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Crop Module 2
AquaCrop input requirements

Jorge Alvar-Beltrán

(13-14 December, 2022)

Content

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- How do crop models work?
- AquaCrop interface
- AquaCrop: climate and crop modules (first two modules)

Day 2 (Introduction to AquaCrop)

- AquaCrop: management and soil modules (last three modules)
- Run simulations and interpret outputs

Days 2-3 (Running your own simulation-standard mode)

- Input requirements (details)
- Create/import climatic files on AquaCrop

AquaCrop input requirements: climatic information

Input variables	Yes/No	Frequency
Precipitation	Yes	Daily, dekadal, monthly
Temperature (max/min)	Yes	Daily, dekadal, monthly
Reference evapotranspiration	Yes/pre-computed	Daily, dekadal, monthly
Relative humidity	+	Daily, dekadal, monthly
Solar radiation	+	Daily, dekadal, monthly
Wind speed	+	Daily, dekadal, monthly
CO_2 concentrations (RCPs 4.5, 8.5 etc.)	Available	Daily, dekadal, monthly

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AquaCrop input requirements: crop information

Input variables	Yes/No	Frequency
Planting date	Yes	Once
Plant density	Yes	Once
Planting method	Yes	Once
Maximum canopy cover	Yes	Once
Time to emergence	Yes	Once
Time to & duration flowering	Yes	Once
Start of canopy senescence	Yes	Once
Crop coefficient	Yes	Once

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AquaCrop input requirements: crop information

Input variables	Yes/No	Frequency
Time to maturity	Yes	Once
Length building up harvest index	+	Once
Crop water productivity	+	Once
Harvest index	Yes	Once
Root depth	+	Once
Time for maximum root depth	+	Once

AquaCrop input requirements: soil information

Input variables	Yes/No	Frequency
Soil texture	Yes/Available	Once
Soil water content (SAT, FC, PWP)	Available	Once
Effective soil depth	+	Once
Soil coarse material	+	Once
Drainage	+	Once
Electrical conductivity	+	Once
Groundwater table (depth)	+	Once
Groundwater table (salinity)	+	Once

AquaCrop input requirements: management info.

Input variables	Yes/No	Frequency
Soil fertility	+	Once
Cover & type of soil mulches	+	Once
Height of soil bunds	+	Once
Surface runoff	+	Once
Irrigation method	Yes (if irrigated)	Once
Application depth	Yes (if irrigated)	At each event
Time of irrigation	Yes (if irrigated)	At each event
Salinity of the irrigation	+	Once

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Crop Module 2
Creating Climate files

Jorge Alvar-Beltrán

(14 December 2022)

Data used in this session

Climate module: create our own climatic files (daily values) for Cahul from 01-01-1981 until 31-12-2099.

- W5E5 reanalysis dataset for the 1981-2019 period.
- 3 GCMs and 1 RCM for the 2017-2099 period.

- Climatic variables: maximum temperature (Tmax), minimum temperature (Tmin), precipitation (pr), relative humidity (hurs), incoming solar radiation (rsds), and wind.

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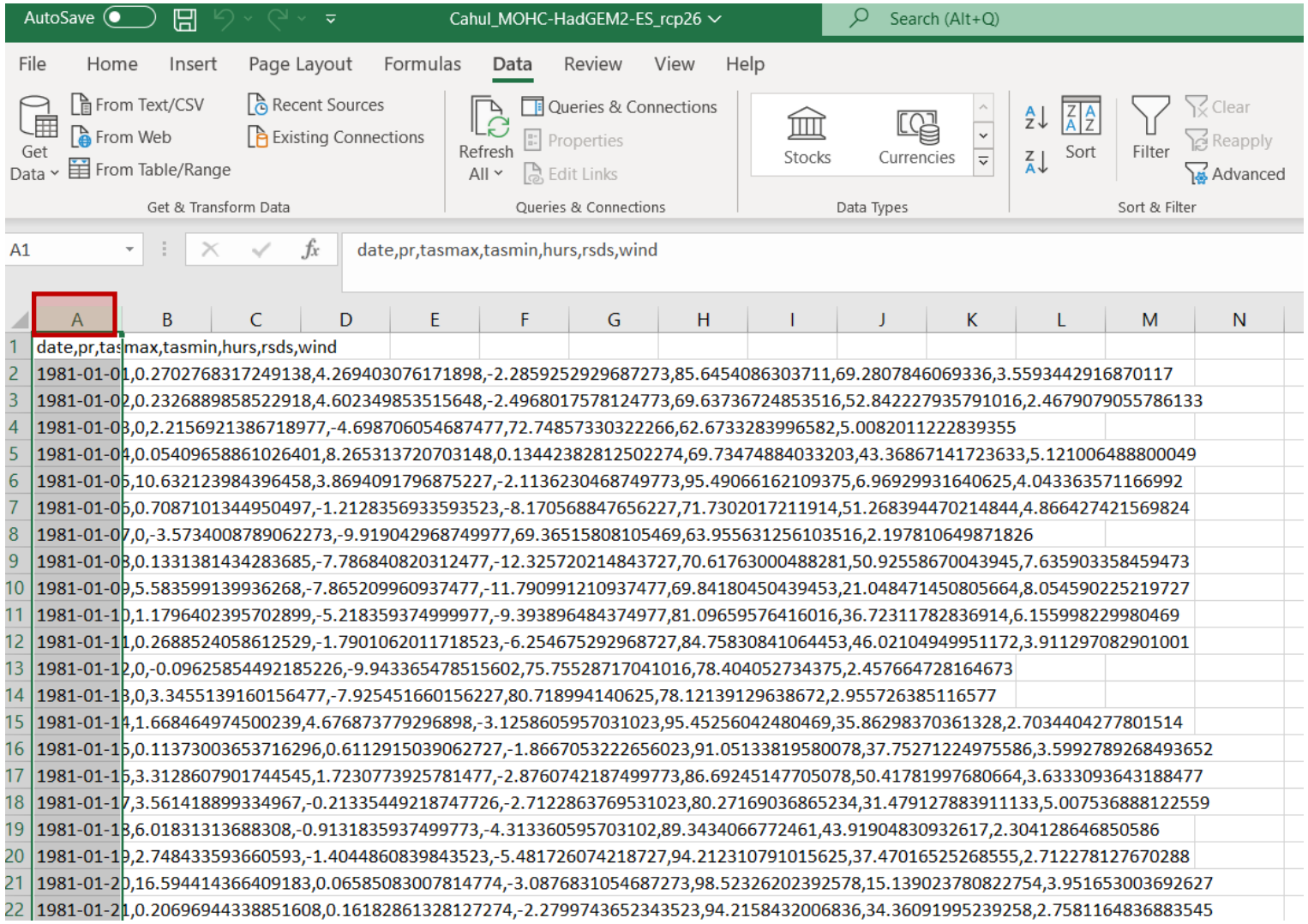
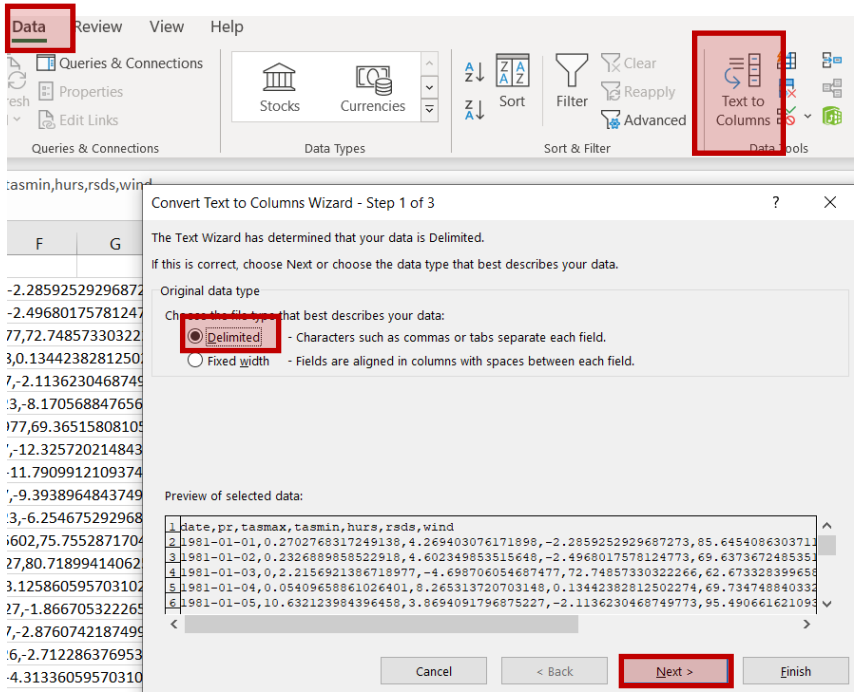
Preparing the CSV climatic files

Step 1: select column **A**



Step 2: click the **Data tab** in the upper toolbar and, afterwards, click in **Text to Columns**

Step 3: click on **Delimited** and then **Next**



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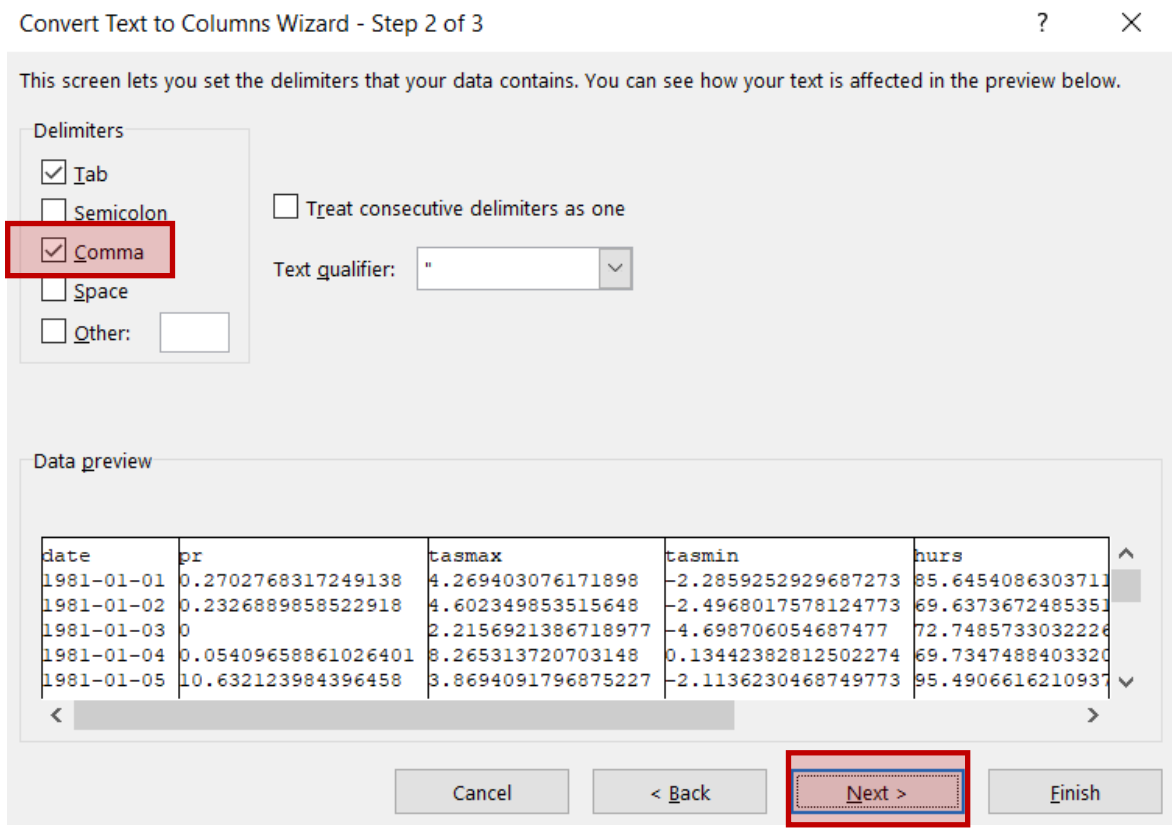
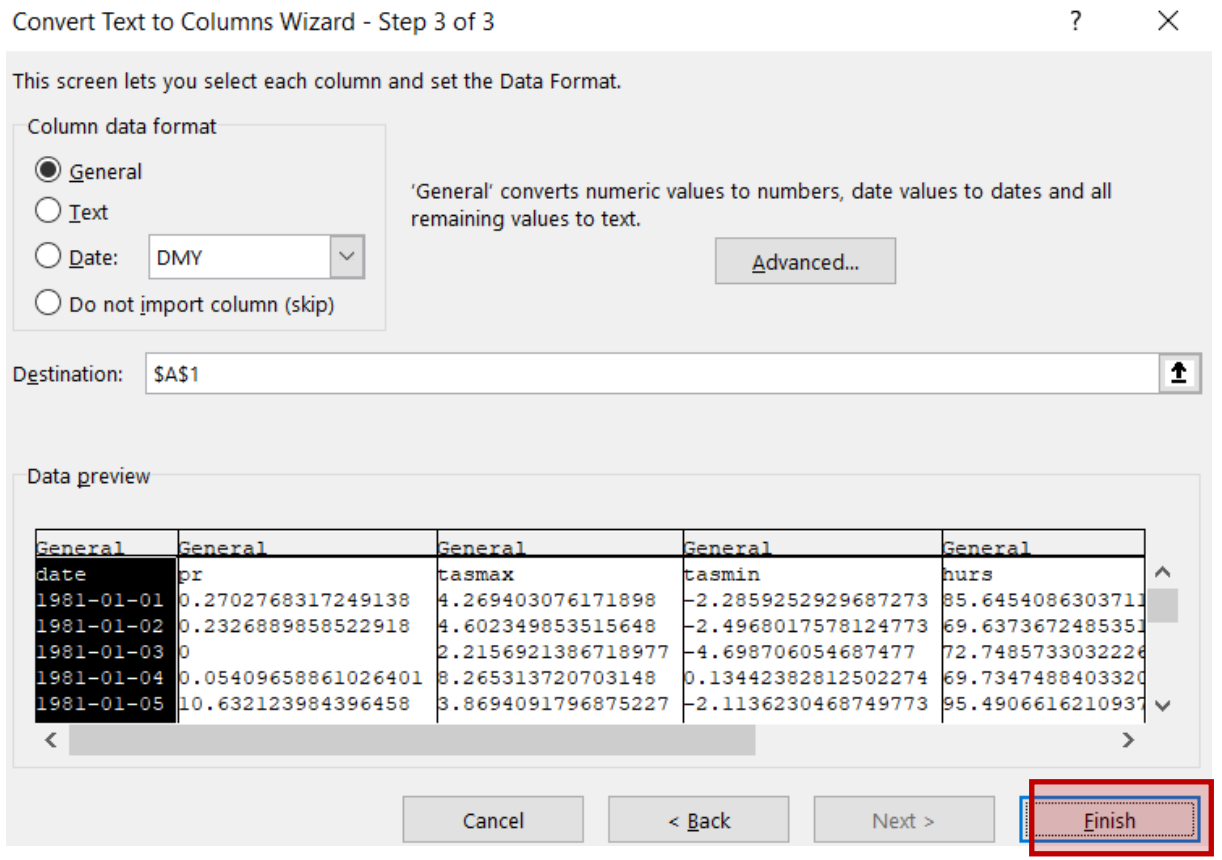
Preparing the CSV climatic files

