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DEVELOPING A SIMULATION MODEL FOR ENVIRONMENT CONDITIONS MONITORING AND AGRICULTURAL PRODUCTION MANAGEMENT BY USING GIS OF SAMOKOV SOIL RESOURCES

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Introduction

•The possibility for maximum yield realization is connected with crops structure, soil cultivations and agricultural land use improving as well as by renders an account of climatic conditions and effective soil water content variations.

•The simulation procedure for soil hydro-physical properties determination was realized by using soil particle size distribution data only. This is a good start position for develop a calculation algorithm for soil water content dynamic monitoring. Kolev, 1994 realized this for the first time for Bulgarian soils, with developed in his Ph.D. thesis universal model.

The meteorological conditions could be modeling by using a simulation model, which was also suggested by Kolev, 1994 in his Ph.D. thesis.

•The following research considers the described physical and hydrophysical properties for two different soil types - Alluvial and Alluvial-Meadow soils and Deluvial and deluvial-meadow, sandy and loamy, mainly stony for the region of the Samokov valley.

The main aims of the study are:

•To demonstrate a simulation procedure for soil hydro-physical properties determination by using the created soil particle size distribution database only.

•To demonstrate how useful is the developed model for monitoring environment conditions and agricultural production management.

Materials and methods

•The Samokov area is situated around 60 km from Sofia. It is surrounded by the three mountains - Rila, Plana and Sredna Gora Mountains and has an elevation from 630 to 1400 m. The soils are cinnamonic forest and brown forest soils and are not fertile. At the foot of the mountain Deluvial and Deluvial-Meadow soils are presented. In the valley of the Iskar river and its feeders can be described some regions with the more generous Alluvial and Alluvial-Meadow soils. This paper is concentrated on two of the typical for the region soil types - Alluvial and Alluvial-Meadow and Deluvial and Deluvial-Meadow soils.

•The climate is moderate continental. The mean annual air temperature is between 7-8 ºC, and it going down to about 6 ºC for the places with evaluation above 1000 m. The sum of air temperature is about 2300 ºC with very high fluctuation. The temperature conditions are suitable for potato, flax, meadow and pastures.

•The method offered by Kolev converts the Russian classification of the soils by their particle size distribution, which was used in Bulgaria, into their USDA classification. Here is used the integral curved line of the particle size distribution and the approximation is calculated after the regression model.This is shown in Kolev et al, 2006 where also is calculated the hydrophysical properties of the soils. The same approach is also used for the determination of the hydraulic conductivity (*k*).

•Experimentally values for soil water content at field capacity (*SMfc* 33 kPa) were obtained by the method of flooded plots (Kachinsky, 1965), soil water content at wilting point (*SMw* 1.50 MPa) after Dolgov, 1948, maximal hygroscopic water content (SMmhwc 1.70 MPa) after Kachinsky, 1965, soil bulk density (BD - ρ_b g/cm^3) was assessed after Kachinsky, 1965 and soil particle density (SD - ρ_s g/cm^3) was determined trough pycnometrical measurements (Klute, 1986). Total porosity (SM0 0 Pa) was calculated by:

$$SMO = 1 - \rho_b / \rho_s \quad (1)$$

•The effective soil water content *Tpwc* (m^3/ha^3), which have an important meaning for the regulation of the water amount in the soils, is determined by:

$$T_{pwc} = 100 * h * \alpha * (\mathrm{SM}_{\mathrm{fc}} - SM_w) \quad (2)$$

•where:
•α is the soil bulk density (g/cm^3)
•*h* is the soil depth (m)
•*SMfc* - water content at field capacity (%)
•*SMw* - water content at permanent wilting point (%)

