Proof-of-Concept Mesoscale Discussions for Short-term Wildfire Prediction

V3

AMS 14th Symposium on Fire & Forest Meteorology

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Damaging fires "occur outside the usual constraints", in fuel and weather that are naturally short-lived (Pyne 2012).

Introduction

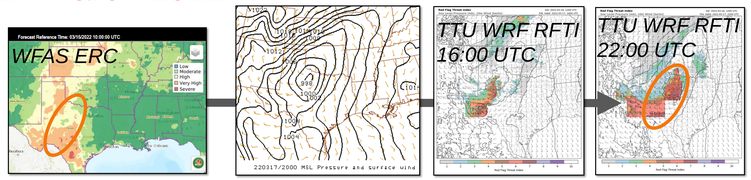
Mesoscale atmospheric processes and their juxtaposition with high-risk fuels greatly influence the potential for dangerous fire behavior and spread. Such atmospheric effects on the fire environment are well suited to the application of skillful meteorological mesoanalysis, including short-term predictions aided and informed through the use of Convection-allowing Models (CAMs). This poster will highlight efforts by the Southern Great Plains Wildfire Outbreak Working Group, an online collaborative multi-agency operations-to-research-to-operations community focused on science-based support to state forestry agencies in Texas, Oklahoma, and Kansas, to provide proof-of-concept mesoscale messaging to inform tactical decision making for wildland fire management officials.

Analogous to Mesoscale Discussions (MDs) issued by the Storm Prediction Center for evolving convective hazards, the group posted a total of 43 fire-focused MDs during the 2021/22 southern Great Plains fire season. The fire MDs were based on detailed analyses spanning the meso-alpha and meso-beta scales using trends in remote sensing and in situ observational data and the evolution of fire-effective atmospheric features depicted in CAMs relative to fuel environments. In many cases, fire MDs successfully predicted the onset of problematic wildfire occurrence on the sub-county warning area scale hours prior to ignition. In other instances, life threatening escalations in fire behavior were highlighted prior to the onset of particularly dangerous fire conditions, including in advance of wildfire/wind shift interactions. This information improved situational awareness of imminent fire impacts and informed mitigative actions and services by fire analysts and meteorologists alike for problematic and significant wildfires. During a subsequent 31 March 2023 wildfire outbreak in the Oklahoma City metropolitan area, fire MDs were translated to public-facing graphics approximately one hour prior to the ignition of damaging wildfires.

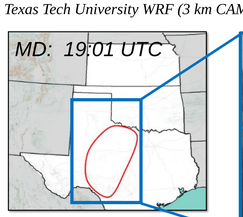
Mesoanalysis

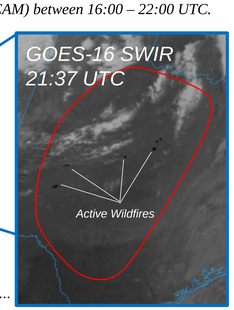
- ✓ Real-time observational analysis on scales of 10-100 km.
- ✓ Application of conceptual models.
- ✓ Develop near-term predictions that *"bridge the observation-to-model gap"*.
- ✓ Communicate evolving threats.

17 March 2022



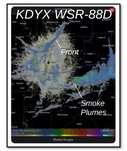
High risk vegetative fuels existed in western and central Texas with Wildland Fire Assessment System (WFAS) Energy Release Component (ERC) ≥90th percentile (yellow-orange). The warm/dry sector of a surface low promoted the development of Extremely Critical fire weather (RFTI 7-8) over this fuelscape in north-central Texas as depicted by the Texas Tech University WRF (3 km CAM) between 16:00 – 22:00 UTC.





19:01 UTC Mesoscale Update:
"The risk of additional new fire ignition and conditional significant Wildfire potential is now increasing… persisting for the next 4-5 hours.
Conditions are now characterized by extremely critical fire weather (RFTIs 7& 8) along and windward of the low level thermal ridge (LLTR) which is now established from near Seymore to Wall to Sonora. This will result in a very favorable environment for dangerous fire behavior considering ambient volatile fuelscape."

