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EFFECT OF CLIMATE CHANGE ON DOBROGEA AGRICULTURAL AREA

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Abstract

In this paper I intended to investigate climate change evolution, comparing period 2001-2013 with reference period 1961-1990 for the agricultural area from Dobrogea region. Data for temperature, rainfall and moisture reserves were used for drawing GIS maps. In conclusion we will see what are the consequences and the necessary measures for the optimal development of agricultural production. This study was made possible with data provided by the ANM.

Key words: *GIS technology, temperatures, soil moisture, climate change, extreme weather phenomenon, environment problems*

INTRODUCTION

In Romania, climate data from the last decades highlights a progressive warming of atmosphere, an increase in the frequency of extreme events. Increasingly evident is the rapid change between heat wave/severe draught and abundant rainfall/flash floods.
Considering predictable climatic scenarios it's estimated a increase in thermal and hydrologic stress based on continual rise in air temperature and drop in rainfall, primarily during the summer month which correspond to the critical period for crops (flowering-filling of grains). Adapting to climate change will be based on experience gained from reaction to extreme climate events, and also on implementing alert plans and integrated management for climate risks (Mateescu, 2012).

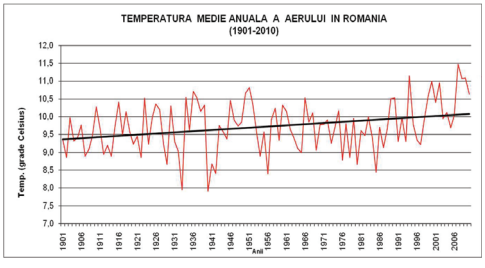

Figure 1. Trend of average air temperature in Romania (1901-2010)

During the first decade of XXI century, in Romania, the year tot year average temperature has risen by 0.4…0.5 degrees Celsius compared to every decade starting from 1961 until present day (Fig. 1).

MATERIALS AND METHODS

This paper was made possible with help from ANM which provided data about average month temperatures and monthly rainfall in the reference interval 1961-1990 and the years 1991-2913 for the following meteorological stations: Adamclisi, Constanta, Corugea, Harsova, Jurilovca, Mangalia, Medgidia, Sulina and Tulcea in the region of Dobrogea. For each station data was processed with Excel creating tables for average temperatures and average rainfall in the following intervals: 1961-1990, 1991-2010 and 2010-2013.
The resulting tables were inserted in ArcGIS and maps made with a well defined classes legend as follows in this paper.

RESULTS AND DISCUSSIONS

We made a table with yearly average air temperatures for the two intervals 1961-1990, 1991-2013 in the region of Dobrogea. Looking at this we can see that the average temperatures from the period 1991-2013 are higher then the temperatures in the other period (Fig. 2).

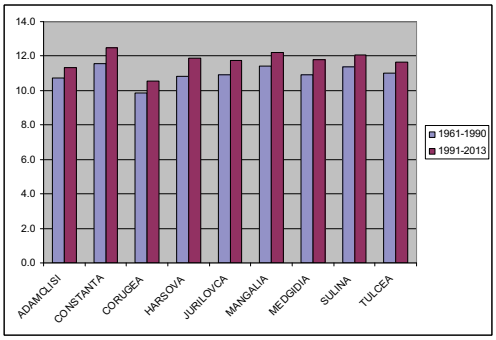

Figure 2. Yearly average air temperatures for the Dobrogea Region

STATION	1961-1990	1991-2013	Difference
ADAMCLISI	10.7	11.3	0.6
CONSTANTA	11.6	12.5	0.9
CORUGEA	9.8	10.6	0.7
HIRSOVA	10.8	11.9	***1.1***
JURILOVCA	10.9	11.7	0.8
MANGALIA	11.4	12.2	0.8
MEDGIDIA	10.9	11.8	0.9
SULINA	11.4	12.1	0.7
TULCEA	11.0	11.7	0.7

Figure 3. Temperature difference between the two periods for Dobrogea region

In Figure 3 we can see that the biggest difference in average air temperature of 1.1 degrees Celsius was recorded at Harsova station, the next station are Constanta and Medgidia with a 0.9 degrees Celsius, followed by Jurilovca and Mangalia with a 0.8 degrees Celsius, Sulina, Tulcea, Corugea 0.7 degrees Celsius and Adamclisi station with a 0.6 degrees Celsius difference. For precipitation I made tables and GIS maps in order to highlight and survey the precipitation quantities fallen in Dobrogea region.

