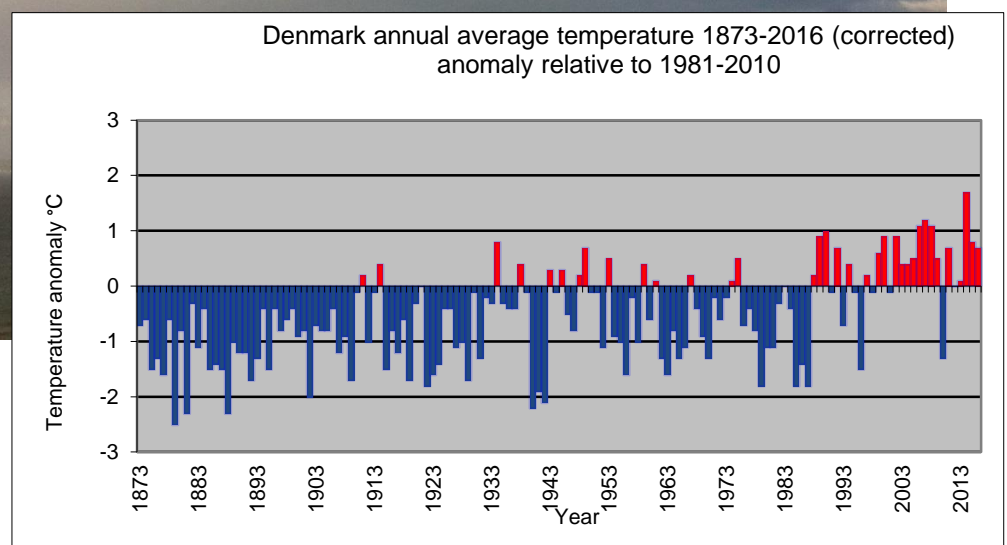
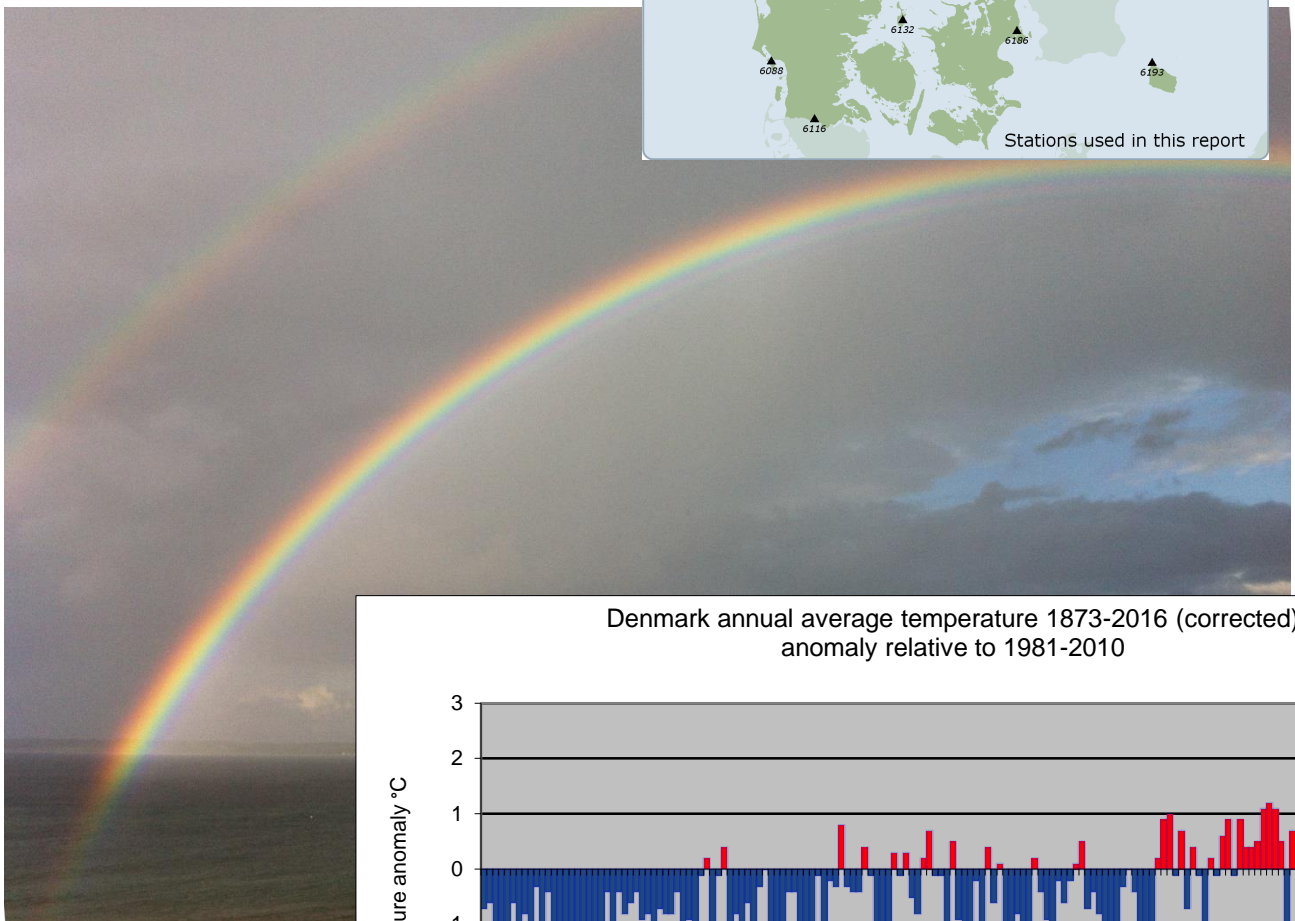
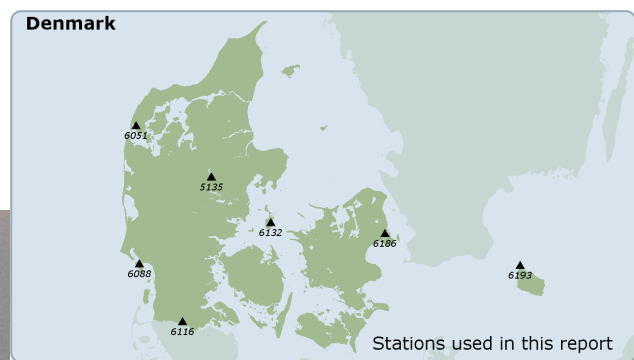


## DMI Report 17-02

# Denmark - DMI Historical Climate Data Collection 1768-2016

John Cappelen (ed)



**Copenhagen 2017**

## Colophon

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DMI Report 17-02

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**Important note:**

This report is an comprehensive annual update (2016 data) of the “DMI daily, monthly, annual and country-wise Danish climate data collection” published for the first time in that form in 1) DMI Technical Report 08-05: DMI Daily Climate Data Collection 1873-2007, Denmark, The Faroe Islands and Greenland - including Air Pressure Observations 1874-2007 (WASA Data Sets). Copenhagen 2008 [14], 2) DMI Technical Report 04-03: DMI Daily Climate Data Collection 1873-2003, Denmark and Greenland. Copenhagen 2004 [37], 3) DMI Technical Report 03-26: DMI Monthly Climate Data Collection 1860-2002, Denmark, The Faroe Island and Greenland. An update of: NACD, REWARD, NORDKLIM and NARP datasets, Version 1. Copenhagen 2003 [29], 4) DMI Technical Report 05-06: DMI annual climate data collection 1873-2004, Denmark, The Faroe Islands and Greenland - with Graphics and Danish Abstracts. Copenhagen 2005 [12], 5) DMI Teknisk Rapport 06-02: Dansk vejr siden 1874 - måned for måned med temperatur, nedbør og soltimer samt beskrivelser af vejret with English translations. København 2006 [13] and 6) DMI Teknisk Rapport 09-12: Storm og ekstrem vind i Danmark – opgørelser og analyser september 2009. København 2009 [15].

**Front Page:**

Double rainbow, north coast of the island Sjælland. Photo: John Cappelen

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## Abstract

This report contains the available DMI historical data collection 1768-2016 for Denmark, including observations (atmospheric pressure), long daily, monthly and annual series of station based data, country-wise values and a list of storms.

## Resumé

Denne rapport indeholder tilgængelige historiske DMI datasamlinger 1768-2016 for Danmark. Det drejer sig om observationer af lufttryk, lange daglige, månedlige og årlige stationsdataserier, landstal og en stormliste.

## 1. Preface

This report contains a DMI historical data collection 1768-2016 for Denmark, including long series of station based data comprising observations of atmospheric pressure plus daily, monthly and annual values of selected parameters and some selected graphics. Finally selected country-wise (region) values and a list of storms for Denmark are published. Description of the general weather and climate in Denmark [31] is included.

This information has been published earlier in different DMI reports [16], [17], [18], [19], [20] and [25]. It is now published in one report divided in sections covering the different data types.

The data collection comprises observational, daily, monthly, annual and country-wise (region) blended data sets with a long record (blended station and country-wise data series) and also daily station data series (single station data series; not blended). A description of the blending and other metadata can be found in Appendices.

Changes in station position, measuring procedures or observer may all significantly bias a time series of observations. For that reason metadata (“data on data”) are important. All available information on station positions and relocations are included in Appendix. Other metadata as descriptions of the construction of data sets and data series behind, rain gauge exposure, information concerning atmospheric pressure data from old manually operated climate stations, the introduction of the Hellmann rain gauge and the introduction of Stevenson screens (thermometer screen, notes on monthly values etc. can also be found in Appendices.

A compiled set of various metadata up to 1996, covering aspects such as station position and relocations, change of instrumentation and observation units etc., that is essential to know when homogenizing time series of climate data can be found in DMI Technical Report 03-24 [35]. This publication contains information concerning a major part of the stations included in this report.

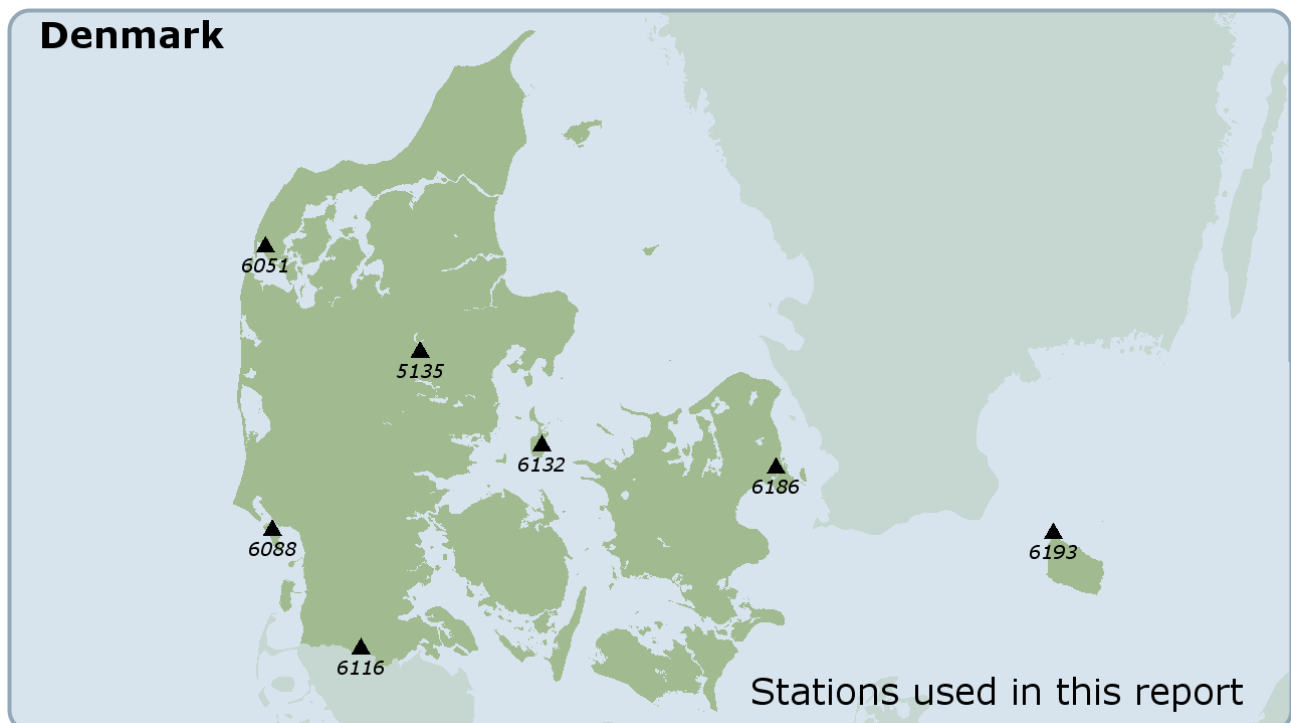
## 2. Overall data overview

Below is a quick overview of all the information from Denmark you can find in this report:

- A station map and -list showing weather stations (present name and location) from where the station based data sets presented in this report comes from.
- Description of the general weather and climate in Denmark.
- A survey and description of the different data collections and parameters.
- Detailed metadata (data about data).
- File formats describing the different data files included in this report.

**Guidance:** Find the data collection you are interested in the data collections overview. Read about it in the specific section and appendix. Find the data set among the data files, which can be downloaded from the publication part of DMI web pages together with this report.

### 2.1. Stations



Station based data sets referred to in the report. Only the latest positions are marked. The official WMO station identifiers for Denmark consist of 5 digits "06xxx". However, in this report the in front "0" is omitted, giving 4 digits i.e. "6132" for Tranebjerg, which is also used on the map. The Danish national station identifiers describing climate/precipitation stations in Denmark consist of 5 digits, either the new format "05XXX" (the in front "0" is omitted), giving 4 digits i.e. "5135" for Grønbæk or the old format, where the station number started with 20-32 dependent on the region i.e. "27080" for the old Tranebjerg station.

| Data set id* | Station*        | First year of appearance |
|--------------|-----------------|--------------------------|
| 6051         | Vestervig       | 1874                     |
| 5135         | Grønbæk         | 1874                     |
| 6088         | Nordby/Fanø     | 1872                     |
| 6116         | Store Jynde vad | 1920                     |
| 6132         | Tranebjerg      | 1872                     |
| 6186         | København       | 1768                     |
| 6193         | Hammer Odde Fyr | 1873                     |

\*latest station number and name

## 2.2. Data collections overview

Data types/parameters marked with “bold” in the “Data Collections” column represent a data set for every station/region mentioned. The data sets can be downloaded from the publication part of DMI web pages together with this report and are described in the sections and appendices specified.

| Type        | Data Collections  | Section, Page, Appendix           |
|-------------|---|-----------------------------------|
| Observation | <ul style="list-style-type: none"> <li><b>Atmospheric pressure (msl)</b><br/>3 data sets (blended):<br/>6051 Vestervig (1874-2016)<br/>6088 Nordby/Fanø (1874-2016)<br/>6193 Hammer Odde Fyr (1874-2016)</li> </ul>   | Sec 4.2.1., p 16, App 2           |
| Daily       | <ul style="list-style-type: none"> <li><b>Air temperature 12 UTC (14 DNT)</b><br/>2 data sets (single stations):<br/>27080 Tranebjerg (1872-2003)<br/>6132 Tranebjerg (2003-2016)<br/>1 data set (blended):<br/>6132 Tranebjerg (1872-2016)</li> <li><b>Highest air temperature</b></li> <li><b>Lowest air temperature</b><br/>22 data sets (single stations):<br/>21100 Vestervig (1874-2003)<br/>6051 Vestervig (2003-2016)<br/>25140 Nordby/Fanø (1874-2003)<br/>6088 Nordby/Fanø (2003-2016)<br/>27080 Tranebjerg (1872-2003)<br/>6132 Tranebjerg (2003-2016)<br/>30380 Landbohøjskolen (1874-1997)<br/>6186 Landbohøjskolen (1995-2016)<br/>32030 Sandvig (1874-1970)<br/>32020 Hammer Odde Fyr (1971-1987)<br/>6193 Hammer Odde (1984-2016)<br/>10 data sets (blended):<br/>6051 Vestervig (1874-2016)<br/>6088 Nordby/Fanø (1874-2016)<br/>5165 Tranebjerg (1872-2016)<br/>6186 København (1874-2016)<br/>6193 Hammer Odde (1874-2016)</li> <li><b>Average atmospheric pressure</b><br/>5 data sets (single stations):<br/>21100 Vestervig (1874-1987)<br/>6052 Thyborøn (1961-2016)<br/>25140 Nordby/Fanø (1874-1987)<br/>6080 Esbjerg Airport (1959-2016)<br/>6193 Hammer Odde Fyr (1874-2016)<br/>3 data sets (blended):<br/>6051 Vestervig (1874-2016)<br/>6088 Nordby/Fanø (1874-2016)<br/>6193 Hammer Odde (1874-2016)</li> <li><b>Accumulated precipitation</b><br/>15 data sets (single stations):<br/>6051(21100) Vestervig (1874-2016)<br/>5135 (21430) Grønbæk (1874-2016)</li> </ul> | Sec 5.2.1.-5.2.6., p 20-23, App 3 |



|  |   |  |
|--|---|--|
|  | <p>6088 (25140) Nordby/Fanø (1874-2016)<br/> 26410 Broderup (1920-1993)<br/> 26409 Tinglev (1995-2006)<br/> 6116 (26400) Store Jyndevad (1987-2016)<br/> 27080 Tranebjerg (1872-2001)<br/> 6132 (27082) Tranebjerg Øst (2001-2016)<br/> 30380 Landbohøjskolen (1874-1996)<br/> 30210 Meteorologisk Institut (1875-1922)<br/> 30210 Meteorologisk Institut (1961-1984)<br/> 5735 (30370) Botanisk Have (1961-2016)<br/> 32030 Sandvig (1874-1970)<br/> 32020 Hammer Odde Fyr (1961-1987)<br/> 6193 Hammer Odde (1984-2016)<br/> 7 data sets (blended):<br/> 6051 Vestervig (1874-2016)<br/> 5135 Grønbæk (1874-2016)<br/> 6088 Nordby/Fanø (1874-2016)<br/> 5165 Tranebjerg (1872-2016)<br/> 6116 Store Jyndevad (1920-2016)<br/> 5735 København (1874-2016)<br/> 6193 Hammer Odde (1874-2016)</p> <ul style="list-style-type: none"> <li>• <b>Cloud Cover 8, 14 and 21 DNT</b></li> </ul> <p>1 dataset (single station):<br/> 6132 Tranebjerg (1872-2000)</p> |  |
| <p><b>Monthly/<br/>Annual</b></p>                        | <ul style="list-style-type: none"> <li>• <b>Average air temperature</b></li> <li>• <b>Average daily minimum air temperature</b></li> <li>• <b>Average daily maximum air temperature</b></li> <li>• <b>Highest air temperature</b></li> <li>• <b>Lowest air temperature</b></li> <li>• <b>Average atmospheric pressure (msl)</b></li> <li>• <b>Hours of bright sunshine</b></li> <li>• <b>Accumulated precipitation</b></li> <li>• <b>Highest 24-hour precipitation</b></li> <li>• <b>No. of days with snow cover</b></li> <li>• <b>Average cloud cover</b></li> </ul> <p>5 data sets (blended):<br/> 6051 Vestervig (1874-2016)<br/> 6088 Nordby/Fanø (1872-2016)<br/> 6132 Tranebjerg (1873-2016)<br/> 6186 København (1768-2016)<br/> 6193 Hammer Odde Fyr (1873-2016)</p>  | <p><b>Sec 6.2.1-6.2.11, p 27-30, App 4</b></p> |
| <p><b>Country-<br/>wise/<br/>Monthly/<br/>Annual</b></p> | <ul style="list-style-type: none"> <li>• <b>Country-wise (Denmark) climate data 1874-2016; Average air temperature, Average of minimum and maximum air temperatures, highest/lowest air temperatures, accumulated precipitation, highest 24-hour precipitation and hours of bright sunshine; tables</b></li> </ul> <p>2 data sets:<br/> All months/years 1891-2016 are characterised by a short text as well as the weather during Eastern, Christmas and Midsummer Day. Record breaking months and years are marked and normals 1961-1990, average 2001-2010 and average 2006-2015 are included. The country-wise extremes are calculated separately in a data set</p>   | <p><b>Sec 7.2.1-7.2.2, p 33-37, App 5</b></p>  |

|                         |  |                                   |
|-------------------------|--|-----------------------------------|
|                         | <ul style="list-style-type: none"> <li><b>Country-wise (Denmark) climate data 1874-2016; Average air temperature, accumulated precipitation, and hours of bright sunshine</b></li> </ul> <p>4 data sets:<br/>Average air temperature; published (1873-2016)<br/>Average air temperature; corrected (1873-2016)<br/>Accumulated precipitation (1874-2016)<br/>Hours of bright sunshine (1920-2016)</p>  |                                   |
| <b>Graphics/ Annual</b> | <ul style="list-style-type: none"> <li><b>Average air temperature; graph</b></li> </ul> <p>7 data sets (blended):<br/>6051 Vestervig (1874-2016)<br/>6088 Nordby/Fanø (1872-2016)<br/>6132 Tranebjerg (1873-2016)<br/>6186 København (1768-2016)<br/>6193 Hammer Odde Fyr (1873-2016)<br/>Country-wise; published (1873-2016)<br/>Country-wise; corrected (1873-2016)</p> <ul style="list-style-type: none"> <li><b>Accumulated hours of bright sunshine; graph</b></li> </ul> <p>2 data set (blended):<br/>6186 København (1920-2016)<br/>Country-wise (1920-2016)</p> <ul style="list-style-type: none"> <li><b>Accumulated precipitation; graph</b></li> </ul> <p>6 data sets (blended):<br/>6051 Vestervig (1874-2016)<br/>6088 Nordby/Fanø (1872-2016)<br/>6132 Tranebjerg (1873-2016)<br/>6186 København (1821-2016)<br/>6193 Hammer Odde Fyr (1873-2016)<br/>Country-wise (1874-2016)</p> | <b>Sec 8.2., p 40-41, App 6</b>   |
| <b>Storm</b>            | <ul style="list-style-type: none"> <li><b>List of storms 1890-2016 (Denmark); table</b></li> </ul> <p>1 data set:<br/>All strong gales to hurricanes registered in Denmark, have been ranked in terms of strength and wind direction and whether there has been snowfall involved</p>  | <b>Sec 9.2.1., p 51-56, App 7</b> |

*Important note: The cut-off data for the quality control of Danish 2016 data are June 1, 2017. Minor changes can take place after this date. This is related to an ongoing quality control of data. Also when compared to earlier published data collections before 2016 minor changes can have been introduced for the same reason.*

## 2.3 Data Dictionary

Elements/Parameters used in this report. 'Method' specifies whether the element is a sum, an average or an extreme. The units of the monthly values in the data files are specified in 'Unit'. The DMI system of element numbers contains more than the shown elements.

| Element Number | Element/Parameter                            | Method      | Unit |
|----------------|--|-------------|------|
| 101            | Average air temperature                      | average     | °C   |
| 111            | Average of daily maximum air temperature     | average     | °C   |
| 112            | Highest air temperature                      | max         | °C   |
| 121            | Average of daily minimum air temperature     | average     | °C   |
| 122            | Lowest air temperature                       | min         | °C   |
| 401            | Atmospheric pressure (msl)                   | obs/average | hPa  |
| 601            | Accumulated precipitation                    | sum         | mm   |
| 602            | Highest 24-hour precipitation                | max         | mm   |
| 701            | No. of days with snow cover (> 50 % covered) | sum         | days |
| 801            | Average cloud cover                          | average     | %    |

## 3. Climate and weather in general; Denmark

### **Between ocean and continent**

Danish weather is extremely changeable. Denmark lies in the path of the westerlies, an area characterised by fronts, extratropical cyclones and unsettled weather. At the same time, the country is situated on the edge of the European Continent, where winters are cold and summers hot. Compared to other geographical areas on the same latitude, Denmark enjoys a relatively warm climate. This is due to the warm Gulf Stream that originates in the tropical ocean off the eastern coast of the USA. By way of comparison, Denmark is situated on the same latitude as Hudson Bay in Canada and Siberia in Russia, areas almost uninhabitable due to their short summers and harsh winters.

### **The weather changes according to the prevailing wind direction**

Denmark has a typical coastal climate with mild, humid weather in winter and cool, changeable weather in summer, and average air temperatures do not vary greatly between the two seasons. However, the climate and weather in Denmark is strongly influenced by the country's proximity to both the sea and the European Continent. This means that the weather changes according to the prevailing wind direction. The westerly wind from the sea typically brings relatively homogeneous weather both summer and winter: mild in winter, cool during summer, always accompanied by clouds, often with rain or showers. If the wind comes from the east or south, the weather in Denmark tends to resemble the weather currently prevailing on the Continent: hot and sunny during summer, cold during winter. Thus, the wind direction and the season are key factors in describing Danish weather.

### **The westerly wind**

As the wind in Denmark is predominantly westerly, depressions, with their windy and rainy weather, generally move along different tracks from the west in a direction north of Denmark. Summer and winter, such weather brings the depressions and their associated frontal systems close by Denmark - one after the other. This brings about the passage of fronts with continued rain, followed by areas with showers in the cold air behind the front. During winter, precipitation from the fronts will often commence as snow if the previous weather was cold with frost. As the depressions often succeed each other like pearls on a string or in 'clusters', the weather in these situations will often repeat itself at intervals of one or two days, and the weather type itself may last from a few days up to several weeks.

The passage of extratropical cyclones is accompanied by a wind - often a strong wind - on the south side of the low. This is normally strongest after the front passes, when the cold air has arrived. Most gales occur in autumn and early winter when the air temperature difference between the still warm Southern Europe and rapidly cooling Scandinavia is greatest.

During summer, a change in the weather to a westerly wind will usually mean a drop in air temperature during passage of the cold front, often followed by quite humid weather with rain or showers. During winter, a change to a westerly wind will often be preceded by cold weather, perhaps, frost. When the cold front passes, air from the ocean will, in fact, be warmer (being heated by the ocean) than the air over land. The air temperature thus rises, even though a cold front is passing! Only if the air behind the front is really cold, such as when it comes from the north or north east, will the passage of a cold front during winter mean colder weather.

### **The calm anticyclones (highs)**

If the extratropical cyclones from the west steer well clear of Denmark, periods of relatively settled anticyclone weather will ensue. During summer this means the ground will continue to be heated, resulting in increasingly hot air temperatures. But with just a light breeze from the sea, a cover of very thin cloud - called stratocumulus - often forms at low altitude, blocking the sun and perhaps ruining an otherwise perfect day for the beach. For Denmark to experience hot and dry summer

weather, the air must preferably come from the continent, where it is usually hot and dry during the summer.

Highs during winter normally mean cold, clear and calm weather. However, because of the substantial radiation, especially at night, fog may easily form which is not readily dispersed during the day. Being very low during winter, the sun fails to heat the ground sufficiently during the short day to make the air temperature rise. In fact, in clear weather during the months of December and January there will be a radiative deficit day and night, also at midday. This means that the air temperature in clear weather will continually drop, in extreme situations falling to below  $-25^{\circ}\text{C}$  inland away from coastal areas. This is rather unusual though and also requires that the air is deprived of any kind of heat from elsewhere. The presence of snow cover is of great importance in this connection, as this increases the albedo while also acting as insulation. Without snow cover the air temperature will only rarely fall below  $-10^{\circ}\text{C}$ , because of the heat supplied from the earth's surface. Finally, the weather must be totally calm to reach extremely low air temperatures, as even a light breeze will bring in milder, more humid air from the sea surrounding Denmark. Should any clouds move in over land, they will act as a blanket, thus ending the cold spell/weather.

### **The easterly wind**

In Denmark, the easterly wind is not as frequent as the westerly, as it is a sign of the inverse of the normal distribution of lows and highs, namely lows to the south and highs to the north. In this situation, the weather is subject to considerable continental influence, since the air originates from the great continental land mass to the east. This means cold weather during winter and warm weather during summer. The easterly wind is especially common during late winter or spring, at which time the cold continental winter-high over Europe has often been dissolved while the similar high over Scandinavia or Russia remains intact. This weather situation is quite stable and may produce cold and windy weather for days or weeks, thus prolonging the cold of winter far into the spring.

Especially in early winter, however, the relatively warm waters of Baltic partly heat the cold easterly wind which may intensify precipitation and cause snow showers in the Baltic Sea, particularly on Bornholm and Lolland/Falster.

### **The southerly wind**

As with air arriving from the east, air reaching Denmark from the south is of continental origin. This causes cold during winter and heat during summer. But air coming from the south will often be moist and accompanied by haze or fog. During summer, the moisture input may cause heavy showers, possibly with thunder. However, this is fairly rare, as thunder will most frequently be associated with fronts - especially cold ones. Moist air from the south preceding the passage of a cold front makes good conditions for thunderstorms. A prolonged heat wave is often terminated by just such a thunder cold front and followed by a change to cooler weather.

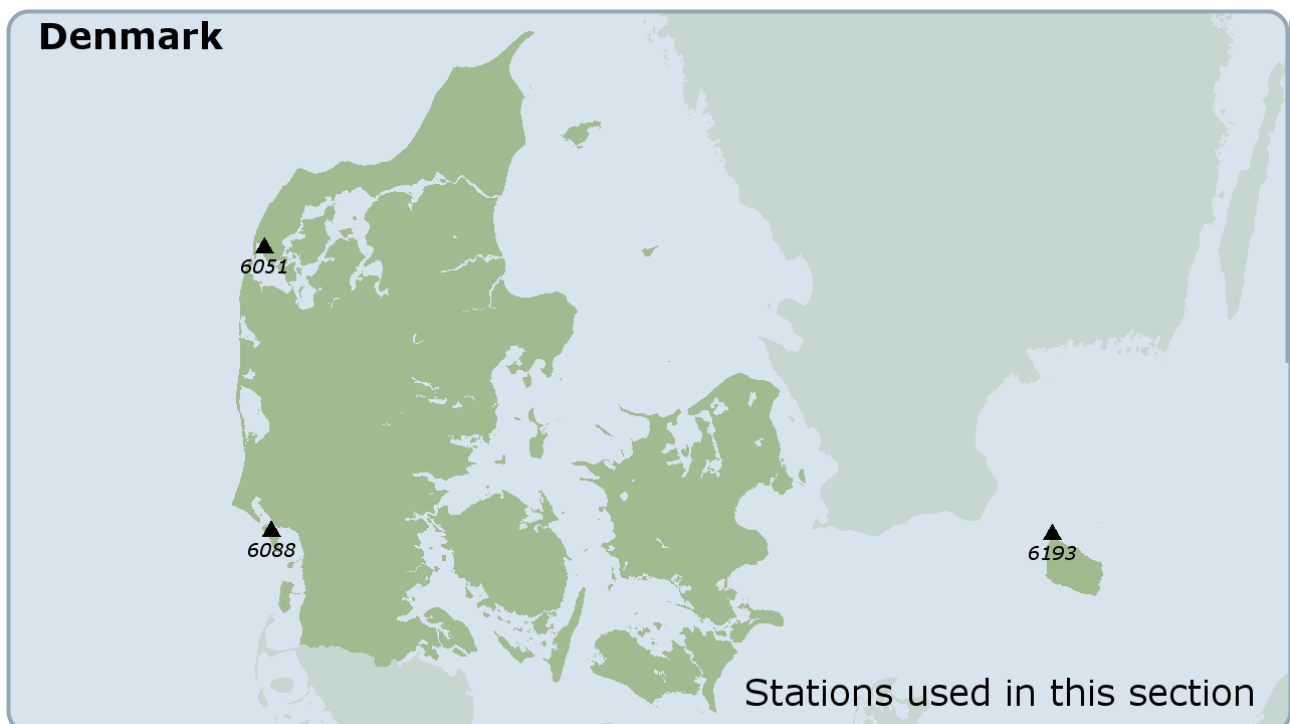
### **The northerly wind**

North is the least frequent wind direction in Denmark. While air from the polar regions is generally cold and dry, it makes a great difference whether the air comes from the north west or from the north east. Since the north-westerly wind comes from the sea, it may be regarded as a colder and drier version of the westerly wind. The north-westerly wind will often only give rise to a few showers and little precipitation, and because of the effect of the Norwegian Mountains it brings dry and sunny weather, particularly to northern Jutland, although this effect may extend as far as Copenhagen. In these situations there will often be showers in south and west Jutland.

By comparison, air from the north and north east more closely resembles a cold and dry version of the typical easterly wind. North-easterly is thus the coldest wind direction in Denmark, and if very cold air from Sweden moves out over, say, the Kattegat, exceptionally heavy showers may form which can lead to prolonged local snowfall. These showers - often called "Kattegat showers" - become heavier the further the air moves over the comparatively warm water.

## 4. Observational Section: Historical DMI Data Collection

| Type        | Data Collections  | Section, Page, Appendix |
|-------------|---|-------------------------|
| Observation | <ul style="list-style-type: none"> <li>Atmospheric pressure (msl)</li> </ul> 3 data sets (blended):<br>6051 Vestervig (1874-2016)<br>6088 Nordby/Fanø (1874-2016)<br>6193 Hammer Odde Fyr (1874-2016) | Sec 4.2.1., p 16, App 2 |



Station based data sets referred to in this section. Only the latest positions are marked. The official WMO station identifiers for Denmark consist of 5 digits "06xxx". However, in this report the in front "0" is omitted, giving 4 digits i.e. "6051" for Vestervig, which is also used on the map. The Danish national station identifiers describing climate stations in Denmark consist of 5 digits. In the old format the station number started with 20-32 dependent on the region i.e. "21100" for the old Vestervig station (see more details in Appendix 1.2 and 2.2).

Latest earlier report:

[21] Cappelen, J. (ed), 2016: Denmark -DMI Historical Climate Data Collection 1873-2015 - with Danish Abstracts. DMI Technical Report No. 16-02.

#### 4.1. Introduction

The purpose of this section is to publish three Danish mean sea level atmospheric pressure data sets; Vestervig, Nordby/Fanø, Hammer Odde Fyr (*observations*) covering the period 1874-2016.

According to the intentions to update regularly, preferably every year, this particular report contains an update (2016 data) of the Danish mean sea level atmospheric pressure series originally published in DMI Technical Report 97-3: North Atlantic-European pressure observations 1868-1995 - WASA dataset version 1.0 [43].

As part of a former project called WASA, selected DMI series of atmospheric pressure observations from Denmark, Greenland and the Faroes 1874-1970 on paper were digitised. The pressure observations were digitised from the meteorological yearbooks, which means that the observations were station level data corrected for index error, air temperature and, since 1893, gravity. From 1971 the pressure data were taken from the DMI Climate Database. The WASA project was originally titled: “The impact of storms on waves and surges: Changing climate in the past 100 years and perspectives for the future” [44].



Figure 4.1.1. Location of the stations that originally provided atmospheric pressure observations to the WASA pressure data set [43]. In this report three updated Danish series Hammer Odde Fyr, Nordby/Fanø and Vestervig are presented. The stations representing these sites are listed in the table 4.2.1. For station co-ordinates confer with the station position file in the data files included in this report (see Appendix 1). Pressure data sets from Tasilaq/Ammassalik, Greenland and Tórshavn, The Faroe Islands are presented in the representative historical Climate Data Collection; DMI Report 17-04 [23] and DMI Report 17-05 [24].

Climate change studies and the related analysis of observed climatic data call for long time series of climate data on all scales, but please note that the digitisation of the observations of atmospheric pressure only can be considered as the first step towards sensible utilisation of the observations for climate change studies. Next follows testing for homogeneity of the series, ensuring that any discovered trend are natural.

During the WASA project the data have been homogenised. The updated series presented in this report have been tested and corrected carefully, mainly based on visual tests. Thus it must be stressed that the updated atmospheric pressure data after the WASA project consist of the values as *observed*, and that no final testing for homogeneity has been performed on these observations for the whole period up to now. They are therefore not necessarily homogenized as such and this should be considered before applying the data series for climate research purposes.

For the benefit of scientists that may wish to conduct such testing various results and remarks concerning observational atmospheric pressure data have been included in the report. For supplementary metadata, see also [43].

The mean sea level atmospheric pressure data sets can be downloaded from the publication part of DMI web pages. Details about the data sets and file formats can be seen in Appendix 2.

## 4.2. Observational data

### 4.2.1. Atmospheric pressure

The Danish atmospheric pressure measurements started 1874 at national climate stations. Measurements of atmospheric pressure were stopped at these manually operated climate stations in 1987. Therefore the atmospheric pressure datasets in table 4.2.1 had to be continued from nearby synoptic stations measuring atmospheric pressure. In the WASA project the data were merged into long homogeneous series seen in table 4.2.1. Appendix 2.2 indicates how the stations were merged and how many observations the series contains in the different parts.

**Important note:** Please be aware that the daily series of atmospheric pressure presented in section 5.2.6 are constructed using the digitised material mentioned above only applying the formulas that can be seen in Appendix 3.3. Other adjustments (Appendix 3.4) have not been applied to the daily value dataset. This is the explanation for small differences between the daily series of atmospheric pressure presented in section 5.3.6 and the daily series that can be calculated using the homogenized atmospheric pressure observations presented here in this section. It is advised for the reader to take this probable need of adjustment into account when using the daily value data set.

Table 4.2.1. Data sets and station series; observations of atmospheric pressure (at msl, mean sea level; element number 401). See details in Appendix 2.

| Dataset*                     | Station series**              | Dataset id  | Period    | Parameter                  |
|------------------------------|-------------------------------|-------------|-----------|----------------------------|
| Vestervig<br>1874-2016       | Vestervig                     | dk_obs_401: | 1874-1987 | Atmospheric pressure (msl) |
|                              | Thyborøn                      | 6051        | 1987-2016 | Atmospheric pressure (msl) |
| Nordby/Fanø<br>1874-2016     | Nordby/Fanø                   | dk_obs_401: | 1874-1987 | Atmospheric pressure (msl) |
|                              | Esbjerg Airport               | 6088        | 1987-2016 | Atmospheric pressure (msl) |
| Hammer Odde Fyr<br>1874-2016 | Sandvig or<br>Hammer Odde Fyr | dk_obs_401: | 1874-1987 | Atmospheric pressure (msl) |
|                              | Hammer Odde Fyr               | 6193        |           |                            |
|                              | Hammer Odde Fyr               |             | 1987-2016 | Atmospheric pressure (msl) |

\*Blended data sets are a part of this observational section, see details in Appendix 2.2.

\*\*Single station series are not a part of this observational section.

*Important note:* During the WASA project the atmospheric pressure datasets 1874-1995 have been homogenised. Since then the updated series presented in this report have been tested and corrected carefully, mainly based on visual tests.

### 4.2.2. Data Dictionary

Table 4.2.2. Element/Parameter used in this section. 'Method' specifies that the parameter is an observation. The units of the observation values in the data files are specified in 'Unit'.

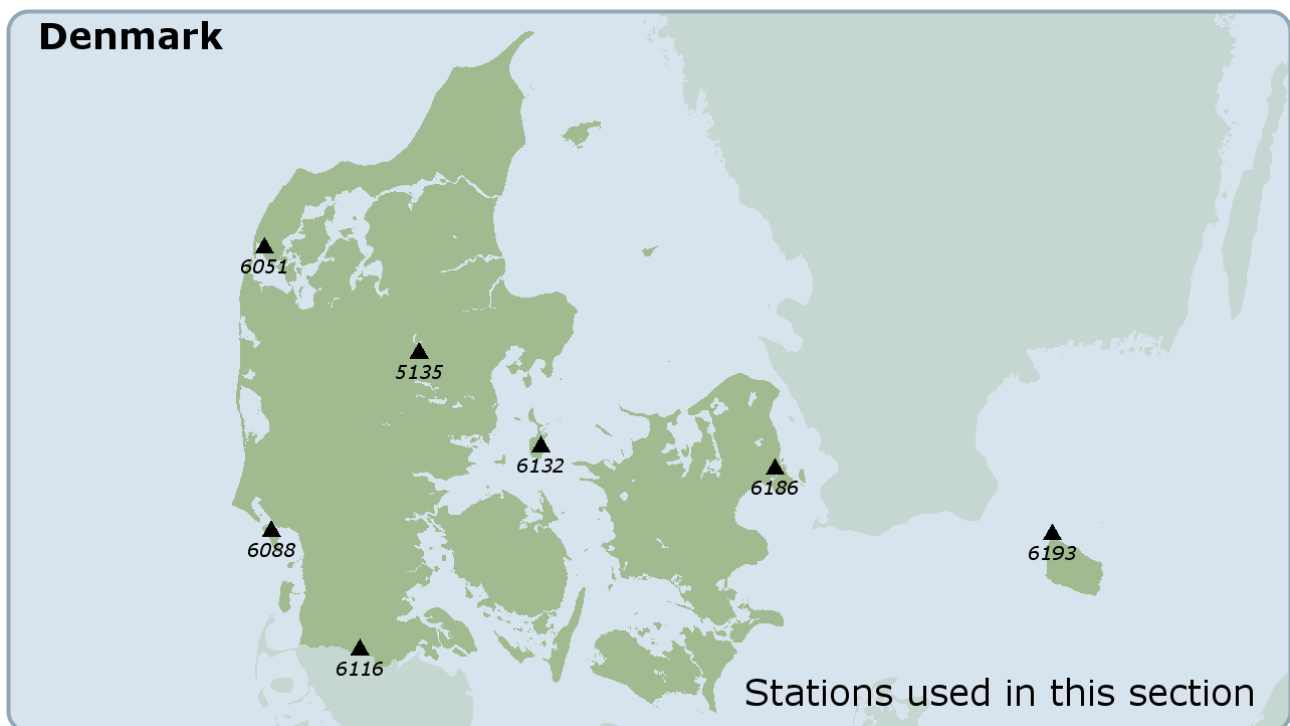
| Element number | Element/Parameter          | Method | Unit |
|----------------|----------------------------|--------|------|
| 401            | Atmospheric pressure (msl) | obs    | hPa  |



## 5. Daily Section: Historical DMI Data Collection

| Type  | Data Collections  | Section, Page, Appendix           |
|-------|---|-----------------------------------|
| Daily | <ul style="list-style-type: none"> <li>• <b>Air temperature 12 UTC (14 DNT)</b><br/>2 data sets (single stations):<br/>27080 Tranebjerg (1872-2003)<br/>6132 Tranebjerg (2003-2016)<br/>1 data set (blended):<br/>6132 Tranebjerg (1872-2016)</li> <li>• <b>Highest air temperature</b></li> <li>• <b>Lowest air temperature</b><br/>22 data sets (single stations):<br/>21100 Vestervig (1874-2003)<br/>6051 Vestervig (2003-2016)<br/>25140 Nordby/Fanø (1874-2003)<br/>6088 Nordby/Fanø (2003-2016)<br/>27080 Tranebjerg (1872-2003)<br/>6132 Tranebjerg (2003-2016)<br/>30380 Landbohøjskolen (1874-1997)<br/>6186 Landbohøjskolen (1995-2016)<br/>32030 Sandvig (1874-1970)<br/>32020 Hammer Odde Fyr (1971-1987)<br/>6193 Hammer Odde (1984-2016)<br/>10 data sets (blended):<br/>6051 Vestervig (1874-2016)<br/>6088 Nordby/Fanø (1874-2016)<br/>5165 Tranebjerg (1872-2016)<br/>6186 København (1874-2016)<br/>6193 Hammer Odde (1874-2016)</li> <li>• <b>Average atmospheric pressure</b><br/>5 data sets (single stations):<br/>21100 Vestervig (1874-1987)<br/>6052 Thyborøn (1961-2016)<br/>25140 Nordby/Fanø (1874-1987)<br/>6080 Esbjerg Airport (1959-2016)<br/>6193 Hammer Odde Fyr (1874-2016)<br/>3 data sets (blended):<br/>6051 Vestervig (1874-2016)<br/>6088 Nordby/Fanø (1874-2016)<br/>6193 Hammer Odde (1874-2016)</li> <li>• <b>Accumulated precipitation</b><br/>15 data sets (single stations):<br/>6051(21100) Vestervig (1874-2016)<br/>5135 (21430) Grønbæk (1874-2016)<br/>6088 (25140) Nordby/Fanø (1874-2016)<br/>26410 Broderup (1920-1993)<br/>26409 Tinglev (1995-2006)<br/>6116 (26400) Store Jyndevad (1987-2016)<br/>27080 Tranebjerg (1872-2001)<br/>6132 (27082) Tranebjerg Øst (2001-2016)<br/>30380 Landbohøjskolen (1874-1996)<br/>30210 Meteorologisk Institut (1875-1922)</li> </ul> | Sec 5.2.1.-5.2.6., p 20-23, App 3 |

|  |   |  |
|--|---|--|
|  | <p>30210 Meteorologisk Institut (1961-1984)<br/> 5735 (30370) Botanisk Have (1961-2016)<br/> 32030 Sandvig (1874-1970)<br/> 32020 Hammer Odde Fyr (1961-1987)<br/> 6193 Hammer Odde (1984-2016)<br/> 7 data sets (blended):<br/> 6051 Vestervig (1874-2016)<br/> 5135 Grønbæk (1874-2016)<br/> 6088 Nordby/Fanø (1874-2016)<br/> 5165 Tranebjerg (1872-2016)<br/> 6116 Store Jyndevad (1920-2016)<br/> 5735 København (1874-2016)<br/> 6193 Hammer Odde (1874-2016)</p> <ul style="list-style-type: none"> <li>• <b>Cloud Cover 8, 14 and 21 DNT</b><br/> 1 dataset (single station):<br/> 6132 Tranebjerg (1872-2000)</li> </ul> |  |
|--|---|--|



Station based data sets referred to in the report. Only the latest positions are marked. The official WMO station identifiers for Denmark consist of 5 digits "06xxx". However, in this report the in front "0" is omitted, giving 4 digits i.e. "6132" for Tranebjerg, which is also used on the map. The Danish national station identifiers describing climate/precipitation stations in Denmark consist of 5 digits, either the new format "05XXX" (the in front "0" is omitted), giving 4 digits i.e. "5135" for Grønbæk or the old format, where the station number started with 20-32 dependent on the region i.e. "27080" for the old Tranebjerg station (see more details in Appendix 1 and 3).

Latest earlier report:

[21] Cappelen, J. (ed), 2016: Denmark -DMI Historical Climate Data Collection 1873-2015 - with Danish Abstracts. DMI Technical Report No. 16-02.

