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Spatial Patterns of Soil Moisture

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Abstract. The previous study of soil moisture is an important factor in hydrological context. Most of the models assume that the initial moisture is constant but most of the time this assumption is more theoretical one. In this paper the focus on the spatial pattern of soil moisture because when an area is recurrent survey for soil water content the sites can be fixed where the soil is consistently wetter or consistently dryer than the average across the studied area, depending of the experiment interest. The spatial pattern study was made over one transect during three consecutive years from April to October in each year.

Keywords: soil moisture, GIS, spatial variability, Gnuplot software

INTRODUCTION

The studied area is that of Chinteni Valley included in hydrographic basin of Somesul Mic river. Our team made the entire characterization of the interest area in previous paper (Matei *et al.*, 2010). In Romania there are numerous areas affected by landslides favoured by water. Due to the slope problems in order to fight against erosion on the landslide area is mandatory to eliminate the excess of moisture and find the sites for the experiment where the measurements are reliable. The existences of such sites are important to soil management and for the time stability of the studied area. The study of soil moisture is important for its role played in the study of runoff, the rates of infiltrations, evapotranspiration. The spatial pattern of soil moisture for an area recurrently surveyed for the soil water content can give information where the soil is consistently wetter or consistently dryer and gives hints to find the perfect place for the next measurements.

In the next section will present the statistical characterisation for the soil moisture order to establish the spatial patterns for soil moisture (Gomez-Plaza *et al.,* 2000).

MATERIALS AND METHODS

The transect we considered five sites and the complete characterisation of the area and the sites and the vegetation presence was made from our team in paper (Matei *et al.*, 2010). Site 1 has been located in area situated upstream of the detach line of landslide and the soil layer have been removed on a depth of 30cm to 40cm. The area has been cultivated with *Lolium perenne* after the land improvement works was finished. The soil characterization for the first site is that of a sandy-clay structure until 80cm depth and a fine structure below.

Site 2 has been located in an area where had existed landslide soil piles formations and the absorbent vegetation had been kept. The area of site 2 was not affected by land improvement work and it was cultivated with the same mixture as site 4. The soil characterization for the second site is that of a sandy-clay structure, the clay ratio is lower than find in site 4.

Site 3 has been located in an area that before land improvement works had contained landslide soil piles formations. These forms had drained and covered with a soil layers with variable thickness; after that the area had cultivated with the same mixture as site 4. The soil characterization for the third site is the same with the fifth site, but this one has in composition more clay than site 5.

Site 4 has located in an area not affected by landslide, situated between tight valley due to erosion and one branch of main drain channel. The area has been cultivated with a misture of *Dactylis glomerata, Lolium perenne and Medicago varia* after the work was finished. The soil characterization for the second site is that of a sandy-clay structure.

Site 5 has been located in an area filling with soil from embankment works. After that soil was cultivated with a mixture of *Phleum pratense, Lotus corniculatus and Trifolium repens.* The soil characterization for the third site is that of a sandy-clay structure for the first tree layers and predominant clay for the last layer.

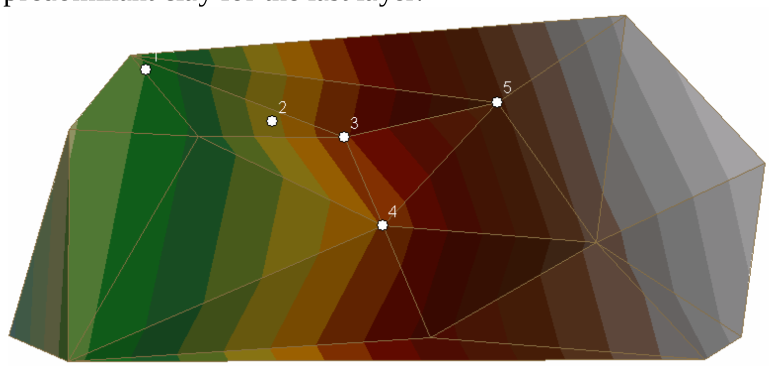

Fig. 1. The terrain model of the area and sites positions

The geographic information system was constructed in (Matei *et al.*, 2010). Figure 1 represents the terrain model of the studied area and shows the sites position and number.The data collected from the observation points were processed and the results are presented in the next section. The soil moister values are for 2007, 2008 and 2009 from April to October for each month at depths 0-10cm, 10cm-20cm, 20cm-40cm, 40cm-60cm, 60cm-80cm and 80cm-100cm. Using the gravimetric method we determined the average moisture for each site on each month for the three years.

RESULTS AND DISCUSSION

Based on the result from geographic information system using the Gnuplot software

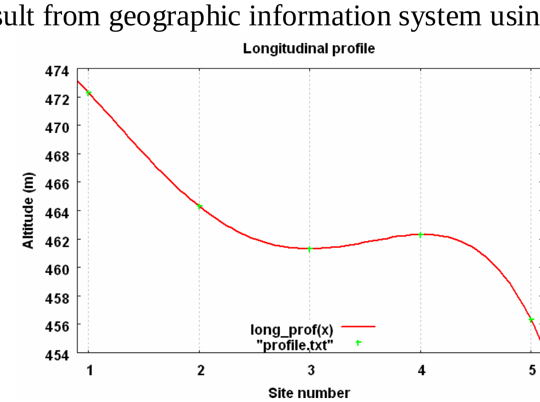

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Fig. 2. Longitudinal profile of the transect

we construct the longitudinal profile of the transect and the result is shown in Figure 2. Figure 3 (a), (b), (c) represent the evolution of average moisture for April, July and October for each year.

