PREDICTING THUNDERSTORM ACTIVITY

*We are indebted to **Captain Bertrand de Courville** for drawing our attention to the important issue discussed in this article. Captain de Courville is Head of Flight Safety at Air France and Chair of the IATA Safety Group.*

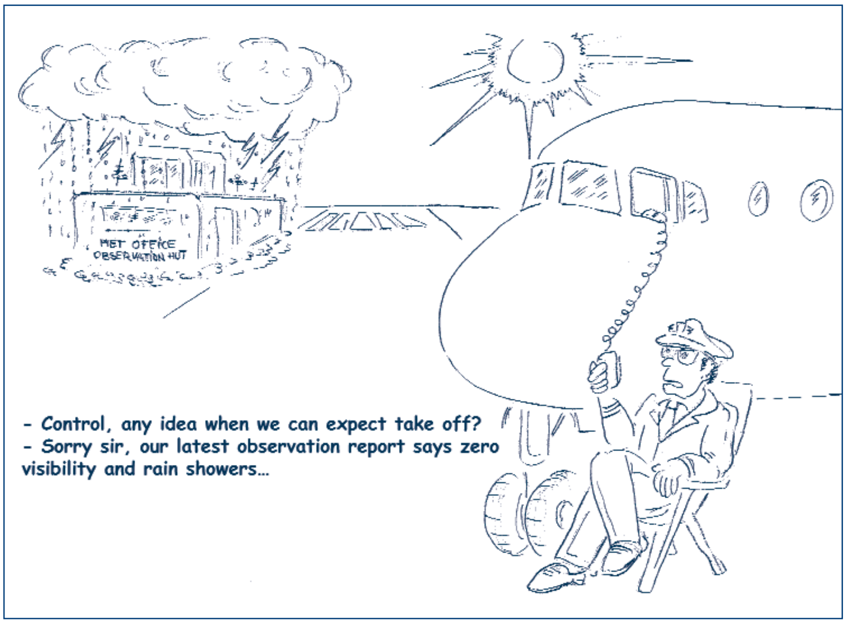
Meteorology is a notoriously exact science. Based on years of accurate observation and making use of the most advanced equipment and the best experience available, scientists have developed ways of predicting precisely what the weather should be doing at any time or place in the future. The only problem is that the weather often takes no notice of the clever formulae and mathematical models and does just what it wants! That is not a criticism of the scientists or their methods, nor of the forecasters, who are only too happy when the weather turns out exactly as they said it would. It is a simple statement of fact.

In order to manage our knowledge of the meteorological situation, regular observations are made and entered on the central computers. This enables forecasters to have warning of changing conditions and to know when and how the weather is deviating from what was expected. Armed with this information they can advise pilots and air traffic controllers of the progress of events, and more importantly, of any unforeseen hazards. This system works pretty well most of the time, but there is one gap in our knowledge that has not yet been bridged, although exciting work is under way on both sides of the Atlantic.

The exception to the rule is in the important area of thunderstorm activity. We know how and why a cumulonimbus cloud develops; and we certainly know what hazards are likely to be associated with it: updrafts, downdrafts, turbulence, wind shear, heavy precipitation, icing, lightning, etc. But if new equipment is on the way, it is not yet in general use, so that the forecaster cannot predict with anything like the desired precision where, when and at what speed the clouds will build or decay; nor has he/she a sufficiently good idea of the nature and intensity of the hazards that will arise at any given time. Moreover, an observer just a short distance away from a runway might experience quite different conditions from an aircraft landing or taking off.

There have been several accidents and serious incidents in which this weakness was a significant factor. These include the 1999 Bangkok runway overrun described in the article "9√P and All That". The most recent to come to light was the runway excursion involving Air France Airbus A340 (AF358) which took place at Toronto/Lester B Pearson airport on 2 August 2005. The report of the investigation board has just been released and may be viewed on the Transportation Safety Board of Canada website[4]. The report makes interesting reading, with findings that bear on many aspects of flight operations.

AF358 departed Paris on a scheduled flight to Toronto, Ontario, with 297 passengers and 12 crew members on board. Before departure, the pilots obtained their arrival weather forecast, which included the possibility of thunderstorms and loaded some extra fuel to give added holding time at Toronto. While approaching their destination, they were advised of weather-related



[4] For the full report, see http://www.tsb.gc.ca/en/reports/air/2005/a05h0002/a05h0002.pdf. A summary of the full report was published in the Air France safety magazine, Sûrvol, a translation of which is published on SKYbrary at http://www.skybrary.aero/index.php/Air_France_358:_Runway_Overrun_at_Toronto

delays. Some aircraft were diverting to their alternate aerodromes. By the time they were cleared for an approach their fuel state was low with only just enough for a diversion to their alternate aerodrome, Ottawa.

As they proceeded on their ILS approach the crew were advised that the aircraft landing ahead of them had reported poor braking action. Their weather radar was displaying heavy precipitation encroaching on the runway from the northwest. At about 300 feet above the runway threshold, the wind changed from a 90 degree crosswind to a tailwind of about 10kts. The aircraft deviated above the glideslope and the groundspeed began to increase. The aircraft crossed the runway threshold about 40 feet above the glideslope.

During the flare, the aircraft travelled through an area of heavy rain, and visual contact with the runway environment was significantly reduced. There were numerous lightning strikes occurring, particularly at the far end of the runway. The aircraft touched down about 3800 feet down the runway, reverse thrust was selected about 12.8 seconds after landing, and full reverse was selected 16.4 seconds after touchdown. The aircraft was not able to stop on the 9000-foot runway and departed the far end at a groundspeed of about 80kts. The aircraft stopped in a ravine and caught fire. All passengers and crew members were able to evacuate the aircraft before the fire reached the escape routes. A total of 2 crew members and 10 passengers were seriously injured during the crash and the ensuing evacuation.

The official report includes the following paragraphs:

2.5.5 WEATHER INFORMATION FOR PREDICTING CONVECTIVE WEATHER

The ability of flight crews to develop an accurate assessment of the current and future state of the weather is critical to effective decision making. Due to increasing time pressure nearing top of descent and during approach and landing, information should be presented in a format that minimizes the amount of synthesis and interpretation required of the user. Given the aim of developing situational awareness, the weather information presented should also allow the user to project into the future and anticipate the future state of the weather.

This occurrence clearly demonstrates how the changeable, unpredictable nature of convective weather makes it difficult to achieve these aims. In this occurrence, although the crew made a concerted effort to gather information with respect to the current weather conditions and although they were offered additional information with respect to wind and runway condition by the tower before landing, they were very surprised by the intensity of the weather encountered as they approached the threshold.

The perception of the crew during the approach was in contrast to the perception of many who were in a position to view the intensity of the storm from the ground in the minutes before the accident. The difference in perception of the storm was not limited to the accident flight crew in that they were one in a line of aircraft on approach for landing. Aircraft landed on Runway 24L approximately 9, 6, 4, and 2 minutes before the landing of AFR358 and there was at least one additional aircraft on approach behind the occurrence flight. It is noteworthy that all these crews had also elected to conduct their approaches in conditions similar to those encountered by AFR358.

Therefore, when dealing with convective weather, the information available to a flight crew on approach does not optimally assist the crew in developing a clear idea of the weather that may be encountered later in the approach. Given the localized, changeable nature of thunderstorms, the weather experienced by those close to or under the storm may not be anticipated by those approaching the storm.