

# **Forensic Meteorology**

## ***Weather Event Reconstruction***

*The Expert Approach*

### **Consulting Engineers & Scientists, Inc.**

41 General Warren Boulevard  
Malvern, Pennsylvania 19355  
610-296-2250 ■ FAX 610-296-2259  
info@ces-experts.com  
www.ces-experts.com

## **PAST WEATHER EVENTS**

### **INTRODUCTION**

The ability to accurately characterize past weather events can support the successful litigation of many types of cases. Most often slip and fall, automobile and aircraft accidents, as well as building damage and roof collapse cases, have elicited the need for meteorological data and information. Supporting meteorological data have proved valuable in other matters as well; for example, damage from local stream and urban flooding, pleasure boating and maritime shipping accidents and even in homicide cases where weather had impacted on evidence or testimony. In some cases, it has proved useful to conduct a supporting climatological analysis to establish whether or not a particular weather event was extraordinary in its occurrence, intensity or duration or may reasonably have been expected at a particular location, season or time of day. The involvement of an expert professional meteorologist in the assembly and interpretation of the required data and information can greatly benefit the attorney for either the plaintiff or the defense or the insurance claim investigator.

### **THE ROLE OF THE PROFESSIONAL METEOROLOGIST**

The oft quoted expression “hindsight is 20/20” simply doesn’t apply to the reconstruction of past weather events. It is relatively rare that an incident occurs at the exact location or the exact time routine weather observations are made. Most commonly, some deduction of relevant weather elements is required based on the available data. It is here that the professional meteorologist brings the greatest skill in the application of sound meteorological and scientific principles in order to arrive at the best possible assessment of conditions at a specific location and time. Simple interpolation rarely applies.

The spatial and time scales of weather phenomena vary over a broad spectrum, ranging from yards and minutes for phenomena such as tornadoes, thunderstorms and downburst winds, to miles and hours for heavy precipitation events, and up to hundreds of miles and days for large mid-latitude and tropical storms. Each scale of phenomena presents the meteorologist with wholly different assessment problems. Depending on the character of the controlling weather event, different types of data and observations must be assembled and utilized. The professional meteorologist is best prepared to provide the attorney with a valid assessment of the weather conditions that prevailed at the time and place of concern, together with an assessment of the weather conditions over the preceding days or weeks, as they may have impacted the weather or ground conditions attendant to the incident of concern.

### **DATA AND INFORMATION REQUIRED**

Each type of case, let alone each specific incident, requires a somewhat different matrix of meteorological data and information. In slip and fall cases, a key parameter is the time-history of precipitation along with the character of the precipitation. What must be established are such factors as when any precipitation started, its duration, when rain may have changed to sleet or freezing rain or snow or vice versa, and with regard to the solid forms of precipitation, how much may have accumulated as a function of time on exposed, untreated ground surfaces. For wintertime incidents, air temperatures can be important; more likely, some insight is needed into ground surface temperatures, in that the snow or ice of concern forms or accumulates on the ground, not in the overlying air. Ground surface temperatures are not a measured parameter but rather must be subjectively deduced from the air temperature, cloud cover, surface wind speeds, and the exposure of a specific accident site to the night sky and any available direct sunlight. The local surface winds and the ground surface configuration can also play a role in local cold air drainage into low-lying areas, the rate of radiative cooling/heating of ground surfaces as well as on the prevailing humidity, which in turn influences local evaporation rates and surface drying.

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In automobile accidents, all of the same parameters apply if a slippery road surface was a factor in an accident. However, in automobile accidents, additional parameters often come into play such as the horizontal visibility and the occurrence of natural obstructions to driver visibility, specifically fog, haze, blowing dust and blowing snow. In some accidents, the level of natural illumination, that is the ambient illumination available from sunlight, twilight or moonlight, as well as the possible impact of sun glare on a driver's ability to see, can become a determining factor.

In building damage and roof collapse cases, the time history of precipitation is a major concern, particularly the time history of precipitation rate or intensity. The amount of snow and ice that accumulates on a roof is obviously an important factor in roof collapse incidents. However, since damaging roof loads often accumulate over a succession of storms occurring over periods of a month or more, intervening episodes of melting and refreezing must be accounted for in assessing roof snow/ice loads at the time of a structural failure. Also important in these cases can be the occurrence of strong surface winds both for the effect they can have on either scouring snow from an exposed roof or inducing the formation of snow drifts on gabled or multi-level roofs and behind rooftop obstructions or parapet walls. Heavy rains and thunderstorms can also be an important factor in the assessment of roof loads. Whether the key ingredient is heavy rain or snow, it sometimes becomes necessary to review the precipitation climatology of a specific location to determine the reasonable expectation of a particular precipitation rate or storm total precipitation and the resulting roof load. Additionally, such meteorological phenomena as thunderstorm downburst (straight-line) winds, tornadoes and lightning can often be the source of significant damage to buildings as well as other structures.

In dealing with occurrences of local stream and urban flooding, the principal considerations are clearly the time-history of the precipitation, and the local topography followed by an evaluation of the precipitation climatology. The question inevitably arises as to whether the contributing precipitation event was unusual in its intensity and/or duration.

All of these variables must be assessed and interpreted in the context of their probable consequence to the matter under litigation. In many cases, it is the 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, that can be more important to a case than the actual weather itself. Often, an assessment of climatological factors, such as whether or not specific weather events were unusual in their extent and/or intensity (Act of God Defense) can be critical to a case.

### **METEOROLOGICAL DATA AND INFORMATION COMMONLY USED**

The primary sources of the meteorological data needed to reconstruct past weather events are the records of surface weather observations made at first-order National Weather Service stations, military weather stations and FAA-staffed airport locations. Additionally, some data are available from stations maintained by other Federal agencies such as the Coast Guard. The National Weather Service maintains a network of hundreds of cooperative observation stations around the country at which limited climatological observations are made generally once each day. In some regions, state and municipal governmental agencies operate river gauge and rainfall observation networks. In some areas, data from fairly sophisticated amateur observation networks can prove valuable in properly assessing past weather events.

As part of their modernization programs, the National Weather Service and the FAA have replaced human observers at most locations with Automated Surface Observing Systems (ASOS). As a result, those parameters highly dependent on human observers, such as cloud

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types, snow depth and the liquid-water equivalent of residual snow and ice on the ground, are often no longer available from these sites. On the other hand, the automated equipment can provide more frequent observations and such parameters as hourly rainfall where previously no precipitation observations had been made. Other automated equipment provides observations from a network of marine reporting stations and offshore platforms and buoys. When necessary, data from more sophisticated sources such as the National Doppler Radar Network jointly implemented recently by the National Weather Service, the FAA and the Air Force or from meteorological observation satellites can be brought into play. The Doppler radars provide certain spatially-detailed products not previously available, such as hourly rainfall, storm total rainfall and wind. 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.

There are a number of National Oceanic and Atmospheric Administration (NOAA) publications that document meteorological and climatological data from across the country and, for that matter, around the world. The knowledge of the professional meteorologist of these publications and the data tabulations they include, should be relied upon to assure the best possible meteorological and climatological assessments.

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*The information presented in this booklet is intended only to be used as a guide in assisting clients concerned with or involved in the legal process where litigation or potential litigation is an issue. The information is further intended to inform clients that Consulting Engineers & Scientists, Inc. has both the expertise and the capability to provide direction and guidance in the specific disciplines and areas presented in this booklet. It is important to note that the information also is general and is not intended to completely cover the specific nuances of a particular matter. If there are any questions concerning this information, please feel free to contact us.*