

# Addressing Critical Knowledge Gaps on Wildland Fires with UAS Technology

Measurements for the project are co-developed with practitioners

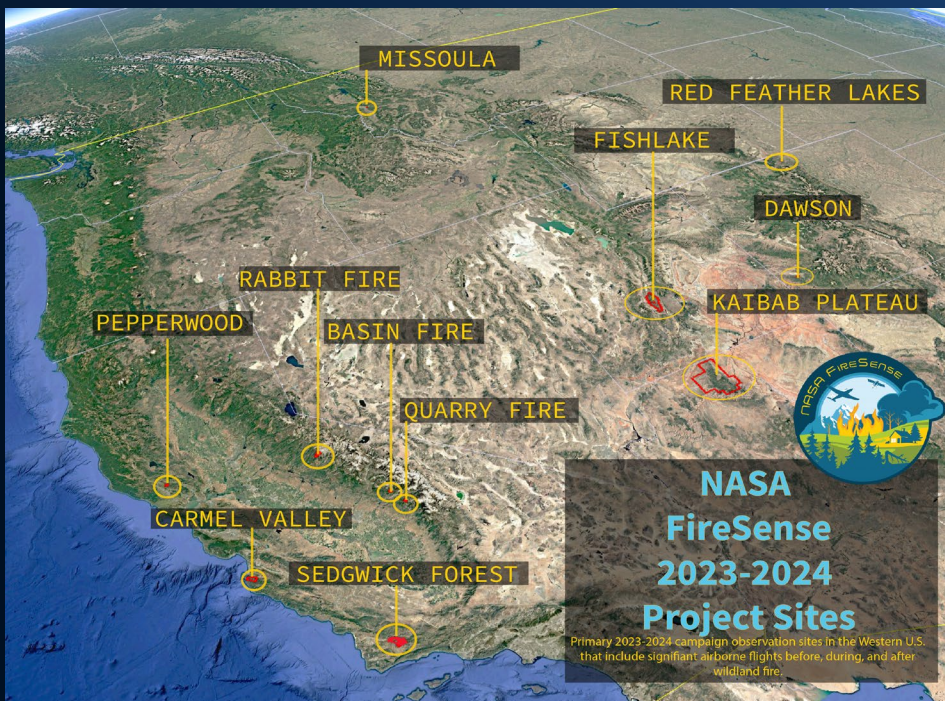


Jennifer Fowler, NASA FireSense Project Manager, NASA Langley Research Center

Jacquelyn Shuman, NASA FireSense Scientist, NASA Ames Research Center

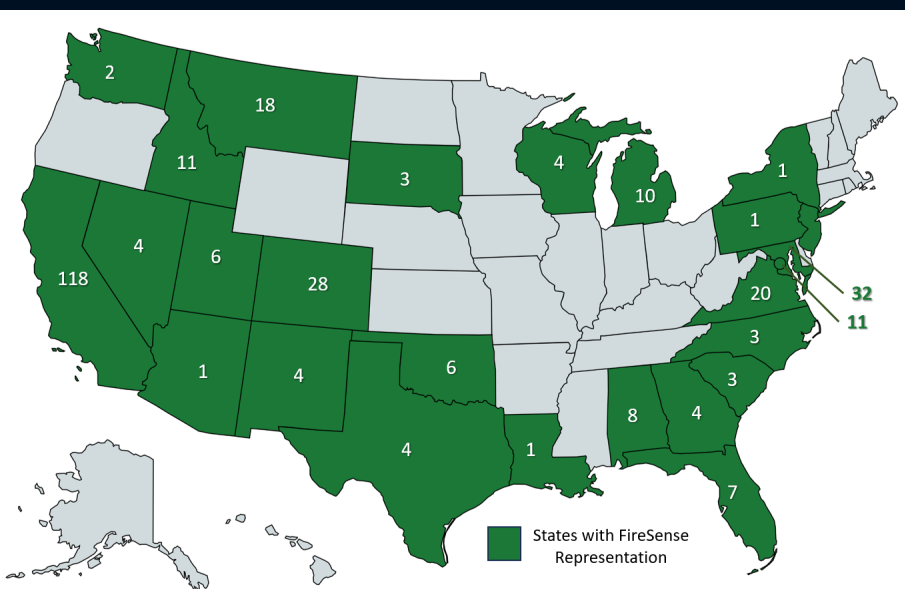
Wildfire Influence on Aerosol, Cloud, and Climate I

January 13<sup>th</sup>, 2025

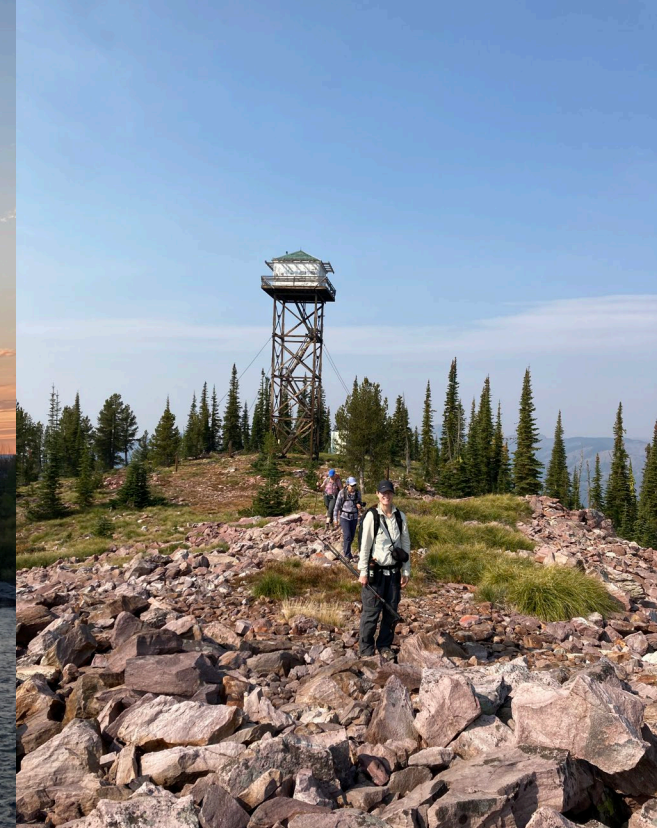


# FireSense

- Delivering NASA's unique Earth science and technological capabilities to US wildland fire management decision makers
- Enables applied and transferable research and technology
  - structured community to liaison between on-ground practitioners and researchers.
  - co-development of solutions to practitioner identified top challenges
  - testing and operational pathways for adoption by decision makers.



