Data-driven fog forecasting for the Indo-Gangetic Plains

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Fog is a socio-natural hazard common during winter in the Indo-Gangetic Plains, disrupting transportation, health, and agriculture. The Indian Institute of Technology Kanpur fog project addresses the challenge of fog forecasting by using data science with *in situ* and satellite observations. A novel fog index quantifies fog duration and intensity, supporting medium-term forecasting, while machine learning models achieve 0.9 accuracy for six-hour visibility forecasts. An uncertainty-aware Bayesian neural network using INSAT-3D data improves fog detection performance compared to the operational INSAT fog product, increasing the probability of detection from 0.13 to 0.68. The real-time results are publicly shared at https://fog.iitk.ac.in/.

Keywords: Forecasting, Indo-Gangetic, INSAT-3D, time-series, visibility.

FOG is a common and dis[illegible] assess fog's impact on crop growth and hydrologists estimate the potential for fog water collection, which serves as a valuable source of freshwater in some regions[6]. Some studies have analysed individual fog events by conducting hydro-meteorological measurements at various heights to understand the physical processes behind fog formation[7]. The insights from such experiments are integrated into NWP models to enhance forecast accuracy. However, NWP models often fail to capture the intricacies of fog formation, limiting their forecasting accuracy[8]. In this context, data science provides a promising method for fog forecasts. A large amount of data on fog, moisture, aerosol, temperature, wind, etc., is available. Using these data, machine learning (ML) and data science-based forecast models for fog are developed[9]. Thus, fog research is a multidisciplinary field with diverse objectives, each targeting different spatial and temporal scales.

The Indian Institute of Technology Kanpur (IITK) fog project explores the data-science methods for monitoring and forecasting fog using *in situ* and remote sensing ob-