CHELSA

Climatologies at High resolution for the Earth Land Surface Areas

BIOCLIM+ A novel set of global climate-related predictors at kilometre-resolution: Technical specification

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CHELSA: File Specification

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Revision history

Version	Date	Changes
1.0	13.06.2022	Initial document
1.1	22.09.2022	Added Köppen-Geiger table

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1. Introduction

A multitude of physical and biological processes on which ecosystems and human societies depend are governed by climatic conditions. Understanding how these processes are altered by climate change is central to mitigation efforts. Based on mechanistically downscaled climate data, we developed a set of climate-related variables at yet unprecedented spatiotemporal detail as a basis for environmental and ecological analyses. We created gridded data for near-surface relative humidity (hurs), cloud area fraction (clt), near-surface wind speed (sfcWind), vapour pressure deficit (vpd), surface downwelling shortwave radiation (rsds), potential evapotranspiration (pet), climate moisture index (cmi), and site water balance (swb), at a monthly temporal and 30 arcsec spatial resolution globally starting 1980 until 2018. At the same spatial resolution, we further estimated climatological normals of frost change frequency (fcf), snow cover days (scd), potential net primary productivity (npp), growing degree days (gdd), and growing season characteristics for the periods 1981-2010, 2011-2040, 2041-2070, and 2071-2100, considering three shared socioeconomic pathways (SSP126, SSP370, SSP585) and five Earth system models. Time-series variables showed high accuracy when validated against observations from meteorological stations. Climatological normals were also highly correlated to observations although some variables showed notable biases, e.g., snow cover days (scd). Together, the data sets presented here allow improving our understanding of patterns and processes that are governed by climate, including the impact of recent and future climate changes on the world’s ecosystems and associated services to societies.

2. CMIP6 ISIMIP3b

2.1 ISIMIP3b BA

CHELSA-BIOCLIM+ is currently only available for a selected number of CMIP6 scenarios. Since the number of models and rcps has increased a lot from CMIP5 to CMIP6, we do not provide a full list of all possible GCM and SSP combinations at 1km resolution anymore. We rather opted for an approach of preselecting GCMs and SSP. The selection follows the models given for the Intersectoral Impact Model Intercomparion Project (ISIMIP). Before downscaling to 1km the models have been bias corrected using a trend-preserving bias correction following (Lange 2019). GCM selection follow that of ISIMIP3b documented here: https://www.isimip.org/documents/413/ISIMIP3b_bias_adjustment_fact_sheet_gWHNhgH.pdf

The priority of the model is given following ISIMIP3b. If less than five models are used, GCMs selection should follow the priority with priority=1 equals highest priority, and priority=5 equals lowest priority.

Some of the models show spatial interpolation artefacts from the statistical downscaling employed in ISIMIP3b_BA. These artefacts are an effect of the statistical downscaling in ISIMIP3b_BA, not from CHELSA, and therefore we cannot remove them.

For a total selection of all possible GCM and scenario combinations for various timeperiods, we provide the chelsa_cmip6 python package available here: https://gitlabext.wsl.ch/karger/chelsa_cmip6

Table 3.1 Climate Scenario Specifiers

Scenario specifier	Description
ssp126	SSP1-RCP2.6 climate as simulated by the GCMs.
ssp370	SSP3-RCP7 climate as simulated by the GCMs.
ssp585	SSP5-RCP8.5 climate as simulated by the GCMs.

Table 3.2. Climate forcing data and source for the CHELSA CMIP6 ISIMIP3 data. The priority of models follows the suggestions of the ISIMIP3b protocol.