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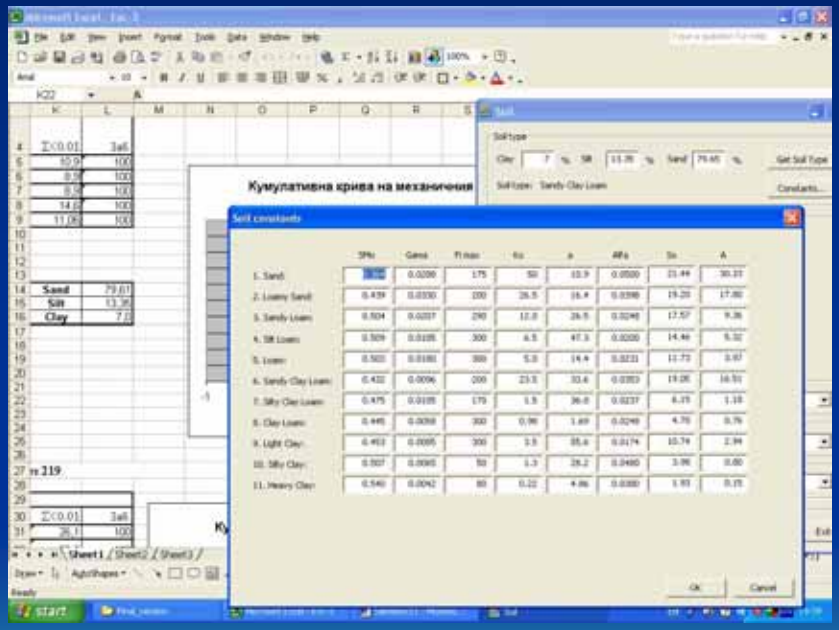

Fig. 1. The calculated soil constants for Alluvial soils.

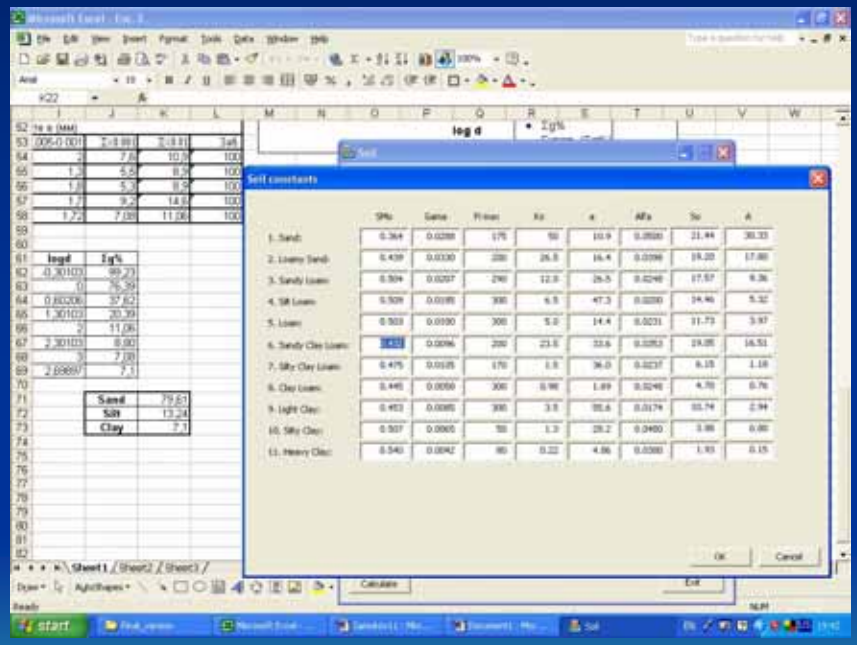

Fig. 2. The calculated soil constants for Deluvial soils.

The General view of the object is shown on Fig. 3.

