The Praxeology of Climate System Changes; Emphasizing the Impact of Subtropical High Pressure Displacement on the Occurrence of Drought Hazards

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Extended Abstract

Introduction

Changes in climate systems are one of the most challenging environmental phenomena and depend on the human application systems in various fields such as agriculture, industry and so on. This is a pervasive environmental phenomenon in climate change that affects environ-mental characteristics such as evaporation, precipitation characteristics, drought, rising sea levels, displacement of high pressures, and so on. Meanwhile, drought is a frequent climate phenomenon in climate systems that its effects are not limited to arid and semi-arid regions. Given the relationship between climate change and drought, such as understanding the behavior and complexity of climatic systems, or the performance of human activities, causing turbulence and complexity. If this relation does not determine, environmental resources may be out of balance and in most cases, it may be endangered. Therefore, identifying and evaluating these changes in general will be an important step in predicting change trends, and ultimately environmental sustainability. Therefore, it can be said that identifying the behavior of these systems on issues such as displacement of sub-tropical high-pressure boundary, or the occurrence of droughts necessitates the interaction of quantitative and qualitative studies. In this paper, in response to this question, that is, identifying the boundaries of climate change from equilibrium to risk, we have tried to systematically identify and evaluate this process. As a case study, the behavior of the impact of displacement of sub-tropical high-pressure system on the occurrence and exacerbation of drought and its impact on management practices is discussed.

Methodology

In order to evaluate the behavior of climate systems changes with emphasis on drought hazards caused by displacement sub-tropical high pressure to the

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northern latitudes, first step is to investigate the status of temporal and spatial variations of the subtropical stack, detecting its position, identifying its northern limit and its effects on droughts in the study area, which is 0 to 45 degrees latitude, and 0 to 71 degrees longitude. Then, the geopotential elevation data of 500 hPa were extracted from the database of National Center for Environmental Prediction, and National Center for Atmospheric Research, over a period of 70 years with a horizontal resolution of 2.5 degrees during the years 1948 - 2018. The reason for choosing this level is due to the most atmospheric disturbances in this level. Afterward, the pressure output data were plotted and analyzed using the Gards software to match the data and the accuracy of the data display. In the next step, to form a database to draw maps and graphs from the extracted data, first, geopotential pressure data was converted to standard format for analysis using panoply software. According to the trend of temporal and spatial variations of subtropical stack, the intensity of higher central curve of the subtropical high-pressure system, has higher the high-pressure power. In the last step, in order to conceptually analyze the theoretical approaches of climate systems, the method of information compilation was collected using library resources and databases. Thus, analyzing systematic approaches to the research, finally confirms relationship between the rate of movement process and high-pressure behavioral behavior. Regarding the drought changes, a qualitative analysis of the information has been obtained. Afterward, the levels of balance, crisis threshold, and environmental hazards of drought or wet were discussed.

Conclusion

In this article, regarding the identification of the behavior of tropical high-pressure systems from equilibrium to hazard, it was attempted to identify and evaluate this process in the form of systematic thinking. As a case study, the behavior of displacement behavior of high-pressure system on the occurrence and exacerbation of drought is discussed. Given Iran's position on the dry belt and the subtropical high-pressure dominance in region during the warm season, the time of high pressure during the past 70 years, between 1948 and 2018, was investigated. In this study, the most externally influential high pressure language on Iran was routed in terms of intensity and direction (northwest). It indicates the influential tabs on Iran have spread to the north and northwest, as well as movement of tabs to higher latitude, higher altitude, greater penetration depth, and range over the study period. It also indicating warming, worsening drought and overall climate change. The results of this study in the quantitative approach indicate that the outer most affecting belt in Iran during the hot months studied reveals several levels of equilibrium, namely static, instantaneous, dynamic, and sustained equilibrium, which have had threshold effects for some years. It is a threat to the start of environmental hazard levels (severe and very severe droughts). In general, environmental hazards, and especially environmental disasters, are two phenomena that arise from the behavior of phenomena and the

types of management levels that have great importance at the time of thresholds, in the case of unorganized or disturbed management and unpredictability of water system behavior. In the final step, in the form of a qualitative approach, the topic of drought management, based on climate system behavior (from equilibrium to disaster), was presented in the framework of active pre-crisis management and post-crisis management in both infrastructures. They have strategies in place to mitigate drought damage to manage and predict the environment. Therefore, it can be said that the interaction between quantitative perspective (statistical analysis from data) and qualitative perspective (equilibrium management levels, thresholds, hazards and disasters) can be effective as a practical approach in environmental management, predicting systems behavior, and reducing environmental hazards.

Keywords: Climate System, Sub-Tropical High-Pressure, Environmental Hazards, Drought, Environmental Management.

References

[1]. Smith, K. (2004). Environmental Hazards, Translated by Ebrahim Moghimi and Shapour Goodarzi nejad, Tehran: Samt Publication.

[2]. Sepehr, A. (2013). Geomorphological Inheritance: Environmental Hazards and Land Diversity, National Conference of Geomorphology and Human Habitat, Iranian Association of Geomorphology.

[3]. Sharifi, M. Ramesht, M, H. Rafiiyan, M. Quidel, Y. (2014). Location Identity and its Perception by Geosystematic, Geographical and Environmental Planning Approaches, Vol. 24, Vol. 50, No. 2, pp. 22-2.

[4]. Azizi, Q. Roshani, A, A. (2001). Investigation of Droughts and Wetlands and Their Prediction Using Halt Witzer Time Series Model in Hormozgan Province, Geographical Research, No. 661.

[5]. Asakereh, H. Qaemi, H. Fatahians, Mukhtar. (2017). Climatology of the Northern Border of the High Pressure Ridge on Iran, Climatic Research, Nos. 25 and 26, Seventh Year, pp. 21-32.

[6]. Alijani, B. (2012). Spatial Analysis of Daily Critical Temperatures and Rainfall in Iran, Applied Geographical Sciences Research, Spring 2011, No. 20, pp. 9-30.

[7]. Alijani, B. (2019). Quantitative Methodology in Geography, Tehran: Samt Publication.

[8]. Alijani, B. Tolabinejad, S. Karbala'i, A, R. (2019). Behavior Assessment of the Effect of Global Warming on Tropical High Pressure, Natural Geography Research, Spring 1398, Number 1, Volume 1, pp. 33-50.

[9]. Alijani, B. (2003).air Types and Their Impact on the Iranian Climate. Yazd University of Humanities Research Issue 2, pp. 1-19.

