



Appendix B: Student Worksheets

Student Handout 1

Activity 1 - Classifying the Major Climate Types

Task 1: Classify each city in Table 1 into one of the 5 major climate types. Use the World Map as reference.

Major climate types: A – Equatorial

B – Arid

C – Warm Temperate

D – Snow

E – Polar

Table 1. Classifying cities into the major climate types

City, Country	Climate Type
Anchorage, Alaska USA	
Bangalore, India	
Bangkok, Thailand	
Cairo, Egypt	
Kiev, Ukraine	
London, England	
New Delhi, India	
Riyadh, Saudi Arabia	
Tokyo, Japan	

Student Worksheets

Activity 1



Figure 1. Map of India, showing the location of New Delhi (Source: worldatlas.com).

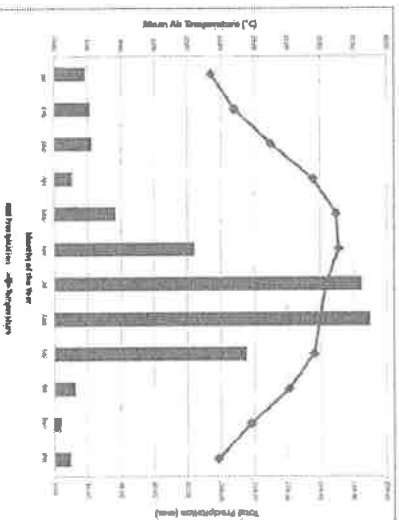


Figure 2. 30 year mean air temperature (C) and total precipitation (mm) for New Delhi, India (Source: NCDC).



Student Worksheets

Activity 1

Table 2: 30 year data for New Delhi, India (1979-2009, from NCDC)

Month	Mean Air Temperature (°C)	Monthly Accumulated Precipitation (mm)
January	13.53	18.58
February	16.98	21.53
March	22.52	22.78
April	28.88	10.47
May	32.33	36.61
June	32.72	84.02
July	30.87	184.49
August	29.99	190.25
September	29.06	115.45
October	25.32	12.59
November	19.54	3.97
December	14.65	9.42

Task 2: Calculate the annual temperature [T_{ann}] from Table 2 or the climograph in Figure 2 by adding up the monthly mean temperatures and dividing by 12 (the number of months in a year). Record this value in Table 2A.

Task 3: Record the coldest month's temperature (T_{min}) and the warmest month's temperature (T_{max}) in Table 2A.

Task 4: Add the monthly precipitation data to determine the accumulated annual precipitation (P_{ann}).

Task 5: Using either Table 1 or the Climograph in Figure 2 as well as the formulas below, determine when precipitation falls and calculate the Precipitation Threshold (P_{th}). Complete Table 2A.

If 70% or more of the precipitation falls during the high-sun (summer) half of the year (April through September in the Northern Hemisphere, or October through March in the Southern Hemisphere) use the following formula:

$$P_{th} = (T_{ann} \times 2) + 28$$

If 70% or more of the precipitation falls during the low-sun (winter) half of the year (November through March in the Northern Hemisphere, or April through September in the Southern Hemisphere) use the following formula:

$$P_{th} = T_{ann} \times 2$$

If precipitation is spread equally throughout the year use the following formula:

$$P_{th} = (T_{ann} \times 2) + 14$$

Student Worksheets

Activity 1

Table 2A: Determining the major climate classification for New Delhi, India

Table 2A		Value
T_{ann}	Annual Air Temperature (°C)	
T_{min}	Air Temperature of Coldest Month (°C)	
T_{max}	Air Temperature of Warmest Month (°C)	
P_{ann}	Accumulated Annual Precipitation (mm)	
P_{th}	Precipitation Threshold (mm)	

Task 6: Using Part 1 of the Köppen-Geiger Climate Classification key determine the major climate classification – Equatorial (A), Arid (B), Warm Temperate (C), Snow (D) or Polar (E).

