



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

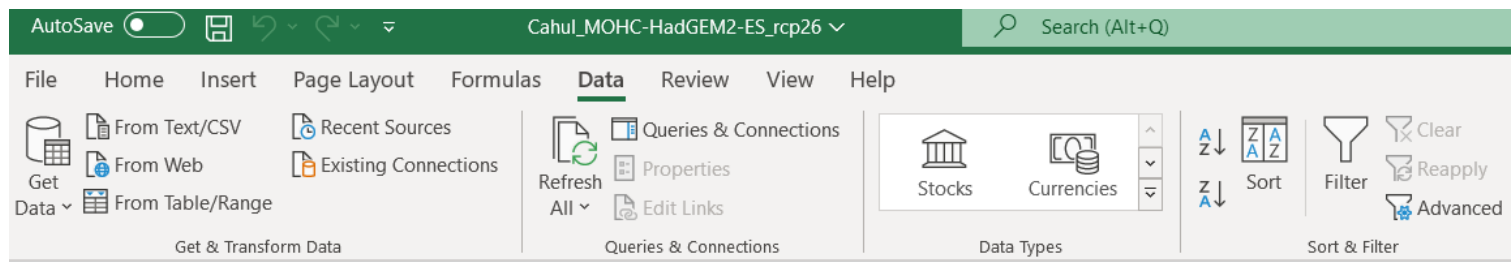
Climate module: create our own climatic files (daily values) for Cahul from 01-01-1981 until 31-12-2099.

- 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

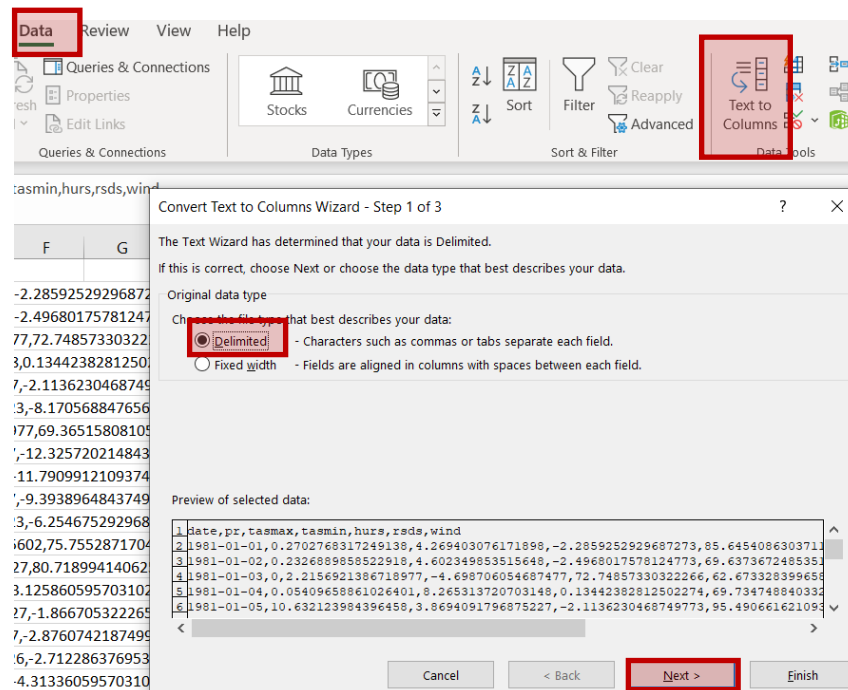


The screenshot shows the Microsoft Excel ribbon with the 'Data' tab selected. The 'Data' tab includes options for 'Get & Transform Data', 'Queries & Connections', 'Data Types', and 'Sort & Filter'. The 'Sort & Filter' group has a 'Sort' button highlighted with a red box.

| 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 |

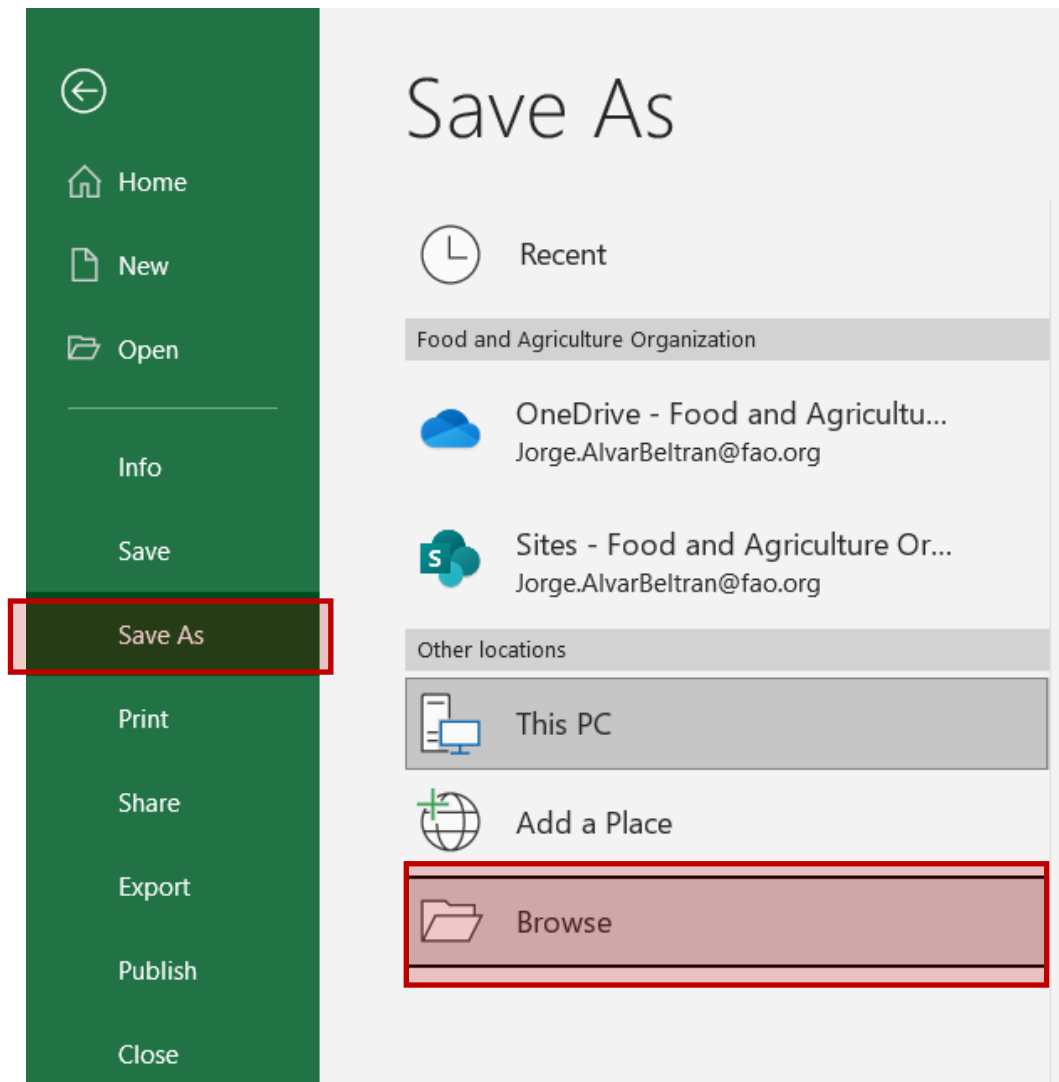
Step 1: delete the first row and column (AquaCrop struggles to read text)

