Observing Thunderstorm Downbursts over the Chesapeake Bay Region

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Topics of Discussion

- Importance of downburst detection and prediction in the Chesapeake Bay region.
- Introduction to thunderstorm downbursts.
- Introduction to downburst prediction products
- Case Study: 6 March 2004 Baltimore Water Taxi Accident
- Conclusions

Severe Thunderstorm Wind Climatology

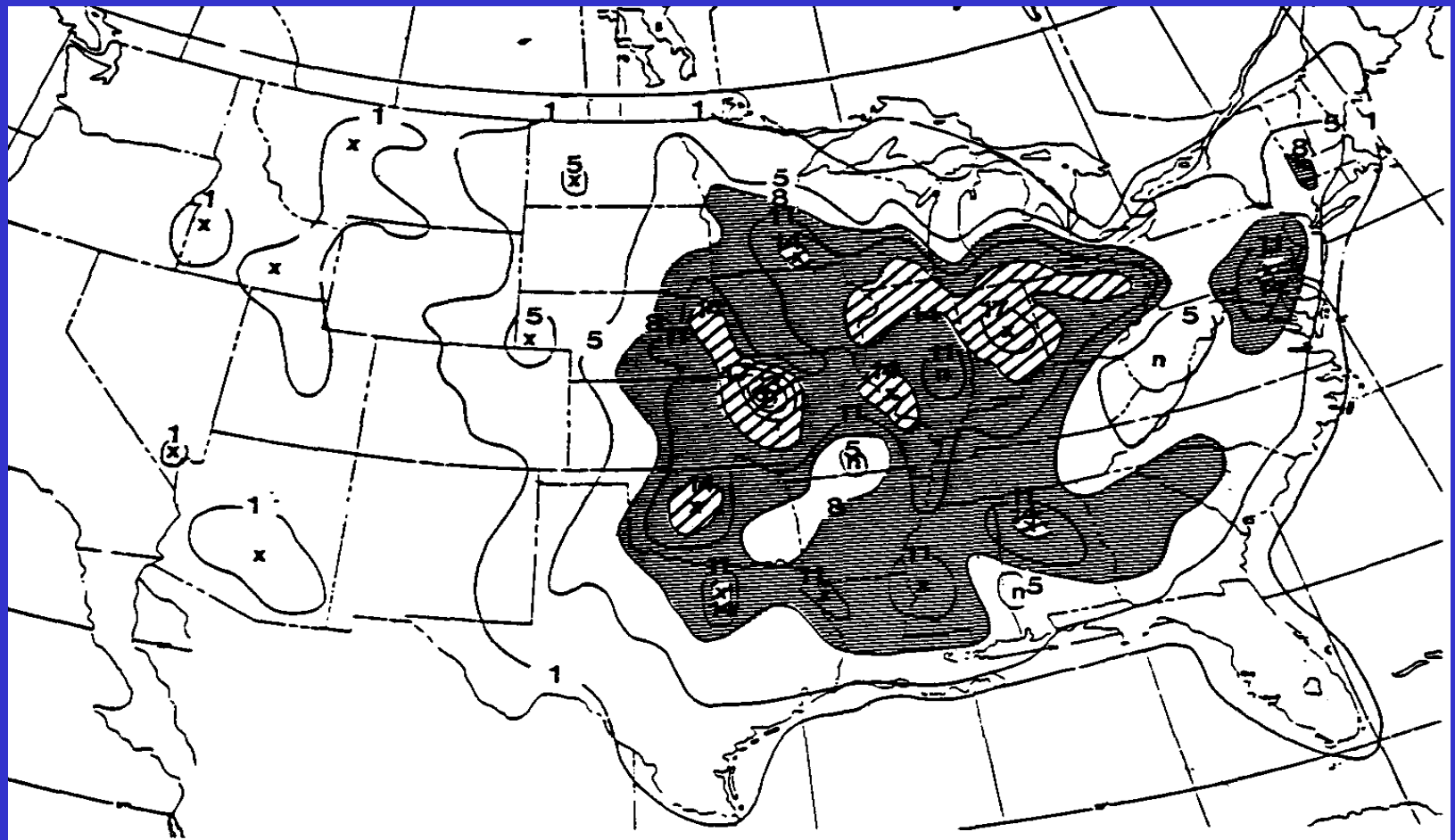
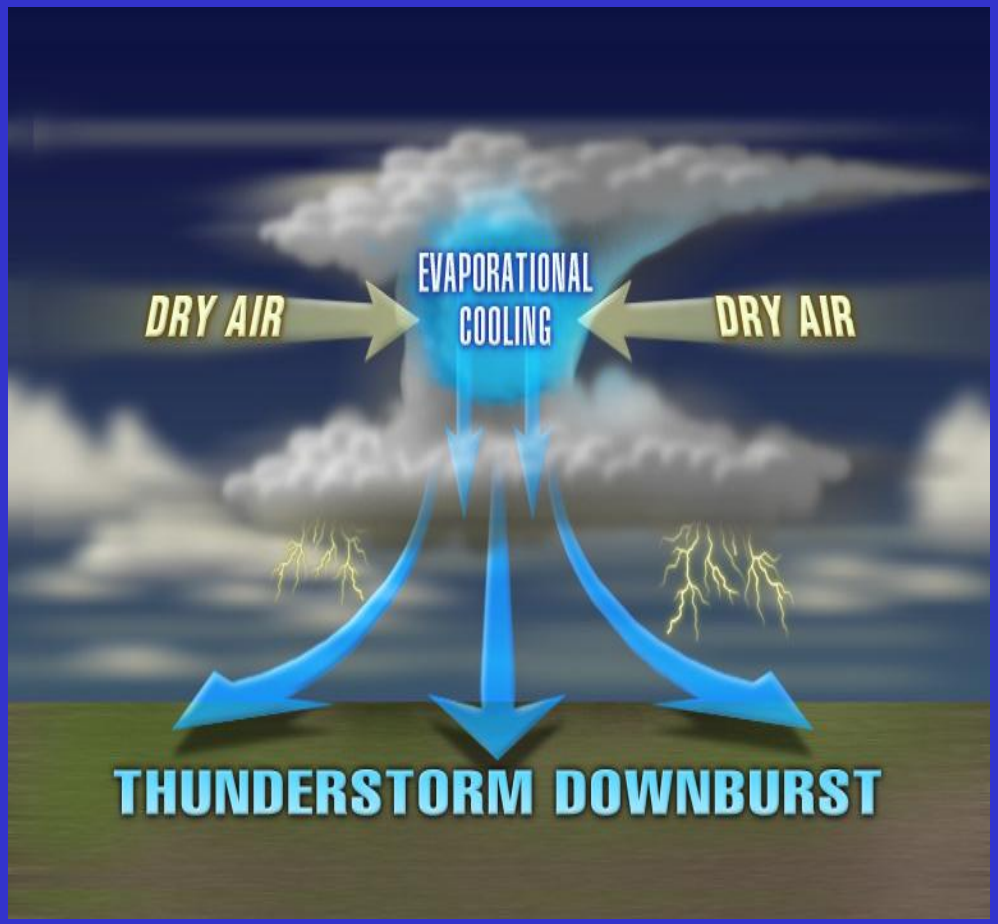


