

Tools and Weather/Climate Information Used by Wildland Fire Managers in the Southwest United States

CLIMAS Investigators: George Frisvold, Dan Ferguson, Mike Crimmins

Key Partners: Chuck Maxwell (U.S. Fish and Wildlife Service; Predictive Services Southwest Coordination Center)

Post-doctoral Researchers and Graduate Students: Trevor McKellar (Environmental Science); Wenting Zheng; Jennie Doss; Taylor Dew; Ning Zhang (Department of Agriculture and Resource Economics)

End Users: Interagency wildland fire community in the West: U.S. Fish and Wildlife Service; U.S. Forest Service; NOAA – National Weather Service; Bureau of Land Management; Bureau of Indian Affairs; National Park Service; Arizona Department of Forestry and Fire Management; New Mexico Forestry Division

Additional Resource Support: U.S. Fish and Wildlife Service

Project Dates: 2019 - 2024

Summary of Impact

New findings: This project aimed to understand how wildland fire managers use available weather and climate data/information and decision support tools. Through focus groups, interviews, and a survey of over 200 fire managers in the Southwest, researchers found that relatively few sources of weather and climate information are consulted by Southwest wildland fire managers. A small percentage of those sources are used to inform specific decisions and tasks related to coordinating and mobilizing resources for wildland fires; decision support tools are commonly used to justify rather than inform decisions.

Tool development: By collaborating with wildland fire meteorologist and regional expert Chuck Maxwell, the team explored ways to better support fire management planning and response. One outcome was the development of the [Southwest Burn Period Tracker \(SBPT\)](#), a tool that calculates a simple fire weather index based on relative humidity. This tool, previously unavailable on a common platform, is now readily accessible to fire managers via Remote Automated Weather Stations (RAWS) across AZ and NM.

Tool use: The SBPT was explicitly designed and tested with the Southwest wildland fire community to ensure its utility and relevance. It is now operationally used by fire managers daily, throughout the year across Arizona and New Mexico. It is linked as a key resource on the Fuels/Fire Danger page of the Southwest Coordination Center website, which was accessed over 1400 times in 2023. Data from the SBPT has also been used during regional and national wildland fire briefings.

Partnership: The transdisciplinary nature of this project team ensured that project outcomes were relevant, responsive to end-user needs, and positioned to make a tangible

impact on wildfire management strategies and outcomes in the Southwest. The partnership continues and will expand into new wildland fire projects beyond this project.

Problem Statement

Wildland fire management in the U.S. is complicated, expensive, and requires a substantial amount of scientific data and information across a huge range of temporal and spatial scales. Although state and federal agencies as well as academic research groups have devoted substantial resources to develop data products, forecasts, outlooks, and decision support tools for wildland fire management, relatively little is known about how these tools have been used to inform wildland fire management decisions.

Research Focus

This study initially focused on two related research questions: 1) How do weather and climate products and tools inform wildland fire management decisions in the Southwest? 2) How are existing decision support systems used by wildland fire managers in the Southwest? As the project evolved, it took a transdisciplinary research approach by adding wildland fire meteorologist and regional wildfire expert Chuck Maxwell to the team. The team added a new project focus to develop operational weather and climate information products for the Southwest wildland fire management community.

Project Activities

Focus groups and interviews: The research team interviewed 12 wildland fire managers via two focus groups, two paired interviews, and one solo interview. The qualitative data from these interviews and focus groups informed a quantitative survey and contributed to one of the project's publications.

Survey: The team developed, tested, and refined an internet survey for western fire managers. The survey garnered 206 responses about use of climate and weather information, a response rate of just over 43% of the target population. Survey responses revealed what data sources fire managers use, the types of decisions they make with that information, and the extent to which decision support tools are used and for what purposes those tools are used.

Weekly meetings: The core team (Frisvold, Ferguson, Crimmins, and Maxwell) met weekly to discuss the

On engagement of the wildfire community:

I saw this project as an opportunity to learn some stuff, do it comprehensively, and get all the people I knew [in the wildfire community] to engage. Getting that engagement was huge and CLIMAS gave fire managers a much wider forum to participate. I think that's part of why we got good engagement. We were able to give them a voice, which helped get the southwest wildfire community to move things forward.

