
3 - shf	Sporadic permafrost extent with high ground ice content and thick overburden
4 - ihf	Isolated patches of permafrost extent with high ground ice content and thick overburden
5 - cmf	Continuous permafrost extent with medium ground ice content and thick overburden
6 - dmf	Discontinuous permafrost extent with medium ground ice content and thick overburden
7 - smf	Sporadic permafrost extent with medium ground ice content and thick overburden
8 - imf	Isolated patches of permafrost extent with medium ground ice content and thick overburden
9 - clf	Continuous permafrost extent with low ground ice content and thick overburden
10 - dlf	Discontinuous permafrost extent with low ground ice content and thick overburden
11 - slf	Sporadic permafrost extent with low ground ice content and thick overburden

12 - ilf	Isolated patches of permafrost extent with low ground ice content and thick overburden
13 - chr	Continuous permafrost extent with high ground ice content and thin overburden and exposed bedrock
14 - dhr	Discontinuous permafrost extent with high ground ice content and thin overburden and exposed bedrock
15 - shr	Sporadic permafrost extent with high ground ice content and thin overburden and exposed bedrock
16 - ihr	Isolated patches of permafrost extent with high ground ice content and thin overburden and exposed bedrock
17 - clr	Continuous permafrost extent with low ground ice content and thin overburden and exposed bedrock
18 - dlr	Discontinuous permafrost extent with low ground ice content and thin overburden and exposed bedrock
19 - slr	Sporadic permafrost extent with low ground ice content and thin overburden and exposed bedrock
20 - ilr	Isolated patches of permafrost extent with low ground ice content and thin overburden and exposed bedrock
21 - g	Glaciers
22 - r	Relict permafrost
23 - l	Inland lakes
24 - o	Ocean/inland seas
25 - ld	Land

Permafrost extent codes

c = continuous	(90-100%)
d = discontinuous	(50- 90%)
s = sporadic	(10- 50%)
i = isolated patches	(0 - 10%)

Ground ice content codes

h = high	(>20% for "f" landform codes) (>10% for "r" landform codes)
m = medium	(10-20%)
l = low	(0-10%)

Landform (terrain and overburden) codes

f	lowlands, highlands, and intra- and intermontane depressions characterized by thick overburden cover (>5-10m)
r	mountains, highlands ridges, and plateaus characterized by thin overburden cover (>5-10m) and exposed bedrock

Projection:

Projection for the raster (*.byte) files is:

Projection: Lambert Azimuthal
Units: meters
Spheroid: defined
Major Axis: 6371228.00000
Minor Axis: 6371228.000
Parameters:
radius of the sphere of reference: 6371228.00000
longitude of center of projection: 0
latitude of center of projection: 90
false easting (meters): 0.00000
false northing (meters): 0.00000

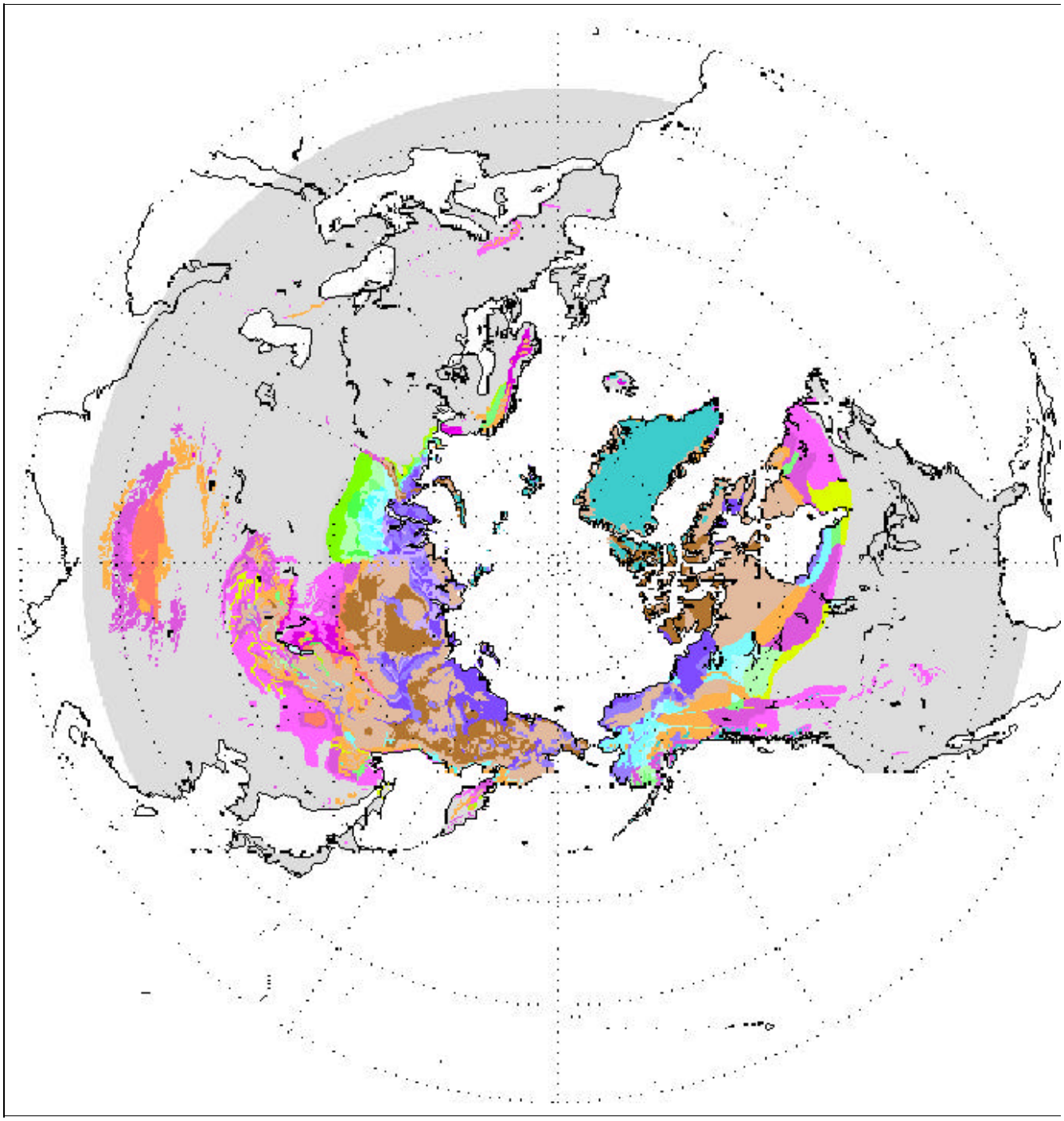
Projection of the shapefiles is:

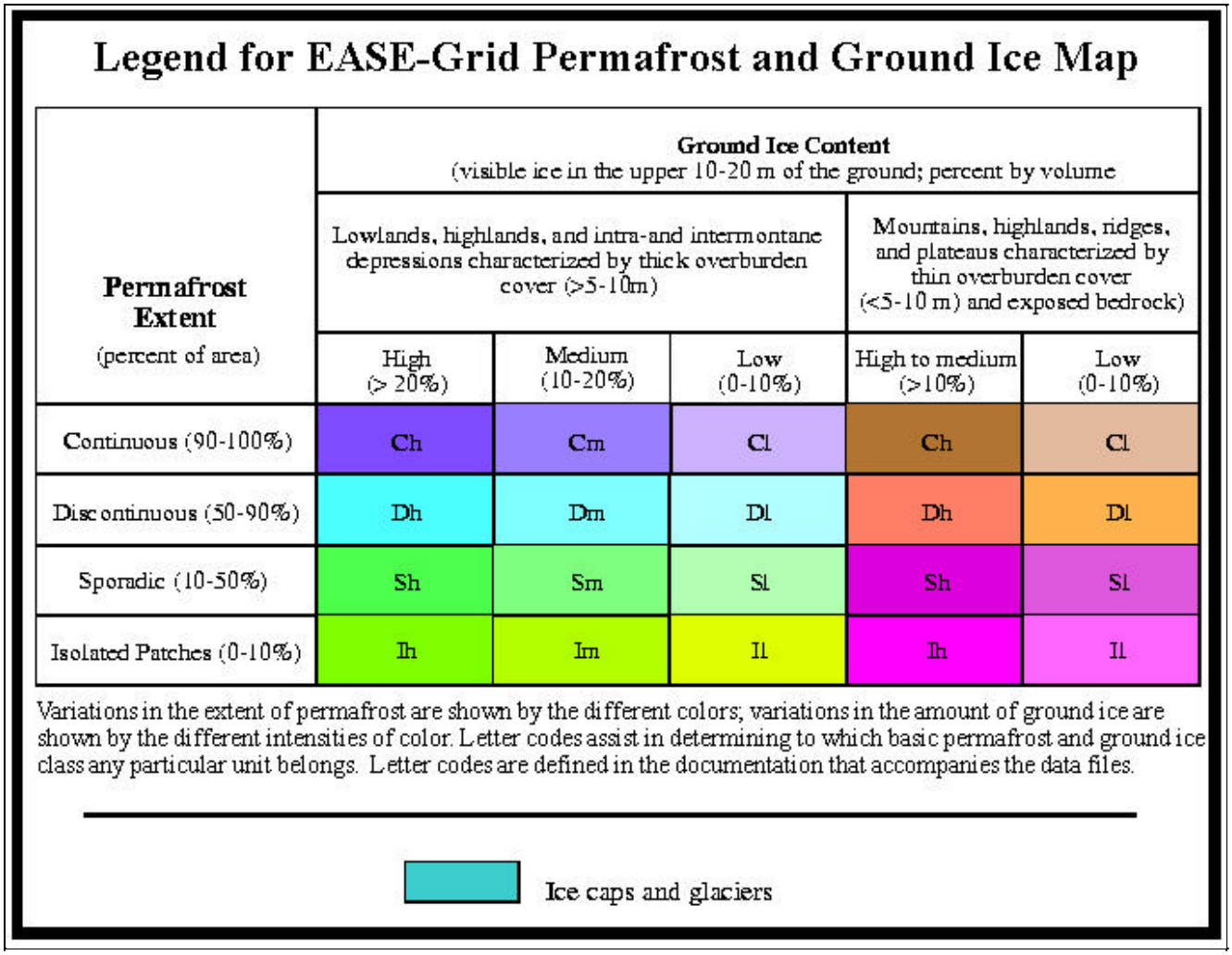
Projection: Lambert Azimuthal
Datum: none
Units: meters
Spheroid: defined
Major Axis: 6370997.00000
Minor Axis: 0.00000
Parameters:
radius of the sphere of reference: 6370997.00000
longitude of center of projection: 180
latitude of center of projection: 90
false easting (meters): 0.00000
false northing (meters): 0.00000

