The "Barn Door" Effect

Charles A. West, Ph.D.

NOAA/National Weather Service Center Weather Service Unit
Hampton, Georgia

Abstract

When enroute and at altitude, commercial aircraft pilots will deviate around convective weather more than five nautical miles for severe weather and lightning avoidance. These same pilots, given a situation where a similar storm is on final approach to their destination airport, will usually fly underneath a heavy to extreme convective cell with tops in excess of 50,000 ft. These cells can and usually do have the potential to produce severe weather including excessive lightning, wind shear, microburst, hail, and occasionally tornadic activity. Most pilots approaching major airports will continue their approach in these conditions usually because the aircraft in front of them has done it successfully, and they can see their final destination or the "Barn Door". Not until a pilot in command reaches their safety threshold and executes a missed approach and flies away from these conditions will this dangerous process end. This study shows forecast products and recommends air traffic management procedures that will help mitigate the potential for future aircraft disasters in final approach convective conditions. These findings and views are those of the author and do not necessarily reflect the views of the National Weather Service.

1. INTRODUCTION

As a child growing up on a horse farm, we frequently rode horses through the country on some treacherous terrain, and the horses usually went where we wanted them to go willingly. This however was not the case if we road too close to the barn and the horses could see their final destination, "the barn door". At that point they were going home, and it became very difficult to modify their decision. This same observation was made with pilots making "go" or "no go" decisions on whether or not to land with thunderstorm activity on or near the final approach to the Atlanta Hartsfield-Jackson International Airport.

Now this is not a comparison of pilots to horses by any mean, but more of the similarities of what influences a pilot's decision process when dealing with severe weather at different stages of flight, and those safety issues associated with such decisions. Studies have been conducted on how close crews will fly to convection enroute and in a terminal environment (Rhoda et al, 2002), and had shown that the same aircrew in many instances will fly under a cell of the same intensity on final approach that they would have went around enroute. This study identifies that because the aircraft in front of them had taken the approach and they can see the runway environment (the "barn door"), the next aircraft in line will also attempt a final approach.

An example of this phenomena is illustrated in a time series case in figures 3.1 and 3.2. As thunder storms approach the airport, aircraft continue to feed into the Atlanta Hartsfield Jackson International Airport. For this particular example, air traffic management had moved traffic that would usually enter from the northern and western arrival gates, to the south and southeast arrival gates. As Thunderstorms reach inside the airport environment at 01:15:15z, multiple aircraft continued on to final approach and land. Aircraft continued to land until 01:53:06z, when the first aircraft made the decision to go missed approach (or refused the approach), in which the aircraft behind them also refused the approach.

For over thirty-eight minutes, flight crews continued to make decisions to flight through or near level 6 (extreme) convection. Situations like this are the norm and not the exception at major airports that handle large volumes of commercial traffic. The question is why? Is it simply that the pilots can see the runway environment and feel safe to land because the aircraft ahead of them landed safely, or is there something else?

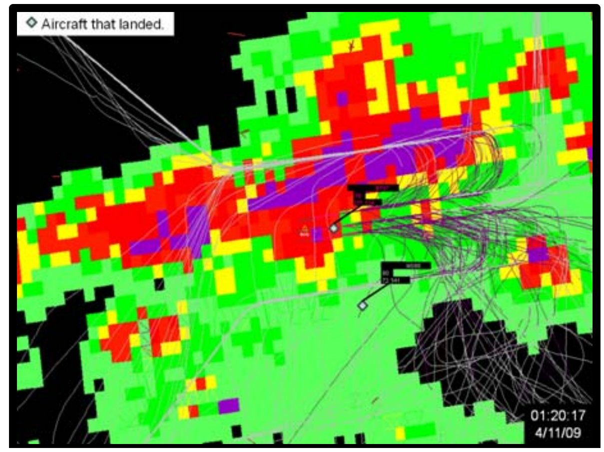
2. THE FAA's THUNDERSTORM AVOIDENCE GUIDELINES

