



ACCESS
Arctic Climate Change
Economy and Society



Project no. 265863

ACCESS
Arctic Climate Change, Economy and Society

Instrument: Collaborative Project
Thematic Priority: Ocean.2010-1 “Quantification of climate change impacts on economic sectors in the Arctic”

D1.41 – User guide containing quality assessment of Arctic weather station and buoy data

Due date of deliverable: **30/04/2012**

Actual submission date: 17/02/2014

Used Person/months: **2**

Start date of project: **1 March 1 2011**

Duration: **48 months**

Organisation name of lead contractor for this deliverable: **Met.no**

Foreword

This report is prepared under the task D1.41 in the ACCESS Project: *Mapping atmospheric circulation changes from weather stations and data buoys (met.no)*.

List of Keywords

IABP	International Arctic Buoy Program
WP	Work Package
LOCEAN	Laboratoire d'Océanographie et du Climat
UPMC	Univ. Pierre et Marie Curie
DAMOCLES	(Developing Arctic Modelling and Observing Capabilities for Long-term Environmental Studies
ERA	European Research Area
FDD	Freezing Degree Days

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Introduction

The ACCESS project “Quantification of Climate Change Impacts on Economic Sectors in the Arctic” is a collaborative effort developed out of the need to evaluate evolutionary impacts on both marine ecosystems and human activities in the Arctic. The main focus of the ACCESS project was to assess how climate specifically affects transportation, fisheries, marine mammals, and the extraction of hydrocarbons in the next 20 years and how they relate to environmental consequences. This is a multi-faceted assessment of the current state of the Arctic that requires several different types of approaches of assimilating data from biological, geophysical, hydrological, and traditional knowledge datasets in the form of: *in situ* measurements, ship based observations, oceanographic data, satellites, models, ecological data, and local and community knowledge. Additionally, it is necessary to take into account changes happening at these interfaces (i.e. ocean-atmosphere, ice-ocean, land-atmosphere, etc.) which can be commonly overlooked. In the context of anthropogenic climate change, it is of key importance to collect reliable and transparent information on climate and its variations.

The ACCESS Task 1.4 includes a selected compilation of Arctic Meteorological Station data from Canada, Finland, Greenland, Iceland, Norway, Russia, and Sweden, as well as buoy data from the International Arctic Buoy Program (IABP) (<http://iabp.apl.washington.edu/index.html>). All available data from weather stations and data buoys over the Arctic were quality controlled by their original facilities (Appendix 3) and made available to other WPs in coordination with the data management task of WP6. Station data from each source were reprocessed to the standard data format suitable to be used in the ACCESS databank.

This data archive will also be used in an assessment of Arctic atmospheric forecasting capabilities in subtask 3.4. Task 1.4 contributed to objective 4 of WP1.LOCEAN (UPMC) and will continue the work initiated during DAMOCLES and taking advantage of the atmospheric data reanalysis (ERA Interim: <http://www.ecmwf.int/research/era/do/get/index>) for estimating the Arctic winter index based on the Freezing Degrees Days (FDD) concept.

This report describes the ACCESS dataset which can be found at: (<http://www.access-eu.org/>). The aim of this report is to provide a user guide on the ACCESS data format for the Seventh Framework Programme theme: *Quantification of Climate Change Impacts on Economic Sectors in the Arctic*. Though this is the latest compilation of records from relevant meteorological stations in the Arctic, more records will continue to be added to this report with further data mining efforts.

1. The ACCESS Dataset

The ACCESS dataset contains approximately 40 years of monthly data from 155 stations in the Arctic. The station network covers five Nordic countries, Canada, and Russia (Figure 1). There are between 4-6 monthly climatic elements describing data from each location in the form of a) average monthly temperature; b) average minimum monthly temperature; c) average maximum monthly temperature; d) average monthly precipitation; and e) the monthly average air pressure at the station or f) sea level (Appendix 1). Station observation information can be found in Appendix 1 and 2.

