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North Atlantic Climatological Dataset (NACD Version 1) - Final Report

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Appendices 2-6 are enclosed as ASCII-files on 2 diskettes (3.5 ", HD, 1.44 MB)

Summary

The National Meteorological Institutes in Northern Europe were started more than a century ago and over the years, a huge amount of data has accumulated. However, much of this data has not been accessible on computers, and has therefore not been subjected to a rigorous testing of homogeneity. The present project represents the largest effort hitherto accomplished within the field of digitisation, homogenisation and analysis of a multi-elemental dataset in this part of the World.

The objectives of NACD have been the following:

I. To co-ordinate the production of a consistent climatological dataset covering the Northern North Atlantic from Greenland in west to Finland in east and from Svalbard in north to Belgium in south. This work has mainly involved the following phases:

- a) Digitisation and quality control
- b) Homogeneity testing and adjustment
- c) Verification of adjustments

II. Analysis of natural varibility of the climate in the Northern North Atlantic region.

III Arrangement of workshops, seminars and conferences for transfer of knowledge between the North European climatic data centres and other researchers dealing with climatic change.

All 3 objectives have been accomplished. The main result of this project has been the production of the first digital version of the North Atlantic Climatological Dataset (NACD Version 1), consisting of 388 individual time series of air temperature, air pressure, precipitation, days with snow cover and cloud cover. Preliminary analysis of the homogenised dataset has shown, that time series of air temperature, cloud cover and precipitation have been increasing, whereas air pressure and days with snow cover have remained unchanged over the period 1890-1990. Other main results of this project can be summarised as:

1).The importance of homogenisation of climatic time series has been widely recognized.
2) Multi-element approach to climatic change studies has been generally accepted
3) Standard data dictionary for monthly climatic data has been defined.
4) Standard exchange format for monthly climatic data has been implemented.
5) Standard metadata format for climatic time series has been suggested.
6) Co-ordination of climatic change studies on a wider European level has been initiated.
7) New techniques for detection of climatic change have been investigated.
8) Improved understanding of causal factors in climatic change issues has been achieved.
9) Several new proposals for future North Atlantic climate studies have been formulated.

More than 100 reports and articles have been published over the past few years, as a result of this project. Apart from the support from our own institutions, the main funding has come from the Environment Programme of the European Commission. We would however also like to acknowledge other funding agencies, such as the Nordic Council of Ministers, the European Science Foundation, the Academy of Finland and the Research Councils in Iceland, Norway and Sweden.

1.0 Introduction

The problems of analysing climate and climatic variations using a climatological dataset are closely interrelated with the problems of quality of observations, and homogeneity of time series, and this situation is consequently embodied in many of the reports from the NACD work. The NACD-publications during the first activity year mainly covered the spectrum: extraction of data from paper archives - digitisation - turning station history archives into metadata - homogenisation - definition of standards and preliminary data analysis, whereas the second activity year has been more focused on collaborative efforts to analyse climatic change.

This report contains a summary of the whole project, whereas the national reports (Frich et al. 1995), gives additional results from each country involved in the present project. A number of ongoing activities have been mentioned briefly in this report. These results will be published separately within the next months. The overall result of this project can however not be evaluated completely until the whole dataset has been applied in a number of comprehensive anlytical studies.

Nearly all the work tasks of the work programme have been completed during the past 2 years. Exceptions from this have been explained in the various chapters, as either publication activities in preparation, or as future plans or new projects. The 2-year funding from the EC has come at a time, when the project was already well established in the Nordic countries, and as the concept of establishing homogenous regional datasets has become more and more popular, the next few years will bring additional results initiated by this project. Some of the Nordic participants have been delayed considerably in their successfull acquisition of national funding related to the project, which explains minor deviations from the original work programme.

Cooperation within the project group has been running smoothly by the help of an electronic communication system, and in addition, the project members have met regularly at 3 NACD Seminars funded by the EC, and at other international meetings over the past 2 years.

The First NACD Seminar was arranged according to the work programme in Brussels, Belgium, from 29 November - 1 December 1993. Attending the meeting were all contractors of the present project (except VI) plus representatives from Germany, Finland and Estonia. The work programme was discussed in detail at this meeting, and financial and other problems were settled.

The fifth of a series of Nordic Climate Workshops was arranged by FMI in Majvik, Finland from 15-18 May, 1994. This event was also known as the European Workshop on Climate Variations, and NACD-participants made a total of 17 out of 41 contributions to the workshop. The proceedings from this workshop have been edited by Raino Heino/FMI (Heino,1994e), and contains a summary of mainly European views on changes in the present climate.

The 19th Nordic Meteorologist's Meeting was arranged in Kristiansand, Norway from 6-10 June, 1994 by DNMI. A special session covered climate changes/climate variations and 4 out of 10 contributions were given by NACD-participants. The preprints from this meeting have been published (Bjørbæk et al., 1994).

The 2nd Meeting of the Regional North European Sub-group on Historical Climatology took place in Tallinn, Estonia from 29 September to 1 October, 1994. Approximately 7 out of 20 contributions were from NACD-participants. The proceedings will be published in early 1996.

The Second NACD Seminar was arranged in Reading, UK, from 17-19 October, 1994, and all contractors plus a national representative from Poland participated in this meeting. The various contractors reported on progress made during the first year of the project. Discussion was concentrated on the work programme for 1994/1995, and definition of exchange standards for data and metadata.

At a workshop in Vienna, Austria during 17-18 February, 1995, nearly all the NACD participants had an opportunity to meet with about 20 other representatives from national meteorological services in Europe. The outcome of this workshop, was a common proposal (MERIT) to the EC, which unfortunately was rejected.

The 6th International Meeting on Statistical Climatology in Galway, Ireland from 19-23 June 1995, was attended by 7 NACD partners. MSI hosted a two-day work group meeting in Dublin before the meeting in Galway, in order to co-ordinate various aspects of the work. The conference proceedings have been published (Ó Muircheartaigh et al., 1995).

At the International Conference on Past, Present and Future Climate in Helsinki Finland during 22-25 August, 1995, most of the NACD participants met again. Proceedings from this Conference have been published (Heikinheimo, 1995) The Nordic subgroup of NACD formulated a new proposal (REWARD) to the Nordic Council of Ministers, whereas the whole group met and discussed the finalisation of the present project.

Finally, the Third NACD Seminar was held in Copenhagen, Denmark during 5-7 October 1995, in order to discuss the final report, and co-ordinate remaining activities. This meeting was attended by all contractors (20 persons).

The results of those meetings have been incorporated in the present report, which contains a state of the art report for the whole project. The report has been divided into 4 main sections. In the first section, the status of digitisation and quality control is described. The next section describes the work done with extraction and storage of metadata. The third section describes the work with implementation and use of the Standard Normal Homogeneity Test (SNHT). Finally a fourth section contains a description of work accomplished under the heading 'Analysis of climate variation'.

Additional validation of other observed or model-based datasets remains to be done, after publication of the first version of the dataset. The techniques for this kind of studies have however been developed during the project period, and the remaining validation will be done in co-operation with the various data and modelling centres.

Finally, we present additional results, which could not be foreseen at the time of writing the original work programme. These results are related to more extensive collaboration between European data producers, and a short description of future plans.

2.0 Digitisation and quality control methods

As indicated in the NACD progress report of 1993-1994 (Frich et al., 1994), it is recognised that the digitising, homogeneity testing and climatological analysis are closely interrelated. The detailed statistical analysis can frequently reveal inhomogeneities that previously were unknown. Consequently, additional series were digitised and used for homogeneity studies and comparisons. This situation is illustrated in fig. 1.

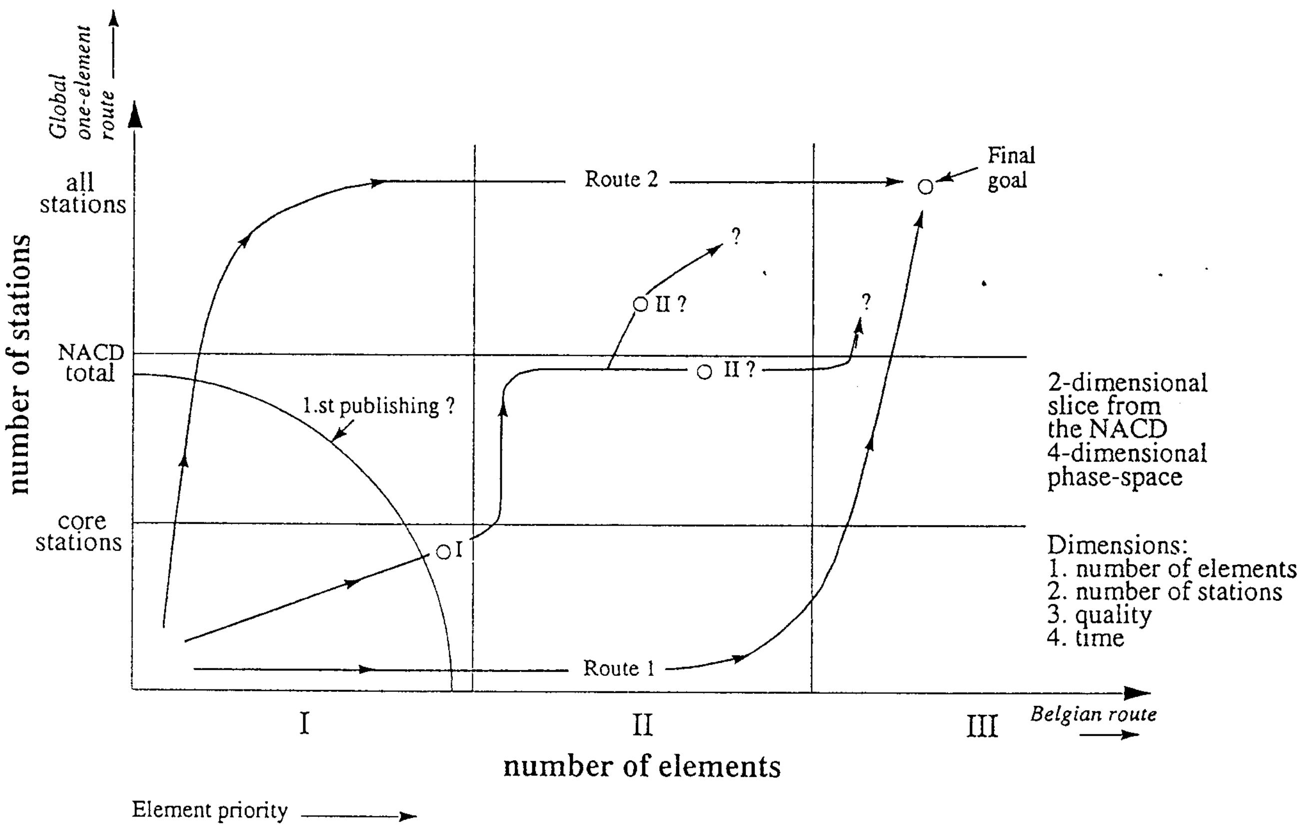

Figure 1 Procedure for completion of a homogenised dataset (After Jónsson et al., 1993).

In the original work programme, it was decided to restrict the project to 5 key elements. Furthermore, it was decided to restrict the the number of stations to about 70. Concerning the time dimension, it was realised, that during a two-year period it was only possible to improve the quality of series from the period 1890-1990.

The digitisation of data has been nearly completed, and monthly values of air temperature, air pressure, precipitation, cloud cover and snow cover from practically all NACD stations have been transferred to digital media. The number of stations contained in the dataset is illustrated in fig. 2, whereas the location of the stations is shown in fig. 3.

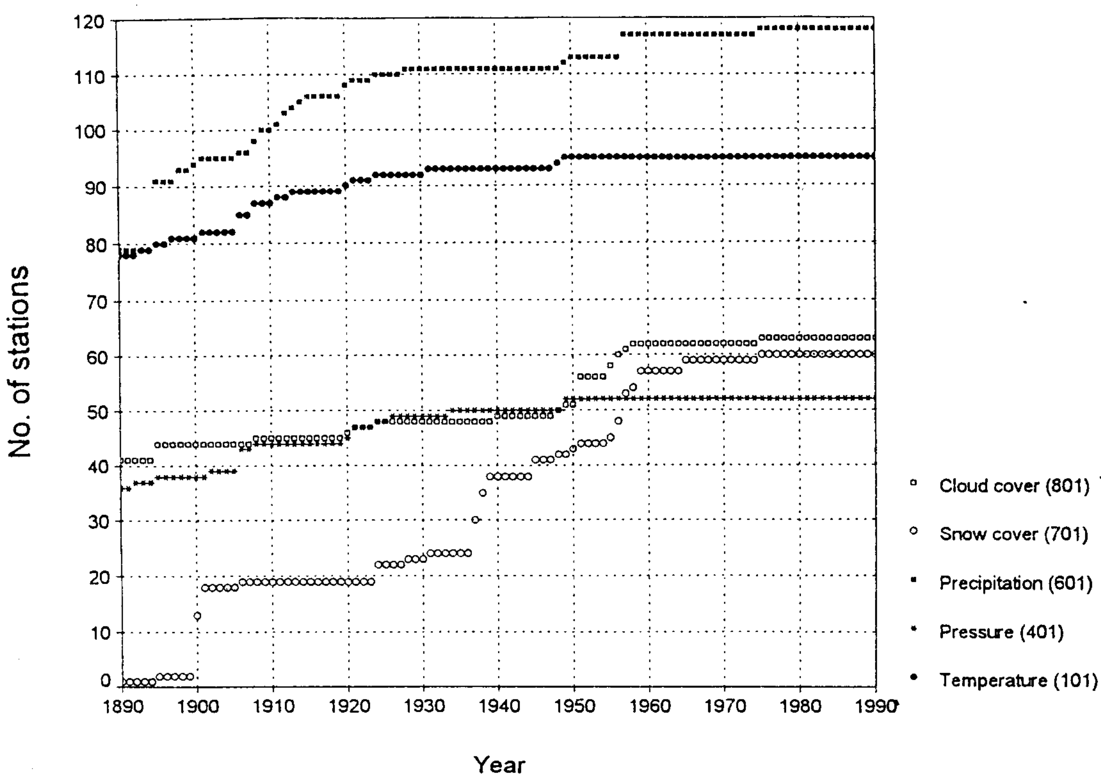

Figure 2 Number of stations included in the North Atlantic Climatological Dataset (NACD Version 1), shown as time series for each of the 5 climatic elements over the period 1890-1990. Minor gaps do occur in some of the series (not shown). See Appendix 2 for further details.

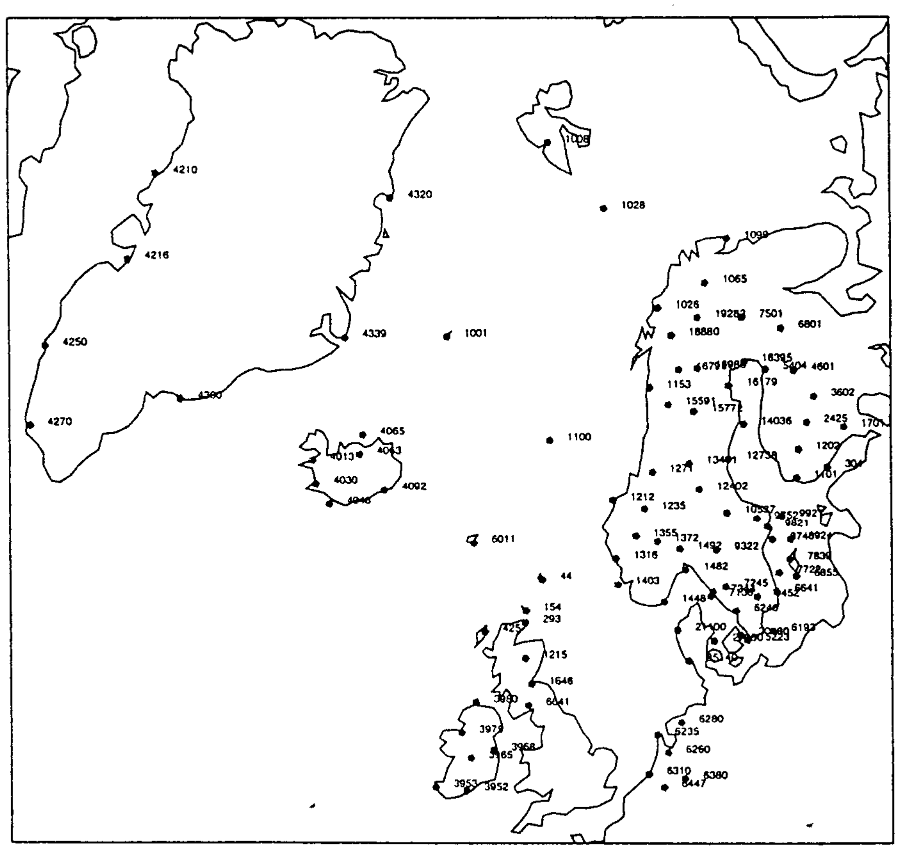

Figure 3a Location of temperature stations included in the North Atlantic Climatological Dataset (NACD Version 1). Based on information contained in Appendix 2.

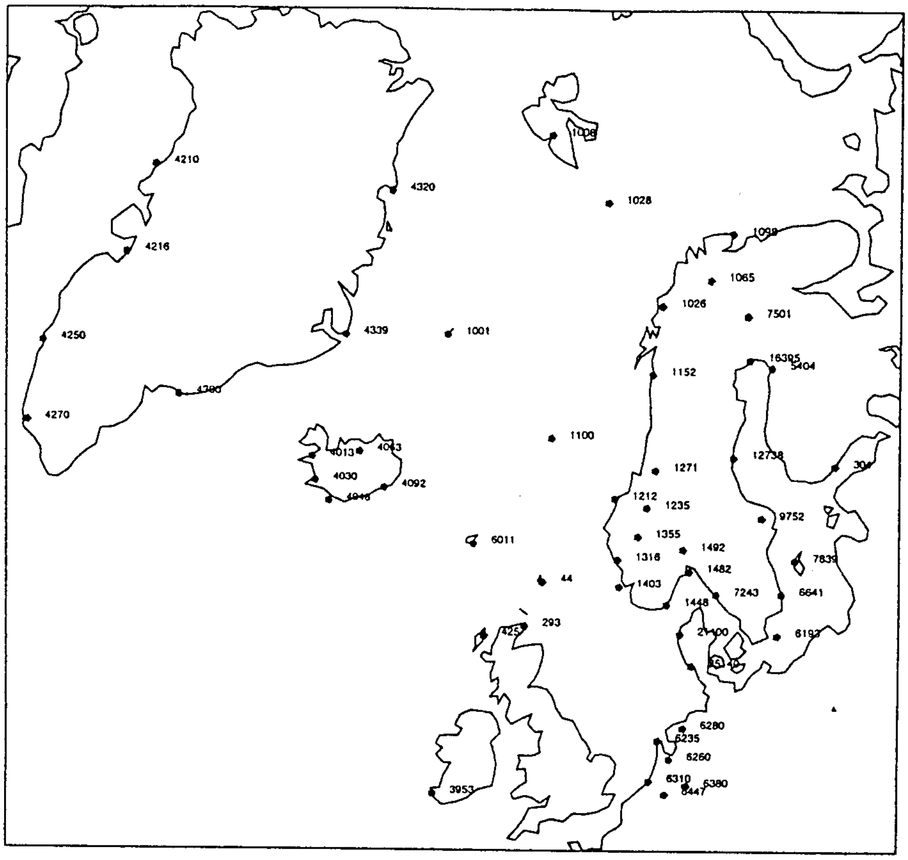

Figure 3b Location of pressure stations included in the North Atlantic Climatological Dataset (NACD Version 1). Based on information contained in Appendix 2.

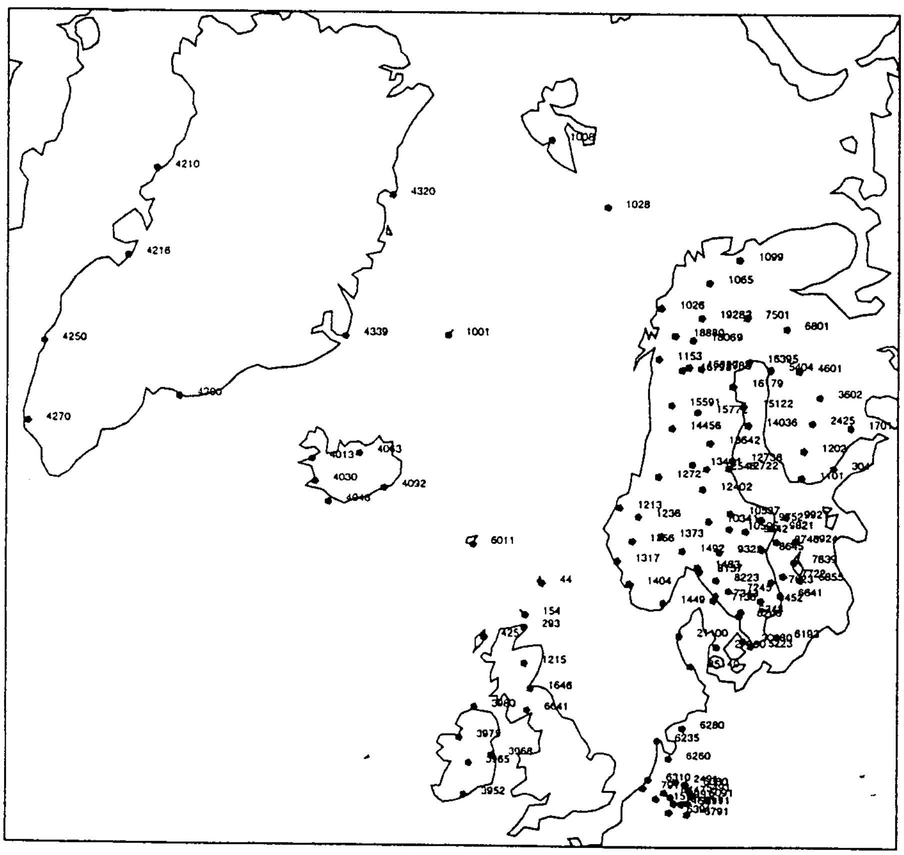

Figure 3c Location of precipitation stations included in the North Atlantic Climatological Dataset (NACD Version 1). Based on information contained in Appendix 2.

