COMPARATIVE ANALYSIS OF CLIMATIC PARAMETERS MEASURED IN TWO DIFFERENT LOCATIONS

Vlad DOBRA, Lorentz JÄNTSCHI, Tudor TODORAN, Gabriela BĂLAN

Tehnical University Cluj-Napoca, 400641 Cluj, Romania
Phone: +4026440-2798; E-mails: vlad.dobra@termo.utcluj.ro, lori@chimie.utcluj.ro, tudor.todoran@termo.utcluj.ro

***Abstract**: The paper is presenting a comparison between two series of data measured with different meteorological stations placed in different locations. Data are transmitted from location acquisition systems to a database, located on a server. The recorded data is available on internet and it can be used to evaluate the local potential of renewable energies such as solar and wind energy or for correlations between monitored parameters and plants growing and to evaluate the influences of the weather parameters in agriculture. There are presented the experimental set-up structure including the major software components.*
***Keywords:** meteorological data, weather station, renewable energy*

1. INTRODUCTION

The paper is presenting data measured with two weather stations of same type. Meteorological stations are placed in different locations; one in Cluj-Napoca and the other one in Reghin, two cities in Romania. Measuring and monitoring environment and meteorological parameters is an very important activity in our day's context of high concern about the global warming.
Scientific literature contains a multitude of studies in both directions for which climatic parameters are important: renewable energies and agriculture. Some of them will be listed below, as follows:
Some discussion about influences of climatic parameters in agriculture are held in papers such as [1-3].
The influence of humidity of soil, resulting from rain or irrigations, on plants growth is presented in [4].
Evapotranspiration was treated in a lot of papers such as [5-10]
Studies about renewable energies, involving meteorological data are presented in [11-15].
The paper represents a start point in research on potential of renewable energies and the subject of the impact in agriculture of the meteorological data in the two monitored locations.

2. MATERIALS AND METHODS

Both weather stations transmit measured and calculated data to a database stored on a server, by internet. Access to the database is done through a Web interface, where users can display all the parameters for different periods with a time step between 1 and 60 minutes.
Each measuring point includes a wireless meteorological station and a leaf-soil station. Both stations are communicating with a console, which displays data in real time.
Figure 1, is presenting the hardware configuration for entire experiment. Each weather station contains sensors that provide information about various climatic parameters. All data provided by sensors are transferred to the console and are stored in data logger with a baud rate of one record for each minute. Data logger can store collected data for two days. With a software special designed for this application, data from data logger arrives in a database located on a server. The server it's placed in Technical University from Cluj-Napoca. This server stores data from both weather stations from Reghin and from Cluj-Napoca. Details about data acquisition system are available in [16]. Weather stations are using their own software that gathers the information from al sensors and create local available databases. Original software was developed with two components: one to collect local available data and to transfer them on the web server and one to allows the access to information from database from all over the world, using a web interface.