Remember that the new columns correspond to:

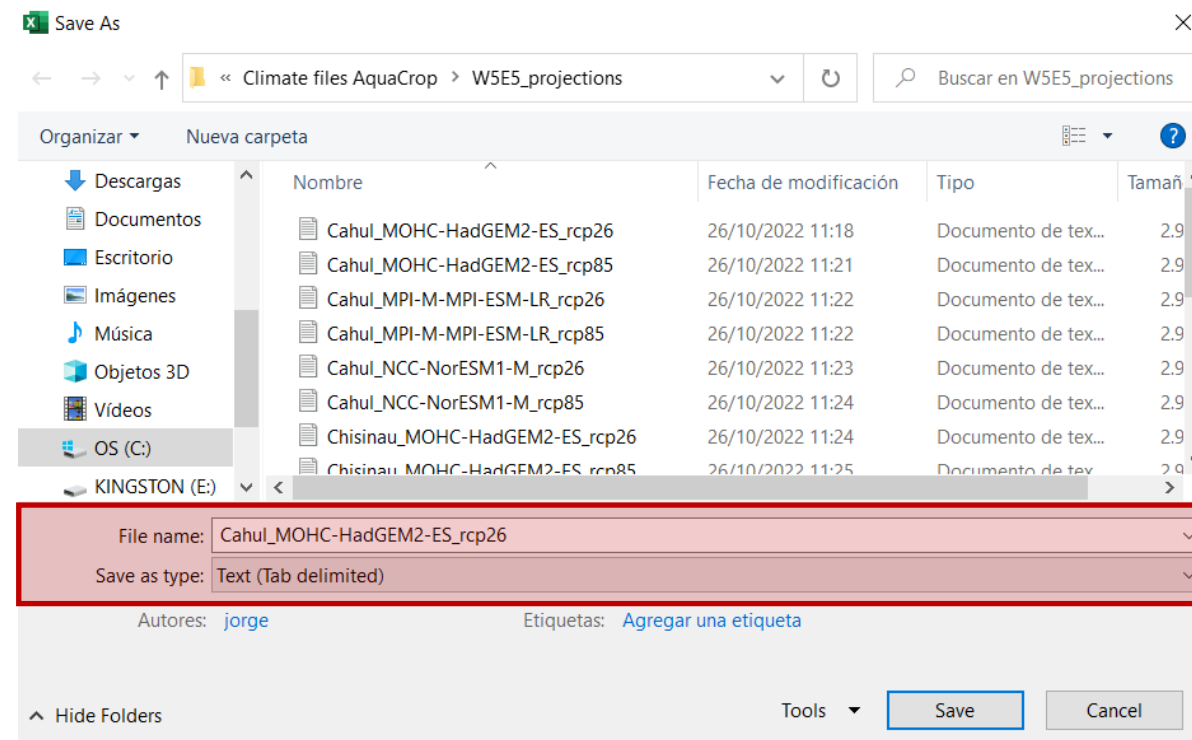
- A) pr: precipitation (mm/day)
- B) Tasmax: maximum temperatures (°C)
- C) Tasmin: minimum temperatures (°C)
- D) Hurs: mean relative humidity (%)
- E) Rsds: incoming solar radiation (w/m²)
- F) Wind: average wind speed (m/s)



Saving the climatic files in the right format



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





Create/import climatic files

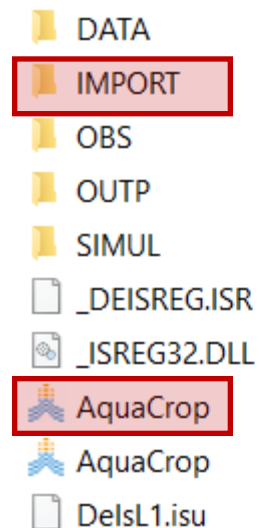
| Year | Date | Tmax | Tmin | Prec. | RH | WS | SR |
|------|------|------|------|-------|-------|-----|-------|
| 2006 | 1 | 19.1 | 1.25 | 0 | 81.45 | 1.6 | 129.5 |
| 2006 | 2 | 23.5 | 4.3 | 0 | 62.9 | 1.8 | 148.5 |
| 2006 | 3 | 23.5 | 2.25 | 0 | 53.45 | 1.9 | 178.1 |
| 2006 | 4 | 20 | 3 | 0 | 64.35 | 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