Spatial Coverage:

Spatial Coverage Map:

spatial coverage map: 25°N - 90°N, 180°W-180°E





Legend for EASE-Grid Permafrost and Ground Ice Map

Permafrost Extent (percent of area)	Ground Ice Content (visible ice in the upper 10-20 m of the ground; percent by volume				
	Lowlands, highlands, and intra-and intermontane depressions characterized by thick overburden cover (>5-10m)			Mountains, highlands, ridges, and plateaus characterized by thin overburden cover (<5-10 m) and exposed bedrock)	
	High (> 20%)	Medium (10-20%)	Low (0-10%)	High to medium (>10%)	Low (0-10%)
Continuous (90-100%)	Ch	Cm	Cl	Ch	Cl
Discontinuous (50-90%)	Dh	Dm	Dl	Dh	Dl
Sporadic (10-50%)	Sh	Sm	Sl	Sh	Sl
Isolated Patches (0-10%)	Ih	Im	Il	Ih	Il

Variations in the extent of permafrost are shown by the different colors; variations in the amount of ground ice are shown by the different intensities of color. Letter codes assist in determining to which basic permafrost and ground ice class any particular unit belongs. Letter codes are defined in the documentation that accompanies the data files.

Ice caps and glaciers

3. Data Access and Tools:

Data Access:

Data are available via ftp.

Related Data Collections:

- All About EASE-Grid
- NSIDC'S EASE-Grid Geolocation Tools Description

4. Data Acquisition and Processing:

Processing Steps:

The investigators initialized the Eurasian section of the map at the United Nations Environmental Programme/Global Resource Information Data Base (UNEP/GRID)-Arendal in Norway. The Norwegian Mapping Authority scanned and vectorized the polygon arcs, and georeferenced, corrected, and attributed the vectorized map at UNEP/GRID-Ardenal.

The North America and Greenland sections were also initialized at UNEP/GRID-Ardenal. The investigators manually digitized permafrost boundaries with an Root Mean Square (RMS) error of approximately 1 mm. Any coastline not coinciding with a permafrost unit was digitized as a generalized line. They digitized glacial boundaries as generalized lines and attributed closed polygons. They updated and corrected North America and Greenland at the Cold Regions Research and Engineering Laboratory (CRREL) in Hanover, New Hampshire, and the United States Geological Survey (USGS) in Woods Hole, Massachusetts. They superimposed digital coastline and glacial boundaries using Arc/Info's Identity command, and corrected and updated attributes. Finally, they joined the data set of North America and Greenland with the compiled Eurasian area.

The investigators refined the full map at CRREL and USGS by appending digital coastlines and country lines to the map region south of 50°N. These data only extend down to 25°N, the limit of Northern Hemisphere permafrost. Finally, they superimposed digital data sets of select deep, large lakes with no underlying permafrost.

Data Source:

Following are input data used in processing the digital map:

- **Environmental Systems Research Institute (ESRI):**
    - Coastline arc data north and south of 50°N ("cntry95.shp")
    - Country arc data south of 50°N ("cntry95.shp")
    - Digital Chart of the World data set generalized by UNEP/Grid-Arendal
    - Eurasian lakes polygon data set from the Digital Chart of the World
- **USGS:** Alaskan deep lakes polygon data set
- **Canadian Soil Information System:** Canadian deep lakes polygon data set ("Hydro" coverage)
- **Geological Survey of Canada:** Glacier arc data set

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6. Document Information:

Document Creation Date:

February 2001

Document Revision Date:

October 2002

Document URL:

http://nsidc.org/data/ggd318.html