Top: NASA FireSense airborne campaign sites 2023-2024, Bottom: States with FireSense representation for the 357 collaborators from 26 states plus D.C.



Missoula, MT

# Missoula, MT



"Good morning, The smoke is thick, the inversions are strong, and the Smoke Spiral is still rotating overhead. It's messy out there, folks.",  
Missoula City-County Air Quality Specialist, Sarah Coefield, Sept. 7, 2017

Maroon

Hazardous

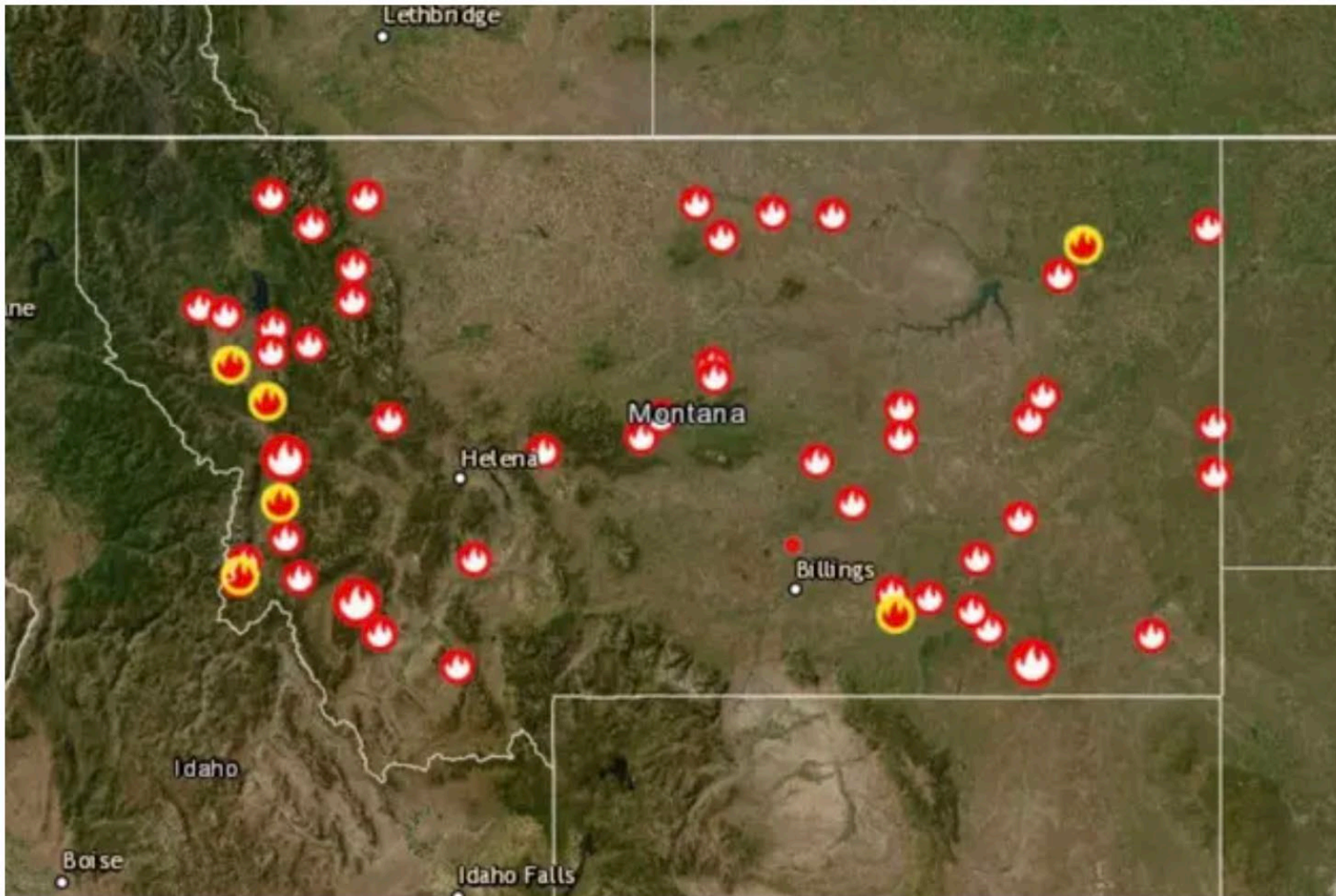
Health warning of emergency conditions: everyone is more likely to be affected.

