Alaska Interagency Fire Danger Operating Plan

2025 Review

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Signatures

I concur with the Fire Danger Committee's recommendation to update Alaska Interagency Fire Danger Operating Plan. This updated plan includes data re-analyses that continues to support the decision-making process for agency administrators, fire program managers, fire operations specialists, dispatchers, agency cooperators, and firefighters.

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2025 Review of the 2024 Alaska Interagency Fire Danger Operating Plan

The Alaska Interagency Fire Danger Operating Plan (AIFDOP) is reviewed annually by the AWFCG (Alaska Wildland Fire Coordinating Group) Fire Danger Committee. Every 5 years, or sooner if deemed necessary by a majority of the Fire Danger Committee voting members, a comprehensive update (to include data re-analysis) will be completed and approved by all AWFCG members whose agency is participating in the AIFDOP. The prior comprehensive update was completed in 2024, and prior to that was the original 2019 AIWFMP (though it was not approved until 2020). Previous AIFDOP summary of changes is in Appendix M.

The 2025 review of the 2024 AIFDOP has been completed by the AWFCG Fire Danger Committee and is approved by the Fire Danger Committee Chair as of **May 29, 2025.**

The following updates were completed:

- Minor grammatical, punctuation, spelling, and format changes.
- Document edited for compliance with Section 508 of the Workforce Rehabilitation Act.
- Hyperlinks were updated where needed.
- Fire Danger Committee Chair signature page was re-signed for the 2025 AIFDOP review.
- Updated Development and Recommendation section to align with current Fire Danger Committee members and contributing Subject Matter Experts.
- Updated map figures throughout (where applicable).
- Removed inconsistent descriptions of “natural outs” and their occurrence.
- Updated AKFF contract contacts.
- Updated the Red Flag Warning and Fire Weather Watch Criteria for 2025.
- Removed references to draft Tundra Adjective Rating in the body text and removed Appendix K. Tundra Adjective Rating. Initial analysis completed by the AICC Fire Behavior Analyst in 2024/2025 indicated poor performance of the draft Tundra Adjective Rating and, with recommendations from the Fire Danger Committee, the references and appendix were removed until the need for this adjective rating can be evaluated, and more analysis can be done to improve performance.
- Clarified the GAR and SAR indice thresholds in Tables 2 and 4.
- Added adjective rating class color scheme to ASR-Spring and ASR-Summer Tables 3 and 5.
- Removed repetitive language on on-going research on building lightning climatology and the need for continued research on seasonal lightning forecasting.
- Removed repetitive text and Figure 25 from Chapter III.E. that was duplicated in Appendix I. regarding analysis of the SAR, GAR, ASR-Spring and ASR-Summer.
- Reorganized Table 6 for improved readability and comparison of adjective rating systems used in Alaska.
- Updated language from Mobilization Guide to Standards for Resource Mobilization.
- Added references to fire behavior/danger tools in IFTDSS and WFDSS NextGen applications.
- Change text references to a single Fire Weather Meteorologist from multiple in Roles and Responsibilities section (Chapter V.E.).

- Revised Chapter VI. Future Needs to reflect changes to Tundra Adjective Rating and conversion from WIMS to FEMS.
- Re-numbered figures and appendices based on removals described above.
- Added new Appendix to track the summary of changes from each previous AIFDOP review year and previous update/re-analysis year.

JENNIFER HROBAK Digitally signed by JENNIFER HROBAK
Date: 2025.05.29 16:39:56 -08'00'

Jennifer Hrobak (BLM Alaska Fire Service, Fire Planner)

Chair – AWFCG Fire Danger Committee

Development and Recommendation

The 2025 AIFDOP was reviewed by the following Fire Danger Committee members and other subject matter experts:

- Casey Boespflug, State Fuels Program Manager (Bureau of Land Management, Alaska Fire Service)
- Mitchell Burgard, Fire Analyst (Alaska Fire Science Consortium)
- Abe Davis, Fuels Management Specialist (U.S. Forest Service, Region 6/10) Deputy Fire Management Officer (National Park Service, Alaska Region)
- Sarah Hayes, Fire Planner (National Park Service, Alaska Region)
- Jennifer Hrobak, Fire Planner (Bureau of Land Management, Alaska Fire Service)
- Jennifer Humphrey, Emergency Operations Coordinator Deputy Center Manager, Alaska Interagency Coordination Center (U.S. Forest Service, Region 6/10)
- Jennifer Jenkins, GIS Specialist (Bureau of Land Management, Alaska State Office)
- Casey O’Connor, Regional Fire Planner (National Park Service, Alaska Region)
- Nathan Perrine, Fire Behavior Analyst (Bureau of Land Management, Alaska Fire Service)
- Tom St Clair, Regional Fire Management Officer (Bureau of Indian Affairs, Alaska Region)
- Heidi Strader, Meteorologist, Alaska Interagency Coordination Center (National Park Service, Alaska Region)
- Amber Sunderland, Dispatch Center Manager, Yukon Fire Dispatch Center (Bureau of Land Management, Alaska Fire Service)

Additional minor contributors may not be captured. Prior Fire Danger Committee members and subject matter experts that significantly contributed to the previous AIFDOPs include Chris Moore (Alaska Interagency Coordination Center), Robert Ziel (Alaska Fire Science Consortium), Mark Cahur (U.S. Forest Service), Mike Butteri (Division of Forestry & Fire Protection), Peter Butteri (US Fish and Wildlife Service), Hilary Shook (U.S. Forest Service, and Larry Weddle (National Park Service) .

I. Introduction

A. Purpose

The public, industry, and agency personnel expect the wildland fire management agencies to implement appropriate and timely decisions which result in safe, efficient, and effective wildland fire management actions. This plan provides analyses to support the decision-making process for agency administrators, fire program managers, fire operations specialists, dispatchers, agency cooperators, and firefighters. It uses the best available scientific methods, historical weather, and fire data to identify breakpoints and indices that can be used in ancillary fire danger planning documents.

An appropriate level of preparedness to meet wildland fire management objectives is based upon an interagency assessment of fire danger that includes vegetation, climate, seasonality, and topography. This assessment utilizes the Canadian Forest Fire Danger Rating System (CFFDRS) which correlates well to the Alaska fire environment. This plan is a science-based tool for fire managers to incorporate a measure of risk associated with decisions that have the potential to significantly compromise safety and control of wildland fires.

Interagency policy and guidance require numerous unit plans and guides, such as this Alaska Interagency Fire Danger Operating Plan (AIFDOP), to meet preparedness objectives.

The AIFDOP guides the application of decision support tools (such as CFFDRS) at the local level which provides the overall operating procedure from which numerous plans and guides, some interrelated, are developed and is supplemental to the Alaska Interagency Standards for Resource Mobilization, the Alaska Interagency Wildland Fire Management Plan (AIWFMP) and individual unit fire management plans. It establishes the management of a fire weather station network and describes how fire danger ratings may be applied to local unit fire management decisions.

The decision points identified and documented in the AIFDOP are implemented as fire business[1] thresholds[2] and may be described in supplemental action plans developed by jurisdictional and Protecting Agencies. These plans are described in Chapter IV of the AIFDOP and are available separately from the establishing agencies.

B. Policy and Guidance

Interagency policy and guidance regarding the development of FDOPs can be found in Chapter 10 of the Interagency Standards for Fire & Aviation Operations (hereinafter referred to as the Red Book). Agency-specific direction can be found in Chapters 2-6 of the Red Book as well as in the following manuals and handbooks:

- U.S. Forest Service – Manual 5100 Wildland Fire Management, Chapter 5120 - Preparedness
- Bureau of Land Management – H-9211-1 - Fire Planning Handbook
- National Park Service – Reference Manual 18, Chapter 5 – Preparedness

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[1] *The characterization of fire occurrence in an area, described in terms of total number of fires and acres per year; and number of fires by time, size, cause, fire-day, large fire-day, and multiple fire-day (NWCG Glossary).*

[2] *Values of one or more fire weather/fire danger indexes that have been statistically related to occurrence of fires (fire business). Generally, the threshold is a value, or range of values, where historical fire activity has significantly increased or decreased (NWCG Glossary).*

- Fish and Wildlife Service – Fire Management Handbook, Chapter 10 - Preparedness (only accessible on DOI network/VPN)
- Bureau of Indian Affairs – Manual 90 Part 90 Chapter 3 Fire Preparedness

C. Fire Danger Operating Plan Objectives

1. Provide an interagency tool for agency administrators, fire managers, dispatchers, agency cooperators, and firefighters to correlate fire danger ratings with appropriate fire business decisions.
2. Delineate Fire Danger Rating Areas (FDRAs) with similar climate, vegetation, and topography.
3. Outline a plan to maintain the use of the interagency fire weather monitoring network consisting of Remote Automated Weather Stations (RAWS) that comply with National Fire Danger Rating System (NFDRS) Weather Station Standards (PMS 426-3) and supplementary weather stations not maintained to NFDRS standards that provide data needed to calculate CFFDRS indices.
4. Determine climatological breakpoints and fire business thresholds through analysis and summarization of an integrated database of historical fire weather, CFFDRS fire indices, MODIS and VIIRS fire heat detections, and fire occurrence data. Document thresholds and breakpoints for use in subordinate plans.
5. Define roles and responsibilities in making fire preparedness decisions, managing weather information, and briefing fire suppression personnel regarding current and potential fire danger.
6. Identify the most effective methods for fire managers to communicate potential fire danger to cooperating agencies, industry, and the public.
7. Identify seasonal risk analysis criteria and establish general fire severity thresholds.
8. Develop and document an online seasonal trend analysis tool for Alaska.
9. Identify and list potential improvements that can be added to the document when they are ready for implementation.

D. Alaska Fire Management Overview

Department of the Interior Manual 620 Chapter 5, the Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement (Master Agreement) and the Alaska Statewide Operating Plan (Operating Plan) work together to define an interagency organization that manages wildland fire across ownership boundaries throughout the state. The Operating Plan further separates Protecting Agency responsibilities from Jurisdictional Agency responsibilities to reduce duplication of effort and provide efficiencies of scale.

Wildland fire management in Alaska has been accomplished on an interagency basis since the mid-1970s when the State of Alaska, Department of Natural Resources - Division of Forestry (now Division of Forestry & Fire Protection) began to assume wildfire suppression responsibilities for state, municipal, and private lands previously protected by the Bureau of Land Management. In 1980, the Alaska National Interest Lands Conservation Act (ANILCA) set aside 157 million acres of public lands to be managed by Department of Interior agencies, leading to a new approach for interagency cooperation in wildfire management. The US Forest Service has maintained protection and jurisdictional authority for the Chugach and Tongass National Forest lands in Alaska since their establishment in 1907.

1. Jurisdictional Agencies

Jurisdictional Agencies have land and resource management responsibility for a specific geographical or functional area as provided by federal, state, or local law **(Figure 1)**. Jurisdictional Agencies must develop and adhere to agency planning documents describing unit level wildland fire and fuels management programs.

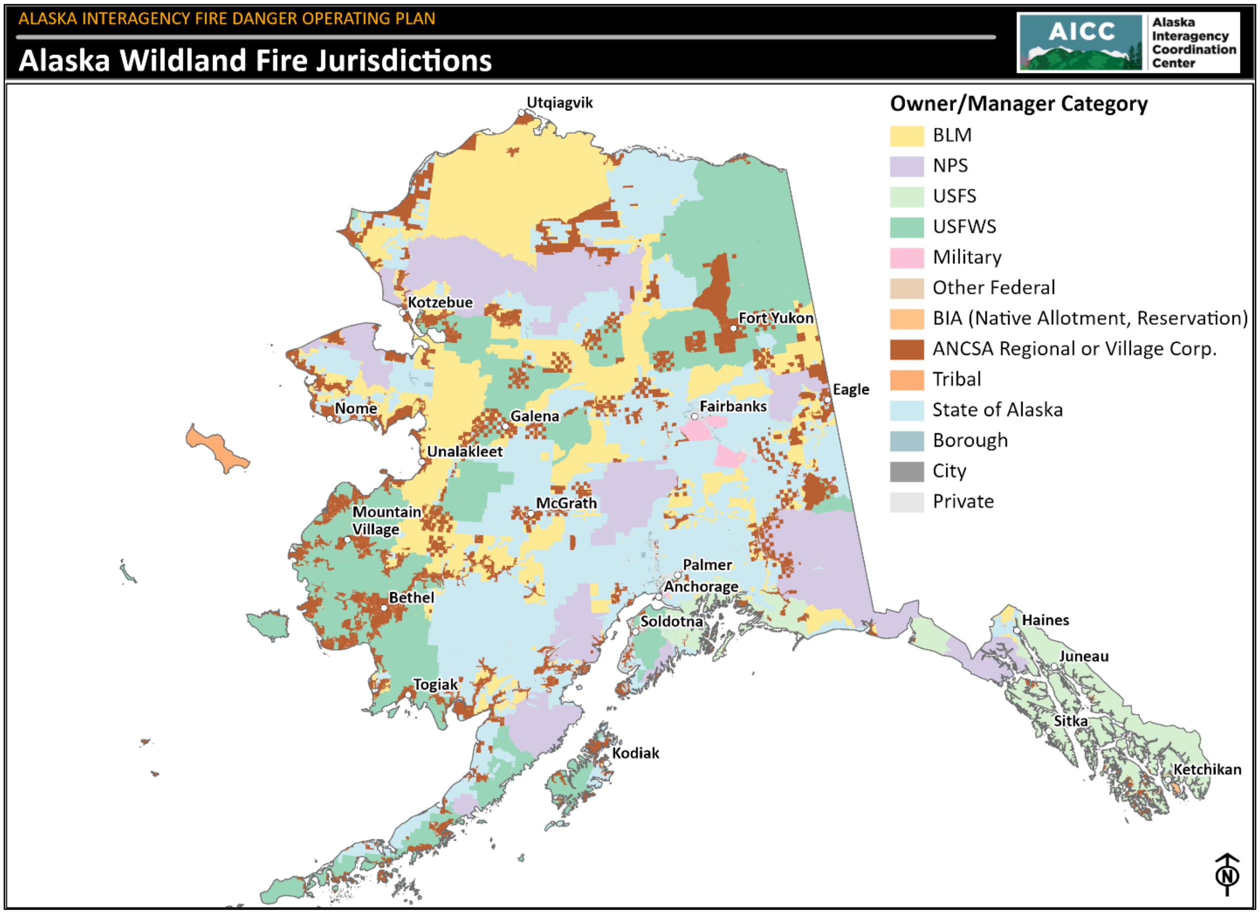


Figure 1: Map of Alaska Wildland Fire Jurisdictions that shows 13 jurisdictions.

2. Protecting Agencies

Protecting Agencies provide wildland fire suppression services for Jurisdictional Agencies within their area of operation. Protecting Agencies are responsible for implementing courses of action that support strategic direction provided by Jurisdictional Agencies through land/resource management plans, unit Fire Management Plans (FMPs), and decision documents for specific incidents that have been developed through a decision support process. The Protecting Agency may provide operational expertise and assist, as requested, in the development of jurisdictional strategic objectives and management requirements.

To promote cost-effective suppression services and minimize unnecessary duplication of suppression systems, three Protecting Agencies **(Figure 2)** have been delegated suppression responsibility for all lands in Alaska based on geographic location instead of jurisdictional authority. Each Protecting Agency responds to all wildfires within their area of responsibility regardless of jurisdiction. The Master Agreement and associated Operating Plan delineate services and billing procedures in accordance with state and federal laws.

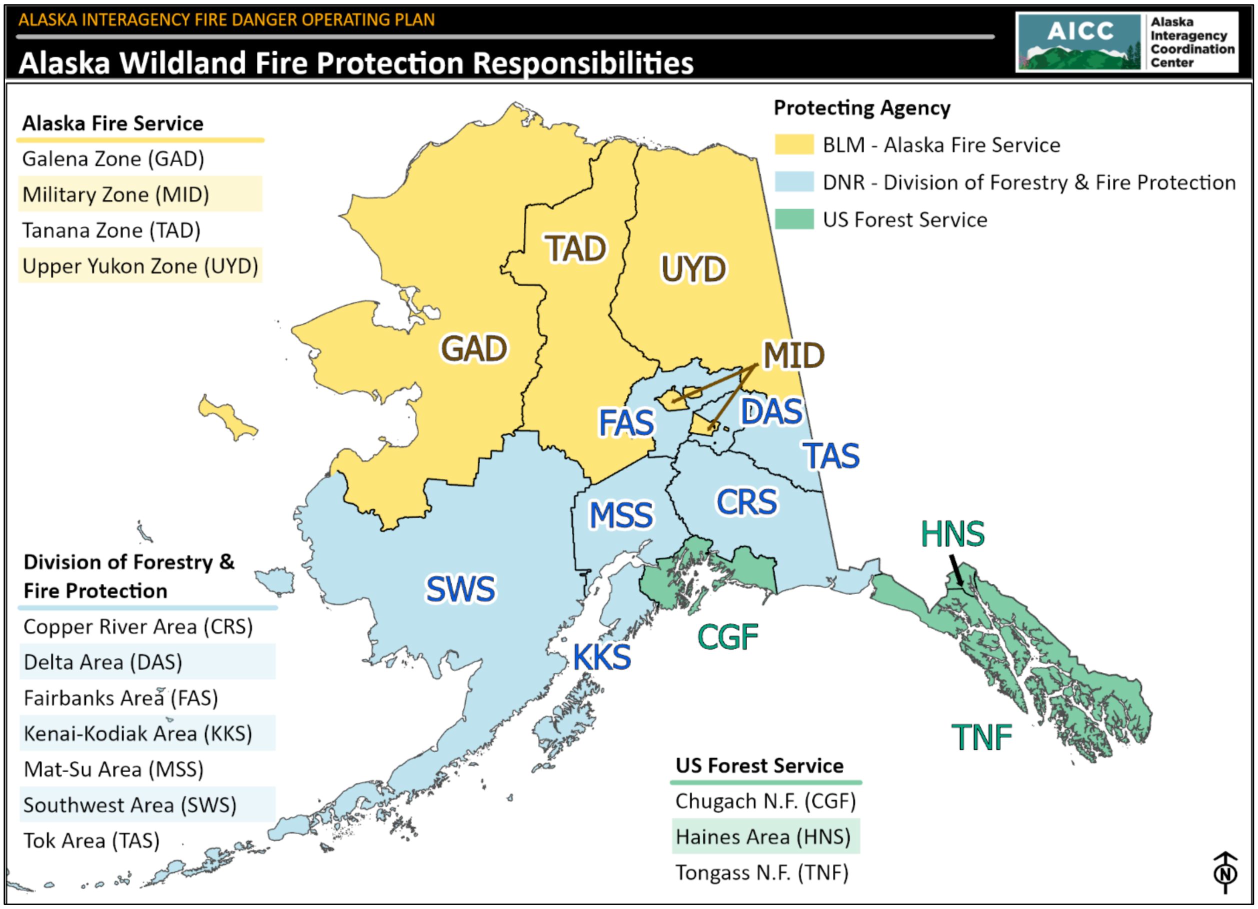


Figure 2: Map of Alaska Wildland Fire Protection Responsibilities by Agency.

E. Canadian Forest Fire Danger Rating System Overview

The Fire Weather Index (FWI), one component of the Canadian Forest Fire Danger Rating System (CFFDRS), tracks the effects of weather on forest fuels. In doing so it gives an estimation of potential fire danger and fire behavior in the area adjacent to a weather station. It is based on the moisture content of three classes of surface/ground fuels, plus the effect of wind on fire behavior **(Figure 3)**. The FWI system is best explained as an accounting system in which for a particular weather station, fuel moisture is added in the form of precipitation and subtracted in the form of drying. Precipitation is the only input component that will add to fuel moisture while the other inputs of temperature, relative humidity, wind speed, and time of year control the rate of drying.

The FWI system requires only 4 weather elements that are collected daily at approximately 1400 Alaska Daylight Time (AKDT) for each observation location. These elements are used to produce daily Fuel Moisture Codes (FFMC, DMC, and DC) which are then combined with wind to calculate Fire Behavior Indices (ISI, BUI, and FWI) that describe how the current dryness and weather impacts potential fire behavior. The FWI system was originally developed for use in the boreal forest and represents daily peak burning conditions (1800 AKDT).

The individual codes and indices are defined below. See **Table 1** for code/index value thresholds and additional interpretations.

Fine Fuel Moisture Code (FFMC): Numerical rating of moisture content of the litter and live moss layers, approximately the top 5 cm of moss/duff profile. Indicator of ignition potential.

Duff Moisture Code (DMC): Numerical rating of moisture content of the loosely compact organic layer (i.e., dead moss layer), approximately 5-10 cm deep. Indicator of lightning ignition potential.

Drought Code (DC): Numerical rating of moisture content of the deep compact organic layer (i.e., upper duff), approximately 10-30 cm deep. Indicator of ground fire and potential mop-up problems.

Initial Spread Index (ISI): Represents weather's effect on fire spread. Best indicator of daily fire potential in the spring.

Buildup Index (BUI): Represents weather's effect on fuel availability and consumption. Indicates depth of burn, fuel consumption and mop-up problems.

Fire Weather Index (FWI): Represent weather's effect on fire intensity. Indicator of overall potential fire behavior.

