



Firefighter hiking toward fire.
Photo by: NPS / Yasunori Matsui



Arctic Observation Storylines: Wildfires

WHY OBSERVING MATTERS AND HOW WE CAN MAKE IT BETTER TOGETHER

The challenge

Alaskan wildfires are increasing in frequency, intensity, and unpredictability due to a rapidly changing climate, particularly in high northern latitudes. Warmer temperatures, longer fire seasons, and the drying of tundra and boreal forests are accelerating wildfire activity, posing escalating threats to ecological systems, Indigenous ways of life, rural communities, public health, and critical infrastructure. Despite growing awareness, Alaska faces significant challenges in wildfire prediction, preparedness, and response —compounded by the need for improved observations, data sharing, community engagement, and adaptation strategies.

Why wildfire observations are important

Accurate and timely wildfire data enables more effective preparedness, planning, and response, reducing recovery costs and safeguarding communities and responders. Real-time information allows fire managers to anticipate fire behavior, optimize resource allocation, and issue timely evacuations, thereby minimizing property loss and injury. Satellites, drones, and predictive models give firefighters a clearer picture of fire movement and behavior — helping them identify hazards and plan safer escape routes. Additionally, early detection and informed planning streamline operational response. Forest management is increasingly employing prescribed burning, which requires knowledge of the seasonality and climatology of fire weather indices to optimize the costs and safety of burn timing.



The US Arctic Observing Network (US AON) is funded by the National Oceanic and Atmospheric Administration's Global Ocean Monitoring and Observing/Arctic Research Program and the National Science Foundation.

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Acronyms

Organizations and General Terms

AICC - Alaska Interagency Coordination Center
AFSC - Alaska Fire Science Consortium
AGC - Alaska Geospatial Council
AK - Alaska
AKDNR - Alaska Department of Natural Resources
BLM - Bureau of Land Management
DOD - Department of Defense
DOI - Department of the Interior
ECMWF - European Centre for Medium-Range Weather Forecasts
EPA - Environmental Protection Agency
EPSCoR - Established Program to Stimulate Competitive Research
ESA - European Space Agency
FEMA - Federal Emergency Management Agency
GINA - Geographic Information Network of Alaska
IARPC - Interagency Arctic Research Policy Committee
JFSP - Joint Fire Science Program
KPSO - Key Products, Services, and Outcomes
NASA - National Aeronautics and Space Administration
NESDIS - National Environmental Satellite, Data, & Information Service
NOAA - National Oceanic and Atmospheric Administration
NSF - National Science Foundation
SME - Subject Matter Expert
UAA - University of Alaska Anchorage
UAF - University of Alaska Fairbanks
US AON - US Arctic Observing Network
USGS - United States Geological Survey
USWFS - U.S. Wildland Fire Service

Observing and Data Systems

ABOVE - Arctic-Boreal Vulnerability Experiment
AKFF - Alaska Fire and Fuels Website
ALDN - Alaska Lightning Detection Network
ASTER - Advanced Spaceborne Thermal Emission and Reflection Radiometer
AVIRIS NG - Airborne Visible-Infrared Imaging Spectrometer - Next Generation
BUI - Buildup Index
CFSv2 - Coupled Forecast System version 2
CFDRS - Canadian Forest Fire Danger Rating System
DEM - Digital Elevation Model
ERA-5 - ECMWF Reanalysis v5
EVT - Existing Vegetation Type
GIS - Geographic Information System
IFSAR - Interferometric Synthetic Aperture Radar
JPSS - Joint Polar Satellite System
LIDAR - Light Detection and Ranging
MF8 - Meteo France version 8
MSI - Multispectral Imager
NDFD - National Digital Forecast Database
NLCD - National Land Cover Database
OMPS - Ozone Mapping and Profiler Suite
RGB - Red, green, blue
SEAS5 - ECMWF seasonal forecasts
VIIRS - Visible Infrared Imaging Radiometer Suite
VIR - Visible Infrared
WSR-88D - Weather Surveillance Radar 1988 Doppler

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Priority actions

The priority actions below are drawn from structured assessments of the key observational products and services that Alaska's wildfire management community depends on (Tables 1 & 2). Actions marked ADVANCE address gaps where current capabilities fall short. Actions marked SUSTAIN identify high-performing capabilities that are at risk without continued investment. Relevant organizations are those centrally concerned with implementing each action; academic and community partners are widely engaged in these actions as well, and are not specifically called out in the table. For the detailed assessments behind these actions, see pages 7–12.

