Comparison of the performance of statistical model and dynamic model to simulate extreme rainfall simulation

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Abstract

Water resources have experienced serious tensions in recent years due to climate change. The current study aims to investigate dynamical and statistical downscaling in order to downscale extreme precipitation in catchment of Gorganrood River over May13-14, 1992 which led to record the extreme discharge in this region. For this purpose, two models namely SDSM and Regcm4 were used. The results showed that SDSM has very low ability to simulate extreme precipitation so that the mean absolute error (MAE) was about 20 mm in the years 1983-2012 with very low coefficients of determination of 0.18 to 0.002, whereas Regcm4 model has recorded a very high coefficient of determination and mean absolute error of the model was about 67 mm. This model, however, could not well simulate Lazoreh station precipitation, because the model takes into account the overall dynamic patterns for simulation. Weather maps analysis indicates that low pressure patterns are dominant in the western half and parts of South and Central Iran in these two days. Direction of low pressure patterns is South and West from Adan sea and the Persian Gulf as well as the Black Sea and the Mediterranean Sea. Geopotential Maps show that low-height patterns are in 500 and 850 Geopotential height in this region.

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Comparison of conventional and intelligent methods in estimating Copula Function Parameters for multivariate frequency analysis of low flows (Case Study: Dez River Basin)

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Abstract

Over the recent years, the dependence structure among hydrological variables has been taken into consideration and it resulted in employment of the multivariate analysis as a suitable alternative for univariate methods. In this study, the copula functions were employed for multivariate frequency analysis of low flows of Dez River basin at Tange Panj-Bakhtiari (TPB) and Tange Panj-Sezar (TPS) hydrometric stations. First, 7-d series of low flow was extracted from measured daily flows at the studied stations over the period of 1956-2012. In the next stage, 11 different distribution functions were fitted into the low flow data whereby logistic distribution had the best fit on the TPB station and the GEV distribution had the best fit on the low flow data of TPS station. After specifying the best fitted marginal distributions, the copula parameter should be estimated. In this study, two methods of inference function for margins (IFM) and particle swarm optimization (PSO) were used to estimate copula parameter. The results showed that the PSO method outperformed IFM in estimating the copula parameter. Among the Ali - Mikhail – Haq, Clayton, Frank, Galambos and Gumbel-Hougaard copulas, the Frank copula function had the lowest error and the highest accuracy in constructing the joint distribution of paired 7-d low flows data and was used for calculating the joint return periods in two states of "OR" and "AND".

Keywords: Frequency analysis, Copula functions, marginal distributions, joint distribution, joint return period.

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Estimation of discharge in ungauged sub-basins using regional analysis of runoff (Case study: Hablehroud Basin)

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Abstract

Estimation of discharge using regional analysis is an effective method for water resources management in ungauged basins. In the present study, in order to estimate annual discharge in the ungauged sub-basins of Hablehroud Basin, linear regression and three independent variables including area, precipitation and slope were used. The basin under study was divided into five major and 44 minor sub-basins and using the data from five active hydrometric stations in the basin, regression equations for estimating annual discharge and specific discharge (the ratio of discharge to basin area) were extracted. The extracted equations were assessed in both major and minor sub-basins. The results showed that discharge estimation using the three variables of area, precipitation and slope in the five major sub-basins has an average error of 1.3%. However, the average error in the 44 minor sub-basins was totally unacceptable. The results also showed that the average error of specific discharge estimation in the five major sub-basins is 2.6%. Despite the increase of error in the major sub-basins, the average error of specific discharge estimation in the 44 minor sub-basins was reduced to 5.33%. The results of the present study indicate that when the basin under study is divided into small sub-basins, specific discharge can be considered as an appropriate variable in regional analysis of runoff.

Keywords: Regional analysis, multivariate regression, physiographic characteristics, ungauged basins.

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Modeling MODIS LAI time series using stochastic approach

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Abstract

Leaf area index is one of the most important variables characterizing energy flux, atmosphere-land surface exchange and vegetation structure. In this research, Leaf area index time series of wheat, alfalfa, apple and potato have been investigated using the modeling **based on** Box-Jenkins method**, and** the result of mathematical relationships between leaf area index and NDVI were compared. The trend of MODIS time series in the period of 2012 to 2015 with seasonal length **of** 46 using seasonal Man –Kendall test was negative. The simulation of time series using ARIMA $(p,0,q) \times (P,1,Q)_{46}$ indicated the **decease in** error and correlation and NASH coefficient**;** for example**,** the correlation coefficien**t**s of wheat, alfalfa, apple and potato w**ere** 0.9, 0.94,0.93 and 0.89**,** respectively. The criteria comparison demonstrated the better performance of SARIMA model especially for alfalfa and apple time series with high values of leaf area index. Stochastic modeling has minimum error relative to the mathematical relationships. According to the high performance of SARIMA model, **preparation** of leaf area index time series with high preci**sion is** more importan**t**.