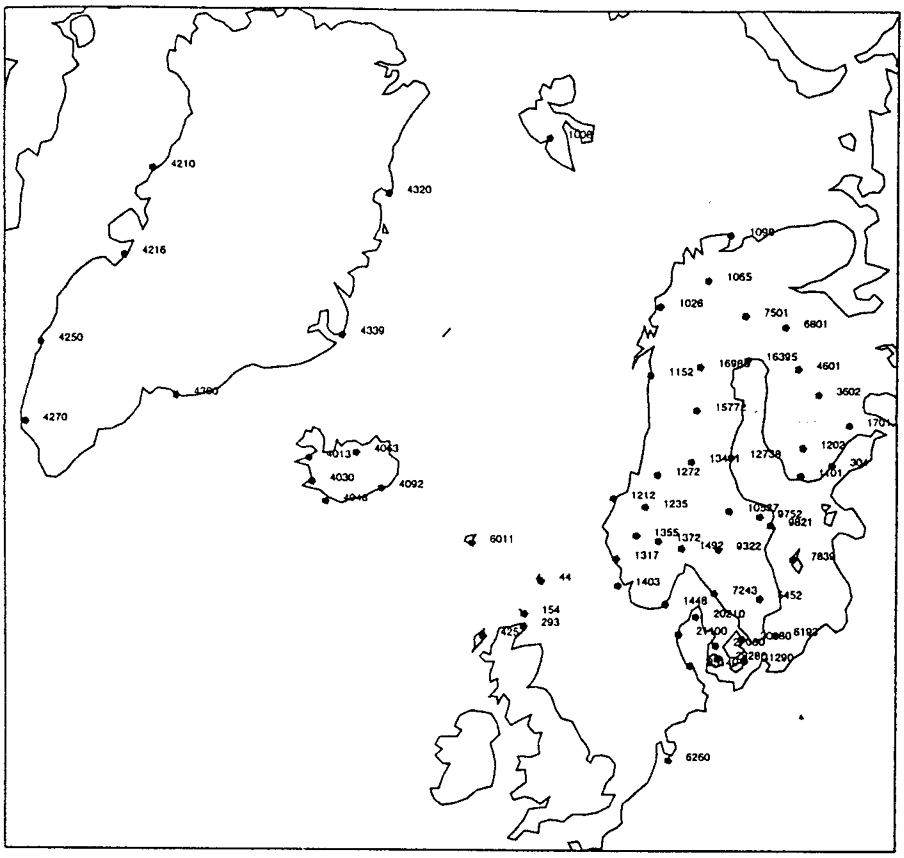

Figure 3d Location of snow cover stations included in the North Atlantic Climatological Dataset (NACD Version 1). Based on information contained in Appendix 2.

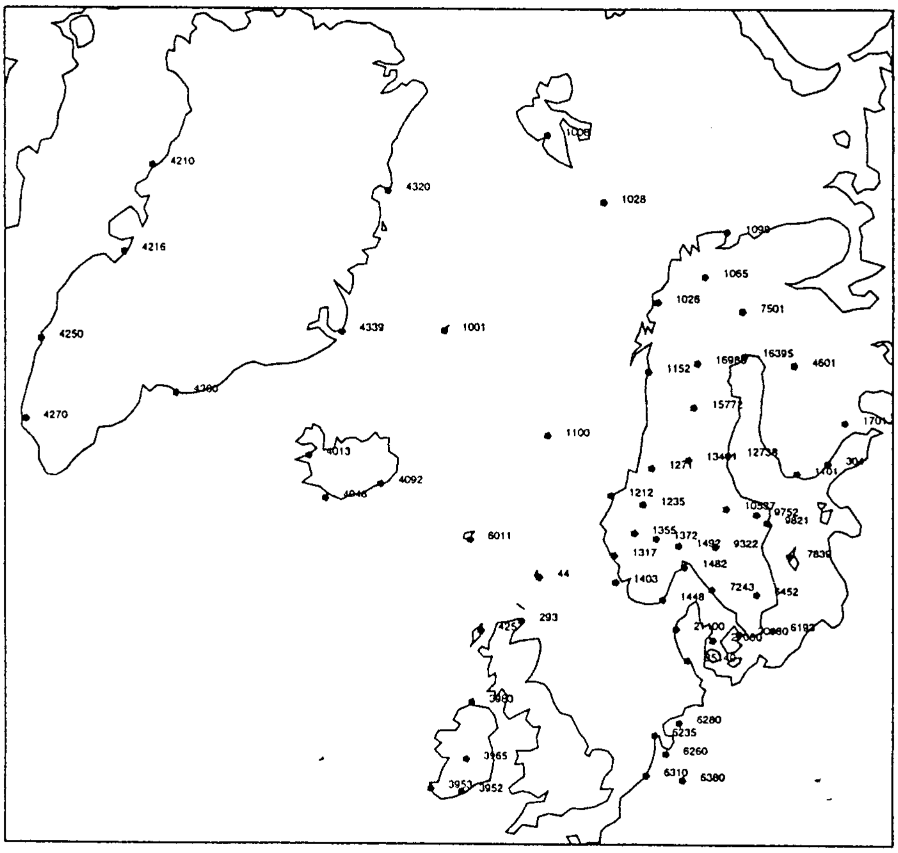

Figure 3e Location of cloud cover stations included in the North Atlantic Climatological Dataset (NACD Version 1). Based on information contained in Appendix 2.

For practical reasons, a large number of additional climatic elements have been digitised. All these various climatic elements are included in Appendix 3, which is a comprehensive data dictionary developed during the NACD project (Frich & Cappelen, 1992, Tuomenvirta, 1992, Larsen et al, 1993, Jónsson et al. 1993). Although homogenisation of some of these additional elements has started, they have not been included in the present version of NACD.

A major effort has also been made at the various national meteorological services participating in another EC-project, which involves digitisation of daily pressure data. This new project will utilize daily pressure observations from a selection of NACD-stations for calculating geostrophic wind over the northeast Atlantic area over the past 100 years. The experience gained from the NACD-project has been a valuable starting point for this new WASA-project. A kick-off meeting was held at DMI in Copenhagen, Denmark in May, 1994, setting out the details of this project. It was decided that DMI should produce a CD-ROM with all digitised pressure observations originating from the WASA-project. This WASA pressure dataset will be available during early 1996 (Schmith et al., in prep.).

For the benefit of future projects, several countries have started digitisation of other daily values. The main effort has been done with respect to precipitation data, but also some temperature series have been or will be digitised on a daily basis throughout the whole period of observation. Some of this digitisation is done using optical character recognition systems, which have been developed during the present project. The selection of data series for digitisation of daily values has been based on the results of homogeneity testing in the present project.

One major result of the present project, is the definition of a common data exchange standard. This standard is linked to the station catalogue (Appendix 2), the data dictionary (Appendix 3). The data exchange standard is described in appendix 4. The first digital version of NACD is enclosed on 2 diskettes in the agreed data exchange format on the back cover of this report.

Quality control of individual monthly values has been secured by a number of methods, including:

1) Double keying of monthly data.

2) Comparison of digitised annual means/sums with means/sums of digitised monthly values and or means/sums of digitised daily values.

3) Various tests for outliers and comparisons with extreme value distributions.

4) Internal logical tests, e.g. Th>Tx>T>Tn>Tl and R01>R1>R10 (c.f. Appendix 3).

5) Comparisons with spatially interpolated values.

Missing values have in some cases been interpolated by using data from nearby stations, and they have been flagged as such in the various national databases. No automatic interpolation routines have been applied to the present version of the dataset.

3.0 Metadata and station history archives

The work with metadata was initiated before the present project started. The development of a system for storing and retrieving metadata is built on the work by e.g. Tuomenvirta (1992), Larsen et al. (1993), Heino (1994) and Tuomenvirta & Drebs (1994). An illustration of the complicated task of organizing metadata in a systematic way is given in figs. 4 and 5.

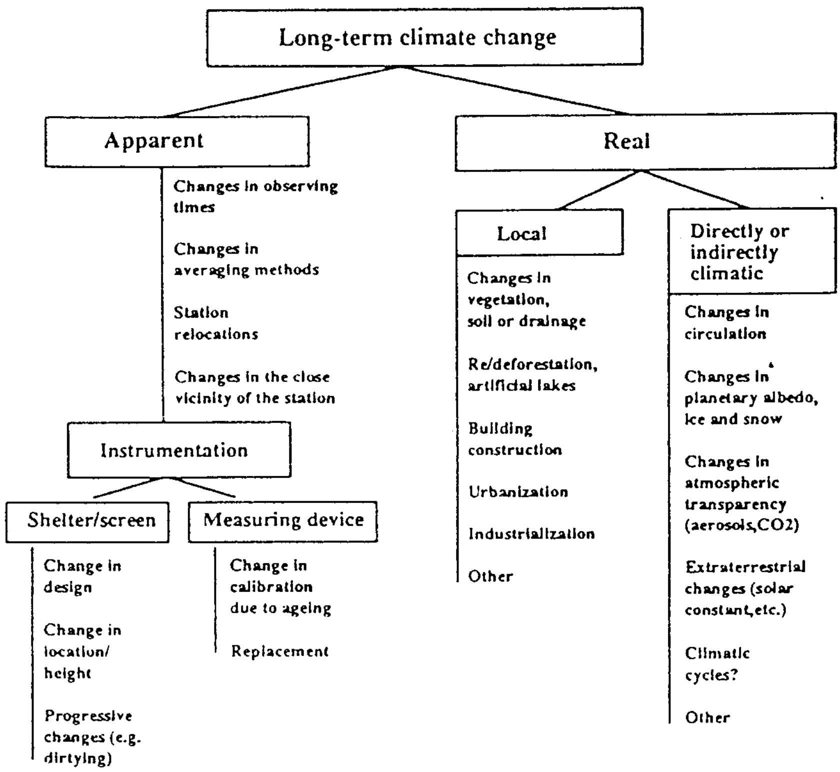

Figure 4 Factors causing long-term climatic changes (After Heino, 1994)

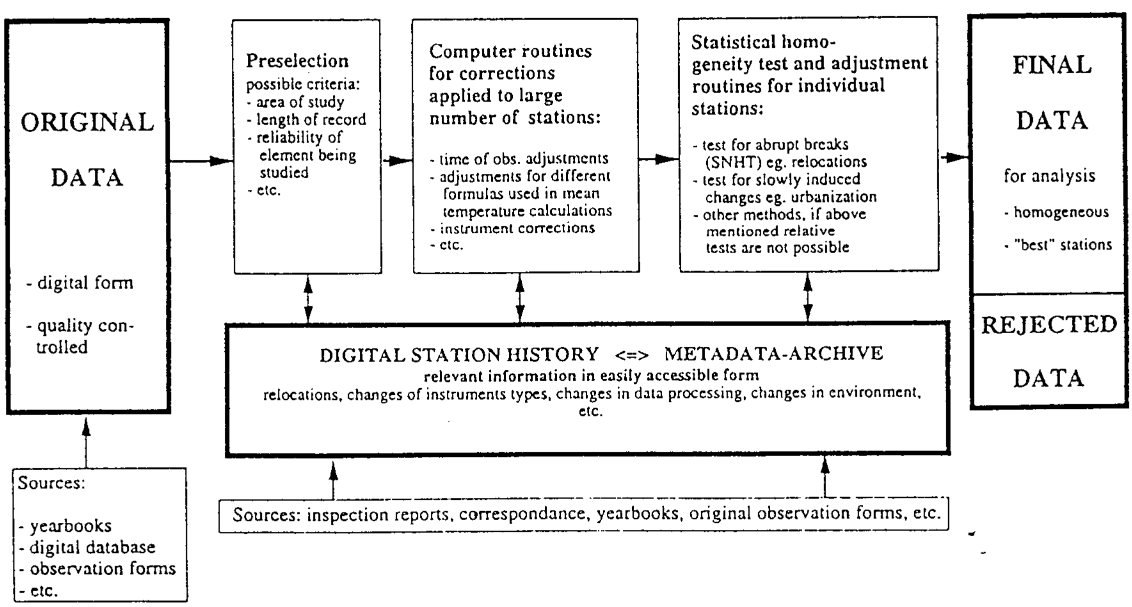

Figure 5 Schematic diagram of the production of a homogenous dataset for climate reseach (after Tuomenvirta & Drebs, 1994).

For the meteorological/climatological processing and analysis of the data it is important to know what type of instrument that has been used, the site of the instruments etc. The NACD-members have worked towards a standard metadata system, which could become more widely accepted. R. Heino, FMI, serves as rapporteur within WMO on the metadata topic. In his latest report on this issue, it is stated: "A straightforward way to identify possible points of inhomogeneity in records is a careful study of the 'methodological history' of the country in question (.e.g. country-wide changes in instrumentation or times of observation and averaging methods). The background of each observing station should also be checked from station inspection reports or other relevant documents. Any changes in instrumentation or observing methods occurring at a particular station should be checked as a possible source of inhomogeneity.

Even if the observations were free of instrumental or observational inhomogeneities, the records may still show local step-like or progressive changes. The effect of major, as well as some minor relocations of the stations typically introduce inhomogeneities. In addition to horizontal moves, a station relocation often includes a change in elevation and environment. Information on station histories is of primary importance to the homogenisation process and can only be assessed station by station.

In addition to urban and industrial effects, there are many other obvious consequences of man's activities for local climates (e.g. de/reforestation, artificial lakes, etc.). Their detection and correction, however, are more difficult, because these, like real variations in climate are generally trend-like. Apparent cyclic changes are also generally gradual and hidden amongst the real changes.

The effects due to different inhomogeneities, which are not the same for all climatic elements have been summarised in table 1.

Table 1 The sources of inhomogeneity and their significance on time series in medium to high latitudes (after R. Heino, FMI).

Source of inhomogeneity	Air temperature	Precipi- tation	Air pressure	Cloud cover	Snow cover
Observers	-	-	+	++	++
Instruments	-	+	+	-	-
Height of instr.	+	+	-1)	-	-
Exposure of -"-	++	+++	-	-	+
Times of obs.	+	-	-	+	-
Calc. methods	++	-	+	-	-
Relocations	++	+++	-	+	+
Environment	+	++	-	+	+

Note
- No major homogeneity problems.
+ Some inhomogeneities.
++ Significant inhomogeneities.
+++ Highly significant inhomogeneities.
1) Providing that exact height information is available.

Studies of methodological or single station histories are quite difficult and time-consuming to conduct. In addition, the necessary information sources for a given country are available only in that country. The language in which the information is described may also hinder this kind of study by outsiders. In practice, data records are never fully homogenised. New information on metadata or new test methods may reveal some need for further adjustments. However, if any adjustments are made, the original data should never be destroyed and replaced with the homogenised data, because future studies may still require the original data.

It is paradoxical that the causes introducing inhomogeneity in the records mostly represent real improvements in the measuring techniques or sites. The improvements, however, may seriously disturb the continuity of the series and introduce relatively large apparent changes, which should be carefully eliminated before proceeding too far towards conclusions supporting or refusing the results of other climatic studies."

To create metadata files with characteristics on instruments, site of equipment etc. the main source of information is given by historical inspection reports and station correspondence between the observer and the respective institute. This is a comprehensive task and this work is concentrated to the most important NACD-stations. It will not be possible to create a complete set of metadata files for all the stocks of NACD-stations. However, it was decided at the Second NACD Seminar in Reading, that a common metadata exhange format is needed. Such a standard was suggested taking into consideration the various national standards of storing metadata.

One major result of the Third NACD Seminar in Copenhagen was the definition of a common metadata exchange standard. This standard is linked to the station catalogue (Appendix 2), the data dictionary (Appendix 3) and the data exchange standard (Appendix 4). The metadata exchange standard is included in Appendix 5. As the volume of metadata is enormous, it was decided to include only selected examples of metadata in the final report. Most part of the metadata will thus remain at the data producing entities, but will be delivered to interested users of NACD Version 1 upon request.

Thus, a distinction should be made between metadata in digital form, and station history archives in paper form, including handwritten documents, photos, maps and reports.

4.0 Homogeneity testing methods

Small changes of the conditions at the meteorological stations, like change of instruments or change of measurement routines, time of observation frequently mean that more or less serious errors are introduced. It is thus urgent to detect and eliminate as far as possible these negative influences. The standard procedure for testing the homogeneity of data series is based on the Standard Normal Homogeneity Test (SNHT) by Alexandersson (1986), with later modifications.

The work within the NACD-countries was originally focused on the monthly temperature and precipitation stocks of data. Hanssen-Bauer & Førland (1994) have homogenised 129 Norwegian precipitation series over the past century. They found that homogeneity testing and documentation of changes by the use of station history archives were of crucial importance for finding reliable regional precipitation trends. Their findings have been summarised in table 2.

Table 2 Causes of inhomogeneities in Norwegian precipitation network, 1895-1990. (After Hanssen-Bauer & Førland, 1994).

Number of inhomogeneities: 151 =	100 %
Causes of inhomogeneities:	
Relocation of gauge	48 %
Changed environment	18 %
Installation of wind shield	9 %
New observer	3 %
Other known reasons	3 %
Reason unknown	21 %

4.1 Parallel observations

The first step in any homogenising effort is to study metadata, and detect when systematic changes of the national network of stations took place. Then analysis of parallel series of measurements should be done. An inventory of known changes in temperature screen design in the Nordic countries has been made by Nordli et al., (1995).

Many stations had previously a thermometer cage located on a North-facing wall, whereas nearly all stations today have free-standing Stevenson screens located away from buildings. Testing of the two screens against each other led to variable results. However, the bulk of the tests showed no effect of the change in winter but there was a tendency of warmer wall screens during summer, the bias amounting to 0.0 - 0.3°C, (see fig. 6). At two Norwegian sites situated at steep valley slopes, the wall screen was colder in winter by 0.5°C at most. It was concluded, that the screen comparisons had shown very variable results, meaning that no standard adjustment could be applied to temperature series where only the date of change from wall screen to Stevenson screen was known. A number of very local factors could influence the measurements significantly.

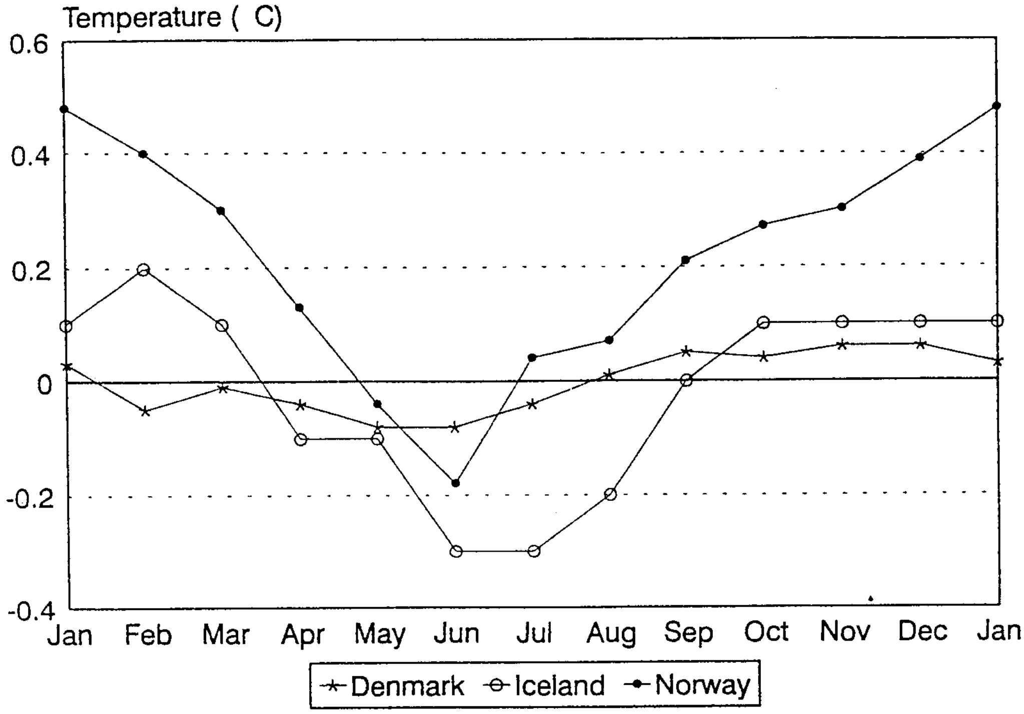

Figure 6. Mean monthly temperature differences: Free-standing screens minus wall screens. Mean values from tests in Denmark (5 tests), Iceland (8 tests), and Norway (2 tests). After Nordli et al. (1995).

