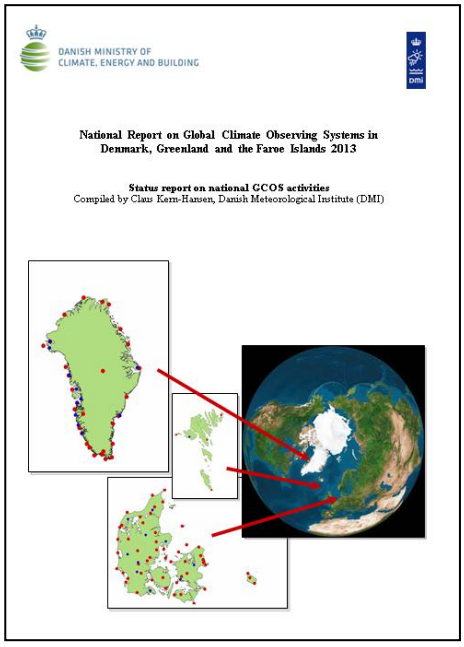
Danish Climate Centre Report 13-05

National Report on Global Climate Observing Systems (GCOS) in Denmark, Greenland and the Faroe Islands 2013

Claus Kern-Hansen (ed)



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Abstract

This report is a DMI series re-print of the report:
National Report on Global Climate Observing Systems in Denmark, Greenland and the Faroe Islands 2013
Status report on national GCOS activities
Compiled by Claus Kern-Hansen, Danish Meteorological Institute (DMI)

Resumé

Denne rapport er en DMI/DKC-rapport udgivelse af rapporten
National Report on Global Climate Observing Systems in Denmark, Greenland and the Faroe Islands 2013
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Compiled by Claus Kern-Hansen, Danish Meteorological Institute (DMI)

DANISH MINISTRY OF
CLIMATE, ENERGY AND BUILDING

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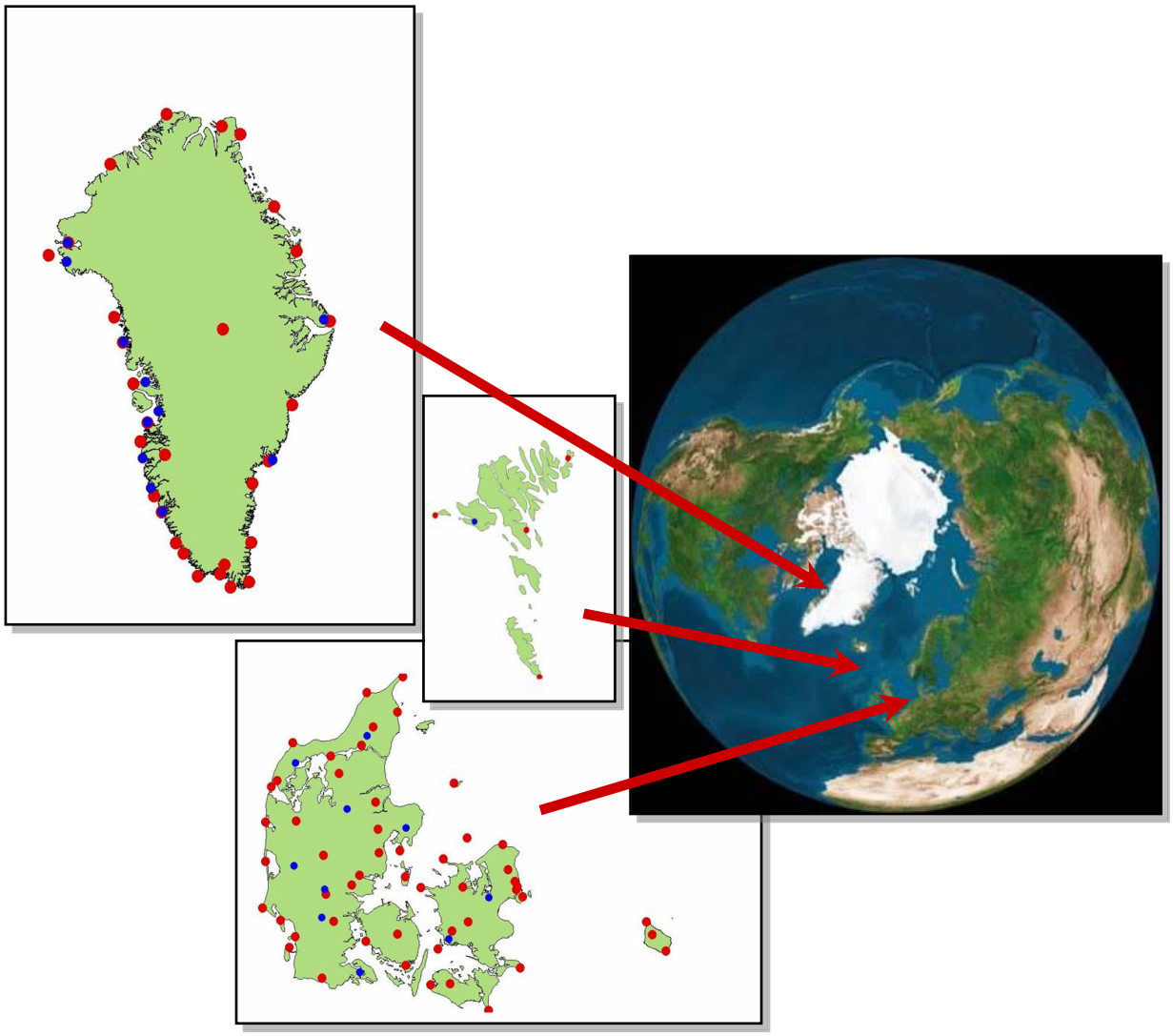

