

## Technical Report 05-06

# DMI Annual Climate Data Collection 1873-2004, Denmark, The Faroe Islands and Greenland

- with Graphics and Danish Abstracts

John Cappelen





## Colophon

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Tórshavn at The Faroe Islands 9 May 2004 - clear sky and sunshine. Photo: Cappelen.



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## **Abstract**

Different annual climate data (plus graphics ) from Denmark, The Faroe Islands and Grenland respectively in the period 1873-2004 are published in this report.

## **Resumé**

Forskellige årlige klimaværdier med tilhørende grafik fra henholdsvis Danmark, Færøerne og Grønland i perioden 1873-2004 er publiceret i denne rapport.

## Introduction

The purpose of this report is to publish different annual climate data together with relevant graphics.

That is:

- Annual mean temperatures for selected meteorological stations in Denmark, the Faroe Islands and Greenland; 1873-2004
- Annual mean temperature, precipitation, hours of bright sunshine and cloud cover for Denmark as a whole; 1873-2004.

Annual values of these parameters regularly forms part (graphical) of the yearly publication “Danmarks Klima”, as well as other publications.

This report (pdf-format) and the matching data set can be downloaded from the publication part of DMI web pages.

### *Dansk Resumé*

*Formålet med denne rapport er at publicere forskellige årlige klimaværdier for perioden 1873-2004 samt tilhørende grafik. Det drejer sig om henholdsvis 1) Årsmiddeltemperaturer for udvalgte meteorologiske stationer i Danmark, på Færøerne og i Grønland for perioden og 2) Landstal for temperatur, nedbør, solskinstimer og skydække for Danmark.*

*Årsværdier af disse landstal indgår regelmæssigt (grafisk) i årbøgerne ”Danmarks Klima” samt i forskellige andre publikations-sammenhænge.*

*Denne rapport (pdf-format) og tilhørende data kan hentes på DMI’s Internetsider under ”DMI - publikationer”.*

# Annual mean temperature 1873-2004 for selected meteorological stations in Denmark, the Faroe Islands and Greenland

A number of meteorological stations have been operated in Denmark, the Faroe Islands and Greenland since the 19th century.

Some of them have digitised records back to 1873 (the Danish Meteorological Institute (DMI) was established 1872), others from a later date.

In table 1 stations used in this report are listed together with a start year.

Station number	Name	First year
04202	Pituffik	1948
04211	Upernavik	1873
04221	Ilulissat	1873
04250	Nuuk	1873
04270	Narsarsuaq	1873
04320	Danmarkshavn	1949
04360	Tasiilaq	1895
06011	Tórshavn	1873
06186	København	1873

**Table 1. The meteorological stations and the start year.**

Nearly all stations have been relocated several times since the start, new station names have been attached, new instruments and new observers have been introduced. The latter have obviously been replaced many times.

It is also 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.) and publication of the DMI Monthly Data Collection (newest one to be published in 2005 is DMI Technical Report 05-05: DMI Monthly Climate Data Collection 1860-2004, Denmark, Faroe Island and Greenland. An update of: NACD, REWARD, NORDKLIM and NARP datasets).

The station numbers and names in the table on the next page refer to the present situation.

At the end of this chapter the different temperature time series are shown as graphs. The first graph shows annual mean temperatures 1873-2004 for selected stations in Denmark, the Faroe Islands and West Greenland. The second graph shows annual mean temperatures 1873-2004 for selected stations in Denmark, the Faroe Islands and East Greenland.

A Gauss filter with filter width (standard deviation) 9 years have been used to create the “bold” smooth curves. A Gauss filter with standard deviation 9 years are comparable to a 30-years running mean. However, the filter gives a more smooth curve than a running mean, as temperatures from central years are given larger weight than temperatures from periferal years. Filter values are also

calculated for the years at either end of the series. It should be noted that these values are computed from one-sided Gauss filters, and that values from later years will change, when the series is updated.

*Dansk resumé:*

*Forskellige meteorologiske stationer i Danmark, på Færøerne og i Grønland har opereret siden forrige århundrede. Nogle af dem har digitaliserede data tilbage til 1873 (Danmarks Meteorologiske Institut (DMI) blev oprettet 1872) og andre fra en senere dato. Mange af stationerne har været flyttet adskillige gange siden de blev etablerede og de har fået nye navne, instrumenter samt observatorer. De sidste er selvsagt blevet udskiftet mange gange under forløbet.*

*Det har selvfølgelig påvirket kvaliteten og homogeniteten af dataserierne, men disse er rettet op så godt som muligt bl.a. i forbindelse med udviklingen af det nordatlantiske datasæt: North Atlantic Climatological Dataset (NACD Version 1) - Final report. DMI Scientific Report 96-1 samt udgivelse af DMI Monthly Data Collection (nyeste version der planlægges publiceret i 2005 er DMI Technical Report 05-05).*

*I slutningen af dette kapitel er de forskellige tidsserier af temperatur vist grafisk. Den første graf viser årsmiddeltemperatur 1873-2004 for udvalgte stationer i Danmark, på Færøerne og Vestgrønland. Den anden graf viser årsmiddeltemperatur 1873-2004 for udvalgte stationer i Danmark, på Færøerne og Østgrønland.*

*Et gaussfilter med filterbredden (standardafvigelse) 9 år er anvendt til de "fede" udjævnede kurver. Et gaussfilter med standardafvigelse på 9 år, der nogenlunde kan sammenlignes med 30 års glidende gennemsnit, er god til at vise den tidslige udvikling. Gaussfilteret udjævner mere end et glidende gennemsnit, da værdier i midten af filteret får større vægt end i udkanten af filteret. Værdierne i tidsseriens ender bliver også filteret, dog med et ensidigt filter. Ved fremtidig opdatering vil filterværdierne i slutningen af tidsserien derved ændres.*

