Evaluation of Bayesian networks model in monthly groundwater level prediction (Case study: Birjand aquifer)

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Abstract

The planning of water resources is based on the volume of water extracted from the aquifer and accurate estimate of this volume considerably helps to development. In this study, the Bayesian networks model using continues and clustering structures was used to simulate the groundwater level of Birjand aquifer. Bayesian networks was calibrated with five input variables of aquifer recharge, water table, temperature, evaporation as well as groundwater withdrawals in the previous month and the groundwater level in the current month as output variable. In continues and clustering scenarios, analysis and calibration of input data is performed based on continuity and uncertainty of variables and some validation indexes respectively and then groundwater level was simulated. The final results showed that the Bayesian network is a powerful tool for simulation of groundwater level under uncertainty and average correlation coefficient in 13 piezometers is 0.83 and 0.56 for continues and clustering structures, respectively. Also it shows that continues structure can be applied to predict the groundwater level with higher correlation.

Keywords: aquifer, clustering, simulation, uncertainty, validation.

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Modeling basil root water uptake under simultaneous water, salinity, and nitrogen deficit stresses conditions

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Abstract

Soil unsaturated zone is one of the important parts of hydrological cycle that has an especial role in agricultural water resources management. The objective of this research was to determine the amount of root water uptake under simultaneous water, salinity, and nitrogen stresses as prevailing conditions in arid and semi-arid regions. To do so, the experiment was conducted with four quantitative levels of irrigation water including 120, 100, 80, and 60 percent of crop water requirement, four qualitative levels of irrigation water including 1.2, 3, 5, and 8 dSm^{-1} and four nitrogen fertilizer levels including 100, 75, 50, and zero percent of fertility requirement. The results indicated that based on calculated statistics, the basil response was suitable simulated by MB-MB-EXP model under simultaneous triple water, salinity, and nitrogen stresses (nRMSE=7.22 and ME=19.05). The sensitivity analysis of the models indicated that MB-MB-VG model with the lowest input parameters and relatively low sensitivity to these parameters (S_c<1.5) has a better accuracy than other studied models (nRMSE=7.45 and ME=19.75).

Keywords: agricultural water management, basil, MB-MB-EXP model, MB-MB-VG model, sensitivity analysis.

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One-dimensional pollutant transport model in natural rivers, with emphasis on the role of storage zones

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Abstract

Rivers are one of the major resources of drinking and agriculture water, so accurate control and modeling of their water quality is essential for protection of human health and environment stability. Transient storage zones have a great effect on contaminant transport, especially in small mountain streams. The main effects include temporary detainment of solute and decrease its concentration in downstream and indirect effect on sorption process of solutes at streambed. In this study a new and comprehensive model that merges numerical schemes with higher order accuracy (QUICK scheme), for modeling pollutant transport with transient storage zones and kinetic sorption in rivers with irregular cross sections at unsteady flow regime, is presented. The model results for a hypothetical example and two sets of real data and comparison of them with results of two common models, show that model have reasonable accuracy and high numerical stability. So presented model could be suggested as an appropriate alternative model for common present models, at many of contaminant transport studies in natural rivers and streams.

Keywords: kinetic sorption, QUICK scheme, transient storage, unsteady flow, water quality modeling.

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Evaluation of furrow irrigation for different inflow hydrographs

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Abstract

Furrow irrigation is the most common type of surface irrigation. Determine the advance and recession time in the field is required the accurate measurement and this can be costly and time consuming. WinSRFR model is used for simulation furrow irrigation by zero inertia and kinematic wave engines. Using this model, advance time, reaction time, infiltration depth, runoff depth and application efficiency are calculated and compared with field data. Also, different inflow hydrograph shapes such as steady, incremental, cut back and hydrograph has been investigated in the research field in Shahid Bahonar University of Kerman. Based on the results, the kinematic wave model, Because of assuming the uniform flow through the furrow's length, has lower precision than zero inertia engine. The results showed that when an inflow hydrograph shape has smooth changes, the precision is increased. The model has the highest accuracy in calculation of advance time (1.2%) in steady inflow hydrograph and lowest accuracy in calculation of advance time (11.2%) in incremental inflow hydrograph. The highest application efficiency and the lowest runoff are accrued in cutback inflow hydrograph with 72 and 28%, respectively.

