The Programs
dew.exe and *dew02.exe*

User's Manual

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Introduction

The Programs *dew.exe* and *dew02.exe* are designed to calculate the average daily dewpoint temperature per month using daily air temperature and humidity data.

One has to use the program *dew.exe* in order to calculate the dewpoint temperature if just average daily temperature data are available. The program *dew02.exe* calculates the dewpoint temperature using minimum and maximum daily temperature data. If you have the choice between using average temperature or minimum and maximum temperature, you should to decide to use minimum and maximum values, because this will generate more precise results. When the average temperature data is used, the dewpoint temperature will be a bit underestimated.

In both cases you have to use average daily humidity data.

The Input File

Program *dew.exe* (Average Temperature)

The input file which stores the average daily temperature [°C] and humidity [%] data must be an ASCII text file with two columns (see figure 1 below) - the first column storing the temperature data and the second column storing the humidity data.

Program *dew02.exe* (Maximum and Minimum Temperature)

The input file storing the maximum and minimum daily temperature [°C] and the average daily humidity [%] data must be an ASCII text file with three columns (see figure 2 below). The first column stores the maximum temperature data the second column the minimum temperature data and the third column the average daily humidity data.

Valid for both Programs

The period of temperature and humidity measurement must start on January 1st and must end on December 31st. In other words, the first value in the input file must have the value of January 1st and the last value the one of December 31st. Even though there is no limit to the number of years employed, one's calculations must be based on the entire year.

If there are any missing data in your measurements, you need to fill these days with NoData values (this must be a number). The temperature NoData value must be greater than 100.0 or less than -100.0. A valid humidity value is between 0.0 and 100.0. Values which are greater or less will be handled as NoData values by the program. Humidity data are often expressed by values between 0 and 1. In that case, each humidity value must be multiplied with factor 100.

NoData entries will be automatically replaced with the mean value of the entire period.

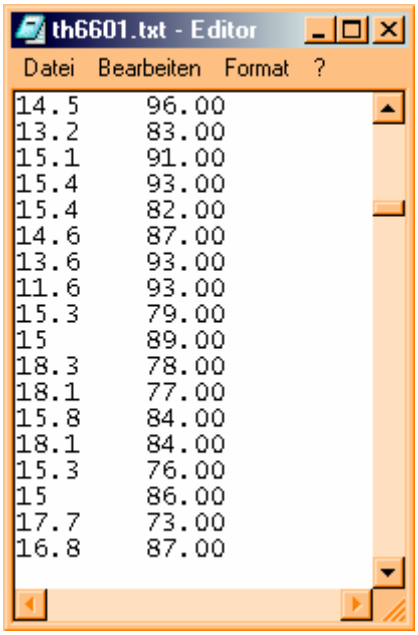

Fig. 1: Input File (dew.exe)
First Column: Average Daily Temperature
Second Column: Average Daily Humidity

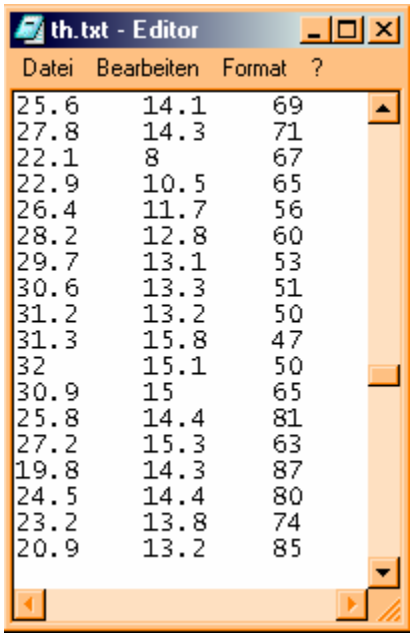

Fig. 2: Input File (dew02.exe)
First Column: Daily Maximum Temperature
Second Column: Daily Minimum Temperature
Third Column: Average Daily Humidity

Creating the Input File

Probably you have two text files. One stores the temperature values and another one the humidity data. Open these files with an spreadsheet application like MICROSOFT EXCEL. If necessary, reduce both periods on top and bottom so that they start on January 1st and end on December 31st. Make sure that the date of the first value of temperature and humidity data match. Afterwards, just copy the temperature and humidity data into a new file according to figure 1 or 2. Save the file without headlines as a text file (*filename.txt*).

If you create the input file with any other application or manipulate the file later with a text editor, make *sure that the last line (the line following the last December 31st value) is a blank line! If there is no blank line or if there is more than one blank line at the end of the file, the program will interrupt with the message "End of file during read" or it will generate wrong output data, respectively.*

Running the Program

Copy the program and the input file into the same directory. Double click the *dew/dew02.exe* or start the program from a DOS prompt (see figure 3 below). First, you will be asked about the name of the input and output file. The name of the input file is the name of the file storing the temperature and humidity data. Do not forget to add the file extension! As regards, the output file you can choose any name. In the next step, you will be asked to enter the

first year of the period. This information is used to calculate if a year is a leap year or not. Simply type in the first year of the period (four numbers) and press <RETURN>.