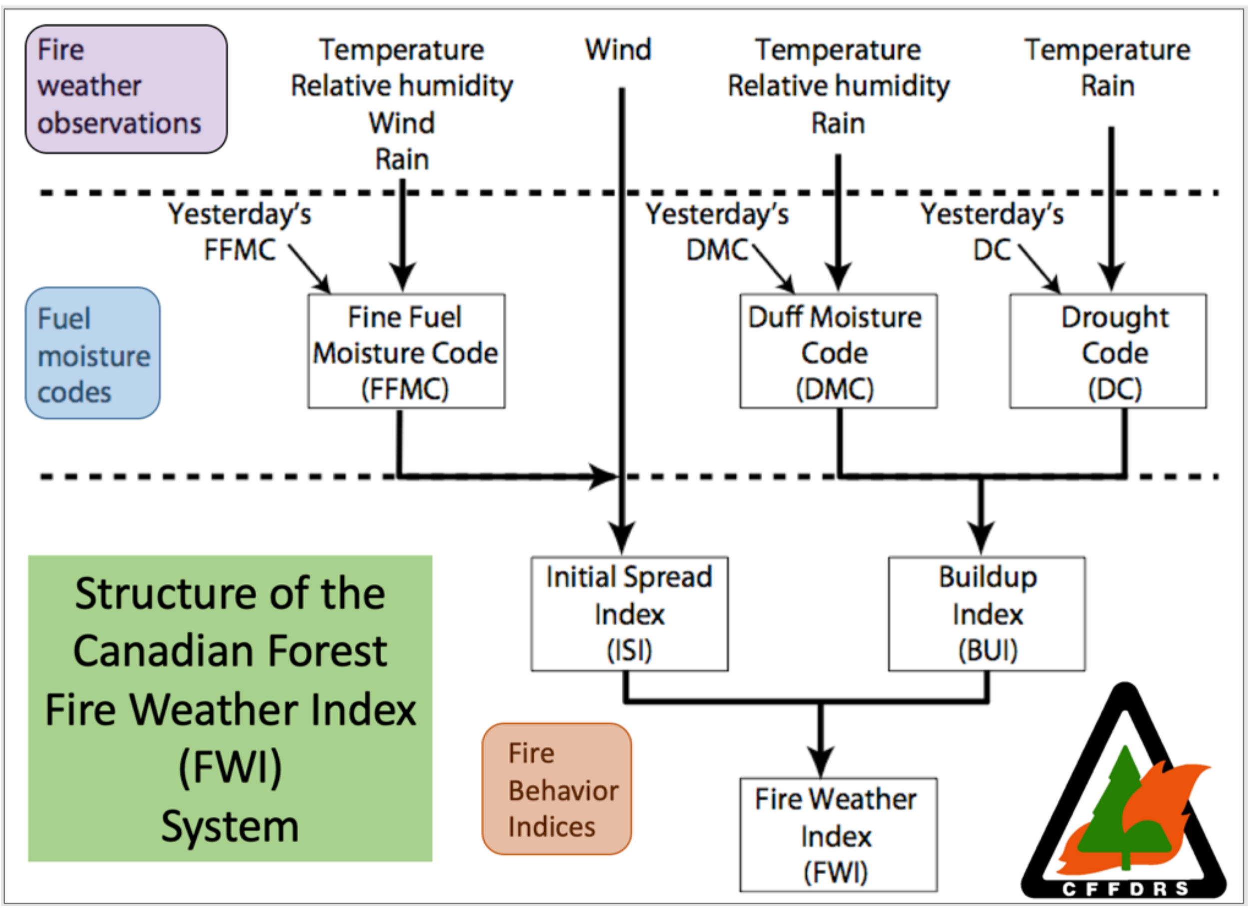


Figure 3: Structure of the CFFDRS Fire Weather Index System.

The Fire Behavior Prediction (FBP) system, another component of CFFDRS, is also used in Alaska. This system uses FBP fuel types, weather and FWI system elements, topography, foliar moisture content and prediction duration to produce quantitative estimates of fire behavior including rate of spread, fuel consumption, and head fire intensity along with a fire description (e.g., surface fire, torching, crown fire, etc.).

At the time of this writing, there is an effort to develop a next generation Canadian Forest Fire Danger System. This has not been evaluated by the Alaska fire community.

F. Alaska Fire Season Overview

In the 1990s, Dan Burrows, BLM Alaska Fire Service (AFS) Tanana Zone Fire Management Officer (FMO), developed a document entitled *Pre-Attack Planning* that provides a representation of seasonality for the fire season in Alaska with emphasis on the boreal Interior. Burrows divided the Alaska fire season into four stages based on the mean historical Buildup Index (BUI) which he used to represent the typical trend in seasonal landscape flammability. These four stages are as follows:

- **Wind-Driven Stage:** This stage begins in the spring after snowmelt and corresponds to the period before full green-up when the soils are still cold, but the dry dead grasses and litter on the surface are favorable for ignition. These are primarily initial attack fires that have the potential to spread in fine dead fuels and grow rapidly in windy conditions.
- **Duff-Driven Stage:** This stage begins in early June and generally relates to longer days around the summer solstice that produce peak heating of spruce canopies and drying of the surface fuels and subsurface duff layers. Fires occurring during this period are characterized by episodic growth events related to hot, dry sunny days, and can produce high flammability despite green fuelbeds. This is normally the peak of the Alaska fire season where fires exhibit a high resistance to control.
- **Drought-Driven Stage:** This stage begins in the middle of July and reflects late season fire growth potential which has fewer additional lightning ignitions. This stage occurs in years where mid- and late-summer rains do not materialize sufficiently to truncate significant fire growth potential. Fires that burn late in the year exhibit a high resistance to extinguishment. Severe drought indices can lead to fires that overwinter and re-initiate the following spring.
- **Diurnal-Limited Stage:** This stage begins in mid-August and is influenced by rapidly shortening days with significant reduction in solar radiation and resultant moderation of daytime temperatures and relative humidity. Shortened burn periods and high overnight humidity recovery limits the spread potential of these fires. Significant fire activity during this period is unusual and has not occurred since 2004 and 2005. Late season fire activity in 2019 was limited to areas affected by a strong wind event in mid-August and was localized to drought conditions in the Susitna Valley and the Kenai Peninsula.

Figure 4 shows an updated version of Burrow's original chart that includes more recent BUI historical data and overlays heat detection data derived from MODIS (Moderate Resolution Imaging Spectroradiometer), an instrument aboard the Terra and Aqua satellites that has been effectively used to identify heat sources in Alaska. This data serves as a proxy for measuring fire growth days. The chart clearly shows that most fire growth occurs during the Duff and Drought-Driven Stages.

Though the seasonality described above is related primarily to the boreal forests of Interior Alaska, the day length effects, and phenology represented by this pattern occur throughout the state. In addition, seasonality is further characterized in Chapter III. G. Seasonality of Alaska Fire Danger Rating Areas and Appendix L where the dates used to define four stages of the fire season are specific to each Fire Danger Rating Area versus those identified in Burrow's original characterization.

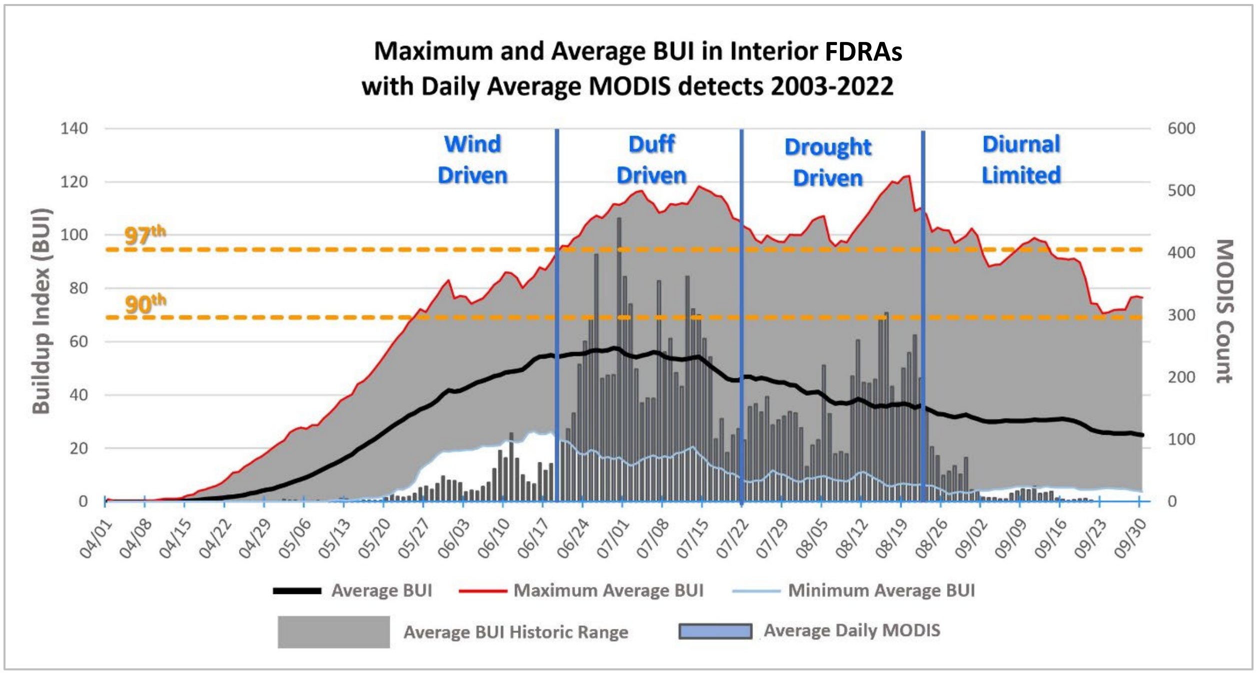


Figure 4: Four stages of fire season for Interior Alaska Fire Danger Rating Areas (FRDAs) as described by the daily average, average maximum and average minimum BUIs in relation to the daily average MODIS heat detections.

G. Fire Occurrence

Though the Alaska Interagency Coordination Center (AICC) Fire History Database includes fire records dating back to 1939, analyses of fire weather, ignitions, and fire growth will only date back to 1999 and run through 2022, providing 23 years of information for the development of this AIFDOP. This dataset is used instead of the USFS Research Data Archive to take advantage of the most accurate and most current data available.

The wildfire occurrence data shown in **Figure 5** is easily related to seasonality, suggesting segmentation of the data for fire danger analyses.

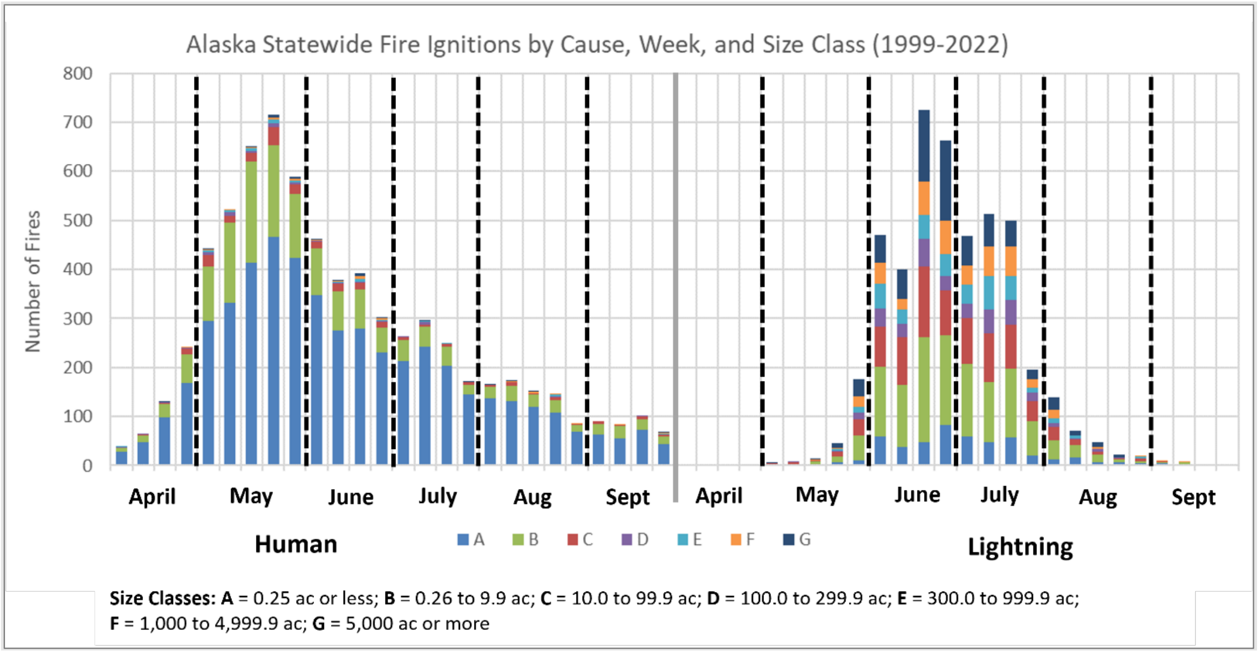


Figure 5: The seasonality of wildfire occurrence (from April through September) in Alaska is shown by using the total weekly ignitions by cause (i.e., lightning or human) and size class.

Human-caused ignitions generally begin to increase in frequency in early April, primarily along the road system in south central Alaska, the Kenai Peninsula, Fairbanks, Delta and Tok **(Figure 5)**. They peak in mid-May, falling off quickly as green-up increases, and then continue to slowly decrease through the summer. Some human caused ignitions continue to be observed into October, though it is infrequent. When viewed by Fire Danger Rating Area (FRDA), the seasonal distribution of human ignitions can be used to determine the appropriate period to focus on pre-suppression activities such as prevention and daily readiness and response actions.

In general:

- Nearly 75% of all human-caused ignitions fall within size class A (¼ acre or less). The majority are 0.1 acre or less.
- The number of human-caused fires peaks during the month of May, suggesting greater flammability conditions during pre-green up than at other times of the year.
- Human-caused ignitions are shown throughout much of the season and suggest a need for some minimum response capability throughout the entire fire season.

Lightning-caused ignitions are the result of convective storms that generally do not begin until the later part of May **(Figure 5)**. Their frequency peaks in mid-June and declines steadily, with very few lightning-caused fires after mid-August. This coincides with the onset of the Diurnal-Limited Stage. There are relatively few Size Class A lightning fires throughout the year because most lightning fires are not actively suppressed.

In general:

- As the weather and fuel conditions become warmer and dryer in late May and into June, the frequency of lightning-caused ignitions increase rapidly for all fire size classes.

- The number of lightning ignitions in the larger fire size classes, greater than 300 acres (size classes E, F, and G), peaks at the beginning of the Duff-Driven Stage. Much of the lightning activity and area burned in 2015, were precipitated by storms in the last half of June. 2015 was also a record setting year for number of wildfires at 770.
- Frequency of lightning ignitions declines rapidly in the Drought-Driven Stage, precisely because drought is an exceptional event. Convective storms decline due to the cooling atmosphere, and mid-summer rains generally moderate fuel moisture conditions.
- Fires that have been naturally extinguished before discovery may not be reported by some units.

Wildfire ignitions highlight the need for pre-suppression actions such as prevention, daily readiness, and initial response. Fire growth statistics, such as acres burned **(Figure 6)**, show how those ignitions respond to variability in the landscape and its flammability.

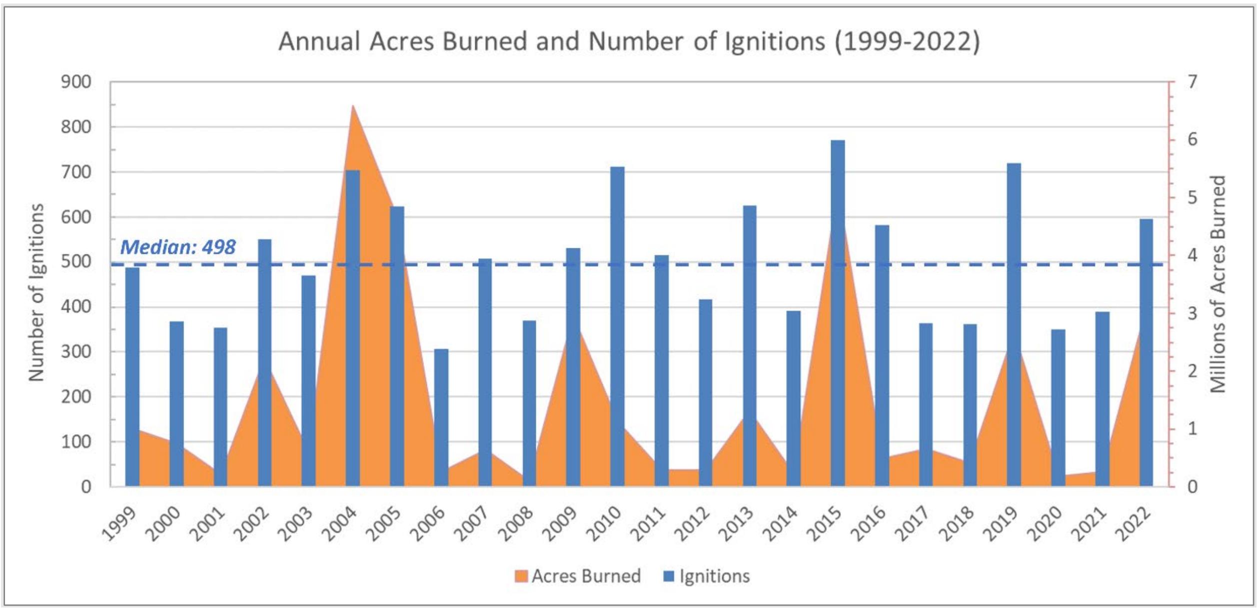


Figure 6: Annual acres burned and number of ignitions in Alaska from 1999-2022.

There were over 12,000 wildfire incidents in Alaska within the 23-year period from 1999 to 2022. **Figure 6** shows that the low years like 2001 and 2006 saw 300-350 starts while years like 2015 and 2019 had over 700. Relative to the area of burnable vegetation, the number of ignitions in Alaska are low when compared to ignitions in the western United States.

Area burned is not always correlated with the number of ignitions in Alaska. Though years with highest totals in area burned (2004, 2005, and 2015) all had above normal numbers of ignitions, 2007 and 2011 had a typical number of fires but burned below the annual median of 651,000 acres. However, lower than average ignitions do tend to produce lower acreage totals.

Ignitions are unevenly distributed both geographically **(Figure 7)** and by cause **(Figure 8).** From 1999-2022, 7,262 (62%) of the total number of reported wildfires were human-caused, while 4,520 (38%) were primarily from lightning-caused natural ignitions. Interestingly, even though there is a higher occurrence of human-caused fires, they only account for 4% of the area burned for the same time period.

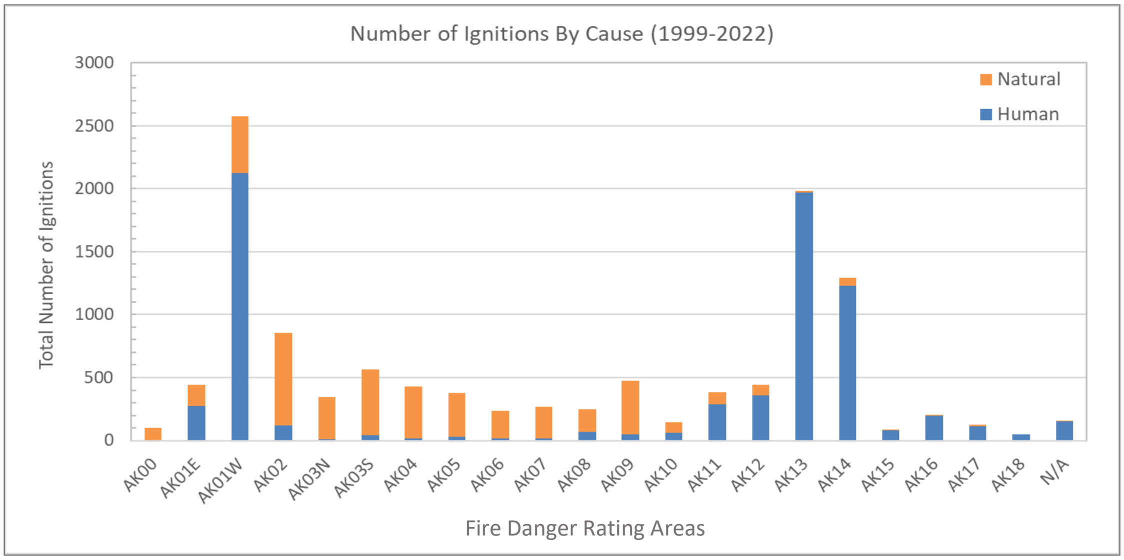


Figure 7: The number of Ignitions in Alaska by Fire Danger Rating Areas and by Cause (human or natural) from 1999-2022.

Figure 8 shows human-caused ignitions in green and natural (primarily lightning-caused) ignitions in orange. The areas protected by Alaska Division of Forestry & Fire Protection (generally FRDAs AK01E, AK01W, AK11, AK12, AK13, and AK14) experience the bulk of human-caused ignitions, primarily because they include much of the connected road system, and the bulk of the population in the state.