New Delhi's main climate type is:



Student Worksheets

Activity 1

Sub-climate classification

Task 7: Study the data, follow the instructions and complete Table 2B.

Table 2B		Value
T _{rain}	Amount of precipitation in the driest month (mm)	
T _{winter}	Amount of precipitation in the wettest winter* month (mm)	
T _{winter}	Amount of precipitation in the driest winter* month (mm)	
P _{spring}	Amount of precipitation in the wettest summer* month (mm)	
P _{summer}	Amount of precipitation in the driest summer* month (mm)	

Are there at least 4 months with Air Temperature greater than 10° C (Vishno)

* Note: Winter and Summer are defined as half-years within this classification system. Therefore, winter is considered to be "low-sun" months (November through March in the Northern Hemisphere, or April through September in the Southern Hemisphere) and summer is considered to be "high-sun" months (April through September in the Northern Hemisphere, or October through March in the Southern Hemisphere).

Task 8: Go to Part 2 of the Köppen-Geiger Climate Classification key. Based on the major climate type determined by calculations in Table 2A (Equatorial, Arid, Warm Temperate, Snow, or Polar) determine the second sub-category (based on precipitation) and the third sub-category (based on temperature).

New Delhi's main climate type is:
(from Table 2A calculations)

New Delhi's first sub-climate classification is:

Second sub-climate classification is:

Köppen-Geiger Classification is:



Appendix C: Köppen-Geiger Climate Classification Key

Part 1 – Major Climate Types

1. Is the temperature of the warmest month [T_{max}] less than 10°C ?
No \longrightarrow Go to POLAR (Page 24)
Yes \longrightarrow Go to WARM TEMPERATE (Page 27)
2. Is the accumulated annual precipitation [P_{ann}] less than $10 \times P_{m}$?
No \longrightarrow Go to ARID (Page 25)
Yes \longrightarrow Go to EQUATORIAL (Page 26)
3. Is the temperature of the coldest month [T_{min}] more than or equal to 18°C ?
No \longrightarrow Go to WARM TEMPERATE (Page 27)
Yes \longrightarrow Go to SNOW (Page 29)
4. Is the temperature of the coldest month [T_{min}] less than 18°C but more than -3°C ?
No \longrightarrow Go to WARM TEMPERATE (Page 27)
Yes \longrightarrow Go to SNOW (Page 29)
5. Is the temperature of the coldest month [T_{min}] less than or equal to -3°C ?
Yes \longrightarrow Go to SNOW (Page 29)
No \longrightarrow Go to POLAR (Page 24)

Welcome

Introduction

Learning Activity

Protocols

Appendix



Köppen-Geiger Climate Classification Key

Part 2 – Sub-climate Classification

POLAR (E)

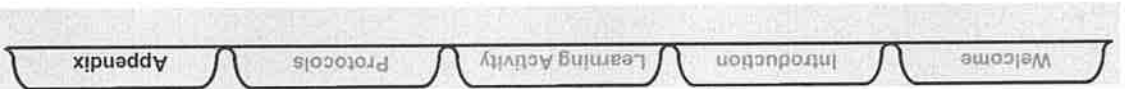
1. Is [T_{max}] less than 0°C ?
No \longrightarrow FROST (F)
Yes \longrightarrow TUNDRA (T)
2. Is [T_{max}] more than 0°C but less than 10°C ?
Yes \longrightarrow TUNDRA (T)

Köppen-Geiger Climate Classification Key

Part 2 – Sub-climate Classification

ARID (B)

1. Is $[P_{ann}]$ more than $5 \times P_{in}$?
No \longrightarrow STEPPE (S) - Then go to 3 below
Yes \longrightarrow DESERT (W) - Then go to 3 below
2. Is $[P_{ann}]$ less than or equal to $5 \times P_{in}$?
Yes \longrightarrow DESERT (W) - Then go to 3 below
No \longrightarrow STEPPE (S) - Then go to 3 below
3. Is $[T_{ann}]$ less than or equal to 18°C ?
Yes \longrightarrow COLD (K)
No \longrightarrow HOT (H)
Is $[T_{ann}]$ more than 18°C ?
Yes \longrightarrow HOT (h)



