World Meteorological Organization

Weather • Climate • Water

The decadal global climate summary

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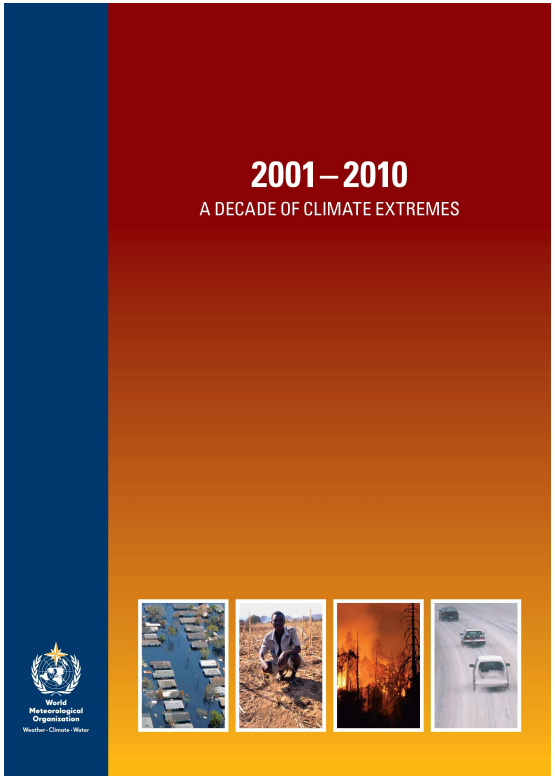
- History
- Features of the decade
- Input from members
- Hands-on session – Theory and practice

History



- In addition to the WMO annual statements on the status of the global climate (produced regularly since 1993) WMO produced, in 2003, a six year Climate Review covering 1996-2001

- The main content was based on the annual State of the Climate reports which are published by NCDC in the Bulletin of the American Meteorological Society

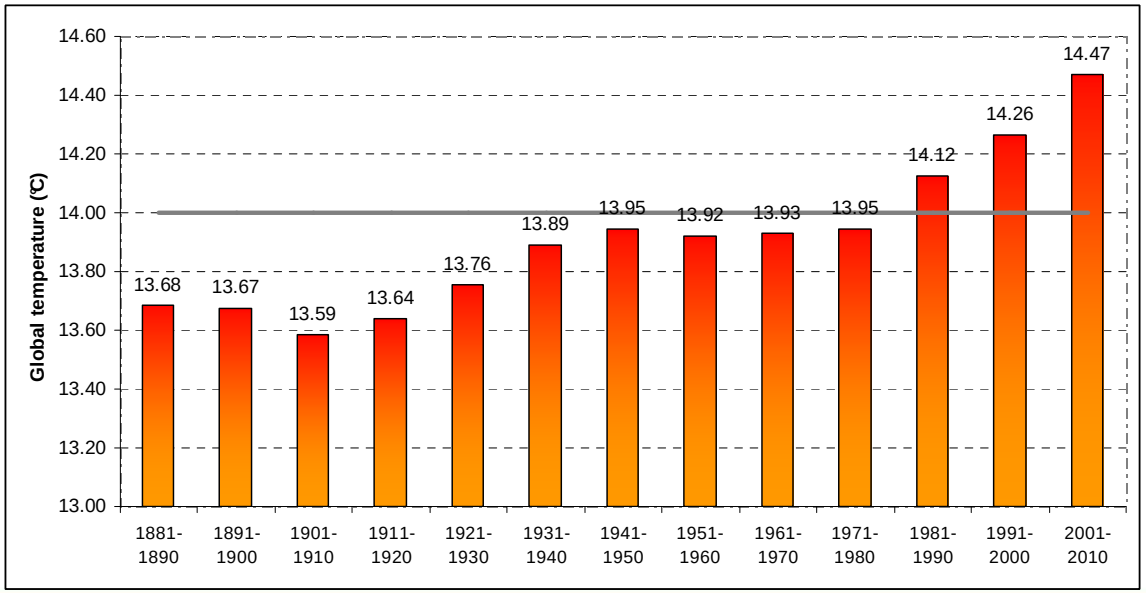
- In 2005, CCl agreed to publish a five year climate summary to complement the WMO annual statements

- Due to the lack of resources WMO decided to produce a decadal climate summary covering 2001-2010

- The publication coincides with the first decade of the twenty first century and aims at providing a decadal perspective of climate variability and change and assessing the current climate knowledge at global, regional and national levels

Features of the decade - temperature

- The decade 2001-2010 was characterized by a record in global temperature increase since sufficiently comprehensive global surface temperature measurement began in 1850
- For global land-surface air temperatures as well as for ocean-surface temperatures this decade was the warmest on record
- This trend is confirmed at national level where 96% of the countries had their warmest decade in 2001 to 2010 and 4% in 1991 to 2000
- The rate of temperature increase was particularly high in the northern hemisphere



Features of the decade – extreme events

• *Flooding* was reported by a great majority of countries as the most frequent extreme event during the last decade followed by droughts, heat waves, heavy rainfalls and severe storms.