[10]. Fox, P, J. Mark, Lee, E. James, Griffiths. (2017). Geomorphology and Environmental Engineering, Theory and Applications, Translated by M. Yamani and A. Gorabi, Tehran: University of Science and Culture.

[11]. Kaviani M, R. Alijani, B. (2017). The Foundations of Climatology, Tehran: Samt Publication, 19th, Edition.
[12]. Babaii Finni, U. Alijani, B. (2014). Spatial Analysis of Iranian Long-term Droughts, Natural Geography Research, Forty-fifth Year, Third Volume, Autumn 2013, pp. 1-12.
[13]. Kardavani, P. (2001), Drought and Ways to Deal with it in Iran, Tehran: Tehran University Press.
[14]. Mohammad Nejad, V. (2011). Comparative Analysis of the Evolution of Alluvial Fans in the South-Eastern Alborz Range (Damghan to Garmsar), University of Tehran, Ph.D. Dissertation in Geography of Geomorphology, with Guidance from M, Yamani.
[15]. Mohammadi, H. (2009). Climate Hazards, Tehran: Tehran University Press.
[16]. Moghimi, E. (2015). Hazard Soince, Tehran: Tehran University Press.
[17]. Moghimi, E. Bagheri Seyyed Shokri, S. Safarad, T. (2012). Landslide Hazard Zoning Using Entropy Model (Case Study: Northwest Zagros Nasser Anticline), Natural Geography Research, No. 79, Spring 2012, pp. 77-90.
[18]. Ellerfelt, C,V. (2016). System Theory in Geomorphology, Translated by Kazem Nosrati and Zahra Sarbazi, Tehran: Shahid Beheshti University Press.
[19]. Bayati Khatibi, M. (2008). the Concept of Time, Its Spectra and Scales in Geomorphology (An Analytical Look at the Concept of Time in Natural Systems), Geography Education Growth, Volume 22, Number 2, Winter 2007, pp. 3-16.
[20]. Chorley, R,J, Schum, S. Sudden, D, E. (2002). Geomorphology, Volume I, Translated by Ahmad Motamed and Ebrahim Moghimi, Tehran: Samt Publication, Second Edition.
[21]. Hejazi Zadeh, Z. Javizadeh, S. (2011). an Introduction to Drought and its Indicators, Tehran: Samt Publication.
[22]. Hosseinzadeh, S, R. (2004), Urban Planning Along with Natural Hazards, Geography and Regional Development, Issue 3, Fall and Winter 2004.
[23]. Hosseinzadeh, M, M. Rahimi Herabadi, S. (2014). The Concept of Thresholds in Geomorphology, Sepehr, Fall 2013, No. 87, pp. 77-81.
[24]. Ramesht, M, H. (2004). Theory of Chios in Geomorphology, Geography and Development, Spring and Summer 2003, pp. 13-36.
[25]. Rahimi Herabadi, S. Hodaie Arani, M. (2015). the Pathology of Geosystems Studies and Its Necessity in Environmental Sustainability (Case Study: Long Citadel in Aran and Bidgol), Proceedings of the Iranian Geographical Sciences Conference, Institute of Geography, University of Tehran.
[26]. Charlton, (2008): Fundamentalsof Fluvial Geomorphology, Routledge Pub.
[27]. Chorley, R, J.Kennedy, B, A. (1971). Physical Geography: A Systems Approach, London: Prentice-hall International.
[28] Dian, J, S. Qiang, F. William, J. R. Thomas J. Reichler. (2008).Widening of the Tropical Belt in a Changing Climate, Nature Publishing Group, pp 20-24.
[29] Dracup. J. A, et al (1980) On the definition of drought, water Resource Res.

[30]. Elverfeldt K,V.(2012), System Theory in Geomorphology, Challenges, Epistemological Consequences and Practical Implications.
[31]. Goudie, A,S.(2006). Global Warming and Fluvial Geomorphology, Geomorphology, No,79, pp, 384–394.
[32]. Huggett, R, J. (2007). Fundamentalsof Geomorphology, Routledge Pub, Second Edition.
[33]. Mallya, G. Mishra,V. Niyogi, D. Tripathi, S. Govindaraju, R, S. (2016). Trends and Variability of Droughts over the Indian monsoon regio, ScienceDirect Weather and Climate Extremes. Vol, 12. June 2016, pp 43-68.
[34]. Phillips, J.D. (2006). Evolutionary Geomorphology: Thresholds and Nonlinearity in Landform Response to Environmental Change, Hydrology and Earth System Sciences Discussions, No, 3, pp, 365–394
[35]. Schumm S, A. (1979). Geomorphic Thresholds. The Concept and Its Applications. Trans Inst Br Geographer 4 (4): pp. 85–515.
[36]. Smith, K. Petley, N. (2009). Environmental Hazards Assessing and Reducing Disaster, Routledge Pub, Fifth Edition.
[37]. Sukarni, M. (2010). The Influence of the Subtropical High-Pressure systems on Rainfall and Temperature Distribution in Suriname and implications for Rice Production in the Nickerie District, A Resarch paper Degree of Master of Science in Natural Resource, the University of the West Indies.

Evaluation and Spatial Prediction of Landslide Hazard in Mountainous Road of Sanandaj-Kamyaran using Advanced Data Mining Algorithms

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Extended Abstract

Introduction

Communication as one of the most important elements of modern civilization provides the background for economic and social development, and development in different regions. Road construction is one of the major causes of landslides in mountainous areas. Landslides are natural disasters that cause a lot of financial and life losses in the country, annually. Identifying high risk areas can reduce the damages and be effective on land development policies. In various studies, different factors and conditioning factors have been considered for the occurrence of landslides. On the other hand, landslide susceptibility mapping is the first and most important step in preventing and controlling of landslides. The roads of Kurdistan province are constantly witnessing mass movements including landslides and rock fall due to the mountainous and climatic conditions. These landslides causing tens of thousands of dollars of damage each year. The Sanandaj-Kamyaran main road is also one of the areas with high hazardous potential due to its location, and variety of environmental variables including climatic, tectonic, lithology and land cover conditions. Hence, spatial prediction of mass movements and landslide susceptibility mapping on the Sanandaj-Kamyaran mountainous road using advanced data mining algorithms such as weight of evidence (WOE) and evidential belief function (EBF) is essential.