title	model	institution	native resolution	ensemble member	priority
GFDL-ESM4	gfdl-esm4	National Oceanic and Atmospheric Administration, Geophysical Fluid Dynamics Laboratory, Princeton, NJ 08540, USA	288x180	r1i1p1f1	1
UKESM1-0-LL	ukesm1-0-ll	Met Office Hadley Centre, Fitzroy Road, Exeter, Devon, EX1 3PB, UK	192x144	r1i1p1f2	2
MPI-ESM1-2-HR	mpi-esm1-2-hr	Max Planck Institute for Meteorology, Hamburg 20146, Germany	384x192	r1i1p1f1	3
IPSL-CM6A-LR	ipsl-cm6a-lr	Institut Pierre Simon Laplace, Paris 75252, France	144x143	r1i1p1f1	4
MRI-ESM2-0	mri-esm2-0	Meteorological Research Institute, Tsukuba, Ibaraki 305-0052, Japan	320x160	r1i1p1f1	5

3. Format and File Organization

All files are provided as georeferenced tiff files (GeoTIFF). GeoTIFF is a public domain metadata standard which allows georeferencing information to be embedded within a TIFF file. Additional information included in the file are: map projection, coordinate systems, ellipsoids, datums, and fill values.

All GeoTIFF files are saved as integer with a compression = deflate, predictor = 2, and an internal scale and offset in case of continuous variables. Scale and offset are internally stored in the GeoTIFF files and are supported by GDAL Version 2.3 or higher.

In some cases, problems have been reported using older versions of GDAL or ArcGIS. In this case the scale and offset has to be set manually for the variables.

GeoTIFF can be viewed using standard GIS software such as:
SAGA GIS – (free) http://www.saga-gis.org/
ArcGIS - https://www.arcgis.com/
QGIS - (free) www.qgis.org
DIVA – GIS - (free) http://www.diva-gis.org/

GRASS – GIS - (free) https://grass.osgeo.org/

3.1 Dimensions

All CHELSA-BIOCLIM+ files contain a variable that define the dimensions of longitude and latitude. The time variable is usually encoded in the filename.

Table 3.1. Dimension Variables

Name	Description	type	Attribute
longitude	Longitude	double	degrees_east
latitude	Latitude	double	degrees_north
variable	variable	int	variable

3.2 Variables

All variables of CHELSA-BIOCLIM+ are time-averaged and contain either monthly, annual means, or long term normals (climatologies), but not mixtures of these. Instantaneous parameters are not provided. Monthly time-averaged are files usually based on means of synoptic hours. Monthly files represent averages for the calendar months, accounting for leap years. For monthly means, each file contains a single month. For annual means or accumulations, files contain a single year. For climatological values, a file contains the means of a given period (e.g. 1981-2010).

4. Grid Structure

All global CHELSA products are in a geographic coordinate system referenced to the WGS 84 horizontal datum, with the horizontal coordinates expressed in decimal degrees. The CHELSA layer extents (minimum and maximum latitude and longitude) are a result of the coordinate system inherited from the 1-arc-second GMTED2010 data which itself inherited the grid extent from the 1-arc-second SRTM data.

Grid extent:

Attribute		value
Resolution		0.0083333333
West extent (minimum X-coordinate, longitude):		−180.0001388888
South extent (minimum Y-coordinate, latitude)		−90.0001388888
East extent (maximum X-coordinate, longitude)		179.9998611111
North extent (maximum Y-coordinate, latitude)		83.9998611111
Rows		20,800
Columns		43,200

Note that because of the pixel center referencing of the input GMTED2010 data the full extent of each CHELSA grid as defined by the outside edges of the pixels differs from an integer value of latitude or longitude by 0.000138888888 degree (or 1/2 arc-second). Users of products based on the legacy GTOPO30 product should note that the coordinate referencing of CHELSA (and GMTED2010) and GTOPO30 are not the same. In GTOPO30, the integer lines of latitude and longitude fall directly on the edges of a 30-arc-second pixel. Thus, when overlaying CHELSA with products based on GTOPO30 a slight shift of 1/2 arc-second will be observed between the edges of corresponding 30-arc-second pixels.