• Consistent with the conclusions of the recent IPCC Special Report on Extremes, fewer minimum temperature records and more maximum temperature records were broken during 2001 – 2010 than in earlier decades.

• The decade saw two unprecedented heat waves in Western Europe in 2003 and Russia in 2010 with many associated fatalities and other severe health impacts.

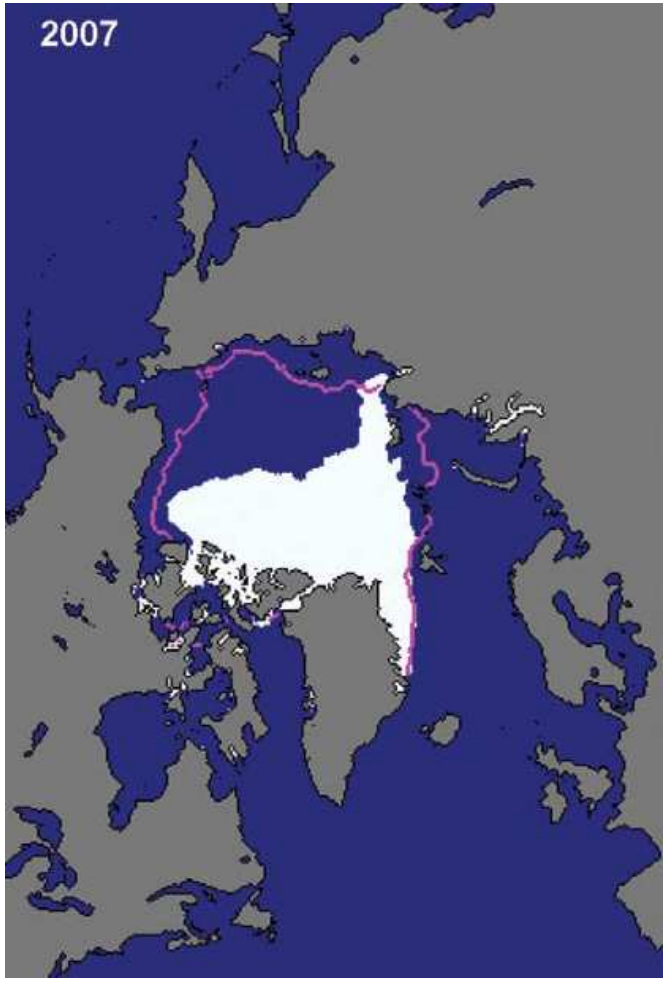
• The decade also saw the most costly Atlantic hurricane, Katrina, in 2005, and major flooding in Pakistan in 2010 with more than twenty million people affected. Many other extremes were also experienced elsewhere in the world.