## 5.1. Introduction

The purpose of this section is to publish available long *daily* DMI data series 1873-2016 for Denmark. This includes air temperature, lowest (minimum) and highest (maximum) air temperature, average mean sea level atmospheric pressure, accumulated precipitation and cloud cover.

According to the intentions to update regularly, preferably every year, this particular report contains an update (2016 data) of the “DMI Daily Climate Data Collection” for the first time published in that form in DMI Technical Report 04-03 [37]. A similar collection of long DMI *monthly* and *annual* Danish climate data series can be found in chapter 6 and 7 in this report.

The digitisation of a great part of the data presented in this chapter and also much of the station history presented are results of various projects. The WASA project<sup>1</sup>, ACCORD<sup>2</sup> project, NACD<sup>3</sup> project and the Danish CD-ROM “Vejr&Vind”<sup>4</sup> have all contributed regarding the data from Denmark together with a digitisation during spring 1999 funded by the Danish Climate Centre<sup>5</sup>.

Climate change studies and the related analysis of observed climatic data call for long time series of daily climate data. In this context the report also serves as the DMI contribution of daily values to the European Climate Assessment & Dataset (ECA&D)<sup>6</sup>. ECA&D was initiated by the European Climate Support Network (ECSN<sup>7</sup>) which is a project within the Network of European Meteorological Services (EUMETNET<sup>8</sup>).

Please note that the digitisation of the observations only can be considered as the first step towards sensible utilisation of the observations for climate change studies. Next follows testing for homogeneity of the series, ensuring that any discovered trend are natural. Thus it must be stressed that the series presented here mostly consist of the values *as observed*, and that no testing for homogeneity has been performed on these daily observations. They are therefore not necessarily homogenized as such, and the report description of each series should therefore be read carefully before applying the data series for climate research purposes.

For the benefit of scientists that may wish to conduct such testing various metadata together with homogeneity test results on relevant series of *monthly* data have been included in the report (see Appendix 3.6). For supplementary metadata see also DMI Technical Report 03-24 [35].

The daily station data series can be downloaded from the publication part of DMI web pages. Details about the data sets and file formats can be seen in Appendix 3.

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<sup>1</sup> WASA: ‘The impact of storms on waves and surges: Changing climate in the past 100 years and perspectives for the future’. See [43,44].

<sup>2</sup> EU project number ENV-4-CT97-0530: Atmospheric Circulation Classification and Regional Downscaling. [1]

<sup>3</sup> EU project number EV5V CT93-0277: North Atlantic Climatological Dataset. See [27].

<sup>4</sup> Vejr & Vind. CD-ROM. Munksgaard Multimedia, Copenhagen 1997 [39].

<sup>5</sup> The Danish Climate Centre (DKC) was established 1998 at DMI. DKC was closed 2014 in a reorganisation of DMI.

<sup>6</sup> Project homepage: <http://www.ecad.eu/>

<sup>7</sup> <http://www.eumetnet.eu/ecsn>

<sup>8</sup> <http://www.eumetnet.eu/>

## 5.2. Daily data

### 5.2.1. Air temperature at 14 hours DNT or 12 UTC

Two (2) Danish station series with a record of air temperatures measured at 14 hours DNT (old part of the series) or 12 UTC (= 13 hours DNT, newer part of the series) can be blended into one long dataset. Table 5.2.1 presents an overview of these station data series (identified by the station name and number) and the possible blended datasets making up the long series. Overlap periods in the single station series have been included when available.

*Table 5.2.1. Data sets and station series; air temperature at 14 hours DNT/12 UTC (element number 101). DNT refers to Danish normal time, which is the time in a given time zone in contrast to summer time, where 1 hour is added. In Denmark the normal time is UTC+1. UTC is "Universal Time Coordinated" - a global indication of time, which refers to the mean solar time on the meridian of Greenwich, England, which is the conventional 0-meridian for geographic longitude. See details in Appendix 3.*

| Dataset*                | Station series | Dataset id          | Period    | Parameter                   |
|-------------------------|----------------|---------------------|-----------|-----------------------------|
| Tranebjerg<br>1872-2016 | Tranebjerg     | dk_daily_101: 27080 | 1872-2003 | Air temperature 14DNT/12UTC |
|                         | Tranebjerg Øst | dk_daily_101: 6132  | 2003-2016 | Air temperature 14DNT/12UTC |

*Important note: The single daily station series mostly consist of the values as observed. No DMI testing for homogeneity has been performed on these daily observations. They have however been carefully quality-tested and corrected, mainly based on visual tests.*

*\*Possible blended full daily datasets using the single daily station series are also a part of this daily section. No DMI testing for homogeneity has been performed on the blended series.*

*See the European Climate Assessment & Dataset (ECA&D) project homepage: <http://www.ecad.eu/> for their "blend"/data handling and quality/homogeneity test. This site also contains the single Danish station series.*

### 5.2.2. Highest air temperature

Eleven (11) Danish station series with a record of daily highest air temperatures can be blended into five (5) long datasets. Table 5.2.2 presents an overview of these station data series (identified by the station name and number) and the possible blended datasets making up the long series. Overlap periods in the single station series have been included when available.

*Table 5.2.2. Data sets and station series; daily highest air temperature (element number 112). See details in Appendix 3.*

| Dataset*                     | Station series  | Dataset id          | Period    | Parameter           |
|------------------------------|-----------------|---------------------|-----------|---------------------|
| Vestervig<br>1874-2016       | Vestervig       | dk_daily_112: 21100 | 1874-2003 | Highest temperature |
|                              | Vestervig       | dk_daily_112: 6051  | 2003-2016 | Highest temperature |
| Nordby/Fanø<br>1874-2016     | Nordby/Fanø     | dk_daily_112: 25140 | 1874-2003 | Highest temperature |
|                              | Nordby/Fanø     | dk_daily_112: 6088  | 2003-2016 | Highest temperature |
| Tranebjerg<br>1873-2016      | Tranebjerg      | dk_daily_112: 27080 | 1873-2003 | Highest temperature |
|                              | Tranebjerg Øst  | dk_daily_112: 6132  | 2003-2016 | Highest temperature |
| København<br>1874-2016       | Landbohøjskolen | dk_daily_112: 30380 | 1874-1997 | Highest temperature |
|                              | Landbohøjskolen | dk_daily_112: 6186  | 1995-2016 | Highest temperature |
| Hammer Odde Fyr<br>1874-2016 | Sandvig         | dk_daily_112: 32030 | 1874-1970 | Highest temperature |
|                              | Hammer Odde Fyr | dk_daily_112: 32020 | 1971-1987 | Highest temperature |
|                              | Hammer Odde Fyr | dk_daily_112: 6193  | 1984-2016 | Highest temperature |

*Important note: The single daily station series mostly consist of the values as observed. No DMI testing for homogeneity has been performed on these daily observations. They have however been carefully quality-tested and corrected, mainly based on visual tests.*

*\*Possible blended full daily datasets using the single daily station series are also a part of this daily section.*

No DMI testing for homogeneity has been performed on the blended series.

See the European Climate Assessment & Dataset (ECA&D) project homepage: <http://www.ecad.eu/> for their "blend"/data handling and quality/homogeneity test. This site also contains the single Danish station series.

### 5.2.3. Lowest air temperature

Eleven (11) Danish station series with a record of daily lowest air temperatures can be blended into five (5) long datasets. Table 5.2.3 presents an overview of these station data series (identified by the station name and number) and the possible blended datasets making up the long series. Overlap periods in the single station series have been included when available.

Table 5.2.3. Data sets and station series; daily lowest air temperature (element number 122). See details in Appendix 3.

| Dataset*                     | Station series  | Dataset id          | Period    | Parameter          |
|------------------------------|-----------------|---------------------|-----------|--------------------|
| Vestervig<br>1874-2016       | Vestervig       | dk_daily_122: 21100 | 1874-2003 | Lowest temperature |
|                              | Vestervig       | dk_daily_122: 6051  | 2003-2016 | Lowest temperature |
| Nordby/Fanø<br>1874-2016     | Nordby/Fanø     | dk_daily_122: 25140 | 1874-2003 | Lowest temperature |
|                              | Nordby/Fanø     | dk_daily_122: 6088  | 2003-2016 | Lowest temperature |
| Tranebjerg<br>1872-2016      | Tranebjerg      | dk_daily_122: 27080 | 1872-2003 | Lowest temperature |
|                              | Tranebjerg Øst  | dk_daily_122: 6132  | 2003-2016 | Lowest temperature |
| København<br>1874-2016       | Landbohøjskolen | dk_daily_122: 30380 | 1874-1997 | Lowest temperature |
|                              | Landbohøjskolen | dk_daily_122: 6186  | 1995-2016 | Lowest temperature |
| Hammer Odde Fyr<br>1874-2016 | Sandvig         | dk_daily_122: 32030 | 1874-1970 | Lowest temperature |
|                              | Hammer Odde Fyr | dk_daily_122: 32020 | 1971-1987 | Lowest temperature |
|                              | Hammer Odde Fyr | dk_daily_122: 6193  | 1984-2016 | Lowest temperature |

*Important note: The single daily station series mostly consist of the values as observed. No DMI testing for homogeneity has been performed on these daily observations. They have however been carefully quality-tested and corrected, mainly based on visual tests.*

*\*Possible blended full daily datasets using the single daily station series are also a part of this daily section. No DMI testing for homogeneity has been performed on the blended series.*

See the European Climate Assessment & Dataset (ECA&D) project homepage: <http://www.ecad.eu/> for their "blend"/data handling and quality/homogeneity test. This site also contains the single Danish station series.

### 5.2.4. Average atmospheric pressure

Five (5) Danish station series with a record of average daily atmospheric pressure data can be blended into three (3) long datasets. Table 5.2.4 presents an overview of these station data series (identified by the station name and number) and the possible blended datasets making up the long series. Overlap periods in the single station series have been included when available.

It is common for all three sites that the atmospheric pressure measurements started 1874 at national climate stations. In Denmark measurements of atmospheric pressure was stopped at these manually operated climate stations in 1987. Therefore the atmospheric pressure series had to be continued from nearby synoptic stations measuring atmospheric pressure. One of the series, that of '6193 Hammer Odde Lighthouse', consists of data from stations sufficiently close that it was straightforward to present the data in one series, 1874-2016.

For the other two sites, the synoptic stations are a little further apart from the old climate stations and therefore these two synoptic stations are presented as independent series. In both cases there should nonetheless be sufficient overlap for it to be fairly straightforward for the reader to merge the data into long series for the old Vestervig and Nordby/Fanø sites also, just as it was done for the pressure observations of the WASA project [43], see also section 4.

Table 5.2.4. Data sets and station series; daily atmospheric pressure (at msl, mean sea level; element number 401). In the data files the Hammer Odde series is presented with the station number 6193, 1874-2016. See details in Appendix 3.

| Dataset*                     | Station series  | Dataset id          | Period    | Parameter                   |
|------------------------------|-----------------|---------------------|-----------|-----------------------------|
| Vestervig<br>1874-2016       | Vestervig       | dk_daily_401: 21100 | 1874-1987 | Average atm. pressure (msl) |
|                              | Thyborøn        | dk_daily_401: 6052  | 1962-2016 | Average atm. pressure (msl) |
| Nordby/Fanø<br>1874-2016     | Nordby/Fanø     | dk_daily_401: 25140 | 1874-1987 | Average atm. pressure (msl) |
|                              | Esbjerg Airport | dk_daily_401: 6088  | 1959-2016 | Average atm. pressure (msl) |
| Hammer Odde Fyr<br>1874-2016 | Sandvig or      | dk_daily_401: 32030 | 1874-1987 | Average atm. pressure (msl) |
|                              | Hammer Odde Fyr | dk_daily_401: 32020 |           | Average atm. pressure (msl) |
|                              | Hammer Odde Fyr | dk_daily_401: 6193  | 1987-2016 | Average atm. pressure (msl) |

*Important note: The single daily station series mostly consist of the values as observed. No DMI testing for homogeneity has been performed on these daily observations. They have however been carefully quality-tested and corrected, mainly based on visual tests.*

*\*Possible blended full daily datasets using the single daily station series are also a part of this daily section. No DMI testing for homogeneity has been performed on the blended series.*

*See the European Climate Assessment & Dataset (ECA&D) project homepage: <http://www.ecad.eu/> for their "blend"/data handling and quality/homogeneity test. This site also contains the single Danish station series.*

### 5.2.5. Accumulated precipitation

Fifteen (15) Danish station series with a record of daily accumulated precipitation can be blended into seven (7) long datasets. Table 5.2.5 presents an overview of these station data series (identified by the station name and number) and the possible blended datasets making up the long series. Overlap periods in the single station series have been included when available.

Table 5.2.5. Data sets and station series; daily accumulated precipitation (element number 601). See details in Appendix 3.

| Dataset*                     | Station series      | Dataset id                 | Period    | Parameter                 |
|------------------------------|---------------------|----------------------------|-----------|---------------------------|
| Vestervig<br>1874-2016       | Vestervig           | dk_daily_601: 6051 (21100) | 1874-2016 | Accumulated precipitation |
| Grønbæk<br>1874-2016         | Grønbæk             | dk_daily_601: 5135 (21430) | 1874-2016 | Accumulated precipitation |
| Nordby/Fanø<br>1874-2016     | Nordby/Fanø         | dk_daily_601: 6088 (25140) | 1874-2016 | Accumulated precipitation |
| Store Jyndevad<br>1920-2016  | Broderup            | dk_daily_601: 26410        | 1920-1993 | Accumulated precipitation |
|                              | Tinglev             | dk_daily_601: 26409        | 1995-2006 | Accumulated precipitation |
|                              | Store Jyndevad      | dk_daily_601: 6116 (26400) | 1987-2016 | Accumulated precipitation |
| Tranebjerg<br>1872-2016      | Tranebjerg          | dk_daily_601: 27080        | 1872-2001 | Accumulated precipitation |
|                              | Tranebjerg Øst      | dk_daily_601: 5165 (27082) | 2001-2016 | Accumulated precipitation |
| København<br>1874-2016       | Landbohøjskolen     | dk_daily_601: 30380        | 1874-1996 | Accumulated precipitation |
|                              | Meteorologisk Inst. | dk_daily_601: 30210        | 1875-1922 | Accumulated precipitation |
|                              | Meteorologisk Inst. | dk_daily_601: 30210        | 1961-1984 | Accumulated precipitation |
|                              | Botanisk Have       | dk_daily_601: 5735 (30370) | 1961-2016 | Accumulated precipitation |
| Hammer Odde Fyr<br>1874-2016 | Sandvig             | dk_daily_601: 32030        | 1874-1970 | Accumulated precipitation |
|                              | Hammer Odde Fyr     | dk_daily_601: 32020        | 1961-1987 | Accumulated precipitation |
|                              | Hammer Odde Fyr     | dk_daily_601: 6193         | 1984-2016 | Accumulated precipitation |

*Important note: The single daily station series mostly consist of the values as observed. No DMI testing for homogeneity has been performed on these daily observations. They have however been carefully quality-tested and corrected, mainly based on visual tests.*

*\*Possible blended full daily datasets using the single daily station series are also a part of this daily section. No DMI testing for homogeneity has been performed on the blended series.*

See the European Climate Assessment & Dataset (ECA&D) project homepage: <http://www.ecad.eu/> for their “blend”/data handling and quality/homogeneity test. This site also contains the single Danish station series.

### 5.2.6. Cloud cover at 8, 14 and 21 hours DNT

One Danish station series with a long record of cloud cover at 8, 14 and 21 hours DNT exists. Table 5.2.6 presents an overview of this station data series (identified by the station name and number).

*Table 5.2.6. Data set and station series; cloud cover at 8, 14 and 21 hours DNT (element number 801). DNT refers to Danish normal time, which is the time in a given time zone in contrast to summer time, where 1 hour is added. In Denmark the normal time is UTC+1. See details in Appendix 3.*

| Dataset                 | Station series | Dataset id          | Period    | Parameter              |
|-------------------------|----------------|---------------------|-----------|------------------------|
| Tranebjerg<br>1872-2000 | Tranebjerg     | dk_daily_801: 27080 | 1872-2000 | Cloud cover 8,14,21DNT |

*Important note: The single daily station series mostly consist of the values as observed. No DMI testing for homogeneity has been performed on these daily observations. They have however been carefully quality-tested and corrected, mainly based on visual tests.*

See the European Climate Assessment & Dataset (ECA&D) project homepage: <http://www.ecad.eu/> for their data handling and quality/homogeneity test.

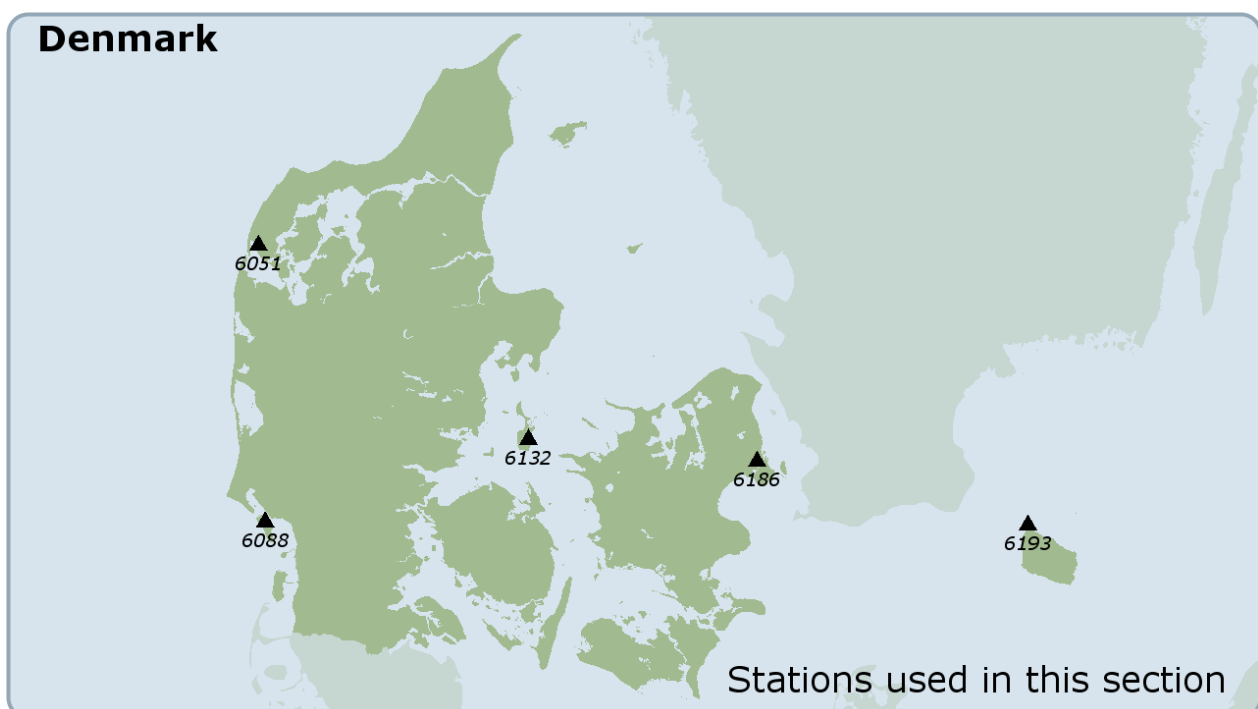
### 5.2.7. Data Dictionary

*Table 5.2.7. Elements/Parameters used in this section. ‘Method’ specifies whether the element is a sum, an average or an extreme. The units of the monthly/annual values in the data files are specified in ‘Unit’.*

| Element number | Element/Parameter                          | Method  | Unit    |
|----------------|--|---------|---------|
| 101            | Air temperature measured at a certain time | obs     | °C      |
| 112            | Highest air temperature                    | max     | °C      |
| 122            | Lowest air temperature                     | min     | °C      |
| 401            | Atmospheric pressure (msl)                 | average | hPa     |
| 601            | Accumulated precipitation                  | sum     | mm      |
| 801            | Cloud cover measured at a certain time     | obs     | various |

## 6. Monthly/Annual Section: Historical DMI Data Collection

| Type               | Data Collections   | Section, Page, Appendix          |
|--------------------|--|----------------------------------|
| Monthly/<br>Annual | <ul style="list-style-type: none"> <li>• Average air temperature</li> <li>• Average daily minimum air temperature</li> <li>• Average daily maximum air temperature</li> <li>• Highest air temperature</li> <li>• Lowest air temperature</li> <li>• Average atmospheric pressure (msl)</li> <li>• Hours of bright sunshine</li> <li>• Accumulated precipitation</li> <li>• Highest 24-hour precipitation</li> <li>• No. of days with snow cover</li> <li>• Average cloud cover</li> </ul> 5 data sets (blended):<br>6051 Vestervig (1874-2016)<br>6088 Nordby/Fanø (1872-2016)<br>6132 Tranebjerg (1873-2016)<br>6186 København (1768-2016)<br>6193 Hammer Odde Fyr (1873-2016) | Sec 6.2.1-6.2.11, p 27-30, App 4 |



Station based data sets referred to in the section. Only the latest positions are marked. The official WMO station identifiers for Denmark consist of 5 digits "06xxx". However, in this report the in front "0" is omitted, giving 4 digits i.e. "6132" for Tranebjerg, which is also used on the map. The Danish national station identifiers describing climate/precipitation stations in Denmark consist of 5 digits, either the new format "05XXX" (the in front "0" is omitted), giving 4 digits i.e. "5165" for Tranebjerg or the old format, where the station number started with 20-32 dependent on the region i.e. "27080" for the old Tranebjerg station (see more in Appendix 1 and 4).

Latest earlier report: [21] Cappelen, J. (ed), 2016: Denmark -DMI Historical Climate Data Collection 1873-2015 - with Danish Abstracts. DMI Technical Report No. 16-02.



## 6.1. Introduction

The purpose of this section is to publish available long *monthly* and *annual* DMI data series 1768-2016 for Denmark. The data parameters include average air temperature, average of minimum and maximum air temperature, lowest and highest air temperature, average atmospheric pressure, accumulated precipitation, highest 24-hour precipitation, hours of bright sunshine, number of days with snow and average cloud cover. Only one data set has data before the 1870s – Copenhagen.

According to the intentions to update regularly, preferably every year, this particular report contains an update (2016 data) of the “DMI Monthly and Annual Climate Data Collection” published for the first time in that form in 1) DMI Technical Report 03-26: DMI Monthly Climate Data Collection 1860-2002, Denmark, The Faroe Island and Greenland. An update of: NACD, REWARD, NORDKLIM and NARP datasets, Version 1, Copenhagen 2003 [29] and 2) DMI Technical Report 05-06: DMI Annual Climate Data Collection 1873-2004, Denmark, The Faroe Islands and Greenland - with Graphics and Danish Abstracts. Copenhagen 2005 [7]. A similar collection of long DMI *daily* Danish climate data series can be found in section 5 in this report.

Some of the monthly data have over the years been published in connection with different Nordic climate projects like NACD (North Atlantic Climatological Dataset [27]), REWARD (Relating Extreme Weather to Atmospheric circulation using a Regionalised Dataset [26]), NORDKLIM (Nordic Co-operation within Climate activities) and NARP (Nordic Arctic Research Programme).

The original DMI Monthly Climate Data Collection published in DMI Technical Report 03-26 [29] was besides a publication of a collection of recommended DMI long monthly data series 1860-2002, also an revision/update of the NACD, REWARD, NORDKLIM and NARP datasets with a clarification on what has been done with the data previously. The method used in this clarification was based on 3 different datasets:

- 1) **Recommended** - a collection of DMI recommended well-documented data series.
- 2) **Observed** - based strictly on raw observations, which have to fulfil certain criteria in terms of frequency etc., in order for arithmetic averages, maximums, minimums etc. to be calculated depending on the parameter. These dataset acts as a baseline, since many of the time-series previously published represent adjusted data, which are not very well documented.
- 3) **Previous** - represents the time-series generated earlier primarily in connection with NACD and REWARD. These time-series are quite complete for the period 1890 – 1995 and many holes have been filled compared to the observed dataset.

The revision/update of those datasets is considered done with the DMI Technical Report 03-26 [29].

**Therefore only already published recommended DMI monthly (and also annual) data series with relevant updates/corrections have been included since and will be included in this and the coming reports comprising DMI monthly and annual data collections from Denmark.**

During some of the former data projects (i.e. NACD) the data have been homogenised based on tests against neighbouring stations.

The updated series presented in this section have been tested and corrected carefully, mainly based on visual tests. Otherwise it is clearly indicated in Appendix 4.2, if care should be taken

when using the series.

Special care should be taken concerning the series with average cloud cover. There are still problems to be solved in the data sets mainly due to the difficult character of the observation – visual back in time and the shift to automatic detection with a ceilometer starting approximately in the beginning of the new millennium. Another visual parameter is observations of snow - the number of days with snow cover. It is however still observed manually in the same manner as all ways. Finally please notice that the recently introduction of automatic rain gauges can have caused small inhomogeneities, not to be discovered in the visual check.

The monthly/annual data sets can be downloaded from the publication part of DMI web pages. Details about the data sets and file formats can be seen in Appendix 4.

## 6.2. Monthly/annual data

### 6.2.1. Average air temperature

Table 6.2.1. Data sets and station series; monthly/annual average air temperature (element number 101). See details in Appendix 4. This counts for all the following tables.

| Dataset*                     | Station series**    | Dataset id                         | Period    | Parameter           |
|------------------------------|---------------------|------------------------------------|-----------|---------------------|
| Vestervig<br>1874-2016       | Vestervig           | dk_monthly_all_<br>1768_2016: 6051 | 1874-2016 | Average temperature |
| Nordby/Fanø<br>1872-2016     | Nordby/Fanø         | dk_monthly_all_<br>1768_2016: 6088 | 1872-2016 | Average temperature |
| Tranebjerg<br>1873-2016      | Tranebjerg          | dk_monthly_all_<br>1768_2016: 6132 | 1873-2003 | Average temperature |
|                              | Tranebjerg Øst      |                                    | 2003-2016 |                     |
| København<br>1768-2016       | Rundetårn           | dk_monthly_all_<br>1768_2016: 6186 | 1768-1819 | Average temperature |
|                              | Gl. Botanisk Have   |                                    | 1820-1859 |                     |
|                              | Landbohøjskolen     |                                    | 1860-2016 |                     |
| Hammer Odde Fyr<br>1873-2016 | Sandvig             | dk_monthly_all_<br>1768_2016: 6193 | 1873-1953 | Average temperature |
|                              | Sandvig/Hammer Odde |                                    | 1953-1960 |                     |
|                              | Hammer Odde Fyr     |                                    | 1961-2016 |                     |

\*Blended monthly data sets part of this monthly/annual section. Count also for the following tables.

\*\*Single station series are not a part of this monthly/annual section. Count also for the following tables.

### 6.2.2. Average daily maximum air temperature

Table 6.2.2. Data sets and station series; monthly/annual average daily max.air temp. (element number 111).

| Dataset*                     | Station series**    | Dataset id                         | Period    | Parameter                     |
|------------------------------|---------------------|------------------------------------|-----------|-------------------------------|
| Vestervig<br>1875-2016       | Vestervig           | dk_monthly_all_<br>1768_2016: 6051 | 1875-2016 | Average daily max temperature |
| Nordby/Fanø<br>1875-2016     | Nordby/Fanø         | dk_monthly_all_<br>1768_2016: 6088 | 1875-2016 | Average daily max temperature |
| Tranebjerg<br>1873-2016      | Tranebjerg          | dk_monthly_all_<br>1768_2016: 6132 | 1873-2003 | Average daily max temperature |
|                              | Tranebjerg Øst      |                                    | 2003-2016 |                               |
| København<br>1861-2016       | Landbohøjskolen     | dk_monthly_all_<br>1768_2016: 6186 | 1861-2016 | Average daily max temperature |
| Hammer Odde Fyr<br>1875-2016 | Sandvig             | dk_monthly_all_<br>1768_2016: 6193 | 1875-1953 | Average daily max temperature |
|                              | Sandvig/Hammer Odde |                                    | 1953-1960 |                               |
|                              | Hammer Odde Fyr     |                                    | 1961-2016 |                               |

### 6.2.3. Highest air temperature

Table 6.2.3. Data sets and station series; monthly/annual highest air temperature (element number 112).

| Dataset*                     | Station series**    | Dataset id                         | Period    | Parameter           |
|------------------------------|---------------------|------------------------------------|-----------|---------------------|
| Vestervig<br>1875-2016       | Vestervig           | dk_monthly_all_<br>1768_2016: 6051 | 1875-2016 | Highest temperature |
| Nordby/Fanø<br>1874-2016     | Nordby/Fanø         | dk_monthly_all_<br>1768_2016: 6088 | 1874-2016 | Highest temperature |
| Tranebjerg<br>1874-2016      | Tranebjerg          | dk_monthly_all_<br>1768_2016: 6132 | 1874-2003 | Highest temperature |
|                              | Tranebjerg Øst      |                                    | 2003-2016 |                     |
| København<br>1861-2016       | Landbohøjskolen     | dk_monthly_all_<br>1768_2016: 6186 | 1861-2016 | Highest temperature |
| Hammer Odde Fyr<br>1874-2016 | Sandvig             | dk_monthly_all_<br>1768_2016: 6193 | 1874-1953 | Highest temperature |
|                              | Sandvig/Hammer Odde |                                    | 1953-1960 |                     |
|                              | Hammer Odde Fyr     |                                    | 1961-2016 |                     |

## 6.2.4. Average daily minimum air temperature

Table 6.2.4. Data sets and station series; monthly/annual average daily minimum air temperature (element number 121).

| Dataset*                     | Station series**    | Dataset id                         | Period    | Parameter                     |
|------------------------------|---------------------|------------------------------------|-----------|-------------------------------|
| Vestervig<br>1875-2016       | Vestervig           | dk_monthly_all_<br>1768_2016: 6051 | 1875-2016 | Average daily min temperature |
| Nordby/Fanø<br>1875-2016     | Nordby/Fanø         | dk_monthly_all_<br>1768_2016: 6088 | 1875-2016 | Average daily min temperature |
| Tranebjerg<br>1873-2016      | Tranebjerg          | dk_monthly_all_<br>1768_2016: 6132 | 1873-2003 | Average daily min temperature |
|                              | Tranebjerg Øst      |                                    | 2003-2016 |                               |
| København<br>1861-2016       | Landbohøjskolen     | dk_monthly_all_<br>1768_2016: 6186 | 1861-2016 | Average daily min temperature |
| Hammer Odde Fyr<br>1873-2016 | Sandvig             | dk_monthly_all_<br>1768_2016: 6193 | 1873-1953 | Average daily min temperature |
|                              | Sandvig/Hammer Odde |                                    | 1953-1960 |                               |
|                              | Hammer Odde Fyr     |                                    | 1961-2016 |                               |

## 6.2.5. Lowest air temperature

Table 6.2.5. Data sets and station series; monthly/annual lowest air temperature (element number 122).

| Dataset*                     | Station series**    | Dataset id                         | Period    | Parameter          |
|------------------------------|---------------------|------------------------------------|-----------|--------------------|
| Vestervig<br>1875-2016       | Vestervig           | dk_monthly_all_<br>1768_2016: 6051 | 1875-2016 | Lowest temperature |
| Nordby/Fanø<br>1875-2016     | Nordby/Fanø         | dk_monthly_all_<br>1768_2016: 6088 | 1875-2016 | Lowest temperature |
| Tranebjerg<br>1873-2016      | Tranebjerg          | dk_monthly_all_<br>1768_2016: 6132 | 1873-2003 | Lowest temperature |
|                              | Tranebjerg Øst      |                                    | 2003-2016 |                    |
| København<br>1861-2016       | Landbohøjskolen     | dk_monthly_all_<br>1768_2016: 6186 | 1861-2016 | Lowest temperature |
| Hammer Odde Fyr<br>1873-2016 | Sandvig             | dk_monthly_all_<br>1768_2016: 6193 | 1873-1953 | Lowest temperature |
|                              | Sandvig/Hammer Odde |                                    | 1953-1960 |                    |
|                              | Hammer Odde Fyr     |                                    | 1961-2016 |                    |

## 6.2.6. Average atmospheric pressure

Table 6.2.6 Data sets and station series; monthly/annual average atmospheric pressure (element number 401).

| Dataset*                     | Station series**     | Dataset id                            | Period    | Parameter                    |
|------------------------------|----------------------|---------------------------------------|-----------|------------------------------|
| Vestervig<br>1874-2016       | Vestervig            | dk_monthly_all_<br>1768_2016: 6051    | 1874-1987 | Average atmospheric pressure |
|                              | Thyborøn             |                                       | 1987-2016 |                              |
| Nordby/Fanø<br>1874-2016     | Nordby/Fanø          | dk_monthly_all_<br>1768_2016: 6088    | 1874-1987 | Average atmospheric pressure |
|                              | Esbjerg/Blåvand/Rømø |                                       | 1987-2016 |                              |
| Tranebjerg<br>1872-2016      | Tranebjerg           | dk_monthly_all_<br>1768_2016: 6132    | 1872-1987 | Average atmospheric pressure |
|                              | Røsnæs Fyr           |                                       | 1987-2016 |                              |
| København<br>1923-2016       | Landbohøjskolen      | dk_monthly_all_<br>1768_2016: 6186    | 1923-1987 | Average atmospheric pressure |
|                              | Københavns Lufthavn  |                                       | 1987-2016 |                              |
| Hammer Odde Fyr<br>1873-2016 | Sandvig              | dk_monthly_all_<br>1768_2016:<br>6193 | 1873-1970 | Average atmospheric pressure |
|                              | Hammer Odde Fyr      |                                       | 1971-1987 |                              |
|                              | Hammer Odde Fyr      |                                       | 1987-2016 |                              |

### 6.2.7. Hours of bright sunshine (Star level)

Table 6.2.7 Data sets and station series; monthly/annual hours of bright sunshine (Star level) (element number 401).

| Dataset*               | Station series**                     | Dataset id                         | Period    | Parameter                   |
|------------------------|--------------------------------------|------------------------------------|-----------|-----------------------------|
| København<br>1876-2016 | Landbohøjskolen (visual obs)         | dk_monthly_all_<br>1768_2016: 6187 | 1876-1887 | Hours of bright<br>sunshine |
|                        | Københavns Toldbod (Campbell-Stokes) |                                    | 1887-2004 |                             |
|                        | Københavns Toldbod (Star)            |                                    | 2005-2016 |                             |

### 6.2.8. Accumulated precipitation

Table 6.2.8. Data sets and station series; monthly/annual accumulated precipitation (element number 601).

| Dataset*                     | Station series**  | Dataset id                         | Period    | Parameter                 |
|------------------------------|-------------------|------------------------------------|-----------|---------------------------|
| Vestervig<br>1874-2016       | Vestervig         | dk_monthly_all_<br>1768_2016: 6051 | 1874-2016 | Accumulated precipitation |
| Nordby/Fanø<br>1872-2016     | Nordby/Fanø       | dk_monthly_all_<br>1768_2016: 6088 | 1872-2016 | Accumulated precipitation |
| Tranebjerg<br>1873-2016      | Tranebjerg        | dk_monthly_all_<br>1768_2016: 6132 | 1873-2001 | Accumulated precipitation |
|                              | Tranebjerg Øst    |                                    | 2001-2016 |                           |
| København<br>1821-2016       | Gl. Botanisk Have | dk_monthly_all_<br>1768_2016: 6186 | 1821-1859 | Accumulated precipitation |
|                              | Landbohøjskolen   |                                    | 1860-1995 |                           |
|                              | Botanisk Have     |                                    | 1996-2016 |                           |
| Hammer Odde Fyr<br>1873-2016 | Sandvig           | dk_monthly_all_<br>1768_2016: 6193 | 1873-1971 | Accumulated precipitation |
|                              | Hammer Odde Fyr   |                                    | 1971-2016 |                           |

### 6.2.9. Highest 24-hour precipitation

Table 6.2.9. Data sets and station series; highest monthly/annual 24-hour precipitation (element number 602).

| Dataset*                     | Station series**  | Dataset id                         | Period    | Parameter                          |
|------------------------------|-------------------|------------------------------------|-----------|------------------------------------|
| Vestervig<br>1874-2016       | Vestervig         | dk_monthly_all_<br>1768_2016: 6051 | 1874-2016 | Highest 24-hour precipita-<br>tion |
| Nordby/Fanø<br>1872-2016     | Nordby/Fanø       | dk_monthly_all_<br>1768_2016: 6088 | 1872-2016 | Highest 24-hour precipita-<br>tion |
| Tranebjerg<br>1873-2016      | Tranebjerg        | dk_monthly_all_<br>1768_2016: 6132 | 1873-2001 | Highest 24-hour precipita-<br>tion |
|                              | Tranebjerg Øst    |                                    | 2001-2016 |                                    |
| København<br>1843-2016       | Gl. Botanisk Have | dk_monthly_all_<br>1768_2016: 6186 | 1843-1859 | Highest 24-hour precipita-<br>tion |
|                              | Landbohøjskolen   |                                    | 1860-1995 |                                    |
|                              | Botanisk Have     |                                    | 1996-2016 |                                    |
| Hammer Odde Fyr<br>1873-2016 | Sandvig           | dk_monthly_all_<br>1768_2016: 6193 | 1873-1971 | Highest 24-hour precipita-<br>tion |
|                              | Hammer Odde Fyr   |                                    | 1971-2016 |                                    |

### 6.2.10. Number of days with snow cover

Table 6.2.10. Data sets and station series; monthly/annual number of days with snow cover (element number 701).

| Dataset*                 | Station series** | Dataset id                         | Period    | Parameter                      |
|--------------------------|------------------|------------------------------------|-----------|--------------------------------|
| Vestervig<br>1939-2016   | Vestervig        | dk_monthly_all_<br>1768_2016: 6051 | 1939-2016 | No. of days with snow<br>cover |
| Nordby/Fanø<br>1957-2016 | Nordby/Fanø      | dk_monthly_all_<br>1768_2016: 6088 | 1957-2001 | No. of days with snow<br>cover |
|                          | Esbjerg Lufthavn |                                    | 2001-2006 |                                |
|                          | Outrup           |                                    | 2007-2016 |                                |
| Tranebjerg<br>1949-2016  | Tranebjerg       | dk_monthly_all_<br>1768_2016: 6132 | 1949-2000 | No. of days with snow<br>cover |
|                          | Tranebjerg Øst   |                                    | 2004-2016 |                                |

|                              |                     |                                    |           |                                |
|------------------------------|---------------------|------------------------------------|-----------|--------------------------------|
| København<br>1938-2016       | Landbohøjskolen     | dk_monthly_all_<br>1768_2016: 6132 | 1938-1996 | No. of days with snow<br>cover |
|                              | Københavns Lufthavn |                                    | 1997-2009 |                                |
|                              | Botanisk Have       |                                    | 2010-2016 |                                |
| Hammer Odde Fyr<br>1939-2016 | Sandvig/Hammer Odde | dk_monthly_all_<br>1768_2016: 6193 | 1939-2002 | No. of days with snow<br>cover |
|                              | Klemensker          |                                    | 2002-2010 |                                |
|                              | Østerlars           |                                    | 2010-2016 |                                |

## 6.2.11. Cloud cover

Table 6.2.11. Data sets and station series; monthly/annual average cloud cover (element number 801).

| Dataset*                     | Station series**    | Dataset id                         | Period    | Parameter           |
|------------------------------|---------------------|------------------------------------|-----------|---------------------|
| Vestervig<br>1874-2016       | Vestervig           | dk_monthly_all_<br>1768_2016: 6051 | 1874-1995 | Average cloud cover |
|                              | Thyborøn            |                                    | 1996-2016 |                     |
| Nordby/Fanø<br>1872-2016     | Nordby/Fanø         | dk_monthly_all_<br>1768_2016: 6088 | 1872-1999 | Average cloud cover |
|                              | Esbjerg Lufthavn    |                                    | 2000      |                     |
|                              | Rømø                |                                    | 2000-2016 |                     |
| Tranebjerg<br>1874-2001      | Tranebjerg          | dk_monthly_all_<br>1768_2016: 6132 | 1872-2000 | Average cloud cover |
|                              | Røsnæs Fyr          |                                    | 2000-2001 |                     |
| København<br>1876-2016       | Landbohøjskolen     | dk_monthly_all_<br>1768_2016: 6186 | 1923-1995 | Average cloud cover |
|                              | Københavns Lufthavn |                                    | 1996-2016 |                     |
| Hammer Odde Fyr<br>1873-2016 | Sandvig             | dk_monthly_all_<br>1768_2016: 6183 | 1873-1889 | Average cloud cover |
|                              | Sandvig/Hammer Odde |                                    | 1890-1995 |                     |
|                              | Hammer Odde Fyr     |                                    | 1996-2016 |                     |

## 6.2.12. Data Dictionary

Table 6.2.12. Elements/Parameters used in this section. 'Method' specifies whether the element is a sum, an average or an extreme. The units of the monthly/annual values in the data files are specified in 'Unit'.

| Element Number | Element/Parameter                            | Method  | Unit  |
|----------------|--|---------|-------|
| 101            | Average air temperature                      | average | °C    |
| 111            | Average of daily maximum air temperature     | average | °C    |
| 112            | Highest air temperature                      | max     | °C    |
| 121            | Average of daily minimum air temperature     | average | °C    |
| 122            | Lowest air temperature                       | min     | °C    |
| 401            | Average atmospheric pressure (msl)           | average | hPa   |
| 504            | Hours of bright sunshine (Star level)        | sum     | hours |
| 601            | Accumulated precipitation                    | sum     | mm    |
| 602            | Highest 24-hour precipitation                | max     | mm    |
| 701            | No. of days with snow cover (> 50 % covered) | sum     | days  |
| 801            | Average cloud cover                          | average | %     |

## 7. Country-wise Section: Historical DMI Data Collection

| Type                           | Data Collections   | Section, Page, Appendix           |
|--------------------------------|--|-----------------------------------|
| Country-wise<br>Monthly/annual | <ul style="list-style-type: none"> <li><b>Country-wise (Denmark) climate data 1874-2016; Average air temperature, Average of minimum and maximum air temperatures, highest/lowest air temperatures, accumulated precipitation, highest 24-hour precipitation and hours of bright sunshine; tables</b></li> </ul> <p>2 data sets:<br/>All months/years 1891-2016 are characterised by a short text as well as the weather during Eastern, Christmas and Midsummer Day. Record breaking months and years are marked and normals 1961-1990, average 2001-2010 and average 2006-2015 are included. The country-wise extremes are calculated separately in a data set</p> <ul style="list-style-type: none"> <li><b>Country-wise (Denmark) climate data 1874-2016; Average air temperature, accumulated precipitation, and hours of bright sunshine</b></li> </ul> <p>4 data sets:<br/>Average air temperature; published (1873-2016)<br/>Average air temperature; corrected (1873-2016)<br/>Accumulated precipitation (1874-2016)<br/>Hours of bright sunshine (1920-2016)</p> | Sec 7.2.1.- 7.2.2, p 33-37, App 5 |

Latest earlier report:

[21] Cappelen, J. (ed), 2016: Denmark - DMI Historical Climate Data Collection 1873-2015 - with Danish Abstracts. DMI Technical Report No. 16-02.

## 7.1. Introduction

The purpose of this section is to publish different *country-wise* (region) monthly and annual climate data. That is:

- Monthly and annual country-wise values of average air temperature, average of minimum and maximum air temperatures, highest/lowest air temperatures, accumulated precipitation, highest 24-hour precipitation and accumulated hours of bright sunshine from Denmark since 1874. In addition every month and year in the period 1891-2016 are characterised by a short text as well as the weather during Eastern, Christmas and Midsummer Day. The different record breaking months and years are also marked. Finally the figures can be compared with the Standard Normal values from the period 1961-90 (latest WMO recommended), average 2001-2010 and average 2006-2015.
- Climate extremes from the above material separately.

Country-wise values also regularly form part (graphical) of the yearly publication “Danmarks Klima”. The newest one published in 2017 is DMI Rapport 17-01: Danmarks klima 2017 – with English Summary. København 2017 [22].

According to the intentions to update regularly, preferably every year, this particular section contains an annual update (2016 data) of the monthly and annual selected country-wise values published for the first time in that form in 1) DMI Teknisk Rapport 06-02: Dansk vejr siden 1874 – måned for måned med temperatur, nedbør og soltimer samt beskrivelser af vejret - with English translations. København 2006 [13] and 2) “DMI Annual Climate Data Collection” published for the first time in that form in DMI Technical Report 05-06: DMI Annual Climate Data Collection 1873-2004, Denmark, The Faroe Islands and Greenland - with Graphics and Danish Abstracts. Copenhagen 2005 [12].

The country-wise data sets can be downloaded from the publication part of DMI web pages. Details about the data sets and file formats can be seen in Appendix 5. The country-wise graphics can be seen in section 8.



## 7.2. Country-wise data

The Danish Meteorological Institute (DMI) has since the beginning in 1872 observed various weather elements at different observation sites in Denmark. These observations have over the years been the basis for the calculation of different country-wise values as i.e. air temperature, precipitation and hours of bright sunshine. Every year since 1874 DMI has continuously published meteorological country-wise values (averages and extremes) for Denmark as a whole, calculated using a selection of stations. In this section country-wise monthly and annual values for Denmark for the period 1874–2016 and for the parameters mentioned in table 7.2.1.2, table 7.2.1.4 and table 7.2.1.7 are described.

In 1991 monthly and annual country-wise values of air temperature, precipitation and hours of bright sunshine supplemented by a short description of the weather were published in the book “Dansk Vejr i 100 år” [41]. The period covered was 1891-1990. The last 6<sup>th</sup> edition of the book was published in 2000, covering the period 1891- August 2000. This climate information from this latest 6<sup>th</sup> edition has been the data source for this report supplemented with information covering the period 1874 - 1890 and September 2000 – December 2016. Those the whole period from 1874 – 2016 are covered. In 2007 the book “Dansk Vejr i 100 år – i tekst og billeder” [42] was published, covering the period 1907- 2007. Minor insignificant differences, compared to the information in this DMI report, can be found in this “latest version” of the first book from 1991.

