Geophysical Research Abstracts
Vol. 21, EGU2019-6242, 2019
EGU General Assembly 2019

Critical Dry Up Period Detection of Streamflow to Extreme Meteorological Events Using a Hydrological Modeling Approach

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Precipitation and soil moisture deficits are often used to characterize the nature of drought. Extended periods of an extreme meteorological event (precipitation deficits) result in a hydrological drought because of streamflow, groundwater and reservoir level reduction. The water deficits have an enormous impact on socioeconomic status and development. The percentile values in the range of Q70–Q95 are commonly adopted as the low threshold for perennial rivers (Kjeldsen et al., 2000). In this study, we quantified the critical dry up period (CDP) and streamflow severity due to extreme meteorological events over a set of 10 watershed located in South Korea. The TPHM, GR4H, and CAT hydrological models were calibrated against daily streamflow data using the Shuffled Complex Evolution algorithm considering similar objective functions. The CAT platform is used to set up the three hydrological models (Kim and Jang, 2017) which have been tested in several basins (Birhanu et al., 2018; Jang et al., 2016; Miller et al., 2014). We selected the Q95 of the flow duration curve compiled using daily streamflows of each watershed as a low threshold level to detect the CDP and seasonal streamflow deviations. The analysis revealed the CDP vary from 30 to 90 days and the streamflow deviations from the Q95 also responded differently in the wet and dry season. In addition, the streamflow deviations increased with increasing duration of precipitation and soil moisture deficits. The result will provide information to water managers, policymakers and other stakeholders regarding the duration and severity of streamflow to extreme meteorological events.

Acknowledgments: This research is supported by the Research Program (20190101-001) of Korea Institute of Civil Engineering & Building Technology and by the Korea Environmental Industry & Technology Institute (KEITI) grant funded by the Ministry of Environment (Grant 18AWMP-B083066-05).

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