The Evolution of some Agroclimatic Indicators between 2009 - 2013 in the Transylvanian Plain

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ABSTRACT

Transylvanian Plain (TP) with an area of 395,616 hectares is considered one of the most affected areas with the lowest capacity to adapt to existing climate change. In these conditions, the climate monitoring and implementation of measures to adapt to these changes are essential for sustainable development of agricultural technologies. Purpose of these paper is to analysis of data obtained in relation to the principles of soil conservation and adaptation to climate phenomena observed in monitoring agro-climatic factors. In this study we used data of temperature and humidity electronically recorded by eight HOBO microstations located in the Transylvanian Plain, which determine the rainfalls and temperature to a height of 1 m, the soil temperature (at 10, 30, 50 cm depth in soil) and soil moisture (at 10 cm depth). In TP the multiannual average of temperature at 10 cm depth in soil recorded during 2009-2013 is 11.22°C, respectively 11.23°C at 50 cm depth in soil and the multiannual average of soil moisture recorded in the same period is 0.227 m³/m³. The multiannual average value of precipitation is 465.25 mm. Results highlight the dynamic evolution of soil moisture and air temperature in Transylvanian Plain due to agro-climatic analysis of the indicators calculated for the period 2009-2013.

Keywords: *climate monitoring, agroclimatic indicators, Transylvanian Plain.*

INTRODUCTION

Climate warming is a phenomenon already revealed by the analysis of observational data for long periods of time (Busuioc *et al.*, 2007). In the report of European Environment Agency (2012) it is on record that the effects of climate change in agriculture are reflected in changing areas of crop suitability and the phenology and plant vegetation period. Babinszky I. *et al.* (2011) believes that increasing the average daily temperature is a consequence shortening plant vegetation period.

For Romania, Busuioc *et al.* (2014) mentioned that were detect an increasing trends of extreme temperatures in all seasons, but regards extreme rainfall climatic signal is not as clear as for temperature extremes.

Depth of soil hydrological reserve can be considered one of the key parameters in modeling soil (Van Den Hurk *et al.*, 2005). European Environmental Agency (2012) considers that there are no clear trends in soil water retention due to the lack of systematic data, but projections suggest significant reductions in soil moisture in the Mediterranean region. Several scientific results on climate changes were included in policies and strategies to adapt to climate change actions (Lereboullet *et al.*, 2013)

Transylvanian Plain (TP) is considered one of the most affected areas with the lowest capacity to adapt to existing climate change.

Under these conditions, the climate monitoring and implementation of measures to adapt to these changes are essential for sustainable development of agricultural technologies (Rusu *et.al*, 2012, 2013).

This paper aims to monitor climatic conditions (soil temperature, air temperature, precipitation) of TP and calculation agroclimatic indicators for the period 2009-2013.

MATERIALS AND METHODS

In the study we used data of temperature and humidity electronically recorded by eight microstations (HOB0-MAN-H21-002 type) located in the Transylvanian Plain, which allow storage of electronic data and viewing it through the HOB0ware Pro Software Version 2.3.0., data which after that was statistically analyzed and interpreted. To record rainfall stations were provided with rain gauges RG3-M type. Climatic elements monitoring stations were located in different areas with different pedoclimatic issues from TP.

Tab. 1. Location of station in Transylvanian Plain

Nr. crt.	Station name	Latitude	Elevation (m)
5	Taga (CJ)	46.975769	316
6	Branistea (BN)	47.17046	291
4	Dipsa (BN)	46.966299	356
7	Zoreni (BN)	46.893457	487
3	Silivasu de Campie (BN)	46.781705	463
8	Filpișu Mare (MS)	46.746178	410
2	Band (MS)	46.584881	318
1	Triteni (CJ)	46.59116	342

MS = Mures County; CJ = Cluj County; BN = Bistrita-Nasaud County

TP stations are located at elevation between 316 m Taga station and 487 m at Zoreni station, covering areas in the Cluj county (CJ), Bistrita-Nasaud county (BN) and Mures county (MS) which are included in the geographical unit. (Tab. 1)

Data on soil temperature were recorded at 10, 30 and 50 cm depth, air temperature and rainfall to a height of 1 m, and soil moisture at 10 cm depth in soil. In terms of soil temperature, in this paper are presented the annual and multi-annual average values to 10 cm and 50 cm depths in soil.

