



Food and Agriculture
Organization of the
United Nations



Crop Module 2

AquaCrop input requirements

Jorge Alvar-Beltrán
(13-14 December, 2022)



Day 1 (introduction to AquaCrop)

- 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



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



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

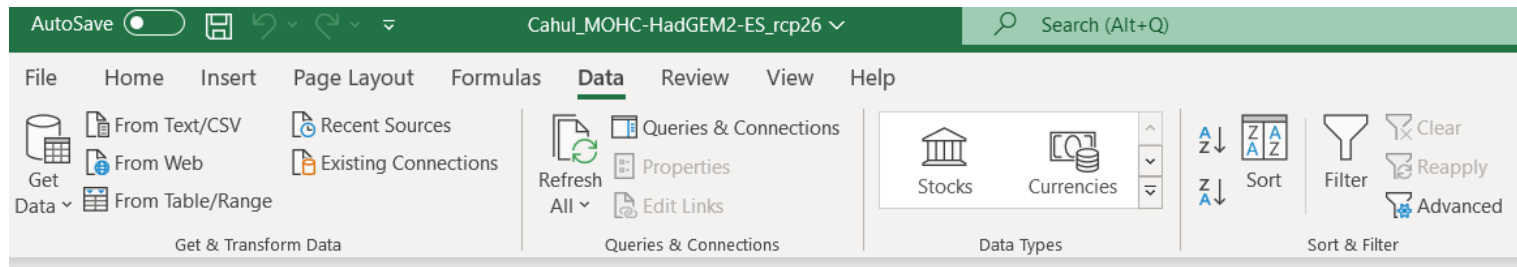
Climate module: create our own climatic files (daily values) for Cahul from 01-01-1981 until 31-12-2099.

- 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.



Preparing the CSV climatic files

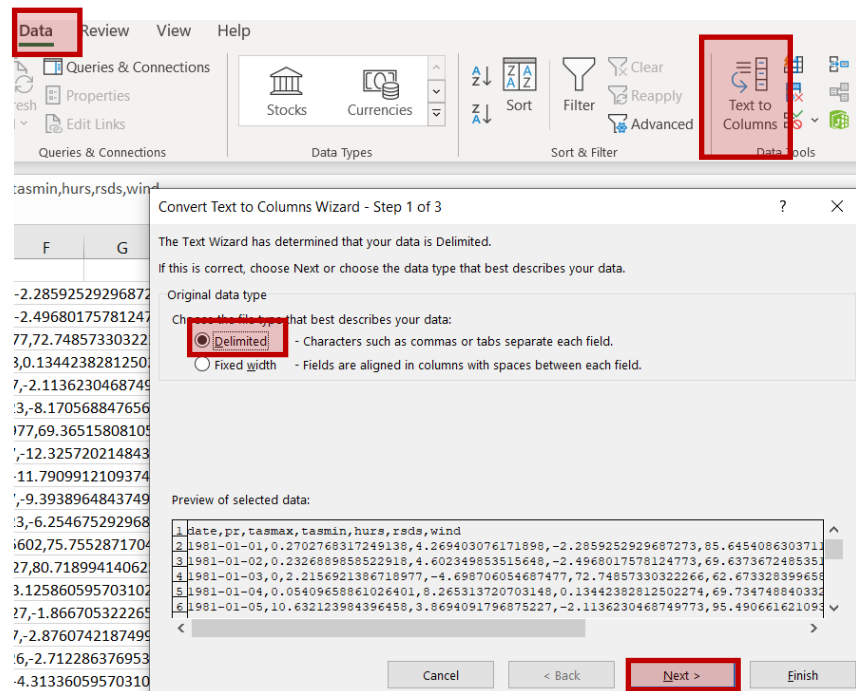
Step 1: select column A



A	B	C	D	E	F	G	H	I	J	K	L	M	N
date,pr,tasmax,tasmin,hurs,rds,wind													
1981-01-01,0.2702768317249138,4.269403076171898,-2.2859252929687273,85.6454086303711,69.2807846069336,3.5593442916870117													
1981-01-02,0.2326889858522918,4.602349853515648,-2.4968017578124773,69.63736724853516,52.842227935791016,2.4679079055786133													
1981-01-03,0.2156921386718977,-4.698706054687477,72.74857330322266,62.6733283996582,5.0082011222839355													
1981-01-04,0.05409658861026401,8.265313720703148,0.13442382812502274,69.73474884033203,43.36867141723633,5.121006488800049													
1981-01-05,10.632123984396458,3.8694091796875227,-2.1136230468749773,95.49066162109375,6.96929931640625,4.043363571166992													
1981-01-06,0.7087101344950497,-1.2128356933593523,-8.170568847656227,71.7302017211914,51.268394470214844,4.866427421569824													
1981-01-07,0,-3.5734008789062273,-9.919042968749977,69.36515808105469,63.955631256103516,2.197810649871826													
1981-01-08,0.1331381434283685,-7.786840820312477,-12.325720214843727,70.61763000488281,50.92558670043945,7.635903358459473													
1981-01-09,5.583599139936268,-7.865209960937477,-11.790991210937477,69.84180450439453,21.048471450805664,8.054590225219727													
1981-01-10,1.1796402395702899,-5.218359374999977,-9.393896484374977,81.09659576416016,36.72311782836914,6.155998229980469													
1981-01-11,0.2688524058612529,-1.7901062011718523,-6.254675292968727,84.75830841064453,46.02104949951172,3.911297082901001													
1981-01-12,0,-0.09625854492185226,-9.943365478515602,75.75528717041016,78.404052734375,2.457664728164673													
1981-01-13,0,3.3455139160156477,-7.925451660156227,80.718994140625,78.12139129638672,2.955726385116577													
1981-01-14,1.668464974500239,4.676873779296898,-3.1258605957031023,95.45256042480469,35.86298370361328,2.7034404277801514													
1981-01-15,0.11373003653716296,0.6112915039062727,-1.8667053222656023,91.05133819580078,37.75271224975586,3.5992789268493652													
1981-01-16,3.3128607901744545,1.7230773925781477,-2.8760742187499773,86.69245147705078,50.41781997680664,3.6333093643188477													
1981-01-17,3.561418899334967,-0.21335449218747726,-2.7122863769531023,80.27169036865234,31.479127883911133,5.007536888122559													
1981-01-18,6.01831313688308,-0.9131835937499773,-4.313360595703102,89.3434066772461,43.91904830932617,2.304128646850586													
1981-01-19,2.748433593660593,-1.4044860839843523,-5.481726074218727,94.212310791015625,37.47016525268555,2.712278127670288													
1981-01-20,16.594414366409183,0.06585083007814774,-3.0876831054687273,98.52326202392578,15.139023780822754,3.951653003692627													
1981-01-21,0.20696944338851608,0.16182861328127274,-2.2799743652343523,94.2158432006836,34.36091995239258,2.7581164836883545													

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**





Preparing the CSV climatic files

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

Convert Text to Columns Wizard - Step 2 of 3

This screen lets you set the delimiters that your data contains. You can see how your text is affected in the preview below.

Delimiters

- ☒ Tab
- ☐ Semicolon
- ☒ **Comma**
- ☐ Space
- ☐ Other:

☐ Treat consecutive delimiters as one

Text qualifier:

Data preview

date	pr	tasmax	tasmin	hurs
1981-01-01	0.2702768317249138	4.269403076171898	-2.2859252929687273	85.6454086303711
1981-01-02	0.2326889858522918	4.602349853515648	-2.4968017578124773	69.6373672485351
1981-01-03	0	2.2156921386718977	-4.698706054687477	72.7485733032226
1981-01-04	0.05409658861026401	8.265313720703148	0.13442382812502274	69.7347488403320
1981-01-05	10.632123984396458	3.8694091796875227	-2.1136230468749773	95.4906616210937

Cancel < Back **Next >** Finish

Step 2: click on **Finish**

Convert Text to Columns Wizard - Step 3 of 3

This screen lets you select each column and set the Data Format.

Column data format

- ☒ **General**
- ☐ Text
- ☐ Date:
- ☐ Do not import column (skip)

'General' converts numeric values to numbers, date values to dates and all remaining values to text.

Advanced...

