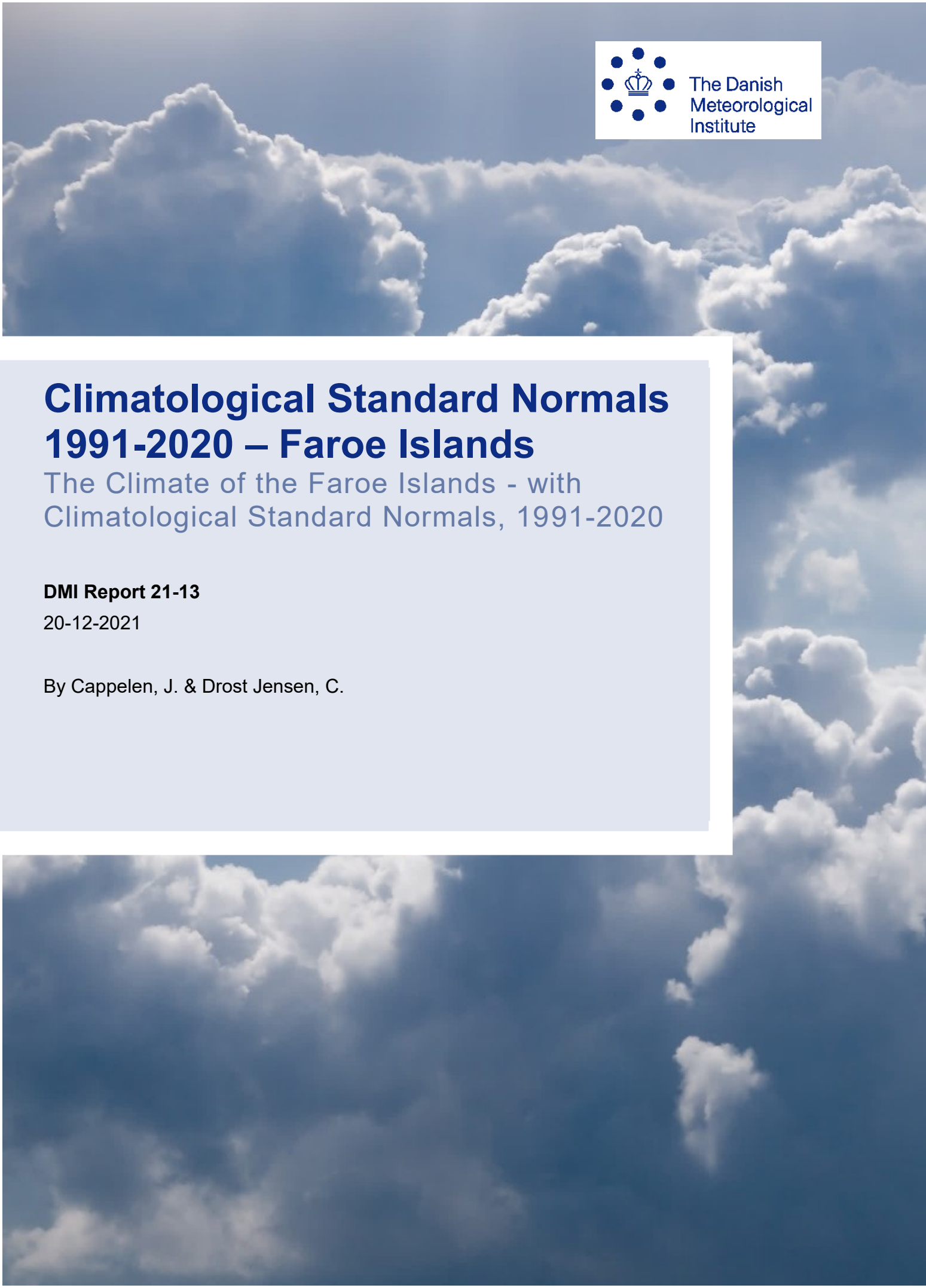

Climatological Standard Normals 1991-2020 – Faroe Islands

The Climate of the Faroe Islands - with Climatological Standard Normals, 1991-2020

DMI Report 21-13

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The Danish Meteorological Institute

Colophon

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Content

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1 Abstract

This report presents 30 years of climatological standard normals 1991-2020 for various climate elements. It contains calculations of air temperature, relative humidity, wind, atmospheric pressure at sea level, sunshine, radiation, precipitation and cloud cover for Tórshavn in the Faroe Islands. This report is a contribution to the World Meteorological Organization (WMO) and their collection of climatological standard normals 1991-2020 from weather station Tórshavn in the Faroe Islands.

2 Resumé

Nærværende rapport præsenterer 30 års klimanormaler 1991-2020 for forskellige klimaelementer. Den indeholder beregninger af lufttemperatur, relativ luftfugtighed, vind, lufttryk ved havets overflade, solskin, stråling, nedbør og skydække fra Tórshavn på Færøerne. Denne rapport er et bidrag til World Meteorological Institute (WMO) og deres indsamling af klimanormaler 1991-2020 fra Tórshavn på Færøerne.

3 Introduction

This report presents 30 years of climatological standard normals 1991-2020 for various climate elements for Tórshavn in the Faroe Islands based on quality-controlled data in the period 1991-2020. Monthly, annual and seasonal climatological standard normals or averages are presented. The station climate elements include average air temperature, averages of minimum and maximum air temperature, lowest and highest air temperature, average relative humidity, lowest relative humidity, average vapor pressure, average mean sea-level atmospheric pressure, accumulated hours of bright sunshine, accumulated global radiation, accumulated precipitation, highest 24-hour precipitation, average cloud cover and various derived climate elements.

The individual monthly, annual and seasonal values from every year (1991-2020) that form the basis of the calculation of the climatological standard normals are included in the associated dataset with this report.

A description of the general weather and climate in the Faroe Islands is included.

This report is a contribution to the collection of WMO climatological standard normals 1991-2020 from weather stations in the Faroe Islands. The contribution is based on the published quality-controlled observational data collection presented in Cappelen (2021) (DMI Report 21-09) along with monthly data from Cappelen (ed.) (2021) (DMI Report 21-05).

The report (pdf-format) and the associated dataset (see Appendix 13.1 for a description of the data file formats) can be downloaded from this link on DMI's website https://www.dmi.dk/publikationer/

4 Weather and Climate in the Faroe Islands

The Faroe Islands (Føroyar) are situated at approximately latitude 62°N, longitude 7°W and consist of 18 small, hilly islands. The islands have a total area of 1399km², and extend 113km from north to south and 75km from east to west. The highest elevations, reaching nearly 890m above sea level, are found in the northern islands.