Looking back in history the calculations of the different parameters always have been based upon the existing station- and data availability at that specific time. Furthermore different methods of data weighting have been used. The selection of stations back in time and the different methods of the calculations have never been published and for that reason the exact details concerning the meteorological parameters for the country as a whole partly are unknown. Since 1950s and up till 2006 (inclusive) it is however known, that methods and data more or less look like today what concerns the area weighting – data from Jutland are weighted with 7/10 and data from the islands with 3/10 (see below for more information). From 2007 the country-wise average values of air temperature, precipitation and hours of bright sunshine are based on interpolation of station data in a fine-meshed grid covering Denmark. The highest and lowest air temperatures are off course still directly measured values.

### 7.2.1. Tables; country-wise monthly/annual climate data

Table 7.2.1.1. Table product; country-wise monthly/annual climate data in table. Details in Appendix 5.

| Product*                                   | Dataset id       | Period    | Parameters        |
|--|------------------|-----------|-------------------|
| Table; Country-wise climate data 1874-2016 | dk_country_table | 1874-2016 | See table 7.2.1.2 |

\*Blended datasets. Only in Danish

Table 7.2.1.2. Elements/Parameters and units used in the dataset described in table 7.2.1.1. Method' specifies whether the element is a sum, an average or an extreme. The units of the monthly/annual values in the data file are specified in 'Unit'. Year of first appearance is also added.

| Element Number | Element/Parameter                                 | Method  | Unit  | First year |
|----------------|---|---------|-------|------------|
| 101            | Average air temperature                           | average | °C    | 1874       |
| 111            | Average of daily maximum air temperature          | average | °C    | 1953       |
| 112            | Highest air temperature                           | max     | °C    | 1874       |
| 121            | Average og daily minimum air temperature          | average | °C    | 1953       |
| 122            | Lowest air temperature                            | min     | °C    | 1874       |
| 504            | Accumulated hours of bright sunshine              | sum     | hours | 1920       |
| 601            | Accumulated precipitation                         | sum     | mm    | 1874       |
| 602            | Highest 24-hour precipitation at a single station | max     | mm    | 1874       |

Figure 7.2.1.1. Example (2011 data) of the country-wise monthly and annual climate data 1874-2016 in table which contain values of air temperature, precipitation and hours of bright sunshine, weather describing text and weather records. The figures can be compared with the Standard Normal values from the period 1961-90 (latest WMO recommended), average 2001-10 and average 2006-15 by moving the cursor to the figure. Every month and year in the period 1891-2016 are characterised by a short text as well as the weather during Eastern, Christmas and Midsummer Day. The different record breaking months and years are also marked. (only in Danish).

| 2011 | Året      | Varmt og solrigt med overskud af nedbør. Rekordvarm april og rekordhøj maksimum temperatur i oktober. Tør april og november og andenvædeste sommer. | 9,0  | 28,2  | -16,5 | 12,1 | 5,8  | 779 | 135,4 | 1683 |           |         |   |
|------|-----------|---|------|-------|-------|------|------|-----|-------|------|-----------|---------|---|
| 2011 | Januar    | Solrig med underskud af nedbør og lidt over normal temperatur.  | 0,3  | 9,8   | -12,4 | 2,4  | -2,1 | 46  | 16,8  | 72   |           |         |   |
| 2011 | Februar   | Solunderskud, ellers normal.  | -0,1 | 9,6   | -16,5 | 1,6  | -2,2 | 40  | 20,2  | 52   |           |         |   |
| 2011 | Marts     | Varm, tør og solrig.  | 3,1  | 15,3  | -7,6  | 6,1  | 0,2  | 31  | 16,4  | 143  |           |         |   |
| 2011 | April     | R Rekordvarm, meget solrig og tør.  | ▲9,9 | 22,5  | -1,6  | 14,5 | 5,5  | 16  | 25,8  | 253  | Påske     | 21.-25. | Solrig, varm og tør. Middeltemp.: 13,6 °C. Soltimer: 63.            |
| 2011 | Maj       | Frost, sommer og sol.   | 11,4 | 26,2  | -3,2  | 15,6 | 7,3  | 54  | 26,9  | 239  |           |         |   |
| 2011 | Juni      | Varm med overskud af nedbør og sol.   | 15,1 | 28,2  | 2,6   | 19,2 | 11,1 | 76  | 89,6  | 252  | Sct. Hans |         | Svag til let vind, for det meste tørt, få spredte småbyger, 10-15°C |
| 2011 | Juli      | Syvende vådeste med overskud af varme og underskud af sol.  | 16,4 | 27,1  | 6,2   | 20,1 | 13,0 | 113 | 135,4 | 171  |           |         |   |
| 2011 | August    | Meget våd og solfattig med overskud af varme.   | 16,1 | 27,6  | 4,9   | 19,8 | 12,9 | 132 | 74,8  | 150  |           |         |   |
| 2011 | September | Lun og våd.   | 14,1 | 25,9  | 3,8   | 17,5 | 10,8 | 92  | 54,2  | 135  |           |         |   |
| 2011 | Oktober   | R Varm og meget solrig med underskud af nedbør.   | 9,8  | ▲26,9 | -2,6  | 13,0 | 6,2  | 61  | 29,4  | 130  |           |         | Rekord den 1. i St. Jydevad   |
| 2011 | November  | Meget tør, mild og grå.   | 6,7  | 14,6  | -3,9  | 8,5  | 4,6  | 18  | 13,8  | 37   |           |         |   |
| 2011 | December  | Varm og våd.  | 4,2  | 11,3  | -5,1  | 6,1  | 1,9  | 99  | 32,4  | 50   | Julen     |         | Meget lurt ca. 5-10°C, blæsende fra sydvest med lidt sol og nedbør  |

The country-wise climate extremes from the above material are published separately. See table 7.2.1.3 for the data set and table 7.2.1.4 for the parameters.

Table 7.2.1.3. Table product; country-wise monthly/annual climate extremes. See details in Appendix 5.

| Product*                                       | Dataset id          | Period    | Parameters        |
|--|---------------------|-----------|-------------------|
| Table; Country-wise climate extremes 1874-2016 | dk_country_extremes | 1874-2016 | See table 7.2.1.4 |

\*only in Danish

Table 7.2.1.4. Elements/Parameters and units used in the dataset described in table 7.2.1.3. Method' specifies whether the element is a sum, an average or an extreme. The units of the monthly/annual values in the data file are specified in 'Unit'. Year of first appearance is also added.

| Element Number | Element/Parameter                                 | Method | Unit  | First year |
|----------------|---|--------|-------|------------|
| 101            | Highest average of air temperature                | max    | °C    | 1874       |
| 101            | Lowest average of air temperature                 | min    | °C    | 1874       |
| 112            | Highest air temperature                           | max    | °C    | 1874       |
| 122            | Lowest air temperature                            | min    | °C    | 1874       |
| 504            | Highest accumulated hours of bright sunshine      | max    | hours | 1920       |
| 504            | Lowest accumulated hours of bright sunshine       | min    | hours | 1920       |
| 601            | Highest accumulated precipitation                 | max    | mm    | 1874       |
| 601            | Lowest accumulated precipitation                  | min    | mm    | 1874       |
| 602            | Highest 24-hour precipitation at a single station | max    | mm    | 1874       |

Figure 7.2.1.2. Country-wise climate extremes 1874-2016. (only in Danish)

| Rekorder siden 1874 (solskintimer siden 1920).  |                  |           |                        |              |                      |                         |   |           |                   |                            |                      |         |      |
|---|------------------|-----------|------------------------|--------------|----------------------|-------------------------|---|-----------|-------------------|----------------------------|----------------------|---------|------|
|   | Jan              | Feb       | Mar                    | Apr          | Maj                  | Jun                     | Jul                                     | Aug       | Sep               | Okt                        | Nov                  | Dec     | År   |
| <b>Absolut højeste temperatur</b>               |                  |           |                        |              |                      |                         |   |           |                   |                            |                      |         |      |
| °C  | 12,4             | 15,8      | 22,2                   | 28,6         | 32,8                 | 35,5                    | 35,3                                    | 36,4      | 32,3              | 26,9                       | 18,5                 | 14,5    |      |
| år  | 2005             | 1990      | 1990                   | 1993         | 1892                 | 1947                    | 1941                                    | 1975      | 1906              | 2011                       | 1968                 | 1953    |      |
| sted  | Sønderborg       | København | Karup                  | Holbæk       | Herning              | Hillerød                | Erslev (Mors)<br>Studsgård<br>v/Herning | Holstebro | Randers           | St. Jyndeved               | Faksinge<br>v/Præstø | Nordby  |      |
| <b>Absolut laveste temperatur</b>               |                  |           |                        |              |                      |                         |   |           |                   |                            |                      |         |      |
| °C  | -31,2            | -29,0     | -27,0                  | -19,0        | -8,0                 | -3,5                    | -0,9                                    | -2,0      | -5,6              | -11,9                      | -21,3                | -25,6   |      |
| år  | 1982             | 1942      | 1888                   | 1922         | 1900                 | 1936                    | 1903                                    | 1885      | 1886              | 1880                       | 1973                 | 1981    |      |
| sted  | Hørsted<br>i Thy | Brande    | Søndersted<br>v/Holbæk | St. Vildmose | Gludsted<br>Plantage | Klosterhede<br>Plantage | Gludsted<br>Plantage                    | Varde     | Aalborg           | Torstedlund<br>v/Rold Skov | Egvad<br>v/Tarm      | Devling |      |
| <b>Højeste middeltemperatur måned/år</b>        |                  |           |                        |              |                      |                         |   |           |                   |                            |                      |         |      |
| °C  | 5,0              | 5,5       | 6,1                    | 9,9          | 13,8                 | 18,2                    | 19,8                                    | 20,4      | 16,2              | 12,2                       | 8,1                  | 7,0     | 10,0 |
| år  | 2007             | 1990      | 1990/2007              | 2011         | 1889                 | 1889                    | 2006                                    | 1997      | 1999/2006<br>2016 | 2006                       | 2006                 | 2006    | 2014 |
| <b>Laveste middeltemperatur måned/år</b>        |                  |           |                        |              |                      |                         |   |           |                   |                            |                      |         |      |
| °C  | -6,6             | -7,1      | -3,5                   | 2,5          | 8,1                  | 10,7                    | 13,6                                    | 12,8      | 10,0              | 5,2                        | 0,7                  | -4,0    | 5,9  |
| år  | 1942             | 1947      | 1942                   | 1888         | 1902                 | 1923                    | 1979                                    | 1902      | 1877              | 1905                       | 1919                 | 1981    | 1879 |
| <b>Flest solskintimer måned/år</b>              |                  |           |                        |              |                      |                         |   |           |                   |                            |                      |         |      |
| timer   | 100              | 140       | 200                    | 272          | 347                  | 303                     | 321                                     | 291       | 201               | 162                        | 88                   | 81      | 1878 |
| år  | 1963             | 1932      | 1943                   | 2009         | 2008                 | 1940                    | 2006                                    | 1947      | 2002/2016         | 2005                       | 1989                 | 2010    | 1947 |
| <b>Færrest solskintimer måned/år</b>            |                  |           |                        |              |                      |                         |   |           |                   |                            |                      |         |      |
| timer   | 14               | 12        | 50                     | 84           | 103                  | 107                     | 137                                     | 113       | 74                | 26                         | 19                   | 8       | 1287 |
| år  | 1969             | 1926      | 1963                   | 1937         | 1983                 | 1987                    | 1922                                    | 1980      | 1998              | 1976                       | 1993                 | 1959    | 1987 |
| <b>Største nedbørmængde måned/år</b>            |                  |           |                        |              |                      |                         |   |           |                   |                            |                      |         |      |
| mm  | 123              | 109       | 100                    | 98           | 138                  | 124                     | 140                                     | 167       | 162               | 177                        | 155                  | 140     | 905  |
| år  | 2007             | 2002      | 1978                   | 1936         | 1983                 | 2007                    | 1931                                    | 1891      | 1994              | 1967                       | 1969                 | 1985    | 1999 |
| <b>Mindste nedbørmængde måned/år</b>            |                  |           |                        |              |                      |                         |   |           |                   |                            |                      |         |      |
| mm  | 6                | 2         | 7                      | 3            | 9                    | 1                       | 15                                      | 10        | 18                | 12                         | 13                   | 7       | 466  |
| år  | 1996/1997        | 1932      | 1918/1969              | 1893/1974    | 1959                 | 1992                    | 1904/1983<br>1994                       | 1947      | 1933              | 1922                       | 1902                 | 1890    | 1947 |
| <b>Største 24 timers nedbør på én lokalitet</b> |                  |           |                        |              |                      |                         |   |           |                   |                            |                      |         |      |
| mm  | 50,0             | 61,8      | 54,8                   | 66,5         | 94,0                 | 153,1                   | 168,9                                   | 151,2     | 132,7             | 100,8                      | 62,3                 | 74,6    |      |
| år  | 1886             | 1881      | 1970                   | 1969         | 2007                 | 1880                    | 1931                                    | 1959      | 1968              | 1982                       | 1981                 | 2010    |      |

Samtlige rekorder er relateret til DMI målestationer.

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When compared to earlier published key country-wise values minor changes can be found. This can be related to an ongoing quality control of data.

The country-wise sunshine values have been corrected compared to earlier published material. The instruments for registration of hours of bright sunshine have been changed several times since 1920. In 2002 DMI converted to a new, automatic and more precise measuring method. That introduced a very large gap between old and new measurements. At the same time the opportunity to correct all the “old” sunshine values also was exploited in such a way so the time series of hours of bright sunshine now can be compared from 1920 to now. This report contains this new data set of hours of bright sunshine. The correction of hours of bright sunshine is also described in details in DMI Technical Report 03-19 [34].

It should also be mentioned that both corrected and uncorrected country-wise air temperature values exist as two separate published series. In the report “Danmarks Klima 1991” [10], an examination of air temperature for Denmark as a whole is described on page 40 in the chapter “Danmarks middelterperatur i perspektiv”. The examination pointed out, that in order to compare values of that parameter on a time scale, it would be necessary to correct the values in periods where a different area weighting has been used.

In the period 1873-1956 the average air temperatures for Denmark as a whole have been calculated using 25 well distributed stations, one half in Jutland and the rest on the Islands. Thus the area weighting at that time was 5/10 for both Jutland and the Islands. In 1957 there was a change. From that year and until 1975; 20 stations was used in Jutland and 10 from the Islands.

In the period 1976-1986 the basis was about 100 stations, where Jutland was weighted with 7/10 and the Islands 3/10. This area weighting reflects that the area of Jutland accounts for about 7/10 of Denmark.

Since 1987 an area weighting using about 20 stations in Jutland and 10 stations on the Islands once more have been used. From 2007 a change for some parameters have been introduced, see above.

Nevertheless the examination described above concluded that only the change in 1957 requires a correction. By comparing the figures before and after 1956/1957, correction factors (in degrees Celsius) were given, which can be added to average air temperatures for Denmark in the period 1873-1956 (see the table 7.2.1.5). The correction factors have been added to the air temperature series in some cases, but not all. Consequently the Danish air temperature series from 1873 since the beginning of the 1990s have existed in 2 versions – one with correction and one without.

In general corrected data have been used in all presentations of the air temperature series on a time scale, while the uncorrected data have been used in all the cases, where it was important to compare the values with already published data in yearbooks back in time.

*Table 7.2.1.5. Correction factors (in degrees Celsius), which can be added to the average air temperatures for Denmark in the period 1873-1956.*

| Jan   | Feb   | Mar   | Apr   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   | Year  |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| -0,06 | -0,01 | -0,04 | -0,07 | -0,09 | -0,20 | -0,21 | -0,18 | -0,14 | -0,15 | -0,14 | -0,15 | -0,12 |

### 7.2.2. Data series; country-wise monthly/annual climate data

Table 7.2.2.1 describes the monthly and annual data set where country-wise values of published/corrected air temperature, accumulated precipitation and hours of bright sunshine are included.

*Table 7.2.2.1. Data set; country-wise monthly/annual climate data series. See details in Appendix 5.*

| Dataset*                               | Dataset id                 | Period    | Parameters        |
|--|----------------------------|-----------|-------------------|
| Country-wise climate data<br>1873-2016 | dk_country_dataseriers_tps | 1873-2016 | See table 7.2.1.7 |

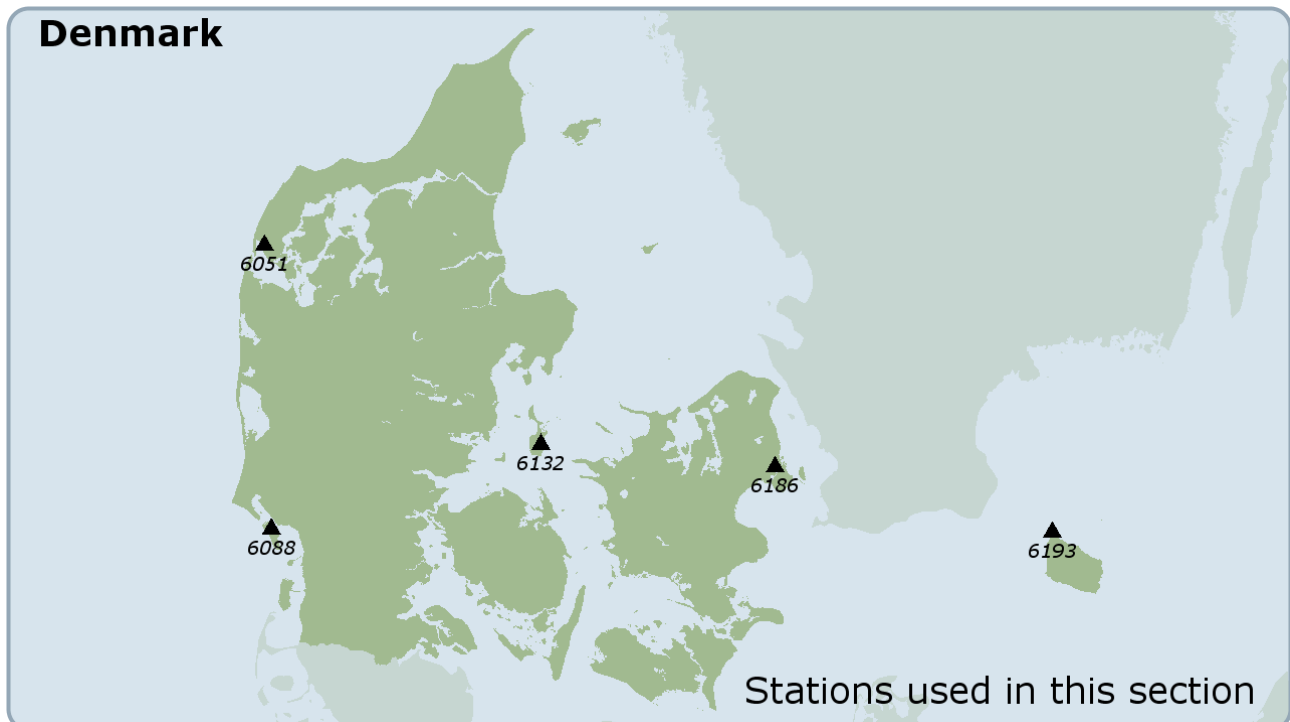
\*Blended datasets.

*Table 7.2.2.1. Elements/Parameters and units used in the dataset described in table 7.2.2.1. Method' specifies whether the element is a sum or an average. The units of the monthly/annual values in the data file are specified in 'Unit'. Year of first appearance is also added.*

| Element Number | Element/Parameter                   | Method  | Units | First year |
|----------------|-------------------------------------|---------|-------|------------|
| 101            | Average air temperature (published) | average | °C    | 1873       |
| 101            | Average air temperature (corrected) | average | °C    | 1873       |
| 601            | Accumulated precipitation           | sum     | mm    | 1874       |
| 504            | Hours of bright sunshine            | sum     | hours | 1920       |

## 8. Graphics Section: Historical DMI Data Collection

| Type                | Data Collections  | Section, Page, Appendix                             |
|---------------------|---|---|
| Graphics/<br>Annual | <ul style="list-style-type: none"> <li>• <b>Average air temperature; graph</b><br/>7 data sets (blended):<br/>6051 Vestervig (1874-2016)<br/>6088 Nordby/Fanø (1872-2016)<br/>6132 Tranebjerg (1873-2016)<br/>6186 København (1768-2016)<br/>6193 Hammer Odde Fyr (1873-2016)<br/>Country-wise; published (1873-2016)<br/>Country-wise; corrected (1873-2016)</li> <br/> <li>• <b>Accumulated hours of bright sunshine; graph</b><br/>2 data set (blended):<br/>6186 København (1920-2016)<br/>Country-wise (1920-2016)</li> <br/> <li>• <b>Accumulated precipitation; graph</b><br/>6 data sets (blended):<br/>6051 Vestervig (1874-2016)<br/>6088 Nordby/Fanø (1872-2016)<br/>6132 Tranebjerg (1873-2016)<br/>6186 København (1821-2016)<br/>6193 Hammer Odde Fyr (1873-2016)<br/>Country-wise (1874-2016)</li> </ul> | Section, Page, Appendix<br>Sec 8.2., p 40-41, App 6 |



*Station based data sets referred to in this section. Only the latest positions are marked. The official WMO station identifiers for Denmark consist of 5 digits "06xxx". However, in this report the in front "0" is omitted, giving 4 digits i.e. "6132" for Tranebjerg, which is also used on the map. The Danish national station identifiers describing climate/precipitation stations in Denmark consist of 5 digits, either the new format "05XXX" (the in front "0" is omitted), giving 4 digits i.e. "5165" for Tranebjerg or the old format, where the station number started with 20-32 dependent on the region i.e. "27080" for the old Tranebjerg station (see more in Appendix 1 and 4).*

Latest earlier report:

[21] Cappelen, J. (ed), 2016: Denmark -DMI Historical Climate Data Collection 1873-2015 - with Danish Abstracts. DMI Technical Report No. 16-02.

## 8.1. Introduction

The purpose of this section is to publish different *graphics* based on annual climate data from Denmark. That is:

- Annual average air temperature, annual accumulated precipitation and annual hours of bright sunshine within the period 1784-2016 for Denmark.

According to the intentions to update regularly, preferably every year, this particular report contains an update (2016 data) of the “DMI Climate Data Graphics Collection” published for the first time in that form in DMI Technical Report 05-06: DMI Annual Climate Data Collection 1873-2004, Denmark, The Faroe Islands and Greenland - with Graphics and Danish Abstracts. Copenhagen 2005 [12].

Five (5) meteorological stations with a long record of air temperature have been operated in Denmark, four of them since the 19th century, one of them since the 18th century. The longest series have digitised records back to 1768 (the Danish Meteorological Institute (DMI) was established 1872. Five (5) meteorological stations with a long record of precipitation have been operated in Denmark since the 19th century, one of them back to 1821. One (1) meteorological station with a long record of hours of bright sunshine has been operated in Denmark since 1876. Country-wise annual values of average air temperature, accumulated precipitation and hours of bright sunshine can be found back to 1873.

It is obvious that the quality and homogeneity of the series have been affected in various degrees. The series have been corrected in the best possible way i.e. in connection with:

- The development of the North Atlantic Climatological Dataset: DMI Scientific Report 96-1: North Atlantic Climatological Dataset (NACD Version 1) - Final report. Copenhagen 1996 [27]
- The regularly publication of the DMI historical monthly data collection in section 6.
- The regularly publication of climatological yearbooks back in time.

The graphics can be downloaded from the publication part of DMI web pages. Details about the graphics can be seen in Appendix 6.

## 8.2. Annual graphics

Annual graphics are available for three (3) parameters; average air temperature, accumulated precipitation and hours of bright sunshine within the period 1768-2016 both for country-wise and for five (5) air temperature data sets, five (5) precipitation data sets and one (1) hours of bright sunshine data set. The graphs are available in an English version.

*Table 8.2.1. Graphical products; country-wise annual average air temperature (element number 101), accumulated precipitation (element number 601) and hours of bright sunshine (element number 504). See details in Appendix 6.*

| Product*   | Graph id                                 | Period    | Parameter                     |
|--|--|-----------|-------------------------------|
| Graph; country-wise (temperature; published) 1873-2016 | dk_graph_annual_pub temperature_country  | 1873-2016 | Average temperature           |
| Graph; country-wise (temperature; corrected) 1873-2016 | dk_graph_annual_corr temperature_country | 1873-2016 | Average temperature           |
| Graph; country-wise (precipitation) 1873-2016          | dk_graph_annual_ precipitation_country   | 1873-2016 | Accumulated precipitation     |
| Graph; country-wise (sunshine) 1920-2016               | dk_graph_annual_ sunshine_country        | 1920-2016 | Acc. hours of bright sunshine |

\* *Blended datasets. Graph (English version).*



Table 8.2.2. Graphical products; annual average air temperatures (element number 101). See details in Appendix 6.

| Product*                               | Station series                | Graph id                             | Period    | Parameter           |
|--|-------------------------------|--------------------------------------|-----------|---------------------|
| Graph; Vestervig<br>1874-2016          | Vestervig                     | dk_graph_annual_<br>temperature_6051 | 1874-2016 | Average temperature |
| Graph; Nordby (Fanø)<br>1872-2016      | Nordby (Fanø)                 | dk_graph_annual_<br>temperature_6088 | 1872-2016 | Average temperature |
| Graph; Tranebjerg (Samsø)<br>1873-2016 | Tranebjerg<br>(Samsø)         | dk_graph_annual_<br>temperature_6132 | 1873-2016 | Average temperature |
| Graph; København<br>1768-2016          | København                     | dk_graph_annual_<br>temperature_6186 | 1768-2016 | Average temperature |
| Graph; Hammer Odde Fyr<br>1873-2016    | Hammer Odde Fyr<br>(Bornholm) | dk_graph_annual_<br>temperature_6193 | 1873-2016 | Average temperature |

\*Graph (English version).

Table 8.2.3. Graphical products; hours of bright sunshine (element number 504). See details in Appendix 6.

| Dataset*                      | Station series     | Dataset id                        | Period    | Parameter                                |
|-------------------------------|--------------------|-----------------------------------|-----------|--|
| Graph; København<br>1876-2016 | Københavns toldbod | dk_graph_annual_<br>sunshine_6186 | 1876-2016 | Acc. hours of bright sun-<br>shine hours |

\*Graph (English version).

Table 8.2.4. Graphical products; annual accumulated precipitation (element number 601). See details in Appendix 6.

| Product*                               | Station series                | Graph id                               | Period    | Parameter                 |
|--|-------------------------------|--|-----------|---------------------------|
| Graph; Vestervig<br>1874-2016          | Vestervig                     | dk_graph_annual_<br>precipitation_6051 | 1874-2016 | Accumulated precipitation |
| Graph; Nordby (Fanø)<br>1872-2016      | Nordby (Fanø)                 | dk_graph_annual_<br>precipitation_6088 | 1872-2016 | Accumulated precipitation |
| Graph; Tranebjerg (Samsø)<br>1873-2016 | Tranebjerg<br>(Samsø)         | dk_graph_annual_<br>precipitation_6132 | 1873-2016 | Accumulated precipitation |
| Graph; København<br>1821-2016          | København                     | dk_graph_annual_<br>precipitation_6186 | 1821-2016 | Accumulated precipitation |
| Graph; Hammer Odde Fyr<br>1873-2016    | Hammer Odde Fyr<br>(Bornholm) | dk_graph_annual_<br>precipitation_6193 | 1873-2016 | Accumulated precipitation |

\*Graph (English version).

The annual data behind the graphics are described in section 6 and 7 and can be downloaded together with the monthly/annual/country-wise data (see appendix 4 and 5). The graphs are shown on the next pages. They show annual average air temperatures and annual accumulated precipitation (2x5 station data sets and 2 country-wise), plus annual accumulated hours of bright sunshine (1 station data set and country-wise). The values are shown relative to average 1981-2010.

### 8.3. Data Dictionary

Table 8.3.1. Elements/Parameters used in this section. 'Method' specifies whether the element is a sum or an average. The units of the annual values in the graphics are specified in 'Unit'.

| Element Number | Element/Parameter                     | Method  | Unit  |
|----------------|---------------------------------------|---------|-------|
| 101            | Average air temperature               | average | °C    |
| 504            | Hours of bright sunshine (Star level) | sum     | hours |
| 601            | Accumulated precipitation             | sum     | mm    |

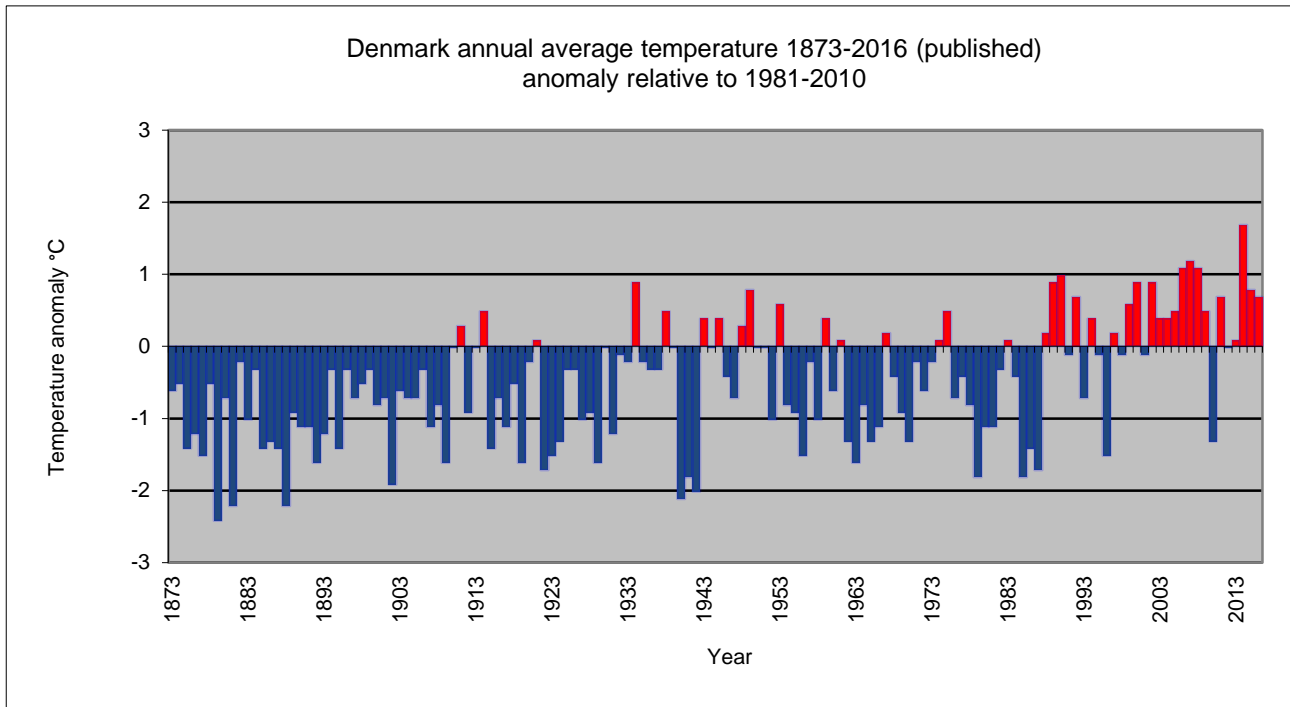


Figure 8.2.1. Annual average air temperature (published values), Denmark 1873-2016, anomaly relative to 1981-2010.

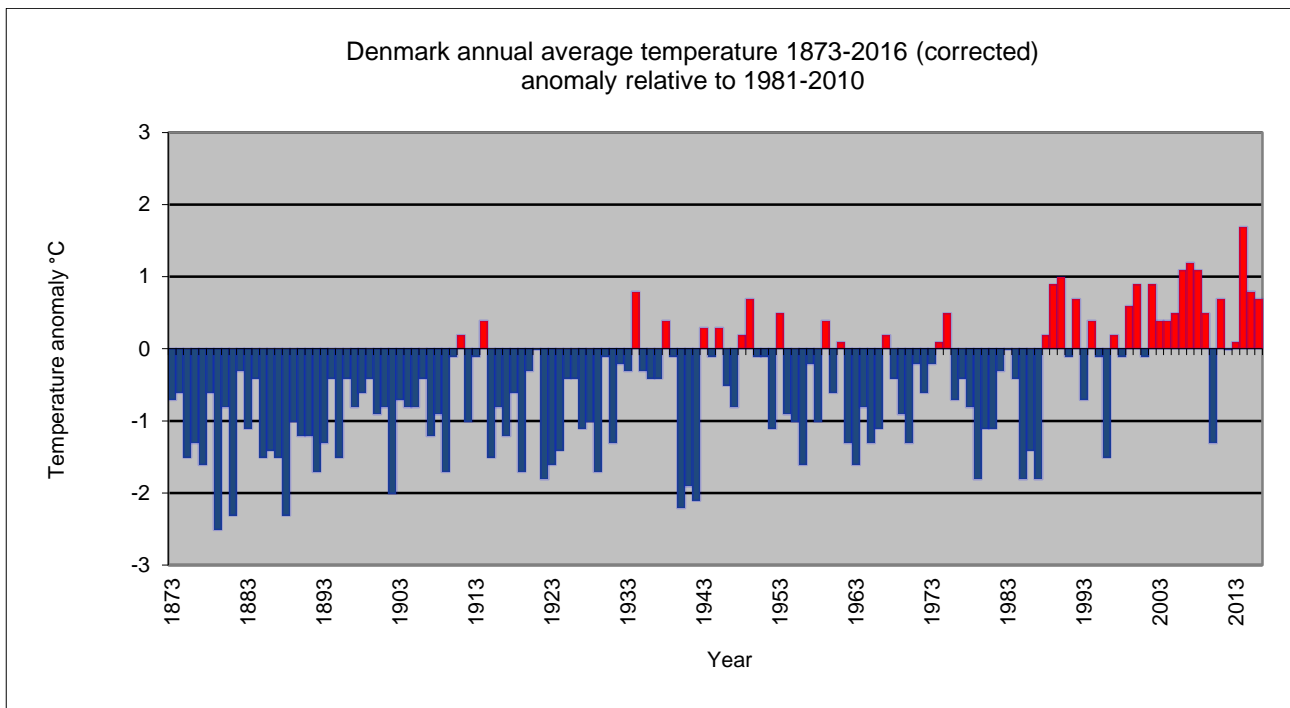


Figure 8.2.2. Annual average air temperature (corrected values), Denmark 1873-2016, anomaly relative to 1981-2010.

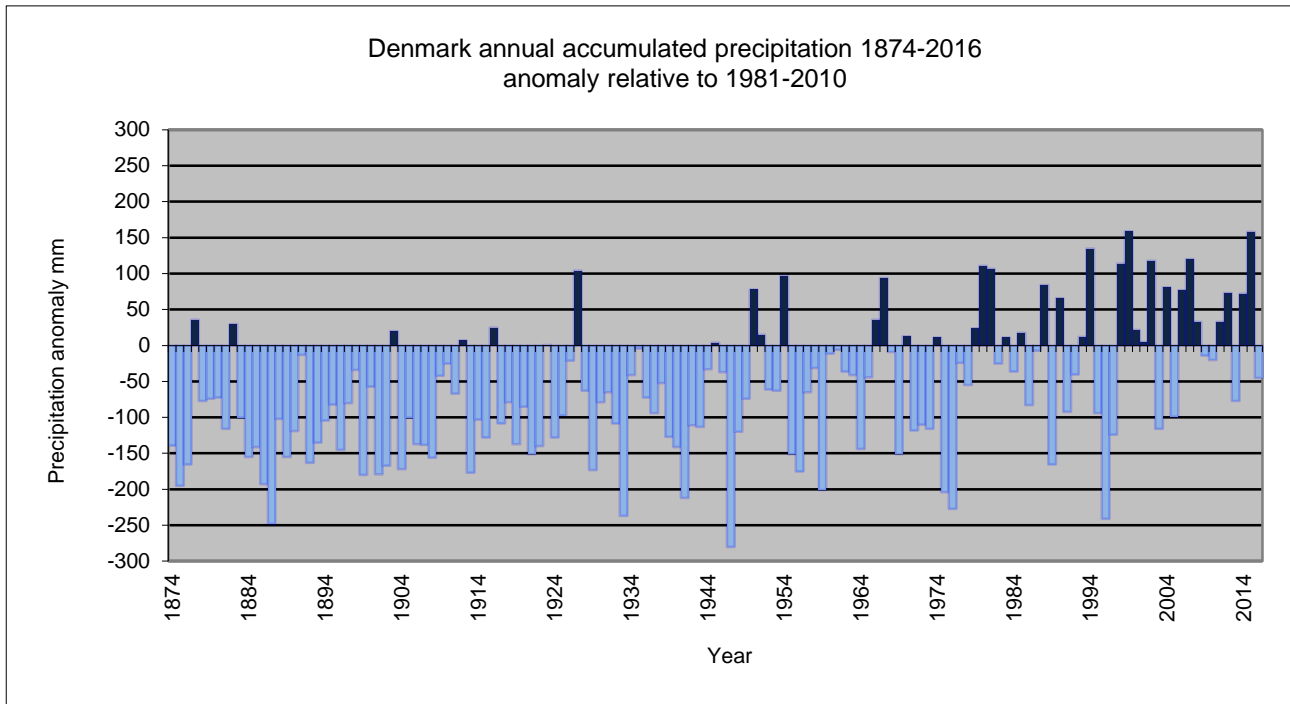


Figure 8.2.3. Annual accumulated precipitation, Denmark 1873-2016, anomaly relative to 1981-2010.

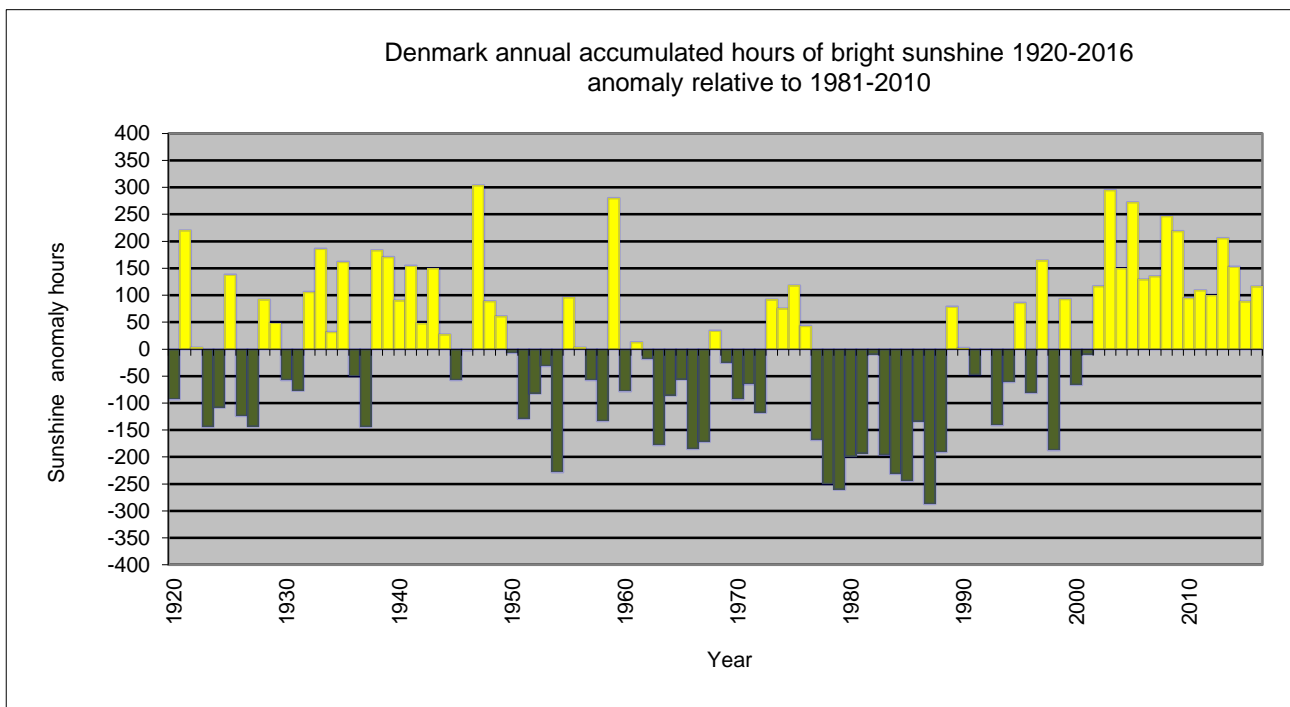


Figure 8.2.4. Annual accumulated hours of bright sunshine, Denmark 1920-2016, anomaly relative to 1981-2010. OBS! DMI has since 2002 observed the hours of bright sunshine using measurements of global radiation instead of measurements from a traditional Campbell-Stokes sunshine recorder. For that reason “new” and “old” hours of bright sunshine cannot directly be compared. It should be noted that all values before 2002 are adjusted ensuring comparability to the new level. For details on that, see [33].

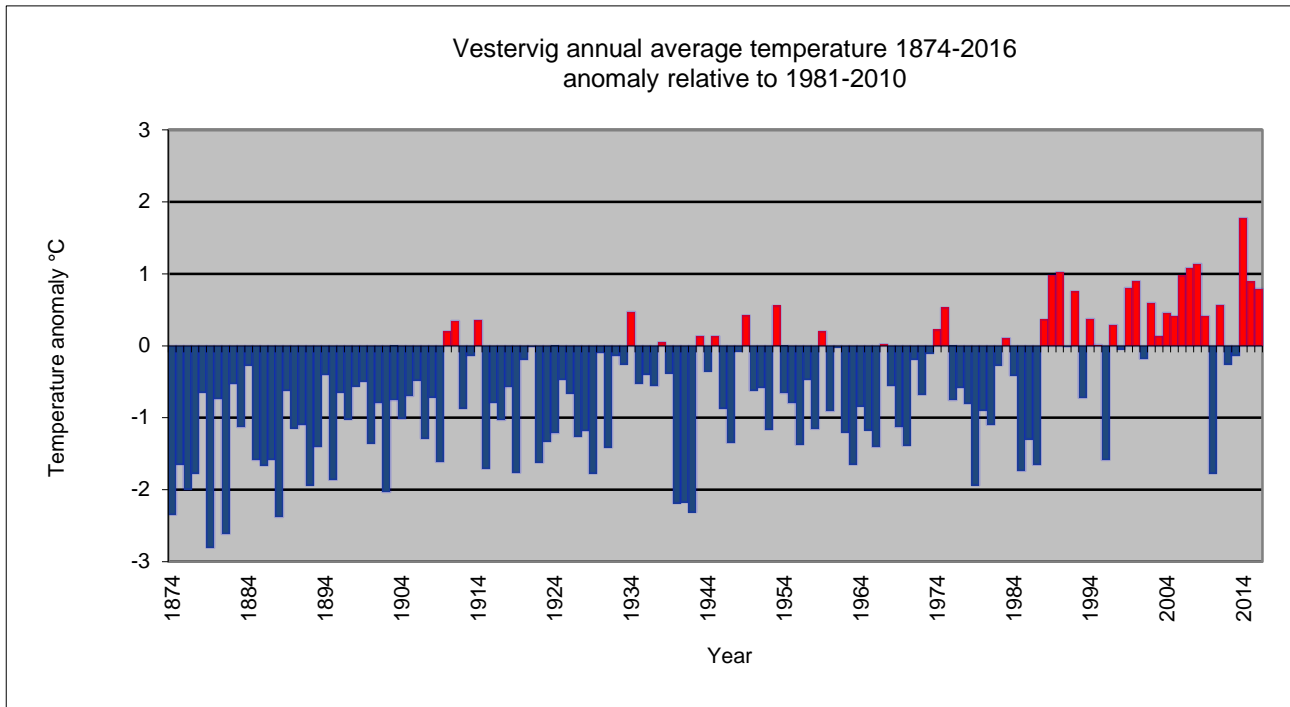


Figure 8.2.5. Annual average air temperature, Vestervig 1874-2016, anomaly relative to 1981-2010.

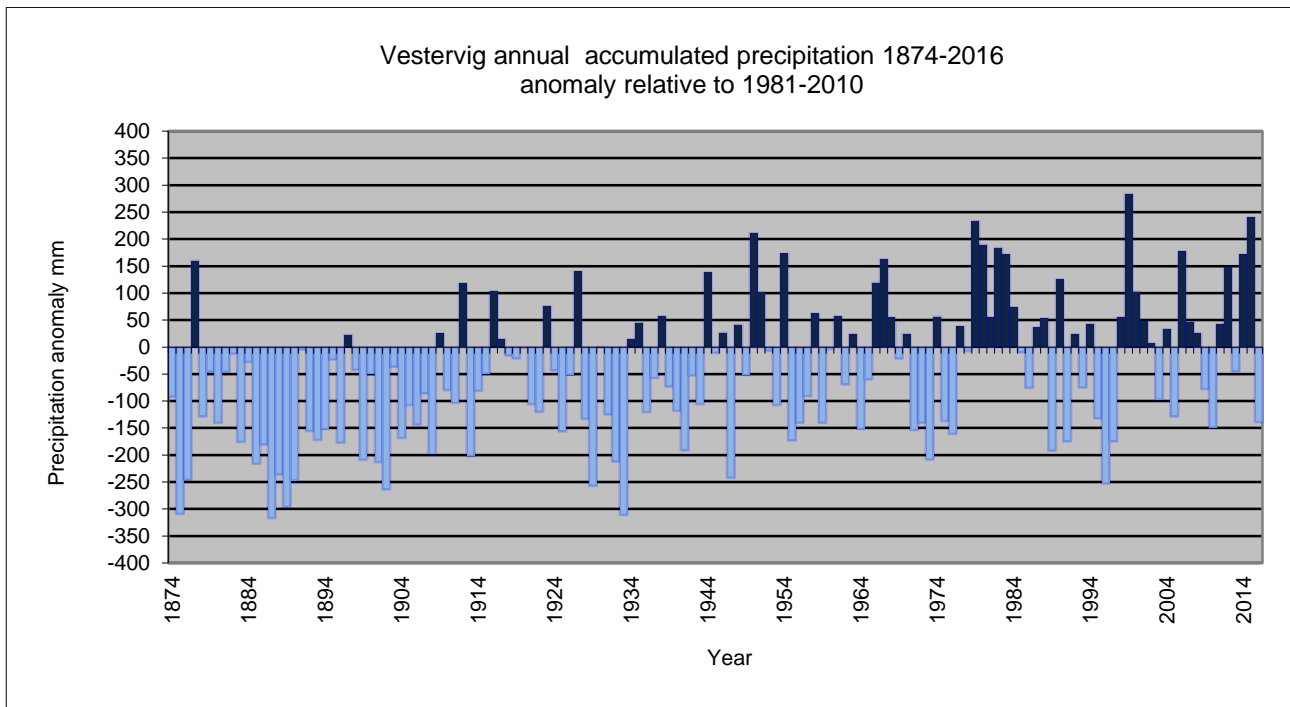


Figure 8.2.6. Annual accumulated precipitation, Vestervig 1874-2016, anomaly relative to 1981-2010.