Features of the decade – GHG and sea ice decline

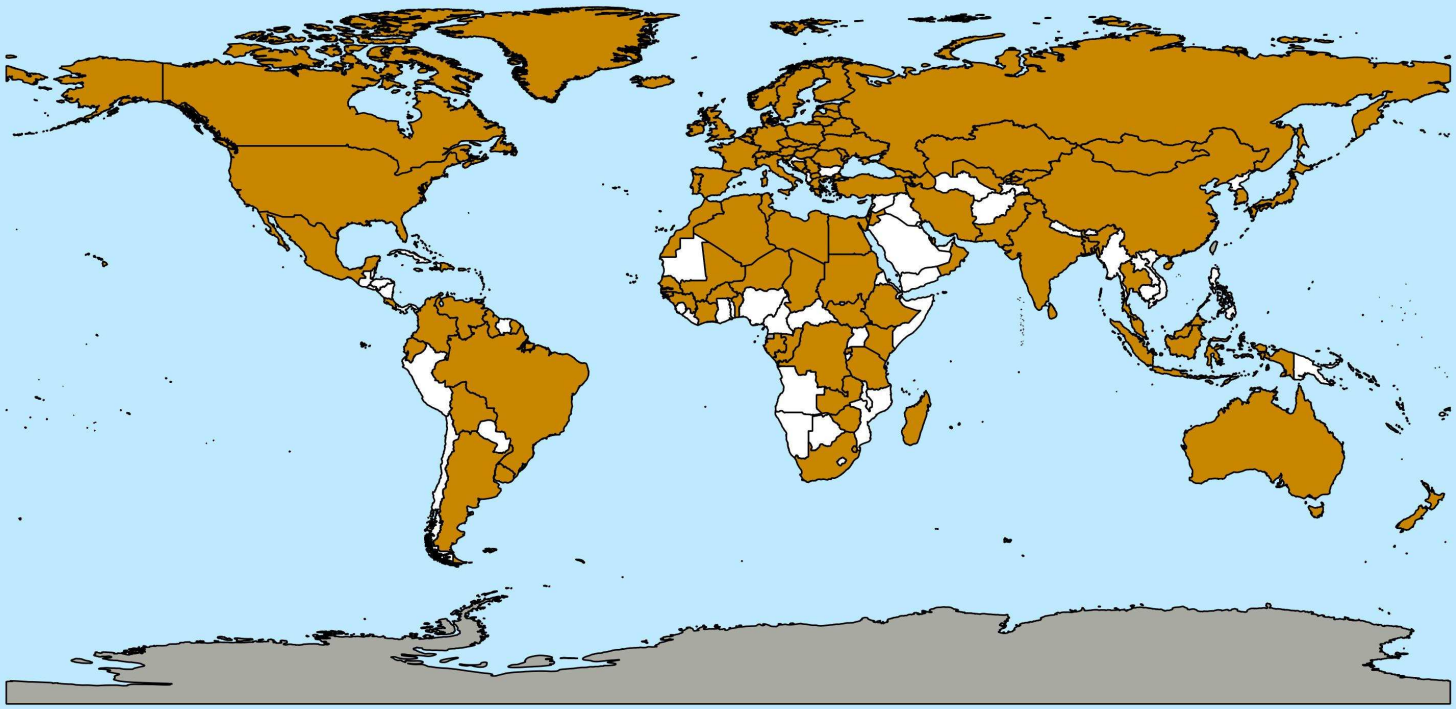
• Increases of the atmospheric content of greenhouse gases due to anthropogenic activities are recognized by IPCC as the key driving factors of the observed climate change.

• CO2 mixing ratio continued to increase through the decade, with a rate higher than in the previous decade, reaching 389 ppm by the end of the decade.
This value is the highest recorded for at least 10000 years and it is 39% higher than the mixing ratio at the beginning of the industrial era (1750).

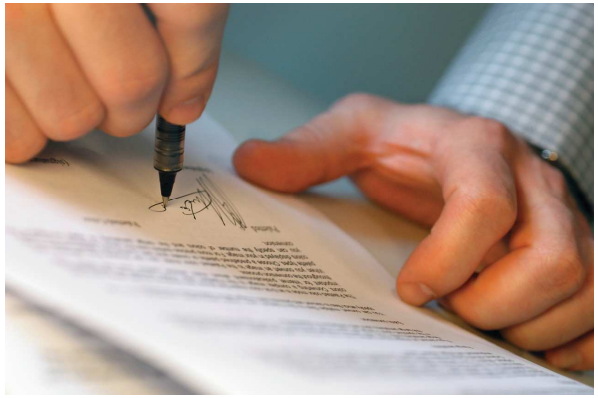
• The dramatic and continuing sea ice decline in the Arctic is one of the most prominent features of the changing state of the climate during the decade with the five lowest minimum sea ice extents at the end of the melting season all recorded in the second half of the decade with the record set in 2007.



Input from WMO Members to the DGCS



Hands-on session



Theory – Guide to Climatological Practices

Climatological standard normals

Climate normals are used for two principal purposes. They serve as a benchmark against which recent or current observations can be compared and they are widely used as a prediction of the conditions most likely to be experienced in a given location.

Under the WMO *Technical Regulations*, **climatological standard normals** are averages of climatological data computed for the following consecutive periods of 30 years: 1 January 1901 to 31 December 1930, 1 January 1931 to 31 December 1960, and so forth.

As far as possible, the data used in the calculation of climate normals and averages should be homogeneous.

Climate normals and averages should be calculated for as many stations as possible if it meets standards for the amount and completeness of available data. As a minimum, they should be calculated, if possible, for all stations whose data are distributed on the Global Telecommunication System

As a guide, normals or period averages should be calculated only when values are available for **at least 80 per cent** of the years of record, with **no more than three consecutive missing years**. An alternative option, when there is an extended period of missing data but reasonably complete data after that time, is to calculate a period average using only data from the years following the break in the record.