Köppen-Geiger Climate Classification Key

Part 2 – Sub-climate Classification

EQUATORIAL (A)

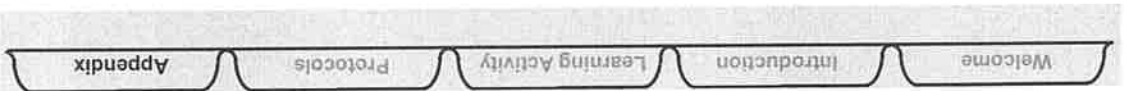
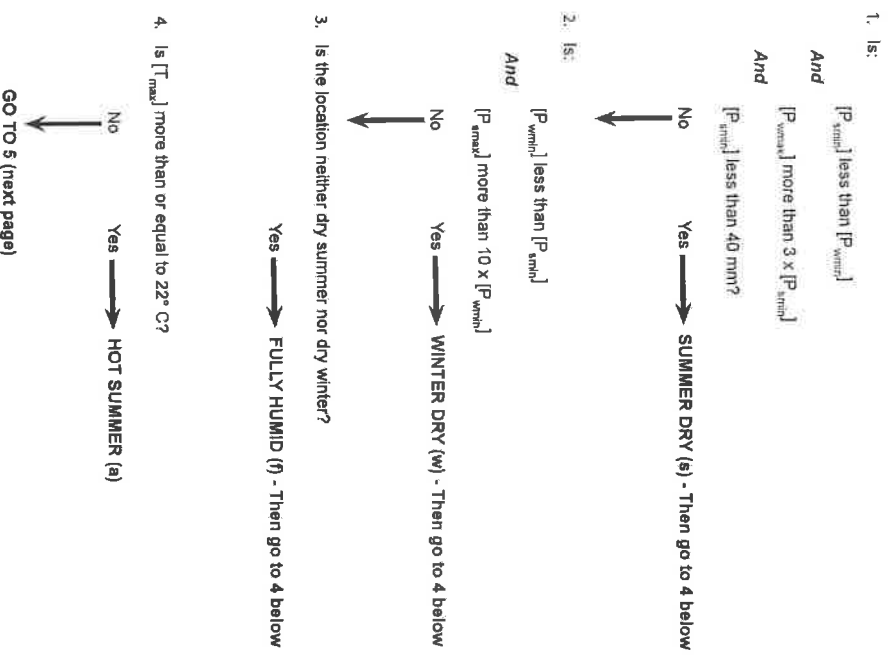
1. Is $[P_{min}]$ more than or equal to 60 mm?
No \longrightarrow RAINFOREST FULLY HUMID (f)
Yes \longrightarrow RAINFOREST FULLY HUMID (f)
2. Is $[P_{ann}]$ less than or equal to $5 \times P_{in}$?
No \longrightarrow MONSOONAL (m)
Yes \longrightarrow MONSOONAL (m)
3. Is $[P_{ann}]$ less than or equal to 60 mm?
No \longrightarrow SAVANNAH SUMMER DRY (s)
Yes \longrightarrow SAVANNAH SUMMER DRY (s)
4. Is $[P_{min}]$ less than or equal to 60 mm?
No \longrightarrow SAVANNAH WINTER DRY (w)
Yes \longrightarrow SAVANNAH WINTER DRY (w)



Köppen-Geiger Climate Classification Key

Part 2 – Sub-climate Classification

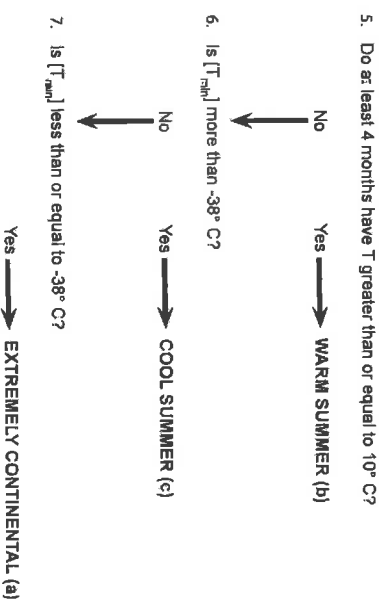
WARM TEMPERATE (C)