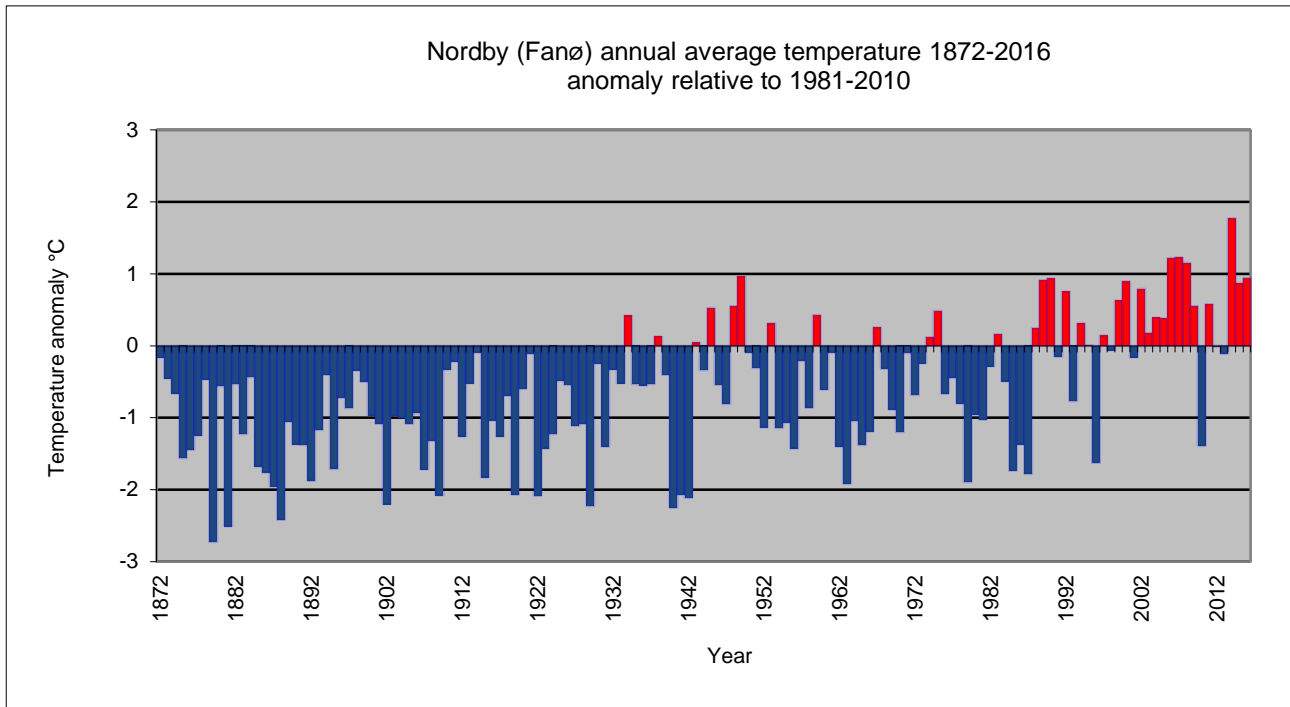


Figure 8.2.7. Annual average air temperature, Nordby (Fanø), 1872-2016, anomaly relative to 1981-2010.

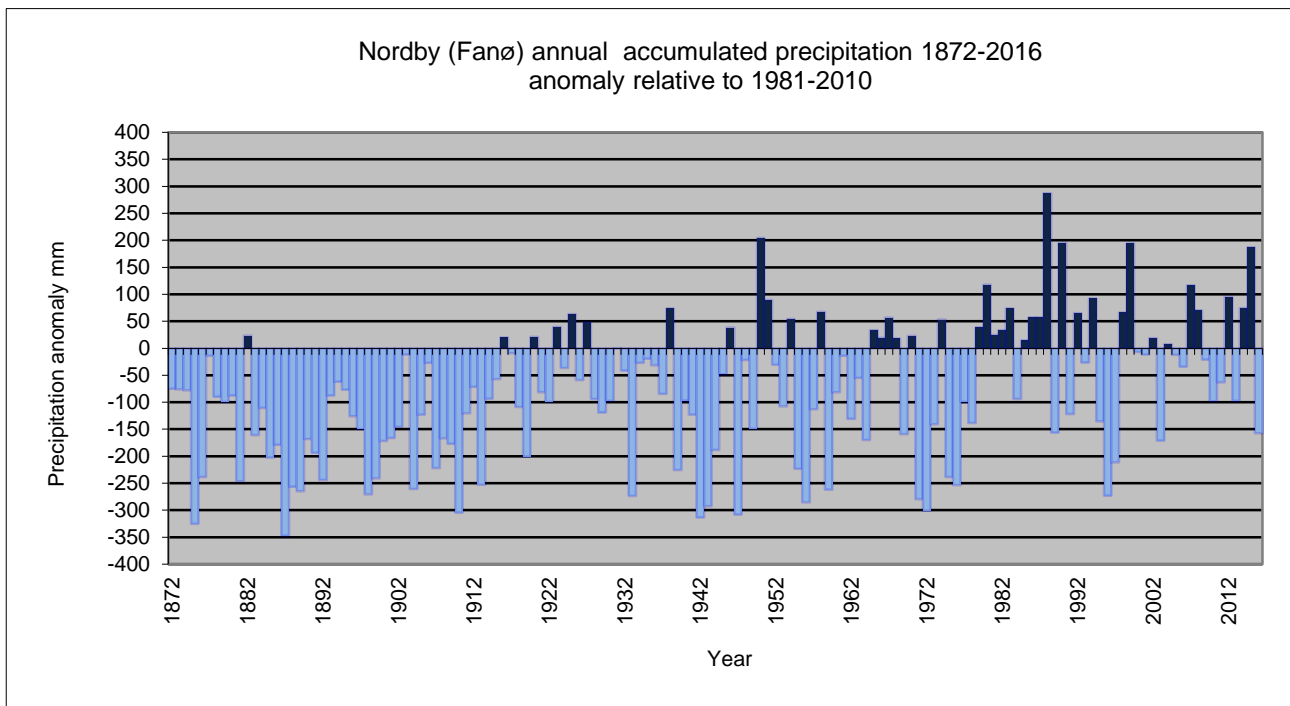


Figure 8.2.8. Annual accumulated precipitation, Nordby (Fanø), 1872-2016, anomaly relative to 1981-2010.

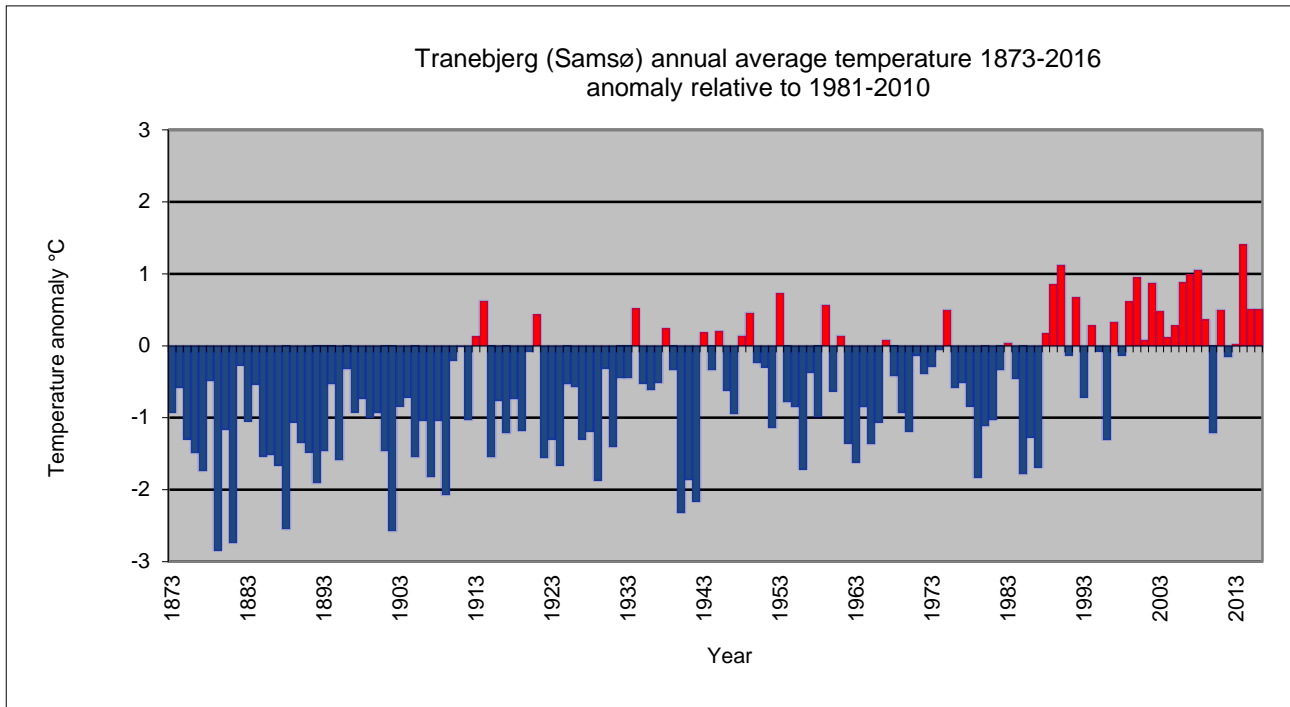


Figure 8.2.9. Annual average air temperature, Tranebjerg (Samsø), 1873-2016, anomaly relative to 1981-2010.

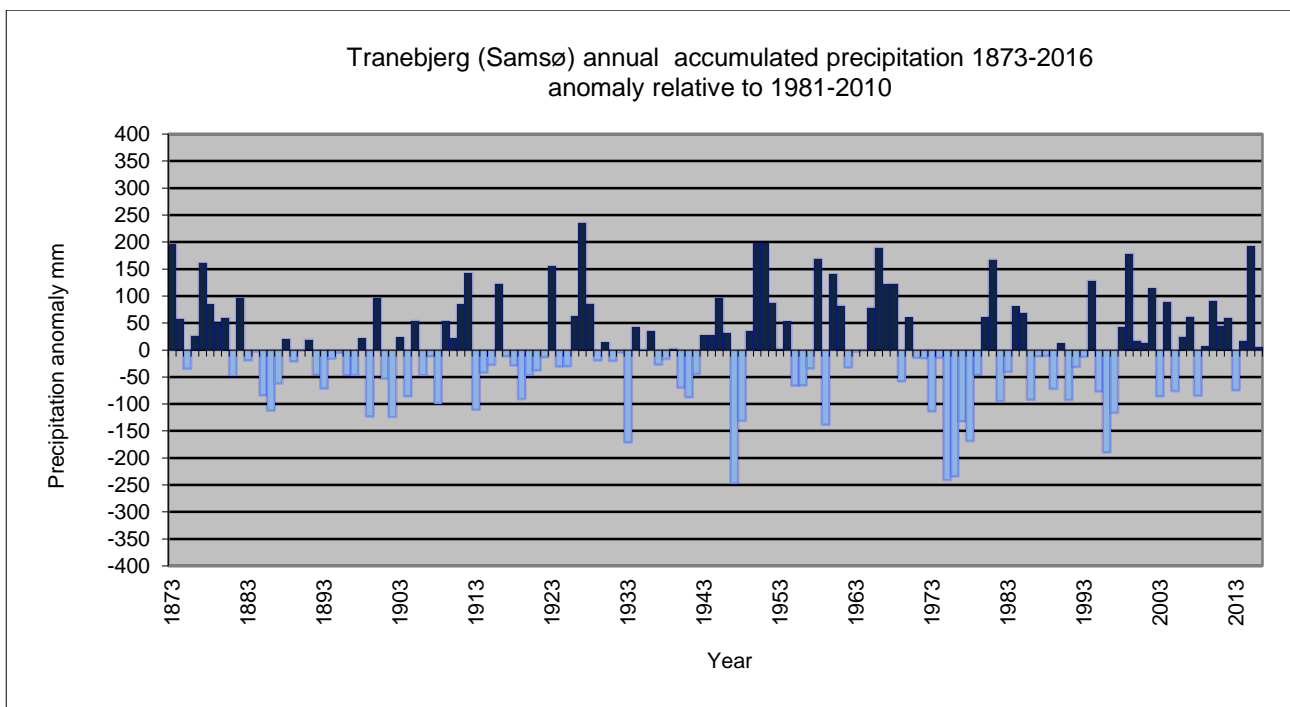


Figure 8.2.10. Annual accumulated precipitation, Tranebjerg (Samsø), 1873-2016, anomaly relative to 1981-2010.

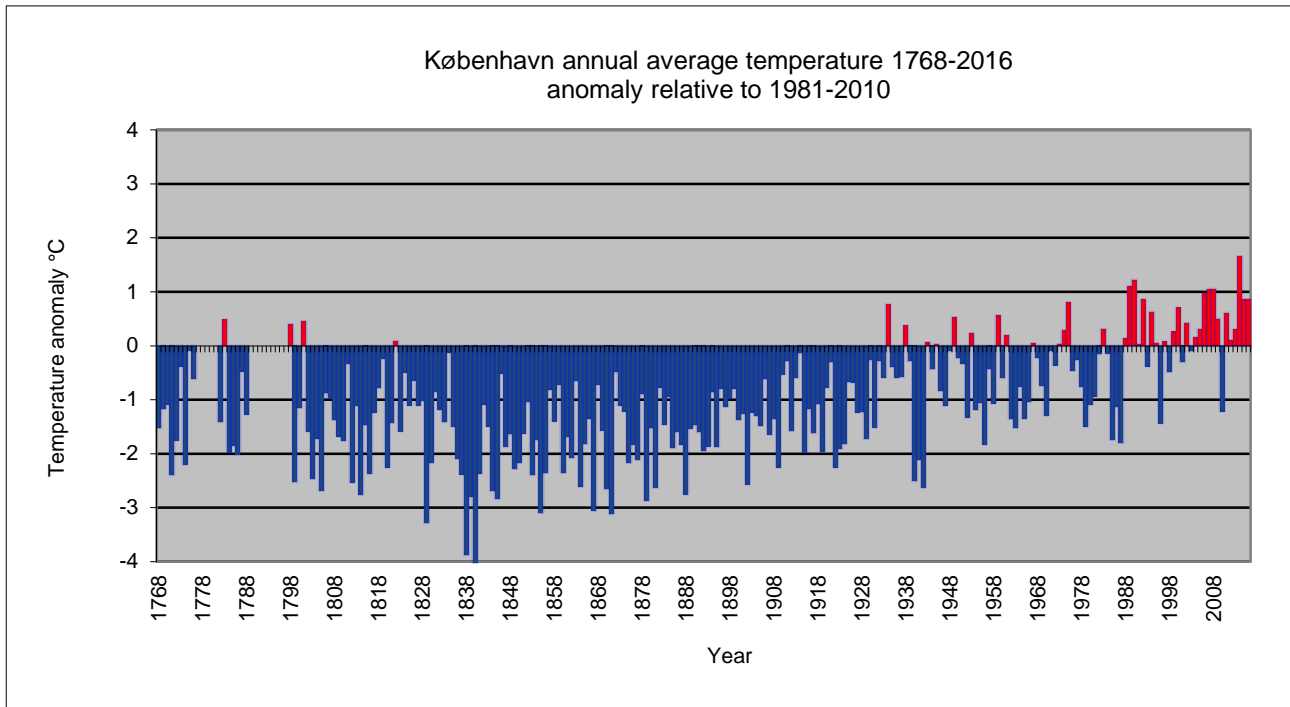


Figure 8.2.11. Annual average air temperature, København, 1768-2016, anomaly relative to 1981-2010. There are missing values for some early years 1777-1781 and 1789-1797.

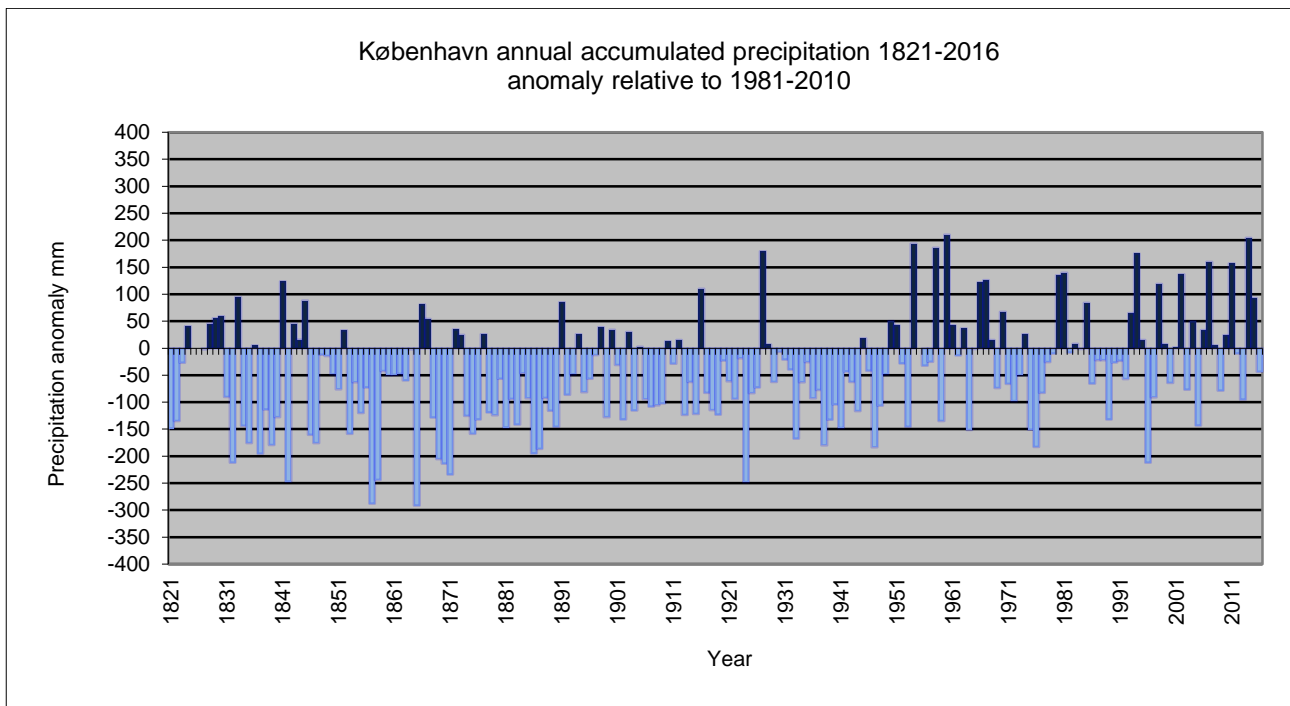


Figure 8.2.12. Annual accumulated precipitation, København, 1821-2016, anomaly relative to 1981-2010. There are missing values for some early years 1825-1826.

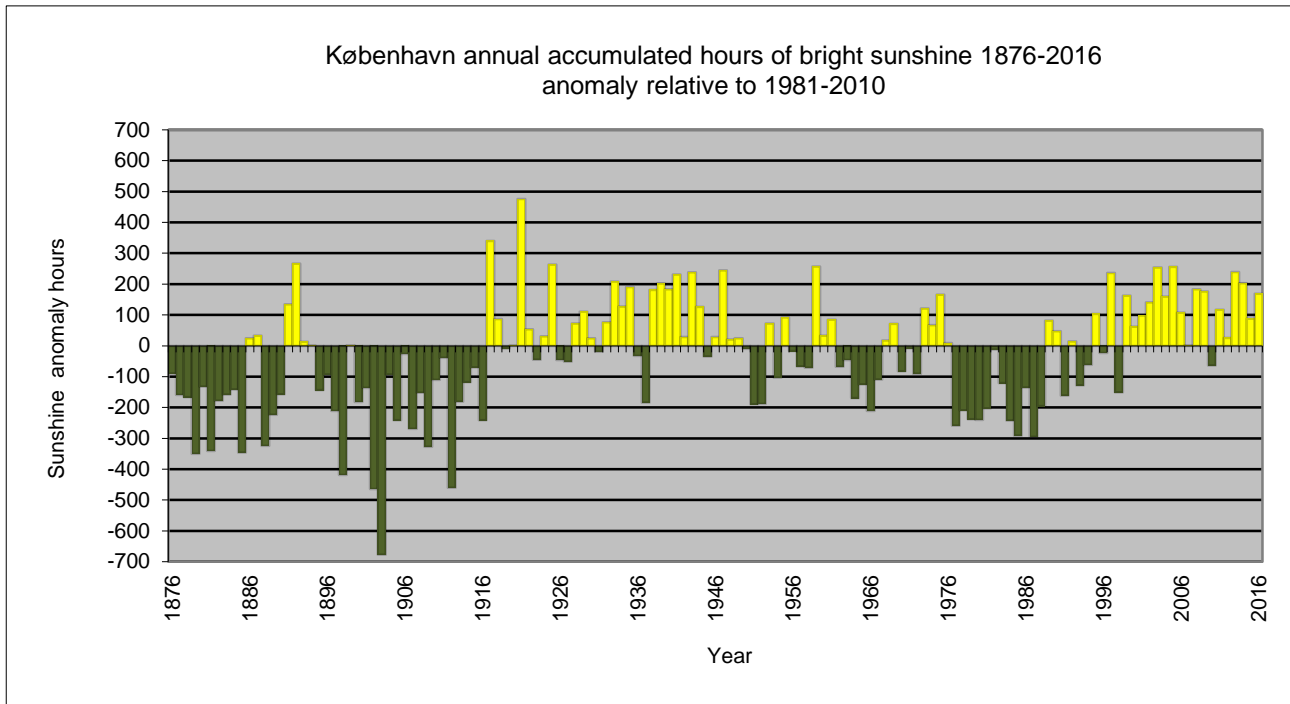


Figure 8.2.13. Annual accumulated hours of bright sunshine, København, 1876-2016, anomaly relative to 1981-2010. OBS! DMI has since 2002 observed the hours of bright sunshine using measurements of global radiation instead of measurements from a traditional Campbell-Stokes sunshine recorder. For that reason “new” and “old” hours of bright sunshine cannot directly be compared. It should be noted that all values before 2002 are adjusted ensuring comparability to the new level. For details on that, see [33].

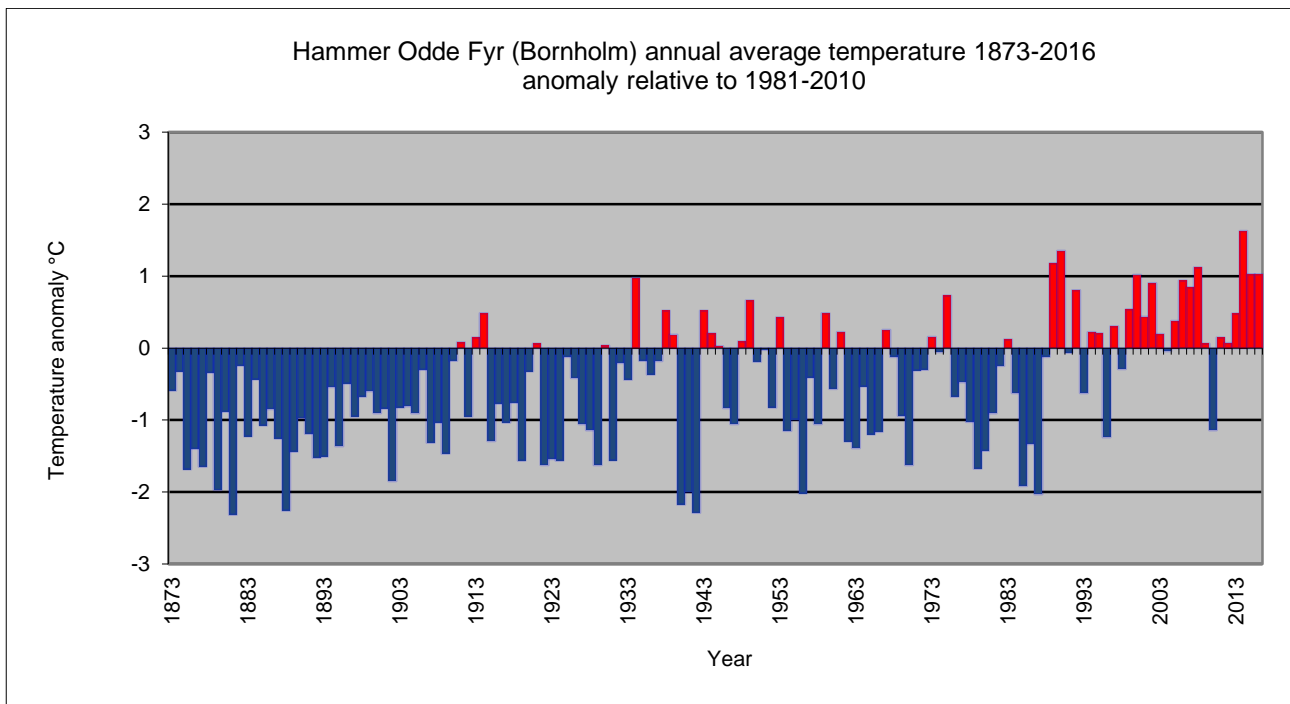


Figure 8.2.14. Annual average air temperature, Hammer Odde Fyr (Bornholm), 1873-2016, anomaly relative to 1981-2010.



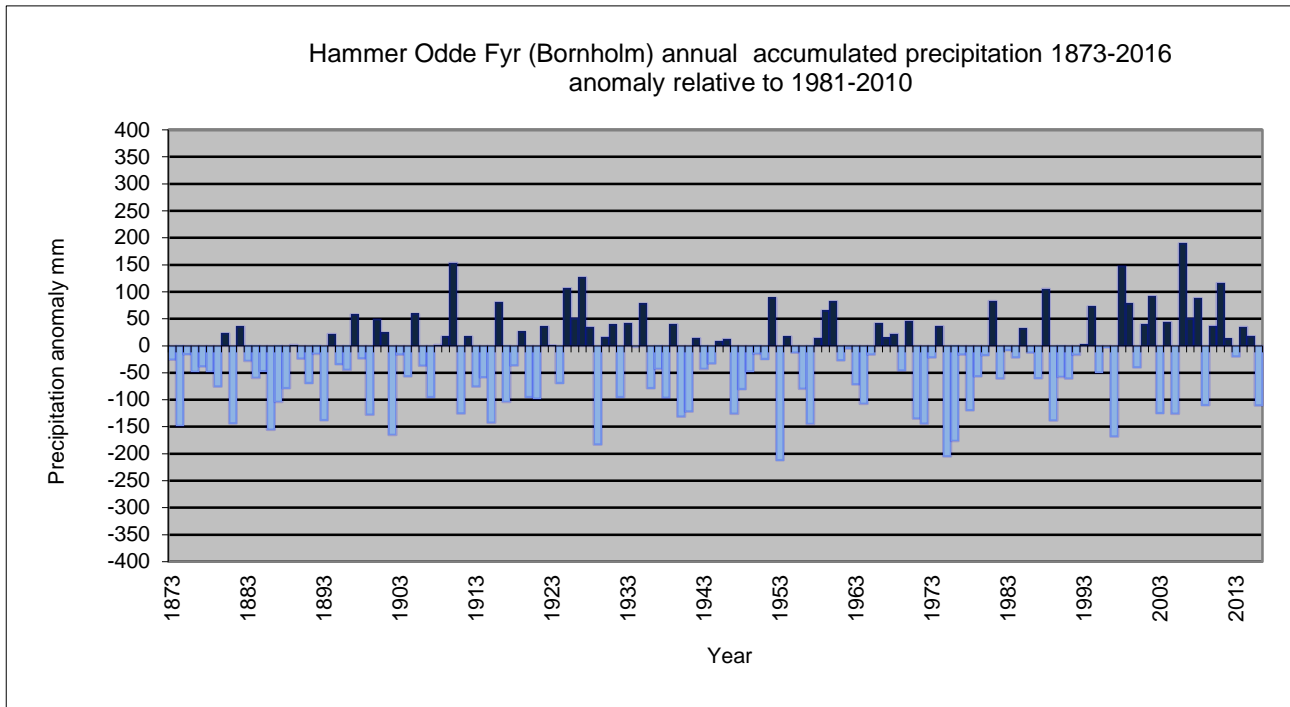


Figure 8.2.15. Annual accumulated precipitation, Hammer Odde Fyr ( Bornholm), 1873-2016, anomaly relative to 1981-2010.

## 9. Storm Section: Historical DMI Data Collection

| Type  | Data Collections  | Section, Page, Appendix    |
|-------|---|----------------------------|
| Storm | <ul style="list-style-type: none"> <li>List of storms 1890-2016 (Denmark); table 1 data set:<br/>All strong gales to hurricanes registered in Denmark, have been ranked in terms of strength and wind direction and whether there has been snowfall involved</li> </ul> | Sec 9.2.1., p 51-56, App 7 |

Latest earlier report:

[21] Cappelen, J. (ed), 2016: Denmark - DMI Historical Climate Data Collection 1873-2015 - with Danish Abstracts. DMI Technical Report No. 16-02.

## 9.1. Introduction

Since 1891, all strong gales to hurricanes, registered in Denmark, have been ranked in terms of strength and wind direction and whether there has been snowfall involved. They are all shown in the table 9.2.1.2 and the four major events are marked in grey.

## 9.2. Storm data

### 9.2.1. Table; list of storms

Table 9.2.1.1. Table product; list of Danish storms. See details in Appendix 7.

| Product*                                 | Dataset id | Period    | Parameter                         |
|--|------------|-----------|-----------------------------------|
| Table; list of storms; Denmark 1891-2016 | dk_storm   | 1891-2016 | Classification, see table 9.2.1.2 |

\*English version.

The table are shown on the next pages, but can also be found on dmi.dk (continuously updated): Storms in Denmark since 1891 (English only):

[http://www.dmi.dk/fileadmin/user\\_upload/Stormlisten/storme-2.pdf](http://www.dmi.dk/fileadmin/user_upload/Stormlisten/storme-2.pdf) [25].

Table 9.2.1.2. The list of classified storms in Denmark 1890-2016.

# STORMS IN DENMARK SINCE 1891

## Classification

Classification of storms are based on a climatological valuation, based on 10 minutes average wind speed

**N or n - wind from north**

**E or e - wind from east**

**S or s - wind from south**

**W or w - wind from west**

**X or x - variable wind direction**

**\* or \* - snow storm (no wind direction indicated in most cases)**

| Class 4                               |                                       | Class 3                                   |  | Class 2           |                   | Class 1          |                  |
|---------------------------------------|---------------------------------------|---|--|-------------------|-------------------|------------------|------------------|
| Capital                               | Small                                 | Capital                                   | Small                                    | Capital           | Small             | Capital          | Small            |
| Strong storm to hurricane, > 28,5 m/s | Strong storm to hurricane, > 28,5 m/s | Strong storm, (hurricane-like) > 26,5 m/s | Strong storm (hurricane-like) > 26,5 m/s | Storm, > 24,5 m/s | Storm, > 24,5 m/s | Stormy, > 21 m/s | Stormy, > 21 m/s |
| National > 30%                        | Regional 10-30%                       | National > 30%                            | Regional 10-30%                          | National > 30%    | Regional 10-30%   | National > 30%   | Regional 10-30%  |

| Period   |      | Remarks                                     | Classification |       |
|----------|------|---|----------------|-------|
| Days     | Year |   | Date           | Index |
| 4-5/1    | 1891 | Snow storm                                  | 5/1-1891       | *2    |
| 10-11/12 | 1891 |   | 11/12-1891     | SW2   |
| 24-25/6  | 1892 |   | 25/6-1892      | W1    |
| 12/2     | 1894 |   | 12/2-1894      | W2    |
| 25-25/3  | 1895 | Strong storm                                | 25/3-1895      | W3    |
| 6-7/12   | 1895 |   | 7/12-1895      | W2    |
| 30-31/1  | 1898 |   | 31/1-1898      | W2    |
| 24-25/3  | 1898 |   | 25/3-1898      | E2    |
| 11-12/5  | 1898 |   | 12/5-1898      | W1    |
| 14/7     | 1898 | Jylland                                     | 14/7-1898      | NW2   |
| 24-25/7  | 1898 |   | 25/7-1898      | NW1   |
| 31/8     | 1898 |   | 31/8-1898      | W1    |
| 17/10    | 1898 |   | 17/10-1898     | E1    |
| 18/10    | 1898 |   | 18/10-1898     | E1    |
| 19/10    | 1898 |   | 19/10-1898     | E1    |
| 2-3/12   | 1898 |   | 3/12-1898      | SW1   |
| 10-11/12 | 1898 |   | 11/12-1898     | W1    |
| 27/12    | 1898 |   | 27/12-1898     | SW1   |
| 17/8     | 1899 |   | 17/8-1899      | W1    |
| 22-23/9  | 1899 |   | 23/9-1899      | W1    |
| 24/11    | 1899 |   | 24/11-1899     | W1    |
| 16-17/2  | 1900 | Snow storm                                  | 17/2-1900      | *1    |
| 17-18/2  | 1900 | Snow storm                                  | 18/2-1900      | *1    |
| 25-26/12 | 1902 | Hurricane-like (The "1902 Christmas" Storm) | 26/12-1902     | w4    |
| 17/1     | 1905 |   | 17/1-1905      | SE1   |
| 31/1     | 1905 |   | 31/1-1905      | W1    |
| 27-28/11 | 1905 | Nordjylland                                 | 28/11-1905     | w2    |
| 13/3     | 1906 |   | 13/3-1906      | W1    |
| 25/3     | 1906 | Snow storm                                  | 25/3-1906      | *1    |
| 28/3     | 1906 |   | 28/3-1906      | W1    |
| 13/1     | 1907 |   | 13/1-1907      | W1    |
| 21/2     | 1907 |   | 21/2-1907      | W1    |
| 16/8     | 1907 | Nordjylland                                 | 16/8-1907      | W1    |
| 8/1      | 1908 | Snow storm, Nordjylland                     | 8/1-1908       | *1    |
| 8/2      | 1908 |   | 8/2-1908       | NW1   |
| 13/11    | 1909 | Snow storm                                  | 13/11-1909     | *1    |
| 3-4/12   | 1909 | Snow storm                                  | 3/12-1909      | *se1  |
| 20/12    | 1909 |   | 20/12-1909     | W2    |
| 24-25/1  | 1910 | Snow storm                                  | 25/1-1910      | *1    |
| 25-26/1  | 1910 | Snow storm                                  | 26/1-1910      | *1    |
| 24-25/2  | 1911 |   | 25/2-1911      | W2    |
| 5-6/11   | 1911 | Strong storm                                | 6/11-1911      | W3    |
| 14/12    | 1912 |   | 14/12-1912     | W2    |
| 31/1     | 1913 |   | 31/1-1913      | S2    |

|          |      |   |            |     |
|----------|------|---|------------|-----|
| 19/11    | 1913 |   | 19/11-1913 | W2  |
| 4/12     | 1913 |   | 4/12-1913  | SW2 |
| 28/9     | 1914 |   | 28/9-1914  | W2  |
| 24/12    | 1915 | Snow storm, Jylland                             | 24/12-1915 | *1  |
| 15/1     | 1916 |   | 15/1-1916  | W1  |
| 16/2     | 1916 | Strong storm, Sydvestjylland                    | 16/2-1916  | w3  |
| 24/12    | 1916 |   | 24/12-1916 | X1  |
| 8/3      | 1917 |   | 8/3-1917   | E2  |
| 14/9     | 1917 |   | 14/9-1917  | W1  |
| 21/9     | 1917 |   | 21/9-1917  | W1  |
| 13/10    | 1917 |   | 13/10-1917 | W1  |
| 25/10    | 1917 |   | 25/10-1917 | W1  |
| 27/11    | 1917 |   | 27/11-1917 | W1  |
| 23/8     | 1918 | Nordjylland                                     | 23/8-1918  | w1  |
| 29/1     | 1920 |   | 29/1-1920  | SE1 |
| 19/1     | 1921 |   | 19/1-1921  | NW1 |
| 22/1     | 1921 |   | 22/1-1921  | W1  |
| 18/6     | 1921 |   | 18/6-1921  | NW1 |
| 23-24/10 | 1921 | Hurricane-like, The "Ulv sund" storm            | 24/10-1921 | n4  |
| 1-2/11   | 1921 |   | 2/11-1921  | W1  |
| 17-18/12 | 1921 |   | 18/12-1921 | W2  |
| 31/12    | 1921 | Strong storm                                    | 31/12-1921 | W3  |
| 20/9     | 1922 |   | 20/9-1922  | W1  |
| 30/8     | 1923 |   | 30/8-1923  | w1  |
| 9-10/10  | 1923 |   | 10/10-1923 | W1  |
| 16/12    | 1923 |   | 16/12-1923 | W2  |
| 24/12    | 1923 | Snow storm, The "Christmas" snow storm          | 24/12-1923 | *1  |
| 10/9     | 1924 |   | 10/9-1924  | W2  |
| 2-3/1    | 1925 |   | 3/1-1925   | W1  |
| 14/6     | 1925 |   | 14/6-1925  | W1  |
| 4/11     | 1925 | The southern parts of Denmark                   | 4/11-1925  | w2  |
| 10/10    | 1926 | The southern parts of Denmark                   | 10/10-1926 | w2  |
| 2-3/10   | 1927 | Strong storm                                    | 3/10-1927  | W3  |
| 24/11    | 1928 |   | 24/11-1928 | W1  |
| 11-12/10 | 1929 | The southern parts of Denmark                   | 12/10-1929 | w2  |
| 9/10     | 1930 |   | 9/10-1930  | W1  |
| 8-9/7    | 1931 | Strong storm, the southeastern parts of Denmark | 9/7-1931   | sw3 |
| 11/10    | 1933 | Strong storm, Jylland                           | 11/10-1933 | SW3 |
| 8/2      | 1934 | Strong storm, Jylland                           | 8/2-1934   | NW3 |
| 27/10    | 1936 |   | 27/10-1936 | SW1 |
| 19/1     | 1937 |   | 19/1-1937  | E2  |
| 24/11    | 1938 |   | 24/11-1938 | SW2 |
| 23-24/8  | 1940 |   | 24/8-1940  | NW1 |
| 3/5      | 1944 |   | 3/5-1944   | W1  |
| 24/2     | 1946 | Snow storm                                      | 24/2-1946  | *1  |
| 1/3      | 1947 | Snow storm                                      | 1/3-1947   | *1  |

|          |      |   |            |     |
|----------|------|---|------------|-----|
| 7/3      | 1947 | Snow storm  | 7/3-1947   | *1  |
| 13/3     | 1947 | Snow storm  | 13/3-1947  | *1  |
| 1/3      | 1949 | Snow storm  | 1/3-1949   | *1  |
| 24/10    | 1949 | Strong storm                                      | 24/10-1949 | W3  |
| 26/10    | 1949 | Strong storm                                      | 26/10-1949 | W3  |
| 6/1      | 1950 | Snow storm  | 6/1-1950   | *1  |
| 28/5     | 1951 | The eastern parts of Denmark                      | 28/5-1951  | ne1 |
| 1/12     | 1951 | Nordjylland                                       | 1/12-1951  | w2  |
| 28/1     | 1953 | The "Holland" storm                               | 28/1-1953  | W1  |
| 11/2     | 1953 | Snow storm  | 11/2-1953  | *1  |
| 21/2     | 1953 |   | 21/2-1953  | W2  |
| 16/1     | 1954 |   | 16/1-1954  | W1  |
| 20/1     | 1954 |   | 20/1-1954  | W1  |
| 21/1     | 1956 |   | 21/1-1956  | W2  |
| 7-8/12   | 1959 |   | 8/12-1959  | E1  |
| 26-27/3  | 1961 |   | 27/3-1961  | NW1 |
| 12/2     | 1962 |   | 12/2-1962  | W1  |
| 16-17/2  | 1962 | The "Hamborg" storm                               | 17/2-1962  | NW2 |
| 25/6     | 1962 |   | 25/6-1962  | NW1 |
| 23/2     | 1967 |   | 23/2-1967  | W1  |
| 17-18/10 | 1967 | Hurricane-like                                    | 18/10-1967 | w4  |
| 15-16/1  | 1968 | Strong storm                                      | 16/1-1968  | W3  |
| 22/9     | 1969 |   | 22/9-1969  | W2  |
| 21/11    | 1971 | Snow storm  | 21/11-1971 | *2  |
| 19/11    | 1973 | Strong storm                                      | 19/11-1973 | NW3 |
| 26/1     | 1975 |   | 26/1-1975  | w2  |
| 3/1      | 1976 | Hurricane-like, Sydvestjylland                    | 3/1-1976   | w4  |
| 24/12    | 1977 | The southern parts of Denmark                     | 24/12-1977 | w2  |
| 28/12    | 1978 | Snow storm, the southern parts of Denmark         | 28/12-1978 | *1  |
| 29/12    | 1978 | Snow storm, the southern parts of Denmark         | 29/12-1978 | *2  |
| 30/12    | 1978 | Snow storm, strong, the southern parts of Denmark | 30/12-1978 | *3  |
| 31/12    | 1978 | Snow storm, the southern parts of Denmark         | 31/12-1978 | *2  |
| 1/1      | 1979 | Snow storm, the southern parts of Denmark         | 1/1-1979   | *2  |
| 2/1      | 1979 | Snow storm, the southern parts of Denmark         | 2/1-1979   | *2  |
| 3/1      | 1979 | Snow storm, the southern parts of Denmark         | 3/1-1979   | *1  |
| 4/1      | 1979 | Snow storm, the southern parts of Denmark         | 4/1-1979   | *1  |
| 21/8     | 1980 |   | 21/8-1980  | W1  |
| 8/2      | 1981 |   | 8/2-1981   | W2  |
| 2/11     | 1981 |   | 2/11-1981  | W2  |
| 20-21/11 | 1981 |   | 21/11-1981 | W1  |
| 24-25/11 | 1981 | Hurricane   | 25/11-1981 | W4  |
| 18/1     | 1983 | Hurricane-like                                    | 18/1-1983  | w4  |
| 13/1     | 1984 | Hurricane-like                                    | 13/1-1984  | w4  |
| 23/6     | 1984 | The southern parts of Denmark                     | 23/6-1984  | w2  |
| 16-17/11 | 1984 |   | 17/11-1984 | E1  |
| 6/9      | 1985 |   | 6/9-1985   | W2  |

|          |      |   |            |     |
|----------|------|---|------------|-----|
| 6/11     | 1985 | Strong storm  | 6/11-1985  | W3  |
| 2/12     | 1986 |   | 2/12-1986  | W2  |
| 24/9     | 1988 | The southern parts of Denmark   | 24/9-1988  | w2  |
| 29/11    | 1988 |   | 29/11-1988 | W2  |
| 14/2     | 1989 | Vestjylland   | 14/2-1989  | w2  |
| 25-26/1  | 1990 | Hurricane-like  | 26/1-1990  | sw4 |
| 26/2     | 1990 | Hurricane-like  | 26/2-1990  | w4  |
| 20/8     | 1990 | The southwestern parts of Denmark   | 20/8-1990  | w1  |
| 21/9     | 1990 | The southwestern parts of Denmark   | 21/9-1990  | w2  |
| 9/1      | 1991 | Hurricane-like  | 9/1-1991   | w4  |
| 22/5     | 1991 |   | 22/5-1991  | W1  |
| 14/1     | 1993 | Hurricane-like, the southern parts and Bornholm   | 14/1-1993  | w3  |
| 22/1     | 1993 |   | 22/1-1993  | W2  |
| 3/12     | 1999 | Hurricane, mostly the southern parts of Denmark   | 3/12-1999  | W4  |
| 17/12    | 1999 |   | 17/12-1999 | sw1 |
| 29-30/1  | 2000 | Strong storm  | 30/1-2000  | W2  |
| 28-29/1  | 2002 | The southernmost parts of Denmark   | 29/1-2002  | W2  |
| 27-28/10 | 2002 | The southern parts of Denmark   | 28/10-2002 | nw1 |
| 6/12     | 2003 | Storm, Kattegat and coastal areas of Nordsjælland   | 6/12-2003  | n1  |
| 18/11    | 2004 | Storm, few coastal areas  | 18/11-2004 | w1  |
| 8/1      | 2005 | Strong storm, Hurricane mostly the northern part of Jutland and the coastal western Jutland       | 8/1-2005   | W3  |
| 27/10    | 2006 | Storm, few coastal areas  | 27/10-2006 | w1  |
| 1/11     | 2006 | Storm, few coastal areas  | 1/11-2006  | *n1 |
| 1/1      | 2007 | Storm, few coastal areas  | 1/1-2007   | w1  |
| 11-12/1  | 2007 | Storm, few coastal areas  | 12/1-2007  | w1  |
| 14/1     | 2007 | Storm, few coastal areas  | 14/1-2007  | w1  |
| 27/6     | 2007 | The southernmost parts of Denmark   | 27/6-2007  | w1  |
| 31/1-1/2 | 2008 | Storm, few coastal areas  | 31/1-2008  | sw1 |
| 22/2     | 2008 | Storm, few coastal areas  | 22/2-2008  | w1  |
| 1/3      | 2008 | Storm, few coastal areas  | 1/3-2008   | nw1 |
| 18/11    | 2009 | Storm, few coastal areas  | 18/11-2009 | w1  |
| 7-8/2    | 2011 | Storm, coastal areas  | 8/2-2011   | w1  |
| 27-28/11 | 2011 | Storm, most significant in the northern and eastern parts of Denmark                              | 28/11-2011 | W2  |
| 8-9/12   | 2011 | Storm, most significant in the western and northern parts of Denmark                              | 9/12-2011  | W1  |
| 3-4/1    | 2012 | Storm, most significant in the western and northern parts of Denmark                              | 4/1-2012   | w2  |
| 28/10    | 2013 | Hurricane, southern parts of Denmark, record breaking in average wind speed and gust, named Allan | 28/10-2013 | sw4 |
| 5-6/12   | 2013 | Hurricane-like, named Bodil   | 6/12-2013  | nw4 |
| 14-15/3  | 2014 | The northern parts of Jutland, Kattegat and Bornholm, named Carl                                  | 15/3-2014  | nw1 |
| 2-3/1    | 2015 | Storm, coastal areas  | 2/1-2015   | w1  |
| 9/1      | 2015 | Storm, coastal areas, named Dagmar  | 9/1-2015   | w1  |
| 10-11/1  | 2015 | Storm, the northern parts of Jutland and coastal areas,   | 10/1-2015  | w2  |

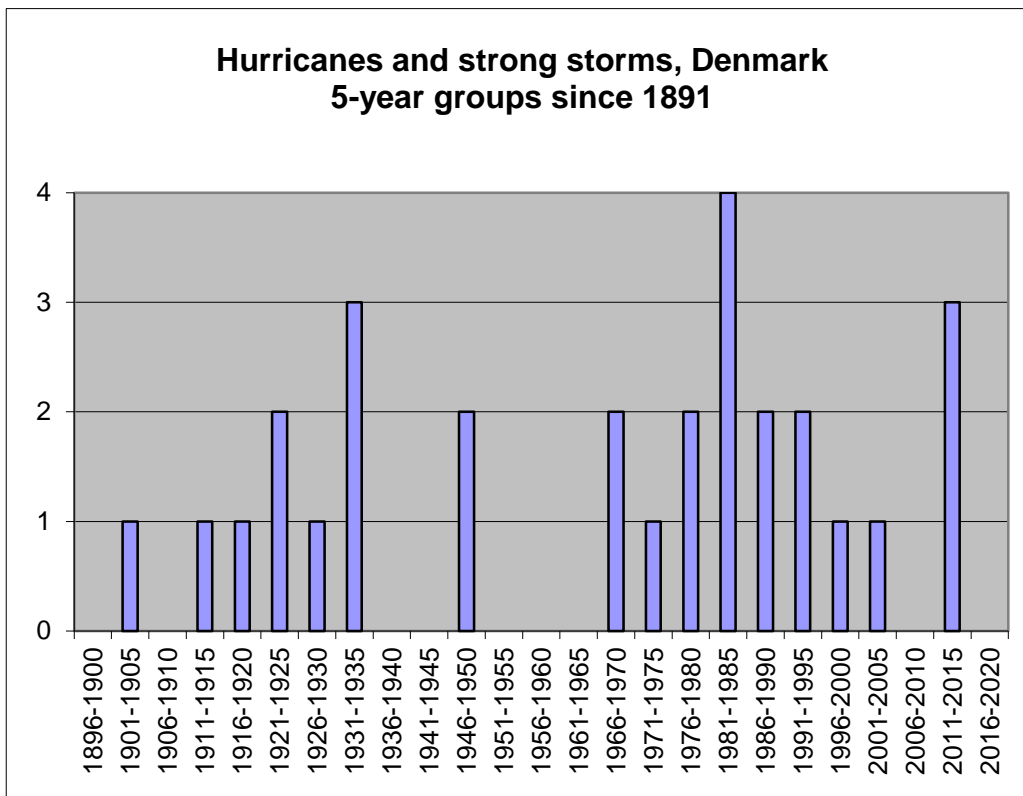
|          |      |  |            |    |
|----------|------|--|------------|----|
|          |      | named Egon   |            |    |
| 7-8/11   | 2015 | Storm, the northern parts of Jutland and some coastal areas, named Freja                                 | 8/11-2015  | W1 |
| 29/11    | 2015 | Strong storm (hurricane-like), coastal areas, named Gorm   | 29/11-2015 | w3 |
| 4/12     | 2015 | Storm, the northern parts of Jutland and some coastal areas along the west coast of Jutland, named Helga | 4/12-2015  | w1 |
| 26-27/12 | 2016 | Storm, the northwestern parts of Jutland, west facing coastal areas and Bornholm, named Urd              | 27/12-2016 | w2 |

|              |            |
|--------------|------------|
| Class 4      | 13         |
| Class 3      | 17         |
| Class 2      | 52         |
| Class 1      | 99         |
| <b>Total</b> | <b>181</b> |

Table 9.2.1.3. Graphical products; Danish storms. See details in Appendix 6.

| Product*                          | Graph id       | Period    | Parameter                               |
|-----------------------------------|----------------|-----------|---|
| Graph; number of storms 1891-2016 | dk_graph_storm | 1891-2016 | Class 3 and 4 storms; see table 9.2.1.2 |

\*English version.