Theory – Guide to Climatological Practices
Daily and annual averages

Annual normals or averages should be calculated as the mean or sum of the 12 monthly normals or averages, without consideration of the varying lengths of the months. No missing monthly normals are permitted in the calculation.

It is recommended that a monthly value should **not** be calculated if **more than ten daily values** or **five or more consecutive daily values** are missing. In the case of elements for which the monthly value is a sum of daily values rather than a mean, a monthly value should be calculated only if either all daily observations are available, or if any missing days are incorporated in an observation accumulated over the period of missing data on the day when observations resume.

The best statistical approximation of an daily temperature average is based on the **integration of continuous observations over a period of time**; the higher the frequency of observations, the more accurate the average.
All ordinary climatological stations observe a daily maximum and minimum temperature. Hence, the recommended methodology for calculating average daily temperature is to take the mean of the daily maximum and minimum temperatures. Even though this method is not the best statistical approximation, its consistent use satisfies the comparative purpose of normals.

Decadal Global Climate Summary

Table A: Maximum and Minimum Values

TABLE A	Parameter	value	date	Station name	Coordinates	
					Lat	Lon
1961-1970	Highest Maximum Temperature (° C)					
	Lowest Minimum Temperature (° C)					
	Maximum 24-hr rainfall (mm)					
1971-1980	Highest Maximum Temperature (° C)					
	Lowest Minimum Temperature (° C)					
	Maximum 24-hr rainfall (mm)					
1981-1990	Highest Maximum Temperature (° C)					
	Lowest Minimum Temperature (° C)					
	Maximum 24-hr rainfall (mm)					
1991-2000	Highest Maximum Temperature (° C)					
	Lowest Minimum Temperature (° C)					
	Maximum 24-hr rainfall (mm)					
2001-2010	Highest Maximum Temperature (° C)					
	Lowest Minimum Temperature (° C)					
	Maximum 24-hr rainfall (mm)					

Highest Maximum Temperature: This value corresponds to the National highest maximum temperature (The National record of the decade).

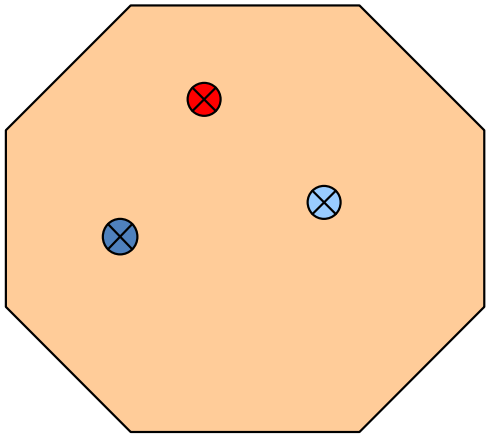
Lowest Minimum Temperature: This value corresponds to the National lowest minimum temperature (The National record of the decade).

Maximum 24-hour Rainfall: This corresponds to the National maximum rainfall of the decade recorded in 24 hours. The 24-h period must be the same for all the stations.

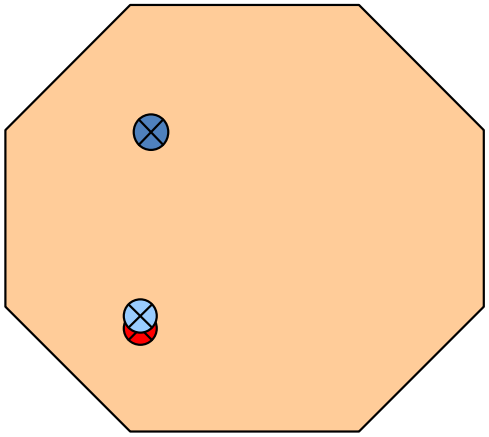
Times of observation are often different among networks. Summary observations such as temperature extremes or total precipitation made for one 24-hour period (such as from 0800 on one day to 0800 on the next day) are not equivalent to those made for a different 24-hour period (such as from 0000 to 2400).