FIG. 9. Frequency of any severe thunderstorm wind occurrence per 26 000 km² per yr.

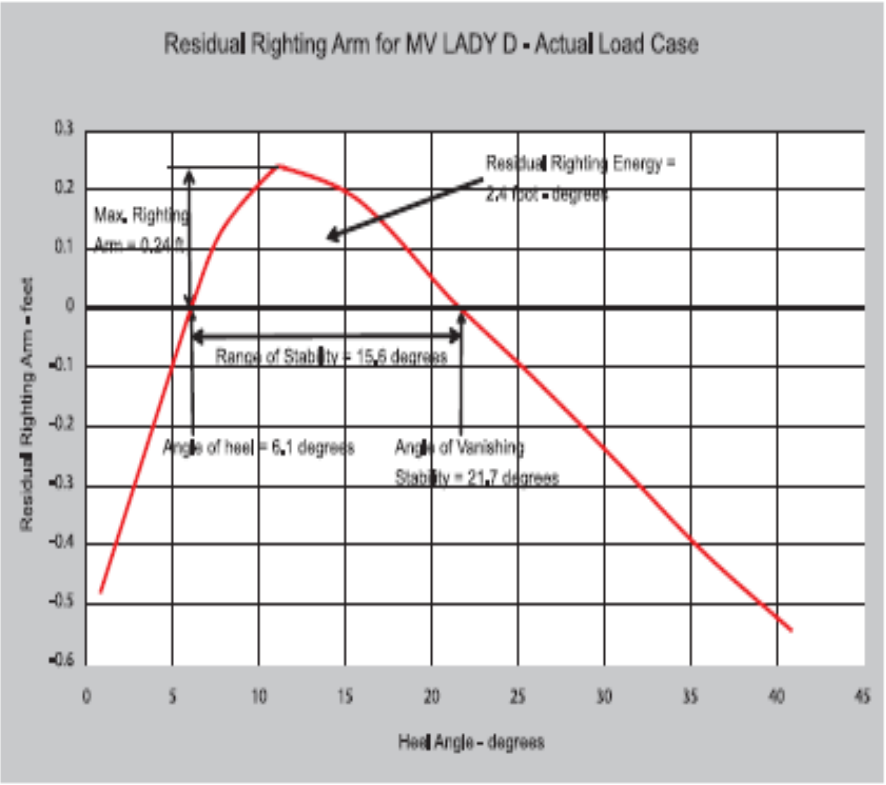
From Kelly et al (1985)

Thunderstorm Downburst



- Strong downdraft produced by a convective storm (or thunderstorm) that causes **damaging winds** on or near the ground. (Fujita and Wakimoto 1981)
- Serious hazard to sailing vessels due to inclined winds that can cause a knock-down.
- Hazard to other types of marine craft based on stability criteria.