Table 1. Priority Actions to ADVANCE capabilities toward fully meeting their requirements.	Relevant Organizations
<p>A1. Update and Sustain Vegetation, Fuels, and Burn Severity Mapping: Ensure frequent updates and statewide coverage for land cover databases, including improved vegetation mapping for fuel type and condition. Focus on developing sustainable long-term datasets that balance comprehensive data with maintainability. Conduct comprehensive comparative assessments of existing products, allocating resources for extensive validation sets and regular (annual/bi-annual) updates. Improve archiving of codes/methods and facilitate knowledge transfer to ensure dataset longevity.</p>	<p>NASA, NOAA, USGS, DOI, DOD, AGC</p>
<p>A2. Strengthen Infrastructure and Socio-Economic for Exposure and Risk Mapping: Improve the collection of statewide datasets that capture information about assets of value to the public, such as infrastructure (buildings, roads, pipelines, fuel treatments, etc.), social factors (population, vulnerability indices, etc.), and economic metrics (property values, building costs, etc.). Incorporating and accuracy checking information on building use is essential for prioritizing mitigation efforts.</p>	<p>FEMA, AKDNR, local boroughs & municipalities, AGC</p>
<p>A3. Enhance Ground-based Observational Networks: Fill large spatial gaps in ground-based hydrometeorological and radar networks to foster better collaboration and shared responsibility among operators. Facilitate access to alternative lightning data for Alaska (e.g., Vaisala).</p>	<p>AICC, USWFS</p>
<p>A4. Invest in Advanced Remote Sensing & Processing Platforms: Increase resources for local aerial acquisition and secure access to high-resolution satellites. Create platforms for processing large remotely sensed datasets and advance US-based uncrewed aerial systems (UAS) technology with LIDAR, multi/hyperspectral, thermal and optical payloads.</p>	<p>NASA</p>
<p>A5. Advance Fire Detection with Next-Gen Systems: Enhance the accuracy of VIIRS and other satellite-derived active fire detections by reducing false positives and improving the ability to detect lower intensity fires. Work with NOAA NESDIS on Next Generation Fire Systems and advocate for the incorporation of commercial data (e.g. FireSat).</p>	<p>NOAA, NESDIS</p>

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Priority actions (cont.)

Table 2. Priority actions needed to SUSTAIN high performing and critical current capabilities.	Relevant Organizations
<p>S1. Maintain Continuous Satellite Data Streams: Ensure sustained funding for critical satellite data sources, including VIIRS, Landsat, Sentinel, and MAXAR imagery. These high-performing inputs provide essential low-latency fire detection and mapping, which is vital for rapid and effective wildfire response.</p>	<p>NOAA, USGS, NASA, ESA</p>
<p>S2. Sustain Multi-Year Support for GINA: Wildfire management in Alaska relies upon GINA's high-performing Active Fire Detection System, covering infrastructure (antennas, processing), software, and satellite downlink technologies. Multi-year support is vital for staff retention and preventing system disrepair, ensuring continuous, low-latency data.</p>	<p>NOAA, NASA</p>
<p>S3. Assure Sustained Access to Indispensable Datasets: Continue funding for licensing third-party data (e.g., building footprints) and sustain foundational datasets like IFSAR DEM and lightning counts. These base layers are crucial for accurate wildfire exposure and fuels mapping products. Maintain availability of state-of-the-art reanalysis products.</p>	<p>ECMWF, NOAA, USWFS, USGS-Alaska Mapping Initiative</p>
<p>S4. Strengthen Collaborative Data Partnerships: Sustain established successful working relationships among data developers and the Alaska wildfire community through boundary organizations like the Alaska Fire Science Consortium. This ensures efficient data flow, addresses user needs, and resolves potential data access or licensing issues.</p>	<p>DOI-Joint Fire Science Program</p>

Connecting Data to Decisions: The Alaska Fire Science Consortium

Observations and data products only deliver societal value when they reach the people who need them, in forms they can actually use. Boundary organizations like the Alaska Fire Science Consortium bridge that gap. When operational users can articulate not just what data they need but how they will use it, research investments are more likely to produce products that get used. The fuels mapping gap — cited in nearly every Alaska wildfire data assessment — illustrates this well: understanding how a fuels map will be used by a fire behavior analyst in the field should shape what that product looks like, long before it's built.

The Alaska Fire Science Consortium (AFSC) is a boundary organization that has worked in Alaska since 2010, enhancing wildland fire science delivery and sustaining engagement among researchers and managers to bridge the gap in information sharing. AFSC is primarily funded by a grant from the Joint Fire Science Program (JFSP) to the University of Alaska Fairbanks and is a member of the JFSP Fire Science Exchange Network. The effectiveness of their work has been documented in the peer-reviewed literature.

The region's managers indicate that they need boundary spanning assistance in several areas:

- To interpret and apply fire science research findings to management challenges, particularly related to climate impacts and fuels management.
- To be aware of and contribute to active research projects relevant to their work.
- To ensure that funded research reaches end users through targeted communication and delivery.



About this assessment

About US AON BENEFIT assessments on Risk Management and Hazard Mitigation

The US Arctic Observing Network (US AON) is a sub-body of the Interagency Arctic Research Policy Committee (IARPC) that focuses on improving observational and data systems in support of broadly shared societal benefits. It has developed its BENEFIT assessment methodology and tool in alignment with other agency and interagency efforts. BENEFIT assessments, such as those summarized in this document, illustrate performance levels in current observing capabilities and provide actionable recommendations to build on strengths and reduce gaps. IARPC requested that US AON apply BENEFIT assessment toward risk management and hazard mitigation in Alaska. US AON is funded by NOAA's Global Ocean Monitoring and Observing Program/Arctic Research Program and the National Science Foundation.

Assessment process

Subject Matter Experts (SMEs) identified during scoping completed a BENEFIT assessment for their KPSO. Each resulted in a concise visualization illustrating the value chain between observing system and data product assets and relevant societal benefits. SMEs provide ratings for each link in the value chain to highlight strengths and gaps that affect how fully systems can meet their requirements. SMEs use a standardized rating rubric, and results are independently reviewed. Some of the KPSOs listed in Table 3 feed into one another; the SME cohort worked together to achieve a common language and interpretation of performance and criticality.