RRmax Tmax Tmin

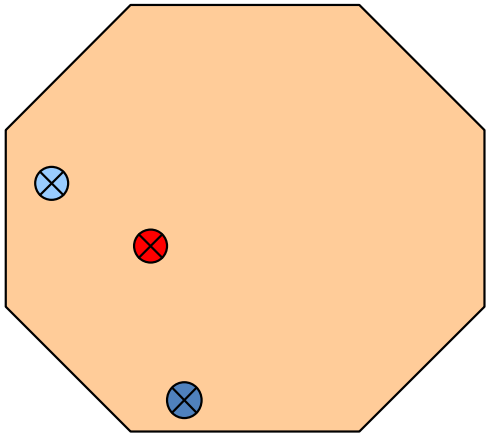
1961 - 1970



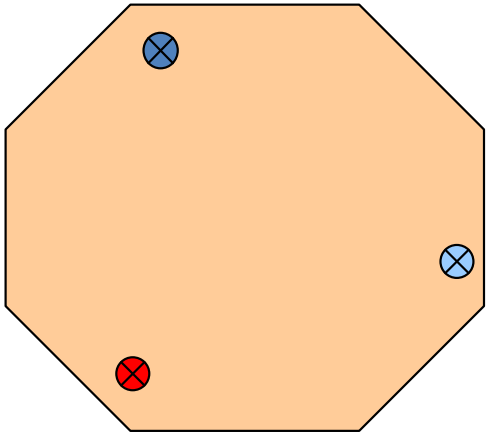
1971 - 1980



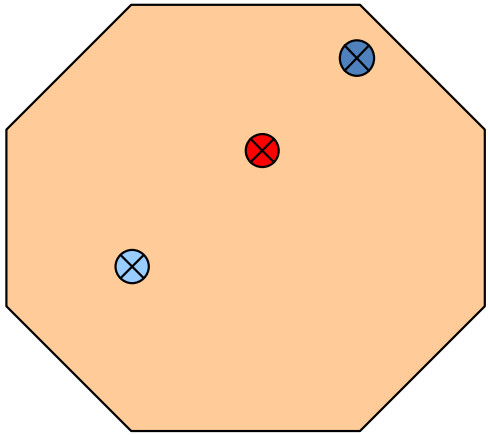
1981 - 1990

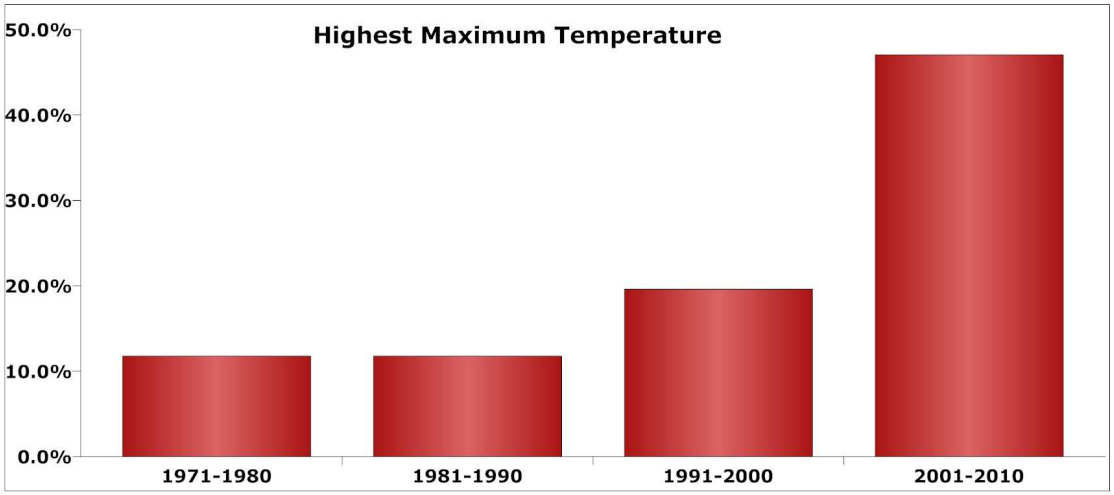


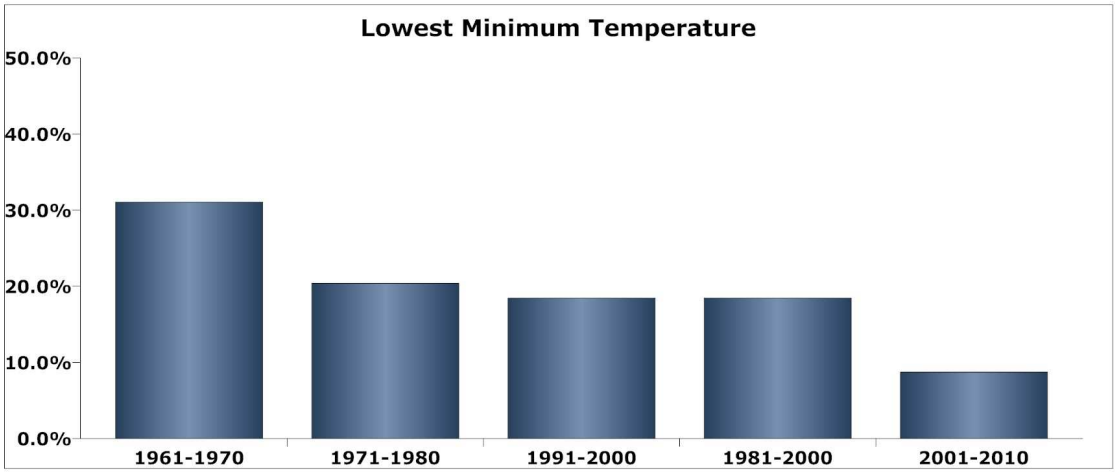
1991 - 2000

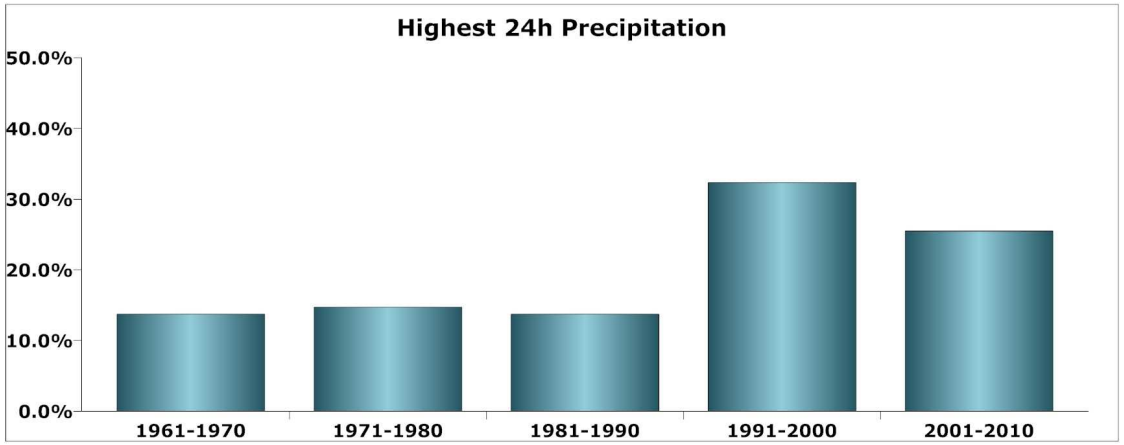


2001 - 2010




Highest Maximum Temperature
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
1971-1980
1981-1990
1991-2000
2001-2010


Lowest Minimum Temperature
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
1961-1970
1971-1980
1991-2000
1981-2000
2001-2010


Highest 24h Precipitation
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
1961-1970
1971-1980
1981-1990
1991-2000
2001-2010