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DCE - Danish Centre for Environment and Energy & Department of Bioscience and the Department of Environmental Science (former National Environmental Research Institute (NERI)), University of Aarhus

Disclaimer

The information in this report represents the best knowledge available to the compiling editor by the time of issue.

Content

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Introduction

This status report has been prepared to give an update on the Danish contribution to the systematic climate observations in the Global Climate Observing System (GCOS) as of 1th of January 2013

The present report is an update of the first report based on the reporting guidelines contained in decision 11/CP.13, by the United Nations Framework Convention on Climate Change (UNFCCC) Subsidiary Body for Scientific and Technological Advice (SBSTA) focussing on Essential Climate Variables. The report was issued in 2008 titled "National Report on Global Climate Observing Systems (GCOS) in Denmark, Greenland and the Faroe Islands 2008" and reprinted in 2013 in the DMI report series "Danish Climate Centre Report" as nr 11-04.

The purpose of this report is to provide an overview of the national Global Climate Observing Systems (GCOS) for the use of the Secretariat of CGOS for its detailed progress report on the Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC.

Chapter 1: Common Issues

1.1 National coordination

Climate research and the generation of climate-related observations are carried out by various government departments in order for them to meet their responsibilities.
Currently, no national plan exists for the whole area of climate research and observations.

In its capacity as National Meteorological Service, The Danish Meteorological Institute (DMI) represents Denmark at World Meteorological Organization (WMO), and therefore currently undertakes the role as national focal point/coordinator for GCOS (NFP-GCOS), with the Terms of Reference to undertake GSN and GUAN issues related to data availability, exchange and quality.
Currently, no national GCOS secretariat has been established in Denmark.

1.2 Efforts undertaken to ensure high-quality climate data records.

A number of agencies in Denmark engage in the systematic observation of elements of the climate system.
Invariably the capture, quality control and archiving of such data are designed to meet the integrated needs of these agencies, deriving from their overall missions.

Typically the drivers for long-term systematic observation of environmental or ecological characteristics arise from an operational, regulatory or research need.
Examples of the former are to be found in the capture of meteorological data for predictive and statistical services by the Danish Meteorological Institute (DMI).
The resulting observation programmes tend to be long term, but the resulting individual data may be seen as perishable and focus might not always be on maintaining stability and reliability in the records.
The general need for systematic and reliable time series is increasingly being understood in the scientific community and incorporated in the collection and data processing procedure.

In this report relevant climate observations for Denmark, Greenland and the Faroe Islands will be described.

1.3 Efforts undertaken to ensure the data exchange and availability

In general the data are available from the institutions operating the observing station / collecting the data, but many can also be found on the web, for instance www.dmi.dk.

Where data such as contributions to GCOS are submitted to the appropriate data centres, they are also available from these centres.

Additionally, all meteorological data and products that are produced by WMO Members (national meteorological services) to the WMO programmes such as the WWW are available under the terms of WMO Resolution 40 (WMO policy and practice for the exchange of meteorological and related data and products including guidelines on relationships in commercial meteorological activities).

Such data are freely available without charge (i.e. at no other cost than the cost of reproduction and delivery, without charge for the data and products themselves and with no condition on their use)
Similarly hydrological data and products are covered under WMO Resolution 25.

Chapter 2: Atmospheric Essential Climate Variables (ECV)

2.1 General information

Denmark participates fully in the GCOS Surface Network (GSN) and the GCOS Upper Air Network (GUAN), and in the Global Ozone Observing System (GO3OS) as part of the Global Atmospheric Watch (GAW).

2.2 Contributions to the GCOS Networks from International relevant stations

2.2.1 Contributions to the GCOS Surface Network (GSN)

The seven designated GSN stations in Denmark, Greenland and on the Faroe Islands are all run by DMI and include (Numbers are WMO station numbers):

Greenland:	4211 Upernarvik, 4250 Nuuk, 4320 Danmarkshavn
	4360 Tasiilaq, 4390 Prins Christian Sund;
The Faroe Islands;	6011 Tórshavn
Denmark:	6186 Copenhagen.

All of these stations currently meet the required standard for surface observation.

2.2.2 Contributions to the GCOS Upper Air Network (GUAN)

Only one GUAN station is designated for Denmark, Greenland and the Faroe Islands:

WMO nr. 4270 Narsarsuaq, Greenland.