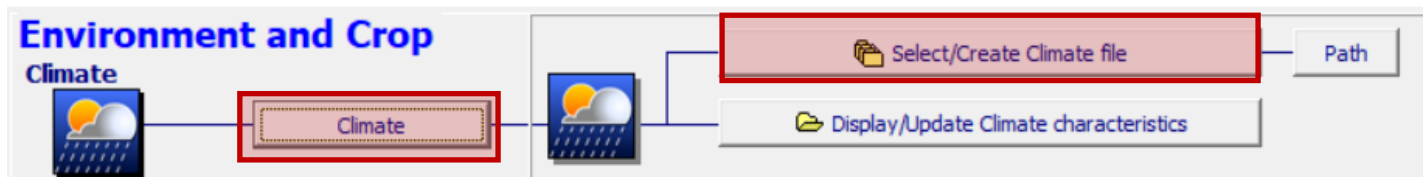
Open txt. file on AquaCrop

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



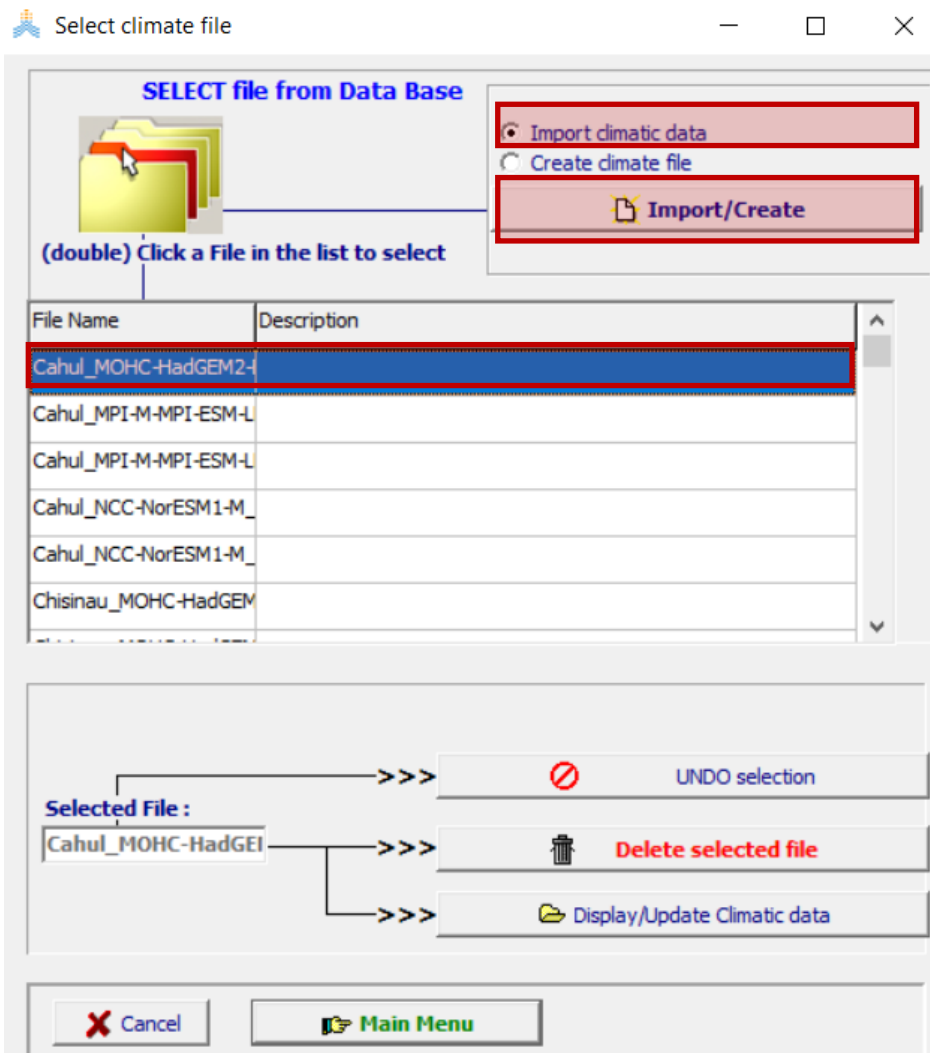
Step 2: open **AquaCrop** and click on **Start**

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





Create a climatic file

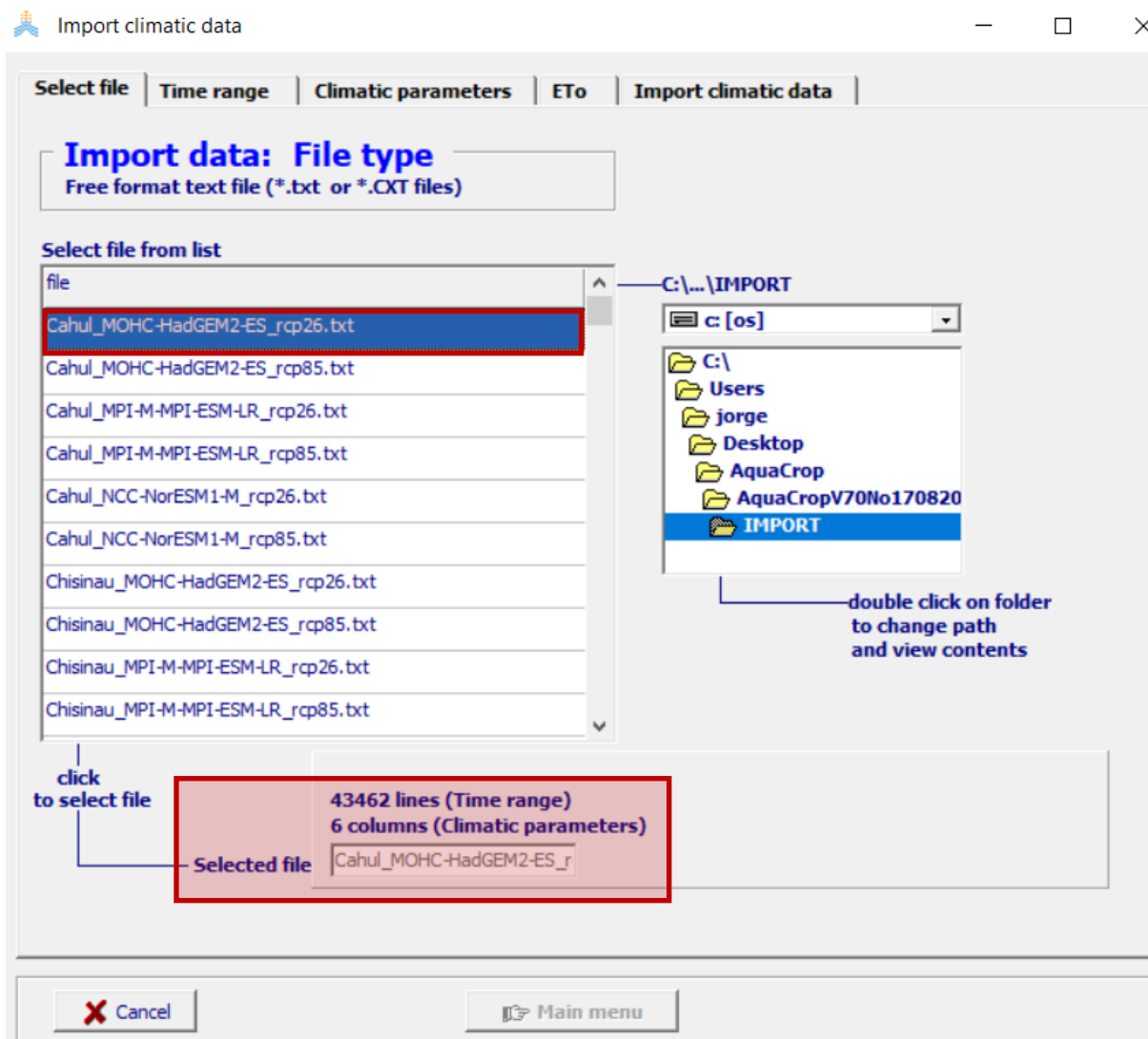


Step 1: click on **Import/Create** climatic file

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) 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)

