Climate Finder

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Edited by Aaron Smalley for The Guild Companion

"For there to be an As climate type, there will have to be an incredible natural phenomena for such to occur, such as a high elevation mountain range, which causes a "rain shadow" effect."

Climate Finder

Although not exhaustively authoritative, this document can aid in determining a locale's climate. This will only work for a world that is very Earth-like. The year should have 12 months, each month with 29-32 days, each day with twenty-four 3600-second hours. If your world's year is significantly shorter or longer than this, then this document will not work. Likewise, it will not work if the world's day is significantly shorter or longer. The world should also have a *summer* and a *winter* season in the temperate zones with an Orbital Obliquity similar to the Earth (22° to 25°). The table below shows what is classified as the summer and winter seasons for the Northern Hemisphere on Earth.

Season	Months
Summer	April, May, June, July, August, September (183 days)
Winter	October, November, December, January, February, March (182 days)

Of course, the seasons for the Southern Hemisphere would be reversed as shown above.

If you use a different calendarial system for your world, simply divide the year as equally as possible into *summer* and *winter* seasons, as shown in the table above.

Helpful Data

Although it is not truly needed, it is helpful to have the data as listed below.

- Mean Annual Precipitation (MAP) in millimeters
- Mean Annual Temperature (MAT) in °C
- Mean Monthly Temperature of Hottest Month in °C
- Mean Monthly Temperature of Coldest Month in °C
- Number of months Mean Monthly Temperature ≥ 10°C
- Mean Monthly Precipitation of Driest Month in millimeters
- Mean Monthly Precipitation of Driest Winter Month in millimeters
- Mean Monthly Precipitation of Wettest Winter Month in millimeters
- Mean Monthly Precipitation of Driest Summer Month in millimeters
- Mean Monthly Precipitation of Wettest Summer Month in millimeters
- Which Season (summer or winter) does the Driest Month Occur (**ONLY** Savannahs)
- Dryness Factor (**ONLY** B climates and see Dryness Factor below)
- Elevation of locale in meters (**ONLY** Highlands)

The reason the data listed above is not truly needed is because you can go through the steps in this climate finder, answering each question as desired. Simply record the answer for each question.

Dryness Factor

This is only needed for the *B* climate types. You will need the Mean Monthly Precipitation in millimeters for all twelve months, then use the below to calculate the Dryness Factor. MAT = Mean Annual Temperature (in °C).

- Total the precipitation for each season(summer and winter).
- Divide the *summer* precipitation by the Mean Annual Precipitation.
  - If answer is ≥0.7, then Dryness Factor = 2 × MAT + 28.
- Divide the *winter* precipitation by the Mean Annual Precipitation.
  - If answer is ≥0.7, then Dryness Factor = 2 × MAT.
- Otherwise, Dryness Factor = 2 × MAT + 14.

Highlands

- Is the elevation of the locale ≥ 2300 meters (7546 feet)?
  - If No, go to **Polar** Section.
  - If Yes, is the Mean Monthly Temperature of the hottest month > 0°C?
    - If No, then climate is **HF** (Highland Frost or Highland Ice Cap).
    - If Yes, then climate is **HT** (Highland Tundra).

Polar

- Is the Mean Monthly Temperature of the hottest month ≤ 10°C?
  - If No, go to **Arid** Section.
  - If Yes, is the Mean Monthly Temperature of the hottest month > 0°C?
    - If No, then climate is **EF** (Polar Frost or Polar Ice Cap).
    - If Yes, then climate is **ET** (Polar Tundra).

Arid

- Is the Mean Annual Precipitation < (10 × Dryness Factor)?
  - If No, go to **Is Tropical?** Section.
  - If Yes, continue below.
- Is the Mean Annual Precipitation < (5 × Dryness Factor)?
  - If No, is the Mean Annual Temperature ≥ 18°C?
    - If No, then climate is **BSk** (Cool Steppe).
    - If Yes, then climate is **BSh** (Hot Steppe).
  - If Yes, is the Mean Annual Temperature ≥ 18°C?
    - If No, then climate is **BWk** (Cool Waste).
    - If Yes, then climate is **BWh** (Hot Waste).