The climate in the Faroe Islands is greatly influenced by the warm Gulf Stream and by the passage of frequent cyclones, which arrive from the south and west depending on the position of the polar frontal zone. Consequently, the climate is humid, unsettled and windy, with mild winters and cool summers.

The Azores High is sometimes displaced towards the islands, in which case settled summer weather with fairly high temperatures may prevail for several weeks. During the winter time, the course of the lows may be more southerly than normal, in which case cold air from the north dominates the weather. This situation may cause sunny weather with an unusually high frequency of days with frost and also snowfall. The latter occurs in conjunction with the build-up of showers in the cold air above the relatively warm sea water. The northern part of the islands particularly almost always experience wintry weather with snow or frost for a prolonged period during the winter time. Occasionally, some of the fiords freeze over with a thin layer of ice.

The maritime climate is also influenced by the bifurcation of the East Iceland current (polar current), a branch of which is directed from eastern Iceland towards the Faroes. This sea current flows round the Faroe Islands in a clockwise direction. The mixing of the water masses causes a relatively large difference in the sea temperatures to the north and to the south or south west of the Faroe Islands as well as local variations in sea surface temperatures.

The cooling of humid air masses by the cold sea water is a contributory cause of frequent fog in June, July and August.

The precipitation pattern reflects the topography of the islands, the precipitation being smallest near the coastal areas and rising to a peak at the center of the hilliest islands. Nearly all coastal areas receive around 1000mm

per year, rising to above 3000mm in the central parts. Investigations (Davidsen et al.) have shown that some places can receive more than 4000mm.

This precipitation distribution is attributable to both topographical and meteorological conditions. The topographical orographic precipitation occurs in conjunction with lows moving east and north-east. The land lifts the air masses, leading to a discharge of precipitation. The amount and intensity of the precipitation are of course also determined by the wind speed and the instability of the air.

Being close to the common cyclone tracks in the North Atlantic region the islands have a windy climate. The air in the lower atmosphere is affected by the hilly islands, causing considerable local winds, as a result from stowing, channeling and turbulence. This and the fact that the sea currents between the islands are very strong, sometimes cause problems for the navigation of ships. The turbulence in the mountain regions also causes problems for air traffic.

Intensive cyclone developments frequently give unstable weather, especially in autumn and winter. Drops in atmospheric pressure of about 20hPa in 24hours occur in nearly all months but sometimes the atmospheric pressure falls more rapidly - occasionally more than 80hPa in 24hours - and such situations cause very high wind speeds and considerable damages all over the islands.

Weather is defined as the momentary state of the atmosphere, while climate is the mean weather over a period. In accordance with international standards, normal climate is related to a period of 30 years. A summary is provided below of the behavior of the most important climate elements in the Faroe Islands. The data are from the period 1991-2020 and are presented in detail in Sections 6-12 and in the form of data files attached to this report. The description is mainly based on the data from Tórshavn.

5 Observations and Methods

5.1 The Meteorological Day and Month

Before 2014 the ’meteorological day’ in the Faroe Islands starts at 06H01 UTC and ends at 06H00 UTC the following day. From 2014 the ’meteorological day’ in the Faroe Islands starts at 00H01 UTC and ends at 00H00 UTC the following day. The Faroe Islands follow UTC in winter time. During summer time it is UTC+1.

The ’meteorological month’ thus starts at 06H01 (before 2014) or 00H01 UTC (from 2014) on the first day of the month and ends at 06H01 (before 2014) or 00H00 UTC (from 2014) on the first day of the following month. In the tables and data files in this report, an event occurring during a meteorological day is always assigned to the date on which the meteorological day starts.

5.2 The Station Type and Observation Site

The location of the synoptic station 6011 Tórshavn used in this report is shown in Figure 1. Further information about the station can be seen in Table 1.

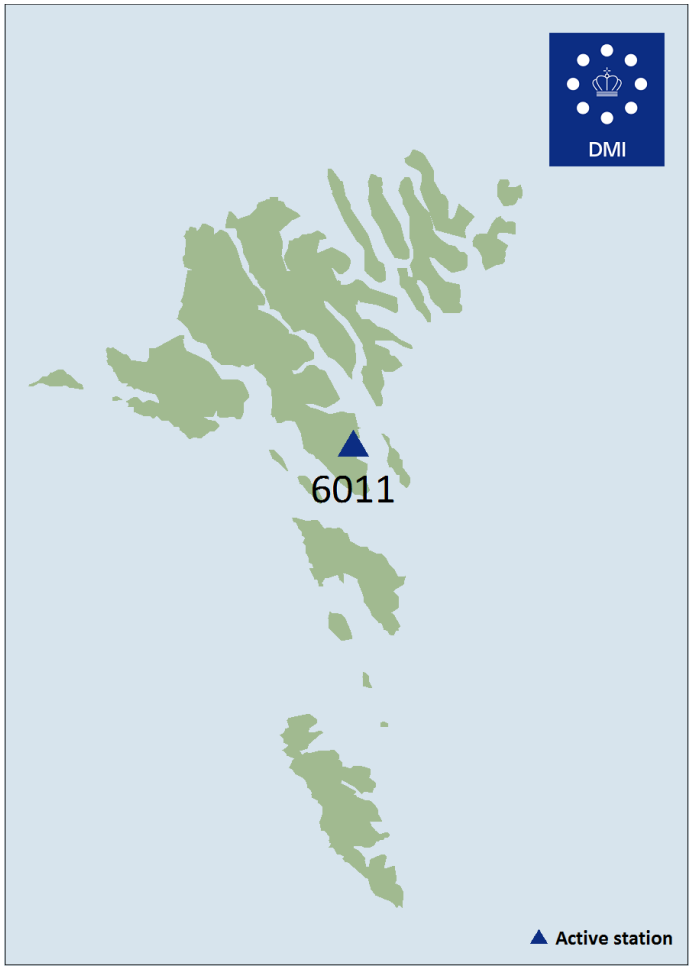


Figure 1: Location of 6011 Tórshavn. Map by M. Scharling.

Table 1: Information about 6011 Tórshavn including station number, name, location, and elevation in meters above sea level (m.a.s.).

Station no.	Station name	Latitude (degrees)	Latitude (minutes)	Latitude N or S	Longitude (degrees)	Longitude (minutes)	Longitude W or E	Elevation (m.a.s.)
6011	Tórshavn	62	01	N	06	46	W	54

This synoptic type of station ideally observes weather, cloud cover, visibility, air temperature, relative humidity, wind, air pressure, precipitation and radiation every hour round the clock or at least 00, 03, 06, 09, 12, 15, 18 and 21hours UTC (older days). Synoptic stations all over the world follow at least the 3-hour interval all round the clock, and they always follow the same guidelines. The synoptic station in Tórshavn has operated with different instrumentation and differing degrees of automation both in time and space, which of course has affected if and how the parameters have been observed. Nowadays Tórshavn is unmanned and have a 1-hour observation schedule. The station number describing synoptic stations in the Faroe Islands consists of 5 digits, always starting with the numbers 06.

