Thunderstorm Forecast over Kolkata with Bipartite Graph Model

SUTAPA CHAUDHURI[1] and ANIRBAN MIDDEY[2]
[1,2]*Department of Atmospheric Sciences*
University of Calcutta
51 / 2 Hazra Road, Kolkata – 700 019, INDIA
chaudhuri_sutapa@yahoo.com
anirban_middey@yahoo.co.in

Single Spectrum Bipartite Graph (SSBG) model is developed to forecast thunderstorms over Kolkata (22° 32′N, 88° 20′E) during the pre – monsoon season (April – May). The statistical distribution of normal probability is observed for Lifted Index (LI), Bulk Richardson Number (BRN), convective available potential energy (CAPE) and convective inhibition energy (CIN) to quantify the threshold values of the parameters for the prevalence of thunderstorms. Method of conditional probability is implemented to ascertain the possibilities of the occurrence of thunderstorms within the ranges of the threshold values. The single spectrum bipartite graph connectivity model developed in this study consists of two sets of vertices; one set includes two time vertices (00UTC, 12UTC) and the other includes four Stability Indices, LI, BRN, CAPE and CIN. Three distinct ranges of maximal eigen values are obtained for the three categories of thunderstorms. Maximal eigenvalues for severe, ordinary and no thunderstorm events are observed to be (2.6 ± 0.12), (1.88 ± 0.09) and $(1.26 \pm .03)$ respectively. The ranges of the threshold values obtained using ten year data (1997 – 2006) are considered as the reference range and the result is validated with the IMD (India Meteorological Department) observation, Doppler Weather Radar (DWR) Products and satellite images. The result reveals that the model provides 12 to 6 hours forecast (nowcasting) of thunderstorms with 96% to 98 % accuracy.
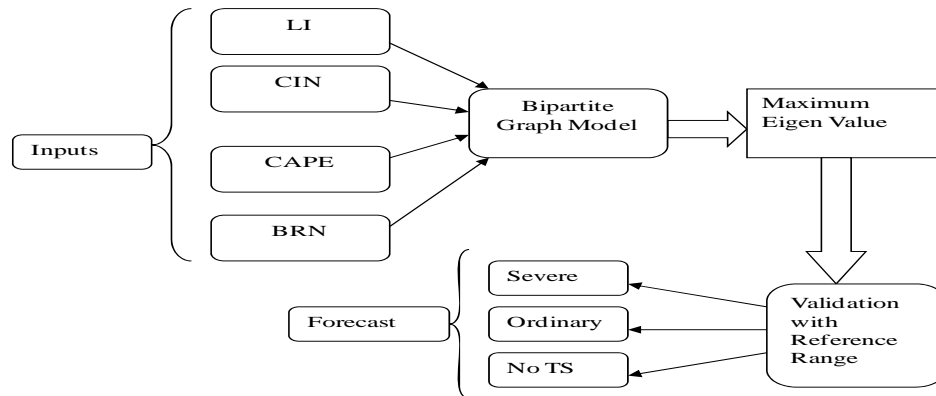
Figure 1 Bipartite graph model for thunderstorm forecast

Keywords: Severe thunderstorm, forecast, bipartite graph, Eigenvalue, threshold values, Adjacency matrix, Conditional probability.

References

[1] S. Chaudhuri and A. Middey, *Advances in Met.* **2009**, 1-12 (2009).
[2] El-Ghoul M, *Solitons and Fractals* **18,** 833-838 (2002)