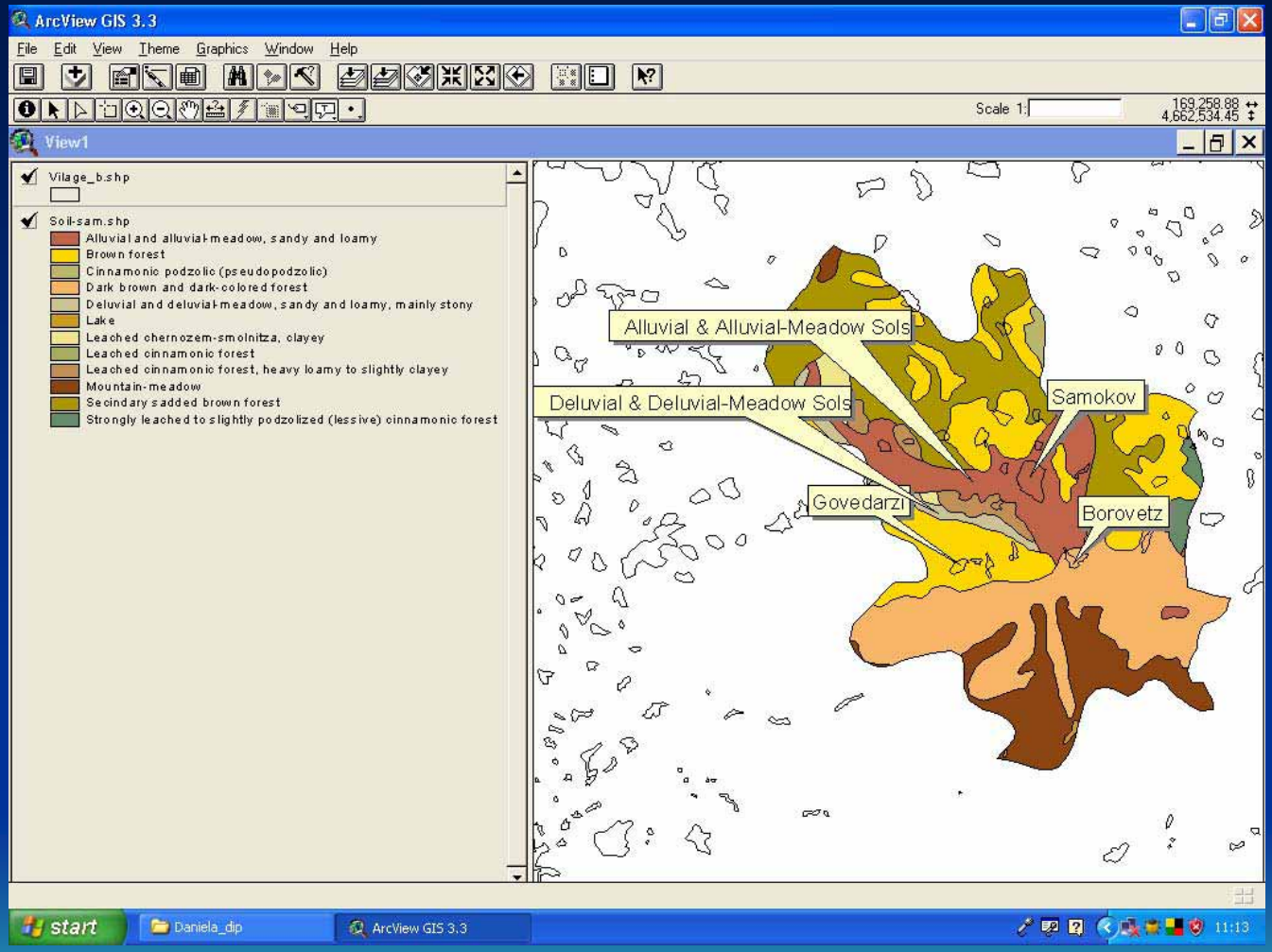

Fig. 3. General view of the object.

•Results and discussion

•Fig. 4 show the water and hydro-physical properties, which here are already included in the attribute table of soils in GIS.