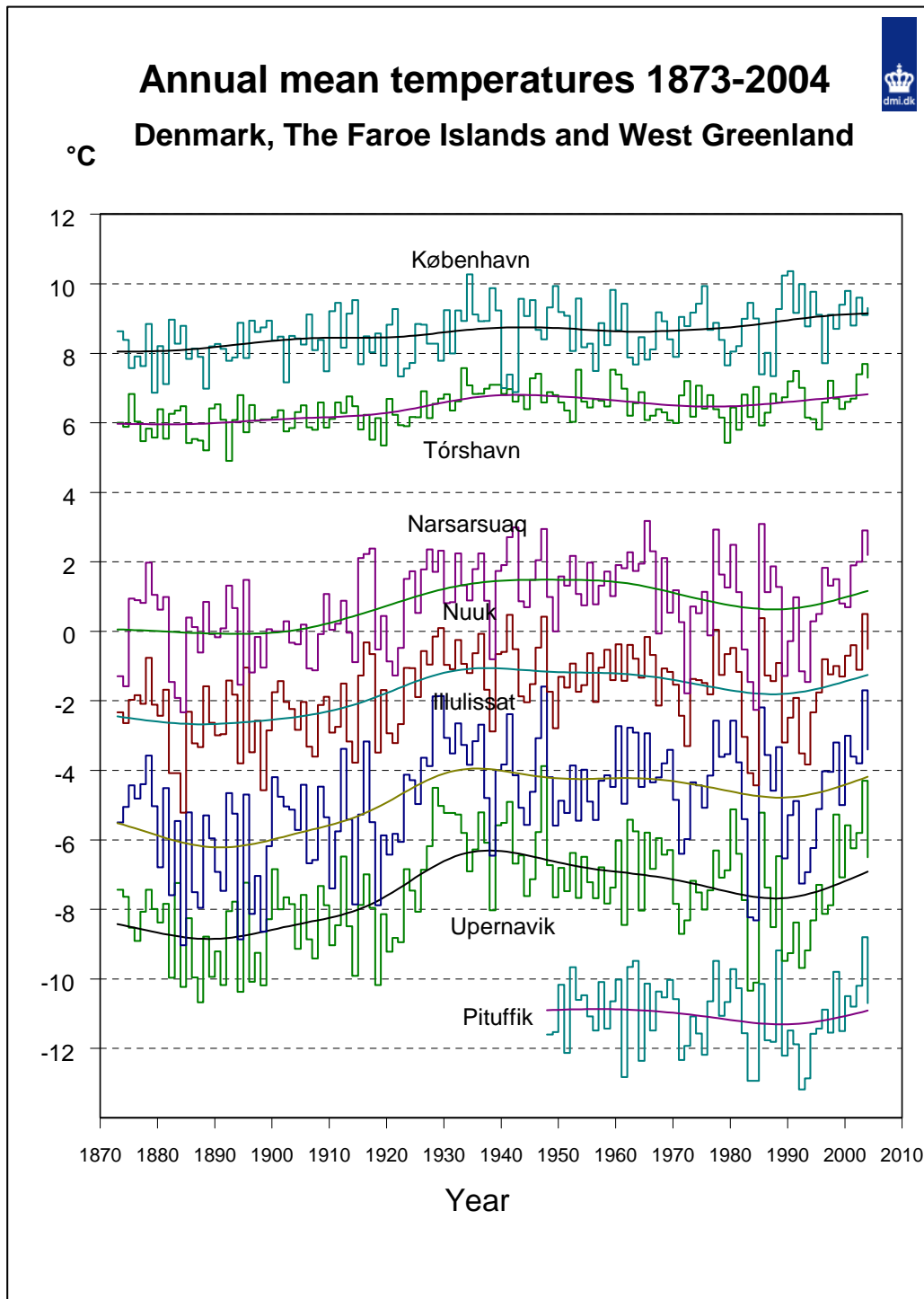


Figure 1. Annual mean temperatures 1873-2004, Denmark, The Faroes and West Greenland.