Step 1: use the **comma** delimiter and click **next**



Step 2: click on **Finish**



Preparing the CSV climatic files

	A	B	C	D	E	F	G
1	date	pr	tasmax	tasmin	hurs	rsds	wind
2	01/01/1981	0.270277	4.269403	-2.28593	85.64541	69.28078	3.559344
3	02/01/1981	0.232689	4.60235	-2.4968	69.63737	52.84223	2.467908
4	03/01/1981	0	2.215692	-4.69871	72.74857	62.67333	5.008201
5	04/01/1981	0.054097	8.265314	0.134424	69.73475	43.36867	5.121006
6	05/01/1981	10.63212	3.869409	-2.11362	95.49066	6.969299	4.043364
7	06/01/1981	0.70871	-1.21284	-8.17057	71.7302	51.26839	4.866427
8	07/01/1981	0	-3.5734	-9.91904	69.36516	63.95563	2.197811
9	08/01/1981	0.133138	-7.78684	-12.3257	70.61763	50.92559	7.635903
10	09/01/1981	5.583599	-7.86521	-11.791	69.8418	21.04847	8.05459
11	10/01/1981	1.17964	-5.21836	-9.3939	81.0966	36.72312	6.155998
12	11/01/1981	0.268852	-1.79011	-6.25468	84.75831	46.02105	3.911297
13	12/01/1981	0	-0.09626	-9.94337	75.75529	78.40405	2.457665
14	13/01/1981	0	3.345514	-7.92545	80.71899	78.12139	2.955726
15	14/01/1981	1.668465	4.676874	-3.12586	95.45256	35.86298	2.70344
16	15/01/1981	0.11373	0.611292	-1.86671	91.05134	37.75271	3.599279
17	16/01/1981	3.312861	1.723077	-2.87607	86.69245	50.41782	3.633309
18	17/01/1981	3.561419	-0.21335	-2.71229	80.27169	31.47913	5.007537
19	18/01/1981	6.018313	-0.91318	-4.31336	89.34341	43.91905	2.304129
20	19/01/1981	2.748434	-1.40449	-5.48173	94.21231	37.47017	2.712278
21	20/01/1981	16.59441	0.065851	-3.08768	98.52326	15.13902	3.951653
22	21/01/1981	0.206969	0.161829	-2.27997	94.21584	34.36092	2.758116
23	22/01/1981	0.597494	-0.6735	-2.57889	92.31093	30.59136	4.915166
24	23/01/1981	0	0.034174	-2.35416	93.94133	40.33419	5.871572

Step 1: delete the first row and column (AquaCrop struggles to read text)

Remember that the new columns correspond to:

A) pr: precipitation (mm/day)
B) Tasmax: maximum temperatures (ºC)
C) Tasmin: minimum temperatures (ºC)
D) Hurs: mean relative humidity (%)
E) Rsds: incoming solar radiation (w/m^2)
F) Wind: average wind speed (m/s)

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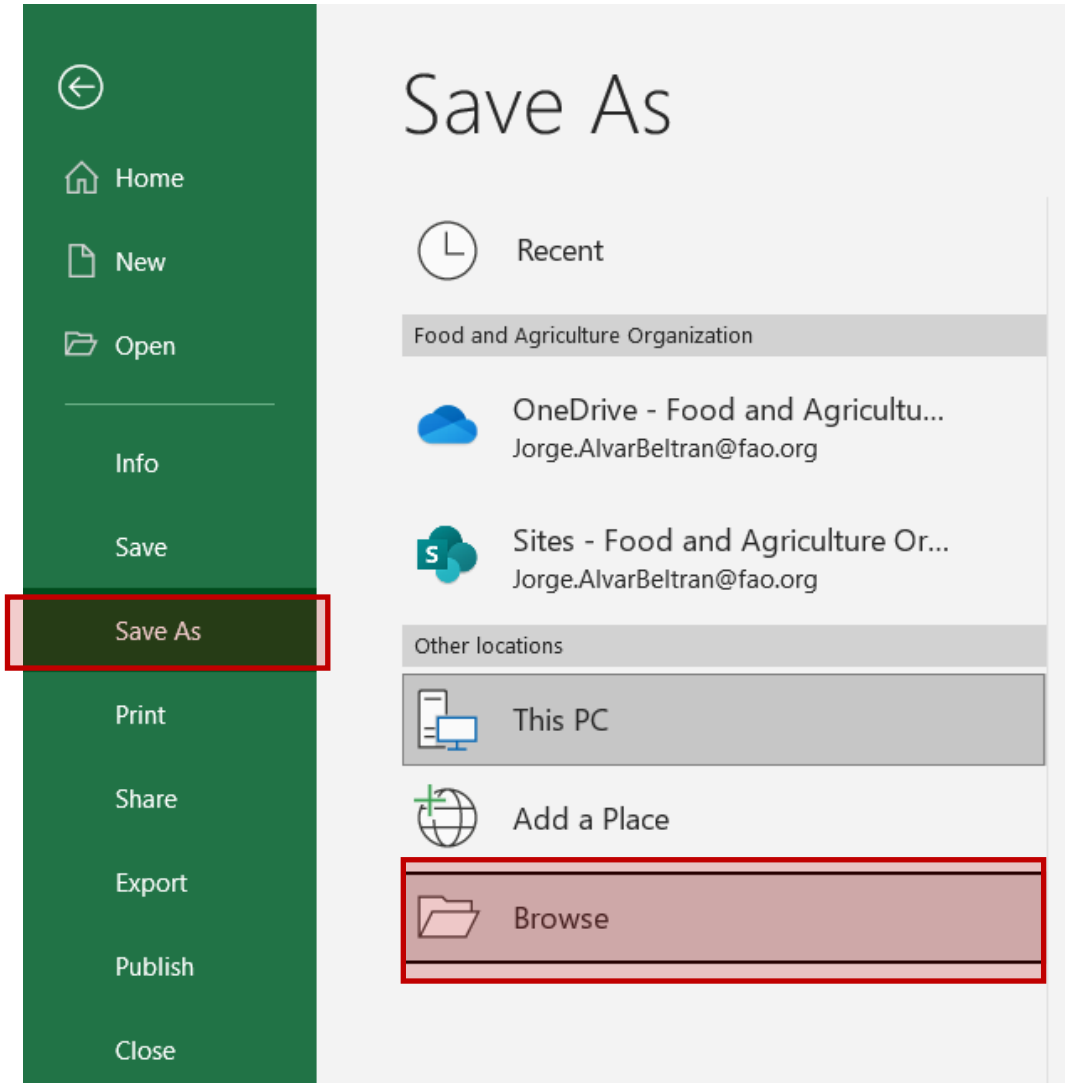
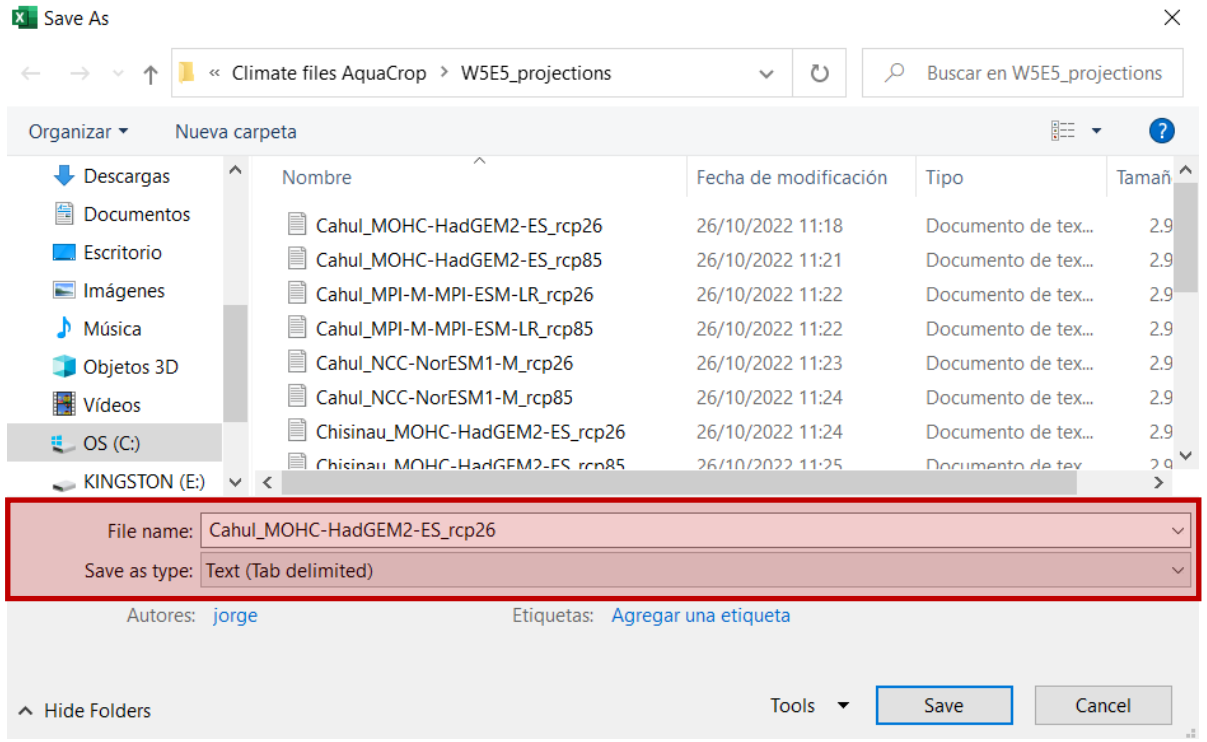
Saving the climatic files in the right format



Step 1: save the CSV file as type "**Text (Tab delimited)**"



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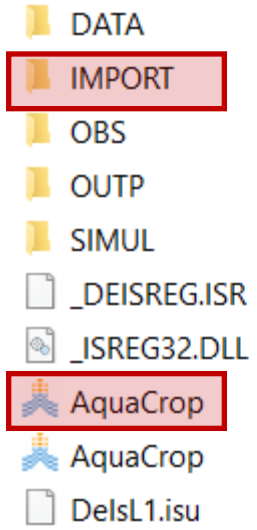
Create/import climatic files

Year	Date	Tmax	Tmin	Prec.	RH	WS	SR
2006	1	19.1	1.25	0	81.45	1.6	129.5
2006	2	23.5	4.3	0	62.9	1.8	148.5
2006	3	23.5	2.25	0	53.45	1.9	178.1
2006	4	20	3	0	64.35	2	177.9
2006	5	22.5	5.3	0	52.7	2	174.8
2006	6	21.6	2.85	0	46.2	1.8	182
2006	7	22.6	3.35	0	49.2	2.1	180.1
2006	8	21	2.2	0	57.45	2.2	175.3
2006	9	21	1.85	0	63.1	2.1	184.1
2006	10	17.2	2.3	0	65.55	2.2	186.2
2006	11	20.2	4.9	0	64.85	2.1	185.6
2006	12	16.1	4.65	0	75.25	1.9	155.6
2006	13	14.7	4.9	0	89	1.8	141.2
2006	14	14.6	4.55	0	89.65	2.1	175.8
2006	15	13.5	5.1	0	86.35	2.3	192.3
2006	16	16.9	5.85	0	80.5	2.4	167.1
2006	17	20.1	5.75	0	63.75	2	194.1
2006	18	18.2	4.85	0	61.1	1.8	195.2
2006	19	21.1	7.55	0	54.2	1.9	195.7
2006	20	21	5.7	0	49.55	2.2	182.2
2006	21	19.1	4.4	0	55.9	2.3	174.2
2006	22	19.6	6.2	0	59.95	1.9	179.4
2006	23	16	3.9	0	69.75	1.9	142.7
2006	24	13.5	2.35	0	76.8	2.2	200.9
2006	25	13.5	3.35	0	81.2	2.1	185.2
2006	26	13.6	5.1	0	80.6	2.3	166.9
2006	27	14.9	5.45	0	80.25	1.9	146.5
2006	28	15.1	6.3	0	75	1.8	204.5
2006	29	15.8	6.8	0	78.7	1.7	195.3
2006	30	16.4	8.2	0	75.85	1.9	204.5
2006	31	17.8	8.35	0	79.4	2	190.6
2006	32	18.8	7.75	0	78.35	1.8	215.6
2006	33	16.9	7.95	0	83.65	1.9	199.8
2006	34	17.4	9.65	0	80.1	1.8	203.1

- Daily values are introduced in AquaCrop as txt. format
- The more climatic variables you have the better it is, as ETo estimations will be closer to reality…
- …and remember: AquaCrop calculates biomass production from crop transpiration.
- AquaCrop does neither read blank cells nor text
- AquaCrop has default CO_2 files from 1900 until 2100

