Second International Conference on
"Natural Hazards and Risks in a Changing World"
5-6 October 2021

Development of Inflow Forecast based Warning System for Downstream Reach of Tehri Dam, India

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ABSTRACT

Hydrological forecasting refers to evaluating the future state of a hydrological system. There is a growing concern among the research community in providing accurate and reliable hydrological forecasts in space and time. Streamflow forecasting is vital for flood forecasting and a range of applications related to design, operation and water resources management. Streamflow forecasts with sufficient lead time are essential for issuing warnings and enacting preventive measures, including evacuation. Increasing lead time also provides significant economic benefits as it facilitates cost-effective water management and protects water shortages. The Early Inflow Warning System minimises and prevents the risk of flooding. Real-time hydrometeorological observations are part of an Early inflow warning system. The usefulness of an early warning system estimates the amount of flood damage to private and public assets that may be avoided by responding to the warning. The benefits of inflow forecasting systems derive from savings on flood damages. This paper discusses the methodology of Medium-range streamflow forecasting using the statistical-dynamical approach. The Local Polynomial regression model is suitable for understanding the nonlinear relationships between the dependent and independent variables for the statistical modelling system. The HEC-HMS hydrologic model is reliable as the dynamical model. An inflow forecast based warning system is under development for the downstream reach of Tehri Dam. The methods have been developed to merge statistical and dynamic forecasts into a single forecast objectively. The HEC-RAS hydraulic model is also used to analyse the effect of release from the Tehri dam and the impact of the Alaknanda river in the downstream area.

OBJECTIVES/RESEARCH GAPES

There is no work has been done Nationally on Hydrological Forecasting in India.

Selection of Different Datasets (i.e, Rainfall, Relative Humidity, Temperature etc.) used in the Study.

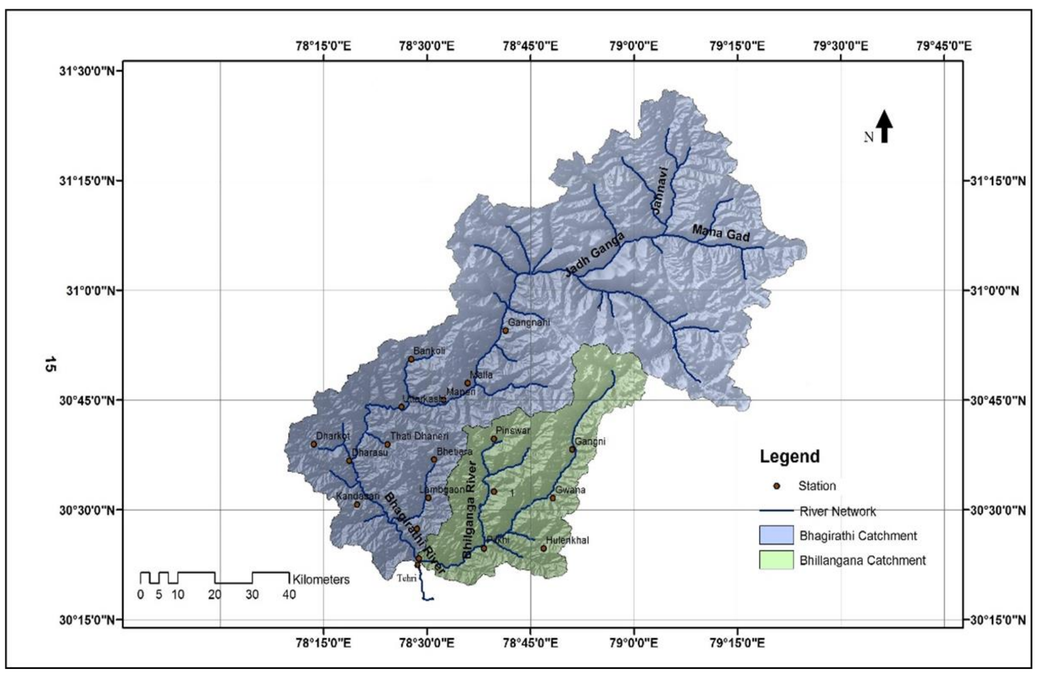
To develop a Medium Range Streamflow forecasting system using Statistical model.

To develop a Medium Range Streamflow forecasting system using Dynamical model.

To improve the accuracy of forecast through merging of Statistical and Dynamical model.

Flood Plain Mapping of Flow released from Tehri Dam to the Dev Prayag

STUDY AREA



NEED OF STREAMFLOW FORECASTING FOR TEHRI DAM

Inundation mapping can be generated for the Released Hydrograph from Tehri Dam.

The longitudinal profile is quite steep so the warning time is very less in this case. This warning system can be increased by linking it with the forecasting of inflow to the dam.

The lead time of forecasts can be increased substantially by developing the inflow forecast models by linking them with forecasting of rainfall.

REFERENCES

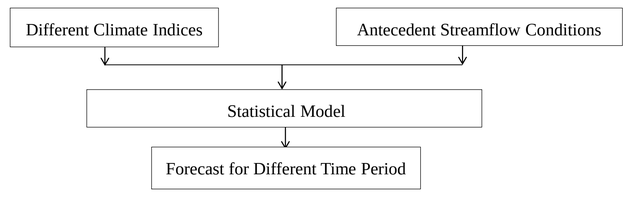
Jasper, K., Gurtz, J. and Lang, H., 2002. Advanced flood forecasting in Alpine watersheds by coupling meteorological observations and forecasts with a distributed hydrological model. *Journal of hydrology*, *267*(1-2), pp.40-52.