Destination:

Data preview

General	General	General	General	General
date	pr	tasmax	tasmin	hurs
1981-01-01	0.2702768317249138	4.269403076171898	-2.2859252929687273	85.6454086303711
1981-01-02	0.2326889858522918	4.602349853515648	-2.4968017578124773	69.6373672485351
1981-01-03	0	2.2156921386718977	-4.698706054687477	72.7485733032226
1981-01-04	0.05409658861026401	8.265313720703148	0.13442382812502274	69.7347488403320
1981-01-05	10.632123984396458	3.8694091796875227	-2.1136230468749773	95.4906616210937

Cancel < Back Next > **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

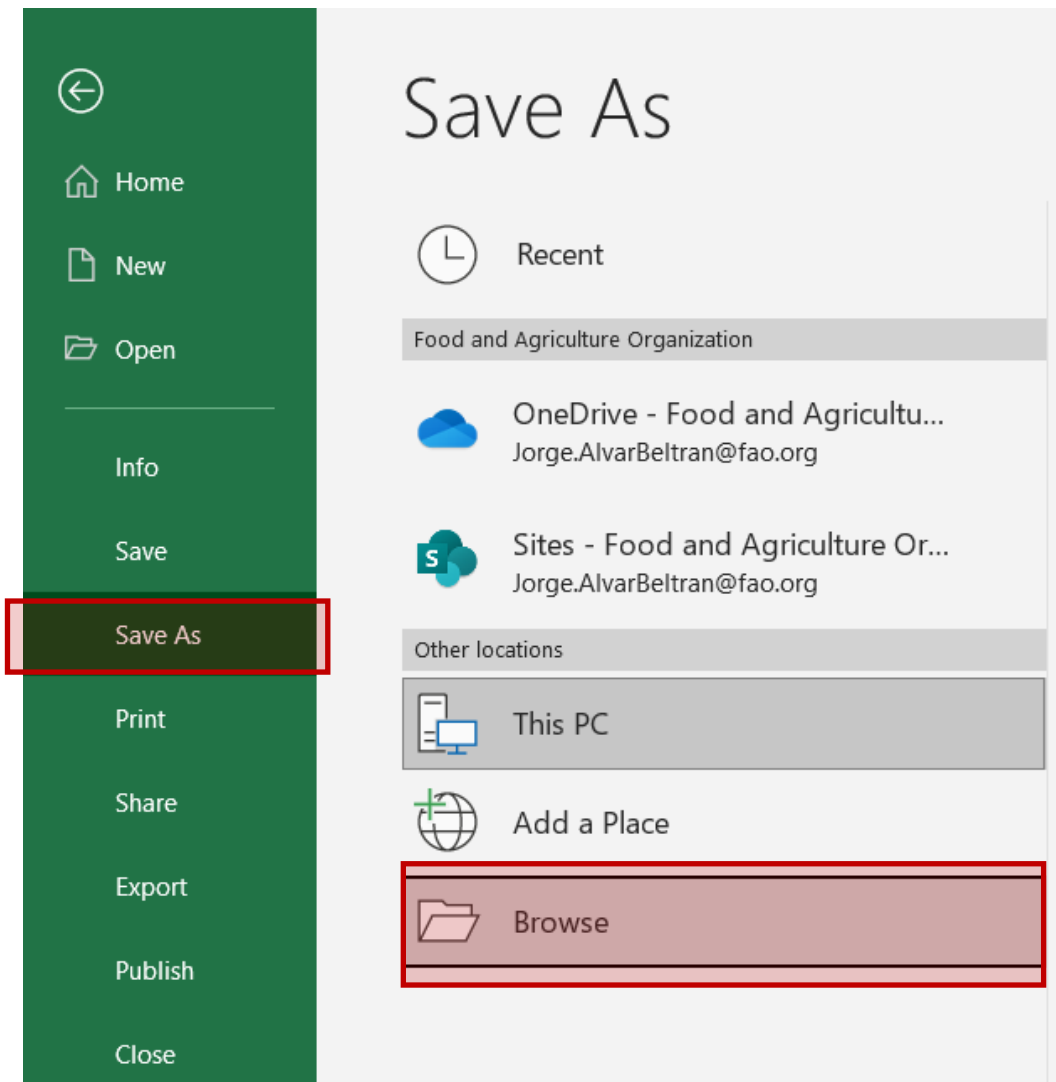
Step 1: delete the first row and column (AquaCrop struggles to read text)

Remember that the new columns correspond to:

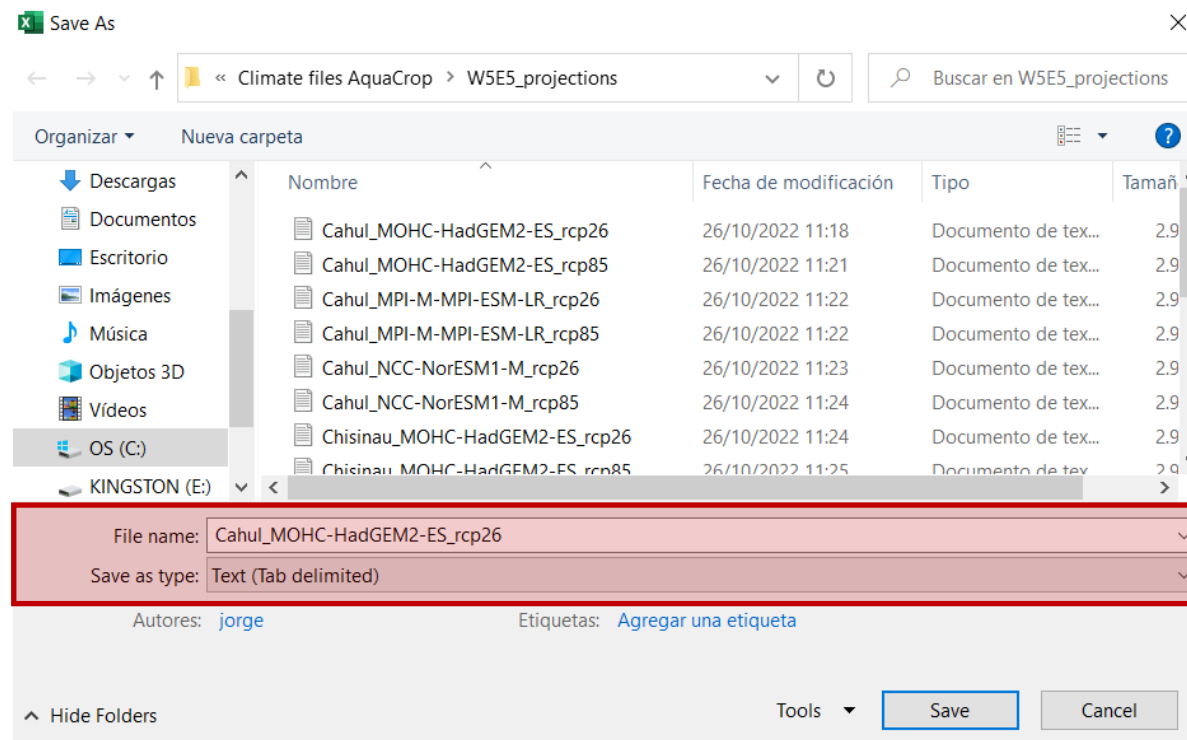
- A) pr: precipitation (mm/day)
- B) Tasmax: maximum temperatures (°C)
- C) Tasmin: minimum temperatures (°C)
- D) Hurs: mean relative humidity (%)
- E) Rsds: incoming solar radiation (w/m²)
- F) Wind: average wind speed (m/s)



Saving the climatic files in the right format



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





Create/import climatic files

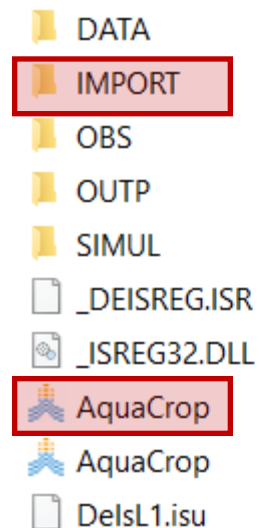
Year	Date	Tmax	Tmin	Prec.	RH	WS	SR
2006	1	19.1	1.25	0	81.45	1.6	129.5
2006	2	23.5	4.3	0	62.9	1.8	148.5
2006	3	23.5	2.25	0	53.45	1.9	178.1
2006	4	20	3	0	64.35	2	177.9
2006	5	22.5	5.3	0	52.7	2	174.8
2006	6	21.6	2.85	0	46.2	1.8	182
2006	7	22.6	3.35	0	49.2	2.1	180.1
2006	8	21	2.2	0	57.45	2.2	175.3
2006	9	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 CO₂ files from 1900 until 2100



