FireSense: Supporting operational partners through co-development

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Overview

Fire is a natural disturbance and fundamental to many ecosystems. Across the United States over the past 20 years, fires have become more common, larger, and more likely to occur at the same time. This leads to increasingly negative impacts on economic (loss of structures and communities), public health (loss of life, and detrimental air pollution), and ecological aspects of society (shifts in vegetation and carbon storage). Wildland fire management is being highlighted globally (UNEP 2022) and within federal agencies (BIL WFMMC report 2023) to identify and implement proactive and science-informed pathways to live more sustainably with fire. Coordinated action is essential for addressing wildland fire management challenges. FireSense, a NASA Science Mission Directorate project, aims to develop and deliver trailblazing technology and tools for use before, during, and after wildland fires by working with practitioners and partners.

Goals

Support proactive wildland fire management through technology development, capability demonstration, and transfer-to-operations for activities before, during, and after wildland fire. These goals are achieved through the following:

- By leveraging partner agreements and co-development
- Through the use and development of NASA knowledge and observing technologies
- Coordinated airborne campaigns focused on utility of technologies in fire mitigation, management, and recovery
- Coordinated stakeholder engagement (Fig 1)

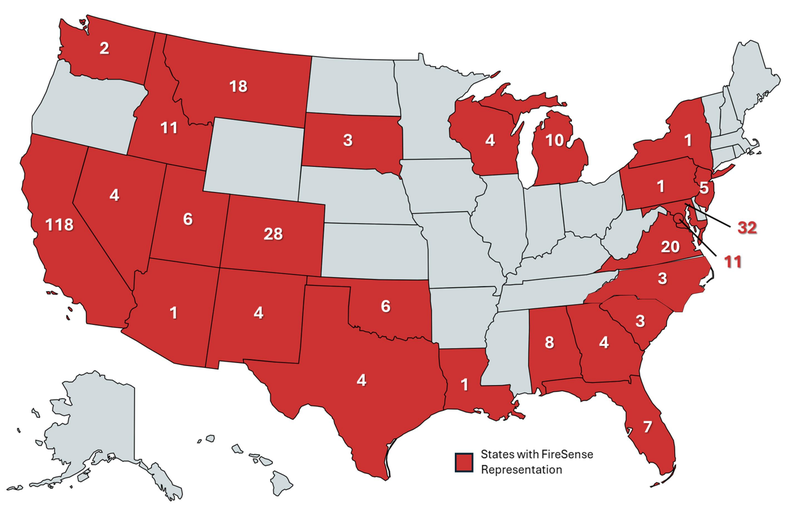

Fig 1. States with FireSense representation from the 357 collaborators shown in red with the number of collaborators based in that state.

Campaign Activities

FireSense campaign activities will be implemented across the US in a variety of ecosystems to test, validate, and calibrate sensors, as well as fire and smoke behavior models. The FireSense 2023-2024 airborne campaign sites focused on the western US and leveraged partner activities in Montana, Colorado, Utah, Arizona and California (Fig. 2). Future campaign sites include locations in Alabama and Florida in coordination with state and federal partners targeting fine scale meteorological and moisture sampling and smoke dispersion.

Fig 2. Primary 2023-24 FireSense campaign sites with airborne flights before, during, or after wildland fire.

Coordination and Sensors

FireSense works to leverage and complement partner activities. Coordinated investment supports a more comprehensive and cohesive response that will advance our understanding of fire behavior and effects through integrated measurement, monitoring, and modeling. This includes coordinated airborne sampling coincident with ground measurements for atmospheric conditions (Fig 3) and fuel and soil moisture (Table 1).

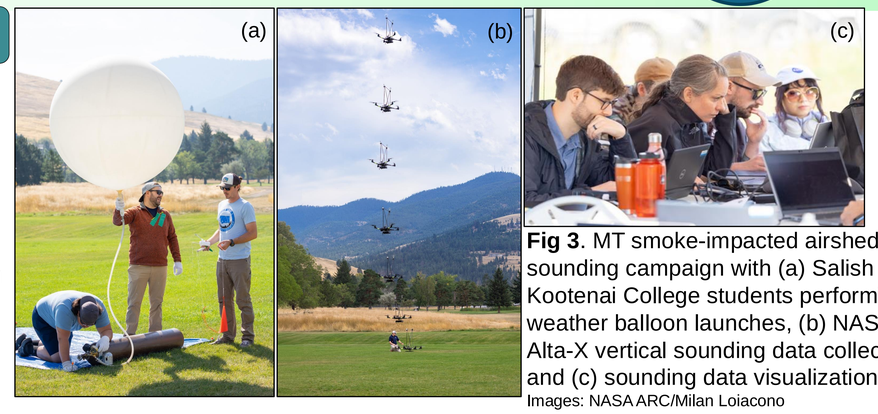

Fig 3. MT smoke-impacted airshed sounding campaign with (a) Salish Kootenai College students performing weather balloon launches, (b) NASA Alta-X vertical sounding data collection, and (c) sounding data visualizations. Images: NASA ARC/Milan Loiacono

By coordinating with local partners FireSense identifies opportunities to demonstrate novel technologies in fire and smoke impacted areas. In August 2024, smoke from multiple wildfires impacted Missoula, MT's community air shed. The FireSense team was asked by the US Forest Service to demonstrate novel technologies for tactical microclimate and wind forecasting in support of active fire response operations. In collaboration with MITRE Corporation and ESRI, FireSense executed a technology demonstration of Uninhabited Aerial Systems (UAS) for atmospheric measurements to support fire weather forecasting. This demonstration featured a NASA-designed payload on an Alta-X UAS, consistent with current USFS UAS operational platforms, and included co-located balloon soundings for data validation and near real-time data visualization. (J. Fowler poster B31H-1364 for more details)

Community of Practice

FireSense enables the transition of applied research and technology through a community of practice that includes fire management practitioners, researchers, and technologists, through the co-development of solutions to practitioner identified challenges. Through this process FireSense provides the testing and operational pathways for adoption of technologies by decision makers.

Initial outcomes:

1. Formation of the FireSense Implementation team (community of practice) to liaise between wildland fire management practitioners, researchers, and technologists (including the commercial industry).

2. Facilitation of targeted workshops to identify top practitioner needs for co-development of technological solutions.

Site	Partners	Use cases	Sensors	Fuel Composition	Fuel Structure	Coordinated air and ground moisture sampling
Fishlake National Forest, Utah	USFS FASMEE	Pre-fire, active fire, post-fire	AVIRIS-3, UAVSAR	Y	Y	
Red Feather Lakes, CO	USGS, CSU	Pre-fire	UAVSAR, SLAP	Y		Y (live & dead fuels)
Carmel Valley, CA	CSU Monterey	Pre-fire	AVIRIS-3, UAVSAR, SLAP	Y		Y (live fuel)
Kaibab National Forest, AZ	USFS	Pre-fire, active fire, post-fire	AVIRIS-3, UAVSAR, MASTER, SWIS	Y	Y	Y (soil)
Sedgewick Nature Reserve, CA	SDSU	Pre-fire, active fire, post-fire	AVIRIS-3, UAVSAR, SLAP	Y	Y	Y (live fuel & soil)
Pepperwood Nature Reserve, CA	Pepperwood, USGS	Pre-fire	UAVSAR, SLAP			Y (soil)

Table 1. Fall 2023 FireSense airborne sampling for selected locations and sampling details.

Access data: https://www-air.larc.nasa.gov/missions/firesense/index.html **Learn more:** https://go.nasa.gov/firesense