Stochastic risk assessment of the impact of climate change on annual typhoon rainfall under synthetic scenarios

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Typhoon rainfalls account for a significant portion of the annual rainfall in Taiwan and most of other Eastern Asia countries. High dependence on typhoon rainfalls for water supply and heavy damages brought about by typhoons make Taiwan particularly vulnerable to impact of climate change on annual typhoon rainfall. Therefore, evaluating the impact of climate changes on annual typhoon rainfall is crucial for water resources management and planning. Most of climate change studies aiming to assess impacts on regional- or local-scale hydrological processes involve usage of general circulation models (GCMs) and some sorts of downscaling techniques. However, the scenarios set for GCMs are not directly linked to basin-scale hydrological processes, even though most practices of water resources management and measures that should be taken to cope with potential climate changes are essentially in basin-scale. To circumvent such difficulties, a stochastic risk assessment approach is proposed for evaluation of changes in typhoon rainfall under certain climate change scenarios. The number of typhoon events and total rainfall of individual typhoon events are, respectively, considered as random variables of the Poisson and Gamma distributions. Climate change scenarios were set by varying various degrees of changes in average number of typhoon events annually and the mean of event-total rainfall. Using stochastic simulation, basin-wide annual typhoon rainfalls were simulated for the Shihmen Reservoir watershed in northern Taiwan. It is found that 10% increases in average annual number of typhoon events and mean event-total rainfall will result in 18% increase in the annual typhoon rainfall of 5-year return period, whereas the annual typhoon rainfall of 10-year return period will increase by 15% under the same climate change scenario. Such increases may cause significant increase in reservoir sediment and pose challenges to reservoir management.

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The Irrigation Rate Spatial Analysis-

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ABSTRACT

Agricultural sector in Taiwan holds the biggest share (70%) of water right. About 87% of agricultural water consumption is utilized for irrigation purpose. Water right reallocation becomes a more pressing pressure on agricultural sector because the shortages in water supply comparing to the continuously increasing water demands. An efficient assessment for agricultural water demand is necessary for this regional water reallocation decisions,

Irrigation Rate is currently used by Irrigation Association in Taiwan for estimating water demand of paddy farming. These irrigation rates were made up through working experience of the staffs and farmers. Although it is a convenient way for demand assessment, it is difficult to adjust according to the cropping pattern change because the relationships between the Irrigation Rate and related affecting factors are unknown. The Irrigation rate are mainly affected by farm water requirement, as well as the losses in percolation, conveyance and irrigation management practices.

This paper introduces the Geographically Weighted Regression to analyze the relationship among irrigation rate and the spatially distributed affecting factor like rainfall, soil and temperature. It is found that the Geographically Weighted Regression does significantly improve the traditional regression and capture the spatial variations of the affecting factors.

Keywords: Irrigation Rate, Water Shortage, Drought Management