Is Tropical?

- Is the Mean Monthly Temperature of the coldest month ≥ 18°C?
  - If No, go to **Is Cold?** Section.
  - If Yes, go to **Tropical** Section.

Tropical

- Is the Mean Monthly Precipitation of the driest month ≥ 60mm?
  - If No, go to next question.
  - If Yes, then climate is **Af** (Tropical Wet).
- Is Mean Monthly Precipitation of driest month ≥ (100 × (Mean Annual Precipitation − 25))?
  - If No, go to next question.
  - If Yes, then climate is **Am** (Tropical Monsoon).
- In which season does the driest month occur?
  - If Summer, then climate is **As** (Dry Summer Savannah).
  - If Winter, then climate is **Aw** (Dry Winter Savannah).

Special Note: *Although there are very few As (Dry Summer Savannah) climate regions here on Earth, it does not mean such cannot occur on another world, especially a magical world. See **Savannah Climates (As, Aw)** below for further information.*

Is Cold?

- Is the Mean Monthly Temperature of the coldest month > −3°C?
  - If No, go to **Cold Temperate** Section.

- If Yes, go to **Warm Temperate** Section.

Cold Temperate

- If… (*MUST* meet *ALL* 3 below):
  - 1) Mean Monthly Precipitation of driest winter month > Mean Monthly Precipitation of driest summer month
    - *AND*
  - 2) Mean Monthly Precipitation of wettest winter month > (Mean Monthly Precipitation of driest summer month × 3)
    - *AND*
  - 3) Mean Monthly Precipitation of driest summer month < 40mm
    - If Yes to all 3, then first two letters are **Ds**, *and* go to **Cold Temperate Summer Type** Section.
    - If No, go to next question.
- If… (*MUST* meet *ALL* 2 below):
  - 1) Mean Monthly Precipitation of driest summer month > Mean Monthly Precipitation of driest winter month
    - *AND*
  - 2) Mean Monthly Precipitation of wettest summer month > (Mean Monthly Precipitation of driest winter month × 10)
    - If Yes to all 2, then first two letters are **Dw**, *and* go to **Cold Temperate Summer Type** Section.
    - If No, then first two letters are **Df**, *and* go to **Cold Temperate Summer Type** Section.

Cold Temperate Summer Type

- If Mean Monthly Temperature of hottest month ≥ 22°C, third letter is **a**.
- If Mean Monthly Temperature of hottest month < 22°C *AND* (number of months Mean Monthly Temperature ≥ 10°C) is ≥ 4, third letter is **b**.
- If (number of months Mean Monthly Temperature ≥ 10°C) is < 4 *AND* Mean Monthly Temperature of the coldest month ≥ -38°C, third letter is **c**.
- Otherwise, third letter is **d**.

Warm Temperate

- If… (*MUST* meet *ALL* 3 below):
  - 1) Mean Monthly Precipitation of driest winter month > Mean Monthly Precipitation of driest summer month
    - *AND*
  - 2) Mean Monthly Precipitation of wettest winter month > (Mean Monthly Precipitation of driest summer month × 3)
    - *AND*
  - 3) Mean Monthly Precipitation of driest summer month < 40mm
    - If Yes to all 3, then first two letters are **Cs**, *and* go to **Warm Temperate Summer Type** Section.
    - If No, go to next question.
- If… (*MUST* meet *ALL* 2 below):
  - 1) Mean Monthly Precipitation of driest summer month > Mean Monthly Precipitation of driest winter month
    - *AND*
  - 2) Mean Monthly Precipitation of wettest summer month > (Mean Monthly Precipitation of driest winter month × 10)
    - If Yes to all 2, then first two letters are **Cw**, *and* go to **Warm Temperate Summer Type** Section.
    - If No, then first two letters are **Cf**, *and* go to **Warm Temperate Summer Type** Section.

Warm Temperate Summer Type

- If Mean Monthly Temperature of hottest month > 22°C, third letter is **a**.
- If Mean Monthly Temperature of hottest month < 22°C *AND* (number of months Mean Monthly Temperature ≥ 10°C) is ≥ 4, third letter is **b**.
- Otherwise, third letter is **c**.