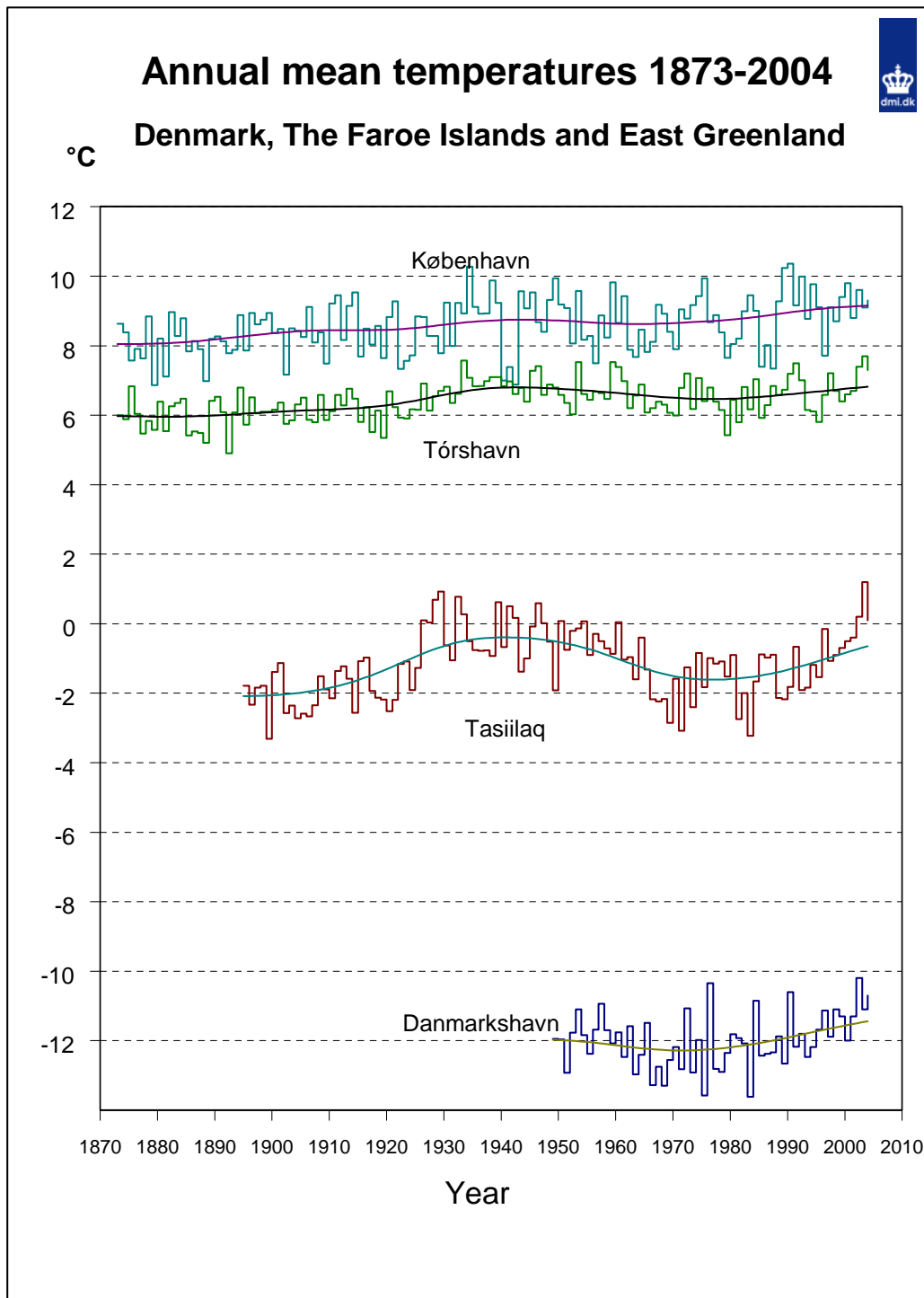


Figure 2. Annual mean temperatures 1873-2004, Denmark, The Faroes and East Greenland.

# Annual mean temperature, precipitation, hours of bright sunshine and cloud cover 1873 - 2004 for Denmark as a whole

Meteorological parameters for Denmark as a whole have been published on a monthly basis since the start of the Danish Meteorological Institute in 1872. Every year since 1873 meteorological means for Denmark as a whole have been calculated using a selection of stations.

In this report annual values for Denmark as a whole for the period 1873 – 2004 and for the parameters mentioned in table 2 are included:

Parameter	First year
Temperature	1873
Precipitation	1874
Hours of bright sunshine	1920
Cloud cover	1874

**Table 2. Parameters and year of first appearance.**

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 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.

The last 10-15 years the methods and data are well known and described in details.

In the report “Danmarks Klima 1991”, published by DMI in 1992, an examination of temperature for Denmark as a whole is described on page 40 in the chapter “Danmarks middeltemperatur 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 mean 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 a area weighting using about 20 stations in Jutland and 10 stations on the Islands once more have been used.

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) was given, which can be added to mean temperatures for Denmark in the period 1873-1956 (see the table below).

The correction factors have been added to the temperature series in some cases, but not all. Consequently the Danish 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 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.

In this report both the corrected and the uncorrected temperature series have been included. In the future it is strongly recommended that it is clearly marked, which data set has been used.

Besides the temperature series also the sunshine series 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 are also described in details in DMI Technical Report 03-19, 2003.

At the end of this chapter the different time series are shown as graphs.

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

**Table 3. Correction factors (in degrees Celsius), which can be added to the mean temperatures for Denmark in the period 1873-1956.**

*Dansk Resumé:*

*Landstal for Danmark er månedsvis blevet publiceret siden Danmarks Meteorologiske Institut's oprettelse i 1872. Således er der hvert år siden 1873 beregnet landsgennemsnit på basis af et antal udvalgte stationer. I denne rapport er medtaget årsværdier af landstal for temperatur, nedbør, solskinstimer og skydække.*

*Landstallene er igennem tiderne beregnet på det til enhver tid eksisterende stations- og datagrundlag og der er benyttet forskellige vægtninger af data.*

*Stationsgrundlaget og de forskellige beregningsmetoder er ikke publiceret eller rapporteret særligt godt og det er derfor ikke muligt at afdække, hvordan landstallene nøjagtigt er fremkommet. Siden engang i 1950'erne vides det dog, at man har benyttet data og metoder, således at arealvægtningen nogenlunde har lignet den nuværende - data fra Jylland vægtes med 7/10 og data fra*

*Øerne med 3/10. De sidste 10-15 år er datagrundlaget for landstallene endvidere kendt og velbeskrevet.*

*I "Danmarks Klima 1991", udgivet af DMI i 1992, er på side 40 beskrevet en undersøgelse af landstal for temperatur i kapitlet "Danmarks middeltemperatur i perspektiv". Det blev i denne artikel påpeget, at for at sammenligne landstal af temperaturer tilbage i tiden, er det nødvendigt at korrigere den beregnede landsmiddeltemperatur i de år, hvor stationsgrundlaget ikke svarer til det udvalg af stationer, der anvendes i dag.*

*For årene 1873-1956 er landsmiddeltemperaturen beregnet ud fra 25 velfordelte stationer, hvoraf ca. halvdelen lå i Jylland og resten lå på Øerne, dvs. tallene blev så at sige vægtet med 5/10 for Jylland og 5/10 for Øerne. I 1957 ændredes stationsudvalget således, at der indgik 20 stationer i Jylland og 10 stationer på Øerne. Dette stationsgrundlag anvendtes frem til og med 1975.*

