



The cross wavelet and wavelet coherence analysis of spatio-temporal rainfall-groundwater system in Pingtung plain, Taiwan

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The increasing frequency and intensity of extreme rainfall events has been observed recently in Taiwan. Particularly, Typhoon Morakot, Typhoon Fanapi, and Typhoon Megi consecutively brought record-breaking intensity and magnitude of rainfalls to different locations of Taiwan in these two years. However, records show the extreme rainfall events did not elevate the amount of annual rainfall accordingly. Conversely, the increasing frequency of droughts has also been occurring in Taiwan. The challenges have been confronted by governmental agencies and scientific communities to come up with effective adaptation strategies for natural disaster reduction and sustainable environment establishment. Groundwater has long been a reliable water source for a variety of domestic, agricultural, and industrial uses because of its stable quantity and quality. In Taiwan, groundwater accounts for the largest proportion of all water resources for about 40%. This study plans to identify and quantify the nonlinear relationship between precipitation and groundwater recharge, find the non-stationary time-frequency relations between the variations of rainfall and groundwater levels to understand the phase difference of time series. Groundwater level data and over-50-years hourly rainfall records obtained from 20 weather stations in Pingtung Plain, Taiwan has been collected. Extract the space-time pattern by EOF method, which is a decomposition of a signal or data set in terms of orthogonal basis functions determined from the data for both time series and spatial patterns, to identify the important spatial pattern of groundwater recharge and using cross wavelet and wavelet coherence method to identify the relationship between rainfall and groundwater levels. Results show that EOF method can specify the spatial-temporal patterns which represents certain geological characteristics and other mechanisms of groundwater, and the wavelet coherence method can identify general correlation between rainfall and groundwater signal at low frequency and high frequency relationship at some certain extreme rainfall events.

Keywords: extreme rainfall, groundwater, EOF, wavelet coherence