

Climate Change Impact on the Future Inflow of the Doroodzan Reservoir in the Province of Fars

Farshid Safshekan^{1*}, Ali Mohammad Akhoond-Ali², Ali Haghighi³, Heidar Zarei⁴

Abstract

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change presents four general circulation models under the SRES emission scenarios of A₂ and B₁. The take-home message of these documents is the expected change in the atmospheric temperature, which undoubtedly would affect the hydrology of watersheds. These warnings dictate the necessity of prediction of the future change in the flow of rivers and the vulnerability of the people who depend on them for their water supplies. Results indicated that the average temperature variations are from -0.13 to 0.96°C and 0.72 to 1.85°C for 2016-2038 and 2039-2061 periods, respectively. Furthermore, the average monthly rainfall variations in the baseline period in comparison to the observed period (1988-2010) are from -3.5 to 182% and -20.7 to 123 % for those two periods, respectively. The daily rainfall- runoff simulation using the IHACRES model yielded the R² of 0.684 and 0.635 for the calibration and validation stages, respectively. Overall, the mean volume of annual runoff into the Doroodzan Reservoir would decrease by 8.4 and 28.15 % as compared with the baseline period for the 2016-2038 and 2039-2061, respectively. Furthermore, the most decrease in the mean volume of monthly runoff of the basin in comparison with the baseline period has been predicted for November to be 42.34 and 54.13 % for those two periods, respectively.

Keywords: Climate change, Inflow of the basin, Doroodzan Dam Basin, Downscaling.

¹ Ph. D Candidate Of Water Resource Engineering, Water Science Faculty, Shahid Chamran University, Ahvaz, Iran. Email: safshekan.2020@yahoo.com, Tel.: +98-071-37310449.

² Professor, Hydrology and Water Resources Engineering Department, Water Science Faculty, Shahid Chamran University, Ahvaz, Iran.

³ Associate Professor, Department of Civil Engineering, Shahid Chamran University, Ahvaz, Iran

⁴ Assistant Professor, Hydrology and Water Resources Engineering Department, Water Science Faculty, Shahid Chamran University, Ahvaz, Iran.

Developing an Appropriate Organizational Structure for Agricultural Water Demand Management in Iran

Mohsen Barahimi¹, Kazem Shahverdi^{2*}, Iran Ghazi³, Naser Taleb Bidokhti⁴

Abstract

Serious attention to agricultural water supply management is inevitable due to an increase in demand for this most precious resource. Water demand management is a strategy that reduces the demand for, increases its use efficiency of, and prevents the waste of its resources. Various laws, pertaining to the prudent water management, have been passed; however, many of them have never been enforced. Therefore, the existing structure was investigated by polling a group of water-related experts. The questionnaire, which was employed for this research, was answered by 38 eminent water experts. The calculated Cronbach's alpha coefficient of the polling was 0.701 that pointed to the strong reliability of the questionnaire. Those water experts were in agreement with reorganization of the water resources management and maintained that a "lack of coordination among relevant agencies" and the "legal difficulties in reforming the consumption patterns" have greatly affected the emergence of the existing water crisis. Therefore, a countrywide organizational chart, consisting of five levels, was proposed: 1. Providing a framework and adapting a firm policy on logical water management in coordination with the judiciary bodies; 2. Enabling the managers of large watersheds to adapt their own policies; 3. Enabling the managers of sub-watersheds to adapt their own policies; 4. Implementing the confirmed policies employing the existing hardware and software and looking for the new methods; 5. Implementing the adapted policies at the local scale. We strongly recommend an assessment of this chart by the concerned water authorities

Keywords: Water demand, Questionnaire, Reform, Structur.

¹ Ph.D. student in water resources, Isfahan Shakhesh Pazhoh University, Isfahan, Iran.

² Young Researchers and Elites Club, Science and Research Branch of Tehran, Islamic Azad University, Iran, Email: shahverdi2006@gmail.com

³ Assistance professor, Isfahan Shakhesh Pazhoh University, Isfahan, Iran.