Priority actions are grouped into two categories based on threshold ratings applied by the SMEs: advance and sustain. ADVANCE actions correspond to observing systems or data products rated 70/100 or lower on satisfying their requirements, with a criticality rating of 6/10 or higher — these are capabilities with significant gaps that need investment to improve. SUSTAIN actions correspond to those rated above 70/100 — these are high-performing capabilities where continued funding and support is needed to prevent deterioration.

Future work

This technical brief includes a range of capabilities across the diverse mission areas in which organizations are working on wildfire management in Alaska. It is not an exhaustive list and is open to future revision.

Related topics that arose in connection with wildfire management concern wildfire smoke detection and forecasting, its impacts on human health and wildlife, and the connections between wildfire management and underlying permafrost. Issues related to the community use of drones in wildfire management also arose. US AON plans to continuously expand the scope of its BENEFIT assessments. If you are interested in working on any of these issues with us, please contact sandy.starkweather@noaa.gov.

How to read BENEFIT assessment diagrams

US AON BENEFIT assessment diagrams use a flowing visualization to show how observations and observing systems support data products, applications, and ultimately societal benefits. The gray boxes represent different “objects” in the observing ecosystem (such as observing systems, data products, and applications), while the connecting bands show how information or capability flows between them. Thicker bands indicate more critical relationships while performance of an input in this context is conveyed by the color of the band. Reading the diagram from left to right helps reveal how observations contribute to decisions, services, and societal outcomes — and where gaps or vulnerabilities may affect the overall system.

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What is included in this report

US AON spoke with more than 60 entities that contribute to environmental risk management and hazard mitigation in Alaska to scope this and other topical technical briefs. In those dialogues, **wildfire management** emerged as an area of priority concerning the mission areas of federal and state agencies, Tribal organizations, academic institutions, and NGOs. While wildfire management is inherently related to other phenomena like smoke detection and forecasting, the contributors to this technical brief focus specifically on the key products and services that relate to fire risks, their forecasting and early detection, and the impacts of research. See Future Work for plans to address wildfire-relevant topics in future assessments, and visit the US AON website to access technical briefs on other risk and hazards topics.

The organizations and efforts included in Table 3 develop Key Products, Services and Outcomes (KPSOs) from Earth observations that address wildfire management. **Table 3 is not comprehensive, but emblematic of critical needs.** Organizations like the U.S. Wildland Fire Service, the Division of Forestry and Fire Protection, and the State of AK Division of Home Security and Emergency Management were identified as key operational decision makers on this topic; their effectiveness relies on the KPSOs that are included in this assessment.

Table 3. Key Products, Services, and Outcomes (KPSOs) included in this assessment

Mission Areas	Responsible Organization*	KPSOs* (for details see pages 7-12)
Forecasting	USWFS	AICC Predictive Services
Community Planning	UAF	Alaska Wildfire Exposure Assessment Tool
	USWFS	Current and Historical Fires in Alaska
Emergency Response	USWFS	Current and Historical Fires in Alaska
	UAF/GINA	Real Time Fire Detection Products (provides data that can be used to detect and monitor fires)
Research	NSF EPSCoR/UAF	Fire Weather Predictability Research
	NSF EPSCoR/UAF	Fire Fuel and Burn Severity Mapping
	USWFS	Current and Historical Fires in Alaska
	UAF/GINA	Real Time Fire Detection Products

* Acronyms on page 2

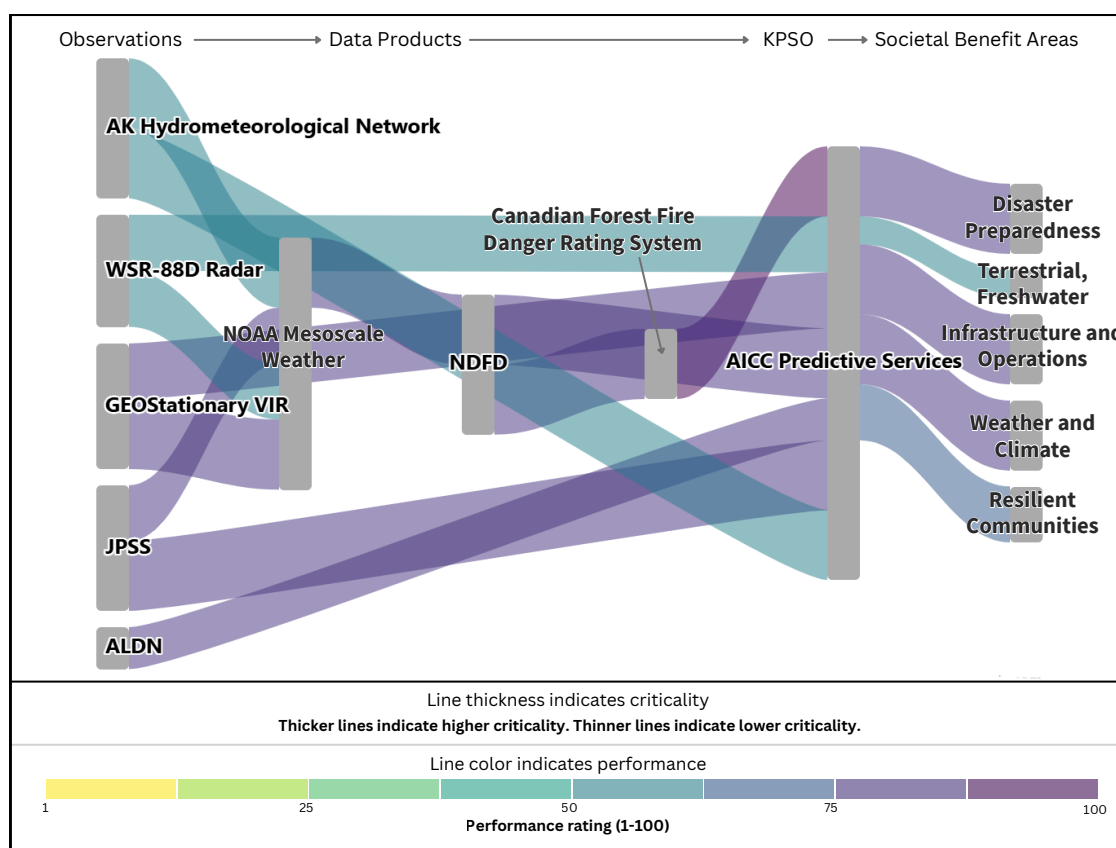
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AICC Predictive Services (USWFS)