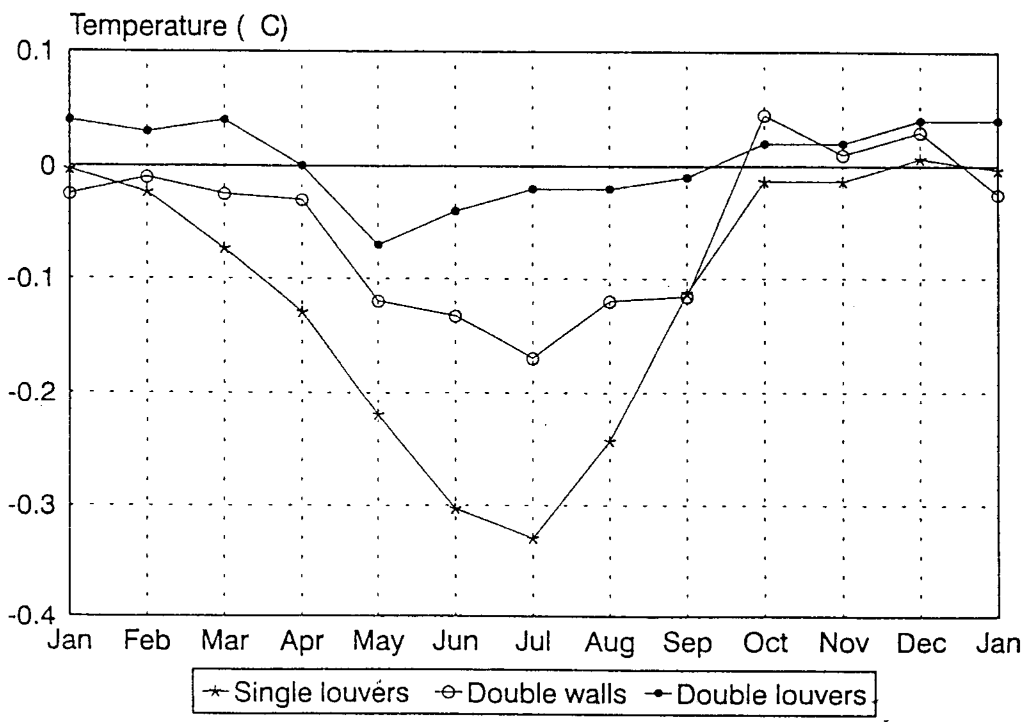

Figure 7. Monthly mean differences between: Temperature of forced ventilated air minus temperature in ordinary free-standing screens. After Nordli et al. (1995).

The first free-standing screens used were single louvered. They were later improved by double louvers. Unless the series are adjusted, this improvement may lead to inhomogeneities in long temperature time series. Compared to ventilated thermometers the single louvered screens were biased about 0.3°C warm in midsummer while the double louvered were unbiased, fig. 7.

In recent years, a small cylindrical screen suitable for automatic weather stations has been introduced. At some stations it has replaced the ordinary free-standing screen in connection with automation. The novel sensor screen is probably unbiased compared to the ordinary free-standing screen concerning mean monthly temperature, but both daily maximum and minimum temperatures are biased mainly caused by less inertia of the novel screen and faster temperature sensors. Higher maximum and lower minimum lead to increased diurnal range. The increase may amount to 1°C or more in midsummer monthly means.

Precipitation gauges

Measurements of precipitation are highly dependent on the type of precipitation gauge used and its exposure, and consequently a change of gauge introduces many complications. The records of precipitation amounts are always underestimates of the real amounts and they can usually be expected to contain great inhomogeneities in both space and time. In addition, most of the random-type inhomogeneities are also negative resulting from reduction in the catch (e.g. due to a leaking gauge, spilling of water). However, in wind exposed areas, drifting/blowing snow may occasionally cause too high gauge values.

Of particular concern is the measurement of snowfall from conventional gauges, where large errors are known to occur. When precipitation errors are expressed as a percentage of the true precipitation, they tend to be largest in windy high latitude climates.

The amount of precipitation collected varies with both the size and the design of the gauge. The amount of precipitation measured by the various gauges presently used is normally lower than that which actually falls. This systematic error is typically largest in high latitude (and mountainous) regions, where the wind speeds are high and a large proportion of precipitation comes in solid form. The principal errors in measuring precipitation are due to the following three causes:

(i) Wetting (or adhesion), i.e. the loss when transferring precipitation from the gauge to the measuring cylinder, This loss is an instrument error and can be estimated quite accurately for different amounts of precipitation. Corrections for wetting have been applied in some countries e.g. in the USSR/Russia since 1966. Until now, no such corrections have been applied to the precipitation data of the NACD-countries and thus changes in the wetting error are due only to gauge changes.

(ii) Evaporation from the gauge depends on inter alia instrument design and material, location of the station and other meteorological parameters (e.g. air temperature, saturation deficit, wind). This error is not accounted for in the NACD-precipitation records, either.

(iii) The largest errors in precipitation measurements are due to aerodynamic (or wind) causes and may be up to 30% or even more, depending on the type of the gauge and its installation.

The adjustments to be applied for precipitation records of the NACD-data do not take into account the present wetting, evaporation and wind errors, i.e. no attempt is made to obtain the true precipitation, but only the "level" of the present gauge-type in each country. Thus the precipitation data cannot be considered homogenous in a spatial sense.

Fig. 8 shows the precipitation gauges used in each NACD-country and a rough estimate on the effect of each change (positive/negative/gradual). In a separate report by Heino et al. (in preparation) more detailed information is given on the gauges used in the NACD-countries as well as on the effect of each change in numerical form.

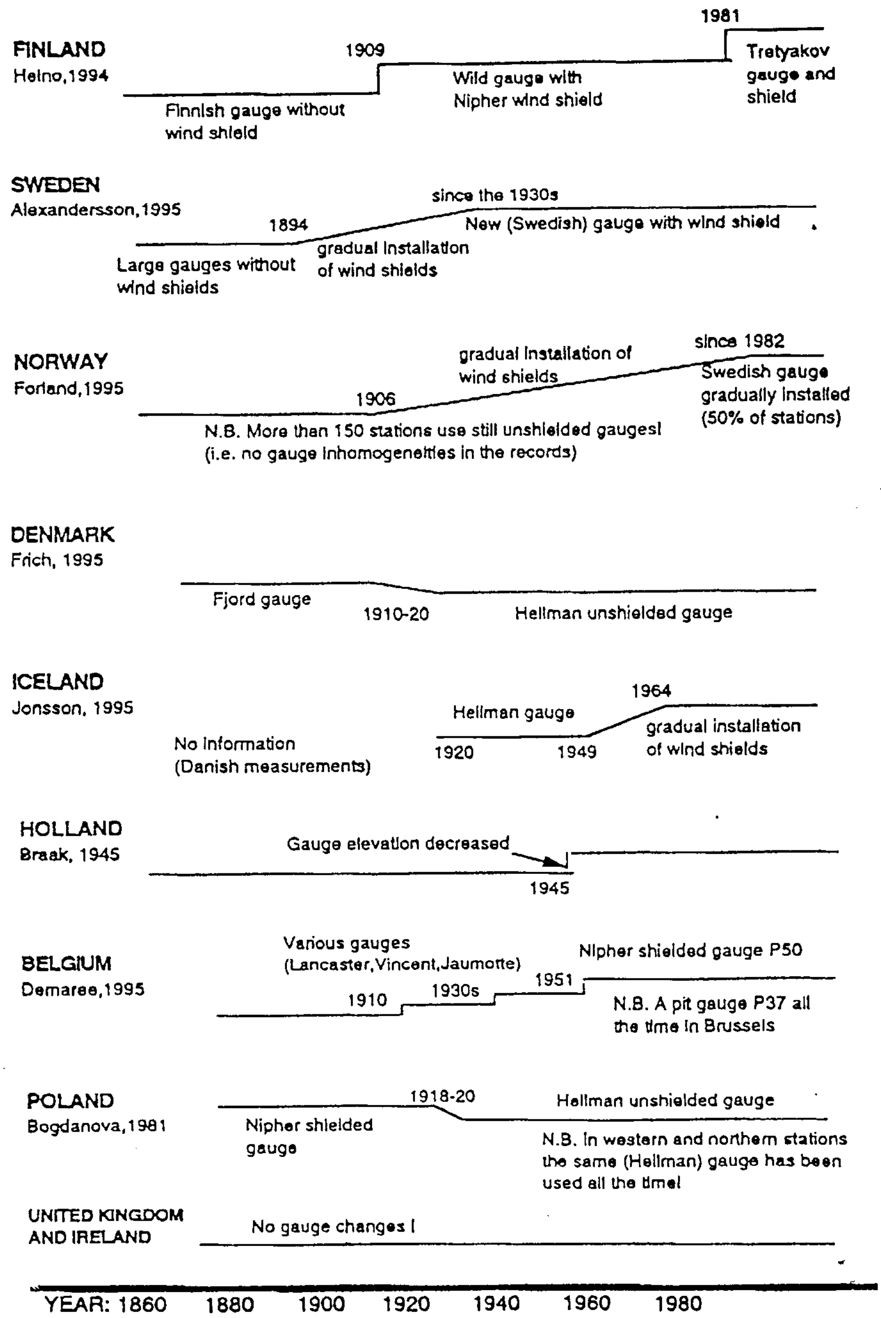

Figure 8 Apparent changes due to change of precipitation gauges in the NACD area. (From Heino et al., in prep.).

4.2 Standard Normal Homogeneity Test (SNHT)

Once the systematic changes in the network has been investigated (see previous chapter) and appropriate adjustments made, the series should be run through a series of relative homogeneity tests. General recommendations as to the use of the Standard Normal Homogeneity Test (SNHT) have been given in e.g. Frich & Cappelen (1992), Steffensen et al. (1993), Frich (1994b) and Hanssen-Bauer & Førland (1994). See also SNHT User Manual to be published in a separate report (Steffensen et al., 1996).

During the NACD-project, the homogenisation of data has been accomplished using the Standard Normal Homogeneity test (SNHT) as described by Alexandersson (1986), and with more wide practical experience presented by e.g. Hanssen-Bauer & Førland (1995). In this test, the most significant break(s) are picked out and compared with a significance level and with metadata. This often leads to reasonable ways of adjusting inhomogenous series. There has also been efforts to generalize the test to linear trends, to adjust for e.g. urban warming (Alexandersson, 1995) and to take into account differences between temperature climate types in the adjustment procedures (Tuomenvirta & Alexandersson, 1995).

To illustrate the new method, which tries to detect artificial linear trends, one example, where the Stockholm temperature series is compared with surrounding rural series, is given in fig. 9.

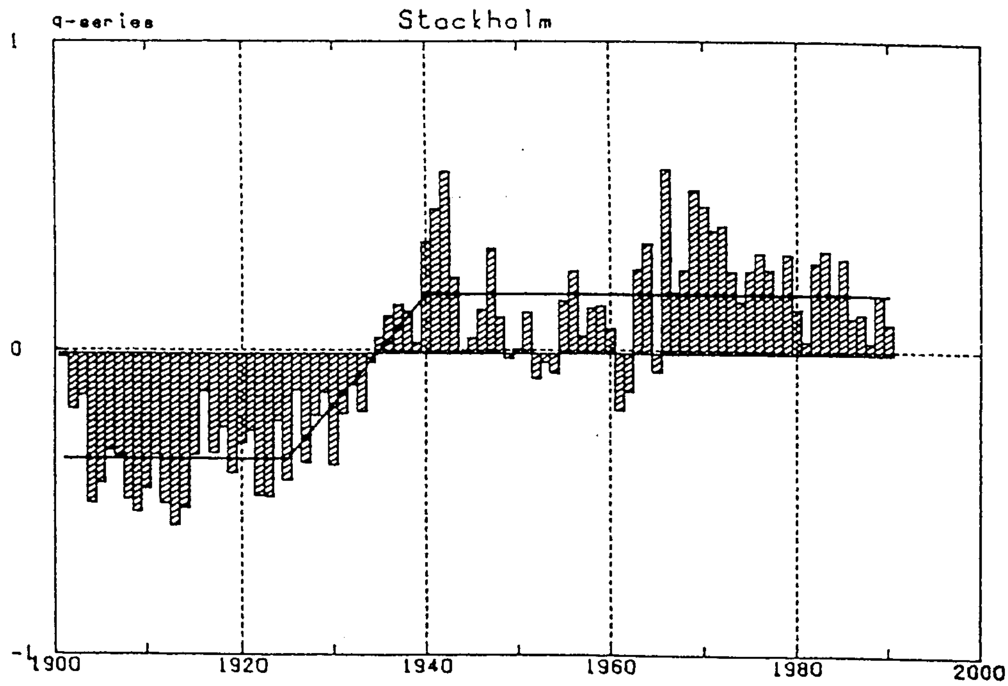

Figure 9 A linear trend of arbitrary length is fitted to the difference between the annual mean temperature in Stockholm, Sweden and reference series from surrounding rural sites. The SNHT trend test picks out 1925-1940 as the most prominent trend section. (After Alexandersson, 1995).

The trend test picks out the period 1925-1940 as a trend section, but it should be noted, that the series of differences is also well described by a sudden change in 1933/34. The total magnitude of the change of the mean annual temperature is estimated to 0.54°C. The chosen period coincides fairly well with a period when nearby blocks were constructed close to the Observatory Hill, while the great expansion of suburbs in the 1960ies might be another trend section but of less significance. The Stockholm series may also be affected by evolution of nearby trees, small relocations on top of the hill etc.

Several intercomparisons of the various test methods have been made over the past few years, e.g. Easterling and Peterson, (1992), Lamarque, (1994), and all show that the SNHT is superior to other test methods. To be used in its original version, the test is however labour intensive. It is also somehow vulnerable to missing values and large errors in the time series. Depending on the quality of available time series, it is therefore recommended to run the data series through some kind of quality control scheme first (see Chapter 2.0). Furthermore, it is generally recommended to have all available metadata at hand before the homogeneity testing starts. Homogenisation of time series without metadata cannot be recommended (c.f. Frich, 1994c).

Most series have generally been tested for single breaks, multiple breaks and trends respectively. Air temperature, air pressure and cloud cover series have been tested by forming differences between a test series and the reference series, whereas series of precipitation and no. of days with snow cover have been tested by using ratios. Generally, air pressure and air temperature have the lowest spatial variability, whereas precipitation has the highest spatial variability. In the former case, no weighting of the reference series has been necessary, whereas weighting by the variance or corrrelation coefficients has been applied, when precipitation stations were located far away from each other or in mountain areas.

The adequate number of reference series depends on the quality of these series. The optimal situation is to have a limited number of high quality (i.e. homogenous) reference stations, but as this is nearly always impossible in practice, it is often necessary to have many reference stations of poorer quality, which can form a roughly homogenous reference series by cancelling out the existent inhomogeneities.

Quite often, the SNHT detects both a linear trend, a single break and a double break in the same series. The standard procedure has been to divide the series into 30-50 year segments in order to test and adjust each single break individually. In many cases it has been difficult to decide whether a short trend or a single break existed in the series. If the trend test shows a trend of 5 years or less and the single break is located in between the start and end years of the trend, the normal procedure was to adjust for a single break. If the trend is more signficant than both the single and the double breaks and the year of the single break is not identical to one of the double break years, the inhomogeneity is most propably a trend.

One special problem encountered, relates to time series which do not adhere to the basic assumption of a normal distribution. This is especially a problem with elements such as precipitation and no. of days with snow cover. This problem has been somehow alleviated by the use of seasonal adjustment factors.

All adjustments made to inhomogenous series in the dataset have been applied to the oldest part of each time series. In most cases, seasonal adjustments have been made, when breaks were significant i.e. above the 95 % confidence level. The adjustment factors were calculated, when a change was documented in the metadata, by using 3-10 reference series from nearby stations. All adjusted series were then tested again, using other reference stations if possible.

4.3 Verification of adjustments

The homogenisation process can be divided into 3 phases. First phase is the internal relative homogeneity test, using e.g. mean temperature versus clock means of temperature and mean maximum and mean minimum temperature series from the same station. This test will detect change of observation hours, change of formula or change of instrument shelter. Adjustments can be verified by consulting the metadata (e.g. Frich, 1994c).

Next phase is a regional homogeneity test, where an NACD-series is tested against reference series not included in the dataset. This test phase will often reveal relocations, change of instruments or change of observer. Adjustments can be verified by consulting the metadata, or by comparing e.g. cloud cover with hours of bright sunshine (e.g. Frich, 1994c).

The final phase is an international relative homogeneity test, where one NACD-series is tested against homogeneous reference series from several countries in the same climatic region. This phase should reveal any nation-wide changes in the observational networks, which might have been overlooked. The final homogeneity testing phase can also be extended to independently derived datasets, such as the UKMO gridded dataset of sea surface temperature (SST) and night marine air temperature (NMAT), see fig. 10.

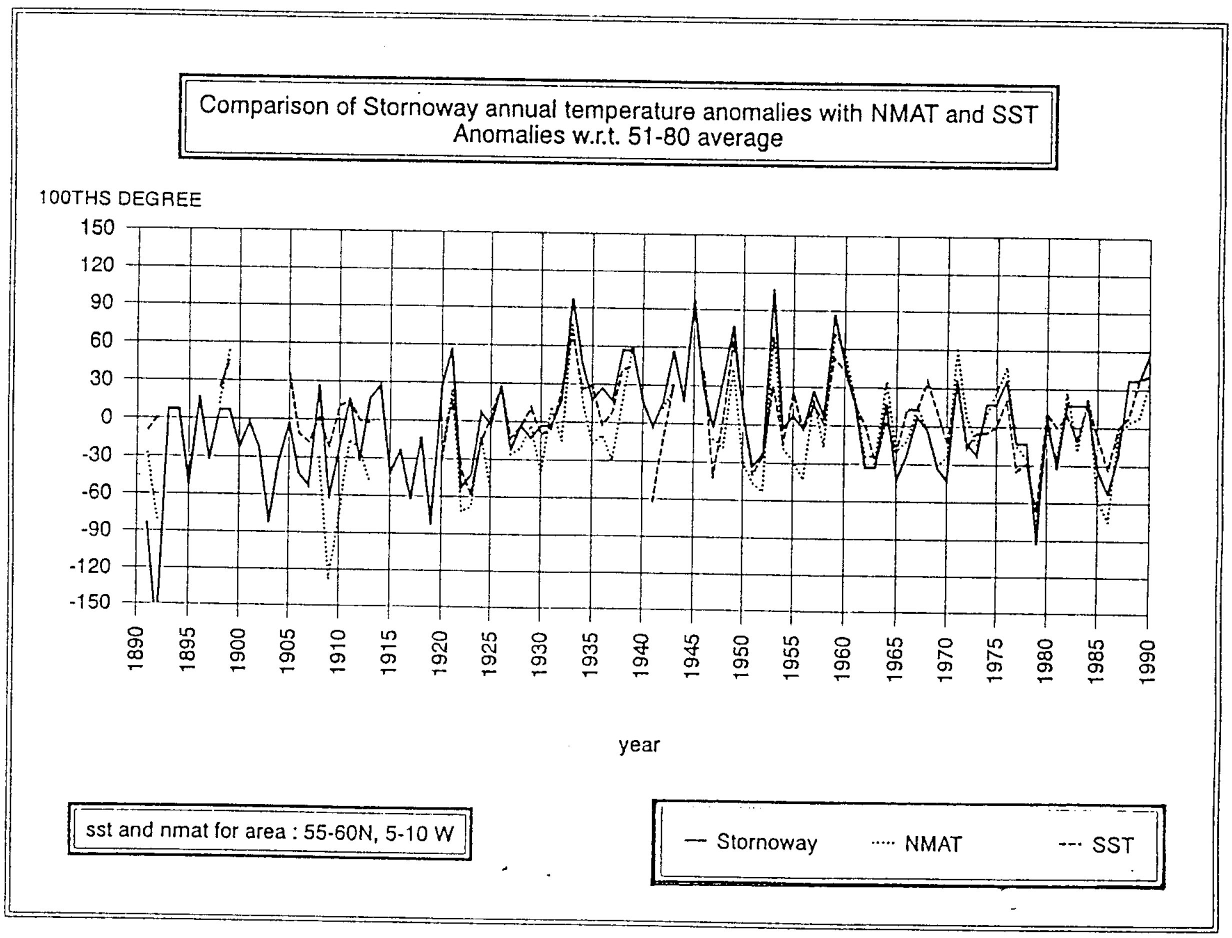

Figure 10 Comparison of Stornoway annual mean temperature with NMAT and SST for area 55-60 N, 5-10 W from the UKMO dataset (after Ashcroft, 1995).

Another way of validating the NACD is through intercomparison with gridded global datasets of e.g. air temperature from land stations. Moberg & Alexandersson, (in press) have performed a comparison between the CRU dataset (Jones & Briffa, 1992) and homogenous temperature series from 6 grid boxes over central Scandinavia. The results are shown in fig. 11.