*I årene 1976-1986 blev landsmiddeltemperaturen beregnet på grundlag af ca. 100 stationer, hvor Jyllands middeltemperatur blev vægtet 7/10 i forhold til Øernes middeltemperatur, der blev vægtet 3/10. Denne vægtning afspejlede, at Jyllands areal udgør ca. 7/10 af Danmarks samlede landareal. Siden 1987 er der igen anvendt ca. 20 stationer i Jylland og 10 stationer på Øerne.*

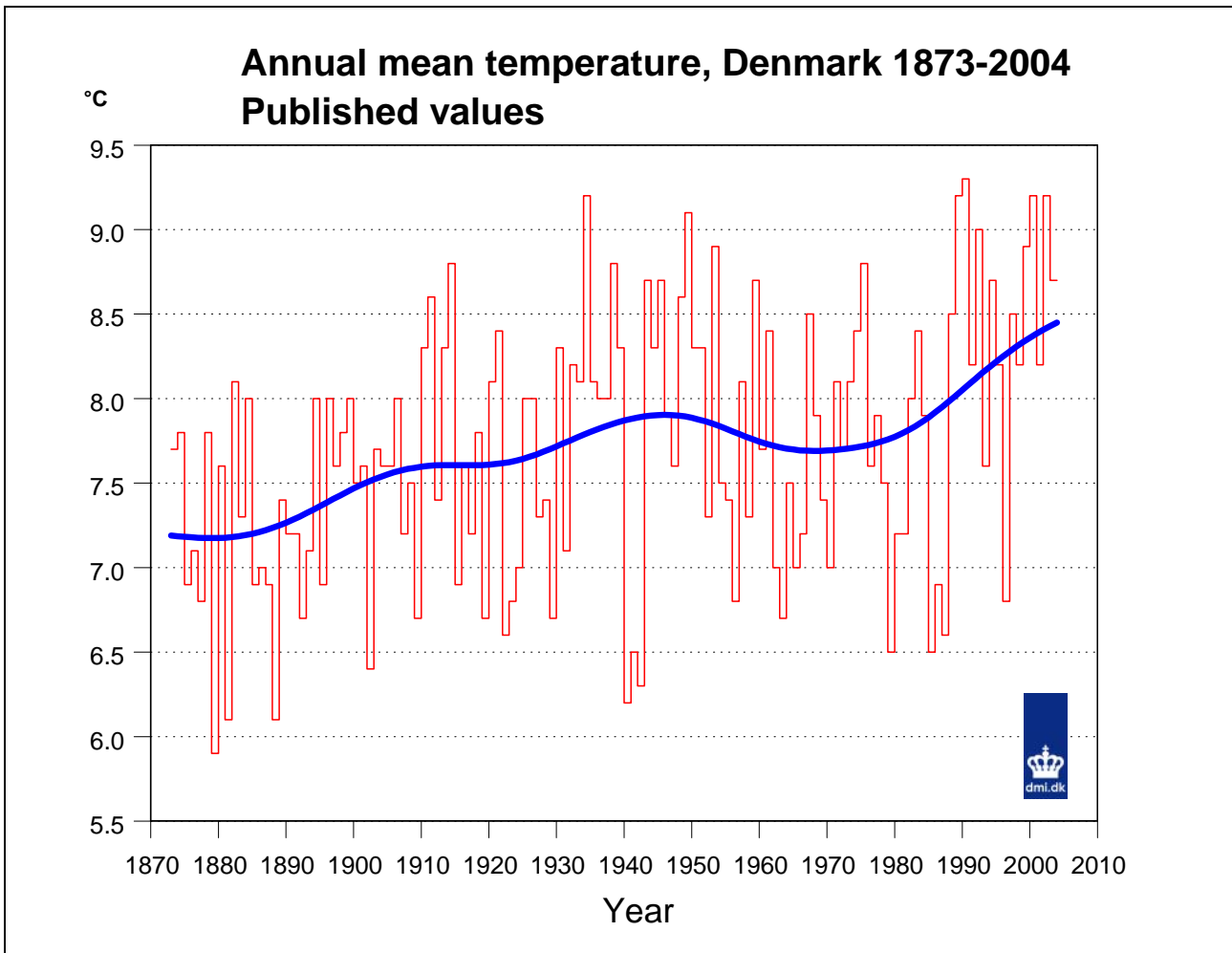
*Til trods for at stationsudvalget ikke har kunnet holdes konstant, konkluderede den ovenfor beskrevne undersøgelse, at kun ændringen i 1957 krævede korrektion.*

*En sammenligning af stationsudvalget før og efter 1956/57 gav korrektionsfaktorer (°C), der kan påføres landstal af temperatur i perioden 1873-1956. Disse korrektioner er siden blevet påført landstals-serien af temperatur i nogle sammenhænge, men ikke alle. Det har bevirket, at landstal af temperatur i en årrække har eksisteret i 2 versioner - en med korrektioner og en uden korrektioner.*