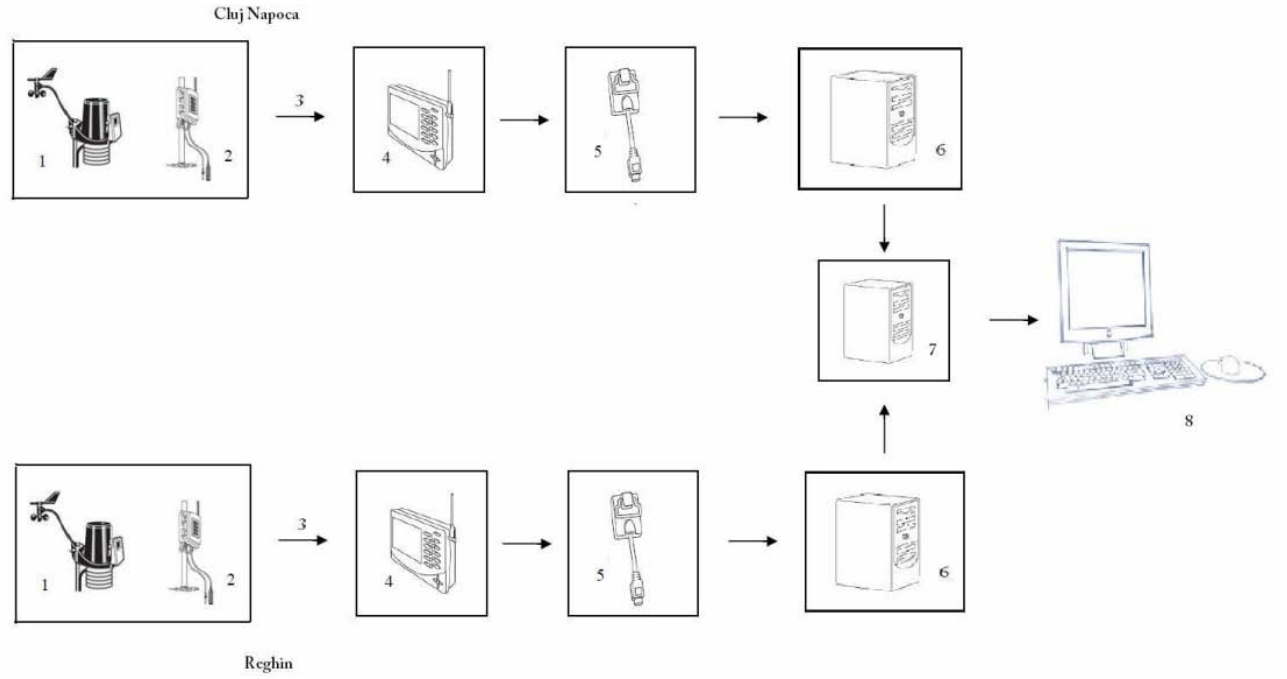

Fig. 1. Schematic configuration for entire structure of monitoring equipment
1 - weather station; 2 – leaf and soil station; 3 – wireless radio communication; 4 – console; 5 – data logger; 6 – local PC; 7 – server; 8 – end user PC

The weather stations are providing measured and calculated parameters. The following parameters are measured with sensors:

- Barometric pressure;
- Outside temperature;
- Relative humidity;
- Rainfall;
- Solar radiation;
- Ultra violet radiation dose;
- Ultra violet radiation index;
- Wind speed;
- Wind direction.

Calculated parameters provided by weather station are:

- Dew point;
- Rain rate;
- Evapotranspiration;
- Heat index;
- Temperature humidity sun wind index;
- Wind chill.

Each leaf&soil station is providing the following parameters:

- Leaf wetness (two measurement points);
- Soil moisture (four measurement points);
- Soil temperature (four measurement points).

Console is providing the following parameters:

- Inside temperature;
- Inside relative humidity;
- Inside dew point temperature(calculated);
- Inside heat (calculated).

Technical information about sensors located on meteorological station and on leaf & soil station are presented in [16]. In the same paper are presented the methods used for calculations, by weather station.

3. RESULTS

As follows, are presented some charts with the variation of daily average values for the following three parameters: total solar radiation, outside temperature and outside relative humidity. The parameters were chosen just to offer an image about what type of data can be obtained from the two weather data acquisition systems.
The charts are representing also, a comparison between data series recorded by the weather stations, between June 21…30, 2009 and July 1…5, 2009.