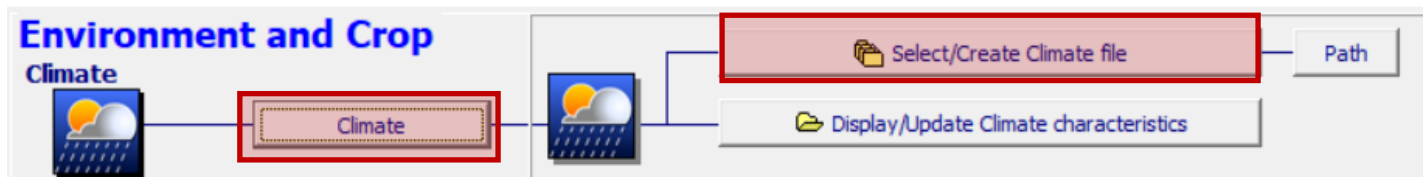
Open txt. file on AquaCrop

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



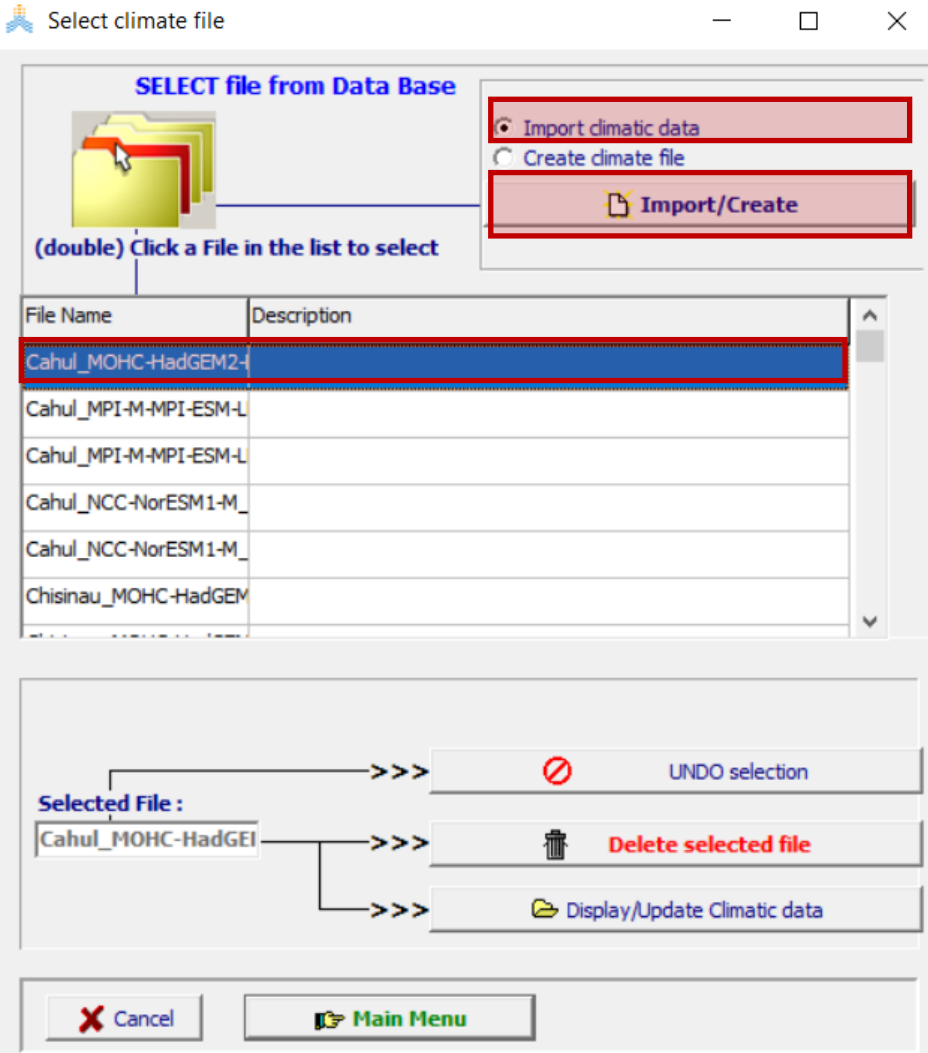
Step 2: open **AquaCrop** and click on **Start**

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





Create a climatic file

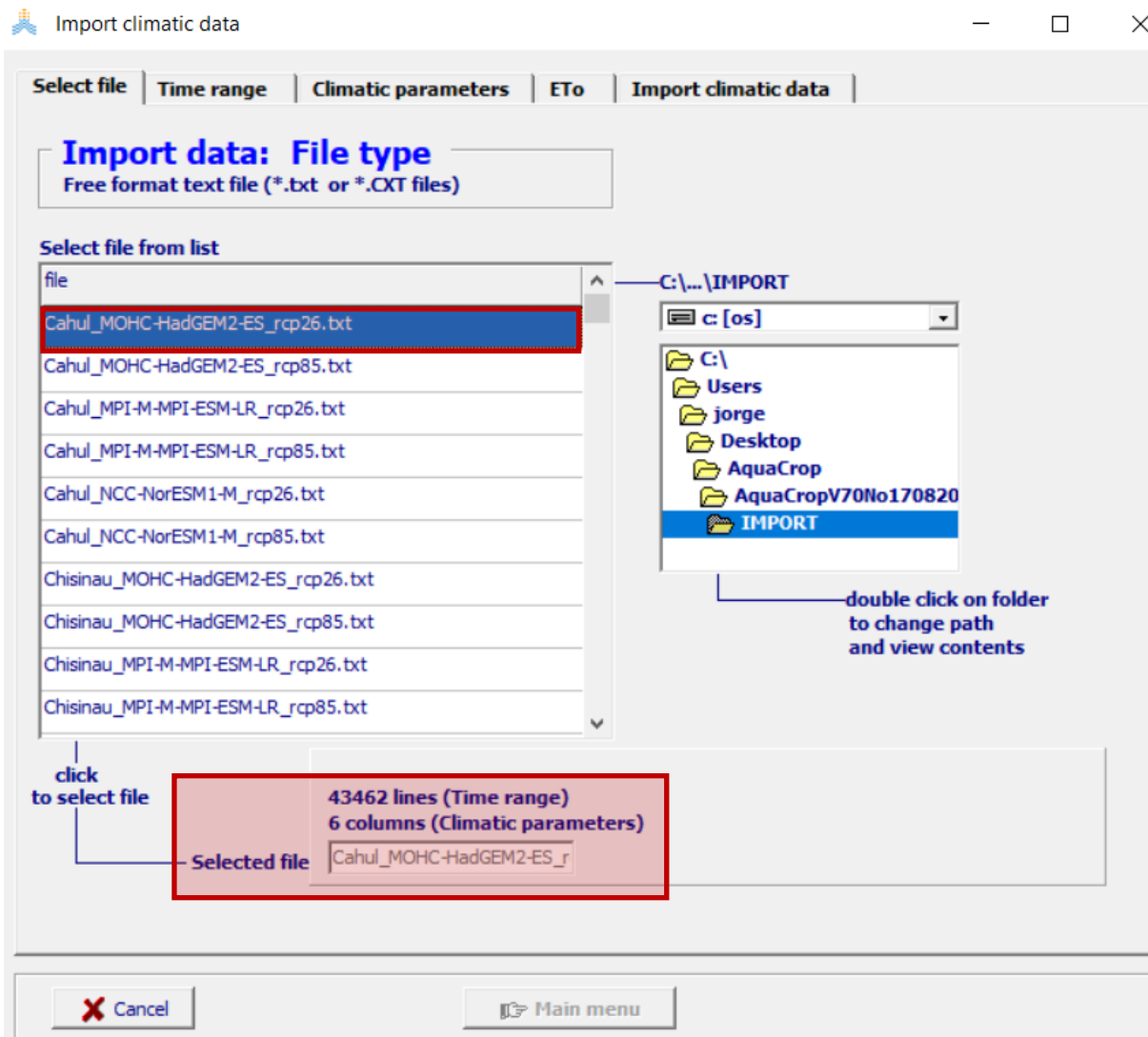


Step 1: click on **Import/Create** climatic file

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_MOHC-HadGEM-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

Import climatic data

Select file **Time range** Climatic parameters ETo Import climatic data

Type and time range of climatic data

Type ☒ Daily ☐ 10-daily ☐ Monthly

Time range

☐ not linked to a specific year

First Day 1 Last Day 31

First Month January Last Month December

First Year 2005 Last Year 2005

Adjust time range
number of days in specified time range (365)
does not correspond with number of lines (43462) in file

>>> number of daily records (=365) in specified time range

Cancel Main menu

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

Import climatic data

Select file | Time range | Climatic parameters | ETo | Import climatic data

Climatic parameters

Not relevant parameters : 1, 2, 3, 4, 5, 6

Column... 1 2 3 4 5 6

<< click in cell to select parameter >>

Symbol.....						
Unit.....						
Code.....						