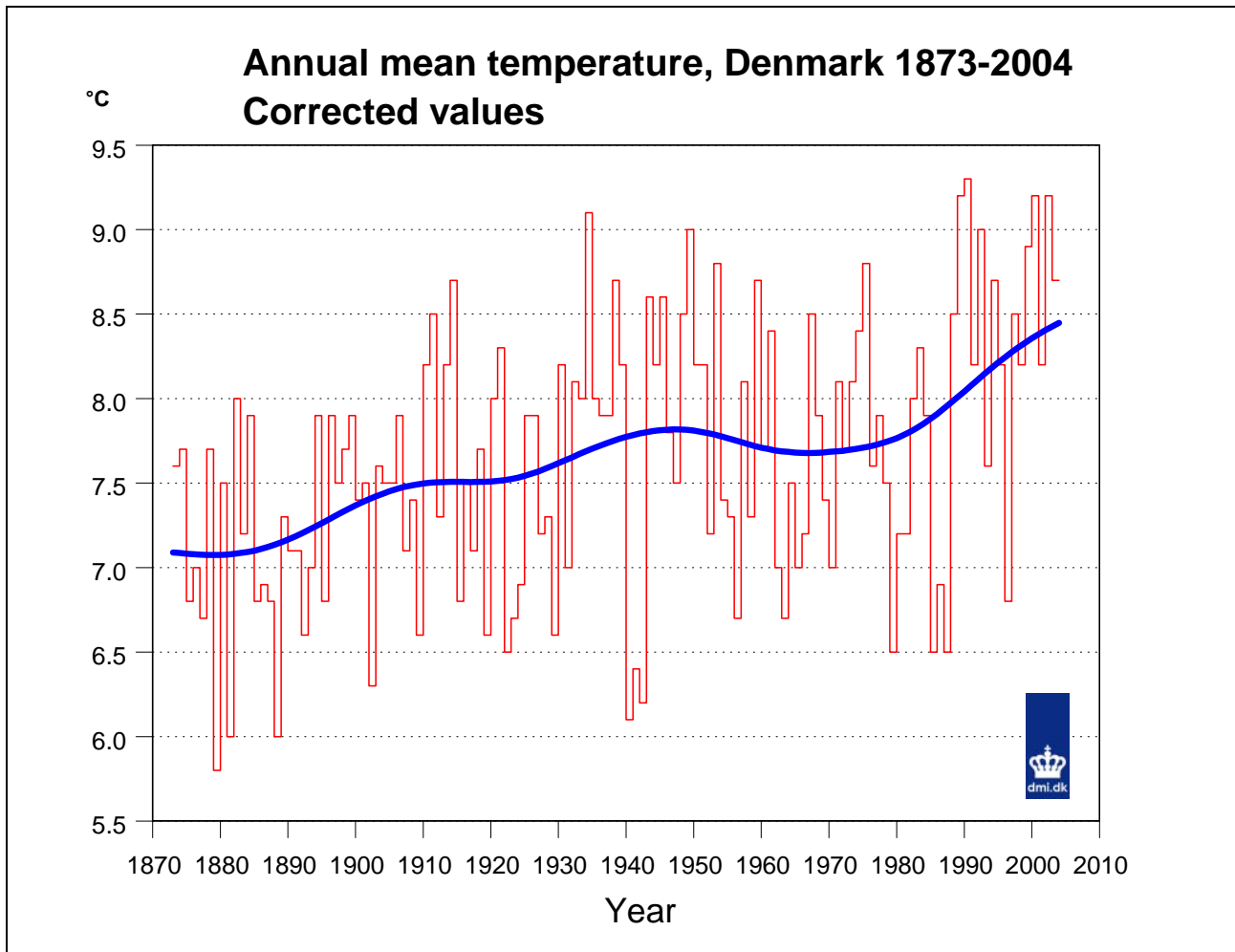
*Generelt er korrigerede data blevet anvendt ved alle præsentationer af udviklingen i landsmiddeltemperatur fra 1873, mens de ukorrigerede data er blevet anvendt, hvor det har været vigtigt, at temperaturerne kunne sammenholdes med allerede publicerede data gennem tiderne.*

*I denne rapport er begge landstal-serier af temperatur medtaget. Det må anbefales, at der i fremtiden klart markeres, hvilke sæt af landsmiddeltemperaturer, der i en given situation bruges.*

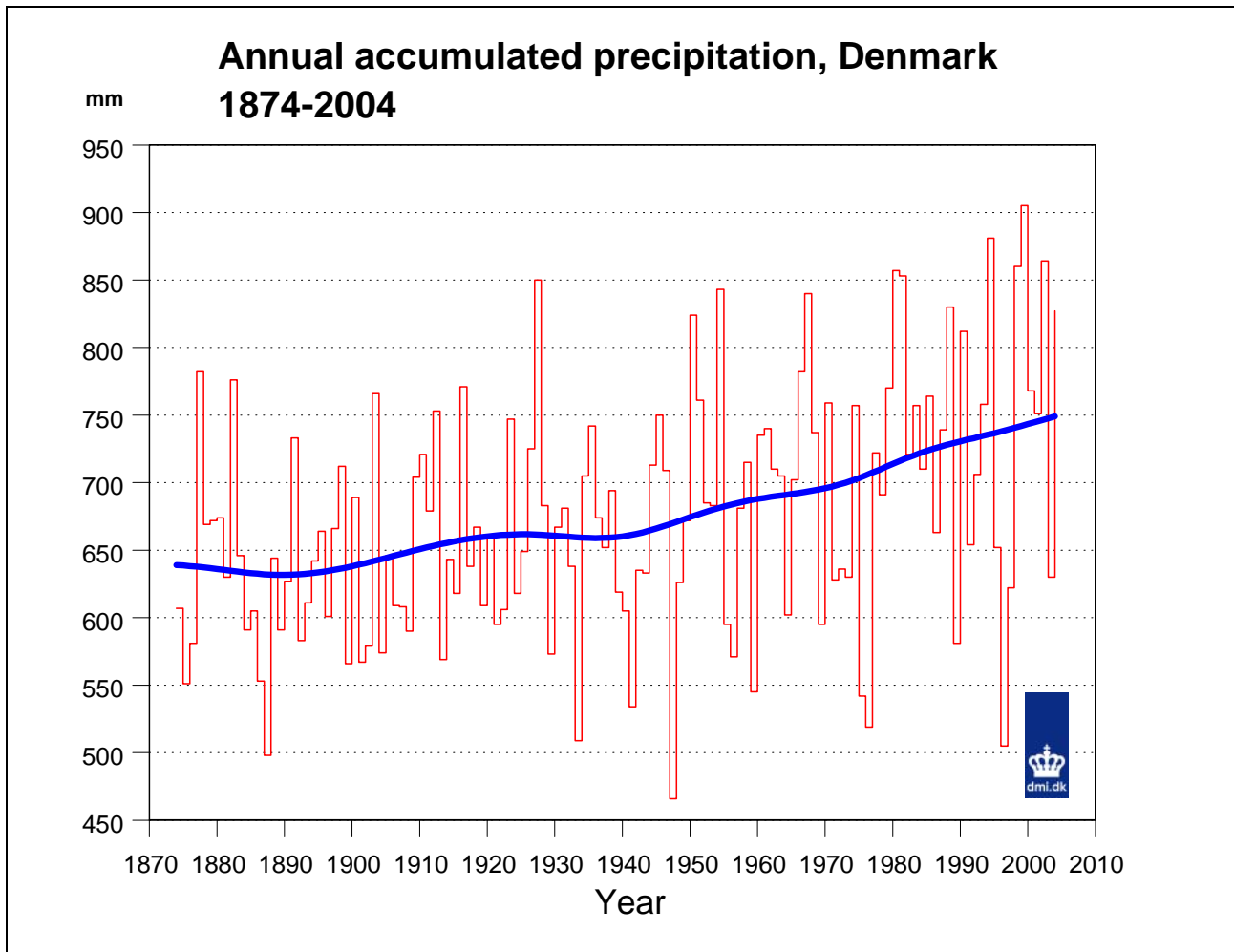
*Udover landstal af temperaturer er også landstal af solskinstimer korrigeret i forhold til tidligere publiceret materiale. Igennem tiderne er instrumenterne til registrering af solskinstimer ændret. I 2002 gik DMI over til en ny, automatisk og mere præcis målemetode. Dette betød et meget stort brud i forhold til de gamle målinger og i forbindelse med overgangen benyttede man lejligheden til at korrigere alle gamle landstalsmånedsværdier af solskinstimer således at de nu er sammenlignelige på det nye niveau. Det er dette nye talsæt for solskinstimer, fra 1920 og op til i dag, der er med i denne rapport. Korrigering af soltimer er tillige beskrevet i detaljer i DMI Teknisk Rapport 03-19, 2003.*