Köppen-Geiger Climate Classification Key

Part 2 – Sub-climate Classification

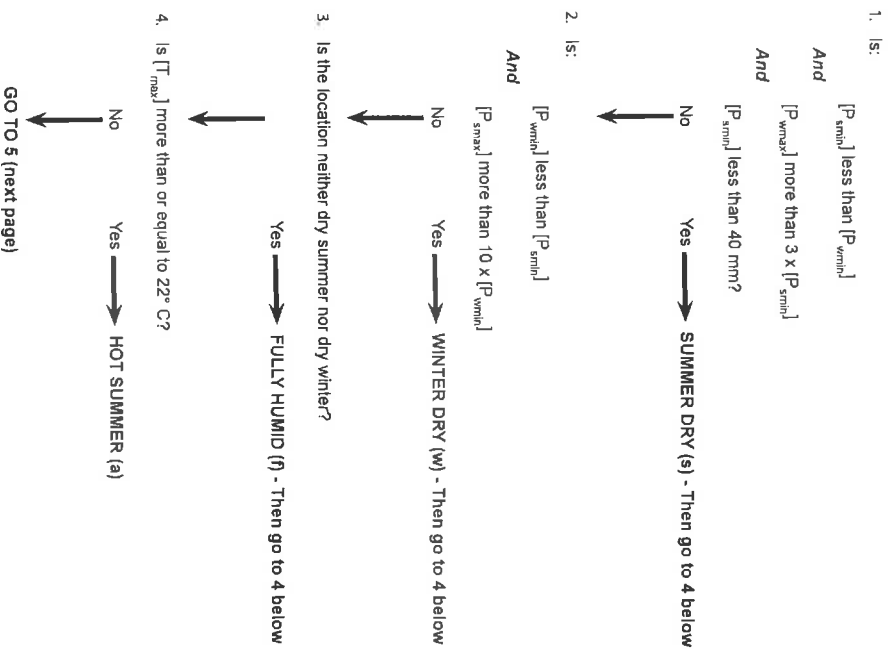
WARM TEMPERATE (C) (Continued)



Köppen-Geiger Climate Classification Key

Part 2 – Sub-climate Classification

SNOW (D)



Appendix

Protocols

Learning Activity

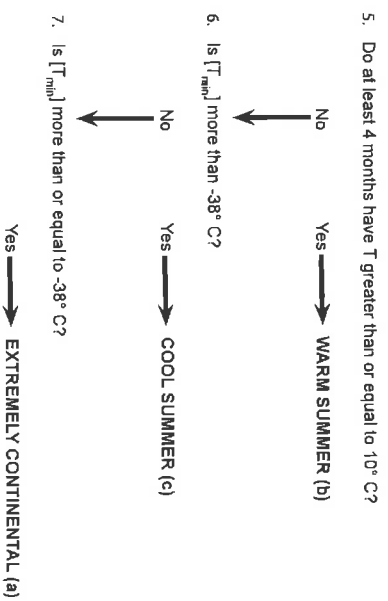
Introduction

Welcome

Köppen-Geiger Climate Classification Key

Part 2 – Sub-climate Classification

SNOW (D) (Continued)



Appendix D: Köppen-Geiger Climate Classification Map and Classification Descriptions