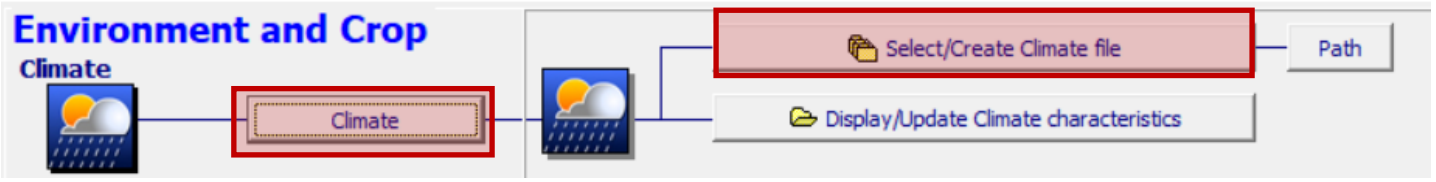
Open txt. file on AquaCrop

Step 1: copy paste the txt file into AquaCrop folder **IMPORT**

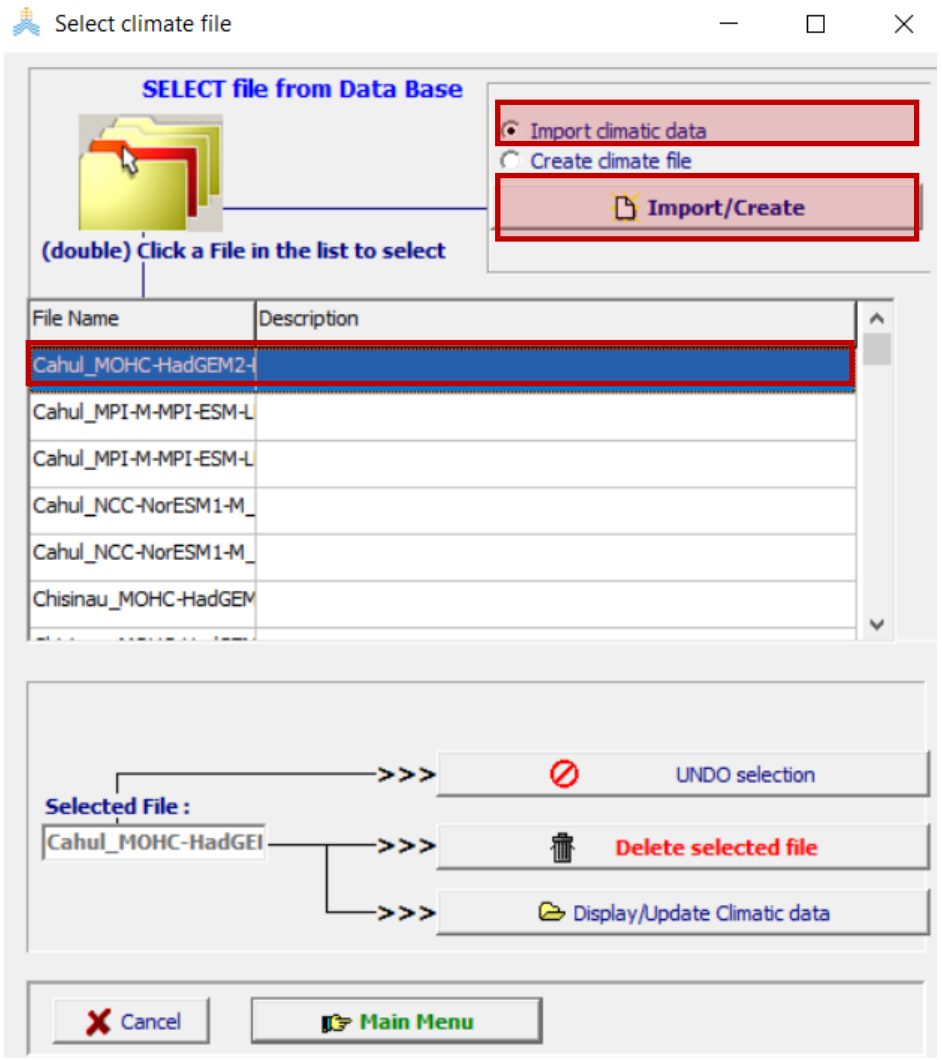


Step 2: open **AquaCrop** and click on **Start**

Step 3: open the **climate** module and click on **Select/Create Climate file**



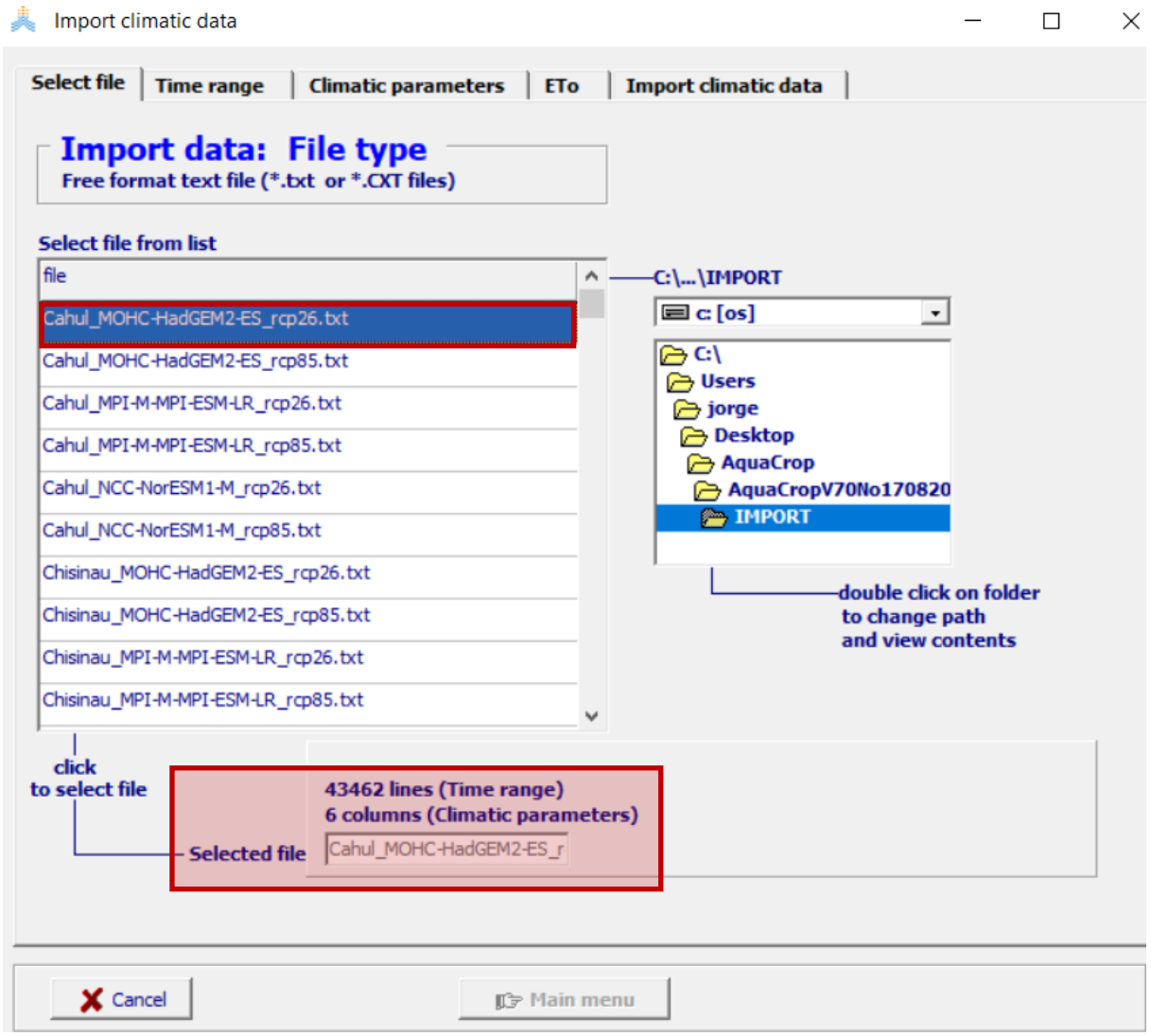
Create a climatic file



Step 1: click on **Import/Create** climatic file

Step 2: select **Cahul_MOHC-HadGEM 2.6** and click on **Import/Create**

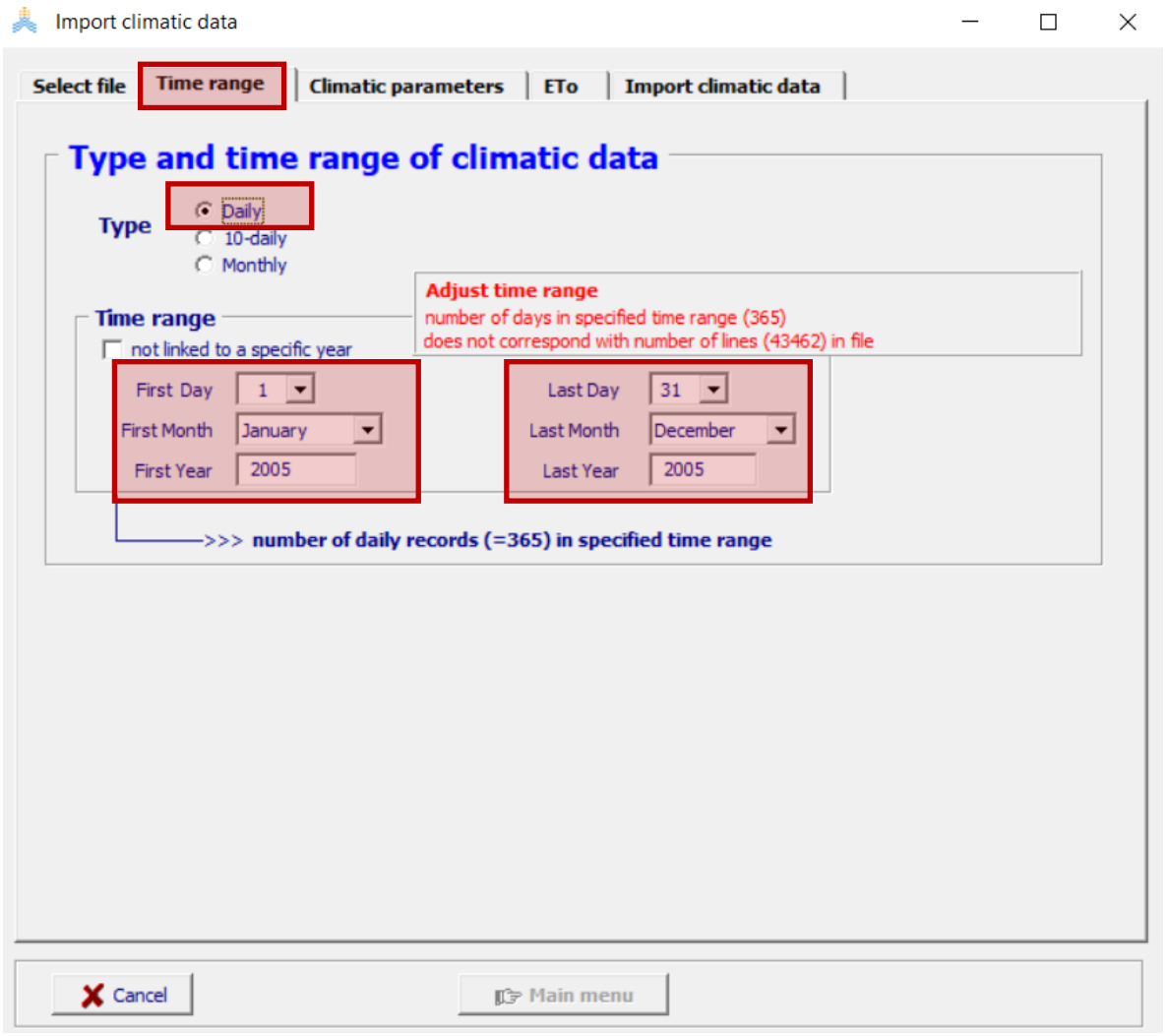
Create a climatic file



Step 1: double click on the file named **Cahul_MOHCHadGEM-ES_rcp26**

Double check that no errors appear in red (e.g., AquaCrop cannot read text, rows missing, blank cells etc.)

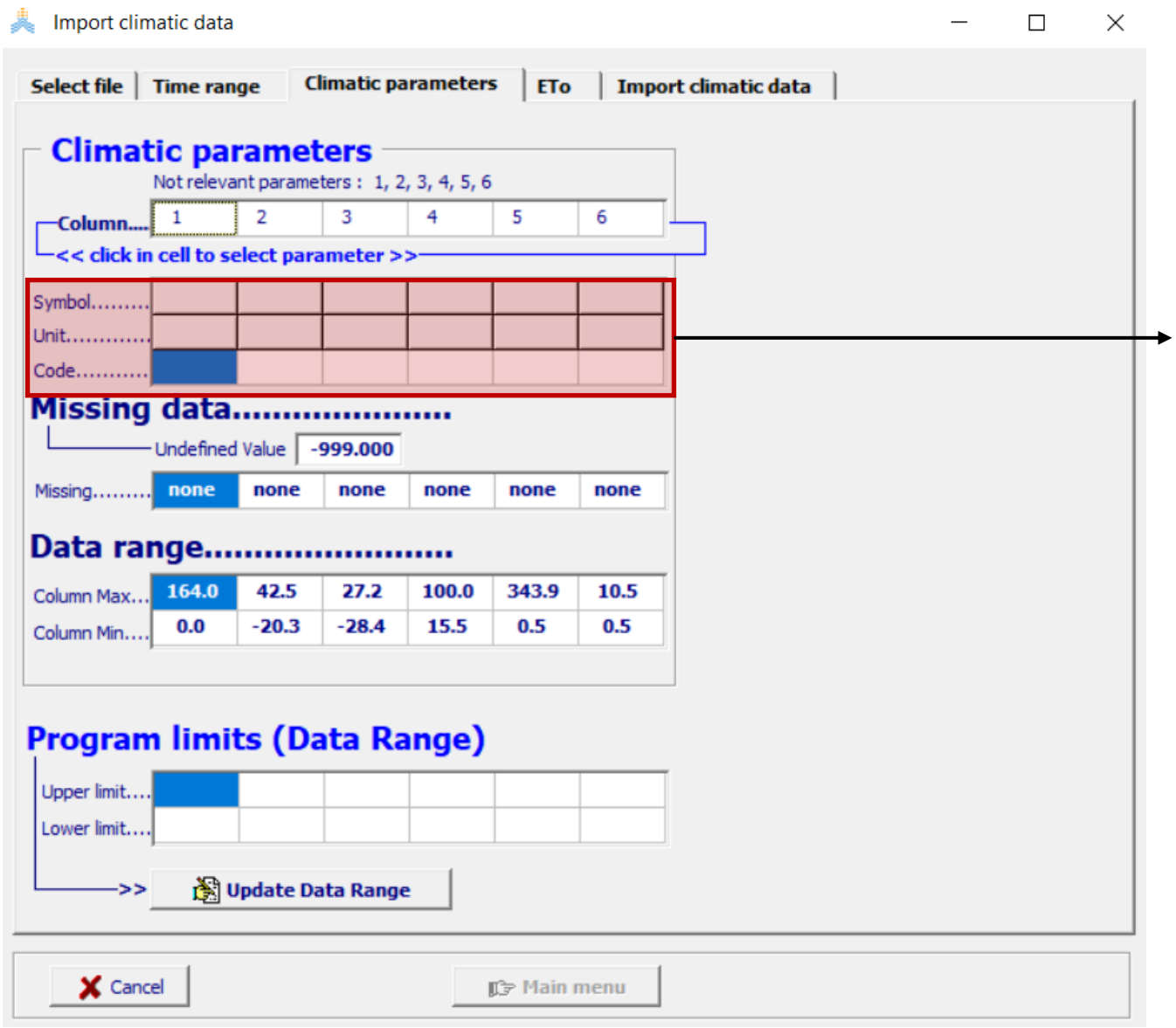
Create a climatic file



Step 1: click on **Time range** and specify the frequency of climate observations/projections. In our case **Daily**.