Materials and methods

In this study according to previous studies and regional conditions, fourteen conditioning factors including slope, aspect, elevation, distance to river, river density, distance to fault, distance to road, land use, soil type, curvature, lithology, normalized difference vegetation index (NDVI), stream power index (SPI), and topographic wetness index (TWI) were used to landslide hazard potential map. Also, two developed data mining models including EBF and WOE were used to extraction of landslide susceptibility mapping. The EBF

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model is based on the Dempster–Shafer Theory of Evidence. Therefore, to implement the EBF model, the layers of the conditioning factors were transformed into evidential data layers and then integrated using knowledge of the spatial relationships between the landslide occurrences and factors influencing the land sliding in order to generate a predictive landslide susceptibility Index (LSI) map. One of the advantages of this model is that both the predicted landslide and flooding zone outputs exist within the same degree of uncertainty. The EBF model is composed of four functions, namely: Bel (degree of Belief), Dis (degree of Disbelief), Unc (degree of Uncertainty) and Pls (degree of Plausibility). Four maps of Bel, Dis, Pls, and Unc were used for the assessment of the fourteen factors influencing landslide. The Weights of Evidence (WOE) is a statistics method can uses in probability condition to assess parameters which are influence on one or more other phenomena. It establishes a relationship between factors and it uses intersected with among variable. Weight of evidence origin was of Bayes' theorem that predicts variable from combine parameter maps. Finally, the receiver operating characteristic (ROC) curve and the area under the curve (AUC) were used for validation of the two achieved landslide susceptibility map.

Discus and Results

The altitudes of the study area are minimum 1293 m and maximum 2288 m. The mapping of altitude levels of the study area and the use of WOE as well as the use of EBF model showed that the altitude of 1300-1450 m had the greatest impact on landslide occurrence in the study area. Investigation of aspect map based on WOE showed that the highest and the lowest frequency of landslide occurred was in the northwest and southwest direction, respectively, but according to the EBF model, the highest and the lowest frequency of landslide occurred was in the northwest and flat directions, respectively. Furthermore, evaluation of river density map in WOE and EBF models showed that medium and low river densities had the most impact on landslide occurrence, respectively, but high and very high river density had least effect on landslide occurrence, respectively. Investigation of the information layers in the WOE model showed that TWI with very low class, SPI with very low class, and distance to fault in very high class had the most impact on landslide occurrence, but in EBF model, TWI with middle class and very high class had the highest and least impact on landslide occurrence, respectively. Also, SPI at very low class and distance to fault at very high class had the greatest impact on landslide occurrence. According to the evaluation criterion used in this study (ROC) and validation data, the WOE function model performed better than the EBF model.

Conclusion

The findings of this research showed that the advanced data mining algorithms based on their structure have sufficient accuracy in spatial predicting of landslide in the study area. In general, it can be said that a rigorous landslide

susceptibility map can help managers especially in natural hazard management section in identifying landslide sensitive areas for disaster management. The field survey is a difficult approach for the preparation of the landslide inventory map, especially for elevation which often affects landslide distribution. Landslides that occur in high altitude areas are often lost, because of the difficulty of accurate field surveys. Thus, it is recommended that identification of landslide locations should be based on high-resolution satellite images.

Keywords: Landslides, Advanced data mining algorithms, Weights of evidence model, evidential belief function, Sanandaj-Kamyaran road.

Reference

[1]. Rajaie, A. (1994). Application of geomorphology in land preparation and environmental management. Qomes publication, Tehran.

[2]. Rostaie, S., Mokhtari, D., Khodaie, F. (2015). Application of logistic regression method to hazard mapping of mass movement on mountain roads (Case Study: Dare Diz), Natural Environment Hazard, 4: 6, pp 89-103.

[3]. Ryazi, B., Karami, N., Karami, M., Hoshyardel, B. (2006). Investigating the effects of road and rail transport on wildlife and providing necessary guidance, Journal of Environmental Science and Technology, 8:3, pp 53-60.

[4]. Zandi, D., Shahabi, H., Chapi, K., Shirzadi, A. (2018). Spatial prediction of road mass movement using advanced data mining algorithms, (Salavat Abad gorge), Master thesis of natural hazard.

[5]. Shadfar, S., Nourozi, A.A., Ghodousi, J., Ghaimoyan, J. (2006). Landslide hazard mapping in Laktrashian watershed, Soil and water conservation journal, 1: 3, pp 1-10.

[6]. Shirzai, A., Solaiman, K., Habibnezhad Roshan, M., Chapi, K. (2017). Introducing a new hybrid model based algorithm to predict the sensitivity of surface landslides around Bijar city, Geography and Development Quarterly, 14:46, pp 225-246.

[7]. Shirzadi, A., Solaimani, K., Habibnezhad Roshan, M., Kawyan, A., Ghasemyan, B. (2015). Comparison of logistic regression, frequency ratio, and analytic hierarchy process in rock fall susceptibility mapping (Caste study; Kurdistan province, Salawat Abad gorge), Journal of Watershed Management, 12: 5, pp 193-203.

[8]. Saffari, A., Akhdar, A. (2012), Comparison of frequency ratio model and fuzzy membership functions in landslide hazard mapping (Case Study: Marivan-Sanandaj Road), Journal of Geography and Environmental Hazards, 1:4, pp 79-96.

[9]. Arabameri, A., Shirani, K., Rezaie, K. (2017). Comparative evaluation of probabilistic methods of event weight and frequency ratio in landslide hazard mapping (Case Study: Vanak Watershed, Isfahan), Journal of Watershed Management, 8:15, pp 147-163.

[10]. Fallahtabar, N. (2000). Influence of some geographical factors on the country's roads, Journal of Geographical Research, 32:38, pp 47-55.

[11]. Ghasemian, B., Abedini, M., Roostai, S., Shirzadi, A. (2017). Assessment of landslide susceptibility using support vector machine algorithm (Case Study: Kamyaran County, Kurdistan Province), Quantitative Geomorphology Research Journal, 6:3, pp 15-36.

[12]. Motavalli, S., Hossainzadeh, M., Esmaili, R., Darafshi, K. (2015). Accuracy assessment of multivariate regression (MR), logistic regression (LR), analytic hierarchy process (AHP) and fuzzy logic (FL) Methods in Landslide Hazard Mapping of Taleghan Watershed, Quantitative Geomorphology Research Journal, 1:13, pp 1-20.

[13]. Mosavi, M., Abedini, M. (2013). Landslide hazard mapping in urban watersheds using WLC Model Case Study: Izeh Khuzestan City Watershed, 2th International Conference on Environmental Hazards, Tehran, Kharazmi University.