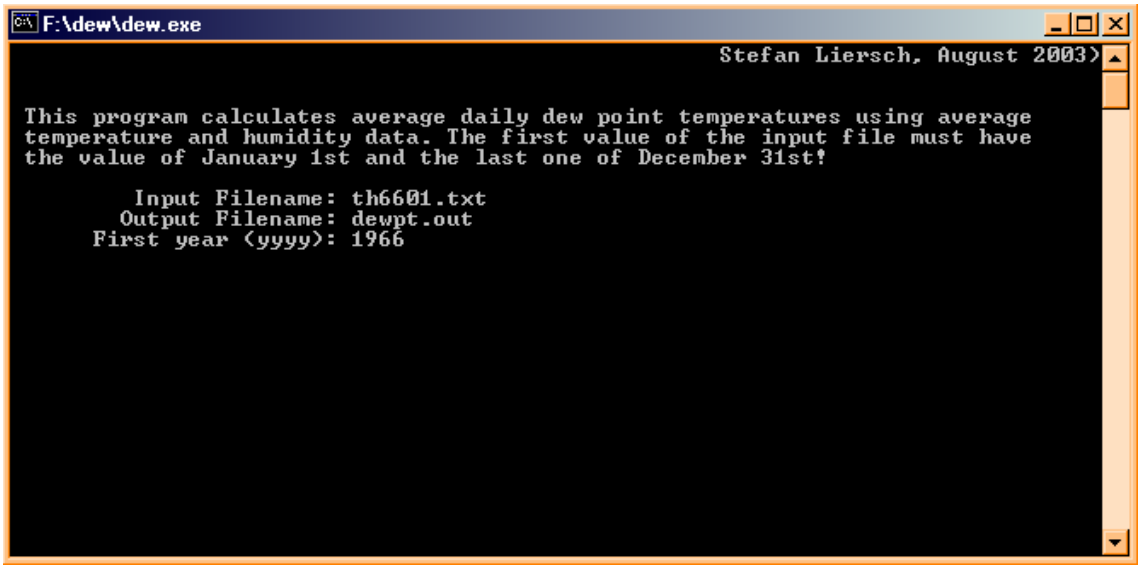

Fig. 3: Program *dew.exe*

After the calculations are finished, the output file (see figure 4) below will automatically be saved in the same directory as the program itself.

F:\dew\dewpt.out

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This file has been generated by the program 'dew.exe'
Input Filename    = th6601.txt
Number of Years   =           36
Number of Records =        13149

Number of NoData Values
tmp =            0
hmd =            0


Average Daily Dew Point Temperature for Period (1966 - 2001)

_____________________________________________________

  Month         tmp          hmd        dewpt
_____________________________________________________

    Jan        1.67        87.21        -0.31
    Feb        2.04        83.18        -0.64
    Mar        4.83        79.30         1.38
    Apr        8.15        73.19         3.33
    May       12.95        71.10         7.48
    Jun       15.47        73.55        10.51
    Jul       17.56        74.88        12.78
    Aug       17.41        75.28        12.73
    Sep       13.58        82.44        10.53
    Oct        9.68        85.64         7.29
    Nov        5.12        87.55         3.14
    Dec        2.65        88.06         0.80
_____________________________________________________


tmp = average daily temperature in month [°C]
hmd = average daily humidity in month [%]
dewpt = average daily dew point temperature in month [°C]


(written by Stefan Liersch, August, 2003)
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Fig. 4: Example of an Output File

Calculating the Dewpoint Temperature

The program calculates the dewpoint temperature of each day. The values listet in the output file are the average daily dewpoint temperatures of each month over the entire period.

First, the saturation vapour pressure e_s will be derived from the daily air temperature values T (see equation 1). After that, the average daily actual vapour pressure e_a will be calculated by using saturation vapour pressure e_s and average humidity data RF (see equation 2).

According to ALLEN, R. G. (1998):

$e_s = 0.6108 * \exp((17.27 * T) / (T + 237.3))$ Eq. 1

The unit of saturation vapour pressure generated by equation 1 is [kPa]. That must be converted into [mbar]. Therefore, the result will be multiplied with the factor 10.

According to HÄCKEL, H. (1999):

$e_a = RF * e_s / 100$ Eq. 2

The daily dewpoint temperature dew will be aproximately calculated by the following equation:

$$dew = (234.18 * \log_{10}(e_a) - 184.2) / (8.204 - \log_{10}(e_a))$$ Eq. 3

e_s = saturation vapour pressure [mbar]
e_a = actual vapour pressure [mbar]
exp = 2.7183 (base of natural logarithm)
T = air temperature [°C]
RF = relative humidity [%]
dew = dewpoint temperature [°C]

Using daily minimum and maximum temperature data, the saturation vapour pressure will be derived twice ($e_{s\,min}$ and $e_{s\,max}$) according to equation 1. In this case the saturation vapour pressure used by equation 2 is the mean value of $e_{s\,min}$ and $e_{s\,max}$.

Note

Be aware of the fact that, if you provide the program with wrong information, you will end up with wrong output data. If the input file does not exist or if you type in a letter instead of a number, the program will produce an error message. In most cases, however, you will not be able to read this message because the program-window closes rather quickly.

References

Allen, R. G. / Pereira, L. S. / Raes, D. / Smith, M. (1998): Crop evaporation – Guidelines for computing crop water requirements – FAO Irrigation and drainage paper 56, http://www.fao.org/docrep/X0490E/x0490e00.htm#Contents, Stand: 17. 10. 2002.

Häckel, H. (1999): Meteorologie, Stuttgart: Ulmer, 4th edition.

In case you are interested in the source code or should you encounter any kind of difficulties while using the program, do not hesitate to send an email to: stliersch@freenet.de.