Class 3 and 4 storms in 5-year groups since 1891.



## 10. References

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## Previous reports

Previous reports from the Danish Meteorological Institute can be found on:  
<http://www.dmi.dk/laer-om/generelt/dmi-publikationer/>

## **Appendices - File formats and metadata**

**Appendix 1 Station history**

**Appendix 2 Observational section**

**Appendix 3 Daily section**

**Appendix 4 Monthly/Annual section**

**Appendix 5 Country-wise section**

**Appendix 6 Storm section**

## Appendix 1. Station history - File Formats and metadata

### Appendix 1.1. File formats; Station position file

A station file included in this report contains the digitised information on the station positions and thereby on any removals of the stations during the operation period. The same metadata can also be seen in tables in Appendix 1.2.

The file name is:

**dk\_station\_position.dat**

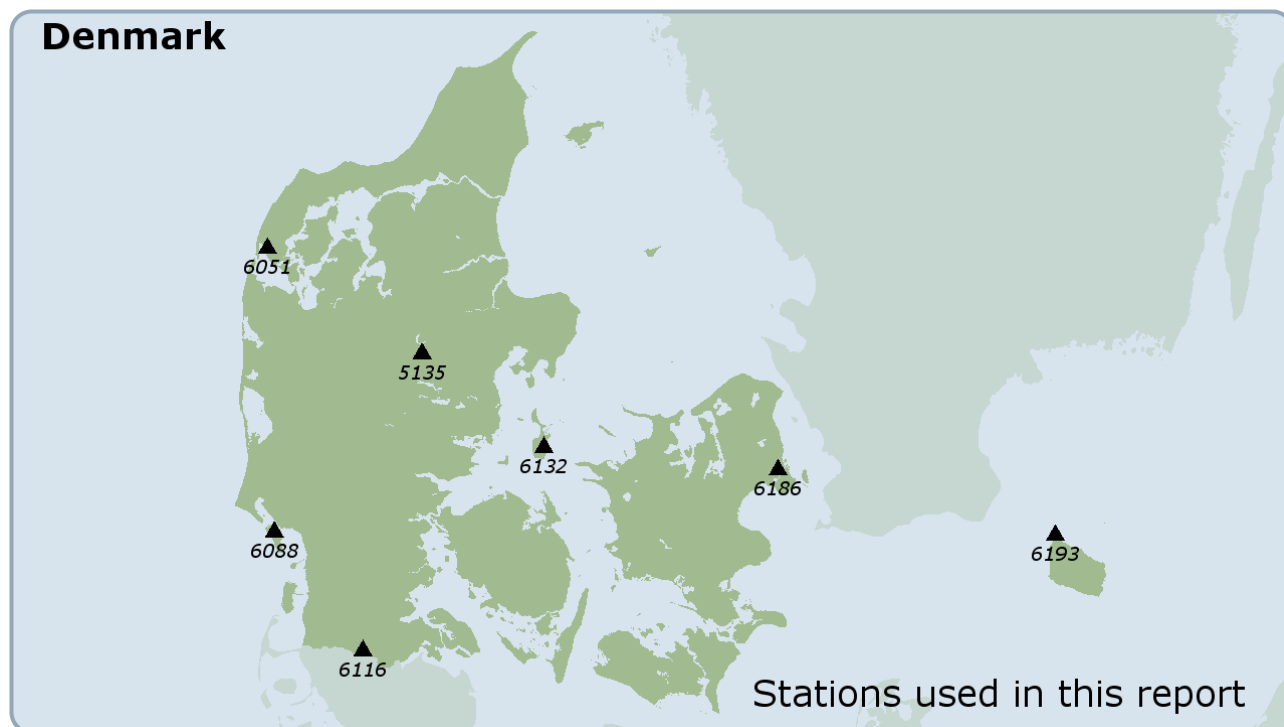
Format of the station position fixed format text file:

| Position | Format | Description  |
|----------|--------|--|
| 1-5      | F5.0   | Station number   |
| 6-35     | A30    | Station name   |
| 36-45    | A10    | Station type (synop_dk = part of WMO synoptic net, clima_man = manual climate station, clima_aut = automatic climate station, precip_man = manual precipitation station, snow_man = manual snow observing station) |
| 46-56    | Date11 | Start date (dd-mmm-yyyy)   |
| 57-67    | Date11 | End date (dd-mmm-yyyy)   |
| 68-70    | A3     | UTM zone   |
| 71-81    | F11.0  | Eastings   |
| 82-92    | F11.0  | Northings  |
| 93-98    | F6.0   | Elevation (metres above mean sea level)  |
| 99-109   | F11.0  | Latitude, degrees N (dddmmss)  |
| 110-120  | F11.0  | Longitude, degrees E (dddmmss)   |

Data are only to be used with proper reference to the accompanying report: Cappelen, J. (ed), 2017: Denmark - DMI Historical Climate Data Collection 1768-2016. DMI Report No. 17-02. Copenhagen.

## Appendix 1.2. Metadata - Station history

By convention a time series is named after the most recent primary station delivering the data. Here is presented an overview back in time of the positions and relocations and starting and (if any) closing dates of the stations used in this report. Also presented are any positions or relocations and starting and closing dates of other stations forming part of the series and therefore referred to in the description of the data series in the next section. More metadata on the series/station may be found in [35]. The information can also be found in a file attached to this report, see Appendix 1.1.



Station based data sets referred to in the report. Only the latest positions are marked. The official WMO station identifiers for Denmark consist of 5 digits "06xxx". However, in this report the in front "0" is omitted, giving 4 digits i.e. "6132" for Tranebjerg, which is also used on the map. The Danish national station identifiers describing climate/precipitation stations in Denmark consist of 5 digits, either the new format "05XXX" (the in front "0" is omitted), giving 4 digits i.e. "5135" for Grønbæk or the old format, where the station number started with 20-32 dependent on the region i.e. "27080" for the old Tranebjerg station.

### 6051 Vestervig

| No.   | Name      | Start       | End         | Type       | UTM | Northings | Eastings | Longitude | Latitude | Elev. |
|-------|-----------|-------------|-------------|------------|-----|-----------|----------|-----------|----------|-------|
| 21100 | Vestervig | 01-JUN-1873 | 30-JUN-1879 | clima_man  | 32V | 6291160   | 459820   | 82100     | 564600   | 47    |
| 21100 | Vestervig | 01-JUL-1879 | 18-SEP-1883 | clima_man  | 32V | 6292610   | 458640   | 81900     | 564600   | 25    |
| 21100 | Vestervig | 19-SEP-1883 | 16-AUG-1892 | clima_man  | 32V | 6291380   | 458510   | 81900     | 564600   | 18    |
| 21100 | Vestervig | 17-AUG-1892 | 30-JUN-1924 | clima_man  | 32V | 6291395   | 458670   | 81900     | 564600   | 22    |
| 21100 | Vestervig | 01-JUL-1924 | 12-APR-1937 | clima_man  | 32V | 6291410   | 458210   | 81900     | 564600   | 17    |
| 21100 | Vestervig | 13-APR-1937 | 31-MAR-1946 | clima_man  | 32V | 6291225   | 458420   | 81900     | 564600   | 27    |
| 21100 | Vestervig | 01-APR-1946 | 01-JAN-2000 | clima_man  | 32V | 6291492   | 458551   | 81919     | 564551   | 18    |
| 21100 | Vestervig | 02-JAN-2000 | 10-SEP-2003 | precip_man | 32V | 6291492   | 458551   | 81919     | 564551   | 18    |
| 21100 | Vestervig | 11-SEP-2003 | 01-APR-2011 | precip_man | 32V | 6291492   | 458551   | 81919     | 564551   | 18    |
| 21100 | Vestervig | 01-JAN-2000 | 10-SEP-2003 | snow_man   | 32V | 6291492   | 458551   | 81919     | 564551   | 18    |
| 21100 | Vestervig | 11-SEP-2003 |             | snow_man   | 32V | 6291492   | 458551   | 81919     | 564551   | 18    |
| 21100 | Vestervig | 17-FEB-2000 | 10-SEP-2003 | clima_aut  | 32V | 6291492   | 458551   | 81919     | 564551   | 18    |
| 21100 | Vestervig | 11-SEP-2003 |             | clima_aut  | 32V | 6291492   | 458551   | 81919     | 564551   | 18    |
| 21120 | Tødsø     | 05-JUN-1881 | 30-JUN-1903 | clima_man  | 32V | 6298350   | 488600   | 84900     | 565000   | 33    |
| 21120 | Erslev    | 01-NOV-1927 | 31-DEC-1949 | clima_man  | 32V | 6298850   | 484730   | 84500     | 565000   | 14    |
| 21120 | Erslev    | 01-JAN-1950 | 31-MAY-1961 | clima_man  | 32V | 6298820   | 483850   | 84400     | 565000   | 20    |

|       |              |             |             |            |     |         |        |        |        |    |
|-------|--------------|-------------|-------------|------------|-----|---------|--------|--------|--------|----|
| 21120 | Erslev       | 01-NOV-1961 | 31-MAY-1974 | clima_man  | 32V | 6299080 | 483560 | 84400  | 565000 | 25 |
| 21120 | Erslev       | 01-JUN-1974 | 30-JUN-1987 | clima_man  | 32V | 6299350 | 483300 | 84400  | 565000 | 19 |
| 21120 | Erslev       | 01-JUL-1987 | 30-JUN-1993 | precip_man | 32V | 6299280 | 483340 | 84400  | 565000 | 20 |
| 21120 | Erslev       | 01-JUL-1993 | 01-APR-2011 | precip_man | 32V | 6299080 | 483585 | 84400  | 565000 | 26 |
| 24020 | Bovbjerg Fyr | 01-MAR-1876 | 24-MAR-1944 | clima_man  | 32V | 6263750 | 445920 | 80700  | 563100 | 41 |
| 24020 | Bovbjerg Fyr | 03-AUG-1945 | 30-NOV-1956 | clima_man  | 32V | 6263750 | 445920 | 80700  | 563100 | 41 |
| 24020 | Bovbjerg Fyr | 01-DEC-1956 | 30-JUN-1987 | clima_man  | 32V | 6263750 | 445950 | 80700  | 563100 | 41 |
| 24020 | Bovbjerg Fyr | 01-MAR-1989 | 01-AUG-1994 | precip_man | 32V | 6263740 | 445950 | 80700  | 563100 | 41 |
| 6019  | Silstrup     | 22-MAR-2002 |             | synop_dk   | 32V | 6309855 | 478246 | 83833  | 565550 | 42 |
| 6051  | Vestervig    | 11-SEP-2003 |             | synop_dk   | 32V | 6291492 | 458551 | 81919  | 564551 | 18 |
| 6052  | Thyborøn     | 01-JAN-1961 | 06-FEB-1985 | synop_dk   | 32V | 6285030 | 452360 | 81300  | 564200 | 3  |
| 6052  | Thyborøn     | 07-FEB-1985 | 21-NOV-2000 | synop_dk   | 32V | 6284510 | 452410 | 81300  | 564200 | 2  |
| 6052  | Thyborøn     | 22-NOV-2000 |             | synop_dk   | 32V | 6285231 | 452017 | 81259  | 564227 | 2  |
| 6030  | Fsn Aalborg  | 01-JAN-1953 |             | synop_dk   | 32V | 6328631 | 551614 | 95107  | 570549 | 3  |
| 6041  | Skagen Fyr   | 01-JAN-1953 | 13-DEC-2000 | synop_dk   | 32V | 6400730 | 597240 | 103800 | 574400 | 3  |
| 6041  | Skagen Fyr   | 14-DEC-2000 |             | synop_dk   | 32V | 6400740 | 597229 | 103759 | 574413 | 3  |
| 6058  | Hvide Sande  | 01-JAN-1989 | 06-NOV-2001 | synop_dk   | 32V | 6206680 | 445780 | 80800  | 560000 | 3  |
| 6058  | Hvide Sande  | 07-NOV-2001 |             | synop_dk   | 32V | 6207426 | 446535 | 80833  | 560028 | 2  |
| 6060  | Fsn Karup    | 01-JAN-1953 |             | synop_dk   | 32V | 6238954 | 507127 | 90655  | 561739 | 52 |

### 5135 Grønbæk

| No.   | Name           | Start       | End         | Type       | UTM | Northings | Eastings | Longitude | Latitude | Elev. |
|-------|----------------|-------------|-------------|------------|-----|-----------|----------|-----------|----------|-------|
| 21430 | Grønbæk        | 01-AUG-1862 | 10-SEP-1879 | precip_man | 32V | 6237065   | 538290   | 93700     | 561700   | 39    |
| 21430 | Grønbæk        | 11-SEP-1879 | 28-FEB-1885 | precip_man | 32V | 6237085   | 538310   | 93700     | 561700   | 38    |
| 21430 | Grønbæk        | 01-APR-1885 | 31-DEC-1891 | precip_man | 32V | 6237085   | 538310   | 93700     | 561700   | 38    |
| 21430 | Grønbæk        | 01-NOV-1892 | 31-DEC-1901 | precip_man | 32V | 6237075   | 538380   | 93700     | 561700   | 35    |
| 21430 | Grønbæk        | 01-AUG-1903 | 30-SEP-1907 | precip_man | 32V | 6237075   | 538380   | 93700     | 561700   | 35    |
| 21430 | Allingskovgård | 01-NOV-1907 | 30-NOV-1917 | precip_man | 32V | 6235150   | 537715   | 93700     | 561600   | 73    |
| 21430 | Allingskovgård | 01-DEC-1917 | 30-NOV-1931 | precip_man | 32V | 6235800   | 538370   | 93700     | 561600   | 37    |
| 21430 | Grønbæk        | 01-DEC-1931 | 31-AUG-1952 | precip_man | 32V | 6237075   | 538380   | 93700     | 561700   | 35    |
| 21430 | Grønbæk        | 01-SEP-1952 | 31-MAR-1971 | precip_man | 32V | 6237100   | 538260   | 93700     | 561700   | 40    |
| 21430 | Grønbæk        | 01-APR-1971 | 11-AUG-1999 | precip_man | 32V | 6237220   | 538567   | 93700     | 561700   | 25    |
| 21430 | Grønbæk        | 12-AUG-1999 | 16-MAR-2005 | precip_man | 32V | 6237215   | 538567   | 93700     | 561700   | 25    |
| 21430 | Grønbæk        | 17-MAR-2005 | 07-AUG-2009 | precip_man | 32V | 6237217   | 538557   | 93700     | 561700   | 25    |
| 21430 | Grønbæk        | 08-AUG-2009 | 01-APR-2011 | precip_man | 32V | 6237217   | 538554   | 93700     | 561700   | 25    |
| 5135  | Grønbæk        | 18-JAN-2010 |             | synop_dk   | 32V | 6237215   | 538556   | 93722     | 561637   | 25    |

### 6088 Nordby/Fanø

| No.   | Name          | Start       | End         | Type       | UTM | Northings | Eastings | Longitude | Latitude | Elev. |
|-------|---------------|-------------|-------------|------------|-----|-----------|----------|-----------|----------|-------|
| 25140 | Nordby        | 01-SEP-1871 | 30-APR-1892 | clima_man  | 32U | 6144290   | 462050   | 82400     | 552700   | 4     |
| 25140 | Nordby        | 01-MAY-1892 | 30-NOV-1899 | clima_man  | 32U | 6144695   | 462190   | 82400     | 552700   | 4     |
| 25140 | Nordby        | 01-DEC-1899 | 29-FEB-1904 | clima_man  | 32U | 6144290   | 462050   | 82400     | 552700   | 4     |
| 25140 | Nordby        | 01-MAR-1904 | 29-FEB-1928 | clima_man  | 32U | 6144260   | 462040   | 82400     | 552700   | 4     |
| 25140 | Nordby        | 01-MAR-1928 | 04-APR-1936 | clima_man  | 32U | 6144940   | 462170   | 82400     | 552700   | 4     |
| 25140 | Nordby        | 05-APR-1936 | 15-DEC-1944 | clima_man  | 32U | 6144610   | 462055   | 82400     | 552700   | 5     |
| 25140 | Nordby        | 16-DEC-1944 | 20-NOV-1955 | clima_man  | 32U | 6144790   | 462400   | 82400     | 552700   | 3     |
| 25140 | Nordby        | 21-NOV-1955 | 22-AUG-1960 | clima_man  | 32U | 6145210   | 462330   | 82400     | 552700   | 5     |
| 25140 | Nordby        | 23-AUG-1960 | 10-SEP-1979 | clima_man  | 32U | 6144210   | 461780   | 82400     | 552600   | 6     |
| 25140 | Nordby        | 11-SEP-1979 | 13-JAN-1994 | clima_man  | 32U | 6144230   | 461760   | 82400     | 552600   | 6     |
| 25140 | Nordby        | 14-JAN-1994 | 14-FEB-1996 | clima_man  | 32U | 6145165   | 462375   | 82400     | 552700   | 3     |
| 25140 | Nordby        | 15-FEB-1996 | 01-JAN-2000 | clima_man  | 32U | 6145060   | 462120   | 82400     | 552700   | 4     |
| 25140 | Nordby        | 02-JAN-2000 | 22-JUL-2003 | precip_man | 32U | 6145060   | 462120   | 82400     | 552700   | 4     |
| 25140 | Nordby        | 23-JUL-2003 | 04-JUL-2007 | precip_man | 32U | 6145047   | 462147   | 82406     | 552656   | 4     |
| 25140 | Nordby        | 05-JUL-2007 | 01-JAN-2009 | precip_man | 32U | 6145059   | 462126   | 82405     | 552657   | 4     |
| 25140 | Nordby        | 07-FEB-2000 | 22-JUL-2003 | clima_aut  | 32U | 6145060   | 462120   | 82400     | 552700   | 4     |
| 25140 | Nordby        | 23-JUL-2003 | 04-JUL-2007 | clima_aut  | 32U | 6145047   | 462147   | 82406     | 552656   | 4     |
| 25140 | Nordby        | 05-JUL-2007 |             | clima_aut  | 32U | 6145059   | 462126   | 82405     | 552657   | 4     |
| 25140 | Nordby        | 01-JAN-2000 | 31-MAY-2002 | snow_man   | 32U | 6145060   | 462120   | 82400     | 552700   | 4     |
| 25135 | Langli        | 01-AUG-1983 | 30-JUN-1987 | clima_man  | 32U | 6152210   | 456890   | 81900     | 553100   | 3     |
| 25135 | Langli        | 01-JUL-1987 | 01-SEP-1999 | precip_man | 32U | 6152210   | 456890   | 81900     | 553100   | 3     |
| 25135 | Langli        | 02-JUN-2000 | 01-DEC-2000 | precip_man | 32U | 6152210   | 456890   | 81900     | 553100   | 3     |
| 25145 | Sønderho      | 01-JUN-1988 | 23-AUG-1999 | precip_man | 32U | 6134345   | 466300   | 82800     | 552100   | 4     |
| 25145 | Sønderho      | 24-AUG-1999 | 01-APR-2009 | precip_man | 32U | 6134432   | 466300   | 82800     | 552100   | 4     |
| 25171 | Esbjerg R/A V | 04-JAN-1979 | 06-JUN-1985 | precip_aut | 32U | 6149460   | 464000   | 82600     | 552900   | 3     |
| 25171 | Esbjerg R/A V | 26-AUG-1985 | 15-JAN-1989 | precip_aut | 32U | 6149500   | 464120   | 82600     | 552900   | 3     |
| 25171 | Esbjerg R/A V | 16-JAN-1989 | 06-AUG-1990 | precip_aut | 32U | 6149440   | 464035   | 82600     | 552900   | 3     |

|       |                  |             |             |            |     |         |        |       |        |    |
|-------|------------------|-------------|-------------|------------|-----|---------|--------|-------|--------|----|
| 25171 | Esbjerg R/A V    | 07-AUG-1990 | 23-MAY-2012 | precip_aut | 32U | 6149430 | 464030 | 82600 | 552900 | 3  |
| 25171 | Esbjerg R/A V    | 24-MAY-2012 |             | precip_aut | 32U | 6149500 | 464020 | 82550 | 552921 | 3  |
| 25172 | Hjerting         | 01-DEC-1985 | 09-JUN-1986 | precip_man | 32U | 6152591 | 460557 | 82300 | 553100 | 9  |
| 25172 | Hjerting         | 10-JUN-1986 | 01-JAN-2007 | precip_man | 32U | 6152596 | 460558 | 82300 | 553100 | 9  |
| 6088  | Nordby           | 23-JUL-2003 | 04-JUL-2007 | synop_dk   | 32U | 6145047 | 462147 | 82406 | 552656 | 4  |
| 6088  | Nordby           | 05-JUL-2007 |             | synop_dk   | 32U | 6145059 | 462126 | 82405 | 552657 | 4  |
| 6080  | Esbjerg Lufthavn | 01-JAN-1959 | 31-MAR-1971 | synop_dk   | 32U | 6151640 | 467420 | 82900 | 553000 | 25 |
| 6080  | Esbjerg Lufthavn | 01-APR-1971 | 30-SEP-1984 | synop_dk   | 32U | 6153140 | 471550 | 83300 | 553100 | 29 |
| 6080  | Esbjerg Lufthavn | 01-OCT-1984 |             | synop_dk   | 32U | 6153858 | 472475 | 83350 | 553144 | 25 |
| 25348 | Vester Vedsted   | 06-MAY-1986 | 01-DEC-2003 | clima_aut  | 32U | 6127418 | 478179 | 83923 | 551729 | 3  |
| 25348 | Vester Vedsted   | 11-DEC-2003 |             | clima_aut  | 32U | 6127418 | 478179 | 83923 | 551729 | 3  |
| 6081  | Blåvandshuk Fyr  | 01-JAN-1953 | 31-JAN-1971 | synop_dk   | 32U | 6157430 | 442240 | 80500 | 553300 | 13 |
| 6081  | Blåvandshuk Fyr  | 18-SEP-1980 |             | synop_dk   | 32U | 6157424 | 442226 | 80503 | 553329 | 16 |
| 6093  | Vester Vedsted   | 11-DEC-2003 |             | synop_dk   | 32U | 6127418 | 478179 | 83923 | 551729 | 3  |
| 6096  | Rømø/juvre       | 02-MAY-1982 | 06-APR-2000 | synop_dk   | 32U | 6116320 | 472070 | 83400 | 551100 | 6  |
| 6096  | Rømø/juvre       | 07-APR-2000 |             | synop_dk   | 32U | 6116270 | 472063 | 83340 | 551128 | 6  |
| 6058  | Hvide Sande      | 01-JAN-1989 | 06-NOV-2001 | synop_dk   | 32V | 6206680 | 445780 | 80800 | 560000 | 3  |
| 6058  | Hvide Sande      | 07-NOV-2001 |             | synop_dk   | 32V | 6207426 | 446535 | 80833 | 560028 | 2  |
| 25045 | Outrup           | 01-OCT-2004 | 14-NOV-2006 | snow_man   | 32U | 6175575 | 458141 | 82000 | 554300 | 17 |
| 25045 | Outrup           | 15-NOV-2006 | 19-AUG-2009 | snow_man   | 32U | 6175311 | 458776 | 82100 | 554300 | 15 |
| 25045 | Outrup           | 20-AUG-2009 | 24-OCT-2012 | snow_man   | 32U | 6175309 | 458775 | 82100 | 554300 | 15 |
| 25045 | Outrup           | 25-OCT-2012 |             | snow_man   | 32U | 6175662 | 458165 | 82002 | 554325 | 18 |

### 6116 Store Jyndeved (Broderup)

| No.   | Name           | Start       | End         | Type       | UTM | Northings | Eastings | Longitude | Latitude | Elev. |
|-------|----------------|-------------|-------------|------------|-----|-----------|----------|-----------|----------|-------|
| 26400 | Store Jyndeved | 15-OCT-1960 | 30-JUN-1978 | clima_man  | 32U | 6083960   | 508370   | 90800     | 545400   | 15    |
| 26400 | Store Jyndeved | 01-JUL-1978 | 30-JUN-1987 | clima_man  | 32U | 6083440   | 507920   | 90700     | 545400   | 14    |
| 26400 | Store Jyndeved | 01-JUL-1987 | 30-JUN-1992 | precip_man | 32U | 6083921   | 508179   | 90800     | 545400   | 15    |
| 26400 | Store Jyndeved | 01-JUL-1992 | 10-DEC-2001 | precip_man | 32U | 6083960   | 508268   | 90800     | 545400   | 15    |
| 26400 | Store Jyndeved | 11-DEC-2001 | 01-APR-2011 | precip_man | 32U | 6083963   | 508297   | 90800     | 545400   | 15    |
| 26409 | Tinglev        | 01-JUN-1995 | 01-JAN-2007 | precip_man | 32U | 6088366   | 516348   | 91500     | 545600   | 23    |
| 26410 | Broderup       | 01-NOV-1894 | 28-FEB-1909 | precip_man | 32U | 6084300   | 516760   | 91600     | 545400   | 22    |
| 26410 | Broderup       | 01-AUG-1909 | 28-FEB-1957 | precip_man | 32U | 6084300   | 516760   | 91600     | 545400   | 22    |
| 26410 | Bajstrup       | 01-MAR-1957 | 21-SEP-1970 | precip_man | 32U | 6084430   | 517470   | 91600     | 545400   | 23    |
| 26410 | Bajstrup       | 22-SEP-1970 | 30-JUN-1986 | precip_man | 32U | 6084500   | 517440   | 91600     | 545400   | 23    |
| 26410 | Gårdeby        | 01-DEC-1986 | 31-MAR-1987 | precip_man | 32U | 6084490   | 516300   | 91500     | 545400   | 22    |
| 26410 | Gårdeby        | 01-APR-1987 | 03-OCT-1989 | precip_man | 32U | 6084580   | 516220   | 91500     | 545400   | 22    |
| 26410 | Gårdeby        | 04-OCT-1989 | 30-SEP-1991 | precip_man | 32U | 6084550   | 516220   | 91500     | 545400   | 22    |
| 26410 | Rødebæk        | 01-JUL-1992 | 28-FEB-1993 | precip_man | 32U | 6082480   | 517130   | 91600     | 545300   | 25    |
| 26410 | Broderup Mark  | 01-MAY-1993 | 30-JUN-1993 | precip_man | 32U | 6083315   | 517350   | 91600     | 545400   | 23    |
| 6116  | Store Jyndeved | 05-SEP-1984 | 23-JUN-1988 | synop_dk   | 32U | 6083730   | 507970   | 90700     | 545400   | 15    |
| 6116  | Store Jyndeved | 06-JUN-2001 |             | synop_dk   | 32U | 6083716   | 507960   | 90727     | 545357   | 15    |

### 6132 Tranebjerg

| No.   | Name           | Start       | End         | Type       | UTM | Northings | Eastings | Longitude | Latitude | Elev. |
|-------|----------------|-------------|-------------|------------|-----|-----------|----------|-----------|----------|-------|
| 27080 | Tranebjerg     | 01-DEC-1872 | 28-FEB-1877 | clima_man  | 32U | 6188790   | 600080   | 103600    | 555000   | 15    |
| 27080 | Tranebjerg     | 01-MAR-1877 | 31-MAR-1884 | clima_man  | 32U | 6188885   | 599720   | 103500    | 555000   | 17    |
| 27080 | Tranebjerg     | 01-APR-1884 | 31-MAY-1918 | clima_man  | 32U | 6188890   | 599630   | 103500    | 555000   | 17    |
| 27080 | Tranebjerg     | 01-JUN-1918 | 30-APR-1950 | clima_man  | 32U | 6188850   | 599630   | 103500    | 555000   | 17    |
| 27080 | Tranebjerg     | 01-MAY-1950 | 31-OCT-1972 | clima_man  | 32U | 6188910   | 599730   | 103600    | 555000   | 15    |
| 27080 | Tranebjerg     | 01-NOV-1972 | 01-FEB-2000 | clima_man  | 32U | 6190400   | 600010   | 103600    | 555100   | 11    |
| 27080 | Tranebjerg     | 02-FEB-2000 | 29-FEB-2000 | precip_man | 32U | 6190400   | 600010   | 103600    | 555100   | 11    |
| 27080 | Tranebjerg     | 01-MAR-2000 | 01-AUG-2001 | precip_man | 32U | 6190468   | 600052   | 103600    | 555100   | 12    |
| 27080 | Tranebjerg     | 15-FEB-2000 | 29-FEB-2000 | clima_aut  | 32U | 6190400   | 600010   | 103600    | 555100   | 11    |
| 27080 | Tranebjerg     | 01-MAR-2000 | 10-AUG-2003 | clima_aut  | 32U | 6190468   | 600052   | 103600    | 555100   | 12    |
| 27080 | Tranebjerg Øst | 20-AUG-2003 |             | clima_aut  | 32U | 6188727   | 601656   | 103723    | 554956   | 16    |
| 6132  | Tranebjerg Øst | 20-AUG-2003 |             | synop_dk   | 32U | 6188727   | 601656   | 103723    | 554956   | 16    |
| 27082 | Tranebjerg Øst | 02-AUG-2001 | 17-NOV-2009 | precip_man | 32U | 6188800   | 601435   | 103700    | 555000   | 18    |
| 27082 | Tranebjerg Øst | 18-NOV-2009 | 01-APR-2011 | precip_man | 32U | 6188798   | 601458   | 103700    | 555000   | 18    |
| 5165  | Tranebjerg Øst | 18-NOV-2010 | 25-SEP-2011 | synop_dk   | 32U | 6188800   | 601458   | 103711    | 554958   | 18    |
| 5165  | Tranebjerg Øst | 26-SEP-2011 |             | synop_dk   | 32U | 6188796   | 601457   | 103711    | 554958   | 18    |
| 27082 | Tranebjerg Øst | 01-OCT-2004 | 17-NOV-2009 | snow_man   | 32U | 6188800   | 601435   | 103700    | 555000   | 18    |
| 27082 | Tranebjerg Øst | 18-NOV-2009 |             | snow_man   | 32U | 6188798   | 601458   | 103700    | 555000   | 18    |
| 27070 | Langør         | 01-JUN-1871 | 31-MAY-1880 | precip_man | 32U | 6197690   | 602720   | 103900    | 555500   | 3     |
| 27070 | Langør         | 01-JUN-1880 | 31-DEC-1928 | precip_man | 32U | 6198330   | 602320   | 103800    | 555500   | 4     |
| 27070 | Langør         | 01-JAN-1929 | 31-OCT-1946 | precip_man | 32U | 6198480   | 601270   | 103700    | 555500   | 3     |



|       |                     |             |             |            |     |         |        |        |        |    |
|-------|---------------------|-------------|-------------|------------|-----|---------|--------|--------|--------|----|
| 27070 | Langør              | 01-NOV-1946 | 31-DEC-1959 | precip_man | 32U | 6198480 | 601820 | 103800 | 555500 | 2  |
| 27070 | Langør              | 01-JAN-1960 | 31-MAY-1977 | precip_man | 32U | 6198480 | 601270 | 103700 | 555500 | 3  |
| 27070 | Langør              | 01-JUN-1977 | 29-FEB-1996 | precip_man | 32U | 6198480 | 601820 | 103800 | 555500 | 2  |
| 27070 | Langør              | 01-MAR-1996 | 01-MAY-1997 | precip_man | 32U | 6198435 | 601255 | 103700 | 555500 | 3  |
| 27070 | Kanhave             | 02-MAY-1997 | 01-JAN-2007 | precip_man | 32U | 6196975 | 600370 | 103600 | 555400 | 2  |
| 27090 | Ørnslund            | 01-JAN-1864 | 30-SEP-1881 | precip_man | 32U | 6182900 | 600180 | 103600 | 554700 | 11 |
| 27090 | Ørnslund            | 01-OCT-1881 | 30-APR-1958 | precip_man | 32U | 6183200 | 599650 | 103500 | 554700 | 6  |
| 27090 | Brattingsborg       | 01-MAY-1958 | 31-DEC-1970 | precip_man | 32U | 6183400 | 599477 | 103500 | 554700 | 6  |
| 27090 | Brattingsborg       | 01-JAN-1971 | 01-JUN-2004 | precip_man | 32U | 6183332 | 599485 | 103500 | 554700 | 6  |
| 28180 | Blangstedgård       | 01-JUL-1885 | 31-DEC-1982 | clima_man  | 32U | 6138250 | 591690 | 102700 | 552300 | 15 |
| 6159  | Røsnæs Fyr          | 01-JAN-1959 | 14-NOV-2001 | synop_dk   | 32U | 6179330 | 617414 | 105200 | 554500 | 15 |
| 6159  | Røsnæs Fyr          | 15-NOV-2001 |             | synop_dk   | 32U | 6179319 | 617433 | 105214 | 554439 | 14 |
| 6073  | Sletterhage Fyr     | 15-MAY-2001 |             | synop_dk   | 32V | 6217942 | 594237 | 103053 | 560546 | 4  |
| 6120  | Odense Lufthavn     | 01-JAN-1959 | 30-JUN-1975 | synop_dk   | 32U | 6148495 | 584135 | 102000 | 552800 | 16 |
| 6120  | Odense Lufthavn     | 01-JUL-1975 | 30-SEP-2013 | synop_dk   | 32U | 6148648 | 584180 | 102000 | 552900 | 15 |
| 6120  | H.C.AndersenAirport | 01-OCT-2013 |             | synop_dk   | 32U | 6148648 | 584180 | 102000 | 552900 | 15 |
| 6169  | Gniben              | 01-JAN-1961 | 31-JUL-1974 | synop_dk   | 32V | 6209380 | 642270 | 111700 | 560000 | 4  |
| 6169  | Gniben              | 01-AUG-1974 | 31-MAR-1979 | synop_dk   | 32V | 6209340 | 642190 | 111700 | 560000 | 10 |
| 6169  | Gniben              | 01-APR-1979 | 14-FEB-1983 | synop_dk   | 32V | 6209560 | 642140 | 111700 | 560100 | 13 |
| 6169  | Gniben              | 15-FEB-1983 |             | synop_dk   | 32V | 6209553 | 642156 | 111648 | 560032 | 14 |

### 6186 Københavns Landbohøjskole

This station has been subject to urban change. Back in time the surroundings were rural whereas today the park of Landbohøjskolen with the synoptic station is surrounded by the city of Copenhagen. Observations in Copenhagen started 1751 in the tower "Rundetårn", but the first 16 years the thermometer was situated inside a room in a little observatory near the top of the tower. In the beginning of 1767 the thermometer was situated outside the observatory facing north and from 1768 the observations were taken 4 times a day. Therefore the series presented in this report starts 1768.

| No.   | Name                   | Start       | End         | Type       | UTM | Northings | Eastings | Longitude | Latitude | Elev.          |
|-------|------------------------|-------------|-------------|------------|-----|-----------|----------|-----------|----------|----------------|
| 30380 | Landbohøjskolen        | 01-JAN-1860 | 01-JUL-1997 | clima_man  | 33U | 6173560   | 345420   | 123200    | 554100   | 9              |
| 6186  | Landbohøjskolen        | 29-NOV-1995 | 12-JUN-1997 | synop_dk   | 33U | 6173560   | 345420   | 123200    | 554100   | 9              |
| 6186  | Landbohøjskolen        | 13-JUN-1997 | 01-JUL-1997 | synop_dk   | 33U | 6174083   | 345667   | 123242    | 554112   | 7              |
| 6186  | Landbohøjskolen        | 02-JUL-1997 |             | synop_dk   | 33U | 6174083   | 345667   | 123242    | 554112   | 7              |
| 6180  | Københavns Lufthavn    | 01-JAN-1953 | 30-JUN-1955 | synop_dk   | 33U | 6167070   | 352740   | 124000    | 553800   | 2              |
| 6180  | Københavns Lufthavn    | 01-JUL-1955 | 30-JUN-1959 | synop_dk   | 33U | 6167170   | 352110   | 123900    | 553800   | 3              |
| 6180  | Københavns Lufthavn    | 01-JUL-1959 | 13-JUL-1971 | synop_dk   | 33U | 6166370   | 352440   | 123900    | 553700   | 3              |
| 6180  | Københavns Lufthavn    | 14-JUL-1971 | 15-JUN-1983 | synop_dk   | 33U | 6165550   | 351570   | 123900    | 553700   | 4              |
| 6180  | Københavns Lufthavn    | 16-JUN-1983 |             | synop_dk   | 33U | 6165840   | 351770   | 123900    | 553700   | 5              |
| 6183  | Drogden Fyr            | 01-JAN-1961 |             | synop_dk   | 33U | 6157060   | 355647   | 124245    | 553213   | 18             |
| 6187  | Københavns Toldbod     | 20-FEB-2004 |             | synop_dk   | 33U | 6174236   | 349105   | 123559    | 554121   | 20             |
| 30340 | Københavns Toldbod     | 01-JAN-1886 | 31-DEC-1949 | fuess      | 33U | 6174250   | 349070   | 123600    | 554100   | 20             |
| 30340 | Københavns Toldbod     | 01-JAN-1950 | 30-JUN-1976 | fuess      | 33U | 6174240   | 349110   | 123600    | 554100   | 20             |
| 30340 | Københavns Toldbod     | 01-JAN-1978 | 30-JUN-1997 | fuess      | 33U | 6174240   | 349110   | 123600    | 554100   | 20             |
| 30340 | Københavns Toldbod     | 01-MAY-1968 | 03-APR-2005 | casella    | 33U | 6174240   | 349110   | 123600    | 554100   | 20             |
| 30341 | Københavns Toldbod     | 20-FEB-2004 |             | clima_aut  | 33U | 6174236   | 349105   | 123559    | 554121   | 20             |
| 30210 | Meteorologisk Institut | 01-JAN-1875 | 31-DEC-1906 | clima_man  | 33U | 6174200   | 349100   | 123600    | 554100   | 13             |
| 30210 | Meteorologisk Institut | 1-JAN-1907  | 31-DEC-1922 | clima_man  | 33U | 6174200   | 349100   | 123600    | 554100   | 5              |
| 30210 | Meteorologisk Institut | 01-JAN-1952 | 28-FEB-1972 | clima_man  | 33U | 6182380   | 347220   | 123400    | 554600   | 15             |
| 30210 | Meteorologisk Institut | 1-MAR-1972  | 31-MAR-1985 | precip_man | 33U | 6177370   | 346930   | 123400    | 554300   | 8              |
| 30210 | Danmarks Met. Inst.    | 01-JUN-2004 |             | clima_aut  | 33U | 6177359   | 346923   | 123348    | 554300   | 8              |
| 30370 | Botanisk Have          | 01-OCT-1955 | 31-DEC-1970 | clima_man  | 33U | 6174193   | 347579   | 123500    | 554100   | 6              |
| 30370 | Botanisk Have          | 01-NOV-1945 | 30-SEP-1955 | precip_man | 33U | 6174193   | 347579   | 123500    | 554100   | 6              |
| 30370 | Botanisk Have          | 01-JAN-1971 | 01-APR-2011 | precip_man | 33U | 6174193   | 347579   | 123500    | 554100   | 6              |
| 5735  | Botanisk Have          | 14-JAN-2010 | 28-NOV-2011 | synop_dk   | 33U | 6174196   | 347575   | 123431    | 554118   | 6              |
| 5735  | Botanisk Have          | 29-NOV-2011 | 23-JUL-2012 | synop_dk   | 33U | 6174199   | 347574   | 123431    | 554118   | 6              |
| 5735  | Botanisk Have          | 24-JUL-2012 |             | synop_dk   | 33U | 6174194   | 347557   | 123430    | 554118   | 6              |
| 30370 | Botanisk Have          | 01-OCT-2004 |             | snow_man   | 33U | 6174193   | 347579   | 123500    | 554100   | 6              |
| 30372 | Rundetårn              | 01-JAN-1751 | 31-DEC-1817 | clima_man  | 33U | 6173480   | 347655   | 123437    | 554055   | 7 <sup>)</sup> |
| 30371 | Gl. Botanisk Have      | 01-JAN-1818 | 31-DEC-1859 | clima_man  | 33U | 6173160   | 348485   | 123525    | 554045   | 3              |

\*) The ground level of the tower is 7 m above MSL. The thermometer was situated app. 43 m above MSL.