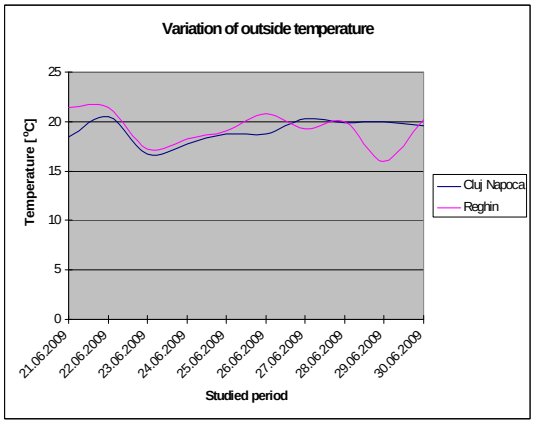

Fig. 2. Variation of outside temperature for June 21…30, 2009

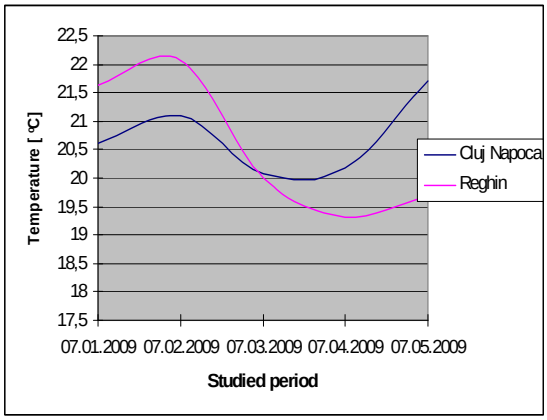

Fig. 3. Variation of outside temperature for July 1…5, 2009

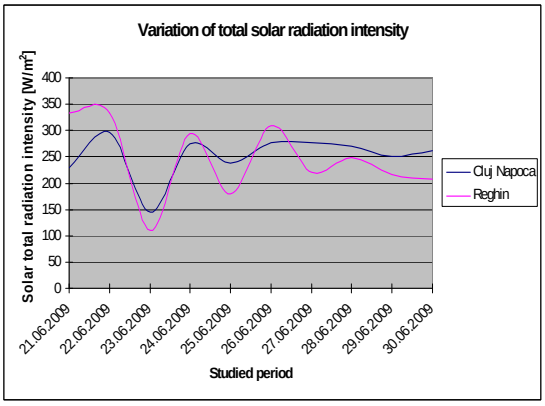

Fig. 4. Variation of total solar radiation intensity for June 21…30, 2009

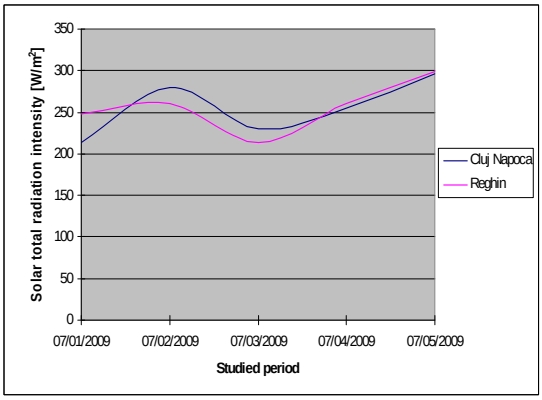

Fig. 5. Variation of total solar radiation intensity for July 1…5, 2009

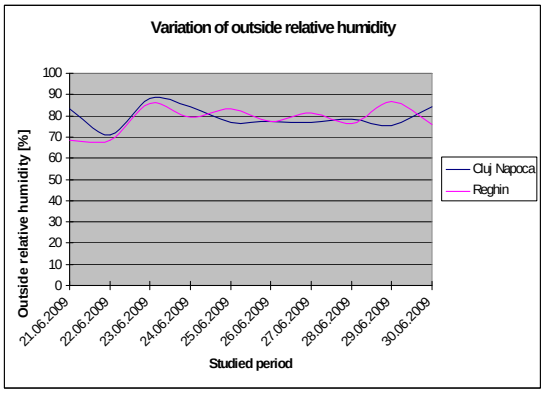

Fig. 6. Variation of outside relative humidity for June 21…30, 2009

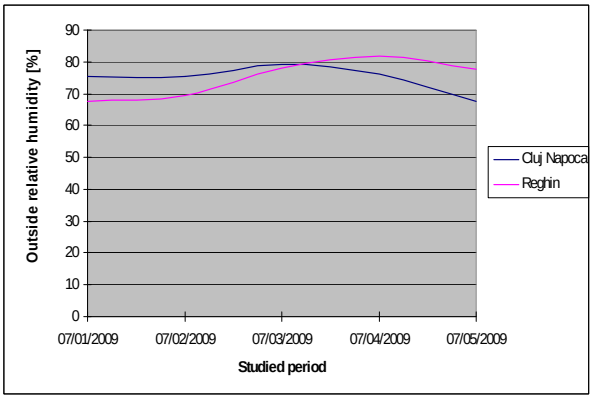

Fig. 7. Variation of outside relative humidity for July 1…5, 2009

In the last 12 month the database has been permanently filled by weather stations with the values of parameters listed in previous chapter. With a long-term monitoring of parameters of interest, will begin an analysis of data

collected. Monitoring of parameters will continue in order to research compiled on renewable energies and on the impact of environmental factors in agriculture.