Regonda, S., Rajagopalan, B., Lall, U., Clark, M. and Moon, Y.I., 2005. Local polynomial method for ensemble forecast of time series. *Nonlinear Processes in Geophysics*, *12(3), pp.397-406.*

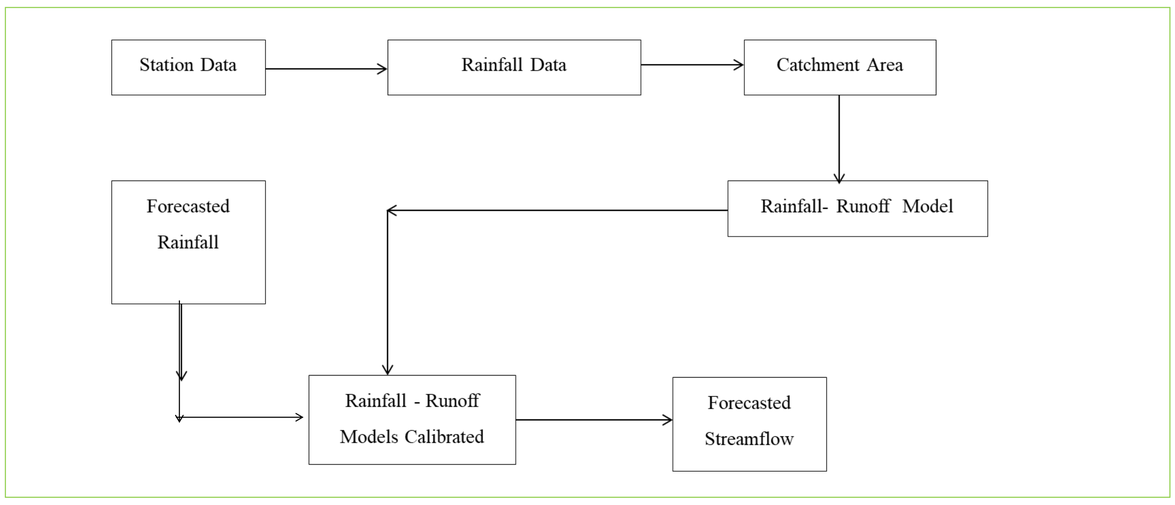
METHODOLOGY

Statistical Model

Nonparametric statistical methods are becoming increasing popular for modeling in hydroclimatological studies (Lall 1995; Regonda et al. 2005; Prairie et al. 2007; Grantz et al. 2007; Block and Rajagopalan 2007). It has the ability to capture nonlinear relationships between the dependent and independent variables.



Dynamical Model



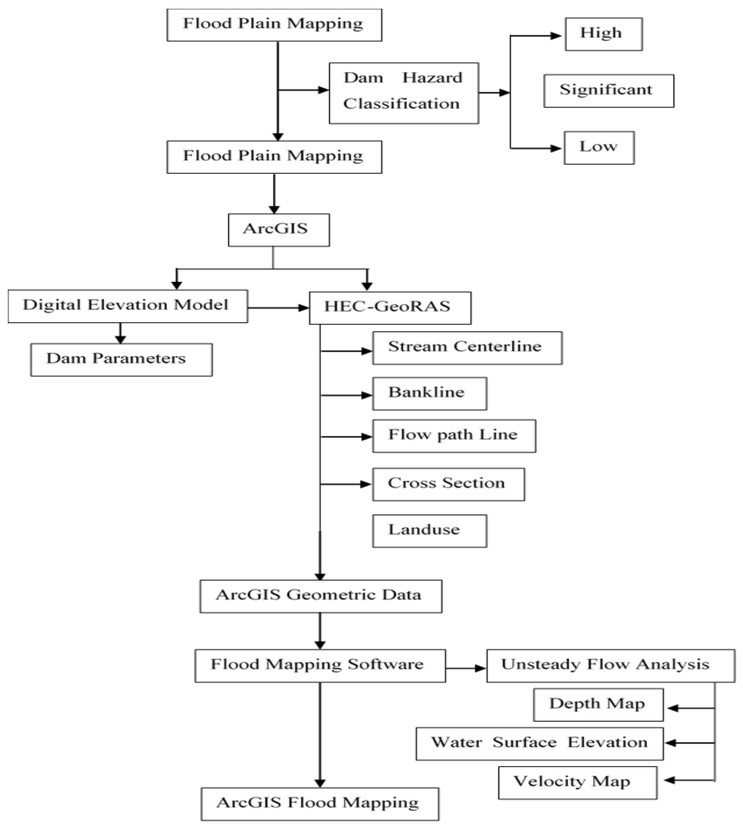
Merging of Statistical model and Dynamical model

Quantile Model Averaging and Weights Inference

To take advantage of the better performing approach, methods were developed to objectively merge statistical and dynamic ensemble forecasts into a single forecast (Schepen & Wang, 2015).

$$y_{QMA}(F) = \sum_{k=1}^{k} w_k y_k(F)$$

Hydraulic Routing



POSSIBLE OUTPUTS

- Analysis of the study area with the suitability of different forecasted products for the reasonable Medium Range streamflow forecasting of flows and stages for Tehri catchment.
- A calibrated Ensemble (Statistical + Dynamical) Model for better assessment of water availability, and well accurate streamflow forecasting system at the medium range time scale.
- Analysis of Flood plain and Development of early warning system for the downstream of Tehri dam length upto Devprayag.