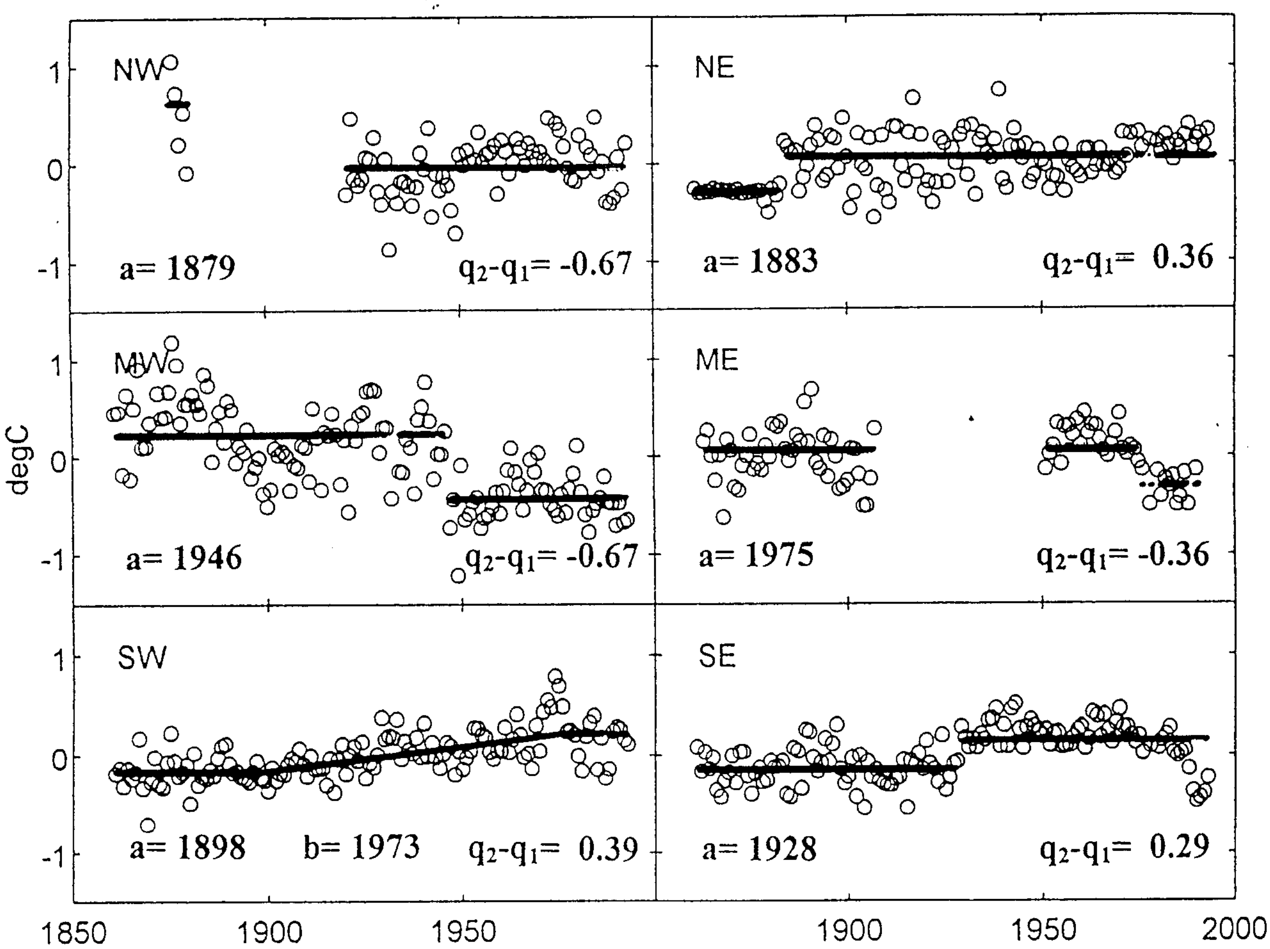

Figure 11 Comparison between gridded annual mean temperature from NACD stations and gridded mean temperature from the CRU dataset. (After Moberg & Alexandersson, in press).

The general findings of these two investigations were, that for larger regions (several gridboxes), the NACD and UKMO and CRU datasets were in good agreement, whereas major deviations were found for individual grid boxes. Nearly all the UKMO grid box temperature series have been colder than the closest NACD station temperature series over the most recent decade. This discrepancy remains unexplained. There is no doubt, that the homogenisation of temperature series accomplished through the present NACD project, will lead to considerable improvement of individual grid box series, wheras the overall effect on the various global temperature datasets is unknown.

5.0 Analysis of natural climate variations

A variety of studies on climate change related topics has been achieved within the NACD project during the past year (November 1994 to October 1995) as can be seen from the list of publications below. The main focus of the publication activities concern inhomogeneity influences and natural climate variations.

A few selected references will help to describe the wide scope of the NACD-publishing activities. It should however be recognized that some of the work was done prior to the commencement of the present project, and that a number of publications are still in preparation.

5.1 Air temperature

Concerning air temperature, a number of publications have appeared recently (e.g.Ashcroft, 1994, Frich (1994a-c), Nordli (1994), Nordli et al. (1994)). Generally these studies confirm and provide more details to the well-known picture of temperature variations in the NACD-area. Moberg & Alexandersson (in press) have analysed urban effects on the long (1759-now) instrumental temperature series from Stockholm, Sweden. They found that the urban effect on this series amounts to nearly 1 K, mainly taking place over the period 1860-1970.

Kaas & Frich (1995) have shown for selected Nordic stations, that the diurnal temperature range (DTR) has not changed significantly over the past 60 years. These observed trends were compared to a statistical projection of the future climate at the same stations, and it was concluded that a doubling of the CO^2 concentration in the next century could lead to a significant reduction in DTR in the continental parts of Scandinavia, whereas the western maritime parts of the North Atlantic region should not expect any significant changes in DTR.

Moberg & Alexandersson (in press) have analysed the temperature trends in 6 5x5 degrees grid boxes located over central Scandinavia since 1860. Generally, the annual mean temperature has increased 0.7-0.9 °C, calculated as the difference between two 30-year periods. The only exception is the NE gridbox situated over eastern Lapland, where a temperature increase of 0.5 °C was not significantly different from 0. The temperature increase has been most pronounced during spring (see table 3), and is well above the global average.

Table 3 Seasonal and annual trends in temperature (°C) over the period 1861 to 1993/94. Average of 6 5x5 degrees grid boxes over Scandinavia (After Moberg & Alexandersson, in press).

Winter	Spring	Summer	Autumn	Year
0.46	1.33	0.46	0.61	0.73

Heino (1994a) has analysed the climate of Finland over the period with instrumental observations. Temperature changes were in general agreement with the study cited above. Notable findings were, that the continentality gradient has increased over Finland, the timing of the peaks of both winter cold and summer warmth has shifted earlier in recent decades. Most other climatic elements studied did not show any significant changes.

The NACD temperature series are presently being analysed using principal component analysis (PCA). The final results will be presented by Hanssen-Bauer et al. (1995). The main analysis is based upon the covariance matrix from 58 NACD series of annual mean temperature during 1891-1990. The 58 stations are situated between 50 and 70 °N and between 25 °W and 25 °E. The 5 first principal components accounts for 95 % of the variance in the dataset. In the Irish series, 70-75 % of the variance is accounted for, while 98 % of the variance is accounted for in most of the Finnish series (fig. 12). The loadings of PC1 are at a maximum in eastern parts of the NACD area. PC2 has positive loadings in northern areas and negative loadings in southern areas. The loadings of PC3 are at maximum in western areas.

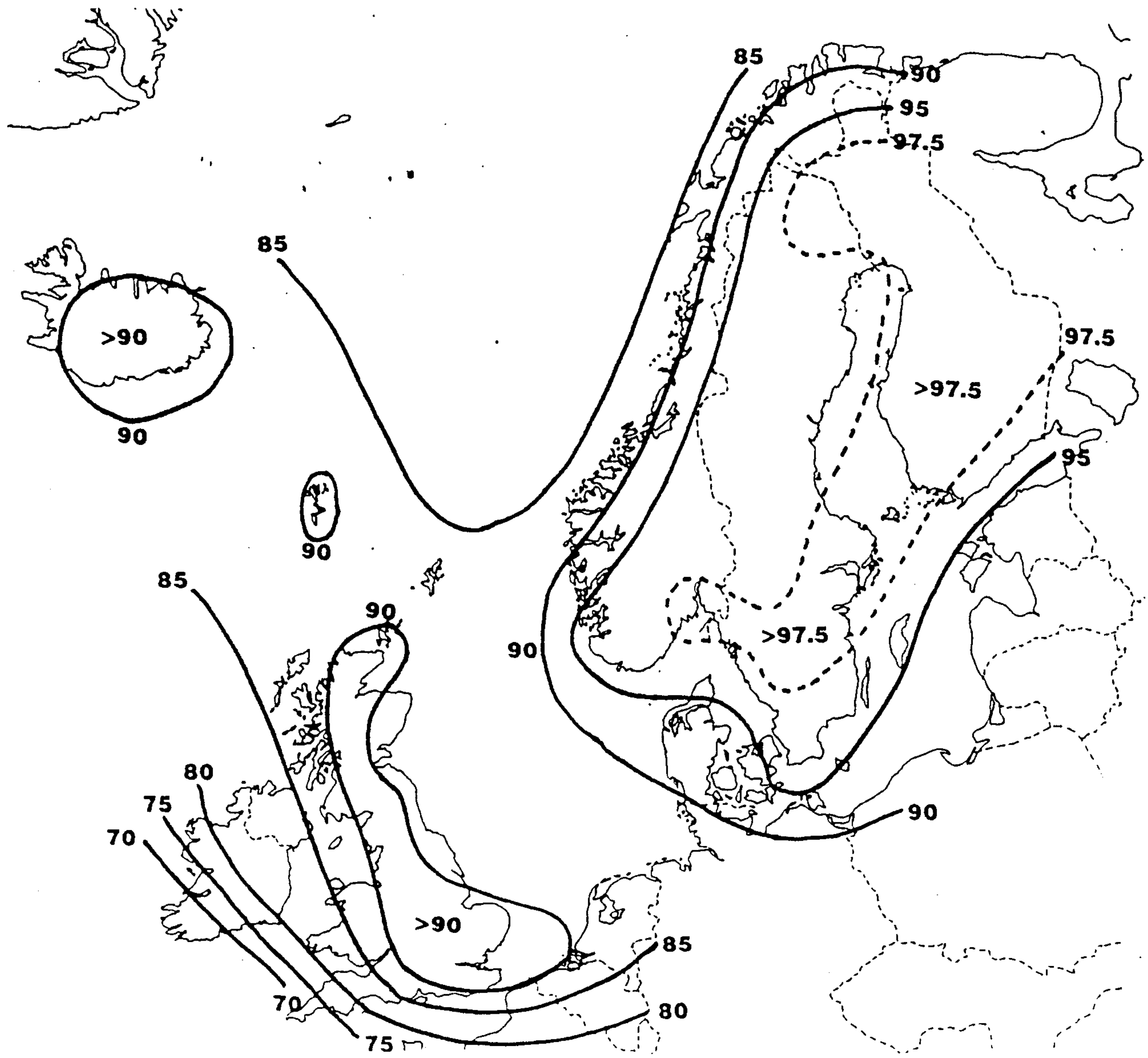

Figure 12 Percent of variance accounted for by the 5 first principal components resulting from a PCA of 58 series of annual mean temperature . (After Hanssen-Bauer et al. 1995).

The analysed area was divided into 6 temperature regions using simple criteria concerning the influence of PC1-PC3. The loadings and scores of PC1-PC5 were used in order to estimate temperature anomaly curves representative for these regions (fig. 13)

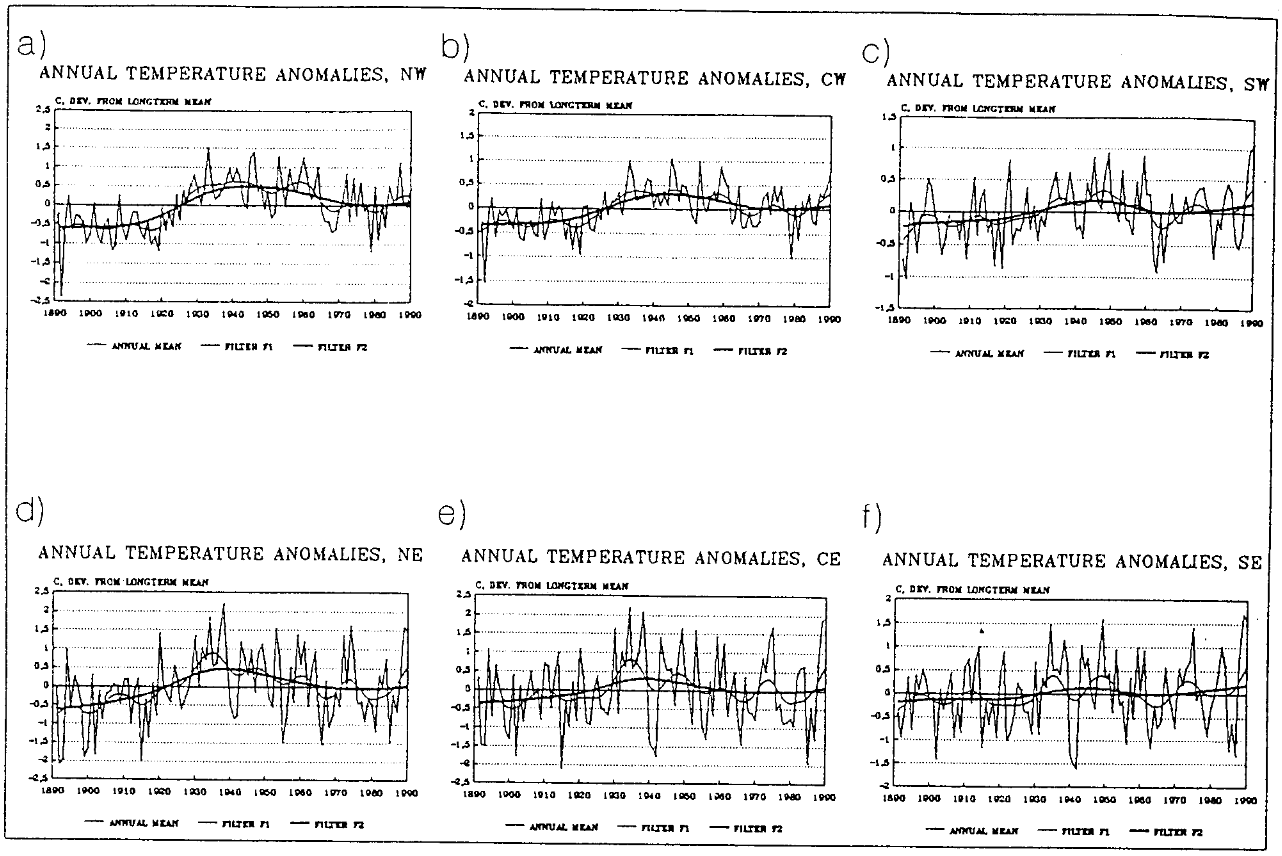

Figure 13 Series of annual temperature anomalies over the period 1891-1990, representative for a) northwesterly, b) central westerly c) southwesterly, d) northeasterly, e) central easterly and e) southeasterly parts of the analysed area. (After Hanssen-Bauer et al., 1995).

5.2 Air pressure

Pressure is in the long run the most conservative of the 5 elements presented in this version of the NACD. There are considerable year to year differences, even decadal variations, but variations of lower frequencies are usually subtle and difficult to detect. The analysis of the pressure dataset has barely begun. Homogeneity within the different countries seems to be reasonably good, but a detailed cross-border-comparison remains. In the northern and western part of the area such a comparison is a difficult task. The distances involved are so large that sub-hPa inconsistencies are only of minimal interest anyway.

The pressure dataset anlysed sofar consists of 46 series, 3 Norwegian arctic stations, 15 mainland Norwegian, 6 series from Sweden, 3 from Finland, Denmark and Scotland respectively, 1 from the Netherlands and the Faeroe Islands respectively, 5 from Iceland and 6 from Greenland. There are some gaps in many of the stations but the period 1950-1975 is almost complete. Before 1920 there are usually around 35 stations present, the total number during the 20's and 30's is over 40. There were some disruptions during the 2nd World War.
Because of the widely variable density of stations in space and time it can be very misleading to calculate the average pressure in the area by simply adding up and dividing by the total number of stations, but the result can nicely serve as a demonstration of the pressure behavior in the area. As seen in fig.14, there is no general trend in the mean January pressure. There are large January-

January differences, even in this large-area average. The great blocking episodes of the sixties, around 1940 and in 1929 are very much in evidence. The highest monthly pressure value in January is found in Helsinki in Finland, but the runner-up station is Stornoway and then Torshavn in the Faeroe Islands. Between 1963 and 1968 the January averages in the whole area only rarely go below 1000 hPa. It is of interest to point out that this is concurrent with the appearance of the "Great Salinity Anomaly" to the north of Iceland. This will be pursued in detail during further analysis of the dataset (Jónsson et al, in prep.). One must again point out the data scarcity in the arctic areas in the early part of the dataset and that one should beware of the dangers of overinterpretation when examining the figures.

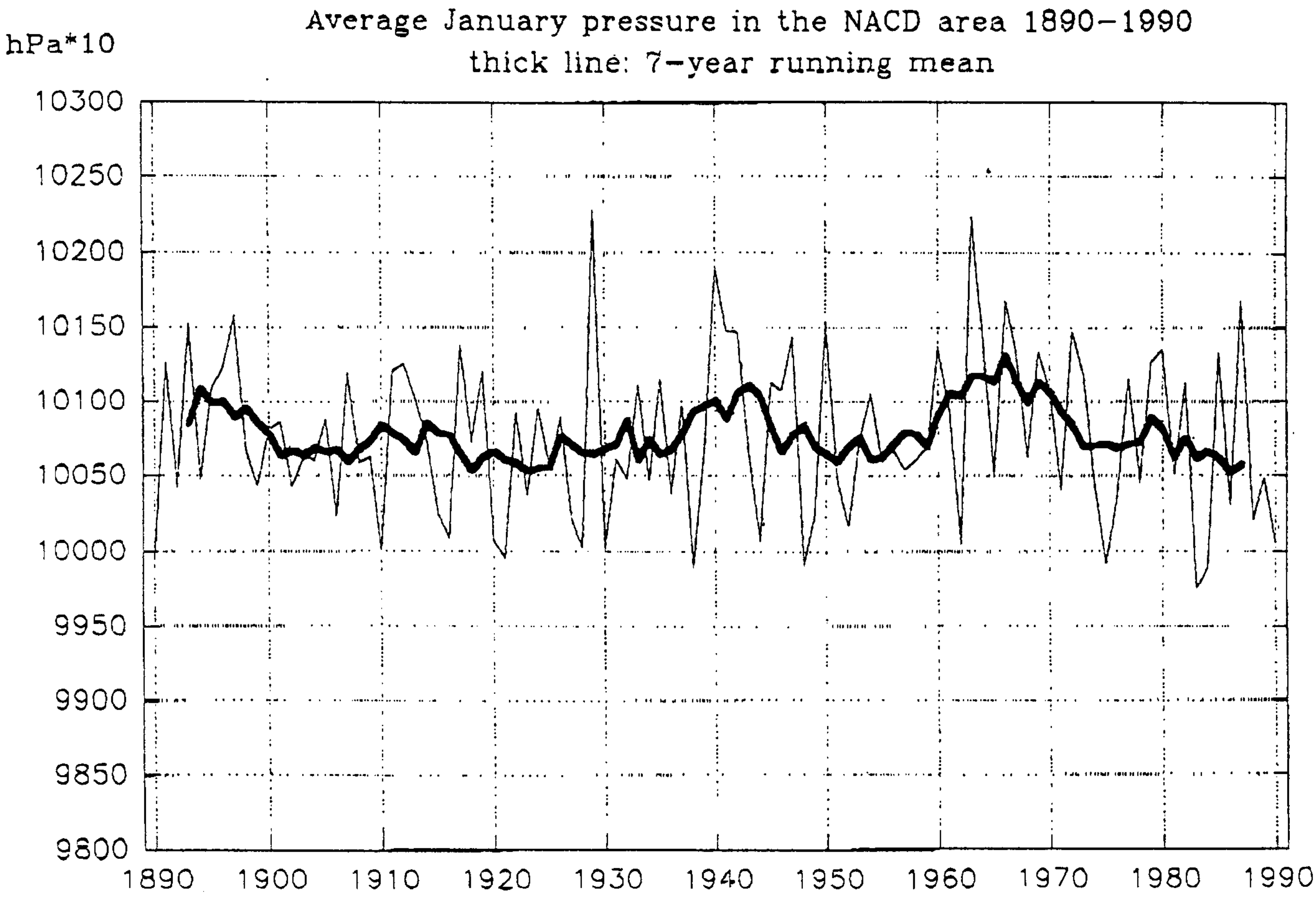

Figure 14 Average pressure in January 1890-1990. Simple mean of 48 stations. After Jónsson et al. (in prep.)

