

The ETo calculator

Reference evapotranspiration (ETo)

The evapotranspiration rate from a reference surface, not short of water, is called the reference evapotranspiration and is denoted as ETo. A large uniform grass (or alfalfa) field is considered worldwide as the reference surface. The reference crop completely covers the soil, is kept short, well watered and is actively growing under optimal agronomic conditions.

Determining ETo from meteorological data

The reference evapotranspiration is assessed in the ETo calculator software from meteorological data by means of the *FAO Penman-Monteith equation*. This method has been selected by FAO as the reference because it closely approximates grass ETo at the location evaluated, is physically based, and explicitly incorporates both physiological and aerodynamic parameters.

Meteorological data (Input)

- **Data Type:** The program can handle daily, ten-day and monthly climatic data. The data can be given in a wide variety of units and data specified in commonly used climatic parameters can be processed (Fig. 1).

The screenshot displays the 'Data and ETo menu' window of the ETo calculator. The interface is organized into several sections for data input:

- Station and File:** Station is set to 'Alger' and Country to 'Algeria'. The File name is 'Alger.DTA'.
- Calculation method and coefficients:** This section is currently inactive.
- Input data description:** This section is active and contains:
 - Air temperature:** Units are set to Celsius. 'Mean temperature' is unchecked, while 'Minimum and Maximum temperature' is checked.
 - Air humidity:** 'Mean Relative Humidity', 'Minimum and Maximum Relative Humidity', and 'Mean dew point temperature' are unchecked. 'Mean actual vapour pressure' is checked, with units set to mbar. Under 'Psychrometric data', 'Natural ventilated' is selected, and the coefficient is 0.000800.
 - IF missing air humidity:** A field for 'T dew = T min + subtract' is set to 2.0 [°C], with a dropdown menu set to 'semi/land'.
- Meteorological data and ETo:** This section is active and contains:
 - Wind speed:** 'Mean wind speed' is checked, with units set to m/sec and a height of measurement of 2.0 [meter]. A dropdown menu for 'IF missing wind speed' is set to 'light to moderate wind'.
 - Sunshine and Radiation:** 'Relative sunshine hours (n/N)' is checked. 'Solar radiation (Rs)' and 'Net radiation (Rn)' are unchecked, with units set to MJ/m2.day. A dropdown menu for 'IF missing radiation' is set to '0.19', with a formula $R_s = 0.19 \times \text{SQRT}(T_{\text{max}} - T_{\text{min}}) \times R_a$ displayed below.

At the bottom of the window, there are buttons for 'Cancel', 'Display Station characteristics', 'Main menu', and 'Help'.

Figure 1.
Climatic parameters available in the ETo calculator.

- **Missing climatic data:** When data for some weather variables are missing, procedures - as outlined in FAO Irrigation and Drainage Paper No. 56 - are used for estimating missing climatic data from Temperature data or from specific climatic conditions. Even where the data set contains only maximum and minimum air temperature it is still possible to obtain reasonable estimates for ten-day or monthly ETo with the FAO Penman-Monteith equation
- **Importing data:** Climatic data can be specified when starting a new application or can be imported from text files or from files exported from FAO software (CLIMWAT and FaoClim).
- **Data range checking:** By selecting appropriate lower and upper limits for meteorological data (Fig. 2) the program applies a quality check when specifying or importing data. Since data limits are part of the description of the station, sharp limits valid for the region can be specified individually for each climatic station.