Keywords: advance time, application efficiency, infiltration depth, recession time, runoff, WinSRFR model.

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Effect of application of super absorbent on the growth and yield of cucumber under deficit irrigation

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Abstract

This study was performed in order to evaluate the effects of application of super absorbent on the yield and water use efficiency of cucumber under deficit irrigation conditions in greenhouse. Plants cultivated in plastic pots and irrigation emitter with four liters per hour discharge was performed. Three levels of irrigation water height (10, 8.3 and 6.2 mm day^{-1}) were used as the main factor in main plots in which. Four levels of super absorbent (0, 0.2, 0.4 and 0.6 percent weight percentage soil of super absorbent mixed in the soil) were distributed as sub plot. The experiment was a split plot based on RCBD with four replications. plant height, stem diameter, chlorophyll content, fruits length, diameter and weight, root length, root weight, fruit yield and water use efficiency were measured. Analysis of variance of the data showed that the simple effect of deficit irrigation is significant on all plant features except stem diameter. The simple effect of deficit irrigation, super absorbent and the interaction at the two factors were also significant on all parameters except the stem diameter. Highest fruit yield was obtained when plants were irrigated at full irrigation intervals and 0.4 percent superabsorbent mixed with the soil.

Keywords: arid and semi-arid regions, drought stress, greenhouse cultivation, superab A200, water shortage, water use efficiency.

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The effects of supplementary irrigation on yield and water use efficiency of three lentil (*Lens Culinaris L.*) cultivars

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Abstract

In this study, the effect of four levels of supplemental irrigation on water use efficiency and yield of three lentil cultivars (Kimia, ILL6037 and Qazvin) in two years 2013 and 2014 was conducted. Experiments were performed in water engineering group research station of Agriculture and Natural Resources Campus of Kermanshah Razi University using by available Pots as two factorial agented and was based on Completely randomized plot that done in three replicates. Different levels of supplemental irrigation were such as: irrigation at flowering, sheathing, seedling and without supplemental irrigation. The supplementary irrigation at flowering, sheathing, seedling stages were applied by observation 50% of the flowering, sheathing and seedling starting, respectively. Results showed that the highest crop seed yield was belong to seedling treatment for variety of Kimia that for the first and second year were determined as 122.3 and 104.1 g/m^2, respectively. In both years of investigation, the Kimia variety than other cultivars under supplementary irrigation at the stage of seedling had the most water use efficiency. Also, the highest amount of protein was for the Kimia cultivar in rain fed treatment (without supplementary irrigation), that for the first and second years was determined as 30.01 and 30.60 percent, respectively.

Keywords: Kimia, pot, protein, rainfed, seedling.

Assessment of long term wastewater irrigation impacts on spatial distribution of salinity and sodicity parameters

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Abstract

In this study, the effects of long term use of urban wastewater (over 40 years) on soil salt content and related parameters were evaluated in the lands south of Tehran. For this analysis, Kriging methods were tested. According to the suitable model indices, Ordinary Kriging (OK) was suitable for pH, Clay, Na^+, Mg^{2+} and sodium adsorption ratio (SAR) interpolation; Log-normal Kriging (log-normal K) was suitable for soil EC and Cl^-; DK was suitable for soil Ca^{2+}. In this study, Na^+, Cl^- and sodium adsorption ratio (SAR) variables with the highest nugget-to-sill ratio showed most affected by extrinsic variations (long term irrigation with wastewater). In spite of wastewater irrigation, results showed low amounts for EC of soils (less than half the critical limit) attributed to good leaching through high and permanent water bodies. However, Na^+ and sodium adsorption ratio (SAR) with amounts higher than critical limit showed need to management measures like gypsum application. Heavy soil of area is a reinforcing factor in sodicity trend related to clay percent higher than 25, so sodicity risk treats total area of study region.