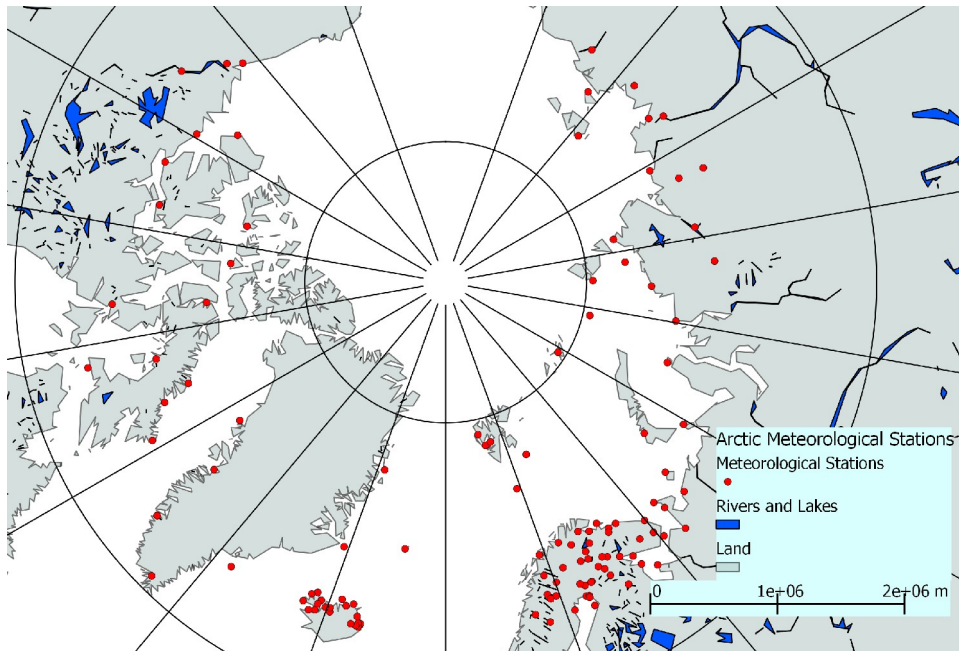


Figure 1. Meteorological stations in the Arctic

The stations in the ACCESS data archive were selected from each country based on the following criteria:

- 1) Record of data from 1970 to 2010 or at least 50% or over the amount of time available
- 2) The meteorological station data were located above 65° latitude
- 3) Open source data records

Due to the nature of logistical nature of meteorological station data, some records do not provide a continuous 40-year archive due to periods of inactivity, varying dates of when stations open and closed, and potential equipment malfunction.

The ACCESS meteorological station data will be disseminated to the ACCESS project partners via the project databank.

2. Description of Arctic Weather Dataset

Though the ACCESS data archives were compiled from sources in the following sections, no further QC steps were performed by Met Norway. Information on the quality control for each data source can be found in this document in Appendix 2

a) Canada

Temperature records for the average monthly, monthly minimum, and monthly maximum data, as well as average monthly precipitation data were collected for weather stations in the Nunavut, Yukon, and Northwest Territories provinces. Meteorological station data were available through:

Government of Canada: <http://climate.weather.gc.ca/>. Data from sixteen weather stations were available that fit the above criteria mentioned in section 1. *The ACCESS Dataset* section. See Appendix 1.a.

b) Finland

Temperature records for the average monthly, monthly minimum, and monthly maximum data, as well as average monthly precipitation and air pressure records were collected for weather stations in Finland. Meteorological station data were available through:

Nordklim: http://www.smhi.se/hfa_coord/nordklim/

European Climate Assessment & Dataset: <http://eca.knmi.nl/> and the use of non-blended data selected from: <http://eca.knmi.nl/dailydata/customquery.php>. The non-blended temperature and precipitation records are directly input from the original meteorological institute and have not been aggregated with an automated procedure (SYNOP messages: <http://eca.knmi.nl/FAQ/index.php#3>) that includes surrounding field observations within a 12.5km distance. This product was chosen for consistency purposes.

