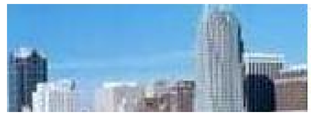
Event Summary
National Weather Service, Raleigh NC



March 23, 2010 Fire Weather Event

Note that this is a PDF version of the event summary and that some links, media or resources may not be avaiable in this format.

Event Headlines -

...Fire damaged or destroyed seven houses in far northeast Raleigh...
...Gusty winds were one factor that allowed the fire to spread quickly...
...Remote sensing instruments, specifically satellite and radar, were able to observe the fire or smoke...

Event Overview -

Weather is believed to have played a significant played a role in a fire that rapidly spread and damaged or destroyed seven houses in far northeast Raleigh on Armadale Laneduring the evening of March 23, 2010. The meteorological conditions on March 23 were similar but not as extreme as more significant recent fire weather events in central North Carolina (February 22, 2007 Fire Weather Event or December 15, 2006 Fire Weather Event).

The weather pattern during the evening hours of March 23 featured an anomalously strong closed low pressure system off the New England coast and a moderately strong northwesterly flow over the Mid Atlantic and the Carolinas. A surface trough extended from the low pressure system near New England southwestward across the Chesapeake Bay and into the Western Piedmont of the Carolinas. The METAR plot from 23 UTC or 700 PM showed surface winds shifted from the west and southwest ahead of the trough to northwest behind the trough, with gusts reaching 25 knots. Surface dew points were in the mid to upper 30s throughout the Piedmont and Foothills of Virginia and North Carolina while temperatures ranged from the upper 50s to mid 60s across the area. During the afternoon, relative humidities decreased to between 35-40 percent by 700 PM EDT.

Weather conditions were rather dry in the Raleigh-Durham area precceding the event. No measureable precipitation was observed at KRDU from March 15 through March 21. Prior to this period, 1.21 inches of precipitation was measured over 4 days from March 10-14 at the Raleigh-Durham International Airport (KRDU). A storm system brought very light precipitation to the area on March 22 and 23 just before the event. A trace of precipitation was observed during the afternoon of March 22nd and 0.01 inches of precipitation was noted during the early morning hours of March 23rd. The dry weather along with above normal temperatures during the week preceding the fire likely contributed to a decrease in fuel moisture (the percent water content of vegetation) and an increased potential for fires.

Factors Contributing to Extreme Fire Behavior and this Event

Various studies have produced a list of weather factors that result in extreme fire behavior by influencing burning conditions at the time of fire initiation or that impact ongoing fires. The critical weather factors contributing to extreme fire behavior and large fire growth include:

- Position and/or location of frontal passages possessing strong winds, and of intense upper level troughs at 500 mb level.
- Low level jets just before and just after cold front passage.
- Dew point depression of 10 degrees C in the 850 mb level.
- Temperature lapse rate of 7 degrees C in the 950 - 850 mb level.
- Pre-frontal and post-frontal (cold) passage associated with Byram (reverse wind speed and low level jet) & Brotak (surface at 9 kts and upper air at 34 kts wind profiles).
- Strong winds above the nocturnal inversion.

- Haines Index of 4.

Conditions on the evening of March 23 were becoming increasingly supportive of extreme fire behavior. Past experience notes that critical fire weather conditions over North Carolina occur when a deepening upper level trough develops over the eastern U.S. is accompanied by a dry frontal passage along with dry antecedent conditions. The dry weather and warmer then normal temperatures during the week preceding the fire likely contributed to a decrease in fuel moisture and an increased potential for fires. Temperatures at the Duke Forest RAWS location in Orange County reached the lower 60s during the afternoon before beginning to cool toward sunset. The relative humidity dropped into the 35-40% range during the afternoon which was notably drier then earlier in the day but still relatively moist compared to previous significant fire weather events which had relative humidities less than 20%. The surface wind turned to more westerly and northwesterly during the day which typically results in drying due to down sloping and advective processes. The evening upper air observation from KGSO showed a mixed layer extending up to around 850 hPa with winds reaching up to around 25 kts. Just a little higher up, the wind field increased to around 50 kts at 800 hPa. The 850 hPa mesoanalysis product from the SPC showed a 50 kt northwest wind just upstream of the area across southern West Virginia and southwestern Virginia.

