Investigation on Longitudinal Change of Karoon River Using Linear Directional Mean (study area: Shoshtar to Arvandrod)

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Introduction: Rivers are always important features of the natural world. They perform vital function in agricultural, navigational, cultural, civilized andr ecreational associations. Mankind through his long history has tried to control behavior of the rivers to change its effective elements for a stable situation. The first studies in this field date back to the "Aristotle" and "Archimedes" and the related applied studies refer to the applied matters about water and rivers in Chinese, Iranian, and Egyptian era. Those presented the great engineering services and management methods to the world. In the last centuries "Leonardo da Vinci", "Guglielnini" and "Frisi" published the first findings about water and rivers. The first classification about rivers based on relative degree of stability was carried out by Davis and after that by miller & wolman, Schumm, Horton, Brierly & Fryirs. There are lots of researches and theories about geomorphology of rivers and their changes in the publications of the scientists. This process has been progressed by the invention of photography in 1826 and airplane by Wright Brothers in 1900. The Existence of important agricultural structure like irrigation and drainage networks and the development of industrial and urban projects make clear the need of the society that are living in the sides of the Karoon river. The damages of geomorphologic changes, alteration of the land uses, wide change of the meander in rout of the river and the role of these factors in natural, economical and societal change are the theories of survival of the intensity, type and amount of changes in Karoon River. This paper is studying the changes of Karoon River using Linear Directional Mean. In Iran, in addition to the classical publications about geom orphologic process and landforms and river changes, there are many studies and researches that used different approaches and methods in the field of morphological changes of rivers. This study has been done by using GIS and RS techniques. Therefore, many papers and studies have been published by Talvary, Khajesahoti & Bajestani, Aleyasin, Barjeste, Alavinejad, Ajdari & Rostami, Morshedi & Alavipanah. Most of these publications are about the "Karoon River" in southwest of Iran. This paper tries to identify and determine some of the effective elements of the Karoon River morphological changes by using GIS and RS. That may help government and managerial authorities of this region of Iran to have a new view to the Karoon River behaviors. Location of the case study: The study area of this research is a lowland part of Karoon River Basin. That is located in south west of Iran where continue from Shoshtar to the Arvandrod River in west of Khoramshahr. The length of this reach is about 364 kilometers, (the UTM projection system in the start and end points are x=298305 y=3553010 and x=227613 y= 3369477, respectively).The Karoon River area is 45231 square kilometer that belongs to the Persian Gulf Watershed.

Material and method: Fluvial geomorphology studies are discussed in different ways and classified in two major groups, empirical and theoretical methods. In the empirical group river changes is detected by using of fields study, historical maps, aerial photos and satellite images at different times and with analysis of the statistic data. But in the theoretical methods, researchers have used wide ranges of models and equations to prove their hypothesis about river morphology changes. In this study by using of the empirical methods, same as field works, air photos interpretation, GPS, compilation of special data sets, satellite images and historical maps, geomorphological changes of Karoon River has been studied. By doing so, aerial photo, topographic map and satellite data of landsat, TM and ETM+ from 1955 to 2007, have been used to extract the center line of Karoon River for a time interval about 52 years. Since fundamental requirement of the Landsat image is that they must be especially georeferenced, a precise geometric correction is done. Then, based on the georefernced images supervised classification through maximum likelihood classification method is runned with null class. For this purpose, training site by field points and GIS vector layers has been used. This approach is just selected for extraction of the river channel and lakes borders. After that, the other geomorphologic features have been vectorized from the aerial photos and by visual interpretation from images and geologic maps. Finally the geomorphologic

features are classified by using the average length of channels and the rate of compass angel of channels relative to the north for driving the rate of changes. For having the correct rate of changes, the river pass is divided into thirteen reaches and the center line of each is drawn by the method. Then the mean lengths and direction of them has been obtained by using of arc GIS software. Finally, the changes of river course have been detected by combination of all of the findings from satellite data, GIS layers, and filed studies. In this study, GPS, ArcGIS, Arcview and Geomantic software have been applied for analysis and interpretation of the data. By the way, mean directional linear of channel was drawn. This method is one of the newest approaches to detect longitudinal and transverse changes of rivers. This model is a fast and easy way to get the best results in the studies about river changes. Measuring direction or orientation In the method the trend of a set of line features is measured by calculating the average angle of the lines. The statistic used to calculate the trend is known as the directional mean. While the statistic itself is termed the "directional mean", it is used to measure either direction or orientation. Many linear features point to a direction-they have a beginning point and an end point. Such lines often represent the paths of objects that move, such as hurricanes. Other linear features such as fault lines have no start and end point. These features are said to have an orientation, but no direction. For example, a fault line might have a northwest–southeast orientation. You can calculate the mean direction or mean orientation of a set of lines. In a GIS, every line is assigned a start and end point, and has a direction. The direction is set when the line feature is created by digitizing or by importing a list of coordinates. You can see the direction of each line by displaying it with an arrowhead symbol. When calculating the mean direction, it is necessary to ensure the directions of the lines are correct. When calculating the mean orientation, the direction of the lines can be ignored. The mean direction is calculated for features that move from a starting point to an end point, such as storms, while mean orientation is calculated for stationary features, such as fault lines (Fig. 1). There may be situations that it is needed to calculate the mean orientation of lines that represent movement. A wildlife biologist is interested in where elk start and end during their seasonal migration. In such a case the mean direction of the paths the elk take during each season must be calculated. However, the biologist would calculate the mean orientation if he or she were interested in the characteristics of the migration routes, in itself, to determine what makes a good route, rather than where the elk start and end. The biologist could calculate the mean orientation using the elk paths in both directions (coming and going) and capture more about their movement. It is important to remember that while most lines have many verticies between the starting point and the ending point; this tool uses only the start point and the end point to determine direction.

Conclusion: The results of the first method show that Karoon River has general tendency from North Northeast to South- Southwest. From 1955 to 2007, length of river has become longer. This process from 1955 to 1991 has been increased and after that from 1991 to 2007 this trend has been decreased. In general, most of changes have occurred in meandering reaches like reach number 2, and direct reaches show lower rate of changes similar to the total rate of the river. Analysis of data indicated that it is possible to determine the rate of morphological changes in reaches of the study by using of the mean lengths and direction (due to north) of the river course during the times of study. For doing so, it would be necessary to vectorize the center line of the river. On Karoon River the higher range of changes has been occurred from 1955 to 1991 in comparison with other periods. Construction of dams plays an effective role on the rate of morphologic changes by the control it exert upon discharge and sediment load. The results have revealed that the length of the first reach has been increased from 1955 to 2007 in a tendency to have higher level of sinuosity.

GIS, linear directional mean, longitudinal changes, morphometric