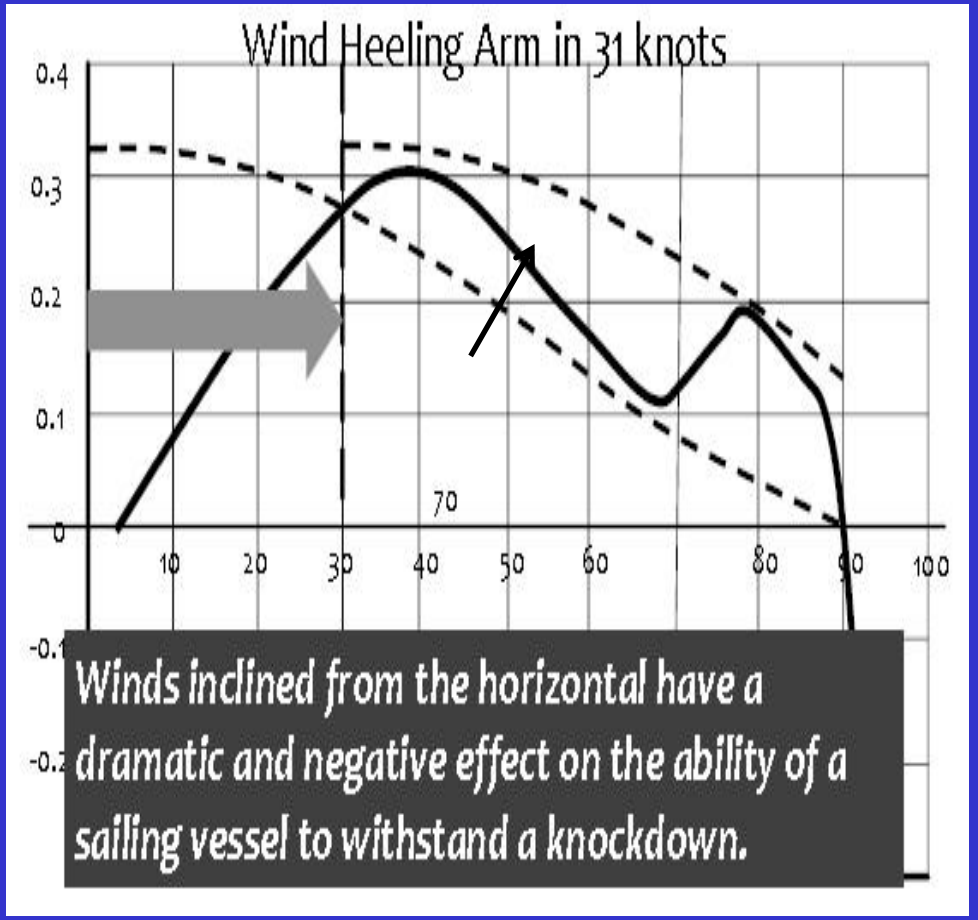
Maritime Downburst Hazards



Graphic courtesy of Alion Science and Technology, JJMA Maritime Sector

Figure 7. Residual righting arm for *Lady D* in 40-knot wind.