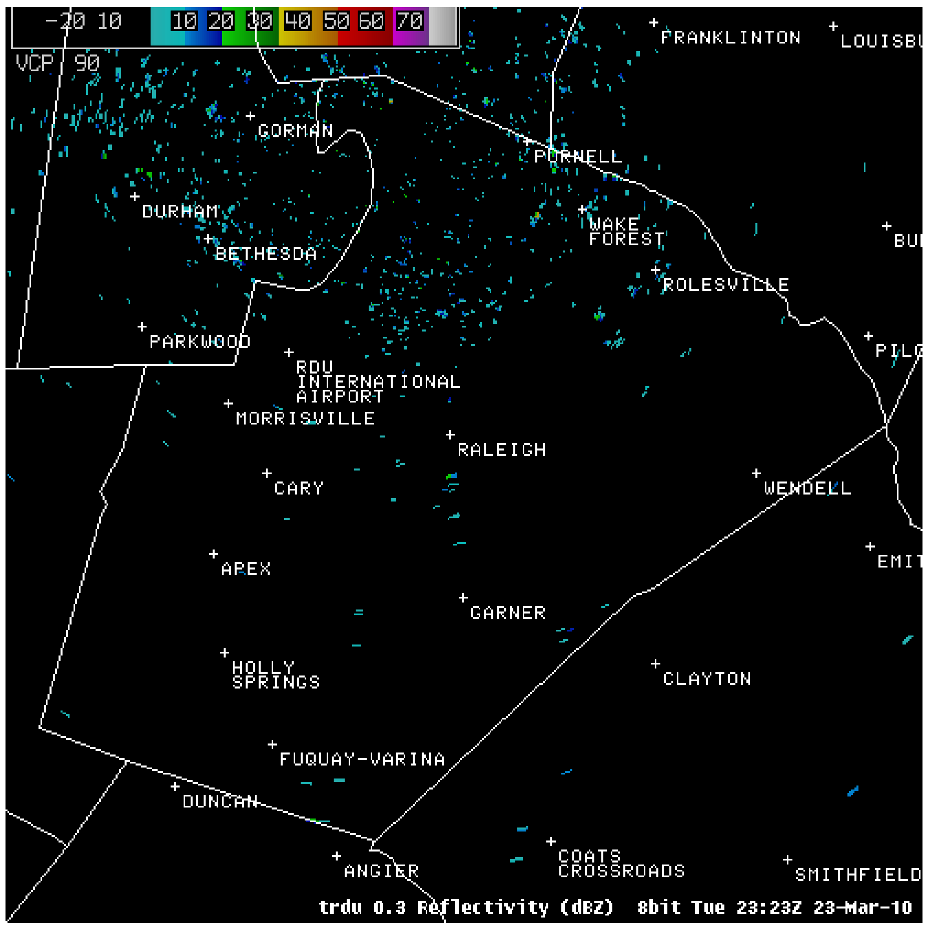
It can be argued that the lack of recent precipitation and the strong and gusty nature of the surface winds were the meteorological conditions that were the most supportive of fires during the evening of March 23. The moisture at the surface with relative humidities in the 35-40 percent range and the overall presence of moisture in mixed layer likely inhibited widespread fire activity.

Remote Sensing of Wildfires

Remote sensing instruments, specifically satellite and radar, provide imagery which can be quite useful for fire detection. Smoke plumes from fires can be viewed with weather surveillance radars and visible channel satellite imagery while the shortwave infrared (3.9 micron) satellite channel can literally sense heat associated with fires.

The sensitivity of the WSR-88D radar and the Terminal Doppler Weather Radar (TDWR) with its enhanced resolution allows forecasters to view non precipitation echoes such as ground clutter, birds, insects, and smoke plumes. On the evening of March 23, both the KRAX WSR-88D located near Clayton, NC and the TRDU TDWR located at the Raleigh-Durham International Airport, showed the smoke plume over northeast Raleigh.

The animation to the right shows the base reflectivity product from the Raleigh, Terminal Doppler Weather Radar (TDWR) from 2323 UTC on March 23 through 0017 UTC on March 24, 2010. Note the smoke plume that develops to the northeast of Raleigh and then spreads southeasterly in the northwesterly low level flow. The smoke plume is observed on this radar for a little more then a half hour. A **Java Loop** of base reflectivity imagery from 2323 UTC on March 23 through 0017 UTC on March 24, 2010 that can be stopped, controlled and zoomed is available. This is one of the first significant fires to be observed with TDWR data from TRDU.