[14]. Bonham-Carter, G.F. (1994). Geographic Information Systems for Geoscientists: Modeling with GIS. Pergamon Press, Canada, p 398

[15]. Carrara, A., G.B. Crosta., P. Frattini. (2003). Geomorphologic and historical data in assessing andslide hazard. Earth Surface Processes and Landforms, 28, pp 1125-1142

[16]. Chen, W., Hong, H., Panahi, M., Shahabi, H., Wang, Y., Shirzadi, A., Rezaie, F. (2019). Spatial Prediction of Landslide Susceptibility Using GIS-Based Data Mining Techniques of ANFIS with Whale Optimization Algorithm (WOA) and Grey Wolf Optimizer (GWO). Applied Sciences, 9(18), pp 3755.

[17]. Chen, W., Shahabi, H., Zhang, S., Khosravi, K., Shirzadi, A., Chapi, K., Pham, B., Zhang, T., Zhang, L., Chai, H. Ma, J. (2018). Landslide Susceptibility Modeling Based on GIS and Novel Bagging-Based Kernel Logistic Regression. Applied Sciences, 8(12), p 2540.

[18]. Chen, W., Xie, X., Peng, J., Wang, J., Duan, Z., Hong, H. (2017). GIS-based landslide susceptibility modelling: a comparative assessment of kernel logistic regression, Naïve-Bayes tree, and alternating decision tree models. Geomatics, Natural Hazards and Risk, pp 1-24.

[19]. Chen, W., Zhang, S., Li, R., Shahabi, H. (2018). Performance evaluation of the GIS-based data mining techniques of best-first decision tree, random forest, and naïve Bayes tree for landslide susceptibility modeling. Science of the Total Environment, 644, pp 1006-1018.

[20]. Constantin, M., M. Bednarik, M.C. Jurchescu., M. Vlaicu. (2011). Landslide susceptibility assessment using the bivariate statistical analysis and the index of entropy in the Sibiciu Basin (Romania). Environment. Earth Sci, 63, pp 397-406.

[21]. Crosby, D. A. (2006). The effect of DEM resolution on the computation of hydrologically significant topographic attributes. M.S. Thesis Arts, Department of Geography, College of Arts and Sciences, University of South Florida.

[22]. Devkota, C. K. Regmi, D. A. Pourghasemi, R. H. Yohida, K. Pradham, B. Ryu, C. L. Dhital, R. M. Althuwaynee, F. O. (2012). Landslide susceptibility mapping using certainty factor, index of entropy and logistic regression models in GIS and

their comparison at Mugling-Narayanghat road section in Nepal Himalaya. Natural Hazards, 65(1), pp 135-165.
[23]. Goetz, J. N., Brenning, A., Petschko, H., Leopold, P. (2015). Evaluating machine learning and statistical prediction techniques for landslide susceptibility modeling. Computers & Geosciences, 81: pp 1-11.
[24]. Huang, F.; Chen, L.; Yin, K.; Huang, J.; Gui, L. (2018). Object-oriented change detection and damage assessment using high-resolution remote sensing images, Tangjiao Landslide, Three Gorges Reservoir, China. Environmental Earth Sciences, 77, pp 183.
[25]. Hungr et al., 2001 O. Hungr, S. Evans, M. Bovis, J. (2001), Hutchinson A review of the classification of landslides of the flow type Environ. Environmental and Engineering Geoscience, 7, pp. 221-238
[26]. Jebur, M., Pradhan, B., Tehrany, M. (2014). Manifestation of LiDAR-derived parameters in the spatial potential in the area of Pohang City, Korea. Journal of Hydrology, 399. pp 158-172.
[27]. Kavzoglu, T; Kutlug Sahin, E; Colkesen, I. (2015). An assessment of multivariate and bivariate approaches in landslide susceptibility mapping: a case study of Duzkoy district, Natural Hazards, 76 (1), pp 471 - 496.
[28]. Kornejady, A., Ownegh, M., Bahremand, A. (2017). Landslide susceptibility assessment using maximum entropy model with two different data sampling methods. Catena, 152, pp.144-162.
[29]. Nefeslioglu, H.A., Duman, T.Y., Durmaz. S. (2008). Landslide susceptibility mapping for a part of tectonic Kelkit Valley (Easten Black Sea Region of Turkey), Geomorphology, 94, pp 401-418.
[30]. Oh, H. J., Kadavi, P. R., Lee, C. W., Lee, S. (2018). Evaluation of landslide susceptibility mapping by evidential belief function, logistic regression and support vector machine models. Geomatics, Natural Hazards and Risk, 9(1), pp 1053-1070.
[31]. Pontius, R.G., L.C. Schneider. (2001). Land-cover change model validation by an ROC method for the Ipswich watershed, Massachusetts, USA. Agriculture, Ecosystems and Environment, 85(1), pp 239- 248.
[32]. Pradhan, B. (2012). Landslide susceptibility mapping at Golestan Province, Iran: A comparison between frequency ratio, Dempster-Shafer and weights-of-evidence models. Journal of Asian Earth Sciences, 61, pp 221-236.
[33]. Qing, F., Wie, C., Haeyuan, H. (2016). Application of frequency ratio weights of evidence and evidential belif function model in land slide susceptibility mapping. Geocarto International, (6)32, pp 619 – 639.
[34]. Regmi, A.D., K.C. Devkota, K. Yoshida, B. Pradhan, H.R. Pourghasemi, T. Kumamoto and A. Akgun. (2014). Application of frequency ratio, statistical index, and weights-of-evidence models and their comparison in landslide susceptibility mapping in Central Nepal Himalaya. Arabian Journal of Geosciences, 7, pp 725-742

[35]. Roodposhti, M. S., Safarrad, T., Shahabi, H. (2017). Drought sensitivity mapping using two one-class support vector machine algorithms. Atmospheric Research, 193, pp 73-82.

[36]. Shahabi, H., Khezri, S., Ahmad, B. B., Hashim, M. (2014). Landslide susceptibility mapping at central Zab basin, Iran: a comparison between analytical hierarchy process, frequency ratio and logistic regression models. Catena, 115,pp 55-70.

[37]. Shirzadi, A., Bui, D. T., Pham, B. T., Solaimani, K., Chapi, K., Kavian, A., Revhaug, I. (2017). Shallow landslide susceptibility assessment using a novel hybrid intelligence approach. Environmental Earth Sciences, 76(2), pp 60.-71.

[38]. Song, K.Y., Oh, J., Choi, J., Park, I., Lee, C., Lee, S. (2012). Prediction of landslides using ASTER imagery and data mining models. Advances in Space Research, 49, pp 978-993.

[39]. Yilmaz, C., Topal, T., Suzen, M.L. (2012). GIS-based landslide susceptibility mapping using bivariate statistical analysis in Devrek (Zonguldak-Turkey). Environmental Earth Science, 65, pp 2161- 2178.

