Research Paper

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Evaluation of Changes in Groundwater Storage by Combining GRACE Satellite Data and GLDAS Hydrological Model of Arid and Semi-arid Areas Case Study: Ravansar Aquifer in Kermanshah Province

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1-Introduction

The climate across most of the Middle East is hot and arid. Water scarcity has long been a serious problem in the region; therefore it has been a particularly challenging issue since the onset of a drought period that began in 2007. In many cases, groundwater resources are nonrenewable, and monitoring their utilization rates is important for planning purposes. Therefore, determining groundwater changes in Iran, which is located in an arid to semi-arid region, is of particular importance. In this regard, Kermanshah province with 950,000 hectares of agricultural land and gardens is one of the agricultural hubs of the country and the groundwater level drawdown in its aquifers, especially in the eastern part of the province is more severe.

2-Methodology

In this study, the current situation of the region has been investigated by examining the groundwater level of observation wells in the Ravansar aquifer and also the spatial zoning of these changes using the Kriging method in GIS software.

In order to evaluate the Gravity Recovery and Climate Experiment satellite (GRACE) data with JPL, GFS, CSR, CRI algorithms, coding in Google Earth Engine cloud computing environment has been used.

In addition, monthly and annual changes of Liquid water equivalent (LWE) were calculated. Meanwhile, the amount of soil moisture (SM) was estimated from the Global Land Data Assimilation System (GLDAS) hydrological model. It should be mentioned that the amount of groundwater storage changes -compared to its observational values- was obtained by subtracting the amount of soil moisture from the estimated values of GRACE satellites.

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3-Results and Discussion

This study showed that GRACE satellite data can provide valuable results for evaluating changes in groundwater storage in different regions. In the present study, the study of different GRACE satellite algorithms showed that the JPL algorithm with a correlation coefficient of 0.73 and error criteria of RMSE =3.17 and MAE = 2.11 has acceptable accuracy. Moreover, the trend of decreasing water resources of Ravansar aquifer has been acquired up to -1.8 cm. it should be mentioned that all the calculations were made on the scale of one square degree and units were expressed in centimeters.

4-Conclusion

The results showed that GRACE satellite shows groundwater storage changes accompanied by GLDAS model.

Keywords: GLDAS, GRACE satellite, Kiriging, Liquid Water Equivalent, Ravansar Aquifer and Iran.