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

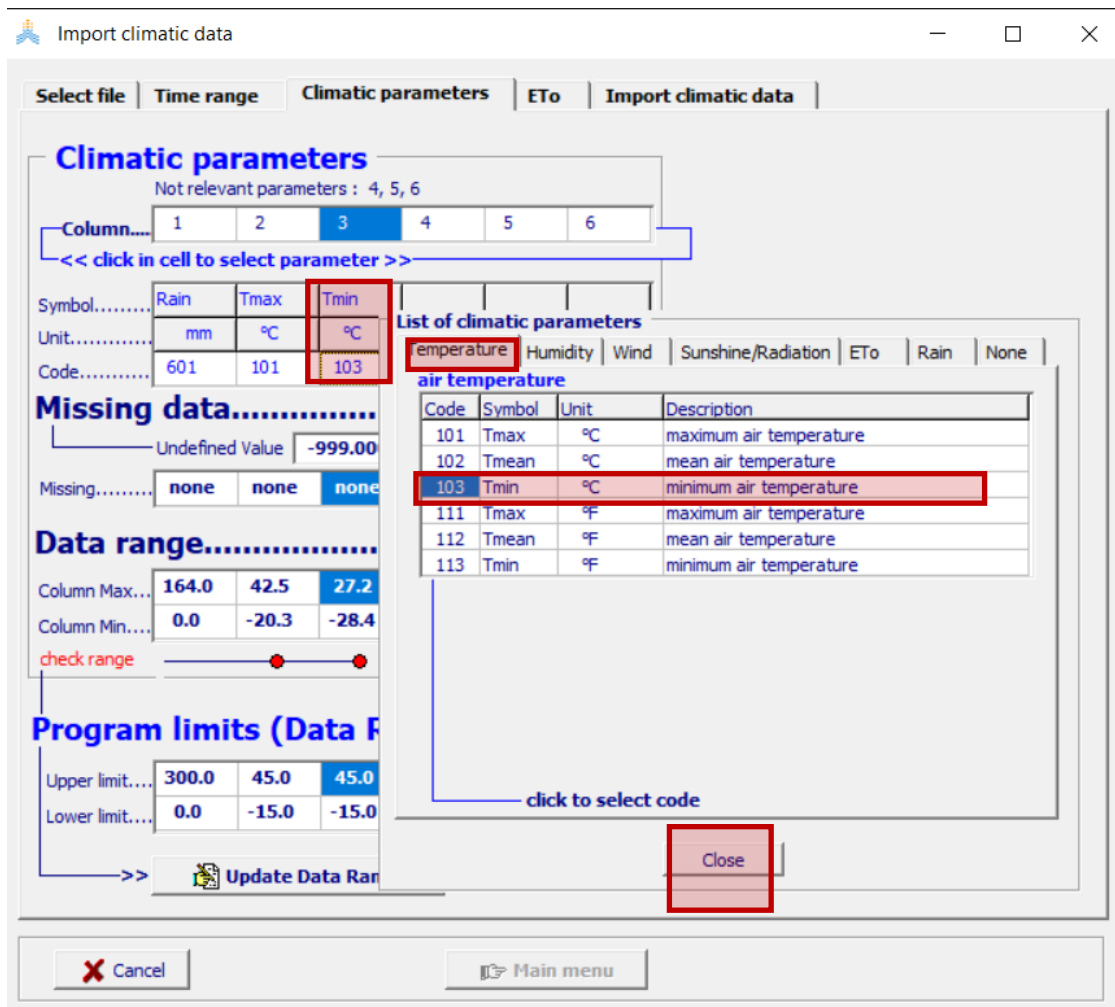
Update Data Ran

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
->> Update Data Range

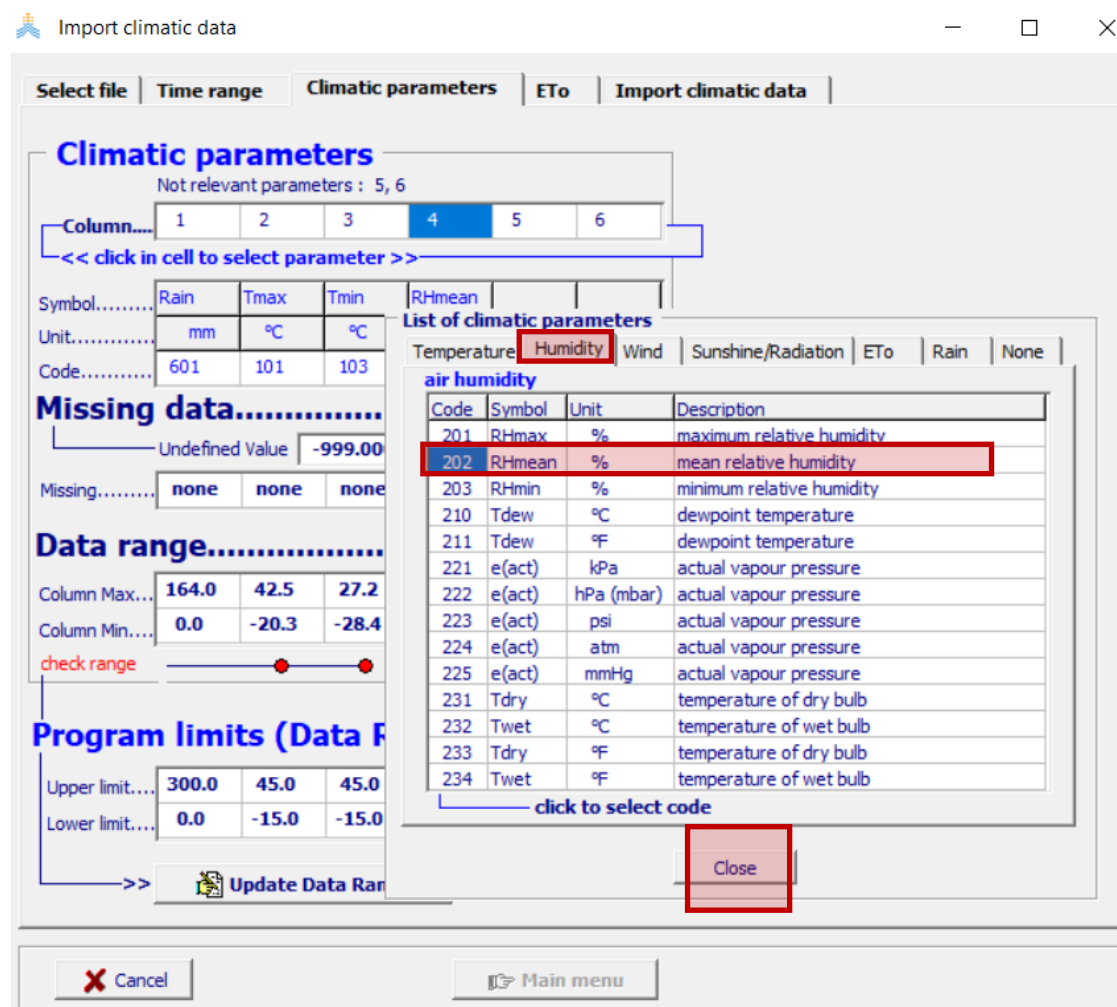
List of climatic parameters
Temperature Humidity Wind Sunshine/Radiation ETo Rain None
air temperature
Code Symbol Unit Description
101 Tmax °C maximum air temperature
102 Tmean °C mean air temperature
103 Tmin °C minimum air temperature
111 Tmax °F maximum air temperature
112 Tmean °F mean air temperature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

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 Ran

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

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 succesfully introduced!

