Time Series of Active Layer Thickness in the Russian Arctic, 1930-1990

Summary

This data set consists of active layer thickness (ALT) measurements based on soil temperatures in the Russian Arctic. The active layer is the top layer of ground that freezes in the winter and thaws in the summer over permafrost. Changes in ALT over northern high-latitude permafrost regions have important impacts on the surface energy balance, hydrologic cycle, carbon exchange between the atmosphere and the land surface, plant growth, and ecosystem as a whole. Warming may thicken the active layer and induce permafrost thaw.

Investigators collected data from 31 ground-based stations. Derived from monthly averages, the record includes annual maximum active layer depths from 1930 to 1990. Data are in tab-delimited ASCII text format and are available via FTP.

Citing These Data

Zhang, T., O. W. Frauenfeld, and R. G. Barry. 2006. *Time series of active layer thickness in the Russian Arctic, 1930-1990*. Boulder, CO: National Center for Atmospheric Research, ARCSS Data Archive.

Overview Table

Category	Description
Data format	Data are in tab-delimited ASCII text files. A station list is provided in tab-delimited ASCII text format or Microsoft Excel format, and an image showing station locations is provided in graphics interchange format (GIF).
Spatial coverage and resolution	Southernmost Latitude: 60.90° N Northernmost Latitude: 70.75° N Westernmost Longitude: 88.30° E Easternmost Longitude: 178.90° E Minumum Altitude: 22 m Maximum Altitude: 802 m
Temporal coverage and resolution	The data record includes annual maximum active layer depths taken from monthly averages collected from 1930 to 1990.
Tools for accessing data	Data can be viewed with a text editor.
File naming convention	Data files are named following the convention TMD2.sss.max where sss is the three-digit station identification number.
File size	File sizes range from 1 KB to 35 KB. Data are distributed as a 48.52 KB compressed (.zip) file.

Parameter(s)	Active layer thickness (ALT) is the only variable included in this data set
Procedures for obtaining data	Data are available for ordering through NCAR.

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1. Contacts and Acknowledgments

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2. Detailed Data Description

Format

Data are in tab-delimited ASCII text files. A station list is also provided in tab-delimited ASCII text format or Excel format, and an image showing station locations is provided in graphics interchange format (GIF).

File Naming Convention and Directory Structure

Data files are named following the convention TMD2.sss.max where sss is the three-digit station

identification number. The supplementary composite file including the average active layer thickness of all 31 sites for each year is titled Composite_1930-1990_ALT.txt. The following files are also included in the directory:

- pf_station_locations.gif - This GIF file shows the distribution of the 31 ground-based stations where data was collected.
- Active_Layer_Station_List.xls - This Excel file includes a list of the 31 ground-based stations with their station ID, region ID, World Meteorological Organization ID, station name, latitude, longitude, and elevation (m).

File Size

File sizes range from 1 KB to 35 KB. Data are distributed as a 48.52 KB compressed (.zip) file.

Spatial Coverage

See image at the end of the document for a visualization of the stations where active layer thickness data were obtained.

Southernmost Latitude: 60.90° N
Northernmost Latitude: 70.75° N
Westernmost Longitude: 88.30° E
Easternmost Longitude: 178.90° E

Minumum Altitude: 22 m
Maximum Altitude: 802 m

Temporal Coverage

The data record includes annual maximum active layer depths taken from monthly averages collected from 1930 to 1990.

Parameter or Variable

Parameter Description

Permafrost is broadly defined as perennially frozen ground, soil, or rock with a temperature at or below 0 °C for at least two years. The active layer is the top layer that freezes in winter and thaws in summer over permafrost. ALT is controlled by many factors including air temperature, vegetation, snow cover, soil moisture, etc. In general the most important factor influencing ALT is summer air temperature. ALT is determined by linearly interpolating between measurement levels to find the position of the 0 °C isotherm at its maximum depth of the year.

Parameter Range

Annual maximum active layer depths range from 0.20 m to 3.17 m.

Sample Data Record

These sample data are from the file TMD2.239.max, collected at the Isit' station (239).

```
1954   -999
1955   -999
1956    0.6
1957  1.16667
1958    1.2
1959  1.12727
1960  1.16923
1961  1.12727
1962  1.09474
1963   1.12
1964   1.08
1965  1.16522
1966  1.13333
1967    1.1
1968   1.18
```

3. Data Access and Tools

Data Access

Data are available for ordering through NCAR.

Volume

The entire data set uncompressed is 107 KB.

4. Data Acquisition and Processing

Data Acquisition Methods

Soil temperature was measured in the former Soviet Union with some records beginning in the 1980s and many others beginning in the 1930s or 1950s. Data collection procedures are summarized by *Gilichinsky et al.* [1998], *Zhang et al.* [2001], and the instruction manuals of the *State Committee of the U.S.S.R. for Hydrometeorology and Environmental Control* [1985]. The data are available primarily as monthly means formed from the daily and sub-daily measurements. Soil temperatures were generally measured at depths of 0, 0.05, 0.10, 0.15, 0.20, 0.40, 0.60, 0.80, 1.20, 1.60, 2.00, 2.40, and 3.20 m. Temperatures at depths from 0.0 m - 0.60 m were measured at least three times per day. Measurements at depths of 80 cm and deeper were made once daily near midday.