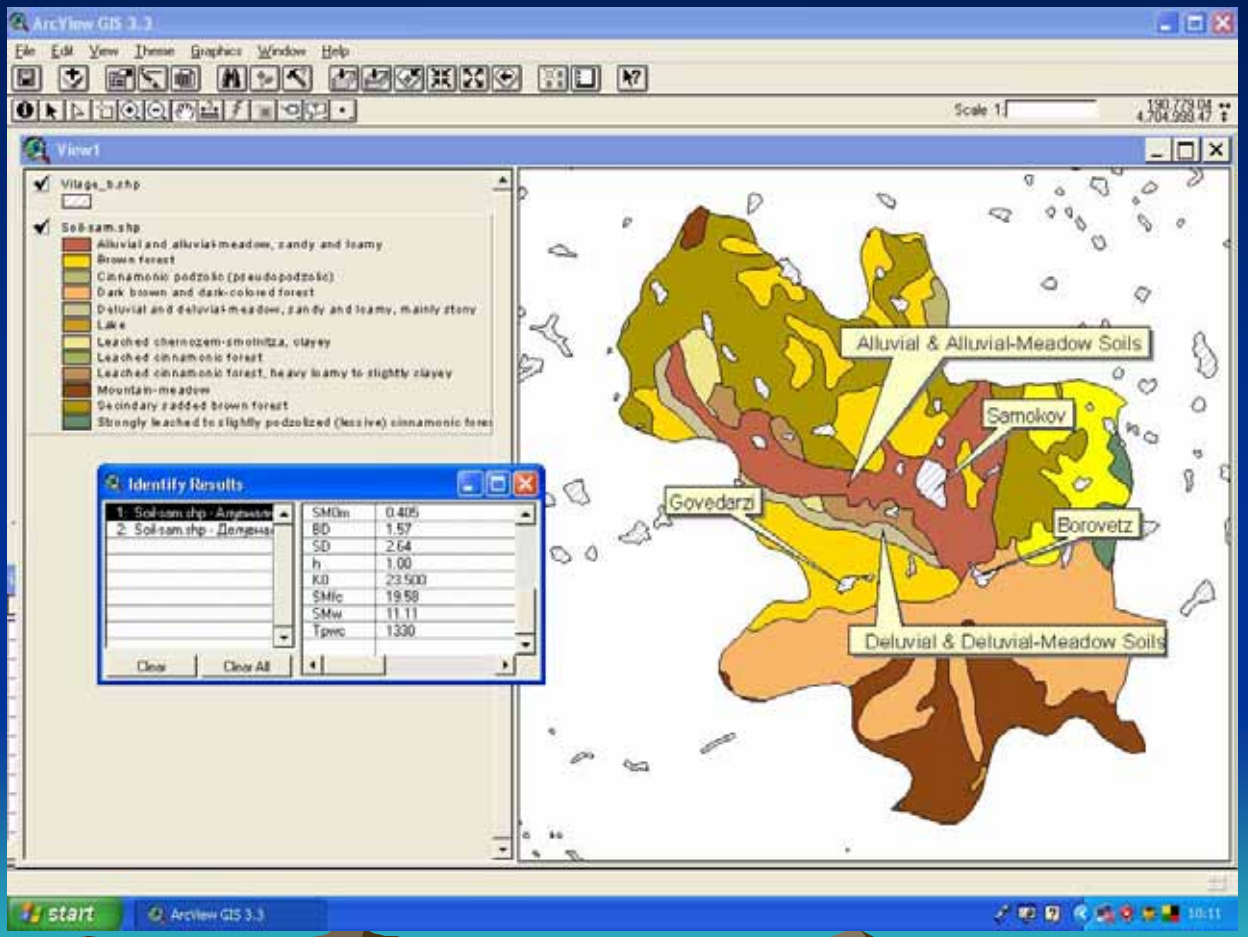

Fig. 4. Adding of SMO, SMfc, SMwp, KO, BD, SD and Tpwc into the attrubute table for the two soils.

•Total porosity SM0 (cm^3/cm^3) and effective water resources Tpwc (m^3/ha^3) by (1) and (2) are calculated with GIS software ArcView 3.3 (function Calculate). The final results are presented on Fig. 5 and Fig. 6 for Alluvial and Alluvial-Meadow soils and Deluvial and Deluvial-Meadow soils, respectively.