# Missoula, MT



# Missoula, MT August 2024

August 27<sup>th</sup>, 2024



56 active fires burning across the state as of 8/9/24) making a **staggering total 1,325 fires in Montana this year.**

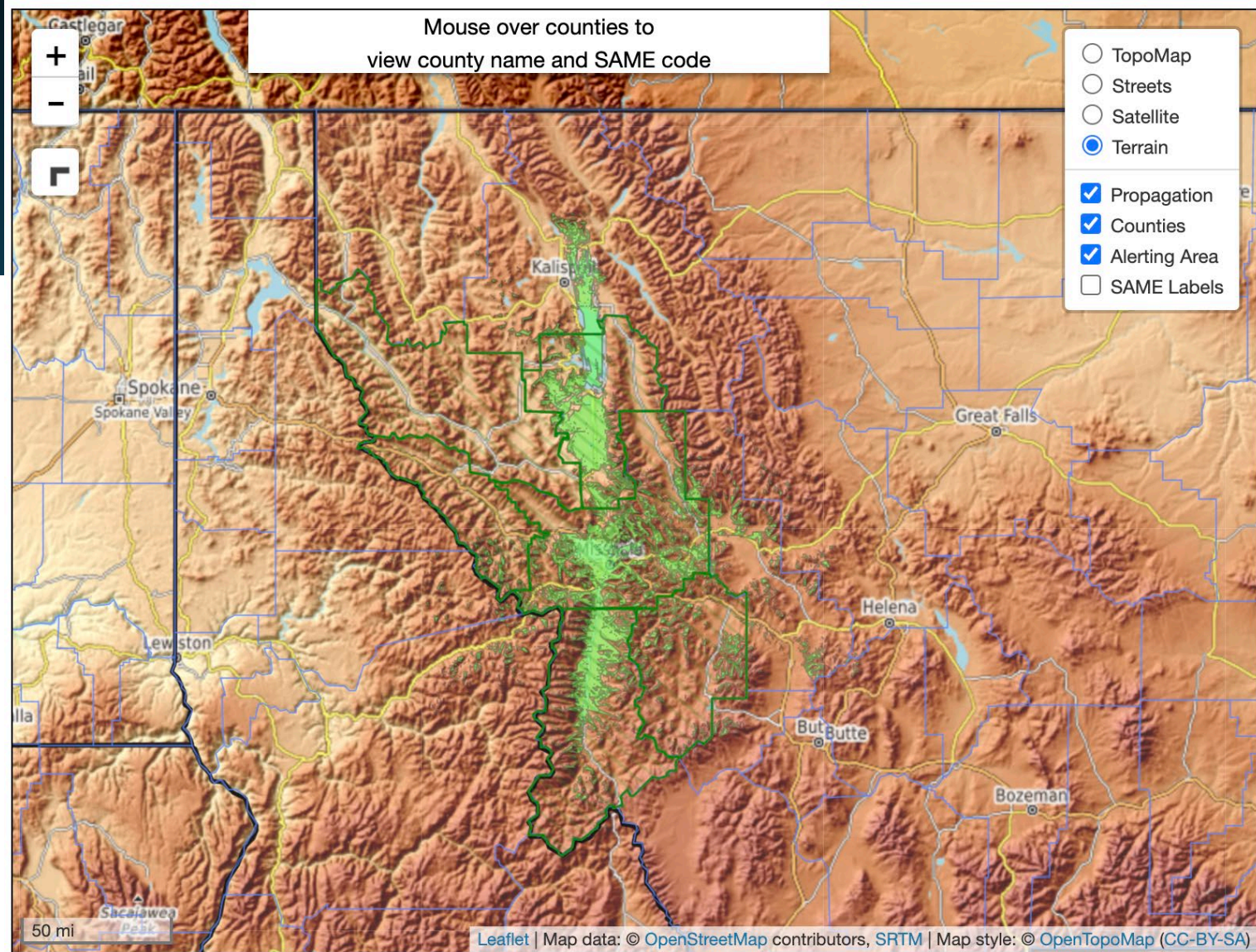
Sharrott Creek fire started Aug 23, 2024 (3204 acres)

# Missoula, MT

Why have a FireSense demonstration?

Radar disadvantage in the Missoula area  
due to radar shadows

<https://www.weather.gov/nwr/sites?site=WXL25>



**Transmitter Status**

LEGEND	Operating Status for WXL25	Areas Receiving Alert Tones	Coverage Area
Normal	<b>NORMAL</b>		<input type="button" value="INFORMATION"/>
Degraded			
Out of Service			

*Geolocation to get your browser location*

**(if you grant permission)**

# FireSense Montana Deployment

“This was an organized, cohesive field demonstration highlighting promising [NASA] technology.” Zach Holder, United States Forest Service, Incident Awareness & Assessment Program Manager



NASA Alta X vertical sounding data collection in a smoke impacted environment. NASA ARC/Milan Loiacono

**“It was great to see and discuss the possibilities of drone weather sensors as it relates to fire weather during your field campaign in August.”**  
**Dan Zumpfe, Science and Operations Officer,**  
**National Weather Service - Missoula, MT**

With MITRE Corporation and ESRI, FireSense technology demonstration:

- Uninhabited Aerial Systems (UAS) for atmospheric vertical soundings
- featured a NASA-designed payload on an Alta-X UAS
- consistent with current USFS UAS operational platforms
- co-located balloon soundings for validation and near real-time visualization.



NASA Alta X vertical sounding data collection visualizations. NASA ARC/Milan Loiacono