Keywords: Modeling, leaf area index, seasonal Man –Kendall, SARIMA.

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Simulation of snowmelt runoff under climate change scenarios in Armand basin

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Abstract

Climate change is a major environmental problem because melting processes of the glaciers and snow packs are sensitive to climate change. The current study aims to predict future changes in climatic parameters, estimate changes in snow covered area and snowmelt runoff under scenarios of climate change in Armand basin. To investigate the effect of climate on precipitation and temperature in Armand basin, three models (NorESM1-M, IPSL-CM5A-LR and CSIRO-MK3.6.0) were used under the scenarios RCP8.5, RCP4.5, RCP2.6. Temperature and precipitation in the next four periods (2021-2030, 2031- 2040, 2041-2050 and 2051-2060) under all three scenarios were calculated. Also, the daily images MODIS (Mod10A1) were used to determine the snow covered area in the basin. The relationship between the snow covered area with the observed temperature and precipitation was studied and the results have been used to predict future snow cover. The results showed that all three scenarios of RCP predict increased temperature and reduced precipitation and snow cover. The study of snowmelt runoff in the observation period (November 2000-May 2006) showed that about 47.7 of the annual runoff in the basin is related to snowmelt. Most snowmelt runoff volume has occurred during the winter. The contribution of total water produced by melting snow during the fall and spring was 34.9 and 52.8 percent, respectively; along with snowmelt, it is expected that runoff will be reduced by about 0.12 cubic meters per second per year.

Keywords: Climate change, SRM model, downscaling models, snow melt, Armand Basin.

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The effect of contour furrow and pitting on increase of vegetation cover in rangelands (Case Study: Bolbol Region in Yazd Province)

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Abstract

One of the important operations that optimizes the use of soil and water in the arid and semi-arid lands is soil and water conservation structures especially precipitation storage structures. Implementation of precipitation conservation such as the development of pitting and contour furrow has been suggested in fields- where vegetation has decreased to the extent that it plays no more role in the prevention of surface runoff, but there are appropriate and palatable plant species individuals, or when soil compaction due to high traffic livestock has decreased water infiltration into the soil- for controlling runoff and floods from rainfall aiming for water saving and increasing vegetation cover. This study was carried out in Bolbol rangeland of Yazd province with average rain fall of 130 mm since 2004 in surface of two hectares. The amount of vegetation and density species was measured in four years (2012) after the creation of mechanical operations of pitting and furrowing. Measurements were carried out along 12 transects and 120 plots. The results showed that pitting, contour furrow and control treatment sites had significant difference from percentage vegetation and density ($p<0.01$). Percentage of vegetation in the mechanical operations of pitting, contour furrow was higher than control, 2.4 and 3.1 times, respectively and the density, 1.5 and 2.2 times, respectively. So, in the study area, pitting structural performance on vegetation was higher than contour furrow.

Keywords: Plant cover, plant species density, runoff, precipitation conservation, Bolbol Rangeland of Yazd province.

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Spatiotemporal assessment of the hydrologic river health index variations in Ardabil Province Watersheds

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Abstract
Assessment of river health can be used as a tool for environmental flow estimation and quantification of the amount, timing and required water flow quality for permanence of river ecosystems. The current study aims to determine the spatial and temporal changes of rivers health with an emphasis on hydrologic indicators by using statistical tests in Ardabil province. For this purpose, the daily discharge data of 24 hydrometric stations with the period of 1367-1390 was used for river health analysis. In addition, the non-parametric Mann-Kendall test and Sen's estimator method were performed to determine the presence or absence of positive and negative trends at different statistical levels. Also, after dividing the existed study span into four periods, the Kruskal–Wallis test was applied for the investigation of temporal variations and the existence of differences between short-term periods. Results showed a significant decreasing trend of river health in studied stations (13 stations from 24 stations). Sula and Firuzabad stations had significant increasing trend and in other remained stations, no significant trend was identified. According to the results obtained from the maps of spatial variability of river health, maximum and minimum change of river health indicators were observed in the central part, and northern and southern parts of the province, respectively. Generally, it can be said that, recently, the overall changes as well as reduction in hydrologic flow health have been more compared to the past which can be associated with increase of exploitation intensity from surface water resources as well as reduction in the water yield due to climate change.