Step 2: select the starting **(01/01/1981)** and end period **(29/12/2099)** of daily climatic information

Create a climatic file

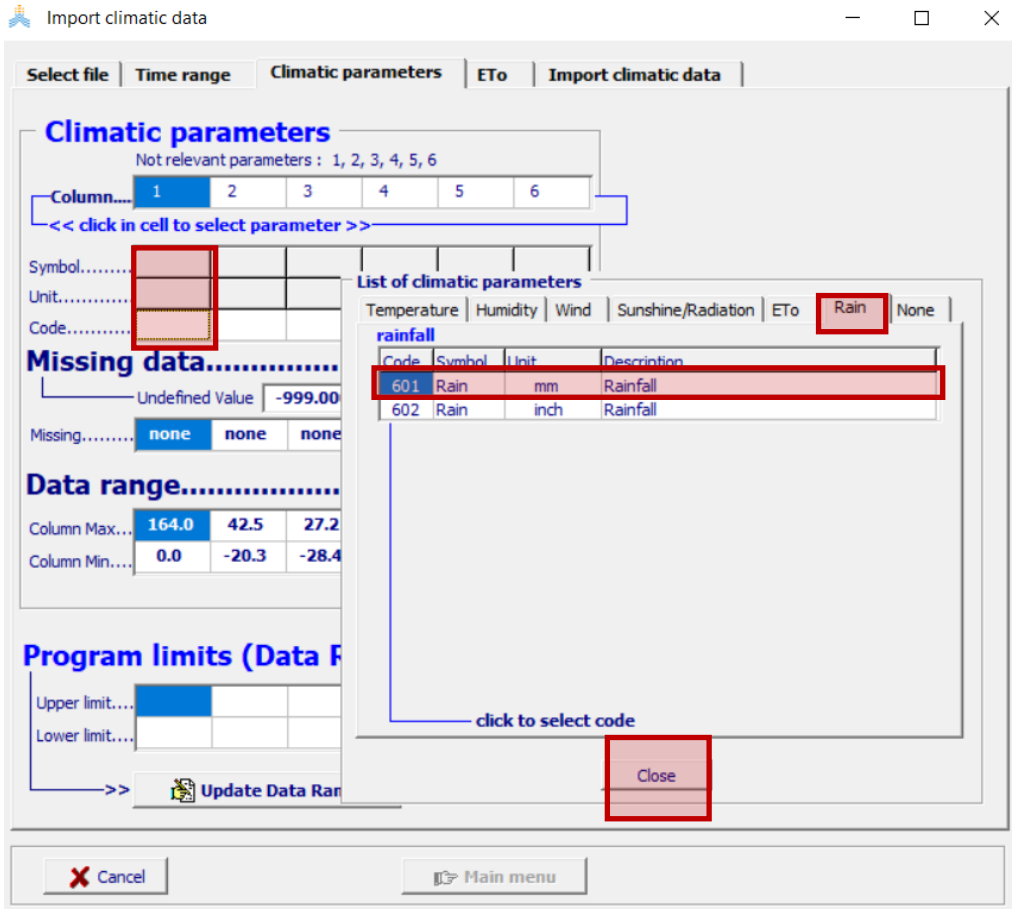


Remember that the new columns correspond to:

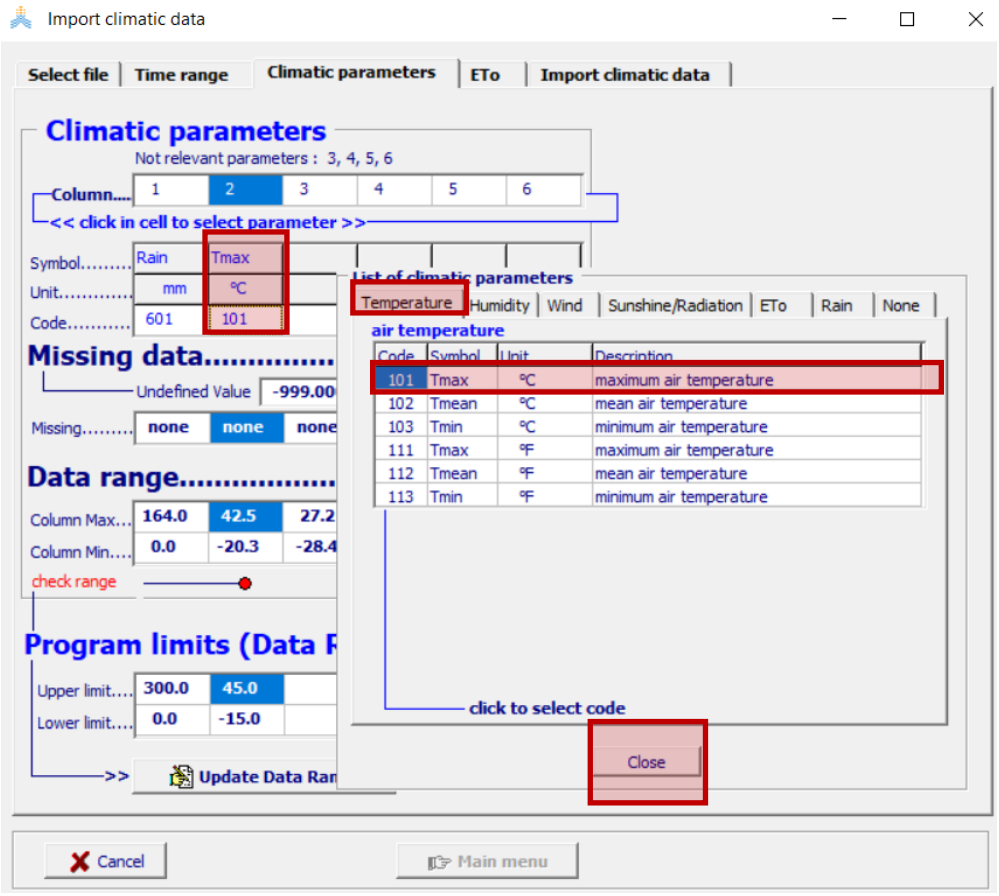
A) pr: precipitation (mm/day)
B) Tasmax: maximum temperatures (ºC)
C) Tasmin: minimum temperatures (ºC)
D) Hurs: mean relative humidity (%)
E) Rsds: incoming solar radiation (w/m^2)
F) Wind: average wind speed (m/s)

Create a climatic file (rain & Tmax)

Step 1: click on the first column (**blank cell**), then select the **rain tab** and **rain (mm).** Finally, click on **close**



Step 2: click on the second column (**blank cell**), then select the **temperature tab** and **Tmax (ºC).** Finally, click on **close**



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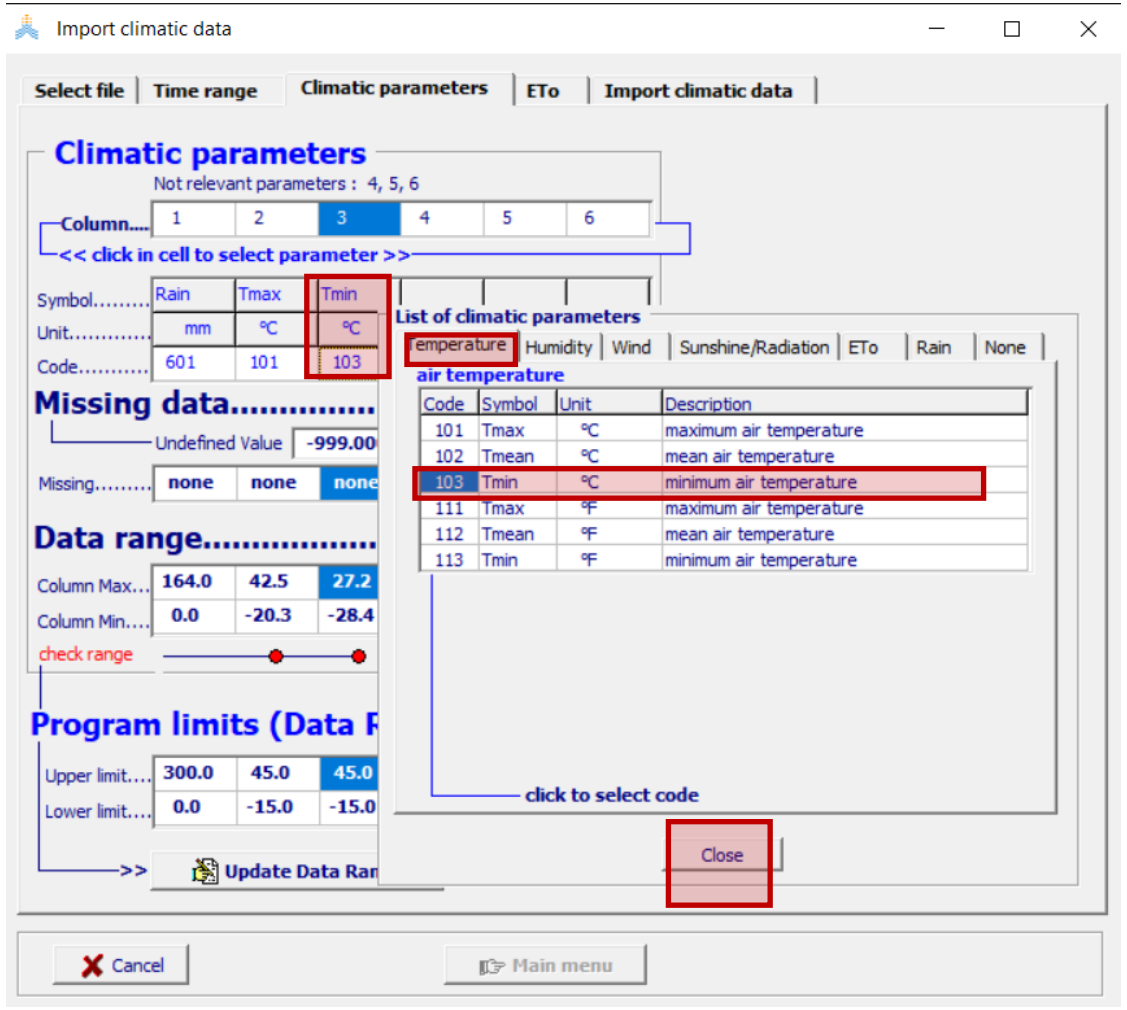
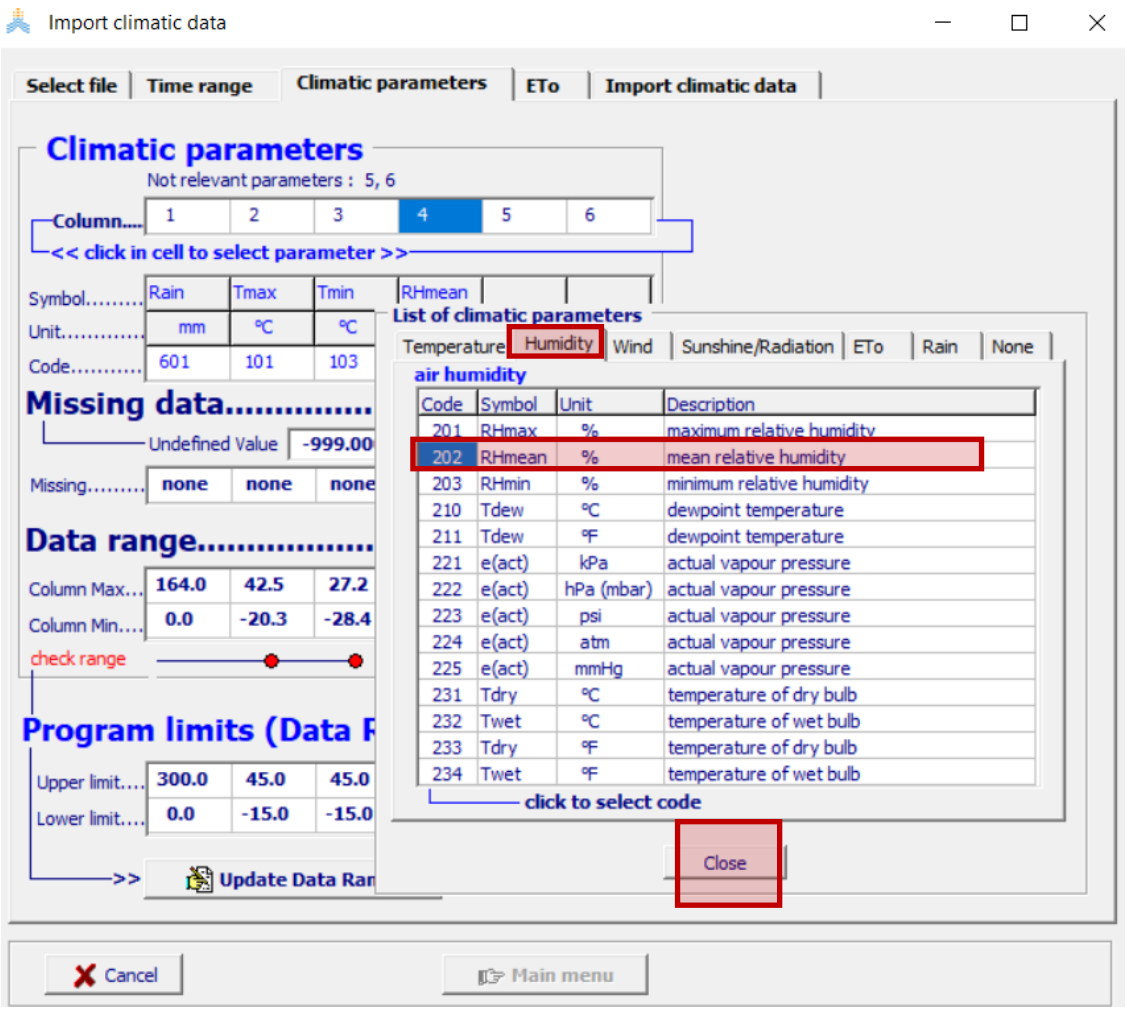
Create a climatic file (Tmin & RH)

Step 3: click on the third column (**blank cell**), then select the **temperature tab** and **Tmin (ºC)**. Finally, click on **close**

