EGU2020-10944
https://doi.org/10.5194/egusphere-egu2020-10944
EGU General Assembly 2020

An example of spatial correlation between soil water content and irrigated alfalfa yield at sub-field scale

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Soil water storage (SWC) is a major spatio-temporal geophysical variable that control many atmospheric and hydrological processes including evaporation from soil surface, transpiration from plant cover, soil water uptake and plant growth. In agricultural practice is widely accepted that SWC is closely linked to plant water stress. In this respect SWC is used as main parameter in irrigation technology of agricultural crops with both uniform and non-uniform water application techniques. For both mentioned types of irrigation a determination of timing water application as well as dozes are critical for developing effective agricultural water management practices and improving of water use efficiency at sub-field scale. In case of uniform water application the SWC is averaged at the field level. In case of non-uniform water (variable rate) application the SWC is averaged for management zones at sub-field scale bringing spatially heterogeneous irrigated into group of quasi-homogeneous areas. Tuning of regulated deficit irrigation by management zones provide great opportunities to control more rigorously plant water stress at quite large agricultural field with site-specific patterns of spatial characteristics depending of surface topography as well as soil & plant cover properties.

A field experiment was conducted in summer 2012 at the Research Center of the Volghsky Scientific Research Institute for Hydrotechnics and Land Reclamation (VolgNIIGiM) located near town Engels (Saratov Region, Russian Federation) at the left bank of the middle part of the Volga river. Main aim of this experiment was to examine the spatial correlation between SWC and alfalfa yield production (AY) at plot of 400m2 which included one half of the field irrigated with pivot machine providing uniform water application. The results of the analysis of variation of both parameters was suspected to be essential to test the spatial correlation between them.

During the field experiment a SWC was monitored before and after 2nd alfalfa harvesting with electromagnetic sensor EM 38 (Geonics Ltd.). Spatial analyses of sets of SWC geodata showed a presence of quite stable patterns within irrigated and non-irrigated parts of experimental plot. Location of SWC patterns was controlled firstly by spatial variation of soil surface elevation forming some shallow ponds and secondly by narrow furrows of circular form formed by wheels of the irrigation machine connecting in some case not adjacent areas. To map alfalfa yield plant samples were harvested from about 10 to 10 m plots. Alfalfa yield data was resulted as organic carbon mass per m^2 after drying in laboratory conditions. Spatial analysis of AY geodata set showed the presence of patterns like SWC patterns. The spatial correlation between SWC and AY

indicated the quite strong relationship between both parameters.

Acknowledgments: The reported study was funded by RFBR, project number 19-29-05261 мк