5.3 The Climate Elements

Table 2 contains a list of the various climate elements referred to in this report, including the calculation methods by which the monthly, seasonal and annual values are calculated from the daily values (e.g. the

monthly value for 'mean temperature' is calculated as the mean of all days in the month, each day containing 24 temperature observations per day).

Table 2: Climate element description including climate element number, unit and calculation method.

Element no.	Description	Unit	Calculation Method
101	Mean air temperature	°C	Mean
111	Mean maximum air temperature	°C	Mean
112	Highest air temperature + date	°C	Max
114	Number of ice days (Tmax < 0°C)	days	Count
115	Number of summer days (Tmax > 25°C)	days	Count
121	Mean minimum air temperature	°C	Mean
122	Lowest air temperature + date	°C	Min
124	Number of cold days (Tmin < -10°C)	days	Count
125	Number of days with frost (Tmin < 0°C)	days	Count
126	Number of tropical days (Tmin > 20°C)	days	Count
147	Accumulated heating degree days (17-tmean)	°C	Sum
201	Mean relative humidity	%	Mean
205	Highest relative humidity	%	Max
207	Lowest relative humidity	%	Min
210	Mean vapor pressure	hPa	Mean
301	Mean wind speed (10 minutes average)	m/s	Mean
302	Highest wind speed (10 minutes average) + date	m/s	Max
305	Highest wind gust (3 seconds-average) + date	m/s	Max
311	Number of days with strong breeze (wind speed >= 10.8m/s)	days	Count
321	Number of days with strong gale (wind speed >= 20.8m/s)	days	Count
326	Number of days with storm (wind speed >= 24.5m/s)	days	Count
331	Number of days with violent storm (wind speed >= 28.5m/s)	days	Count
371	Mean wind direction	degrees	Mean*
401	Mean sea-level atmospheric pressure	hPa	Mean
410	Highest sea-level atmospheric pressure + date	hPa	Max
420	Lowest sea-level atmospheric pressure + date	hPa	Min
504	Accumulated sunshine	hours	Sum
550	Accumulated global radiation	MJ/m2	Sum
601	Accumulated precipitation	mm	Sum
602	Highest 24 hour precipitation + date	mm	Max
604	Number of days with precipitation >= 0.1mm	days	Count
605	Number of days with precipitation >= 1.0mm	days	Count
606	Number of days with precipitation >= 10.0mm	days	Count
801	Mean cloud cover	%	Mean
802	Number of clear days (N < 20%)	days	Count
803	Number of cloudy days (N > 80%)	days	Count

** See appendix 13.1 on the calculation of mean wind direction.*

5.4 Erroneous or Missing Values

The time series of original observations from the weather station has been examined carefully and all erroneous data have been removed before calculating the monthly, seasonal and annual values. Monthly, seasonal and annual values that are based on a limited number of days, have additionally been removed before calculating the monthly, seasonal and annual climatological standard normals or averages.

The monthly and annual data behind the statistics can be seen in the attached files. In case of missing data in the whole period in question, the gaps are empty in the monthly and annual time series. Otherwise, the number of days present behind the calculation is stated (see Appendix 13.1 Data File Formats).

Taking into account that the weather in the Faroe Islands varies a lot even over short distances together with the fact that the network of DMI weather stations is rather sparse, the use of observations from neighboring stations has been impossible.

DMI maintains information (metadata) on the origin of the monthly and annual values in every series presented in this report.

5.5 Homogeneity of the Series

Temporal and spatial homogeneity of observations is crucial to any kind of analysis. The homogeneity of a time series ideally requires that the local measurements have been carried out with the same type of instrument and according to instructions unchanged over time.

Inhomogeneity occurs when one or more factors change during the observation period. Changes in the instrumentation set-up, e.g. the introduction of automatic equipment, does not necessarily lead to abrupt inhomogeneity, but some changes do. The relocation of a station nearly always has an effect. The same sometimes applies to changes in observation methods, especially with regard to changes from visual (subjective) observations to automatic measurements.

Since 1991 different types of changes have occurred at the Tórshavn station, but these changes have not significantly affected the homogeneity of the time series mainly because the station have been located at almost the same spot in the period. To ensure an acceptable level of homogeneity, all the series - in addition to a careful examination of the original observations - have been subjected to close visual scrutiny.

5.6 Calculation of Climatological Standard Normals or Averages

Climatological standard normals cannot be calculated for all of the climate elements at 6011 Tórshavn due to missing data for some climate elements. In this case, so-called ‘averages’ are calculated instead, which enables the calculation of climate statistics from shorter time series than 30 years. The difference between the two calculations can be seen in the following two definitions defined by WMO, 2017:

- ***Climatological standard normals:*** *“Averages of climatological data computed for the following consecutive periods of 30 years: 1 January 1981–31 December 2010, 1 January 1991–31 December 2020, and so forth” (WMO, 2017).*
- ***Average:*** *“The mean of monthly values of climatological data over any specified period of time (not necessarily starting in a year ending with the digit 1). In some sources, this is also referred to as “provisional normal” (WMO, 2017).*

When data is missing, these WMO guidelines are followed in the calculation of the individual monthly values and the climatological standard normals or averages:

- The calculation of individual monthly mean or count values for climate elements 101, 111, 114, 115, 121, 124, 125, 126, 201, 210, 301, 311, 321, 326, 331, 371, 401, 604, 605, 606, 801, 802 and 803

should not be carried out if there are more than 11 or more missing days during the month. Furthermore, 5 continuous missing days of data or more during the month also means that the monthly mean or count value should not be calculated (WMO, 2017).
- The calculation of individual monthly extreme values for climate elements 112, 122, 205, 207, 302, 305, 410, 420 and 602 can be carried out no matter the amount of missing data (WMO, 2017).
- The calculation of the individual monthly sum values for climate elements 147, 504, 550 and 601 requires data completeness e.g. all daily values should be present (WMO, 2017).
- For the calculation of climatological standard normals or averages for all climate elements there should be at least 80% data coverage of the data period in question (WMO, 2017).

The guidelines described above have been followed to a large extend. However, some averages for certain climate elements deviate from the guidelines. For an overview of this, please see Standard Normals Calculation – script in Appendix 13.3.