[40]. Zhang, K., Wu, X., Niu, R., Yang, K., Zhao, L. (2017). The assessment of landslide susceptibility mapping using random forest and decision tree methods in the Three Gorges Reservoir area, China. Environmental Earth Sciences, 76(11), pp 405-414.

Identifying key Factors Affecting Project Portfolio Management Effectiveness Model Aimed at Reducing Environmental Hazards in Iranian Construction Projects

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Extended Abstract

Introduction

The construction industry holds a major potential of hazards for the environment, and may impact it at different levels. Despite its potential threats to the environment, the construction industry plays a positive role in society as well. It is still necessary to find ways to conciliate industry development, especially active organizations in this industry, with environmental protection. Today, to survive in the global competition and acquire the competitive advantage, organizations and project-centered economic agents recognize their long-term and strategic goals in the true selection, full execution, and effective management of projects. Therefore, if the project portfolio management is based on an appropriate framework capable of planning, assessing, prioritizing, and selecting projects, it can carry out this mission as a proper approach and enhance the efficacy and effectiveness of the organizational projects. Furthermore, the establishment of a proper platform, in which an organization can better and more soundly manage a set of projects, can be reckoned as that organization's factor of success. Project portfolio by the literature, is defined as a set of projects that are executed in an economic unit, under similar strategic goals, and common resources. The rate of physical and financial resources of these projects is often limited. Thus, the projects under the same management compete to attract these scarce and limited resources.

Project portfolio management is a method for implementing the strategy the organization. Indeed, it is collaborative management of projects and more advantageous compared to the separated management of every project in traditional approaches. It is because portfolio management is a symbol operating as a communicational bridge between organizational strategies and projects. Indeed, the project portfolio management is an approach through which the organizational projects are adjusted and coordinated for the realization of prospects and missions. Moreover, it optimizes the time and costs of the projects' execution and accelerates the achievement of respected goals and

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interests. Diverse attributes influence the accomplishment of project portfolio management. This paper endeavors to determine and measure the key attributes affecting project portfolio management so that organizations can take maximum advantage of their executed projects.

Though in the literature that are many studies which have been focused on project portfolio management, limited studies have examined the attributes affecting PPM, and there are still many challenges to understanding the essential factors which affect the effectiveness of PPM in an construction organization, company or group. This paper focuses on attributes, which affects effectiveness of project portfolio management, from both theoretical and empirical viewpoints. We provide an integrative conceptual framework for organizing the literature on effectiveness of project portfolio management. Most of effective attributes are identified from the questionnaires filled out by 159 experts from Iranian construction companies. The obtained results reveal that strategic factors, operational factors and organizational structure have the most significant influence on effectiveness of PPM. Besides, we provided effective solutions for the organizations to improve their performance. Our findings can help practitioners develop a more focused approach in dealing with the most significant attributes.

Materials and methods

Regarding the lack of theoretical point of views, complete and better frameworks are essential to summery and conduct all attributes which are most effective project portfolio management. In this research, it would be realized by answering the following research question.

Research Question: What are the most important attributes on effectiveness of project portfolio management within projects?

The paper develops a conceptual framework for the analysis of effectiveness of PPM in projects. Based on this theoretical framework, the paper proposes research hypotheses and builds a causal model that links the constructs of the model. The factors regarding effectiveness of PPM in general are summed up from literature and then the issue is studied by conducting a survey in companies. Participants of the study included well-known and successful construction companies. Using in-depth data from Iranian construction Company, we study the attributes of effectiveness of PPM.

After the data collection process, data were categorized using the Excel software and analyzed using the LISREL software package. The statistical methods involved descriptive and inferential parts, in which the frequency tables were used in the descriptive part, and confirmatory factor analysis was used in the inferential part.

Discussion and Results

Based on a systematic investigation of effective attributes in PPM currently available in the literature, a common frame of reference for effectiveness of

PPM development is developed. This frame of reference consists of seven main factors. Besides, it will provide a good departure point for future work in ppm, both academically and practically. These factors including strategic factors, operational factors, stakeholders, quality, risk management, control and organizational structure. These factors have investigated in construction projects and it has been identified that these items are effective on ppm and there is a direct relationship between them. Organizations should attempt to maximize the effect of these attributes in order to increase effectiveness of ppm.

In the structural equation modeling, the relationships between the latent variables, which are extracted by the theory, are examined based on the data. In this research, there are 37 observed variables (including items of the questionnaire) and seven latent variables. The significance model is used to test the significance, and the standard model is used to inspect the nature and intensity of the effects among the factors. Since the hypothesis testing is performed in the 95% confidence level, the results are significant when the absolute value of their respective t-value is greater than 1.96. Indeed, the values inside the interval (-1.96, 1.96) are considered as insignificance. Before the hypothesis testing, the model fitting should be confirmed. For this purpose, the confirmatory factor analysis was used.

After investigating the standard estimation model, the results of the t-value obtained indicate that all the relationships between the constructs exist because they all have a significance coefficient larger than 1.96, showing the significance of the relationships between the constructs. Indeed, the results indicate that the questionnaire, as the research instrument, has realized the research purpose. A positive factor loading (path coefficient) indicates the strength of the relationship. A path coefficient below 0.3 shows a weak impact, and the values between 0.3 and 0.6 represent an acceptable impact. Finally, factor loadings larger than 0.6 imply a very desirable intensity of variable impact on the effectiveness of project portfolio management. Moreover, the minimum acceptable value for the t-value is 1.96. Table 7 represents the values obtained by the software for the factor loadings and t-value for seven concepts of the research.

Conclusion

A review of the studies in the area of project portfolio management showed that various researchers focused on the impact of a special factor on the success and effectiveness of project portfolio management. In this research, all the key factors were extracted, defined, and categorized into seven groups and 37 effective factors using the meta-synthesis approach and interviews with the experts. These factors were examined in Iran's construction industry using structural equation modeling in order to reduce environmental hazards in construction projects. It was observed that all the factors directly affected the success of project portfolio management. The factors can be ranked based on the

intensity of their impact as follows: (1) strategic factors, (2) operational factors, (3) factors related to organizational structure, (4) control factors (5), risk management factors, (6) quality factors, and (7) factors related to the stakeholders. Also, among the 37 observed variables, 21 factors have a very desirable impact, 12 factors have an acceptable impact, and four factors have a weak impact on the project portfolio management effectiveness in project-oriented organizations of Iran's construction industry.