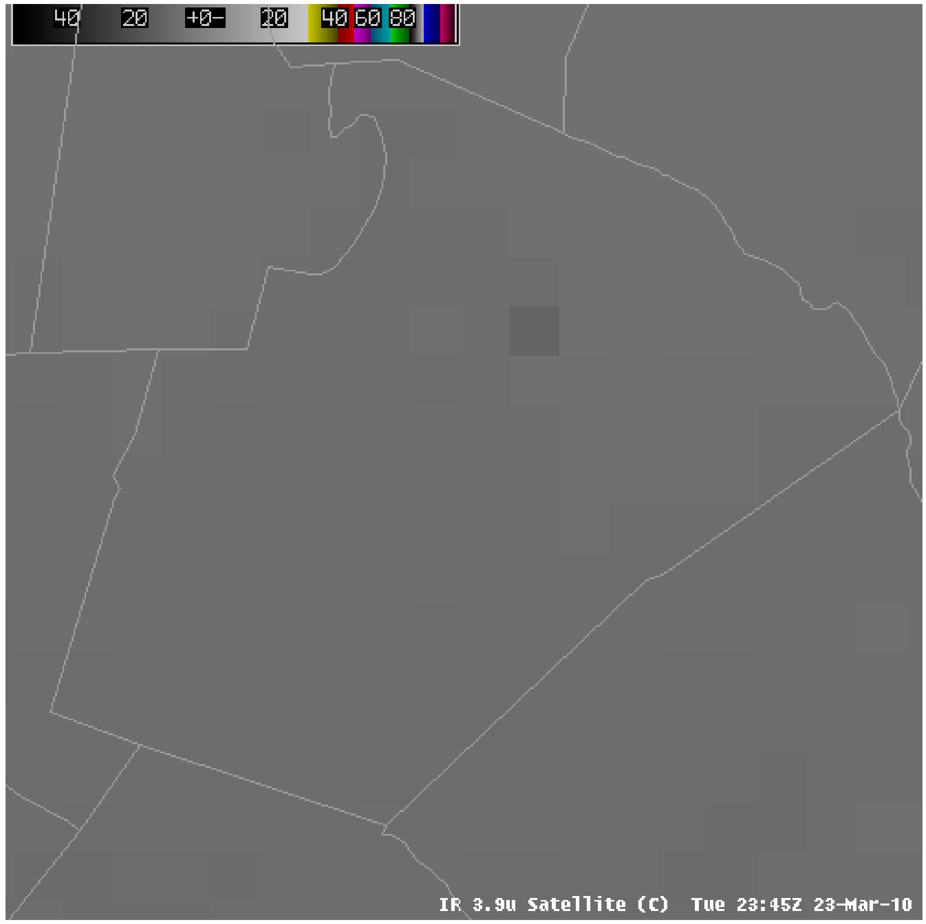
Meteorologists often use long wave (10.7 micron) infrared satellite imagery in weather forecasting. But the properties of the 3.9 micron channel, however, make it valuable for detecting hot spots associated with fires. Blackbody radiance in the 3.9 micron channel increases more rapidly with temperature than the radiance in the 10.7 micron channel. Therefore, the 3.9 micron channel is more sensitive to sub pixel hot spots than the 10.7 micron channel, and is resultantly better suited for fire detection. More information on using 3.9 micron channel imagery for fire detection is available at the Regional and Mesoscale Meteorology Branch (RAMMB) 3.9 micron Channel Tutorial.

The image to the right is the 3.9 micron channel satellite imagery from 2345Z (745 PM EDT) over Wake County North Carolina. The fire was first reported around 2320Z (720 PM EDT) and the satellite image is believed to correspond to the approximate time in which the fire was most intense; this was the best 3.9 micron channel image of the event. The one dark pixel that can be seen in the imagery is associated with the fire on Armadale Lane. The image indicates a pixel temperature of 14 deg C or more.

There are a few limitations to using the 3.9 micron channel to detect sub pixel hot spots, they include:

- The 3.9 micron imagery can not see through most clouds

- Warm ground conditions can saturate the 3.9 micron sensor, making it impossible to discriminate fires that may be contained within the area



Acknowledgements

The photograph of the fire and the firefighters working the fire was provided by the Raleigh/Wake Firefighting Blog. The fire danger and fuel moisture images were provided by the Wildland Fire Assessment System (WFAS). Data for the Duke Forest RAWS station provided by the Western Regional Climate Center. SPC mesoanalysis graphics provided by the Storm Prediction Center.

Case study team -
Kathleen Carroll
Phil Badgett
Jonathan Blaes