

Role of Runoff Ratio in the Sensitivity of Streamflow

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¹POSTECH

(a) Purpose of study or research hypothesis

The purpose of this study is to quantify the role of runoff ratio on the change in streamflow and to investigate the effect of runoff ratio on the streamflow given climatic change over the globe.

(b) Key issue(s) or problem(s) addressed

The estimate of streamflow change is important for the prediction and management of global freshwater resources, but it remains unclear whether the runoff ratio of a catchment, that is the ratio of runoff to precipitation, has a significant effect on the water system. This study has two main questions: Is the hydrologic sensitivity to change of runoff ratio quantified given climate change and runoff ratio at the climate regime scales?, If yes, how does the impact of the change in runoff ratio on the hydrologic sensitivity vary across the climate regimes?

(c) Methodology or approach used

According to water budget analysis, the evapotranspiration (E) is estimated using the observational streamflow (Q) records at over 1,600 gage stations over the globe and the corresponding drainage area-averaged precipitation (P). And, these stations into the six climatic regimes based on changes in precipitation (P) and evapotranspiration (E) and their ratio (E/P) and then conduct an analytical analysis for the hydrologic sensitivity at the climate regime scales.

(d) Results or conclusions derived from the project

Results show that the streamflow changes shows a consistent direction to that of the precipitation change in most gages, but 37 % of gages have been drier due to the increased evapotranspiration that is greater than the increased precipitation in the last six decades. In addition, under the six climatic regimes, the streamflow can be changed between -70% and 70% as a hydrologic response to the decreased runoff ratio by 0.05 over the regions with a runoff ratio less than 0.3. Using the observed changes in runoff ratio, we succeed to identify the areas that are more vulnerable to floods and droughts in a changing environment.

(e) Implications of the project relevant to congress themes

The findings of this study suggest that runoff ratio is a potential source of the long-term streamflow change in a changing environment. The runoff ratio can be changed due to anthropogenic factors climate change and land cover change. Particularly, land cover change can cause decrease/increase the soil moisture storage and evapotranspiration, resulting in the change in runoff ratio and eventually the change in the sensitivity of streamflow. Thus, disaster-sensitive areas can be identified and prepared and we can estimate the range of streamflow change due to the change in runoff ratio by the land cover change in the future using the analytic solution. This study shows an insight of how the information of change in runoff ratio can be utilized in advancing our understanding of the hydrologic sensitivity.

Keywords : Climate change, Streamflow, Runoff ratio