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Study of the effects of hydro-geomorphology factors on the water quality changes of Siminehrood River at various stations during 2003-2013

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Abstract

In this study, the effects of hydro-geomorphology factors on the water quality changes of Siminehrood River and the process of these changes were studied at different spatial and temporal scales. Data related to physical, chemical and hydrological parameters during 2003-2013 were received from the regional water organization of West Azarbaijan province and its seasonal average was calculated for each station. The related maps were extracted using GIS software. Then, the process of changing water quality during different seasons was studied for each station and the relationship between variables and their significance level was achieved by Pearson correlation test and SPSS software. Finally, Schueller and Wilcox diagrams were traced during each station and each season using Chemistry software for assessing the type and chemical quality of river water for drinking water and agricultural purposes. The quality of Kavlan station water during spring with amounts TDS (174.9), EC (269.1) and the concentration of chloride and sulfate ions (0.7) as the most favorable and Miandoab station during summer with amounts TDS (359.3), EC (529.3) and the concentration of chloride and sulfate ions (3.7) were introduced as the most critical spatial and temporal periods, respectively. In all research stations, the decrease of river water quality in form of the increase of EC, TDS and the concentration of chloride and sulfate ions had a direct and meaningful correlation with the discharge variable. In Siminehrood basin, the physical characteristics of the basin and hydro-geomorphology factors play a role in the presence or lack of pollution sources and seasonal-spatial changes of water quality. According to Schueller classification, Siminehrood River water is in a good and quite tasteless category in terms of drinking water. Also, in Wilcox diagram, all the stations are related to the C2S1 class for each season and have a slightly salty quality suitable for agricultural purposes.

Keywords: Basin, Siminehrood River, water quality, Schueller diagram, Wilcox diagram.

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Surface water quality prediction using data mining method (Case study: Rivers of northern side of Sahand Mountain)

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Abstract

Monitoring and assessment of surface water quality are very expensive and time consuming processes, thus finding cheap, simple and relatively exact methods which determine water quality class based on minimum parameters would be very useful. Decision tree as one of the data mining techniques classifies data sets based on a tree structure. In this study, the decision tree method was used to classify water quality in some hydrometric stations located at northern side of Sahand Mountain, including Bostanabad, PoleSenikh, Lighvan and Vanyar. The water quality classes were defined based on if-then rules. For every considered river, the discharge and 12 hydrochemical parameters, including Ca^{2+}, Mg^{2+}, Cl^-, HCO_3^-, Na%, pH, SO_4^{2-}, total anions, total cations, total dissolved solids (TDS), sodium adsorption ratio (SAR) and Electrical conductivity (EC) were collected and used for developing decision tree model. The results showed that the decision tree model could evaluate water quality class with high accuracy based on only four parameters: EC, pH, SAR and Na^+. Moreover, the error of developed models in testing phase for Bostanabad, Vanyar, PoleSenikh and Lighvan stations were 3.4, 8.1, 22.9 and 1.6%, respectively.

Keywords: Surface water quality, data mining, decision tree, hydrochemical parameters, quality monitoring.

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Application of DWQI for comprehensive evaluation of drinking water quality

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Abstract

Water quality is considered as one of the most important factors in development of the civilizations and sustainability of human activities. Water quality can be evaluated by comparing each of the chemical properties in water samples with their reference values. The single parameter comparison method is characterized by some limitations and a comprehensive evaluation of water quality is not possible using this method. Thus, water quality indices have been developed during the last 3 decades. The aim of this study was to comprehensively evaluate the water quality in Ardabil aquifer with a newly proposed drinking water quality index ($DWQI_{Proposed}$). The $DWQI_{Proposed}$ was also compared with the conventional water quality indices including $DWQI_A$ and $DWQI_G$. Water samples were collected from 60 wells in Ardabil aquifer during the September 2014 and analyzed for 21 different physical, chemical, and biological properties. $DWQI_{Proposed}$ were computed in four steps including parameter selection, parameter categorization, development of sub-index with regression statistics, and aggregation of the sub indices. Based on the obtained results, although there was a quantitative difference between the $DWQI_{Proposed}$ and $DWQI_G$, their probability distribution functions reflect a similar pattern. DWQIProposed and $DWQI_A$ have similar values for samples with excellent water quality. ANOVA results indicated that the mean difference between three indices is significant ($P<0.05$) but there was a high correlation between these three indices ($r=0.98-0.99$, $P<0.001$). Among the health related properties, Nitrate has the highest correlation coefficient with water quality indices ($r=0.712-0.815$, $P<0.001$) which emphasizes the effect of nitrate on water quality at the region. Water quality indices are considered to have strong spatial dependence and their kriging maps clearly showed the declining trend in water quality when moved from north-eastern parts of the region to the south-western parts.