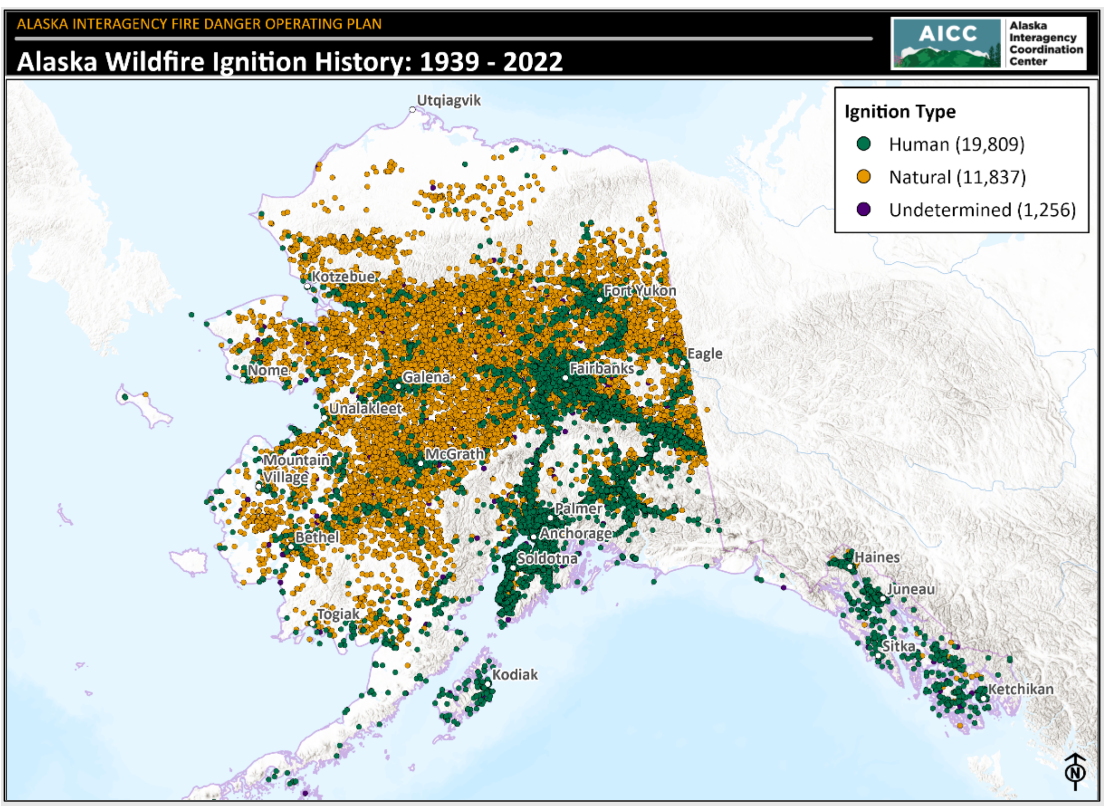


Figure 8: Map of wildfire occurrence in Alaska by ignition type (i.e., human, natural and undetermined) from 1939-2022.

Area burned **(Figure 9)** and **(Figure 10)** highlights temporal and spatial distinctions. Due to the convergence of a lightning prone landscape **(Figure 11)**, flammable fuels, and large areas of limited protection as defined in the AIWFMP, fires in the Interior account for most of the acreage burned in the State. Fire Danger Rating Areas AK01E, AK01W, AK02, AK03N, AK03S, AK05, AK07, and AK09, which cover Interior Alaska, include 32.6 million (91%) of 35.9 million acres burned over the 23-year period.

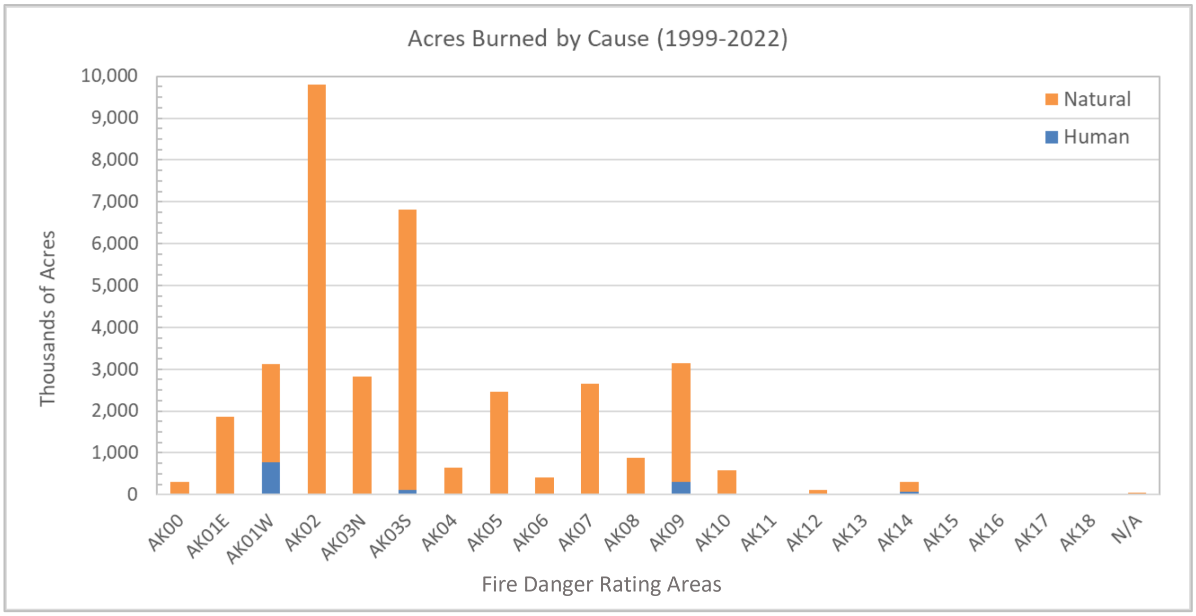


Figure 9: Area Burned in Alaska by Fire Danger Rating Areas and by Cause (human or natural) from 1999-2022.

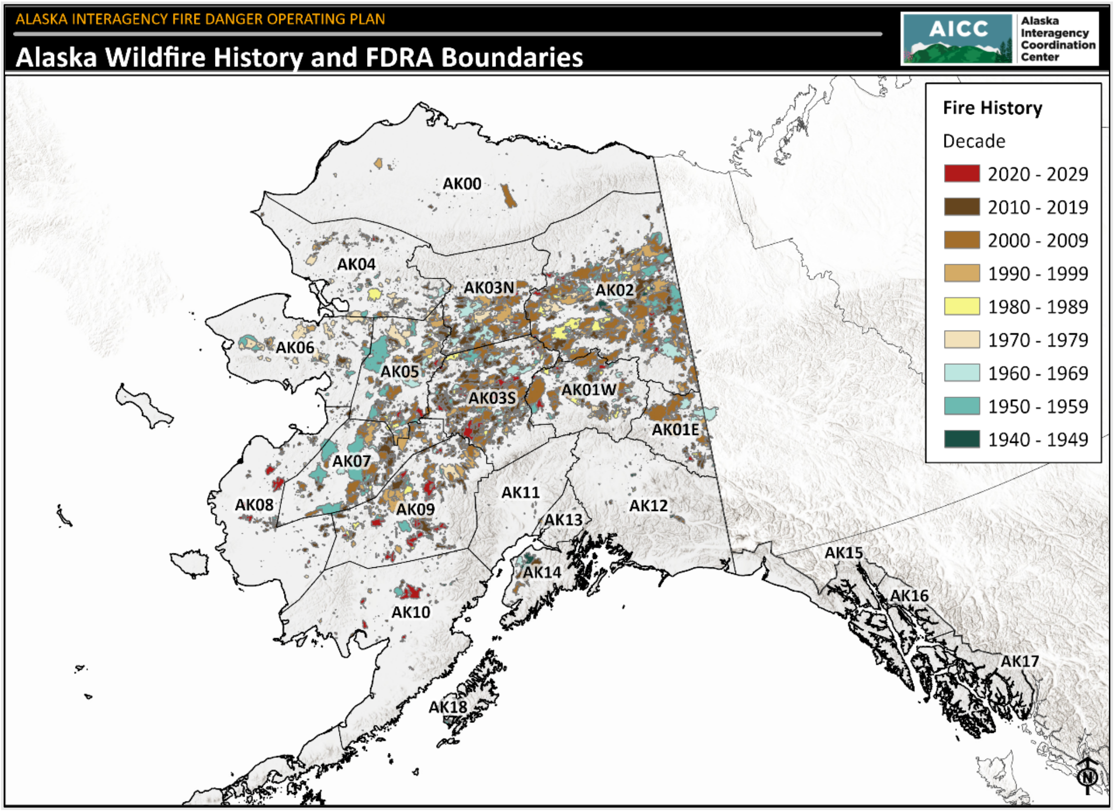


Figure 10: Map of Alaska area burned by decade from 1940-2022.

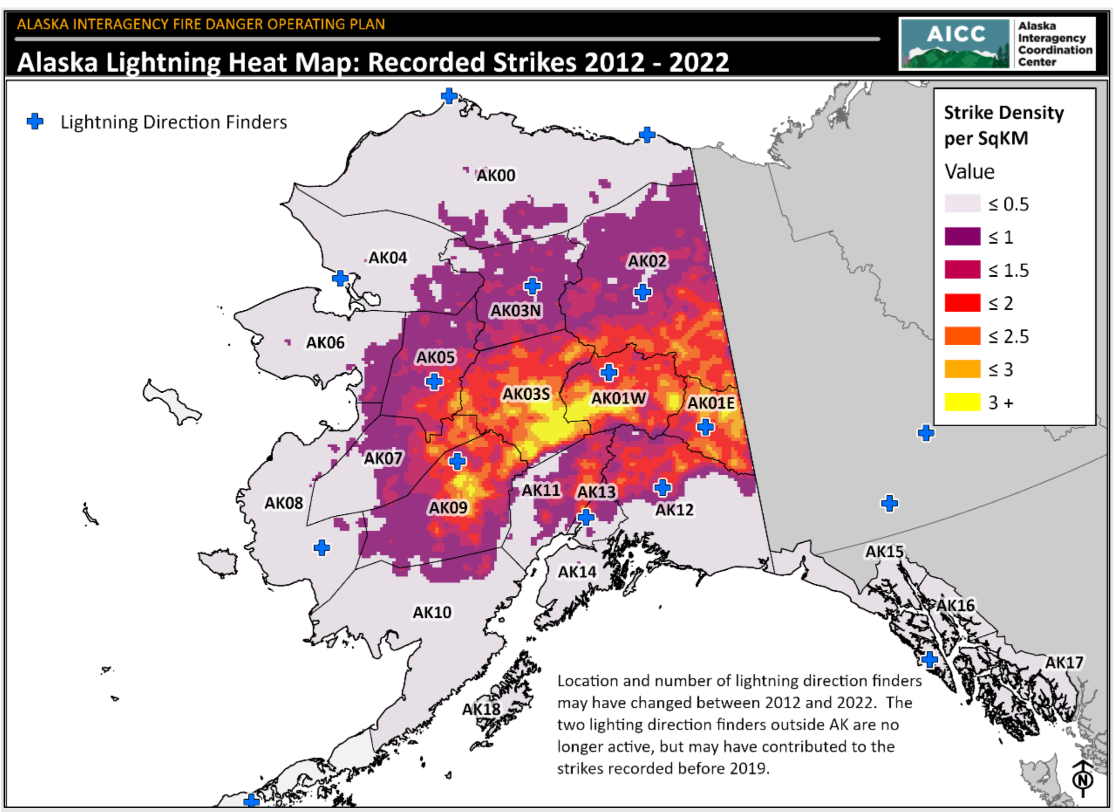


Figure 11: Map of lightning density in Alaska from 2012-2022.

H. Alaska Vegetation and Fuels Overview

In 2001, the United States Geological Survey (USGS) divided Alaska into 32 ecoregions. Those ecoregions were also generalized into nine broad ecoregion groups (Level 2) based on climate parameters, vegetation response and disturbance processes **(Figure 12)**. Tundra is normally considered a flat or rolling treeless plain that is dominated by mosses, lichens, herbs, and dwarf shrubs. Taiga is a moist subarctic forest dominated by conifers that begins where the tundra ends. By comparing the Alaska Wildfire History Map **(Figure 11)** to the ecoregions below, you can clearly see that the interior boreal forest (shown in pink) is where most of the fire activity in Alaska occurs. The other major visible vegetation breaks are the areas of tundra along the west and north coasts and the coastal rainforest in the south.

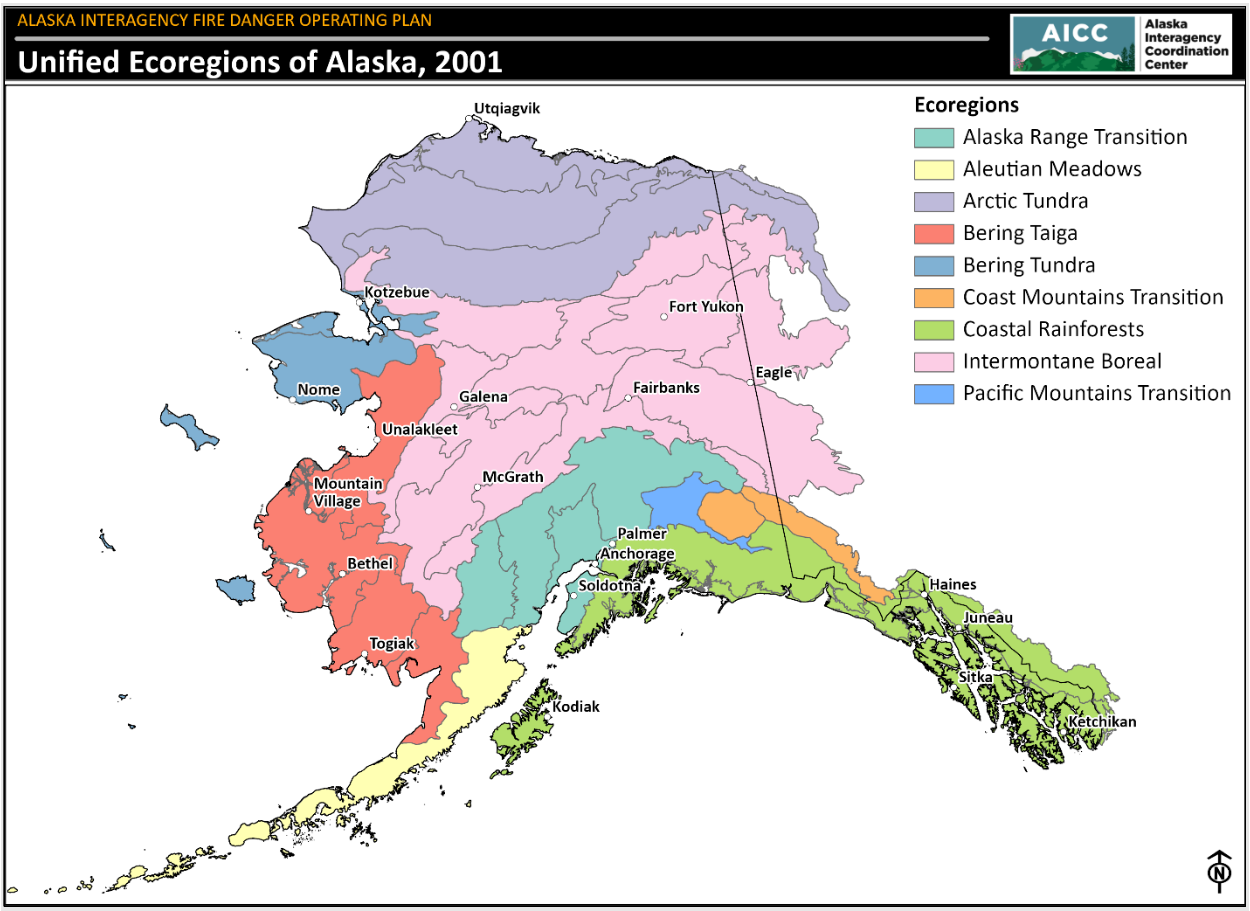


Figure 12: Map of 2001 Unified Ecoregions of Alaska.

Fuels (or vegetation) within these ecoregions have been described using CFFDRS FBP Fuel Types. In general, black spruce (C-2) is considered the most flammable fuel type in Alaska. Hardwoods (D-1 & D-2), mainly aspen and birch, are usually a barrier to fire spread except during drought and extended fire seasons when fires are still burning during the Drought-Driven Stage. Grassy areas (O-1a & O-1b) burn readily before green-up and are the major fuel types that support fire growth in the early Wind-Driven Stage. Alaska fuel types are described in detail the *Fuel Model Guide to Alaska Vegetation (2018)* and are depicted below **(Figure 13)**.

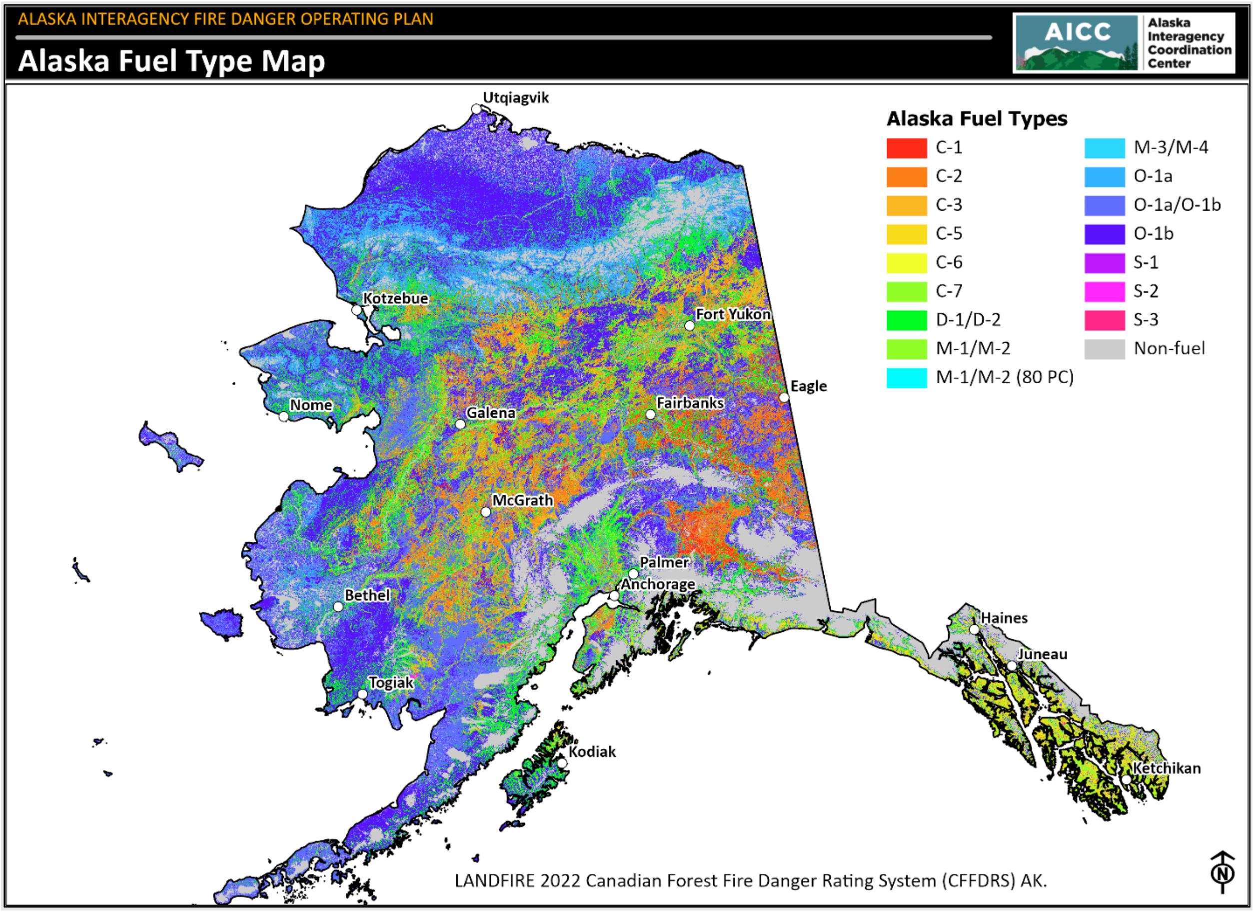


Figure 13: Map of CFFDRS Fire Behavior Prediction (FBP) system fuel types found in Alaska (from LANDFIRE 2022).

See Appendix A: Topography, Appendix B: Vegetation, and Appendix C: Climate for more information.

II. Fire Danger Rating Area Inventory

A. Fire Danger Rating Area Development

In 2007, Predictive Services meteorologists across the country were tasked with generating Predictive Service Areas (PSAs) that had relatively homogenous fire danger. The goal was to analyze weather, fuels, and resultant fire ignitions and size to better understand and forecast fire behavior. This was challenging across a large landscape with few observing platforms and highly variable terrain and fuel types. Seventeen PSAs were initially developed, expanding to 21 by the second decade as more observing stations were installed, remote sensing improved, and the recognition of fire's presence in all parts of the state grew.

An attempt to define Fire Danger Rating Areas (FDRAs) based on ecoregion and fire history encountered the same issues as PSA development. These challenges caused the FDRAs to resemble the existing PSAs and it was decided that they were reasonable estimates of homogenous fire danger rating areas. Thus, the PSAs were adopted as FDRAs **(Figure 14)**, which has kept the historical database and prior analyses intact and relevant, including research accomplished by outside agencies.

Descriptions of each FDRA can be found in Appendix D: Fire Danger Rating Area Descriptions.

