National Remote Sensing Centre

Indian Space Research Organisation, Government of India, Hyderabad.

Science Story

Lightning Detection System (LDS) Network in India

Atmospheric Lightning, in particular cloud to ground (CG), is an important natural disaster causing death and property damage in many parts of the world, including India. Given the country's vast expanse, varying topography, and its dependence on the convection, lightning flashes are more problematic during the monsoon season. Understanding the atmospheric lightning flashes and their occurrences is one of the most important questions of the Earth's climate science with meagre climate qualified database over the Indian subcontinent.

Recognizing the importance of timely detection and warning, India has taken steps to implement and enhance the network of Lightning Detection System (LDS).

Principle of Lightning Detection System

Most LDS use a combination of Very High Frequency (VHF) and Low Frequency (LF) detectors. Lightning emits radio waves, and these frequencies are especially useful in detecting them.

The system calculates the time difference in the detection of the radio wave by different sensors. With this data, it can triangulate the exact location of the lightning strike.

Lightning Detection and Warning Systems in India

Advanced Lightning Detection & Warning System (LDWS): India's Ministry of Earth Sciences initiated the LDWS to provide real-time information and early warnings about lightning events. This system covers the entire country.

Mobile Apps: Several state governments, in collaboration with the Indian Meteorological Department (IMD) and other organizations, have introduced mobile applications to provide real-time lightning alerts to users. These apps give warnings about potential lightning strikes in the vicinity, allowing individuals to take precautionary measures.

Network of Sensors: The LDWS system relies on a network of ground-based sensors that detect and triangulate the location of lightning events.