5. File Naming Conventions

The filename of each CHELSA data product follows a similar structure including the respective model used, the variable short name, the respective time variables, and the accumulation (or mean) period in the following basic format:

CHELSA_[short_name]_[timeperiod]_[Version].tif

For CMIP6 data:

CHELSA_[short_name]_[timeperiod]_[model] _[ssp] _[Version].tif

6. Changes between version 1 and 2

- Shift from ERA-Interim to ERA5 as forcing data.
- Version 2 uses a temperature lapse rate based on the 950 and 850 hPa pressure level from the ERA5 reanalysis atmospheric temperature instead of estimating the temperature lapse rate through the entire atmosphere.
- Version 2 uses an improved bias correction for precipitation that wraps around the dateline. Precipitation is also bias corrected for systematic gauge undercatch using (Beck et al. 2020).
- All variables are saved as integers with a given offset and scale embedded in the geotiff file to arrive at e.g. Celsius or kg m^-2 (mm) (only for climatologies).

7. Variable Names

Table 7.1 gives the variable short names, longnames, units, scale, offsets, and explanations. Scale and offset are internally stored in the GeoTIFF files and are supported by GDAL Version 2.3 or higher. In some cases, problems have been reported using older versions of GDAL or ArcGIS. In this case the scale and offset has to be set manually for the variables. This can be done by first multiplying the raster values with the 'scale' value and then adding the 'offset' value.

7.1. Climatologies

shortname	longname	unit	scale	offset	explanation
cmi_max	Maximum monthly climate moisture index	kg m^{-2} $month^{-1}$	0.1	0	The climate moisture index of the month with the highest precipitation surplus
cmi_mean	Mean monthly climate moisture index	kg m^{-2} $month^{-1}$	0.1	0	Average monthly climate moisture index over 1 year
cmi_min	Minimum monthly climate moisture index	kg m^{-2} $month^{-1}$	0.1	0	The climate moisture index of the month with the highest precipitation deficit
cmi_range	Annual range of monthly climate moisture index	kg m^{-2} $month^{-1}$	0.1	0	Difference between maximum and minimum monthly climate moisture index
cmi_01, …, cmi_12	Monthly climate moisture indicies	kg m^{-2} $month^{-1}$	0.1	0	Climate moisture indices for each month
fcf	Frost change frequency	count	-	-	Number of events in which tmin or tmax go above, or below 0°C
fgd	first day of the growing season TREELIM	julian day	-	-	first day of the growing season according to TREELIM (https://doi.org/10.1007/s00035-014-0124-0)

gdd0	Growing degree days heat sum above 0°C	°C	0.1	0	heat sum of all days above the 0°C temperature accumulated over 1 year.
gdd5	Growing degree days heat sum above 5°C	°C	0.1	0	heat sum of all days above the 5°C temperature accumulated over 1 year.
gdd10	Growing degree days heat sum above 10°C	°C	0.1	0	heat sum of all days above the 10°C temperature accumulated over 1 year.
gddlgd0	Last growing degree day above 0°C	julian day	-	-	Last day of the year above 0°C
gddlgd5	Last growing degree day above 5°C	julian day	-	-	Last day of the year above 5°C
gddlgd10	Last growing degree day above 10°C	julian day	-	-	Last day of the year above 10°C
gdgfgd0	First growing degree day above 0°C	julian day	-	-	First day of the year above 0°C
gdgfgd5	First growing degree day above 5°C	julian day	-	-	First day of the year above 5°C
gdgfgd10	First growing degree day above 10°C	julian day	-	-	First day of the year above 10°C
gsl	growing season length TREELIM	number of days	-	-	Length of the growing season
gsp	Accumulated precipitation amount on growing season days TREELIM	kg m^{-2} gsl^{-1}	0.1	0	precipitation sum accumulated on all days during the growing season based on TREELIM (https://doi.org/10.1007/s00035-014-0124-0)
gst	Mean temperature of the growing season TREELIM	°C	0.1	-273.15	Mean temperature of all growing season days based on TREELIM (https://doi.org/10.1007/s00035-014-0124-0)
hurs_max	Maximum monthly near-surface relative humidity	%	0.01	0	The highest monthly near-surface relative humidity
hurs_mean	Mean monthly near-surface relative humidity	%	0.01	0	Average monthly near-surface relative humidity over 1 year
hurs_min	Minimum monthly near-surface relative humidity	%	0.01	0	The lowest monthly near-surface relative humidity