Alaska Interagency Coordination Center (AICC) provides decision support information for wildfire behavior based on fuel, terrain, and weather observations and forecasts. Short-range forecasts are determined by ingesting weather data into the Canadian Forest Fire Danger Rating System (CFFDRS) through the Alaska Fire and Fuels Website (AKFF), while monthly and seasonal forecasts use long-range weather models and teleconnections to determine trends. During fire season, daily briefings and products are provided to a wide audience of stakeholders, including federal, state, and local agencies. This informs resource management, preparedness, and risk mitigation for the public and firefighters.

<https://fire.ak.blm.gov/>



Key Takeaways

- Improve the hydrometeorological network with more stations, maintenance, and collaboration (A3)
- Increase WSR-88D Radar Coverage to improve tracking of lightning, precipitation, and winds (A3)
- Enhance Arctic representation in national forecast models to improve fire danger predictions
- Maintain Alaska Fire and Fuels Website to provide fire danger information for response planning (S3)
- Sustain AICC Predictive Services to provide critical environmental intelligence for anticipating wildfires and optimizing resource pre-positioning (S4)
- Sustain and expand JPSS for more frequent high-resolution imagery to track fire growth and support forecast model initialization (S1)

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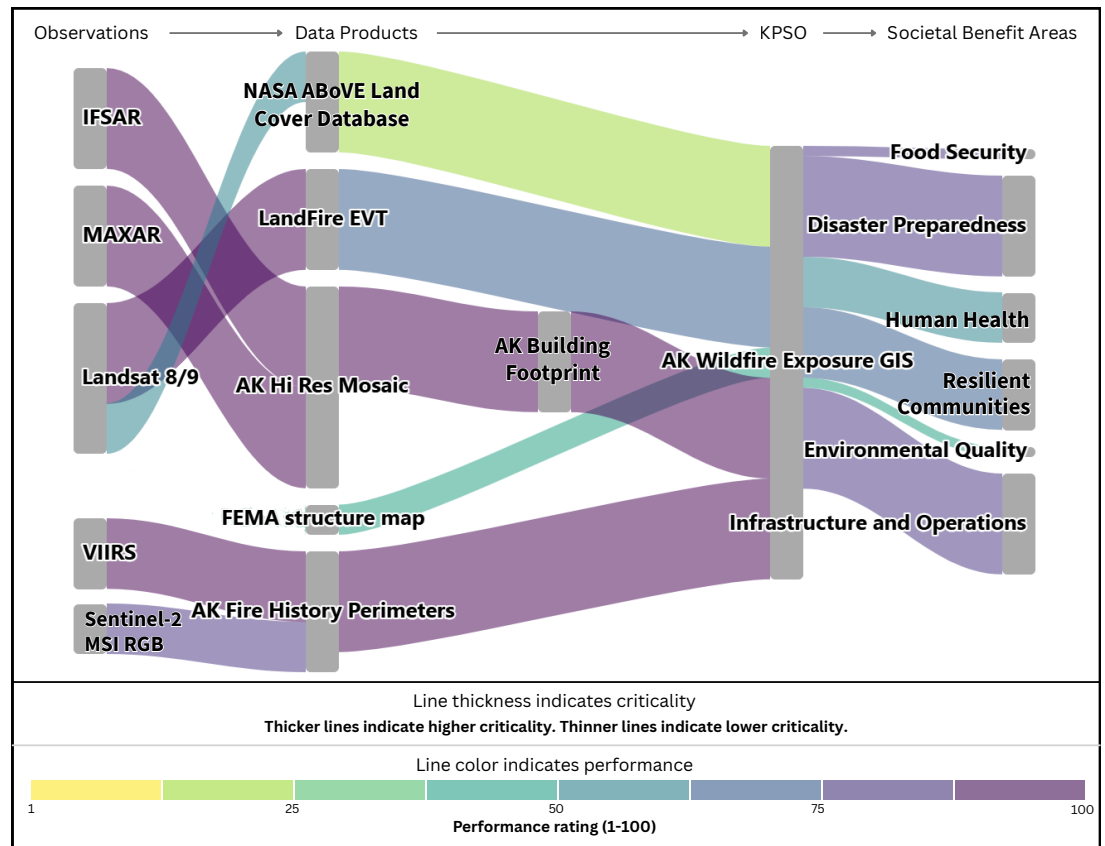
Alaska Wildfire Exposure Assessment Tool (UAF)

The AK Wildfire Exposure GIS tool calculates wildfire risk to support decision-making. It enables communities and agencies to evaluate wildfire hazard and exposure, prioritize mitigation actions, and allocate resources effectively. Using the best available data and incorporating local context, the tool offers a rapid and flexible method for calculating exposure—the potential for an entity, asset, resource, system, or geographic area to come into contact with a wildfire hazard. The tool is used to support applications for community wildfire defense grants, guide local mitigation planning, and inform public engagement efforts. By delivering timely, data-driven insights, the tool strengthens community preparedness, enhances resilience, and contributes to broader societal benefits by reducing wildfire risk and its impacts.

