

Review Research Paper

Forensic Meteorology: Tip of the Iceberg

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Abstract

The master field called Forensic science has been playing pivotal roles in solving the umpteen varieties of crimes taking place across the globe. As technology infiltrates every aspect of our lives, it is no wonder that solving crimes has become almost futuristic in its advances. But, as climate change is intensifying, there is an increase in natural calamities and cataclysmic related phenomenon throughout the world leading rise to an increase in the criminal issues related to it. The ability to accurately characterize weather events supports the successful litigation of many types of cases. Hence, Forensic meteorology is one such stream which has the potential to form the basis of some inventive plot lines by helping to determine the role of weather in crimes and in the loss of lives and money. It is the science of using historic weather records, atmospheric data, eyewitness accounts, and reenactment simulations in order to determine the weather conditions at a specific time and location. This review paper aims at highlighting the said stream of forensics by bringing to notice the role and scope of Forensic meteorology.

Key Words: Climate Forensic; Climatology; Weather Elements; Crime and Weather

Introduction:

The use of science or technology in the investigation and establishment of facts or evidence in a court of law is what Forensic Science deals with. Forensic science has proved its mettle in a variety of cases and has gained recognition in almost every branch of science. Forensic meteorology is the science of using historic weather records, atmospheric data, eyewitness accounts, and reenactment simulations in order to determine the weather conditions at a specific time and location. [1]

It is thus an upcoming field that deals with the application of various meteorological data to legal cases and related investigations in which weather may have been a factor. [2] The ever changing lifestyle of people has led to grave changes in the atmospheric conditions and its related phenomenon.

The issue of climate change is being responsible for the alarming increase in natural calamities and disasters. This in turn has led to an increase in the criminal activities related to it. With increasing losses from severe weather in recent years, the demand for Forensic meteorological services has also grown. [3]

During a severe drought in upstate New York in the late 1800s, a Presbyterian minister, Duncan McLeod, organized a community prayer for rain. Within an hour, small clouds had formed and the temperature had begun to fall.

A few hours later a severe thunderstorm moved through the region, bringing almost two inches of rain and washing out a highway bridge. Worse, though, was the bolt of lightning that hit and burned to the ground a barn owned by Phinneas Dodd. The sole objector to the community prayer, Dodd did not believe in tampering with Mother Nature.

He asked McLeod for \$5000 to replace the barn, and when McLeod refused, Dodd slapped him with a lawsuit. It was one of the first court cases involving weather and the law. [4-6]

In the end, "the defense counsel finally persuaded the court to dismiss the action on the grounds that defendants had prayed only for rain, and that the lightning had been a gratuitous gift of God." [4] Forensic meteorology deals with determining the magnitudes of each weather element at the exact location of issue.

Meteorological data like historic weather records, local atmospheric records, radio and satellite imaging, eyewitness accounts etc. is

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retrieved and analyzed with an aim to recreate a time line of relevant meteorological events required to solve the case. The types of cases regarding forensic meteorology can be categorized as litigation proceedings (civil and criminal) and Investigations (insurance, environmental impact assessment etc.).

Various events where Forensic meteorology takes the stand include snow, rain, hurricanes, cyclones, tornadoes, floods, drought, storms, pollution and the list is vast.

The range of crimes involving meteorological aspects can be equally as diverse as vehicle accidents, traffic accidents, murders, suicides, skiing accidents, kite surfing accidents, bad aircraft landings, bombing, agricultural disputes, property insurance disputes, building collapses, slip and fall cases, fires etc. [1] For instances where a blistering heat wave overwhelms electrical transformers and thousands of people lose the power.

When a plane plummets into a sea while the sky is hazy and dark or when a person dies while he was snowboarding, or a case where a vehicle falls into a valley on account of low visibility and rains, or be it the petty insurance claims in a flooded area. In all such cases, it's a good bet that forensic meteorologists will be working alongside government investigators and civil litigators to assess the role of weather in the losses of lives and money.

Role of Forensic Meteorologists:

Forensic meteorologists aim at carefully explaining what the weather conditions were and how it impacted the environment.