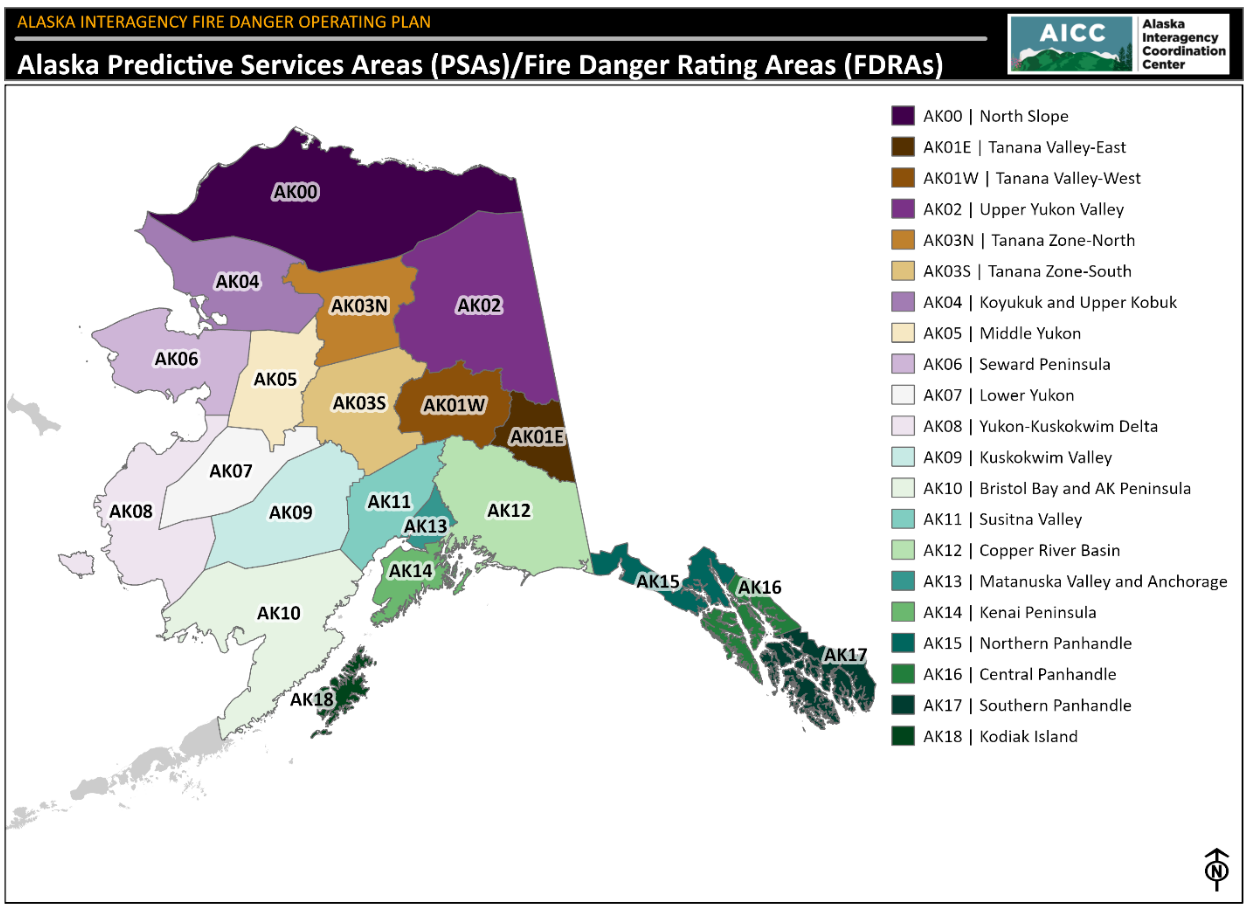


Figure 14: Map of Alaska Predictive Service Areas that were adopted and used as Fire Danger Rating Areas for fire analyses in the Alaska Interagency Fire Danger Operating Plan.

B. Alaska Sub-Region Adjective Class Area Development

The Alaska Sub-Region (ASR) – Spring and ASR-Summer Adjective Ratings (described in Chapter III, Appendix F and Appendix H) are based on an exercise that grouped existing FDRAs into similar analysis areas. These groupings, called Alaska Sub-Region Adjective Class Areas, were developed by the National Park Service in 2019 by combining FDRAs with similar climatology, fire business thresholds related to CFFDRS indices, Protection Area boundaries, and response strategies **(Figure 15)**. The ASR Adjective Class Areas were developed for two primary reasons:

1) Grouping the 21 individual FDRAs into 8 ASR Adjective Class Areas reduced unnecessary complexity. Climatological analysis indicated many adjacent FDRAs had the same weather and/or CFFDRS variables (e.g., 1400 ATF, BUI and FWI) that had the highest statistical relationship with Ignition Days[3] and MODIS/VIIRS Days[4] and had similar thresholds for fire activity. Adjacent FDRAs that met these criteria were combined.
2) ASR Spring and Summer Adjective Class Ratings were designed to be updated as frequently as annually. Combining FDRAs with similar climatology into ASR Adjective Class Areas significantly reduces the annual workload needed for re-analysis with minimal reduction in data accuracy.

The Alaska Sub-Regions and associated adjective ratings have been used by the National Park Service since 2019. The Galena Zone is also using them to develop staffing guides.

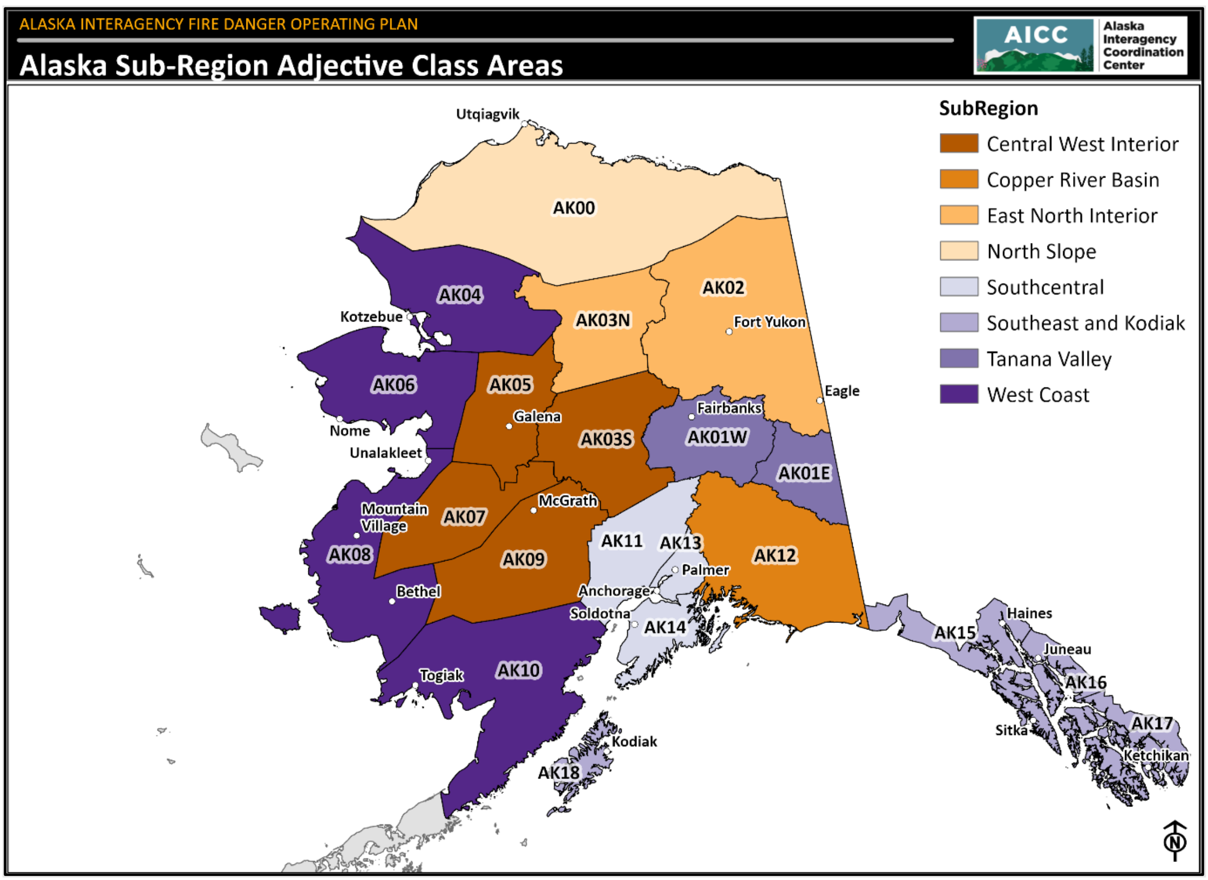


Figure 15: Map of Fire Danger Rating Areas combined into Alaska Sub-Region Adjective Class Areas.

[3] *A day (24-hr period) where at least one wildfire ignition occurred.*
[4] *A day (24-hr period) where at least one MODIS or VIIRS heat detect occurred.*

C. Fire Weather, Fuel Moisture, and Fire Behavior

The wildland fire management community in Alaska has maintained a database of surface weather observations since 1994 to support assessments of current and forecasted fire potential for decision-makers. This database has evolved into the authoritative source for daily surface fire weather observations and calculated CFFDRS codes and indices used for decision support. This database is maintained within the Alaska Fire and Fuels (AKFF) online system. Annual summaries of recent fire seasons can be found at the AICC website under Fire Season Summaries.

1. Alaska Fire and Fuels System

Alaska Fire and Fuels System (AKFF) is the Alaska interagency Fire Weather Index (FWI) and Fire Behavior Prediction (FBP) monitoring system. It provides public access to fire weather that is collected hourly, processes FWI codes and indices, and provides them in a range of tools and displays to aid fire managers in assessing fire potential each day. Data is collected and stored in a database; displayed in tabular, graphical, and geospatial formats; available for historic queries; and downloadable. Details about data use and management for AKFF can be found in the System Sources and Standards section of the *Alaska Fire and Fuels User Guide*.

AKFF was jointly built using API web services by MesoWest & Synoptic Labs teams. The key contacts for additional information on the AKFF contract are:

- John Horel, University of Utah, Manager: john.horel@utah.edu
- Heidi Strader, AICC Predictive Services: heidi_strader@nps.gov

2. Alaska Seasonal Trend Analysis

Alaska has developed an online Seasonal Trend Analysis Tool **(Figure 16)** that graphically represents fire potential by weather station or group of weather stations within a FDRA. The trend analysis is a tool to help firefighters understand daily fire potential and allows for seasonal tracking of fire severity. This tool defaults to the Buildup Index (BUI) but can be customized by the user to display other variables. The Seasonal Trend Analysis Tool is introduced to out-of-state firefighters at the Alaska orientation and in-briefings.

The Seasonal Trend Analysis Tool is based on the BUI, which is an indicator of fire season severity. It is designed to be used in lieu of Fire Danger PocketCards (normally based on ERC) described in the Red Book (Chapter 10). In Alaska, the Seasonal Trend Analysis Tool is considered and used as a PocketCard equivalent.

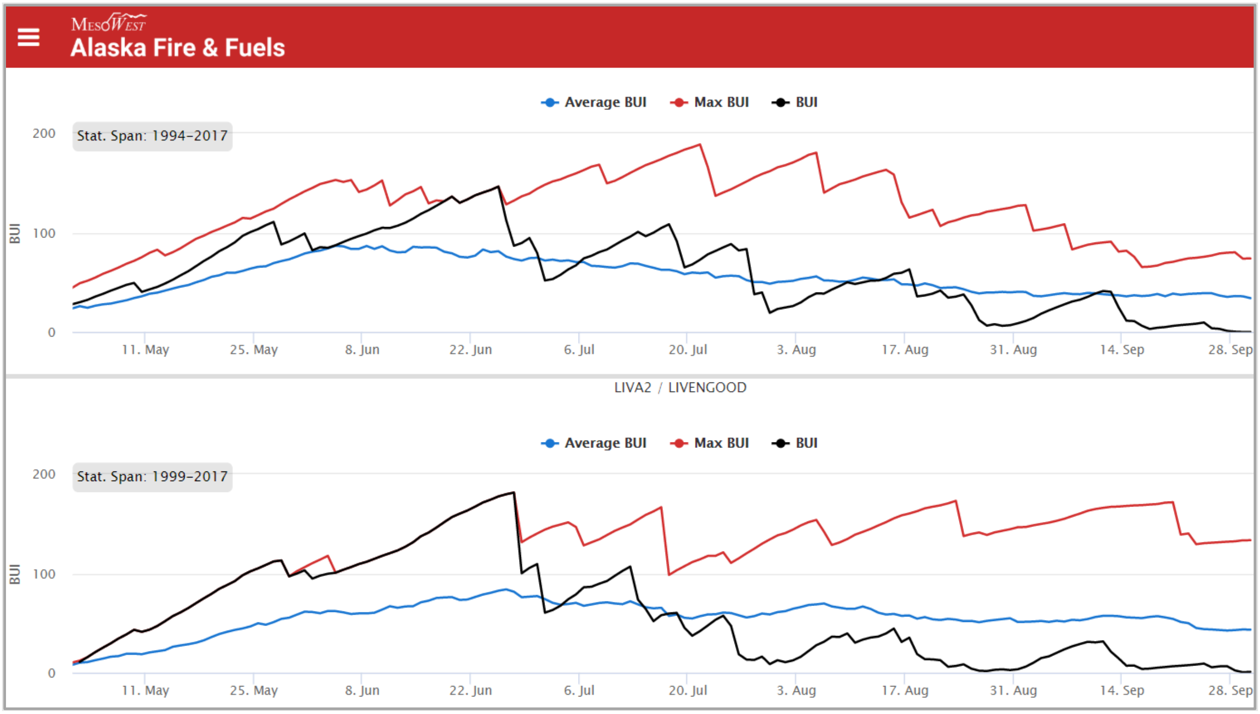


Figure 16: The Seasonal Trend Analysis Tool on the Alaska Fire and Fuels website shows the average and maximum BUI compared to the current BUI for each weather station within a given Fire Danger Rating Area.

3. Alaska Weather Station Networks

AKFF provides data from more than 250 surface observing stations across the state. These locations come from a mix of agency Remote Automatic Weather Stations (RAWS), Federal Aviation Administration (FAA) airport locations, USGS monitoring locations, military cold climate research stations, and US Array monitoring locations. A list of stations can be found in AKFF.

4. Fire Weather Watches and Red Flag Warnings

Fire Weather Watch and Red Flag Warning criteria are summarized in **Figure 17** below. More information on how and when Watches and Warnings are issued can be found in the Alaska Fire Weather Program Annual Operating Plan.

General non-convective Red Flag Warning Criteria:			
All zones	Temp ≥ 75°F	RH ≤ 25%	Wind ≥ 15 mph (sustained)
Exceptions to non-convective Red Flag Warning Criteria:			
937: Delta Junction	No Temp criteria	RH ≤ 25%	Wind ≥ 30 mph (sustained)
Pre-Green up* in zones: 701-704: Anchorage/Eagle River/Hillside/Turnagain Arm 711-714, 746: Mat-Su Valley 721-727: Kenai Peninsula	Temp ≥ 65°F	RH ≤ 25%	Wind ≥ 15 mph (sustained)
**Green up will be discussed with local fire managers each spring to ensure an appropriate change date for South Central zones.*			
Lightning Red Flag Warning Criteria:			
All zones	Thunderstorm Coverage = Scattered to Numerous Fuel conditions = Very Burnable per Predictive Services CFFDRS Adjectives		

Figure 17: Alaska Red Flag Warning and Fire Weather Watch criteria by fire weather zone.

III. Fire Danger Analyses

A. Introduction to Analyses

1. CFFDRS Use in Alaska

In 1992, the Alaska Wildland Fire Coordinating Group (AWFCG) made the decision to adopt the CFFDRS FWI System as Alaska's primary fire danger and decision support tool instead of the National Fire Danger Rating System (NFDRS). The factors listed below contributed to that decision. Additional information on why Alaska adopted the CFFDRS system can be found in *Why Alaska Fire Potential Assessments are Different, R. Ziel (2018)*.

a) NFDRS does not track fuel flammability as well as CFFDRS.

The Energy Release Component (ERC) is the National Fire Danger Rating System (NFDRS version 4) index analogous to BUI. Its trend peaks earlier than the historical peak of Alaska's fire season. In addition, the maximum ERC trend does not show the peaks in flammability that are associated with periods of maximum fire growth as represented by BUI **(Figure 18)**.

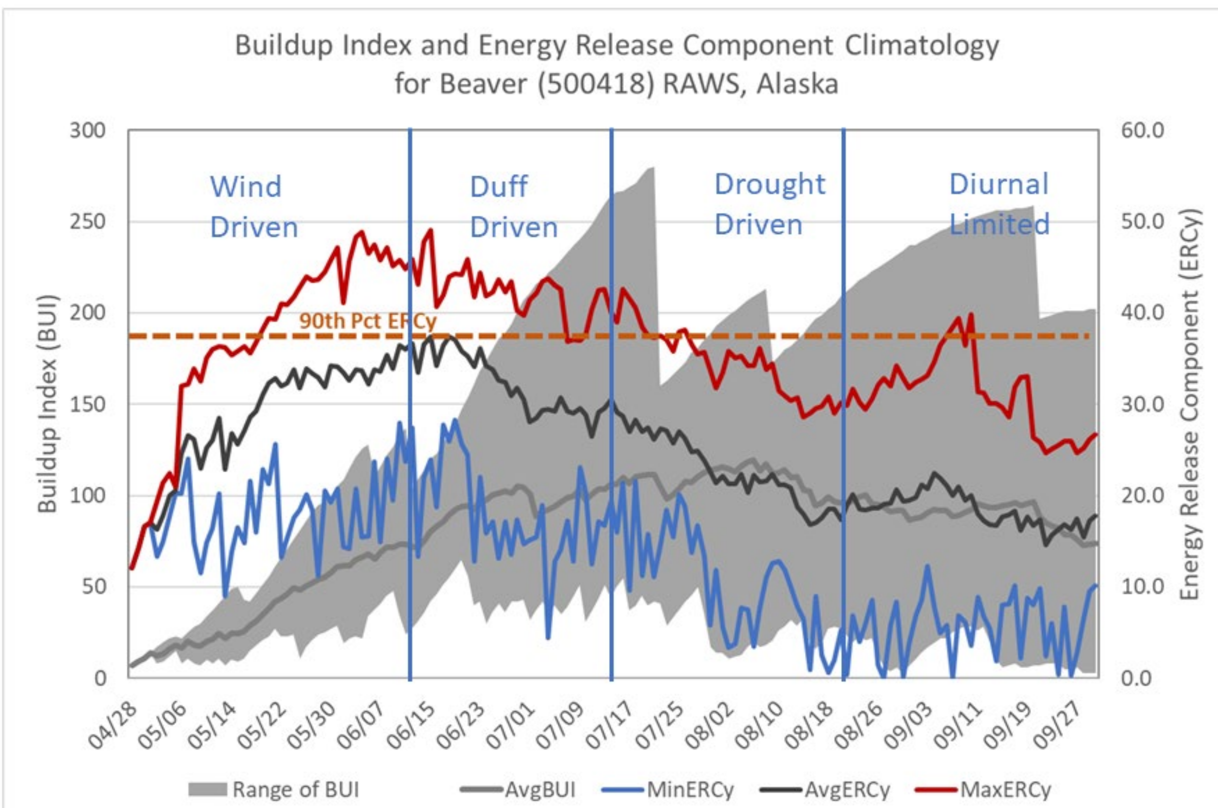


Figure 18: Tracking seasonality with Buildup index (BUI) versus Energy Release Component (ERC).

b) Snow Flags are not automatically set in NFDRS version 4 for Alaska.

During the conversion to NFDRS version 4, a snow flag was applied to existing datasets using MODIS data. This methodology was unavailable for Alaska, and though snow flags are being created for historical datasets, their accuracy is still questionable. Manual setting of snow flags is not feasible, rendering the Alaska weather data unusable with NFDRS version 4.

The 2013 season illustrates these issues with the dataset. This was a very wet spring in the Fairbanks area with large amounts of snow remaining on the ground until May 22, represented by the black line in **Figure 19.** ERC from the Fairbanks RAWS highlights the problems caused by the lack of snow flags for Alaska historic weather data. ERC was above the 97th percentile and near all-time maximum values around the snow free date when fuels were just becoming burnable.