The station is run by DMI and is operated in accordance with the required standard.

2.2.3 Contributions to the Global Atmosphere Watch (GAW)

As part of the GAW programme, Denmark contributes to the Global Ozone Observing System (GO3OS) with three stations in Greenland and one in Denmark.

The stations in Greenland are: Kangerlussuaq, Pituffik and Illoqqortoormiut
The station in Denmark is located in Copenhagen

The stations in Greenland are Arctic stations in the Network for the Detection of Atmosphric Composition Change (NDACC) that is supported by the International Ozone Commission

Table 1a. National contributions to the surface-based atmospheric essential climate variables

Contributing networks specified in the GCOS implementation plan	ECVs[a]	Number of stations or platforms currently operating	Number of stations or platforms operating in accordance with the GCMPs	Number of stations or platforms expected to be operating in 2015	Number of stations or platforms providing data to the international data centres	Number of stations or platforms with complete historical record available in international data centres
GCOS Surface Network (GSN)	Air temperature	7	7	7	7	7
	Precipitation	7	7	7	7	7
Full World Weather Watch/Global Observing System (WWW/GOS) surface network (RBSN stations)	Air temperature, air pressure, wind speed and direction, water vapour	37	37	37	37	37
	Precipitation	15	15	15	15	Not known
Baseline Surface Radiation Network (BSRN)	Surface radiation	0	0	0	0	0
Solar radiation and radiation balance data (RBSN stations)	Surface radiation	7	7	7	7	Not known
Ocean drifting buoys	Air temperature, air pressure	0 **(note1)**	0 **(note1)**	0 **(note1)**	0 **(note1)**	0 **(note1)**
Moored buoys	Air temperature, air pressure	0	0	0	0	0
Voluntary Observing Ship Climate Project (VOSClim)	Air temperature, air pressure, wind speed and direction, water vapour	0	0	0	0	0
Ocean Reference Mooring Network and sites on small isolated islands	Air temperature, wind speed and direction, air pressure	0	0	0	0	0
	Precipitation	0	0	0	0	0

Note 1: Denmark (DMI) participates in the EUMETNET programme SURFMAR, which operates approximately 80 drifting buoys

Table 1b. National contributions to the upper-air atmospheric essential climate variables

Contributing networks specified in the GCOS implementation plan	ECVs	Number of stations or platforms currently operating	Number of stations or platforms operating in accordance with the GCMPs	Number of stations or platforms expected to be operating in 2015	Number of stations or platforms providing data to the international data centres	Number of stations or platforms with complete historical record available in international data centres
GCOS Upper Air Network (GUAN)	Upper-air temperature, upper-air wind speed and direction, upper-air water vapour	1	1	1	1	1
Full WWW/GOS Upper Air Network	Upper-air temperature, upper-air wind speed and direction, upper-air water vapour	5	5	5	5	5

Table 1c. National contributions to the atmospheric composition

Contributing networks specified in the GCOS implementation plan	ECVs	Number of stations or platforms currently operating	Number of stations or platforms operating in accordance with the GCMPs	Number of stations or platforms expected to be operating in 2015	Number of stations or platforms providing data to the international data centres	Number of stations or platforms with complete historical record available in international data centres
World Meteorological Organization/ Global Atmosphere Watch (WMO/GAW) Global Atmospheric CO_2 & CH_4 Monitoring Network	Carbon dioxide	0	0	0	0	0
	Methane	0	0	0	0	0
	Other greenhouse gases	0	0	0	0	0
WMO/GAW ozone sonde network[a]	Ozone	2	2	2	2	2
WMO/GAW column ozone network[b]	Ozone	3	3	3	3	3
WMO/GAW Aerosol Network[c]	Aerosol optical depth	3	3	3	3	3
	Other aerosol properties	0	0	0	0	0

2.3 Satellite observations as base for atmosphere related ECV observations

Denmark is member state in EUMETSAT and ESA.
Especially through EUMETSAT Denmark takes functional part in activities related to the utilization of satellite data in analyses related to ECVs and climate monitoring.
The table below is indicating **in blue** areas where the Danish participation is more significant.

Table 2. Global products requiring satellite observations – atmospheric essential climate variables