—
Chuck Maxwell, Predictive Services, Southwest
Coordination Center

project and synthesize findings for presentations, publications, and other kinds of outreach.

Project Outputs

Decision Support:

The [Southwest Burn Period Tracker \(SBPT\)](#) is a tool that calculates and presents a simple fire weather index called Burn Period – the number of hours per day where the hourly average relative humidity is less than or equal to 20%. This index, which was already informally used by the wildland fire management community but not readily accessible through a common platform, is calculated daily at Remote Automated Weather Stations (RAWS) across the southwest U.S. The tool provides up-to-date Burn Period values at all RAWS in Arizona and New Mexico and adds climatological context and forecast information to these values. An [ArcGIS version of the Burn Period Tracker](#) is available for integration into national, wildfire assessment platforms.

Peer-reviewed Publications:

Crimmins, M.A., C. Maxwell, D.B. Ferguson, G.B. Frisvold. 2024. Burn Period: A use-inspired metric to track wildfire risk across Arizona and New Mexico in the southwest U.S. *Journal of Applied Meteorology and Climatology*. <https://doi.org/10.1175/JAMC-D-24-0067.1>. In press.

Ferguson, D.B., G.B. Frisvold, C. Maxwell, and M.A. Crimmins. 2024. How Are Weather and Climate Products and Decision Support Systems Used in Wildland Fire Decision Making in the US Southwest? *Weather, Climate, and Society*. <https://doi.org/10.1175/WCAS-D-24-0069.1>. In press.

Frisvold, G.B., N. Zhang, M.A. Crimmins, D. Ferguson, C. Maxwell, C. 2024. Demand for Information for Wildland Fire Management. *Atmosphere* 15(11): 1364. <https://doi.org/10.3390/atmos15111364>.

Theses:

Dew, Taylor J. 2021. [It is a Dry Heat: Econometric Model of Historic Fires](#). MS Thesis, Department of Agricultural & Resource Economics, University of Arizona.

Zhang, N. 2022. Demand for Information by U.S, Southwest Wildland Fire Managers. MS Thesis, Department of Agricultural & Resource Economics, University of Arizona.

Selected Scientific Findings:

On data use: Despite having access to a wide range of weather and climate data, study results show that Southwest wildland fire managers only consult about a third of them. Few Southwest wildland fire managers use decision support systems to inform decision-making. For example, the Wildfire Decision Support System (WFDSS), designed to aid fire managers and analysts in decision-making, is primarily used for documenting and

justifying decisions after they are made, rather than informing those decisions initially (Figure 1).