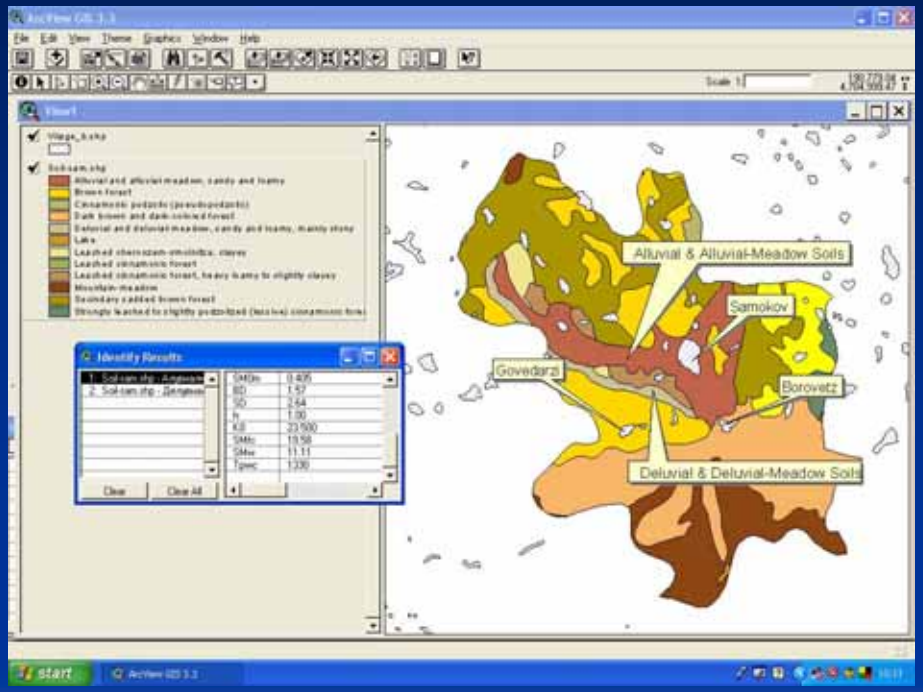

Fig. 5. The final results for Alluvial and Alluvial-Meadow soils.

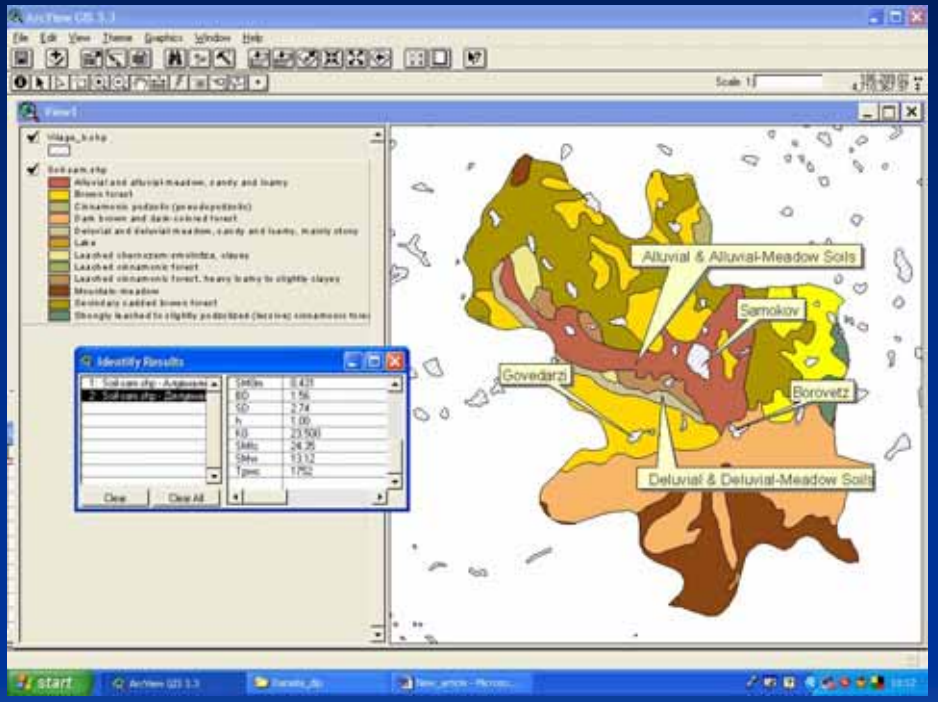

Fig. 6. The final results for Deluvial and Deluvial-Meadow soils.