hurs_range	Annual range of monthly near-surface relative humidity	%	0.01	0	Difference between maximum and minimum near-surface relative humidity
hurs_01, …, hurs_12	Monthly near-surface relative humidity	%	0.01	0	Near-surface relative humidity for each month
kg0	Köppen-Geiger climate classification	category	-	-	Köppen Geiger Koeppen, W., Geiger, R. (1936): Handbuch der Klimatologie. Gebrüder Borntraeger, Berlin. Wikimedia.
kg1	Köppen-Geiger climate classification	category	-	-	Köppen Geiger without As/Aw differentiation Koeppen, W., Geiger, R. (1936): Handbuch der Klimatologie. Gebrüder Borntraeger, Berlin. Wikimedia.
kg2	Köppen-Geiger climate classification	category	-	-	Köppen Geiger after Peel et al. 2007 Peel, M. C., Finlayson, B. L., McMahon, T. A. (2007): Updated world map of the Koeppen-Geiger climate classification. Hydrology and earth system sciences discussions, 4(2), 439-473. Free Access.
kg3	Köppen-Geiger climate classification	category	-	-	Wissmann 1939 Wissmann, H. (1939): Die Klima- und Vegetationsgebiete Eurasiens: Begleitworte zu einer Karte der Klimagebiete Eurasiens. Z. Ges. Erdk. Berlin, p.81-92.
kg4	Köppen-Geiger climate classification	category	-	-	Thornthwaite 1931 Thornthwaite, C. W. (1931): The climates of North America: according to a new classification. Geographical review, 21(4), 633-655. JSTOR.
kg5	Köppen-Geiger climate classification	category	-	-	Troll-Pfaffen Troll, C. & Paffen, K.H. (1964): Karte der Jahreszeitenklimate der Erde. Erdkunde 18, p5-28 Free Access.
lgd	last day of the growing season TREELIM	julian day	-	-	Last day of the growing season according to TREELIM

					(https://doi.org/10.1007/s00035-014-0124-0)
ngd0	Number of growing degree days	number of days	-	-	Number of days at which tas > 0°C
ngd5	Number of growing degree days	number of days	-	-	Number of days at which tas > 5°C
ngd10	Number of growing degree days	number of days	-	-	Number of days at which tas > 10°C
npp	Net primary productivity	g C m^{-2} yr^{-1}	0.1	0	Calculated based on the ‘Miami model’, Lieth, H., 1972. "Modelling the primary productivity of the earth. Nature and resources", UNESCO, VIII, 2:5-10.
pet_penman_max	Maximum monthly potential evapotranspiration	kg m^{-2} $month^{-1}$	0.01	0	The highest monthly potential evaporation; calculated with the Penman-Monteith equation.
pet_penman_mean	Mean monthly potential evapotranspiration	kg m^{-2} $month^{-1}$	0.01	0	Average monthly potential evaporation over 1 year; calculated with the Penman-Monteith equation.
pet_penman_min	Minimum monthly potential evapotranspiration	kg m^{-2} $month^{-1}$	0.01	0	The lowest monthly potential evaporation; calculated with the Penman-Monteith equation.
pet_penman_range	Annual range of monthly potential evapotranspiration	kg m^{-2}	0.01	0	Difference between maximum and minimum monthly potential evapotranspiration; calculated with the Penman-Monteith equation
pet_penman_01, …, pet_penman_12	Monthly potential evapotranspiration	kg m^{-2} $month^{-1}$	0.01	0	Potential evapotranspiration for each month; calculated with the Penman-Monteith equation
pr_01, …, pr_12	Monthly precipitation amount	kg m^{-2} $month^{-1}$	0.1	0	Precipitation amount for each month; "Amount" means mass per unit area. "Precipitation" in the Earth's atmosphere means precipitation of water in all phases.
rsds_max	Maximum monthly surface downwelling shortwave flux in air	MJ m^{-2} d^{-1}	0.001	0	The highest monthly surface downwelling shortwave flux in air
rsds_mean	Mean monthly surface downwelling	MJ m^{-2} d^{-1}	0.001	0	Average monthly surface downwelling shortwave flux in air over 1 year