Keywords: Comprehensive water quality indices, water quality groups, Nitrate, kriging.

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Drawing geometric characteristics of subterranean structures and removing evaporation with tilt shift
(Case Study: Sansan village, Kashan)

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Abstract

According to some researches, Iran is facing its greatest and worst drought in over 30 years. Kashan plain basin is one of the critical areas that has water loss and progressive destruction of agriculture due to the lack of management on the use of groundwater resources. One of the most important inventions of Iranians that has long been an effective factor in management of water resources from the past, has been Qanat. This research aims to improve water resources management through studying Sansan's qanat around Kashan. So, due to the structural cognition of qanat, the depth of wells was determined according to the laws of free fall. The results show the inefficiency of the method, and the reasons are explained in detail. The depth and hydraulic slope were determined by rope and the length measurement tool. Therefore, qanat's schema was drawn in three particles: elementary, middle and end, which was the first of its kind. The results of tilt-shift on the rise in water flow and losses from evaporation were studied showing the possibility of increasing freshwater by five times**.**

Keywords: Sansan, qanat, hydraulic slope, evaporation.

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Flood susceptibility zonation using new ensemble Bayesian-AHP methods (Case study: Neka Watershed, Mazandaran Province)

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Abstract

Flood susceptibility mapping is the first step in flood management programs. Flood prediction can help reduce its following damages. The main objective of this study is identification of prone areas to flooding using new ensemble Bayesian-AHP methods in the Neka-Sari watershed, Iran. Flood inventory map was prepared based on statistical analyses. A total of 240 (70 %) and 102 (30 %) out of 342 observed events were used as training and validation data set, respectively. Based on literature review and extensive field studies, a total of 11 parameters in relation to flood occurrences were selected for flood mapping, including slope percent, elevation, distance to river, drainage density, NDVI, lithology, land use, topography wetness index (TWI), stream power index (SPI), rainfall, and curvature. The weights of each factor were determined by AHP method. Also, the relation between factor classes and flood events and the weight of each class were estimated using Bayesian theory. Finally, by integration of factors and their classes in ArcGIS, flood susceptibility map was obtained with five classes. In order to evaluate the obtained model, ROC curve was employed. Results showed that the ensemble model had a high accuracy (76.10 %) in flood susceptibility mapping. Also, slope percent, elevation, and land use had the highest effect on flood events with values of 0.260, 0.195, and 0.146, respectively. According to the results, 24.17 and 37.15 % of the study area are categorized in high and very high susceptibility classes, respectively. The presented combined model can be used for further studies on natural hazard mapping and disaster management.

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Assessment of GRACE satellite data for estimating the groundwater level changes in Qazvin province

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Abstract
Given that Qazvin Province is ranked as the seventh dry place in the country, it is necessary to manage vast water resources in this province. Water storage estimation methods have been developed over the years and observation of changes in the gravitational field by satellite GRACE is one of these methods. This satellite produces a series of water storage changes data with spatial resolution of 1 ° on a regional scale. This study aimed to evaluate data from GRACE satellites in Qazvin province to find a comprehensive solution for quick and easy access to water resources. To validate the GRACE satellite data, land surface model data (GLDAS) and wells data in the region were used. The results show that the GRACE satellites as a Gravity satellite just produced to estimate changes in Earth's water supply, give a good estimate of the changes in the ground water storage and groundwater level changes. Statistical analysis showed that RMSE =5.54, MAE = 4.16 and MBE = 1.5 the seasonal scale in millimetre between groundwater level data from the GRACE satellites and observation wells, and RMSE =2.92, MAE = 4.24 and MBE =0.184 month scale in centimetre between the data changes in land water storage from GRACE satellite and GLDAS model. Also, the correlation between changes in water storage data from the GRACE satellite and GLDAS model and groundwater level changes from GRACE satellite and observational data is significant at the 99% probability level. The results showed that GRACE satellite shows terrestrial water storage changes better than GLDAS model.