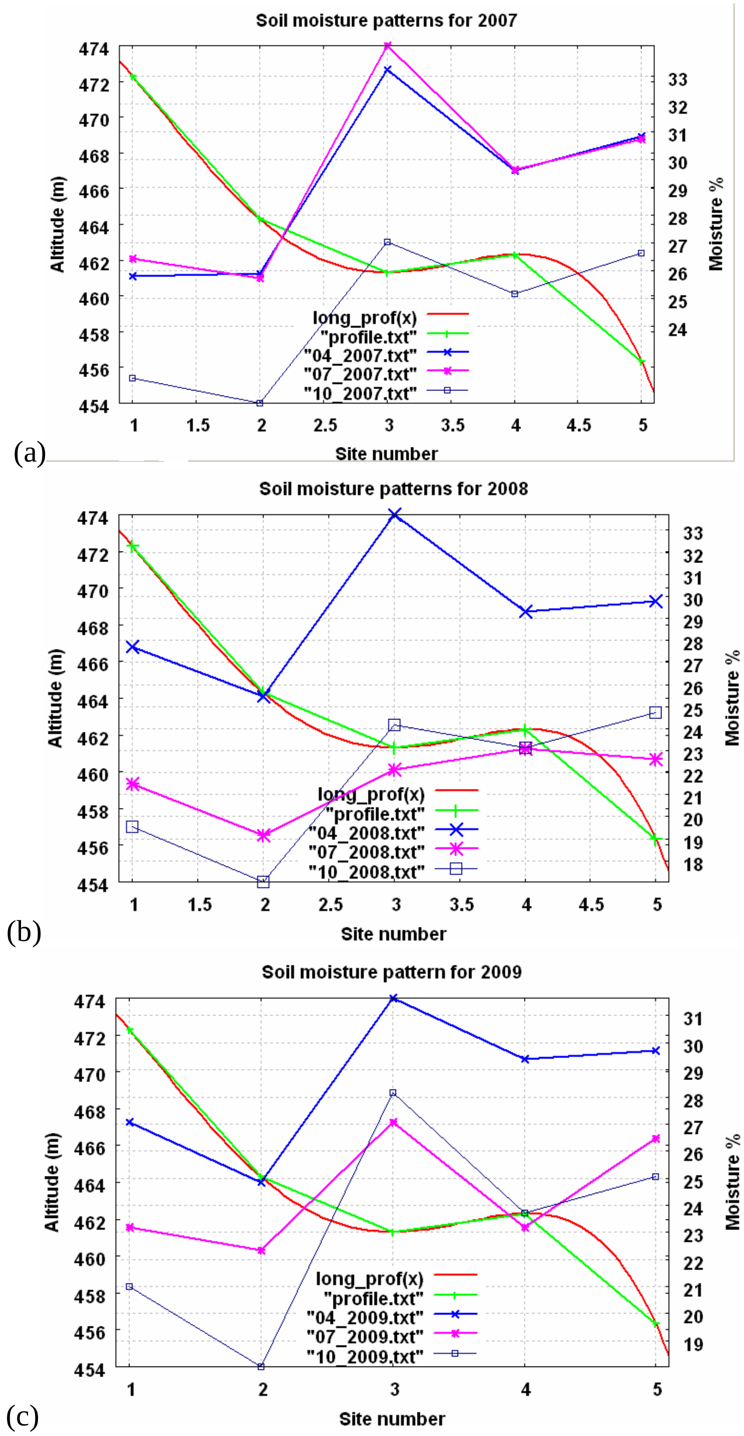


Fig. 3. Different measurement date and the longitudinal profile

When the soil is wet, the water redistribution near sites seems affected by topography slope. In each year the moisture for two month are closed by and the third is far from them due to the precipitation regime for each year. For the wettest month, the standard deviation has the maximum values and the direst month produce the lowest standard deviation.

The spatial patterns of soil water content at transect scale are given in Table 1. The different behavior for the almost similar condition in soil and vegetation can be explained by the watersheds and steepest point for soil profile determined by GIS analysis (Matei *et al.*, 2010).