	shortwave flux in air				
rsds_min	Minimum monthly surface downwelling shortwave flux in air	MJ m^{-2} d^{-1}	0.001	0	The lowest monthly surface downwelling shortwave flux in air
rsds_range	Annual range of monthly surface downwelling shortwave flux in air	MJ m^{-2} d^{-1}	0.001	0	Difference between maximum and minimum monthly surface downwelling shortwave flux in air
rsds_01, …, rsds_12	Monthly potential evapotranspiration	MJ m^{-2} d^{-1}	0.001	0	Potential evapotranspiration for each month; calculated with the Penman-Monteith equation
scd	Snow cover days	count	-	-	Number of days with snowcover calculated using the snowpack model implementation in from TREELIM (https://doi.org/10.1007/s00035-014-0124-0)
sfcWind_max	Maximum monthly near-surface wind speed	m s^{-1}	0.001	0	The highest monthly near-surface wind speed; near surface represents 10 m above ground.
sfcWind_mean	Mean monthly near-surface wind speed	m s^{-1}	0.001	0	Average monthly near-surface wind speed over 1 year; near surface represents 10 m above ground.
sfcWind_min	Minimum monthly near-surface wind speed	m s^{-1}	0.001	0	The lowest monthly near-surface wind speed; near surface represents 10 m above ground.
sfcWind_range	Annual range of monthly near-surface wind speed	m s^{-1}	0.001	0	Difference between maximum and minimum monthly near-surface wind speed; near surface represents 10 m above ground.
sfcWind_01, …, sfcWind_12	Monthly near-surface wind speed	m s^{-1}	0.001	0	Near-surface wind speed for each month; near surface represents 10 m above ground.
swe	Snow water equivalent	kg m^{-2} $year^{-1}$	0.1	0	Amount of luquid water if snow is melted
tasmax_01, …, tasmax_12	Mean daily maximum 2m air temperature	°C	0.1	-273.15	Daily maximum air temperature at 2 metres from hourly ERA5 data for each month
tas_01, …, tas_12	Mean daily air temperature	°C	0.1	-273.15	Daily mean air temperature at 2 metres from hourly ERA5 data for each month
tasmin_01, …, tasmin_12	Mean daily minimum air temperature	°C	0.1	-273.15	daily minimum air temperature at 2 metres from hourly ERA5 data for each month

clt_max	Maximum monthly total cloud cover	%	0.01	0	The highest percentage of monthly total cloud cover
clt_mean	Mean monthly total cloud cover	%	0.01	0	Average monthly total cloud cover over 1 year
clt_min	Minimum monthly total cloud cover	%	0.01	0	The lowest percentage of monthly total cloud cover
clt_range	Annual range of monthly total cloud cover	%	0.01	0	Difference between maximum and minimum monthly total cloud cover
clt_01, …, clt_12	Monthly total cloud cover	%	0.01	0	Total cloud cover for each month
vpd_max	Maximum monthly vapor pressure deficit	Pa	0.1	0	The highest monthly vapor pressure deficit
vpd_mean	Mean monthly vapor pressure deficit	Pa	0.1	0	Average monthly vapor pressure deficit over 1 year
vpd_min	Minimum monthly vapor pressure deficit	Pa	0.1	0	The lowest monthly vapor pressure deficit
vpd_range	Annual range of monthly vapor pressure deficit	Pa	0.1	0	Difference between maximum and minimum monthly vapor pressure deficit
vpd_01, …, vpd_12	Monthly vapor pressure deficit	Pa	0.1	0	Vapor pressure deficit for each month