The following guidelines were published in the Airmen's Information Manual AC00-24b Thunderstorm Avoidance, under the category "DO'S AND DON'TS OF THUNDERSTORM FLYING":

(1) Don't land or take off in the face of an approaching thunderstorm. A sudden gust front of low level turbulence could cause loss of control.
(2) Don't attempt to fly under a thunderstorm even if you can see through to the other side. Turbulence and wind shear under the storm could be disastrous.
(3) Don't fly without airborne radar into a cloud mass containing scattered embedded thunderstorms. Scattered thunderstorms not embedded usually can be visually circumnavigated.
(4) Don't trust the visual appearance to be a reliable indicator of the turbulence inside a thunderstorm.
(5) Do avoid by at least 20 miles any thunderstorm identified as severe or giving an intense radar echo. This is especially true under the anvil of a large cumulonimbus.
(6) Do circumnavigate the entire area if the area has 6/10 thunderstorm coverage.
(7) Do remember that vivid and frequent lightning indicates the probability of a severe thunderstorm.
(8) Do regard as extremely hazardous any thunderstorm with tops 35,000 feet or higher whether the top is visually sighted or determined by radar.

3. STUDY FINDINGS

Of the twenty cases sampled at the Atlanta Hartsfield-Jackson Airport in 2009, this study found that during all of the thunderstorm events, aircraft continued on final approach through or near (within 2nm) of thunderstorms until an aircrew refused the approach(an example of which in figure 3.1), and then all behind them refused also. No decisions to close the airport or stop traffic by air traffic control were made based on neither current weather nor the forecast, until the first aircraft refused the landing. Once an aircraft refused the approach, multiple aircraft