Keywords: Groundwater, rainfall, GRACE satellite, GLDAS model.

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Determination of submarine groundwater discharge probable areas into the Persian Gulf on coastlines of Bushehr Province using standard thermal anomaly map

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Abstract

Submarine Groundwater Discharge (SGD) is defined as any water subsurface flow from the land into the sea. Recognizing the area having this flow is very important for hydrologic and ecologic studies. For determination of Submarine Groundwater Discharge Probable Areas into the Persian Gulf on Coastlines of Bushehr Province, at first, required corrections (atmospheric, radiometric, and geometric) were made on the obtained thermal band 10 data of Landsat 8 during 2015 and 2016 across the study area using ENVI® 5.3 software. Then, by mapping sea surface temperature (SST) and standard temperature anomaly (STA) and thus determining the minimum shared area of thermal anomalies during 2015 and 2016 by GIS10.3.1 software, SGD probable areas into the Persian Gulf on Bushehr Province coastlines was recognized and mapped. The results show that there are SGD probable areas on Bandar Mogham to Kangan, Kangan to Mond River, Mond River to Shif Island, Bandargah to Ganaveh, and Bandar Rig to Hendijan coastlines with, respectively, 2823, 4165, 6159, 4725, and 4445 hectares. This area on coastlines of Bushehr Province is 22317 hectares discharging into the Persian Gulf that may suppose an impressive flow. Therefore, it is necessary to survey more details and use quantification methods for estimating the precise rate.

Keywords: Submarine groundwater discharge, standard thermal anomaly, Persian Gulf.

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Regionalization of the East part of Lake Urmia Basin based on impact of seasonal precipitation on rainfed yield using the ward and K-means methods

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Abstract

Management and optimal use of water in agriculture is essential for management and conservation of water resources. This study aimed to evaluate the effect of seasonal precipitation fluctuations on annual rainfed yield. Monthly precipitation data for 26 rainfall stations with Statistical period of 1992 to 2014 of the east part of Lake Urmia basin were used. Clustering was done with Ward and K-means methods. The homogeneity of cluster was checked through H-Statistics method and homogeneous clusters were shown in GIS environment. The effect of seasonal precipitation was compared with annual rainfed yield. Results showed that the effect of precipitation in the spring, autumn and winter on the amount of rainfed yield is positive and precipitation in these seasons has a remarkable effect on increasing yield. In the three seasons, precipitation caused an increase of soil moisture storage which is used in summer. But, there is an inverse relationship between precipitation and annual rainfed yield in the summer. In order to identify areas combined with increased precipitation and rainfed yield, iso-line of precipitation seasons with the rainfed yield of the study area was drawn. The results of this line showed that in the spring, autumn and winter at the Daryan, Lighvan, Khormazard, Sahlan, Harvy, Saidabad, ShirinKandy, Ghorigol, Tabriz and Moghanjigh, the increased amount of pricipitation is directly related to the amount of yield. These areas can introduce more eligible rainfed cultivation in East of Lake Urmia and recognition of the effects of precipitation on yield rainfed areas can be more practical and reliable.

Keywords: Clustering, East of Lake Urmia, seasonal precipitation, regionalization, yield rainfed.

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Prioritization of flood risk based on multi-criteria decision-making models (Gray systems theory-ELECTRE-TOPSIS)

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Abstract

In recent years, flood control projects have been more extended in the country. Given the cost of implementation, prioritizing the sub-basins is of great importance and making decisions about flood and integrated watershed management is quite necessary. The first and most important step in the runoff flood management projects is prioritizing essential areas to carry out flood control projects. Decision-making methods provide effective tools for dealing with issues involving more than one goal. In this study, Parchin watershed basin was studied. Then, using multi-criteria decision-making methods (ELECTRE, Grey and TOPSIS), the sub-basins were prioritized. The results of Grey method were investigated by gray relational analysis for the score of 9 sub-basins. The sub-basin 7 with the highest score (0.719443) was prioritized as the first, and sub-basin 1 with score of (0.466119) was determined to be the second priority and, sub-basin 4 with the lowest score value (.331493) was introduced as the last priority. In TOPSIS method, rating was done using calculated nearness to ideal solution options, sub-basin 7 with the highest nearness coefficient (0.843721) is ranked first. The results from rating showed that all three methods were evaluated equally in first priority; however, other priority methods gave different results. According to the above-mentioned results, the three TOPSIS methods and gray analysis are more similar and more accurate than the electronic method.