7.2. Monthly

shortname	longname	unit	scale	offset	explanation
cmi	Climate moisture index	kg m^{-2} $month^{-1}$	0.1	0	Climate moisture index is the difference between precipitation amount and potential evapotranspiration
hurs	Near-surface relative humidity	%	0.01	0	
pet_penman	Potential evapotranspiration	kg m^{-2} $month^{-1}$	0.01	0	Calculated with the Penman-Monteith equation.
pr	Precipitation amount	kg m^{-2} $month^{-1}$/100	-	-	"Amount" means mass per unit area. "Precipitation" in the earth's atmosphere means precipitation of water in all phases.
rsds	Surface downwelling shortwave flux in air	MJ m^{-2} d^{-1}	0.001	0	Attenuating effects of clouds are accounted for

sfcWind	Near-surface wind speed	m s^{-1}	0.001	0	Near surface represents 10 m above ground.
tasmax	Mean daily maximum 2m air temperature	K/10	-	-	Daily maximum air temperatures at 2 metres from hourly ERA5 data
tas	Mean daily air temperature	K/10	-	-	Daily mean air temperatures at 2 metres from hourly ERA5 data
tasmin	Mean daily minimum air temperature	K/10	-	-	Daily minimum air temperatures at 2 metres from hourly ERA5 data
clt	Total cloud cover at surface	%	0.01	0	Considers clouds across the entire atmospheric column as seen from the surface upwards
vpd	Vapor pressure deficit	Pa	0.1	0	

7.3. Annual

shortname	longname	unit	scale	offset	explanation
swb	Soil water balance	kg m^{-2} $year^{-1}$	0.1	0	Site water balance (swb) is the cumulative amount of water available throughout the year. It maximum is given by available water holding capacity of the soil. Minimum values indicate that evaportranspiration has exceeded precipitation minus runoff.

7.4. Climate classification – Köppen Geiger

shortname	kg0, kg1, kg2	kg0, kg1, kg2
longname	**Köppen Geiger, Köppen Geiger without As/Aw differentiation, Köppen Geiger after Peel et al. 2007**	**Köppen Geiger, Köppen Geiger without As/Aw differentiation, Köppen Geiger after Peel et al. 2007**
value	**code**	**class name**
1	Af	equatorial fully humid
2	Am	equatorial monsoonal
3	As	equatorial summer dry
4	Aw	equatorial winter dry
5	BWk	cold desert
6	BWh	hot desert
7	BSk	cold steppe

8	BSh	hot steppe
9	Cfa	warm temperate fully humid hot summer
10	Cfb	warm temperate fully humid warm summer
11	Cfc	warm temperate fully humid cool summer
12	Csa	warm temperate summer dry hot summer
13	Csb	warm temperate summer dry warm summer
14	Csc	warm temperate summer dry cool summer
15	Cwa	warm temperate winter dry hot summer
16	Cwb	warm temperate winter dry warm summer
17	Cwc	warm temperate winter dry cool summer
18	Dfa	snow fully humid hot summer
19	Dfb	snow fully humid warm summer
20	Dfc	snow fully humid cool summer
21	Dfd	snow fully humid extremely continental
22	Dsa	snow summer dry hot summer
23	Dsb	snow summer dry warm summer
24	Dsc	snow summer dry cool summer
25	Dsd	snow summer dry extremely continental
26	Dwa	snow winter dry hot summer

27	Dwb	snow winter dry warm summer
28	Dwc	snow winter dry cool summer
29	Dwd	snow winter dry extremely continental
30	ET	polar tundra
31	EF	polar frost

7.5. Climate classification – Wissmann 1939

shortname	**kg3**	**kg3**
longname	**Wissmann 1939**	**Wissmann 1939**
value	**code**	**class name**
1	I_A	Rainforest equatorial
2	I_F	Rainforest weak dry period
3	I_T	Savannah and monsoonal Rainforest
4	I_S	Steppe tropical
5	I_D	Desert tropical
6	II_Fa	-
7	II_Fb	-
8	II_Tw	-
9	II_Ts	-
10	II_S	-
11	II_D	-
12	III_F	-