ECVs/ Global products requiring satellite observations	**Fundamental climate data records required for product generation (from past, current and future missions)**
Surface wind speed and direction Surface vector winds analyses, particularly from reanalysis	Passive microwave radiances and scatterometry
Upper-air temperature Homogenized upper-air temperature analyses: extended MSU-equivalent temperature record, new record for upper-troposphere and lower-stratosphere temperature using data from radio occultation, temperature analyses obtained from reanalyses **EUMETSAT ROM-SAF/CM-SAF**	Passive microwave radiances, GPS radio occultation, high-spectral resolution IR radiances for use in reanalysis
Water vapour Total column water vapour over the ocean and over land, tropospheric and lower stratospheric profiles of water vapour **EUMETSAT ROM-SAF/CM-SAF**	Passive microwave radiances, GPS radio occultations, UV/VIS radiances, IR imagery and soundings in the 6.7um band, microwave soundings in the 183 GHz band
Cloud properties Cloud radiative properties (initially key ISCCP products)	VIS/IR imagery, IR and microwave soundings
Precipitation Improved estimates of precipitation, both as derived from specific satellite instruments and as provided by composite products	Passive microwave radiances, high-frequency geostationary IR measurements, active radar (for calibration)
Earth radiation budget Top-of-atmosphere Earth radiation budget on a continuous basis	Broadband radiances, spectrally-resolved solar irradiances, geostationary multi spectral imagery
Ozone Profiles and total column of ozone, global UV indices **EUMETSAT O3M-SAF**	UV/VIS and IR microwave radiances
Aerosol properties Aerosol optical depth and other aerosol properties	VIS/NIR/SWIR radiances
Carbon dioxide, methane and other long-lived greenhouse gases Distribution of greenhouse gases, such as CO_2 and CH_4, of sufficient quality to estimate regional sources and sinks	NIR/IR radiances
Upper-air wind Upper-air wind analyses, particularly from reanalysis	VIS/IR imagery, Doppler wind lidar
Atmospheric reanalyses	Key FCDRs and products identified in this report, and other data of value to the analyses

2.4 Other networks for monitoring weather and atmospheric composition.

2.4.1 Climatological/meteorological surface stations

DMI operates and receives data from a network of approximately 100 automatic meteorological stations in Denmark, Greenland and on the Faroe Islands. Measurements are made in accordance with the WMO recommendations.

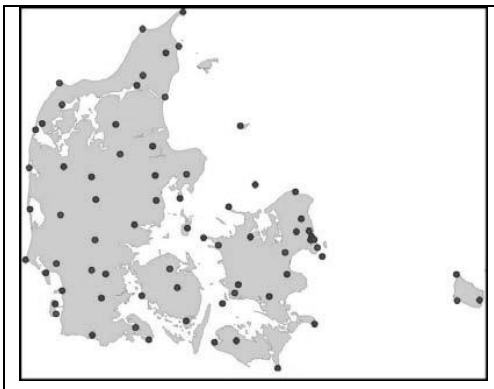

Fig. 1 – DMIs network of weather stations in Denmark

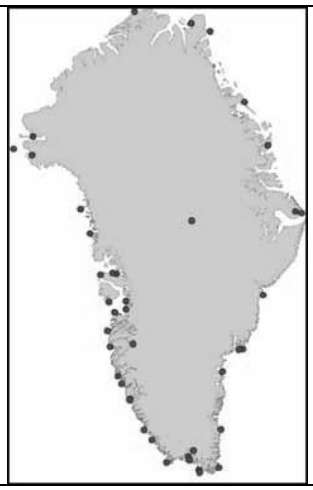

Fig. 2 – DMIs network of weather stations in Greenland

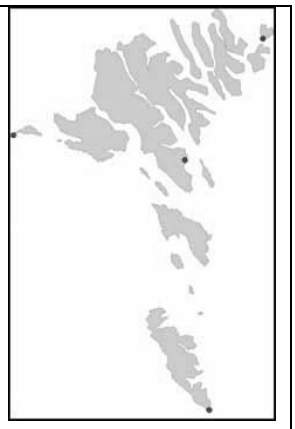

Fig. 3– DMIs network of weather stations on the Faroe Islands

As of 2001 a special dedicated network of (manual) stations for climatological observations has been discontinued, due to the convergence between the different network technologies. The objectives behind this decision are to eliminate human errors, to benefit from potential savings due to this rationalisation, and to reach a higher observation frequency. Climatological data are now obtained from the automatic network described above.

Climatological data are collected to define the climate in Denmark, Greenland and on the Faroe Islands and to create a national database for a wide range of enquiries and research activities. Climatological work mostly consists of preparing annual and monthly statistics, including calculation of averages, percentiles and standard deviations.

Substantial recorded data are needed to establish reliable averages and trends. The daily inflow of data from Denmark, Greenland and the Faroe Islands is around 100,000 observations, and the central database at DMI currently contains more than 300,000,000 observations. Some of the recorded data are from as early as 1872.
A monthly summary is prepared for the three stations in Denmark, one on the Faroe Islands and eight in Greenland using the CLIMAT format. These data are routinely submitted via the GTS.

2.4.2 Precipitation observation networks (stations and radar)

For national purposes, more data concerning precipitation is needed than can be provided from the overall surface climatological and meteorological network described above. In Denmark the precipitation observation network consists of approximately 250 stations, all automatic. Half of this network is jointly operated by DMI and The Water Pollution Committee of the Society of Danish Engineers (Spildevandskomitéen - SVK), the other half is owned and operated by DMI.

Information on precipitation can also be obtained from weather radar data. In Denmark, DMI runs a network of five weather radars which provides 100% coverage of Danish land areas and coastal marine areas. The network's geographical coverage is unsurpassed, and hence provides detailed information about precipitation on national and local scales. By calibrating radar data against point measurements of precipitation the latest scientific results show a high absolute accuracy.

During wintertime, a network of 75 manual snow depth stations are operated in Denmark, reporting once a day.