Keywords: extrinsic factors, heavy soil, nugget to sill, ordinary and disjunctive Kriging.

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Waste load allocation in Sefidrud using water quality trading

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Abstract

Water quality trading (WQT) is a novel framework for surface water quality management. This research studies the optimal waste load allocation (WLA) in regard based on BOD parameter in downstream of Sefidrud River. For this purpose, the river is simulated by Qual2kw software and the total maximum daily loads (TMDLs) required are determined. The impact factors of pollutes are also specified using sensitivity analysis and normalized. The optimal WLA is defined through total abatement cost functions and impact factors in which the minimization of total cost is an objective. The analytical results show that WLA based on TMDLs may save 10% economically in comparison with the conventional command and control policy in which water quality index (WQI) may increase 20 units in regard. Moreover, WQT also develops cost savings to about 26% in which 418 credits may be traded. Here, the industrial and domestic sources that have high impact factors or low marginal costs are assigned as permit sellers. The primary permit price is also estimated within the recommended market. In addition, in long term, the efficiency of market is confirmed in which 466 credits may be traded and save 10 percent in overall.

Keywords: BOD, discharge permits, Sefidrud, waste load allocation (WLA), water quality trading (WQT).

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Investigation of climate variability impacts on multilayer aquifers (Case study: Gorgan plain)

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Abstract

In many arid and semi-arid regions, groundwater resources exploitation is inevitable to meet water demands. This paper aims to study the response of phreatic and confined aquifers in a multilayer groundwater system to climate variability. To achieve this aim, Gorgan plain multilayer aquifer has been investigated using different meteorological and hydrological drought indices (DI, PNI, SPI and GRI) and the correlation analysis method. 19 rain gauge stations, 19 observation wells and 19 piezometric wells data with the time period of 38, 38 and 14 years, respectively, has been used. The SPI showed better performance in monitoring of climate variability and detecting drought events, so it used to compare with GRI. Also, the results indicate difference between aquifers response to meteorological droughts. In this case, long-term 18-month and 48-month SPI indices are the most correlated parameters to the groundwater in both phreatic and confined aquifers and the effect of fluctuations in rainfall remained up to 15 months and 5 months in each zone, respectively. This reflects this fact that, if the principles of sustainable exploitation be followed, confined aquifer has a high reliability and only when prolonged drought or wet condition occurs, it could be affected.

Keywords: confined aquifer, correlation analysis, groundwater resource index, phreatic aquifer, standardized precipitation index.

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Effect of slope on soil wetting pattern under surface drip irrigation and simulation HYDRUS-2D model

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Abstract

In this study, effect of slope on soil wetting pattern under surface drip irrigation and simulation with HYDRUS-2D model evaluated. The physical model made of Plexiglas to size 83, 6 and 54 cm (length, width, height) filled with silty clay loam soil was used. To achieve the desired discharge, a small drip irrigation system created that includes a water tank with a fixed height (about 2 meters), a emitters regulated manually, and pipe transferring the water to emitters. Discharge was 4 L/hr and the slopes of selective were 0, 5, 15 and 25 percent. Irrigation time for each test was fixed and 2 hours. Readings of wet pattern was performed until 24 hours after irrigation and fixed wetting pattern. HYDRUS-2D model was Simulation selection model. To determine soil hydraulic parameters Rosetta model used. For The maximum wet depth and maximum wet width obtained RMSE value between 1.44-3.4% that shows the error is low. The results showed that HYDRUS-2D model have high ability to simulate the wetting pattern flat and slope lands.

Keywords: maximum wet depth, maximum wet width, moisture pattern, sloping land, Richards equation.

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