FireSense project office discussion with practitioners. NASA ARC/Milan Loiacono

# Missoula, MT

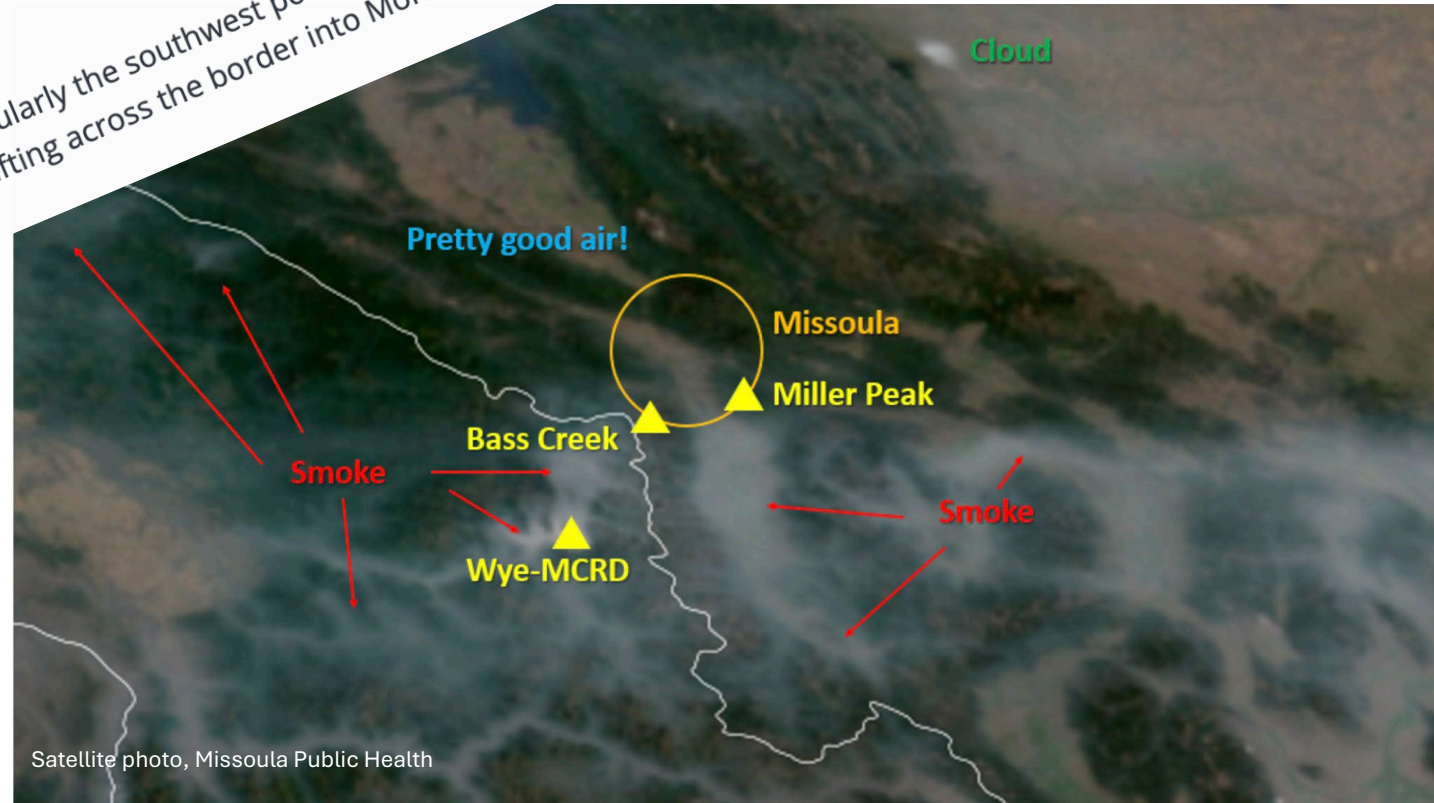
Requesting permission

## Smoke Forecast for Tuesday, August 27, 2024 9:30 AM

AUGUST 27 2024

### Current Conditions

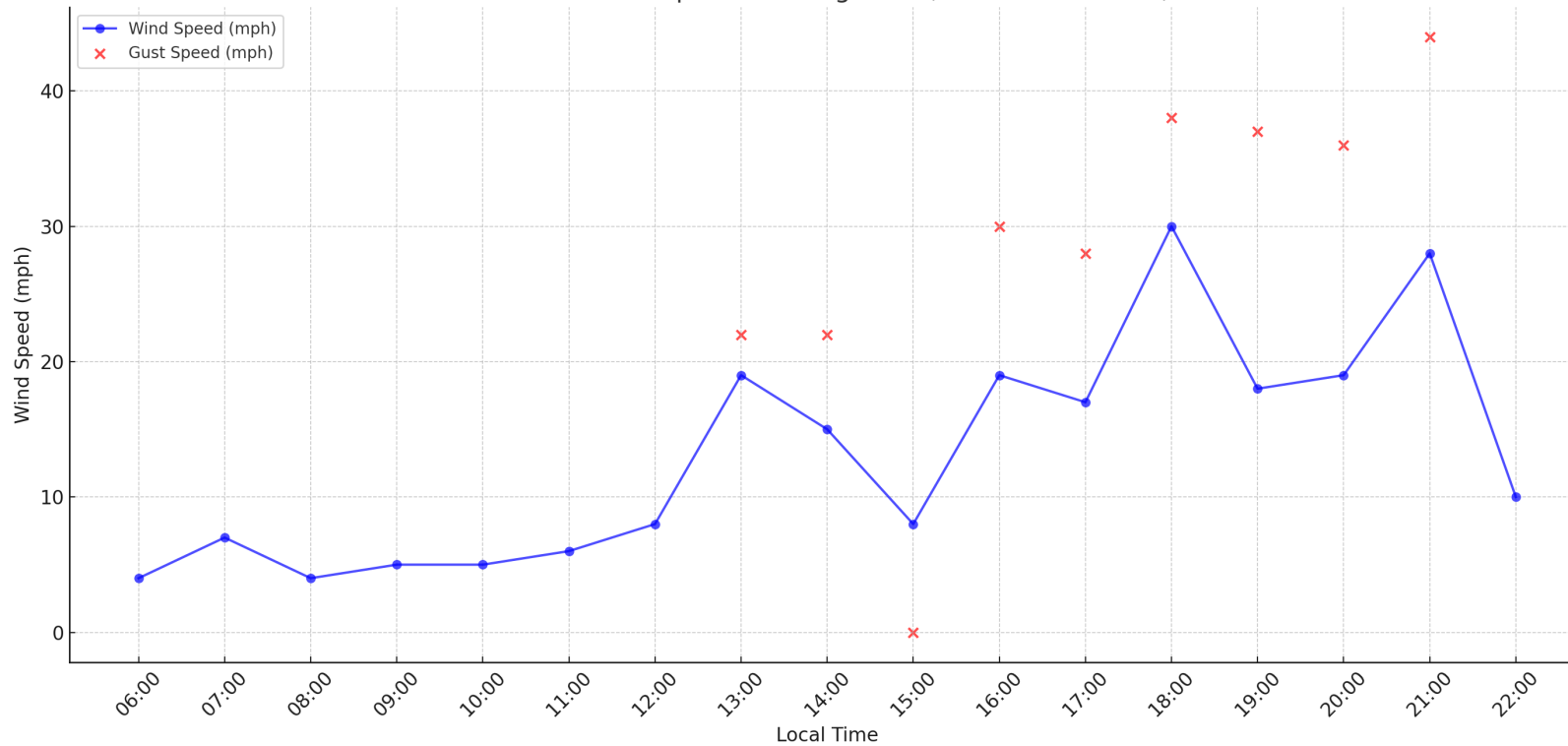
Light smoke is widespread early Tuesday across the Treasure State, particularly the southwest portion of the state. Numerous active fires continue to burn across the mountains of Central Idaho, and the smoke has been drifting across the border into Montana. Fortunately, the bulk of the smoke was aloft on Monday, so there weren't any major impacts to air quality.