In Greenland and the Faroe Islands, precipitation are primary measured at the automatic weather stations.

2.4.3 Surface radiation observation networks

Radiation is measured as 10- minute mean values of global radiation at the DMI operated weather station.

2.4.4 Solar ultraviolet (UV) radiation and stratospheric ozone stations

Solar Ultraviolet (UV) radiation at different wavelengths is measured by DMI at two stations in Greenland, namely Pittuffik and Kangerlussuaq. In addition, DMI performs daily measurements of total ozone at Copenhagen, Kangerlussuaq, and Pittuffik, and weekly ozone soundings at Illoqqortoormiut as well as sporadic ozone soundings at Pituffik during the winter months. DMI provides near real time global UV-indices as part of the EUMETSAT O3M-SAF.

2.4.5 Upper air strata measurements – Radio sounding observations

DMI runs radio sounding stations at the following six locations: Tórshavn (the Faroe Islands), Danmarkshavn, Illoqqortoormiit, Tasiilaq, Narsarsuaq and Aasiaat (Greenland). Two soundings are made every day at these stations.

2.4.6 Ice observations

DMI is responsible for the systematic surveillance of sea ice conditions in the Greenland waters. Observations concerning ice conditions have been collected for approximately 140 years and an extensive volume of data is available in a graphic format as monthly summaries, ice maps etc. Since 1959 special emphasis has been on the waters south of Cape Farewell (the southern tip of Greenland) in order to improve navigation safety in what is an important navigation area. Ice maps containing detailed information on the relevant ice conditions are prepared several times a week. The most recent maps are available in vector graphic format.

Since 1999 weekly summaries of the ice conditions for all Greenland waters have been prepared. These summaries, which are based on satellite data, are generated semi-automatically and are primarily intended for climatological analyses as the energy radiation from the sea is highly dependent on whether it is covered with ice or not.

2.4.7 Climatological data sets

Over the years, DMI has established a number of very long climatological series with differing periods of information representing Denmark, Greenland and the Faroe Islands.

The long daily time series include: precipitation, temperature, atmospheric pressure and cloud cover for a number of Danish locations as well as precipitation and temperatures for two Greenland Stations 1874-2012

The long monthly time series include: temperatures, precipitation, atmospheric pressure, cloud cover and snow for stations in Denmark, Greenland and on the Faroe Islands
The long annual time series include: temperature for a number of stations in Denmark, Greenland and on the Faroe Islands (1873-2012), as well as temperatures, precipitation, hours of sunshine and cloud cover given as national averages for Denmark

All the above mentioned datasets are freely available through the annual updates of DMI Technical Reports at www.dmi.dk

2.4.8 Air quality monitoring

Air pollution is automatically monitored in both urban and rural areas across Denmark. This monitoring network is operated by DCE - Danish Center for Environment and Energy at Aarhus University (formed in 2011 to replace the former National Environmental Research Institute (NERI) and measures a wide range of pollutants:

- Nitrogen monoxide (NO)
- Nitrogen dioxides (NO_2)
- Ozone (O_3)
- Sulphur dioxide (SO_2)
- Total Suspended Particulate matter, TSP (PM_{10})
- The chemical composition of particles (sulphate, sea salt, heavy metals etc.)
- Nitrogen compounds (ammonia (gas), particulate ammonium, sum of nitric acid and particulate nitrate)
- Carbon monoxide (CO)

Furthermore, at a number of NERI stations deposition of air pollution via precipitation is monitored.

Figure 4 shows the types and distribution of air quality monitoring stations across Denmark.

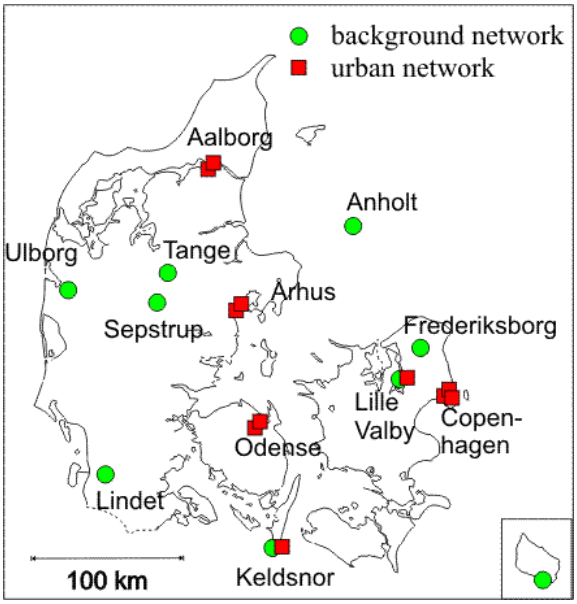

Fig. 4 – National Network of Air quality monitoring stations in Denmark operated by DCE (former NERI)

Chapter 3: Oceanic essential climate variables (Oceanic ECV)

3.1 National contribution to oceanographic ECV

Oceanographic observations for GCOS are based on the GOOS climate module for the open ocean, which comprises the following programmes: drifting and moored buoy programmes managed by the DBCP (Data Buoy Co-operation Panel), the Ship of Opportunity Programme (SOOP), the Argo array of profiling floats, the Global Sea Level Observing System (GLOSS), the Voluntary Observing Ships Programme (VOS) and the Automated Shipboard Aerological Programme (ASAP).

