



Spatial-temporal recharge simulation under observed climate variability

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The main objective of the present work is to evaluate groundwater recharge and its temporal dynamics on sites with different landscapes and soil profiles under observed climate variability during 60 years of simulation (from 1955 to 2015).

Study sites are located to south from Voronezh city on the left bank of Don River. The climate of study area is characterized by hot and dry summer and moderately cold winter with steady snow cover and well expressed transitional seasons. Area represents slightly hilly plain with gentle landforms. The shallow subsurface deposits are alluvial, fluvio-glacial and moraine formations. The prevailing type of topsoil is ordinary chernozem with the thickness up to 2 meters. In addition, sandy soils can be met on river terraces and fluvio-glacial formations.

Three typical sites with different landscapes and soil profiles are selected for research. Sites are located within 50 km distance from each other. First site is located in forest, top soil is represented by sandy chernozem on sand. Second and third sites are located in the field, with sandy soil on loamy sand and chernozem on silt loam respectively.

Hydraulic parameters of soils for unsaturated flow simulation are obtained during field and laboratory work. Main hydrophysical characteristic and hydraulic conductivity at certain moisture content are obtained by centrifuge method. Van Genuchten parameters and hydraulic conductivity at full saturation are chosen by RETC code using obtained water retention functions of tested examples.

Ground water recharge is evaluated by point-scale simulation of surface and subsurface water balance. Surface water balance is calculated using SufBal code based on daily observed values of precipitation, air temperature, wind speed and humidity. Resulting values of potential evapotranspiration and water inflow to soil are used as atmospheric boundary condition for simulation of unsaturated flow with root water uptake using HYDRUS-1D code.

Simulation results for 60 years of modeling show that there is a considerable variation of groundwater recharge values (38 – 97 mm/year) for three studied profiles, also a significant temporal variation of ground water recharge is obtained for each site. Maximum groundwater recharge value (97 mm/year) is obtained for site in forest area on sandy soil, mean value (77 mm/year) – for site in field area on sandy and loamy soil, minimum value (38 mm/year) – for site in filed area on silt loam soil. Minimum groundwater recharge value is explained by better water-retaining properties of chernozem and silty soils and maximum value – by poorer water-retaining properties of sandy soils and sand.

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