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Spatial regression between soil surface elevation, water storage in root zone and biomass productivity of alfalfa within an irrigated field

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Efficiency of water use for the irrigation purposes is connected to the variety of circumstances, factors and processes appearing along the transportation path of water from its sources to the root zone of the plant. Water efficiency of agricultural irrigation is connected with variety of circumstances, the impacts and the processes occurring during the transportation of water from water sources to plant root zone.
Agrohydrological processes occur directly at the irrigated field, these processes linked to the infiltration of the applied water subsequent redistribution of the infiltrated water within the root zone. One of them are agrohydrological processes occurring directly on an irrigated field, connected with infiltration of water applied for irrigation to the soil, and the subsequent redistribution of infiltrated water in the root zone. These processes have the strongly pronounced spatial character depending on the one hand from a spatial variation of some hydrological characteristics of soils, and from other hand with distribution of volume of irrigation water on a surface of the area of an irrigated field closely linked with irrigation technology used.
The combination of water application parameters with agrohydrological characteristics of soils and agricultural vegetation in each point at the surface of an irrigated field leads to formation of a vector field of intensity of irrigation water.
In an ideal situation, such velocity field on a soil surface should represent uniform set of vertically directed collinear vectors. Thus values of these vectors should be equal to infiltration intensities of water inflows on a soil surface. In soil profile the field of formed intensities of a water flow should lead to formation in it of a water storage accessible to root system of irrigated crops. In practice this ideal scheme undergoes a lot of changes. These changes have the different nature, the reasons of occurrence and degree of influence on the processes connected with formation of water flow and water storage.
The major changes are formed as a result of imposing of the intensity fields on a soil surface and its field capillary infiltration rate. Excess of the first intensity over the second in each point of soil surface leads to formation of a layer of intensity of water not infiltrated in soil. Thus generate the new field of vectors of intensity which can consist of vertically directed vector of speed of evaporation, a quasi horizontal vector of intensity of a surface water flow and quasi vertical vector of intensity of a preferential flow directed downwards. Principal cause of excess of irrigation water application intensity over capillary infiltration rate can be on the one hand spatial non-uniformity of irrigation water application, and with other spatial variability of capillary infiltration rate, connected with spatial variability of water storage in the top layers of soil.
As a result the spatial redistribution of irrigation water over irrigated filed forms distortions of ideal model of irrigation water storage in root zone of soil profile. The major differences consist in increasing of water storage in the depressions of a relief of an irrigated field and accordingly in their reduction on elevated zones of a relief, as well as losses of irrigation water outside of boundaries of a root zone of an irrigated field, in vertical, and horizontal directions.
One of key parameters characterizing interaction between irrigation technology and soil state an irrigated field are intensity of water application, intensity and volume of a capillary infiltration, the water storage in root zone at the moment of infiltration starting and a topography of an irrigated field. Fnalyzing of spatial links between these characteristics a special research had been carried out on irrigated by sprinkler machine called Fregate at alfalfa field during the summer of 2012. This research carried out at experimental farm of the research institute VolgNIIGiM situated at a left bank of Volga River of Saratov Region of Russia (N51.384650°, E46.055890°). The digital elevation model of soil surface has been created, as well as monitoring of spatial water storage with EM 38 device and of a biomass were carried out. Layers of corresponding spatial data have been created and analyzed. The carried out analysis of spatial regresses has shown presence of links between productivity of a biomass of a alfalfa, water storage and topography. The obtained results shows the significance to include spatial characteristics of the topography and water storage to the irrigation models, as well as adaptation of sprinkler technology to allow

differentiate the volume and rate of the applied water within the field. Special attention should be done to quantify relationships between uniform technology of water application by sprinkler and spatial nonuniformity of moisture storage (zoning of high soil moisture in depressions) in soil and as consequence of infiltration capacity.