Import climatic data

Select fileTime rangeClimatic parametersEToImport climatic data

Climatic parameters

Column....123456

<< 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... | 164.0 | 42.5 | 27.2 | 100.0 | 343.94 | 10.47 |
| Column Min.... | 0.0 | -20.3 | -28.4 | 15.5 | 0.52 | 0.46 |

Program limits (Data Range)

| | | | | | | |
|-----------------|-------|-------|-------|-------|--------|-------|
| Upper limit.... | 300.0 | 45.0 | 45.0 | 100.0 | 366.80 | 11.00 |
| Lower limit.... | 0.0 | -31.0 | -31.0 | 15.0 | 0.00 | 0.00 |

>> Update Data Range

CancelMain 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

Select fileTime rangeClimatic parametersEToImport climatic data

Coordinates of Meteorological station

StationOHC-HadGEM2-ES_rcp26

Altitude222meter above sea level (m.a.s.l.)

Latitude22degrees22minutesNorth

adjust coordinates

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

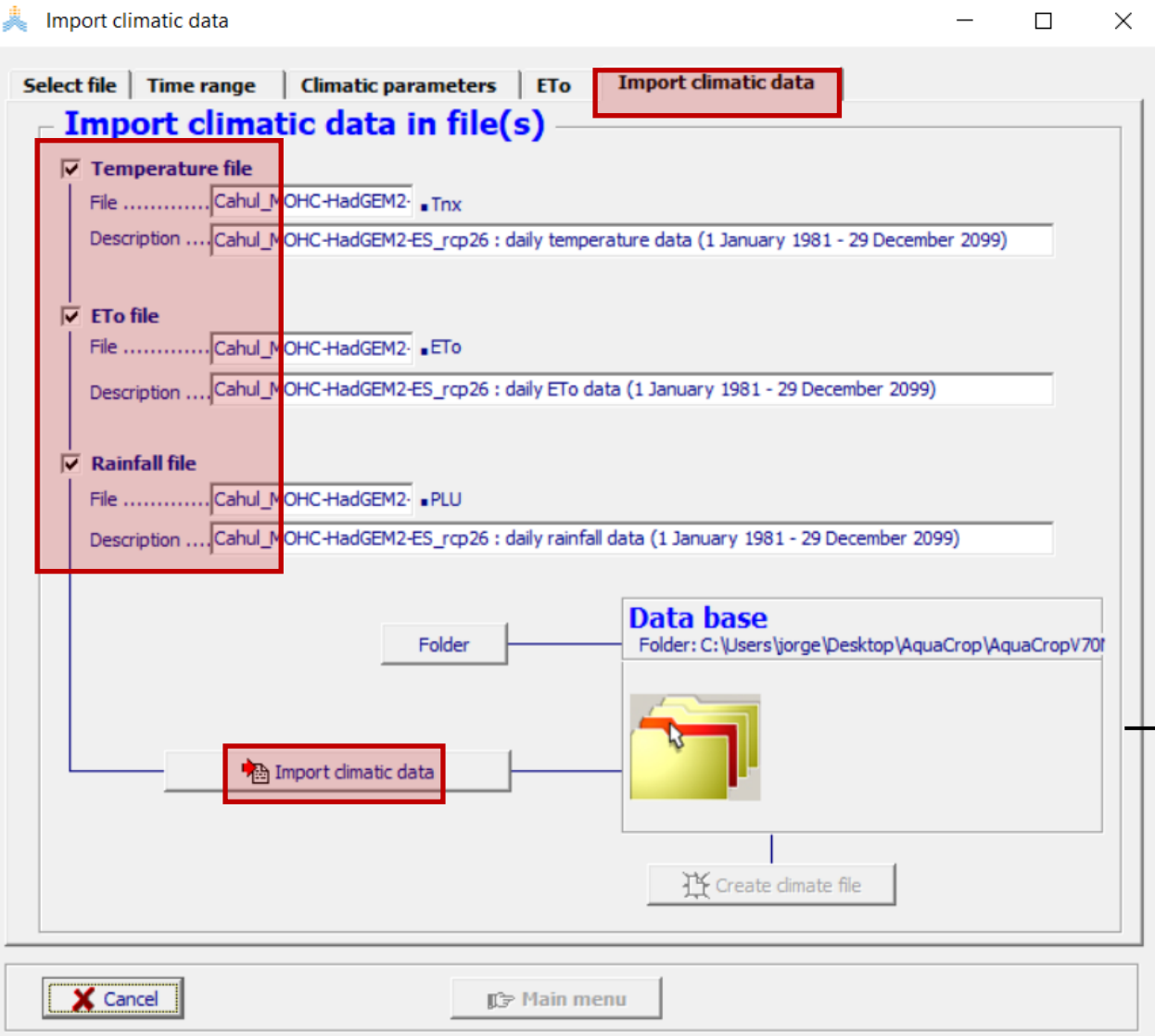
ETo calculator

ETo

Reference evapotranspiration (evaporating power of the atmosphere)

