

## Interpretation sheet and distribution

### 1. Identification information:

**Resource title:** Penman-Monteith reference evapotranspiration

**Resource type:** gridded meteorology

**Resource frequency:** daily

**Unit of data:** mm

**Geographic extent:**

North Bounding Latitude 50

South Bounding Latitude 44

East Bounding Longitude 27

West Bounding Longitude 17

**Upper altitude level:** 2337 m

**Lower altitude level:** 11 m

**Temporal extent:** 1961-2010

### Abstract

The grids show the daily Penman-Monteith reference evapotranspiration values across interest area in the form of two dimensional array data. The data are based on CarpatClim dataset ([www.carpatclim-eu.org](http://www.carpatclim-eu.org)).

The Pannonian Basin Experiment (PannEx) is an initiative of the Regional Hydroclimate Project (RHP) of the World Climate Research Programme (WCRP) Global Energy and Water Exchanges (GEWEX) Project. A gridded meteorological dataset is available for the PannEx region as part of the CarpatClim database, which consists of homogenized (MASH, Szentimrey), gridded (MISH, Szentimrey and Bihari) and harmonized daily meteorological observations for several climate parameters with 0.1° spatial resolution the period of 1961-2010. The estimation of the Penman-Monteith reference evapotranspiration ( $ET_0$ ) on the daily scale was performed for the CarpatClim grid as one of the first results in the PannEx initiative.

The widely used Penman-Monteith Reference Evapotranspiration method, the so-called FAO-56 methodology (Allen et al., 1998) is applicable for the computation of daily  $ET_0$  for the CarpatClim database. The Penman-Monteith method combines both energy and mass balances to model the  $ET_0$ . The method assumes a surface of short grass (0.12 m high) that is well watered, actively growing, completely shades the soil, and has an albedo of 0.23. The necessary variables we used for estimation of the radiation balance and  $ET_0$  are as follows: global radiation (direct and diffuse short wave radiation), temperature (mean (arithmetic mean of maximum and minimum temperature), maximum, and minimum), surface air

pressure, wind speed and relative humidity at 2 m above the ground. The 17-step calculation process published by experts from the University of Florida (Zotarelli et al., 2010) was adapted and coded for the CarpatClim dataset.

The formula used to express reference evapotranspiration  $ET_0$  (mm day<sup>-1</sup>) and which we applied for the gridded daily data is the following:

$$ET_0 = \frac{0.408\Delta(R_n - G) + \gamma \frac{900}{T + 273} u_2 (e_s - e_a)}{\Delta + \gamma(1 + 0.34u_2)},$$

where  $R_n$  is the net radiation at the crop surface (MJ m<sup>-2</sup> d<sup>-1</sup>),  $G$  is the soil heat flux density (MJ m<sup>-2</sup> d<sup>-1</sup>) (at daily timescales  $G$  is assumed to be zero),  $T$  is the mean daily air temperature at 2 m height, (°C),  $u_2$  is the wind speed at 2 m height (m s<sup>-1</sup>),  $e_s$  is the saturation vapor pressure (kPa),  $e_a$  is the actual vapor pressure (kPa),  $e_s - e_a$  is the saturation vapor pressure deficit (kPa),  $\Delta$  is the slope of the vapor pressure curve (kPa °C<sup>-1</sup>),  $\gamma$  is the psychrometric constant (kPa °C<sup>-1</sup>).

*Allen, R. G., Pereira, L. S., Raes, D., and Smith, M.: Crop evapotranspiration – guidelines for computing crop water requirements – FAO Irrigation and drainage paper 56, 300. FAO: Rome, 6541, 1998.*

*Zotarelli, L., Dukes, M. D., Romero, C. C., Migliaccio, K. W., and Morgan, K. T.: Step by Step Calculation of the Penman-Monteith Evapotranspiration (FAO-56 Method), IFAS Extension, University of Florida, <http://edis.ifas.ufl.edu>, 2010.*

## 2. Description of the grids:

**Spatial resolution:** 0.1°x 0.1° grid (10kmx10km) grid

**Reference system:** WGS 1984

## 3. Encoding

**File coding:** Stored data (grids) format: ASCII (plain file) Identifying labels for gridded data: PM\_DailyGrid.ser

**Data coding:** The complete data sets give total coverage of the CARPATCLIM interest area in the period 1961- 2010. Each grid consists of 61 rows and 101 columns. The data start at the NW upper corner of the files, position 50° lat N and 17° long E and are arranged in latitudinal bands. The data ends at the SE lower corner, position 44° lat N and 27° long E.

•••• The ASCII (plain text) file has a data format as follows: One column is one series, and the format is:

**row 1:** indices of the series (j=1,...,5895)

**row i:** rows containing grid data (i>1)

**column 1:** year

**column 2:** month

**column 3:** day

**column 3+j:** series j (j=1,...,5895)

**Grid cell with no value:**-9999

#### 4. Distribution

**Available Format:** ASCII (plain text)

**Status:** Available for downloading

**Access Constraint:** Data is freely available for download. Any use of the data shall give acknowledgement of the source in reference to the

CarpatClim dataset: [www.carpatclim-eu.org](http://www.carpatclim-eu.org)

as well as

Lakatos M., Weidinger T., Hoffmann L., Bihari Z., Horváth Á. (2020): Computation of daily Penman–Monteith reference evapotranspiration in the Carpathian Region and comparison with Thornthwaite estimates. Advances in Science and Research. MS No.: asr-2019-32. Special Issue: 18th EMS Annual Meeting: European Conference for Applied Meteorology and Climatology 2018. <https://www.adv-sci-res.net/16/251/2020/>

**Data Transmission:** Online