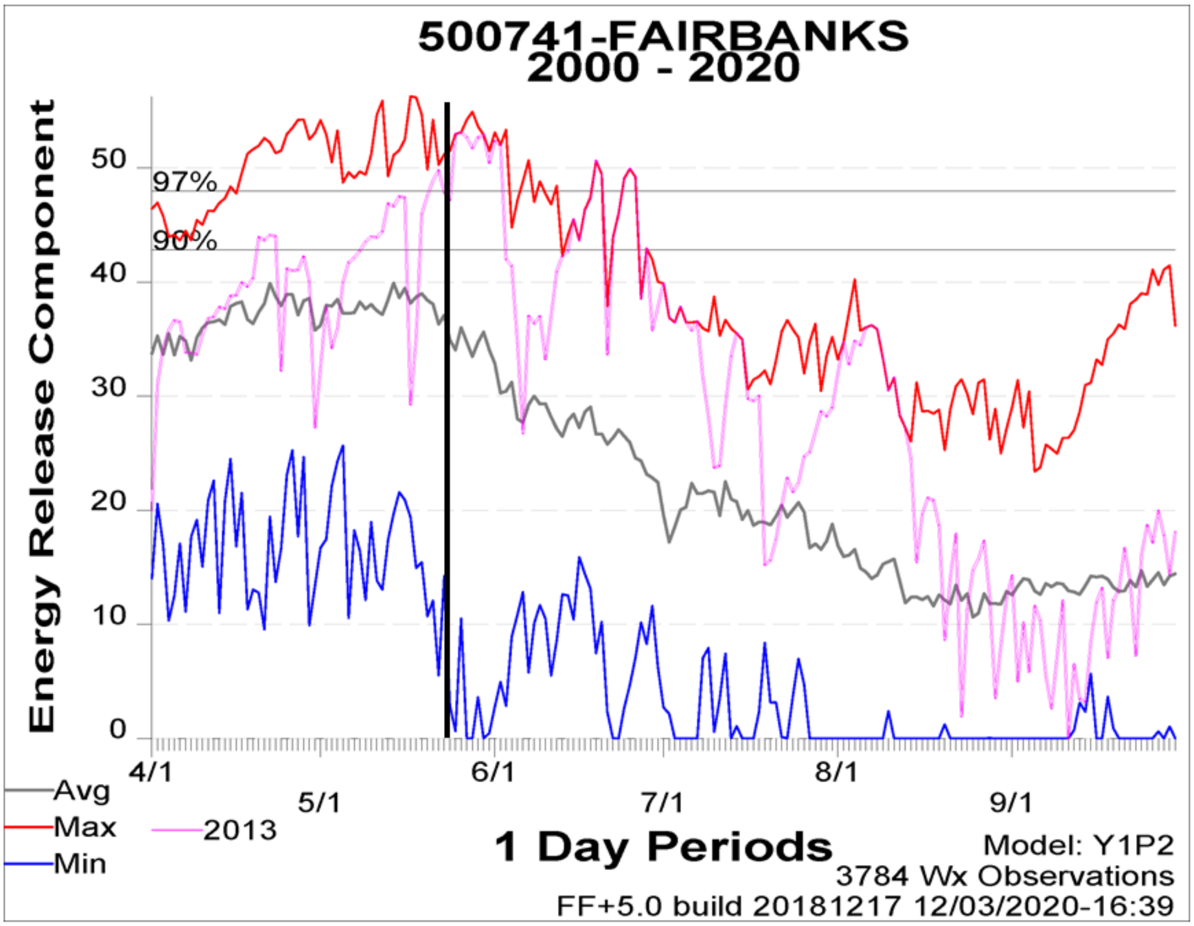


Figure 19: Energy Release Component (ERC) for the Fairbanks RAWS from April through September 2013.

In contrast, the 2013 BUI graph for the Fairbanks RAWS **(Figure 20)**, shows that the fuels were not dry enough for significant fire spread until the middle to the end of June with record setting values through the first week of July and again during the middle of August, which corresponded to peaks in fire activity.

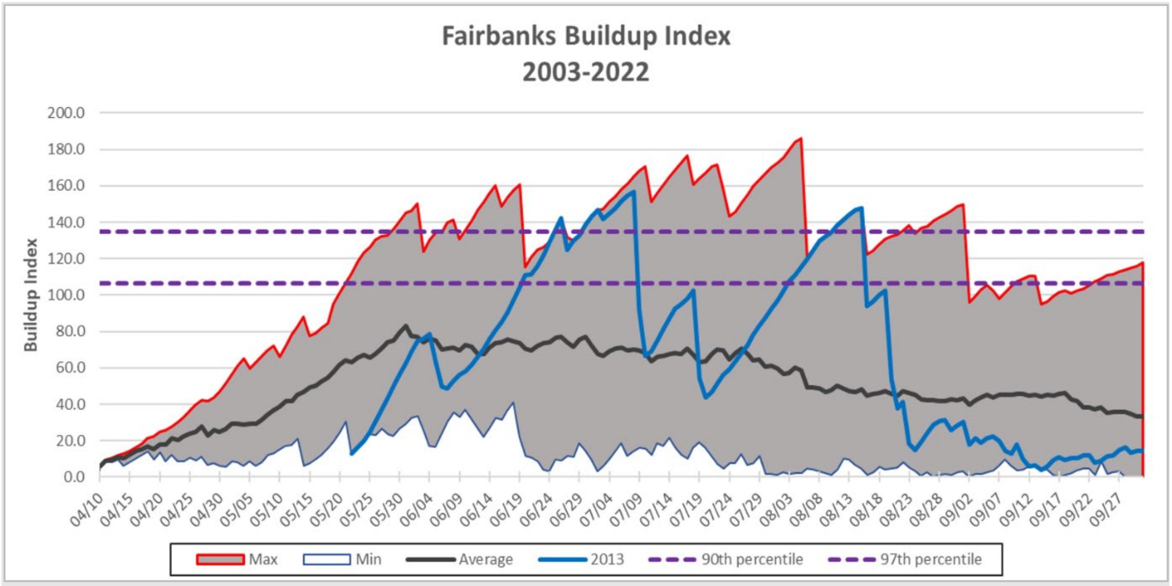


Figure 20: Build Up Index (BUI) for the Fairbanks RAWS from April through September of 2013.

c) A larger network of surface weather observation locations that are compatible with FWI calculations.

The network of stations used for FWI calculations is much larger (323 stations) and more effectively distributed than the network of Weather Information Management System (WIMS) RAWS (166 stations) alone as shown below **(Figure 21)**. Only WIMS RAWS are available for use in NFDRS calculations. Traditionally, surface weather observations from a network of standard fire RAWS are collected and stored nationally at the USFS Weather Information Management System (WIMS). It is the source for NFDRS estimates for flammability and fire potential, which is used to support fire behavior analysis tools found within the Wildland Fire Decision Support System (WFDSS).

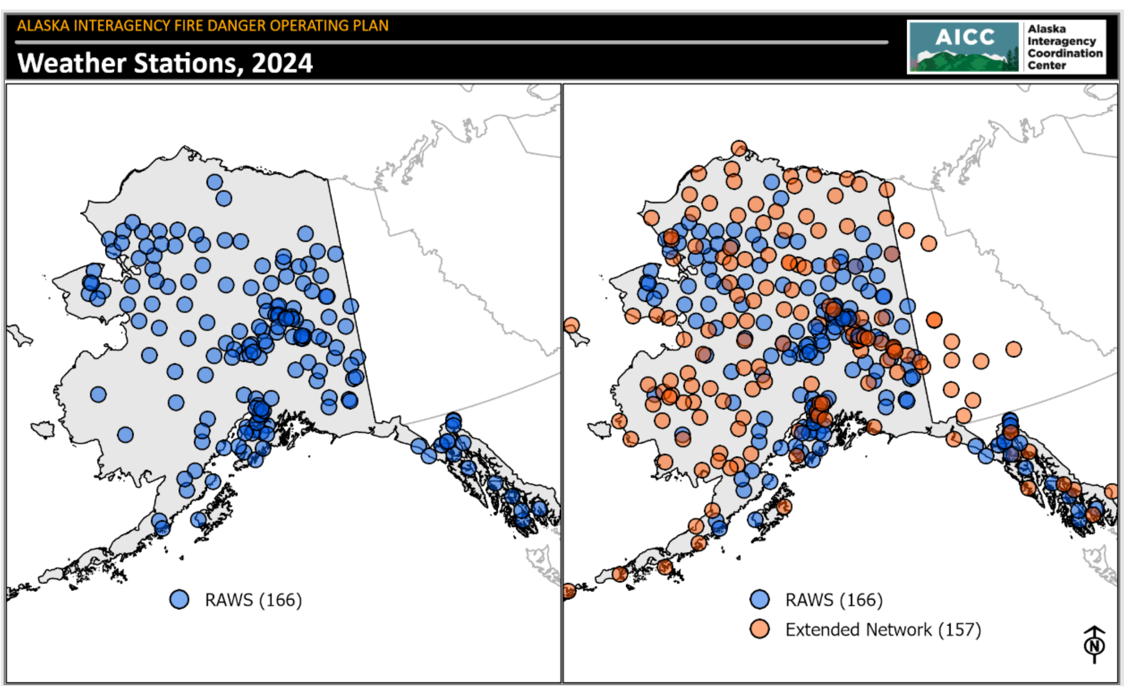


Figure 21: Alaska WIMS RAWS Network (left) compared to the Extended Weather Station Network (right).

d) National datasets are missing, inaccurate or ineffective for Alaska.

The southernmost point in Alaska is about 5° latitude farther north than CONUS domains (54° N vs 49° N) and nearly 6 degrees farther west (130.25° W vs 124.5° W). Any CONUS domain for gridded products would have to cover vast areas of Canada and the Pacific Ocean to include Alaska. For that reason, any national products that include Alaska effectively need separate datasets and separate mapping domains, many of which do not exist for fire weather and fire potential applications.

The Wildland Fire Assessment System (WFAS), a clearinghouse of gridded fire danger information maintained by the U.S. Forest Service, does not include information on Alaska in any of its products.

While the National Weather Service (NWS) National Digital Forecast Database (NDFD) provides separate domains for weather forecasts in Alaska, many of the supporting products, such as the national Quantitative Precipitation Estimates (QPE) are manually produced without sufficient radar data support in Alaska.

The NWS Storm Prediction Center produces a variety of severe weather prediction tools, including one for severe fire potential but only for the CONUS domain.

Many other efforts and products, if they include or produce information for Alaska, do so at a much lower resolution global domain. For example, the Evaporative Demand Drought Index (EDDI) and Stratified Precipitation Evapotranspiration Index (SPEI).

e) Climate histories and re-analyses are problematic.

Unlike CONUS, Alaska surface weather observation networks include very few stations with long duration histories and even fewer with year-round records. Most analyses of current weather and climate trends reference data from a variety of climate re-analysis and forecast models that cover global, or at least continental, datasets. Many were evaluated in *An Evaluation of Reanalysis Products for Alaska to Facilitate Climate Impact Studies Lader et al., 2016*. This paper showed a strong bias in basic surface weather elements, including 2m temperature, 2m dew point, surface windspeed, and precipitation estimates when compared to reference surface observation histories. These biases render the climatologies ineffective in producing reference histories for fire danger fuel moisture codes and fire behavior indices. They are also ineffective in representing fuel moisture and landscape flammability in both absolute values and season trends. Furthermore, they suffer from very coarse resolutions and significant reporting time lag.

Notable among these misinformed datasets is the North American Regional Re-analysis (NARR), a comprehensive and robust set of surface and upper air datasets favored for many CONUS analyses and output products. *Lader et al., 2016* concludes that the NARR is not well suited for wildfire applications in Alaska.

Efforts are underway to identify the best source of reanalysis products, develop methodologies for downscaling data to a useful resolution and bias correction to improve utility as a reference history for assessing current conditions and forecast products.

f) Poor forecast fuel moisture and fire danger estimates from NFDRS led to workarounds in tools utilizing only NFDRS inputs.

In a guide produced for fire behavior analysis in Alaska, Fuel moisture, seasonal severity and fire growth analysis in the US fire behavior analysis tools: using Fire Weather Index (FWI) codes and indices as guides in Alaska, a thorough analysis of the shortcomings of the NFDRS outputs in Alaska fuel types is provided. In addition, there are recommendations for using CFFDRS outputs to provide objective guidance for initial settings for many analysis inputs into the Wildland Fire Decision Support System

(WFDSS) and the Interagency Fuel Treatment Decision Support System (IFTDSS). The CFFDRS FWI system was formally calibrated for northern boreal ecosystems and effectively identifies thresholds for the Alaska landscapes as well as important trends in changing fire growth potential.

2. Fire Weather Index Thresholds

The FWI portion of the CFFDRS has been in use in Alaska for many decades. A meaningful table of threshold values and their interpretation for each index **(Table 1)** has been used to populate tables on the AICC website, as a reference in the Alaska Handy Dandy, and for making maps for briefings for many years. The AKFF website also has tables and maps that are customizable using these thresholds. These thresholds come from expert opinions and literature, and have changed little over time, though a discerning eye will find some small differences amongst past versions of the table.

In 2011, Robert Ziel vetted the FWI Threshold Table through FMOs, Analysts and other interested fire management personnel. Ziel and his co-authors last published the table in the AWFCG endorsed *Alaska Field Guide for CFFDRS Fire Weather Index (FWI) System (2015)*. Though the thresholds give insight to overall potential across landscapes and areas of responsibility, they need to be combined with FBP system inputs specific to the fuels and terrain at the site to produce fire behavior interpretations when evaluating a specific fire situation. These thresholds were developed primarily for use in Interior Alaska but can be applied across the state.

Table 1: CFFDRS FWI fuel moisture codes and fire behavior index thresholds by adjective class (low, moderate, high, very high and extreme).

Class	LOW	MOD	HIGH	VHIGH	EXT	Interpretation
Max Temp (T°)	<50°	50° to 59.9°	60° to 69.9°	70° to 79.9°	80°+	Fire intensity and crown fire potential
Min Relative Humidity (RH%)	51% to 100%	41% to 50%	31% to 40%	21% to 30%	<20%	Fine fuel moisture and ignition potential
Fine Fuel Moisture Code (FFMC)	0 to 79.9	80 to 85.9	86 to 88.9	89 to 91.9	92+	Below 74, little chance of ignition or surface fire spread with an open flame. Active spread in light fuels at 80. Ignition potential high at 90 and extreme fire behavior expected at 92.
Duff Moisture Code (DMC)	0 to 39.9	40 to 59.9	60 to 79.9	80 to 99.9	100+	Duff layer not involved below 20. Influence of duff on surface fire noticeably increases at 40. Extreme fire behavior becomes possible above 60.
Drought Code (DC)	0 to 149.9	150 to 349.9	350 to 399.9	400 to 449.9	450+	Minimal significant ground fire below 300.
Initial Spread Index (ISI)	0 to 1.9	2 to 4.9	5 to 7.9	8 to 10.9	11+	Expected spread potential. Used in fire behavior predictions.
Build-up Index (BUI)	0 to 39.9	40 to 59.9	60 to 89.9	90 to 109.9	110+	Fuel availability and flammability. Seasonal severity. Used in Fire Behavior Predictions.
Fire Weather Index (FWI)	0 to 8.9	9 to 17.9	18 to 27.9	28 to 34.9	35+	Fire intensity and extreme fire potential.
Daily Severity Rating (DSR)	NA	NA	NA	NA	NA	A transformation of the FWI that emphasizes its higher values. Can be cumulated through the season to represent overall conditions.

3. Fire Analysis Types

Fire analysis is segmented into three different types:

- Fire Occurrence (Human-Caused Ignitions)
- Fire Growth
- Fire Occurrence and Growth

Human-caused ignitions begin to occur in the Wind-Driven Phase, between snow free and green-up, and typically before lightning ignitions occur. Most of these early season ignitions are suppressed quickly and do not provide sufficient fire growth data. Therefore, we rely on occurrence analysis to provide meaningful fire danger ratings (Grass Adjective Rating and Alaska Sub-Region Spring Adjective Class Rating) during this phase of fire season.

Once lightning-caused ignitions begin to impact the state in early June, analysis transitions to fire growth or a combination of ignitions (i.e., occurrence) and growth to provide meaningful outputs (Spruce Adjective Rating and Alaska Sub-Region Summer Adjective Class Rating). Much of the growth displayed by these fires does not tend to occur on the day of ignition but occurs when weather variables support large fire growth, hence MODIS (Moderate Resolution Imaging Spectroradiometer) and VIIRS (Visible Infrared Imaging Radiometer Suite) detections are analyzed along with the occurrence data.

B. Fire Occurrence Analyses

1. Fire Year Seasonality Impacts

The seasonality of ignitions is important, though the occurrence of new fires is persistent throughout much of the year. It is important to analyze the temporal and spatial distribution of human-caused ignitions. Analysis of ignitions is important for day-to-day local preparedness decisions. There are additional factors unrelated to the weather and fuel conditions such as holidays, weekends and special events that complicate Fire Danger analysis of human-caused ignitions. Additionally, it is important to note these human-caused ignitions tend to be clustered along the road network and near communities.

Regardless of ignition date, fire growth is highly correlated to landscape flammability, current weather, and cumulative drying of fuels in areas where fires remain active. Analysis should be segmented both seasonally to integrate important climate and weather trends and spatially to integrate differences in landscape condition that represent important differences in day-to-day, week-to-week, and seasonal trends for significant fire growth potential.

Adjective ratings help quantify the severity of current conditions and have been calculated based on the fuel type most available to burn. In the spring (Wind-Driven Phase), the main fuel is dried grass. Once green-up occurs, flammability transitions from wind-driven grass fires to more Duff-Driven spruce fires as deeper fuel layers dry and are available to burn. The transition varies year to year but usually occurs in early to mid-June.

2. Grass Adjective Rating

Human-caused fires in Alaska were responsible for 62% of all fires in the state from 1999-2022. These fires tend to occur in the spring, before green-up, during the Wind-Driven Phase of fire season. In early spring, ignitions are constrained by cold soil and frozen duff, residual snow under forest canopy and saturated wetlands. However, later in Wind-Driven phase, cumulative drying of both the cured grasses and other fine fuels increase the potential for large fire growth.

*The **Grass Adjective Rating (GAR)** is designed to categorize fire ignition and fire spread potential from snow free through green-up in Alaska.*

Table 2 identifies criteria for the GAR. It should be used primarily during the Wind-Driven Stage when human-caused fire ignitions in grass fuel types are a significant problem, though some potential remains throughout the fire season. In rare cases, potential can continue into the winter months when there is little to no snow cover. A.

Table 2: Grass Adjective Rating (GAR) criteria by adjective class (low, moderate, high, very high and extreme).

Grass (Spring)	**ISI < 2**	**ISI ≥ *but* < 6**	**ISI ≥ *but* < 8**	**ISI ≤ 8**
FFMC < 86	**LOW**	**MODERATE**	**MODERATE**	**VERY HIGH**
FFMC ≥ 86 *but* < 92		**MODERATE**	**HIGH**	**VERY HIGH**
FFMC ≥ 92 *and* FWI < 36.0			**VERY HIGH**	**VERY HIGH**
FFMC ≥ 92 *and* FWI ≥ 36.0			**VERY HIGH**	**EXTREME**

a) GAR Inputs

The Grass Adjective Rating was developed from threshold analysis that used ignitions (i.e., fire occurrence), Ignition Days[5], and daily FWI system values.

b) Methodology Used to Develop the GAR

The GAR uses Fine Fuel Moisture Code (FFMC) as a proxy for ignition potential, the Initial Spread Index (ISI) as a proxy for expected fire growth, and the FWI to evaluate potential for extreme fire events. A threshold analysis was conducted to quantify breakpoints for the adjective classes.

The resulting GAR is mainly used by the State of Alaska DOF (Division of Forestry & Fire Protection) in the Fairbanks, Delta, Mat Su, Kenai, and Tok Protection Areas during the spring for initial attack staffing, burn permit administration, and fire restrictions when human-caused fire ignitions are a significant problem. For example, with a GAR in the Low and Moderate adjective classes, no burning restrictions are applied. Burning with restrictions is allowed in the High adjective class rating. In the Very High and Extreme adjective classes, burning is completely restricted.

The GAR may also be considered for use in tundra landscapes, though it is not specifically calibrated for that fuel type.

[5] *A day (24-hr period) where at least one wildfire ignition occurred.*

3. Alaska Sub-Region Spring Adjective Class Rating

*While the GAR is primarily designed for use in grassy fuel types in Interior Alaska, the **Alaska Sub-Region Spring (ASR-Spring)** Adjective Class can be used statewide and provides a rating of the potential for ignition and spread potential in forested and non-forested fuel types from snow free (estimated April 1) to green-up (estimated May 31).*

It was developed by the NPS to compliment the GAR and the Alaska Sub-Region Summer (ASR – Summer) Adjective Class Rating that was developed for use from June 1st to September 30th (see Chapter III.D.1). The NPS is currently using the ASR – Spring to help determine local unit preparedness levels, inform fire restrictions and in severity requests.

a) ASR-Spring Inputs

The ASR – Spring is customized to eight Alaska Sub-Region Class Areas (see Chapter II.B. and **Figure 15** for more details on ASR Adjective Class Areas). The thresholds for each ASR Class Area are largely based on a best fit (conditional frequency) analysis of fire history records and the following variables:

- 1400 Air Temperature and FFMC as they suggest potential for increased ignitions.
- ISI and FWI as they suggest potential for fire spread.
- DMC as it serves a proxy for short term drought conditions (increasing available fuel bed), conditions that include increased potential for fire persistence after ignition and potential for significant fire growth at elevated levels.

b) Methodology Used to Develop the ASR-Spring

The ASR – Spring was designed to illustrate regionally specific normal and departure from normal fire conditions from April 1 to May 31 using standardized percentiles for each adjective class. The target percentage of the Temperature/CFFDRS variables (listed above) for each class are: Low = 50% (0 - 50th percentile); Moderate = 25% (50 - 75th percentile); High = 15% (75 - 90th percentile); Very High = 7% (90 - 97th percentile); and Extreme = 3% (97 - 100th percentile). (See Appendix F and **Figure 31** for the ASR-Spring analysis results.)

To determine the ASR-Spring rating for any given ASR Class Area, use the criteria for each Temperature/CFFDRS variable shown in **Table 3**. Select the **lowest** ranking variable to determine the overall ASR-Spring Adjective Class Rating for that Class Area.

For example, at an observation location in the North Slope ASR Adjective Class Area the Temp/CFFDRS variable values are: 1400 Temperature is 57°F; FFMC is 64; DMC is 6; ISI is 1; and FWI is 2. Using the criteria in Table 3 for the North Slope ASR Class Area, the values are ranked as: 1400 Temp is Very High (>56-61); FFMC is Low (≤ 65); DMC is Moderate (>3-7): ISI is Low (≤ 1); and FWI is Moderate (>1-3). The **lowest** ranked variable class(es) are *Low* so the ASR-Spring would be *Low*. In this example, if the FFMC and ISI values ranked as Moderate, the lowest ranked class(es) would be moderate and therefore, the ASR-Spring would be Moderate.