# Missoula, MT

August 27<sup>th</sup>, 2024

Forecasted Wind Speeds on August 27, 2024 in Missoula, MT

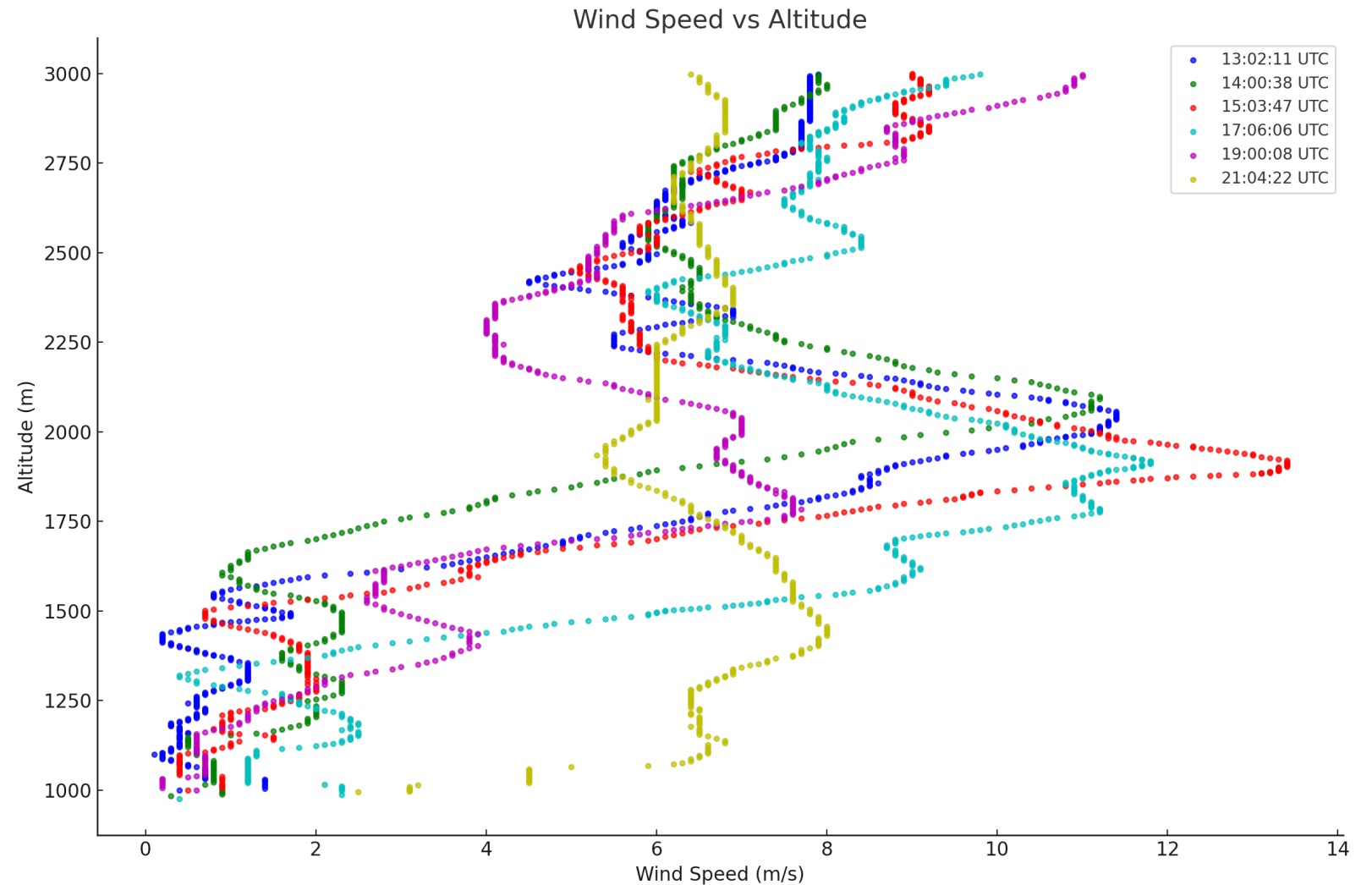


## Forecast

- Cold front passage in afternoon starting around 1pm local time
- Gusts could exceed 40 mph
- Concern for increased fire behavior and smoke production