Meteorol. Z., 15, 2006

M. Kottek et al.: World Map of the Köppen-Geiger climate classification updated

261

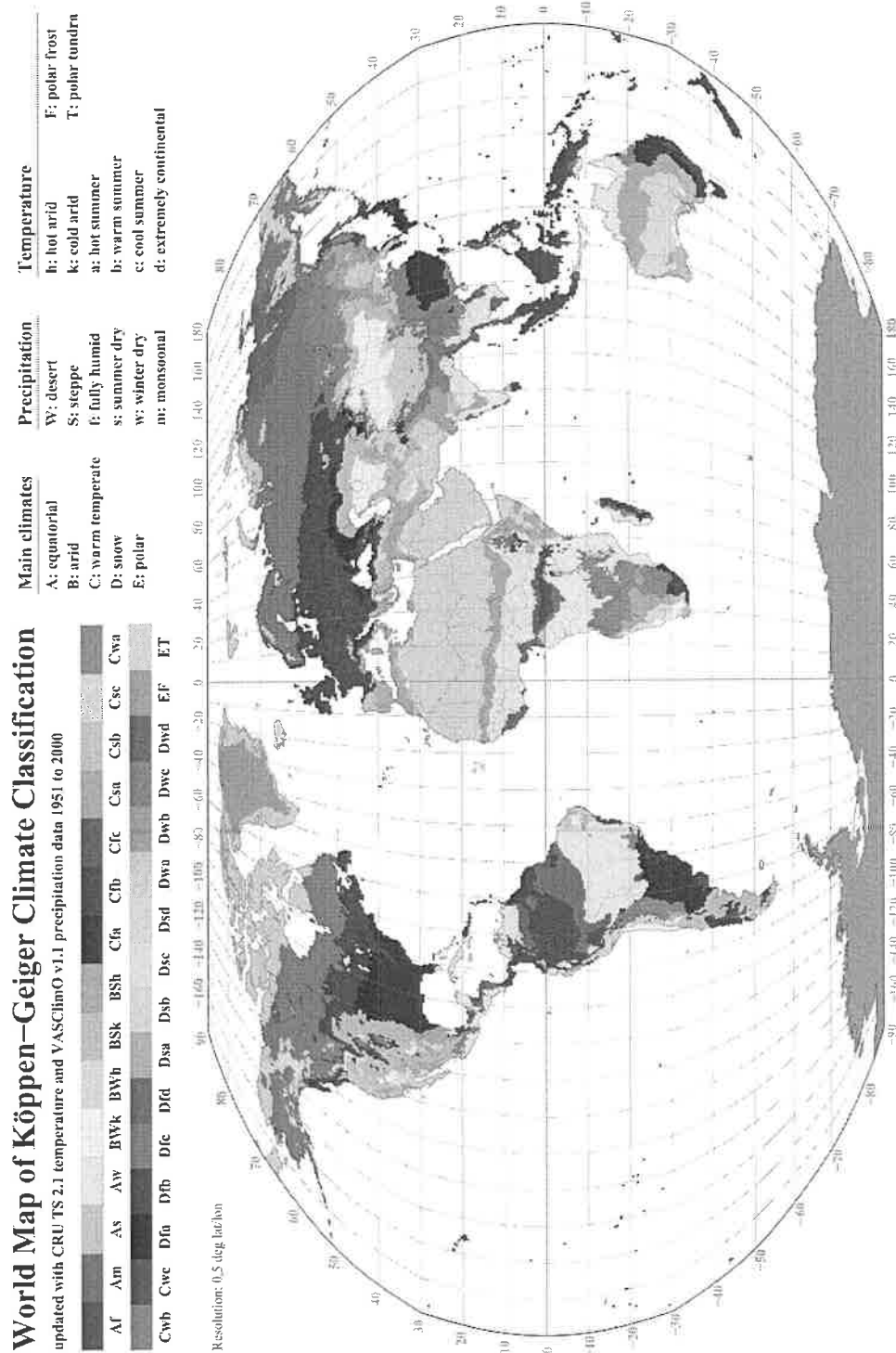


Figure 3: World Map of Köppen-Geiger climate classification updated with mean monthly CRU TS 2.1 temperature and VASCLimO v 1.1 precipitation data for the period 1951 to 2000 on a regular 0.5 degree latitude/longitude grid. (Source: Markus Kottek et al., "World Map of the Köppen-Geiger climate classification updated," Meteorologische Zeitschrift, Vol. 15, No. 3, 259-263 (June 2006). http://www.schweizerbart.de/resources/downloads/paper_free/55034.pdf

