

Fog Monitoring in Northern India using NOAA AVHRR Satellite Data

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ABSTRACT

Fog is suspension of very small microscopic water droplets in the air. Fog forms during the night or early morning hours when radiative cooling at the earth's surface cools the air near the ground to a temperature at or below its dew point in the presence of a shallow layer of relatively moist air near the surface. 'River of fog' is a common scenario during winter season, which not only occurs in northern India but also in Pakistan and Bangladesh. Fog is a natural phenomenon. The emission of pollutants in great amounts due to human activities and changes in land use/land cover has increased density and frequency of fog. Fog plays a negative role in traffic by producing severe smog episodes. Various studies have shown clear relationship between fog occurrence and the human health and severe damages to forest and vegetation by increasing wetness period. Therefore, it is necessary to monitor the occurrences and dissipation of fog.

It is an arduous task to monitor the fog by ground-based sparse network of meteorological observation centres, although the satellite based monitoring of fog is convenient and accurate. The AVHRR data of NOAA satellites provide large area coverage but also facilitate for fog monitoring during night. This study is an attempt to monitor fog using meteorological satellite NOAA -17 AVHRR data pertaining to 2003 -2004 period. Brightness temperature differences between channels 4 and 3 of NOAA AVHRR are used in order to detect fog at day as well as at night in order to find out fog extent and frequency. Fog top albedo of channel-1 of AVHRR data is utilized for assessment of optical and microphysical properties of fog while simple thermodynamic equation based methodology is used in assessment of fog clearance temperature.

Study reveals that fog occurs not only in northern part of India including Jammu and Kashmir, Jharkhand, Madhya Pradesh, West Bengal, Orissa, and several parts of northeast of India but also in Pakistan, Nepal, Bangladesh and Myanmar. Sometimes, single fog event covers the entire northern region. Maximum fog frequency is noticed in Delhi, north Haryana, south Punjab, western Uttar Pradesh, and north Bihar while minimum fog frequency was observed in north-west Rajasthan, northern Madhya Pradesh and Chhattisgarh. The fog top heights as well as optical and microphysical properties were calculated for Delhi region using imagery dated 22nd December 2003 at 10.46 (hr IST). Those pixels, which had high digital number showed greater fog optical depth, liquid, water content and hence require more temperature for fog clearance.