## 6193 Hammer Odde Fyr/Lighthouse

| No.   | Name               | Start       | End         | Type       | UTM | Northings | Eastings | Longitude | Latitude | Elev. |
|-------|--------------------|-------------|-------------|------------|-----|-----------|----------|-----------|----------|-------|
| 32030 | Sandvig            | 11-NOV-1872 | 31-AUG-1953 | clima_man  | 33U | 6127090   | 486180   | 144700    | 551700   | 13    |
| 32030 | Sandvig            | 01-SEP-1953 | 30-JUN-1966 | clima_man  | 33U | 6127105   | 486140   | 144700    | 551700   | 13    |
| 32030 | Sandvig            | 01-AUG-1966 | 30-NOV-1972 | clima_man  | 33U | 6127010   | 485840   | 144700    | 551700   | 12    |
| 32025 | Hammeren Fyr       | 01-JAN-1880 | 31-JUL-1962 | clima_man  | 33U | 6126930   | 484770   | 144600    | 551700   | 77    |
| 32020 | Hammer Odde Fyr    | 01-MAR-1953 | 30-JUN-1974 | clima_man  | 33U | 6128190   | 485630   | 144600    | 551800   | 7     |
| 32020 | Hammer Odde Fyr    | 01-JUL-1974 | 30-JUN-1987 | clima_man  | 33U | 6128170   | 485710   | 144700    | 551800   | 11    |
| 6191  | Christiansø Fyr    | 01-JAN-1961 | 31-MAR-2000 | synop_dk   | 33U | 6130820   | 511970   | 151100    | 551900   | 13    |
| 32080 | Klemensker         | 01-OCT-1954 | 30-NOV-1971 | clima_man  | 33U | 6114630   | 487970   | 144900    | 551100   | 110   |
| 32080 | Klemensker         | 01-SEP-1953 | 30-SEP-1954 | precip_man | 33U | 6114630   | 487970   | 144900    | 551100   | 110   |
| 32080 | Klemensker         | 01-OCT-1994 | 21-SEP-1998 | precip_man | 33U | 6114674   | 488059   | 144900    | 551100   | 111   |
| 32080 | Klemensker         | 22-SEP-1998 | 01-DEC-2004 | precip_man | 33U | 6114671   | 488062   | 144900    | 551100   | 111   |
| 32080 | Klemensker         | 02-DEC-2004 | 01-AUG-2010 | precip_man | 33U | 6114234   | 488024   | 144900    | 551000   | 108   |
| 32080 | Klemensker         | 01-DEC-2002 | 01-DEC-2004 | snow_man   | 33U | 6114671   | 488062   | 144900    | 551100   | 111   |
| 32080 | Klemensker         | 02-DEC-2004 | 31-MAY-2010 | snow_man   | 33U | 6114234   | 488024   | 144900    | 551000   | 108   |
| 32175 | Østerlars          | 15-MAY-1998 | 20-MAY-2008 | precip_man | 33U | 6113107   | 498094   | 145800    | 551000   | 94    |
| 32175 | Østerlars          | 21-MAY-2008 | 01-APR-2011 | precip_man | 33U | 6113129   | 498051   | 145800    | 551000   | 94    |
| 32175 | Østerlars          | 20-JAN-2005 | 20-MAY-2008 | snow_man   | 33U | 6113107   | 498094   | 145800    | 551000   | 94    |
| 32175 | Østerlars          | 21-MAY-2008 |             | snow_man   | 33U | 6113129   | 498051   | 145800    | 551000   | 94    |
| 6193  | Hammer Odde Fyr    | 05-OCT-1977 | 29-AUG-2001 | synop_dk   | 33U | 6128170   | 485710   | 144700    | 551800   | 11    |
| 6193  | Hammer Odde Fyr    | 30-AUG-2001 |             | synop_dk   | 33U | 6128170   | 485579   | 144622    | 551755   | 8     |
| 6190  | Bornholms Lufthavn | 01-JAN-1959 | 31-MAY-1977 | synop_dk   | 33U | 6102830   | 483820   | 144500    | 550400   | 13    |
| 6190  | Bornholms Lufthavn | 01-JUN-1977 |             | synop_dk   | 33U | 6102556   | 484066   | 144500    | 550400   | 15    |
| 6199  | Dueodde N Fyr      | 01-JAN-1959 | 30-SEP-1962 | synop_dk   | 33U | 6095230   | 504720   | 150400    | 550000   | 16    |
| 6199  | Dueodde S Fyr      | 01-OCT-1962 | 30-JUN-1977 | synop_dk   | 33U | 6094150   | 504810   | 150500    | 550000   | 6     |

### Appendix 1.3. File formats; Station angles file

Another station file contains digitised information on the rain gauge exposure.

The file name is:

**dk\_station\_ang.dat**

The file contains the digitised information on the rain gauge exposure. The information is expressed as the angle to the horizon in eight directions, as the summarising angle index and the exposure class. The information is only available for some of the stations and only through the recent years.

The text file has the following format:

| Position | Format     | Description                       |
|----------|------------|-----------------------------------|
| 1-5      | F5.0       | Station number                    |
| 6-25     | Datetime20 | Start date (DD-MMM-YYYY HH:MM:SS) |
| 26-45    | Datetime20 | End date (DD-MMM-YYYY HH:MM:SS)   |
| 46-51    | F6.0       | Angle towards N                   |
| 52-57    | F6.0       | Angle towards NE                  |
| 58-63    | F6.0       | Angle towards E                   |
| 64-69    | F6.0       | Angle towards SE                  |
| 70-75    | F6.0       | Angle towards S                   |
| 76-81    | F6.0       | Angle towards SW                  |
| 82-87    | F6.0       | Angle towards W                   |
| 88-93    | F6.0       | Angle towards NW                  |
| 94-99    | F6.0       | Angle index                       |
| 100-177  | A78        | Remarks                           |
| 178-178  | A1         | Exposure class                    |

The following dependence of exposure class on angle index are used:

| Exposure class | Description                       | Min. index | Max. index |
|----------------|-----------------------------------|------------|------------|
| A              | Well sheltered                    | 20         | 30         |
| B              | Moderately sheltered              | 6          | 19         |
| C              | Freely exposed, unsheltered       | 0          | 5          |
| D              | Overprotected, too well sheltered | >=31       |            |

## Appendix 2. Observational section - File Formats and metadata

### Appendix 2.1. File Formats; Observation data files

The observation files included in this report contains blended mean sea level (msl) atmospheric pressure observations 1874-2016 from three (3) stations in Denmark; 6051 Vestervig, 6088 Nordby (Fanø) and 6193 Hammer Odde Fyr (Bornholm).

The file names are determined as follows:

**dk\_obs\_401\_<station number>\_<period>.csv**

In this report three (3) ;-separated csv-files:

**dk\_obs\_401\_6051\_1874\_2016.csv**

**dk\_obs\_401\_6088\_1874\_2016.csv**

**dk\_obs\_401\_6193\_1874\_2016.csv**

There **can** be missing dates/records/values between the start and the end date.

#### **Format and units of the atmospheric pressure observation file:**

Station number (stat\_no); year (year); month (month); day (day); hour UTC (hour); atmospheric pressure reduced to msl (hPa) (elem\_val)

The element/parameter numbers and units can be seen in the data dictionary, table 4.2.2, in section 4.2.

Data are only to be used with proper reference to the accompanying report:

Cappelen, J. (ed), 2017: Denmark - DMI Historical Climate Data Collection 1768-2016. DMI Report No. 17-02. Copenhagen.

## Appendix 2.2. Metadata - Description of observational atmospheric pressure datasets

Three (3) Danish data sets have long series of atmospheric pressure observations (at msl, mean sea level). The table presents an overview of the blended station data series (identified by the station name and station number) resulting in the long data sets and how many observations the series contains in the different parts.

Additional metadata can be seen in DMI Technical Report 97-3: North Atlantic-European pressure observations 1868-1995 - WASA dataset version 1.0 [43].

| Dataset/period                   | Station                                      | Start             | End               | Obs. hours (utc)    |
|----------------------------------|--|-------------------|-------------------|---------------------|
| <b>Vestervig<br/>1874-2016</b>   | 21100 Vestervig                              | 01 January 1874   | 31 July 1987      | 7,13,20             |
|                                  | 6052 Thyborøn                                | 01 August 1987    | 22 November 2000  | 0,3,6,9,12,15,18,21 |
|                                  | 6052 Thyborøn                                | 22 November 2000  | 31 December 2016  | 0 – 23 every hour   |
| <b>Nordby/Fanø<br/>1874-2016</b> | 25140 Nordby/Fanø                            | 01 January 1874   | 31 July 1987      | 7,13,20             |
|                                  | 6080 Esbjerg Airport                         | 01 August 1987    | 10 September 2003 | 0,3,6,9,12,15,18,21 |
|                                  | 6080 Esbjerg Airport                         | 10 September 2003 | 31 December 2016  | 0 – 23 every hour   |
| <b>Hammer Odde<br/>1874-2016</b> | 32030 Sandvig or                             | 01 January 1874   | 31 May 1987       | 7,13,20             |
|                                  | 32020 Hammer Odde Fyr                        | 01 June 1987      | 30 August 2001    | 0,3,6,9,12,15,18,21 |
|                                  | 6193 Hammer Odde Fyr<br>6193 Hammer Odde Fyr | 30 August 2001    | 31 December 2016  | 0 – 23 every hour   |

*The three Danish series of atmospheric pressure observations (at msl, mean sea level). Important note: Blended data sets are a part of the observational section, Single station series are not a part of the observational section.*

## Appendix 3. Daily section – File formats and metadata

### Appendix 3.1. File formats; Daily data files

The daily files included in this report contain single and blended daily DMI data series 1872 - 2016 comprising different parameters for selected meteorological stations in Denmark.

The file names are determined as follows:

**dk\_daily\_<element number>.xlsx**

**dk\_daily\_<station number>\_<element number>.csv**

In this report six (6) Excel-files and sixty-two (62) ;-separated csv-files:

**dk\_daily\_101.xlsx**

**dk\_daily\_112.xlsx**

**dk\_daily\_122.xlsx**

**dk\_daily\_401.xlsx**

**dk\_daily\_601.xlsx**

**dk\_daily\_801.xlsx**

**dk\_daily\_27080\_101.csv (period 1872-2003)**

**dk\_daily\_6132\_101.csv (period 2003-2016)**

**dk\_daily\_27080\_6132\_101.csv (period 1872-2016) (blend)**

**dk\_daily\_21100\_112.csv (period 1874-2003)**

**dk\_daily\_6051\_112.csv (period 2003-2016)**

**dk\_daily\_21100\_6051\_112.csv (period 1874-2016) (blend)**

**dk\_daily\_25140\_112.csv (period 1874-2003)**

**dk\_daily\_6088\_112.csv (period 2003-2016)**

**dk\_daily\_25140\_6088\_112.csv (period 1874-2016) (blend)**

**dk\_daily\_27080\_112.csv (period 1873-2003)**

**dk\_daily\_6132\_112.csv (period 2003-2016)**

**dk\_daily\_27080\_6132\_112.csv (period 1873-2016) (blend)**

**dk\_daily\_30380\_112.csv (period 1874-1997)**

**dk\_daily\_6186\_112.csv (period 1995-2016)**

**dk\_daily\_30380\_6186\_112.csv (period 1874-2016) (blend)**

**dk\_daily\_32030\_112.csv (period 1874-1970)**

**dk\_daily\_32020\_112.csv (period 1971-1987)**

**dk\_daily\_6193\_112.csv (period 1984-2016)**

**dk\_daily\_32030\_32020\_6193\_112.csv (period 1874-2016) (blend)**

**dk\_daily\_21100\_122.csv (period 1874-2003)**

**dk\_daily\_6051\_122.csv (period 2003-2016)**

**dk\_daily\_21100\_6051\_122.csv (period 1874-2016) (blend)**

**dk\_daily\_25140\_122.csv (period 1874-2003)**

**dk\_daily\_6088\_122.csv (period 2003-2016)**

**dk\_daily\_25140\_6088\_122.csv (period 1874-2016) (blend)**

**dk\_daily\_27080\_122.csv (period 1872-2003)**

**dk\_daily\_6132\_122.csv (period 2003-2016)**

**dk\_daily\_27080\_6132\_122.csv (period 1872-2016) (blend)**

**dk\_daily\_30380\_122.csv (period 1874-1997)**

**dk\_daily\_6186\_122.csv (period 1995-2016)**  
**dk\_daily\_30380\_6186\_122.csv (period 1874-2016) (blend)**  
**dk\_daily\_32030\_122.csv (period 1874-1970)**  
**dk\_daily\_32020\_122.csv (period 1971-1987)**  
**dk\_daily\_6193\_122.csv (period 1984-2016)**  
**dk\_daily\_32030\_32020\_6193\_122.csv (period 1874-2016) (blend)**

**dk\_daily\_21100\_401.csv (period 1874-1987)**  
**dk\_daily\_6052\_401.csv (period 1962-2016)**  
**dk\_daily\_21100\_6952\_401.csv (period 1874-2016) (blend)**  
**dk\_daily\_25140\_401.csv (period 1874-1987)**  
**dk\_daily\_6080\_401.csv (period 1959-2016)**  
**dk\_daily\_25140\_6080\_401.csv (period 1874-2016) (blend)**  
**dk\_daily\_6193\_401.csv (period 1874-2016)**

**dk\_daily\_6051\_601.csv (period 1874-2016)**  
**dk\_daily\_5135\_601.csv (period 1874-2016)**  
**dk\_daily\_6088\_601.csv (period 1874-2016)**  
**dk\_daily\_26410\_601.csv (period 1920-1993)**  
**dk\_daily\_26409\_601.csv (period 1995-2006)**  
**dk\_daily\_6116\_601.csv (period 1987-2016)**  
**dk\_daily\_26410\_6116\_601.csv (period 1920-2016) (blend)**  
**dk\_daily\_27080\_601.csv (period 1872-2001)**  
**dk\_daily\_5165\_601.csv (period 2001-2016)**  
**dk\_daily\_27080\_5165\_601.csv (period 1872-2016) (blend)**  
**dk\_daily\_30380\_601.csv (period 1874-1996)**  
**dk\_daily\_30210\_1\_601.csv (period 1875-1922)**  
**dk\_daily\_30210\_2\_601.csv (period 1961-1984)**  
**dk\_daily\_5735\_601.csv (period 1961-2016)**  
**dk\_daily\_30380\_5735\_601.csv (period 1874-2016) (blend)**  
**dk\_daily\_32030\_601.csv (period 1874-1970)**  
**dk\_daily\_32020\_601.csv (period 1961-1987)**  
**dk\_daily\_6193\_601.csv (period 1984-2016)**  
**dk\_daily\_32030\_32020\_6193\_601.csv (period 1874-2016) (blend)**

**dk\_daily\_27080\_801.csv (period 1872-2000)**

The general format is:

Station number (stat\_no); Year (year); Month (month); Day (day); Hour (hour); Element/Parameter value (elem\_val)

From 2011 and forward interpolated values can be included in the data series.

The element/parameter numbers and units can be seen in the data dictionary, table 5.2.7, in section 5.2.

Data are only to be used with proper reference to the accompanying report: Cappelen, J. (ed), 2017: DMI Historical Climate Data Collection 1768-2016, Denmark. DMI Report 17-02. Copenhagen.

## Air temperature at 14 hours DNT or 12 UTC files

### **dk\_daily\_101.xlsx**

The sheets in the xlsx-file are named:

27080\_101 (period 1872-2003)  
6132\_101 (period 2003-2016)  
27080\_6132\_101 (period 1872-2016) (blend)

The data can also be found in separate csv-files:

**dk\_daily\_27080\_101.csv (period 1872-2003)**  
**dk\_daily\_6132\_101.csv (period 2003-2016)**  
**dk\_daily\_27080\_6132\_101.csv (period 1872-2016) (blend)**

The different sheets/files contain air temperature observed daily at 14 hours DNT or 12 UTC. There are no missing dates between the start and the end date. Any missing values are filled in by "null".

### **Format and units of air temperature 14 hours DNT/12 UTC file:**

Station number (stat\_no); year (year); month (month); day (day); hour DNT or UTC (hour); air temperature 14 hours DNT/12 UTC in °C (elem\_val)

## Daily highest air temperature files

### **dk\_daily\_112.xlsx**

The sheets in the xlsx-file are named:

21100\_112 (period 1874-2003)  
6051\_112 (period 2003-2016)  
21100\_6051\_112 (period 1874-2016) (blend)

25140\_112 (period 1874-2003)  
6088\_112 (period 2003-2016)  
25140\_6088\_112 (period 1874-2016) (blend)

27080\_112 (period 1873-2003)  
6132\_112 (period 2003-2016)  
27080\_6132\_112 (period 1873-2016) (blend)

30380\_112 (period 1874-1997)  
6186\_112 (period 1995-2016)  
30380\_6186\_112 (period 1874-2016) (blend)

32030\_112 (period 1874-1970)  
32020\_112 (period 1971-1987)  
6193\_112 (period 1984-2016)  
32030\_32020\_6193\_112 (period 1874-2016) (blend)

The data can also be found in separate csv-files:

**dk\_daily\_21100\_112.csv (period 1874-2003)**  
**dk\_daily\_6051\_112.csv (period 2003-2016)**  
**dk\_daily\_21100\_6051\_112.csv (period 1874-2016) (blend)**



**dk\_daily\_25140\_112.csv (period 1874-2003)**  
**dk\_daily\_6088\_112.csv (period 2003-2016)**  
**dk\_daily\_25140\_6088\_112.csv (period 1874-2016) (blend)**  
**dk\_daily\_27080\_112.csv (period 1873-2003)**  
**dk\_daily\_6132\_112.csv (period 2003-2016)**  
**dk\_daily\_27080\_6132\_112.csv (period 1873-2016) (blend)**  
**dk\_daily\_30380\_112.csv (period 1874-1997)**  
**dk\_daily\_6186\_112.csv (period 1995-2016)**  
**dk\_daily\_30380\_6186\_112.csv (period 1874-2016) (blend)**  
**dk\_daily\_32030\_112.csv (period 1874-1970)**  
**dk\_daily\_32020\_112.csv (period 1971-1987)**  
**dk\_daily\_6193\_112.csv (period 1984-2016)**  
**dk\_daily\_32030\_32020\_6193\_112.csv (period 1874-2016) (blend)**

The different sheets/files contain daily highest air temperatures. There are no missing dates between the start and the end date. Any missing values are filled in by "null".

### Format and units of daily highest air temperature file:

Station number (stat\_no); year (year); month (month); day (day); hour DNT or UTC (hour); highest air temperature in °C (elem\_val)

- UTC (since 2001 or if station number starts with 6).
- Highest air temperature (°C). The highest air temperature, covering the previous 24 hours, is read in the morning (the same as the lowest air temperature). For the manual climate stations (21100, 25140, 27080, 30380, 32020 and 32030) please note: During the period 1 Jan 1913 - 1 Jan 1971 the highest air temperature is listed on the previous day (where it most often occurs). During the periods 1 Jan 1874 - 31 Dec 1912 and 2 Jan 1971 – present day the highest air temperature is listed on the date it has been read. This change in practice was only regarding the highest air temperature, not the lowest air temperature. Because of the change back and forth in practise the data files (and DMI annals) hold no highest air temperature for the 24-hours period starting in the morning 31 Dec 1912 and ending in the morning 1 Jan 1913. And conversely the highest air temperature of the 24-hours that starts in the morning 1 Jan 1971 and ends in the morning 2 Jan 1971 is listed TWO times in the data files: With time stamp 1 Jan 1971 at 8 hours AND with time stamp 2 Jan 1971 at 8 hours, just as the change of practice dictates for those dates.
- Please notice that the "hour" changed 1 Jan 2012 to 23 UTC (winter) and 22 UTC (summer). This reflects the wish to define the day as a "Calendar day".
- For that reason TWO 1 Jan 2012 are included. The first one covering the previous 24 hours up to 1 Jan 2012; 6 UTC, the second one covering the previous 24 hours up to 1 Jan 2012; 23 UTC. Please notice the time overlap here. For 6088 Nordby/Fanø that change took place 1 May 2011.

### Daily lowest air temperature files

#### dk\_daily\_122.xlsx

The sheets in the xlsx-file are named:

21100\_122 (period 1874-2003)  
 6051\_122 (period 2003-2016)  
 21100\_6051\_122 (period 1874-2016) (blend)

25140\_122 (period 1874-2003)  
6088\_122 (period 2003-2016)  
25140\_6088\_122 (period 1874-2016) (blend)

27080\_122 (period 1872-2003)  
6132\_122 (period 2003-2016)  
27080\_6132\_122 (period 1872-2016) (blend)

30380\_122 (period 1874-1997)  
6186\_122 (period 1995-2016)  
30380\_6186\_122 (period 1874-2016) (blend)

32030\_122 (period 1874-1970)  
32020\_122 (period 1971-1987)  
6193\_122 (period 1984-2016)  
32030\_32020\_6193\_122 (period 1874-2016) (blend)

The data can also be found in separate csv-files:

**dk\_daily\_21100\_122.csv (period 1874-2003)**  
**dk\_daily\_6051\_122.csv (period 2003-2016)**  
**dk\_daily\_21100\_6051\_122.csv (period 1874-2016) (blend)**  
**dk\_daily\_25140\_122.csv (period 1874-2003)**  
**dk\_daily\_6088\_122.csv (period 2003-2016)**  
**dk\_daily\_25140\_6088\_122.csv (period 1874-2016) (blend)**  
**dk\_daily\_27080\_122.csv (period 1872-2003)**  
**dk\_daily\_6132\_122.csv (period 2003-2016)**  
**dk\_daily\_27080\_6132\_122.csv (period 1872-2016) (blend)**  
**dk\_daily\_30380\_122.csv (period 1874-1997)**  
**dk\_daily\_6186\_122.csv (period 1995-2016)**  
**dk\_daily\_30380\_6186\_122.csv (period 1874-2016) (blend)**  
**dk\_daily\_32030\_122.csv (period 1874-1970)**  
**dk\_daily\_32020\_122.csv (period 1971-1987)**  
**dk\_daily\_6193\_122.csv (period 1984-2016)**  
**dk\_daily\_32030\_32020\_6193\_122.csv (period 1874-2016) (blend)**

The different sheets/files contain daily lowest air temperatures. There are no missing dates between the start and the end date. Any missing observations are filled in by "null".

#### **Format and units of lowest air temperature files:**

Station number (stat\_no); year (year); month (month); day (day); hour DNT or UTC (hour); lowest air temperature in °C (elem\_val)

- UTC (since 2001 or if station number starts with 6).
- Lowest air temperature previous 24 hours (°C).
- Please notice that the "hour" changed 1 Jan 2012 to 23 UTC (winter) and 22 UTC (summer). This reflects the wish to define the day as a "Calendar day".
- For that reason TWO 1 Jan 2012 are included. The first one covering the previous 24 hours up to 1 Jan 2012; 6 UTC, the second one covering the previous 24 hours up to 1 Jan 2012; 23 UTC. Please notice the time overlap here. For 6088 Nordby/Fanø that change took place 1 May 2011.

## Daily average atmospheric pressure files

### dk\_daily\_401.xlsx

The sheets in the xlsx-file are named:

21100\_401 (period 1874-1987)  
6052\_401 (period 1962-2016)  
21100\_6952\_401 (period 1874-2016) (blend)

25140\_401 (period 1874-1987)  
6080\_401 (period 1959-2016)  
25140\_6080\_401 (period 1874-2016) (blend)

6193\_401 (period 1874-2016)

The data can also be found in separate csv-files:

**dk\_daily\_21100\_401.csv (period 1874-1987)**  
**dk\_daily\_6052\_401.csv (period 1962-2016)**  
**dk\_daily\_21100\_6952\_401.csv (period 1874-2016) (blend)**  
**dk\_daily\_25140\_401.csv (period 1874-1987)**  
**dk\_daily\_6080\_401.csv (period 1959-2016)**  
**dk\_daily\_25140\_6080\_401.csv (period 1874-2016) (blend)**  
**dk\_daily\_6193\_401.csv (period 1874-2016)**

The different sheets/files contain daily average atmospheric pressure (msl). There are no missing dates between the start and the end date. Any missing observations are filled in by “null”.

### Format and units of atmospheric pressure observation files:

| Position | Format | Description  |
|----------|--------|--|
| 1-5      | F5.0   | Station number   |
| 6-9      | F4.0   | Year   |
| 10-11    | F2.0   | Month  |
| 12-13    | F2.0   | Day  |
| 14-15    | F2.0   | End hour (UTC)<br>Please notice that the “End hour” changed 1 Jan 2012 to 23 UTC (winter) and 22 UTC (summer). This reflects the wish to define the day as a “Calendar day”.<br>For that reason TWO 1 Jan 2012 are included. |
| 16-20    | F5.0   | Atmospheric pressure reduced to MSL (0.1 hPa)  |
| 21-25    | F5.0   | No. of observations in daily average (-9999: Not available, but ideally 8 with start 3-4 decades ago (least 4 observations per day); 24 in recent years.   |

### Format and units of daily atmospheric pressure files:

Station number (stat\_no); year (year); month (month); day (day); UTC (hour); average atmospheric pressure in hPa (elem\_val), No. of observations in daily average (no\_obs)

- Atmospheric pressure reduced to msl (hPa)
- Please notice that the “hour” changed 1 Jan 2012 to 23 UTC (winter) and 22 UTC (summer). This reflects the wish to define the day as a “Calendar day”. For that reason TWO 1 Jan 2012

are included.

- No. of observations in daily average are 3 in older parts of the series. 14 and 21 hours DNT the previous day and 8 hours DNT on the actual day (or at least two observations). In newer parts of the series this number is not stated ("null"), but ideally 8 (every 3 hours; or at least 4 observations) starting 3-4 decades ago. 24 observations (every hour) in recent years.

## Daily accumulated precipitation files

### dk\_daily\_601.xlsx

The sheets in the xlsx-file are named:

6051\_601 (period 1874-2016)

5135\_601 (period 1874-2016)

6088\_601 (period 1874-2016)

26410\_601 (period 1920-1993)

26409\_601 (period 1995-2006)

6116\_601 (period 1987-2016)

26410\_6116\_601 (period 1920-2016) (blend)

27080\_601 (period 1872-2001)

5165\_601 (period 2001-2016)

27080\_5165\_601 (period 1872-2016) (blend)

30380\_601 (period 1874-1996)

30210\_1\_601 (period 1875-1922)

30210\_2\_601 (period 1961-1984)

5735\_601 (period 1961-2016)

30380\_5735\_601 (period 1874-2016) (blend)

32030\_601 (period 1874-1970)

32020\_601 (period 1961-1987)

6193\_601 (period 1984-2016)

32030\_32020\_6193\_601 (period 1874-2016) (blend)

The data can also be found in separate csv-files:

**dk\_daily\_6051\_601.csv (period 1874-2016)**

**dk\_daily\_5135\_601.csv (period 1874-2016)**

**dk\_daily\_6088\_601.csv (period 1874-2016)**

**dk\_daily\_26410\_601.csv (period 1920-1993)**

**dk\_daily\_26409\_601.csv (period 1995-2006)**

**dk\_daily\_6116\_601.csv (period 1987-2016)**

**dk\_daily\_26410\_6116\_601.csv (period 1920-2016) (blend)**

**dk\_daily\_27080\_601.csv (period 1872-2001)**

**dk\_daily\_5165\_601.csv (period 2001-2016)**

**dk\_daily\_27080\_5165\_601.csv (period 1872-2016) (blend)**

**dk\_daily\_30380\_601.csv (period 1874-1996)**

**dk\_daily\_30210\_1\_601.csv (period 1875-1922)**

**dk\_daily\_30210\_2\_601.csv (period 1961-1984)**

**dk\_daily\_5735\_601.csv (period 1961-2016)**

**dk\_daily\_30380\_5735\_601.csv (period 1874-2016) (blend)**  
**dk\_daily\_32030\_601.csv (period 1874-1970)**  
**dk\_daily\_32020\_601.csv (period 1961-1987)**  
**dk\_daily\_6193\_601.csv (period 1984-2016)**  
**dk\_daily\_32030\_32020\_6193\_601.csv (period 1874-2016) (blend)**

The different sheets/files contain daily accumulated precipitation. There are no missing dates between the start and the end date. Any missing observations are filled in by "null".

**Format and units of daily precipitation file:**

Station number (stat\_no); year (year); month (month); day (day); hour local time or UTC (hour); accumulated precipitation in mm (elem\_val)

- UTC (since 2001 or if station number starts with 6 (station 6193, whole period)).
- Accumulated precipitation (mm) previous 24 hours. -1 means more than 0 mm, but less than 0.1 mm, -2 means accumulation for several days up to the day where precipitation differs from 0. Please note: Before 1931 the 'daily precipitation' for station 21430 may in some cases be the precipitation accumulated for several days or for the whole month.
- Please notice that the "hour" changed 1 Jan 2012 to 23 UTC (winter) and 22 UTC (summer). This reflects the wish to define the day as a "Calendar day". For that reason TWO 1 Jan 2012 are included. The first one covering the previous 24 hours up to 1 Jan 2012; 6 UTC, the second one covering the previous 24 hours up to 1 Jan 2012; 23 UTC. Please notice the time overlap here.

**Cloud cover at 8, 14 and 21 hours DNT file**

**dk\_daily\_801.xlsx**

The sheet in the xlsx-file is named:  
27080\_801 (period 1872-2000)

The data can also be found in a separate csv-file:  
**dk\_daily\_27080\_801.csv (period 1872-2000)**

The sheet/file contains cloud cover observed daily at 8, 14 and 21 hours DNT. There are no missing dates between the start and the end date. Any missing observations are filled in by "null".

**Format and units of cloud cover file:**

Station number (stat\_no); year (year); month (month); day (day); cloud cover at 8 hours DNT (N8), cloud cover at 14 hours DNT (N14), cloud cover at 21 hours DNT (N21); cloud cover at 8 hours DNT in octas (N8 (octas)); cloud cover at 14 hours DNT in octas (N14 (octas)); cloud cover at 21 hours DNT in octas (N21 (octas)); Average of N8 (octas), N14 (octas) and N21 (octas) (averageN)

- Cloud cover units at 8, 14 and 21 hours DNT have been changed during time:  
 1 Dec 1872 - 31 Dec 1873: 0-4 (0= cloudless, 1= 1/4 part clouded, ..., 4= overcast)  
 1 Jan 1874 - 31 Dec 1951 : 0-10 (0= cloudless, 1= 1/10 part clouded, ..., 10= overcast)  
 Since 1 Jan 1952: 0-8 (0= cloudless, 1= 1/8 part clouded, ..., 8 = overcast) (octas)
- Cloud cover at 8, 14 and 21 DNT back to start of the series have all been converted to octas, see N8 (octas), N14 (octas) and N21 (octas).

## Appendix 3.2. Metadata - Description of daily station data series

### Air temperature at 14 hours DNT or 12 UTC

Two (2) Danish station series with a record of air temperatures measured at 14 hours DNT (old part of the series) or 12 UTC (= 13 hours DNT, newer part of the series) can be blended into one (1) long data set. The table presents an overview of these station data series (identified by the station name and number) and the possible blended datasets making up the long series (not in this report). Overlap periods have been included when available.

| Dataset/period*                 | Station   | Start                             | End                                |
|---------------------------------|---|-----------------------------------|------------------------------------|
| <b>Tranebjerg<br/>1872-2016</b> | 27080 Tranebjerg<br>6132 Tranebjerg             | 1 December 1872<br>21 August 2003 | 20 August 2003<br>31 December 2016 |
|                                 | Blended:<br>27080 Tranebjerg<br>6132 Tranebjerg | 1 December 1872<br>21 August 2003 | 20 August 2003<br>31 December 2016 |

*Important note: The single daily station series mostly consist of the values as observed. No DMI testing for homogeneity has been performed on these daily observations. They have however been carefully quality-tested and corrected, mainly based on visual tests.*

*\*Possible blended full daily datasets using the single daily station series are also a part of this report. No DMI testing for homogeneity has been performed on the blended series.*

### Highest air temperature

Eleven (11) Danish station series with a record of daily highest air temperatures can be blended into five (5) long data sets. The table presents an overview of these station data series (identified by the station name and number) and the possible blended datasets making up the long series (not in this report). Overlap periods have been included when available.

| Dataset/period*                  | Station   | Start                             | End                                   |
|----------------------------------|---|-----------------------------------|---------------------------------------|
| <b>Vestervig<br/>1874-2016</b>   | 21100 Vestervig<br>6051 Vestervig                 | 2 August 1874<br>02 October 2003  | 10 September 2003<br>31 December 2016 |
|                                  | Blended:<br>21100 Vestervig<br>6051 Vestervig     | 2 August 1874<br>02 October 2003  | 10 September 2003<br>31 December 2016 |
| <b>Nordby/Fanø<br/>1874-2016</b> | 25140 Nordby/Fanø<br>6088 Nordby/Fanø             | 2 May 1874<br>25 July 2003        | 18 July 2003<br>31 December 2016      |
|                                  | Blended:<br>25140 Nordby/Fanø<br>6088 Nordby/Fanø | 2 May 1874<br>25 July 2003        | 18 July 2003<br>31 December 2016      |
| <b>Tranebjerg<br/>1873-2016</b>  | 27080 Tranebjerg<br>6132 Tranebjerg               | 1 January 1873<br>21 August 2003  | 10 August 2003<br>31 December 2016    |
|                                  | Blended:<br>27080 Tranebjerg<br>6132 Tranebjerg   | 1 January 1873<br>21 August 2003  | 10 August 2003<br>31 December 2016    |
| <b>København<br/>1874-2016</b>   | 30380 Landbohøjskolen<br>6186 Landbohøjskolen     | 1 January 1874<br>1 December 1995 | 30 June 1997<br>31 December 2016      |
|                                  | Blended:  |                                   |                                       |

|                                  |  |  |  |
|----------------------------------|--|--|--|
|                                  | 30380 Landbohøjskolen<br>6186 Landbohøjskolen  | 1 January 1874<br>1 December 1995  | 30 November 1995<br>31 December 2016   |
| <b>Hammer Odde<br/>1874-2016</b> | 32030 Sandvig<br>32020 Hammer Odde Fyr<br>6193 Hammer Odde Fyr<br><br>Blended:<br>32030 Sandvig<br>32020 Hammer Odde Fyr<br>6193 Hammer Odde Fyr | 2 April 1874<br>1 January 1971<br>1 January 1984<br><br>2 April 1874<br>1 January 1971<br>1 January 1984 | 31 December 1970<br>24 June 1987<br>31 December 2016<br><br>31 December 1970<br>31 December 1983<br>31 December 2016 |

*Important note: The single daily station series mostly consist of the values as observed. No DMI testing for homogeneity has been performed on these daily observations. They have however been carefully quality-tested and corrected, mainly based on visual tests.*

*\*Possible blended full daily datasets using the single daily station series are also a part of this report. No DMI testing for homogeneity has been performed on the blended series.*

*Important information regarding the manual climate stations 21100, 25140, 27080, 30380, 32020 and 32030: During the period 1 Jan 1913 - 1 Jan 1971 the highest air temperature is listed on the previous day (where it most often occurs). During the periods 1 Jan 1874 - 31 Dec 1912 and 2 Jan 1971 – present day the highest air temperature is listed on the date it has been read. This change in practice was only regarding the highest air temperature, not the lowest air temperature. Because of the change back and forth in practise the data files (and DMI annals) hold no highest air temperature for the 24-hours period starting in the morning 31 Dec 1912 and ending in the morning 1 Jan 1913. And conversely the highest air temperature of the 24-hours that starts in the morning 1 Jan 1971 and ends in the morning 2 Jan 1971 is listed TWO times in the data files: With time stamp 1 Jan 1971 at 8 hours AND with time stamp 2 Jan 1971 at 8 hours, just as the change of practice dictates for those dates.*

*See the European Climate Assessment & Dataset (ECA&D) project homepage: <http://www.ecad.eu/> for their "blend"/data handling and quality/homogeneity test. This site also contains the single Danish station series.*

## Lowest air temperature

Eleven (11) Danish station series with a record of daily lowest air temperatures can be blended into five (5) long data sets. The table presents an overview of these station data series (identified by the station name and number) and the possible blended datasets making up the long series (not in this report). Overlap periods have been included when available.

| Dataset/period*                  | Station   | Start                             | End                                   |
|----------------------------------|---|-----------------------------------|---------------------------------------|
| <b>Vestervig<br/>1874-2016</b>   | 21100 Vestervig<br>6051 Vestervig                 | 19 June 1874<br>02 October 2003   | 10 September 2003<br>31 December 2016 |
|                                  | Blended:<br>21100 Vestervig<br>6051 Vestervig     | 19 June 1874<br>02 October 2003   | 10 September 2003<br>31 December 2016 |
| <b>Nordby/Fanø<br/>1874-2016</b> | 25140 Nordby/Fanø<br>6088 Nordby/Fanø             | 1 May 1874<br>25 July 2003        | 18 July 2003<br>31 December 2016      |
|                                  | Blended:<br>25140 Nordby/Fanø<br>6088 Nordby/Fanø | 1 May 1874<br>25 July 2003        | 18 July 2003<br>31 December 2016      |
| <b>Tranebjerg<br/>1872-2016</b>  | 27080 Tranebjerg<br>6132 Tranebjerg               | 1 December 1872<br>21 August 2003 | 10 August 2003<br>31 December 2016    |

|                                  |  |  |  |
|----------------------------------|--|--|--|
|                                  | Blended:<br>27080 Tranebjerg<br>6132 Tranebjerg  | 1 December 1872<br>21 August 2003  | 10 August 2003   |
| <b>København<br/>1874-2016</b>   | 30380 Landbohøjskolen<br>6186 Landbohøjskolen<br><br>Blended:<br>30380 Landbohøjskolen<br>6186 Landbohøjskolen                                   | 1 January 1874<br>1 December 1995<br><br>1 January 1874<br>1 December 1995                                   | 30 June 1997<br>31 December 2016<br><br>30 November 1995<br>31 December 2016   |
| <b>Hammer Odde<br/>1874-2016</b> | 32030 Sandvig<br>32020 Hammer Odde Fyr<br>6193 Hammer Odde Fyr<br><br>Blended:<br>32030 Sandvig<br>32020 Hammer Odde Fyr<br>6193 Hammer Odde Fyr | 1 January 1874<br>1 January 1971<br>1 January 1984<br><br>1 January 1874<br>1 January 1971<br>1 January 1984 | 31 December 1970<br>24 June 1987<br>31 December 2016<br><br>31 December 1970<br>31 December 1983<br>31 December 2016 |

*Important note: The single daily station series mostly consist of the values as observed. No DMI testing for homogeneity has been performed on these daily observations. They have however been carefully quality-tested and corrected, mainly based on visual tests.*

*\*Possible blended full daily datasets using the single daily station series are also a part of this report. No DMI testing for homogeneity has been performed on the blended series.*

*See the European Climate Assessment & Dataset (ECA&D) project homepage: <http://www.ecad.eu/> for their "blend"/data handling and quality/homogeneity test. This site also contains the single Danish station series.*

### Average atmospheric pressure

Five (5) Danish station series with a record of average daily atmospheric pressure data can be blended into three (3) long data sets. The table presents an overview of these station data series (identified by the station name and number) and the possible blended datasets making up the long series (not in this report except the Hammer Odde series). Overlap periods have been included when available.

| Dataset/period*                  | Station  | Start  | End   |
|----------------------------------|--|--|---|
| <b>Vestervig<br/>1874-2016</b>   | 21100 Vestervig<br>6052 Thyborøn<br><br>Blended:<br>21100 Vestervig<br>6052 Thyborøn                   | 01 January 1874<br>02 March 1962<br><br>01 January 1874<br>02 March 1962 | 01 August 1987<br>31 December 2016<br><br>01 March 1962<br>31 December 2016 |
| <b>Nordby/Fanø<br/>1874-2016</b> | 25140 Nordby/Fanø<br>6080 Esbjerg Airport<br><br>Blended:<br>25140 Nordby/Fanø<br>6080 Esbjerg Airport | 01 January 1874<br>29 March 1959<br><br>01 January 1874<br>29 March 1959 | 01 August 1987<br>31 December 2016<br><br>28 March 1959<br>31 December 2016 |
| <b>Hammer Odde<br/>1874-2016</b> | 32030 Sandvig or<br>32020 Hammer Odde Fyr<br>6193 Hammer Odde Fyr                                      | 01 January 1874<br>-<br>02 June 1987                                     | -<br>1 June 1987<br>31 December 2016  |



|  |  |                                 |                                 |
|--|--|---------------------------------|---------------------------------|
|  | Blended:<br>32030 Sandvig <b>or</b><br>32020 Hammer Odde Fyr<br>6193 Hammer Odde Fyr | 01 January 1874<br>02 June 1987 | 1 June 1987<br>31 December 2016 |
|--|--|---------------------------------|---------------------------------|

*Important note: The single daily station series mostly consist of the values as observed. No DMI testing for homogeneity has been performed on these daily observations. They have however been carefully quality-tested and corrected, mainly based on visual tests.*

*\*Possible blended full daily datasets using the single daily station series are also a part of this report. No DMI testing for homogeneity has been performed on the blended series.*

*See the European Climate Assessment & Dataset (ECA&D) project homepage: <http://www.ecad.eu/> for their "blend"/data handling and quality/homogeneity test. This site also contains the single Danish station series.*

### **Additional information concerning daily averages and atmospheric pressure:**

At DMI daily averages on observations are made (as a principle) for the meteorological day from (but not including) the previous day at 6 hours UTC until and including the actual day at 6 hours UTC and the meteorological day is given the date of the day it ends. The observation hours and observation frequencies varies for the station types used, therefore details on the number of observations forming part of the daily values are included below.

*21100 Vestervig and 25140 Nordby/Fanø (manually operated climate station, observing 8, 14 and 21 hours DNT):*

The daily average (approximating the '6 hours UTC to 6 hours UTC' definition) is made from three measurements: 14 and 21 hours DNT the previous day and 8 hours DNT on the actual day (or at least two observations). The date of the daily value is the date of the day it ends. The observations were station level data and were reduced to MSL following the formulas described in the subsection 'Concerning reduction to MSL' below.

DNT refers to Danish normal time, which is the time in a given time zone in contrast to summer time, where 1 hour is added. In Denmark the normal time is UTC+1. UTC is "Universal Time Coordinated" - a global indication of time, which refers to the mean solar time on the meridian of Greenwich, England, which is the conventional 0-meridian for geographic longitude.

*6052 Thyborøn (synoptical station at least observing 0,3,6,9,12,15,18 and 21 hours UTC):*

The data are averaged over the meteorological day (6 to 6 hours UTC). The average was made from the available measurements at 9, 12, 15, 18, 21, 0, 3 and 6 hours UTC if at least four of these measurements were available. The data are MSL pressure.

*6080 Esbjerg Airport (synoptical station at least observing 0,3,6,9,12,15,18 and 21 hours UTC):*

The data are averaged over the meteorological day (6 to 6 hours UTC). The average was made from the available measurements at 9, 12, 15, 18, 21, 0, 3 and 6 hours UTC if at least four of these measurements were available. The data are MSL pressure. During the period 1964-1971 the station in the winter only has measurements during daytime and consequently many daily averages are missing during that period.

*6193 Hammer Odde Fyr (synoptical station at least observing 0,3,6,9,12,15,18 and 21 hours UTC) and 32030 Sandvig/ 32020 Hammer Odde Fyr (manually operated climate station, observing 8, 14 and 21 hours DNT):*

1 January 1874 – 1 June 1987 the data are from the climate stations 32030 Sandvig and 32020 Hammer Odde Fyr and the averaging follows that of 21100 Vestervig and 25140 Nordby/Fanø (see above). The observations were station level data and were reduced to MSL following the formulas described in the subsection 'reduction to MSL' below. 2 June 1987 – 31 December 2016 the data are from 6193 Hammer Odde Fyr and the averaging follows that of 6052 Thyborøn.

### Concerning reduction to MSL

As part of the WASA project [43], selected DMI series of pressure observations 1874-1970 were digitised. The pressure observations were digitised from the meteorological yearbooks, which means that the observations were station level data corrected for index error, air temperature and, since 1893, gravity.

**Important note:** For the present data set, the pressure data from these “old” manually operated climate stations were reduced to mean sea level applying the formulas that can be seen in Appendix 3.3. Other adjustments (Appendix 3.3) have not been applied to the daily value dataset. This is the explanation for small differences between the daily series presented in section 5.2.6 and the daily series that can be calculated using the homogenized atmospheric pressure observations presented in section 4.2.1. It is advised for the reader to take this probable need of adjustment into account when using the daily value data set.