Table 3: ASR - Spring Adjective Class Rating Criteria. Select the Adjective Class of the **lowest** rated variable in the ASR Class Area to represent the overall ASR-Spring Adjective Class Rating.

ASR-Spring Adjective Class Rating						
ASR Adjective Class Areas (FDRAs)	**Temp/CFFDRS Variables**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
North Slope (AK00)	1400 Temp (˚F)	≤39	>39-48	>48-56	>56-61	>61
	FFMC	≤65	>65-81	>81-86	>86-88	>88
	DMC	≤3	>3-7	>7-12	>12-28	>28
	ISI	≤1	>1-2	>2-4	>4-6	>6
	FWI	≤1	>1-3	>3-5	>5-14	>14
Central West Interior (AK03S, AK05, AK07, AK09)	1400 Temp (˚F)	≤53	>53-61	>61-67	>67-72	>72
	FFMC	≤80	>80-84	>84-88	>88-91	>91
	DMC	≤10	>10-16	>16-24	>24-46	>46
	ISI	≤1	>1-3	>3-5	>5-7	>7
	FWI	≤5	>5-9	>9-14	>14-18	>18
Southeast and Kodiak (AK15, AK16, AK17, AK18)	1400 Temp (˚F)	≤41	>41-51	>51-58	>58-61	>61
	FFMC	≤69	>69-83	>83-85	>85-87	>87
	DMC	≤3	>3-5	>5-9	>9-22	>22
	ISI	≤1	>1-4	>4-7	>7-10	>10
	FWI	≤2	>2-4	>4-10	>10-18	>18
Tanana Valley (AK01E, AK01W)	1400 Temp (˚F)	≤47	>47-54	>54-59	>59-68	>68
	FFMC	≤87	>87-90	>90-91	>91-93	>93
	DMC	≤20	>20-32	>32-50	>50-54	>54
	ISI	≤4	>4-6	>6-8	>8-10	>10
	FWI	≤7	>7-15	>15-19	>19-28	>28
Copper River Basin (AK12)	1400 Temp (˚F)	≤53	>53-59	>59-63	>63-68	>68
	FFMC	≤83	>83-88	>88-90	>90-92	>92
	DMC	≤10	>10-24	>24-33	>33-45	>45
	ISI	≤2	>2-4	>4-8	>8-10	>10
	FWI	≤5	>5-11	>11-15	>15-23	>23
East North Interior (AK02, AK03N)	1400 Temp (˚F)	≤54	>54-61	>61-66	>66-72	>72
	FFMC	≤87	>87-89	>89-91	>91-93	>93
	DMC	≤11	>11-26	>26-34	>34-40	>40
	ISI	≤4	>4-6	>6-8	>8-11	>11
	FWI	≤7	>7-13	>13-22	>22-27	>27
West Coast (AK04, AK06, AK08, AK10)	1400 Temp (˚F)	≤41	>41-44	>44-48	>48-63	>63
	FFMC	≤81	>81-84	>84-87	>87-89	>89
	DMC	≤6	>6-9	>9-14	>14-18	>18
	ISI	≤2	>2-4	>4-6	>6-8	>8
	FWI	≤2	>2-4	>4-10	>10-18	>18
Southcentral (AK11, AK13, AK14)	1400 Temp (˚F)	≤48	>48-51	>51-53	>53-58	>58
	FFMC	≤83	>83-85	>85-87	>87-89	>89
	DMC	≤13	>13-19	>19-26	>26-58	>58
	ISI	≤3	>3-4	>4-6	>6-8	>8
	FWI	≤6	>6-13	>13-19	>19-23	>23

In 2024 the ASR – Spring Adjective class thresholds (**Table 3**) were re-analyzed using MODIS/VIIRS Days[6] and fire occurrence (from April 1 – May 31). While there was a modest improvement in the conditional frequency analysis (likelihood of fire events) there was a significant improvement in reaching the targeted percentiles per adjective class level. In addition, the analysis resulted in a simplification of the criteria for each adjective class. Use of the new criteria no longer incorporates the GAR adjectives classes as inputs into the Low, Moderate or High ASR-Spring classes. See **Appendix F** (**Figures 31-32)** and **Appendix I** for additional information regarding the results of the analysis.

4. Lightning Ignition Discovery Days Analysis

In Alaska, the occurrence of lightning-caused ignitions alone is not a useful analysis tool. Existing ignition datasets tend to have errors in start dates due to the size of Alaska and lack of observations. Though VIIRS detections are improving this dataset, they can't identify the heat signatures from low intensity fires, such as some tundra fires.

There have been continual upgrades to the Alaska Lightning Detection System (ALDS) operated by BLM AFS. The largest upgrade occurred in 2012 when the system switched from Vaisala to Time of Arrival (TOA). This upgrade led to changes in hardware as well as the algorithms used to differentiate strokes and flashes. A 2012 lightning analysis showed that the TOA system observed 30% more lightning strikes than the previous system. We currently do not have a reliable way to predict lightning fire occurrence on a day-to-day basis.

C. Fire Growth Analyses

Traditional fire danger analysis has been based on Ignition Days and ignores subsequent growth days. Analyses based on fire occurrence statistics alone do not consider days of significant growth beyond Ignition Day nor the factors that are responsible for this growth.

Area burned in Alaska is much less dependent on weather and fuel flammability conditions on the day fires start because many natural starts in the limited management option are not initially suppressed and have opportunity to grow on subsequent days.

Since 2004, Alaska fire managers have been monitoring the daily frequency and location of MODIS and more recently VIIRS active fire detects to evaluate day-to-day variability in fire growth for individual fires. These data provide the basis for fire growth analyses that more thoroughly explain the Alaska fire situation than occurrence analysis alone.

The methodology used for fire growth analyses included:

- Defining an analysis area (FDRA).
- Analyzing a period of historical fire danger rating indices.
- Developing thresholds based on conditional frequency[7] (i.e., likelihood) of historic fire occurrence (fire counts and Ignition Days) and historic fire growth events and size (MODIS Active Fire counts and Active Fire days) related to the indices.

[6] A day (24-hr period) that at least one MODIS or VIIRS heat detect occurred.
[7] Number of days a fire ignition occurred while a fire danger parameter was met divided by the total number of days a fire danger parameter was met.

Fire danger rating thresholds based on this methodology predict fire growth as well as occurrence and produce a comparative likelihood of fire activity or growth. This comparative frequency analysis minimizes the occurrence of false positive and negative indications that the thresholds produce.

Figure 22 shows a comparison of average daily heat detects between MODIS and VIIRS satellite data. The MODIS satellites, Terra and Aqua, which have provided heat detections for decades, have exceeded their anticipated lifespan. VIIRS heat detects became available in the 2012 fire season. With its higher resolution, VIIRS data shows a higher average number of daily heat detects but the overall pattern is very similar to MODIS. This plan spans the MODIS and VIIRS data eras. MODIS is primarily used in this plan as it spans a full 20-year period for climatology. Future revisions will move to more robust VIIRS analyses, which will have 20 years of data by 2031.

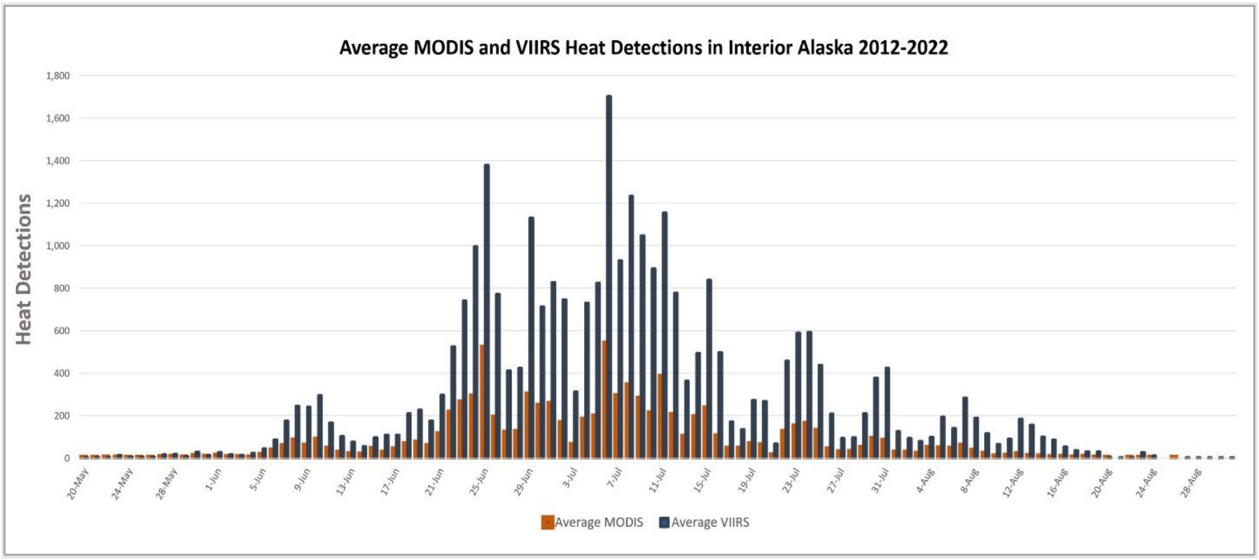


Figure 22: Average daily number of MODIS heat detections compared to VIIRS heat detections in Alaska from mid-May through August 2012 – 2022.

Figure 23 demonstrates the high degree of correlation between VIIRS and MODIS active fire detections and the reported area burned in Alaska over 11 and 18-year periods, respectively. These data have explicit locations (latitude/longitude) and date/times that provide details about fire growth events not otherwise available. Further, the heat detects database is substantial with over 257,000 individual records that can be associated with current weather conditions and fuel flammability over the analysis period and FRDAs.

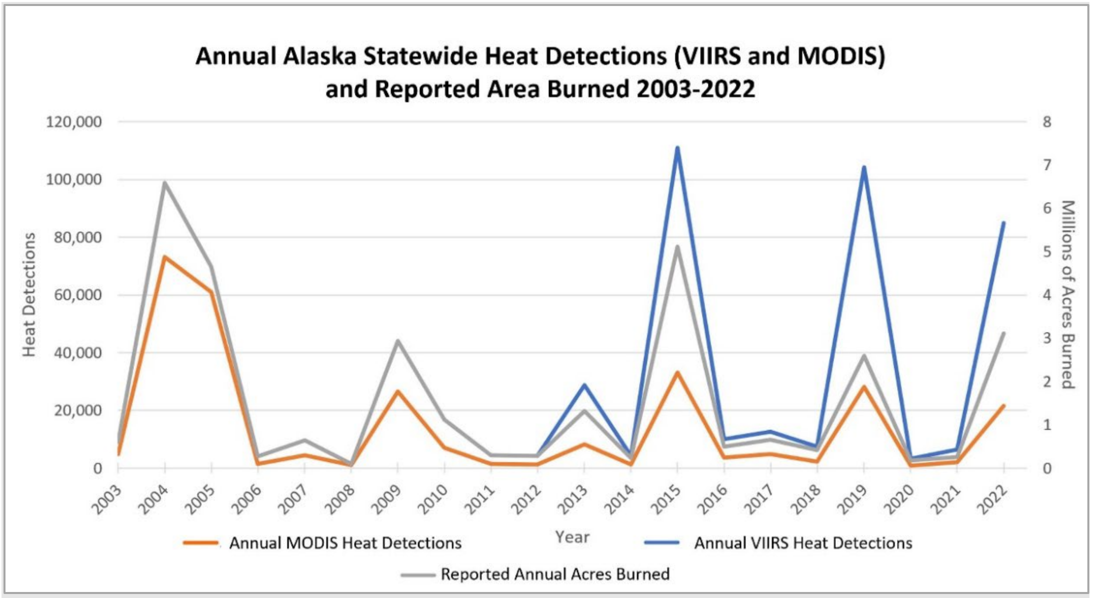


Figure 23: Annual MODIS and VIIRS heat detections and reported area burned in Alaska from 2003-2022.

The Geographic Information Network of Alaska (GINA) provides direct broadcast fire detection data in near-real time (approximately 30-minute latency) for operational use in Alaska. However, the data source for the reprocessed historic MODIS dataset used for this analysis is provided by the NASA Fire Information for Resource Management System (FIRMS).

1. Fire Growth Seasonality

The MODIS heat detections analyzed above provide an insight into the total area burned in any given year over the recent two-decade period. When these MODIS active fire detections are compared with the reported acreage burned and displayed as an average of all twenty fire seasons **(Figure 24)**, a strong correlation can be observed between the two data sources, especially in peak fire season. Both data sources show that the most acres burn between mid-June and mid-July.

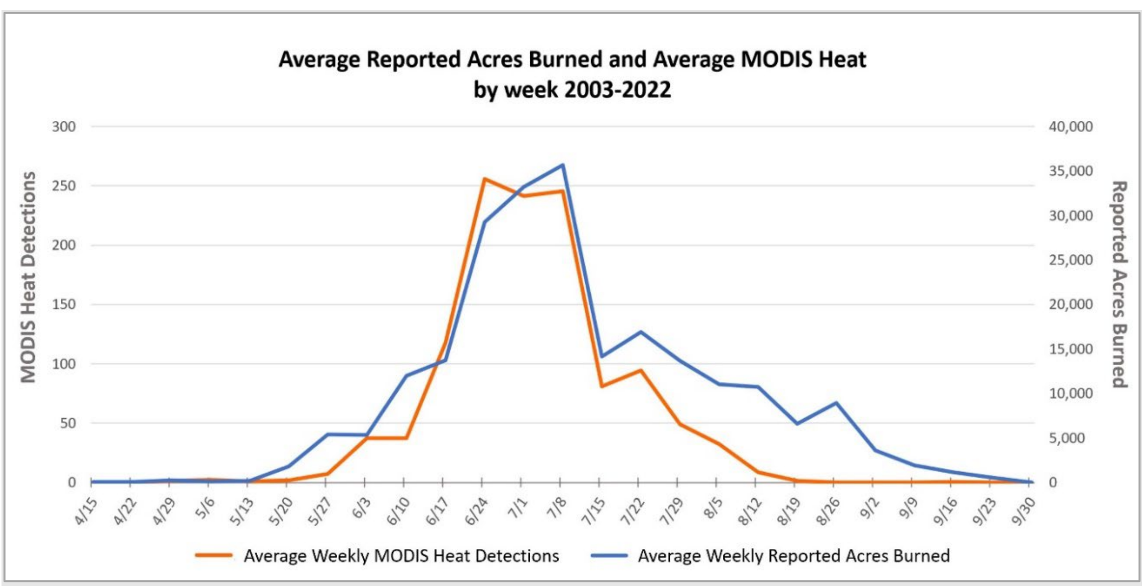


Figure 24: Average reported acres burned and average MODIS detections by week in Alaska from 2003-2022.

Not only does **Figure 24** show that satellite heat detects can be used to represent fire growth, but the curve charts a pattern for the average fire season in Alaska in terms of acreage burned. Though any given fire season is rarely 'average', a few observations and assumptions can be made based on this averaged seasonal fire growth:

In general:

- After snow-free, when continuous fine fuels are available to burn, the rate of spread can be fast. Depending on availability of deeper fuels layers, fires that are not suppressed may tend to extinguish overnight, or they may persist. Aggressive initial attack is effective at limiting early season fire growth.
- Lightning potential begins to increase in late May, and major increases in potential can come in mid to late-June with the transition to deeper fuel availability in the Duff-Driven Stage. The increase in acres burned is due to the increase in lightning-cause ignitions and drying subsurface fuels that contribute to large fire growth in combination with limited fire suppression activities. The Duff-Driven Stage is normally the peak activity of the Alaska fire season. If weather conditions are conducive to support fire growth, fires tend to grow episodically with large growth occurring in black spruce.
- The decline in growth rates shown at the end of July corresponds to an increased occurrence and significance of widespread precipitation events and associated dampening of mid and deeper duff fuels. Most years, southwest flow through the interior of Alaska is the physical mechanism for this increase in moisture.

The fire occurrence and fire growth information described above are combined with weather conditions and fire danger indices to produce a set of meaningful thresholds and criteria as described below, to inform both planning and decision-making.

2. Spruce Adjective Rating

Since much of the area burned in Alaska occurs during the Duff-Driven Stage in the Interior boreal forest (dominated by black spruce), focus over the years has been on rating fire potential based on these conditions. The Spruce Adjective Rating (SAR) was developed in part from an analysis that was conducted for the period from 2001-2013 in preparation for a paper presented at The Fire and Forest Meteorology Symposium in 2015. Its conclusions can effectively be applied to forested regions throughout the state.

*The **Spruce Adjective Rating (SAR)** provides a rating of the potential for large fire growth in black spruce dominated fuel types.*

The criteria shown in **Table 4** represent the combination of current and cumulative conditions as a 5-class danger rating. These ratings are produced for each surface weather observation location where FWI codes and indices are calculated. They are provided as gridded data on AKFF.

- The primary criteria are FFMC and BUI, with individual thresholds drawn from the Fire Weather Index thresholds.
- Temperature criteria suggest elevated potential for significant fire growth when cumulative drying, as represented by BUI, is at lower levels.
- FWI criteria are used to distinguish the most significant days of extreme fire growth potential.

Table 4: Spruce Adjective Rating Criteria

<table>
<tr><th>Spruce (Summer)</th><th>BUI < 40</th><th>BUI ≥ 40 but < 60</th><th>BUI ≥ 60 but < 90</th><th>BUI ≥ 90 but < 110</th><th>BUI ≥ 110</th></tr>
<tr><td>FFMC < 80</td><td rowspan="4">LOW</td><td rowspan="3">LOW</td><td rowspan="3">LOW</td><td rowspan="2">LOW</td><td>LOW</td></tr>
<tr><td>FFMC ≥ 80 but < 82</td><td rowspan="2">MODERATE</td></tr>
<tr><td>FFMC ≥ 82 but < 84</td><td rowspan="2">MODERATE</td></tr>
<tr><td>FFMC ≥ 84 but < 86</td><td rowspan="2">MODERATE</td><td>MODERATE</td><td rowspan="2">HIGH</td></tr>
<tr><td>FFMC ≥ 86 but < 89</td><td>MODERATE</td><td rowspan="2">HIGH</td><td>HIGH</td></tr>
<tr><td>FFMC ≥ 89 but < 90</td><td rowspan="5">HIGH</td><td rowspan="4">HIGH</td><td rowspan="2">VERY HIGH</td><td rowspan="2">VERY HIGH</td></tr>
<tr><td>FFMC ≥ 90 but < 92</td><td rowspan="2">VERY HIGH</td></tr>
<tr><td>FFMC ≥ 92 but < 93</td><td rowspan="3">VERY HIGH if FWI < 36</td><td rowspan="3">VERY HIGH if FWI < 28</td></tr>
<tr><td>FFMC ≥ 93 <u>and</u> Temp < 75°F</td><td rowspan="2">VERY HIGH if FWI < 36</td></tr>
<tr><td>FFMC ≥ 93 <u>and</u> Temp ≥ 75°F but < 80°F</td><td rowspan="2">VERY HIGH if FWI < 40</td></tr>
<tr><td rowspan="2">FFMC ≥ 93 <u>and</u> Temp ≥ 80°F</td><td>VERY HIGH if FWI < 40</td><td rowspan="2">EXTREME if FWI ≥ 36</td><td rowspan="2">EXTREME if FWI ≥ 36</td><td rowspan="2">EXTREME if FWI ≥ 28</td></tr>
<tr><td>EXTREME if FWI ≥ 40</td><td>EXTREME if FWI ≥ 40</td></tr>
</table>

In 2024, an updated validation analysis was completed for SAR adjective classes using conditional frequencies. Conditional frequencies were calculated utilizing fire occurrence (2002-2022), VIIRS Days and VIIRS Detections (2012-2022) and MODIS Days and MODIS Detections (2002-2022). The validation analysis indicates that the SAR continues to work well as an adjective class system, including outside interior boreal forest FDRAs, particularly in identifying the conditions that support a high magnitude of fire growth. See **Appendix G** (**Figures 34-37)** and **Appendix I** for additional information regarding the results of the analysis.

D. Fire Occurrence and Growth Analysis

1. Alaska Sub-Region Summer Adjective Class Rating

While much of the area burned in Alaska occurs during the Duff-Driven Stage in the Interior boreal forest (dominated by black spruce), there are fires that occur annually outside of the Interior, including during and after the Duff-Driven Stage. The ASR – Summer expands the rating system to incorporate vegetation systems throughout Alaska from the Duff-Driven Stage to the end of September. The ASR – Summer can effectively be applied to forested and non-forested regions throughout the state.

*The **ASR – Summer** provides a rating of the potential for ignition and large fire growth days in forested and non-forested fuel types from June 1 through September 30.*

a) ASR – Summer Inputs

The ASR – Summer is customized to eight Alaska Sub-Region Class Areas (see Chapter II.B. and **Figure 15** for more details on ASR Adjective Class Areas). The variables and threshold criteria for each ASR Class Area are largely based on a best fit (conditional frequency) analysis of fire history records. The following three variable combinations were selected:

- 1400 Temperature as it suggests potential for elevated ignitions and significant fire growth.
- DMC or BUI as a proxy for short term drought conditions (increasing available fuel bed), conditions that include increased potential for fire persistence after ignition and potential for significant fire growth at elevated levels.
- FFMC or FWI as it suggests ignition potential.

b) Methodology Used to Develop the ASR - Summer

The ASR – Summer was designed to illustrate regionally specific normal and departure from normal fire conditions from June 1 through September 30 using standardized percentiles for each adjective class. The target percentage of weather/CFFDRS observations for each class is as follows: Low = 50% (0 - 50th percentile); Moderate = 25% (50 - 75th percentile); High = 15% (75 - 90th percentile); Very High = 7% (90 - 97th percentile); Extreme = 3% (97 - 100th percentile).