Missing data.....

Undefined Value -999.000

Missing..... none none none none none none

Data range.....

Column Max...	164.0	42.5	27.2	100.0	343.9	10.5
Column Min...	0.0	-20.3	-28.4	15.5	0.5	0.5

Program limits (Data Range)

Upper limit...						
Lower limit...						

>> Update Data Range

Cancel Main menu

- Remember that the new columns correspond to:
- A) pr: precipitation (mm/day)
 - B) Tmax: maximum temperatures (°C)
 - C) Tmin: minimum temperatures (°C)
 - D) Hurs: mean relative humidity (%)
 - E) Rsds: incoming solar radiation (w/m²)
 - 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**

Import climatic data

Select file | Time range | Climatic parameters | ETo | Import climatic data

Climatic parameters

Not relevant parameters : 1, 2, 3, 4, 5, 6

Column... 1 2 3 4 5 6

<< click in cell to select parameter >>

Symbol... Rain

Unit... mm

Code... 601

Missing data.....

Undefined Value -999.00

Missing... none none none

Data range.....

Column Max... 164.0 42.5 27.2

Column Min... 0.0 -20.3 -28.4

Program limits (Data F

Upper limit... 300.0 45.0

Lower limit... 0.0 -15.0

Update Data Ran

Close

Cancel Main menu

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

Import climatic data

Select file | Time range | Climatic parameters | ETo | Import climatic data

Climatic parameters

Not relevant parameters : 3, 4, 5, 6

Column... 1 2 3 4 5 6

<< click in cell to select parameter >>

Symbol... Tmax

Unit... °C

Code... 101

Missing data.....

Undefined Value -999.00

Missing... none none none

Data range.....

Column Max... 164.0 42.5 27.2

Column Min... 0.0 -20.3 -28.4

Program limits (Data F

Upper limit... 300.0 45.0

Lower limit... 0.0 -15.0

Update Data Ran

Close

Cancel Main menu

Create a climatic file (Tmin & RH)

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

Import climatic data

Select file | Time range | Climatic parameters | ETo | Import climatic data

Climatic parameters
Not relevant parameters : 4, 5, 6

Column... 1 2 3 4 5 6
 << click in cell to select parameter >>

Symbol..... Rain Tmax Tmin
 Unit..... mm °C °C
 Code..... 601 101 103

Missing data.....
 Undefined Value -999.00
 Missing..... none none none

Data range.....
 Column Max... 164.0 42.5 27.2
 Column Min... 0.0 -20.3 -28.4
 check range

Program limits (Data F)
 Upper limit... 300.0 45.0 45.0
 Lower limit... 0.0 -15.0 -15.0

List of climatic parameters
 Temperature Humidity Wind Sunshine/Radiation ETo Rain None
 air temperature
 Code Symbol Unit Description
 101 Tmax °C maximum air temperature
 102 Tmean °C mean air temperature
 103 Tmin °C minimum air temperature
 111 Tmax °F maximum air temperature
 112 Tmean °F mean air temperature
 113 Tmin °F minimum air temperature

click to select code

Close

Cancel Main menu

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

Import climatic data

Select file | Time range | Climatic parameters | ETo | Import climatic data

Climatic parameters
Not relevant parameters : 5, 6

Column... 1 2 3 4 5 6
 << click in cell to select parameter >>

Symbol..... Rain Tmax Tmin RHmean
 Unit..... mm °C °C %
 Code..... 601 101 103

Missing data.....
 Undefined Value -999.00
 Missing..... none none none

Data range.....
 Column Max... 164.0 42.5 27.2
 Column Min... 0.0 -20.3 -28.4
 check range

Program limits (Data F)
 Upper limit... 300.0 45.0 45.0
 Lower limit... 0.0 -15.0 -15.0

List of climatic parameters
 Temperature Humidity Wind Sunshine/Radiation ETo Rain None
 air humidity
 Code Symbol Unit Description
 201 RHmax % maximum relative humidity
 202 RHmean % mean relative humidity
 203 RHmin % minimum relative humidity
 210 Tdew °C dewpoint temperature
 211 Tdew °F dewpoint temperature
 221 e(act) kPa actual vapour pressure
 222 e(act) hPa (mbar) actual vapour pressure
 223 e(act) psi actual vapour pressure
 224 e(act) atm actual vapour pressure
 225 e(act) mmHg actual vapour pressure
 231 Tdry °C temperature of dry bulb
 232 Twet °C temperature of wet bulb
 233 Tdry °F temperature of dry bulb
 234 Twet °F temperature of wet bulb

click to select code

Close

Cancel Main menu

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**

Import climatic data

Select file | Time range | Climatic parameters | ETo | Import climatic data

Climatic parameters
Not relevant parameters : 5, 6

Column.... 1 2 3 4 **5** 6
 << click in cell to select parameter >>

Symbol..... Rain Tmax Tmin RHmean
 Unit..... mm °C °C
 Code..... 601 101 103

Missing data.....
 Undefined Value -999.00
 Missing..... none none none

Data range.....
 Column Max... 164.0 42.5 27.2
 Column Min... 0.0 -20.3 -28.4
 check range

Program limits (Data F
 Upper limit... 300.0 45.0 45.0
 Lower limit... 0.0 -15.0 -15.0

List of climatic parameters
 Temperature Humidity Wind **Sunshine/Radiation** ETo Rain None

sunshine and radiation

Code	Symbol	Unit	Description
401	n	hour/day	actual duration of sunshine in a day
402	n/N	-	relative sunshine duration
421	Rs	MJ/m2.day	solar or shortwave radiation
422	Rs	W/m2	solar or shortwave radiation
423	Rs	J/cm2.day	solar or shortwave radiation
424	Rs	mm/day	solar or shortwave radiation
425	Rs	cal/cm2.day	solar or shortwave radiation
431	Rn	MJ/m2.day	net radiation
432	Rn	W/m2	net radiation
433	Rn	J/cm2.day	net radiation
434	Rn	mm/day	net radiation
435	Rn	cal/cm2.day	net radiation

click to select code

Close

Cancel Main menu

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

Import climatic data

Select file | Time range | Climatic parameters | ETo | Import climatic data

Climatic parameters
Not relevant parameters : 6

Column.... 1 2 3 4 5 **6**
 << click in cell to select parameter >>

Symbol..... Rain Tmax Tmin RHmean Rs
 Unit..... mm °C °C
 Code..... 601 101 103

Missing data.....
 Undefined Value -999.00
 Missing..... none none none

Data range.....
 Column Max... 164.0 42.5 27.2
 Column Min... 0.0 -20.3 -28.4
 check range

Program limits (Data F
 Upper limit... 300.0 45.0 45.0
 Lower limit... 0.0 -15.0 -15.0

List of climatic parameters
 Temperature Humidity **Wind** Sunshine/Radiation ETo Rain None

wind speed

Code	Symbol	Unit	Description
301	u(x)	m/sec	wind speed (x m above soil surface)
302	u(x)	km/day	wind speed (x m above soil surface)
303	u(x)	knot	wind speed (x m above soil surface)
304	u(x)	ft/sec	wind speed (x m above soil surface)