Temperature data from **Berkeley Earth:** <http://berkeleyearth.org/data>

Data from 11 weather stations were available that fit the above criteria mentioned in section 1. The ACCESS Dataset section. See Appendix 1.b.

c) Greenland

Temperature records for the average monthly, monthly minimum, and monthly maximum data, as well as average monthly precipitation and air pressure records until 2001 were collected for weather stations in Greenland. Meteorological station data were available through:

Nordklim: http://www.smhi.se/hfa_coord/nordklim/

Meteorological records were checked against the Cappelen et al, 2012 report for verification of station information.

Temperature data (for 43 stations) from **Berkeley Earth:** <http://berkeleyearth.org/data>

Data from 47 weather stations were available that fit the above criteria mentioned in section 1. The ACCESS Dataset section. See Appendix 1.c.

d) Iceland

Temperature records for the average monthly, monthly minimum, and monthly maximum data, as well as average monthly precipitation and air pressure records were collected for 19 weather stations in the Northeast, North, and Northwest regions of Iceland. Meteorological station data were available through:

Nordklím: http://www.smhi.se/hfa_coord/nordklím/

Icelandic Meteorological Institute: <http://www.vedur.is/>.

Data from 28 weather stations were available that fit the above criteria in section 1. The ACCESS Dataset section. See Appendix 1.d.

e) Norway

Temperature records for the average monthly, monthly minimum, and monthly maximum data, as well as average monthly precipitation and air pressure (from the station and sea level) data were collected from weather stations in Troms and Finnmark counties, Svalbard and Jan Mayen. Meteorological station data were available through:

Norwegian Meteorological Institute: <http://sharki.oslo.dnmi.no/>.

Data from 10 weather stations were available that fit the above criteria mentioned in section 1. The ACCESS Dataset section. See Appendix 1.e.

f) Russia

Temperature records for the average monthly, monthly minimum, and monthly maximum data, as well as average monthly precipitation and air pressure data were collected for 59 weather stations in Russia. Meteorological station data were available through:

Russian Research Institute of Hydrometeorological Information-World Data Center: <http://meteo.ru/>.

Data from weather stations were available that which fit the above criteria mentioned in section 1. The ACCESS Dataset section. See Appendix 1.f.

g) Sweden

Temperature records for the average monthly, monthly minimum, and monthly maximum data, as well as average monthly precipitation and air pressure records (air pressure records until 2001) were collected for 10 weather stations in Sweden. Meteorological station data were available through:

Nordklím: http://www.smhi.se/hfa_coord/nordklím/

Swedish Meteorological Institute: <http://www.smhi.se> and climate data records: <http://www.smhi.se/klimatdata/meteorologi/dataserier-2.1102>.

Data from weather stations were available that which fit the above criteria mentioned in section 1. The ACCESS Dataset section. See Appendix 1.g.

3. Description of Buoy Data

The international Arctic Buoy Program (IABP) is an international network of drifting buoys in the Arctic that provide meteorological and oceanographic data for real-time operational requirements and research (http://iabp.apl.washington.edu/overview_history.html). Participants include from the United States, Canada, Germany, Japan, Norway, France, Russia and the United Kingdom assist in data management and buoy research and production. The IABP data is continuously uploaded to the Data Buoy Cooperation Panel which allows operations and sea ice forecasters ease of access to real-time and archived data (<http://www7.ncdc.noaa.gov/CDO/CDOMarineSelect.jsp>). Mean monthly temperature and air pressure records from 1970 - present were compiled for the areas 60°N for the ACCESS project.

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Appendix 1: Meteorological Station Data Parameters

The following parameters are included in the ACCESS data archive. However, some may not be available for for some stations (see Section 1. ACCESS Dataset):

1. Station Name
2. Country
3. Province
4. Station Code
5. Latitude
6. Longitude
7. Month
8. Year
9. Average Monthly Temperature Data (C°)
10. Average Monthly Minimum Temp Data (C°)
11. Average Monthly Maximum Temp Data (C°)
12. Average Monthly Precipitation (mm)
13. Average Monthly Air Pressure (station) (hPa)
14. Average Monthly Air Pressure (sea level) (hPa)

