Observations of Haboobs Associated with Mesoscale Convective Vortices

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Haboob traversing southwest Lubbock on 18 June 2009. This feature was located ahead of a quasi-linear convective system with an embedded mesoscale convective vortex. The haboob was a contributor to a fatal aircraft accident near Dougherty, Texas later that evening.

INTRODUCTION

- Haboobs (intense dust storms commonly observed in arid regions) have a history of being one of the most lethal weather events across West Texas. Yet, operational determination that a haboob is in progress is challenging without visual confirmation since only a small percentage of outflow boundaries produce this type of event.
- Motivation for the examination of these events was trigged by a haboob induced auto fatality in 2006 and a fatal aircraft accident in 2009.
- Often, outflow boundaries may traverse the same geographic area without lifting large amounts of dust, yet another boundary produces a haboob. Differentiating between these two situations has historically been quite challenging.
- Analysis of three haboob events since 2003 focused initially on using surface observable elements, such as temperature, dewpoint, pressure, and wind to discern between boundaries which may support haboob conditions versus those which do not. However, no definitive pattern was observed.
- However, radar analysis indicated that a mesoscale convective vortex (MCV), anchored in one end of the outflow boundary, was evident on each known haboob case and absent under minimal dust-lifting boundaries during climatologically favorable conditions in West Texas.

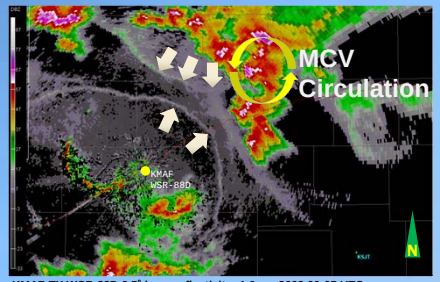
Images of the 3 June 2003 haboob across Midland, Texas. The substantive reduction in visibility after boundary passage is depicted in the image to the right. Courtesy NWS Midland.

PERMIAN BASIN HABOOB

3 June 2003

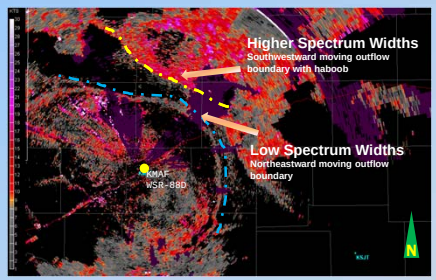
Large scale haboob with visibility under one-quarter mile traverses Midland metro region

- Thunderstorms near Midland created an outflow boundary which traveled north and northeast without producing a haboob.
- Storms associated with a MCV circulation generated outflow which created a haboob as it traveled southwest. As boundaries collided, the southwestward traveling boundary completely dominated with the boundary pushing well southwest of the KMAF radar.



KMAF TX WSR-88D 0.5˚ base reflectivity 4 June 2003 00:05 UTC

- Radar indicated wind velocities of 30-40 kt in the southwestward moving boundary were marginally higher than the 15-20 kt velocities found in the northeastward moving boundary. However, this wind velocity alone is not normally sufficient to loft large quantities of dust across West Texas.
- It is theorized that the enhanced forcing and turbulence associated with the MCV provided the necessary kinematics to create a vertically deeper and stronger boundary – and thus helped generate the haboob event.
- Examination of the spectrum width product revealed a much broader and more intense turbulent region behind the southwesterly moving MCV-anchored boundary. An elongated area of high spectrum width values along the outflow boundary were observed with haboob events.



KMAF WSR-88D 0.5˚ spectrum width 4 June 2003 00:05 UTC

MULTI-VEHICLE ACCIDENT WITH FATALITY

10 July 2006

Haboob induced visibility reductions resulted in a multi-vehicle, single fatality vehicle accident in Terry County, Texas

- Thunderstorm complex near Lubbock produced a southwestward propagating haboob.
- The event resulted in one of the most significant reductions in visibility in recent years and was associated with a fairly well defined MCV. The visibility reduction was a primary factor in a multi-vehicle collision.

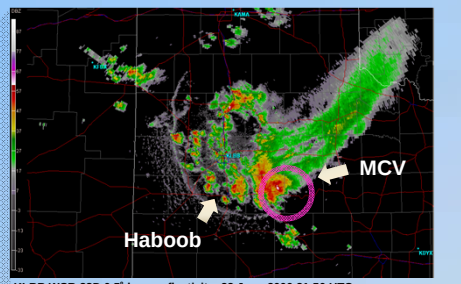
Conditions near Brownfield (50 km southwest of Lubbock) after a thunderstorm-induced haboob reduced visibilities to less than a few hundred feet. This storm was a factor in a vehicular accident which proved fatal.

FATAL AIRCRAFT ACCIDENT

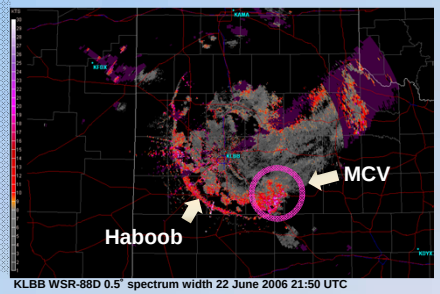
18 June 2009

Aircraft encountered a haboob in flight resulting in a crash which was fatal to all occupants aboard.

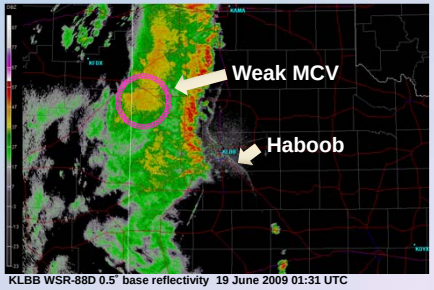
- Quasi-linear convective system with a subtle mesoscale convective vortex pushed an outflow boundary/haboob through Lubbock with sharp visibility reductions observed in the city.
- A single engine aircraft en-route from Houston to Plainview encountered the intense haboob several hours later, after sunset, resulting in near-instantaneous entry into instrument metrological conditions. Loss of visual reference and extreme turbulence contributed to the crash of the aircraft near Dougherty (about 80 km of Lubbock). Both occupants sustained injuries incompatible with life.



KLBB WSR-88D 0.5˚ base reflectivity 22 June 2006 21:50 UTC



KLBB WSR-88D 0.5˚ spectrum width 22 June 2006 21:50 UTC



KLBB WSR-88D 0.5˚ base reflectivity 19 June 2009 01:31 UTC

CONCLUSIONS

- Three haboob events were analyzed in an effort to better detect the likelihood for visibility-reducing conditions.
- While surface analysis revealed no clear evidence supporting the presence of a haboob, interrogations of Doppler spectrum width may provide clues that a haboob is in progress.
- Each analyzed case depicted a mesoscale convective vortex (MCV) anchored to the end of the haboob-bearing outflow boundary. Haboobs were not observed with outflow boundaries lacking MCVs.
- Any outflow boundary coupled to a MCV, regardless of apparent MCV strength, should be considered as a candidate for haboob generation when occurring across areas where surface soil conditions are supportive (e.g. protracted dry periods over sandy soils.)
- While not part of this study, local observations indicate that prior day moderate to heavy rainfall tends to bring smaller particles to the surface which enhances opportunity for lifting dust into the atmosphere.
- All factors should be considered as part of the warning decision process and appropriate call-to-action statements should be included to warn of the potential hazard.

For additional information contact:

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