Furthermore, this report contains extra data compared to the datasets that were reported to the WMO. Only the following climate elements were reported to the WMO for the Faroe Islands: 101, 111, 112, 114, 115, 121, 122, 124, 125, 126, 201, 207, 210, 301, 302, 311, 321, 326, 331, 371, 401, 410, 420, 504, 601, 602, 604, 605, 606, 801, 802 and 803. In this report, extra climate elements (147, 305 and 550) are included. There are several reasons why the dataset to the WMO was reduced. In some cases, the data from the station did not meet the data quality recommended by the WMO, e.g. for 305 and 550 that has only been available since 2014. In other cases, the climate element was not relevant for the WMO such as 147, which is mainly used within the Danish Commonwealth.

For detailed information about the calculation of individual monthly values and climatological standard normals or averages, see the WMO Guidelines on the Calculation of Climate Normals (WMO, 2017).

6 Air Temperature and Heating Degree Days

Our understanding of temperature is actually a measure of the content of energy in the air - that is the average kinetic energy for a single molecule. The more energy there is in the air, the higher the temperature.

Reasonably correct and for that reason comparative, air temperature readings assume the protection of the sensor against unwanted influence from the surroundings (such as radiation or precipitation) according to regulations described by the WMO. In the Faroe Islands and other places, the thermometers are placed inside a so-called “radiation screen” 2m above the ground. The screen could be a white painted slat, allowing ventilation or more recently a metal screen, when dealing with new types of sensors.

Air temperature is measured every hour or at least every 3 hours round the clock (older days). In addition, extremes are measured: highest and lowest air temperatures.

During the climatological standard normal period 1991-2020, the annual mean temperature in Tórshavn was 7.0°C. Mean temperatures were around 4.2°C in January and February and about 11.0°C in July and August.

The temperature fluctuations in the Faroe Islands are generally small, but it does happen that the temperature reaches 20°C. In Tórshavn, the highest temperature in the period was 20°C on 12 June 1992 and also 20 August 2004. The lowest temperature was -9.2°C on 1 March 1998. The absolute highest temperature registered in the Faroe Islands was 26.3°C observed at Vága Floghavn on 17 July 2003. During wintertime the temperature sometimes drops below 0°C. The absolute lowest temperature registered in the Faroe Islands was -12.3°C, which was observed at Kirkja 4 March 2001.

No cold days (Tmin < 10°C), summer days (Tmax > 25°C) or tropical days (Tmin > 20°C) have been registered in Tórshavn in the period in question.

Heating Degree Days (HDD) is a measure of likely energy consumption for heating buildings taking the climate into account. HDD is defined simply as the positive difference between a fixed indoor temperature (basis temperature) and the outdoor temperature during the time period under consideration (i.e. one day/one month). In the Faroe Islands, the basis temperature is 17°C. The basis temperature is what the heating system should be able to produce energy for.

This may seem as a chilly indoor temperature, but as a rule of thumb one should add approximately 3°C originating from the so-called heating sources like ourselves, lightning, TV, computers, domestic appliances etc. Therefore, the indoor temperature will be equivalent to 20°C.

Thereby, a daily mean temperature of +5°C results in a registration of 17-5 = 12 HDD's. In addition, sunshine and wind affect the amount of energy used for heating. Sunshine will reduce the number of HDD, and on the other hand, wind speed above a certain level will increase the HDD number.

The HDDs (climate element 147) shown in Table 3 are not corrected for sunshine, wind or anything else. They are calculated as the positive difference between 17°C and the outdoor temperature measured in a ventilated and shadowed screen.

Table 3: Climatological standard normals 1991-2020, mean air temperature (101), mean maximum air temperature (111), highest air temperature (112), number of ice days (114), number of summer days (115), mean minimum air temperature (121), lowest air temperature (122), number of cold days (124), number of days with frost (125), number of tropical days (126) and accumulated heating degree days (147).

Climate Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DJF	MAM	JJA	SON	Annual	Unit
101	4.3	4.0	4.3	5.5	7.1	9.1	10.8	11.2	10.0	7.8	5.8	4.5	4.3	5.6	10.4	7.9	7.0	**°C**
111	6.2	6.0	6.4	7.6	9.3	11.3	12.9	13.3	11.9	9.6	7.6	6.5	6.2	7.8	12.5	9.7	9.0	**°C**
112	11.3	13.0	12.3	18.3	18.9	20.0	19.1	20.0	17.7	16.3	14.7	12.4	13.0	18.9	20.0	17.7	20.0	**°C**
114	0.3	0.5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.8	1.6	0.4	0.0	0.1	2.1	**days**
115	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**days**
121	2.1	1.6	2.0	3.2	5.0	7.3	9.1	9.3	8.1	5.7	3.6	2.2	2.0	3.4	8.6	5.8	4.9	**°C**
122	-8.8	-9.2	-9.2	-6.2	-2.4	0.8	3.8	3.2	0.4	-3.9	-5.1	-7.8	-9.2	-9.2	0.8	-5.1	-9.2	**°C**
124	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**days**
125	7.3	8.1	7.1	4.2	0.9	0.0	0.0	0.0	0.0	0.8	4.3	7.8	23.2	12.2	0.0	5.1	40.5	**days**
126	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**days**
147	392.3	368.1	392.3	346	306.8	235.9	194.6	181.1	208.4	282.6	335.3	387.2	1147.6	1045.1	611.6	826.3	3630.6	**days**

7 Relative Humidity and Vapor Pressure

Humidity is the amount of water vapor present in the air. The higher the temperature, the greater the number of water molecules that the air can hold. The most commonly used measure of humidity is relative humidity given in percent.

But what does this mean? Relative humidity does not indicate the total amount of water vapor in the air but tells us how close the air is to being saturated at a given temperature. Air with 100% relative humidity is therefore said to be saturated: it is filled to capacity with water vapor.

The climate in the Faroe Islands is very humid. The relative humidity is high, during the period 2010-2020 the average annual relative humidity in Tórshavn was 83.6%. It is highest (about 88.5%) around July and August as a result of the frequent fog at that time of the year. The difference in the relative humidity between nighttime and daytime is small, which is normal in a maritime climate.

A direct measure of humidity is absolute humidity. This is the mass of water vapor in a given volume of air, i.e. grams per m^3. The air's moisture content may also be described by measuring or calculating the pressure exerted by the water vapor in the air. The unit is hPa.

The actual amount of water vapor, and thus the vapor pressure, is determined by the temperature, and for that reason, the absolute humidity and vapor pressure is higher in the summer compared to the winter.

Table 4: Averages 2010-2020, relative humidity (201), minimum relative humidity (207) and vapor pressure (210).

