

# Weather Impact over Uttarakhand using k-Means Clustering Technique for Cloudburst Prediction

Deepalakshmi, J.Karthikeyan

Head & Assistant Professor, Department of Computer Science & Applications, Sir Theagaraya College, Chennai, India

Assistant Professor, Department of Computer Science & Applications, Sir Theagaraya College, Chennai, India

Email: profdeepalakshmi@gmail.com, Jkarthi108@gmail.com

**Abstract** — with the advancement of information technology and their tremendous development, ‘Numerical Weather Prediction’ is used by many meteorological services for predicting weather forecasts. This is available mostly for the welfare of the public. As this needs more scientific knowledge, Global Forecast Model came into existence for prediction of weather development from Numerical Weather Prediction. Data mining Clustering technique is applied in this analysis for forecasting the National Centre for Medium Range Weather Forecasting model which helps in predicting cloudburst. Tamil Nadu recently overcame a dreadful cloudburst on October 2015. Foretelling of cloudburst is exceptionally hard. This could be foretold only a few hours before. In difference to the on top of statement we have a tendency to predict cloud burst two or three days before. In this article rainstorm over Uttarakhand that created a heavy loss has been analysed by k-means algorithm.

**Keywords**— Cloudburst; Temperature; Numerical weather prediction; clustering; Relative humidity

## I. INTRODUCTION

The study conveys with the latest tremor of cloudburst over Uttarakhand that caused an enormous loss. This has been analyzed by making use of k-means cluster and Spectral cluster technique of information mining and has been imparted in this analysis to predict the forecast given by ESSO – NCMRWF. The prediction emulates that with the mining of NWP model the information is predicted in advance. These attributes are used to test the air pressure levels

- 1) Relative Humidity at air pressure level of 600hPa, 700hPa, 850hPa and 925hPa.
- 2) Specific humidity at air pressure level of 600hPa, 700hPa, 850hPa and 925hPa.
- 3) Temperature at air pressure level of 700hPa, 600hPa, 500hPa and 400hPa.and
- 4) Pressure at air pressure level of 20hPa, 15hPa, 10hPa and 5hPa.

The event Cloud burst happens when the unit forces between the H<sub>2</sub>O molecules. This will increase because of the fast reduction inside the high temperature in the rainclouds causing the lightning to stay within the cloud solely. This results in overactive energy building within the cloud. They're known as cloud bursts most probable outcome of it had been thought previously that clouds were dense liberally occupied with water. The intention for the cloud burst is that the fast condensation of the rainclouds. Meteorologists outline deluge as heavy downfall (100mm/hour) in a very little volume of time in a few little space (30 to 50 Sq.km). In India, Cloudbursts occur throughout the monsoon season owing to

sturdy convection related to orographic forcing over the chain of hill stations. The attributes used in the formation of cloudburst are specific humidity, atmospheric pressure levels, relative humidity and temperature.

## II. LITERATURE SURVEY

The state of Uttarakhand was caused by heavy rain and cloudburst in certain locations, between 14 to 17 June, 2013, recording the peak rainfall in 20 years in a three-day period, which triggered landslides and flash floods in multiple locations in the state. A perusal [1] shows the District wise rainfall distribution (14-17 June, 2013) and the total damage and loss in the flash flood and landslide. The network of rain gauges of Indian Meteorological Department (IMD), Uttarakhand government, numerical models and remote observation sources such as satellites and radars captured this widespread heavy rainfall episode [2]. The episode was comparable to the 2010 Leh flash flood episode, in that the synoptic conditions were similar in both cases.

Lacking of several warning and expectation impulsive heavy rain reasons the wide destruction in the area. The free resources occupied with dirt, fragments and rocks rolls down slope area and wash away the inferior areas causing loss to natural life and belongings. Steamy areas have the huge amount of humidity. Here foundation of immense drop of water is a natural occurrence because here convection present becomes robust. When cumulus clouds which are full of water arises down, deluge type rain happens with a reduction amount equal to or larger than 100 mm/hour (4.94 inches / hour). Throughout rainy season, the southern aspects of the Himalayan elevation hills are more disposed to the natural tragedies and happenings of destruction like cloud burst. The reasons and properties of cloudburst and helpful methods to reduce the impact of cloudburst and location map of the area are shown [4]. The three key reasons can be identified in the context of Uttarakhand disaster [5] such as Deforestation, Haphazard construction work and the damming effect. Because of tremor, an attempt is made to make use of data of recent incident in kedarnath area of Uttarakhand[6]. The Data Mining techniques can be made use of these weather details [7]. In this study we have made use of sub-grid scale weather events like cloudbursts by applying data mining techniques [8]. In this case, the best choice in unsupervised learning is that one could use *k*-means affinity directly.

