

Step 2: Preparing your environmental data:

1. Download climate variables: <https://www.worldclim.org/>

WorldClim - Global Climate Data
Free climate data for ecological modeling and GIS

Contact

WorldClim

WorldClim is a set of global climate layers (gridded climate data) with a spatial resolution of about 1 km². These data can be used for mapping and spatial modeling.

The *new* **Version 2.0** is now available (current climate only --- more coming soon)

The old version is **Version 1.4**.
For this version you can get data for past, current and future climates.

[Read more](#)

2. Select the version you want to use (we opted for version 2.0)

WorldClim Version2

WorldClim version 2 has average monthly climate data for minimum, mean, and maximum temperature and for precipitation for 1970-2000.

You can download the variables for different spatial resolutions, from 30 seconds (~1 km²) to 10 minutes (~340 km²). Each download is a "zip" file containing 12 GeoTiff (.tif) files, one for each month of the year (January is 1; December is 12).

variable	10 minutes	5 minutes	2.5 minutes	30 seconds
minimum temperature (°C)	tmin 10m	tmin 5m	tmin 2.5m	tmin 30s
maximum temperature (°C)	tmax 10m	tmax 5m	tmax 2.5m	tmax 30s
average temperature (°C)	tavg 10m	tavg 5m	tavg 2.5m	tavg 30s
precipitation (mm)	prec 10m	prec 5m	prec 2.5m	prec 30s
solar radiation (kJ m ⁻² day ⁻¹)	srad 10m	srad 5m	srad 2.5m	srad 30s
wind speed (m s ⁻¹)	wind 10m	wind 5m	wind 2.5m	wind 30s
water vapor pressure (kPa)	vapr 10m	vapr 5m	vapr 2.5m	vapr 30s

Below you can download the standard (19) WorldClim **Bioclimatic variables** for WorldClim version 2. They are the average for the years 1970-2000. Each download is a "zip" file containing 19 GeoTiff (.tif) files, one for each month of the **variables**.

variable	10 minutes	5 minutes	2.5 minutes	30 seconds
Bioclimatic variables	bio 10m	bio 5m	bio 2.5m	bio 30s

- a. There are various variables available, the bioclimatic variables represent a “standard” obtained from each of the above. Use these ones for your modelling exercise.
 - i. 10m, 5m, 2.5m, 30s refers to the spatial resolution at the equator in the WGS84 projection
 1. 30s is 1 Km data
 2. 5m is 10 Km resolution (download this one)

3. What are the bioclimatic variables?

Bioclimatic variables

Bioclimatic variables are derived from the monthly temperature and rainfall values in order to generate more biologically meaningful variables. These are often used in [species distribution modeling](#) and related ecological modeling techniques. The bioclimatic variables represent annual trends (e.g., mean annual temperature, annual precipitation) seasonality (e.g., annual range in temperature and precipitation) and extreme or limiting environmental factors (e.g., temperature of the coldest and warmest month, and precipitation of the wet and dry quarters). A quarter is a period of three months (1/4 of the year).

They are coded as follows:

BIO1 = Annual Mean Temperature
BIO2 = Mean Diurnal Range (Mean of monthly (max temp - min temp))
BIO3 = Isothermality (BIO2/BIO7) (* 100)
BIO4 = Temperature Seasonality (standard deviation *100)
BIO5 = Max Temperature of Warmest Month
BIO6 = Min Temperature of Coldest Month
BIO7 = Temperature Annual Range (BIO5-BIO6)
BIO8 = Mean Temperature of Wettest Quarter
BIO9 = Mean Temperature of Driest Quarter
BIO10 = Mean Temperature of Warmest Quarter
BIO11 = Mean Temperature of Coldest Quarter
BIO12 = Annual Precipitation
BIO13 = Precipitation of Wettest Month
BIO14 = Precipitation of Driest Month
BIO15 = Precipitation Seasonality (Coefficient of Variation)
BIO16 = Precipitation of Wettest Quarter
BIO17 = Precipitation of Driest Quarter
BIO18 = Precipitation of Warmest Quarter
BIO19 = Precipitation of Coldest Quarter

This scheme follows that of ANUCLIM, except that for temperature seasonality the standard deviation was used because a coefficient of variation does not make sense with temperatures between -1 and 1).

To create these values yourself, you can use the 'biovars' function in the R package [dismo](#)

4. Download the future scenario data

a. The future scenario is only available on section 1.4

WorldClim Version 1

WorldClim version 1 has average monthly climate data for minimum, mean, and maximum temperature and for precipitation for 1960-1990. You can also download derived [bioclimatic variables](#).