From U.S. NTSB report



From Canadian TSB report

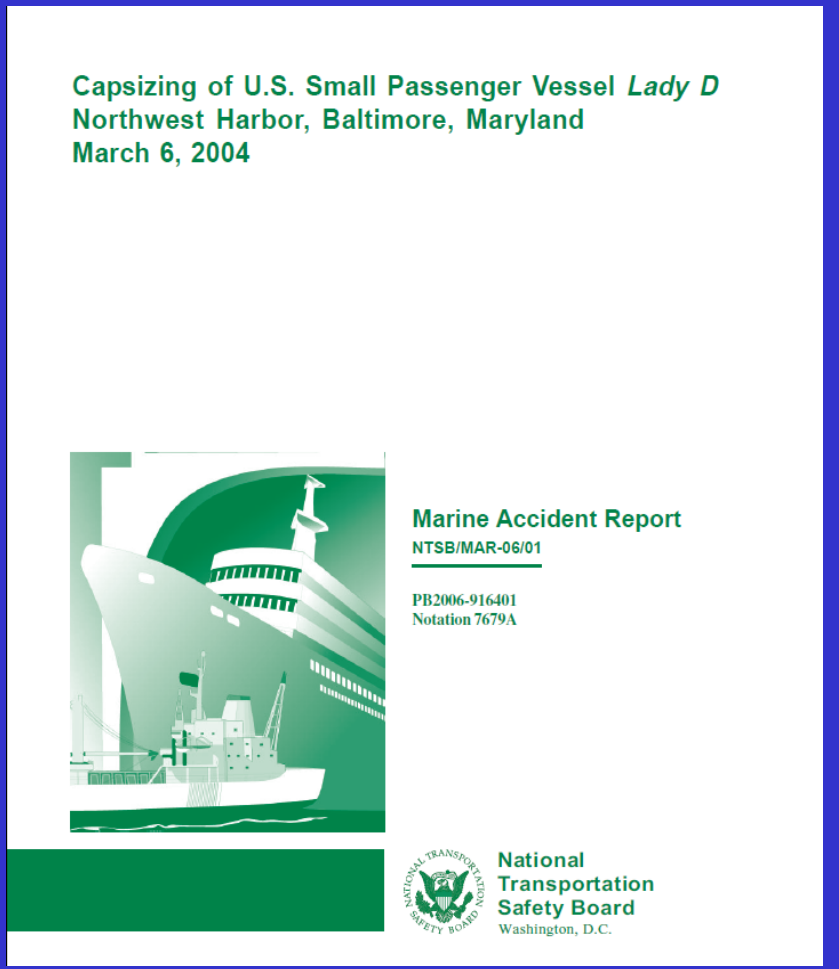
Introduction

- Downburst prediction algorithms, employing data from geostationary satellites (GOES) and numerical weather prediction (NWP) models have been developed to address the need for improved monitoring and warning capability over coastal and open ocean waters. Two downburst prediction products are currently being tested and validated over the Chesapeake Bay region:
- **Downburst Index (DI)**
- **GOES two-channel temperature difference (TD)**
- Generated hourly at the NOAA Center for Weather and Climate Prediction (NCWCP).

Downburst Index (DI)

- Based on factors that promote thunderstorms with potential for strong winds:
  - Large storm precipitation content (esp. hail, rain)
  - Large changes of temperature and moisture (humidity) with height in the lower atmosphere.
  - Index values are positively correlated with downburst wind strength.
  - Severe downbursts may occur when the DI > **50.**

6 March 2004
Baltimore Water Taxi Accident



From **National Transportation Safety Board. 2006.** ***Capsizing of U.S. Small Passenger Vessel Lady D, Northwest Harbor, Baltimore, Maryland March 6, 2004. Marine Accident Report NTSB/MAR-06/01.*** **Washington, DC.**

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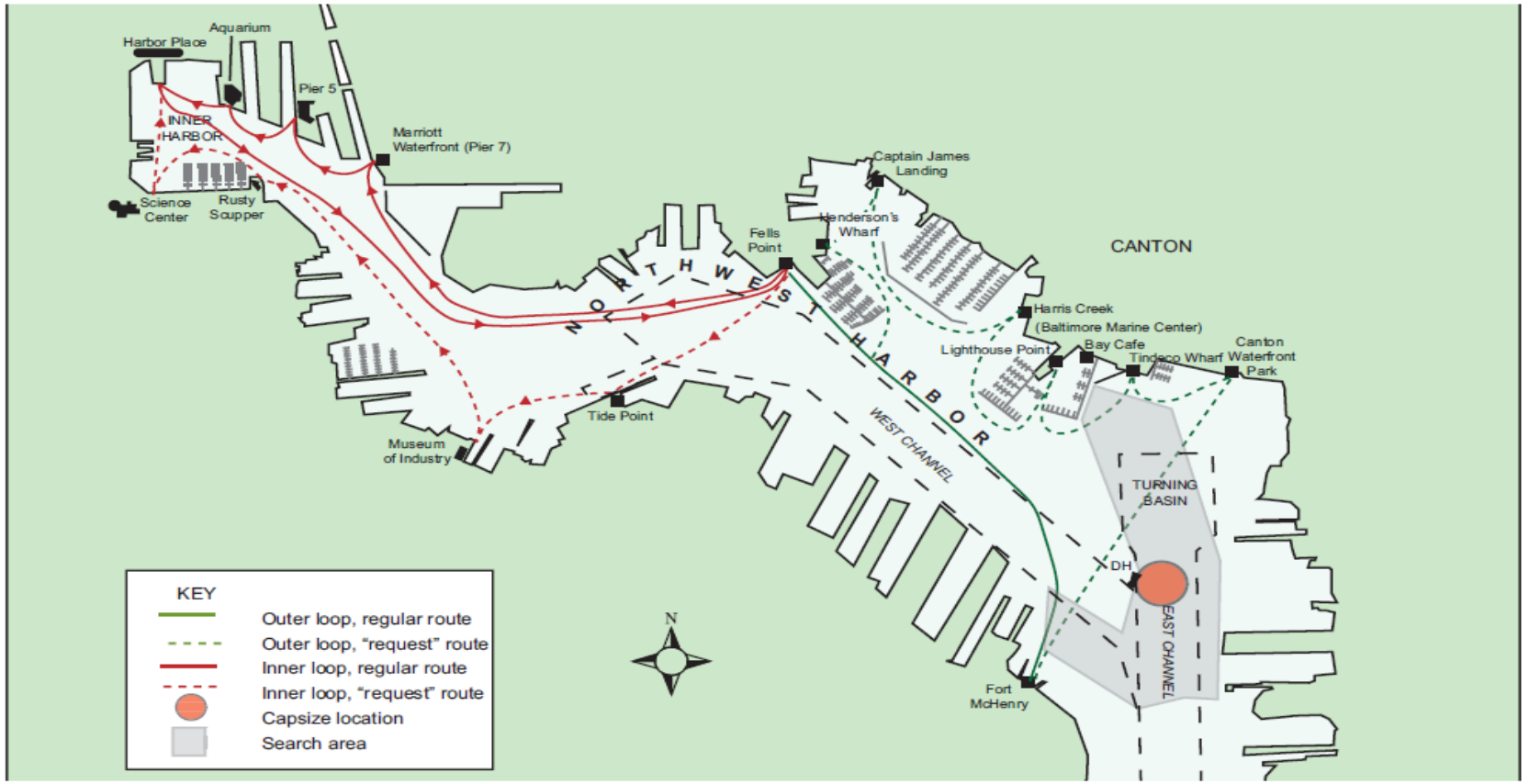