Height wind speed measurement
 2.0 meter above ground level

click to select code

Close

Update Data Range

Cancel Main menu

Update data ranges exceeding limits

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

Import climatic data

Select file | Time range | Climatic parameters | ETo | Import climatic data

Climatic parameters

Column... 1 2 3 4 5 6

<< click in cell to select parameter >>

Symbol	Rain	Tmax	Tmin	RHmean	Rs	u(x)
Unit	mm	°C	°C	%	W/m2	m/sec
Code	601	101	103	202	422	301

Missing data

Undefined Value: -999.000

Missing: none none none none none none

Data range

Column	Max	Min
1	164.0	0.0
2	42.5	-20.3
3	27.2	-28.4
4	100.0	15.5
5	343.94	0.52
6	10.47	0.46

check range

Program limits (Data Range)

Parameter	Upper limit	Lower limit
Rain	300.0	0.0
Tmax	45.0	-15.0
Tmin	45.0	-15.0
RHmean	100.0	15.0
Rs	366.80	0.00
u(x)	8.00	0.00

Update Data Range

Cancel Main menu

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

Limits of climatic data

Station: Cahul_MOHC-HadGEM2-ES_rcp26

Limits

adjust limit with

Rainfall

Lower limit: 0 mm/day Upper limit: 300 mm/day

Temperature

Maximum, mean and minimum air temperature
Dewpoint temperature, wet and dry bulb temperature

Lower limit: -15 °C Upper limit: 45 °C

Relative humidity

Maximum, mean and minimum relative humidity

Lower limit: 15 percent Upper limit: 100 percent

Vapour pressure

Actual vapour pressure

Lower limit: 0.0286 kPa Upper limit: 9.5825 kPa

Wind speed

Lower limit: 0 m/sec Upper limit: 8 m/sec

Hours of bright sunshine

Lower limit: 0 hours/day Upper limit: 14.0 hours/day

Radiation

Solar or shortwave radiation, Net radiation

Lower limit: 0 MJ/m2.day Upper limit: 31.7 MJ/m2.day


ETo (reference ET)

Lower limit: 0 mm/day Upper limit: 10 mm/day

Save and Close

Introduce coordinates

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

 Import climatic data

Import climatic data

Select file | Time range | Climatic parameters | ETo | Import climatic data

Climatic parameters

Column... 1 2 3 4 5 6
-<< click in cell to select parameter >>-

Symbol	Rain	Tmax	Tmin	RHmean	Rs	u(x)
Unit	mm	°C	°C	%	W/m2	m/sec
Code	601	101	103	202	422	301

Missing data

Undefined Value: -999.000


Missing: none none none none none none



Data range

Column Max	1	2	3	4	5	6
Max	164.0	42.5	27.2	100.0	343.94	10.47
Min	0.0	-20.3	-28.4	15.5	0.52	0.46

Program limits (Data Range)

Upper limit	1	2	3	4	5	6
Upper	300.0	45.0	45.0	100.0	366.80	11.00
Lower	0.0	-31.0	-31.0	15.0	0.00	0.00

>>  Update Data Range

 Cancel  Main menu


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.

 Import climatic data

Import climatic data

Select file | Time range | Climatic parameters | **ETo** | Import climatic data

Coordinates of Meteorological station

Station: OHC-HadGEM2-ES_rcp26 

Altitude: 222 meter above sea level (m.a.s.l.)

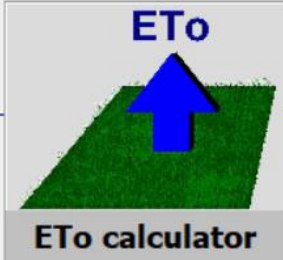
Latitude: 22 degrees 22 minutes North
specified in ☒ Degrees and Minutes ☐ Decimal degrees



ETo calculation (FAO Penman-Monteith method)

considered

- Air temperature: Maximum (Tmax) and minimum (Tmin) air temperature (available)
- Air humidity: Actual vapour pressure (derived from relative humidity)
- Radiation: Net radiation (available solar radiation and calculated longwave radiation)
- Wind speed: Wind speed (available)