STATION	1961-1990	1991-2010	2011-2013
ADAMCLISI	447.7	***533.4***	***455.9***
CONSTANTA	396.3	***464.8***	***441.1***
CORUGEA	410.9	***458.7***	395.4
HIRSOVA	421.1	***430.6***	***511.8***
JURILOVCA	376.4	369.2	309.7
MANGALIA	398.4	***471.5***	***439.9***
MEDGIDIA	430.1	***485.9***	***480.0***
SULINA	281.4	223.2	249.2
TULCEA	445.9	***491.6***	***490.1***

Figure 4. Average precipitation quantity fallen in Dobrogea region

In Figure 4 we can see that the average precipitation quantity fallen during period 1991-2013 is higher than the reference mainly for the stations: Adamclisi, Tulcea, Medgidia, Mangalia, Constanta, Corugea and Harsova. For Jurilovca and Sulina station, the precipitation were lower then the reference period. To highlight this I made the following GIS maps (Fig. 5,6):

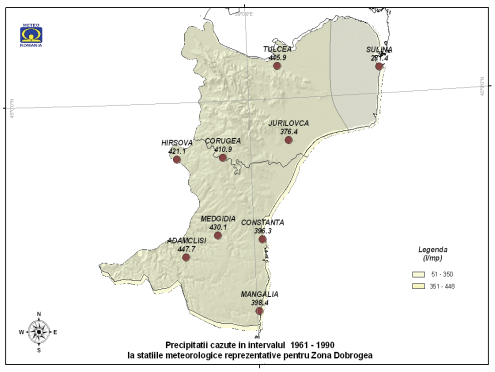

Figure 5. Average precipitation quantity (1961-1990) in Dobrogea region for every single station.

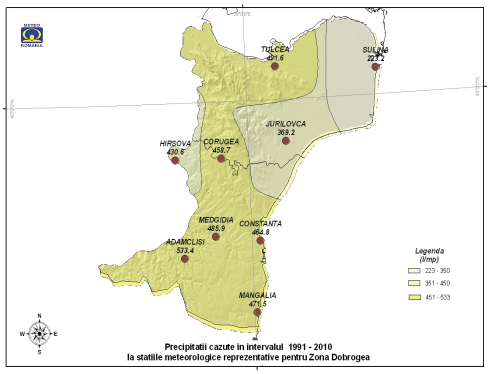

Figure 6. Average precipitation quantity (1991-2010) in Dobrogea region for every single station.

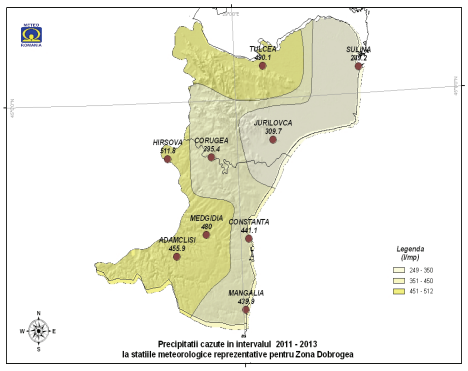

Figure 7. Average precipitation quantity (2011-2013) in Dobrogea region for every single station.

It can be seen how precipitation quantity rises in the north, north-west, west and south parts of Dobrogea during the years 1991-2013.

In the next table are shown the average precipitation quantity for every month of the two reference intervals and the differences for precipitation (l/m^2) (Fig. 8).

MONTH	1961-1990	1991-2013	Difference
January	28.1	28.2	0.1
February	28.6	19.5	*-9.1*
March	24.7	29.9	5.2
April	29.0	31.5	2.5
May	41.7	42.2	0.5
June	45.6	45.5	-0.1
July	37.7	48.5	***10.8***
August	35.7	35.7	0.0
September	33.8	48.4	***14.6***
October	26.9	36.4	***9.5***
November	34.8	33.6	-1.1
December	34.4	35.5	1.1

Figure 8. Average precipitation quantity fallen in Dobrogea region

We can see that for the month of July 1991-2013, the average precipitation quantity was exceeded by 10.8 l/m^2, and in September by 14.6 l/m^2, also in the month of October 9.5 l/m^2 this month are considered predominantly rainy, the month of February and November are droughty, recording lower values for precipitation quantities than the reference, this are -9.1 l/m^2 and -1.1 l/m^2.