The trends at individual stations are subtle and should not be overemphasized. The pressure gradients between stations are consequently also subdued. An interesting exception can be seen in fig. 15, the annual pressure difference between Vardø in Northern Norway and Lerwick in the Shetland Islands. In the early part of the series the average pressure on annual basis is very similar at both locations, but later in the period the Vardø pressure is clearly higher than in Lerwick. This merits a much closer inspection.

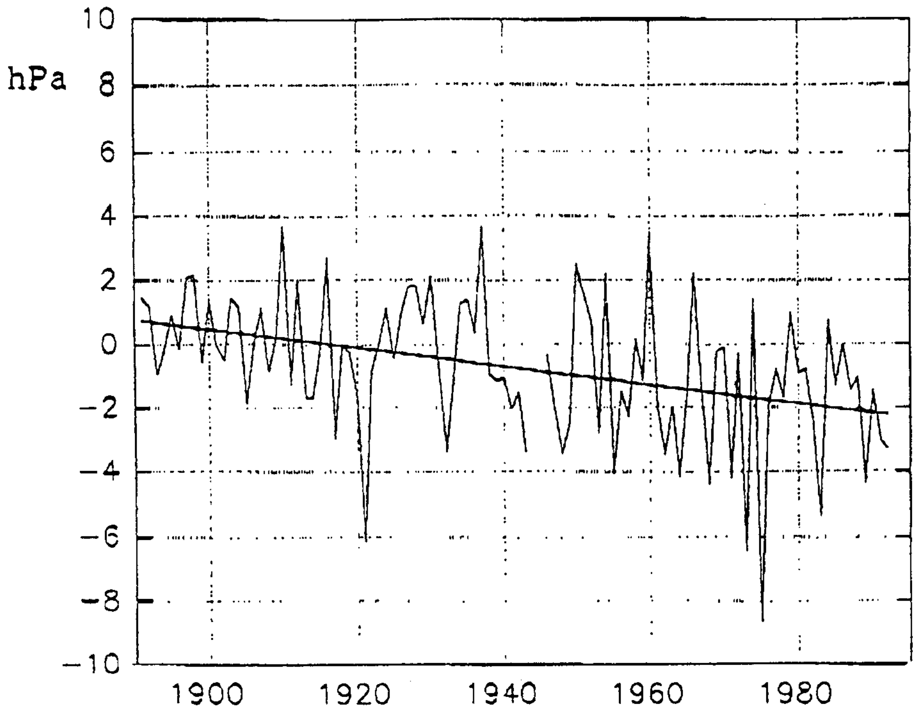

Figure 15 Pressure difference (annual means) between Vardø in Northern Norway and Lerwick on the Shetland Islands over the period 1890-1990. After Jónsson et al. (in prep.)

Other studies on air pressure include those of Alexandersson (1994a&b), Brandt & Schmith (1994), Mietus, (1994b, 1995), Schmith (1995). The general finding was that the pressure gradient over Northwestern Europe has remained stable over most of this century, although an increased gradient has been observed in the most recent decades over the Northeastern parts of the North Atlantic Ocean The pressure gradient has thus increased over Southwestern Norway, meaning an increase in wind speed and a larger advection of moist air masses from SSW. The strength of the zonal flow for March is illustrated in fig. 16.

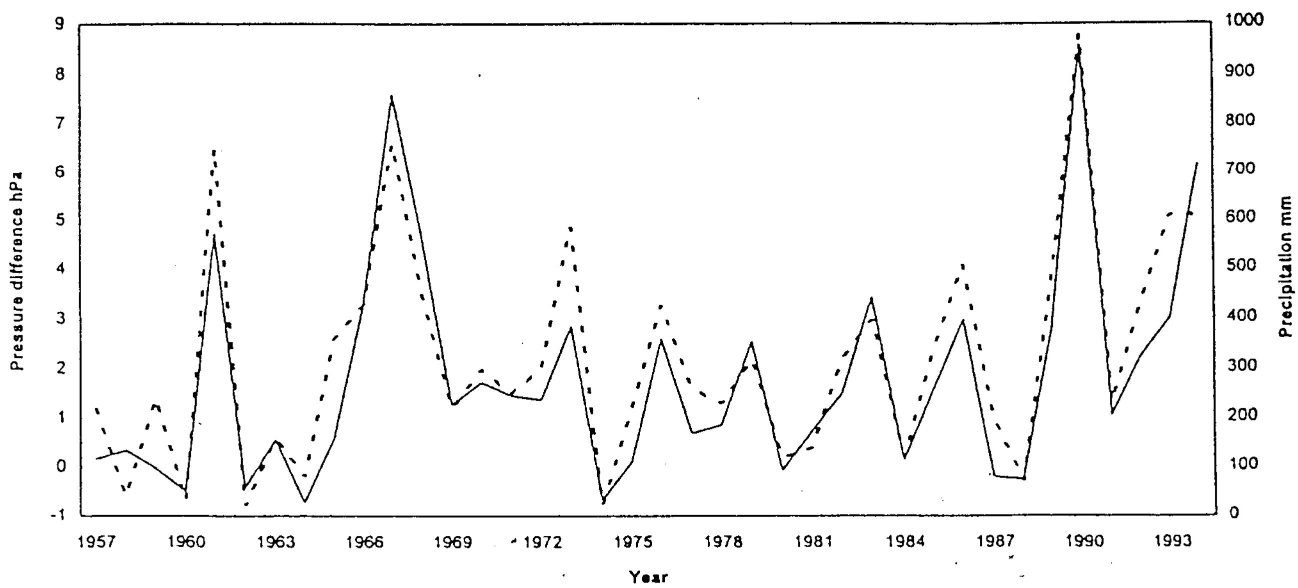

Figure 16 Covariation of zonal wind component and precipitation in March for the station Samnager, Western Norway 1957-1994. After Tveito et al., in prep.

5.3 Precipitation

The main part of the analytical work has dealt with changing trends in precipitation (Frich (1994d), Førland (1994a&b), Hanssen-Bauer (1994), Hanssen-Bauer & Førland (1994), Nordli et al. (1994)). A general picture emerges from these studies: Precipitation trends have been significantly positive especially during the winter half year around the periphery of the North Atlantic ocean, whereas the continental parts of Europe have experienced a stable - or during spring and summer even drier precipitation climate over the latest decades. These changes are illustrated in fig. 17.

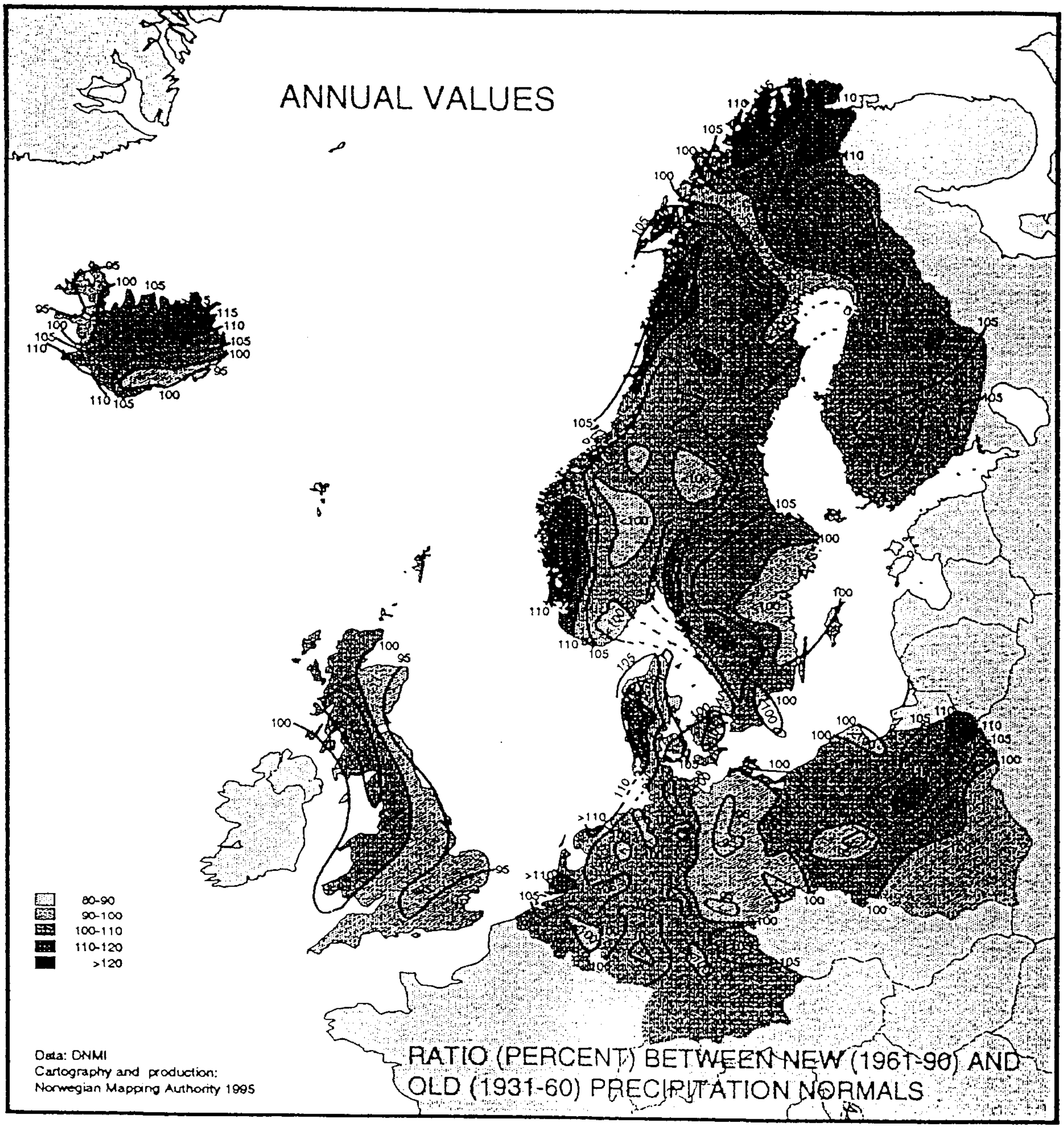

Figure 17 Changes in annual mean precipitation from 1931-60 to 1961-90. (Førland et al., 1995)

A pricipal component analysis of all NACD precipitation series has started, and preliminary results indicate that the patterns of change illustrated in fig. 17 represents a significant change in our precipitation climate.

5.4 Snow cover

The hemispheric or global studies of snow cover based on satellite data cover only the time period from 1972 onwards, eg. Groisman et al. (1994) and Robinson et al. (1993). Three studies have analysed variations of snow cover in NACD-area (Førland, 1994c; Heino, 1994a and Drebs et al., in prep.). Figure 18 shows the smoothed variations in the standardized snow cover. The areas with less snow show greater relative fluctuations than the northern areas. The recent decades show decrease of snow cover, as does also the satellite data. However, fluctuations of similar size have occured also earlier during this century.

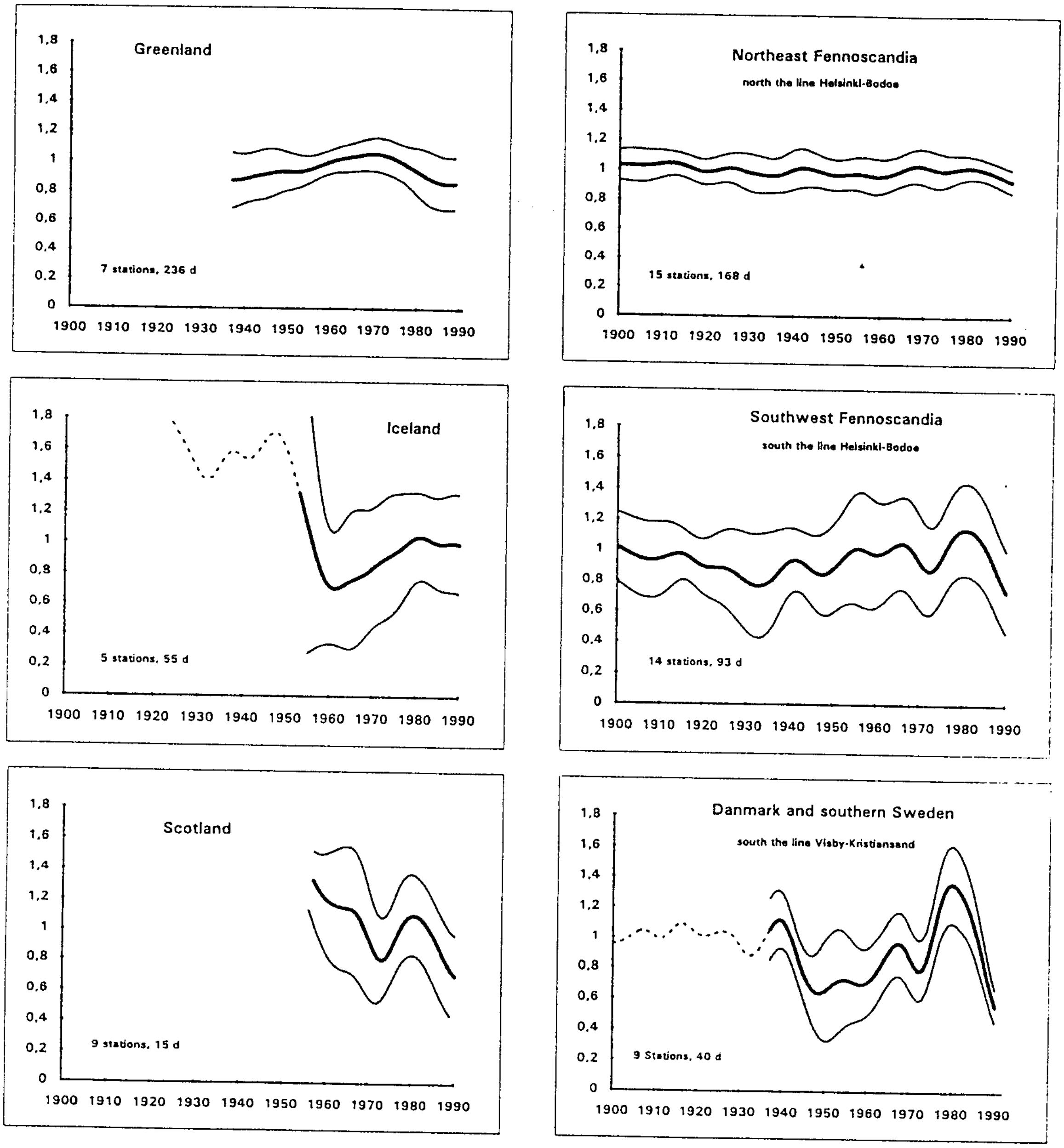

Figure 18 Smoothed time series of standardized snow cover duration. Standardization is done by dividing the series of twelve month (form July to June) number of snow cover days) by their respective 1961-90 average. The area mean normal value (in days) is given after the number of stations in the lower-left corner of each diagram. The mean curves are given with +/- one standard deviation (thin solid line). The mean curves of reduced number of stations are drawn with dashed line. Temporal smoothing was done with 3-sigma Gaussian filter.

5.5 Cloud cover

Studies of cloud cover trends have been reported by e.g. Kaas & Frich (1995), Frich (1994b&c), Jónsson (1994b) and Heino (1994c). The main conclusions are that the cloud cover over most of the North Atlantic region has increased during this century. A regional average of all 63 stations in NACD Version 1 over the period 1890-1990 is plotted in fig. 19.

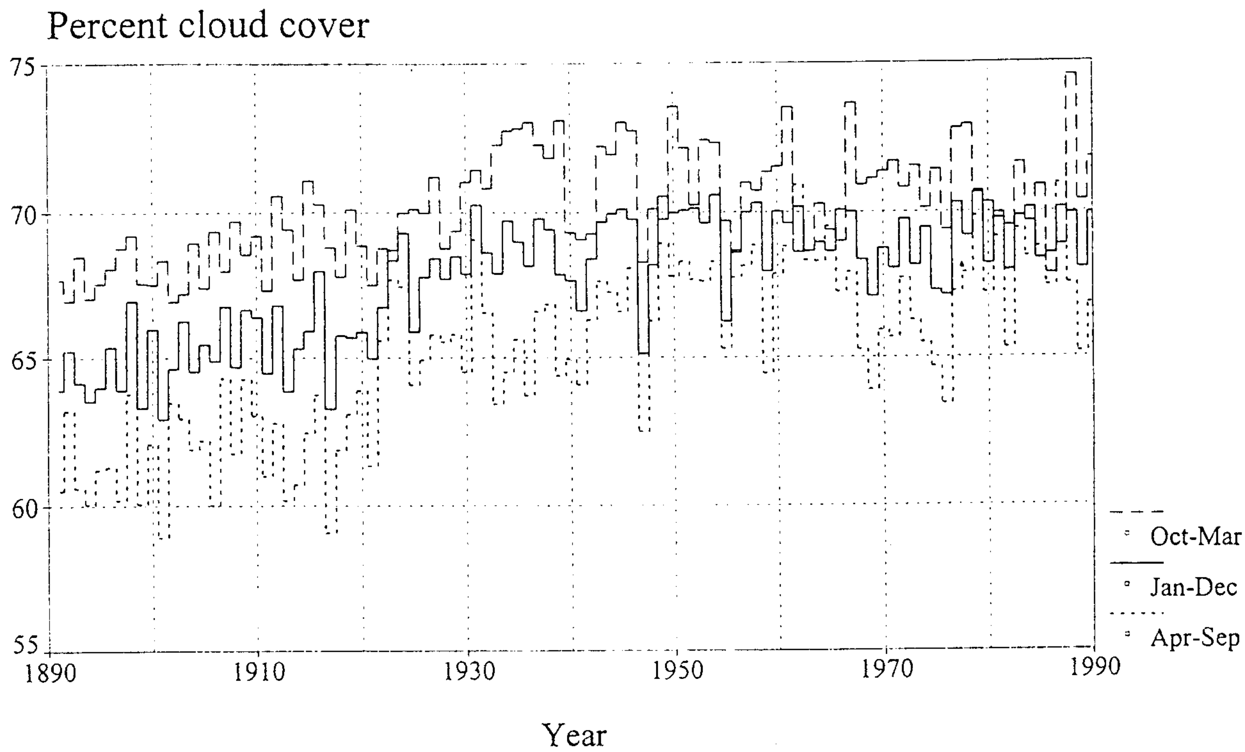

Figure 19 Annual and seasonal mean cloud cover over the period 1890-1990 for the whole NACD region. About 45 stations used 1890-1950 and about 60 stations used 1960-1990.(After Frich et al., in prep.)

All seasons show an apparent increasing trend in cloud cover over the period 1890 to 1990. A steady increase is observed during summer (JJA) of about 7 %, whereas the winter (DJF) increase is only about 3 %, mostly taking place during the 1920ies and 30ies. The decreasing standard deviation (not shown) over the past century could be real, but it is more likely reflecting the increasing number of observing stations, and the increasing spatial homogeneity of the time series included.

As most of the cloud cover series have not yet been homogeneity tested (status N, c.f. Appendix 2), these preliminary results may only have limited value. In order to validate the adjustments needed for change of observer bias, change of code bias, change of observation hour bias and change of spatial coverage bias, the adjusted cloud cover series will be compared with independently derived series of sunshine hours (c.f. Frich, 1994c). This task will require a considerable effort from the involved National Meteorological Services.

6.0 Future work

As stated in the introduction, a number of unforeseen results have emerged from the NACD project. One is the establishment of an informal European Climatic Data Consortium (ECDC). The other main results of this project, is the formulation of several new proposals, which will help to maintain the cooperation between the National Meteorological Services in Northern Europe. Some of the Nordic countries have obtained the economic support from their respective research councils at a very late stage of the project, which means that some results of the present project will be reported separately. There is however no doubt, that the NACD project has had a major impact already on the persons and institutions involved in the various work tasks. This impact will last for several years into the future.

As already mentioned, NACD represents the largets effort hitherto accomplished within the field of digitisation, homogenisation and analysis of a multi-elemental dataset in this part of the World. The methods and principles used for creating the dataset has been described in the present report. The following standards will be used by the National Meteorological Services in their future efforts to improve the quality of series included in NACD Version 1.

1) Standard station catalogue and data dictionary for monthly climatic data.
2) Standard exchange format for data and metadata.
3) Standard methods for homogeneity testing and adjustment of time series.

More than 100 reports and articles have already been published over the past few years as a result of this project. The following main findings with respect to climatic change in the NACD-area over the period 1890-1990 will be investigated further:

4) Temperature, cloud cover and precipitation has generally increased.
5) Pressure and snow cover has not changed significantly.
6) The observed changes are mainly restricted to the winter half year.

Several new findings may appear, when multi-elemental analysis of the whole dataset continues. The dataset has been, or will be used for a wide number of climate applications. Examples of the most obvious use of the dataset are:

7) Detection of climatic changes and attribution of these to anthropogenic causes.
8) Validation of other datasets and hindcasting of climatic elements not included.
9) Seasonal forecasting and climate predictions.
10) Statistical downscaling of future climatic changes.