You can download climate data for:

- **Current** conditions (interpolations of observed data, representative of 1960-1990)
- **Future** conditions: downscaled global climate model (GCM) data from CMIP5 (IPPC Fifth Assessment)
- **Past** conditions (downscaled global climate model output)

- b. Select the same resolution as before (5 minutes in the case of this tutorial)

Future climate data

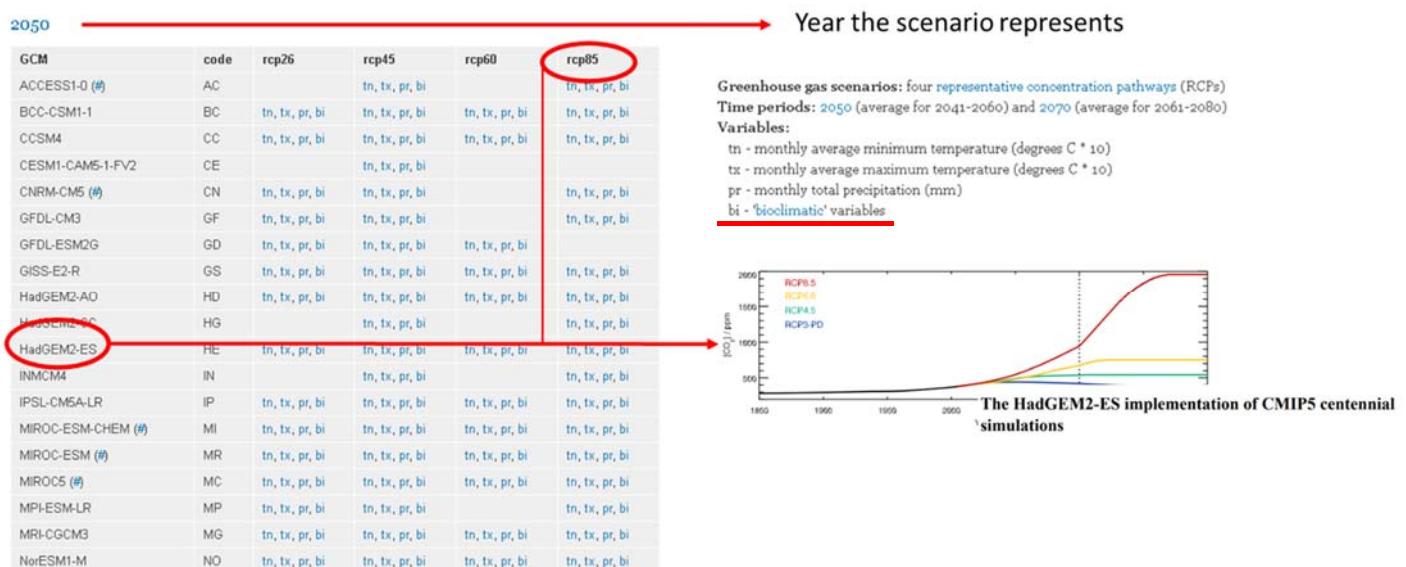
WorldClim 1.4 downscaled (CMIP5) data

The data available here are the IPCC5 climate projections from global climate models (GCMs) for four [representative concentration pathways](#) (RCPs). These are the most recent GCM climate projections that are used in the Fifth Assessment IPCC report. The GCM output was [downscaled and calibrated \(bias corrected\)](#) using WorldClim 1.4 as baseline 'current' climate.

The data are available at different spatial resolutions (expressed as minutes or seconds of a degree of longitude and latitude): [10 minutes](#), [5 minutes](#), [2.5 minutes](#), [30 seconds](#). The variables included are monthly minimum and maximum temperature, precipitation, and 'bioclimatic' variables.

5. Future climate scenarios:

- a. Each scenario will have different assumptions
- b. For this tutorial we downloaded the HadGEM2-ES (code HE)
 - i. More info @ <https://portal.enes.org/models/earthsystem-models/metoffice-hadley-centre/hadgem2-es>



- c. To download the bioclimatic variables, select "bi" on each of the scenarios you want to use. We used all 4 in our case.

- i. Download them to your downloads folder

6. Unzip all the data (Present and future scenarios) to appropriate folders created in the beginning:

- a. Present
- b. Future
 - i. One subfolder per each scenario

- c. Note: if you decide to explore this data in ArcGIS, the software will create some auxiliary files which might make your R scripts stop working. Just erase these auxiliary files or create another folder for exploring the environmental data to avoid this.