RESULTS AND DISCUSSIONS

In TP the multiannual average of temperature at 10 cm depth in soil recorded during 2009-2013 is 11.22°C, respectively 11.23°C at 50 cm depth in soil and the multiannual average of soil moisture recorded in the same period is 0.227 m³/m³.

Temperature range of multiannual average at 10 cm depth in soil is between 10.47°C (at Triteni station) and 12.92°C (at Filpișu Mare station) and the annual average temperature at 50 cm depth in the soil was between 10.63°C (Zoreni station) and 12.80°C (Filpișu Mare station) (Tab.2)

In agreement with previous studies on the thermal characterization of soils in the Transylvanian Plain, based on temperatures recorded at 50 cm in the soil, mean annual temperature is within the range of 8°C - 15°C specific mesic soils. (Haggard *et al.*, 2010; Weindorf *et al.*, 2009)

In TP during period 2009-2013, the soil moisture at 10 cm depth recorded a value of multiannual average 0.227 m³/m³, the highest value obtaining at Triteni station (0.251 m³/m³) and the lowest value at Band station (0.197 m³/m³).

Tab. 2. Multiannual average (years 2009 - 2013) of temperature and water content at 10 cm soil depth, for 8 stations in TP

Nr. crt.	Station name	T °C at 10 cm in soil	T °C at 50 cm in soil	Soil moisture (m ³ /m ³) at 10 cm in soil
1	Taga (CJ)	10.67	10.89	0.209
2	Branistea (BN)	11.18	11.04	0.225
3	Dipsa (BN)	11.50	11.70	0.240
4	Zoreni (BN)	10.71	10.63	0.231
5	Silivasu de Câmpie (BN)	10.90	10.71	0.244
6	Filpișu Mare (MS)	12.92	12.80	0.221
7	Band (MS)	11.38	11.25	0.197
8	Triteni (CJ)	10.47	10.80	0.251
Average TP		11.22	11.23	0.227

MS = Mures County; CJ = Cluj County; BN = Bistrita-Nasaud County

In terms of rainfall, multiannual average value recorded during 2009-2013 was 465.25 mm which value is below the average annual area (500-700 mm/year). During this period there is a linear trend in their fall starting from an average annual of 503.84 mm in 2009 to a value of 492.8 mm in 2013, recording the highest value of annual average of 607.84 mm in 2010 and the lowest value in 2012 (345.25 mm). The year 2012 can be characterized by values of rainfall deficit for TP which is also reflected in the low values of soil moisture (0.202 m³/m³) for the period analyzed (Fig.1.a.).

Soil moisture at 10 cm depth are reflected the same tendency linear decrease from a annual average of 0.245 m³/m³ in 2009 to a value of 0.211 m³/m³ in 2013, recorded highest value of annual average 0.260 m³/m³ in 2010 and lowest value of annual average 0.202 m³/m³ in 2012 (Fig. 1.b.).

Rain factor (Lang) value were calculate for four station (Branîştea, Dipşa, Silivaşu de Câmpie and Căianu) between 2009-2013 and the results indicate a Mediterranean climate at Căianu station where value of Lang factor were between 20 and 40 (35.84) and for the other stations Lang

Fig.1. The evolution of the average values of rainfall (mm) and soil moisture (m³/m³) in TP between 2009 - 2013 (a. Rainfall evolution; b. Soil moisture evolution)

Fig. 2. Rain Factor's evolution between 2009 - 2013 for 4 station in TP

factor values are between 40 and 70 indicating a semiarid climate. (Fig. 2)

CONCLUSION

Different pedogenetic horizons, exhibition, gradient and vegetation covering different types of soils are factors that work together to characterize the thermal regime of the soil.

Results highlight the dynamic evolution of soil temperature at 10 cm and 50 cm depth in soil, soil moisture at 10 cm depth in soil, in Transylvanian Plain due to agro-climatic analysis of the indicators calculated for the period 2009 - 2013.

Based on the results obtained from the statistical analysis and interpretation of agroclimatic indicators one can develop specific measures to adapt to the effects of observed climate changes.

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