Geophysical Research Abstracts,
Vol. 11, EGU2009-3420-1, 2009
EGU General Assembly 2009

Forecasting approaches to the Mekong River

E.J. Plate
em. Professor of Hydrology and Water Resources Planning, University of Karlsruhe, Germany (PLATE@IWK.UKA.DE)

Hydrologists distinguish between flood forecasts, which are concerned with events of the immediate future, and flood predictions, which are concerned with events that are possible, but whose date of occurrence is not determined. Although in principle both involve the determination of runoff from rainfall, the analytical approaches differ because of different objectives. The differences between the two approaches will be discussed, starting with an analysis of the forecasting process. The Mekong River in south-east Asia is used as an example.

Prediction is defined as forecast for a hypothetical event, such as the 100-year flood, which is usually sufficiently specified by its magnitude and its probability of occurrence. It forms the basis for designing flood protection structures and risk management activities. The method for determining these quantities is hydrological modeling combined with extreme value statistics, today usually applied both to rainfall events and to observed river discharges. A rainfall-runoff model converts extreme rainfall events into extreme discharges, which at certain gage points along a river are calibrated against observed discharges. The quality of the model output is assessed against the mean value by means of the Nash-Sutcliffe quality criterion. The result of this procedure is a design hydrograph (or a family of design hydrographs) which are used as inputs into a hydraulic model, which converts the hydrograph into design water levels according to the hydraulic situation of the location. The accuracy of making a prediction in this sense is not particularly high: hydrologists know that the 100-year flood is a statistical quantity which can be estimated only within comparatively wide error bounds, and the hydraulics of a river site, in particular under conditions of heavy sediment loads has many uncertainties. Safety margins, such as additional freeboards are arranged to compensate for the uncertainty of the prediction.

Forecasts, on the other hand, have as objective to obtain an accurate hydrograph of the near future. The method by means of which this is done is not as important as the accuracy of the forecast. A mathematical rainfall-runoff model is not necessarily a good forecast model. It has to be very carefully designed, and in many cases statistical models are found to give better results than mathematical models. Forecasters have the advantage of knowing the course of the hydrographs up to the point in time where forecasts have to be made. Therefore, models can be calibrated on line against the hydrograph of the immediate past. To assess the quality of a forecast, the quality criterion should not be based on the mean value, as does the Nash-Sutcliffe criterion, but should be based on the best forecast given the information up to the forecast time. Without any additional information, the best forecast when only the present day value is known is to assume a no-change scenario, i.e. to assume that the present value does not change in the immediate future.
For the Mekong there exists a forecasting system which is based on a rainfall-runoff model operated by the Mekong River Commission. This model is found not to be adequate for forecasting for periods longer than one or two days ahead. Improvements are sought through two approaches: a strictly deterministic rainfall-runoff model, and a strictly statistical model based on regression with upstream stations. The two approaches are com-pared, and suggestions are made how to best combine the advantages of both approaches. This requires that due consideration is given to critical hydraulic conditions of the river at and in between the gauging stations. Critical situations occur in two ways: when the river overtops, in which case the rainfall-runoff model is incomplete unless overflow losses are considered, and at the confluence with tributaries. Of particular importance is the role of the large Tonle Sap Lake, which dampens the hydrograph downstream of Phnom Penh. The effect of these components of river hydraulics on forecasting accuracy will be assessed.