Appendix 2: Station Observations

<u>Station Name</u>	<u>Country</u>	<u>lat</u>	<u>lon</u>	<u>Start Date</u>	<u>End Date</u>	<u>Months of Obs</u>
Aklavik	Canada	68.22	-135.01	1981	2007	298
Arctic_Bay	Canada	73.03	-85.15	1971	1976	38
Cambridge_Bay	Canada	69.11	-105.14	1970	2012	516
Cape_Dorset	Canada	64.23	-76.53	1970	2007	365
Cape_Dyer_A	Canada	66.58	-61.62	1970	1993	279
Cape_Hooper	Canada	68.47	-66.82	1970	1991	256
Clinton_Point	Canada	69.58	-120.8	1970	1993	282
Clyde_A	Canada	70.49	-68.52	1970	2007	451
Fort_Good_Hope_A	Canada	66.24	-128.65	1970	2007	367
Lady_Franklin_Point	Canada	68.5	-113.22	1970	1993	276
Longstaff_bluff	Canada	68.9	-75.14	1970	1991	258
Rea_Point	Canada	75.38	-105.72	1970	1986	191
Repulse_Bay_A	Canada	66.52	-86.22	1973	2007	291
Resolute Cars	Canada	74.72	-94.97	1970	2012	513
Sachs_Harbour_A	Canada	72	-125.27	1970	2007	434
Shingle_Point_A	Canada	68.95	-137.22	1970	1993	271
Ylitornio Meltosjärvi	Finland	66.53	24.65	1970	2014	517
Rovaniemi Apukka	Finland	66.58	26.01	1970	2014	517
Kemi Kemi-Tornio airport	Finland	65.78	24.58	1970	2014	517
Salla Kellosekä	Finland	66.95	28.98	1970	2014	517
Hailuoto Ojakylä	Finland	65.02	24.73	1970	2014	517
Rovaniemi airport	Finland	66.56	25.83	1970	2014	517
Inari Ivalo airport	Finland	68.61	27.41	1970	2014	517
Sodankylä Vuotso	Finland	68.08	27.19	1970	2014	517

<u>Station Name</u>	<u>Country</u>	<u>lat</u>	<u>lon</u>	<u>Start Date</u>	<u>End Date</u>	<u>Months of Obs</u>
Savukoski	Finland	67.29	28.18	1970	2014	517
Utsjoki Nuorgam	Finland	70.08	27.90	1970	2014	517
Kuusamo Kiutaköngäs	Finland	66.37	29.31	1970	2014	517
Pello centre	Finland	66.77	23.96	1971	2014	505
Kittilä Pokka	Finland	68.17	25.78	1972	2014	504
Salla Värriötunturi	Finland	67.75	29.61	1974	2014	469
Kemi Ajos	Finland	65.67	24.52	1984	2014	349
Tasiilaq (Ammassalik)	Greenland	65	-37	1970	1990	144
Illoqqortoormiut	Greenland	70	-21	1970	1990	141
Danmarkshavn	Greenland	76	-18	1970	1990	141
Mittarfik Narsarsuaq	Greenland	61	-45	1970	1990	144
Nuuk	Greenland	64	-51	1970	1990	144
Ilulissat	Greenland	69	-51	1970	1990	144
Upernavik	Greenland	72.47	-56.1	1970	1981	138
Ásgarður	Iceland	65.23	-21.754	1992	2013	256
Seyðisfjörður	Iceland	65.281	-14	1970	2002	385
Kollaleira sjálfvirk stöð	Iceland	65.037	-14.24	1976	2006	365
Egilsstaðaflugvöllur	Iceland	65.276	-14.405	1970	1998	339
Hallormsstaðaháls	Iceland	65.08	-14.675	1970	1990	241
Skjaldþingsstaðir sjálfvirk stöð	Iceland	65.704	-14.821	1994	2013	233
Brú á Jökuldal	Iceland	65.109	-15.53	1970	1998	342
Raufarhöfn sjálfvirk stöð	Iceland	66.456	-15.953	1970	2009	468