Climate element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DJF	MAM	JJA	SON	Annual	Unit
201	80.8	80.9	80.0	80.4	82.3	86.2	88.7	88.4	86.5	84.7	82.4	82.1	81.3	80.9	87.8	84.5	83.6	**%**
207	50.0	48.0	45.0	44.0	42.0	33.0	51.0	47.0	51.0	54.0	49.0	44.0	44.0	42.0	33.0	49.0	33.0	**%**
210	6.9	6.9	7.0	7.5	8.4	10.2	11.6	11.7	10.8	9.3	7.9	7.1	7.0	7.6	11.2	9.3	8.8	**hPa**

8 Atmospheric Air Pressure

Atmospheric pressure is defined as the weight of a column of air, standing on $1cm^2$ of a horizontal plane. The atmospheric pressure is always decreasing with increasing height above ground.

In the old days, atmospheric pressure was registered in millimeters - the height of a column of mercury in a barometer. 760mmHg represents the normal atmospheric pressure at the surface of the earth. The atmospheric pressure can also be registered in hectopascal (hPa or with an older name millibar (mb)) - the international unit for the registration of atmospheric pressure. 1hPa (100Pa = $100N/m^2$) is the same as 1mb (=1/1000bar). 1013.25hPa represents the normal atmospheric pressure at the surface of the earth. In this report, hPa is used and the atmospheric pressure is reduced to the same reference: the mean sea level (MSL) assuming a standard atmosphere between the official level of the station and MSL.

The normal annual atmospheric pressure observed in Tórshavn and reduced to mean sea level is 1007.8hPa, lowest from October through February (1001.8 – 1006.2hPa) and highest in May (1014.2hPa). The lowest recorded atmospheric pressure in the period was 931.8hPa on 11 January 1993 and the highest atmospheric pressure of 1048.9hPa was recorded on 13 December 1995. Surprisingly, not only is it common with relatively long periods of low atmospheric pressure, it is also common with relatively long periods of high pressure.

The Faroe Islands are situated close to the common cyclone tracks and the atmospheric pressure is subject to frequent and substantial changes as mentioned above. A 20hPa rise and fall within 24hours is possible in all months. The average annual range in atmospheric pressure is approximately 80hPa. The atmospheric pressure is more changeable in the winter months compared to the summer months. The range in the winter months is approximately double that in the summer months.

Table 5: Climatological standard normal 1991-2020, mean sea level atmospheric pressure (401), highest mean sea level atmospheric pressure (410) and lowest mean sea level atmospheric pressure (420).

Climate element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DJF	MAM	JJA	SON	Annual	Unit
401	1001.8	1004.0	1007.0	1011.0	1014.2	1013.6	1011.1	1010.0	1008.7	1006.2	1003.5	1002.7	1002.8	1010.7	1011.6	1006.1	1007.8	**hPa**
410	1046.8	1044.7	1048.6	1044.1	1041.1	1037.5	1033.2	1028.4	1037.4	1037.1	1040.1	1048.9	1048.9	1048.6	1037.5	1040.1	1048.9	**hPa**
420	931.8	938.4	949.4	960.5	971.7	967.5	988.8	963.7	964.8	948.7	955.4	936.4	931.8	949.4	963.7	948.7	931.8	**hPa**

9 Wind

The term “wind” generally means the movement of air. In meteorological terms, the “wind” is the actual horizontal movement over a certain period of time, normally 10 minutes. The wind direction is given as the mean direction from where the wind blows over the time period in question (i.e. 10 minutes). The wind speed is the speed with which the wind moves compared to the ground. Gust, on the other hand, is both negative and positive deviations from the mean wind speed over a short time period, normally a few seconds (the duration of the gust must not exceed 1 minute). Only the positive deviations are reported.

The wind direction and especially the wind speed normally change relatively fast at low elevations just above the ground, because of the braking and deflection of the air when moving over terrain (hills, vegetation, buildings, etc.). Because of this, an international agreement states that wind measurements must be carried out 10m over open and flat terrain.

In Tórshavn, west and south-westerly winds is the most frequent wind direction in the period 1991-2020, easterly winds being the most infrequent. The highest 10min average wind measured during the period 1991-2020 was 37.2m/s on 25 December 2016, but a 10min average of 50m/s and wind gusts up to almost 70m/s have been registered at Mykines Light house at the westernmost parts of the Faroe Islands.

The mean wind speed is generally high in the Faroe Islands, particularly during autumn and winter. The normal annual wind speed in Tórshavn is 6.6m/s. It is normally lowest during summer (average 5.0m/s) and highest during winter (average 7.8m/s). May to August are normally without strong winds, i.e. storm, while autumn and winter are particularly windy with numerous gales, usually blowing from west and south-west.

Vigorous development of cyclones is typically an autumn and winter phenomenon, sometimes with wind speeds of more than 40m/s and gusts above 70m/s.

Though the general climate is very windy, calm periods do occur, most often in midsummer, but then only for very short periods of time.

Table 6: Climatological standard normals 1991-2020, mean wind speed (301), highest wind speed (10-minutes average) (302), number of days with strong breeze (311), number of days with strong gale (321), number of days with storm (326) and number of days with violent storm (331).

Climate element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DJF	MAM	JJA	SON	Annual	Unit
301	7.8	8.0	7.5	6.8	5.6	5.2	4.9	4.9	6.1	6.8	7.6	7.5	7.8	6.6	5.0	6.8	6.6	**m/s**
302	31.4	30.9	25.8	26.3	23.2	22.7	23.7	21.1	27.3	28.8	31.4	37.2	37.2	26.3	23.7	31.4	37.2	**m/s**
311	20.6	18.5	18.0	13.7	8.8	6.7	5.9	6.4	11.6	15.5	18.3	19.3	58.4	40.5	19.0	45.4	163.3	**days**
321	1.9	2.0	1.3	0.5	0.1	0.1	0.1	0.0	0.6	0.7	1.2	1.7	5.6	1.9	0.2	2.5	10.2	**days**
326	0.4	0.8	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.6	1.8	0.2	0.0	0.5	2.5	**days**
331	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.5	0.0	0.0	0.1	0.6	**days**

Table 7: Average 2014-2020, wind gust (3-seconds average) (305).

Climate element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DJF	MAM	JJA	SON	Annual	Unit
305	39.6	33.8	35.1	28.8	27.2	23.6	22.0	25.4	36.2	33.6	32.9	52.4	52.4	35.1	25.4	36.2	52.4	**m/s**

Table 8: Climatological standard normals 1991-2020, mean wind direction (371).

Climate element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DJF	MAM	JJA	SON	Annual	Unit
371	246	255	265	301	350	22	261	234	235	245	260	259	253	305	277	247	267	**degrees**

Table 9: Wind direction names with corresponding wind direction in degrees. Wind directions have been divided into 12 sectors. The sign "~" indicates that the degrees e.g. "~30" more or less correspond to the name of the wind direction NNE.