Keywords: Multi-criteria decision-making model, ELECTRE, Grey, TOPSIS, Shannon entropy.

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Evaluation of the effect of de-icing salt along snowy road on vegetation composition and diversity (Case Study: mountain road of Godar Kafanooieh of Baft as the roof of Iranian desert)

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Abstract

An intense utilization of salt for lowering the freezing point of water in the mountainous areas of Iran country has been applied for a long period. Therefore, this study aimed to determine the effect of road deicing salt on the vegetation composition, species richness and diversity indices in rangeland ecosystems of the area adjacent to Godar Kafanooieh road, Baft-Kerman, Iran in 2016. Sampling of vegetation was carried out after determining a homogeneous area of ecological factors on the side of the road where runoff flowed into it. The establishment of 80 plots based on a systematic sampling of vegetation along the four transects with length of 150 meters was performed. In this regard, the first ten plots on each transect were established every 5 meters and the distances between other plots were 10 meters. After calculating the diversity and richness indices based on presence or absence of species in the PAST and BIO-DAP software, the effect of distance from the salting road was examined by one-way ANOVA test, and mean comparison was analyzed by Duncan's multiple range test. Results from 0 to 40 meters far from the road showed that plant species as *Hertia intermedia*, *Ephorbia larica* and *Glycyrrhiza glabra* have a high proportion of species composition. A significant increasing rate of Dominance and Burger indicators (86.7 and 97.7 percent in comparison to near road and 18.27 and 115 percent in comparison to farthest distance from road (150 meters), respectively) and the decreasing rate of Simpson, Shannon, Margarof, Menhing and Fisher indicators (45.2, 49.6, 38.5, 14.6 and 30.2 percent in comparison to near road and 53.4, 68.5, 77.6, 51.4 and 76.8 percent in comparison to the farthest distance from road (150 meters), respectively) at the 40 meters far from the road indicated the dominance of few species with high population (mostly *Salsola inconesense*). Native rangeland species (*Artemisia aucheri*) along with other species such as *Stipa barbata* and *Astragalus parrowianus* were observed at 50 meters distance from the road and their contribution to vegetation composition was raised with increasing the distance. According to this research, salt deicing due to changing the ecologic condition for invader and halophyte species, will decrease richness and diversity of species and will also diminish the potential and increase vulnerability of near rangeland ecosystems.

Keywords: Salting, ecosystem, diversity, mountains, Kerman.

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Choosing the best province in potato production using water footprint assessment

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Abstract

The water footprint is considered as an indicator of freshwater resources appropriation which brings valuable insight about the environmental impact of a given product. The current study aims to determine the best country's province for the potato crop production in terms of fresh water consumption using water footprint indicator. For this purpose, first, the data on harvested area, production and yield in major producing provinces were collected for the crop year 2014-15. Then, to calculate the water footprint in each province, information such as crop water requirement and effective precipitation were collected separately for each province and finally water footprint components were determined. The results showed that green, blue and grey water footprint had the most contribution in all provinces, respectively. According to calculated total water footprint, Hamedan province is the best region for potato harvesting and Semnan province is the most difficult region for this purpose. Water footprint average for potato production was calculated to be 527 m^3/ton in the country. According to water footprint indicator and potato production of provinces, it was determined that in mentioned crop year, Hamedan province by using 338 MCM and North Khorasan by using 18 MCM of water, used the highest and the lowest amount of water for this agricultural production, respectively.

Keywords: Water footprint assessment, water resources, water requirement, water consumption.

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Zoning concentration and ecological risk assessment of heavy metals in sediments of Mighan wetland

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Abstract

With the rise of population and the industry development, many pollutants had been released to environment. Besides, aquatic ecosystems are more vulnerable to chemicals with different combinations particularly heavy metals. In this study, the pollution of sediment around the basin of Mighan wetland with lead, zinc, and copper heavy metals was assessed by acid digestion and Atomic Absorption Spectroscopy, and Contamination Factor (CF) and Potential Ecological Risk Index (RI) were measured. Based on the results, comparisons of metal concentration with sediment quality guidelines (SQGs) were performed. Finally, zoning metals using Kernel Density Estimation showed that the southern and western parts of the wetlands because of industrial zones, agricultural lands wastewater, and industrial area have a high concentration of pollutants. Meanwhile, investigation of heavy metals represented a high concentration of copper metal relative to zinc and lead metals in the region. In the end, the requirement for contaminants controlling in the Mighan wetland is recommended.