In figure 9 I showed the total amount of precipitation fallen for the month of September 2005 since it is the rainiest month in the string of month after 1991. During this month the rainfall quantities exceeded 300 l/m^2.

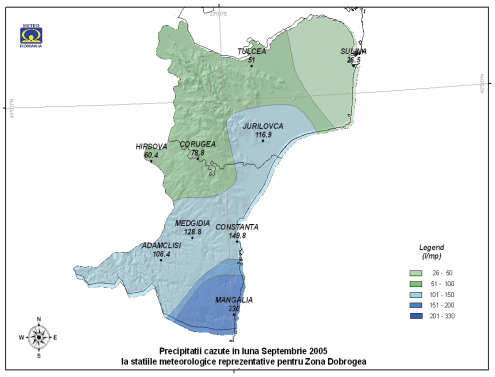

Figure 9. Amount of rainfall in the month of september 2005 at meteo stations from Dobrogea county

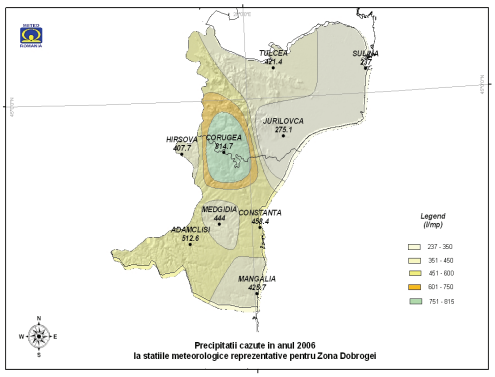

Figure 10. Amount of rainfall in the year 2006 at meteo stations from Dobrogea county

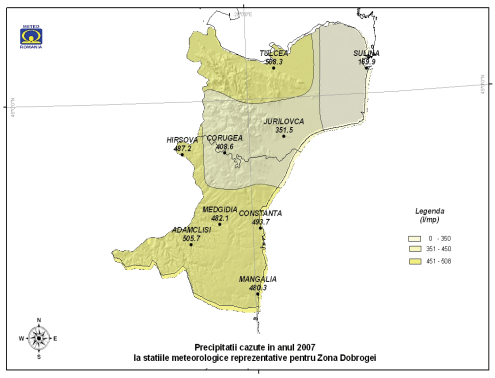

Figure 11. Amount of rainfall in the year 2007 at meteo stations from Dobrogea county

Analysing the data set it's noticed that the years 2006 and 2007 were the most arid years after

1991, compared with the year to year average for the 1961-1990 interval for each station (Fig 10,11).

CONCLUSIONS

In conclusion, a tendency to rise can be seen for the average multiannual temperature (Fig. 12), but also the rise in precipitation shown in figure 13. This confirms the theory of global warming and also the rapid change of extreme events draught/ abundant rainfall, heat wave/ floods. Land reclamation will be needed, draining and irrigation specific to the crop area.

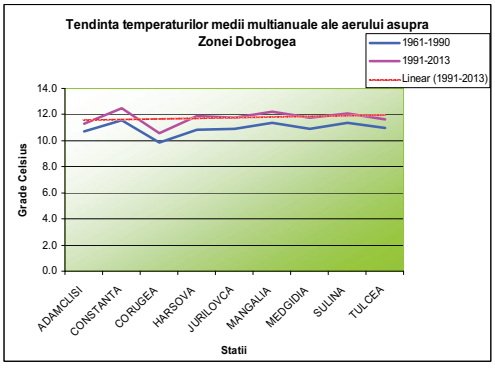

Figure 12. Tendency of average multiannual air temperature for Dobrogea

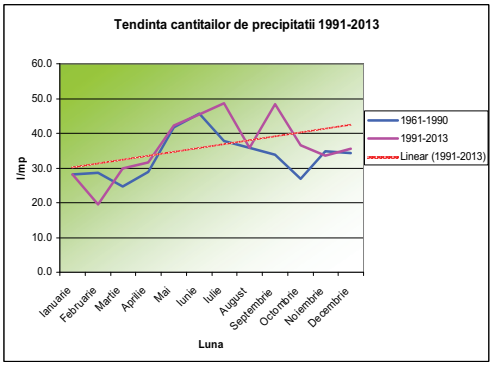

Figure 13. Tendency of fallen precipitation quantity for Dobrogea

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