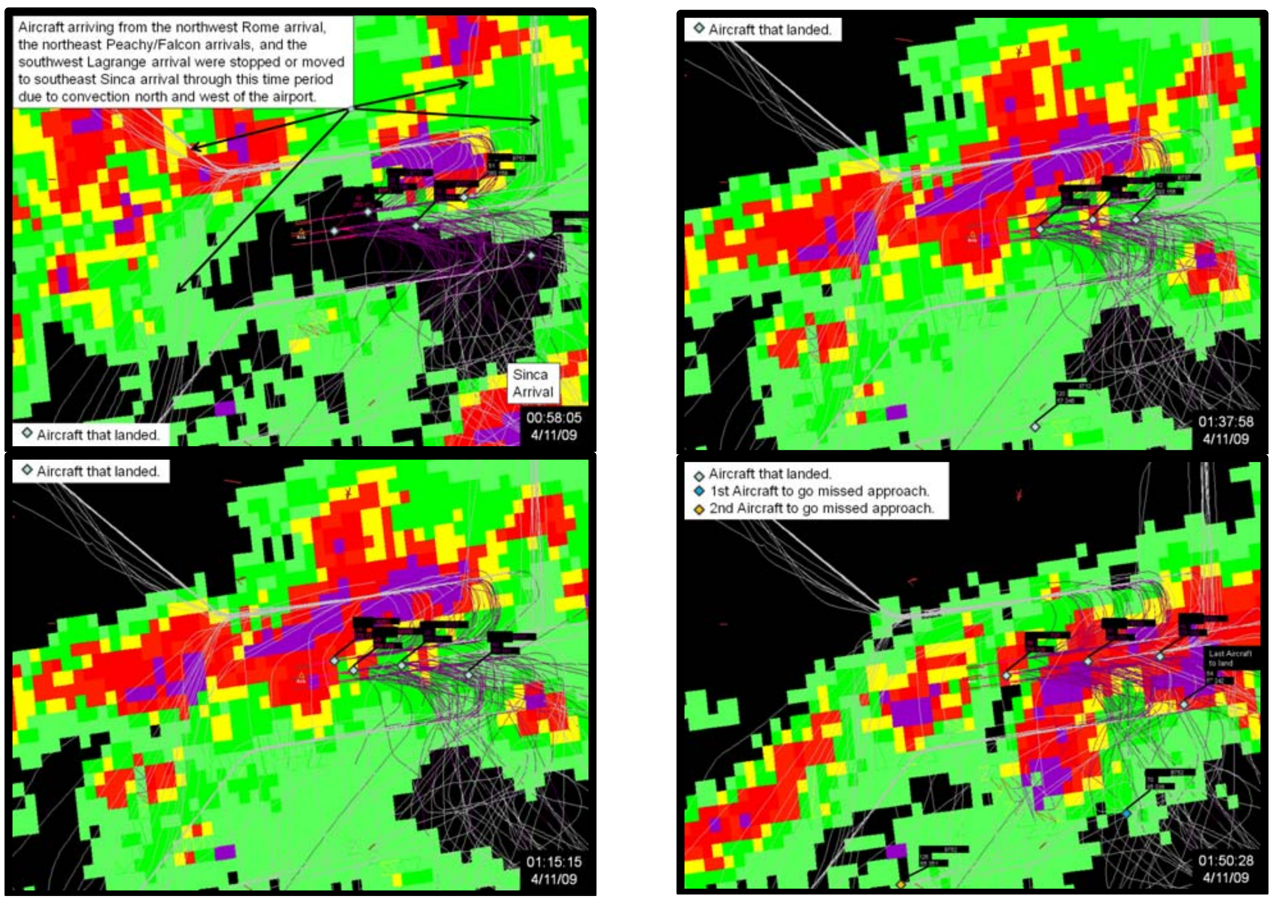
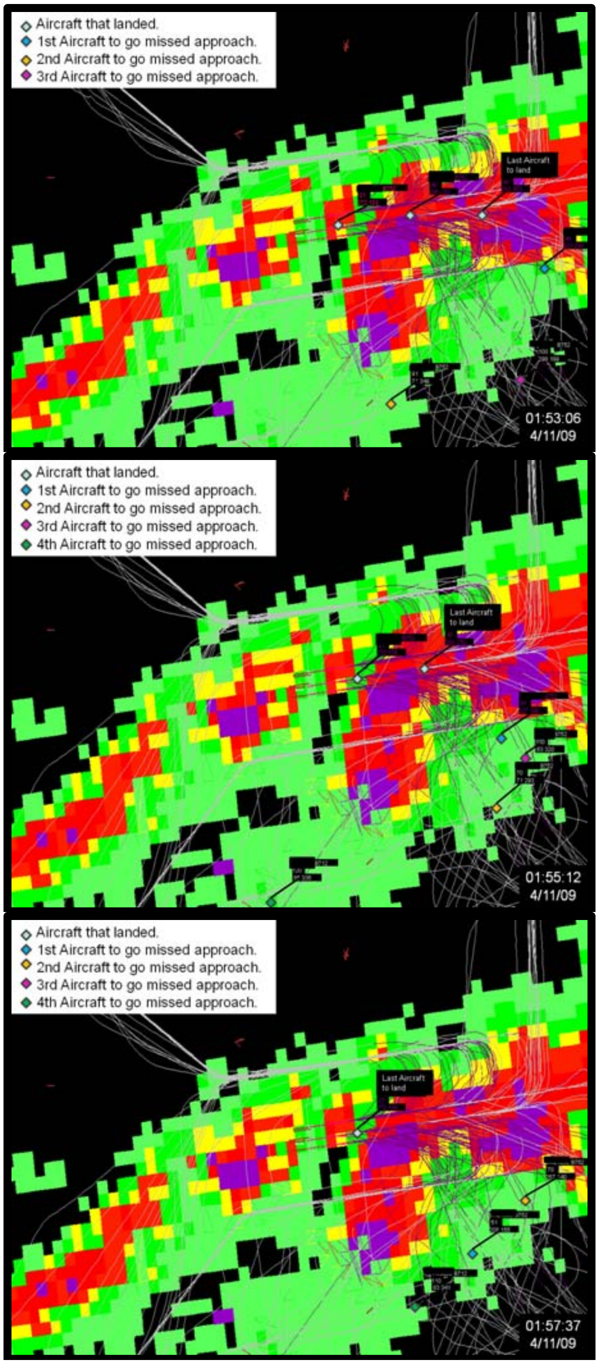


Figure 3.1 Time series showing the approach of thunderstorms with aircraft continuing flight through it.

went into holding starting at 01:53:06 through 02:00:26, (as illustrated in figure 3.2) causing potentially congested traffic.



