The Deadly Intersection of Smoke and Fog: A Case Study of the 2023 Southeast Louisiana Superfog Event

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Abstract

On October 23, 2023, a series of catastrophic vehicle collisions occurred on Interstate 55 in Southeast Louisiana, between mile markers 13 and 15. The crashes, which involved 189 vehicles, resulted in seven fatalities and over 70 injuries. The Louisiana State Police attributed these events to a combination of superfog formation and drivers' failure to adjust their speed to the rapidly deteriorating visibility conditions.

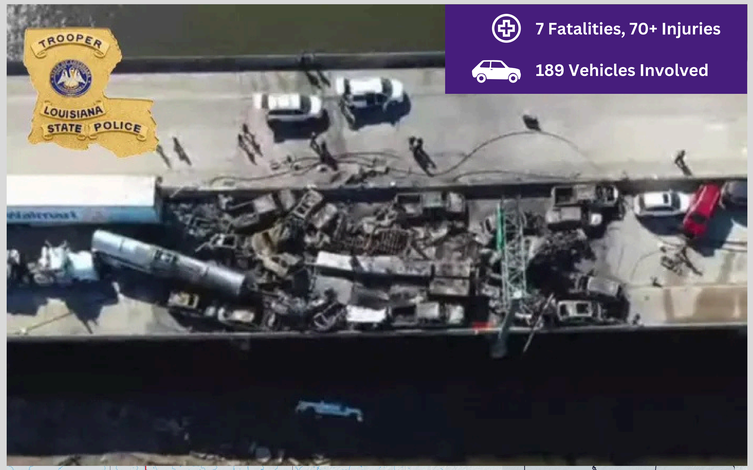
Superfog is an extreme form of fog that forms when smoke interacts with water vapor under specific atmospheric conditions, leading to severely reduced visibility. This phenomenon was particularly pronounced on the morning of October 23 due to a wetlands fire that had ignited near Bayou Sauvage Urban National Wildlife Refuge approximately 10 days prior. The smoke from this wildfire, rich in cloud condensation nuclei (CCN), contributed to the formation of superfog by enhancing the condensation process. Wildfires are known to inject additional CCN and moisture into the atmosphere, providing the necessary ingredients for superfog formation when combined with favorable meteorological conditions.

The term “superfog” has been recognized in meteorological literature for over two decades and refers to a situation where visibility can drop to near-zero levels. In this case, the National Weather Service had issued Dense Fog Advisories in advance of the event, explicitly warning that smoke from nearby wildfires could exacerbate fog formation. Analysis of the environmental conditions on the morning of the crashes indicates that the region was primed for radiation fog development, characterized by mostly clear skies, a saturated near-surface layer, a low-level temperature inversion, and a significant dry air layer above the inversion. These conditions are typically conducive to the formation of dense fog, which can significantly impair visibility.

Observations from nearby monitoring stations confirmed that visibility in the area was consistently below one-quarter mile and, at times, reduced to near-zero. Despite these hazardous conditions, Interstate 55 remained open, while the nearby Causeway Bridge over Lake Pontchartrain was closed due to the dense fog.

This event underscores the critical need for enhanced monitoring and communication strategies during conditions conducive to superfog formation, particularly in regions prone to wildfires. The incident also highlights the importance of public awareness regarding the dangers of superfog and the necessity for drivers to adjust their speed in response to rapidly changing visibility conditions.

Understanding the complex interplay between wildfire smoke, atmospheric moisture, and local meteorological conditions is crucial for improving forecast accuracy and mitigating the risks associated with superfog events. Further research into the microscale processes that govern superfog formation, as well as the development of more precise predictive models, is essential to preventing future tragedies like the one that occurred on I-55.



Top: Aerial view of the aftermath of the crashes on I-55 via Louisiana State Police.

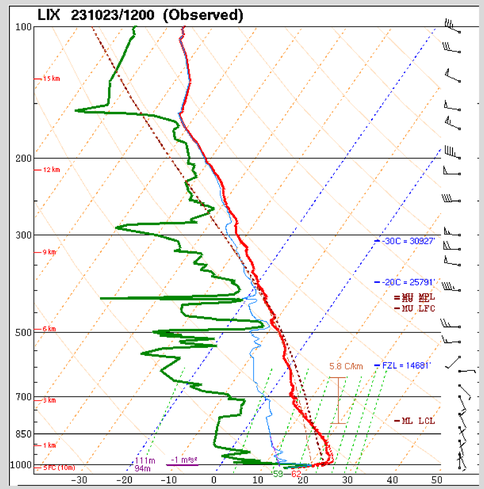
Middle: Map showing crash sites and location of wildfire near Bayou Sauvage National Wildlife Refuge.

Bottom: GOES-16 snow/cloud layer imagery showing the superfog extending from Lake Pontchartrain across I-55. Credit: the Cooperative Institute for Research in the Atmosphere at Colorado State University and the National Oceanic and Atmospheric Administration (CSU/CIRA & NOAA)



Wildfire Near Bayou Sauvage Wildlife Refuge

The smoke that aided in superfog formation on Oct. 23, 2023 originated from a 200-acre marsh fire burning on private land near the Bayou Sauvage Urban Wildlife Refuge on the eastern side of New Orleans. The fire had been burning since at least mid-October, with residents in the New Orleans area reporting noxious fumes from the smoke in the days leading up to the crashes on I-55. The fumes were likely made worse by burning peat, a type of decaying organic matter that is found in the marsh soil. The fire was difficult for crews to access and attack because of its marshy location. The smoke from this fire is also believed to have contributed to a second set of superfog crashes on I-10 near Irish Bayou on November 7, 2023. One person was killed and eight others injured in that series of crashes.



Observed Sounding

The observed sounding from Slidell, LA (LIX) at 12Z on October 23, 2023 shows an environment that was primed for radiation fog development. A saturated near-surface layer is noted, with a strong temperature inversion present just above the surface. A significant layer of dry air was present just above the saturated near-surface layer. Winds were generally light in the lower atmosphere, but the direction is important. Southeasterly flow transported smoke from near Bayou Sauvage to the crash site on I-55.

Image credit: Storm Prediction Center