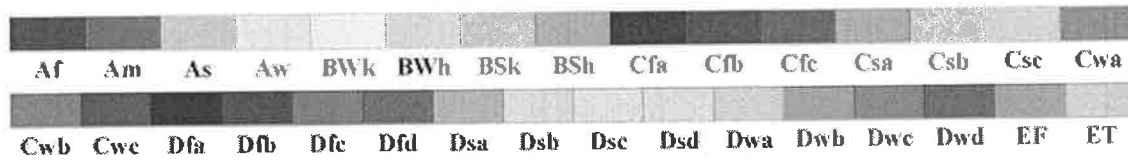


Köppen-Geiger Climate Classification Category Descriptions

There are five major types of climate classification: Equatorial, Arid, Warm Temperate, Snow, and Polar. Each type can then be further classified by precipitation and temperature conditions. This results in 31 different climate classifications. Here we provide a general description of each, color coded to the legend below and the Köppen-Geiger Climate Classification Google Earth kml file (see: <http://globe.gov/scrc/pilots/classification>).

World Map of Köppen–Geiger Climate Classification

updated with CRU TS 2.1 temperature and VASCLimO v1.1 precipitation data 1951 to 2000



Equatorial rainforest, fully humid (Af): A climate which sees all twelve months with very warm temperatures and a lot of rainfall.

Equatorial monsoon (Am): Area characterized by all twelve months having a mean temperature of greater than or equal to 18° C and a mean annual accumulated precipitation greater than or equal to $25 \times (100 - P_{\min})$ where P_{\min} is the month with the least amount of precipitation (mm).

Equatorial savannah with dry summer (As): Area characterized by all twelve months having a mean temperature greater than or equal to 18° C and a summer month with precipitation less than 60 mm.

Equatorial savannah with dry winter (Aw): Area characterized by all twelve months having a mean temperature greater than or equal to 18° C and a winter month with precipitation less than 60 mm.

Arid desert cold (BWk): A climate whose mean annual temperature is less than 18° C and is too dry to support most plants.

Arid desert hot (BWh): A climate whose mean annual temperature is greater than or equal to 18° C and is too dry to support most plants.

Arid Steppe cold (BSk): A climate whose mean annual temperature is less than 18° C and is too dry to support a forest, but not dry enough to be a desert, usually consisting of grassland plains.

Arid Steppe hot (BSh): A climate whose mean annual temperature is greater than or equal to 18° C and is too dry to support a forest, but not dry enough to be a desert, usually consisting of grassland plains.

Warm temperate fully humid with hot summer (Cfa): A climate where the coldest month is warmer than -3° C but colder than +18° C and precipitation is generally the same throughout the year. This climate is usually found inland in the interior of continents or on their east coast, usually between 25° and 35° latitude.



Köppen-Geiger Climate Classification Category Descriptions

Warm temperate fully humid with warm summer (Cfb): A climate where the coldest month is warmer than -3°C but colder than $+18^{\circ}\text{C}$ and precipitation is generally the same throughout the year. This climate is usually found inland in the interior of continents or on their east coast, usually between 35° and 45° latitude.

Warm temperate fully humid with cool summer (Cfc): A climate where the coldest month is warmer than -3°C but colder than $+18^{\circ}\text{C}$ and precipitation is generally the same throughout the year. This climate is usually found inland in the interior of continents or on their east coast, usually between 45° and 55° latitude, but may extend to 65° latitude.

Warm temperate with dry, hot summer (Csa): A climate where the coldest month is warmer than -3°C but colder than $+18^{\circ}\text{C}$ and summers are dry and hot. This climate is usually found inland on western sides of continents.