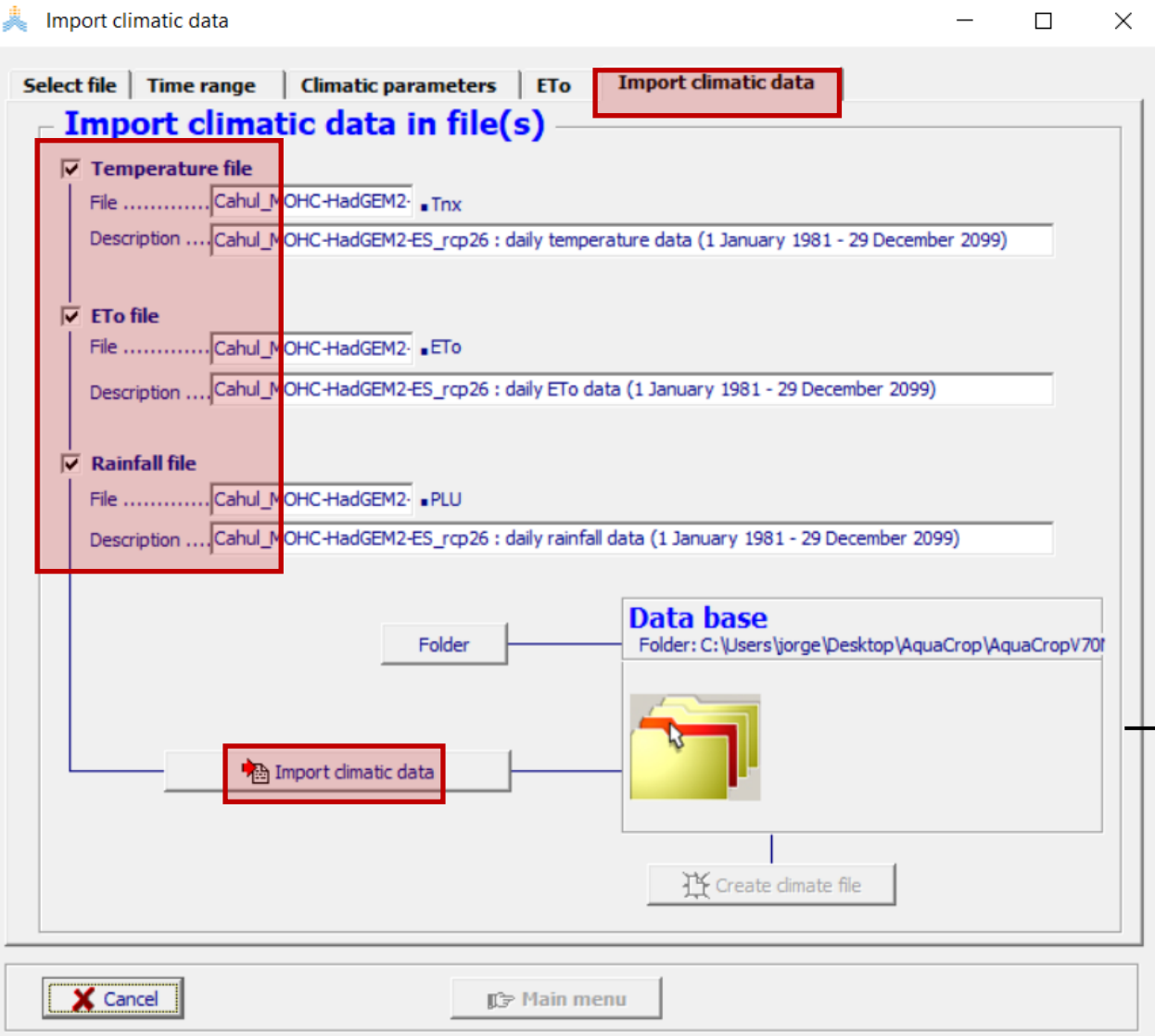
Coefficients

 **ETo**
Reference evapotranspiration
(evaporating power of the atmosphere)

 Cancel  Main menu

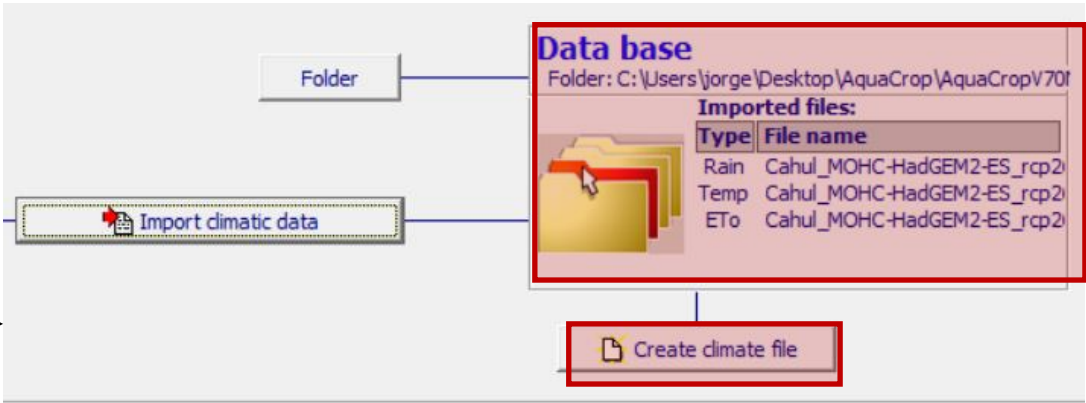


Import climatic data into AquaCrop



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**

Create climate file

File Name
|GEM2-ES_rcp26 | CLI

Description
| |

Selected Rain, ETo, Temperature and CO2 file

	File Name	Description
<input checked="" type="radio"/> Rain	(None)	Specify Rain data when Running AquaCrop
<input type="radio"/> ETo	(None)	Specify ETo data when Running AquaCrop
<input type="radio"/> Temp	(None)	Default temperature data: Tmin = 12.0 and Tmax = 28.0 °C
<input type="radio"/> CO2	MaunaLoa.CO2	Default atmospheric CO2 concentration from 1902 to 2099

Data Base

Select file from Rain Data Base

Create a new Rain file

Cancel Create climate file

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

Select rain file

SELECT file from Data Base

(double) Click a File in the list to select

File Name	Description
Cahul_MOHC-HadGEM2-ES_rcp26	Cahul_MOHC-HadGEM2-ES_rcp26 : daily rainfall data (1 January 1981 to 31 December 2099)
Cahul_MOHC-HadGEM2-ES_rcp85	Cahul_MOHC-HadGEM2-ES_rcp85 : daily rainfall data (1 January 1981 to 31 December 2099)
Cahul_MPI-M-MPI-ESM-LR_rcp26	Cahul_MPI-M-MPI-ESM-LR_rcp26 : daily rainfall data (1 January 1981 to 31 December 2099)
Cahul_MPI-M-MPI-ESM-LR_rcp85	Cahul_MPI-M-MPI-ESM-LR_rcp85 : daily rainfall data (1 January 1981 to 31 December 2099)
Cahul_NCC-NorESM1-M_rcp26	Cahul_NCC-NorESM1-M_rcp26 : daily rainfall data (1 January 1981 to 31 December 2099)
Cahul_NCC-NorESM1-M_rcp85	Cahul_NCC-NorESM1-M_rcp85 : daily rainfall data (1 January 1981 to 31 December 2099)