<https://bit.ly/alaskawildfireexposure>

Quantifying wildfire exposure and structural risk has been key to developing strategies for mitigating the risk. The interactive tools and maps developed enable us to visualize and understand the threat of an advancing wildfire that could cost many homes and lives.

- Doug Schrage, Anchorage Fire Department Chief



Key Takeaways

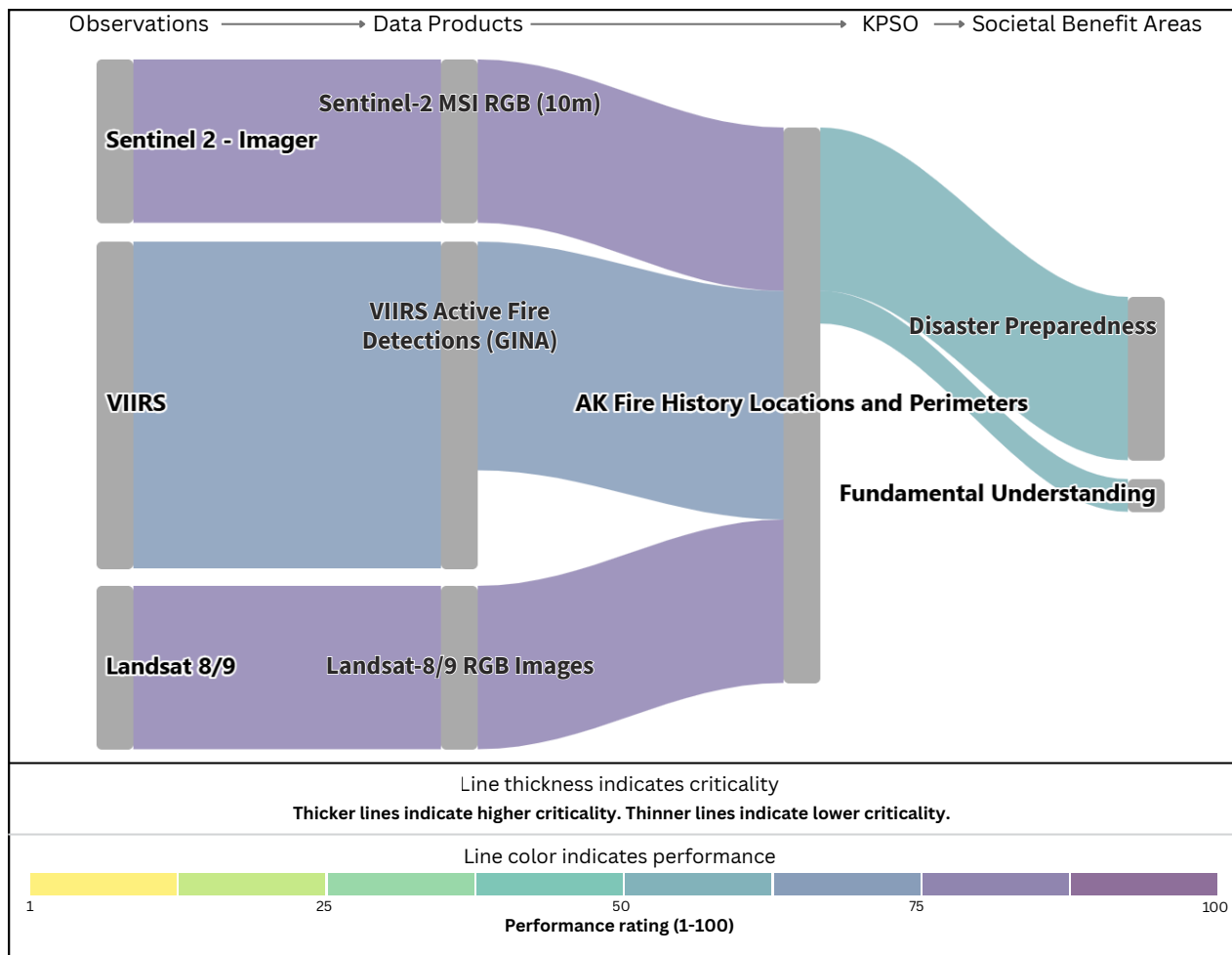
- Develop a sustainable annual land cover product, given ABoVE Land Cover data changes (A1)
- Improve LandFire EVT accuracy for Alaska (A1)
- Create building-footprint inventories that accurately incorporate Building Occupancy Classification standards (e.g., FEMA, state and local agencies) (A2)
- Maintain public access to and communication about the exposure tool (S3 & S4)
- Sustain Maxar Hi-Res Mosaic which is essential for understanding wildfire exposure (S1)
- Ensure regular AK Building Footprint Updates (S1 & S4)



Current and Historical Fires in Alaska (USWFS)

This assessment describes capabilities to assess fire history locations and perimeters. Alaska wildland fire history consists of wildland fire locations and wildland fire perimeter polygons. A fully functional Alaska Fire History would accurately depict wildland fire activity from 1940 to present. All wildland fires, including tundra fires, 10 acres or larger would have a polygon representing the fire perimeter.