Keywords: Project portfolio management, environmental hazards, key factors, construction industry, project.

References

[1].Beringer, C., Jonas, D. and Georg Gemünden, H. 2012. Establishing project portfolio management: An exploratory analysis of the influence of internal stakeholders' interactions, Project Management Journal, 43(6), pp. 16–32.

[2].Beringer, C., Jonas, D., & Gemünden, H. G. (2012). Establishing project portfolio management: An exploratory analysis of the influence of internal stakeholders' interactions.Project Management Journal, 43(6), 16-32.

[3].Cooper, R.G., Edgett, S.J. and Kleinschmidt, E.J. (1999) 'New product portfolio management: Practices and performance', Journal of Product Innovation Management, 16(4), pp. 333–351.

[4].Dietrich, P., & Lehtonen, P. (2005). Successful management of strategic intentions through multiple projects–Reflections from empirical study. International Journal of Project Management,23(5), 386-391.

[5].Dye, L. D., & Pennypacker, J. S. (1999). Project portfolio management: selecting and prioritizing projects for competitive advantage. Univerza v Mariboru, Ekonomsko-poslovna fakulteta.

[6].Gutiérrez, E. and Magnusson, M. (2014) Dealing with Legitimacy: A Key Challenge for Project Portfolio Management Decision Makers. International Journal of Project Management, 32, 30–9.

[7].Hadjinicolaou, N., & Dumrak, J. (2017). Investigating association of benefits and barriers in project portfolio management to project success. Procedia Engineering, 182, 274-281.

[8].Kester, L., Griffin, A., Hultink, E.J. and Lauche, K. (2011) Exploring Portfolio Decision-Making Processes. Journal of Product Innovation Management, 28, 641–61.

[9].Kester, L., Hultink, E.J. and Griffin, A. (2014) AnEmpirical Investigation of the Antecedents and Outcomes of NPD Portfolio Success. Journal of Product Innovation Management, 31, 1199–213.

[10]. Kester, L., Hultink, E.J. and Lauche, K. (2009) Portfolio Decision-Making Genres: A Case Study. Journal of Engineering & Technology Management, 26, 327–41.

[11]. Killen, C.P. (2013) Evaluation of Project Interdependency Visualizations through Decision Scenario Experimentation. International Journal of Project Management, 31, 804–16.

[12]. Killen, C.P. and Kjaer, C. (2012) Understanding Project Interdependencies: The Role of Visual Representation, Culture and Process. International Journal of Project Management, 30, 554–66.
[13]. Kock, A., Heising, W. and Gemünden, H.G. 2016. A contingency approach on the impact of front-end success on project portfolio success, Project Management Journal, 47(2), pp. 115–129
[14]. Kopmann, J., Kock, A., Killen, C. and Gemuenden, H. (2014) 'Business Case Control: The Key to Project Portfolio Success or Merely a Matter of Form?', European Academy of Management, EURAM, 4-7 June, Valencia.
[15]. Marnewick, C. 2015. Portfolio management success, in Levin, G. and Wyzalek, J. (eds), Portfolio management: A strategic approach
[16]. Martinsuo, M. (2013) Project Portfolio Management in Practice and in Context. International Journal of Project Management, 31, 794–803.
[17]. McNally, R.C., Durmus¸og˘ lu, S.S. and Calantone, R.J. (2013) New Product Portfolio Management Decisions: Antecedents and Consequences. Journal of Product Innovation Management, 30, 245–61.
[18]. Meskendahl, S. 2010. The influence of business strategy on project portfolio management and its success: A conceptual framework, International Journal of Project Management, 28(8), pp. 807–817.
[19]. Mosavi, A. (2014) Exploring the Roles of Portfolio Steering Committees in Project Portfolio Governance. International Journal of Project Management, 32, 388–99.
[20]. Patanakul, P. (2015). Key attributes of effectiveness in managing project portfolio. International Journal of Project Management, 33(5), 1084-1097.
[21]. PMI -Project management Institute, (2013). Project Management Body of Knowledge. 5th edition.
[22]. Sandelowski, M., & Barros, J. (2007). Handbook for Synthesizing Qualitative Research. , Springer publishing company Inc
[23]. Sascha Meskendahl, (2010), The influence of business strategy on project portfolio management and its success, A conceptual framework, international journal of project management.
[24]. Stettina, C.J. and Hörz, J. 2015. Agile portfolio management: An empirical perspective on the practice in use, International Journal of Project Management, 33(1), pp. 140–152.
[25]. Teller, J. and Kock, A. 2013. An empirical investigation on how portfolio risk management influences project portfolio success, International Journal of Project Management, 31(6), pp. 817–829.
[26]. Unger, B.N., Rank, J. and Gemünden, H.G. (2014) Corporate Innovation Culture and Dimensions of Project Portfolio Success: The Moderating Role of National Culture. Project Management Journal, 45, 38–57.
[27]. Voss, M. 2012. Impact of customer integration on project portfolio management and its success: Developing a conceptual framework, International Journal of Project Management, 30(5), pp. 567–581.

The Vulnerability of Infrastructure of the Southern Regions of Khuzestan Province in Climate Change Conditions

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Extended Abstract

Introduction

The phenomenon of climate change and global warming is an undeniable reality in today's climate. Given that all living beings experience and adapt to their climate in certain climates, or they can live and work in certain climates. Inanimate elements such as utilities, industries, tools, and in general all infrastructures are also affected by the climatic conditions, or they are designed to work in specific climates. As a result, any change in climate can either affect their performance or shorten their useful life. Sometimes it can cause serious and irreparable damage to these facilities or infrastructure. The purpose of this research is to reveal the impact of climate change on the infrastructure of the southern part of Khuzestan province, which contains the most important cities of the province; Ahvaz, Abadan, Khorramshahr, and Mahshahr. It is one of the largest commercial ports of the country and one of the largest petrochemical industries in the country, as well as the largest oil and gas reservoirs in this part of the province. Therefore, the southern part of Khuzestan province is one of the most important strategic areas of the country, and the Middle East. The infrastructure used in this area is also of great economic value. As a result, any changes to any of the climatic elements can affect their efficiency, service life, and quality of operation.