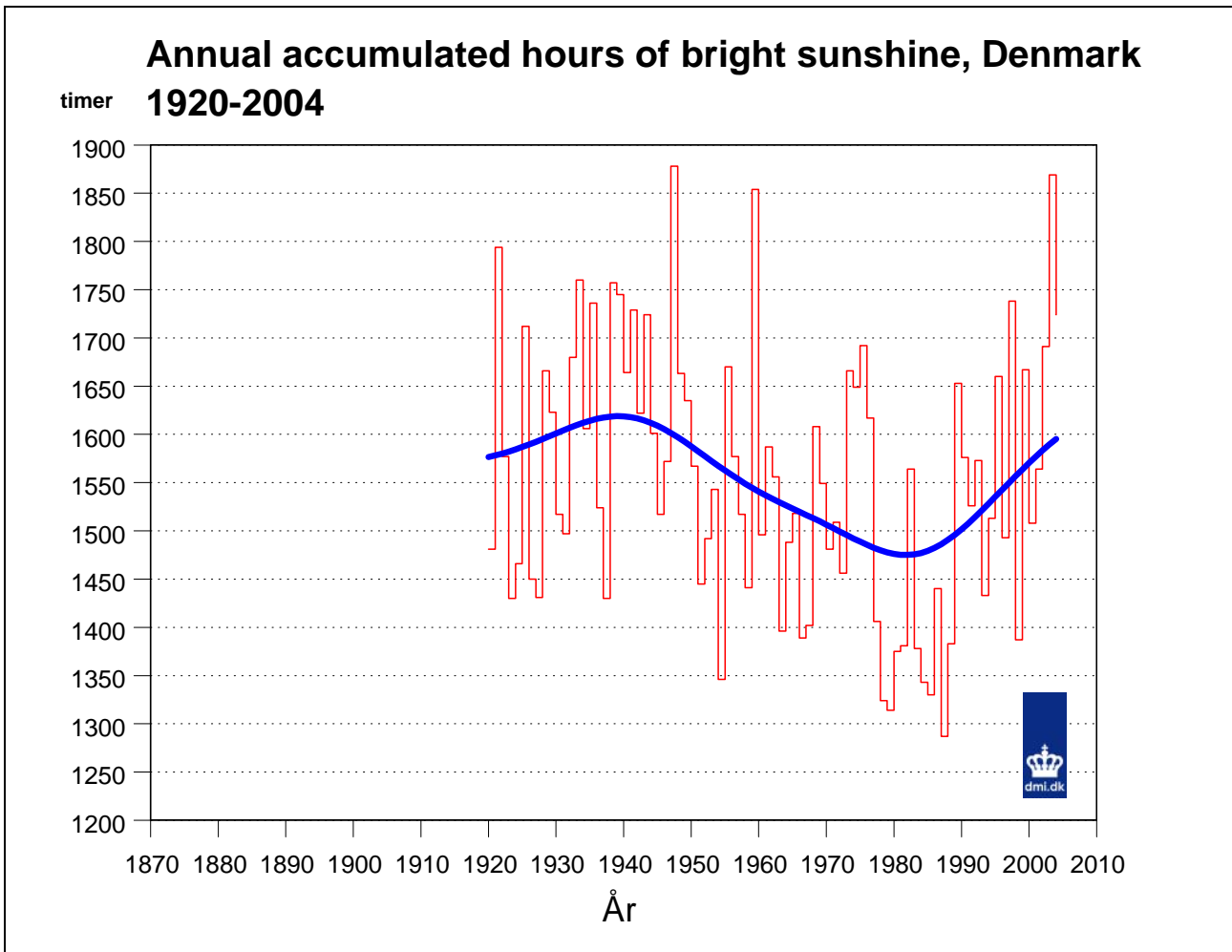
**Figure 3. Annual mean temperature, Denmark 1873-2004, published values. A Gauss filter with filter width (standard deviation) 9 years have been used to create the “bold” smooth curve. A Gauss filter with standard deviation 9 years are comparable to a 30-years running mean. However, the filter gives a more smooth curve than a running mean, as temperature values from central years are given larger weight than temperature values from periferal years. Filter values are also calculated for the years at either end of the series. It should be noted that these values are computed from one-sided Gauss filters, and that values from later years will change when the series is updated.**



