TECHNICAL SESSION - V

MODELLING OF HYDROLOGICAL PROCESSES IN MOUNTAINOUS AREA I

GENERAL REPORT
by
B.P.Parida,
I.I.T. New Delhi

In this session under the theme 'Modelling of Hydrological Processes in Mountainous Areas' six papers have been submitted. It is expected will that their rich content will provide basis to generate a lot of discussions. Papers in this session either provide a basis or directly relate to flow simulation/ long term forecasting from mountainous watersheds.

Borovikova, Agalfseva and Pakazber under in their paper have tried to describe the philosophy behind the mathematical model developed to issue operational forecast of monthly flows from mountainous rivers in the Rep. of Uzbekistan with lead time upto six months, reliability level as high as 100 and as low as 57 percent.

In the model they account for snow, glacier and rain components separately and allow them through linear two volume model for transformation to run off, the upper one for rapid inflow transformation and the lower one through deeper acquifers. They use separate relationship between precipitation and altitude for three identified sub-zones, such that variation of rainfall with altitude can be accounted for appropriately. They also use climatic information (to overcome temperature and percipitation anomolies) for enabling issue of long-term forecasts through more than one season.

They operate the model using an integrated data base, through what they call as Automated Information System of Hydrological Forecasting (AISHF). Such a system seems to be quite useful for operation of reservoirs located for power generation in the hills of this country. So authors may comment on general appreciability of the model/system as it seems to be a dedicated one. They may also enlighten the participants by bringing out the Equation form of the model, type of data base used and amount of effort involved in adapting such a system. It is not known why the authors have used data of 1951 instead of some recent past. They may please comment on it and can bring out the reliability figures of some recent forecasts.

The next paper by Singh and Seth is indeed a nice piece of work in the sense that they have tried to minimise some of the process noise of the kind -

(i) error caused by estimating rainfall by Thiessen polygon method for the entire basin and

(ii) error caused due to catchment response simulation by conventional unit hydrograph,

usually encountered while carrying out rainfall runoff modelling in mountainous watersheds.

To overcome the areal and elevation effect of rainfall in such watersheds, concept of distributed model by use of isochrones have been used. Response from each such area can then be determined at the outlet to obtain a very reliable simulation result.

Further to achieve better correlation between simulated and observed flow peaks as well as time to peak, they have carried out sensitivity analysis of parameters.

To make the study more comprehensive in light of the changing global climatic senario the authors have carried out further investigation by introduction of systematic errors to the inputs. They have applied such concepts to real life data of a mountainous watershed i.e. Kishau on Tons, to estimate design flood. Authors may please indicate if some detailed documentation of the model is available for use by others to compare results.

M. Hoque in his paper describes the use of finite element method instead of conventionally used finite difference methods, as used in MIKE 11 model, to simulate floods with either complete hydrodynamic, kinetic or diffusive behaviour of a river. The effort though is praise worthy but lacks essence in the sence that, why use complicated procedures if simpler ones can yield as good a result which are comparable. The author has used the model for simulating flows of R. Jamuna of Bangladesh, for the months of April and May. Because during these months the channel properties like the roughness coefficient and cross section, flow conditions (including lateral inflow or outflow to and from channel) are more or less stable. If he had used it at least for one complete year simulation then it could possibly have proved the usefulness of the model.

Further, it is not clear, if the watershed belongs to a mountainous one or not.

Author may kindly clarify the above points and may also indicate what kind of increments in space and time he has used in his exercise to track such large volume of flow over 230 km length of the river.

R.Kumar in his paper has attempted at studying the hydrological behaviour of a mini-agricultural watershed in the Himalayan mountainous region. The paper primarily deals with study of response characteristics including soil and nutrient losses from the watershed with appropriate land use and continued soil and water conservation measures.

It also describes the gradual development of an experimental watershed including instrumentation such that effects of watershed management practices can be observed. The findings bythe author reinforced the general consensus that appropriate watershed management practices including soil conservation can arrest the soil and nutrient losses from watershed during rainfall.

Author may agree that the relationship that may accrue from such observations are not optimal and neither can the results be directly transferable to a natural watershed of some thousand sq. kms. in size evenin the same region. In such a case, author may throw some light on the limitation and usefulness of these exercises and kind of expenditure involved in such a study.

Paper by James, Sreedharan, Mayya and Gowde is a commendable effort to bringout the usefulness applicability of Linear Perturbation Model for run-off estimation from five catchments of the Western Ghat region.

As shown by the authors, the results in terms of model efficiency are quite encouraging for mountainous catchments of area greater than 1000 Km^2. It would be interesting to know why there has been an uniform reduction in model efficiency with decrease in size of the basin.

Authors have used different sets of calibration and verification period for different catchments. It is felt that the resulting Table 8 possibly could have shown a different picture if an uniform period say between 1973-77 and 1978-79 were used for calibration and verification respectively. Further, the memory length used by the authors as given in Col. (3) of Table 7 seems to be little large while considering mountainous watersheds. Even Fig. 1 furnished by the authors is quite suggestive in this regard. Author may comment on this aspect please.

Y. Putty and R. Prasad in their paper have attempted at modifying the Kentuky Watershed model to suit the Indian conditions and use it for flow simulation from some watersheds in the Western Ghats Region of the country.

Source areas defined as the portion of watershed where rainfall is readily transformed into run-off are frequently located near streams. Since the extent of slope, type and extent of vegetation and soil cover can vary within a mountainous watershed considerably, the variable source area concept which offers more logical structure for assessing a water-shed's response to percipitation has rightly been used by the authors. They have identified such areas as large as 60 % of the total area at Yettinahole (27 Km^2). This figure though looks very high may be the case once flows are non-Hortonian. Authors may clarify this situation please.

The model has been applied to very small, one can say mini catchments, of the order of only 4.5 and 27 sq. Kms. Such attempts do not reflect the true modelling capability as the flow response time from such catchments may be in the order of hours whereas the observations are in the order of day/s. Probably usefulness of such an extensive model could have been well appreciated, if the model were applied on a fairly large catchment.

Authors may throw some light as to the extent of efforts they had to put to accomplish such a task i.e. in data collection and preparation, and making the model operational (calibration and verification). Also they may present their experience, particularly if any difficulties were encountered in optimization of a large number of parameters.

CONCLUSION

Mountainious watersheds are usually characterised by their elevation, slope, forest cover, land-use soil cover and drainage pattern. In such catchments data are usually sparse due to either little instrumentation or poor accessibility to such sites. Probably simple, physically based/geomorphologic models which demand less of observations may prove more useful as additional complexity gives no guarantee of model accuracy and rather reduces adaptibility and ease of use.

But to capture the rapid response mechanism, consideration of physics of preferential pathways to enable flows through micro and macropores, need be incorporated in the model to put it on a more rational and physically correct and less empirical footing.

The authors deserve special appreciations for their commendable effort in not only carrying out the scientific studies but also contributing their experiences in form of technical papers for this session.