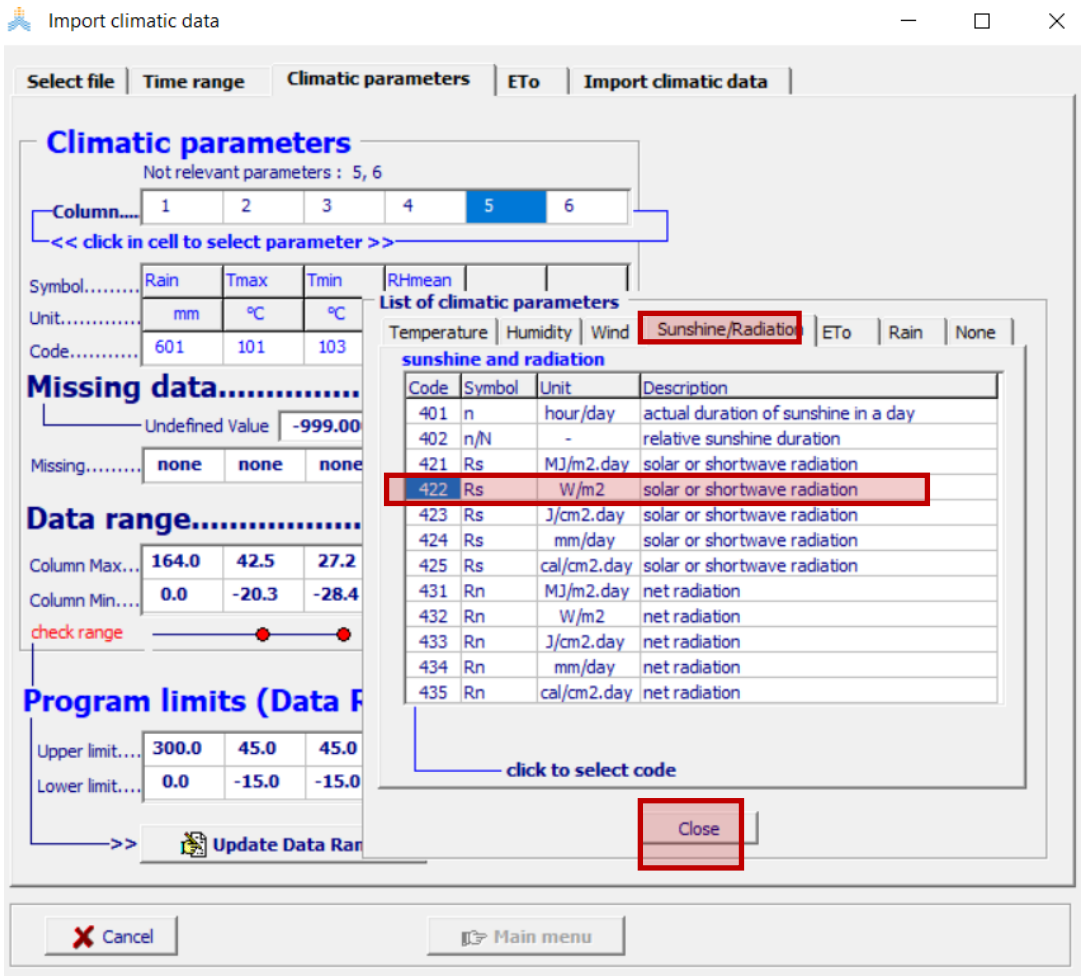


Step 4: click on the fourth column (**blank cell**), then select the **Humidity tab** and **RH mean (%)**. Finally, click on **close**

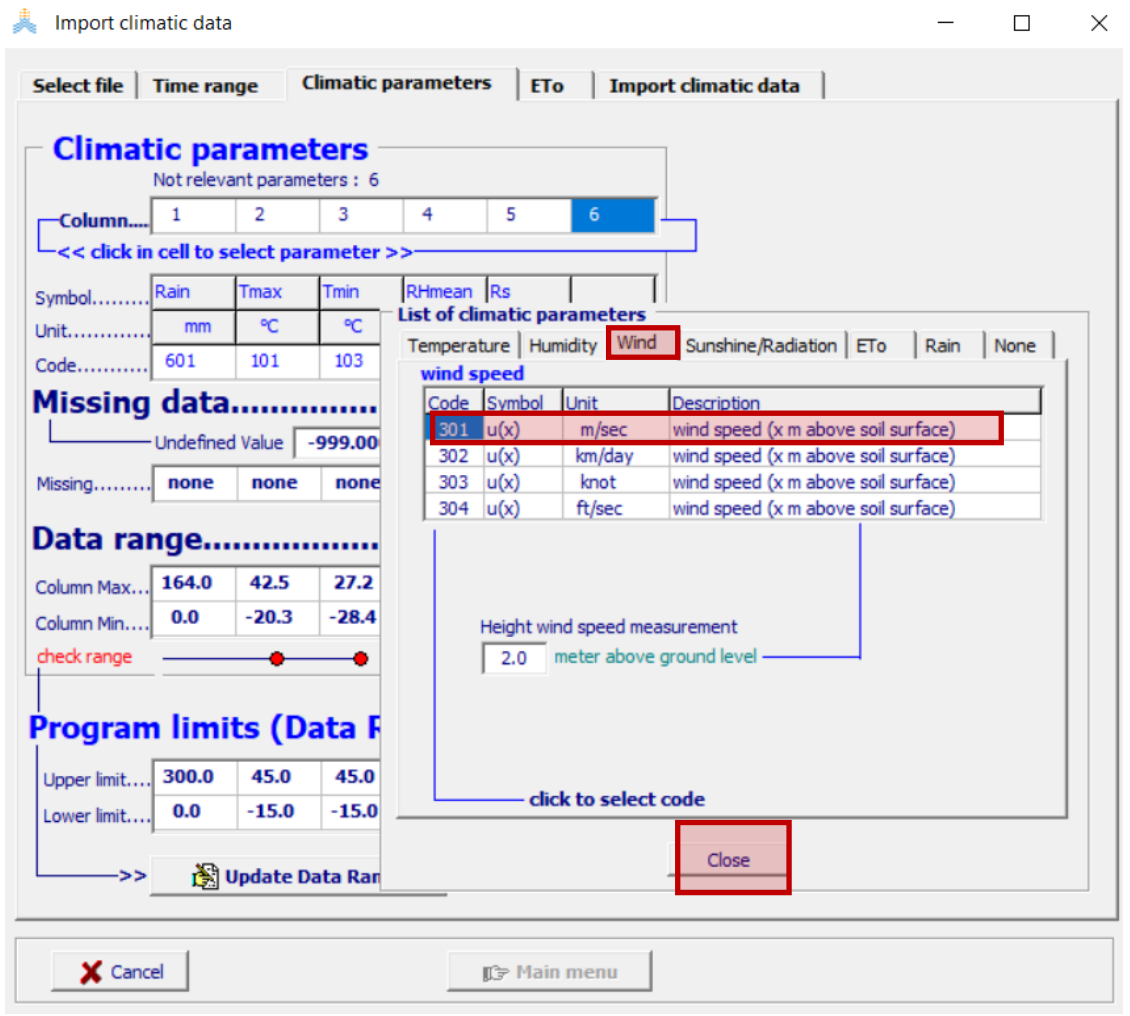


Create a climatic file (solar radiation & wind)

Step 5: click on the fifth column (**blank cell**), then select the **sunshine/radiation tab** and **solar or shortwave radiation (w/m²)**. Finally, click on **close**



Step 6: click on the sixth column (**blank cell**), then select the **wind tab** and **wind speed (m/s)**. Finally, click on **close**



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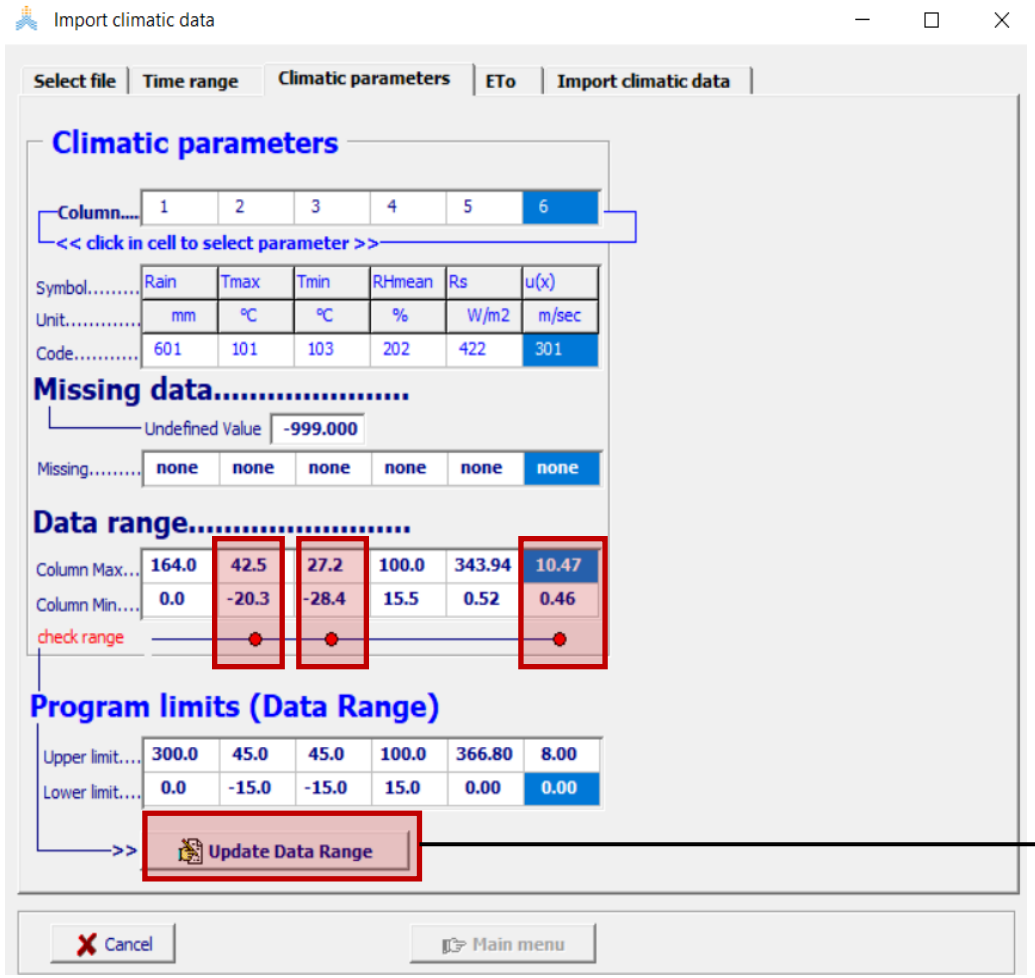
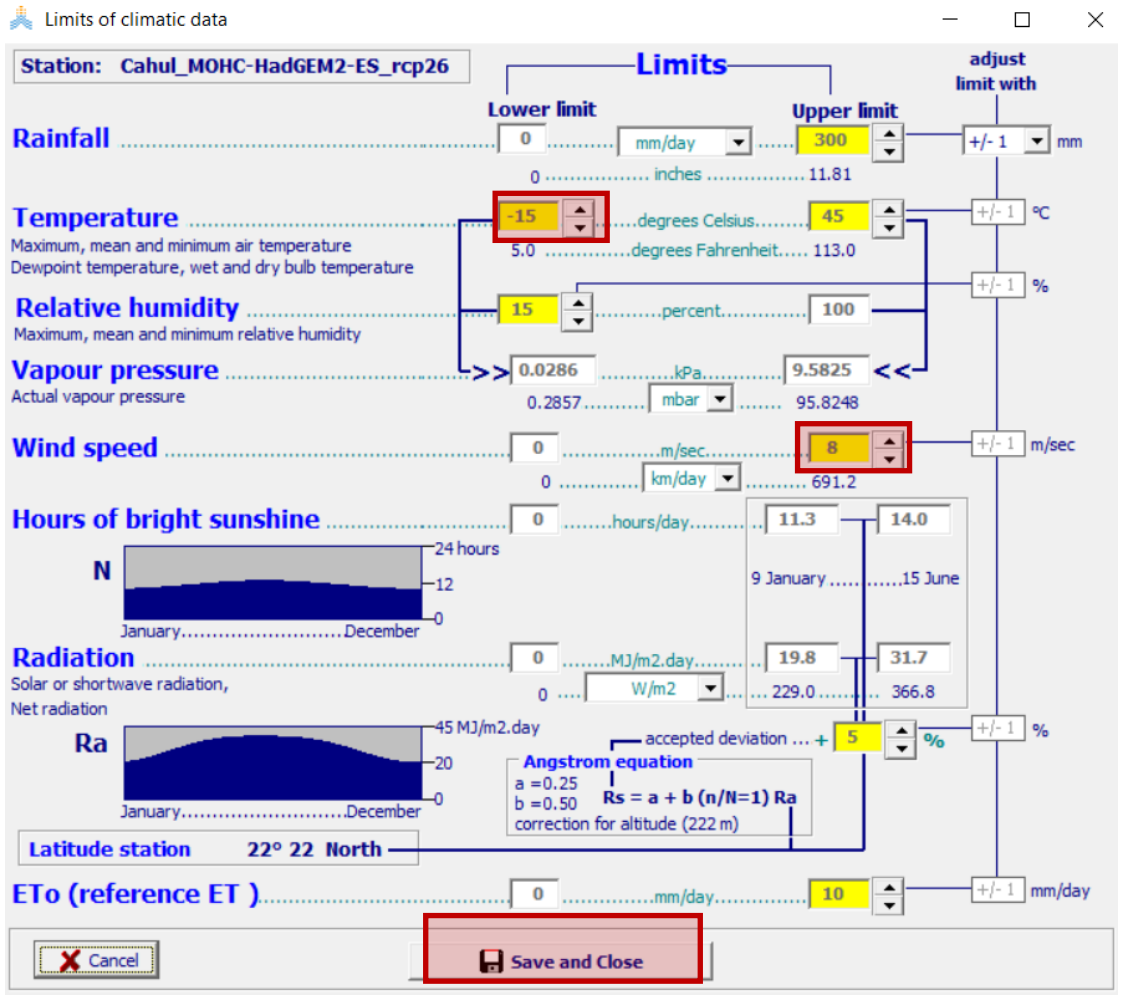
Update data ranges exceeding limits

Now you can visualize all the imported parameters as well as the data ranges for each of these variables

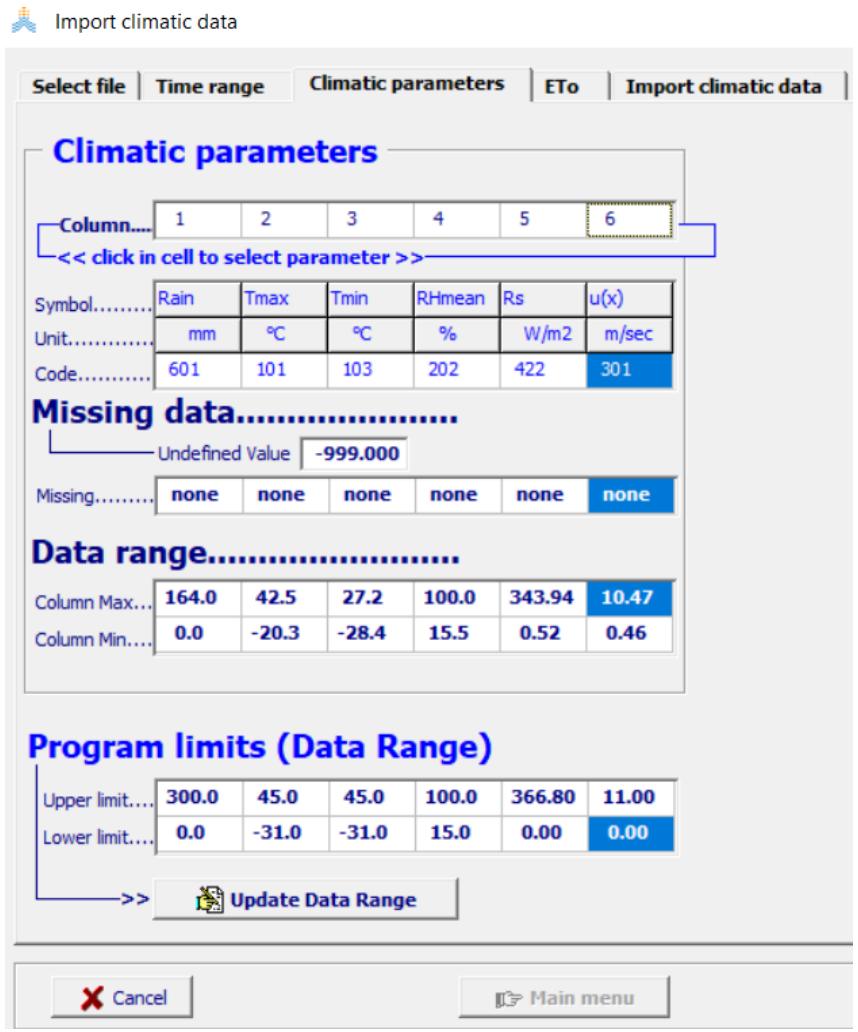


Steps 1-2: change the lower limit of **Tmin** to **-30ºC** and the upper limit of **wind speed** to **11m/s**. Finally, click on **save and close**