Decadal Global Climate Summary

Table B: Decadal Temperature

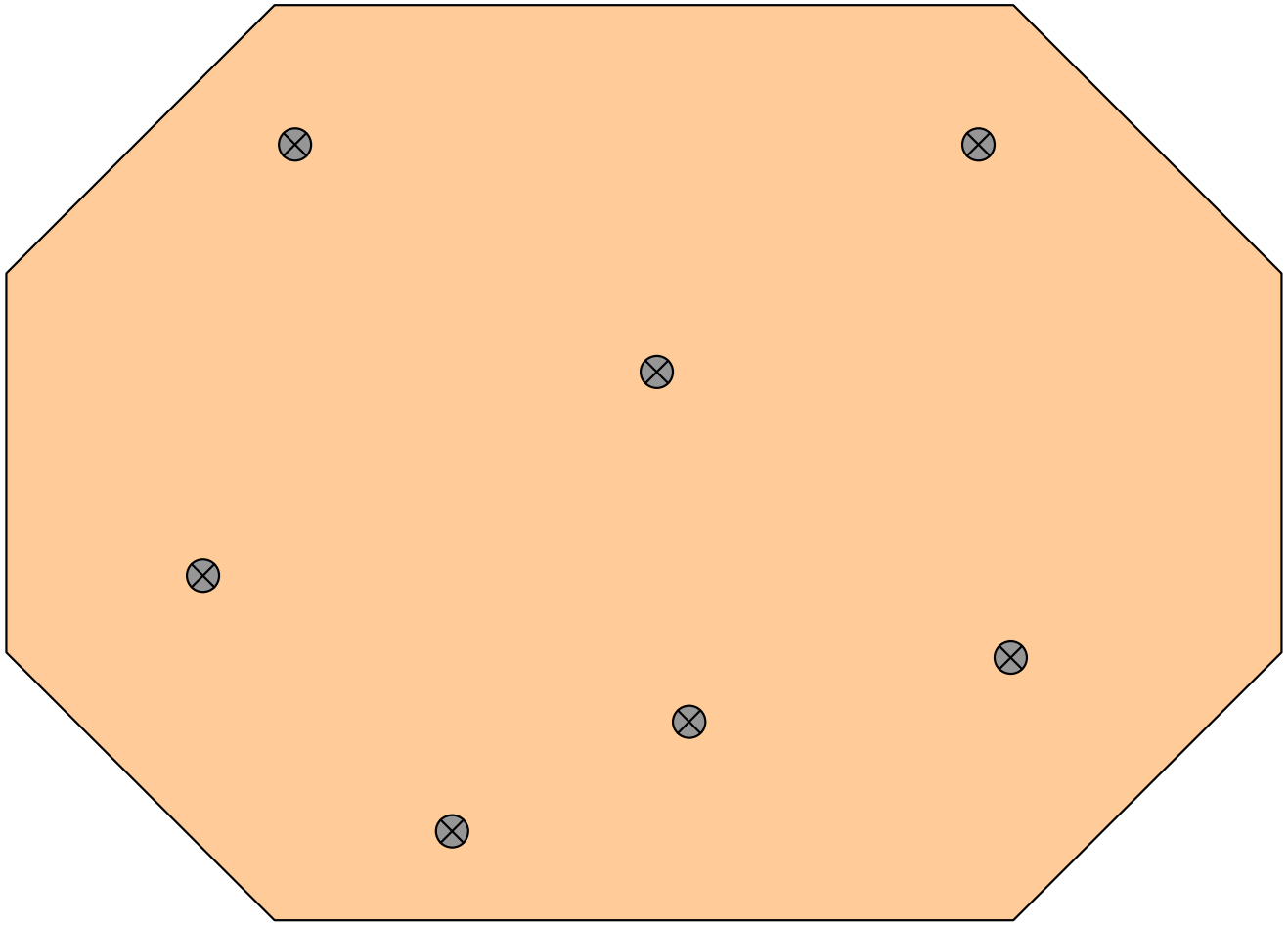
TABLE B DECADE	Mean Temperature (℃)	Anomaly with respect to 1961-1990 (℃)
1901-1910		
1911-1920		
1921-1930		
1931-1940		
1941-1950		
1951-1960		
1961-1970		
1971-1980		
1981-1990		
1991-2000		
2001-2010		

To complete this table it is suggested to take into account the following recommendations:

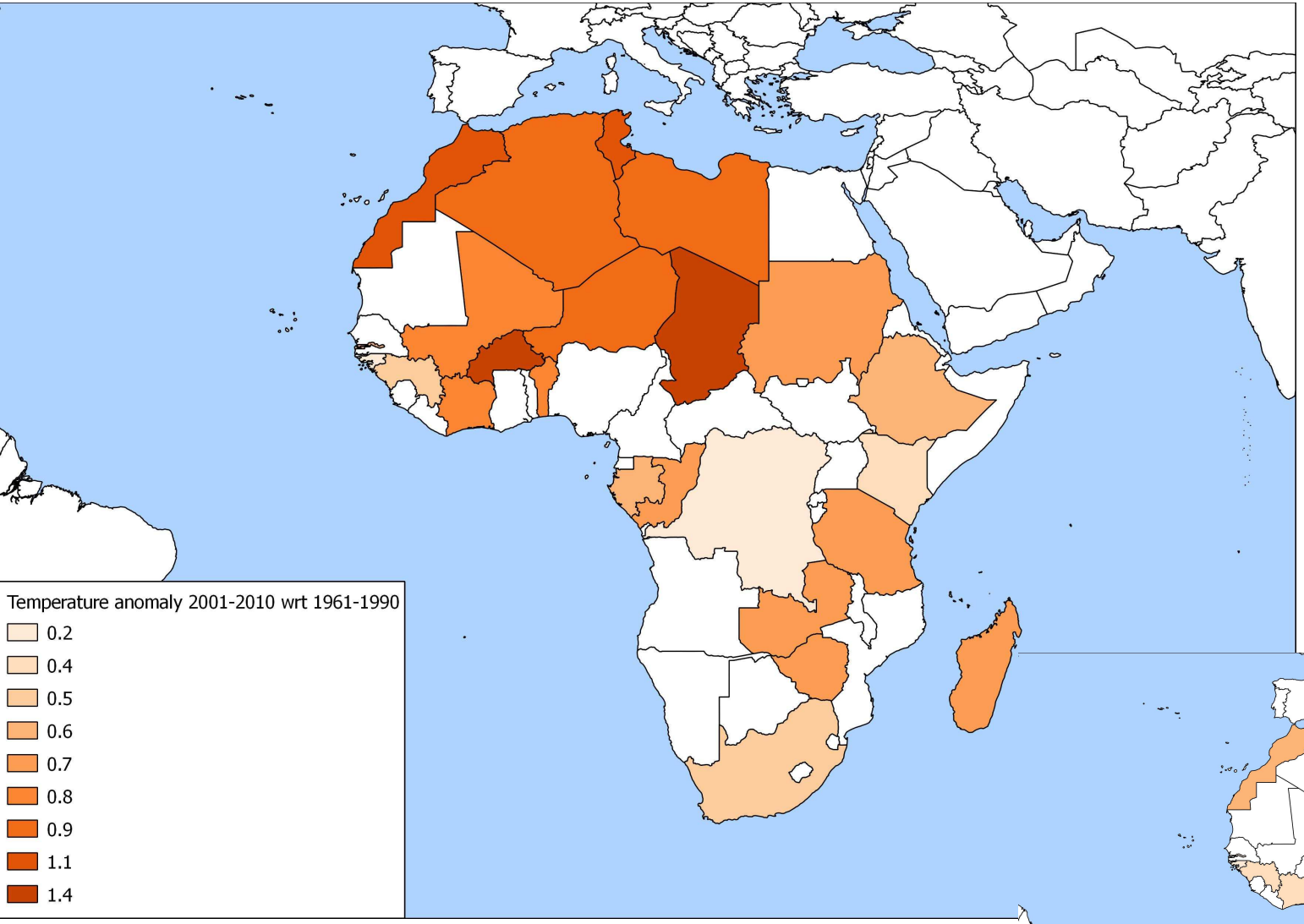
- It's recommended to use stations with the same period of observations and a good geographical distribution.
- From these stations compute the annual series of mean temperature and their anomaly with respect to 1961-1990 reference period.
- Calculate decadal averages of these two quantities for each station.

