Abstract

In the study a weather model was coupled with a hydrologic model and a hydraulic model for predicting floods in Nilwala river basin in southern Sri Lanka. The basin is located mainly in the Matara district within the latitudes 5° 55' - 6° 13' and longitudes 80° 25' - 80° 38'. The basin covers about 1,073 km^2. The river originates at Pannilkanda at an altitude of 1050 m, traversing 72 km it meets the Indian Ocean at Matara.

WRF 3.0 (Weather Research and Forecasting) weather model was used to predict rainfall over the basin 24 h into future. The model was fine-tuned to suit its operating environment by investigating the impacts of its physics options on precipitation forecasting. In model fine-tuning, impacts of microphysics schemes, cumulus schemes, land surface schemes, long/shortwave schemes and boundary layer schemes on rainfall predictions were investigated. Model predictions were compared with observed point rainfall data for three rainfall events to find reasonably good physics combination. It was seen that model physics combination; Ferrier microphysics scheme, Kain-Fritsch cumulus scheme, Rapid Update Curve land surface scheme, Rapid Radiative Transfer Model longwave radiation scheme, Dudhia shortwave scheme and Yonsei boundary layer scheme yields better precipitation predictions over the basin when compared with the other physics combinations tested.

After fine-tuning the weather model, hydrologic model HEC-HMS 3.3 (Hydrologic Engineering Center-Hydrologic Modeling System) was calibrated and verified with Clark's, Snyder's and SCS transformation methods for three rainfall-runoff events on its

application to Nilwala basin upstream of Pitabeddara. In all model runs Green-Ampt loss model was executed with recession base flow method. It was found that Snyder's method performs better than other methods in calibration and verification. Snyder's method produced Nash-Sutcliff efficiencies greater than 70% and 50% in calibration and verification respectively. Ungauged portion of Nilwala basin was divided into 10 sub basins and Snyder's method was applied based on judgments and assumptions. Snyder's basin lag time was calculated for all the sub basins. Hydraulic conductivity for the whole basin was assumed to be same as for the upper basin. In order to couple weather model with hydrologic model a Microsoft Excel based program was developed. The program converts the distributed rainfall output of WRF into a lumped input for HEC-HMS sub basins.

As a demonstration May-2003 flood was simulated with the model combination. WRF predicted rainfall was introduced to HEC-HMS and the generated river discharges of sub basin were ingested to the HEC-RAS 4.0 (Hydrologic Engineering Center-River Analysis System) hydraulic model for water profile computations along the Nilwala main river from Pitabeddara to Matara. Output of HEC-RAS was exported to Arc GIS 9.2 where it was two dimensionally visualized as a flood map. Flood map generated was compared with observed flood inundation data obtained from literature. Model was capable of predicting Hulandawa, Akuressa, Malimbada as inundated regions which have been indicated as inundated areas in literature.