<u>Station Name</u>	<u>Country</u>	<u>lat</u>	<u>lon</u>	<u>Start Date</u>	<u>End Date</u>	<u>Months of Obs</u>
Mánárþakki sjálfvirk stöð	Iceland	66.199	-17.103	1970	2013	527
Grímsey	Iceland	66.54	-18.07	1970	2000	351
Nautabú sjálfvirk stöð	Iceland	65.458	-19.369	1970	2004	418
Sauðárkrókur flugvöllur	Iceland	65.726	-19.574	1970	1978	86
Blönduós	Iceland	65.658	-20.293	1981	2003	264
Gjögurflugvöllur	Iceland	65.995	-21.33	1970	1993	277
Hólmavík	Iceland	65.687	-21.681	1970	2013	523
Hornbjargsviti	Iceland	66.411	-22.379	1970	2001	306
Stykkishólmur sjálfvirk stöð	Iceland	65.072	-22.732	1970	2013	528
Bolungarvík	Iceland	66.161	-23.254	1994	2013	233
Lambavatn	Iceland	65.492	-24.093	1970	2013	528
Jan Mayen	Norway	70.9394	-8.669	2004	2013	120
Troms	Norway	69.6537	18.9368	2004	2013	120
Bjørnøya	Norway	74.5167	19.005	1971	2013	515
Hopen	Norway	76.5097	25.0133	1971	2013	516
Isfjord Radio	Norway	78.0667	13.6333	1971	2004	159
Longyearbyen	Norway	78.225	15.625	1971	1977	79
Ny-Ålesund I	Norway	78.925	11.93	1971	1974	43
Finmark_Alta	Norway	69.9775	23.3582	1971	2013	515
Finmark-Karasjohka-Karasjok	Norway	69.4683	25.5023	1971	2004	404
Finmark-Kirkenes	Norway	69.7255	29.8977	1971	2013	515
POLAR_GMO_IM.E. T.KRENKELJ	Russia	80.60	58.00	1970	2013	417

<u>Station Name</u>	<u>Country</u>	<u>lat</u>	<u>lon</u>	<u>Start Date</u>	<u>End Date</u>	<u>Months of Obs</u>
OSTROV_VIZE	Russia	79.50	76.98	1970	2013	483
OSTROV_GOLOMJA NNYJ	Russia	79.55	90.62	1970	2012	464
Barencburg	Russia	78.07	14.25	1970	2013	519
Russkij	Russia	77.20	96.40	1970	1998	315
GMO_IM.E.K.FEDOR OVA	Russia	77.72	104.30	1970	2013	491
Sterlegova	Russia	75.42	88.90	1970	2012	482
IM.M.V.Popova	Russia	73.33	70.05	1970	2013	395
OSTROV_DIKSON	Russia	73.50	80.40	1970	2013	505
Malye_Karmakuly	Russia	72.37	52.70	1970	2013	510
Hatanga	Russia	71.98	102.47	1970	2013	520
Im.E.K.Fedorova(Bolv anski_Nos)	Russia	70.45	59.08	1970	2013	487
Volochanka	Russia	70.97	94.50	1970	2013	523
OSTROV_KOTEL'NY J	Russia	76.00	137.87	1970	2013	518
Terpjaj-Tumsa	Russia	73.55	118.67	1970	1997	328
Shalaurova_mys	Russia	73.18	143.23	1970	2000	361
Saskylah	Russia	71.97	114.08	1970	2013	522
Tiksi	Russia	71.58	128.92	1970	2013	524
DZALINDA	Russia	70.13	113.97	1970	2013	522
KJUSJUR	Russia	70.68	127.40	1970	2013	502
Jubilejnaja	Russia	70.77	136.22	1970	2013	496
CHOKURDAH	Russia	70.62	147.88	1970	2013	524
Ostrov_Vrangelja	Russia	70.98	178.48	1970	2013	517
Vajda-Guba	Russia	69.93	31.98	1970	2013	512

