

# A Review : An Image Mining Approach For Thunderstorm Detection Using Saliency Maps

Miss. Pranali S. Doifode, Prof. JayantRohankar

**Abstract:-**Thunderstorm is a sudden electrical expulsion manifested by a blaze of lightning with a muffled sound. It is one of the most spectacular mesoscale weather phenomena in the atmosphere which occurs seasonally. On the other hand, prediction of thunderstorms is said to be the most complicated task in weather forecasting, due to its limited spatial and temporal extension either dynamically or physically. Every thunderstorm produce lightning, this kills more people every year than tornadoes. Heavy rain from thunderstorm leads to flash flooding, and causes extensive loss to property and other living organisms. Different scientific and technological researches are been carried on for the forecasting of this severe weather feature in advance to reduce damages. In this regard, many of the researchers proposed various methodologies like STP model, MOM model, CG model, LM model, QKP model, DBD model and so on for the detection, but neither of them could provide an accurate prediction. The present research adopted clustering and wavelet transform techniques in order to improve the prediction rate to a greater extent. This is the first research study carried on thunderstorm prediction using the clustering and wavelet techniques resulting with higher accuracy. The proposed model yields an average accuracy of 89.23% in the identification of thunderstorm.

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## Introduction:

Thunderstorm is a vicious, climatic disturbance that is associated with heavy rains, lightning, thunders, thick clouds and gusty surface winds. Thunderstorm take place when a layer of warm and moist air rises to a larger extent, and updrafts to the cooler regions of the atmosphere. The updraft that contains moisture condenses in order to form massive cumulonimbus clouds and eventually leads to the formation of precipitation. Columns of frozen air then sink earthward, striking the ground with strong downdrafts and horizontal winds. Meanwhile, electrical charges mount up on cloud particles and causes lightning. This further heats the air in a fierce manner by which shock waves are produced, resulting in thunder.

Usually, thunderstorm have the spatial area for a few kilometers with a life span less than an hour. However, multi-cell thunderstorm have a life span of several hours and may travel over a few hundreds of kilometers. A thunderstorm is said to be severe when it contains hail measuring of about an inch or more, winds gusting to an extent of 50 knots (57.5 mph). Throughout the world it is estimated that 16 million thunderstorm occur each year, and at any given moment, there are roughly 2,000 thunderstorms in progress. There are about 100,000 thunderstorms each year in the U.S. alone. About 10% of these reach severe levels. Under the right conditions, rainfall from thunderstorms causes flash flooding, killing more people each year than hurricanes, tornadoes or lightning.

Cloud to ground lightning frequently occurs as part of the thunderstorm phenomena, which on severity becomes hazardous to the property, wildlife and population across the globe to a major extent. One of the most significant lightning hazards is to the wildfires, as they can even ignite the ground surfaces. Wildfires can devastate vegetation and the biodiversity of an ecosystem. Recently, thunderstorm in Uttar Pradesh has taken more than 110 human lives and dented famous mango belt of U.P. during May 15<sup>th</sup> 2008. In Canada, Alberta and southern Ontario are places best known for severe thunderstorms. In Canada the Saskatchewan

Government Insurance estimated that 5900 claims cost close to \$4 million and total damages were estimated at \$10 million due to the thunderstorms. On 18<sup>th</sup> May 2013, United States incurred losses of about \$125 million to \$250 million dollars due to the disastrous effect of thunderstorms.

## Brief Literature Survey

Paper [1]:-Kishor Kumar Reddy C, Anisha P R &Narasimha Prasad. "Detection Of Thunderstorms Using Data Mining and Image Processing ". International Journal of Scientific and Engineering Research 978-1-4799-2259-14/\$31.00 2014.

This is the first research study carried on thunderstorm prediction using the clustering and wavelet techniques resulting with higher accuracy. The proposed model yields an average accuracy of 89.23% in the identification of thunderstorm.

Paper [2]:-HimadriChakrabarty, Murthy, C.A., Sonia Bhattacharya and Ashis Das Gupta, "s," International Journal of Scientific and Engineering Research, 2013,pp. 1313-1318.