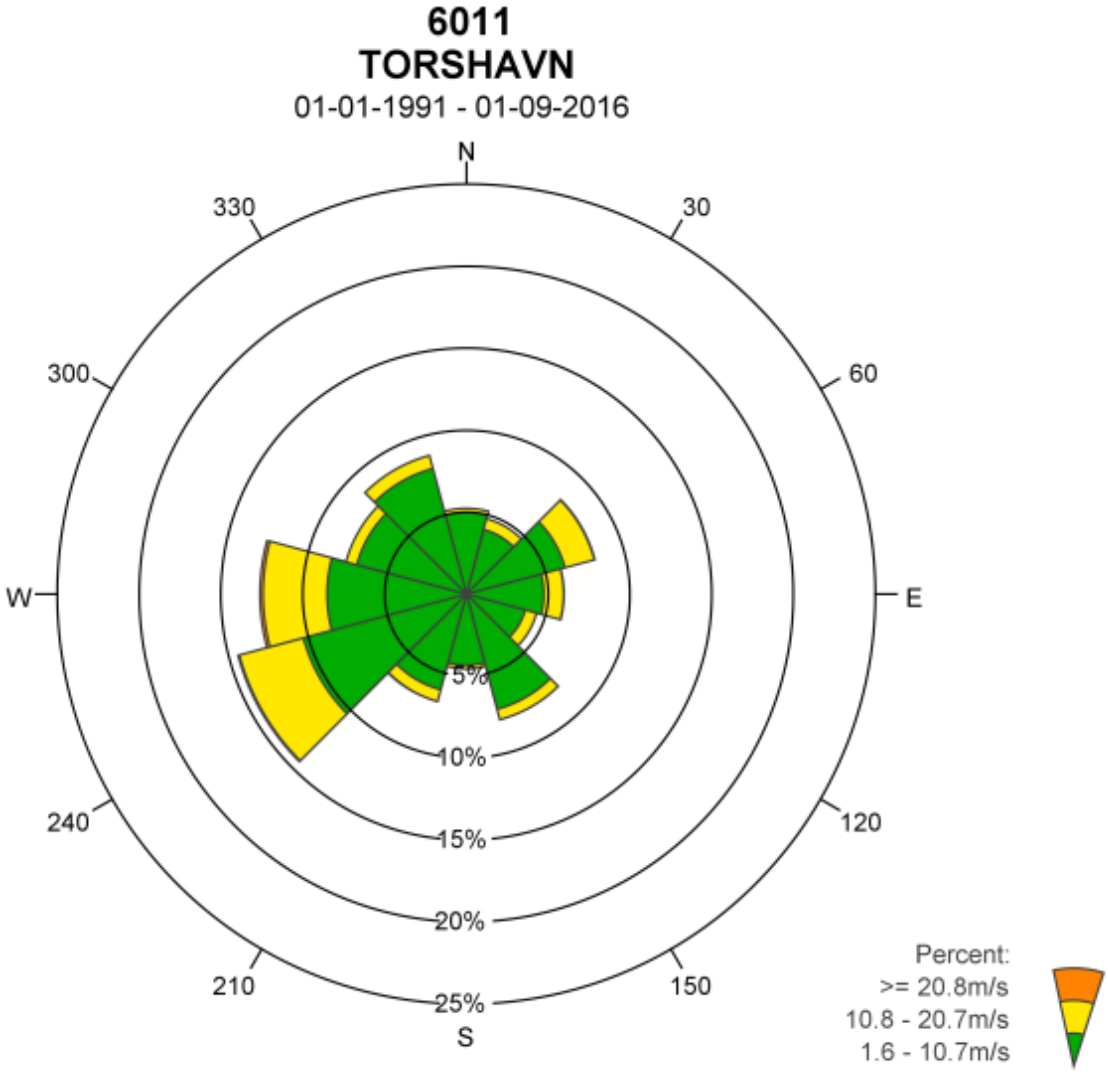
Wind direction	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
Degrees	0/360	~30	~60	90	~120	~150	180	~210	~240	270	~300	~330

9.1 Wind Rose

The wind rose shown in Figure 2 shows the distribution of wind direction and wind speed. The wind direction is divided into 12 sectors, each containing 30 degrees. Furthermore, the wind speed is divided into sub groups. The distribution in percent can also be seen in the frequency table just below the wind rose.

Please note that calm situations are defined as wind speeds below or equal to 1.5m/s. Calm wind situations are not included in the wind rose. This means that the calculation of the total mean wind speed in the frequency table could be higher compared to a mean wind speed calculated in the conventional manner, as this takes all wind speeds (also calm) into account.

Due to missing wind direction data from 02-09-2016 to 31-12-2020, the wind rose from Tórshavn is only made of hourly values from 01-01-1991 to 01-09-2016, since both wind speed and wind direction is needed to produce the figure. Please note that the highest mean wind speed in the wind rose does not correspond to the highest wind speed in the standard climate normals above due to these missing data.



	N	30	60	E	120	150	S	210	240	W	300	330	Total
%	5.2	4.8	8.1	6.0	4.5	7.9	4.6	6.8	14.4	12.6	7.6	8.8	91.3
% 1.6 - 10.7m/s	5.0	4.1	6.2	4.8	3.7	7.3	4.4	6.0	10.3	8.5	6.9	7.9	75.1
% 10.8 - 20.7m/s	0.3	0.7	1.9	1.2	0.7	0.7	0.2	0.7	4.1	3.9	0.7	0.8	15.8
% >= 20.8m/s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.4
Mean wind speed	5.7	6.6	7.7	7.2	7.0	5.9	5.1	6.4	8.5	8.8	6.1	6.5	7.1
Max wind speed	22.0	24.2	28.3	23.9	24.7	22.6	30.9	26.8	32.5	31.4	32.9	22.1	32.9

Number of observations = 196405
Source: DMI
Calm defined as wind speed <= 1.5m/s
Number of observations with calm/varying wind direction: 17144=8.7%
Observations with calm/varying wind direction are not used in the statistics

Figure 2: Wind rose 6011 Tórshavn calculated on data (climate element 301 and 371) from 1991 to 2016. Due to missing data of mean wind direction (climate element 371) in the period 02-09-2016 to 2020 the wind rose only contain data up until 01-09-2016.

10 Sunshine and Radiation

The term “hours of bright sunshine” over a fixed period generally means the accumulated time period, where the insolation from the sun reaches the surface of the Earth and exceeds a certain minimum intensity.

