



# Designing efficient rain-gauge networks for improved flood forecasting in a large river basin

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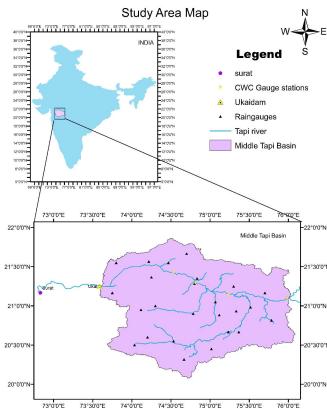


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## Background

Accurate runoff estimation is fundamental to improving streamflow forecasting, particularly in large river basins with sparse or uneven rain-gauge coverage. This study investigates the identification of representative rain gauges from a densely but randomly distributed network to support reliable runoff simulation in data-limited regions.

## Study Area



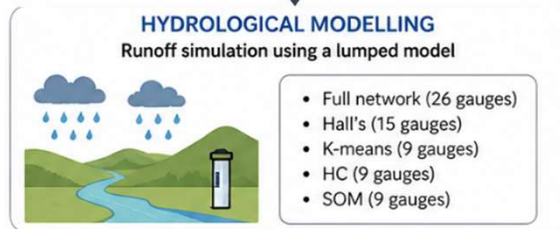
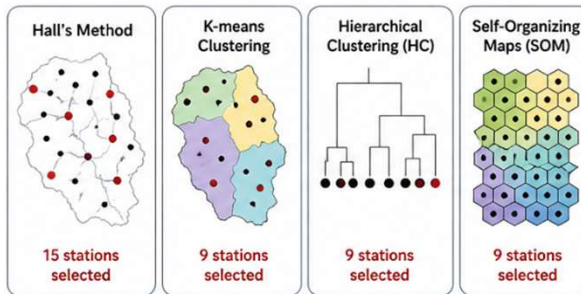
Study area (Middle Tapi Basin): 32000 km<sup>2</sup>  
Total rain gauges installed: 26

## Objective

The present study aims to select key rain gauges from randomly installed rain gauges in large basins with wide ungauged areas.

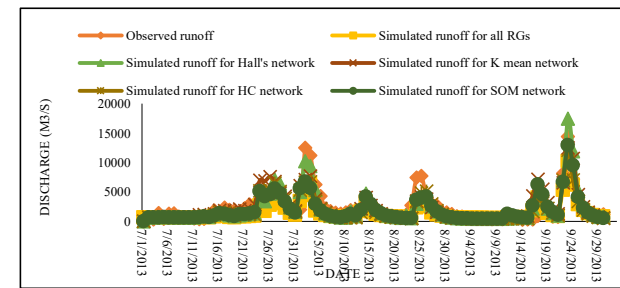
## Methodology

Identify key rain gauges from 26 stations

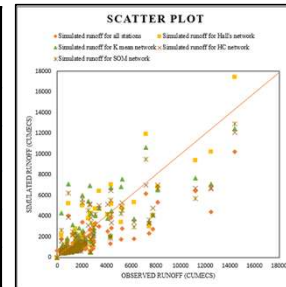


## Results

- Full network (26 gauges)
- Hall's (15 gauges)
  - K-means (9 gauges)
  - HC (9 gauges)
  - SOM (9 gauges)



Statistical Parameters	Model with all 26 RGs	Hall's method	HC clustering	K-mean clustering	SOM clustering
R <sup>2</sup>	0.721	0.816	0.755	0.627	0.675
Pearson's r	0.849	0.903	0.86	0.792	0.822
NRMSE	0.761	0.602	0.599	0.727	0.670
NSE	0.563	0.729	0.721	0.604	0.664
IA	0.821	0.932	0.912	0.883	0.891



## Conclusions and Implications

- The use of 15 key rain gauges identified through Hall's method is recommended for runoff prediction in the Middle Tapi Basin.
- The proposed framework is transferable and can be applied to other large basins with heterogeneous rainfall patterns and limited monitoring infrastructure, offering a practical approach for optimizing rain-gauge networks to enhance hydrological modelling and flood forecasting.