<https://fire.ak.blm.gov/predsvcs/maps.php>



Key Takeaways

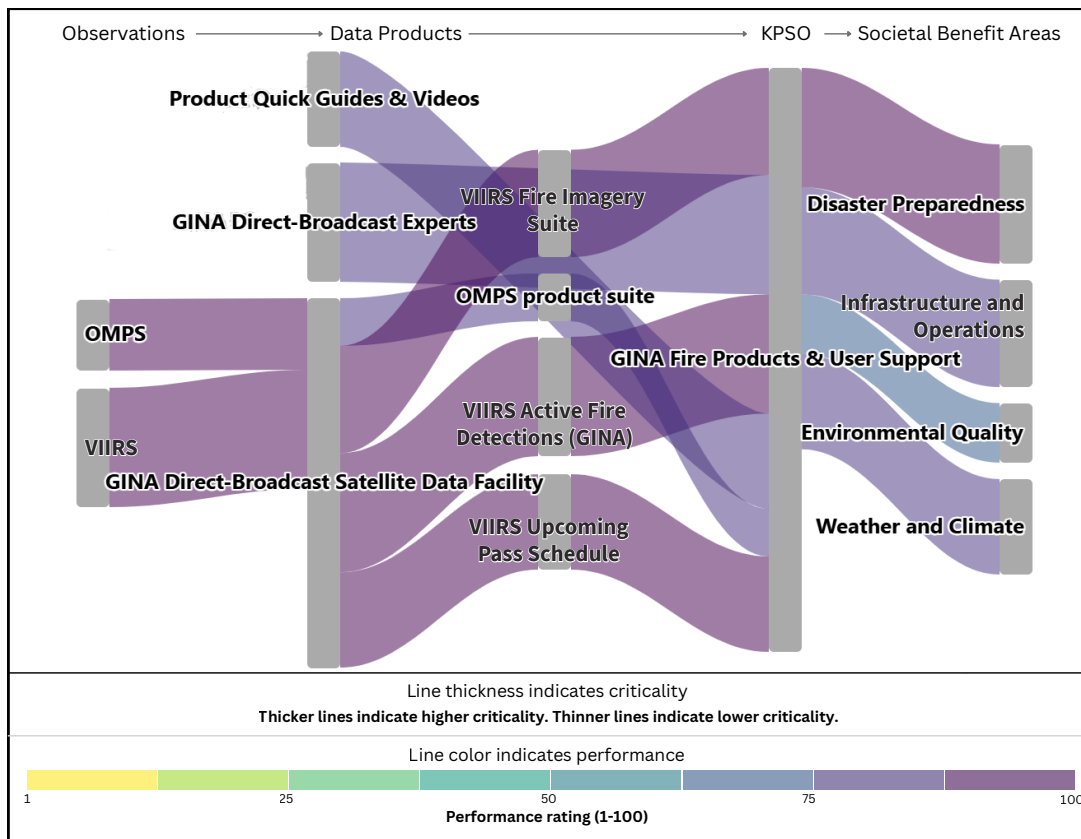
- Enhance VIIRS active fire detection: reduce false positives & improve low-intensity fire detection (A5)
- Incorporate unburned areas located within fire perimeters to create a more comprehensive and accurate representation of past fire events in the dataset
- Continue support for the Alaska wildland fire history dataset, as it is a critical and high-performing tool for tracking fire occurrences statewide (S1)
- Sustain funding for GINA's infrastructure, which provides fast, cost-effective wildland fire data (S2)



Real Time Fire Detection Products (UAF/GINA)

The Geographic Information Network of Alaska (GINA) at UAF ingests satellite data received on local antennas and generates fire-relevant derived products. The VIIRS instrument detects active fire; GINA distributes VIIRS imagery to agencies and the public within minutes of a satellite overpass. GINA also delivers six distinct wildfire detection and monitoring products to the Alaska Interagency Coordination Center (AICC) and additional products to NOAA's National Weather Service and Cooperative Institutes. During fire season, GINA provides comprehensive support, including technical troubleshooting with a two-hour response time, quick-reference training materials, and expert data interpretation upon request.

<https://gina.alaska.edu/>



Key Takeaways

- Enhance VIIRS active fire detection: reduce false positives & improve low-intensity fire detection (A5)
- Refine OMPS Product Suite for air quality, including improved user support (A4)
- Enhance fire modeling research to build new tools, e.g., for smoke assessment or machine learning-driven fire modeling
- Maintain VIIRS Active Fire Detections to detect wildfires quickly and prevent response delays (S1)
- Sustain funding for GINA's infrastructure, which provides fast, cost-effective data for fire managers (S2)
- GINA's experts provide critical value, but require more trained personnel to build redundancy and ensure the continuous support of this vital response service (S2)