Materials and methods

To study the climate change trend, climate data from this province was first selected for stations with a common statistical base over the 1989–2017 period. According to this criterion, 8 stations were selected from synoptic stations in the southern part of the province. Climatic elements examined during this period were: annual precipitation, mean temperature of the hot and cold season, partial precipitation over 5 mm, dust codes, the occurrence of warm waves above 95 m. Two elements of trend analysis, namely the Sensor Slope Estimator Trend Analysis and the Mann-Kendall Trend Analysis Test, were analyzed for the 29-year time series trend of these elements during the baseline statistical period (1989–2019). Groundwater level changes in the area were also investigated

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using groundwater discharge data of the Khuzestan Regional Water Company. The climate change period under the two scenarios RCP4.5 and RCP8.5, the fifth CMIP5 report, was derived using the HadGEM2-ES model (The Hadley Center Global Environmental Model version 2). Finally, three climate elements, minimum and maximum temperature, precipitation were simulated under the two emission trajectories for the region and climate change of 2070 compared to baseline. AHP algorithm was used to create a pairwise comparison matrix of climatic hazards and the weight of each climatic factor in the extent of damage in south Khuzestan was determined using AHP Calculator online software. After determining the weight of each factor, in ArcGIS software, these weights were applied to the layers of each of the climate factors, and four climatic damage zones were identified and the area of these zones and their hazards were determined.

Discus and Results

The output map in the RASTER Calculator utility, ArcGIS software, shows four climate-risk classes. The high hazard potential area in the northern and central parts of the study area includes Ahvaz, Hoveizeh, Bavi, Ramshir, Hamidiyeh, northern parts of Mahshahr, and Hendijan, as well as Omidiyeh. The high climatic hazard class covers a large part of Khorramshahr, southern areas of Ahvaz, southern areas of Mahshahr, Shadegan, Hendijan, and Abadan. This climate hazard class, after a very high hazard class, can cause the most damage to the infrastructure in the study area. In the highly climatic hazard arena, infrastructure facilities such as communications roads, oil refineries, cities and villages, power lines and water lines are exposed to numerous climatic hazards.

Conclusion

The heat stress due to high temperatures and warm waves in this part of the study area is higher than other parts of the study area. In this region, the role of warm waves, especially during the period of June to August (June to late August), is very high in climate risk. The results of another study (Bruno et al,2020) also show an increase in the number and durability of summer warm waves in Khuzestan province. Extremely high temperatures, especially at temperature records above 50 ° C, cause extensive fires in rangeland and dryland areas. In refinery zones, fire hazards in refineries are caused by extreme temperature stresses that ignite the refinery's volatile gases and affect all infrastructure. This is in line with the results of (Jamalizadeh et al.2020) work on the role of high pressure in high temperatures in Khuzestan province.

Keywords: Vulnerability, Infrastructure, Climate Change, Southern Regions, Khuzestan Province.

Non-criminal Preventive from Environmental Hazards in the Oil and Gas Industry

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Extended Abstract

Following the devastating and irreversible effects of oil and gas industry activities around the world, as well as the increasing use of fossil fuels that have brought widespread hazards to the environment and human health, governments and the international community are seeking solutions for Cope with this environmental challenge. Although one of the solutions seems to be criminal suppressive measures, but considering the lack of impact of the penalties on the recovery of some previous injuries, the importance of preventive non-criminal measures that prior to the occurrence of such hazards is a strategic priority. Daily leakage of thousands of liters of oil into the seas and oceans, land degradation and land-use alterations caused by oil and gas pipes crossing, numerous pollution and platform explosions, car-borne pollution, only part of the risks and disadvantages is the use of hydrocarbons. This requires the application of various types of measures, which are intended to prevent them from being implemented in criminal law. Because the various dangers associated with activities related to the oil and gas industry sometimes fall under the heading of environmental degradation and sometimes do not constitute a specific criminal offense, their prevention in this regard is a crime or an instance of Environmental deviations have a significant place. However, the exploitation of oil and gas reservoirs has never been without the ecological side effects; contaminants leakage, damage to surrounding lands, fires and climate pollution have been observed in various locations. Recently, the social consequences of projects, especially in remote areas, have attracted the attention of experts and authorities. The world oil and gas industry has long been committed to environmental protection and has achieved remarkable results, but it is important to note that further improvements can always be made. It indicates the widespread destructive effects and dangers of these activities. If environmental laws are violated or ignored in the course of the activities of the oil and gas industry, these actions must be countered. This research is descriptive and analytical using library resources such as books, essays, doctoral dissertations and dissertations and other valid electronic resources. Therefore, the authors do not

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seek field studies and analysis of existing statistics. On the other hand, since there is no legal analysis of the risks of environmental pollution in the field of oil and gas in the existing scientific articles and sources, the present article is based on international documents governing oil and gas activities. Effective strategies to reduce the risks of environmental pollution and health hazards for humans have been tried and presented in a new research. Given that Iran is one of the major countries in the extraction and extraction of hydrocarbon resources, the feasibility of such non-criminal measures makes the preventive study of special importance. Failure to comply with the scientific rules for the extraction and extraction of these resources can contaminate the soil, aquatic and aerial environments and may pose immense challenges to the environment as well as the various organisms present in the environment. The occurrence of some destructive effects such as air pollution, respiratory problems, destruction and environmental pollution, etc. in some areas of Iran, especially the oil wells and gas resources in the south of the country, is an undeniable problem. The main reasons for such hazards from oil and gas pollution can be attributed to the lack of scientific rules regarding the production and refining and utilization of oil and gas hydrocarbon resources as well as the mismanagement and lack of reducing and controlling strategies of these activities. Non-criminal confrontation has the capability of design. The key question of this paper is therefore, what are the non-criminal strategies for preventing and confronting environmental hazards in the oil and gas industry and what is the impact of these strategies on preventing environmental degradation? Obliging to maintain standards for oil and gas extraction compliance with standards, as well as frequent monitoring of the health of activities and permissions in issuing instructions, can have a significant impact on risk reduction. In addition, since non-criminal measures are the basis for effective pre-emptive control and oversight, it can be possible to enhance the effectiveness of non-criminal strategies by enhancing the participatory activity of NGOs. On this basis, hazards knowledge, while combining the study of the adverse effects of the past as well as paying attention to the future full of risks arising from the activities of the oil and gas industry, gives non-criminal measures a more practical application. For example, the preventive activities of the prosecutors of Ahvaz, Abadan and Assaluyeh to reduce the air pollution caused by the refineries located in these cities. The reason for this action has been the environmental and health impacts of the citizens as a justification for this judicial action. Considering the knowledge of the hazards and its findings, attention should be given to the potential for harm to different areas of society. In order that, drawing on experts' knowledge of the hazards and proper management of scientific findings, preventive measures focused on protecting the future and health, quality of life and social safety.

Keywords: Hazards, Oil & Gas Industry, Environment, Prevention and Non-Criminal Counter.