4. CONCLUSIONS

The main purpose of this paper it's to conclude that the research is presenting the conditions established to allow advanced researches to evaluate the energy potential of monitored locations and to establish correlations between climatic parameters and growing process of plants. The two types of researches can be approached, because the monitoring equipment has been tested in both locations and the structure of database include a lot of relevant information for the two fields of research.
Besides the short presentation of monitoring equipment, the paper has proposed to present the kind of data that can be obtained from the developed data acquisition system and database.

REFERENCES

[1] Menzel, A.: Plant phenological anomalies in Germany and their relation to air temperature and NAO, Climatic Change 57(3):243-263, 2003.
[2] Roujou de Boubee, D.; Van Leeuwen, C.; Dubourdieu, D.: Organoleptic impact of 2-methoxy-3-isobutylpyrazine on red Bordeaux and Loire wines. Effect of environmental conditions on concentrations in grapes during ripening. Journal of Agricultural and Food Chemistry 48(10):4830-4834, 2000.
[3] Caprio, J.M.; Quamme, H.A.: Weather conditions associated with apple production in the Okanagan Valley of British Columbia, Canadian Journal of Plant Science 79(1):129-137, 1999.
[4] Jerapat, S.; Siriphanich, J.: Effect of irrigation on dry matter of durian pulp cv. Monthong, Acta Horticulturae 768:251-255, 2008.
[5] Gonzalez Dugo, M.P.; Neale, C.M.U.; Mateos, L.; Kustas, W.P.; Prueger, J.P.; Anderson, M.C.; Li, F.: A comparison of operational remote sensing-based models for estimating crop evapotranspiration, Agricultural and Forest Meteorology 149(11):1843-1853, 2009.
[6] Jaber, F.; Shukla, S.; Srivastava, S.: Evapotranspiration losses for drip-irrigated watermelon in shallow water table and sandy soil conditions, 2007 ASABE Annual International Meeting, paper no. 07-2018, 2007.
[7] Bhantana, P.; Lazarovitch, N.: Evapotranspiration, crop coefficient and growth of two young pomegranate (Punica granatum L.) varieties under salt stress, Agricultural Water Management 97(5):715-722, 2010.
[8] Sentelhas, P.C.; Gillespie, T.J.; Santos, E.A.: Evaluation of FAO Penman-Monteith and alternative methods for estimating reference evapotranspiration with missing data in Southern Ontario, Canada, Agricultural Water Management 97(5):635-644, 2010.
[9] Raz-Yaseef, N.; Rotenberg, E.; Yakir, D.: Effects of spatial variations in soil evaporation caused by tree shading on water flux partitioning in a semi-arid pine forest, Agricultural Forest Meteorology 150(3):454-462, 2010.
[10] Martinez-Cob, A.; Faci, J.M.: Evapotranspiration of an hedge-pruned olive orchard in a semiarid area of NE Spain, Agricultural Water Management 97(3):410-418, 2010.
[11] Bălan, M.; Damian, M.; Jäntschi, L.: Preliminary Results on Design and Implementation of a Solar Radiation Monitoring System, Sensors 8(2):963-978, 2008.
[12] Bălan, M.; Damian, M.; Jäntschi, L.: Solar Radiation Monitoring System, Actual Tasks on Agricultural Engineering, Opatija Croatia, 36:507-517, 2008.
[13] Bălan, M.; Damian, M.; Jäntschi, L.; Ion, I.: Study concerning the Influence of Some Working Conditions on the Heat Pumps Performances, Actual Tasks on Agricultural Engineering, Opatija Croatia, 36:535-544, 2008.
[14] Muylaert de Araújo, M.S.; Vasconcelos de Freitas, M.A.: Acceptance of renewable energy innovation in Brazil - case study of wind energy, Renewable and Sustainable Energy Rewiews 12(2):584-591, 2008.
[15] Hrayshat, E.S.: Analysis of renewable energy situation in Jordan, Renewable and Sustainable Energy Rewiews 11(8):1873-1887, 2007.
[16] Bălan, M.; Bolboacă, S.D.; Sestraş, R.E., Jäntschi, L.: Experimental setup to study the local renewable energy potential and the environment influence on fruits growing, Actual Tasks on Agricultural Engineering, Opatija, Croatia, 37:265-271, 2009.