In this paper, it has been found how much correct prediction of the 'occurrence 'no occurrence' of severe storms can be done using vertical wind shears at different geo-potential heights of the atmosphere having the now casting time of around 12 hours. Multilayer Perceptron is found to yield very promising result. The result indicates that forecasting can be done correctly above 98% both for 'squall-storm days' and 'no storm days'.

Paper [3] :-Litta, A.J., Sumam Mary Idicula and Naveen Francis C, "Artificial Neural Network Model for the Prediction of Thunderstorms over Kolkata", International Journal of Computer Applications, 2012 ,pp. 50-55.

In this paper, experiments are conducted on artificial neural network (ANN) model to predict severe thunderstorms that occurred over Kolkata on 3 May 2009, 11 May 2009 and 15 May 2009 using thunderstorm affected parameters and validated the model results with observation. The performance of ANN model in predicting hourly surface

temperature during thunderstorm days using different learning algorithms are evaluated. A statistical analysis based on mean absolute error, root mean square error, correlation coefficient and percentage of correctness is performed to compare the predicted and observed data. The results show that the ANN model with LiebenbergMarquardt algorithm predicted the thunderstorm activities well in terms of sudden fall of temperature and intensity as compared to other learning algorithms.

Paper [4]:-Rudolf kaltenbock, GerharDiendorfer and Nikolai Dotzek, "Evaluation of Thunderstorm Indices from ECMWF Analyses, Lightning data and Severe Storm reports," Atmospheric research Journal, Elsevier, 2009,pp. 381-396.

This study describes the environmental atmospheric characteristics in the vicinity of different types of severe convective storms in Europe during the warm seasons in 2006 and 2007. 3406 severe weather events from the European Severe Weather Database ESWD were investigated to get information about different types of severe local storms, such as significant or weak tornadoes, large hail, damaging winds, and heavy precipitation. These data were combined with EUCLID (European Cooperation for Lightning Detection) lightning data to distinguish and classify thunderstorm activity on a European scale into seven categories: none, weak and 5 types of severe thunderstorms. Sounding parameters in close proximity to reported events were derived from daily high-resolution T799 ECMWF (European Centre for Medium-range Weather Forecasts) analyses.

Paper [5]:-Tajbakhsh, S., Ghafarian, P, and Sahraian, F., "Instability Indices and Forecasting Thunderstorms: the case of 30 April 2009," Natural hazards and Earth System Sciences, pp. 403-413.

In this paper, one meteorological case study for two Iranian airports are presented. Attempts have been made to study the predefined threshold amounts of some instability indices such as vertical velocity and relative humidity. Two important output variables from a numerical weather prediction model have been used to survey thunderstorms. The climatological state of thunder days in Iran has been determined to aid in choosing the airports for the case studies. The synoptic pattern, atmospheric thermodynamics and output from a numerical weather

prediction model have been studied to evaluate the occurrence of storms and to verify the threshold instability indices that are based on Gordon and Albert (2000) and Miller (1972).

### Conclusion

In this topic we have been conducted with various hybrid algorithm for the prediction of thunderstorms. It was demonstrated that the resulting mechanism out Rasika V. Kalbende et al Thunderstorms and lightning Detection system using Hybrid Approach 351| International Journal of Current Engineering and Technology, Vol.5, No.1 (Feb 2015) performs the previous methods such as STP model, MOM model, CG model, LM model, QKP model, DBD model in the detection of thunderstorms. In order to compute accuracy, the four basic performance measures i.e. sensitivity, specificity, accuracy and precision are computed. The proposed method predicts the thunderstorms with an average accuracy of 89.23%.

### References

- [1] Kishor Kumar Reddy C, Anisha P R &Narasimha Prasad. "Detection Of Thunderstroms Using Data Mining and Image Processing ". International Journal of Scientific and Engineering Research 978-1-4799-2259-14/\$31.00 2014.
- [2] HimadriChakrabarty, Murthy, C.A., Sonia Bhattacharya and Ashis Das Gupta, "Application of Artificial Neural Network to Predict Squall-Thunderstroms Using RAWIND Data," International Journal of Scientific and Engineering Research, 2013,pp. 1313-1318. AZDX31
- [3] Litta, A.J., Sumam Mary Idicula and Naveen Francis C, "Artificial Neural Network Model for the Prediction of Thunderstroms over Kolkata", International Journal of Computer Applications, 2012 ,pp. 50-55.
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