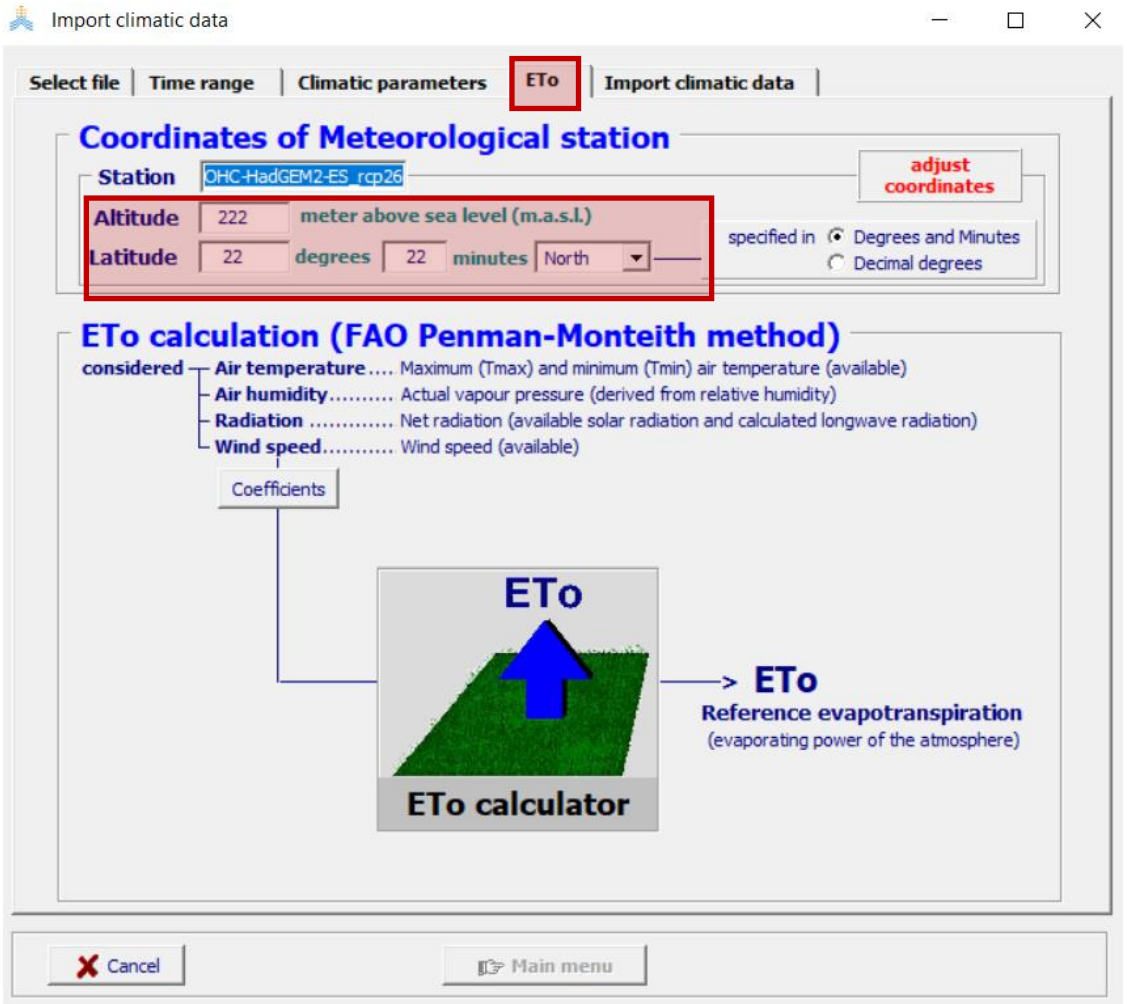


Introduce coordinates

As you can see, all the imported parameters have been succesfully introduced!



Step 1: since we are preparing the climatic file for **Cahul**, change the **altitude** to **37** masl and the **latitude** to **45** degrees and **53** minutes.



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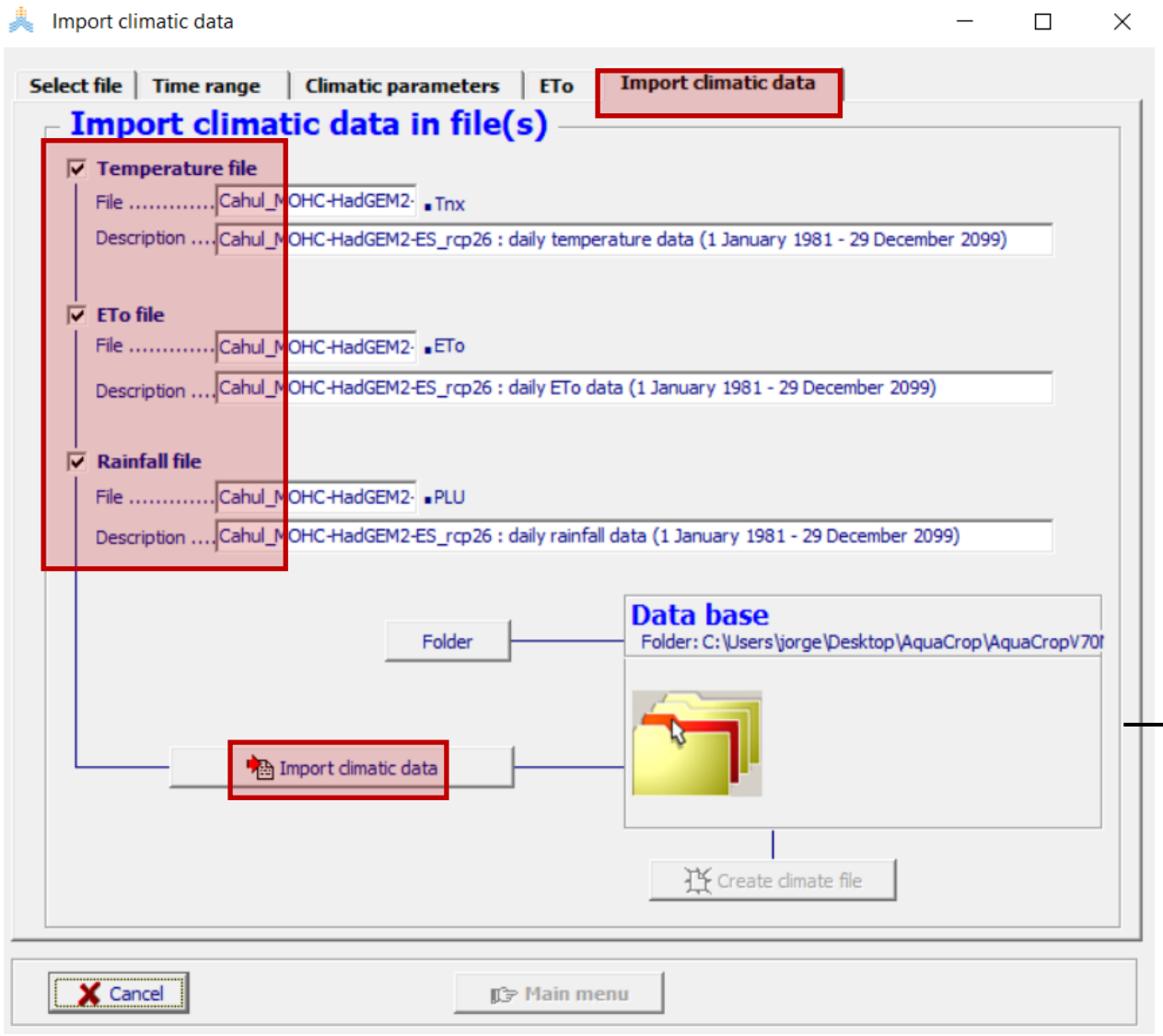
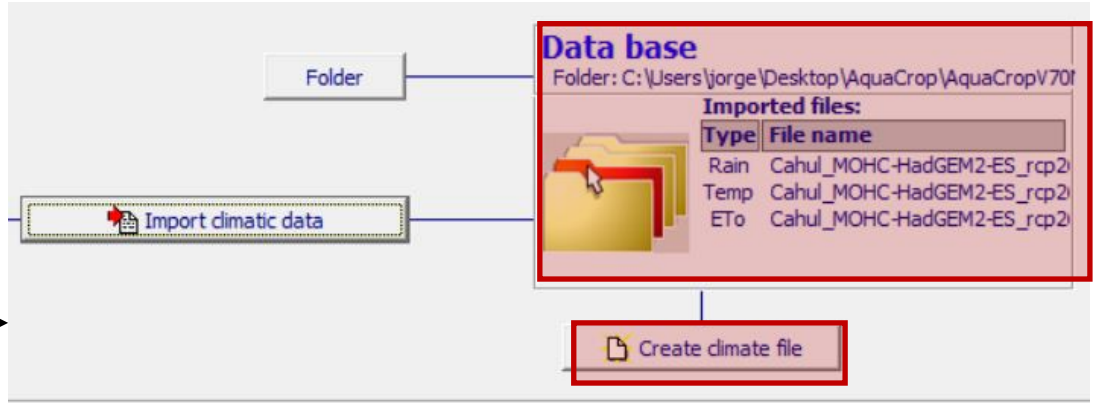
Import climatic data into AquaCrop



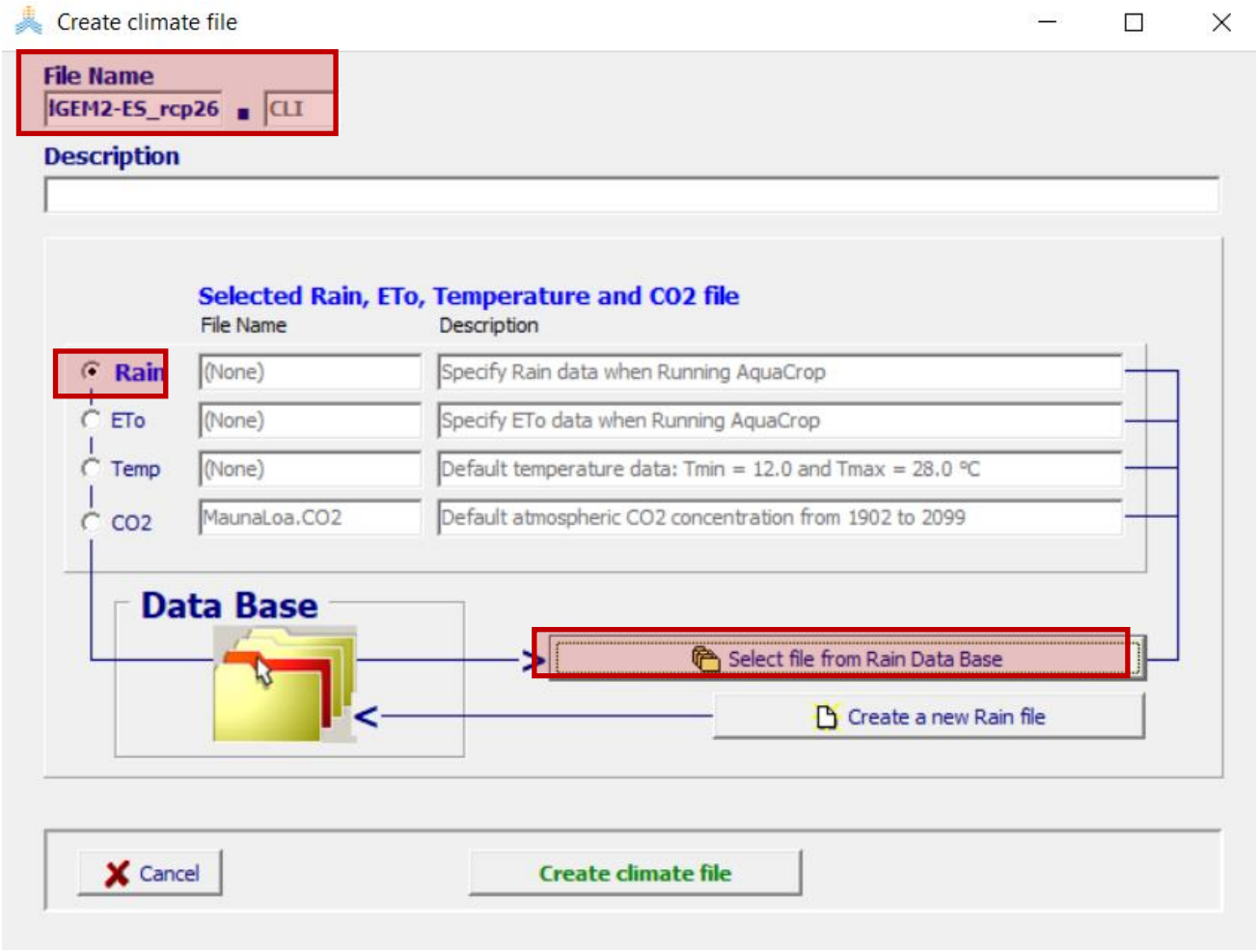
Step 1: click on **Import climatic data** and double check that the temperature, ETo and Rainfall file are selected/ticked

Step 2: click on **import climatic data** and then on **create climate file**.