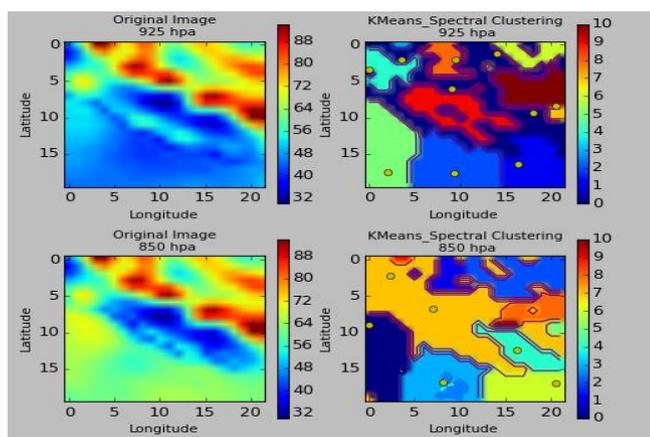
### Case Study - Output Products of GFS

The Global Forecast System (GFS) is a universal numerical weather prediction model run by Earth System Science Organization -National Centre for Medium range weather forecasting (ESSO-NCMRWF).

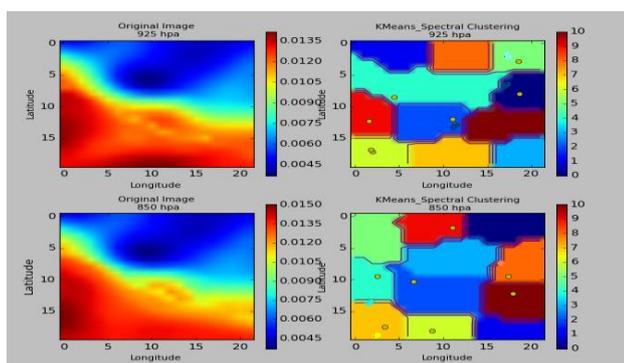
The models under consideration are: Global Forecast System (T574) with T574L64 resolution (~22 km in tropics). The datasets predicted by forecasting are specified in Gridded Binary Format which is data format. This one remains established on World Meteorological Organization’s Commission for Elementary Systems which predicts datasets values of atmospheric pressure levels.

The GRIB files are directly separated by weather parameters using Python coding instead of converting .csv format through NDFD Grib2 Decoder package of NOAA. For investigating four attributes such as Pressure, Relative Humidity, Specific humidity and Temperature at different levels are measured. The Specific Humidity and Relative Humidity at atmospheric pressure levels are of 925 hPa have been used to instigate coincidence which is the necessary constituent for cloudburst formation. Python programming has been applied with *k*-means algorithm along with spectral clustering. *k*-means calculates based on distance from center to each cluster. The distance is the measure for the similar type of data. After that, Spectral clustering is used to visualize the centroids in each clusters and it uses several mathematical concepts in order to divide similar data points in the same group and dissimilar data points in different groups. The above methods are used for the datasets of temperature at atmospheric pressure levels of 700hPa, 600hPa, 500hPa, and 400hPa separately. Likewise other attributes such as Relative Humidity and Specific Humidity have atmospheric pressure levels of 600hPa, 700hPa, 850hPa and 925hPa separately.

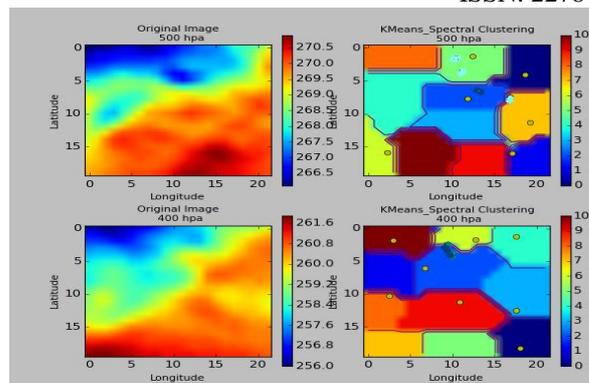
**III. RESULTS AND DISCUSSIONS**



Analysis of Relative Humidity



Analysis of Specific Humidity



Analysis of temperature

**IV. CONCLUSIONS**

Cloudburst has been predicted by K-means and Spectral clustering technique. After a thorough analysis of specific humidity and Relative humidity attributes at atmospheric pressure levels, it is found cloudburst occurs at maximum level at 925hPa among clusters. Similarly the temperature attribute shows that the cloudburst is formed at 400hPa. Hence the signal indicates the occurrence of cloudburst in advance.

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