Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

AHW27-05 会場:301B 時間:5 月 24 日 10:00-10:15

Climate change impacts on groundwater recharge on an agricultural island, western Japan, estimated by SWAT/Hydrus model

Climate change impacts on groundwater recharge on an agricultural island, western Japan, estimated by SWAT/Hydrus model

金 广哲 [1*] ; 清水 裕太 [2] ; 小野寺 真一 [1] ; 齋藤 光代 [3] ; 松森 堅治 [2]
JIN, Guangzhe[1*] ; SHIMIZU, Yuta[2] ; ONODERA, Shin-ichi[1] ; SAITO, Mitsuyo[3] ; MATSUMORI, Kenji[2]

[1] 広島大学大学院総合科学研究科, [2](独) 農業・食品産業技術総合研究機構・近畿中国四国農業研究センター, [3] 岡山大学大学院環境生命科学研究科
[1]Hiroshima University Graduate School of Integrated Arts and Sciences, [2]National Agriculture and Food Research Organization, Western Region Agricultural Research Center, [3]Graduate School of Environmental and Life Science, Okayama University

Estimation of groundwater recharge, quantity, and water balance is important for efficiently managing groundwater resources. It is particularly important in regions with little rain, which face the risk of water shortage. However, the water balance of a watershed is sensitive to climate variability and change. Climate changes due to global warming may alter rainfall patterns and increase the occurrence of extreme events (floods and droughts), it will significantly affect the sustainability of water supplies in the coming decades, clarify the future water budgets will be necessary and important. The objective of this research is to estimate water balance and clarify the drought impact on groundwater recharge rate in an agriculture catchment using the SWAT Model, and validate and estimate the groundwater movement using the Hydrus Model.

The study catchment (IKS) is located in the central Seto Inland Sea. Groundwater resources are important water supply resources for irrigation. However, due to the small annual precipitation with large inter-annual variation, and steep sloping topography, the island faces a risk of water shortage, especially in the drought season. As input to SWAT Model, topographic data (10 m grid), soil map (1/25000), land use map of 2006 (100m grid) and weather information were used to build and calculate the SWAT Model. Evaporation was estimated by the Penman-Monteith method. Simulation time periods is 2000-2013, including warm up period of 2000-2003 and calibration period of 2003-2004. The calibration was conducted using the Sequential Uncertainty Fitting (SUFI2). The calibration and validation results of Nash-Sutcliffe efficiency (NSE), RMSE-observations standard deviation ratio (RSR), and percent bias (PBIAS) indicate the parameters are evaluated as acceptable. For input into Hydrus 1D, the groundwater recharge rate was obtained from the value in related sub basin from the SWAT model. The simulated groundwater level data were compared with observed groundwater level data from a 15m depth observation well in the downstream area of the IKS catchment.

The result shows in the low precipitation year, the groundwater recharge and surface run off decreased to 25% and 30%, respectively. Both river discharge and groundwater recharge fluctuated between the high and low precipitation years compared to average water balance, and these variations are larger than the precipitation fluctuation. The simulated groundwater level data shows the quick response to variation of precipitation. Under different rainfall intensities, groundwater levels gradually decreased and responded to the changes in groundwater recharge with no precipitation supplied. The groundwater level was also highly related to precipitation variability and the groundwater supply is highly related to heavy rainfall events and the obviously decreasing groundwater resources in the drought season. As result of global climate change, an increasing fluctuation trend between extremely low rainfall and extremely high rainfall has been observed across Japan. The annual precipitation from the Ikuchi Island suggests that years of low rainfall have become more frequent since 1976. A decreasing trend of precipitation from 5-year average data is shown, with rate of 103mm/100years. In consideration of this decreasing trend in precipitation, we estimate the annual groundwater recharge rate had considerable inter-annual variations and decreased on an average by 140mm/100years, which is relatively larger than the trend of precipitation. The groundwater level in drought years decreased with an estimated decrease of 1.2m/100years. This may indicate the drought impact on groundwater resources will increase in the future. The recharge resources will decrease and groundwater storage will decline under the trend of decreasing precipitation in the future.

キーワード: climate change, drought impact, groundwater recharge rate, water balance, SWAT Model, Hydrus Model
Keywords: climate change, drought impact, groundwater recharge rate, water balance, SWAT Model, Hydrus Model