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Using adaptive Neuro-Fuzzy network (ANFIS) to predict underground water quality in west of Fars province during 2003 to 2013 period

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Abstract

Due to the reduced rainfall and overuse of underground water, checking the water quality is one of the most important challenges discussed in various areas, such as Iran. Estimation of water quality using models such as neural network results in costs reduction and better management. The current study aims is to assess ground water quality using adaptive fuzzy neural network (ANFIS) in the west of Fars province during 2003 to 2013 period. Three methods including grid partitioning, sub-clustering and FCM with two models of Hybrid and back propagation were used to predict the quality of ground water for the study area. In this study, electrical conductivity (EC) and sodium adsorption ratio (SAR) were used to train the neural network. In addition, water quality class diagram Wilcox was used to train the network. In chemical pollution, according to Wilcox diagram, EC and SAR are the most important factors based on which waters can be classified in different classes such as very appropriate, suitable and unsuitable for agriculture. Results show that among various models provided to predict groundwater quality, Hybrid models in FCM method have the greatest accuracy for the prediction of water quality in the study area with a maximum R (0.99) and minimum error.

Keywords: Water quality, adaptive Neuro -Fuzzy inference system (ANFIS), EC, SAR.

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Assessment of spatial distribution of soil erodibility in Khoor and Biabanak Regions

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Abstract
Currently, erosion is one of the most important environmental problems in Iran watersheds. Therefore, determination of the sediment and soil erodibility is very important for conservation and management of natural resources. The current study aims to evaluate the spatial distribution of soil erodibility and its relationship with some of the soil properties using geostatistical methods in the Khoor and Biabanak regions. For this purpose, 33 soil samples were taken from depths of 0-50 cm along three transects from playa to mountain units for determination of the components of sand, clay, silt, organic carbon and organic matter. Values of K factor and SEI were calculated using the values of these parameters. Finally, to determine the spatial distribution, interpolation methods were tested and the most suitable method was chosen. The results showed that Radial Basis Function was the most suitable of interpolation methods for the spatial distribution of the elements of sand, clay and K factor with RMSE 3.27, 3.22 and 0.0036, respectively. The simple Kriging method was suitable for carbon components and organic material with RMSE 0.34 and 0.59, respectively. For silt, Kriging Ordinary with RMSE 0.88, and for SEI index, Universal Kriging method with RMSE 0.0014 were suitable. According to the results of soil erodibility values, minimum and maximum amounts of K factor with 0.025 and 0.07 t h MJ^{-1} mm^{-1}, as well as minimum and maximum values of SEI with 0.03 and 0.07 are extensive in the East, West and North West areas, respectively.

Keywords: Erodibility, soil texture, geostatistic, Khoor and Biabanak.

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Droughts analysis in the Northeast of Iran using Joint Deficit Index (JDI)

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Abstract

Monitoring and prediction of droughts, especially accurate determination of its start time and duration, is very important in water resources management and planning drought mitigation strategies. In this study, drought conditions in the Northeast of Iran was evaluated by means of Joint Deficit Index (JDI). Monthly precipitation data from 6 synoptic stations including Torbat Heydariyeh, Sabzevar, Semnan, Shahroud, Gorgan and Mashhad during the period of 1971 to 2011 were used for calculating the JDI index. Results showed that in recent years the number of dry months across study area (especially at wet regions) increased, significantly. As in all of considered stations (except Semnan station), the percentage of dry months increased to over (more than) 50% over the past 10 years (2002-2011). Results showed that the JDI provides a comprehensive assessment of droughts and it is capable of reflecting both emerging and prolonged droughts in an accurate manner and allows for a month-by-month drought assessment.

Keywords: Copula functions, drought, Joint Deficit Index, empirical copula.

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Groundwater vulnerability zonation using DRASTIC and SI models in GIS (Case Study: Ajabshir Plain)

