Optimal design of seasonal flood limited water levels and its application for the Three Gorges Reservoir

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Abstract

Reservoirs perform both flood control and integrated water resources development, in which the flood limited water level (FLWL) is the most significant parameter of tradeoff between flood control and conservation. This study was aimed at developing the varied seasonal FLWL to obtain more economic benefits without decreasing the original flood prevention standards. The Copula function was used to build the joint distribution of seasonal floods, which clarified the relationship between the frequencies of the seasonal flood quantiles and those of the annual maximum. A constraint was then established to meet the requirement that the total flood risk of the seasonal FLWL should be less than that of the original FLWL. The seasonal FLWL can optimally be determined because numerous schemes of seasonal design floods are able to satisfy a given flood prevention standard. As a result, a simulation-based optimization model was proposed to maximize multiple benefits, such as flood control, hydropower generation and navigation. Using the case study of the China's Three Gorges Reservoir (TGR), the proposed method was demonstrated to provide an effective design for the seasonal FLWL, which decreases a slight FLWL for the main flood season to largely increase the FLWL of the pre-flood and post-flood seasons. The optimal designed seasonal FLWL scheme involves tradeoffs among flood control, hydropower generation and navigation, and enhancement of the economic benefits without increasing the flood risk. (C) 2015 Elsevier B.V. All rights reserved.

Keywords

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