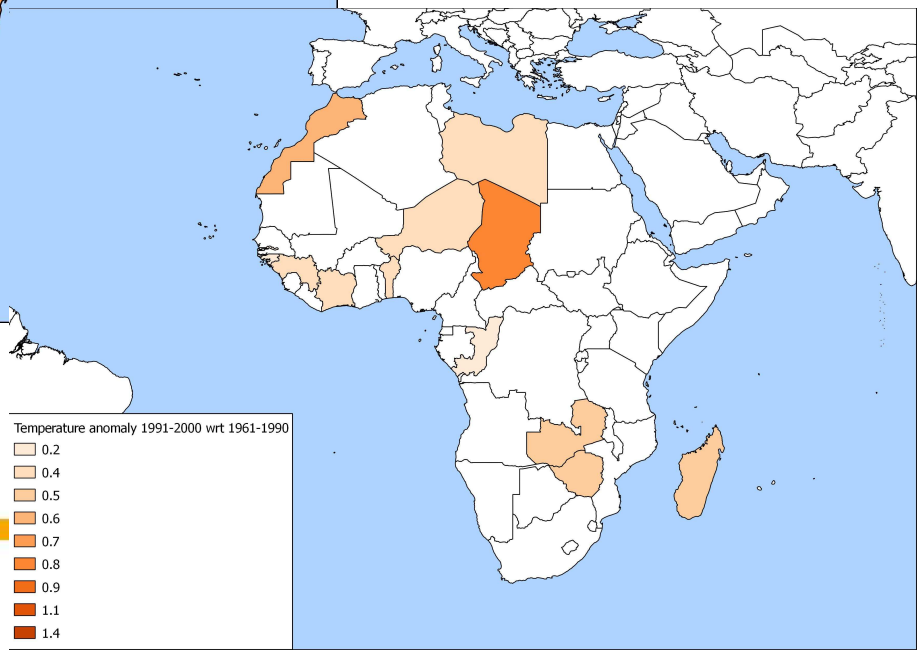
IMPORTANT: If you use another method to compute these averages please indicate and explain.

Calculate station anomaly (T-Tmean) before calculating national anomaly!!!



Temperature anomaly 2001-2010 wrt 1961-1990 for Africa





Decadal Global Climate Summary

Table C: Annual anomalies and ranking

TABLE C			
RANKING 2001-2010	YEAR	Temperature (℃)	Anomaly (℃)
Warmest			
2			
3			
4			
5			
6			
7			
8			
9			
Coldest			

Order the national annual mean temperature and anomaly from warmest to coldest with the correspondent year.

The anomaly has to be calculated with respect to 1961-1990 reference period. See explanations under Table B.

Each annual anomaly for the years: 2001,2002,…,2010 is required

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Thank you for your attention

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