Figure 1. Each Seaport Taxi vessel followed one of two round-trip routes unless passenger traffic warranted otherwise. The inner loop between the Inner Harbor complex and Fells Point included two regular stops and two "request" stops, meaning passengers could ask to disembark at these sites or customers on shore could telephone or radio to be picked up there. The outer loop route, which originated at Fells Point, had one regular stop at Fort McHenry and six request stops in the Canton area.

From **National Transportation Safety Board. 2006.** ***Capsizing of U.S. Small Passenger Vessel Lady D, Northwest Harbor, Baltimore, Maryland March 6, 2004. Marine Accident Report NTSB/MAR-06/01.*** **Washington, DC.**

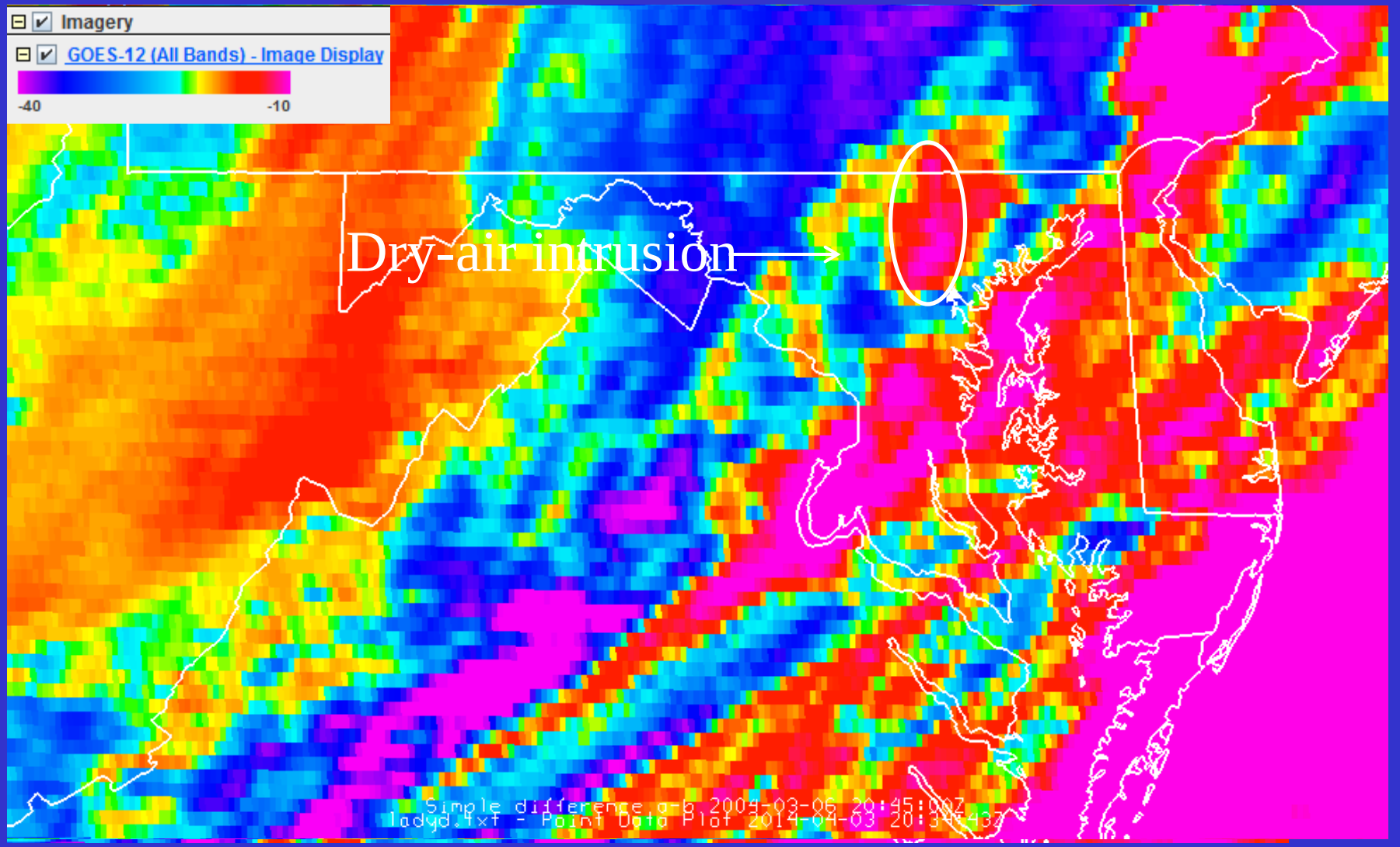
6 March 2004
Baltimore Water Taxi Accident