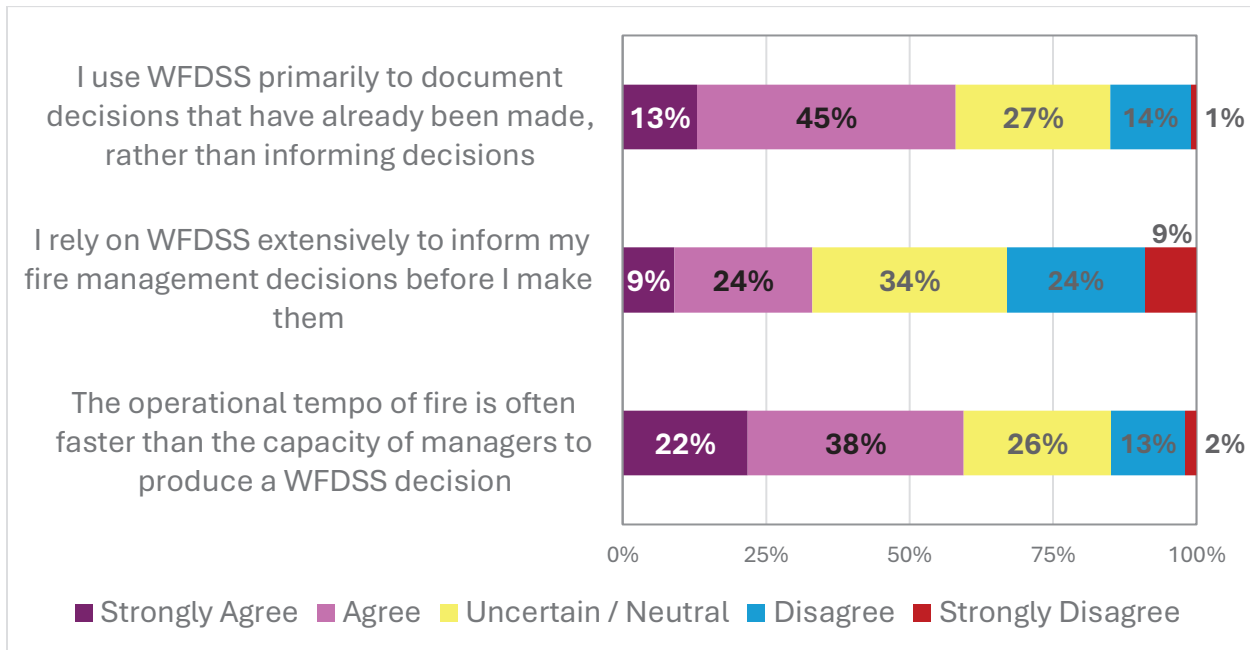


Figure 1: Survey results regarding the Wildfire Decision Support System (WFDSS).

Leveraged Funding:

Supporting new initiatives beyond this project:

- U.S. Forest Service (\$750,000)
- U.S. Geological Survey, Southwest Climate Adaptation Science Center (\$150,000)

Project Challenges

Challenges for this project were mostly related to IT and data access. Forecast data from NOAA became unavailable due to a hardware failure, impacting delivery of SBPT forecast information. A new data access point had to be quickly developed to maintain data availability. Additionally, the changing IT infrastructure at University of Arizona, where the SBPT is housed, made it challenging to develop long-term plans to maintain the SBPT in the University system.

Societal Impacts by Category

Connectivity:

- This project strengthened a collaborative partnership between CLIMAS researchers and Chuck Maxwell who has strong connections with the western fire and land management community. This partnership facilitated two-way communication, allowing researchers to quickly connect with fire managers, understand their needs,

and collaboratively develop targeted tools and resources to improve wildfire management on the ground.

Regarding the project team:

For CLIMAS, this is yet another case of demonstrating that transdisciplinary research works. We have Chuck, our partner, doing this on his own time, bringing things to the table that the rest of us don't know. One of our best outcomes is our diverse group working together. I think it's a good model of how you can do this type of work if you have the right people in the room together

—
Dan Ferguson, CLIMAS

- The transdisciplinary nature of this team, which included an economist, a social scientist, a climatologist, and a wildland fire meteorologist/government liaison, pushed the research in new directions. The CLIMAS wildfire research agenda has evolved and will continue to expand beyond this initial project.

Capacity Building:

- This research provided training and support for four graduate student researchers. Taylor Dew's and Ning

Zhang's M.S. theses were direct results of this project.

- An early career scholar, Trevor McKellar, gained experience in developing climate service decision support tools while helping develop the Burn Period Tracker.
- The National Interagency Fire Center is developing training materials using historical Burn Period plots developed through this project. This agency requested an [Archive of the Burn Period Tracker](#) for training and research purposes.

Instrumental:

- The SBPT is used by fire managers daily, throughout the year, across Arizona and New Mexico. It is used in operational decision making regarding the execution of prescribed fires and wildland fire management planning.
- Information from the SBPT is referenced during regional and national wildfire briefings.
- The Burn Period Tracker is linked as a key resource on the [Fuels/Fire Danger page of the Southwest Coordination Center website](#). It was accessed over 1400 times in 2023.

On use of a decision support tool:

A highlight of this project for me was being able to use things like the burn period tracker right away, operationally, to brief my fire managers who had informed the development of the tool. The tracker is built right into our operations, especially regarding the summertime monsoon and moisture conditions. We've been having fires now over the summer, during times that we did not in past decades, and the burn period tracker seems to resolve that very well.

—
Chuck Maxwell, Predictive Services, Southwest Coordination Center