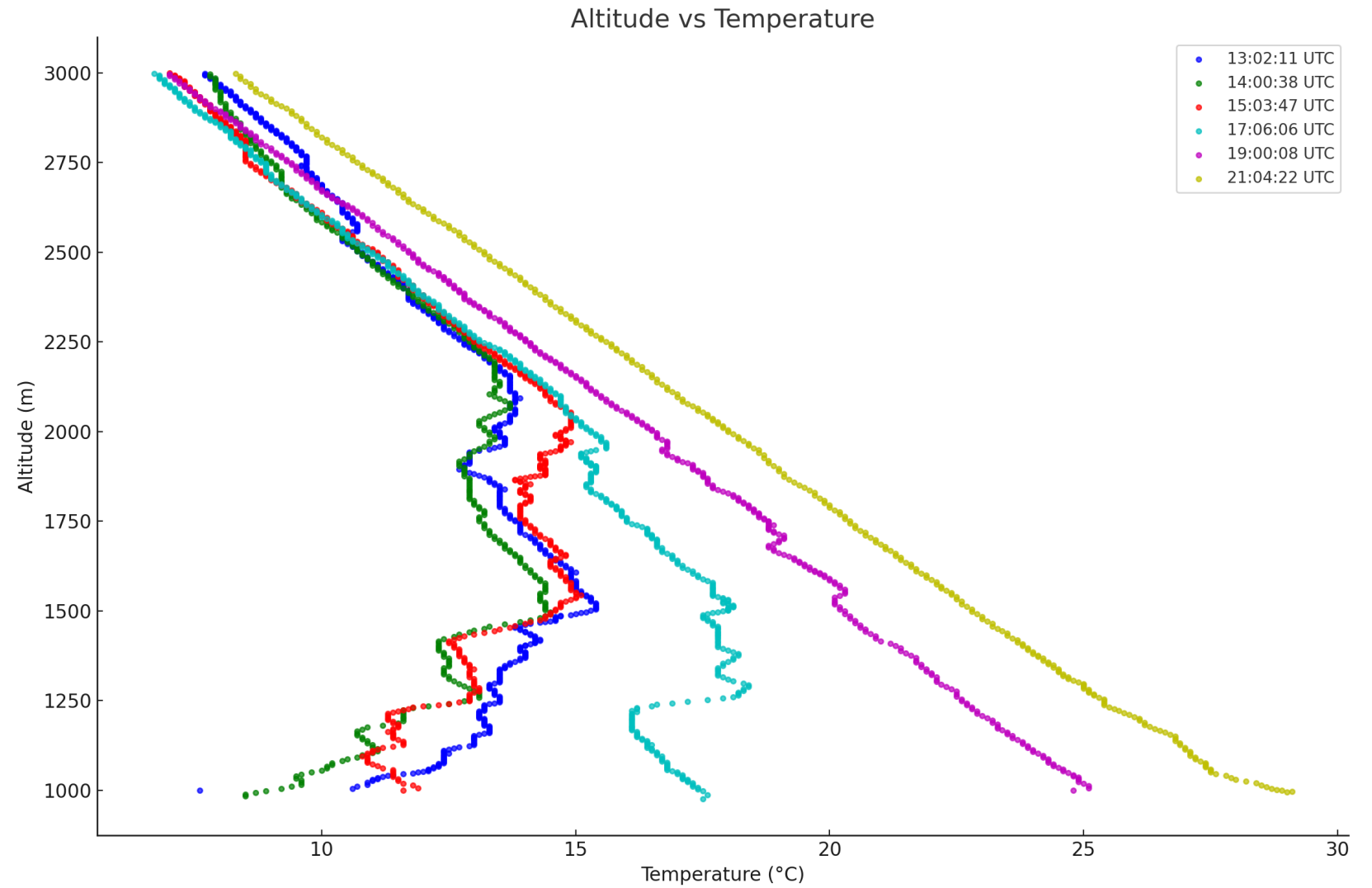
# FireSense Montana Deployment

August 27<sup>th</sup>, 2024



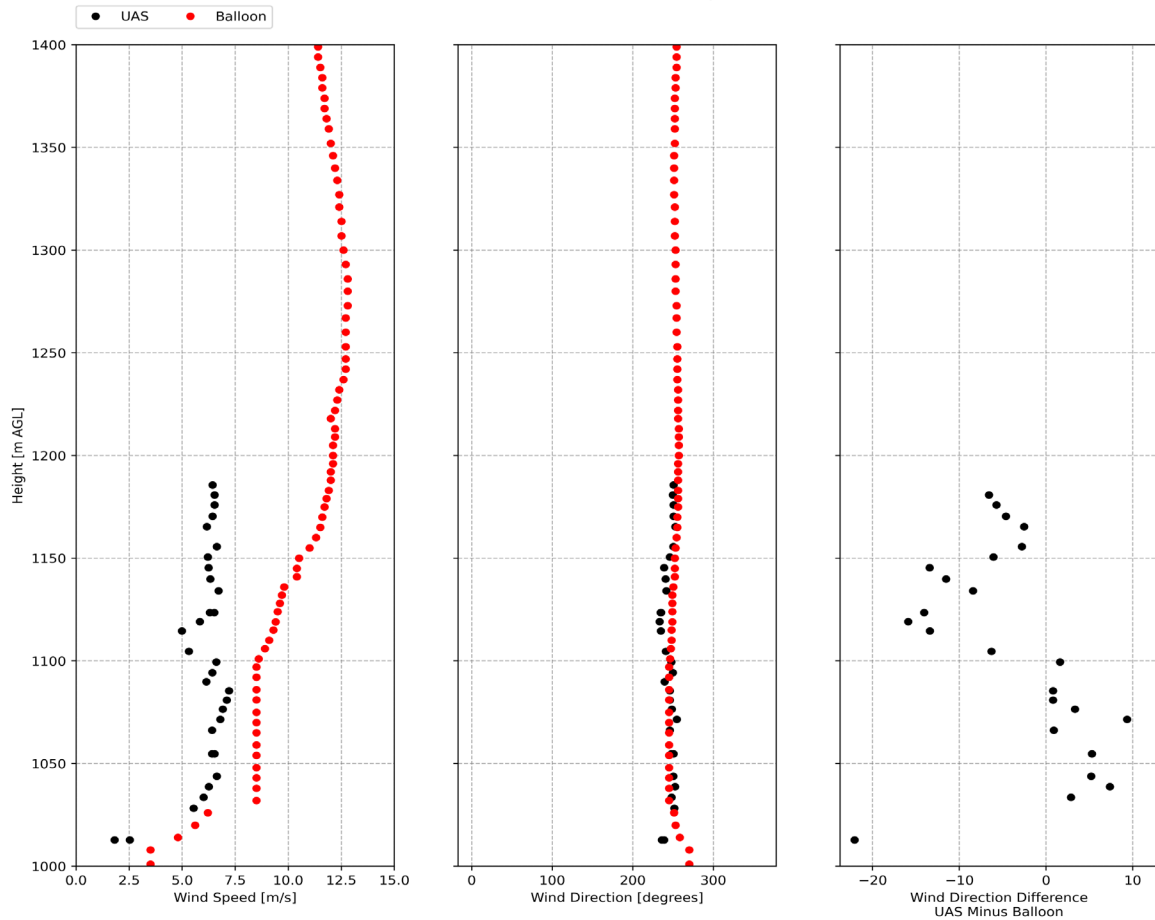
# FireSense Montana Deployment

August 27<sup>th</sup>, 2024



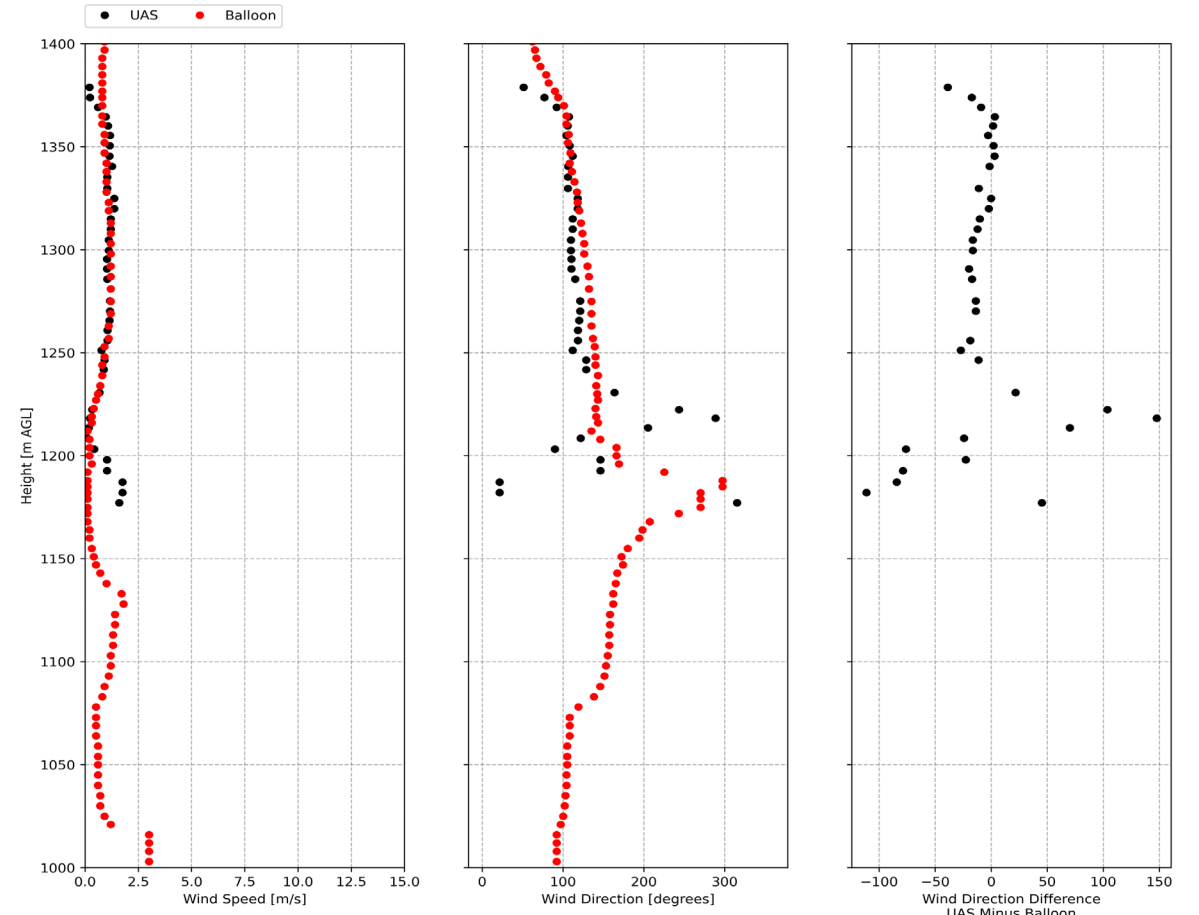
# FireSense Montana Deployment

2024/08/28 15:14 UAS Flight  
2024/08/28 15:00 Balloon Flight



8/28/24

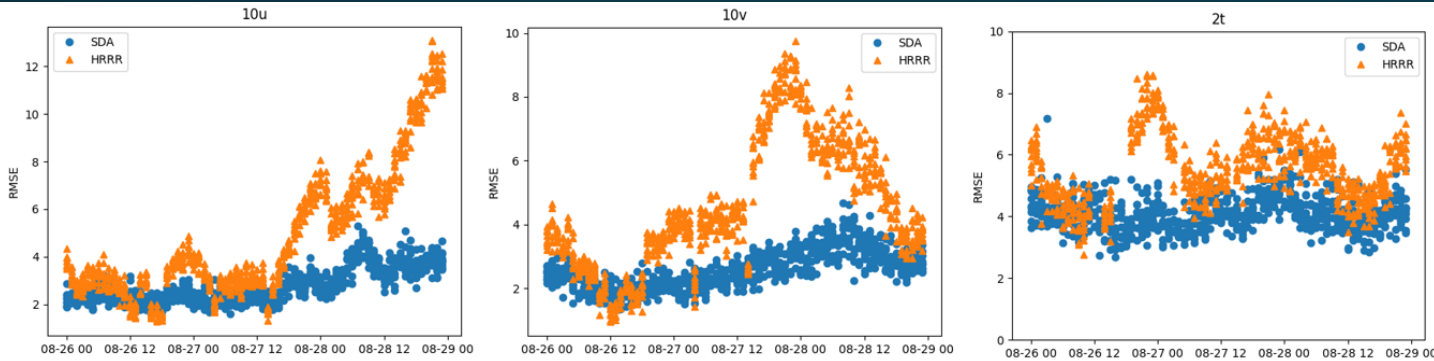
2024/08/29 14:48 UAS Flight  
2024/08/29 14:35 Balloon Flight



8/29/24

# FireSense Montana Deployment

We worked with partners for near realtime visualizations and forecasts.



ESRI sample cluster analysis for data collected from balloon borne sondes below.



Graphics by MITRE/Conor Lewellyn

- SDA
- ▲ HRRR