- On March 6, 2004, the Lady D, a pontoon water taxi with 2 crewmembers and 23 passengers on board, capsized while en route from Fort McHenry to Fells Point, Maryland, when it encountered a strong thunderstorm with high winds.
- As result of this accident, 5 passengers died; 4 passengers suffered serious injuries; and 12 people sustained minor injuries.
- Accident occurred during a moderate downburst event, with a nearby measured wind gust of 41 knots.

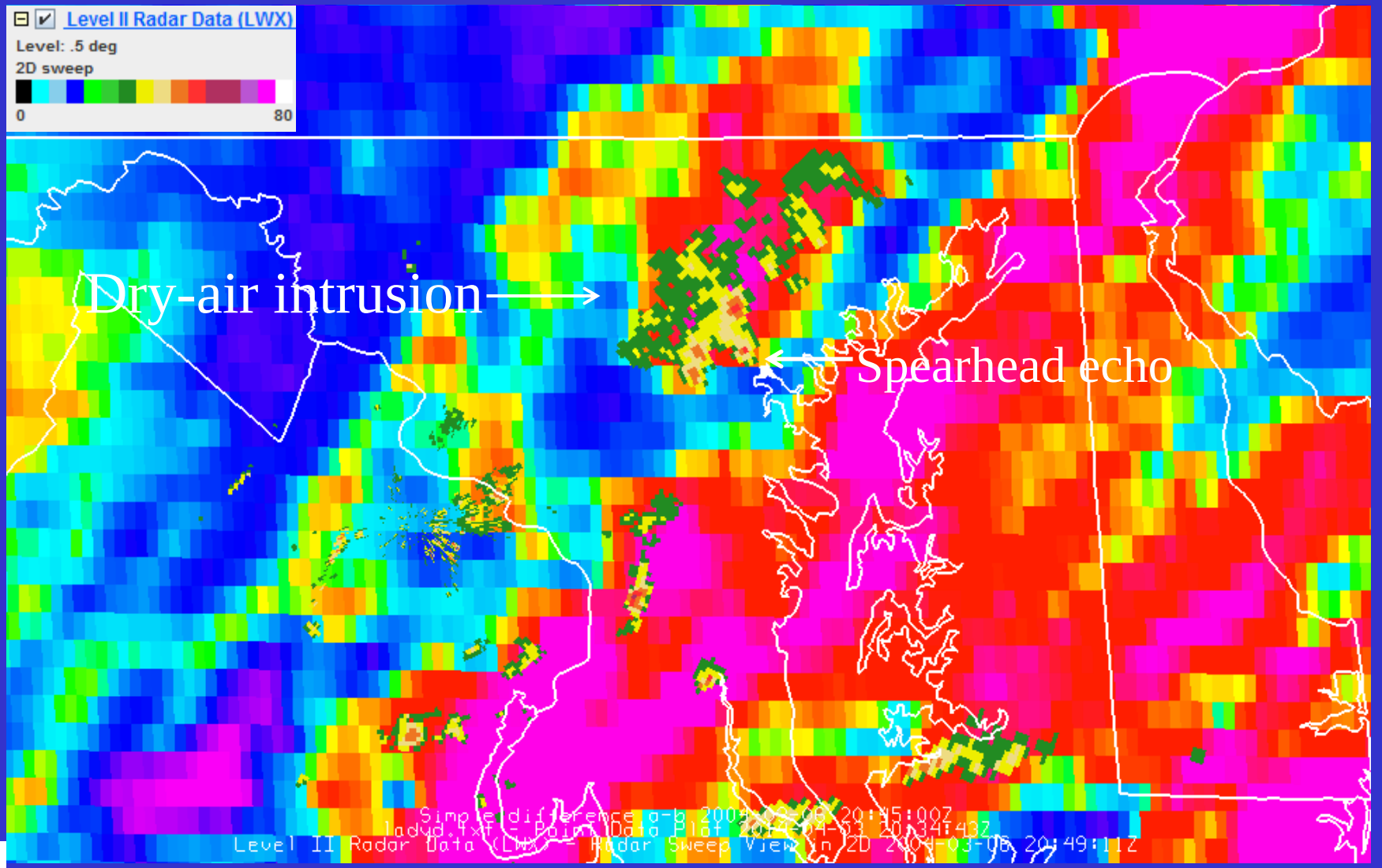
6 March 2004
Thunderstorm Event Summary

- A cluster of thunderstorms developed over the Blue Ridge Mountains of Maryland during the afternoon of 6 March along a strong cold front.
- Between 2000 and 2100 UTC, the storm cluster tracked rapidly eastward from Frederick County toward the Baltimore Harbor .
- An unstable air mass, especially favorable for strong thunderstorm-generated winds, was in place over the Chesapeake Bay region ahead of the cold front.