Projection of Changes in Precipitation Index of the Southern Coast of the Caspian Sea in Order to Hazards Reduction in the Periods of 2021-2050

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Extended Abstract

Introduction

Precipitation is the most important climatic variable, and an important component of the hydrological cycle, which its fluctuations can have significant impacts on human society and the natural environment. Over the past few decades, the frequency and severity of extreme precipitation events have increased, especially under the influence of global warming. Based on previous researches, precipitation patterns have changed in most parts of the world in recent decades so that the occurrence of extreme precipitation has increased in most parts of the world such as China, USA, and Australia. The purpose of this study was to investigate the changes in annual, seasonal, and monthly precipitation amounts and extreme precipitation events in Guilan and Mazandaran provinces, using CanECM2 climate model data. Evaluating such changes can help policymakers and planners in regulation effective strategies to adapt to the potential risks of climate change.

Data and Method

To study and monitor the precipitation of Guilan and Mazandaran provinces on the Caspian coast and north of Alborz mountain range, 7 synoptic weather stations, including Astara, Rasht, Bandar Anzali, Ramsar, Gharakhil, Noshahr, and Babolsar with appropriate statistical length and geographical distribution

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were used. SDSM version 3.5 was used to simulate precipitation changes over the future period (2021-2050) and compared to the base period (1986-2015). In addition, daily precipitation data of Astara, Rasht, Bandar Anzali, Ramsar, Gharakhil, Noshahr, and Babolsar synoptic stations for base period (1986-2015), the large scale predictors of atmospheric re-analyzed data (NCEP), and data for CanECM2 model under three scenarios RCP2.6, RCP4.5 and RCP8.5 as large-scale predictors were used. After examining the quality control of precipitation data, the large-scale predictors of atmospheric re-analyzed data (NCEP) using stepwise modeling with respect to Pearson correlation coefficients, partial correlation coefficients and percentage of partial correlation reduction were selected. In order to ensure the efficiency of the model, 15-year period (1986-2000) for model calibration and the 15-year period 2001-2015 for model validation selected. In this step, Wilcoxon non-parametric test, Coefficient of Residual Mass, and Root Mean Square Error (RMSE) as well as index of agreement (d-indices) were used to evaluate the model efficiency. After doing model calibration and validation, the downscaling of precipitation data was performed using CanECM2 data under three emission scenarios for the future period (2021-2050) and changes in simulated precipitation values in different scenarios was investigated in comparison to base (1986-2015). Moreover, nine extreme indices introduced by CCL / CLVAR were used to investigate the intensity, duration and frequency of precipitation in the base and future periods. In addition, the frequency of days above a certain threshold of two extreme indices R10, R20, precipitation intensity from PRCPTOT, Rx5day, Rx1day, R99 and R95, and duration and durability of two CDD and CWD were used. The calculation of these extreme indices performed by the RClimDex1.0 software.

Discussion and Results

Based on the skewness and Kurtosis values and the results of the Kolmogorov-Smirnov and Shapiro-Wilk tests, it was found that the distribution of precipitation data was not normal at Bandar Anzali station. Model validation results showed that difference between observed and simulated values in some of weather stations in some months was positive or negative. In other words, in some months the simulated values were more than observed ones and in others less than observed values. However, based on Wilcoxon test, it was found that P-value was higher than 0.05 at all weather stations and thus, there could be no significant difference between the mean observed and simulated precipitation data on seasonal and annual time series data. Therefore, the efficiency of the model in simulated precipitation was confirmed at the study area. The results revealed that under the RCP2.6, RCP4.5 and RCP8.5 scenarios precipitation will not reduce during 2021-2050 period. It is expected that the average precipitation will increase by approximately 20 to 70 mm during the future period (2020-2021) as compared to base period (1986-2015). Comparison of the mean annual precipitation (PRCPTOT) in the base period with the future period based on

RCP2.6, RCP 4.5 and RCP8.5 emission scenarios showed that the annual precipitation of all the weather stations will be increased over the future period (2021-2050). The results also showed that at all weather stations, the number of consecutive dry days reduced during the future period (2021-2050) as compared to the base period (1986-2015). The results also showed that the eastern part of the study area will have higher number of consecutive dry days in the future period as compared to the western part of the study area. The results showed that the number of consecutive wet days during the base and future period indicated that, on average, about one to three days of the number of consecutive wet days in the study area reduced during the 2021-2050 as compared to the base period. Changes in the number of consecutive wet days during the future period also have a similar spatial behavior like the base period. Moreover, the results showed an increase in precipitation of more than 10 mm happened in most of the stations, excluding Babolsar and Gharakhil, in the future 2021-2050 as compared to the base period. For the Gharakhel station, a decrease in precipitation of more than 10 mm for 1 day was observed. The results showed a very slight increase in the number of days with heavy rainfall of 20 mm or more occurred in the future as compared to the base period in the coastal areas of Mazandaran province. Overall, the results showed that the number of days with very heavy rainfall in the study area was similar to the base period in the study area. In addition, based on the results of all emission scenarios, it is expected that the R95p and R99p will decrease in the central part of the study area, including Ramsar and Nowsher stations in the future in comparison with the base period. An increase in the amount of extremely humid days is expected in the future period toward the east and west of the study area, which is much higher in the west coast of the region (Gilan province). The results also showed that, like the R99P, RX1day will decrease toward the western parts of the region, especially in Bandar Anzali Station with maximum daily precipitation of 140, 130 and 141.4 for RCP 2.6 scenarios, RCP4.5 and RCP8.5, respectively, in the future period. The results also showed that in the future period, the maximum daily precipitation increased in the western parts of the study area and decreased in the eastern and central parts relative to the base period.

Conclusion

The results of three scenarios showed that the average annual precipitation in the study area increased, on average, by 20 to 70 mm as compared to base period (1986-2015). In addition, the results of analysis of precipitation indices showed an increase of precipitation with more than one mm in all weather stations and an increase of precipitation with more than 10 mm in most of the weather stations, excluding Babolsar and Gharakhil, in the future period 2021-2050 in comparison with the base period. However, the precipitation more than 20 mm was similar in the future and base period with a little change. The results revealed that a decrease in R95p and R99p indices at Ramsar and Nowshahr

stations and an increase in the western and eastern parts will occurred in the future. Moreover, a decrease in the dry period length will happened in the future as compared to the base period. The extreme precipitation values are expected to be high for the region, which will increase the average annual precipitation.

keywords: Climate Scenarios, Emissions Scenarios, Modeling, precipitation extreme indices, SDSM, The southern shore of the Caspian Sea.