<u>Station Name</u>	<u>Country</u>	<u>lat</u>	<u>lon</u>	<u>Start Date</u>	<u>End Date</u>	<u>Months of Obs</u>
Poljarnoe	Russia	69.20	33.48	1970	2013	439
Teriberka	Russia	69.20	35.12	1970	2013	504
Kolguev_Severnyi	Russia	69.53	49.08	1970	2013	504
Janiskoski	Russia	69.00	28.80	1970	2013	519
MURMANSK	Russia	68.97	33.05	1970	2013	513
Svjatoj_Nos	Russia	68.15	39.80	1970	2013	464
Kanin_Nos	Russia	68.65	43.30	1970	2013	508
Kovdor	Russia	67.57	30.45	1970	2013	518
Kandalaksa	Russia	67.15	32.35	1970	2013	518
Krasnoshel'e	Russia	67.35	37.05	1970	2013	518
Kanevka	Russia	67.13	39.67	1970	2013	512
SOJNA	Russia	67.88	44.13	1970	2013	523
Indiga	Russia	67.68	48.68	1970	2013	510
Umba	Russia	66.68	34.35	1970	2013	518
Ostrov_Sosnovez	Russia	66.48	40.68	1970	2013	498
Kalevala	Russia	65.22	31.17	1970	2013	523
GRIDINO	Russia	65.90	34.77	1970	2013	491
Zizgin	Russia	65.20	36.82	1970	2013	504
Mezen'	Russia	65.87	44.22	1970	2013	522
Abisko	Sweden	68.21	18.49	1970	2001	372
Jokkmokk	Sweden	66.61	19.38	1970	2001	372
Kvikkjokk	Sweden	66.89	18.02	1970	2001	372
Haparanda	Sweden	65.84	24.11	1970	2001	372
Piteaa	Sweden	65.26	21.48	1970	2001	362
Stensele	Sweden	65.04	17.09	1970	2001	372

<u>Station Name</u>	<u>Country</u>	<u>lat</u>	<u>lon</u>	<u>Start Date</u>	<u>End Date</u>	<u>Months of Obs</u>
Taernaby/Hemavan	Sweden	65.8	15.1	1970	2001	372
Karesuando	Sweden	68.26	22.31	1970	2001	372
Kiruna	Sweden	67.49	20.2	1970	2000	336
Tjaamotis	Sweden	66.55	18.32	1970	1997	335

Appendix 3: Supporting documents for quality control of ACCESS data

2.a Canada

Documentation for the Digital Archive of Canadian Climatological Data can be found at:

http://climate.weather.gc.ca/prods_servs/documentation_index_e.html

2.b Finland

Documentation for the Nordklім Nordic Methods for Quality Control of Climate data can be found at: http://www.smhi.se/hfa_coord/nordklім/index.php?page=reports

Documentation for Berkeleyearth.org data can be found at: <http://berkeleyearth.org/about-data-set> and <http://berkeleyearth.org/source-files>

Documentation for European Climate Assessment & Dataset records can be found at: <http://eca.knmi.nl/FAQ/index.php#3>

2.c Greenland

Documentation for the Nordklім Nordic Methods for Quality Control of Climate data can be found at: http://www.smhi.se/hfa_coord/nordklім/index.php?page=reports

Documentation for Berkeleyearth.org data can be found at: <http://berkeleyearth.org/about-data-set> and <http://berkeleyearth.org/source-files>

2.d Iceland

Documentation for the Nordklім Nordic Methods for Quality Control of Climate data can be found at: http://www.smhi.se/hfa_coord/nordklім/index.php?page=reports

2.e Norway

Documentation for the Nordklім Nordic Methods for Quality Control of Climate data can be found at: http://www.smhi.se/hfa_coord/nordklім/index.php?page=reports

Documentation for quality level of data from Eklіma.met.no can be found at:

http://eklіma.met.no/Help/examples/html/report66_en.html

2.f Russia

Documentation for the Russian Research Institute of Hydrometeorological Information-World Data Center can be found at: <http://meteo.ru/>

Baseline Climatological data sets: http://meteo.ru/english/climate/cl_data.php

Description of Hourly Meteorological variables observed at the Russian meteorological network: <http://meteo.ru/english/climate/descrip12.htm>

2.g Sweden

Documentation for the Nordklім Nordic Methods for Quality Control of Climate data can be found at: http://www.smhi.se/hfa_coord/nordklім/index.php?page=reports

Documentation for the climate data series 1961-2011 for the Swedish Meteorological and Hydrological Institute can be found at: <http://www.smhi.se/klimatdata/meteorologi/dataserier-2.1102>