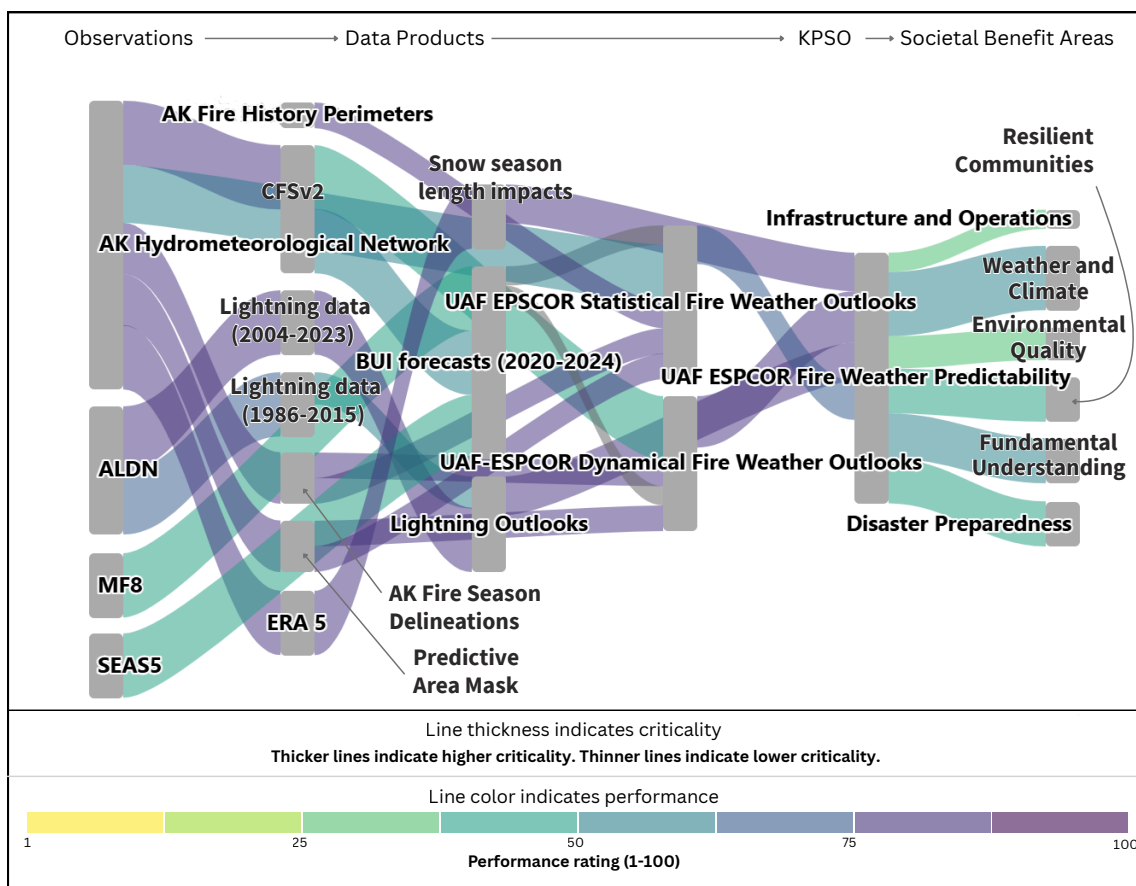
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Fire Weather Predictability Research (NSF EPSCoR/UAF)

This assessment includes activities led under the UAF’s EPSCoR Fire and Ice and EAPI projects, focused on advancing seasonal predictability of fire weather in Alaska. This research develops seasonal outlooks to provide actionable information ahead of each fire season. Current efforts are expanding these outlooks to include lightning potential, with a longer-term goal of integrating weather, lightning, and fuel conditions into a comprehensive seasonal fire risk framework. The intended outcome is to support proactive fire management and resource planning, reduce suppression costs, and improve preparedness across Alaska.

<https://sites.google.com/alaska.edu/eapi/wildfire-build-up-index>



Key Takeaways

- Improve hydrometeorological network coverage with more stations, especially in lower-elevation high-risk areas, to strengthen fire weather outlooks and improve seasonal forecast reliability (A3)
- Improve skill and consistency of CFSv2, MF8, and SEAS5 to deliver more actionable dynamical predictions of the Buildup Index and related fire weather indicators (A3)
- Expand lightning data sources (e.g., Vaisala) and improve ALDN datasets to support longer lightning climatologies and seasonal lightning outlook development (A3)
- Maintain reanalysis data (e.g., ERA5, ERA5 Snow) for model initialization and climate assessment (S3)
- Ensure long-term continuity of ALDN datasets for lightning variability and predictability studies (S3)