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Abstract

Ajabshir Plain is located in the eastern Azerbaijan province and in the north-west of Iran. This plain provides the water for drinking, agriculture, and industry in Ajabshir city. In this research, regarding the hydrology and hydrogeology conditions of the study area, the vulnerability of the aquifer against the pollutants was zoned using DRASTIC and SI models and geographical information system. In DRASTIC model, 7 factors including depth to water, net recharge, aquifer media, soil media, topography, impact of vadose zone and hydraulic conductivity are used to generate the vulnerability map. The vulnerability assessment of aquifer is also affected by 5 factors including depth of groundwater, net recharge, lithology of the aquifer, topography and land use in the SI model. After preparing information layers and rating in ArcGIS software, the final map of aquifer vulnerability to pollution was prepared through integrating layers. Regarding the SI vulnerability map, about 2.24% of the study area is located in very low vulnerability area, 5.27% in low vulnerability area, 45.08% in moderate to low vulnerability area, 39.09% in moderate to high vulnerability area, and 8.3% in high vulnerability area. According to the DRASTIC model, 13.4% of the study area was allocated to very low vulnerability, 55.43% to low vulnerability, 28.69% to moderate to low vulnerability, and 3.08% to moderate to high vulnerability. The evaluation of two models by TDS element indicated that SI model (correlation coefficient= 0.76) is more accurate than DRASTIC model in terms of preparing vulnerability map for the study area. Moreover, both of prepared vulnerability maps showed that conservation of groundwater resources of Ajabshir plain by managers and planners is necessary to control and prevent the aquifer from pollution and its stability for the future generation.

Keywords: Groundwater, vulnerability, GIS, SI model, DRASTIC model, Ajabshir Plain.

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Application of interactive interval linear programming for optimal water and crop area allocation considering virtual water content and socio-economic factors
(Case study: Dorudzan-Korbal Plain)

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Abstract

One of the key issues in the practical planning for water resources is the existence of uncertain factors. One of the approaches for decision making under such circumstances is interval programming. The current study aims to develop an interactive optimization model for water and crop area allocation. The developed model consists of four objectives that take into account socio-economic factors, the virtual water content of crops, and meeting environmental water requirements. For solving the model, four crop area scenarios (assumptions) were considered. Results showed that by raising the level of satisfaction threshold on the constraints, the amount of water allocated to each water user is declined. So that from the satisfaction level of 0.65 to the level of complete satisfaction, the model allocates only the minimum amount of water (40 MCM) to meet the environmental water needs. Based on considered scenarios for solving the model, the largest cultivation areas are allocated to wheat and maize for autumn and spring cultivations, respectively. Solving the model in the absence of upper bound for crop areas revealed that the greatest difference between optimal crop area and the highest cultivation area belong to rice with 2777 and 5821.6 hectares in Dorudzan and Korbal districts, respectively. The main advantage of the developed model in the present study is the linear formulation as well as its ability to deal with uncertain parameters. Outcomes of the model provide information required for the assessment of risk and reliability of planning options for water allocation.

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Effect of spur dike as a protective structure on riverbend using a mathematical model CCHE2D
(Case Study: Hormozgan Minab River)

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Abstract
Instability of river bank leads to lots of problems in short and long terms. Gradual destruction of river bank, consequently, gives rise to risk for structures and lands along the river coast. It can cause the field of sedimentation, reducing local angle of meanders and finally, making a new path for river. The current study presents a numerical modeling of the effect of successive spur dike on flow and sediment patterns and provides protection for the bank of Minab River using two-dimensional model CCHE2D. The parameters used for calibration include water depth and flow rate, measured in three river banks. At this stage, optimal networking of different models were used, moreover, Network 50*500 was chosen because it was closer to the results of field measurements. The results of this study show that geometry of river flow and sediment regulated and guided the breakwater in the Thalweg river velocity and shear stress influences, so that a spur dike can decrease velocity by 66 percent, leading to deviation of maximum velocity lines from the banks and river bank zone, obviating 20 cm erosion and substituting 5 cm sediment on bank zone and finally it will establish and protect river banks.

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Application of LS-SVM, ANN, WNN and GEP in rainfall- runoff modeling of Kiyav-Chay River

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Abstract

Streamflow forecasting is necessary for water resources management and planning in rivers, lakes, reservoirs and protection of river banks during flood. In this study, different soft computing models including artificial neural networks (ANN), the hybrid of wavelet-artificial neural networks (WANN), gene expression programming (GEP) and least square-support vector machines (LS-SVM) were utilized for river flow estimation of Khiav-Chay. Statistical measures and ANOVA test were used for evaluation of applied models. The results indicated that WANN model was the best model with the highest correlation coefficient (R=0.877) and the lowest root mean squared error (RMSE=0.696) and Nash Sutcliff coefficient (NS=0.767) in validation phase. The results of ANOVA test were in agreement with statistical criteria values and WANN model with the lowest F statistic (F=0.11) and the highest significant resultant (0.75) was selected as the best model. Furthermore, in estimation of maximum discharge, WANN with mean relative error of 30.19% has the minimum error of estimation compared to other models.

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