⁴ Professor, Faculty of civil and environment, Shiraz university, Shiraz, Iran.

An Assessment of a Dam Impact on the Meander Morphodynamics of the Downstream Reaches Using the CCHE2D Software (Case Study the Karkheh Dam)

Ali Leagat¹, Arash Adib^{2*}, Hamid Reza Gafouri³

Abstract

Stability of streambeds is dependent on different factors some of which maybe destabilized at any moment. Dam erection on the riverbed is the most important among those factors. Some morphological changes of a meandering river, the most obvious of which are the gradient change and the area deducted or added to the riverbed, were studied downstream of the Karkheh Dam. To delineate the areas, which had been taken from or added to the riverbed due to the lateral and longitudinal displacement of the meanders, morphology of the downstream river bed prior to and after the dam construction were studied employing satellite imagery, and their extent was calculated using the CCHE2D model. Slope reduction, as expected, follows an increase in the riverbed breadth. The average width of the riverbed was reduced from 273 m to 60 m (78% reduction) after the dam construction. The land taken off the streambed was almost 21 hectares for each kilometer of the length of the river. Mean, maximum and minimum horizontal thalweg displacements were 340,768 and 53 meters, respectively; 56% of the displacements were towards right (west) and 59% of the displacement took place out of the original streambed. The mean annual lateral displacement of the riverbed was 34 meters after the dam construction. This finding illustrates the instability of the terrain through which the river flows.

Key words: Erosion, Dam, Meander, Morphology, CCHE2D model.

¹ PhD Candidate, Civil Engineering Department, Engineering Faculty, Shahid Chamran University of Ahvaz

² Associate Professor, Civil Engineering Department, Engineering Faculty, Shahid Chamran University of Ahvaz
Email: arashadib@yahoo.com Tel: 09122153969

³ Professor, Civil Engineering Department, Engineering Faculty, Shahid Chamran University of Ahvaz

Simulation of Flow Characteristics Over Semi Cylindrical Weirs Using Ansys CFX Numerical Model

Hojat Karami^{1*}, Saeed Farzin², Ali Heydari³, Khosrow Hosseini⁴

Abstract

Weirs are the most important and very applicable barriers built across channels to control the flow of water or change its direction. They are also widely used in current measurement in open channels and many hydraulic engineering studies. The advantage of the semi-cylindrical and circular crested weirs as compared with other structures and measuring instruments is their higher discharge coefficient, stability of flow pattern, non-obstruction by floating materials, simplicity of design, durability, wide applicability and economics. One of the newest and most useful software in the field of computational fluid dynamics is Ansys CFX, which provides fairly reliable results. This software, which benefits from the continuity and momentum equations and the application of a turbulence model, was used to simulate flow over three semi cylindrical weirs with different radii in a laboratory study. After selecting the optimum mesh size for simulating the flow in the multiphase form of the fluid model, the k- ϵ , RNG k- ϵ and k- ω turbulence models were used to simulate the flow, and the results of the numerical solution was compared with the collected data extracted from experimenting with the physical models. The mesh size selection was based on the optimum mesh, root mean square error, mean absolute error and the coefficient of determination. The results showed that for cylinder with 4, 6, 7 cm radius, the discharge coefficient ranged from 1.2 to 1.4. Furthermore, both the flow and the discharge coefficient increased with an increase in the radius. Moreover, the location of minimum pressure on the weir moved upstream with incremental discharge in conformity with previous studies.

Keywords: Semi-cylindrical weir, Discharge coefficient, Ansys CFX, Turbulence models, Fluid volume

¹ Assistant Professor, Department of Water Engineering and Hydraulic Structures, Faculty of Civil Engineering, Semnan University, Semnan, Iran. Email: hkarami@semnan.ac.ir

² Assistant Professor, Department of Water Engineering and Hydraulic Structures, Faculty of Civil Engineering, Semnan University, Semnan, Iran.

³ Graduated Msc. Student, Department of Water Engineering and Hydraulic Structures, Faculty of Civil Engineering, Semnan University, Semnan, Iran.