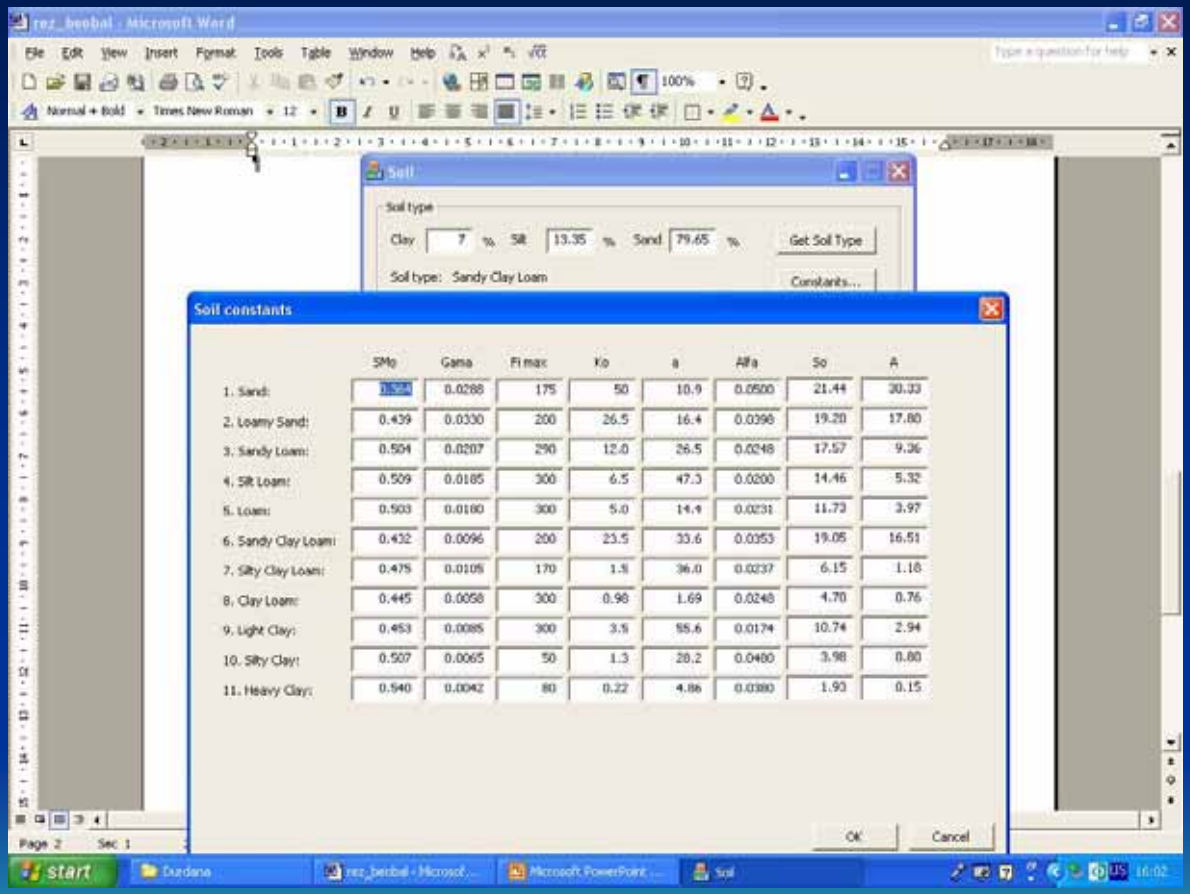

Fig. 7. The results for Alluvial and Alluvial-Meadow soils after simulation model using.