Savannah Climates (As, Aw)

Here on Earth, there are no As climate types, except in very small localized regions caused by a "*rain shadow*" effect due to mountains. The interior southwestern quadrant of the large island of Hawai'i has an As climate due to the trade winds coming from the northeast during the *summer* months with most, if not all, moisture falling on the northeastern faces of Mauna Kea and Mauna Loa.
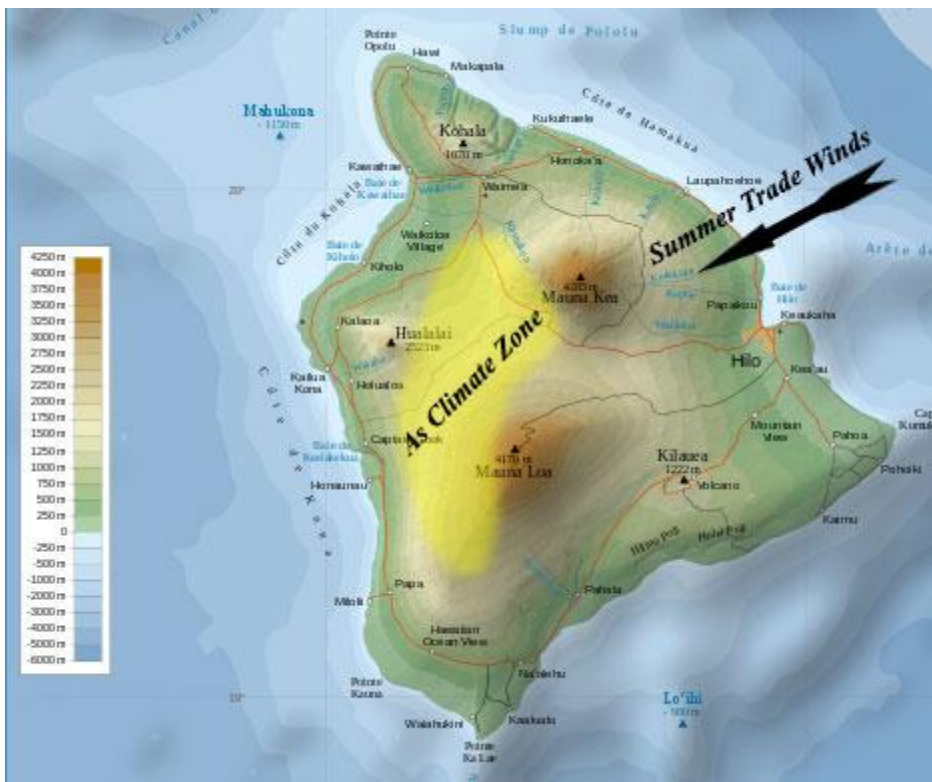
The As indicates that it is the summer season that is the driest. However, this is very unlikely since it is the ITCZ (Inter-Tropical Convergence Zone) which dictates the wet and dry seasons in tropical savannahs. During the summer season in the tropical savannah regions, the ITCZ will be bringing in moisture, thus causing the summer season to be wet. Obversely, during the winter season, the ITCZ will be on the other side of the equator, causing the winter season to be the dry season.

The only other region on Earth that has an As climate (as far as I know) is on the island of Sri Lanka, due to the "*rain shadow*" effect of its highlands. During the monsoon season in Myanmar and Thailand, the northeastern quadrant of Sri Lanka is an As climate.

Thus, although it may not be completely impossible for there to be an As climate type, it is so improbable, it may as well be impossible. For there to be an As climate type, there will have to be an incredible natural phenomena for such to occur, such as a high elevation mountain range, which causes a "rain shadow" effect. Otherwise, you will be required to create a world that is entirely fantastical in nature where the laws of nature do not exist. Also, notice that the As row in the table below is highlighted in red to indicate it is a highly improbable climate type. Not impossible, just highly improbable.