5. References and Related Publications

Frauenfeld, O. W., T. Zhang, R. G. Barry, and D. Gilichinsky. 2004. Interdecadal changes in seasonal freeze and thaw depths in Russia. *Journal of Geophysical Research* 109, D05101.

doi:10.1029/2003JD004245.

Gilichinsky, D. A., R. G. Barry, S. S. Bykhovets, et. al. 1998. A century of temperature observations of soil climate: Methods of analysis and long-term trends, in *Proceedings of 7th International Conference on Permafrost*, edited by A. Lewkowicz and M. Allard, pp. 313-317, Cent. d'Etudes Nordiques, Univ. Laval, Ste-Foy, Canada.

State Committee of the U.S.S.R. for Hydrometeorology and Environmental Control. 1985. Instructions for meteorological stations and posts, in *Meteorological Observations at Stations*, vol. 3, part 1, Gidrometeoizdat, Leningrad.

Zhang, T., O. W. Frauenfeld, M. C. Serreze, et. al. 2005. Spatial and temporal variability in active layer thickness over the Russian Arctic Drainage Basin. *Journal of Geophysical Research* 100, D16101. doi:10.1029/2004JD005642.

Zhang, T., R. G. Barry, D. Gilichinsky, et. al. 2001. An amplified signal of climatic change in soil temperatures during the last century at Irkutsk, Russia. *Climate Change* 49, 41-76.

6. Document Information

List of Acronyms

The following acronyms are used in this document:

ALT: Active Layer Thickness
ARCSS: Arctic System Sciences
GIF: Graphics Interchange Format
NSF: National Science Foundation
NCAR: National Center for Atmospheric Research
OPP: Office of Polar Programs
URL: Uniform Resource Locator

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March 3, 2006

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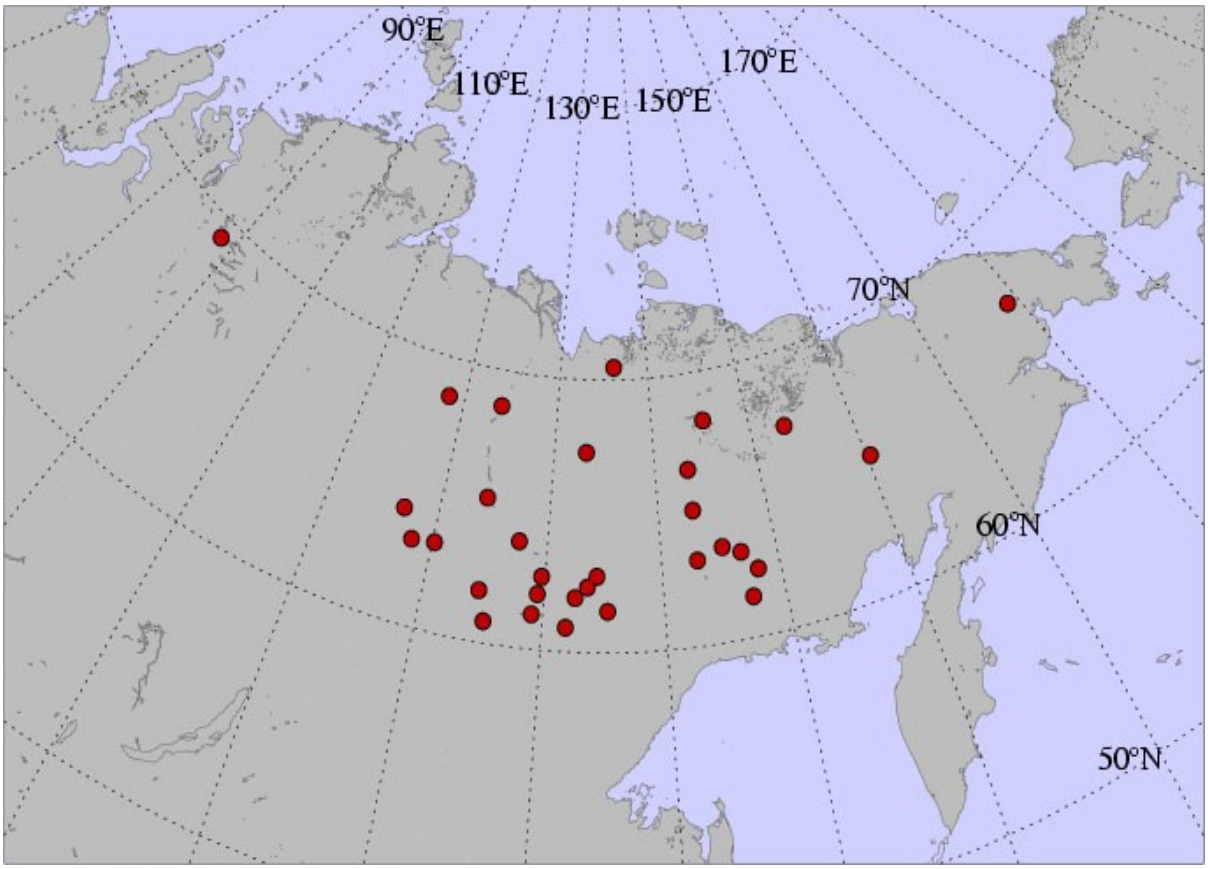
June 23, 2010

Document URL

http://data.eol.ucar.edu/codiac/dss/id=106.ARCSS160

Russian Arctic Station Locations



This image shows locations of the 31 stations where active layer thickness data were obtained.