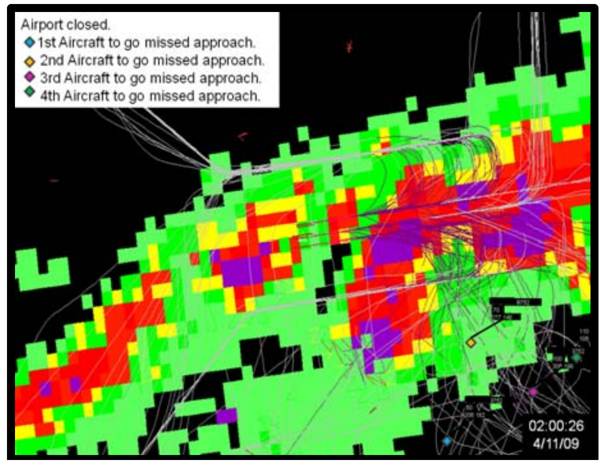


Figure 3.2. Time series showing the first aircraft to refuse the final aploach and the congestion to follow.

Forecaster analysis of FAA weather decision aids like the ITWS, along with forecasts based on weather radar analysis would have facilitated an airport closer prior to an aircraft having to encounter the thunderstorm environment. If traffic would have been stopped based on forecast, holding would have been reduced by approximately 70% based on the situations sampled.

4. SUMMARY OF FUTURE WORK

Future research deeper into the human factors of why decisions to fly into thunderstorms are being made by pilots needs to be conducted. This research should focus more in the field of psychology rather than meteorology. The results of this study and considerations of current aircraft technology should be utilized to update FAA flight regulations and the Airman's Information Manual.

A current risk factor analysis study should also be conducted to establish the amount of risk human lives are being subjected to versus economic impact of a continuous traffic flow into a major airport. In conjunction, the amount of reduced risk produced by weather forecast based decisions over pilot based decisions, needs to be considered.

5. ACKNOWLEDGEMENTS

The author wishes to express his appreciation to the Federal Aviation Administration (FAA) at the Atlanta Air Route Traffic Control Center in Hampton, Ga, for allowing access to aircraft and weather data. The author would also like to thank Mr. Arthur “Tom” Crook with Lockheed Martin and the FAA’s Southern Region Headquarters, for helping with procuring PDARs simulations.

6. REFERENCES

Cornman, L. B., G. Meymaris and M. Limber, 2004: An update on the FAA Aviation Weather Research Program’s *in situ* turbulence measurement and reporting system. *11th AMS Conference on Aviation, Range, and Aerospace Meteorology*.

Den Braven, W. and Schade, J. 2003. Concept and Operation of the Performance Data Analysis and Reporting System (PDARS). In *Proceedings of the 2003 SAE International Advances in Aviation Safety Conference*, Montréal, Québec, Canada

Williams, J. K., J. Wolfff, A. Cotter and R. Shermand, 2006: Evaluating the Effectiveness of the FAA’s CIT Avoidance Guidelines. *12th AMS Conference on Aviation, Range, and Aerospace Meteorology*.

Rhoda, D. A., E. A. Kocab, M. L. Pawlak 2002: Aircraft Encounters with Thunderstorms in Enroute vs. Terminal Airspace above Memphis, Tennessee. 10th Conference on Aviation, Range, and Aerospace Meteorology, American Meteorological Society, Portland, OR, USA, 13-16 May 2002.