Finally, it is foreseen that the results of this joint effort of the NACD-participants will have a major impact on future studies of the climate system in the Northern North Atlantic area. Ongoing, and future projects such as WASA, ADVICE, ACROSS, REWARD and CLIVAR will benefit considerably from the successfull international co-operation already demonstrated by the NACD-group.

6.1 European Climatic Data Consortium (ECDC)

The concept of a European Climatic Data Consortium (ECDC) was first introduced at the European Workshop on Climate Change in Majvik, Finland in May 1994 (Frich, 1994c) and reintroduced at the Vienna Workshop in February 1995. At both these meetings, a considerable number of European countries indicated their interest in the ECDC concept.

A number of initiatives have been taken both in Europe and world-wide over the past few years. The general purpose of these initiatives has been not only to collect more data, but to homogenise existing data and make it more easily available to the scientific community. The organisation of homogenised data series has so far not been discussed in a detailed manner.

One problem which faces us is of course that two or more versions of the original data series already exist in digital form in the various data centres around the World. The homogenisation procedure involves adjustments and corrections which should preferably relate to the original climatic data as it was first published in meteorological yearbooks. Quite often, the versions which already exist in Global or European data centres are based on other sources (e.g. World Weather Records, Monthly Climatic Data of the World and/or CLIMAT reports), or a mixture of these and other sources.

The ECDC has been set up as an INTERNET listserver ("The ECDC-switchboard") located at the Danish Meteorological Institute in Copenhagen.

The purpose of creating the ECDC-switchboard can be summarised as follows:

1. Communication of common standards
2. Requests for data and metadata.
3. Requests for co-authors to joint publications.
4. Invitations to seminars, workshops, meetings etc.
5. Distribution of electronic publications.
6. Distribution of homogeneous time series.

The ECDC-switchboard can be used by sending an E-mail to

ecdc@dmi.min.dk

The philosophy is that mail sent to the above address will be distributed to all of the registered users of the switchboard system. Presently there are 63 users from 28 countries, but several more people have indicated their interest and will register as users, once they have established E-mail addresses in their home countries. This will eventually raise the number of European countries to about 30. As the system is very open and flexible, it could in principle distribute E-mail to all countries in the World. In order to avoid too much irrelevant noise on the lines, it is also possible to define smaller user groups.

One such ECDC sub-group is well established, in order to make it easier for project members to communicate. This particular group of people are all contractors in the NACD project (EV5V CT93-0277). The members of the sub-group can be reached at:

ecdc.nacd@dmi.min.dk

Another sub-group has been set up after the International Conference on Past, Present and Future Climate in Helsinki, August 1995. This group consists of 17 persons interested in historical climatology and related proxydata. Contacts to only this sub-group can be made at:

ecdc.hist@dmi.min.dk

The ECDC-switchboard system makes use of already existing technology (INTERNET), and it is also independent of hard- and software at the respective national meteorological services (NMSs) and other data producing units.

At the moment, the standards of exchange of data are those of the NACD and therefore mainly valid for monthly values. The exchange of daily values and/or observations is however also possible in restricted quantities.

This system is not considered the ultimate goal of an integration of data into a real distributed database or a perfect Client/Server solution . However, this scheme is the most pragmatic solution at the moment to circumvent many of the controversial questions. It allows for the exchange of climatic data in a standard format between different systems of data storage.

One of the advantages of this present system is, that it allows a continued exchange of messages in clear text and data in standard ASCII-format. The system is flexible in two ways:

1) Data producers can send their data to all users at once with no restrictions on the use of data except proper references.

2) Data users can request data from all users at once and obtain data directly from the data producers according to individual bilateral agreements.

The advantage of such a system is, that updating, adjustment and homogenisation can continue at the data producing entity, and therefore data users will always get the newest version of the data. It is obvious, that the habit of homogenisation has come to stay, so for the time being, it is not adviceable to collect more data in any database before the heterogeneous series have been adjusted by the people in charge at each individual NMS or university.

It is envisaged that the ECDC could evolve into a dynamic data centre (i.e. a consortium or network of persons and institutions), which improves our ability to detect climatic changes when and if they occur. In the meantime, discussions should continue on how and when adjustments of climatic time series should be made. It is of special concern, how adjustments made by national meteorological services using all available metadata, should be communicated to the Global data centres. A kind of distributed database system could be a solution to this problem, and hopefully the ECDC-Listserver can demonstrate the advantages of a relatively simple, non-bureaucratic and inexpensive system.

It should be recognized that the ECDC-switchboard system will be used for both data and metadata exchange after the cessation of this project. The updating of the dataset has not been finally decided, as a number of administrative problems are still unsolved.

6.2 New projects

The following projects can be regarded as extensions of or complementary to the present project, and have obtained funding from the respective Environment Programmes of the European Commission and the Nordic Council of Ministers:

Acronym	Co-ordinator	Purpose
WASA	Hans von Storch/DKRZ	Analyse waves and storms in the Northeast Atlantic.
ADVICE	Trevor Davies/CRU	Analyse climatic variability in Europe.
REWARD	Eirik Førland/DNMI	Analyse relation between circulation and extremes.
ACROSS	Povl Frich/DMI	Analyse atmospheric and oceanic circulation.

All four projects are somehow inter-related, and the co-operative spirit from the NACD project will be continued, as will the exhange of know how and data.

7.0 Conclusions

The main result of this project has been the production of the first digital version of the North Atlantic Climatological Dataset (NACD Version 1), consisting of 388 individual time series of air temperature, air pressure, precipitation, days with snow cover and cloud cover. Preliminary analysis of the homogenised dataset has shown that air temperature, cloud cover and precipitation have increased, whereas air pressure and days with snow cover have remained basically unchanged over the period 1890-1990. Other main results can be summarised as:

1) The importance of homogenisation of climatic time series has been widely recognized.
2) Multi-element approach to climatic change studies has been generally accepted
3) Standard data dictionary for monthly climatic data has been defined.
4) Standard exchange format for monthly data has been implemented.
5) Standard metadata format for climatic time series has been suggested.
6) Co-ordination of climatic change studies on a wider European level has been initiated.
7) New techniques for detection of climatic change have been investigated.
8) Improved understanding of causal factors in climatic change studies has been achieved.
9) Several new proposals for future North Atlantic climate studies have been formulated.

This project has fully demonstrated the need for a homogenisation of the observational data, when time series for regional climate analysis is considered. The project has also demonstrated the extent of the required effort not only to digitise the data, but certainly also the effort that has been put into the project nationally - because of local language differences - to extract the metadata from the various sources. The various national contributions to this project should not be underestimated and it should be realized, that the successfull completion of this project has required considerable sacrifice from all persons and institutions involved.

More than 100 reports and articles have been published over the past few years, as a result of this project. It is concluded, that this project will have a lasting impact on the persons and institutions involved in the project. We modestly think, that this co-operative project has been a good example to the rest of Europe and other regions around the World, as a solution to the problem of detecting climatic change. The interest already shown by other researchers has been a constant encouragement throughout the project, and we think that both the selection of stations, time period and climatic elements will secure a wider use of this dataset.

A new interesting use of this dataset will be in the field of making seasonal climate outlooks for Northern Europe. A homogenous dataset is of crucial importance for a reliable statistical model, which can be used for planning socio-economic activities months and years ahead. One major obstacle to achieve this goal is the problem of updating this dataset.

We do however think that NACD Version 1 forms a solid basis for future work in this direction. But, even NACD Version 1, - despite the huge effort to construct a reliable dataset -, will have to be revised in the near future, as more data are digitised, homogeneity testing proceeds and more metadata appears from the national archives. We must therefore warn against collecting this dataset and other historical data in a central database on either European or Global level without recognizing, that the most adequate system is a distributed database, firmly based in each national meteorological service, which can secure the quality of observations, the homogeneity of time series and dissemination of results to the public.

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Appendix 2 NACD Version 1, Station Catalogue

The NACD station catalogue describes the most recent number, name,position, altitude and status of the station data in the NACD. It is assumed, that all stations are still operating. A copy of the station catalogue is enclosed on diskette # 1. All variables are separated by blanks. Missing station numbers: -9999. The station catalogue is sorted by element number, country code and national station number.

Position	Format	Variable
1-5	I5	Nat_no. = National number, any system
7-9	A3	Country = Country code (see description below)
11-15	I5	WMOno. = Official station number from WMO INFOCLIMA
17-36	A20	Name = Official name of station
38-44	I2+I2+A1	Latitude = Degrees and minutes N or S
46-53	I3+I2+A1	Longitude = Degrees and minutes E or W
55-58	I4	Altitude = Height above mean sea level in meters
60-63	I4	Start = Start year of station (any element)
65-67	I3	Element = Element no. from data dictionary
69-72	I4	Begin = First year of element in data file
74-74	A1	Status = Status of element in data file (see description below)

Status code	Description
H	Homogenous, rigourously tested and maybe adjusted
T	Tested, maybe adjusted but not perfectly homogenous
N	Not tested, but not necessarily inhomogenous
E	Environmental changes prevents climatic change studies
I	Inhomogenous series which is presently unadjustable

Country code	Country
B	Belgium
DK	Denmark
FIN	Finland
FR	Faroe Islands
G	Greenland
GB	Great Britain
IRL	Ireland
IS	Iceland
N	Norway
NL	Netherlands
S	Sweden

Nat_no	Country	WMOno.	Name	Lat.	Long.	Alt.	Start	Element	Begin	Status
I5	A3	I5	A20	I2+I2+A1	I3+I2+A1	I4	I4	I3	I4	A1
6447	B	6447	UCCLE	50 48 N	4 21 E	100	1833	101	1890	H
6193	DK	6193	HAMMERODDE FYR	55 18 N	14 47 E	11	1853	101	1890	H
21100	DK	-9999	VESTERVIG	56 46 N	8 19 E	18	1873	101	1890	H
25140	DK	-9999	NORDBY	55 26 N	8 24 E	5	1872	101	1890	H
27080	DK	-9999	TRANEBJERG	55 51 N	10 36 E	11	1838	101	1890	H
30380	DK	6186	KOEBENHAVN	55 41 N	12 32 E	9	1751	101	1890	E
304	FIN	2978	HELSINKI	60 10 N	24 57 E	4	1829	101	1890	E
1101	FIN	2972	TURKU	60 31 N	22 16 E	51	1873	101	1890	H
1202	FIN	-9999	TAMPERE	61 28 N	23 44 E	85	1873	101	1890	T
1701	FIN	2958	LAPPEENRANTA	61 5 N	28 9 E	105	1886	101	1890	T
2425	FIN	-9999	JYVASKYLA	62 12 N	25 43 E	137	1883	101	1890	H
3602	FIN	-9999	KUOPIO	62 54 N	27 41 E	119	1846	101	1890	T
4601	FIN	2897	KAJAANI	64 17 N	27 40 E	132	1846	101	1890	H
5404	FIN	-9999	OULU	65 2 N	25 29 E	13	1846	101	1890	T
6801	FIN	2896	KUUSAMO	65 59 N	29 13 E	263	1908	101	1908	H
7501	FIN	2836	SODANKYLA	67 22 N	26 39 E	179.	1891	101	1908	H
6011	FR	6011	TORSHAVN	62 1 N	6 46 W	43	1873	101	1890	H
4210	G	4210	UPERNAVIK	72 47 N	56 10 W	63	1873	101	1890	T
4216	G	4216	JAKOBSHAVN	69 13 N	51 3 W	39	1866	101	1890	T
4250	G	4250	GODTHAAB	64 10 N	51 45 W	50	1866	101	1890	T
4270	G	4270	IVIGTUT/NARSARSUAQ	61 12 N	48 10 W	30	1866	101	1890	T
4320	G	4320	DANMARKSHAVN	76 46 N	18 46 W	11	1949	101	1949	H
4339	G	4339	SCORESBYSUND	70 29 N	22 0 W	65	1924	101	1924	T
4360	G	4360	AMMASALIK	65 36 N	37 38 W	50	1895	101	1895	T
44	GB	3005	LERWICK	60 8 N	1 11 W	82	1856	101	1890	H
154	GB	3017	KIRKWALL	58 57 N	2 54 W	26	1857	101	1890	H
293	GB	3075	WICK	58 27 N	3 5 W	36	1869	101	1890	H
425	GB	3026	STORNOWAY	58 13 N	6 19 W	15	1856	101	1890	T
1215	GB	-9999	BRAEMAR	57 0 N	3 24 W	339	1856	101	1890	T
1646	GB	-9999	EDINBURGH	55 55 N	3 11 W	134	1770	101	1890	H
6641	GB	-9999	DUMFRIES	55 4 N	3 36 W	49	1856	101	1890	T
3952	IRL	3952	ROCHES POINT	51 48 N	8 15 W	40	1876	101	1890	T
3953	IRL	3953	VALENTIA OBS.	51 56 N	10 15 W	9	1892	101	1893	T
3965	IRL	3965	BIRR	53 5 N	7 53 W	70	1873	101	1890	T
3968	IRL	3968	PHOENIX PARK	53 22 N	6 19 W	39	1850	101	1890	T
3975	IRL	3975	MARKREE CASTLE	54 8 N	8 28 W	49	1875	101	1890	T
3980	IRL	3980	MALIN HEAD	55 22 N	7 20 W	20	1885	101	1890	T
4013	IS	4013	STYKKISHOLMUR	65 5 N	22 44 W	8	1845	101	1890	H
4030	IS	4030	REYKJAVIK	64 8 N	21 54 W	52	1823	101	1890	E
4048	IS	4048	VESTMANNAEYJAR	63 24 N	20 17 W	118	1877	101	1890	H
4063	IS	4063	AKUREYRI	65 41 N	18 5 W	23	1882	101	1890	H
4065	IS	4065	GRIMSEY	66 32 N	18 1 W	32	1874	101	1890	H
4092	IS	4092	TEIGARHORN	64 18 N	15 12 W	14	1872	101	1890	H
1001	N	1001	JAN MAYEN	70 56 N	8 40 W	10	1921	101	1921	N
1008	N	1008	SVALBARD LUFTHAVN	78 15 N	15 28 E	28	1911	101	1911	T
1026	N	1026	TROMSOE	69 39 N	18 56 E	100	1867	101	1890	T
1028	N	1028	BJOERNOEYA	74 31 N	19 1 E	16	1910	101	1920	H
1065	N	1065	KARASJOK	69 28 N	25 31 E	129	1877	101	1890	H
1098	N	1098	VARDOE	70 22 N	31 5 E	14	1867	101	1890	H
1100	N	1100	SHIP "M"	66 0 N	2 0 E	0	1948	101	1948	N
1153	N	1153	GLOMFJORD	66 49 N	13 59 E	39	1867	101	1890	T
1212	N	1212	ONA	62 52 N	6 32 E	13	1868	101	1890	T
1235	N	1235	KJOEREMSGRENDI/DOMB.	62 6 N	9 3 E	626	1864	101	1890	H
1271	N	1271	VAERNES/TONDHEIM	63 28 N	10 56 E	12	1761	101	1890	I
1316	N	1316	BERGEN-FREDRIKSBERG	60 24 N	5 19 E	41	1861	101	1890	E
1355	N	1355	LAERDAL	61 4 N	7 31 E	36	1869	101	1890	T

1372	N	1372	NESBYEN	60	34	N	9	7	E	167	1895	101	1897 T
1403	N	1403	UTSIRA FYR	59	18	N	4	53	E	55	1867	101	1890 H
1448	N	1448	OKSOEY FYR	58	4	N	8	3	E	9	1869	101	1890 H
1482	N	1482	FERDER FYR	59	2	N	10	32	E	6	1885	101	1890 H
1492	N	1492	OSLO-BLINDERN	59	57	N	10	43	E	94	1837	101	1890 E
6235	NL	6235	DE KOOY	52	55	N	4	47	E	0	1906	101	1906 H
6260	NL	6260	DE BILT	52	6	N	5	11	E	2	1706	101	1890 H
6280	NL	6280	EELDE	53	8	N	6	35	E	4	1906	101	1906 H
6310	NL	6310	VLISSINGEN	51	27	N	3	36	E	8	1855	101	1931 H
6380	NL	6380	MAASTRICHT	50	55	N	5	47	E	114	1906	101	1906 H
5223	S	2616	FALSTERBO	55	23	N	12	49	E	5	1880	101	1890 H
6240	S	-9999	HALMSTAD	56	40	N	12	55	E	25	1860	101	1890 E
6452	S	2640	VAEXJOE	56	52	N	14	48	E	166	1860	101	1890 T
6641	S	2672	KALMAR	56	43	N	16	17	E	15	1860	101	1890 T
6855	S	2680	HOBURG	56	55	N	18	8	E	38	1880	101	1890 T
7138	S	2516	VINGA	57	38	N	11	36	E	19	1880	101	1890 H
7243	S	2512	GOETEBORG	57	46	N	11	53	E	20	1860	101	1890 T
7245	S	-9999	BORAAS	57	46	N	12	56	E	135	1884	101	1890 T
7722	S	2592	OELANDS NORRA UDDE	57	22	N	17	6	E	4	1854	101	1890 H
7839	S	2590	VISBY	57	40	N	18	20	E	42	1860	101	1890 H
8745	S	2582	LANDSORT	58	44	N	17	52	E	13	1879	101	1890 H
8924	S	2584	GOTSKA SANDOEN	58	23	N	19	11	E	12	1880	101	1890 T
9322	S	2418	KARLSTAD	59	21	N	13	28	E	46	1859	101	1890 T
9752	S	2462	UPPSALA	59	51	N	17	37	E	13	1722	101	1890 T
9821	S	2485	STOCKHOLM	59	20	N	18	3	E	44	1756	101	1890 T
9927	S	2496	SVENSKA HOEGARNA	59	26	N	19	30	E	12	1879	101	1890 T
10537	S	2433	FALUN	60	37	N	15	37	E	160	1860	101	1890 T
12402	S	2324	SVEG	62	1	N	14	21	E	360	1875	101	1890 T
12738	S	-9999	HAERNOESAND	62	37	N	17	56	E	8	1859	101	1890 T
13411	S	2226	OESTERSUND	63	11	N	14	29	E	376	1860	101	1890 T
14036	S	2288	HOLMOEGADD	63	35	N	20	45	E	6	1854	101	1890 H
15591	S	2104	TAERNABY/HEMAVAN	65	49	N	15	5	E	475	1885	101	1901 T
15772	S	-9999	STENSELE	65	4	N	17	9	E	325	1861	101	1890 H
16179	S	-9999	PITEAA	65	19	N	21	29	E	6	1860	101	1890 T
16395	S	2196	HAPARANDA	65	49	N	24	8	E	5	1860	101	1890 T
16798	S	2120	KVIKKJOKK	66	57	N	17	44	E	337	1886	101	1890 T
16988	S	2142	JOKKMOKK	66	37	N	19	38	E	260	1860	101	1890 T
18880	S	-9999	ABISKO	68	21	N	18	49	E	388	1913	101	1913 H
19283	S	2080	KARESUANDO	68	26	N	22	29	E	327	1879	101	1890 T
6447	B	6447	UCCLE	50	48	N	4	21	E	100	1833	401	1890 H
6193	DK	6193	HAMMERODDE FYR	55	18	N	14	47	E	11	1853	401	1890 H
21100	DK	-9999	VESTERVIG	56	46	N	8	19	E	18	1873	401	1890 H
25140	DK	-9999	NORDBY	55	26	N	8	24	E	5	1872	401	1890 H
304	FIN	2978	HELSINKI	60	10	N	24	57	E	4	1829	401	1890 N
5404	FIN	-9999	OULU	65	2	N	25	29	E	13	1846	401	1890 N
7501	FIN	2836	SODANKYLA	67	22	N	26	39	E	179	1891	401	1908 N
6011	FR	6011	TORSHAVN	62	1	N	6	46	W	43	1873	401	1890 H
4210	G	4210	UPERNAVIK	72	47	N	56	10	W	63	1873	401	1890 T
4216	G	4216	JAKOBSHAVN	69	13	N	51	3	W	39	1866	401	1890 T
4250	G	4250	GODTHAAB	64	10	N	51	45	W	50	1866	401	1890 T
4270	G	4270	IVIGTUT/NARSARSUAQ	61	12	N	48	10	W	30	1866	401	1890 T
4320	G	4320	DANMARKSHAVN	76	46	N	18	46	W	11	1949	401	1949 T
4339	G	4339	SCORESBYSUND	70	29	N	22	0	W	65	1924	401	1924 T
4360	G	4360	AMMASALIK	65	36	N	37	38	W	50	1895	401	1895 T
44	GB	3005	LERWICK	60	8	N	1	11	W	82	1856	401	1890 H
293	GB	3075	WICK	58	27	N	3	5	W	36	1869	401	1890 H
425	GB	3026	STORNOWAY	58	13	N	6	19	W	15	1856	401	1890 H
3953	IRL	3953	VALENTIA OBS.	51	56	N	10	15	W	9	1892	401	1892 T
4013	IS	4013	STYKKISHOLMUR	65	5	N	22	44	W	8	1845	401	1890 H
4030	IS	4030	REYKJAVIK	64	8	N	21	54	W	52	1823	401	1890 H