### Accumulated precipitation

Fifteen (15) Danish station series with a record of daily accumulated precipitation can be blended into seven (7) long data sets. The table presents an overview of these single station data series (identified by the station name and number). Overlap periods have been included when available. Possible blended datasets making up the full long series are described.

| Dataset/period*                      | Station  | Start            | End              |
|--------------------------------------|--|------------------|------------------|
| <b>Vestervig<br/>1874-2016</b>       | 6051/21100 Vestervig   | 1 January 1874   | 31 December 2016 |
|                                      | Blended:<br>6051/21100 Vestervig   | 1 January 1874   | 31 December 2016 |
| <b>Grønbæk<br/>1874-2016</b>         | 5135/21430 Grønbæk/<br>Allingskovgård                                    | 1 September 1874 | 31 December 2016 |
|                                      | Blended:<br>5135/21430 Grønbæk/<br>Allingskovgård                        | 1 September 1874 | 31 December 2016 |
| <b>Nordby/Fanø<br/>1874-2016</b>     | 6088/25140 Nordby/Fanø   | 1 January 1874   | 31 December 2016 |
|                                      | Blended:<br>6088/25140 Nordby/Fanø                                       | 1 January 1874   | 31 December 2016 |
| <b>Store Jynde vad<br/>1920-2016</b> | 26410 Broderup/Bajstrup/<br>Gårdeby/Rødebæk/Broderup<br>Mark             | 1 July 1920      | 30 June 1993     |
|                                      | 26409 Tinglev  | 1 June 1995      | 31 December 2006 |
|                                      | 6116/26400 Store Jynde vad   | 1 July 1987      | 31 December 2016 |
|                                      | Blended:<br>26410 Broderup/Bajstrup/<br>Gårdeby/Rødebæk/Broderup<br>Mark | 1 July 1920      | 30 June 1987     |
| <b>Tranebjerg<br/>1872-2016</b>      | 27080 Tranebjerg   | 1 December 1872  | 01 August 2001   |
|                                      | 5165/27082 Tranebjerg Øst  | 02 August 2001   | 31 December 2016 |

|                                  |  |  |  |
|----------------------------------|--|--|--|
|                                  | Blended:<br>27080 Tranebjerg<br>5165/27082 Tranebjerg Øst  | 1 December 1872<br>02 August 2001  | 01 August 2001<br>31 December 2016   |
| <b>København<br/>1874-2016</b>   | 30380 Landbohøjskolen<br>30210 Meteorologisk Institut<br>30210 Meteorologisk Institut<br>5735/30370 Botanisk Have<br><br>Blended:<br>30380 Landbohøjskolen<br>5735/30370 Botanisk Have | 1 January 1874<br>1 January 1875<br>1 January 1961<br>1 January 1961<br><br>1 January 1874<br>2 October 1996 | 1 October 1996<br>30 June 1922<br>31 December 1984<br>31 December 2016<br><br>1 October 1996<br>31 December 2016     |
| <b>Hammer Odde<br/>1874-2016</b> | 32030 Sandvig<br>32020 Hammer Odde Fyr<br>6193 Hammer Odde Fyr<br><br>Blended:<br>32030 Sandvig<br>32020 Hammer Odde Fyr<br>6193 Hammer Odde Fyr                                       | 1 January 1874<br>1 January 1961<br>1 January 1984<br><br>1 January 1874<br>1 January 1971<br>1 January 1984 | 31 December 1970<br>30 June 1987<br>31 December 2016<br><br>31 December 1970<br>31 December 1983<br>31 December 2016 |

*Important note: The single daily station series mostly consist of the values as observed. No DMI testing for homogeneity has been performed on these daily observations. They have however been carefully quality-tested and corrected, mainly based on visual tests.*

*\*Possible blended full daily datasets using the single daily station series are also a part of this report. No DMI testing for homogeneity has been performed on the blended series.*

*See the European Climate Assessment & Dataset (ECA&D) project homepage: <http://www.ecad.eu/> for their "blend"/data handling and quality/homogeneity test. This site also contains the single Danish station series.*

### Cloud cover at 8, 14 and 21 hours DNT

One (1) Danish station series with a long record of cloud cover at 8, 14 and 21 hours DNT exists. The table presents an overview of this station data series (identified by the station name and number).

| Dataset/period                  | Station          | Start           | End             |
|---------------------------------|------------------|-----------------|-----------------|
| <b>Tranebjerg<br/>1872-2000</b> | 27080 Tranebjerg | 1 December 1872 | 31 January 2000 |

*Important note: The single daily station series mostly consist of the values as observed. No DMI testing for homogeneity has been performed on these daily observations. They have however been carefully quality-tested and corrected, mainly based on visual tests.*

*See the European Climate Assessment & Dataset (ECA&D) project homepage: <http://www.ecad.eu/> for their data handling and quality/homogeneity test.*

### Appendix 3.3. Information concerning atmospheric pressure data

The atmospheric pressure data from the old manually operated climate stations were reduced to mean sea level by applying the formulas that can be seen in tables A3.3.1, A3.3.2, A3.3.3 and A'3.3.4, see [9], [43].

| Station 21100 Vestervig<br>Reduction to mean sea level |                   |  |
|--|-------------------|--|
| First<br>(yyyy.mm)                                     | Last<br>(yyyy.mm) | Pressure reduced to mean sea level (0.1 hPa) =   |
| .  | 1879.06           | $P * ( 1 - 0.00259 * \cos( 2 * 56.75 * 3.14/180 ) ) * ( 1 + 9.82/287.04 * 47.4/(T/10+273.15 ) )$ |
| 1879.07  | 1883.09           | $P * ( 1 - 0.00259 * \cos( 2 * 56.75 * 3.14/180 ) ) * ( 1 + 9.82/287.04 * 25.7/(T/10+273.15 ) )$ |
| 1883.10  | 1892.12           | $P * ( 1 - 0.00259 * \cos( 2 * 56.75 * 3.14/180 ) ) * ( 1 + 9.82/287.04 * 25.0/(T/10+273.15 ) )$ |
| 1893.01  | 1924.06           | $P * ( 1 + 9.82/287.04 * 25.0/(T/10+273.15 ) )$  |
| 1924.07  | 1937.03           | $P * ( 1 + 9.82/287.04 * 19.3/(T/10+273.15 ) )$  |
| 1937.04  | 1946.03           | $P * ( 1 + 9.82/287.04 * 27.0/(T/10+273.15 ) )$  |
| 1946.04  | 1946.04           | $P * ( 1 + 9.82/287.04 * 19.0/(T/10+273.15 ) )$  |
| 1946.05  | .                 | $P * ( 1 + 9.82/287.04 * 19.6/(T/10+273.15 ) )$  |

Table A3.3.1. Formulas to obtain mean sea level atmospheric pressure for station 21100 Vestervig from the data in the internal DMI database 'wasa' (1874-1970) and 'clima\_man' (1971-1987). Until and including 1892 the formulas are also correcting the atmospheric pressure for gravity. The formulas are stored in the database 'wasa\_formula'. 'P' is the station level atmospheric pressure (0.1 hPa) and 'T' is the air temperature at station level (0.1°C).

| Station 25140 Nordby/Fanø<br>Reduction to mean sea level |                   |  |
|--|-------------------|--|
| First<br>(yyyy.mm)                                       | Last<br>(yyyy.mm) | Pressure reduced to mean sea level (0.1 hPa) =   |
| .  | 1892.04           | $P * ( 1 - 0.00259 * \cos( 2 * 55.5 * 3.14/180 ) ) * ( 1 + 9.82/287.04 * 5.5/(T/10+273.15 ) )$ |
| 1892.05  | 1892.12           | $P * ( 1 - 0.00259 * \cos( 2 * 55.5 * 3.14/180 ) ) * ( 1 + 9.82/287.04 * 8.0/(T/10+273.15 ) )$ |
| 1893.01  | 1899.11           | $P * ( 1 + 9.82/287.04 * 8.0/(T/10+273.15 ) )$   |
| 1899.12  | 1928.07           | $P * ( 1 + 9.82/287.04 * 5.5/(T/10+273.15 ) )$   |
| 1928.08  | 1936.03           | $P * ( 1 + 9.82/287.04 * 10.5/(T/10+273.15 ) )$  |
| 1936.04  | 1944.11           | $P * ( 1 + 9.82/287.04 * 6.9/(T/10+273.15 ) )$   |
| 1944.12  | 1945.05           | $P * ( 1 + 9.82/287.04 * 7.0/(T/10+273.15 ) )$   |
| 1945.06  | 1955.11           | $P * ( 1 + 9.82/287.04 * 3.0/(T/10+273.15 ) )$   |
| 1955.12  | 1960.08           | $P * ( 1 + 9.82/287.04 * 9.7/(T/10+273.15 ) )$   |
| 1960.09  | .                 | $P * ( 1 + 9.82/287.04 * 6.7/(T/10+273.15 ) )$   |

Table A3.3.2. Formulas to obtain mean sea level atmospheric pressure for station 25140 Nordby/Fanø, Fanø from the data in the internal DMI database 'wasa' (1874-1970) and 'clima\_man' (1971-1987). Until and including 1892 the formulas are also correcting the atmospheric pressure for gravity. The formulas are stored in the database 'wasa\_formula'. 'P' is the station level atmospheric pressure (0.1 hPa) and 'T' is the air temperature at station level (0.1°C).

| Station 32030 Sandvig                               |                   |   |
|---|-------------------|---|
| Reduction of atmospheric pressure to mean sea level |                   |   |
| First<br>(yyyy.mm)                                  | Last<br>(yyyy.mm) | Pressure reduced to mean sea level (0.1 hPa) =  |
| -   | 1892.12           | $P * ( 1 - 0.00259 * \cos( 2 * 55.25 * 3.14/180 ) ) * ( 1 + 9.82/287.04 * 15.1/(T/10+273.15) )$ |
| 1893.01   | 1942.08           | $P * ( 1 + 9.82/287.04 * 15.1/(T/10+273.15) )$  |
| 1942.09   | 1966.08           | $P * ( 1 + 9.82/287.04 * 11.0/(T/10+273.15) )$  |
| 1966.09   | 1969.12           | $P * ( 1 + 9.82/287.04 * 21.7/(T/10+273.15) )$  |

Table A3.3.3. Formulas to obtain mean sea level atmospheric pressure for station 32030 Sandvig, Bornholm from the data in the internal DMI database 'wasa' (1874-1970) listed as '6193'. Until and including 1892 the formulas are also correcting the atmospheric pressure for gravity. The formulas are stored in the database 'wasa\_formula'. 'P' is the station level atmospheric pressure (0.1 hPa) and 'T' is the air temperature at station level (0.1°C). The data from 1970 was already reduced to msl.

| Station 32020 Hammer Odde Fyr/Lighthouse            |                   |  |
|---|-------------------|--|
| Reduction of atmospheric pressure to mean sea level |                   |  |
| First<br>(yyyy.mm)                                  | Last<br>(yyyy.mm) | Pressure reduced to mean sea level (0.1 hPa) = |
| 1971.01   | -                 | $P * ( 1 + 9.82/287.04 * 10.9/(T/10+273.15) )$ |

Table A3.3.4. Formulas to obtain mean sea level atmospheric pressure for station 32020 Hammer Odde Fyr, Bornholm from the data in the internal DMI database 'wasa' (1970) listed as '6193' and 'clima\_man' (1971-1987). The formulas are stored in the database 'wasa\_formula'. 'P' is the station level atmospheric pressure (0.1 hPa) and 'T' is the air temperature at station level (0.1°C). The data from 1970 was already reduced to msl.

### Appendix 3.4. More information concerning the series of atmospheric pressure

The reduction formulas of tables A3.3.1 to A3.3.4 in Appendix 3.3 make use of the barometer heights listed in tables A3.4.1 to A3.4.5 below.

To homogenize the 21100 Vestervig atmospheric pressure and the 25140 Nordby/Fanø atmospheric pressure observation series of the WASA dataset were additionally added the adjustments (units 0.1 hPa) listed in tables A3.4.4 and A3.4.5 (look for type '11' and '12'). **These adjustments have not been applied to the present daily value dataset, but available information on the adjustments is included in tables A3.4.4 and A3.4.5. It is advised for the reader to take this probable need of adjustment into account when using the data.**

| Station 32030 Sandvig metadata |          |      |  |
|--------------------------------|----------|------|--|
| Start                          | End      | Type | Description  |
| 18721111                       | 19660901 | 1    | 55 17'N 14 47'E  |
| 19660901                       | -        | 1    | 15 17'N 14 46'E (Strandgade 17)  |
| 18721111                       | 19660901 | 2    | H = 14 m   |
| 19660901                       | 19660901 | 2    | Hs = 12 m  |
| 19110112                       | 19110112 | 2    | Hb = 15.1 m  |
| 19420824                       | 19420824 | 2    | Hb = 15.1 m  |
| 19420825                       | 19560101 | 2    | Hb = 11 m  |
| 19560101                       | 19620101 | 2    | Hb = 22.0 m (but same observer)  |
| 19620101                       | 19660914 | 2    | Hb = 21.7 m (but same observer)  |
| 19660914                       | -        | 2    | Hb = 11.7 m (Strandgade 17)  |
| 18721204                       | 18880817 | 5    | Kapplersk barometer no. 9  |
| 18880817                       | 18971106 | 5    | Bar. no. 2094  |
| 18971106                       | -        | 5    | Bar. no. 1381  |
| 18730101                       | -        | 6    | 0.1 mm Hg – 7000   |
| 18730101                       | 18930101 | 7    | $P = (p8+p14+p21)/3$   |
| 18930101                       | 19550601 | 7    | $P=(p8+p14+p21)/3 + \text{corr. } 45 \text{ N}$  |
| 19550601                       | -        | 7    | $P=(p8+p14+p21)/3 + \text{corr. } 45 \text{ N} + \text{red. sea level}$                        |
| 18730101                       | 18930101 | 10   | $P=4/3*(7000+p)*(1-k1*\cos(2*\varnothing))*(1+Hb/k2/(k3+t))$                                   |
| 18930101                       | 19560101 | 10   | $P=4/3*(7000+p)*(1+Hb/k2/(k3+t))$ in 0.1 hPa   |
| 19560101                       | -        | 10   | $P=4/3*(7000+p)$ in 0.1 hPa  |
| -                              | 18921200 | 10   | $P * ( 1 - 0.00259 * \cos( 2 * 55.25 * 3.14/180 ) ) * ( 1 + 9.82/287.04 * 15.1/(T/10+273.15))$ |
| 18930100                       | 19420800 | 10   | $P * ( 1 + 9.82/287.04 * 15.1/(T/10+273.15 ) )$  |
| 19420900                       | 19530800 | 10   | $P * ( 1 + 9.82/287.04 * 11.0/(T/10+273.15 ) )$  |
| 19530900                       | 19550500 | 10   | $P * ( 1 + 9.82/287.04 * 21.7/(T/10+273.15 ) )$  |

Table A3.4.1. Meta data regarding atmospheric pressure measurements at station 32030 Sandvig, Bornholm (used in the 6193 Hammer Odde atmospheric pressure series) (from NACD and WASA projects, see list of references). Description type number: 2=regarding vertical position. 5=regarding the instrument. 6=units of original measurements and later changes. 7=Formula for calculating originally published monthly values. 8=environment. 9=Time series forming part of primary time series. 10= Formula. Calculations made after original publication, e.g. reduction of atmospheric pressure. 11= Test procedure, most important results by comparison with neighbouring stations. 12= Adjustment made after test, given as 12 monthly values (0.1 hPa).

| Station 32020 Hammer Odde Fyr (lighthouse) metadata |          |      |  |
|---|----------|------|--|
| Start   | End      | Type | Description  |
| 19530301  | 19740701 | 1    | 55 18' N 14 46' E  |
| 19740701  | -        | 1    | 55 18' N 14 47' E  |
| 19530301  | 19740701 | 2    | Hs = 7 m   |
| 19740701  | 19800101 | 2    | Hs = 11 m  |
| 19800101  | 19800101 | 2    | Hs = 11.0 m  |
| 19530308  | 19550501 | 3    | M.P. J..... (signature illegible)  |
| 19550501  | 19550601 | 3    | J. Jensen  |
| 19550601  | 19661101 | 3    | E. Due   |
| 19661101  | 19670301 | 3    | J. Kyhn-Madsen   |
| 19670301  | 19700801 | 3    | E. Due   |
| 19700801  | 19701001 | 3    | Mogens Christensen   |
| 19701001  | -        | 3    | Pedersen   |
| 19530301  | 19530308 | 4    | 8, 14, 21 C.E.T.   |
| 19530308  | -        | 4    | 8, 14, 21 C.E.T.   |
| 19530301  | 19720101 | 8    | Source of data: Station book.  |
| 19720101  | 19740701 | 8    | source of data: klima_man.   |
| 19740701  | -        | 8    | Therm. Screen and prec. gauge moved                                      |
| 19540701  | 19800101 | 2    | Hb = 11 m  |
| 19800101  | 19800101 | 2    | Hb = 10.9 m  |
| 19540701  | 19620103 | 5    | Barometer no.?   |
| 19620103  | -        | 5    | Adie no. 2179  |
| 19540701  | 19710101 | 7    | $P = (p8+p14+p21)/3 + \text{corr } 45 \text{ N} + \text{red. sea level}$ |
| 19710101  | -        | 7    | $P = (p8+p14+p21)/3 + \text{corr. } 45\text{N}$                          |
| 19540701  | -        | 10   | $P = 4/3*(7000+p)$   |
| 19710100  | -        | 10   | $P * ( 1 + 9.82/287.04 * 10.9/(T/10+273.15 ) )$                          |

Table A3.4.2. Meta data regarding atmospheric pressure measurements at station 32020 Hammer Odde Fyr, Bornholm (used in the 6193 Hammer Odde pressure series) (from NACD and WASA projects, see list of references). Description type number: 2=regarding vertical position. 5=regarding the instrument. 6=units of original measurements and later changes. 7=Formula for calculating originally published monthly values. 8=environment. 9=Time series forming part of primary time series. 10= Formula. Calculations made after original publication, e.g. reduction of atmospheric pressure. 11= Test procedure, most important results by comparison with neighbouring stations. 12= Adjustment made after test, given as 12 monthly values (0.1 hPa).

| Station 32025 Hammeren Fyr (Lighthouse) metadata |          |      |   |
|--|----------|------|---|
| Start  | End      | Type | Description                                       |
| 18800121   | -        | 1    | 55 17'N 14 47'E 33U 6126.930 484.770              |
| 18800121   | -        | 2    | Hs = 77.4 m                                       |
| 19441130   | 19441130 | 8    | Lighthouse evacuated                              |
| 18880821   | 19110501 | 2    | Hb = 80 m   |
| 19110501   | 19110501 | 2    | Hb = 88 m   |
| 19550701   | 19550701 | 2    | Hb = 76.51 m                                      |
| 18880821   | 19040806 | 5    | Aneroidbarometer no. 16                           |
| 19040806   | 19110501 | 5    | Bar. no. 2571                                     |
| 19110501   | 19110501 | 5    | Bar. no. 2571                                     |
| 19590601   | 19590601 | 5    | Bar. no. 2571                                     |
| 19120101   | -        | 6    | 0.1 mm Hg – 7000                                  |
| 19120101   | -        | 7    | $P = (p8+p14+p21)/3 + \text{corr. } 45 \text{ N}$ |
| 18880821   | 19120101 | 8    | No NACD-data until 1912                           |
| 19120101   | 19170101 | 8    | NACD-data from 1912 to 1916 except 1914           |
| 19170101   | 19530101 | 8    | No NACD-data from 1917 to 1953                    |
| 19530101   | 19530101 | 8    | Data from 1953 not reduced to sea level           |
| 19120101   | -        | 10   | $P=4/3*(7000+p)*(1+Hb/k2/(k3+t))$ in 0.1 hPa      |
| -  | -        | 10   | $P * ( 1 + 9.82/287.04 * 76.5/(T/10+273.15 ) )$   |

Table A3.4.3. See caption for table A3.4.1 and A3.4.2.

| Station 21100 Vestervig metadata |          |      |  |
|----------------------------------|----------|------|--|
| Start                            | End      | Type | Description  |
| 18730603                         | 18790701 | 2    | Hb = 47.4 m (Hurupvej 34)  |
| 18790701                         | 18831001 | 2    | Hb = 25.7 m (Lindalsminde skole)   |
| 18831001                         | 18920816 | 2    | Hs=18-19 m on map: Hb=25.0 m, disputed point!  |
| 18920816                         | 19240630 | 2    | Hs=22 m on map, Hb=25.0 m, matter of dispute!  |
| 19240630                         | 19370413 | 2    | Hb = 19.3 m (Vestergade 45)  |
| 19370413                         | 19460401 | 2    | Hb = 27.0 m (Margrethevej 6)   |
| 19460401                         | 19810101 | 2    | Hb = 19.6 m (Klostergade 20)   |
| 19810101                         | 19810101 | 2    | Hb = 19.6 m  |
| 18730603                         | 18760722 | 5    | Barometer (Kappler) no. 1188   |
| 18760722                         | 18800324 | 5    | no. 6  |
| 18800324                         | 18800324 | 5    | Barometer cleaned. Reduction changed.  |
| 18831001                         | 18831001 | 5    | Bar. No. 6   |
| 18920725                         | 18930510 | 5    | Barometer new. No number.  |
| 18930510                         | 18930907 | 5    | Bar. No. 2233  |
| 18930907                         | 18970917 | 5    | Bar. No. 2177  |
| 18970917                         | -        | 5    | Bar. No. 2364  |
| 18731201                         | -        | 6    | 0.1 mm Hg – 7000   |
| 18731201                         | 18930101 | 7    | $P = (p8+p14+p21)/3$   |
| 18930101                         | 19530101 | 7    | $P=(p8+p14+p21)/3 + \text{corr. } 45 \text{ N}$  |
| 19530101                         | 19710101 | 7    | $P=(p8+p14+p21)/3 + \text{corr. } 45 \text{ N} + \text{red. sea level}$                          |
| 19710101                         | -        | 7    | $P=(p8+p14+p21)/3 + \text{corr. } 45 \text{ N}$  |
| 18870819                         | 18870819 | 8    | New reduction table  |
| 18731201                         | 18930101 | 10   | $P=4/3*(7000+p)*(1-k1*\cos(2*\emptyset))*(1+Hb/k2/(k3+t))$                                       |
| 18930101                         | 19530101 | 10   | $P=4/3*(7000+p)*(1+Hb/k2/(k3+t))$ in 0.1 hPa   |
| 19530101                         | 19710101 | 10   | $P=4/3*(7000+p)$ in 0.1 hPa  |
| 19710101                         | -        | 10   | $P=4/3*(7000+p)*(1+Hb/k2/(k3+t))$ in 0.1 hPa   |
| 19870800                         | -        | 9    | 6052   |
| -                                | 18790600 | 10   | $P * ( 1 - 0.00259 * \cos( 2 * 56.75 * 3.14/180 ) ) * ( 1 + 9.82/287.04 * 47.4/(T/10+273.15 ) )$ |
| 18790700                         | 18830900 | 10   | $P * ( 1 - 0.00259 * \cos( 2 * 56.75 * 3.14/180 ) ) * ( 1 + 9.82/287.04 * 25.7/(T/10+273.15 ) )$ |
| 18831000                         | 18921200 | 10   | $P * ( 1 - 0.00259 * \cos( 2 * 56.75 * 3.14/180 ) ) * ( 1 + 9.82/287.04 * 25.0/(T/10+273.15 ) )$ |
| 18930100                         | 19240600 | 10   | $P * ( 1 + 9.82/287.04 * 25.0/(T/10+273.15 ) )$  |
| 19240700                         | 19370300 | 10   | $P * ( 1 + 9.82/287.04 * 19.3/(T/10+273.15 ) )$  |
| 19370400                         | 19460300 | 10   | $P * ( 1 + 9.82/287.04 * 27.0/(T/10+273.15 ) )$  |
| 19460400                         | 19460400 | 10   | $P * ( 1 + 9.82/287.04 * 19.0/(T/10+273.15 ) )$  |
| 19460500                         | 19521200 | 10   | $P * ( 1 + 9.82/287.04 * 19.6/(T/10+273.15 ) )$  |
| 19710100                         | -        | 10   | $P * ( 1 + 9.82/287.04 * 19.6/(T/10+273.15 ) )$  |
| -                                | 19240600 | 11   | 97.5% significant break, station moved   |
| -                                | 18920800 | 11   | 97,5% significant break, station moved   |
| -                                | 19671200 | 11   | 97.5% significant break, not supported in meta data  |
| -                                | 19240600 | 12   | -4.0-4.0-4.0-4.0-4.0-4.0-4.0-4.0-4.0-4.0-4.0-4.0   |
| -                                | 18920800 | 12   | 4.0 4.0 4.0 4.0 4.0 4.0 4.0 4.0 4.0 4.0 4.0 4.0  |
| -                                | 19671200 | 12   | 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0  |

Table A3.4.4. Meta data regarding atmospheric pressure measurements at station 21100 Vestervig (from NACD and WASA projects, see references). Description type number: 2=regarding vertical position. 5=regarding the instrument. 6=units of original measurements and later changes. 7=Formula for calculating originally published monthly values. 8=environment. 9=Time series forming part of primary time series. 10= Formula. Calculations made after original publication, e.g. reduction of atmospheric pressure. 11= Test procedure, most important results by comparison with neighbouring stations. 12= Adjustment made after test, given as 12 monthly values (0.1 hPa) to be added.



### Station 25140 Nordby/Fanø metadata

| Start    | End      | Type | Description   |
|----------|----------|------|---|
| -        | 19940114 | 2    | No barometer on this station  |
| 18711201 | 18740101 | 2    | Hb = 5.5 m (Hovedgaden 101)   |
| 18740101 | 18740101 | 2    | Hb = 5.5 m (Hovedgaden 101)   |
| 18920501 | 18991201 | 2    | Hb = 8.0 m. (Nordby Realskole)  |
| 18991201 | 19030101 | 2    | Hb = 5.5 m (Hovedgaden 101)   |
| 19030101 | 19030101 | 2    | Hb = 5.5 m (Hovedgaden 101)   |
| 19050101 | 19050101 | 2    | Hb= 5.5 m (Hovedgaden 103?)   |
| 19130101 | 19130101 | 2    | Hb = 5.5 m (Hovedgaden 103)   |
| 19280806 | 19360405 | 2    | Hb = 10.5 m (Vestervejen 43)  |
| 19360405 | 19441216 | 2    | Hb = 6.9 m (Kallesbjergvej 1)   |
| 19441216 | 19450615 | 2    | Hb = 7 m? (situated on first floor?)  |
| 19450615 | 19551121 | 2    | Hb = 3.0 m (moved to ground floor?)   |
| 19551121 | 19600822 | 2    | Hb = 9.7 m Navigationskolen, Vestervejen 1  |
| 19600822 | 19940114 | 2    | Hb = 6.7 m (Bavnebjerg Toft 1)  |
| -        | 19940114 | 5    | No barometer  |
| -        | 19420620 | 5    | Barometer broken  |
| 18710723 | 18730601 | 5    | Siphon barometer  |
| 18730601 | 18770326 | 5    | Kappler mercury (cistern) barometer no. 4   |
| 18770326 | 18770627 | 5    | Bar. no. 14   |
| 18770627 | 18780501 | 5    | Bar. no. 12   |
| 18780501 | 18780501 | 5    | Bar. no.?   |
| 18801227 | 18801227 | 5    | New reduction table   |
| 18870501 | 18870501 | 5    | Barometer needs cleaning  |
| 18870721 | 18870721 | 5    | Barometer cleaned?  |
| 18870820 | 18950721 | 5    | Bar. no. 2015   |
| 18950721 | 18950816 | 5    | Bar. no. 3021   |
| 18950816 | 18950816 | 5    | Some data unreliable  |
| 18980929 | 19001218 | 5    | Bar. no. 2177   |
| 19001218 | 19360405 | 5    | Bar. no. 2439   |
| 19360405 | 19361220 | 5    | Barometer moved   |
| 19361220 | 19420620 | 5    | Bar. no. 115521   |
| 19420929 | 19490510 | 5    | Bar. no. 194704   |
| 19490510 | 19490510 | 5    | Barometer no.?  |
| 18720101 | -        | 6    | 0.1 mm Hg – 7000  |
| 18720101 | 18930101 | 7    | $P=(p_8+p_{14}+p_{22})/3$   |
| 18930101 | 19280806 | 7    | $P=(p_8+p_{14}+p_{22})/3 + \text{corr. } 45 \text{ N}$  |
| 19280806 | -        | 7    | $P = (p_8+p_{14}+p_{21})/3 + \text{corr. } 45 \text{ N}$                                      |
| 19280801 | 19360405 | 8    | Station moved to Vestervejen 23   |
| 19360405 | 19441216 | 8    | Station moved to Kallesbjergvej 1   |
| 19441216 | 19530101 | 8    | Station moved to Sparekassen, Hovedgaden?   |
| 19530101 | 19530101 | 8    | From 1953: data not reduced to sea level  |
| 18720101 | 18930101 | 10   | $P=4/3*(7000+p)*(1-k_1*\cos(2*\varnothing))*(1+Hb/k_2/(k_3+t))$                               |
| 18930101 | -        | 10   | $P=4/3*(7000+p)*(1+Hb/k_2/(k_3+t))$ in 0.1 hPa  |
| 19420600 | 19420900 | 9    | 25100   |
| 19520900 | 19520900 | 9    | 25150   |
| 19521100 | 19521100 | 9    | 25150   |
| 19870800 | -        | 9    | 6080  |
| -        | 18920400 | 10   | $P * ( 1 - 0.00259 * \cos( 2 * 55.5 * 3.14/180 ) ) * ( 1 + 9.82/287.04 * 5.5/(T/10+273.15) )$ |
| 18920500 | 18921200 | 10   | $P * ( 1 - 0.00259 * \cos( 2 * 55.5 * 3.14/180 ) ) * ( 1 + 9.82/287.04 * 8.0/(T/10+273.15) )$ |
| 18930100 | 18991100 | 10   | $P * ( 1 + 9.82/287.04 * 8.0/(T/10+273.15 ) )$  |
| 18991200 | 19280700 | 10   | $P * ( 1 + 9.82/287.04 * 5.5/(T/10+273.15 ) )$  |
|          |          |      | table continues.....  |
|          |          |      | .....table continued  |

| Station 25140 Nordby/Fanø metadata |          |      |   |
|------------------------------------|----------|------|---|
| Start                              | End      | Type | Description   |
| 19280800                           | 19360300 | 10   | $P * ( 1 + 9.82/287.04 * 10.5/(T/10+273.15 ) )$     |
| 19360400                           | 19441100 | 10   | $P * ( 1 + 9.82/287.04 * 6.9/(T/10+273.15 ) )$      |
| 19441200                           | 19450500 | 10   | $P * ( 1 + 9.82/287.04 * 7.0/(T/10+273.15 ) )$      |
| 19450600                           | 19551100 | 10   | $P * ( 1 + 9.82/287.04 * 3.0/(T/10+273.15 ) )$      |
| 19551200                           | 19600800 | 10   | $P * ( 1 + 9.82/287.04 * 9.7/(T/10+273.15 ) )$      |
| 19600900                           | -        | 10   | $P * ( 1 + 9.82/287.04 * 6.7/(T/10+273.15 ) )$      |
| -                                  | 19420900 | 11   | 97,5% significant break, barometer broken           |
| -                                  | 19360400 | 11   | 97,5% significant break, station moved              |
| -                                  | 19661200 | 11   | 97.5% significant break, not supported in meta data |
| -                                  | 19040200 | 11   | 97,5% significant break, station moved              |
| -                                  | 19441200 | 11   | 97,5% significant break, station moved              |
| -                                  | 19420900 | 12   | 12.012.012.012.012.012.012.012.012.012.012.0        |
| -                                  | 19360400 | 12   | 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0         |
| -                                  | 19661200 | 12   | 6.0 6.0 6.0 6.0 6.0 6.0 6.0 6.0 6.0 6.0 6.0         |
| -                                  | 19040200 | 12   | 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0         |
| -                                  | 19441200 | 12   | -21 -21 -21 -21 -21 -21 -21 -21 -21 -21 -21         |

Table A3.4.5. Meta data regarding atmospheric pressure measurements at station 25140 Nordby/Fanø, Fanø (from NACD and WASA projects, see references). Description type number: 2=regarding vertical position. 5=regarding the instrument. 6=units of original measurements and later changes. 7=Formula for calculating originally published monthly values. 8=environment. 9=Time series forming part of primary time series. 10= Formula. Calculations made after original publication, e.g. reduction of atmospheric pressure. 11= Test procedure, most important results by comparison with neighbouring stations. 12= Adjustment made after test, given as 12 monthly values (0.1 hPa) to be added.

### Appendix 3.5. Introduction of the Hellmann rain gauge and Stevenson screens

Some events like replacement of rain gauges and thermometer screens can sometimes cause serious “break points” in the time series. In table A3.5.1 is listed relevant information on dates (it took place from app. 1910 – 1925) for introduction of the Hellmann rain gauge and for introduction of Stevenson screens concerning the stations in this report. The information originates from DMI Technical Report 94-20 [8].

| Station No. | Name  | Fjord gauge replaced by Hellmann | Stevenson screen mounted |
|-------------|---|----------------------------------|--------------------------|
| 21100       | Vestervig   | ~1915                            | 1924.07                  |
| 21430       | Grønbæk/Allingskovgård                            | N/A                              |                          |
| 25140       | Nordby, Fanø                                      | ~1913                            | 1928.08                  |
| 26410       | Broderup/Bajstrup/Gårdeby/Rødebjerg/Broderup Mark | N/A                              |                          |
| 27080       | Tranebjerg  | 1911.09                          | 1919.08                  |
| 30210       | Meteorologisk Institut                            | N/A                              |                          |
| 30380       | Landbohøjskolen                                   | Before 1922                      | 1919.09                  |
| 32030       | Sandvig   | 1911.09                          | 1913.09                  |

Table A3.5.1. Information on station instrumentation concerning rain gauge and Stevenson screen (thermometer screen). From 'table 6' in [8].

### Appendix 3.6. Information about corresponding monthly series

No test for homogeneity has been performed on the series of daily observations presented in this report. But as part of the NACD project (see section 4.1. Introduction) the corresponding *monthly* series for some of the stations and elements were tested, adjusted and published in [27]. The quality codes of these series of monthly data are shown in table A3.6.1 together with comments on the adjustments made. Element numbers and quality codes are explained in tables A3.6.2 and A3.6.3.

| Station No. | Element No. | Period          | Quality | Comments  |
|-------------|-------------|-----------------|---------|---|
| 21100       | 101         | 1890.01-1995.12 | H       | No adjustments made   |
| 21100       | 111         | 1890.01-1995.12 | T       | Adjusted 1890.01-1953.12 due to new observation procedure   |
| 21100       | 112         | 1890.01-1995.12 | T       | Adjusted 1890.01-1953.12 due to new observation procedure   |
| 21100       | 121         | 1890.01-1995.12 | T       | Adjusted 1890.01-1924.03 due to introduction of Stevenson screen 01 Apr. 1924. Adjusted 1890.01-1946.03 due to relocation of screen 01 Apr. 1946  |
| 21100       | 122         | 1890.01-1995.12 | T       | Adjusted 1890.01-1924.03 due to introduction of Stevenson screen 01 Apr. 1924. Adjusted 1890.01-1946.03 due to relocation of screen 01 Apr. 1946  |
| 21100       | 601         | 1873.10-1995.12 | H       | No adjustments made   |
| 21430       | 601         | 1862.08-1994.12 | N       | No adjustments made   |
| 25140       | 101         | 1890.01-1995.12 | H       | No adjustments made. Values from station 25150 inserted 1942.06-1942.09, 1952.09 and 1952.11  |
| 25140       | 111         | 1890.01-1995.12 | T       | Adjusted 1890.01-1899.11 due to relocation of screen 1 Dec. 1899. Adjusted 1890.01-1928.07 due to introduction of Stevenson screen August 1928  |
| 25140       | 112         | 1890.01-1995.12 | T       | Adjusted 1890.01-1899.11 due to relocation of screen 1 Dec. 1899. Adjusted 1890.01-1928.07 due to introduction of Stevenson screen August 1928. Adjusted 1914.12-1928.07 cause of break unknown   |
| 25140       | 121         | 1890.01-1995.12 | T       | Adjusted 1890.01-1904.03 due to relocation of screen 7 Apr. 1904 and new screen. Adjusted 1890.01-1995.12 due to introduction of Stevenson screen 6 Aug. 1928. Adjusted 1890.01-1936.03 due to relocation of screen 5 Apr. 1936. Adjusted 1890.01-1944.12 due to relocation of screen 16 Dec. 1944. Adjusted 1890.01-1960.08 due to relocation of screen 22 Aug. 1960 |
| 25140       | 122         | 1890.01-1995.12 | T       | Adjusted 1890.01-1928.07 due to introduction of Stevenson screen 6 Aug. 1928. Adjusted 1890.01-1944.12 due to relocation of screen 16 Dec 1944. Adjusted 1936.03-1958.07 due to relocation of screen 5 Apr. 1936 and painting of screen 2 Aug. 1958   |
| 25140       | 601         | 1871.12-1995.12 | H       | No adjustments made   |
| 26410       | 601         | 1894.11-1990.12 | N       | No adjustments made   |
| 27080       | 101         | 1890.01-1994.12 | H       | No adjustments made   |
| 27080       | 111         | 1890.01-1995.12 | T       | Adjusted 1890.01-1918.05 due to relocation and new Stevenson screen 01 Jun. 1918. Adjusted 1890.01-1972.11 due to relocation 16 Nov. 1972   |
| 27080       | 121         | 1890.01-1995.12 | T       | No adjustments made   |
| 27080       | 601         | 1872.12-1995.12 | H       | No adjustments made   |
| 27080       | 801         | 1890.01-1995.12 | H       | Adjusted 1890.01-1918.08 due to new observer<br>Adjusted 1890.01-1963.08 due to new observer  |
| 30380       | 101         | 1751.01-1889.12 | T       | No adjustments made   |

|       |     |                 |   |   |
|-------|-----|-----------------|---|---|
| 30380 | 101 | 1890.01-1997.03 | E | No adjustments made   |
| 30380 | 111 | 1896.01-1995.12 | T | Adjusted 1896.01-1919.08 due to new Stevenson screen 1919/08/20. Adjusted 1894.01-1984.12 due to urban warming  |
| 30380 | 112 | 1890.01-1995.12 | T | Adjusted 1890.01-1919.08 due to new Stevenson screen 1919/08/20. Adjusted 1890.01-1977.12 due to urban warming.   |
| 30380 | 601 | 1861.01-1995.12 | H | No adjustments made   |
| 6193  | 101 | 1890.01-1995.12 | H | Series consists of stations 32030, 32020 and 6193. No adjustments made  |
| 6193  | 111 | 1890.01-1995.12 | T | Series consists of stations 32030, 32020 and 6193. Adjusted 1890.01-1913.09 due to introduction of Stevenson screen. Adjusted 1890.01-1953.08 due to relocation of screen |
| 6193  | 112 | 1890.01-1995.12 | T | Series consists of stations 32030, 32020 and 6193. Adjusted 1890.01-1913.09 due to introduction of Stevenson screen   |
| 6193  | 121 | 1890.01-1995.12 | T | Series consists of stations 32030, 32020 and 6193. Adjusted 1890.01-1913.09 due to installation of Stevenson screen 17 Sep. 1913  |
| 6193  | 122 | 1890.01-1995.12 | T | Series consists of stations 32030, 32020 and 6193. Adjusted 1890.01-1970.12 due to relocation 31 Dec. 1970  |
| 6193  | 601 | 1890.01-1995.12 | H | Series consists of stations 32030, 32020 and 6193. No adjustments made  |

Table A3.6.1. Quality of series of monthly values published in [27].

| Element no. | Description                      | Unit   | Method  |
|-------------|----------------------------------|--------|---------|
| 101         | Average air temperature          | 0.1 °C | Average |
| 111         | Average maximum air temperature  | 0.1 °C | Average |
| 112         | Absolute maximum air temperature | 0.1 °C | Max     |
| 121         | Average minimum air temperature  | 0.1 °C | Average |
| 122         | Absolute minimum air temperature | 0.1 °C | Min     |
| 601         | Precipitation sum                | 0.1 mm | Sum     |
| 801         | Average cloud cover              | %      | Average |

Table A3.6.2. Explanation of element numbers used in table A3.6.1.

| Quality code | Description   |
|--------------|---|
| H            | Homogeneous, rigorously tested and possibly adjusted    |
| T            | Tested, possibly adjusted but not perfectly homogeneous |
| E            | Environmental changes prevent climatic change studies   |
| I            | Inhomogeneous series which is presently not adjustable  |
| N            | Not tested, but not necessarily inhomogeneous           |

Table A3.6.3. Explanation of quality codes used in table A3.6.1.

## Appendix 4. Monthly/annual section - File formats and metadata

### Appendix 4.1. File formats; Monthly/annual data files

The monthly/annual files included in this report contain monthly and annual DMI blended data series within the period 1768-2016 comprising different parameters from five (5) stations in Denmark.

The file name are determined as follows:

**dk\_monthly\_all\_<period>.dat**

In this report one (1) ;-separated csv file:

**dk\_monthly\_all\_1768\_2016.csv**

#### Format of the monthly/annual file:

Station number (stat\_no); element number (elem\_no); year (year); January value (jan); February value (feb); March value (mar); April value (apr); May value (may); June value (jun); July value (jul); August value (aug); September value (sep); October value (oct); November value (nov); December value (dec); Annual value (annual); country code (DK= Denmark) (co\_code)

The element/parameter numbers and units can be seen in the data dictionary, table 6.2.12, in section 6.2.

In the file **dk\_monthly\_all\_1768\_2016.csv** data are sorted according to element and station number. Furthermore all missing values are filled with "null". An annual value and a country code have been included.

Data are only to be used with proper reference to the accompanying report:  
Cappelen, J. (ed), 2016: Denmark - DMI Historical Climate Data Collection 1768-2016. DMI Report No. 16-02. Copenhagen.

#### Special remarks:

The annual values 2014-2016 are calculated directly on hourly values. The annual values before 2014 are calculated on the monthly values mentioned in section 6.2.3.

In the monthly section the reference "NARP1" refers to the "NARP dataset version 1", see [29].

The monthly data sets referred to in this report have been constructed by a number of persons. Their names and initials/abbreviations are: Poul Frich (PF), John Cappelen (JC), Ellen Vaarby Laursen (EVL), Rikke Sjølin Thomsen (RST), Bent Vraae Jørgensen (BVJ) and Lotte Sligting Stannius (LSS).

The monthly data sets are referred to by their creator (abbreviations seen above) and the number they have in the internal DMI data set classification.

Therefore, monthly data set "JC-TS1220" means a data set (time series TS) created by John Cappelen with number 1220 in the data set classification.

“Monthly\_db” refers to an internal DMI monthly database Ingres klimadb/postgreSQL ClimaDB with monthly values of various weather parameters.

The reference “TR” refers to DMI Technical Reports. Therefore, “TR99-5” as an example means DMI Technical Report 99-5 [31] available from:

<http://www.dmi.dk/laer-om/generelt/dmi-publikationer/>

In this report months are referred to by year/month number (ex. 2000/03 = March 2000) and the minimum criteria used here for calculating a valid monthly value is that measurements from more than at least 21 days are present in that month, so the number of daily values are ranging 22-31. Additionally a subjective validation has been performed.