Selected File :
Cahul_MOHC-HadGEM2-ES_rcp26

UNDO selection

Delete selected file

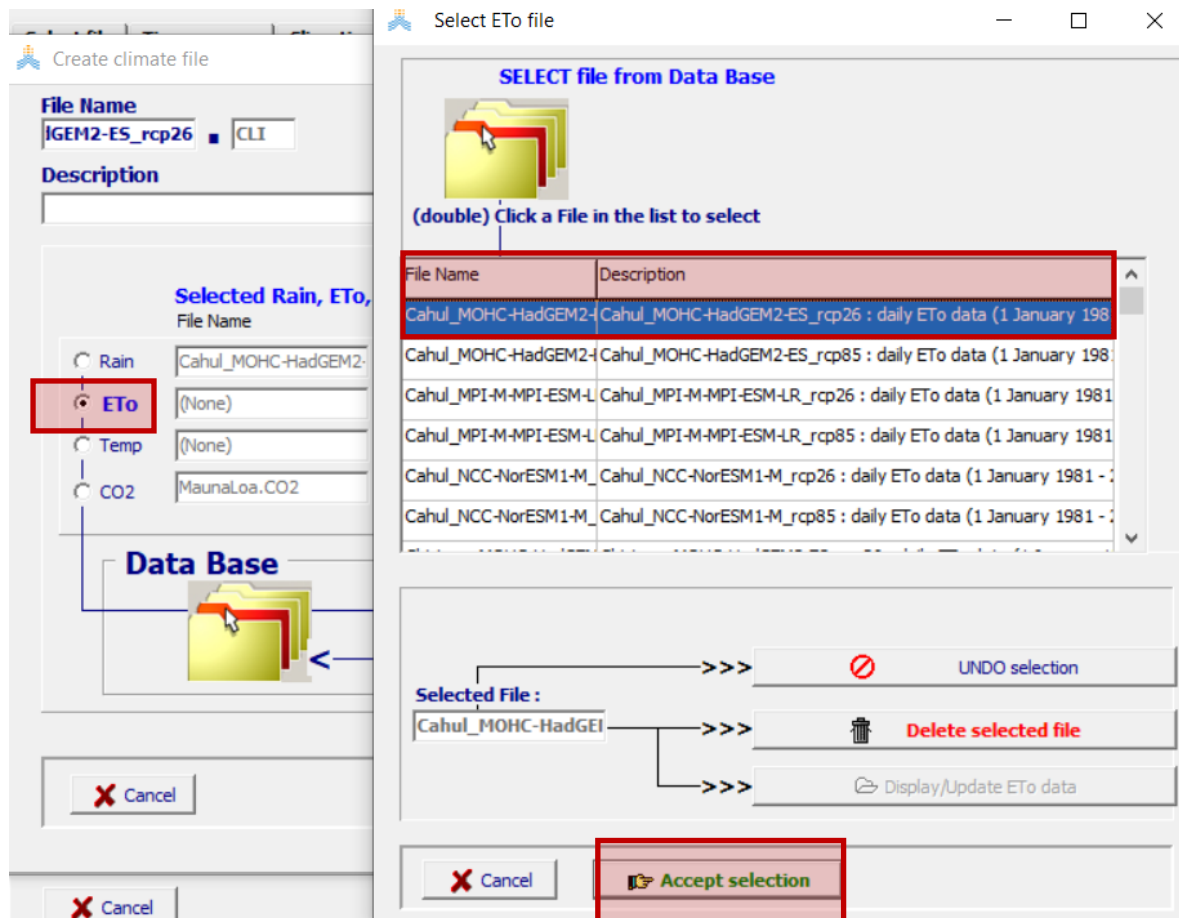
Display/Update Rain data

Cancel Accept selection

Select the ETo and Temp files

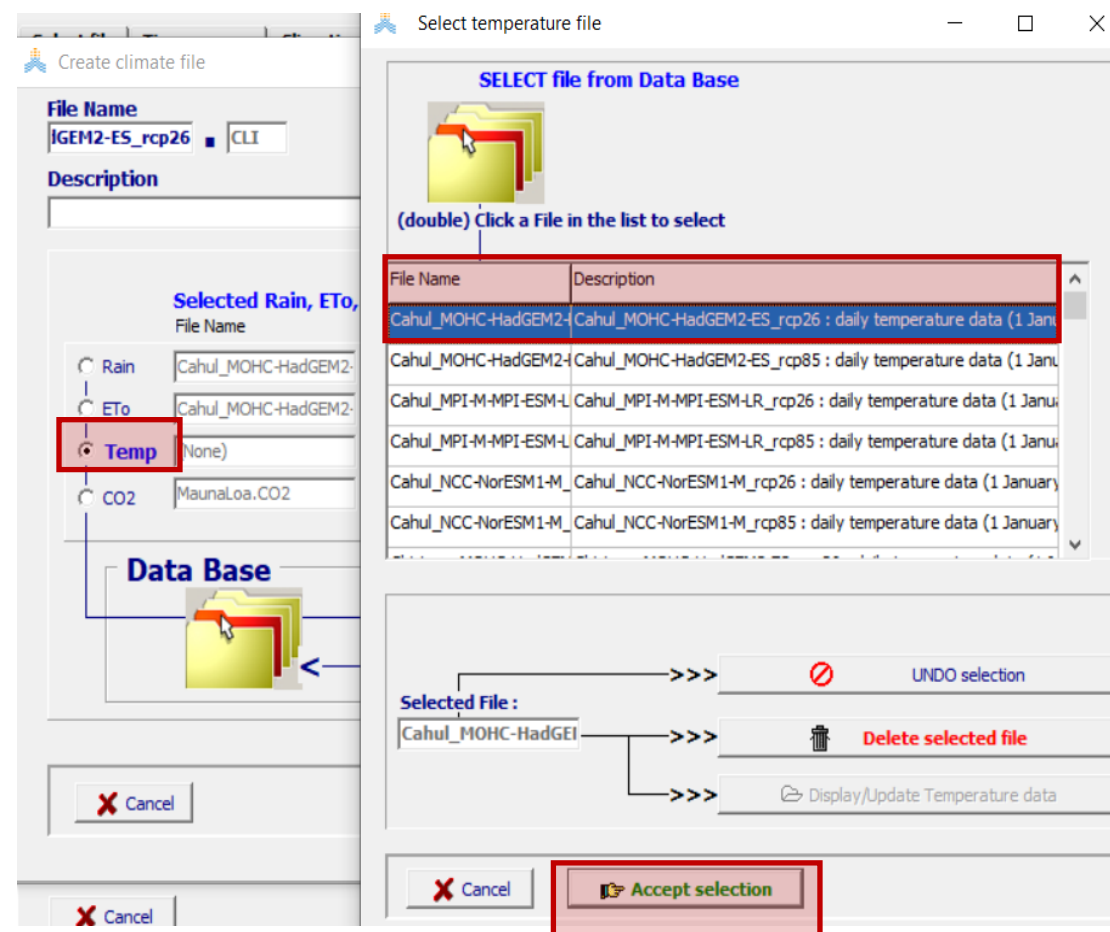
Step 1. Click on **Eto**, select file from **ETo Database** and **accept selection**

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 CO₂ file and create climate file

Step 1. Click on **CO₂** and select **RCP 2.6-CO₂** from database

Create climate file

File Name

IGEM2-ES_rcp26

CLI

Description

Selected Rain, ETo, File Name

Rain

ETo

Temp

CO2

Cahul_MOHC-HadGEM2-

Cahul_MOHC-HadGEM2-

Cahul_MOHC-HadGEM2-

MaunaLoa.CO2

Data Base

Cancel

Select CO2 file

SELECT file from Data Base

(double) Click a File in the list to select

File Name	Description
RCP2-6.CO2	Yearly atmospheric CO2 concentration - IPCC: RCP 2.6
RCP4-5.CO2	Yearly atmospheric CO2 concentration - IPCC: RCP 4.5
RCP6-0.CO2	Yearly atmospheric CO2 concentration - IPCC: RCP 6.0
RCP8-5.CO2	Yearly atmospheric CO2 concentration - IPCC: RCP 8.5
SSP1_1.9.CO2	Atmospheric CO2 concentration from 1902 to 2099 - Scenarion SSF
SSP1_2.6.CO2	Atmospheric CO2 concentration from 1902 to 2099 - Scenarion SSF

Selected File :

RCP2-6.CO2

UNDO selection

Delete selected file

Display/Update CO2 data

Cancel

Accept selection

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

Create climate file

File Name

IGEM2-ES_rcp26

CLI

Description

Selected Rain, ETo, Temperature and CO2 file

Rain

ETo

Temp

CO2

Cahul_MOHC-HadGEM2-

Cahul_MOHC-HadGEM2-

Cahul_MOHC-HadGEM2-

RCP2-6.CO2

Cahul_MOHC-HadGEM2-ES_rcp26 : daily rainfall data (1 January 1981 - 29

Cahul_MOHC-HadGEM2-ES_rcp26 : daily ETo data (1 January 1981 - 29 Dec

Cahul_MOHC-HadGEM2-ES_rcp26 : daily temperature data (1 January 1981

Yearly atmospheric CO2 concentration - IPCC: RCP 2.6

Data Base

Select file from CO2 Data Base

Create a new CO2 file

Cancel

Create climate file



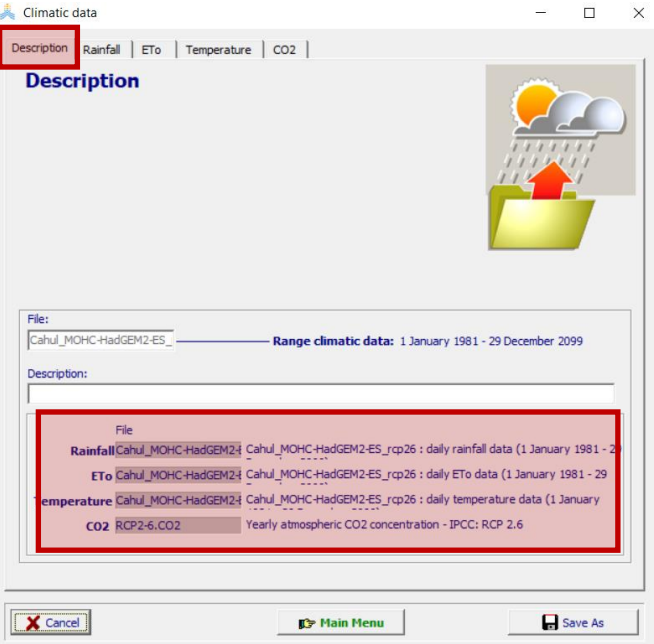
Visualize the climatic results for Cahul

Environment and Crop

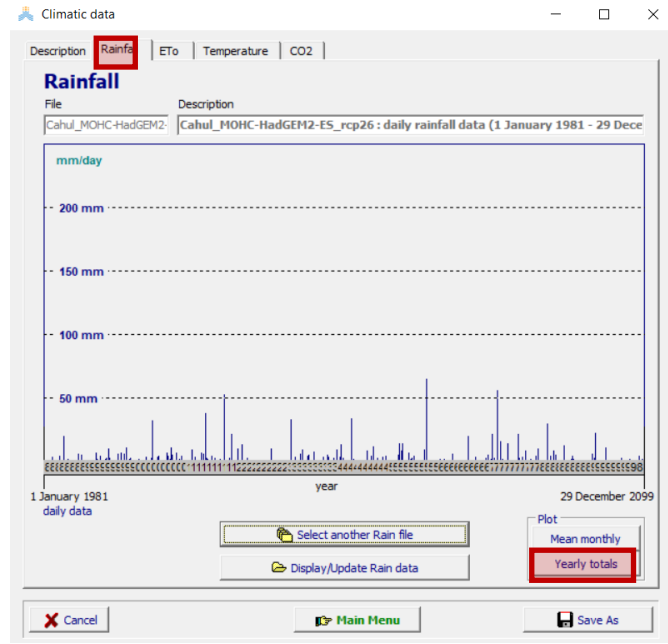


Step 1. Click on the **climate module** and **select Cahul_MOHC-HadGEM2-ES_rcp26**