**Figure 4. Annual mean temperature, Denmark 1873-2004, corrected values. A Gauss filter with filter width (standard deviation) 9 years have been used to create the “bold” smooth curve. A Gauss filter with standard deviation 9 years are comparable to a 30-years running mean. However, the filter gives a more smooth curve than a running mean, as temperature values from central years are given larger weight than temperature values from periferal years. Filter values are also calculated for the years at either end of the series. It should be noted that these values are computed from one-sided Gauss filters, and that values from later years will change when the series is updated.**

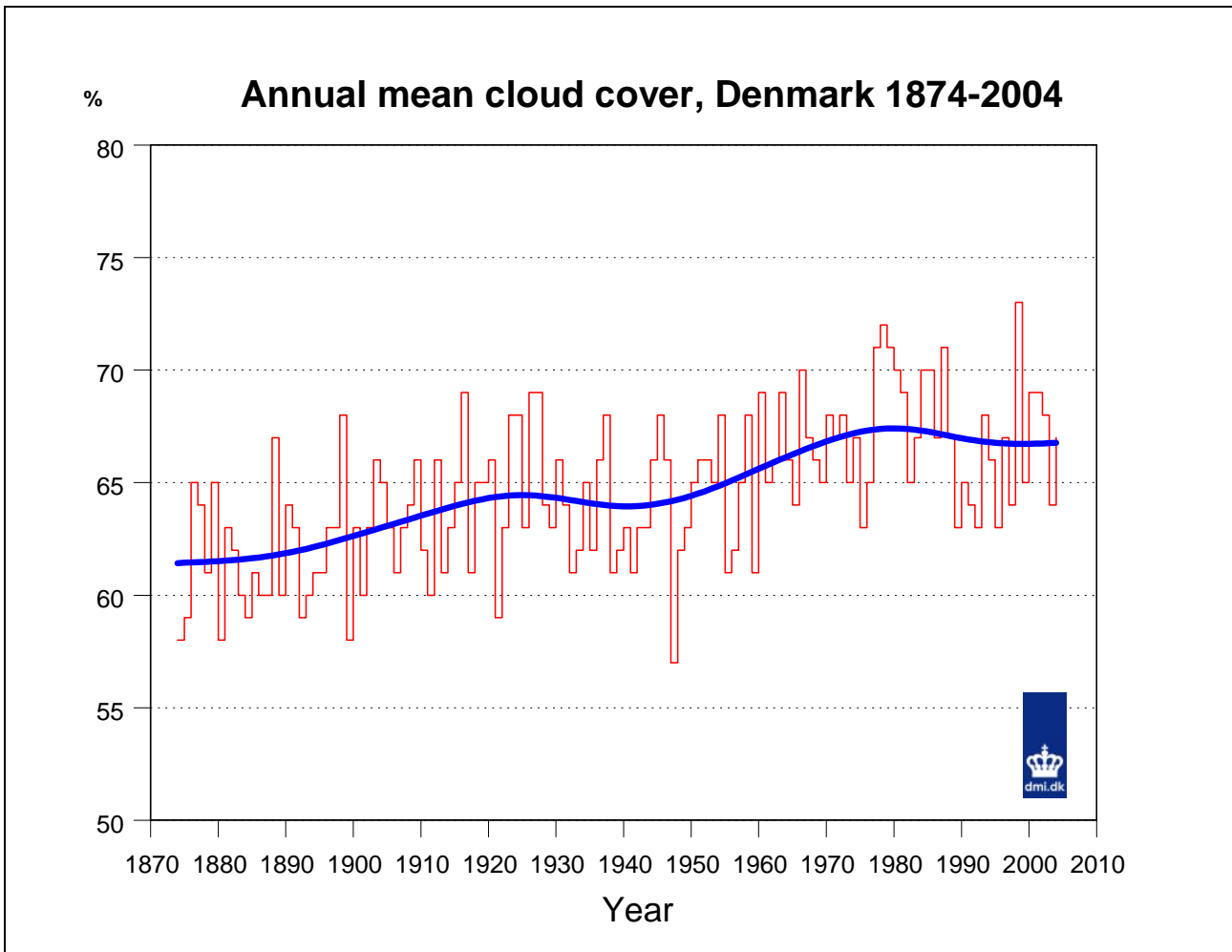


**Figure 5. Annual accumulated precipitation, Denmark 1873-2004. A Gauss filter with filter width (standard deviation) 9 years have been used to create the “bold” smooth curve. A Gauss filter with standard deviation 9 years are comparable to a 30-years running mean. However, the filter gives a more smooth curve than a running mean, as precipitation values from central years are given larger weight than precipitation values from periferal years. Filter values are also calculated for the years at either end of the series. It should be noted that these values are computed from one-sided Gauss filters, and that values from later years will change when the series is updated.**



**Figure 6. Annual accumulated hours of bright sunshine, Denmark 1920-2004. A Gauss filter with filter width (standard deviation) 9 years have been used to create the “bold” smooth curve. A Gauss filter with standard deviation 9 years are comparable to a 30-years running mean. However, the filter gives a more smooth curve than a running mean, as sunshine values from central years are given larger weight than sunshine values from periferal years. Filter values are also calculated for the years at either end of the series. It should be noted that these values are computed from one-sided Gauss filters, and that values from later years will change when the series is updated.**





**Figure 7. Annual mean cloud cover, Denmark 1874-2004. A Gauss filter with filter width (standard deviation) 9 years have been used to create the “bold” smooth curve. A Gauss filter with standard deviation 9 years are comparable to a 30-years running mean. However, the filter gives a more smooth curve than a running mean, as cloud cover values from central years are given larger weight than cloud cover values from periferal years. Filter values are also calculated for the years at either end of the series. It should be noted that these values are computed from one-sided Gauss filters, and that values from later years will change when the series is updated.**

## File formats - Annual mean temperature 1873-2004 for selected meteorological stations in Denmark, the Faroe Islands and Greenland

Data are included in this report also as a EXCEL worksheet and a ASCII file.