Denmark participates in the ASAP programmes as described in paragraph 3.2

Table 3a. National contributions to the oceanic essential climate variables – surface

Contributing Networks specified in the GCOS imple-mentation plan	ECVs	Number of stations or platforms currently operating	Number of stations or platforms operating in accord-ance with the GCMPs	Number of stations or platforms expected to be operating in 2015	Number of stations or platforms providing data to the international data centres	Number of stations or platforms with complete historical record available in international data centres
Global surface drifting buoy array on 5x5 degree resolu-tion	Sea surface temperature, sea level pressure, position-change based current	0 **(note 2)**	0 **(note 2)**	0 **(note 2)**	0 **(note 2)**	0 **(note 2)**
GLOSS Core Sea-level Network	Sea level	0	0	0	0	0
Voluntary observing ships (VOS)	All feasible surface ECVs	0 **(note 2)**	0 **(note 2)**	0 **(note 2)**	0 **(note 2)**	0 **(note 2)**
Ship of Oppor-tunity Pro-gramme	All feasible surface ECVs	0	0	0	0	0

Note 2: Denmark (DMI) participates in the EUMETNET programme SURFMAR, which operates approximately 80 drifting buoys & 10 voluntary observing ships (VOS) of which DMI maintains 4.

Table 3b. National contributions to the oceanic essential climate variables – water column

Contributing Networks specified in the GCOS imple-mentation plan	ECVs	Number of stations or platforms currently operating	Number of stations or platforms operating in accord-ance with the GCMPs	Number of stations or platforms expected to be operating in 2015	Number of stations or platforms providing data to the international data centres	Number of stations or platforms with complete historical record available in international data centres
Global refer-ence mooring network	All feasible surface and subsurface ECVs	0	0	0	0	0
Global tropical moored buoy network	All feasible surface and subsurface ECVs	0	0	0	0	0
Argo network	Temperature, salinity, current	0	0	0	0	0
Carbon inventory survey lines	Temperature, salinity, ocean tracers, biogeo-chemistry variables	0	0	0	0	0

3.2 Automated Shipboard Aerological Programme (ASAP).

The E-ASAP (Eucos ASAP) in its present form began in the mid1980s.
The programme's objective is to record profile data from the upper air strata in ocean areas using automated sounding systems carried on board merchant ships plying regular ocean routes.
Several national meteorological services operate ASAP units and the collected data are made available in real time via GTS.
ASAP data are archived alongside other radio sounding data by many national meteorological services.
ASAP is an important contribution to both the WWW and GCOS.
Today most of the soundings are from the North Atlantic and north-west Pacific, but the programme is expanding to other ocean basins through a new, co-operative World-wide Recurring ASAP Project (WRAP).

Denmark operates three ASAP units mounted on ships plying fixed routes from Denmark to Greenland.

3.3 Satellite observations as base for oceanic ECV observations

Denmark is member state of both EUMETSAT and ESA.
Especially through EUMETSAT Denmark takes functional part in activities related to the utilization of satellite data in analyses related to ECVs and climate monitoring.
The table below is indicating **in blue** areas where the Denmark participation is more significant.

Table 4. Global products requiring satellite observations – oceans

ECVs/ Global products requiring satellite observations	Fundamental climate data records required for product generation (from past, current and future missions)
Sea Ice Sea ice concentration **EUMETSAT O&SI SAF**	Microwave and visible imagery
Sea Level Sea level and variability of its global mean	Altimetry
Sea Surface Temperature Sea surface temperature **EUMETSAT O&SI SAF**	Single and multi-view IR and microwave imagery
Ocean Colour Ocean colour and oceanic chlorophyll-a concentration derived from ocean colour	Multi-spectral VIS imagery
Sea State Wave height and other measures of sea state (wave direction, wavelength, time period)	Altimetry
Ocean Salinity Research towards the measurement of changes in sea surface salinity	Microwave radiances
Ocean Reanalyses Altimeter and ocean surface satellite measurements **EUMETSAT O&SI SAF**	Key FCDRs and products identified in this report, and other data of value to the analyses

3.4 Additional national oceanographic monitoring

3.4.1 Sea temperatures

Denmark has a network for the collection of sea temperatures at 24 coastal stations around Denmark. The stations are operated by DMI, the Danish Coastal Authority, and local authorities respectively. Data are available from each of the responsible bodies. Furthermore, sea surface temperatures are monitored using satellites, and DMI prepares daily maps for the North Sea and Baltic Sea areas.

3.4.2 National tide gauge network

In Denmark an extensive national network of tide gauges are operated jointly by DMI, local authorities and the Danish Coastal Authority. The network consists of 86 automatic stations.

In Greenland a tide gauge station is operated by DTU-Space/National Space Instuitute http://www.space.dtu.dk/english.