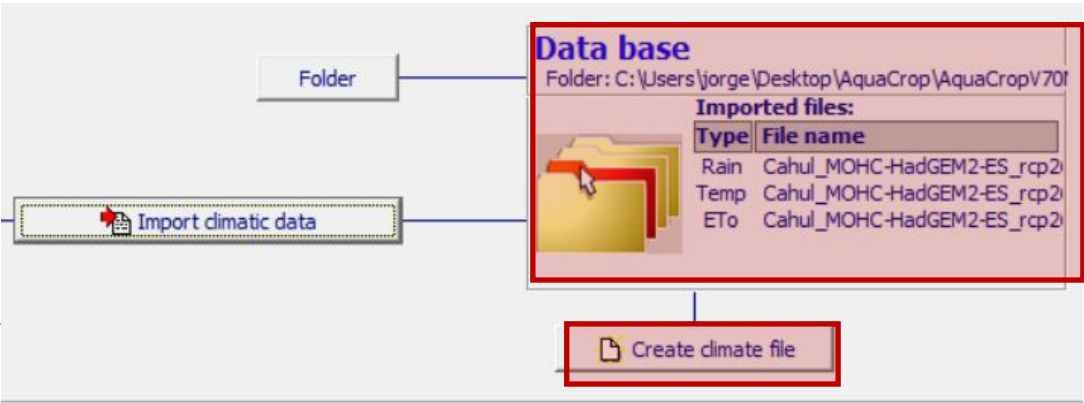
CancelMain menu

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
IGEM2-ES_rcp26

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

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

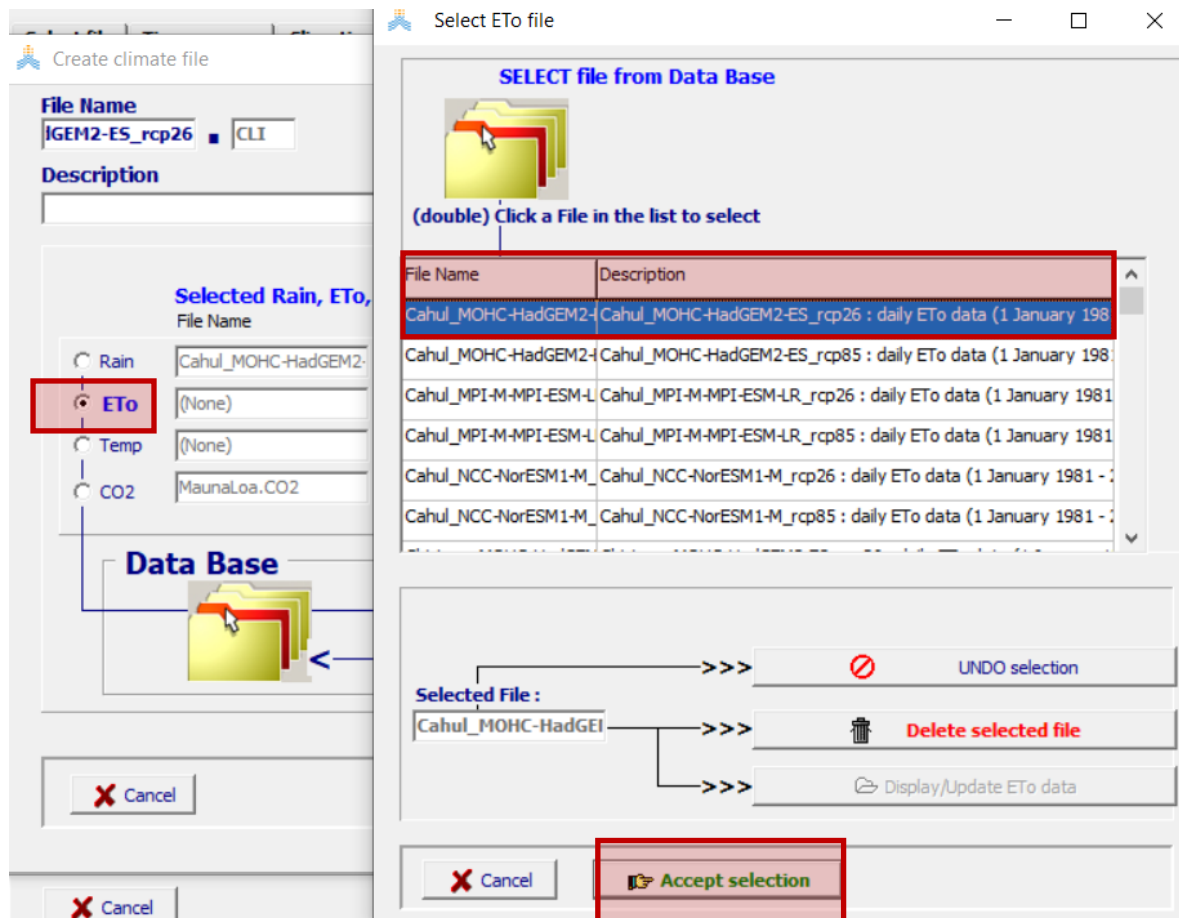
| File Name | Description |
|------------------------------|---|
| Cahul_MOHC-HadGEM2-ES_rcp26 | Cahul_MOHC-HadGEM2-ES_rcp26 : daily rainfall data (1 January 1981 to 31 December 2099) |
| Cahul_MOHC-HadGEM2-ES_rcp85 | Cahul_MOHC-HadGEM2-ES_rcp85 : daily rainfall data (1 January 1981 to 31 December 2099) |
| 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

Select the ETo and Temp files

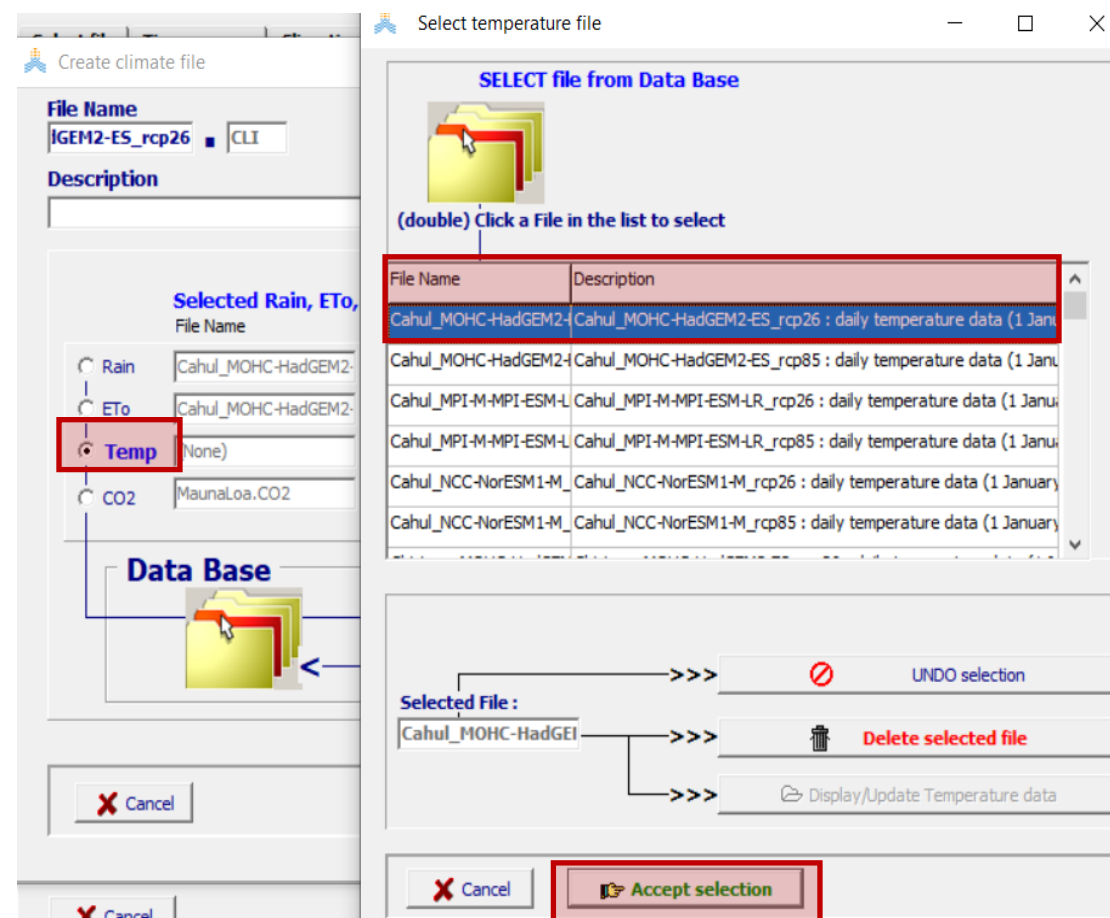
Step 1. Click on **Eto**, select file from **ETo Database** and **accept selection**