## Appendix 4.2. Metadata - Description of monthly data sets

### Vestervig (VEST) – 6051; 1874-2016

| <b>Element No.101 (Average Air Temperature)</b>   |               |                                     |                     |                       |
|---|---------------|-------------------------------------|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>                      | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1874 – 2016   | Monthly-db VEST 21100/6051 + TR99-5 | 1716                | 0                     |
| Details: Created using monthly-db VEST 21100: 1874-1960, TR99-5: 1961-1990, monthly-db VEST 21100: 1991-2003/8, monthly-db VEST 6051: 2003/10-2016. Three months (2000/1+2, 2003/9) were filled using monthly-based regression with 6052 Thyborøn: Jan. 2000: $st_{21100} = 1.0718 * st_{6052} - 9.417$ ( $r^2=0.988$ ), Feb. 2000: $st_{21100} = 1.0474 * st_{6052} - 6.970$ ( $r^2=0.995$ ), Sept. 2003: $st_{21100} = 1.003 * st_{6052} - 9.573$ ( $r^2=0.954$ ). Two months (2008/7+8) were filled using monthly-based regression with an average of 6052 Thyborøn and 6019 Silstrup: July 2008: $st_{6051} = 0.984 * (st_{6052} + st_{6019}) / 2 - 9.417$ ( $r^2=0.99$ ), Aug. 2008: $st_{6051} = 1.015 * (st_{6052} + st_{6019}) / 2 - 5.084$ ( $r^2=0.96$ ). |               |                                     |                     |                       |

| <b>Element No.111 (Average of Daily Maximum Air Temperature)</b>   |               |                                     |                     |                       |
|--|---------------|-------------------------------------|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>                      | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1875 – 2016   | Monthly-db VEST 21100/6051 + TR99-5 | 1704                | 1                     |
| Details: Created using monthly-db VEST 21100: 1875-1960, TR99-5: 1961-1990, monthly-db VEST 21100: 1991-2003/8, monthly-db VEST 6051: 2003/10-2016. 3 months (1970/12, 2000/1+2) were filled using data from 6052 Thyborøn. 1 month (2003/9) was filled using monthly-based regression with 6052: Sept. 2003: $st_{21100} = 1.014 * st_{6052} + 0.64$ ( $r^2=0.932$ ). 2 months (2008/7+8) were filled using monthly-based regression with an average of 6052 Thyborøn and 6019 Silstrup: Jul. 2008: $st_{6051} = 0.946 * (st_{6052} + st_{6019}) / 2 + 15.581$ ( $r^2=0.98$ ), Aug. 2008: $st_{6051} = 1.351 * (st_{6052} + st_{6019}) / 2 - 66.992$ ( $r^2=0.98$ ). 1924/5 could not be filled, no data available. |               |                                     |                     |                       |

| <b>Element No.112 (Highest Air Temperature)</b>  |               |                                     |                     |                       |
|--|---------------|-------------------------------------|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>                      | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1875 – 2016   | Monthly-db VEST 21100/6051 + TR99-5 | 1704                | 0                     |
| Details: Created using monthly-db VEST 21100: 1875-1960, TR99-5: 1961-1990, monthly-db VEST 21100: 1991-2003/9, monthly-db VEST 6051: 2003/10-2016. 4 months (1962/6, 1970/12, 2000/1+2) were filled using data from 6052 Thyborøn. 2003/9 for station VEST 21100 is not complete, but the highest air temperature in Sept. 2003 occurred in the existing part of the series. Two months (2008/7+8) were filled using data from 6019 Silstrup. |               |                                     |                     |                       |

| <b>Element No.121 (Average of Daily Minimum Air Temperature)</b>  |               |                                     |                     |                       |
|---|---------------|-------------------------------------|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>                      | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1875 – 2016   | Monthly-db VEST 21100/6051 + TR99-5 | 1704                | 0                     |
| Details: Created using monthly-db VEST 21100: 1875-1960, TR99-5: 1961-1990, monthly-db VEST 21100: 1991-2003/8, monthly-db VEST 6051: 2003/10-2016. 4 months (1962/6, 1970/12, 2000/1+2) were filled using data from 6052 Thyborøn. 1 month (2003/9) was filled using monthly-based regression with 6052: Sept. 2003: $st_{21100} = 1.03 * st_{6052} - 21.94$ ( $r^2=0.829$ ). 2 months (2008/7+8) were filled using monthly-based regression with an average of 6052 Thyborøn and 6019 Silstrup: Jul. 2008: $st_{6051} = 0.975 * (st_{6052} + st_{6019}) / 2 - 1.092$ ( $r^2=1.0$ ), Aug. 2008: $st_{6051} = 0.644 * (st_{6052} + st_{6019}) / 2 + 43.569$ ( $r^2=0.82$ ). |               |                                     |                     |                       |

| <b>Element No.122 (Lowest Air Temperature)</b>  |               |                                     |                     |                       |
|---|---------------|-------------------------------------|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>                      | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1875 – 2016   | Monthly-db VEST 21100/6051 + TR99-5 | 1704                | 0                     |
| Details: Created using monthly-db VEST 21100: 1875-1960, TR99-5: 1961-1990, monthly-db VEST 21100 1991-2003/9, monthly-db VEST 6051 2003/10-2016. Four months (1962/6, 1970/12, 2000/1+2) were filled using data from 6052 Thyborøn. 2003/9 for station VEST 21100 is not complete, but the lowest air temperature in September 2003 occurred in the existing part of the series. |               |                                     |                     |                       |



## Vestervig (VEST) – 6051 (continued)

| <b>Element No.401 (Average Atmospheric Pressure)</b>  |               |                              |                     |                       |
|---|---------------|------------------------------|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>               | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1874 – 2016   | Monthly-db VEST 21100 + 6052 | 1716                | 0                     |
| Details:<br>Created using monthly-db VEST 21100: 1874-1987/7 reduced to mean sea level (see appendix), monthly-db 6052 Thyborøn: 1987/8-2016. Missing (2011/7-8) filled using 6058 Hvide Sande. |               |                              |                     |                       |

| <b>Element No.601 (Accumulated Precipitation) – Not necessarily homogenous</b>  |               |                            |                     |                       |
|---|---------------|----------------------------|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>             | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1874 – 2016   | Monthly-db VEST 21100/6051 | 1716                | 0                     |
| Details:<br>Created using monthly-db VEST 21100/6051: 1874-2016. 16 November 2010 an automatic raingauge was installed at 6051 Vestervig. Not necessarily homogenous, because of new ways of detection from 2010. |               |                            |                     |                       |

| <b>Element No.602 (Highest 24-hour Precipitation) – Not necessarily homogenous</b>  |               |                            |                     |                       |
|---|---------------|----------------------------|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>             | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1874 – 2016   | Monthly-db VEST 21100/6051 | 1716                | 0                     |
| Details:<br>Created using monthly-db VEST 21100/6051: 1874-2016. Missing (1950/1+4, 1954/1) filled using the average of 24020 Bovbjerg Fyr and 21120 Erslev. 16 November 2010 an automatic raingauge was installed at 6051 Vestervig. Not necessarily homogenous, because of new ways of detection from 2010. |               |                            |                     |                       |

| <b>Element No.701 (Number of Days with Snow Cover)</b>   |               |                                |                     |                       |
|--|---------------|--------------------------------|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>                 | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1939 – 2016   | Monthly-db VEST 21100 + TR99-5 | 936                 | 0                     |
| Details:<br>Created using monthly-db VEST 21100: 1939-1960, TR99-5 VEST 21100: 1961-1990, monthly-db VEST 21100: 1991-2016. VEST 21100 stopped 701 observations in August 2001 and started again January 2004. September 2001- December 2003 were filled using the average of 6030 FSN Aalborg and 6060 FSN Karup. 2004/6-2004/9 had problems, but were filled with zero. The many missing month are missing zero's for June-September months from 1970-1990. These zero's were inserted. After this, two months were missing (1955/3 and 1970/12). 1970/12 was filled using 6052 while 1955/3 was filled using the average of 6030 FSN Aalborg, 6041 Skagen Fyr and 6060 FSN Karup. |               |                                |                     |                       |

| <b>Element No.801 (Average Cloud Cover) - Inhomogenous based on a visual test</b>  |               |   |                     |                       |
|--|---------------|---|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>                          | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1874 – 2016   | PF-TS110 + Monthly-db VEST 21100 + 6052 | 1716                | 0                     |
| Details:<br>Created using monthly-db VEST 21100: 1874-1889, PF-TS110 1890-1995 and monthly_db 6052 Thyborøn: 1996-2016. VEST 21100 stops cloud cover observations in December 1999. 6052 values were used for the period 2000-2005 + for filling values in 1962/5+6. Eight months (2010/1-5, 2010/12 and 2011/7-8) were filled using data from 6058 Hvide Sande. 22 November 2000 a ceilometer for automatic detection of cloud cover was installed at 6052 Thyborøn. Inhomogenous based on a visual test, possible several breaks. New ways of detection from 2000. |               |   |                     |                       |

## Nordby/Fanø (NORD) – 6088; 1872-2016

| <b>Element No.101 (Average Air Temperature)</b>  |               |                                     |                     |                       |
|--|---------------|-------------------------------------|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>                      | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1872 – 2016   | Monthly-db NORD 25140/6088 + TR99-5 | 1740                | 0                     |
| <p>Details: Created using monthly-db NORD 25140: 1872-1960, TR99-5 25140: 1961-1990, monthly-db NORD 25140: 1991-2003/6, monthly-db NORD 6088: 2003/8-2011/4, ObsDB (calc) 0-23utc NORD 6088: 2011/5-2016. 4 months (1993/12, 1994/1, 2000/1, 2002/6) were filled using average values from stations 6080 Esbjerg Lufthavn, 6081 Blåvandshuk Fyr and 25348 Vester Vedsted. 2003/7 was filled using an average value from stations 6080 Esbjerg Lufthavn, 6081 Blåvandshuk Fyr, 6096 Rømø/Juvre and 25348 Vester Vedsted. 2005/4, 2007/8, 2007/9 were filled using average values from stations 6080 Esbjerg Lufthavn, 6096 Rømø/Juvre and 6093 Vester Vedsted. 2016/1 was interpolated using surrounding stations.</p> |               |                                     |                     |                       |

| <b>Element No.111 (Average of Daily Maximum Air Temperature)</b>  |               |                                     |                     |                       |
|---|---------------|-------------------------------------|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>                      | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1875 – 2016   | Monthly-db NORD 25140/6088 + TR99-5 | 1704                | 0                     |
| <p>Details: Created using monthly-db NORD 25140: 1875-1960, TR99-5 25140: 1961-1990, monthly-db NORD 25140: 1991-2003/6, monthly-db NORD 6088: 2003/8-2011/4, ObsDB (calc) 0-23utc NORD 6088: 2011/5-2016. 4 months (1993/12, 1994/1, 2000/1, 2002/6) were filled using average values from stations 6080, 6081 and 25348. 2003/7 was filled using an average value from stations 6080, 6081, 6096 and 25348. 2005/4, 2007/8, 2007/9 were filled using average values from stations 6080 Esbjerg Lufthavn, 6096 Rømø/Juvre and 6093 Vester Vedsted. 2016/1 was interpolated using surrounding stations.</p> |               |                                     |                     |                       |

| <b>Element No.112 (Highest Air Temperature)</b>   |               |                                     |                     |                       |
|---|---------------|-------------------------------------|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>                      | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1874 – 2016   | Monthly-db NORD 25140/6088 + TR99-5 | 1716                | 0                     |
| <p>Details: Created using monthly-db NORD 25140: 1874-1960, TR99-5 25140: 1961-1990, monthly-db NORD 6088: 1991-2011/4, ObsDB (calc) 0-23utc NORD 6088: 2011/5-2016. 4 months (1993/12, 1994/1, 2000/1, 2002/6) were filled using average values from stations 6080, 6081 and 25348. 2005/4 was filled using an average value from stations 6080 Esbjerg Lufthavn, 6096 Rømø/Juvre and 6093 Vester Vedsted. 2016/1 was interpolated using surrounding stations.</p> |               |                                     |                     |                       |

| <b>Element No.121 (Average of Daily Minimum Air Temperature)</b>  |               |                                     |                     |                       |
|---|---------------|-------------------------------------|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>                      | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1875 – 2016   | Monthly-db NORD 25140/6088 + TR99-5 | 1704                | 0                     |
| <p>Details: Created using monthly-db NORD 25140: 1875-1960, TR99-5 25140: 1961-1990, monthly-db NORD 25140: 1991-2003/6, monthly-db NORD 6088: 2003/8-2011/4, ObsDB (calc) 0-23utc NORD 6088: 2011/5-2016. 4 months (1993/12, 1994/1, 2000/1, 2002/6) were filled using average values from stations 6080, 6081 and 25348. 2003/7 was filled using an average value from stations 6080, 6081, 6096 and 25348. 2005/4, 2007/8, 2007/9 were filled using average values from stations 6080 Esbjerg Lufthavn, 6081 Blåvandshuk Fyr, 6096 Rømø/Juvre and 6093 Vester Vedsted. 2016/1 was interpolated using surrounding stations.</p> |               |                                     |                     |                       |

| <b>Element No.122 (Lowest Air Temperature)</b>   |               |                                     |                     |                       |
|--|---------------|-------------------------------------|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>                      | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1875 – 2016   | Monthly-db NORD 25140/6088 + TR99-5 | 1704                | 0                     |
| <p>Details: Created using monthly-db NORD 25140: 1875-1960, TR99-5 25140: 1961-1990, monthly-db 6088: 1991-2011/4, ObsDB (calc) 0-23utc NORD 6088: 2011/5-2016. 4 months (1993/12, 1994/1, 2000/1, 2002/6) were filled using average values from stations 6080, 6081 and 25348. 2005/4 and 2007/8 were filled using average values from stations 6080 Esbjerg Lufthavn, 6081 Blåvandshuk Fyr, 6096 Rømø/Juvre and 6093 Vester Vedsted. 2016/1 was interpolated using surrounding stations.</p> |               |                                     |                     |                       |

## Nordby/Fanø (NORD) – 6088 (continued)

| <b>Element No.401 (Average Atmospheric Pressure)</b>  |               |  |                     |                       |
|---|---------------|--|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>                         | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1872 – 2016   | Monthly-db NORD 25140 + 6080/6081/6096 | 1740                | 5                     |
| Details:<br>Created using monthly-db NORD 25140: 1872-1987/7 reduced to mean sea level (see appendix). Extended using the average of 6080, 6081 and 6096 for the period 1987/7 – 2016. Five months 1942/6 – 1942/9 and 1952/11 are missing. |               |  |                     |                       |

| <b>Element No.601 (Accumulated Precipitation) – Not necessarily homogenous</b>   |               |                            |                     |                       |
|--|---------------|----------------------------|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>             | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1872 – 2016   | Monthly-db NORD 25140/6088 | 1740                | 0                     |
| Details:<br>Created using monthly-db NORD 25140/6088: 1872-2016. 1 month (1993/12) was filled using the average from 4 nearby manual stations (25135 Langli, 25145 Sønderho, 25171 Esbjerg Renseanlæg Vest and 25172 Hjerting). In the period 2 January – 13 June 2009 the daily acc. precipitation are interpolated values. 11 June 2009 an automatic raingauge was installed at 6088 Nordby. Not necessarily homogenous, because of new ways of detection from 2009. |               |                            |                     |                       |

| <b>Element No.602 (Highest 24-hour Precipitation) – Not necessarily homogenous</b>  |               |                            |                     |                       |
|---|---------------|----------------------------|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>             | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1872 – 2016   | Monthly-db NORD 25140/6088 | 1740                | 0                     |
| Details:<br>Created using monthly-db NORD 25140/6088: 1872-2016. 1 month (1993/12) was filled using the average from 3 nearby manual stations (25135 Langli, 25171 Esbjerg Renseanlæg Vest and 25172 Hjerting). In the period 2 January – 13 June 2009 the precipitation are interpolated values. 11 June 2009 an automatic raingauge was installed at 6088 Nordby. Not necessarily homogenous, because of new ways of detection from 2009. |               |                            |                     |                       |

| <b>Element No.701 (Number of Days with Snow Cover) – Not necessarily homogenous</b>   |               |  |                     |                       |
|---|---------------|--|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>                               | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1957 – 2016   | Monthly-db NORD 25140 + 6080 + 25045 +TR99-5 | 720                 | 0                     |
| Details:<br>Created using monthly-db NORD 25140: 1957-1960, TR99-5 NORD 25140: 1961-1990, monthly-db NORD 25140: 1991-2001/8, 6080: 2001/9-2006, 25045: 2007-2016. Jun – Sept. months 1970-1990 had missing zero's which were inserted. 2 missing months (1993/12 and 1994/1) were filled using values from 6080. Not necessarily homogenous, different locations involved. |               |  |                     |                       |

| <b>Element No.801 (Average Cloud Cover) - Inhomogenous based on a visual test</b>   |               |  |                     |                       |
|---|---------------|--|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>                                 | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1872 – 2016   | Monthly-db NORD 25140 + PF-TS126 + 6080 + 6096 | 1740                | 2                     |
| Details:<br>Created using monthly-db NORD 25140: 1872-1889, PF-TS126 1890-1995 and monthly-db 25140: 1996-1999. 6080 are used for 2000/1- 2000/3 and 6096 for the remaining period 2000/4 – 2016. 6096 are used because 6080 Esbjerg Lufthavn has an unstable number of observations per month. 1959/10 was filled using a value from 6081 Blåvandshuk, 1993/12 + 1994/1 were filled using values from 6080. 2006/8 and 2006/9 are missing. 2006/1, 2008/2, 2008/3, 2008/8+10, 2010/4+5+6, 2011/10 and 2013/10 were filled using values from 6058 Hvide Sande. 7 April 2000 a ceil-ometer for automatic detection of cloud cover was installed at 6096 Rømø/Juvre. Inhomogenous based on a visual test, possible several breaks. New ways of detection from 2000. |               |  |                     |                       |

## Tranebjerg (TRAN) – 6132; 1872-2016

| <b>Element No.101 (Average Air Temperature)</b>   |               |                                     |                     |                       |
|---|---------------|-------------------------------------|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>                      | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1873 – 2016   | Monthly-db TRAN 27080/6132 + TR99-5 | 1728                | 0                     |
| Details:<br>Created using monthly-db TRAN 27080: 1873-1960, TR99-5 27080: 1961-1990, monthly-db TRAN 27080: 1991-2003/7, monthly-db TRAN 6132: 2003/9-2016. 1995/2, 2000/2, 2003/4-5, 2003/8, 2005/1 and 2009/5 were filled using values from 6159 Røsnæs Fyr, the closest station outside Samsø. |               |                                     |                     |                       |

| <b>Element No.111 (Average of Daily Maximum Air Temperature)</b>   |               |                                     |                     |                       |
|--|---------------|-------------------------------------|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>                      | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1873 – 2016   | Monthly-db TRAN 27080/6132 + TR99-5 | 1728                | 4                     |
| Details:<br>Created using monthly-db TRAN 27080: 1875-1960, TR99-5 27080: 1961-1990, monthly-db TRAN 27080: 1991-2003/7, monthly-db TRAN 6132: 2003/9-2016. 1873/12, 1925/10, 1947/11 and 1949/3 could not be filled, while 1995/2, 2000/2, 2005/1 and 2009/5 were filled using values from 6159 Røsnæs Fyr. |               |                                     |                     |                       |

| <b>Element No.112 (Highest Air Temperature)</b>   |               |                                     |                     |                       |
|---|---------------|-------------------------------------|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>                      | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1873 – 2016   | Monthly-db TRAN 27080/6132 + TR99-5 | 1728                | 3                     |
| Details:<br>Created using monthly-db TRAN 27080: 1873-1960, TR99-5 27080: 1961-1990, monthly-db TRAN 27080: 1991-2003/7, monthly-db TRAN 6132: 2003/9-2016. 1925/10, 1947/11 and 1949/3 could not be filled, while 1995/2, 2000/2, 2003/4 and 2009/5 were filled using values from 6159 Røsnæs Fyr. |               |                                     |                     |                       |

| <b>Element No.121 (Average of Daily Minimum Air Temperature)</b>   |               |                                     |                     |                       |
|--|---------------|-------------------------------------|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>                      | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1873 – 2016   | Monthly-db TRAN 27080/6132 + TR99-5 | 1728                | 2                     |
| Details:<br>Created using monthly-db TRAN 27080: 1873-1960, TR99-5 27080: 1961-1990, monthly-db TRAN 27080: 1991-2003/7, monthly-db TRAN 6132: 2003/9-2016. 1947/11 and 1949/3 could not be filled, while 1995/2, 2000/2, 2003/4-5, 2003/8, 2005/1 and 2009/5 were filled using values from 6159 Røsnæs Fyr. |               |                                     |                     |                       |

| <b>Element No.122 (Lowest Air Temperature)</b>   |               |                                     |                     |                       |
|--|---------------|-------------------------------------|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>                      | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1873 – 2016   | Monthly-db TRAN 27080/6132 + TR99-5 | 1728                | 2                     |
| Details:<br>Created using monthly-db TRAN 27080: 1873-1960, TR99-5 27080: 1961-1990, monthly-db TRAN 27080: 1991-2003/7, monthly-db TRAN 6132: 2003/8-2016. 1947/11 and 1949/3 could not be filled, while 1995/2, 2000/2 and 2003/4 were filled using values from 6159 Røsnæs Fyr. |               |                                     |                     |                       |

## Tranebjerg (TRAN) – 6132 (continued)

| <b>Element No.401 (Average Atmospheric Pressure)</b>  |               |                              |                     |                       |
|---|---------------|------------------------------|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>               | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1872 – 2016   | Monthly-db TRAN 27080 + 6159 | 1729                | 12                    |
| Details:<br>Created using monthly-db TRAN 27080: 1872/12-1987/7 reduced to mean sea level (see appendix). Extended using 6159 Røsnæs Fyr for the period 1987/8 – 2016. One month (2009/2) was filled using an average of 6073 Sletter Hage Fyr, 6169 Griben, 6120 Odense Airport. 2011/9 was filled using 6169 Griben. Twelve months are missing: 1911/5-8, 1924/8, 1925/1, 1945/11, 1946/9, 1947/11, 1949/3, 1972/10-11. |               |                              |                     |                       |

| <b>Element No.601 (Accumulated Precipitation) - Not necessarily homogenous</b>  |               |                                      |                     |                       |
|---|---------------|--------------------------------------|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>                       | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1873 – 2016   | Monthly-db TRAN 27080 + 27082 + 5165 | 1728                | 0                     |
| Details:<br>Created using monthly-db TRAN 27080: 1873-2001/7, 27082: 2001/8 – 2011/3, /4, monthly-db TRAN 5165: 2011/4-2016. Months 1972/10+11 and 1995/2 were filled using average values from stations 27070 Langør and 27090 Brattingsborg. 18 November 2010 an automatic rain gauge was installed at 5165 Tranebjerg Øst. Not necessarily homogenous, because of new ways of detection from 2010. |               |                                      |                     |                       |

| <b>Element No.602 (Highest 24-hour Precipitation) - Not necessarily homogenous</b>  |               |                                      |                     |                       |
|---|---------------|--------------------------------------|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>                       | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1873 – 2016   | Monthly-db TRAN 27080 + 27082 + 5165 | 1728                | 0                     |
| Details:<br>Created using monthly-db TRAN 27080: 1873-2001/7, 27082: 2001/8-2011/3, monthly-db TRAN 5165: 2011/4-2016. Months 1972/10+11 and 1995/2 were filled using average values from stations 27070 Langør and 27090 Brattingsborg. 18 November 2010 an automatic rain gauge was installed at 5165 Tranebjerg Øst. Not necessarily homogenous, because of new ways of detection from 2010. |               |                                      |                     |                       |

| <b>Element No.701 (Number of days with Snow Cover)</b>   |               |  |                     |                       |
|--|---------------|--|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>                         | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1949 – 2016   | Monthly-db TRAN 27080 + TR99-5 + 27082 | 816                 | 44                    |
| Details:<br>Created using monthly-db TRAN 27080: 1949-1960, TR99-5: 1961-1990, monthly-db TRAN 27080: 1991- 2000, 27082: 2004/9 - 2016. Months 1949/3, 1955/1+2 were filled using values from 28180 Blangstedgaard. 44 months are missing: 2001/1 -2004/8. This series was continued from 2004/9 using data from 27082 Tranebjerg Øst. |               |  |                     |                       |

| <b>Element No.801 (Cloud Cover)</b>  |               |                                       |                     |                       |
|--|---------------|---------------------------------------|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>                        | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1874 – 2001   | Monthly-db TRAN 27080 + 6159 + TR99-5 | 1546                | 0                     |
| Details:<br>Created using monthly-db TRAN 27080: 1874-1960, TR99-5: 1961-1990, monthly-db TRAN 27080: 1991- 2000/1, monthly-db 6159 2000/2 – 2001/10. Months 1947/4+11, 1948/1+11 were filled using values from 28180 Blangstedgaard. Months 1949/3, 1972/10+11, 1995/2 were filled using values from 6159 Røsnæs Fyr. This series could not without severe problems be extended using data from a station on the islands Fyn or Sjælland i.e. 6159 Røsnæs Fyr, so this is not done. |               |                                       |                     |                       |

## København (KOEB) – 6186; 1768-2016

| <b>Element No.101 (Average Air Temperature)</b>   |               |  |                     |                       |
|---|---------------|--|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>   | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1768 – 2016   | Monthly-db KOEB 6186/30380+ Rundetårn+old Botanical Garden | 2988                | 168                   |
| Details:<br>Created using monthly-db KOEB 6186/30380: 1860-2016, and keyed in data from Rundetårn: 1768-1819 and the old Botanical Garden: 1820-1859 (Willaume-Jantzen, V. (1896) [45]). 168 missing months: 1777/1-1781/12 and 1789/1-1797/12. |               |  |                     |                       |

| <b>Element No. 111 (Average of Daily Maximum Air Temperature)</b>  |               |                            |                     |                       |
|--|---------------|----------------------------|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>             | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1861 – 2016   | Monthly-db KOEB 6186/30380 | 1872                | 0                     |
| Details:<br>Created using monthly-db KOEB 6186/30380: 1861-2016. 1970/12 was filled using a value from station 6180 Københavns Lufthavn. |               |                            |                     |                       |

| <b>Element No. 112 (Highest Air Temperature)</b>   |               |                            |                     |                       |
|--|---------------|----------------------------|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>             | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1861 – 2016   | Monthly-db KOEB 6186/30380 | 1872                | 0                     |
| Details:<br>Created using monthly-db KOEB 6186/30380: 1861-2016. 1970/12 was filled using a value from station 6180 Københavns Lufthavn. |               |                            |                     |                       |

| <b>Element No. 121 (Average of Daily Minimum Air Temperature)</b>  |               |                            |                     |                       |
|--|---------------|----------------------------|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>             | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1861 – 2016   | Monthly-db KOEB 6186/30380 | 1872                | 0                     |
| Details:<br>Created using monthly-db KOEB 6186/30380: 1861-2016. 1970/12 was filled using a value from station 6180 Københavns Lufthavn. |               |                            |                     |                       |

| <b>Element No. 122 (Lowest Air Temperature)</b>   |               |                            |                     |                       |
|---|---------------|----------------------------|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>             | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1861 – 2016   | Monthly-db KOEB 6186/30380 | 1872                | 0                     |
| Details:<br>Created using monthly-db KOEB 6186/30380: 1861-2016. 1970/12 was filled using station 6180 Københavns Lufthavn. |               |                            |                     |                       |

## København (KOEB) – 6186 (continued)

| <b>Element No.401 (Average Atmospheric Pressure)</b>   |               |                              |                     |                       |
|--|---------------|------------------------------|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>               | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1923 – 2016   | Monthly-db KOEB 30380 + 6180 | 1128                | 1                     |
| Details: Created using monthly-db KOEB 30380: 1923/1-1987/7 reduced to mean sea level (see appendix). Extended using 6180 Kbh Lufthavn for the period 1987/8 – 2016. One month is missing: 1957/10. In monthly-db there are also data from 30380 in the period 1860/1- 1875/12 reduced to mean sea level, but these data are not part of this publication. |               |                              |                     |                       |

| <b>Element No. 504 (Hours of bright sunshine)</b>  |               |   |                     |                       |
|--|---------------|---|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>                                  | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1876 – 2016   | EVL-TS276+Monthly-db KOEB30380/30340/30341/6187 | 1692                | 0                     |
| Details: Created using EVL-TS276 1876-1997 (see also [30]), monthly-db 30340 Kbh Tolddod: 1998-2004, monthly_db 30341 Kbh Tolddod: 2005-2011 and 6187 Kbh Tolddod: 2012-2016. The EVL-TS276 + 30340 from 1998-2004 series was converted from casella to star level by JC using following monthly conversion factors: (1,05;0,98;0,94;0,91;0,87;0,84;0,83;0,83;0,84;0,88;0,96;1,10) [33]. |               |   |                     |                       |

| <b>Element No. 601 (Accumulated Precipitation) - Not necessarily homogenous</b>   |               |  |                     |                       |
|---|---------------|--|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>   | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1821 – 2016   | Monthly-db KOEB 6186/30380+30370+5735+old botanical garden | 2352                | 19                    |
| Details: Created using monthly-db KOEB 6186/30380: 1860-1995, 30370: 1996-2011/3, monthly-db 5735: 2011/4-2016 plus keyed in data from the old Botanical Garden 1821-1859 (Willaume-Jantzen, V. (1896) [45]). The 19 missing months are in 1825, 1926/1-1926/4 and 1926/9-1926/11. The former published series (latest 1821-2004 and earlier) has been changed, because the use of the station 30381 in that series for the period 1996/1-2004/12 wasn't appropriate. 14 January 2010 an automatic raingauge was installed at 5735 Botanisk Have. Not necessarily homogenous, because of new ways of detection from 2010. |               |  |                     |                       |

| <b>Element No. 602 (Highest 24-hour Precipitation) - Not necessarily homogenous</b>   |               |  |                     |                       |
|---|---------------|--|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>   | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1843 – 2016   | Monthly-db KOEB 6186/30380+30370+5735+old botanical garden | 2088                | 0                     |
| Details: Created using monthly-db KOEB 6186/30380: 1860-1995, 30370: 1996-2011/3, monthly-db 5735: 2011/4-2016 plus keyed in data from the old Botanical Garden 1843-1859 (Willaume-Jantzen, V. (1896) [45]). For 1974/4 a value from 6180 was used. The former published series (latest 1843-2004 and earlier) has been changed, because the use of the station 30381 in that series for the period 1996/1-2004/12 wasn't appropriate. 14 Jan 2010 an automatic raingauge was installed at 5735 Botanisk Have. Not necessarily homogenous, because of new ways of detection from 2010. |               |  |                     |                       |

| <b>Element No. 701 (Number of Days with Snow Cover)</b>   |               |   |                     |                       |
|---|---------------|---|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>                            | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1938 – 2016   | Monthly-db KOEB 6186/30380 + 6180 + 30370 | 948                 | 0                     |
| Details: Created using monthly-db KOEB 6186/30380: 1938-1996, 6180: 1997-2009 and 30370: 2010-2016. Jun, Jul, Aug & Sep months 1970-1990 had missing data, zero's were inserted. 1970/12 was filled using a values from 6180. |               |   |                     |                       |

| <b>Element No. 801 (Cloud Cover) - Inhomogenous</b>   |               |  |                     |                       |
|---|---------------|--|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>                               | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1876 – 2016   | PF-TS153 + Monthly-db KOEB 6186/30380 + 6180 | 1692                | 0                     |
| Details: Created using monthly-db KOEB 6186/30380: 1876-1889, PF-TS153 1890-1995 and monthly-db 6180: 1996-2016. 1937/1 was filled using 6183, which was the only possibility. From January 2011 observations from a ceilometer for automatic detection of cloud cover are used at some hours at 6180 Kbh Lufthavn. Inhomogenous, because of new ways of detection from 2011. |               |  |                     |                       |

## Hammer Odde Fyr (HAMM) – 6193; 1873-2016

| <b>Element No.101 (Average Air Temperature)</b>  |               |   |                     |                       |
|--|---------------|---|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>                              | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1873 – 2016   | Monthly-db HAMM 6193/32020 + 32030 + TR99-5 | 1728                | 0                     |
| Details:<br>Created using monthly-db 1873-1953: 32030 Sandvig, 1953-1960: Average of 32030 and 32020 Hammer Odde Fyr /6193 Hammer Odde Fyr, 1961-1990: TR99-5 6193 Hammer Odde Fyr, 1991-2016: 6193 Hammer Odde Fyr. |               |   |                     |                       |

| <b>Element No.111 (Average of Daily Maximum Air Temperature)</b>   |               |   |                     |                       |
|--|---------------|---|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>                              | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1875 – 2016   | Monthly-db HAMM 6193/32020 + 32030 + TR99-5 | 1704                | 0                     |
| Details:<br>Created using monthly-db 1875-1953: 32030 Sandvig, 1953-1960: Average of 32030 and 32020/6193, 1961-1990: TR99-5 6193, 1991-2016: 6193 Hammer Odde Fyr. Missing values for 1951/9+10 were filled using 32025 Hammeren Fyr. |               |   |                     |                       |

| <b>Element No.112 (Highest Air Temperature)</b>  |               |   |                     |                       |
|--|---------------|---|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>                              | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1874 – 2016   | Monthly-db HAMM 6193/32020 + 32030 + TR99-5 | 1716                | 2                     |
| Details :<br>Created using monthly-db 1874-1953: 32030-Sandvig, 1953-1960: Average of 32030 and 32020/6193, 1961-1990: TR99-5 6193, 1991-2016: 6193 Hammer Odde Fyr. Missing 1874/3 and 1874/5. Missing values for 1951/9+10 were filled using 32025 Hammeren Fyr. |               |   |                     |                       |

| <b>Element No.121 (Average of Daily Minimum Air Temperature)</b>  |               |   |                     |                       |
|---|---------------|---|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>                              | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1873 – 2016   | Monthly-db HAMM 6193/32020 + 32030 + TR99-5 | 1728                | 0                     |
| Details:<br>Created using monthly-db 1873-1953: 32030-Sandvig, 1953-1960: Average of 32030 and 32020/6193, 1961-1990: TR99-5 6193, 1991-2016: 6193 Hammer Odde Fyr. |               |   |                     |                       |

| <b>Element No.122 (Lowest Air Temperature)</b>  |               |   |                     |                       |
|---|---------------|---|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>                              | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1873 – 2016   | Monthly-db HAMM 6193/32020 + 32030 + TR99-5 | 1728                | 0                     |
| Details:<br>Created using monthly-db 1873-1953: 32030-Sandvig, 1953-1960: Average of 32030 and 32020/6193, 1961-1990: TR99-5 6193, 1991-2016: 6193 Hammer Odde Fyr. |               |   |                     |                       |



## Hammer Odde Fyr (HAMM) – 6193 (continued)

| <b>Element No.401 (Average Atmospheric Pressure)</b>   |               |                                    |                     |                       |
|--|---------------|------------------------------------|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>                     | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1873 – 2016   | Monthly-db HAMM 6193/32020 + 32030 | 1728                | 0                     |
| Details: Created using monthly-db 1873-1970: 32030-Sandvig reduced to mean sea level (see appendix), 1971-1987/06: 32020 Hammer Odde Fyr/Lighthouse reduced to mean sea level (see appendix) and 1987/07-2016: 6193 Hammer Odde Fyr/Lighthouse. Missing value 1966/07 filled with 32020 reduced to mean sea level. |               |                                    |                     |                       |

| <b>Element No.601 (Accumulated Precipitation) - Not necessarily homogenous</b>   |               |                                    |                     |                       |
|--|---------------|------------------------------------|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>                     | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1873 – 2016   | Monthly-db HAMM 6193/32020 + 32030 | 1728                | 0                     |
| Details: Created using monthly-db 1873-1953: 32030-Sandvig, 1953-1971: Average of 32030 and 32020/6193, 1971-2016: 6193/32020-Hammer Odde Fyr. The value for 2009/3 is added 3,0 mm (missing values have been replaced by interpolated values 4-9/3). The value for 2011/9 is added 0,4 mm (missing values have been replaced by interpolated values 1/10) and 2011/10 is added 21,6 mm (missing values have been replaced by interpolated values 2-14/10). 30 August 2001 an automatic raingauge was installed at 6193 Hammer Odde Fyr. Not necessarily homogenous, because of new ways of detection from 2001. |               |                                    |                     |                       |

| <b>Element No.602 (Highest 24-hour Precipitation) - Not necessarily homogenous</b>  |               |                                    |                     |                       |
|---|---------------|------------------------------------|---------------------|-----------------------|
| <i>Dataset</i>  | <i>Period</i> | <i>Content</i>                     | <i>Total months</i> | <i>Missing months</i> |
| Recommended   | 1873 – 2016   | Monthly-db HAMM 6193/32020 + 32030 | 1728                | 0                     |
| Details: Created using monthly-db 1873-1953: 32030-Sandvig, 1953-1971: Average of 32030 and 32020/6193, 1971-2016: 6193/32020-Hammer Odde Fyr. Missing values (1948/3, 1951/7 and 1952/12) were filled using values from 32025 Hammeren Fyr. 30 August 2001 an automatic raingauge was installed at 6193 Hammer Odde Fyr. Not necessarily homogenous, because of new ways of detection from 2001. |               |                                    |                     |                       |

| <b>Element No.701 (Number of days with Snow Cover) – Not necessarily homogenous</b>  |               |   |                     |                       |
|--|---------------|---|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>  | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1939 – 2016   | Monthly-db HAMM 6193/32020+32030+6190+32080<br>+32175 | 936                 | 10                    |
| Details: Created using monthly-db Average of 32030-Sandvig 1939-1971, 6193/32020 Hammer Odde Fyr, 6190 1953-2002, Bornholms Lufthavn 32080 Klemensker 2002-2010/7 and 32175 Østerlars 2010/8-2016. Period 2001/9-2002/12 taken from 6190 because 6193 had stopped these observations. 2004/1-2005/12 taken from 32080 Klemensker because 6190 had stopped these observations. Out of the 46 missing values, the the months 6, 7, 8 and 9 in the period 1971-77 and 2003 were set to zero. After this, 11 missing months are left. One (1955/1) was filled using 32025 Hammeren Fyr. The remaining ten (1952/1, 1953/5, 2003/1-5 and 2003/9-12) cannot be filled, since there are no observations of element 701 on Bornholm for these months. Not necessarily homogenous, many different locations involved. |               |   |                     |                       |

| <b>Element No.801 (Average Cloud Cover) - Inhomogenous based on a visual test</b>  |               |  |                     |                       |
|--|---------------|--|---------------------|-----------------------|
| <i>Dataset</i>   | <i>Period</i> | <i>Content</i>                               | <i>Total months</i> | <i>Missing months</i> |
| Recommended  | 1873 – 2016   | PF-TS97 + Monthly-db HAMM 6193/32020 + 32030 | 1728                | 16                    |
| Details: Created using monthly-db 32030: 1873-1889, PF-TS97 1890-1995 and monthly-db 6193: 1996-2016. 14 months missing from PF-TS97: 1911/1, 1953/5, 1966/7, 1973/3+7, 1974/3+7+12, 1987/7-12. 1953/5 and 1966/7 were filled with 32020. 1973/3+7 and 1974/3+7 were filled using values from 6190. 1974/12 by an average of 6191 Christianø Fyr and 6199 Dueodde Fyr. 1987/7-12 were filled with 6193. The months 1911/1, 2009/1-4 and 2010/7-2011/6 cannot be filled. 30 August 2001 a ceilometer for automatic detection of cloud cover was installed at 6193 Hammer Odde Fyr. Inhomogenous based on a visual test, possible several breaks. New ways of detection from 2001. |               |  |                     |                       |

### Appendix 4.3. Regarding monthly data of atmospheric pressure

The reading of a mercury barometer is proportional to the length of a mercury column in the barometer, which is balanced against the weight of the entire atmospheric column of air above the open surface of the mercury. The mercury barometer was therefore calibrated to “standard conditions” (0°C and a certain standard gravity). At other conditions corrections must be used.

The formula used to correct old barometer readings for the stations presented in this publication is given below. The formula simply corrects for gravity (part 1) and reduces the pressure to mean sea level (part 2):

$$P * (1 - 0,00259 * \cos (2 * \varphi * \pi/180)) * (1 + 9.82/287.04 * h/(T/10+273.15))$$

P is atmospheric pressure (0.1 hPa) at station level,  $\varphi$  is the latitude in degrees, h is the height of the barometer in meters above sea level and T is the air temperature at station level (0.1 °C)

For the calculation are used monthly means of P and T. This introduces an error compared to a reduction performed on the actual observations. The error is proportional to the difference between ‘the average P to T ratio’ and ‘the ratio of average P to average T’ (T in Kelvin). This means the error is zero if T is constant within the period. Within a month the maximum T-range would normally be within 30 degrees. And a numerical variation of 30 is small when compared to the air temperature in Kelvin and the atmospheric pressure in 0.1 hPa. Therefore the error introduced by using monthly values may be considered small.

The different station specific corrections, which have been used in the construction of the pressure series in this report, can be seen in the following DMI publication:

DMI Technical Report 03-24: Metadata, selected climatological and synoptic stations, 1750-1996, Copenhagen 2003 [35].

This publication can be downloaded from the publication part of DMI’s web site:

<http://www.dmi.dk/laer-om/generelt/dmi-publikationer/>

| Station 25140 Nordby/Fanø:<br>Reduction of atmospheric pressure to mean sea level.<br>Until and including 1892 also correction for gravity. |          |   |
|---|----------|---|
| Start   | End      | Formula, P: station level pressure (0.1 hPa), T: Air temperature at station level (0.1°C) |
| -   | 18920400 | $P * (1 - 0.00259 * \cos(2 * 55.5 * 3.14/180)) * (1 + 9.82/287.04 * 5.5/(T/10+273.15))$   |
| 18920500  | 18921200 | $P * (1 - 0.00259 * \cos(2 * 55.5 * 3.14/180)) * (1 + 9.82/287.04 * 8.0/(T/10+273.15))$   |
| 18930100  | 18991100 | $P * (1 + 9.82/287.04 * 8.0/(T/10+273.15))$   |
| 18991200  | 19280700 | $P * (1 + 9.82/287.04 * 5.5/(T/10+273.15))$   |
| 19280800  | 19360300 | $P * (1 + 9.82/287.04 * 10.5/(T/10+273.15))$  |
| 19360400  | 19441100 | $P * (1 + 9.82/287.04 * 6.9/(T/10+273.15))$   |
| 19441200  | 19450500 | $P * (1 + 9.82/287.04 * 7.0/(T/10+273.15))$   |
| 19450600  | 19551100 | $P * (1 + 9.82/287.04 * 3.0/(T/10+273.15))$   |
| 19551200  | 19600800 | $P * (1 + 9.82/287.04 * 9.7/(T/10+273.15))$   |
| 19600900  | -        | $P * (1 + 9.82/287.04 * 6.7/(T/10+273.15))$   |

*Example: The formulas take care that the published atmospheric pressure is reduced to mean sea level, 0°C and gravity at 45° Latitude. The air temperature used is the monthly average air temperature in the NORD6088 ‘recommended’ series. See also Appendix 3.3.*

## Appendix 5. Country-wise section - File formats and metadata

### Appendix 5.1. File formats; Country-wise monthly/annual climate data

1) Monthly and annual country-wise Danish climate data 1874-2016 arranged in a table are included in this section as an Excel file. The table contain values of air temperature, precipitation and hours of bright sunshine, weather describing text and weather records from Denmark as a whole since 1874. The figures can be compared with the Standard Normal values from the period 1961-90 (latest WMO recommended), the average 2001-2010 and the average 2006-2015 by moving the cursor to the figure. Every month and year in the period 1891-2016 are characterised by a short text as well as the weather during Eastern, Christmas and Midsummer Day. The different record breaking months and years are also marked.

The file name is determined as follows: **dk\_country\_table\_<period>.xlsx**  
In this report one (1) Excel-file: **dk\_country\_table\_1874\_2016.xlsx**

#### Format of the country-wise monthly/annual table file:

For every month and year the file contains one line in the following format:

1. Year
2. Month
3. Eventually a mark indicating a weather record "R", or an equal weather record "Rt".
4. General description of the weather in text (Danish only) 1891-2016
5. Average air temperature 1874-2016
6. Highest air temperature 1874-2016
7. Lowest air temperature 1874-2016
8. Average of daily maximum air temperature 1953-2016
9. Average of daily minimum air temperature 1953-2016
10. Accumulated precipitation 1874-2016
11. Highest 24-hour precipitation at a single station 1874-2016
12. Accumulated hours of bright sunshine 1920-2016
13. The weather during Eastern, Christmas and Midsummer Day are stated in "Særlige begivenheder"(special events) with matching dates (Danish only) 1891-2016

The element/parameter numbers and units can be seen in the data dictionary, table 7.2.1.2, in section 7.2.

2) The country-wise Danish climate extremes are separately included (table) as an Excel file.

The file name is determined as follows: **dk\_country\_extremes\_<period>.xlsx**  
In this report one (1) Excel-file: **dk\_country\_extremes\_1874\_2016.xlsx**

#### Format of the country-wise monthly/annual extreme table file:

For the twelve months and the year the file contains an extreme for the following parameters in the the specified order:

1. Month and Year
2. Highest air temperature 1874-2016
3. Lowest air temperature 1874-2016
4. Highest average air temperature 1874-2016
5. Lowest average air temperature 1874-2016
6. Highest accumulated hours of bright sunshine 1920-2016
7. Lowest accumulated hours of bright sunshine 1920-2016

8. Highest accumulated precipitation 1874-2016
9. Lowest accumulated precipitation 1874-2016
10. Highest 24-hour precipitation at a single station 1874-2016

The element/parameter numbers and units can be seen in the data dictionary, table 7.2.1.4, in section 7.2.

3) Monthly/annual country-wise data series of annual average air temperature, accumulated precipitation and hours of bright sunshine within the period 1873-2016 for Denmark as a whole are also included as an Excel file.

The file name is determined as follows: **dk\_country\_dataserie\_tps\_<period>.xlsx**

In this report one (1) Excel-file: **dk\_country\_dataserie\_tps\_1873\_2016.xlsx**

Four (4) different sheets contain the four (4) elements/parameters: monthly/annual published/corrected average air temperature, accumulated precipitation and hours of bright sunshine. Any missing values are filled with "null".

#### **Format of the country-wise monthly/annual data series:**

For the twelve months and the year the file contains values in separate sheets for the following parameters in the specified order:

1. Average air temperature (published) 1873-2016
2. Average air temperature (corrected) 1873-2016
3. Hours of bright sunshine 1920-2016
4. Accumulated precipitation 1874-2016

The format is:

Station number; "DK" for Denmark/country-wise (stat\_no); element number (elem\_no); year (year); January value (jan); February value (feb); March value (mar); April value (apr); May value (may); June value (jun); July value (jul); August value (aug); September value (sep); October value (oct); November value (nov); December value (dec); Annual value (annual)

The element/parameter numbers and units can be seen in the data dictionary, table 7.2.1.7, in section 7.2.

Data are only to be used with proper reference to the accompanying report: Cappelen, J. (ed), 2017: Denmark - DMI Historical Climate Data Collection 1768-2016. DMI Report No. 17-02. Copenhagen.

## Appendix 6. Graphics section - File formats and metadata

### Appendix 5.1. File formats - Annual graphics

The graphics included in this report contain annual average air temperatures (5 station/2 country-wise data sets), annual accumulated precipitation (5 station/1 country-wise data sets), annual accumulated hours of bright sunshine (1 station/1 country-wise data set) and number of hurricanes/strong storms (1 country-wise data set) within the period 1768 - 2016.

The file names are determined as follows:

**dk\_graph\_annual\_pubtemperature\_country\_<period>.png**  
**dk\_graph\_annual\_corrtemperature\_country\_<period>.png**  
**dk\_graph\_annual\_precipitation\_country\_<period>.png**  
**dk\_graph\_annual\_sunshine\_country\_<period>.png**  
**dk\_graph\_annual\_temperature\_<station number>\_<period>.png**  
**dk\_graph\_annual\_precipitation\_<station number>\_<period>.png**  
**dk\_graph\_sunshine\_<station number>\_<period>.png**  
**dk\_graph\_storm\_<period>.png**

In this report sixteen (16) png-files:

**dk\_graph\_annual\_pubtemperature\_country\_1873\_2016.png**

Annual average air temperatures 1873-2016 (published); anomaly relative to 1981-2010. Country-wise, Denmark. (English version)

**dk\_graph\_annual\_corrtemperature\_country\_1873\_2016.png**

Annual average air temperatures 1873-2016 (corrected); anomaly relative to 1981-2010. Country-wise, Denmark. (English version)

**dk\_graph\_annual\_precipitation\_country\_1874\_2016.png**

Annual accumulated precipitation 1874-2016; anomaly relative to 1981-2010. Country-wise, Denmark. (English version)

**dk\_graph\_annual\_sunshine\_country\_1920\_2016.png**

Annual accumulated hours of bright sunshine 1920-2016; anomaly relative to 1981-2010. Country-wise, Denmark. (English version)

**dk\_graph\_annual\_temperature\_6051\_1874\_2016.png**

Annual average air temperatures 1873-2016; anomaly relative to 1981-2010. Vestervig, Denmark. (English version)

**dk\_graph\_annual\_precipitation\_6051\_1874\_2016.png**

Annual accumulated precipitation 1874-2016; anomaly relative to 1981-2010. Vestervig, Denmark. (English version)

**dk\_graph\_annual\_temperature\_6088\_1872\_2016.png**

Annual average air temperatures 1872-2016; anomaly relative to 1981-2010. Nordby (Fanø), Denmark. (English version)

**dk\_graph\_annual\_precipitation\_6088\_1872\_2016.png**

Annual accumulated precipitation 1872-2016; anomaly relative to 1981-2010. Nordby (Fanø), Denmark. (English version)

**dk\_graph\_annual\_temperature\_6132\_1873\_2016.png**

Annual average air temperatures 1873-2016; anomaly relative to 1981-2010. Tranebjerg (Samsø), Denmark. (English version)

**dk\_graph\_annual\_precipitation\_6132\_1873\_2016.png**

Annual accumulated precipitation 1873-2016; anomaly relative to 1981-2010. Tranebjerg (Samsø), Denmark. (English version)

**dk\_graph\_annual\_temperature\_6186\_1768\_2016.png**

Annual average air temperatures 1768-2016; anomaly relative to 1981-2010. København, Denmark. (English version)

**dk\_graph\_annual\_precipitation\_6186\_1821\_2016.png**

Annual accumulated precipitation 1821-2016; anomaly relative to 1981-2010. København, Denmark. (English version)

**dk\_graph\_annual\_sunshine\_6186\_1876\_2016.png**

Annual accumulated hours of bright sunshine 1876-2016; anomaly relative to 1981-2010. København, Denmark. (English version)

**dk\_graph\_annual\_temperature\_6193\_1873\_2016.png**

Annual average air temperatures 1873-2016; anomaly relative to 1981-2010. Hammer Odde Fyr (Bornholm), Denmark. (English version)

**dk\_graph\_annual\_precipitation\_6193\_1873\_2016.png**

Annual accumulated precipitation 1873-2016; anomaly relative to 1981-2010. Hammer Odde Fyr (Bornholm), Denmark. (English version)

**dk\_graph\_storm\_1891\_2016.png**

Hurricanes and strong storms 1891-2016, Denmark; 5-year groups. Denmark. (English version)

Data are only to be used with proper reference to the accompanying report: Cappelen, J. (ed), 2017: Denmark - DMI Historical Climate Data Collection 1768-2016. DMI Report No. 17-02. Copenhagen.

## Appendix 7. Storm section - File formats and metadata

### Appendix 7.1. File formats; List of storms

A list of storms included in this report contains all classified storms in Denmark 1891-2016.

The file name is determined as follows:

**dk\_storm\_<period>.pdf**

In this report one (1) pdf-file:

**dk\_storm\_1891\_2016.pdf**

For every classified storm the format is as follows:

1. Period - Days.
2. Period - Year.
3. Remarks.
4. Classification - Date.
5. Classification - Index.

Data are only to be used with proper reference to the accompanying report: Cappelen, J. (ed), 2017: Denmark - DMI Historical Climate Data Collection 1768-2016. DMI Report No. 17-02. Copenhagen.