Data are available from the responsible bodies.

3.4.3 Hydrographic and marine surveys

The Danish Centre for Environment and Energy (DCE) (former National Environmental Research Institute (NERI)), has the overall responsibility for surveillance of the Danish waters. Surveillance of fjords and coastal waters is carried our by the regional authorities, while DCE is responsible for mapping the open waters.

All of the surveys are part of the Danish nationwide monitoring programme NOVANA
All marine NOVANA data (regional and state) are collected annually in the national marine database, MADS, by DCE.

The Danish Institute for Fisheries Research carries out yearly surveys in Danish waters, primarily in the North Sea and the Baltic Sea. Relevant oceanographic parameters are measured and recorded for these areas.

Furthermore, DMI is involved in the following projects:

- Measurements of water transports across the Greenland-Scotland Ridge
- Monitoring of the oceanographic conditions along West Greenland
- Monitoring of currents in the Danish straits and wter level along the Danish coastline

Chapter 4: Terrestrial Essential Climate Variables (ECV)

4.1 General information

The terrestrial observation system is not as well established as the atmospheric or the oceanographic one. The reason is that most of the terrestrial observations are not part of international observation routines with a regular/daily exchange of data.

4.2 Global Terrestrial Network – Hydrology (GTN-H)

The GTN-H is a joint effort of the World Meteorological Organization / Climate and Water Department (WMO/CLW), the GCOS, and the Global Terrestrial Observing System (GTOS12), co-sponsored by WMO, UNESCO, ICSU, UNEP and FAO.

GTN-H represents the observational arm of the Group on Earth Observations / Integrated Global Water Cycle Observations Theme (GEO/IGWCO).

The following hydrological variables have been identified as essential for the GTN-H13 network: Precipitation, river discharge, groundwater, water vapour, lake level/ area, isotopic composition, soil moisture, water use, snow cover, glaciers and ice caps, evapotranspiration, water quality/ biogeochemical fluxes.

For most of the variables a global network is defined and a contact established.

The **Global Precipitation Climate Centre (GPCC)** based at German Meteorological Institute/Deutsche Wetterdienst (DWD) and operating under the auspices of the World Meteorological Organization (WMO), as well as
Global Runoff Data Centre (GRDC), based at the Bundesanstalt für Gewässerkunde (Federal Institute of Hydrology, BfG) in Koblenz, Germany, and operating under the auspices of the World Meteorological Organization (WMO), are both parts
of the GTN-H Panel and represent their respective networks on precipitation and river discharge.

DMI contributes to GPCC with precipitation data, and DCE is reporting to GRDC under GTN-R (see paragraph 4.3).

4.3 Global Terrestrial Network for River Discharge (GTN-R)

DCE is reporting to the Global Runoff Data Centre (GRDC), based at the Bundesanstalt für Gewässerkunde (Federal Institute of Hydrology, BfG) in Koblenz, Germany, and operating under the auspices of the World Meteorological Organization (WMO).

GTN-R is a GRDC contribution to the Implementation Plan for the Global Observing System for Climate and to GTN-H.
Denmark is reporting 14 stations as shown in Table 5.

4.4 Global Terrestrial Network for Lakes (GTN-L)

As with several other data types, lake level data are recorded by both local authorities as well as at national level.

DCE is operating a database, from which national and part of local data from lakes may be available upon request.

4.5 Global Terrestrial Network on Glaciers (GTN-G)

The Geological Survey of Denmark and Greenland (GEUS), is mapping the mass-balance of the Greenlandic Icecap.
As part of these activities, a network of stations (PROMICE) is operated.
http://promice.dk/about_us_uk/main.html
The PROMICE network operates 20 automatic mass balance stations in Greenland, as shown in Table 5.

4.6 Global Terrestrial Network for Permafrost (GTN-P)

Soil or rock that is permanently frozen throughout the year is called permafrost.
Permafrost is present in Greenland, and monitored at selected sites as part of (primary) individual research projects.
There is no information on any nationwide monitoring or reporting, neither nationally or internationally.

Table 5. National contributions to the terrestrial domain essential climate variables

Contributing networks specified in the GCOS implementation plan	ECVs	Number of stations or platforms currently operating	Number of stations or platforms operating in accordance with the GCMPs	Number of stations or platforms expected to be operating in 2015	Number of stations or platforms providing data to the international data centres	Number of stations or platforms with complete historical record available in international data centres
GCOS baseline river discharge network (GTN-R)	River discharge	14	14	14	14	14
GCOS Baseline Lake Level/ Area/Temperature Network (GTN-L)	Lake level/area/ temperature	0	0	0	0	0
WWW/GOS synoptic network (RBSN stations)	Snow cover	3	3	3	3	Not known
GCOS glacier monitoring network (GTN-G)	Glaciers mass balance and length, also ice sheet mass balance	20	N/A	20	Data are presently available upon request	Not known
GCOS permafrost monitoring network (GTN-P)	Permafrost borehole temperatures and active layer thickness	0	0	0	0	0

4.7 Satellite observations as base for Terrestrial related ECV observations

Denmark is member state in EUMETSAT and ESA.
Especially through EUMETSAT Denmark takes functional part in activities related to the utilization of satellite data in analyses related to ECVs and climate monitoring.
At present DMI does not operate any activities in the areas shown in Table 6.