4048	IS	4048	VESTMANNAEYJAR	63	24	N	20	17	W	118	1877	401	1890	H
4063	IS	4063	AKUREYRI	65	41	N	18	5	W	23	1882	401	1890	H
4092	IS	4092	TEIGARHORN	64	18	N	15	12	W	14	1872	401	1890	H
1001	N	1001	JAN MAYEN	70	56	N	8	40	W	10	1921	401	1921	H
1008	N	1008	SVALBARD LUFTHAVN	78	15	N	15	28	E	28	1911	401	1934	T
1026	N	1026	TROMSOE	69	39	N	18	56	E	100	1867	401	1890	H
1028	N	1028	BJOERNOEYA	74	31	N	19	1	E	16	1910	401	1920	H
1065	N	1065	KARASJOK	69	28	N	25	31	E	129	1877	401	1890	T
1098	N	1098	VARDOE	70	22	N	31	5	E	14	1867	401	1890	T
1100	N	1100	SHIP "M"	66	0	N	2	0	E	0	1948	401	1949	H
1152	N	1152	BODOE	67	16	N	14	26	E	11	1867	401	1890	H
1212	N	1212	ONA	62	52	N	6	32	E	13	1868	401	1926	H
1235	N	1235	KJOEREMSGRENDI/DOMB.	62	6	N	9	3	E	626	1864	401	1890	T
1271	N	1271	VAERNES/TONDHEIM	63	28	N	10	56	E	12	1761	401	1890	T
1316	N	1316	BERGEN-FLORIDA	60	23	N	5	20	E	12	1861	401	1890	I
1355	N	1355	LAERDAL	61	4	N	7	31	E	36	1869	401	1890	T
1403	N	1403	UTSIRA FYR	59	18	N	4	53	E	55	1867	401	1921	H
1448	N	1448	OKSOEY FYR	58	4	N	8	3	E	9	1869	401	1890	H
1482	N	1482	FERDER FYR	59	2	N	10	32	E	6	1885	401	1890	T
1492	N	1492	OSLO-BLINDERN	59	57	N	10	43	E	94	1837	401	1890	T
6235	NL	6235	DE KOOY	52	55	N	4	47	E	0	1906	401	1906	H
6260	NL	6260	DE BILT	52	6	N	5	11	E	2	1706	401	1902	H
6280	NL	6280	EELDE	53	8	N	6	35	E	4	1906	401	1906	H
6310	NL	6310	VLISSINGEN	51	27	N	3	36	E	8	1855	401	1906	H
6380	NL	6380	MAASTRICHT	50	55	N	5	47	E	114	1906	401	1906	H
6641	S	2672	KALMAR	56	43	N	16	17	E	15	1860	401	1890	T
7243	S	2512	GOETEBORG	57	46	N	11	53	E	20	1860	401	1890	T
7839	S	2590	VISBY	57	40	N	18	20	E	42	1860	401	1890	T
9752	S	2462	UPPSALA	59	51	N	17	37	E	13	1722	401	1890	T
12738	S	-9999	HAERNOESAND	62	37	N	17	56	E	8	1859	401	1890	T
16395	S	2196	HAPARANDA	65	49	N	24	8	E	5	1860	401	1890	T
791	B	-9999	SINT-ANDRIES-BRUGGE	51	10	N	3	10	E	11	1880	601	1890	H
1591	B	-9999	ATH/CHIEVRES	50	38	N	3	47	E	32	1883	601	1890	H
2491	B	-9999	LEOPOLDSBURG/KOERSEL	51	6	N	5	16	E	48	1880	601	1890	H
2992	B	-9999	GEMBLOUX/ERNAGE	50	34	N	4	40	E	160	1880	601	1890	H
4691	B	-9999	MAREDSOUS/METTET	50	17	N	4	46	E	222	1882	601	1890	H
5391	B	-9999	ROCHEFORT	50	11	N	5	13	E	193	1880	601	1890	H
5491	B	-9999	THIMISTER	50	39	N	5	52	E	266	1882	601	1890	H
6091	B	-9999	STAVELOT	50	24	N	5	55	E	297	1880	601	1890	H
6191	B	-9999	HIVES	50	9	N	5	35	E	398	1882	601	1890	H
6391	B	-9999	CHIMAY	49	59	N	4	21	E	318	1880	601	1890	H
6447	B	6447	UCCLE	50	48	N	4	21	E	100	1833	601	1890	H
6791	B	-9999	CHINY/LACUISINE	49	44	N	5	21	E	374	1882	601	1890	H
6193	DK	6193	HAMMERODDE FYR	55	18	N	14	47	E	11	1853	601	1890	H
21100	DK	-9999	VESTERVIG	56	46	N	8	19	E	18	1873	601	1890	H
25140	DK	-9999	NORDBY	55	26	N	8	24	E	5	1872	601	1890	H
27080	DK	-9999	TRANEBJERG	55	51	N	10	36	E	11	1838	601	1890	H
30380	DK	6186	KOEBENHAVN	55	41	N	12	32	E	9	1751	601	1890	H
304	FIN	2978	HELSINKI	60	10	N	24	57	E	4	1829	601	1890	E
1101	FIN	2972	TURKU	60	31	N	22	16	E	51	1873	601	1909	H
1202	FIN	-9999	TAMPERE	61	28	N	23	44	E	85	1873	601	1890	T
1701	FIN	2958	LAPPEENRANTA	61	5	N	28	9	E	105	1886	601	1890	T
2425	FIN	-9999	JYVASKYLA	62	12	N	25	43	E	137	1883	601	1890	T
3602	FIN	-9999	KUOPIO	62	54	N	27	41	E	119	1846	601	1890	T
4601	FIN	2897	KAJAANI	64	17	N	27	40	E	132	1846	601	1890	T
5404	FIN	-9999	OULU	65	2	N	25	29	E	13	1846	601	1890	T
6801	FIN	2896	KUUSAMO	65	59	N	29	13	E	263	1908	601	1908	H
7501	FIN	2836	SODANKYLA	67	22	N	26	39	E	179	1891	601	1908	H
6011	FR	6011	TORSHAVN	62	1	N	6	46	W	43	1873	601	1890	T
4210	G	4210	UPERNAVIK	72	47	N	56	10	W	63	1873	601	1890	N

4216	G	4216	JAKOBSHAVN	69	13	N	51	3	W	39	1866	601	1890	N
4250	G	4250	GODTHAAB	64	10	N	51	45	W	50	1866	601	1890	N
4270	G	4270	IVIGTUT/NARSARSUAQ	61	12	N	48	10	W	30	1866	601	1890	N
4320	G	4320	DANMARKSHAVN	76	46	N	18	46	W	11	1949	601	1949	N
4339	G	4339	SCORESBYSUND	70	29	N	22	0	W	65	1924	601	1924	N
4360	G	4360	AMMASALIK	65	36	N	37	38	W	50	1895	601	1895	N
44	GB	3005	LERWICK	60	8	N	1	11	W	82	1856	601	1890	H
154	GB	3017	KIRKWALL	58	57	N	2	54	W	26	1857	601	1950	H
293	GB	3075	WICK	58	27	N	3	5	W	36	1869	601	1890	H
425	GB	3026	STORNOWAY	58	13	N	6	19	W	15	1856	601	1890	H
1215	GB	-9999	BRAEMAR	57	0	N	3	24	W	339	1856	601	1890	H
1646	GB	-9999	EDINBURGH	55	55	N	3	11	W	134	1770	601	1890	H
6641	GB	-9999	DUMFRIES	55	4	N	3	36	W	49	1856	601	1890	H
3952	IRL	3952	ROCHES POINT	51	48	N	8	15	W	40	1876	601	1890	N
3965	IRL	3965	BIRR	53	5	N	7	53	W	70	1873	601	1890	N
3968	IRL	3968	PHOENIX PARK	53	22	N	6	19	W	39	1850	601	1890	N
3975	IRL	3975	MARKREE CASTLE	54	8	N	8	28	W	49	1875	601	1890	N
3980	IRL	3980	MALIN HEAD	55	22	N	7	20	W	20	1885	601	1890	N
4013	IS	4013	STYKKISHOLMUR	65	5	N	22	44	W	8	1845	601	1890	T
4030	IS	4030	REYKJAVIK	64	8	N	21	54	W	52	1823	601	1920	T
4048	IS	4048	VESTMANNAEYJAR	63	24	N	20	17	W	118	1877	601	1890	T
4063	IS	4063	AKUREYRI	65	41	N	18	5	W	23	1882	601	1928	T
4092	IS	4092	TEIGARHORN	64	18	N	15	12	W	14	1872	601	1890	T
1001	N	1001	JAN MAYEN	70	56	N	8	40	W	10	1921	601	1921	N
1008	N	1008	SVALBARD LUFTHAVN	78	15	N	15	28	E	28	1911	601	1975	N
1026	N	1026	TROMSOE	69	39	N	18	56	E	100	1867	601	1895	N
1028	N	1028	BJOERNOEYA	74	31	N	19	1	E	16	1910	601	1920	N
1065	N	1065	KARASJOK	69	28	N	25	31	E	129	1877	601	1895	H
1099	N	-9999	BJOERNSUND	69	27	N	30	4	E	28	1895	601	1895	H
1153	N	-9999	KRAAKMO	67	48	N	15	59	E	76	1895	601	1895	H
1213	N	-9999	OERSKOG	62	29	N	6	49	E	4	1898	601	1898	H
1236	N	-9999	SKJAAK	61	54	N	8	10	E	432	1895	601	1895	H
1272	N	-9999	LIEN I SELBU	63	13	N	11	7	E	255	1895	601	1895	H
1317	N	1317	BERGEN-FLORIDA	60	23	N	5	20	E	12	1861	601	1895	T
1356	N	-9999	VETTI	61	0	N	7	1	E	329	1895	601	1895	H
1373	N	-9999	REINLI	60	50	N	9	30	E	628	1895	601	1895	H
1404	N	-9999	NEDSTRAND	59	21	N	5	48	E	10	1895	601	1895	H
1449	N	-9999	MESTAD	58	13	N	7	54	E	151	1900	601	1900	H
1483	N	-9999	HALDEN	59	7	N	11	23	E	8	1872	601	1895	H
1492	N	1492	OSLO-BLINDERN	59	57	N	10	43	E	94	1837	601	1890	H
6235	NL	6235	DE KOOY	52	55	N	4	47	E	0	1906	601	1957	H
6260	NL	6260	DE BILT	52	6	N	5	11	E	2	1706	601	1906	H
6280	NL	6280	EELDE	53	8	N	6	35	E	4	1906	601	1957	H
6310	NL	6310	VLISSINGEN	51	27	N	3	36	E	8	1855	601	1957	H
6380	NL	6380	MAASTRICHT	50	55	N	5	47	E	114	1906	601	1957	H
5223	S	2616	FALSTERBO	55	23	N	12	49	E	5	1880	601	1890	T
6240	S	-9999	HALMSTAD	56	40	N	12	55	E	25	1860	601	1890	T
6348	S	-9999	HAVRARYD	56	47	N	13	8	E	185	1912	601	1912	H
6452	S	2640	VAEXJOE	56	52	N	14	48	E	166	1860	601	1890	T
6641	S	2672	KALMAR	56	43	N	16	17	E	15	1860	601	1890	H
6855	S	2680	HOBURG	56	55	N	18	8	E	38	1880	601	1890	T
7138	S	2516	VINGA	57	38	N	11	36	E	19	1880	601	1890	E
7243	S	2512	GOETEBORG	57	46	N	11	53	E	20	1860	601	1890	T
7245	S	-9999	BORAAS	57	46	N	12	56	E	135	1884	601	1890	T
7623	S	-9999	KROKSHULT	57	23	N	16	5	E	130	1912	601	1912	H
7722	S	2592	OELANDS NORRA UDDE	57	22	N	17	6	E	4	1854	601	1890	T
7839	S	2590	VISBY	57	40	N	18	20	E	42	1860	601	1890	T
8157	S	-9999	HAAVELUND	58	56	N	11	26	E	100	1911	601	1911	T
8223	S	-9999	VAENERSBORG	58	21	N	12	22	E	50	1860	601	1890	T
8645	S	-9999	AALBERGA	58	44	N	16	33	E	25	1879	601	1890	H

8745	S	2582	LANDSORT	58	44	N	17	52	E	13	1879	601	1890 T
8924	S	2584	GOTSKA SANDOEN	58	23	N	19	11	E	12	1880	601	1890 T
9322	S	2418	KARLSTAD	59	21	N	13	28	E	46	1859	601	1890 T
9642	S	-9999	LISJOE	59	42	N	16	4	E	60	1879	601	1890 H
9752	S	2462	UPPSALA	59	51	N	17	37	E	13	1722	601	1890 H
9821	S	2485	STOCKHOLM	59	20	N	18	3	E	44	1756	601	1890 T
9927	S	2496	SVENSKA HOEGARNA	59	26	N	19	30	E	12	1879	601	1890 T
10341	S	2410	MALUNG	60	42	N	13	41	E	308	1879	601	1890 T
10505	S	-9999	GRAENGESBERG	60	4	N	14	59	E	315	1901	601	1901 T
10537	S	2433	FALUN	60	37	N	15	37	E	160	1860	601	1890 H
12402	S	2324	SVEG	62	1	N	14	21	E	360	1875	601	1890 T
12546	S	-9999	SOESJOE	62	46	N	15	29	E	430	1915	601	1915 H
12722	S	-9999	SIDSJOE	62	23	N	17	17	E	60	1889	601	1890 T
12738	S	-9999	HAERNOESAND	62	37	N	17	56	E	8	1859	601	1890 H
13411	S	2226	OESTERSUND	63	11	N	14	29	E	376	1860	601	1890 T
13642	S	2244	JUNSELE	63	41	N	16	52	E	210	1881	601	1890 T
14036	S	2288	HOLMOEGADD	63	35	N	20	45	E	6	1854	601	1890 T
14456	S	-9999	LEIPIKVATTNET	64	55	N	14	9	E	475	1914	601	1914 H
15122	S	-9999	LOEVAANGER	64	22	N	21	19	E	21	1881	601	1890 T
15591	S	2104	TAERNABY/HEMAVAN	65	49	N	15	5	E	475	1885	601	1890 T
15772	S	-9999	STENSELE	65	4	N	17	9	E	325	1861	601	1890 H
16179	S	-9999	PITEAA	65	19	N	21	29	E	6	1860	601	1890 T
16395	S	2196	HAPARANDA	65	49	N	24	8	E	5	1860	601	1890 T
16798	S	2120	KVIKKJOKK	66	57	N	17	44	E	337	1886	601	1890 T
16897	S	-9999	TJAAMOTIS	66	55	N	18	32	E	300	1909	601	1909 H
16988	S	2142	JOKKMOKK	66	37	N	19	38	E	260	1860	601	1890 T
18069	S	2044	KIRUNA	67	49	N	20	20	E	442	1898	601	1898 T
18880	S	-9999	ABISKO	68	21	N	18	49	E	388	1913	601	1913 H
19283	S	2080	KARESUANDO	68	26	N	22	29	E	327	1879	601	1890 T
6193	DK	6193	HAMMERODDE FYR	55	18	N	14	47	E	11	1853	701	1939 H
20210	DK	-9999	TYLSTRUP	57	11	N	9	57	E	13	1905	701	1937 H
21100	DK	-9999	VESTERVIG	56	46	N	8	19	E	18	1873	701	1939 H
25140	DK	-9999	NORDBY	55	26	N	8	24	E	5	1872	701	1956 H
27080	DK	-9999	TRANEBJERG	55	51	N	10	36	E	11	1838	701	1948 H
28280	DK	-9999	AARSLEV	55	19	N	10	26	E	49	1906	701	1956 H
30380	DK	6186	KOEBENHAVN	55	41	N	12	32	E	9	1751	701	1938 H
31290	DK	-9999	NAESGAARD	54	52	N	12	7	E	15	1860	701	1956 H
304	FIN	2978	HELSINKI	60	10	N	24	57	E	4	1829	701	1937 E
1101	FIN	2972	TURKU	60	31	N	22	16	E	51	1873	701	1937 N
1202	FIN	-9999	TAMPERE	61	28	N	23	44	E	85	1873	701	1950 N
1701	FIN	2958	LAPPEENRANTA	61	5	N	28	9	E	105	1886	701	1957 N
3602	FIN	-9999	KUOPIO	62	54	N	27	41	E	119	1846	701	1957 T
4601	FIN	2897	KAJAANI	64	17	N	27	40	E	132	1846	701	1937 N
6801	FIN	2896	KUUSAMO	65	59	N	29	13	E	263	1908	701	1937 T
7501	FIN	2836	SODANKYLA	67	22	N	26	39	E	179	1891	701	1937 T
6011	FR	6011	TORSHAVN	62	1	N	6	46	W	43	1873	701	1939 H
4210	G	4210	UPERNAVIK	72	47	N	56	10	W	63	1873	701	1938 H
4216	G	4216	JAKOBSHAVN	69	13	N	51	3	W	39	1866	701	1938 H
4250	G	4250	GODTHAAB	64	10	N	51	45	W	50	1866	701	1951 H
4270	G	4270	IVIGTUT/NARSARSUAQ	61	12	N	48	10	W	30	1866	701	1938 H
4320	G	4320	DANMARKSHAVN	76	46	N	18	46	W	11	1949	701	1957 H
4339	G	4339	SCORESBYSUND	70	29	N	22	0	W	65	1924	701	1957 H
4360	G	4360	AMMASALIK	65	36	N	37	38	W	50	1895	701	1958 H
44	GB	3005	LERWICK	60	8	N	1	11	W	82	1856	701	1959 H
154	GB	3017	KIRKWALL	58	57	N	2	54	W	26	1857	701	1957 T
293	GB	3075	WICK	58	27	N	3	5	W	36	1869	701	1959 H
425	GB	3026	STORNOWAY	58	13	N	6	19	W	15	1856	701	1959 H
4013	IS	4013	STYKKISHOLMUR	65	5	N	22	44	W	8	1845	701	1965 T
4030	IS	4030	REYKJAVIK	64	8	N	21	54	W	52	1823	701	1965 T
4048	IS	4048	VESTMANNAEYJAR	63	24	N	20	17	W	118	1877	701	1924 T

4063	IS	4063	AKUREYRI	65	41	N	18	5	W	23	1882	701 1924 T
4092	IS	4092	TEIGARHORN	64	18	N	15	12	W	14	1872	701 1924 T
1008	N	1008	SVALBARD LUFTHAVN	78	15	N	15	28	E	28	1911	701 1975 N
1026	N	1026	TROMSOE	69	39	N	18	56	E	100	1867	701 1901 N
1065	N	1065	KARASJOK	69	28	N	25	31	E	129	1877	701 1901 N
1098	N	1098	VARDOE	70	22	N	31	5	E	14	1867	701 1901 N
1152	N	1152	BODOE	67	16	N	14	26	E	11	1867	701 1928 N
1212	N	1212	ONA	62	52	N	6	32	E	13	1868	701 1945 N
1235	N	1235	KJOEREMSGRENDI/DOMB.	62	6	N	9	3	E	626	1864	701 1931 N
1272	N	-9999	LIEN I SELBU	63	13	N	11	7	E	255	1895	701 1895 N
1317	N	1317	BERGEN-FLORIDA	60	23	N	5	20	E	12	1861	701 1906 N
1355	N	1355	LAERDAL	61	4	N	7	31	E	36	1869	701 1945 N
1372	N	1372	NESBYEN	60	34	N	9	7	E	167	1895	701 1901 N
1403	N	1403	UTSIRA FYR	59	18	N	4	53	E	55	1867	701 1945 N
1448	N	1448	OKSOEY FYR	58	4	N	8	3	E	9	1869	701 1938 N
1492	N	1492	OSLO-BLINDERN	59	57	N	10	43	E	94	1837	701 1901 N
6260	NL	6260	DE BILT	52	6	N	5	11	E	2	1706	701 1955 H
6452	S	2640	VAEXJOE	56	52	N	14	48	E	166	1860	701 1900 N
7243	S	2512	GOETEBORG	57	46	N	11	53	E	20	1860	701 1900 N
7839	S	2590	VISBY	57	40	N	18	20	E	42	1860	701 1900 N
9322	S	2418	KARLSTAD	59	21	N	13	28	E	46	1859	701 1900 N
9752	S	2462	UPPSALA	59	51	N	17	37	E	13	1722	701 1890 N
9821	S	2485	STOCKHOLM	59	20	N	18	3	E	44	1756	701 1900 N
10537	S	2433	FALUN	60	37	N	15	37	E	160	1860	701 1900 N
12738	S	-9999	HAERNOESAND	62	37	N	17	56	E	8	1859	701 1900 N
13411	S	2226	OESTERSUND	63	11	N	14	29	E	376	1860	701 1900 N
15772	S	-9999	STENSELE	65	4	N	17	9	E	325	1861	701 1900 N
16395	S	2196	HAPARANDA	65	49	N	24	8	E	5	1860	701 1900 N
16988	S	2142	JOKKMOKK	66	37	N	19	38	E	260	1860	701 1900 N
6193	DK	6193	HAMMERODDE FYR	55	18	N	14	47	E	11	1853	801 1890 H
21100	DK	-9999	VESTERVIG	56	46	N	8	19	E	18	1873	801 1890 H
25140	DK	-9999	NORDBY	55	26	N	8	24	E	5	1872	801 1890 H
27080	DK	-9999	TRANEBJERG	55	51	N	10	36	E	11	1838	801 1890 H
30380	DK	6186	KOEBENHAVN	55	41	N	12	32	E	9	1751	801 1890 H
304	FIN	2978	HELSINKI	60	10	N	24	57	E	4	1829	801 1890 E
1101	FIN	2972	TURKU	60	31	N	22	16	E	51	1873	801 1955 N
1701	FIN	2958	LAPPEENRANTA	61	5	N	28	9	E	105	1886	801 1958 N
4601	FIN	2897	KAJAANI	64	17	N	27	40	E	132	1846	801 1957 N
7501	FIN	2836	SODANKYLA	67	22	N	26	39	E	179	1891	801 1908 N
6011	FR	6011	TORSHAVN	62	1	N	6	46	W	43	1873	801 1890 H
4210	G	4210	UPERNAVIK	72	47	N	56	10	W	63	1873	801 1890 T
4216	G	4216	JAKOBSHAVN	69	13	N	51	3	W	39	1866	801 1890 T
4250	G	4250	GODTHAAB	64	10	N	51	45	W	50	1866	801 1890 T
4270	G	4270	IVIGTUT/NARSARSUAQ	61	12	N	48	10	W	30	1866	801 1890 T
4320	G	4320	DANMARKSHAVN	76	46	N	18	46	W	11	1949	801 1949 T
4339	G	4339	SCORESBYSUND	70	29	N	22	0	W	65	1924	801 1924 T
4360	G	4360	AMMASALIK	65	36	N	37	38	W	50	1895	801 1895 T
44	GB	3005	LERWICK	60	8	N	1	11	W	82	1856	801 1890 T
293	GB	3075	WICK	58	27	N	3	5	W	36	1869	801 1890 T
425	GB	3026	STORNOWAY	58	13	N	6	19	W	15	1856	801 1890 T
3952	IRL	3952	ROCHES POINT	51	48	N	8	15	W	40	1876	801 1956 N
3953	IRL	3953	VALENTIA OBS.	51	56	N	10	15	W	9	1892	801 1940 N
3965	IRL	3965	BIRR	53	5	N	7	53	W	70	1873	801 1955 N
3980	IRL	3980	MALIN HEAD	55	22	N	7	20	W	20	1885	801 1956 N
4013	IS	4013	STYKKISHOLMUR	65	5	N	22	44	W	8	1845	801 1890 H
4048	IS	4048	VESTMANNAEYJAR	63	24	N	20	17	W	118	1877	801 1890 H
4092	IS	4092	TEIGARHORN	64	18	N	15	12	W	14	1872	801 1890 H
1001	N	1001	JAN MAYEN	70	56	N	8	40	W	10	1921	801 1921 N
1008	N	1008	SVALBARD LUFTHAVN	78	15	N	15	28	E	28	1911	801 1975 N
1026	N	1026	TROMSOE	69	39	N	18	56	E	100	1867	801 1890 N