Besides years the files contains the annual mean temperatures in degrees Celsius to one decimal place (the variable is specified with a "T" followed by a station number) and a Gaussian filtered value to 2 decimal places (the variable is specified with a "F" followed by a station number).

Description of the data format:

Variable	Type	Start	End	Format
YEAR	YEAR	1	4	F4.0
T04202	TEMP	5	12	F8.1
F04202	FILTER	13	20	F8.2
T04211	TEMP	21	28	F8.1
F04211	FILTER	29	36	F8.2
T04221	TEMP	37	44	F8.1
F04221	FILTER	45	52	F8.2
T04250	TEMP	53	60	F8.1
F04250	FILTER	61	68	F8.2
T04270	TEMP	69	76	F8.1
F04270	FILTER	77	84	F8.2
T04320	TEMP	85	92	F8.1
F04320	FILTER	93	100	F8.2
T04360	TEMP	101	108	F8.1
F04360	FILTER	109	116	F8.2
T06011	TEMP	117	124	F8.1
F06011	FILTER	125	132	F8.2
T06186	TEMP	133	140	F8.1
F06186	FILTER	141	148	F8.2

*Dansk resumé:*

*Datamaterialet medfølger denne rapport i et EXCEL regneark og i en ASCII fil. Udover årstal er angivet årsmiddeltemperaturen i grader celsius med 1 decimal (variablen er angivet med et "T" efterfulgt af stationsnummer) og en Gauss-filtreret værdi med 2 decimaler (variablen er angivet med et "F" efterfulgt af stationsnummer).*

# File formats - Annual mean temperature, precipitation, hours of bright sunshine and cloud cover 1873 - 2004 for Denmark as a whole

Data are included in this report also as a EXCEL worksheet and a ASCII file.

Besides years the files contains:

1. *uncorrected "Published" annual mean temperature for Denmark as a whole* in degrees Celsius to one decimal place (the variable is specified with a "T" followed by a "DK") and a Gaussian filtered value to 2 decimal places (the variable is specified with a "F").
2. *corrected annual mean temperature for Denmark as a whole* in degrees Celsius to one decimal place (the variable is specified with a "T" followed by a "DK" and a "K") and a Gaussian filtered value to 2 decimal places (the variable is specified with a "F").
3. *Annual accumulated precipitation for Denmark as a whole* in millimetres (the variable is specified with a "P" followed by a "DK") and a Gaussian filtered value to 2 decimal places (the variable is specified with a "F").
4. *Annual accumulated hours of bright sunshine for Denmark as a whole* in hours (the variable is specified with a "S" followed by a "DK") and a Gaussian filtered value to 2 decimal places (the variable is specified with a "F").
5. *Annual mean cloud cover for Denmark as a whole* in % (the variable is specified with a "C" followed by a "DK") and a Gaussian filtered value to 2 decimal places (the variable is specified with a "F").

Description of the data format:

Variable	Type	Start	End	Format
YEAR	YEAR	1	4	F4.0
T_DK	TEMP	5	12	F8.1
FT_DK	FILTER	13	20	F8.2
T_DK_K	TEMP	21	28	F8.1
FT_DK_K	FILTER	29	36	F8.2
P_DK	PREC	37	44	F8.0
FP_DK	FILTER	45	52	F8.2
S_DK	SUN	53	60	F8.0
FS_DK	FILTER	61	68	F8.2
C_DK	CLOUD	69	76	F8.0
FC_DK	FILTER	77	84	F8.2

*Dansk resumé:*

*Datamaterialet medfølger denne rapport i et EXCEL regneark og i en ASCII fil. Udover årstal indeholder filerne:*

1. *ukorrigerede landstal af årsmiddeltemperatur i grader celsius med 1 decimal (variablen er angivet med et "T" efterfulgt af et "DK") og en Gauss-filtreret værdi med 2 decimaler (variablen er angivet med et foranstillet "F").*

2. *korrigerede landstal af årsmiddeltemperatur i grader celsius med 1 decimal (variablen er angivet med et "T" efterfulgt af et "DK" og et "K" for korrigeret) og en Gauss-filtreret værdi med 2 decimaler (variablen er angivet med et foranstillet "F").*
3. *landstal af den akkumulerede årsnedbør i hele millimeter (variablen er angivet med et "P" efterfulgt af et "DK") og en Gauss-filtreret værdi med 2 decimaler (variablen er angivet med et foranstillet "F").*
4. *landstal af det akkumulerede soltimeantal i hele timer (variablen er angivet med et "S" efterfulgt af et "DK") og en Gauss-filtreret værdi med 2 decimaler (variablen er angivet med et foranstillet "F").*
5. *landstal af det årlige middelskydække i % (variablen er angivet med et "C" efterfulgt af et "DK") og en Gauss-filtreret værdi med 2 decimaler (variablen er angivet med et foranstillet "F").*

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John Cappelen and Bent Vraae Jørgensen:

The Climate of Denmark 2004 with The Faroe Islands and Greenland.

DMI Technical Report 05-05:

John Cappelen:

DMI Monthly Climate Data Collection 1860-2004, Denmark, Faroe Island and Greenland. An update of: NACD, REWARD, NORDKLIM and NARP datasets.

## Previous reports

Previous reports from the Danish Meteorological Institute can be found on:

<http://www.dmi.dk/dmi/dmi-publikationer.htm>