Lower RMS error with Score-based Data Assimilation (SDA) (blue) vs. NOAA HRRR (orange) shown above

Above, RMS error when compared to MesoWest weather station observations for the “Score-based Data Assimilation” (SDA) model run by MITRE and the NOAA HRRR model for wind speed at 10 meters in the u direction (left), v direction (middle), and 2-meter temperature (right).

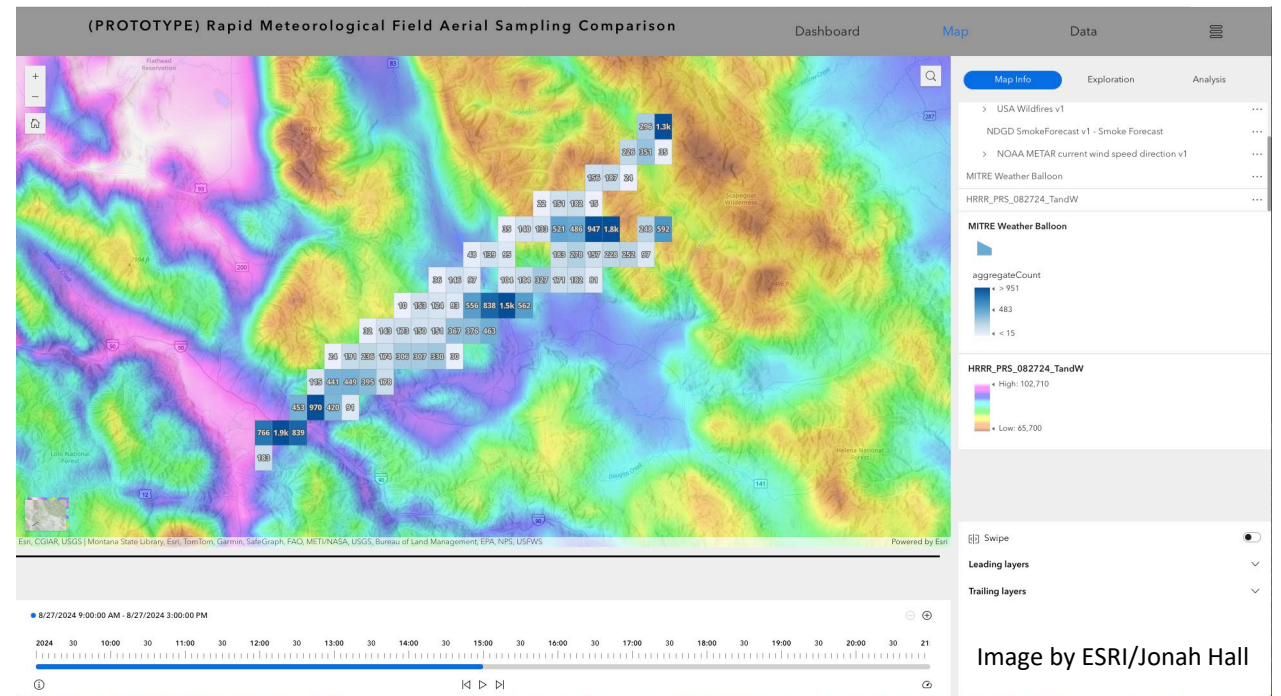


Image by ESRI/Jonah Hall



## Next Steps: 1yr, 5 yr, 10 yr

- Top priorities
  - assess mixing height for smoke dispersion forecasting for prescribed fire planning
  - producing real-time plots as seen in previous slides can address this
- This work and recent studies indicate boundary layer above 2250m AGL
  - suggesting UAS profiling needs to be above that, with 3000m optimal target
  - Or, is there “acceptable” altitude that meets user’s needs?
- Further investigation of microclimate effects and rapid atmospheric changes as seen in difference between the balloon and UAS data
- Increase the deployment from a point source to a grid or other technology
- Model evaluation

# Questions?



## Thank you!!!

For further information, please contact:

Michael Falkowski, FireSense Program Manager  
michael.falkowski@nasa.gov

Jacquelyn Shuman, FireSense Project Scientist  
jacquelyn.k.shuman@nasa.gov

Jennifer Fowler, FireSense Project Manager  
jennifer.w.fowler@nasa.gov



<https://cce.nasa.gov/firesense/index.html>