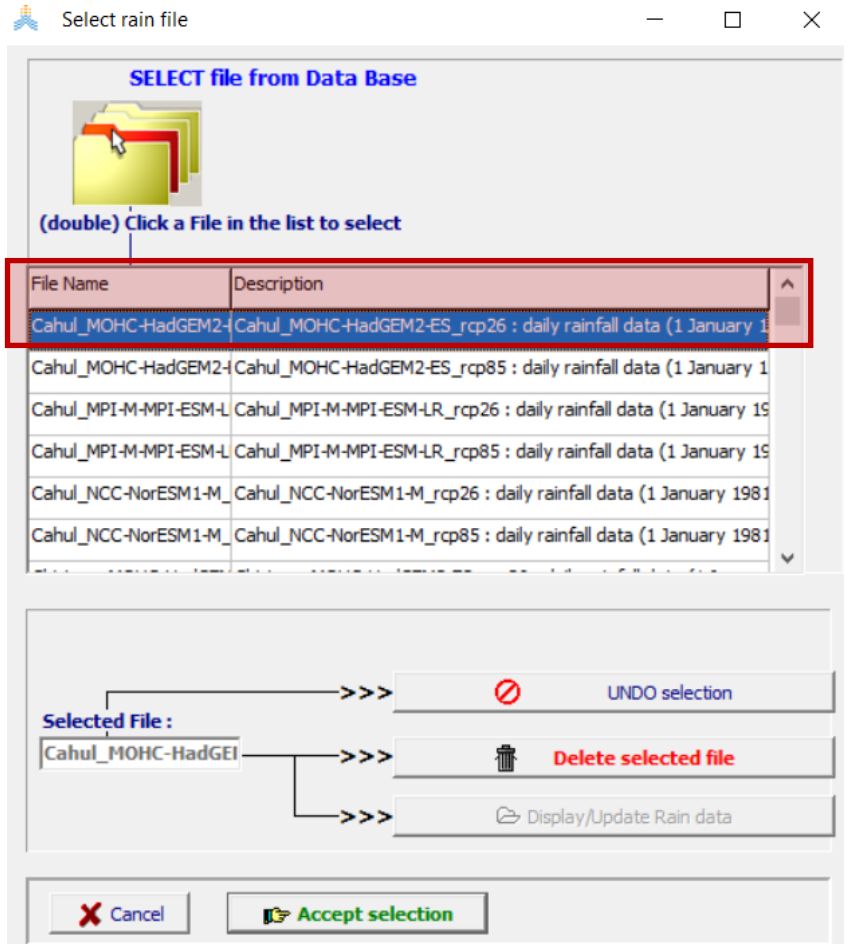


Select the rain file

Step 1. Name the climatic file as **Cahul_MOHC-HadGEM2-ES_rcp26**
Step 2. Click on **Rain** and **Select File from Rain Database**



Step 3. Select the correct rain file named: **Cahul_MOHC-HadGEM2-ES_rcp26: daily rainfall**



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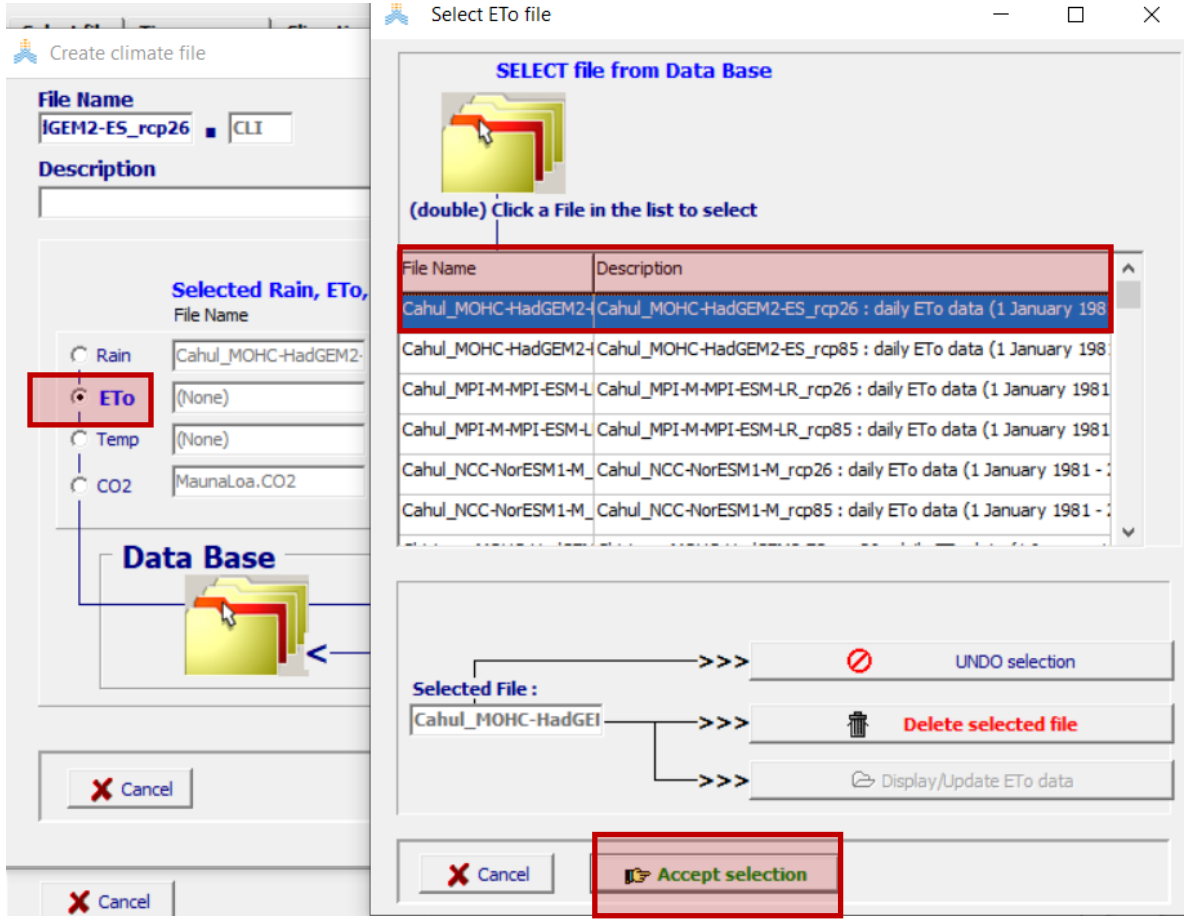
Select the ETo and Temp files

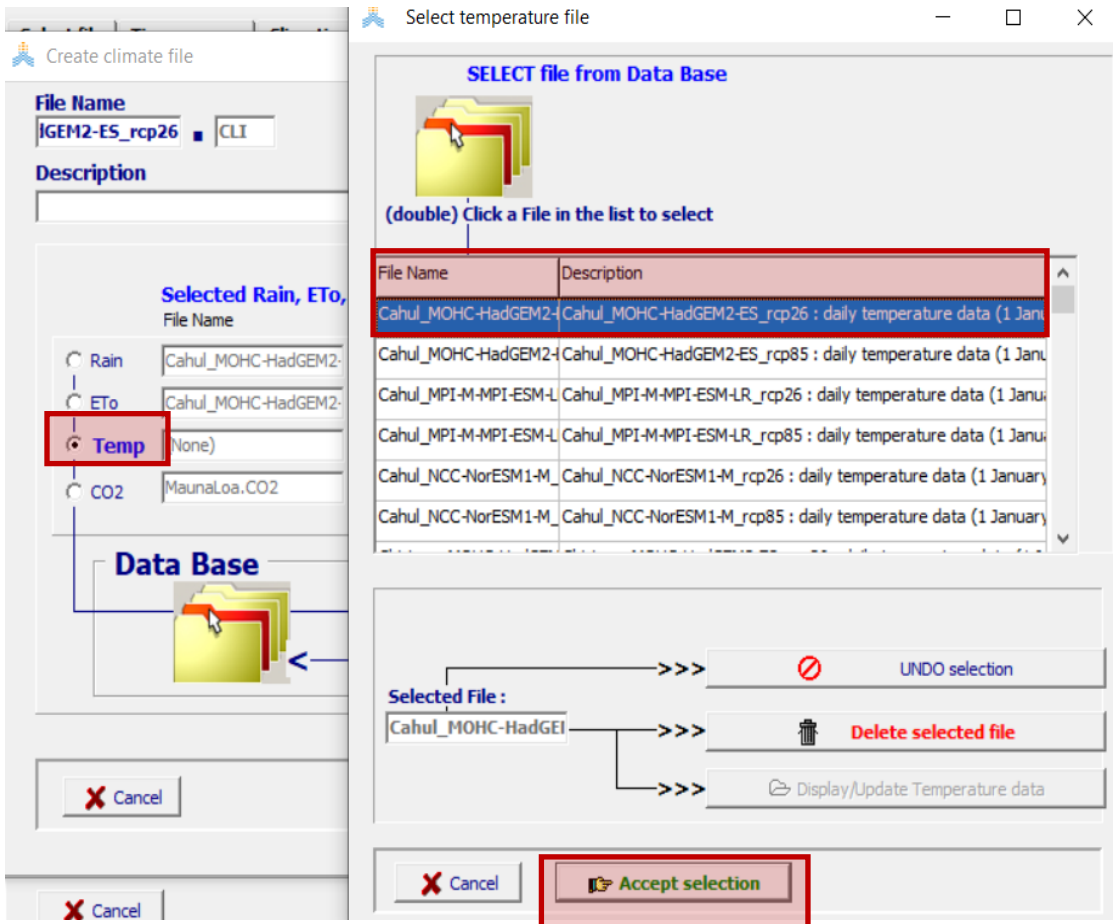
Step 1. Click on **Eto**, select file from **ETo Database** and **accept selection**

Remember that the file is named: ***Cahul_MOHC-HadGEM2-ES_rcp26: daily ETo data***



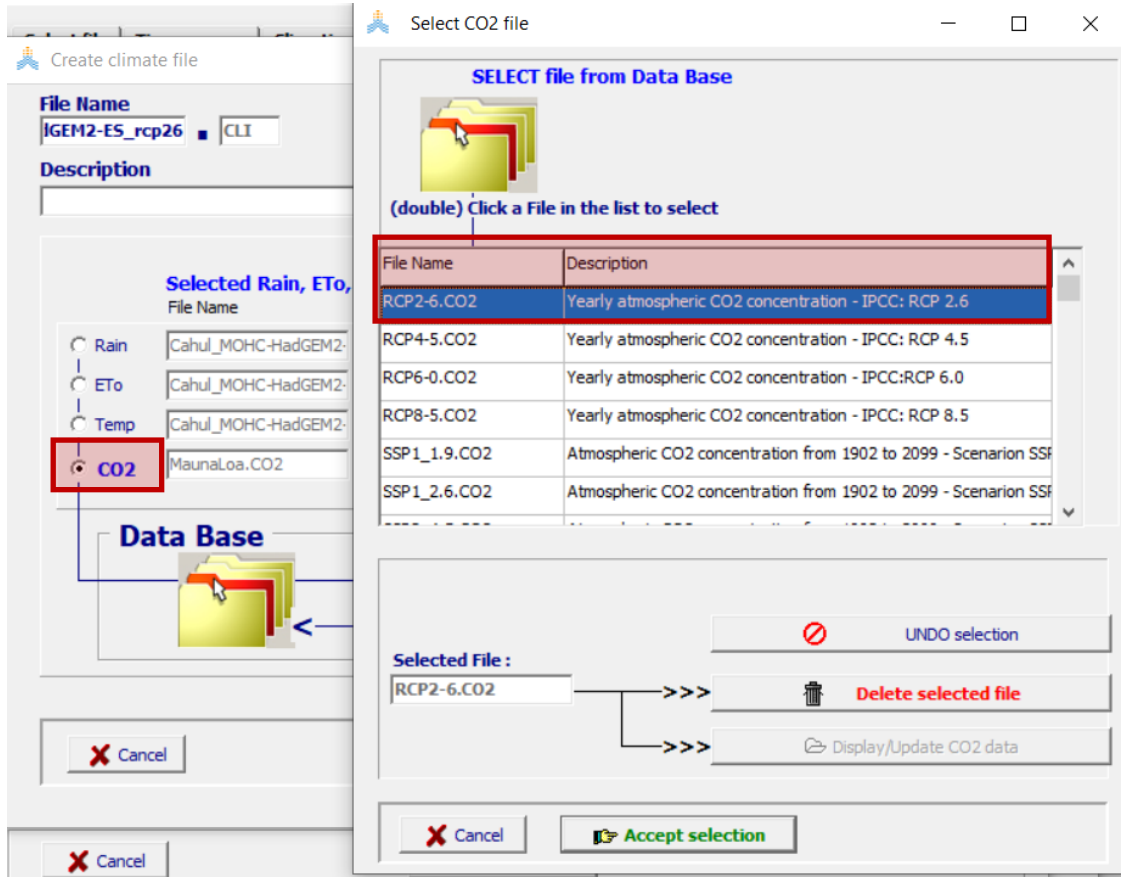
Step 2. Click on **Temp**, select file from **Temp Database** and **accept selection**

Remember that the file is named: ***Cahul_MOHC-HadGEM2-ES_rcp26: daily temperature data***