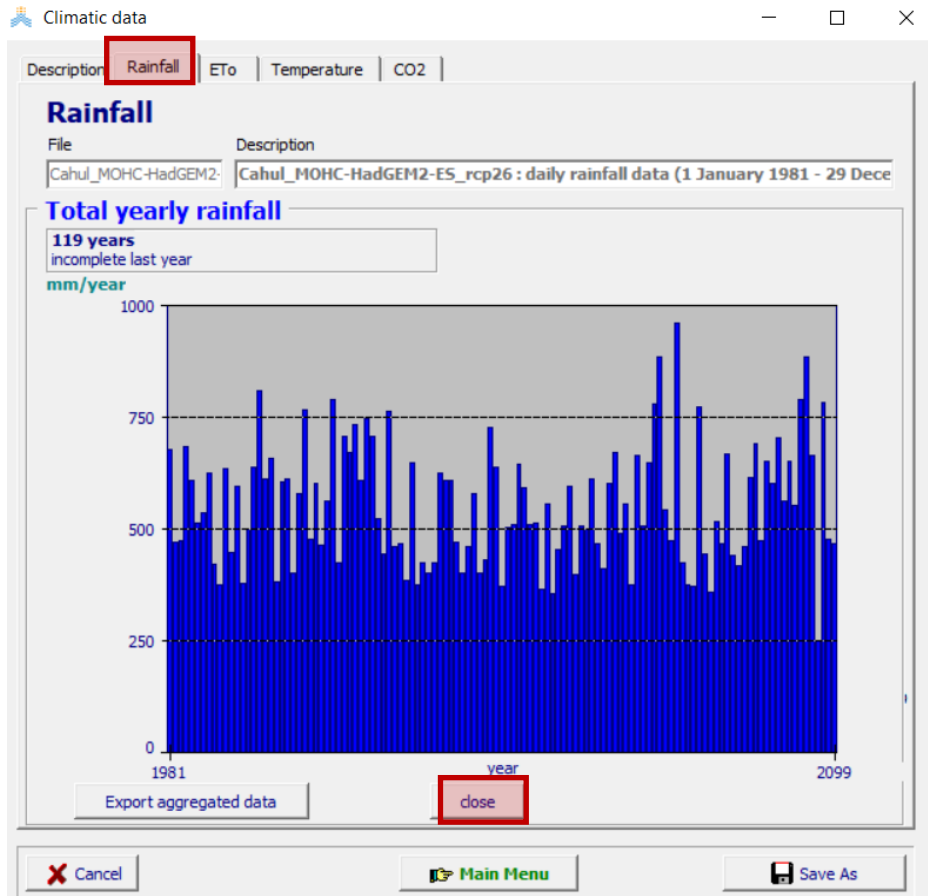
Step 1. In **description** verify that the climate files are the right ones



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



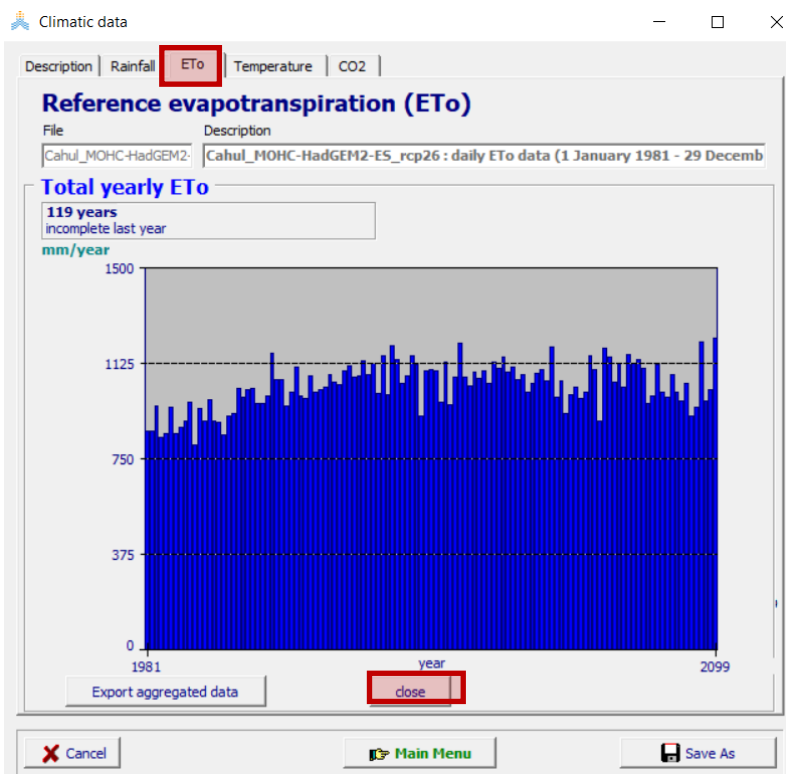
Step 3. Visualize the rainfall data → then **close**



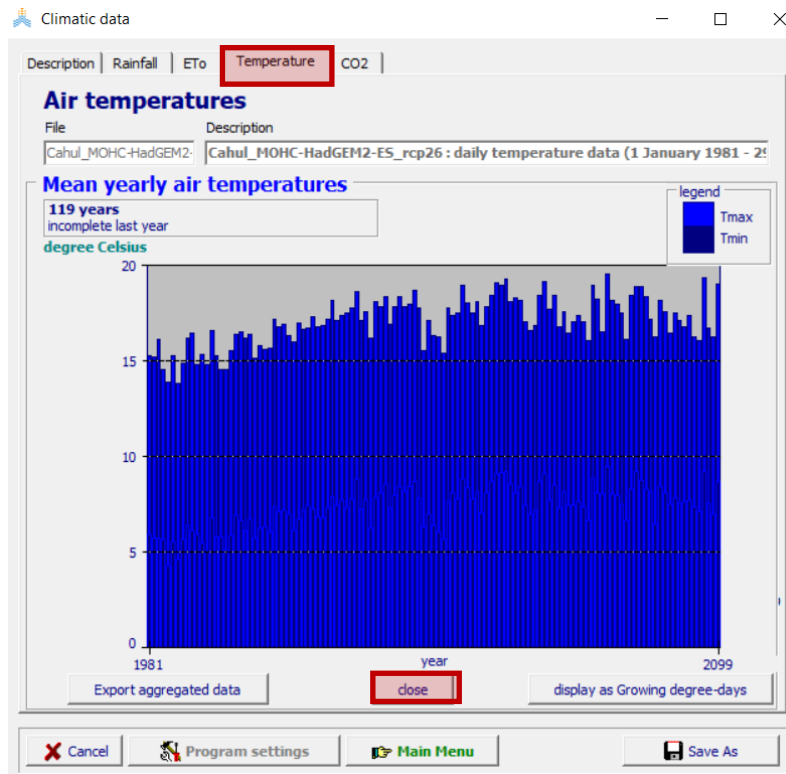


Visualize the climatic results for Cahul

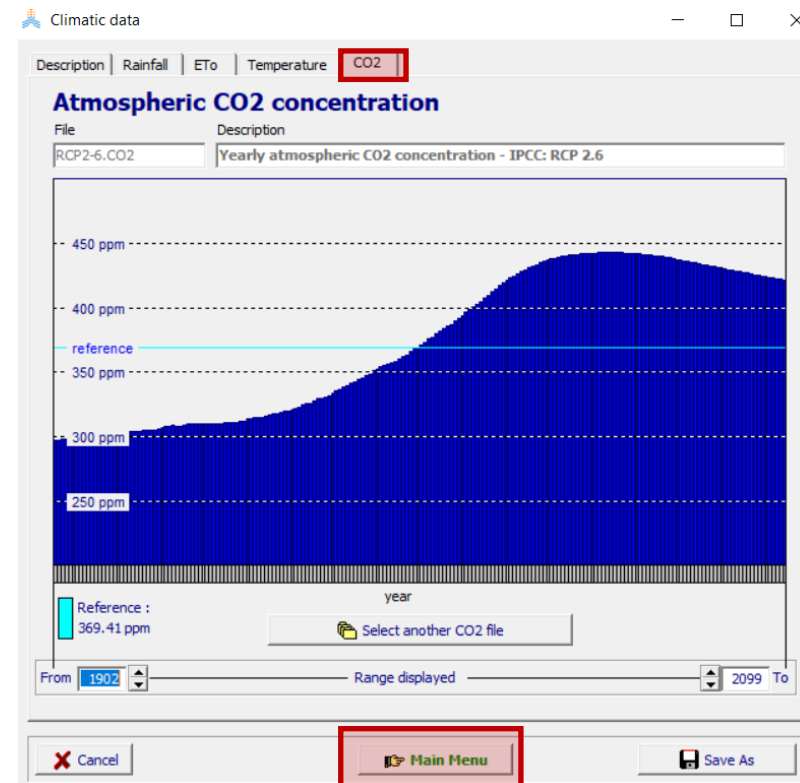
Step 4. Click on the **ETo** tab and visualize the ETo data → then **close**



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



Step 5. Click on the **CO₂** tab and visualize the CO₂ 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 CO₂.

Thank you!

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