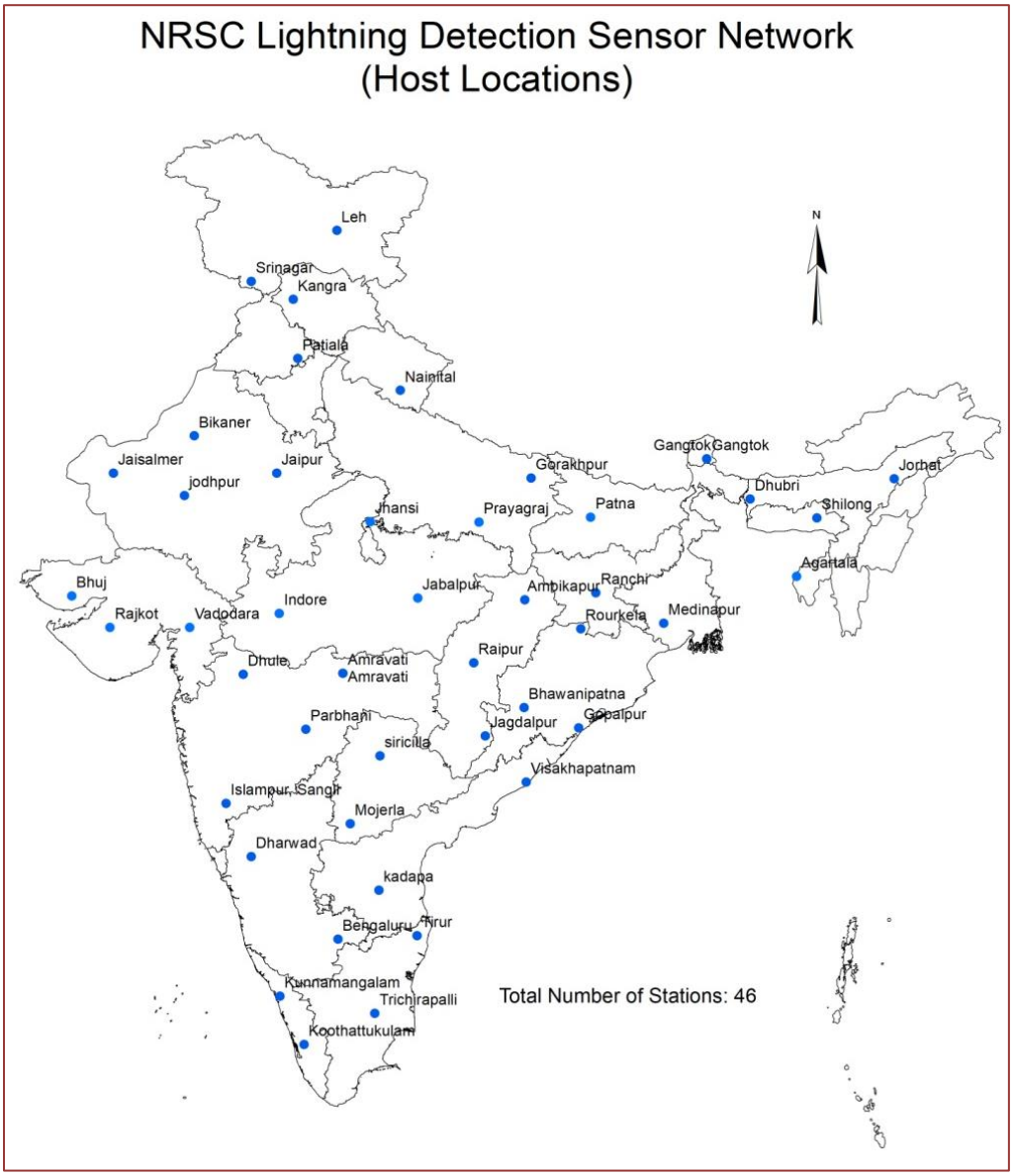

Fig. : 1 : NRSC's Lightning Detection System Network of sensors across India

NRSC's LDS Network

NRSC conceptualised the establishment of Ground-based Lightning Detection Sensor Network (LDSN) in December 2016. These are a network of ground based sensors placed at various locations in India. They triangulate the position of lightning flashes by detecting the VHF signals produced by the lightning. Till May 2023, NRSC installed 46 sensors at different parts of the country (Fig. 1). NRSC LDSN has large frequency range of 5 KHz – 50 MHz. The position accuracies are about 500 m.

The prime objectives of the LDSN are

1) To detect CG lightning flash occurrences, and generate essential climate variable (ECV)
2) To understand relation between atmospheric NOx and lightning occurrences
3) To achieve a lead time of CG lightning occurrences by integrating the obtained data with numerical weather prediction models.

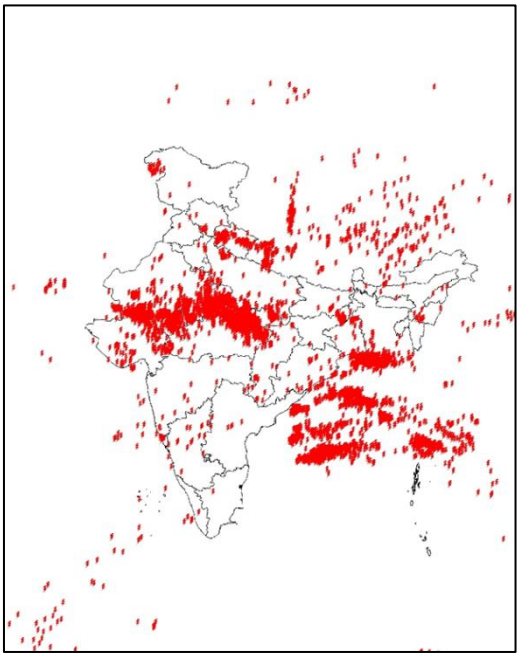

Fig. 2: Lightening flashes detected by NRSC LSDN on 03 July 2019

The LDSN data has been utilized to study the seasonal and diurnal characteristics of the CG lightning occurrences which reveal diverse spatio-temporal nature

With present network, NRSC generates regular Lightning ECVs on daily basis with latency of 1 day and are hosted and disseminated through BHUVAN/NICES (https://bhuvan-app1.nrsc.gov.in/lightning/) and NDEM (https://ndem.nrsc.gov.in/meteorological_lightiningecv.php). It is 'first such product worldwide'.

How is LDS useful ?

- Safety: Provides warnings to industries, outdoor events, or recreational activities so that precautions can be taken.
- Research: Helps scientists understand lightning behavior and its relationship with other atmospheric phenomena.
- Operational Planning: For industries like aviation, power transmission etc., knowing where lightning is can help saving fuel and ensuring passenger safety.

At present, efforts are ongoing to: 1) identify the CG lightning occurrence signatures of atmospheric NOx, 2) Parameterization of Weather Ranging and Forecasting (WRF)-Elec numerical weather prediction model to identify the most appropriate combination of schemes for day ahead outlook map generation of CG lightning occurrences, and, 3) Generation of lightning vulnerability maps to support the mitigation plan and policy.

In summary, while India has made significant strides in setting up an effective Lightning Detection System, challenges remain, especially in ensuring the broad reach of warnings and increasing public awareness. However, continued efforts in this direction can significantly reduce the number of lightning-related casualties in the country.