Geophysical Research Abstracts
Vol. 13, EGU2011-5560, 2011
EGU General Assembly 2011

Estimating Probable Maximum Precipitation by Considering Co-movement of Typhoon and Southwesterly Flow

Pao-Shan Yu (1), Jau-Ming Chen (2), Tao-Chang Yang (1), Cheng-Chin Liu (1), and Yu-Chen Lin (1)

(1) Department of Hydraulic and Ocean Engineering, National Cheng Kung University, Tainan, Taiwan (yups@mail.ncku.edu.tw), (2) Institute of Navigation Science and Technology , National Kaohsiung Marine University, Kaohsiung, Taiwan

In recent years, climate anomaly has occurred around the world and the rainfall intensity becomes larger and larger which even exceeded the world record in some places and caused great damage to life and property. The Natural Disaster Hotspots-A Global Risk Analysis (Dilley et al., 2005) indicated that for the four natural disasters (i.e. typhoon, earthquake, flood and drought) in Taiwan, the ratio of the area threatened by two/three natural disasters to the total area of Taiwan is 90% and the ratio of the population bearing two/three natural disasters to the population of Taiwan is 73%. Each of the two ratios is the largest in the world. Typhoons frequently hit Taiwan during typhoon season (July to October) in every year. Especially in August 2009, Typhoon Morakot coupled with the southwesterly flow caused great damage in Taiwan. The two-day rainfall (2361 mm) of this typhoon is very close to the world record (2467 mm) which reveals that Taiwan is facing the serious problem of extreme storm.
The probable maximum precipitation (PMP) is defined as "theoretically the greatest depth of precipitation for a given duration that is physically possible over a given size storm area at a particular geographical location at a certain time of year" (WMO, 1986). Even though, the PMP approach has been widely proposed and used as design criterion of major flood protection works (e.g., reservoir's spillway capacity). Many techniques used for estimating PMP, such as (1) statistical analyses of extreme rainfalls, (2) the maximization and transposition of actual storms, and (3) the storm model approach etc., have been proposed. Three types of storm events in Taiwan include typhoons, southwesterly flow events, and northeast monsoon events. The conventional estimating methods of PMP considered different types of storm events separately. Tsengwen reservoir is a main water supply reservoir in southern Taiwan. The rainfall of Typhoon Morakot coupled with the southwesterly flow in the upstream catchment of Tsengwen reservoir nearly reached the PMP of the reservoir calculated in the design stage, which warned us to review the reservoir safety. The study will reassess the conventional estimating methods of PMP for supplying more reasonable approaches for estimating PMP which considers the co-movement effect of typhoon and southwesterly flow.
According to Manual for Estimation of PMP (WMO, 1986), dew points are a key weather variable for calculating the moisture maximization factors which are used in the approaches of maximization and transposition of actual storms (i.e. the dew point adjustment method and the storm transposition method). The study tried to use other weather variables, such as specific humidity, wind speed and moisture flux, to investigate and compare their abilities for calculating the moisture maximization factors. Twenty storm events were used as the data set, including southwesterly flow events, typhoon events, and the events with co-movement of typhoon and southwesterly flow. The correlation coefficients between rainfall intensity and each of the four weather variables (i.e. dew point, specific humidity, wind speed, and moisture flux) were calculated. For all rainfall events, it's found that the relationships between rainfall intensity and the four weather variables, respectively, have no significant difference which suggests using the dew point as an index to calculate the moisture maximization factor is satisfactory and easy to estimate PMP. The study further used the storm transposition method, which considered the co-movement of typhoon and southwesterly flow, to estimate the PMP in the upstream catchment of reservoir. The result will be compared with the PMP of the reservoir calculated in the design stage to discuss their difference.
Keywords: probable maximum precipitation, storm transposition, moisture maximization, dew point, humidity, co-movement.