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Hydrodynamic modelling of extreme flood events in the Kashmir valley in India

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Floods are one of the most predominant, costly and deadly hazards of all natural vulnerabilities. Every year, floods exert a heavy toll on human life and property in many parts of the world. The prediction of river stages and discharge during flood extremes plays a vital role in planning structural and non-structural measures of flood management. The predictions are also valuable to prepare the flood inundation maps and river floodplain zoning. In the Kashmir Valley, floods occur mainly and very often in the Jhelum Basin mostly due to extreme precipitation events and rugged mountainous topography of the basin. These floods cause extreme damage to life and property in the valley from time to time. Excessive rainfall, particularly in higher sub-catchments causes the snow to melt resulting in excessive runoff downhill to the streams causing floods in the Kashmir Valley where Srinagar city is located. However, very few hydrological studies have been undertaken for the Jhelum Basin mainly due to non-availability of hydrological data due to very complex mountainous terrain. Therefore, the present study has been conducted to model the extreme flood events in the Jhelum Basin in Kashmir Valley. An integrated NAM and MIKE 11 HD model has been setup for Jhelum basin up to Ram Munshi Bagh gauging site and then four most extreme historical flood events in the time series has been analyzed separately including the most recent and most extreme flood event of 2014. In September 2014, the Kashmir Valley witnessed the most severe flood in the past 60 years due to catastrophic rainfall from 1st to 6th September wherein the valley received unprecedented rainfall of more than 650 mm in just 3 days breaking record of many decades. The MIKE 11 HD and NAM model has been calibrated using 21 years (1985-2005) data and validated using 9 years (2006-2014) data. The efficiency indices of the model for calibration and validation period is 0.749 and 0.792 respectively. The model simulated extreme flood events showed good agreement (within $\pm 15\%$) with corresponding observed peak discharge. The model could simulated the most severe flood event of 2014 reasonably well with simulated peak discharge of 2055 m3/s which is just 3% more than the observed discharge. The developed hydrodynamic model may be useful in simulating extreme flood events in the Kashmir Valley with reasonably good reproduction of extreme flood events.