Adjective class thresholds **(Table 5)** were developed for each Alaska Sub-Region Adjective Class Area by analyzing MODIS Days, MODIS Detections/Day, VIIRS Days, VIIRS Detections/Day and Fire Occurrence. The adjective class thresholds apply to all FRDAs within that ASR Class Area. The **lowest** ranking temperature or CFFDRS variable establishes the ASR – Summer Adjective Class Rating for that observation location.

For instance, using **Table 5**, assume a station in the North Slope ASR Class Area has a forecasted 1400 Temperature of 67˚F (Extreme), DMC of 25 (Very High) and FWI of 6 (High). The lowest ranking variable is the FWI at High. Therefore, the forecasted ASR-Summer Adjective Class Rating for that day is High.

Table 5: ASR - Summer Adjective Rating Criteria. Select the Adjective Class of the lowest rated variable in the ASR Class Area to represent the overall ASR-Summer Adjective Class Rating.

ASR - Summer Adjective Class Rating						
ASR Adjective Class Rating Areas (FDRAs)	**Temp/CFFDRS Variables**	**Low**	**Moderate**	**High**	**Very High**	**Ext**
North Slope (AK00)	1400 Temp (˚F)	≤39	>39-50	>50-61	>61-65	>65
	DMC	≤6	>6-9	>9-18	>18 -28	>28
	FWI	≤1	>1-4	>4-6	>6-19	>19
Central West Interior (AK03S, AK05, AK07, AK09)	1400 Temp (˚F)	≤50	>50-57	>57-65	>65-69	>69
	DMC	≤11	>11-26	>26-38	>38 -73	>73
	FWI	≤1	>1-5	>5-15	>15-17	>17
Southeast and Kodiak (AK15, AK16, AK17, AK18)	1400 Temp (˚F)	≤47	>47-57	>57-62	>62-63	>63
	DMC	≤4	>4-9	>9-13	>13-26	>26
	FWI	≤1	>1-3	>3-9	>9-16	>16
Tanana Valley (AK01E, AK01W)	1400 Temp (˚F)	≤45	>45-55	>55-65	>65-73	>73
	BUI	≤32	>32-46	>46-71	>71-88	>88
	FWI	≤2	>2-12	>12-17	>17-24	>24
Copper River Basin (AK12)	1400 Temp (˚F)	≤55	>55-59	>59-66	>66-74	>74
	BUI	≤24	>24-43	>43-71	>71-90	>90
	FWI	≤2	>2-11	>11-17	>17-22	>22
East North Interior (AK02, AK03N)	1400 Temp (˚F)	≤48	>48-59	>59-67	>67-73	>73
	FFMC	≤60	>60-85	>85-87	>87-90	>90
	DMC	≤33	>33-53	>53-78	>78-106	>106
West Coast (AK04, AK06, AK08, AK10)	1400 Temp (˚F)	≤44	>44-53	>53-59	>59-62	>62
	FFMC	≤30	>30-71	>71-84	>84-87	>87
	DMC	≤11	>11-19	>19-30	>30-54	>54
Southcentral (AK11, AK13, AK14)	1400 Temp (˚F)	≤51	>51-58	>58-62	>62-67	>67
	FFMC	≤64	>64-67	>67-87	>87-89	>89
	DMC	≤16	>16-36	>36-50	>50-79	>79

In 2024 the ASR - Summer Adjective threshold analysis using conditional frequencies was completed. Results utilizing fire occurrence, VIIRS Days and MODIS Days conditional frequency analysis indicated a significant improvement compared to the original threshold analysis therefore the thresholds for the ASR-Summer Adjective were updated **(Table 5)**. See **Appendix H** (**Figures 38-42)** and **Appendix I** for additional information regarding the results of the analysis.

E. Analysis Summary of Fire Danger Adjective Ratings

In summary, the AIFDOP utilizes CFFDRS indices and weather parameters with five breakpoints (i.e., classes) to determine preparedness levels and adjective class ratings. Additionally, other factors such as the 7-day outlook, lightning activity, fire activity, etc. will inform preparedness and staffing levels. A combination of climatological breakpoints and fire business thresholds were considered when determining breakpoints for the ASR - Spring and ASR – Summer Adjective Class Ratings, whereas fire business thresholds only were considered for the Grass and Spruce Adjective Ratings.

The AIFDOP does not identify one method or criteria for informing decision tools, rather it identifies several adjective class rating systems (e.g., GAR, ASR-Spring, SAR, and ASR-Summer) and their applicability as identified in **Table 6**. These adjective class rating systems are not intended to replace other existing decision support tools. Instead, they offer optional decision tools that are applicable to all fire organizations in the state. All adjective ratings are currently calculated from forecasts in AKFF and are available in grid, station, and tabular formats statewide.

Table 6: Comparison of adjective class ratings systems used in Alaska.

	GAR	ASR-Spring	SAR	ASR-Summer
Purpose	Designed to categorize fire ignition and fire spread potential from snow free through green-up.	Provides a rating of the potential for ignition and spread potential in forested and non-forested fuel types from snow free (estimated April 1) to green-up (estimated May 31).	Provides a rating of the potential for large fire growth in black spruce dominated fuel types.	Provides a rating of the potential for ignition and large fire growth days in forested and non-forested fuel types from June 1 through September 30.
Analysis Type	Occurrence	Occurrence and growth	Growth	Occurrence and growth
FRDA Applicability	All FDRAs – primarily designed for use in grassy fuel types. **Note:** Consider use in FDRAs that are predominately tundra (e.g., AK04, AK06, AK08) outside of snow free to green-up.	All FRDAs	AK01E, AK01W, AK02, AK03N, AK03S, AK05, AK07, AK09 (primarily Boreal Interior Forest.) **Note:** While this adjective has the most applicability in the boreal forest, the Spruce Adjective Rating is an effective tool in most FRDAs.	All FRDAs
Seasonality	Snow free to green-up (approx. April 1 – May 31) Potentially useful in tundra throughout the fire season and non-tundra areas after leaf-off.	Snow free to green-up (approx. April 1- May 31)	Post green-up (approx. June 1) through August / September	Post green-up (June 1) through September 30
Indices	FFMC, ISI and FWI	Temp, FFMC, DMC, ISI and FWI	Temp, FFMC, BUI and FWI	Varies by FDRA, but includes Temp, FFMC, DMC, BUI and FWI
Current Use	DOF for initial attack staffing, burn permit administration, and fire restrictions.	NPS to help determine local unit preparedness levels, inform fire restrictions and in severity requests. Used in combination with lightning forecast and red flag warnings.		NPS to help determine local unit preparedness levels, inform fire restrictions and in severity requests. Used in combination with lightning forecast and red flag warnings.

F. Fire Slowing Criteria

Weather events that temporarily slow or stop fires produce decision challenges for fire managers. Rain events do not always end fire growth, and the effects may only be temporary. A Fire Ending Event Workshop was held in 2008 and defined a fire ending event as a 5-day period with 0.50 inches of rain and precipitation duration of 25 hours, and the average mean RH over 50%. This metric is not very easily verifiable for field or office personnel. The Tactical Incident Analysis Tool **(Table 7)** is meant to be easily usable by field personnel and fire managers. It attempts to give a common operating picture for personnel to compare fuel conditions and rain event characteristics and their implications for staffing levels and long-term fire strategy.

Table 7 is an attempt to combine three factors and predict when a fire may become active again.

- BUI is used to summarize fuel dryness preceding a rain event.
- The amount of precipitation over 72 hours categorizes the weather event.
- A temperature of 70 degrees and 30% RH was used as an average forecast to predict the days needed for fuels to dry to burnable conditions.

The resultant drying days may also differ depending on the phase of the fire season that the rain event occurs. During the early part of the fire season (Wind-Driven Stage), shorter duration events will have greater effect on fire activity, though dormant fuels will dry quickly. During the peak of fire season (Duff-Driven Stage), the upper layers of duff are the main drivers of fire spread. This layer is less affected by rain than surface fuels but also needs longer to dry before it is burnable.

Table 7: Tactical Analysis Tool – Drying Days.

Buildup Index vs. 72 Hour Precipitation	Greater than 1.5" Precipitation over 72 Hours	Between .75" and 1.5" Precipitation over 72 Hours	Less than .75" Precipitation over 72 Hours
Low BUI	**9-11 Days**	**7-9 Days**	**7-9 Days**
Moderate BUI	**7-9 Days**	**5-7 Days**	**4-6 Days**
High BUI	**7-9 Days**	**4-6 Days**	**2-4 Days**
Extreme BUI	**5-7 Days**	**3-5 Days**	**1-3 Days**

Table 7 results represent waiting time (i.e., drying days) from the end of rain event to when fuels will dry out enough to burn. It is a guideline that estimates drying based on the number of days reaching a maximum temperature of 70°F and minimum relative humidity of 30% after the rain event. If the weather following the rain event is warmer than 70°F and drier than 30% humidity, the number of days for the fuels to reach burnable conditions will be less. Conversely, if the temperatures are cooler and the humidity is higher, the numbers of days needed for drying may be more. The Tactical Analysis Tool drying days are now automatically calculated daily and available spatially through the AICC ArcGIS Map and Feature Services and the Alaska Wildland Fire Operations NIFC WebApp (password required).

A common question is how to determine whether fire growth has stopped or just temporarily slowed. Large fire growth has been correlated with FFMC values above 88 and BUI above 80. The time it takes for indices to rebound to burnable levels is the combination of three factors:

- **Antecedent Conditions**: How dry were the fuels before the rain event? FFMC is a measure of short-term dryness of surface fuels and reacts very quickly to precipitation. BUI is a measure of dryness in layers of duff below the surface. These lower duff layers are where fire is sheltered from rain. BUI dryness before precipitation dictates how soon after the fuels are burnable.
- **Amount and Duration of Rain**: All three moisture codes in the Canadian system (FFMC, DMC, DC) are affected by different thresholds of rain. FFMC drops quite quickly and does not need much rain to decline. DMC and DC, the two codes that make up BUI, need greater amounts of rain to decrease. The combination of larger rain amounts spread out over long time periods has the greatest effect on these values. Rain of short duration or less than .11 inches does not penetrate deeper duff enough to counteract seasonal drying.
- **Forecast Weather**: Weather following the rain event will affect how much drying the fuels need to become burnable. Tactical decisions are normally revisited after rain events to reassess tactics, staffing levels, and assess values threatened by fire spread. Each weather station on AKFF provides a three-day weather forecast that is updated every afternoon. A longer term seven-day forecast is available for each FDRA. These two products, coupled with weather forecasts, can help determine the near-term outlook.

This analysis provides users with a helpful tool for determining potential for future fire growth. However, variations in fuels and conditions necessitate a carefully thought-out process for each fire and each fire season. Staff at AICC Predictive Services welcome thoughts and observations and are always willing to provide consultation and information on upcoming weather and its subsequent effect on fuels.

G. Seasonality of Alaska FDRAs

Seasonal charts for each FDRA **(Appendix L: Alaska FDRA Seasonality Charts)** provide historical ranges for BUI, Average BUI, and MODIS detections by week, framed around the four stages of the Alaska fire season (see Chapter I.F.; i.e., wind-driven, duff-driven, drought-driven, and diurnal-limited) and two historically significant fire seasons for the FDRA. Tracking seasonal progression will help place the current fire season in a well referenced historical context.

Term files for each FDRA were created using available weather stations with at least ten years of data. Each FDRA was analyzed for historical dates when the BUI fell below 80 and did not recover for the rest of the season. This criterion was used based on growth day analysis conducted in 2015. When the BUI did not fall below 80 later in each fire season, an additional criterion, the FFMC falling below 88, was used to simulate the shortening days during the Diurnal-Limited Stage of fire season, which limits the ability of fuels to support fire spread during short autumn days. Though the FFMC is not a long-term indicator of drought, when used in conjunction with the BUI at this time of year, it helps simulate the diminishing daylight and dropping temperatures. This will limit fire growth despite very dry deeper fuels. Therefore, targeting the time frame where the FFMC stays below 88 recognizes that the shorter, cooler days will limit fire spread.

These dates were then broken out into percentiles and presented in a table with the fire season stage beneath each FDRA graph to compare the current BUI values to historic averages in relation to historic MODIS fire detection counts.

Available long-term weather data, the number of RAWS stations, and correlations made to BUI are stronger in the Interior Boreal Forest of Alaska than on the west coast in the tundra fuel types. As more data becomes available, analyses will continue to track fire season trends and update findings as necessary.

IV. Fire Danger-Based Decisions and Tools

A. Staffing Level

1. Staffing Plans

Staffing plans describe actions to be taken by units to ensure adequate response capability as fire danger escalates. Mitigating actions are designed to enhance the unit's fire management capability during short periods (one burning period, Fourth of July, or other pre-identified events) where normal staffing cannot meet initial attack, prevention, or detection needs. The decision points identified and documented in the Fire Danger Analyses chapter of the AIFDOP may be implemented by local staffing plans. It is the responsibility of each unit to communicate their staffing plans with the applicable Protecting Agencies and/or Jurisdictional Agencies. Existing unit staffing plans and associated decisions and planned actions include:

- BLM Alaska Fire Service – Combined Zone Staffing/Step Up Plan
- BLM Alaska Fire Service – Western Coastal Galena Zone Staffing Plan
- Fairbanks Area Staffing and Action Plan
- Delta Area Staffing and Action Plan
- Tok Area Staffing and Action Plan
- Mat-Su Staffing and Action Plan
- Kenai-Kodiak Staffing and Action Plan
- Copper River Staffing and Action Plan
- Southwest Alaska Staffing and Action Plan
- Bering Land Bridge NP Staffing Plan
- Denali NP&P Staffing Plan
- Katmai NP&P Staffing Plan
- Lake Clark NP&P Staffing Plan
- Western Arctic NP Staffing Plan
- Wrangell -St. Elias NP&P Staffing Plan
- Yukon-Charley Rivers NP Staffing Plan
- Chugach National Forest Preparedness Plan
- Tongass National Forest Preparedness Plan
- Alaska Region Fire Duty Officer Guide and Preparedness Plan (FWS)

B. Preparedness Level

1. Preparedness Plans

Preparedness plans provide management direction given identified levels of burning conditions, fire activity, and resource commitment, and are required at national, state/regional, and local levels. Preparedness Levels (1-5) are determined by incremental measures of burning conditions, fire activity, and resource commitment. Fire danger rating is a critical measure of burning conditions.

The National Fire Preparedness Plan is included in Chapter 10 of the National Interagency Standards for Resource Mobilization. The Alaska Preparedness Plan is included in Chapter 10 of the Alaska Interagency

Standards for Resource Mobilization. Current breakpoints for statewide preparedness levels are identified in that document.

An automated Statewide Preparedness Level (PL) Tool, incorporating the Spruce Adjective Rating, Resource Availability, Seven-Day Fire Potential, and current fire activity, remains under development by AICC Predictive Services. It was tested in 2021 and 2022 and shows a fair depiction of Preparedness Level as conditions increase. The downward trend of Preparedness Level as the season wanes has proven difficult to capture in the Tool. Testing and modifications will continue for the 2024 season.

In addition, some jurisdictional units have developed local preparedness plans. Most of the plans tier from the Alaska Statewide Preparedness Plan. Contact local units for their current plans.

2. Prevention Plans

Prevention plans are a Jurisdictional Agency responsibility. They document the wildfire problems identified by a prevention analysis. These plans examine human-caused fires, as well as the risks, hazards, and values for the planning unit. Components of the plan include mitigation (actions initiated to reduce impacts of wildland fire to communities), prevention of unwanted human-caused fires, education (facilitating and promoting awareness and understanding of wildland fire), enforcement (actions necessary to establish and carry out regulations, restrictions, and closures), and administration of the prevention program.

Fire danger breakpoints that may be used to inform prevention plans are identified and documented in Chapter III. Fire Danger Analyses of the AIFDOP. Some jurisdictional units have developed local prevention plans. Contact local units for their current plans.

3. Restriction Plans

A Restriction Plan is a document that outlines coordination efforts regarding fire restrictions and closures. An interagency approach for initiating restrictions or closures helps provide consistency among the land management partners while defining the restriction boundaries so they are easily distinguishable to the public. Based on fire danger, managers may impose fire restrictions or emergency closures to public lands. Public use restrictions are a jurisdictional responsibility. It is recognized that jurisdictional agencies have varying authorities, terminology, and processes for issuing burn restrictions, suspensions, and/or closures.

The Alaska DOF burn permit program restricts open burning based on fire danger criteria. The US Army has a restrictions program related to their training activities. Restrictions and closure processes for other agencies can be found on the ADEC Alaska Fire Restrictions webpage or their specific agency fire program websites . The ADEC webpage was developed by the AWFCG Wildland Fire Prevention and Education Committee to communicate authorities and any existing restrictions. Decision points for when additional restrictions and/or closures are put in place are often subject to additional discretionary criteria and are not currently referenced in the AIFDOP.

C. Response (or Dispatch) Level Plans

1. Initial Response Plan

Initial response plans, also referred to as run cards or pre-planned response plans, specify the fire management response (i.e., number and type of suppression assets to respond) within a defined geographic area to an unplanned ignition. Responses are based on fire weather, fuel conditions, fire management objectives, and resource availability. The geographic scale and type of initial response in Alaska does not lend itself to a traditional run card approach. Smokejumpers may be dispatched to a broad area across the state, often with little information on the size, status, fire potential, or specific values threatened by a fire. The AIWFMP provides statewide initial response direction including Fire Management Options based on a broad scale assessment of values independent of jurisdictional boundaries. Initial response to a wildfire is based on various factors including:

- Firefighter safety (considerations include site condition, location, surrounding vegetation, and presence of hazardous materials)
- Values at risk
- Jurisdictional land management direction
- Fire Management Option at point of origin
- Probability of success
- Availability and prioritization of firefighting resources
- Analysis of the overall statewide situation including time of season and available resources

Alaska fire management agencies recognize the differences in missions among local, state, tribal, and federal agencies and have collaborated to develop wildfire management options that consider a full spectrum of responses to wildfire, from suppression actions designed to contain and control fire growth, to periodic surveillance of fires that can spread naturally across the landscape.

Fire management options are selected by Jurisdictional Agencies based upon legal mandates, policies, regulations, resource management objectives, and local conditions, including but not limited to population density, environmental factors, and identified values. Management options are assigned at a landscape scale and apply across jurisdictional boundaries. Ideally, boundaries are readily identifiable from both the air and ground; are based on fuel types, access, topographic features, natural barriers, and fire regimes; and can be feasibly defended. Management option designations are intended to be flexible to respond to changes in objectives, fire conditions, land-use patterns, resource information, and technologies. Jurisdictional Agencies are responsible for updating and reviewing management options and site designations annually. Management options may only be changed with the approval of all affected Jurisdictional Agencies. Non-standard responses may be implemented on specific incidents with Jurisdictional and Protecting Agency concurrence.

Four fire management options are defined in the AIWFMP; Critical, Full, Modified, and Limited **(Figure 25).** These options are employed statewide by federal and state agencies, and Alaska Native groups to:

- Prioritize areas for protection actions and for the allocation of available firefighting resources to achieve protection objectives.
- Optimize the ability to achieve land use and resource management objectives, and to integrate fire management, mission objectives, land use, and natural resource goals.
- Reinforce the premise that the cost of suppression efforts should be commensurate with the values identified for protection.

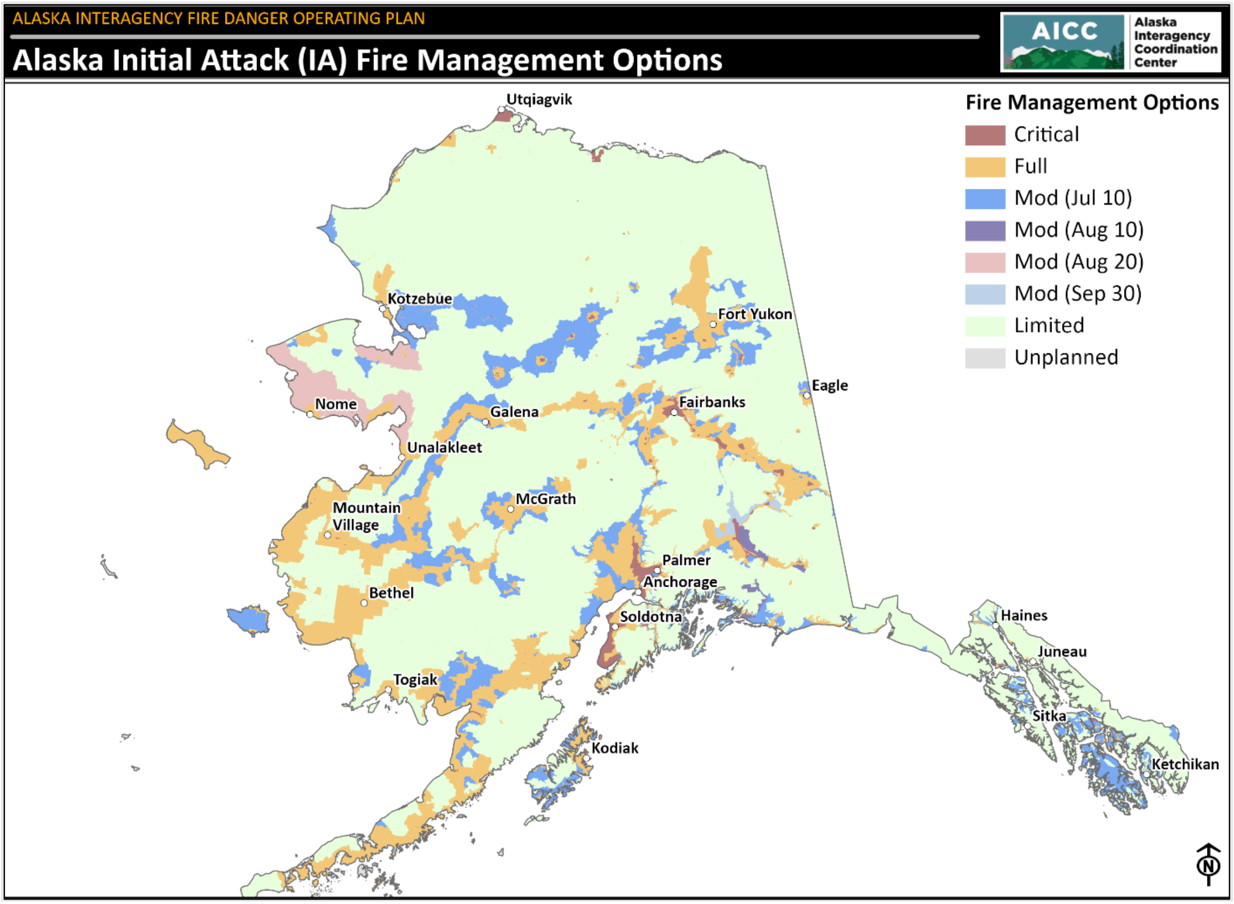


Figure 25: AIWFMP Fire Management Options.