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

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

Rain

ETo

Temp

CO2

Cahul_MOHC-HadGEM2-

Cahul_MOHC-HadGEM2-

Cahul_MOHC-HadGEM2-

RCP2-6.CO2

Selected Rain, ETo, Temperature and CO2 file

| File Name | Description |
|---------------------|--|
| Cahul_MOHC-HadGEM2- | Cahul_MOHC-HadGEM2-ES_rcp26 : daily rainfall data (1 January 1981 - 29 Dec |
| Cahul_MOHC-HadGEM2- | Cahul_MOHC-HadGEM2-ES_rcp26 : daily ETo data (1 January 1981 - 29 Dec |
| Cahul_MOHC-HadGEM2- | Cahul_MOHC-HadGEM2-ES_rcp26 : daily temperature data (1 January 1981 |
| RCP2-6.CO2 | 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



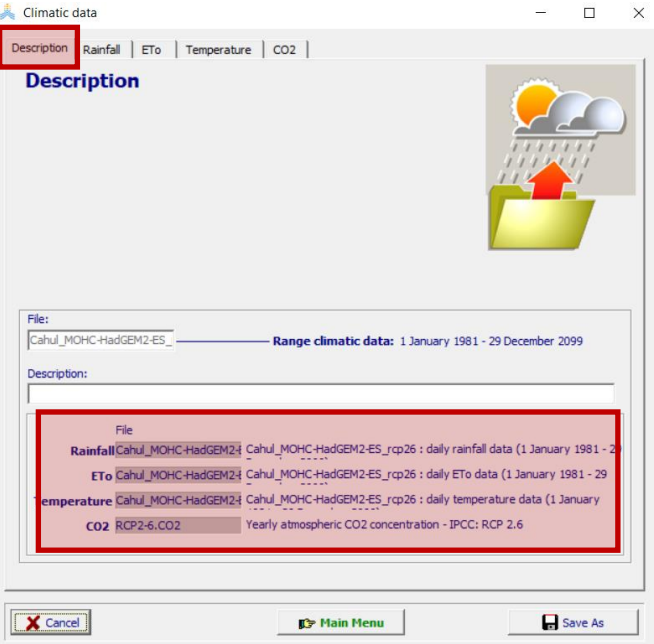
Visualize the climatic results for Cahul

Environment and Crop

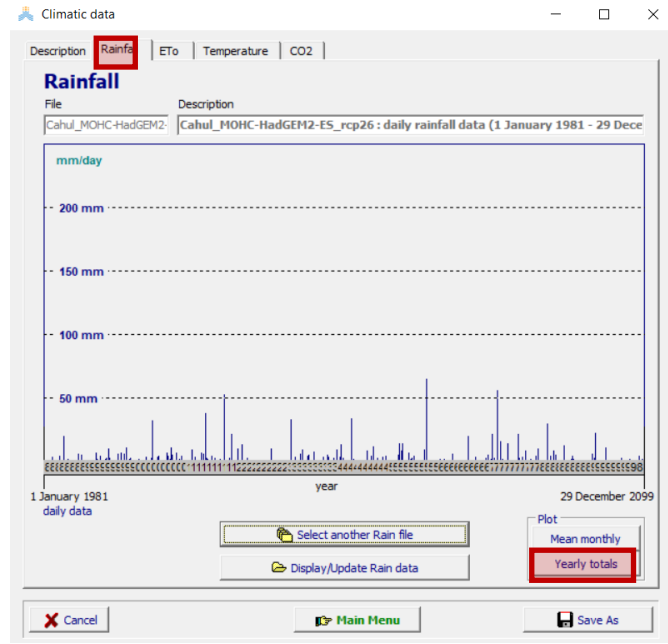


Step 1. Click on the **climate module** and **select Cahul_MOHC-HadGEM2-ES_rcp26**

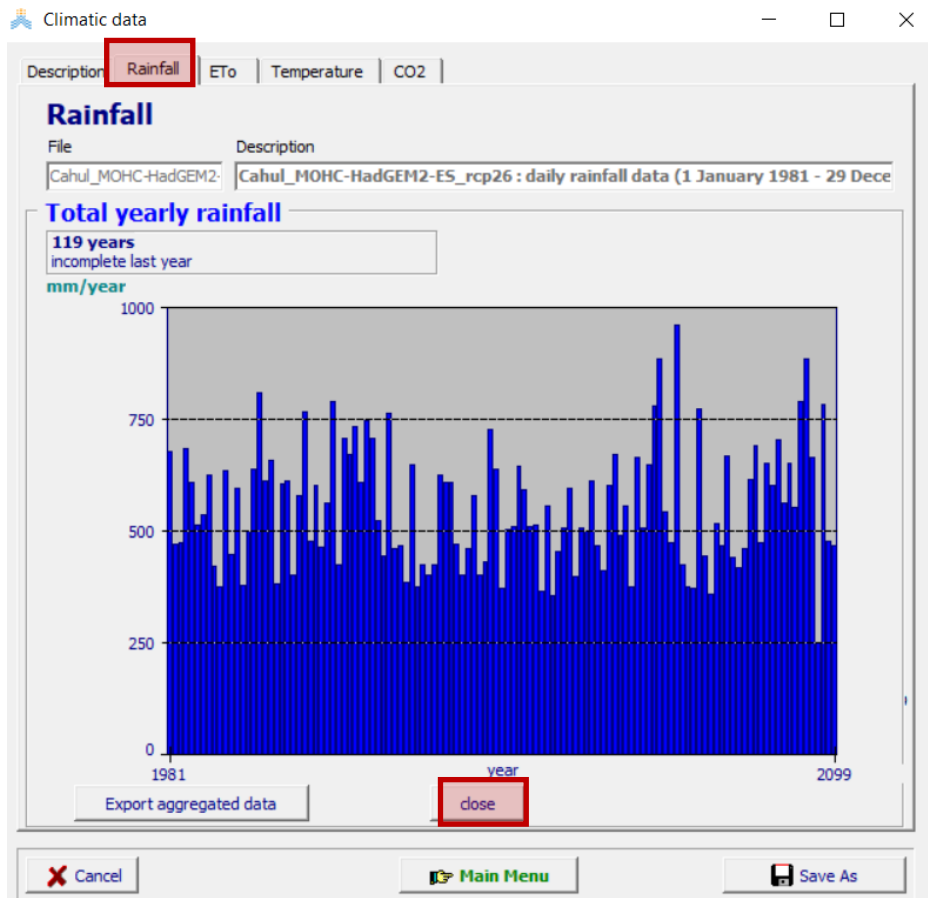
Step 1. In **description** verify that the climate files are the right ones