13	III_Tw	Summer green and coniferous forest winter dry
14	III_Ts	Summer green and coniferous forest cool etesien
15	III_S	-
16	III_D	-
17	IV_F	Humid boreal forest
18	IV_T	Winter dry boreal forest
19	IV_S	Boreal steppe
20	IV_D	Boreal desert
21	V	Polar tundra
22	VI	Polar frost

7.6. Climate classification – Thornthwaite 1931

shortname	**kg4**	**kg4**
longname	**Thornthwaite 1931**	**Thornthwaite 1931**
value	**code**	**class name**
1	-	Wet/Tropical
2	-	Humid/Tropical
3	-	Subhumid/Tropical
4	-	Semiarid/Tropical
5	-	Arid/Tropical
6	-	Wet/Mesothermal
7	-	Humid/Mesothermal

8	-	Subhumid/Mesothermal
9	-	Semiarid/Mesothermal
10	-	Arid/Mesothermal
11	-	Wet/Microthermal
12	-	Humid/Microthermal
13	-	Subhumid/Microthermal
14	-	Semiarid/Microthermal
15	-	Arid/Microthermal
16	-	Wet/Taiga
17	-	Humid/Taiga
18	-	Subhumid/Taiga
19	-	Semiarid/Taiga
20	-	Arid/Taiga
21	-	Wet/Tundra
22	-	Humid/Tundra
23	-	Subhumid/Tundra
24	-	Semiarid/Tundra
25	-	Arid/Tundra
26	-	Wet/Frost

27	-	Humid/Frost
28	-	Subhumid/Frost
29	-	Semiarid/Frost
30	-	Arid/Frost

7.7. Climate classification – Troll-Pfaffen

shortname	**kg5**	**kg5**
longname	**Troll-Pfaffen**	**Troll-Pfaffen**
value	**code**	**class name**
1	I_1	Polar ice-deserts
2	I_2	Polar frost-debris belt
3	I_3	Tundra
4	I_4	Sub-polar tussock grassland and moors
5	II_1	Oceanic humid coniferous woods
6	II_2	Continental coniferous woods
7	II_3	Highly continental dry coniferous woods
8	III_1	Evergreen broad-leaved and mixed woods
9	III_2	Oceanic deciduous broad-leaved and mixed woods
10	III_3	Sub-oceanic deciduous broad-leaved and mixed woods
11	III_4	Sub-continental deciduous broad-leaved and mixed woods
12	III_5	Continental deciduous broad-leaved and mixed woods as well as wooded steppe
13	III_6	Highly continental deciduous broad-leaved and mixed woods as well as wooded steppe

14	III_7	Deciduous broad-leaved and mixed wood and wooded steppe favoured by warmth but withstanding cold and aridity in winter
15	III_7a	Thermophile dry wood and wooded stepe which withstands moderate to hard winters
16	III_8	Humid deciduous broad-leaved and mixed wood which favours warmth
17	III_9	High grass-steppe with perennial herbs
18	III_9a	Humid steppe with mild winters
19	III_10	Short grass- or dwarf shrub-
20	III_10a	Steppe with short grass dwarf shrups and thorns
21	III_11	Central and East-Asian grass and dwarf shrub steppe
22	III_12	Semi-desert and desert with cold winters
23	III_12a	Semi-desert and desert with mild winters
24	IV_1	Sub-tropical hard-leaved and coniferous wood
25	IV_2	Sub-tropical grass and shrub-steppe
26	IV_3	Sub-tropical thorn- and succulants-steppe
27	IV_4	Sub-tropical steppe with short grass hard-leaved monsoon wood and wooded-steppe
28	IV_5	Sub-tropical semi-deserts and deserts
29	IV_6	Sub-tropical high-grassland
30	IV_7	Sub-tropical humid forests (laurel and coniferous forests)
31	V_1	Evergreen tropical rain forest and half deciduous transition wood

32	V_2	Rain-green humid forest and humid grass-savannah
33	V_2a	Half deciduous transition wood
34	V_3	Rain-green dry wood and dry savannah
35	V_4	Tropical thorn-succulent wood and savannah
36	V_4a	Tropical dry climates with humid months in winter
37	V_5	Tropical semi-deserts and deserts