Longer/Shorter Years

Unfortunately, I have no suggestions for a world's year that is significantly longer or shorter than the above listed suggestion of 12 months, with each month having 29-32 days, each day equal to twenty-four 3600-second hours. I am currently working on a method to help in calculating for a year/month/day that are significantly longer/shorter. Until then, the only advice I can give is to research such on your own. Just make sure to use university/science web sites for your information. Wikipedia is not completely reliable, since anyone with an account can change a Wikipedia page. But, you can use the list of References and External Site Links at the bottom of each page (if there are any) for more reliable information. Specifically, look for links to Journal Articles and university/science websites.

Longer/Shorter Days

The only suggestion I can offer here is to remember that the slower the world's rotation (longer day) means that the diurnal temperature range (DTR) will be greater. Obversely, the faster the world's rotation (shorter day) means that the DTR will be smaller. For example, if the Earth rotated once every 36 hours, its DTR may be about 270 to 310 °K instead of its normal 280 to 295 °K. If Earth rotated once every 18 hours, the DTR may only be 285 to 290 °K. *Please note that these DTRs have not been calculated and are best guesstimates.*

Climate Codes Descriptions

Letters			Description	Rule
1st	2nd	3rd		
A			Tropical	$T_{cold} \geq 18°C$
	f		- rainforest	$P_{dry} \geq 60mm$
	m		- monsoon	Not(Af) & $P_{dry} \geq 100mm - MAP \div 25$
	s		- savannah, dry summer	Not(Af) & $P_{sdry} < 100mm - MAP \div 25$
	w		- savannah, dry winter	Not(Af) & $P_{wdry} < 100mm - MAP \div 25$
B			Arid	$MAP < 10 \times P_{threshold}$
	W		- waste (desert)	$MAP < 5 \times P_{threshold}$
	S		- steppe	$MAP \geq 5 \times P_{threshold}$
		h	- hot	$MAT \geq 18°C$
		k	- cold	$MAT < 18°C$
C			Temperate	$T_{hot} \geq 10°C$ & $0°C < T_{cold} < 18°C$
	s		- dry summer	$P_{sdry} < 40mm$ & $P_{sdry} < P_{wwet} \div 3$
	w		- dry winter	$P_{wdry} < P_{swet} \div 10$
	f		- no dry season	Not(Cs OR Cw)
		a	- hot summer	$T_{hot} \geq 22°C$
		b	- warm summer	Not(a) & $T_{mon10} \geq 4$
		c	- cold summer	Not(a OR b)
D			Cold	$T_{hot} \geq 10°C$ & $T_{cold} \leq 0°C$
	s		- dry summer	$P_{sdry} < 40mm$ & $P_{sdry} < P_{wwet} \div 3$
	w		- dry winter	$P_{wdry} < P_{swet} \div 10$
	f		- no dry season	Not(Ds OR Dw)

		a	- hot summer	$T_{hot} \geq 22°C$
		b	- warm summer	Not(a) & $T_{mon10} \geq 4$
		c	- cold summer	Not(a OR b OR d)
		d	- severely cold winter	Not(a OR b) & $T_{cold} < -38°C$
E			Polar Climate	$T_{hot} < 10°C$
	T		- tundra	$T_{hot} > 0°C$
	F		- frost	$T_{hot} \leq 0°C$
H			Highland	elevation ≥ 2300 meters
	T		- tundra	$T_{hot} > 0°C$
	F		- frost	$T_{hot} \leq 0°C$

Climate Codes Descriptions Table Notes

- **Highland** climate is a new climate class that uses the same rules as Polar Climate, except elevation is the primary rule. It has yet to gain full acceptance, but it is slowly being accepted by most climatologists.
- T_{cold} = temperature of the coldest month
- T_{hot} temperature of the hottest month
- T_{mon10} = number of months above 10°C
- MAT = mean annual temperature
- P_{dry} = precipitation of the driest month
- $P_{threshold}$ = precipitation threshold, which varies according to the following rules:
  - if 70% of MAP occurs in winter, then $P_{threshold}$ = 2 × MAT
  - if 70% of MAP occurs in summer, then $P_{threshold}$ = 2 × MAT + 28
  - otherwise $P_{threshold}$ 2 × MAT + 14
- P_{sdry} = precipitation of the driest summer month
- P_{wdry} = precipitation of the driest winter month
- P_{wwet} = precipitation of the wettest winter month
- P_{swet} = precipitation of the wettest summer month
- MAP = mean annual precipitation

Climate Color Codes for Cartography

Notes: Hover cursor over a table row and it will be highlighted. The colors listed below are only a suggestion. Whatever color schema you choose is your choice. Color Codes are listed in RGB (0 to 255), CMYK (0% to 100%), and HTML hexicode values.