1028	N	1028	BJOERNOEYA	74	31	N	19	1	E	16	1910	801	1920	N
1065	N	1065	KARASJOK	69	28	N	25	31	E	129	1877	801	1890	N
1098	N	1098	VARDOE	70	22	N	31	5	E	14	1867	801	1890	N
1100	N	1100	SHIP "M"	66	0	N	2	0	E	0	1948	801	1948	N
1152	N	1152	BODOE	67	16	N	14	26	E	11	1867	801	1895	N
1212	N	1212	ONA	62	52	N	6	32	E	13	1868	801	1890	N
1235	N	1235	KJOEREMSGRENDI/DOMB.	62	6	N	9	3	E	626	1864	801	1890	N
1271	N	1271	VAERNES/TONDHEIM	63	28	N	10	56	E	12	1761	801	1890	N
1317	N	1317	BERGEN-FLORIDA	60	23	N	5	20	E	12	1861	801	1890	N
1355	N	1355	LAERDAL	61	4	N	7	31	E	36	1869	801	1890	N
1372	N	1372	NESBYEN	60	34	N	9	7	E	167	1895	801	1895	N
1403	N	1403	UTSIRA FYR	59	18	N	4	53	E	55	1867	801	1890	N
1448	N	1448	OKSOEY FYR	58	4	N	8	3	E	9	1869	801	1890	N
1482	N	1482	FERDER FYR	59	2	N	10	32	E	6	1885	801	1890	N
1492	N	1492	OSLO-BLINDERN	59	57	N	10	43	E	94	1837	801	1890	N
6235	NL	6235	DE KOOY	52	55	N	4	47	E	0	1906	801	1951	H
6260	NL	6260	DE BILT	52	6	N	5	11	E	2	1706	801	1951	H
6280	NL	6280	EELDE	53	8	N	6	35	E	4	1906	801	1951	H
6310	NL	6310	VLISSINGEN	51	27	N	3	36	E	8	1855	801	1951	H
6380	NL	6380	MAASTRICHT	50	55	N	5	47	E	114.	1906	801	1951	H
6452	S	2640	VAEXJOE	56	52	N	14	48	E	166	1860	801	1890	N
7243	S	2512	GOETEBORG	57	46	N	11	53	E	20	1860	801	1890	N
7839	S	2590	VISBY	57	40	N	18	20	E	42	1860	801	1890	N
9322	S	2418	KARLSTAD	59	21	N	13	28	E	46	1859	801	1890	N
9752	S	2462	UPPSALA	59	51	N	17	37	E	13	1722	801	1890	N
9821	S	2485	STOCKHOLM	59	20	N	18	3	E	44	1756	801	1890	N
10537	S	2433	FALUN	60	37	N	15	37	E	160	1860	801	1890	N
12738	S	-9999	HAERNOESAND	62	37	N	17	56	E	8	1859	801	1890	N
13411	S	2226	OESTERSUND	63	11	N	14	29	E	376	1860	801	1890	N
15772	S	-9999	STENSELE	65	4	N	17	9	E	325	1861	801	1890	N
16395	S	2196	HAPARANDA	65	49	N	24	8	E	5	1860	801	1890	N
16988	S	2142	JOKKMOKK	66	37	N	19	38	E	260	1860	801	1890	N

Appendix 3 NACD Version 1, Data Dictionary

Bold elements are included in the dataset. A copy of the data dictionary is enclosed on diskette # 1.

No.		Element	Unit	Abbr.
000		All elements / whole station		ALL
100		Air temperature		Tair
	101	**Mean temperature**	**0.1 °C**	**T**
	110	Maximum temperature	0.1 °C	Tmax
	111	Mean maximum temperature	0.1 °C	Tx
	112	Highest maximum temperature	0.1 °C	Th
	113	Day of Th	date	Thd
	114	No. of ice days (Tmax < 0 °C)	days	Id
	115	No. of summer days (Tmax > 25 °C)	days	Su
	116	No. of hot days (Tmax > 40 °C)	days	Hd
	120	Minimum temperature	0.1 °C	Tmin
	121	Mean minimum temperature	0.1 °C	Tn
	122	Lowest minimum temperature	0.1 °C	Tl
	123	Day of Tl	date	Tld
	124	No. of cold days (Tmin < -10 °C)	days	Cd
	125	No. of days with frost (Tmin < 0 °C)	days	Fd
	126	No. of tropical nights (Tmin > 20 °C)	days	Tr
	130	Degree days		DGD
	131	Heating degree days (sum of 17 -Tday)	0.1 K	HGD
	132	Growing degree days (sum of Tday > 4 °C)	0.1 K	GGD
	133	Melting degree days (sum of Tday > 0 °C)	0.1 K	MGD
	134	Freezing degree days (sum of Tday < 0 °C)	0.1 K	FGD
	150	Mean temperature at 0 UTC	0.1 °C	T00
	151	Mean temperature at 1 UTC	0.1 °C	T01
	152	Mean temperature at 2 UTC	0.1 °C	T02
	153	Mean temperature at 3 UTC	0.1 °C	T03
	154	Mean temperature at 4 UTC	0.1 °C	T04
	155	Mean temperature at 5 UTC	0.1 °C	T05
	156	Mean temperature at 6 UTC	0.1 °C	T06
	157	Mean temperature at 7 UTC	0.1 °C	T07
	158	Mean temperature at 8 UTC	0.1 °C	T08
	159	Mean temperature at 9 UTC	0.1 °C	T09
	160	Mean temperature at 10 UTC	0.1 °C	T10
	161	Mean temperature at 11 UTC	0.1 °C	T11
	162	Mean temperature at 12 UTC	0.1 °C	T12
	163	Mean temperature at 13 UTC	0.1 °C	T13
	164	Mean temperature at 14 UTC	0.1 °C	T14

No.	Element	Unit	Abbr.
165	Mean temperature at 15 UTC	0.1 °C	T15
166	Mean temperature at 16 UTC	0.1 °C	T16
167	Mean temperature at 17 UTC	0.1 °C	T17
168	Mean temperature at 18 UTC	0.1 °C	T18
169	Mean temperature at 19 UTC	0.1 °C	T19
170	Mean temperature at 20 UTC	0.1 °C	T20
171	Mean temperature at 21 UTC	0.1 °C	T21
172	Mean temperature at 22 UTC	0.1 °C	T22
173	Mean temperature at 23 UTC	0.1 °C	T23
200	Air humidity		HUM
201	Mean relative humidity	%	RH
202	Mean daytime relative humidity (6-18 local time)	%	RHD
203	Mean nighttime relative humidity (18-6 local time)	%	RHN
210	Mean vapour pressure	hPa	VP
215	Mean potential evapotranspiration	0.1 mm/d	EVAP
220	Mean wetbulb temperature	0.1 °C	WT
230	Mean dewpoint temperature	0.1 °C	DT
240	Mean absolute humidity	g/m**3	AH
250	Mean relative humidity at 0 UTC	%	RH00
251	Mean relative humidity at 1 UTC	%	RH01
252	Mean relative humidity at 2 UTC	%	RH02
253	Mean relative humidity at 3 UTC	%	RH03
254	Mean relative humidity at 4 UTC	%	RH04
255	Mean relative humidity at 5 UTC	%	RH05
256	Mean relative humidity at 6 UTC	%	RH06
257	Mean relative humidity at 7 UTC	%	RH07
258	Mean relative humidity at 8 UTC	%	RH08
259	Mean relative humidity at 9 UTC	%	RH09
260	Mean relative humidity at 10 UTC	%	RH10
261	Mean relative humidity at 11 UTC	%	RH11
262	Mean relative humidity at 12 UTC	%	RH12
263	Mean relative humidity at 13 UTC	%	RH13
264	Mean relative humidity at 14 UTC	%	RH14
265	Mean relative humidity at 15 UTC	%	RH15
266	Mean relative humidity at 16 UTC	%	RH16
267	Mean relative humidity at 17 UTC	%	RH17
268	Mean relative humidity at 18 UTC	%	RH18
269	Mean relative humidity at 19 UTC	%	RH19
270	Mean relative humidity at 20 UTC	%	RH20
271	Mean relative humidity at 21 UTC	%	RH21
272	Mean relative humidity at 22 UTC	%	RH22
273	Mean relative humidity at 23 UTC	%	RH23

No.	Element	Unit	Abbr.
300	Wind		WIN
310	Wind direction	deg. N	D
311	Frequency of N winds (338 ≤ D or D ≤ 22)	%	DN
312	Frequency of NE winds (23 ≤ D ≤ 67)	%	DNE
313	Frequency of E winds (68 ≤ D ≤ 112)	%	DE
314	Frequency of SE winds (113 ≤ D ≤ 157)	%	DSE
315	Frequency of S winds (158 ≤ D ≤ 202)	%	DS
316	Frequency of SW winds (203 ≤ D ≤ 247)	%	DSW
317	Frequency of W winds (248 ≤ D ≤ 292)	%	DW
318	Frequency of NW winds (293 ≤ D ≤ 337)	%	DNW
319	Frequency of calm (F ≤ 1 m/s)	%	D0
320	Most frequent wind direction	code 1-9	DD
330	Wind speed	m/s	F
331	Mean wind speed	m/s	FF
332	No. of windy days (F ≥ 11 m/s)	days	F11
333	No. of stormy days (F ≥ 21 m/s)	days	F21
334	No. of days with storm (F ≥ 26 m/s)	days	F26
335	No. of days with hurricane (F ≥ 31 m/s)	days	F31
400	Air pressure (reduced to MSL, 45 °N, 0 °C)		PPP
401	**Mean pressure**	**0.1 hPa**	**P**
410	Maximum pressure	0.1 hPa	Px
411	Day of maximum air pressure	date	Pxd
420	Minimum pressure	0.1 hPa	Pn
421	Day of minimum air pressure	date	Pnd
450	Mean pressure at 0 UTC	0.1 hPa	P00
451	Mean pressure at 1 UTC	0.1 hPa	P01
452	Mean pressure at 2 UTC	0.1 hPa	P02
453	Mean pressure at 3 UTC	0.1 hPa	P03
454	Mean pressure at 4 UTC	0.1 hPa	P04
455	Mean pressure at 5 UTC	0.1 hPa	P05
456	Mean pressure at 6 UTC	0.1 hPa	P06
457	Mean pressure at 7 UTC	0.1 hPa	P07
458	Mean pressure at 8 UTC	0.1 hPa	P08
459	Mean pressure at 9 UTC	0.1 hPa	P09
460	Mean pressure at 10 UTC	0.1 hPa	P10
461	Mean pressure at 11 UTC	0.1 hPa	P11
462	Mean pressure at 12 UTC	0.1 hPa	P12
463	Mean pressure at 13 UTC	0.1 hPa	P13
464	Mean pressure at 14 UTC	0.1 hPa	P14
465	Mean pressure at 15 UTC	0.1 hPa	P15
466	Mean pressure at 16 UTC	0.1 hPa	P16
467	Mean pressure at 17 UTC	0.1 hPa	P17

No.	Element	Unit	Abbr.
468	Mean pressure at 18 UTC	0.1 hPa	P18
469	Mean pressure at 19 UTC	0.1 hPa	P19
470	Mean pressure at 20 UTC	0.1 hPa	P20
471	Mean pressure at 21 UTC	0.1 hPa	P21
472	Mean pressure at 22 UTC	0.1 hPa	P22
473	Mean pressure at 23 UTC	0.1 hPa	P23
500	Sunshine / radiation		SUN
501	Hours of bright sunshine (SUN ≥ 200 w/m²)	hours	S
502	Maximum daily sunshine (SUN ≥ 200 w/m²)	0.1 hours	Sx
503	Day of Sx	date	Sxd
550	Global radiation	w/m²	GR
600	Precipitation		RRR
601	**Precipitation sum**	**0.1 mm**	**R**
602	Maximum daily precipitation	0.1 mm	Rx
603	Day of Rx	date	Rxd
604	No. of days with RRR ≥ 0.1 mm	days	R01
605	No. of days with RRR ≥ 1 mm	days	R1
606	No. of days with RRR ≥ 10 mm	days	R10
607	No. of days with snow falling (RRR* ≥ 0.1 mm)	days	Sn
700	Weather		WWW
701	**No. of days with snow cover (> 50% covered)**	**days**	**dsc**
702	No. of days with fog (vis. < 1 km)	days	dfg
703	No. of days with thunder	days	dtd
704	No. of days with hail	days	dhl
705	No. of days with Aurora Borealis	days	dab
706	No. of days with freezing rain	days	dfr
707	No. of days with sleet	days	dsl
708	No. of days with drizzle	days	ddr
709	No. of days with rain	days	dr
800	Cloud cover		NNN
801	**Mean cloud cover**	**%**	**N**
802	No. of clear days (NNN < 20 %)	days	Kv
803	No. of cloudy days (NNN > 80 %)	days	Sv
850	Mean cloud cover at 0 UTC	%	N00
851	Mean cloud cover at 1 UTC	%	N01
852	Mean cloud cover at 2 UTC	%	N02
853	Mean cloud cover at 3 UTC	%	N03
854	Mean cloud cover at 4 UTC	%	N04
855	Mean cloud cover at 5 UTC	%	N05
856	Mean cloud cover at 6 UTC	%	N06
857	Mean cloud cover at 7 UTC	%	N07

No.	Element	Unit	Abbr.
858	Mean cloud cover at 8 UTC	%	N08
859	Mean cloud cover at 9 UTC	%	N09
860	Mean cloud cover at 10 UTC	%	N10
861	Mean cloud cover at 11 UTC	%	N11
862	Mean cloud cover at 12 UTC	%	N12
863	Mean cloud cover at 13 UTC	%	N13
864	Mean cloud cover at 14 UTC	%	N14
865	Mean cloud cover at 15 UTC	%	N15
866	Mean cloud cover at 16 UTC	%	N16
867	Mean cloud cover at 17 UTC	%	N17
868	Mean cloud cover at 18 UTC	%	N18
869	Mean cloud cover at 19 UTC	%	N19
870	Mean cloud cover at 20 UTC	%	N20
871	Mean cloud cover at 21 UTC	%	N21
872	Mean cloud cover at 22 UTC	%	N22
873	Mean cloud cover at 23 UTC	%	N23
900	Snow depth		SSS
901	Mean snow depth	cm	SDm
902	Maximum snow depth	cm	SDx
903	Day of maximum snow depth	date	SDxd
904	Snow depth on 15th	cm	SD15
905	Snow depth on the last day of the month	cm	SDl

Appendix 4 NACD Version 1, Data Exchange Standard

NACD Version 1 consist of 5 ASCII files enclosed on diskettes 1 and 2, where each record contains data from one year in the following fixed format:

Postion	Format	Description
1-5	I5	National station number (see appendix 2 Station Catalogue)
6-8	I3	Element number (see appendix 3 Data Dictionary)
9-12	I4	Year
13-17	I5	January value (unit as in appendix 3 Data Dictionary)
18-22	I5	February value do
23-27	I5	March value do
28-32	I5	April value do
33-37	I5	May value do
38-42	I5	June value do
43-47	I5	July value do
48-52	I5	August value do
53-57	I5	September value do
58-62	I5	October value do
63-67	I5	November value do
68-72	I5	December value do
73-75	A3	Country code (see appendix 2 Station Catalogue)

Missing value: -9999
No blanks included, except leading blanks.
No missing years between start and end of data series.

Appendix 5 NACD Version 1, Metadata Exchange System

ASCII file (example enclosed on diskette # 1), where each record contains information about one station and one element for each period of comparable conditions, as defined by start and end date.

Position	Format	Description	Note
1-5	I5	Station number	see appendix 2 Station Catalogue
6-8	I3	Element number	see appendix 3 Data Dictionary
9-16	I8	Start date	YYYYMMDD, where MM and DD are optional
17-24	I8	End date	YYYYMMDD, where MM and DD are optional
25-26	I2	Type of metadata	01-12, see description below
27-28	A2	Adjustment made	AB, AT, MB, MT or NO, see description below
29-32	F4	January value	F4 means free-field format
33-36	F4	February value	do
37-40	F4	March value	do
41-44	F4	April value	do
45-48	F4	May value	do
49-52	F4	June value	do
53-56	F4	July value	do
57-60	F4	August value	do
61-64	F4	September value	do
65-68	F4	October value	do
69-72	F4	November value	do
73-76	F4	December value	do
77-78	A2	Source of metadata	See description below

If NO adjustment is made, the 12 monthly adjustment fields are turned into a textfield (A48), which can be used for writing any kind of metadata in clear text, according to the following 12 types:

Type	Abbr.	Explanation
01	pos_h	Horizontal position, e.g. latitude longitude.
02	pos_v	Vertical position, e.g. height above sea level, height above ground.
03	observ	Observers name or type of observation personnel.
04	obshour	Observation hours in either local time and/or UTC.
05	instrum	Instrument type, type of screen, code system for visual observations, etc.
06	unit	Unit of original observations + later changes(e.g. N% = N*1.25).
07	formula	Formula for calculating published monthly values (e.g. T = (Tx+Tn)/2)
08	environ	Environmental conditions, e.g. urban, forest, angles to horizon etc.
09	time_s	Time series constructed from older station numbers, or periods interpolated.
10	calcul	Calculations performed after original publication (e.g. pressure reduced to MSL).
11	homogen	Homogeneity tests performed (e.g. SNHT, reference stations and results).
12	adjust	Adjustments made to original series (e.g. 12 monthly adjustment factors)

Adjustments made:	AB addition, break	MB multiplication, break
	AT addition, trend	MT multiplication, trend

Sources of metadata:	MY	=	Meteorological Yearbook
	OL	=	Original observation List
	CP	=	Correspondance Protocol
	IP	=	Instrument Protocol
	IR	=	Inspection Report
	OS	=	Other Sources

Appendix 6 North Atlantic Climatological Dataset (NACD Version 1)

NACD Version 1 is published together with this report and proper reference should always be made to this report, when using this dataset. New versions of the dataset may be published in the future, or updates may be obtained directly from the participating National Meteorological Services (see Chapter 6.1, European Climatic Data Consortium (ECDC) or Appendix 1, List of Participants) through bilateral or multilateral agreements. The following 4 standard agreements may be used:

1) Agreement of understanding between DMI and ... (c.f. Jonsson et al, 1993)
2) ECSN, Memorandum Of Understanding.
3) ECOMET (to be specified).
4) EUMETNET (to be specified).

NACD Version 1 is enclosed on 2 diskettes as 5 uncompressed ASCII files. For details on station catalogue, data dictionary and data format, please consult appendices 2-4.

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