Warm temperate with dry, warm summer (Csb): A climate where the coldest month is warmer than -3°C but colder than $+18^{\circ}\text{C}$ and summers are dry and mild. This climate is usually found closer to the coast on western sides of continents.

Warm temperate with dry, cool summer (Csc): A climate where the coldest month is warmer than -3°C but colder than $+18^{\circ}\text{C}$ and summers are dry and cool. This climate is usually found on the western coast of continents, where they are influenced by cold ocean currents.

Warm temperate with dry winter and hot summer (Cwa): A climate where the coldest month is warmer than -3°C but colder than $+18^{\circ}\text{C}$ and dry winters. This climate is also characterized by hot, humid summers and is usually found on the interiors of continents or on their east coast.

Warm temperate with dry winter and warm summer (Cwb): A climate where the coldest month is warmer than -3°C but colder than $+18^{\circ}\text{C}$ and a noticeable difference between the dry winters and rainy summers. This climate is usually found in the highlands of some tropical countries.

Warm temperate with dry winter and cool summer (Cwc): A climate where the coldest month is warmer than -3°C but colder than $+18^{\circ}\text{C}$ and a noticeable difference between the dry winters and rainy summers. This climate is usually found in the highest altitudes of some tropical countries.

Snow with fully humid hot summer (Dfa): A climate where there is at least one month colder than -3°C and precipitation is generally the same throughout the year, and summers can get very hot. This climate is usually found between 35° and 45° latitude.

Snow fully humid warm summer (Dfb): A climate where there is at least one month colder than -3°C and precipitation is generally the same throughout the year. This climate is usually found between 45° and 55° latitude, but may extend up to 60° latitude.



Köppen-Geiger Climate Classification Category Descriptions

Snow fully humid cool summer (*Dfc*): A climate where there is at least one month colder than -3°C and precipitation is generally the same throughout the year. This climate is found even further toward the poles, usually found between 45° and 55° latitude, but may extend up to 60° latitude.

Snow fully humid extremely continental (*Dfd*): A climate where there is at least one month colder than -3°C and precipitation is generally the same throughout the year. This climate is found only in eastern Siberia and is notable for its extreme winter cold.

Snow dry, hot summer (*Dsa*): A climate where there is at least one month colder than -3°C and summers are dry and hot. This climate is usually at high elevations near locations that are warm temperate with dry, hot summers.

Snow dry, warm summer (*Dsb*): A climate where there is at least one month colder than -3°C and summers are dry and warm. This climate is usually at even higher elevations near locations that are warm temperate with dry, hot summers.

Snow dry, cool summer (*Dsc*): A climate where there is at least one month colder than -3°C and summers are dry and warm. This climate is usually at the highest elevations near locations that are warm temperate with dry, hot summers.

Snow dry summer extremely continental (*Dsd*): A climate where there is at least one month colder than -3°C and winter is wetter than summer. This climate is found only in eastern Siberia and is notable for its extreme winter cold.

Snow dry winter hot summer (*Dwa*): A climate where there is at least one month colder than -3°C with dry winters and wet summers. This climate is usually found in eastern Asia between 35° and 45° latitude.

Snow dry winter warm summer (*Dwb*): A climate where there is at least one month colder than -3°C with dry winters and wet summers. This climate is usually found in eastern Asia between 45° and 55° latitude but may extend up to 60° latitude.

Snow dry winter cool summer (*Dwc*): A climate where there is at least one month colder than -3°C with dry winters and wet summers. This climate is usually found in eastern Asia between 55° and 65° latitude but may extend up to 70° latitude.

Snow dry winter extremely continental (*Dwd*): A climate where there is at least one month colder than -3°C with dry winters and wet summers. This climate is found only in eastern Siberia and is notable for its extreme winter cold.

Polar frost (*EF*): A climate where each month is colder than 10°C , but the warmest month is still warmer than 0°C . This climate is generally found on the northern edges of Northern Hemisphere continents and surrounding islands.

Polar tundra (*ET*): A climate where each month is colder than 0°C . This climate is generally found in Antarctica and inner Greenland.