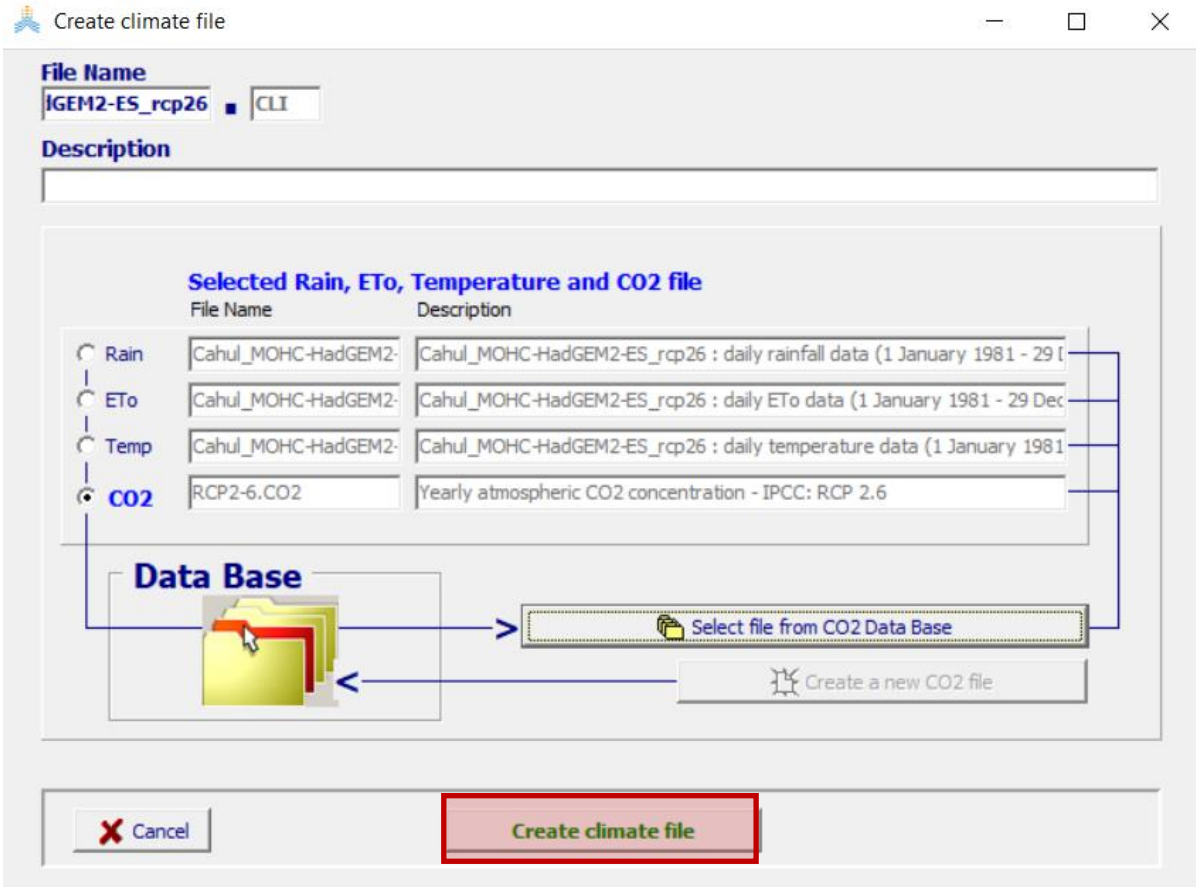


Select the CO_2 file and create climate file

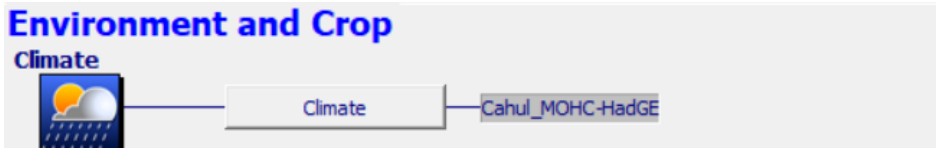
Step 1. Click on **CO_2** and select **RCP 2.6-CO_2** from database



Step 2. Click on **Create climate file**

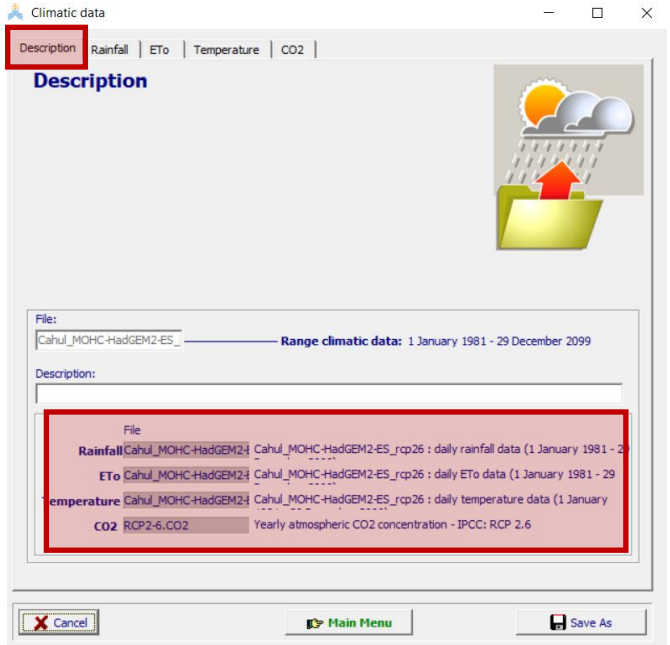


Visualize the climatic results for Cahul

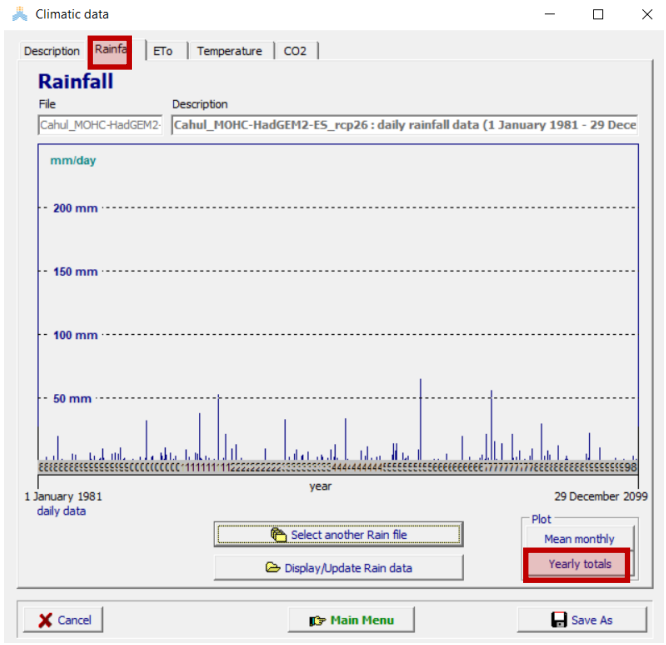


Step 1. Click on the **climate module** and **select Cahul_MOHC-HadGEM2-ES_rcp26**

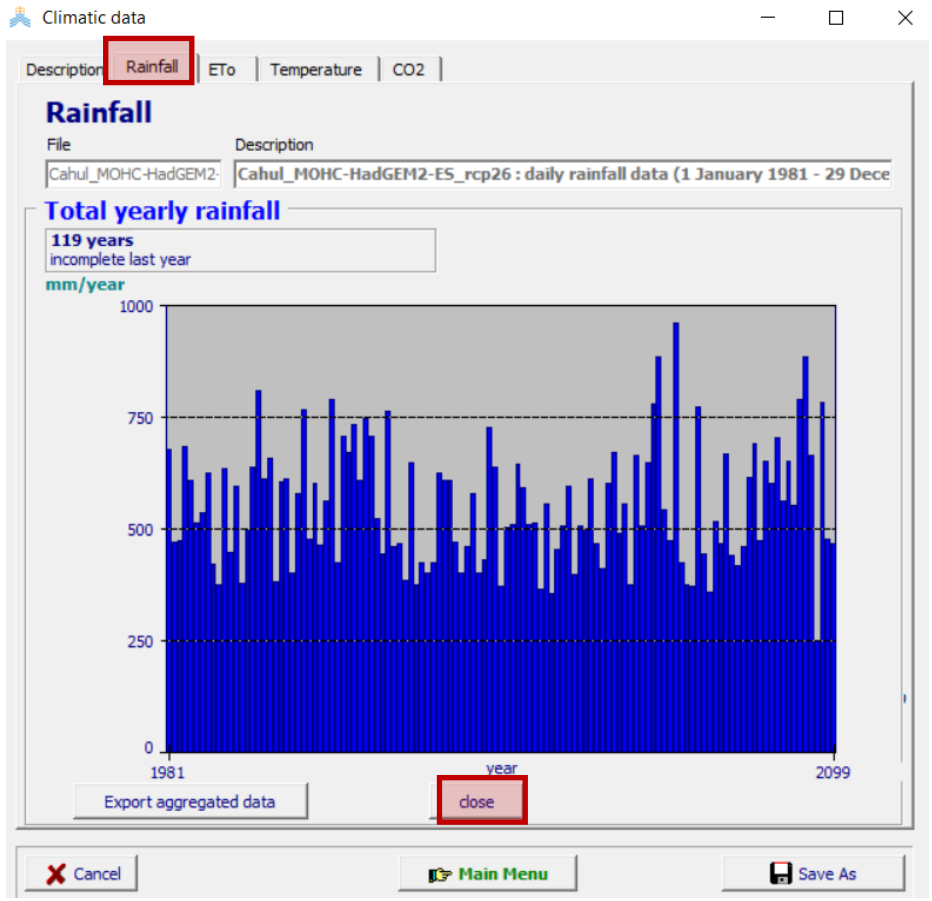
Step 1. In **description** verify that the climate files are the right ones



Step 2. Click on the **rainfall tab** and on **yearly totals**



Step 3. Visualize the rainfall data → then **close**



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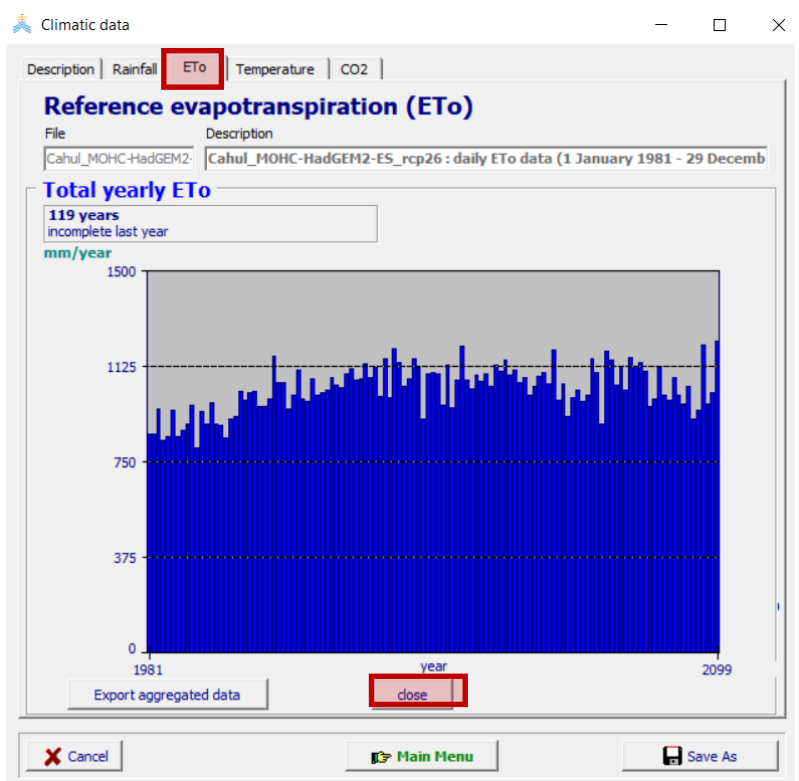
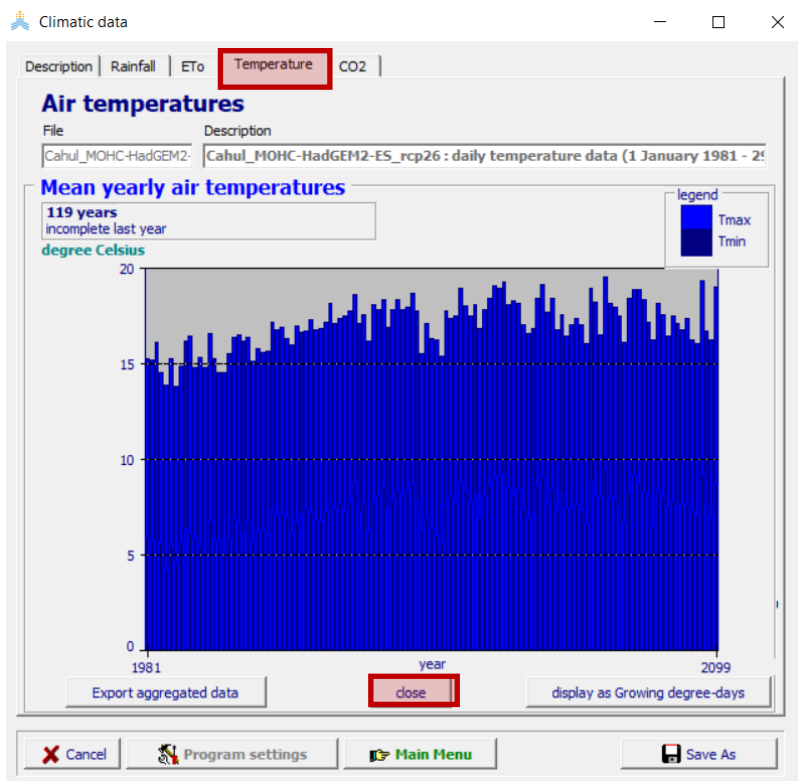
Visualize the climatic results for Cahul

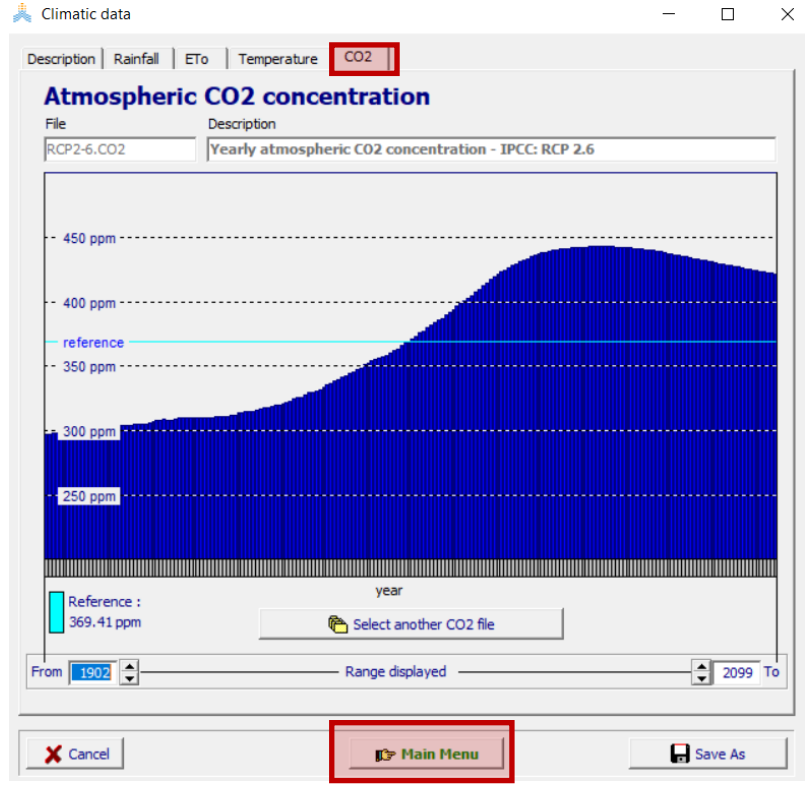
Step 4. Click on the **ETo** tab and visualize the ETo data → then **close**



Step 5. Click on the **Temperature** tab and visualize the temperature data → then **close**



Step 5. Click on the **CO_2** tab and visualize the CO_2 data for RCP 2.6 → then click on **Main Menu**



Take away messages

- Creating climatic files in AquaCrop its a long, but straightforward process.
- If the user wants to produce daily simulations, daily weather values are required.
- To compute ETo, the user needs at least three input climatic parameters (precipitation, Tmax and Tmin).
- The maximum number of climatic parameters is six.
- AquaCrop automatically computes missing parameters (e.g., wind speed or relative humidity) necessary for running the Penman Monteith equation.
- It is important to use the right naming when saving the climatic files.
- AquaCrop automatically produces visuals for precipitation, ETo, temperature and CO_2.

Thank you!

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