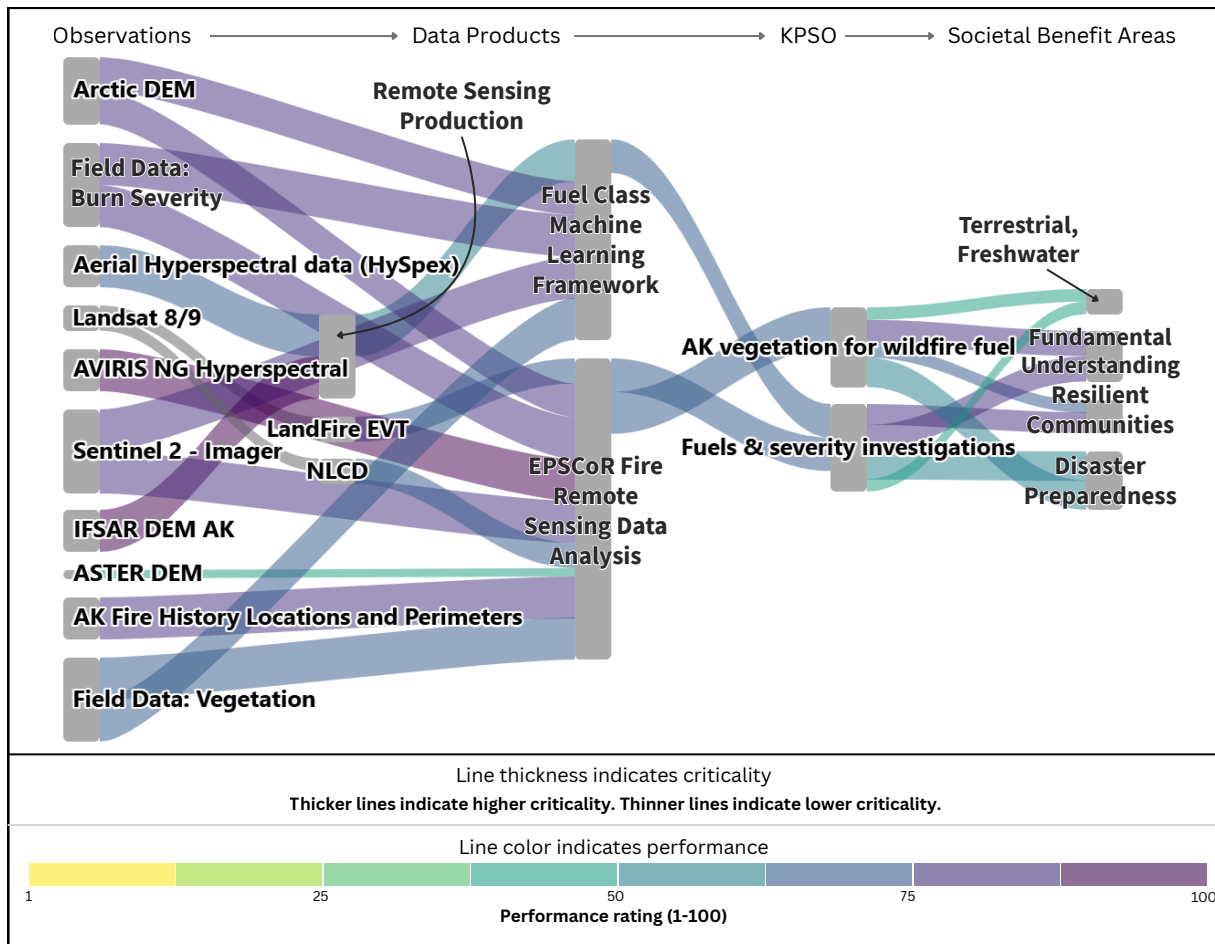


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Fire Fuel and Burn Severity Mapping (NSF EPSCoR/UAF)

This assessment includes activities led under the UAF's EPSCoR Fire and Ice project. The research developed and validated methods designed to scale into operational wildfire fuels and burn severity mapping across Alaska. Key inputs included aerial and satellite imagery from national agencies as well as high-resolution elevation data. Field work provided model validation data. A processing chain for specially acquired in-house aerial hyperspectral data was developed.

<https://www.alaska.edu/epscor/projects/fire-and-ice/>



Key Takeaways

- Improve fuel mapping accuracy, which requires validation sets and coordination (A1)
- Strengthen standardized collection of field data for vegetation and burn severity
- Resource localized imagery acquisition and processing of advanced UAS or fixed-wing remote sensing resources and payloads (including hyperspectral) (A4)
- Maintain IFSAR DEM, a high-quality Digital Elevation Model (DEM) (S3)
- Sustain Sentinel-2 imagery data, as a dataset of choice for land surface mapping (S1)
- Continue support for the Alaska wildland fire history dataset, as it is a critical and high-performing tool for tracking fire occurrences statewide (S1)

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Resources and further reading

From Spark to Strategy: Understanding Alaska's Wildland Fire Response

https://uaf-accap.org/event/wildfire_review_2024/

Alaska's Changing Wildfire Environment — Alaska Fire Science Consortium

<https://www.frames.gov/afsc/ACWE>

Wildland Fire in High Northern Latitudes — NOAA Arctic Report Card 2020

<https://arctic.noaa.gov/report-card/report-card-2020/wildland-fire-in-high-northern-latitudes/>

Building Wildfire Resilience and Community Dialogue in Alaska — Alaska Venture Fund Summary

<https://alaskaventure.org/building-wildfire-resilience-and-community-dialogue-in-alaska/>

Arctic Monitoring and Assessment Programme (AMAP) Arctic Climate Change Update 2024: Key Trends and Impacts

<https://www.amap.no/documents/doc/amap-arctic-climate-change-update-2024-key-trends-and-impacts/3851>

2024 NextGen Satellite Workshop Report — GINA, University of Alaska Fairbanks

https://gina.alaska.edu/wp-content/uploads/2025/07/Final-Alaska-NextGen-Satellite-Workshop-Report_508_authors.pdf

UAF Fire Weather Predictability (FiWePs)

<https://sites.google.com/alaska.edu/fiweeps/home>

Report for AK PANOCESU Collaborative Effort to Develop a Statewide Wildfire Exposure Map

<https://scholarworks.alaska.edu/handle/11122/16291>

Fire on Ice: The Arctic's Changing Fire Regime — NASA Earth Observatory

<https://science.nasa.gov/earth/earth-observatory/fire-on-ice-the-arctics-changing-fire-regime/>



Brooker Mt Fire Suppression, Denali NP, 2013.
National Park Service photo by Stacey Skrivanek

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