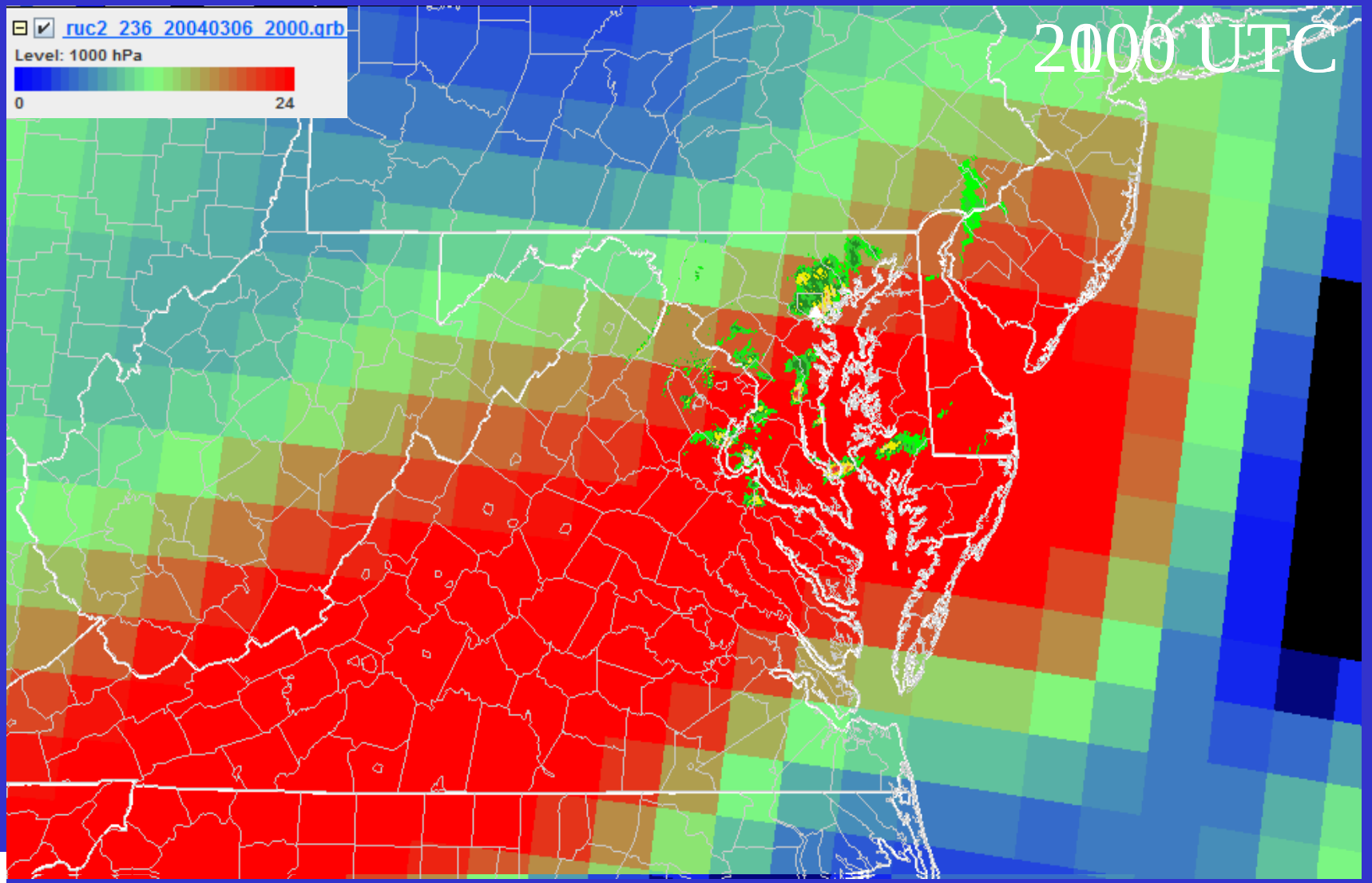
GOES-12 WV-IR BTD



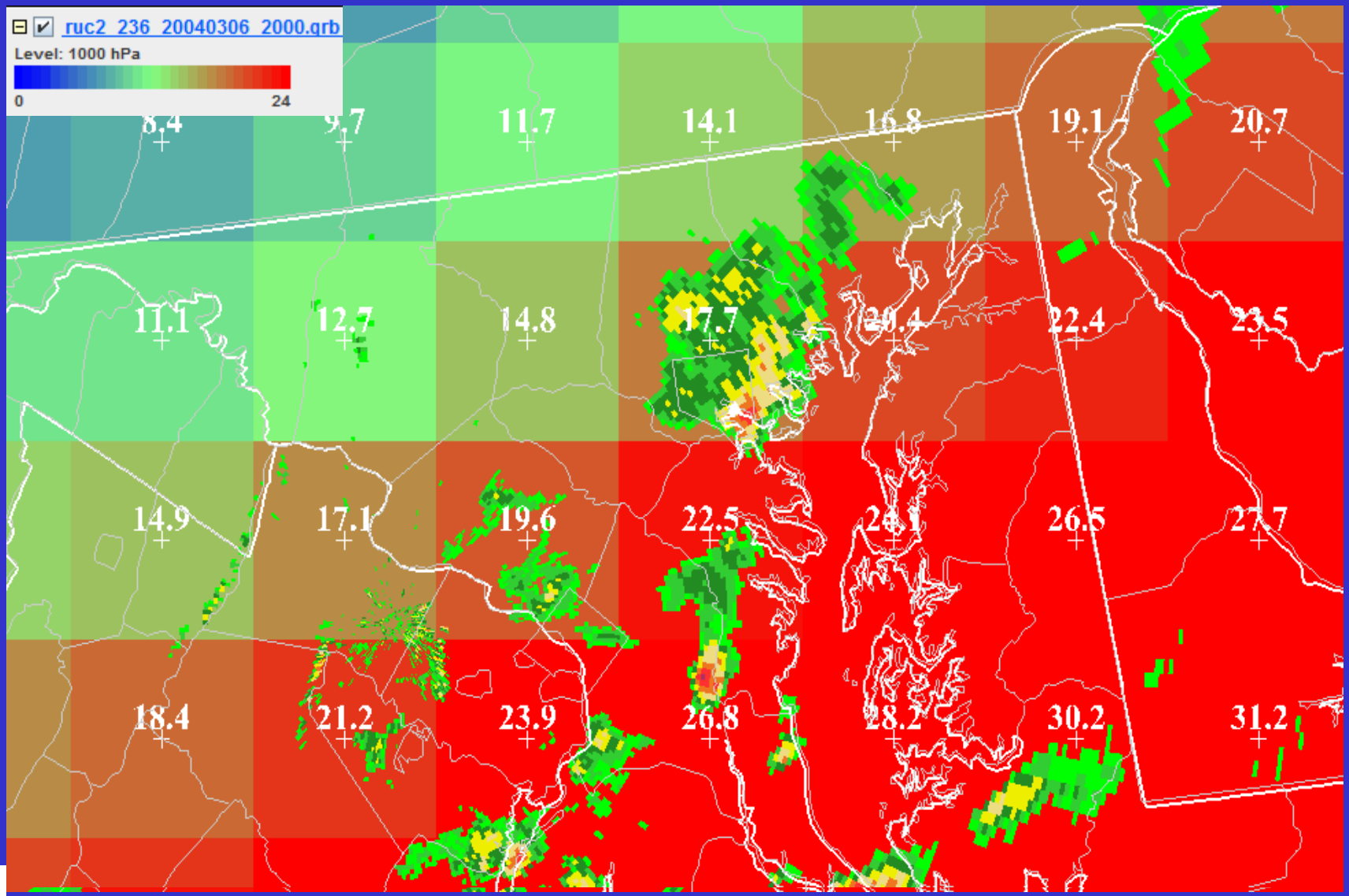
GOES-12-NEXRAD Composite



Downburst Index



Downburst Index



Conclusions

- The GOES two-channel TD and downburst index products effectively indicated wind gust potential associated with thunderstorm that resulted in the capsize of the Lady D on 6 March 2004.
- NTSB concluded that the Lady D capsized as a result of the combined effects of excessive load, and the wind and wave conditions during the thunderstorm.
- Over 75 confirmed downburst events documented between 2010-2013 thunderstorm seasons over Chesapeake Bay region.