The annual climatological standard normal total for hours of bright sunshine observed in Tórshavn in the period 2007-2020 was 1002.1hours. The highest number of hours of bright sunshine observed in Tórshavn normally occur in May and June, i.e. 157.8 and 135.4hours, respectively. The lowest number is in December and January, 22.7 and 29.8hours, respectively. Sometimes in December, very few hours of bright sunshine have been recorded and in December 1942 no sunshine at all were recorded according to Cappelen (2021).

Global radiation is the total short-wave radiation from the sky falling onto a horizontal surface of the ground. It includes both the direct solar radiation and the diffuse radiation resulting from reflected or scattered sunlight. The unit of the observations is W/m^2. The unit of the accumulated global radiation is MJ/m^2.

Table 10: Average 2007-2020, hours of bright sunshine (504).

Climate element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DJF	MAM	JJA	SON	Annual	Unit
504	29.8	53.0	91.5	116.2	157.8	135.4	106.9	101.6	88.9	59.7	38.6	22.7	105.5	365.5	343.9	187.2	1002.1	**hours**

Table 11: Average 2014-2020, accumulated global radiation (550).

Climate element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DJF	MAM	JJA	SON	Annual	Unit
550	21.6	68.5	177.3	333.5	469.4	466.8	427.9	356.6	222.2	98.8	31.1	11.0	101.1	980.2	1251.3	352.1	2684.7	**MJ/m2**

11 Cloud Cover

Clouds are structures developed in the lower atmosphere as a result of the condensation of water vapor. They consist of tiny water drops or ice crystals “floating” in the air. Clouds can also contain larger particles of water or ice as well as non-aqueous fluid or solid particles like those found in smoke or dust.

The amount of clouds specifies how much of the sky is actually covered by clouds, as seen from the observation site. The cloud cover, specified for every single layer or as the total cloud cover, can be stated in octas or in percent (% in this report). 0% total cloud cover (0/8) corresponds to clear sky, while 100% (8/8) correspond to an overcast weather situation.

From the total cloud cover, the number of clear days (total cloud cover < 20%) and the number of cloudy days (total cloud cover > 80%) are calculated.

Formations of clouds at the Faroe Islands and elsewhere too, are in broad terms partly connected to the passage of lows and the adjoining cloud systems, and partly connected to local conditions.

The oceanic location, combined with the polar front and frequent passages of cyclones, cause an extremely large number of cloudy days (i.e. a cloud cover of more than 80%), 179.2days annually in the period 2008-2020 in Tórshavn. During this period, an average of only 4.0days annually in Tórshavn could be classified as clear, i.e. with a cloud cover of less than 20%. In the same period, the average cloud cover was 76%, the highest being 80%, 82% and 80%, respectively in June, July and August and the lowest being 72% in May.

Table 12: Average 2008-2020, cloud cover (801), number of clear days (802), and number of cloudy days (803).

Climate element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DJF	MAM	JJA	SON	Annual	Unit
801	74.0	73.0	73.0	74.0	72.0	80.0	82.0	80.0	76.0	76.0	73.0	74.0	74.0	73.0	81.0	75.0	76.0	**%**
802	0.2	0.0	0.1	0.3	0.8	0.5	0.5	0.4	0.2	0.3	0.3	0.4	0.6	1.2	1.4	0.8	4.0	**days**
803	13.1	10.0	12.2	13.8	13.5	18.5	21.5	19.2	15.4	16.0	12.2	13.8	36.9	39.5	59.2	43.6	179.2	**days**

12 Precipitation

Precipitation is defined as the solid or liquid result of the precipitation processes, which take place in a cloud and subsequently fall from it. The result can be coherent precipitation or showers or what can be deposited from the air to the ground or the surface of the sea. In broad terms, this can be rain, sleet, snow, hail, dew, white frost, and deposit of fog.

The total amount of precipitation that falls on the ground in a given period (in this report days, months, seasons and years) is defined by the depth of a volume of precipitation (in liquid form; solid precipitation is melted before the reading) covering a horizontal plane on the surface of the ground if there was no run-off or evaporation.

No matter which method is used to measure the amount of precipitation, it is important that the registration should be as close as possible to the “true” precipitation. Obviously, this can be very difficult, especially under extreme conditions.

The Faroe Islands is characterized by some extreme conditions, and for that reason registration of precipitation is a difficult task. Especially because of lack of shelter, high wind speeds and sometimes solid precipitation, which can result in both drifting snow and snow deposits. The rain gauge in Tórshavn is placed 1.5 meters above the ground and in addition provided with a considerably large shelter arrangement in order to minimize the problems. In recent times, automatic rain gauges have been introduced. These instruments weigh the precipitation - after melting – which provides the amount and intensity of the precipitation. No matter what, the registration of precipitation in the Faroe Islands will always be subject to a considerable degree of uncertainty.

The normal annual precipitation at Tórshavn is 1399.2mm. Precipitation totals are highest in autumn and winter, and lowest in the summer.

There are large geographical variations in the annual rainfall in the Faroe Islands. In the southern and western parts of the islands, the annual precipitation is lowest. The northern part of the islands, which has the highest and most massive mountains, has an annual precipitation level above 3000mm. Most of this variation is due to orographic differences. The rather low amount of precipitation in some coastal areas in the southernmost and westernmost parts of the Faroe Islands could also be attributed to the special wind conditions in these exposed coastal areas.

The number of days with precipitation greater than 0.1mm is 264.3 in Tórshavn, annually. The number of days with precipitation greater than 1.0mm is 192.0 and the number of days with precipitation greater than 10.0mm is 44.5 in Tórshavn.

The highest 24-hour precipitation in Tórshavn registered in the period 1991-2020 was 65mm recorded on 10 January 1992 and also 8 October 1998, but much wetter days has been registered other places, e.g. in Hvalvik where 182mm was registered 15-16 September 1998.

In the wintertime, the precipitation sometimes falls as snow. Snow is precipitation in the form of ice crystals, stuck together as snowflakes. The word “snow” is also used when talking about precipitation that has already fallen and lying on the surface of the earth.

Days with snowfall, days with snow cover and snow depth are not registered anymore, so the statistics for the period 1991-2020 are missing.

Table 13: Climatological standard normals 1991-2020, accumulated precipitation (601), highest 24-hour acc. precipitation (602), days with precipitation >= 0.1mm (604), days with precipitation >= 1.0mm (605) and days with precipitation >= 10.0mm (606).