They acquire and interpret data, perform specialized analysis, prepare written reports and even deliver expert testimony. [2] The various roles of a Forensic meteorologist ranges from a variety of tasks including Investigation, Visitation

Source of Data/Information:

The use of high quality, reliable data is crucial to ensure the accuracy of forensic meteorological analyses. The required data and information in regards of the investigation under forensic meteorology can be obtained from the authorized meteorological organizations and departments of respective nations.

In India, this can be retrieved from the Indian Meteorological Department (IMD) of the Government of India. [9] IMD has 6 regional meteorological centres and different types of operational units such as meteorological Centres at state capitals, Forecasting Offices, Agro-meteorological Advisory service centres, Flood Meteorological Offices, Area cyclone warning centres and cyclone warning centres along with

to loss and/or injury sites and review of work procedures, methods and conditions, Inspection of failed products, equipment, buildings and systems, Retrieval and Analysis/interpretation of the data, Preparation of written reports, Production of visual aids for presentation, Presentation of conclusions, reports and testimony, Delivery of expert testimony, Evaluation of opposing theories, reports and conclusions, Discredit or refuse another witness's testimony and even to Assist the court in understanding the relevance of certain technical facts.

Forensic meteorologists have the expertise to determine inaccuracies that frequently exist in data that is available to the general public. They also have access to many more resources and the knowledge to interpret those resources.

The interpretation of these resources allows forensic meteorologists to pinpoint weather conditions at the exact location of incident, even when the nearest reporting site may be several miles away. [7]

Data/Information Required:

Depending upon the factors involved, each specific case or incident requires a somewhat different matrix of meteorological data and information. Data required for some commonly occurring cases are depicted in tabular form. (Table 1)

These data includes surface weather observations, upper air soundings, radar imagery, satellite imagery, three-dimensional analysis meteorological models, lightning data, snow and ice cover data, and climatological data and summaries. If needed, high-resolution numerical modeling can be coupled with available data to reconstruct an event.

separate divisions to deal with specialized subjects like civil aviation, seismology etc.

In some cases, the visible and infrared imagery from satellites, as well as the time-lapse imagery from geostationary satellites, has proved to be most useful in assessing cloud cover, the occurrence of severe weather, the timing of weather events and the presence of certain phenomena such as fog.

This can be obtained from the National Remote Sensing Centre of the Indian Space Research Organization (ISRO). [10] The knowledge of the professional meteorologist of these institutional publications and the data tabulations they include should be relied upon to assure the best possible meteorological and climatological assessments.

Conclusion:

The field of Forensic meteorology is growing fast, although its use in criminal cases is probably under-exploited at present. Forensic experts can determine the progression and magnitude of different weather elements throughout any questioned event. The involvement of an expert professional meteorologist in the assembly and interpretation of the required data and information can greatly benefit the legal proceedings. The knowledge that we have about this particular field is indeed the “tip of the iceberg”.

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Table 1: Data Required in Some Commonly Encountered Cases: [8]

Case	Data Required
Slip and fall cases	<ul style="list-style-type: none"> • Time-history of precipitation • Character of the precipitation.
Wintertime incidents	<ul style="list-style-type: none"> • Air temperatures • Ground surface temperatures • Cloud cover • Surface wind speeds • Exposure of a specific accident site to the night sky and any available direct sunlight. • Rate of radiative cooling/heating of ground surfaces • Prevailing humidity
Automobile accidents	<ul style="list-style-type: none"> • Time-history of precipitation • Character of the precipitation. • Horizontal visibility and occurrence of natural obstructions to driver visibility • Fog, haze, blowing dust and blowing snow. • Level of natural illumination from sunlight, twilight or moonlight • Impact of sun glare on a driver's ability to see
Building damage and roof collapse cases	<ul style="list-style-type: none"> • Time history of precipitation rate or intensity • Amount of snow and ice that accumulates on a roof • Heavy rains • Precipitation climatology • Thunderstorm downburst (straight-line) winds, tornadoes, lightning
Local stream and urban flooding	<ul style="list-style-type: none"> • Time-history of the precipitation, • Local topography • Precipitation climatology
Other common cases	<ul style="list-style-type: none"> • Timing of events such as freezing and thawing, the onset of strong winds, the changeover from rain to snow or snow to rain, the onset and duration of freezing rain and so forth • Climatological factors, such as whether or not specific weather events were unusual in their extent and/or intensity (Act of God Defense)