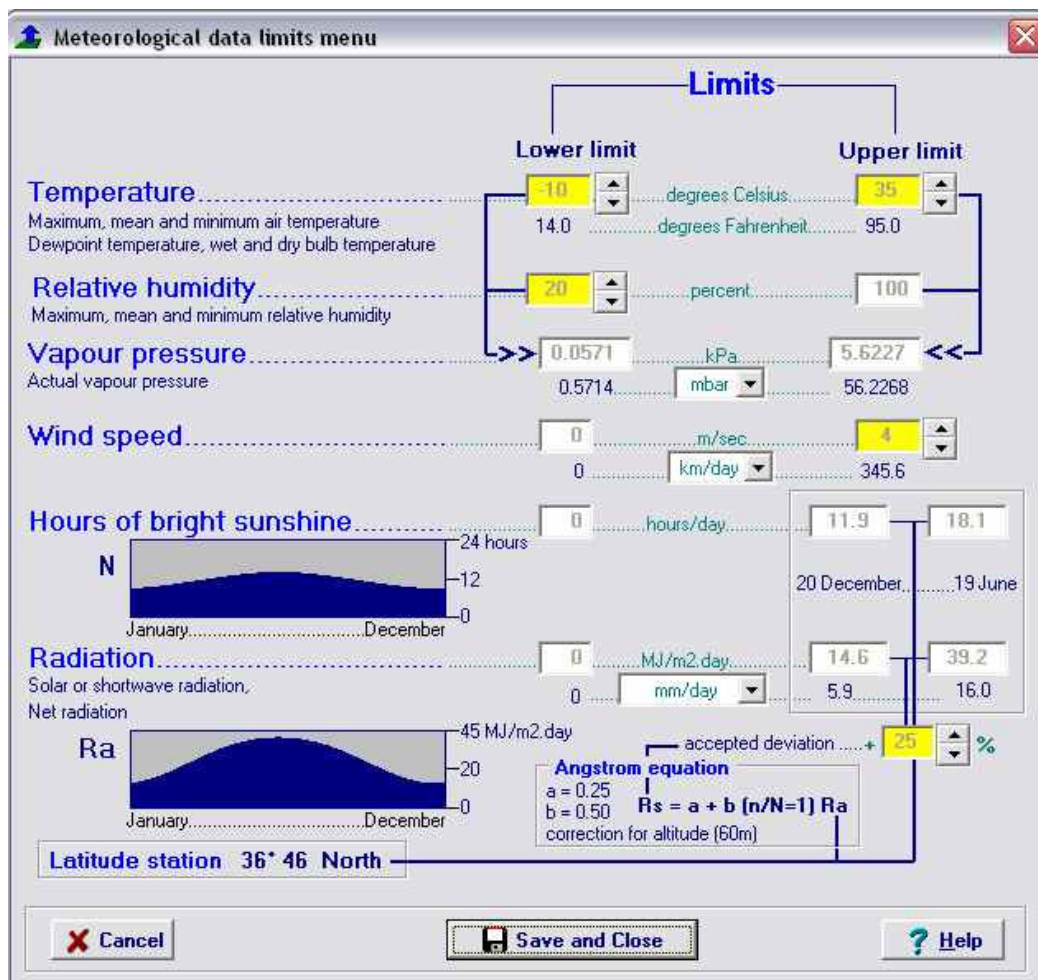


Figure 2. Upper and lower limits of climatic data for range checking.

Output

Specified and derived climatic data can be plotted (Fig. 3) and exported in text files in various ways specified by the user.

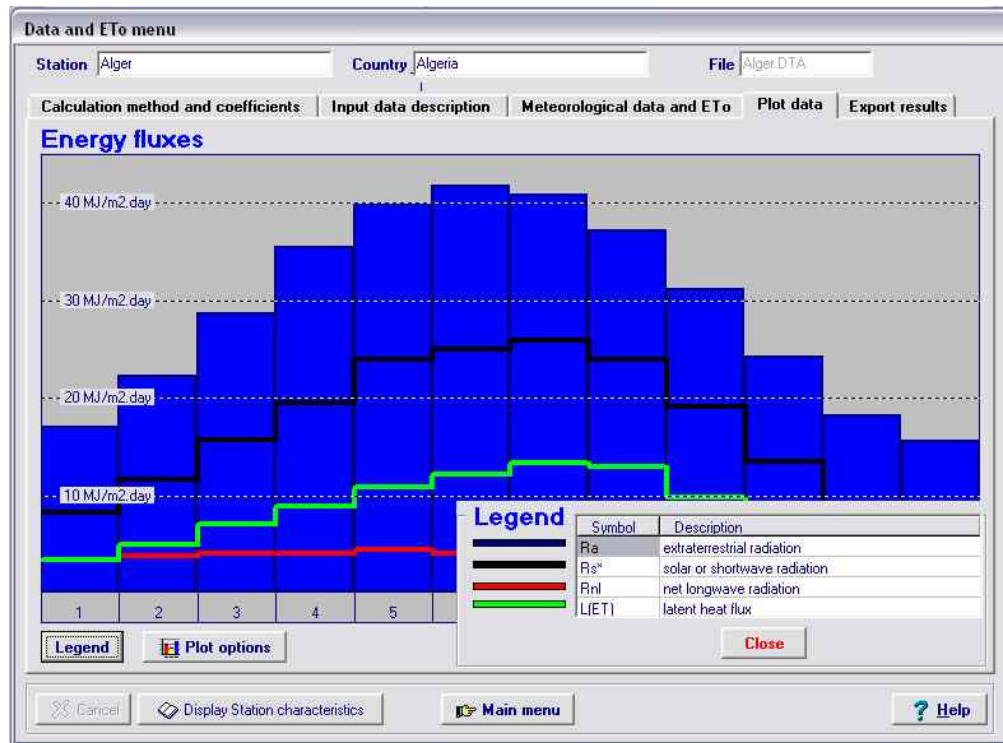
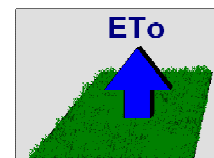


Figure 3.
Plot of energy fluxes
Extraterrestrial (bars), solar and net longwave radiation and latent heat flux.

The ETo Calculator is public domain software, and an installation disk (1.5 Mb) and a software copy of the Reference Manual can be obtained from:

TO DOWNLOAD: xxxxxx



If the ETo calculator software is correctly installed, it occupies less than 2 Mb on disk. The main directory (default "C:\Program Files\FAO\EToCalc") contains:

- the executable file (EToCalc.EXE), and
- four subdirectories:
 - o DATA (containing 'DSC' (station description), and 'DTA' (data) files),
 - o IMPORT (containing 'CXT' (text) files with climatic data that can be imported),
 - o HELP (containing help files), and
 - o REPORT (containing 'REP' (exported results) files).