Climate Code	Color (RGB)			Color (CMYK)				Color Hexicode	Color Example
	R	G	B	C	M	Y	K		
Af	0	51	0	80	51	89	66	003300	
Am	0	102	0	88	34	100	28	006600	
As	0	153	0	84	13	100	3	009900	
Aw	0	204	0	73	0	100	0	00cc00	
BWh	204	0	0	13	100	100	4	cc0000	
BWk	153	0	0	24	100	100	25	990000	
BSh	204	153	0	21	39	100	1	cc9900	
BSk	153	102	0	33	57	100	18	996600	
Cfa	0	255	0	63	0	100	0	00ff00	
Cfb	102	255	102	50	0	90	0	66ff66	
Cfc	153	255	153	37	0	59	0	99ff99	
Csa	255	140	0	0	55	100	0	ff8c00	

Csb	255	174	0	0	36	100	0	ffae00	
Csc	255	207	0	1	17	99	0	ffcf00	
Cwa	102	255	140	49	0	69	0	66ff8c	
Cwb	102	255	174	47	0	51	0	66ffae	
Cwc	102	255	207	45	0	33	0	66ffcf	
Dfa	0	0	153	100	98	5	6	000099	
Dfb	0	0	204	93	86	0	0	0000cc	
Dfc	0	0	255	88	77	0	0	0000ff	
Dfd	51	51	255	83	74	0	0	3333ff	
Dsa	102	0	255	75	78	0	0	6600ff	
Dsb	153	0	255	62	80	0	0	9900ff	
Dsc	204	0	255	45	82	0	0	cc00ff	
Dsd	255	0	255	27	82	0	0	ff00ff	
Dwa	0	102	255	81	61	0	0	0066ff	
Dwb	0	153	255	70	34	0	0	0099ff	
Dwc	0	204	255	63	0	0	0	00ccff	
Dwd	0	255	255	52	0	13	0	00ffff	
ET	204	204	204	19	15	16	0	cccccc	
EF	255	255	255	0	0	0	0	ffffff	
HT	153	153	51	43	29	100	5	999933	
HF	204	204	102	23	10	75	0	cccc66	

Universal Temperature Codes

Although not used or accepted extensively, some climatologists do use the below thermal codes to add a final pair of letters to the climate codes. These letter codes will replace the third letter for the BS, BW, C, and D climates.

Example: *Where I used to live in Wilmington, NC is classified as a Cfa climate type. Using the below, this would be changed to Cfhl, indicating very hot summers and mild winters.*

Example: *When I lived in Albuquerque, NM is classified as a BSk climate type. Using the below, this would be changed to BShk, indicating very hot summers and cool winters.*

Notice, the above climate classification system does not use the Universal Thermal Code system since it is still too new and has yet to actually be implemented. Below is the most current (as of 2010) definition of this thermal code system.

Code	Description	Mean Average Celsius Range		Mean Average Farenheit Range		Season		C & D Climate 3rd Letter (avg.)	
		Min	Max	Min	Max			Summer	Winter
i	severely hot	≥ 35		≥ 95		summers			
h	very hot	28	34.9	82.4	94.8				
a	hot	23	27.9	73.4	82.2			a	
b	warm	18	22.9	64.4	73.2			b	
l	mild	10	17.9	50	64.2		winters	c	
k	cool	0.1	9.9	32.2	49.8				a

o	cold	-9.9	0	14.2	32				b
c	very cold	-24.9	-10	-12.8	14				c
d	severely cold	-39.9	-25	-39.8	-13				d
e	excessively cold	≤ -40		≤ -40					

Flowchart

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NOAA. Climate Center.

NOAA. National Climatic Data Center.