Climate element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DJF	MAM	JJA	SON	Annual	Unit
601	167.3	131.2	129.5	95.4	70.3	63.1	71.2	93.4	118.1	146.8	155.2	157.7	456.2	295.2	227.7	420.1	1399.2	**mm**
602	65.0	53.0	56.0	35.0	44.0	49.0	50.0	46.1	49.0	65.0	62.0	46.1	65.0	56.0	50.0	65.0	65.0	**mm**
604	26.1	23.2	25.0	21.6	18.8	15.2	17.3	19.1	21.3	25.4	25.6	25.7	75.0	65.4	51.6	72.3	264.3	**days**
605	20.7	17.3	18.9	14.7	12.2	9.2	11.0	12.9	15.9	19.0	19.8	20.4	58.4	45.8	33.1	54.7	192.0	**days**
606	5.7	4.4	4.1	2.6	1.7	1.8	2.3	2.8	4.0	5.0	4.9	5.2	15.3	8.4	6.9	13.9	44.5	**days**

13 Appendix

13.1 Data File Formats

Monthly data series (csv format):
Station,Year,Month,Name,Lattitude,Longitude,Height,101,antDays101,111,antDays111,112,antDays112,attr112,114,antDays114,115,antDays115,121,antDays121,122,antDays122,attr122,124,antDays124,125,antDays125,126,antDays126,147,antDays147,201,antDays201,205,antDays205,207,antDays207,210,antDays210,301,antDays301,302,antDays302,attr302,305,antDays305,attr305,311,antDays311,321,antDays321,326,antDays326,331,antDays331,371,antDays371,401,antDays401,410,antDays410,attr410,420,antDays420,attr420,504,antDays504,550,antDays550,601,antDays601,602,antDays602,attr602,604,antDays604,605,antDays605,606,antDays606,801,antDays801,802,antDays802,803,antDays803

Annual data series (csv format):
Station,Year,Name,Lattitude,Longitude,Height,101,antDays101,111,antDays111,112,antDays112,attr112,114,antDays114,115,antDays115,121,antDays121,122,antDays122,attr122,124,antDays124,125,antDays125,126,antDays126,147,antDays147,201,antDays201,205,antDays205,207,antDays207,210,antDays210,301,antDays301,302,antDays302,attr302,305,antDays305,attr305,311,antDays311,321,antDays321,326,antDays326,331,antDays331,371,antDays371,401,antDays401,410,antDays410,attr410,420,antDays420,attr420,504,antDays504,550,antDays550,601,antDays601,602,antDays602,attr602,604,antDays604,605,antDays605,606,antDays606,801,antDays801,802,antDays802,803,antDays803

antDays<element number> – number of days behind the calculations
attr<element number> - the date on which the extreme has occurred

Climatological standard normals or averages (csv format):
The climatological standard normals or averages for all climate elements are contained in one file named ‘fr_normals_all.csv’. The file has the following format:

Climate element,First yr,Last yr,Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec,DJF,MAM,JJA,SON,Annual

For a description of the climate elements see Table 2 in Section 5.3.

13.2 Calculation of mean wind direction

13.2.1 Daily values of mean wind direction

The mean wind direction is calculated using the hourly values of wind direction (dd) and wind speed (ff). For every hourly value in which the wind direction (dd) and the wind speed (ff) exist, the component is calculated using the following equation:

If ff > 0 then ff = 1
xsum = ff * cos(dd *π/180)
ysum = ff * sin(dd * π/180)
If at least 12 valid hourly values (ff and dd) exist, the hourly values of xsum and sxsum are summarized and the hourly values of ysum and sysum are also summarized.

Then the daily values of the mean wind direction are calculated using the following equation:
atan2(sysum, sxsum) * 180/π
If the value < 0, then do an addition with 360

13.2.2 Monthly and yearly values of mean wind direction

For the days during the month/year in which a daily value of the mean wind direction (d371) can be found, two mean values are formed:

meanSinWindDir = sin(d371 * π/180)
and
meanCosWindDir = cos(d371 * π/180)

Then the mean wind direction are calculated using the following equation:

If atan2(meanSinWindDir, meanCosWindDir) < 0:
middelvindretning = atan2(meanSinWindDir, meanCosWindDir) * 180/π + 360
or
middelvindretning = atan2(meanSinWindDir, meanCosWindDir) * 180/π

13.3 Calculation of Climatological Standard Normals and Averages – script

Table 14: Explanation of calculation abbreviations*. For an overview of mean, count and extreme parameters, see Section 5.6.

Abbreviation	Explanation
-e	climate element, e.g. 101
-fd	first date, i.e. first year, e.g. 2010
-ld	last date, i.e. last year, e.g. 2020
-no rules	calculation of climatological standard normal/average has been carried out with no WMO rules
-pb	print basic information, i.e. information about the program that calculate the climatological standard normals or averages. Not important for the understanding the calculation of climatological standard normals or averages
-prim	print primary normals only, i.e. primary normals e.g. mean calculation of 101 or count calculation of 601
-s	station number, stations included in the calculation of climatological standard normals or averages

The command "*java -cp /opt/TKBasisNAClimateNormals/lib/'*' tkbasisnaclimatenormal.TKBasisNAClimateNormal*" is not important for the understanding of calculation of climatological standard normals or averages.

If no specific rules are written with regards to the different climate elements, then the WMO-rules for the calculation of climatological standard normals or averages have been followed.

Script used to calculate Climatological standard normals and averages from Tórshavn:

```
# 601100 Torshavn
java -cp /opt/TKBasisNAClimateNormals/lib/'*' tkbasisnaclimatenormal.TKBasisNAClimateNormal -e
101,111,112,114,115,121,122,124,125,126,147,301,302,311,321,326,331,371,401,410,420,601,602,604,605,606 -s
601100 -prim -pb
java -cp /opt/TKBasisNAClimateNormals/lib/'*' tkbasisnaclimatenormal.TKBasisNAClimateNormal -fd 2010 -ld 2020 -e
201,205,207,210 -s 601100 -prim -pb
java -cp /opt/TKBasisNAClimateNormals/lib/'*' tkbasisnaclimatenormal.TKBasisNAClimateNormal -fd 2014 -ld 2020 -e
305,550 -s 601100 -prim -norules -pb
java -cp /opt/TKBasisNAClimateNormals/lib/'*' tkbasisnaclimatenormal.TKBasisNAClimateNormal -fd 2007 -ld 2020 -e
504 -s 601100 -prim -pb
java -cp /opt/TKBasisNAClimateNormals/lib/'*' tkbasisnaclimatenormal.TKBasisNAClimateNormal -fd 2008 -ld 2020 -e
801,802,803 -s 601100 -prim -pb
```

14 References

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Davidsen, E. et al., 1997: Orographically enhanced precipitation on the Faroe Islands. Personal note.

WMO, 2017. *WMO Guidelines on the Calculation of Climate Normals*. WMO-No. 1203. [online] World Meteorological Organization (WMO). Available at: <https://library.wmo.int/doc_num.php?explnum_id=4166> [Accessed 22 October 2021].

15 Previous Reports

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