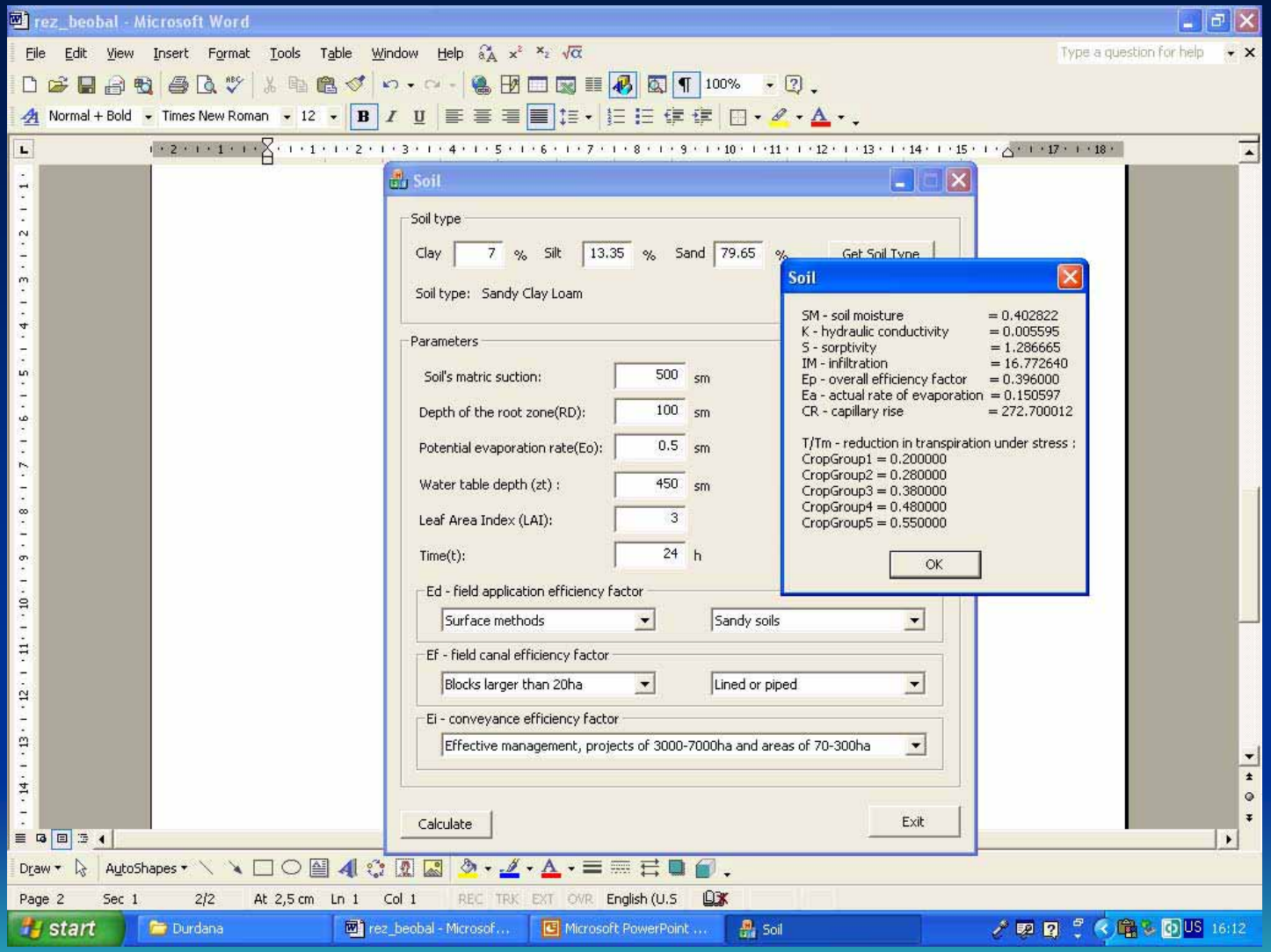

Fig. 8. The results for Alluvial and Alluvial-Meadow soils after first simulation.