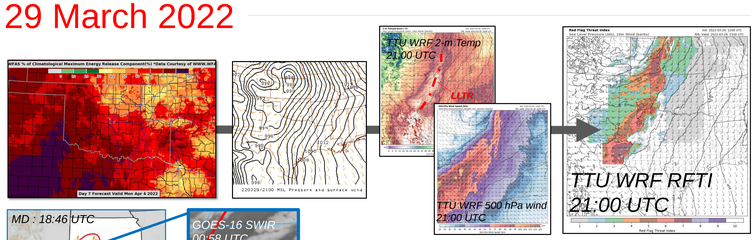
00:54 UTC Mesoscale Update:

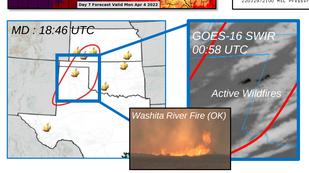


…VERY DANGEROUS WIND SHIFT IMMINENT AT EASTLAND COUNTY FIRE COMPLEX…

"The front is rapidly approaching. A dramatic increase in burn area is likely to occur. The complex of fires could present an imminent threat to life and property in/around Rising Star and Gorman following frontal passage."

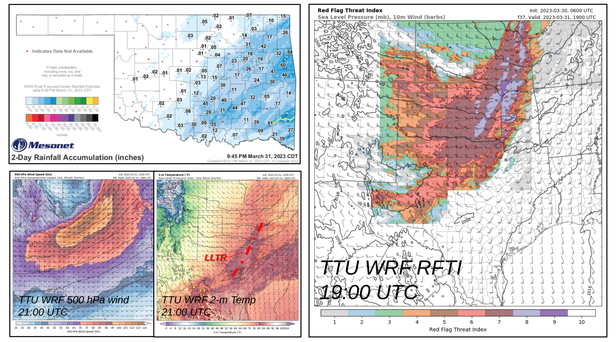
29 March 2022

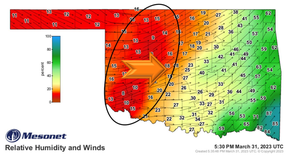


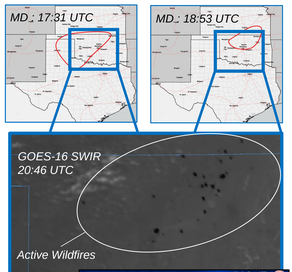


18:46 UTC Mesoscale Update:
"The best alignment of extremely critical conditions is beginning. The low-level thermal ridge is amplifying along the 100th meridian… The most likely areas for new/significant fire ignition and spread will begin to shift/edge eastward toward the eastern Panhandles and far western Oklahoma in the next 0-3 hrs."

31 March 2023







Preceding overnight rainfall moistened vegetative fuels and established a definitive southeastern extent to the fire risk. High-resolution CAMs showed a midlevel jet overspreading a LLTR, a conceptual model for Plains wildfire episodes. The Oklahoma Mesonet showed a corridor of single digit relative humidity and gusts ≥50 kt on the windward LLTR, where TTU WRF RFTIs were forecast to reach Extremely Critical levels (RFTI 7-8).

17:31 UTC Mesoscale Update: "RHs are now falling rapidly to 10-20% in the highlighted area, and this trend will continue to advance eastward closer to the advancing LLTR. Extremely critical fire weather will peak in this corridor by 18-20z. New problematic fire occurrence is likely with possible growth of large and locally damaging fires."

18:53 UTC Mesoscale Update: New fire starts/ignitions are increasing rapidly…possibly in association with a localized 'blow torch effect'. The potential exists for new fire starts to outpace local jurisdiction resources and for the evolution of damaging/dangerous wildfires.

MDs were translated into public-facing social media graphics.

Summary

- ✓ Mesoscale analysis performed with knowledge of the fire environment (weather & fuels) can inform short-term predictions of new wildland fire ignition and problematic spread/extreme fire behavior.

"Mesoscale discussions have proven to be a valuable input for us at Oklahoma Forestry Services. The MDs assists us by maintaining a forward lean to preparedness while focused on immediate fire operations. The real time fire environment snapshot is invaluable for maintaining sound situational awareness at all levels – from the firefighter on the ground to the agency heads that are supporting operations."

- Drew Daily, Deputy Chief of Fire Operations, Oklahoma Forestry Services

Most fire behavior-related wildland firefighter fatalities in the United States are the result of mesoscale phenomenon (Chandler 1976).

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