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



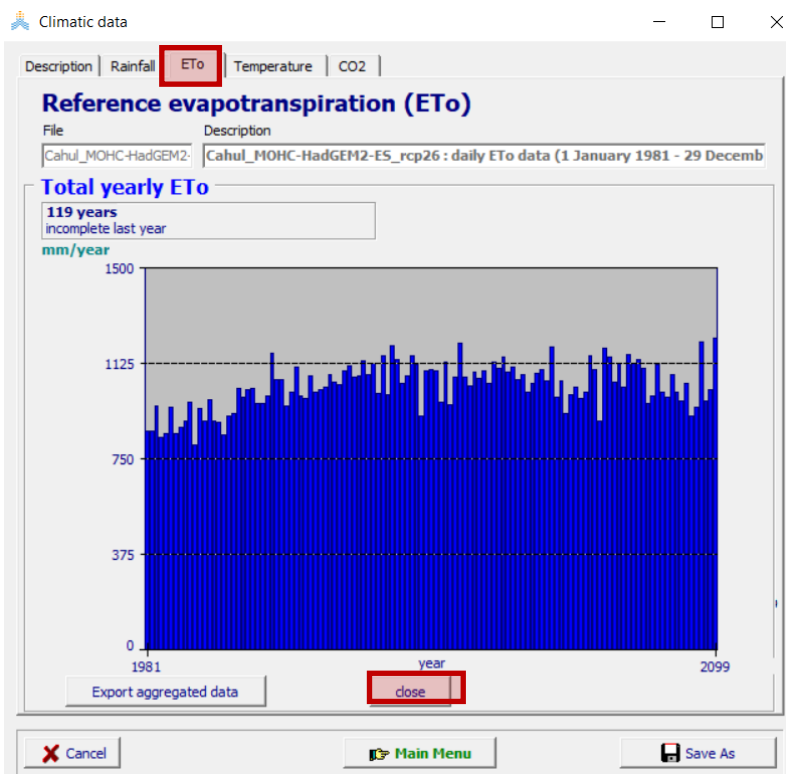
Step 3. Visualize the rainfall data → then **close**



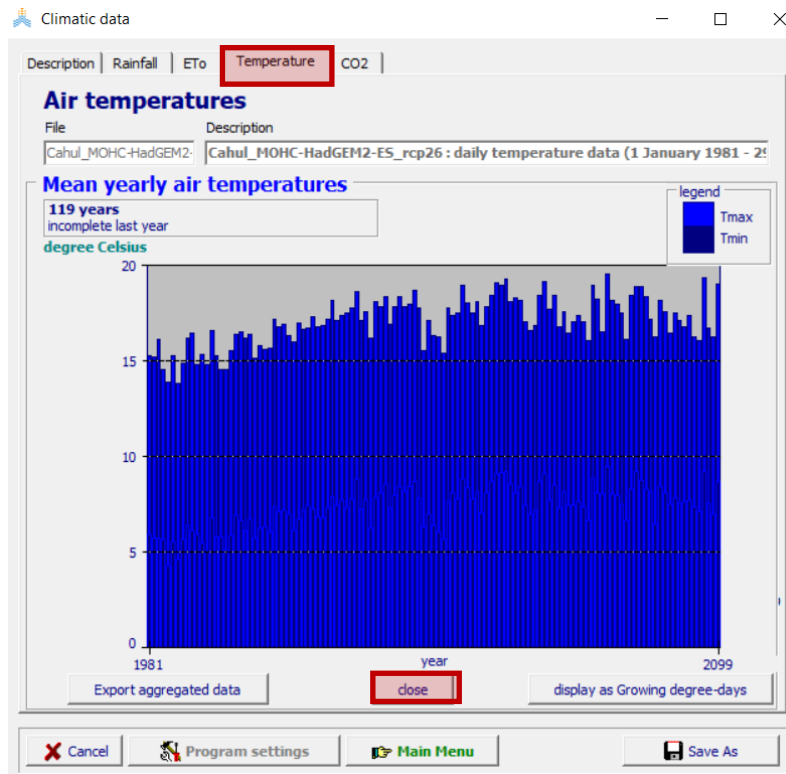


Visualize the climatic results for Cahul

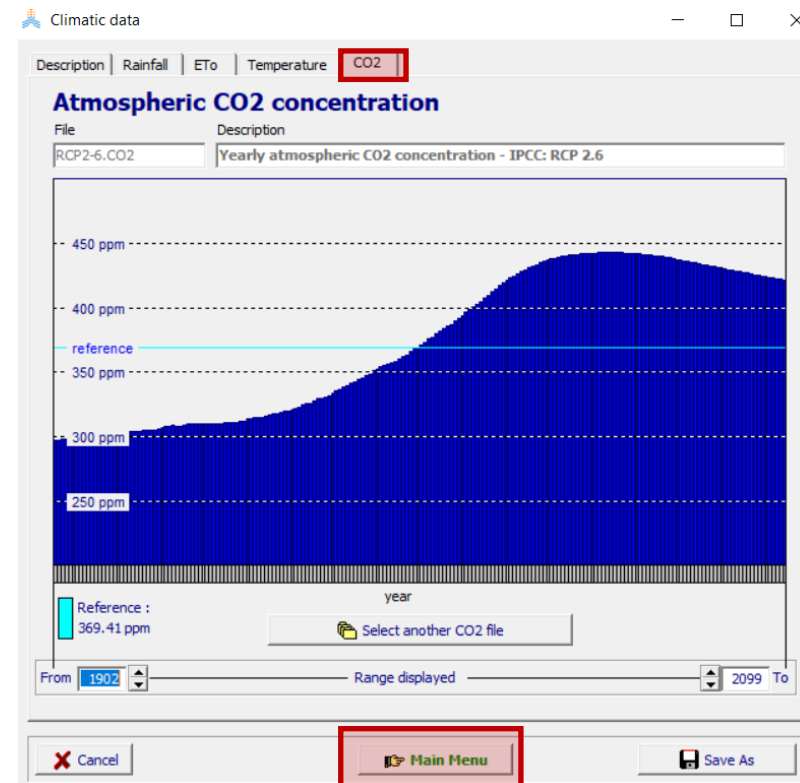
Step 4. Click on the **ETo** tab and visualize the ETo data → then **close**



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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