⁴ Associated Professor, Department of Water Engineering and Hydraulic Structures, Faculty of Civil Engineering, Semnan University, Semnan, Iran.

Monthly Evapotranspiration Modeling in the Absence of Climatic Data Using the Soft Computing Methods in West and Northwest of Iran

Saman Maroufpoor^{1*}, Eisa Maroufpoor², Hadi Sanikhani³

Abstract

Evapotranspiration (ET_0), a major component of the hydrologic cycle, is important in water resources development and irrigation planning. The ET_0 for west and northwest of Iran was estimated using the FAO Penman-Montieth method (FAO-56) as the reference. The performance of four different data-driven methods, namely the Artificial Neural Networks (ANN), Adaptive Neuro Fuzzy Inference System (ANFIS) with grid partition (GP), ANFIS with subtractive clustering (SC), and Gene Expression Programming (GEP) were investigated on the ET_0 estimation. Latitude, longitude and altitude of stations, and the periodicity component were used as inputs to the applied models to predict the long-term monthly ET_0 using the data from 12 stations in the west and northwest of Iran. The maximum coefficients of determination (R^2) were found to be 0.994, 0.998 and 0.997 for the ANN, ANFIS-GP and ANFIS-SC models at the Sanandaj Station, respectively. The highest R^2 (0.982) of the GEP model was calculated for the Khoy Station. The root mean squared error ranged 0.311-1.551, 0.368-1.319, 0.450-1.80 and 0.435-0.833 mm/day for the ANN, ANFIS-GP, ANFISSC and GEP models, respectively. The results revealed the high accuracy of the GEP in the prediction of ET_0 . Therefore, the GEP model can be applied as a simple method in future studies as an alternative to the use of empirical relationships for the ET_0 estimation.

Keywords: Adaptive Neuro-Fuzzy Inference System, Artificial Neural Network, Crop water requirement, Gene Expression Programming, Geographical information

¹ PhD student, Water Resources Management and Planning, Dept. of Irrigation and Reclamation Engineering, University of Tehran, Karaj, Iran. Email: S.Maroufpoor@ut.ac.ir

² Associate Professor, Water science and Engineering, University of Kurdistan, Sanandaj, Iran.

³ Assistant Professor, Water science and Engineering, University of Kurdistan, Sanandaj, Iran.

A Comparative Study of Applying the Hadcm3 and ECHO-G Softwares to the Climate Change Assessment of the Babolroud Watershed Between 2046-2065 Period

Razzaghian Hadi¹, Mohseni Behrouz^{2*}, Shahriari Ghorban³

Abstract

The Babolroud watershed has experienced different climate related events such as flooding and drought in recent years that emphasize the urgent need to investigate the impact of climate change on meteorology and hydrology of the watershed. Two general atmospheric circulation softwares were used to predict these changes. However, the large scale computational grid of such software discourages their application to meteorology parameters prediction in small scales. Therefore, an interface tool called the LARS- WG model has been developed to facilitate assessment of such parameters in more manageable scales and at the desired localities. The data generated by the HadCM3 general circulation of the atmosphere software were incorporated into the LARS-WG software under a similar scenario for the 2046-2065 periods. They were downscaled, compared and evaluated the four climatic variables related to the statistical base period of 1982-2011. These data were introduced into the LARS-WG software for calibration and verification. Furthermore, the relationships between the collected data were established between rainfall depth, maximum and minimum temperatures and radiation to simulate the future events. It was observed that the ECHO-G software prediction was lower for precipitation and higher for temperature under the similar scenario as compared to those predicted by the HadCM3 software. Precipitation depth as predicted by this software for the Babolroud watershed ranged from -52 to +17 %. The results indicated a moderate increase in precipitation in the rainy season and an extreme decrease in the summer month. The highest reduction was related to the August rainfall (43 mm) as predicted by the ECHO-G software. The highest increase in precipitation was related to October (27 mm) as predicted by the HadCM3 software.

Key words: Drought, General circulation, Weather generator, Scenario, LARS-WG software.

