A Model for Developing Reservoir Operation Rules for Irrigation Projects

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Abstract

At a basin scale the criteria for designing reservoirs for irrigation projects are based in three aspects: i) Storage required for supplying crop water requirements at an irrigated area, which are calculated for critical drought conditions. ii) Storage required for releasing the minimum ecological river flow under the described weather condition. iii) Spillway dimensions to evacuate high peak flow events. Those aspects are fundamental for designing a reservoir, however, designing reservoir operation rules is also an important aspect and normally it is a big uncertainty for project managers. This study focuses on developing a mathematical model for operating reservoirs for irrigation projects into an integrated basin context. The crop cycle is simulated for several year based on long term historical hydro-meteorological time series in a daily basis. Irrigation requirements are obtained from those simulations. Those results are clustered in 10-day periods during the crop cycle. Frequency analyses of the irrigation requirements are performed. Those results are applied for building irrigation schedules for dry, normal, and rainy conditions. Furthermore, frequency analyses are performed to the distributed rainfall for determining similar weather thresholds. The reservoir operation consists in first routing the inflow thorough the reservoir to the different outlets. A conceptual hydrological routing model is applied for this purpose. Second, the amount of water to release from the reservoir to the irrigation scheme depends on amount of rainfall measured during the precedent 10-days and on the irrigation schedule for that weather condition. The model was developed for a case study in the Ecuadorian Coast, which is a large irrigation project, called PACALORI. The reservoir operation rules were obtained by modeling the system for 42 years of hydro-meteorological data. The model would be implemented in a real time operation, depending on the monitoring implementation for measuring rainfall, flow, and meteorological variables.

Keywords: reservoir operation rules, irrigation, reservoir routing