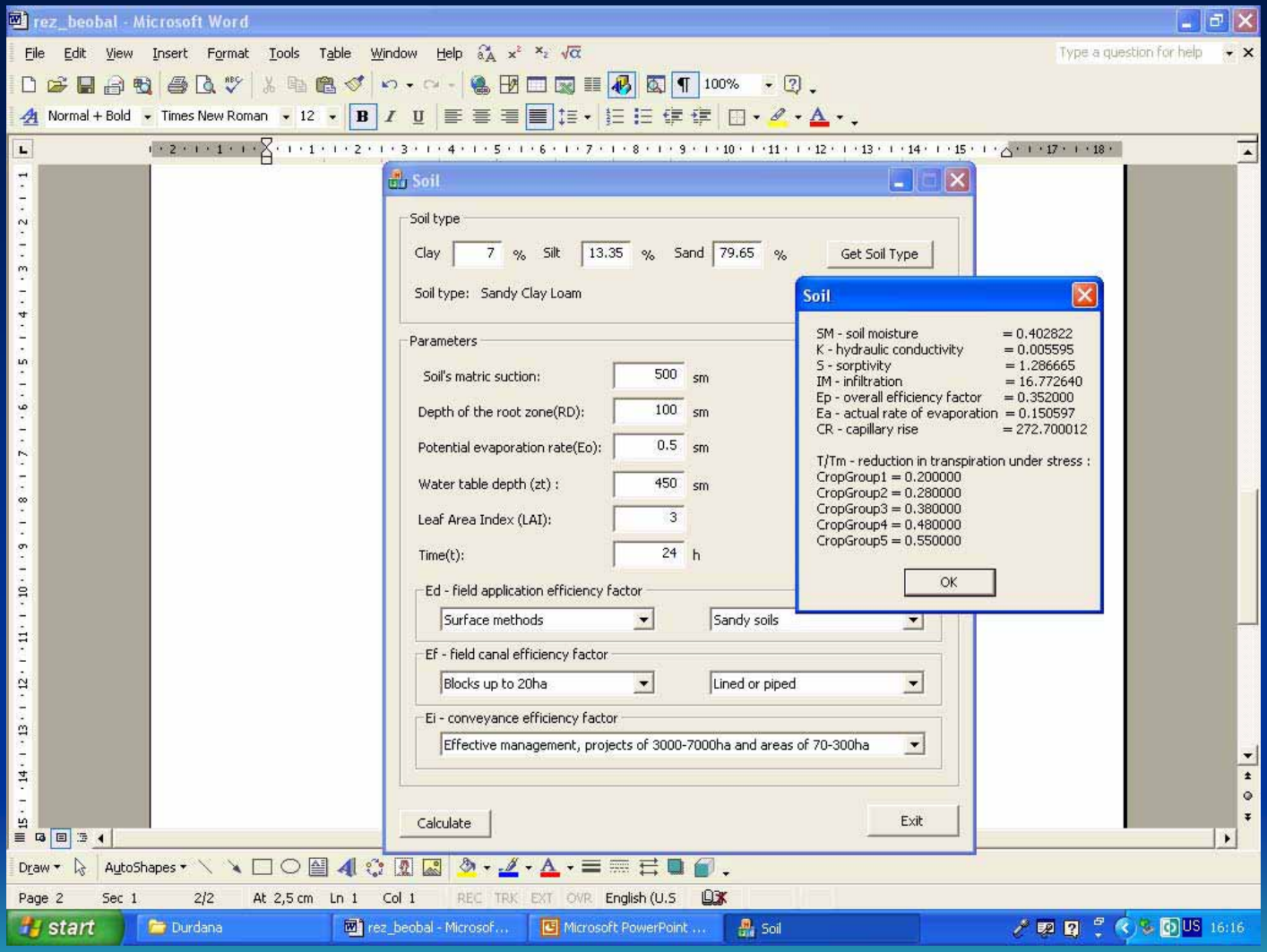

Fig. 9. The results for Alluvial and Alluvial-Meadow soils after second simulation.

•Conclusions

•The approach suggested by Kolev, 1994 for calculating SMfc, SMwp, K0 and calculating Tpwc and the values of total porosity (*SM0*) by using GIS software, gives more quality and quantity information of the studied soil.

•To demonstrate how useful is the developed model for monitoring environment conditions and agricultural production management.

•It is obvious that GISoSR with that information will improve the information using.

•Of course such kind of study should continue with different Bulgarian soil types.

Acknowledgements

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Thank for your attention!