Table 6. Global products requiring satellite observations – terrestrial

ECVs/ Global products requiring satellite observations	**Fundamental climate data records required for product generation (from past, current and future missions)**
Lakes Maps of lakes, lake levels, surface temperatures of lakes in the Global Terrestrial Network for Lakes	VIS/NIR imagery and radar imagery, altimetry, high-resolution IR imagery
Glaciers and ice caps Maps of the areas covered by glaciers other than ice sheets, ice sheet elevation changes for mass balance determination	High-resolution VIS/NIR/SWIR optical imagery, altimetry
Snow cover Snow areal extent	Moderate-resolution VIS/NIR/IR and passive microwave imagery
Albedo Directional hemispherical (black sky) albedo	Multispectral and broadband imagery
Land cover Moderate-resolution maps of land-cover type, high-resolution maps of land-cover type, for the detection of land-cover change	Moderate-resolution multispectral VIS/NIR imagery, high-resolution multispectral VIS/NIR imagery
fAPAR Maps of fAPAR	VIS/NIR imagery
LAI Maps of LAI	VIS/NIR imagery
Biomass Research towards global, above ground forest biomass and forest biomass change	L band/P band SAR, Laser altimetry
Fire disturbance Burnt area, supplemented by active fire maps and fire radiated power	VIS/NIR/SWIR/TIR moderate-resolution multispectral imagery
Soil moisture[a] Research towards global near-surface soil moisture map (up to 10 cm soil depth)	Active and passive microwave

Chapter 5: Additional information

5.1 Detailed reporting

Denmark provided a detailed report as part of "Denmark's Fifth National Communication on Climate Change Under the United Nations Framework Convention on Climate Change and the Kyoto Protocol" to the UNFCCC in 2009.

5.2 WMO RA VI Pilot Regional Climate Centres Network (RCC-Network) and European Climate Assessment & Dataset (ECA&D).

Through DMI's active participation in the EUMETNET Expert Team Climate (former EUMET-NET programme ECSN (European Climate Support Network)) Denmark contributes very actively to the European Climate Assessment & Dataset (ECA&D) http://eca.knmi.nl/ – at present the most comprehensive climate dataset and analysis for Europe.
ECA&D forms the backbone of the climate data node in the Regional Climate Centre (RCC) ["The Regional Climate Centre Node on Climate Data"] (RCC-CD for WMO Region VI (Europe and the Middle East)) since 2010.
In addition to the cooperation on data, DMI contributes active to The Regional Climate Centre Node on Climate Monitoring"] (RCC-CM for WMO Region VI (Europe and the Middle East)) providing national climate monitoring products and information.

The data and information products contribute to the Global Framework for Climate Services (GFCS).

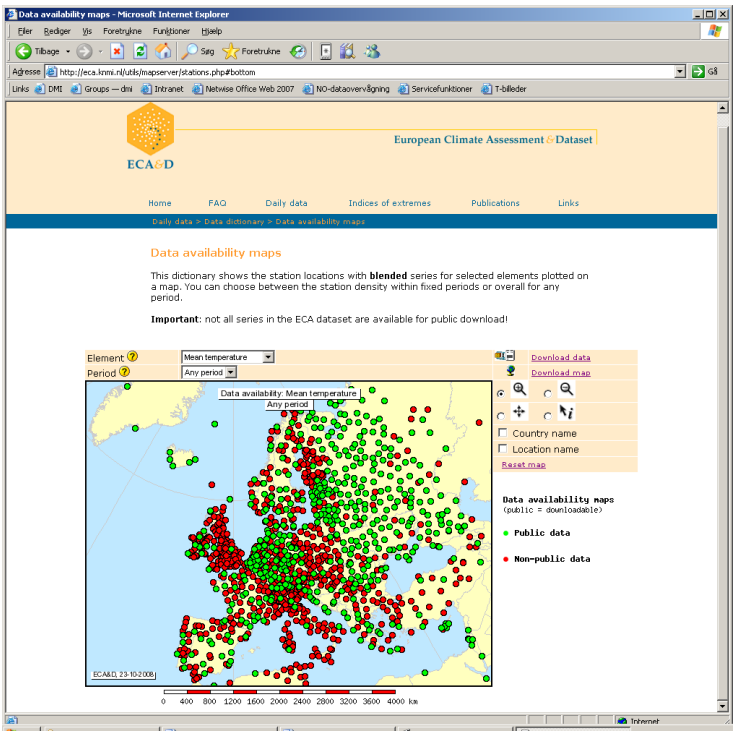

Fig.5 Homepage of the *European Climate Assessment & Dataset (ECA&D).*

References

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Previous reports

Previous reports from the Danish Meteorological Institute can be found on:
http://www.dmi.dk/dmi/dmi-publikationer.htm