Tab. 1

Analyse of variance for soil water content at consecutive measurements dates

	2007			2008			2009		
Period(+)	Evolution		Sig.(++)	Evolution		Sig.(++)	Evolution		Sig.(++)
04-05	0.87	Recharge	-	0.39	Recharge	-	-0.64	Drying	-
05-06	-2.80	Drying	*	-7.41	Drying	***	-5.40	Drying	**
06-07	2.20	Recharge	*	-0.48	Drying	-	1.94	Recharge	-
07-08	-2.79	Drying	*	1.60	Recharge	-	-0.06	Drying	-
08-09	-3.92	Drying	*	-2.17	Drying	*	0.41	Recharge	-
09-10	1.82	Recharge	-	0.59	Recharge	-	-1.59	Drying	-
04-06	-1.93	Drying	-	-7.02	Drying	***	-6.04	Drying	**
04-07	0.26	Recharge	-	-7.50	Drying	***	-4.09	Drying	*
04-08	-2.52	Drying	*	-5.90	Drying	**	-4.15	Drying	*
04-09t	-6.45	Drying	**	-8.07	Drying	***	-3.74	Drying	*
04-10	-4.63	Drying	*	-7.48	Drying	***	-5.34	Drying	**

(+) represents the months of the year

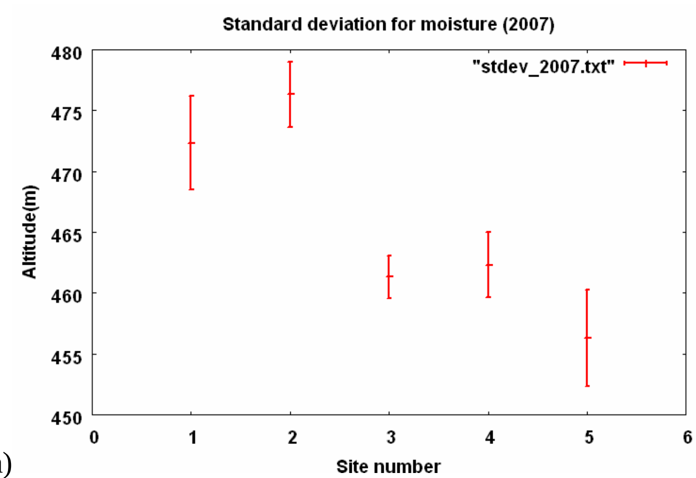
(++) represents the statistical significance

The difference between spring month and the other shows the role of vegetation correlated with variability of the precipitation amount.

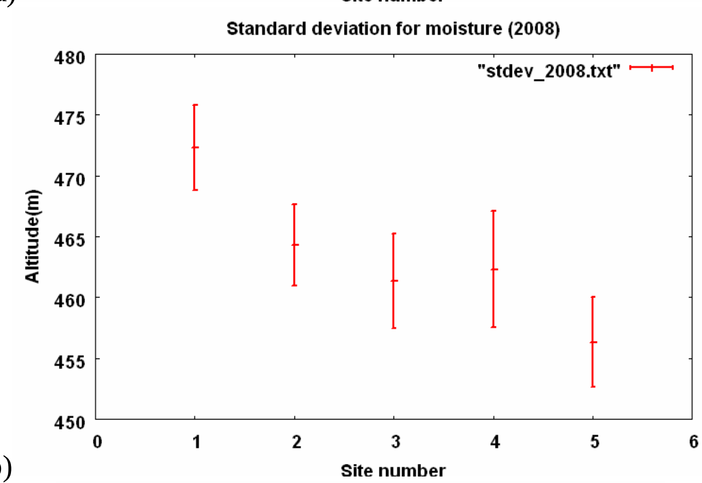
Spatial patterns of soil water content at point scale are shown in Figure 4 (a), (b), (c) show the difference for average moisture for each location. Each point is marked with its position according to transect and error bars indicate standard deviation. The temporal stability of the pattern tend to maintain through time so each point preserved its relative difference respect to average soil moisture – the driest points always remain the same and the wettest points too.

CONCLUSIONS

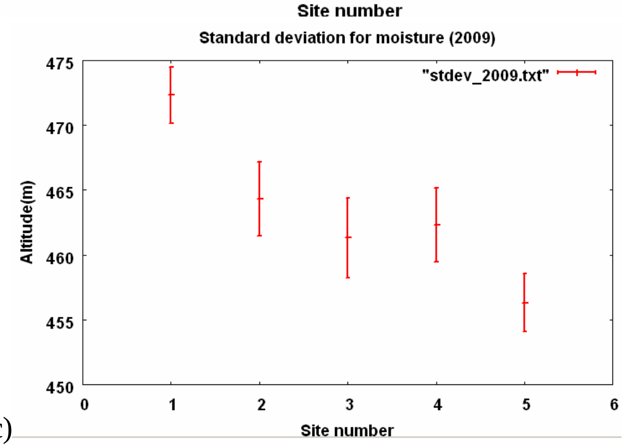
The evolution of soil water content, the spatial patterns of soil water content at transect scale and spatial patterns of soil water content at point scale show that the average moisture is affected by the local topography and soil type. The highest moisture was determined for profile 3 for all years and this result is in agreement with the characteristics of the soil (Matei, 2010), the watershed that is the second as capacity and the steepest path that is very short. The small values for the moisture are reached in all years for site 2 because its watershed has a steep slope and the steepest path for site 2 is ended in the watershed of site 3. The moisture for the other three sites is ascending ordered: site 1, site 4 and site 5 because the watershed for site5 is the largest and in the deepest layer of the soil profile there is more clay than in other tow sites.



(a)



(b)



(c)

Fig. 4. Standard deviation for mean of the average moisture content

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