¹ Assistant Professor, Faculty of Agricultural Sciences, Department of Natural Resources and environmental Engineering, Payam Noor University

² Members of the Faculty of Agricultural Sciences, Department of Natural Resources and environmental Engineering, Payam-e-Noor University, 19395-4697, Tehran, I.R. of Iran. Email: mohseni_m@pnu.ac.ir

³ Assistant Professor, Faculty of Agricultural Sciences, Department of Natural Resources and environmental Engineering, Payam Noor University

Uncertainty analysis of the statistically downscaling Precipitation and Temptation on the Qorantalar

Mehdi Ahmadi^{1*}, Bagher Ghermez Cheshmeh², Hoda Ghasemiyeh³

Abstract

One consequence of a significant increase in the man-made greenhouse gases in recent decades has been a global rise in air temperature with the commensurate rise in the atmospheric heat energy, which in turn affects the hydrologic cycle. Thus a drastic change in the amount, distribution and timing of the hydrologic events is logical. Therefore, preparation for the future water-related events dictates an implication of detailed studies on the prediction of the future rise in temperature and the resultant change in precipitation. The Atmosphere-Ocean General Circulation Model (AOGCM) is considered to be the most reliable software for the predicting the weather-related events. The statistical downscaling method (SDSM) and the Artificial Neural Networks (ANN) were tested to remove the uncertainty related to the AOGCM. Of a few software used for downscaling, SDSM was proved to be the most reliable for predicting the 2011-2040 changes in air temperatures and precipitation under the A₂, B₂ scenarios of the HadCM₃ for the Qorantalar Watershed. Results indicated that there would be an increase of 7% and 6% in the precipitation amount, and 0.34 and 0.86 degrees Celsius in temperature using the A₂ and B₂ scenarios, respectively.

Keywords: Climate change analysis, SDSM, Artificial Neural Networks.

¹ MS graduated, Natural resources and Earth Science college, Kashan university
Email: ahmadimehdi533@yahoo.com

² Assistant Professor, soil and water conservation research center, Tehran, Iran

³ Assistant professor, Natural resources and Earth Science college, Kashan university

Farmers' Perception of the Seriousness of the Declining Groundwater Volume and their Reactions to Mitigation of its undesirable Outcomes (Case Study: The Hamedan - Bahar Plain)

Nemat hassani¹, Payam yadollahi^{2*}, Ali asghar mortazavi³

Abstract

The declining groundwater resources have jeopardized food security in many marginal drylands. As Iran is dependent on this immensely precious resource that provides some 60% of its needs in hydrologically normal years, and undoubtedly more during droughts, the populace, particularly their irrigation farmers have to be concerned with this dwindling resource. Therefore, the farmers' attitudes towards utilization of groundwater resources are of utmost importance. The purpose of this study, which was implemented through questionnaires, was an assessment of some effective factors, which govern the farmer's attitudes towards water resources management behaviors in Hamedan-Bahar Plain. Of the 476 farmers who operated wells deeper than 150 meters, 250 were randomly selected for this study. The data were analyzed using the multiple regression analysis based on their answers. The results indicated that understanding of vulnerabilities ($\beta=0.48$), realization of the damage ($\beta =0.55$), perception of the barriers to water conservation ($\beta =0.57$) and acceptance of responsibility for mismanagement of groundwater resources ($B=0.42$) had significant correlation coefficients ($p <0.01$).

Keywords: Effective factors on farmers' attitudes, Water resource management behaviors, Descriptive study, Water users.

¹ Associate Professor, Civil Engineering, Water and Environment Faculty, Shahid Beheshti University, Tehran.

² Master of Science in Natural Disasters Management (Flood & Earthquake), Civil Engineering, Water and Environment Faculty, Shahid Beheshti University, Tehran. Tel : 09183114292 – 08138210190
Email: payam.yadollahi@yahoo.com,

³ Assistant Professor, Civil Engineering, Water and Environment Faculty, Shahid Beheshti University, Tehran.

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