For all fire management options, management decisions beyond initial response should be assessed situationally by the Protecting Agency and the affected Jurisdictional Agencies. If the pre-designated response is no longer appropriate or has a low probability of success, a decision support process (including situational assessment and risk analysis) will be used to develop incident-specific objectives, requirements, and courses of action, and to document the rationale behind them.

Currently, the only formal consideration of fire danger in the fire management options is reflected in the Modified Option Conversion Date **(Chapter IV.D.)**. Likely most fire managers are informing their decisions as to a standard or non-standard response based on many things including current and forecast indices from the AKFF website.

2. Standards for Resource Mobilization

Standards for Resource Mobilization identify standard procedures used by federal, state, and local organizations for activating, assembling, and transporting resources to respond to or support an incident. These Standards are intended to facilitate interagency dispatch coordination and ensure the timeliest and most cost-effective incident support services available are provided. Communication and cooperation between Units, Geographic Area Coordination Centers, State and Regional Offices, and other cooperative agencies are addressed.

The National Interagency Standards for Resource Mobilization and the Alaska Interagency Standards for Resource Mobilization can be accessed from the AICC website.

D. AIWFMP Modified Conversion Date

The Conversion Date is when AWFCG votes to convert approximately 46 million acres of Modified Option areas to Limited (AIWFMP 3.2.2.3 Modified Fire Management Option). The initial assumption was that fires starting in Modified after July 10 would have less chance to spread and impact values at risk as fire growth potential diminishes. Based on a record of Conversion Dates from 1995 to the present, July 10 is the most utilized date for Conversion **(See Appendix E: Historical Modified Conversion Dates)**. July 10 is commonly referred to as the Conversion Date, but that is an oversimplification. July 10 is usually the first date when conversion of management options is considered. Before and after Modified Conversion has occurred, fire managers have the option of a non-standard response for any fire start based on current conditions. From the AIWFMP:

> "When establishing Modified Management Option areas, Jurisdictional Agencies assign a default conversion date for the area. The default conversion date for most Modified areas in Alaska is July 10. Some Modified areas have been assigned different default conversion dates based on local influences. The AWFCG reviews assigned conversion dates each season as they are approached and determines if conversion is appropriate based on local and statewide fire and weather conditions. The decision to convert may be made statewide, by a geographically defined area, or by administrative unit, and can be informed by Fire Danger Operating Plan (FDOP) analyses.
>
> A Jurisdictional Agency may request, through their AWFCG representative, that the AWFCG consider an earlier date during unusually wet fire seasons, or request postponement of the conversion date during unusually dry fire seasons. Requests must include a rationale and supporting data for the change as well as the opinions of all affected Jurisdictional Agencies. Protecting Agencies may facilitate this process. The rationale and supporting data will be included with the AWFCG decision record. If the conversion date is postponed, the AWFCG will re-evaluate at intervals no longer than 10-days until conversion takes place."

Over time, the Conversion Date has become associated with other fire management decisions. While these decisions sometimes quickly follow conversion, they are separate decisions. After the Conversion Date:

- The Alaska fire season is not over. New starts may have less potential for large growth events. Even though hot, dry weather is possible, it is less likely and usually lasts for shorter periods. The likelihood of wildfires threatening values located in Modified Option areas decreases.
- Resources are still needed to staff fires in Alaska. Once Conversion occurs, there is normally still fire on the landscape that needs to be managed. Resource needs may diminish, but there is usually still a need for on the ground personnel.
- Once the fire management needs are met in Alaska, resources are released to the assist other Geographic Areas. This process usually occurs around the Conversion Date but is considered throughout the Alaska fire season based on needs in Alaska and needs in on other areas.

Two things must be present for an extended fire season to occur: existing fire on the landscape or significant ignition after July 10 combined with the absence or delay of the usual August rains. Extended fire seasons occur regularly. Forecasting extended fire seasons is not currently reliable. A seasonal BUI forecast is being developed by researchers at UAF. See Chapter VI. Future Needs.

Since its implementation, there have been several analyses on the effectiveness of July 10 as the conversion date. Another analysis should be completed as climatology becomes more variable and the fire environment continues to shift.

V. Operational Procedures

A. Observation and Forecast Timing

The *Weather Guide for the Canadian Forest Fire Danger Rating System* calls for weather observations to be taken at solar noon, typically 1200 LST. However, this is complicated by the fact that most of Alaska is covered by a single time zone that spans more than 30 degrees of longitude.

The Alaska Time Zone is based on time at 150° W longitude. Solar noon at 150° W is at 2200 UTC or at 1400 AKDT. Reported observation time for all stations in Alaska is 1400 AKDT (or 1300 AKST, generally during the inactive season). The actual time of the daily FWI observation differs significantly from solar noon at each observation location. This is based on the time of solar noon along the longitude at the station location and the actual observation time for each station that can be up to 59 minutes and 50 seconds after the reported hour.

In an analysis of all active weather stations in the AKFF database, the number of minutes after 1400 AKDT that the observation is collected for each location is compared to the calculated solar noon for the longitude at the station location. The difference between those times was collected and averaged for stations in each FDRA to determine the average time after solar noon that the observations are taken. The results are graphed in **Figure 26.**

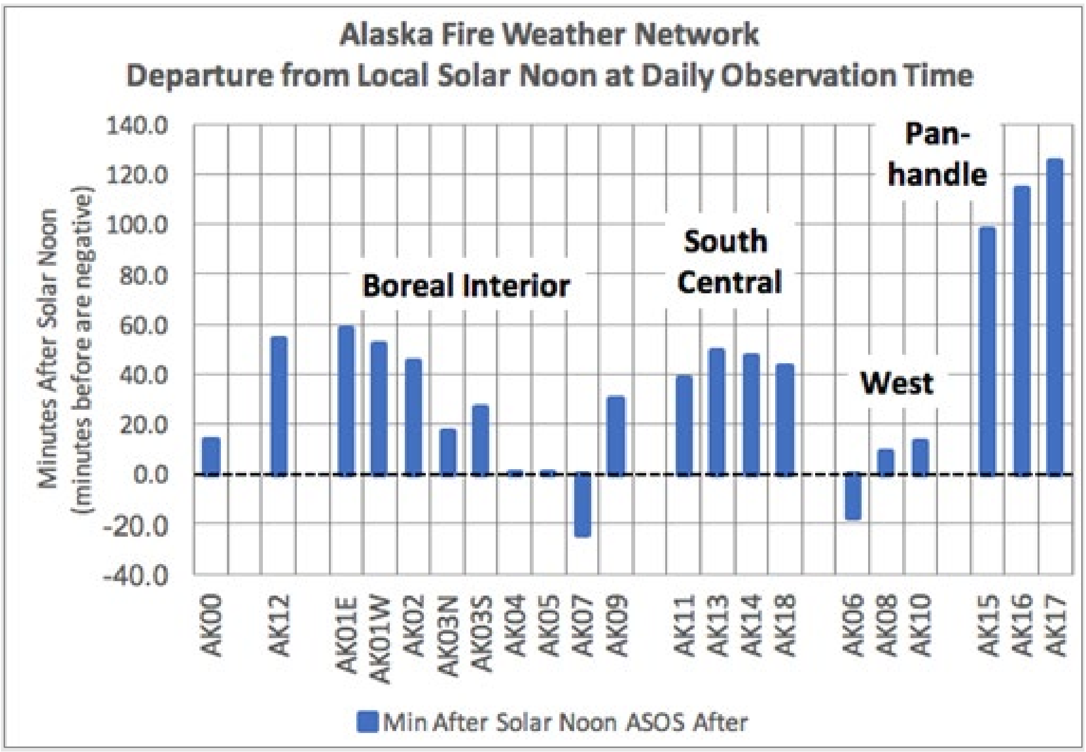


Figure 26: Departure from Solar Noon by FDRA.

As seen in the graph, average daily observation time, considering the longitude and reporting time factors, differs from FDRA to FDRA. Observations for the Boreal Interior and South-Central FDRAs, nearest 150° W, are generally about 40 minutes after solar noon. Western Alaska tundra FRDAs are most nearly at solar noon. FDRAs on the panhandle have observation times that are approaching 2 hours after solar noon.

The CFFDRS Weather Guide also recommends taking daily FWI observations up to two hours after solar noon at high latitudes to account for discrepancy in standard daily FFMC and to accurately account for daily peak fire danger conditions in places like Alaska. Overall, observation time patterns seem reasonable for most of the FDRAs shown here.

- Observations are collected by MesoWest and Synoptic Labs (MW/SL) through a variety of active push and pull procedures. These observations are made available to Synoptic Labs' Mesonet API as quickly as possible. Observations are associated with the date, hour, and minute that they are reported by the sensor.
- AKFF uses Mesonet API to extract observations collected by MW/SL and put them into a rectangular database of observations for daily and hourly records.
- Because AKFF utilizes a variety of station networks and encounters a range of precipitation gauge standards, precipitation values are the 24-hour integrated precipitation from the period of 2300 – 2259 UTC, representing the date that 2200 UTC falls on. These integrations are made by the MW/SL APIs and are accomplished outside the AKFF system. Errors are known to exist in the precipitation integration procedures, many originate from discrepancies in type of reported precipitation, and that the tolerances are for computing the boundaries of an integration period.

Fortunately, all of this produces a daily observation time that is consistent with the time established as the 1300 AKST fire weather observation used by the Weather Information Management System (WIMS) to calculate National Fire Danger Rating System components and indices for that system.

B. Gridded Analysis and Forecast Products

Gridded fire danger indices are displayed on AKFF. These gridded values are processed based on calculated indices from nearby weather stations and the following inputs.

Real-Time Mesoscale Analysis (RTMA) produces hourly analysis of weather conditions that NWS uses to verify forecast products. These grids utilize the most recent forecast models and estimates as well as surface weather observations to model weather across Alaska. AKFF uses the RTMA analysis grids for Surface Temperature and Dew Point to calculate the Relative Humidity. The analysis for surface wind speed is also collected from RTMA.

Quantitative Precipitation Estimates (QPE) are gridded rainfall estimates obtained from the NWS River Forecast Center at midday and at 1700 AKDT each day. These estimates offer precipitation totals in 6-hour blocks, with the first three blocks for each fire day (ending at 1600 AKDT) arriving with the midday package and the final 6-hour block for that fire day arriving in the late afternoon package. The earliest that analysis (observational) FWI grids can be observed on AKFF is after the late afternoon QPE package arrives (sometime after 1800AKDT).

The 00z (1600 AKDT) set of analysis grids and the 4 combined grids of precipitation estimates are used in combination with the analysis fuel moisture grids from the day before to calculate the current day's FWI codes and indices, which can then be used to initialize subsequent forecast grids.

Multi Radar Multi Sensor (MRMS) Precipitation Estimates are new gridded rainfall estimates that the Alaska-Pacific River Forecast Center will begin using sometime in the near future. This product will be available hourly, with more frequent quality checks, so the wait for a quality product will be much less than with the old QPE product. This would lead to more accurate calculations of observed and forecast FWI grids.

NWS National Digital Forecast Database (NDFD) products are timed to follow the update of global forecast models. Those models are updated 4 times a day at 00z (1600 AKDT), 06z (2200 AKDT), 12z (0400 AKDT), and 18z (1000 AKDT). NWS NDFD forecast grids are generally updated within a couple hours of 00z (1600 AKDT) and 12z (0400 AKDT) each day. Since each update includes surface weather forecasts every 3 hours, none of the forecast times coincide directly with solar noon. One is an hour early at 21z (1300 AKDT) and one is 2 hours late at 0z (1600 AKDT).

Because of the recommendation for later observations for high latitudes and the offset of the AKDT time zone, AKFF uses the 1600 AKDT forecast weather to represent solar noon conditions and to provide the daily FWI weather forecasts. These weather forecasts are used for gridded FWI calculations and for the point forecasts at the grid locations where the weather stations are found. Once the 1400 AKDT weather observations arrive, the 1600 AKDT forecast weather data is replaced by the observation data in the FWI calculation for that afternoon. The forecasted 1600 AKDT weather data and the 1400 AKDT observation data inputs are meant to represent the expected 1800 FWI system variables. Due to the later forecast time window, these forecasted daily FWI weather values provide slightly higher temperatures, lower humidity, and higher wind speeds than conditions at the corresponding station locations. As a result, FWI codes and indices from station observations will generally be slightly lower than their forecasted counterparts earlier in the day.

Precipitation totals for daily observations and analysis may differ in some situations. Gridded QPE analyses combine estimates for the 24 hours ending at 1600 AKDT. Point observations combine the estimates for the 24 hours reported at 1400 AKDT. The effective difference is a one-hour gap, and the 1500 rainfall estimate may be missed in the current day's forecast. Day 2 and Day 3 forecasts are unaffected and will always be consistent between grid and point forecasts.

C. Training

It is essential that fire personnel in Alaska have a working knowledge of both NFDRS and CFFDRS. Fire Analysts need to understand NFDRS to work in the Interagency Fuel Treatment Decision Support System (IFTDSS), in the fire behavior analysis programs within the Wildland Fire Decision Support System (WFDSS) and have a working knowledge of CFFDRS for tactical applications. Most tactical personnel regularly work in the Lower 48 after the Alaska season. The dependence on NFDRS also extends to dispatchers and other support personnel. The following classes are offered in Alaska or are available online:

- CAN-290 course (CFFDRS FWI and FBP Systems) is offered once a year, alternating locations between the Interior and South-Central Alaska
- Self-paced CFFDRS course is available on the Wildland Fire Learning Portal
- S-491 Intermediate National Fire Danger Rating System (Note: S-491 transitioned to NFDRS v4 in April 2019. Those that took it prior to that, may want to consider re-taking the course.)
- NFDRS Transition Training, Case Studies, and other Fire Danger Resources are available on the Wildland Fire Learning Portal – Fire Danger Training (FDSC) course.
- WIMS Basic Navigation self-paced course is available on the Wildland Fire Learning Portal
- RAWS Maintenance Training

Any personnel with an interest in developing an in-depth knowledge of NFDRS can travel out of state to attend additional training. Analysts coming to Alaska are mentored on the use of CFFDRS. These analysts are provided links to these documents, the AKFF User Guide, and a Guide to Fire Analysis in Alaska for reference.

D. Weather Station Monitoring and Maintenance

Each agency is responsible for the annual maintenance and calibration of their RAWS. The Remote Sensing Laboratory located at the National Interagency Fire Center (NIFC) maintains and calibrates the BLM RAWS annually. The Interior Telecommunications Group's annual operating plan and the Alaska Statewide Operating Plan provide detail on how maintenance responsibilities will be shared among agencies.

E. Roles and Responsibilities

1. Alaska Interagency Coordination Center

a) Center Manager/Deputy Center Manager

The Center Manager and Deputy are responsible for setting statewide preparedness levels (PL). The Statewide Preparedness Level Tool may be used for guidance. Calculations are based on current and predicted fire activity, fire behavior and resource availability.

b) Predictive Services Fire Weather Meteorologist

The Meteorologist acts as the main liaison between fire managers/operational personnel and the developers/maintainers of the AKFF system. The Fire Behavior Analyst can also assist in this data flow. Either the Meteorologist or the Fire Behavior Analyst can work with Fire Weather Station Owners/Managers or FMOs regarding station issues. Interpretation of data within AKFF can also be requested from any member of the Predictive Services Team.

The Meteorologist is the main focal point for weather station outages and can document the issues within AKFF and contact the appropriate owners to discuss repair options.

The Meteorologist inputs snow-free dates into AKFF for CFFDRS startup. These dates can be found within AKFF by looking at prior year data.

Though the Meteorologist may find inconsistencies in the weather and FWI data, it is up to the station owners and dispatch operators to alert Predictive Services staff since they are most familiar with current conditions in their zones and areas.

The Meteorologist provides daily weather briefings and outlook products (including the 7-day forecast product) to keep all fire operations and planning personnel abreast of upcoming weather, fuels, and fire behavior/danger concerns. They also provide spring updates and refreshers where the content, interpretation, and limitations of this information is discussed.

c) Predictive Services Fire Behavior Analyst

The Fire Behavior Analyst provides analysis and decision support on an interagency basis to all wildland fire management agencies in Alaska. In addition, they provide information for the daily weather briefing and the Multi-Agency Coordinating Group briefings about fuels analysis, fire behavior, and the overall fire situation in Alaska and the country. This position is the subject matter expert for fire danger in Alaska, has an in-depth knowledge of the Canadian Forest Fire Danger Rating System, the National Fire

Danger Rating System, assists with formal fire behavior and fire danger training, provides fire behavior and fire danger guidance as needed and is the focal point for maintaining this document.

2. National Weather Service

There are three different Weather Forecast Offices (WFOs) within Alaska. The Fairbanks Office provides forecast support for areas north of the Alaska Range divided into two areas: Western Alaska and Interior Alaska. The Anchorage Office provides forecast support for South Central and Southwest Alaska, while the Juneau Office provides forecast support for Southeast Alaska. Fire Weather Planning Forecasts are issued by the National Weather Service two times daily, once by 8 am and again by 4 pm (Southeast does not have an afternoon issuance). In addition, all offices provide Red Flag Warning/Fire Weather Watch support for certain criteria.

Each WFO is also responsible for exporting the National Digital Forecast Database (NDFD) data twice daily. These data are used in the calculations of the AKFF gridded forecasts.

The Alaska-Pacific River Forecast Center exports 24-hour (00Z-24Z) precipitation data twice daily for use in AKFF. The initial observation estimates come out by 1800 AKDT, while the final observations are available at 1200 AKDT the next day. These data are also used in the calculations of the AKFF forecasts.

There is an existing Fire Weather Annual Operating Plan which is an agreement between the NWS and the Alaska Wildland Fire Coordinating Group. It describes required products, relationships and defines schedules for the entire fire season.

3. Fire Weather Station Managers

Stations are owned and operated by several different agencies including NPS, BLM, FWS, USFS, DNR, FAA, NWS, and the Alaska Earthquake Center (AEC). Station owners must understand that station data may be used to inform weather, fuels, and fire danger patterns outside of their jurisdictional area. Therefore, it is important to complete station and site maintenance including brushing and clearing to NFDRS standards early in the season and to ensure stations remain operational through the heart of fire season until the end of season rains occur. It is possible to join efforts to reduce costs to keep stations up and running throughout the season. The Predictive Services Team can assist with this.

Fire Weather Station Owners/Managers must work with FMOs to determine snow-free dates for CFFDRS startup. This information must be passed on to the Predictive Services Meteorologist as soon as possible. Station management is described in detail in the *AKFF Station Manager Guide*.

4. Data Managers

Each dispatch office is responsible for ensuring their daily 1400 AKDT observation for each station from April 1 through September 30 is correct. These observations are automatically uploaded into the WIMS database, but quality control is still critical. It is imperative that dispatch offices report any suspicious or missing data to the Predictive Services Meteorologist in a timely fashion. Though WIMS data are not used operationally in Alaska, they are used in the WFDSS fire behavior analysis tools. There is no way to upload AKFF data into WFDSS, so WIMS data must be kept current for WFDSS use. In addition, Alaska weather data are used in multiple applications. Any identified errors need to be corrected in all applications.

5. Fire Danger Committee

The AWFCG Fire Danger Committee is responsible for annual review of the AIFDOP and for updating it every five years or sooner if necessary. The Fire Danger Committee charter and committee membership is available on the AICC – AWFCG and AICC – AWFCG Committees webpages, respectively.

6. Protecting & Jurisdictional FMOs & Duty Officers

FMOs for both the state and federal agencies are responsible for reviewing AKFF data daily and ensuring that any spurious or missing data is reported to the Predictive Services Meteorologist as soon as possible. Precipitation data can often be incorrect or missing due to mechanical, technical and/or environmental reasons. FMOs should also ensure that indices calculated by AKFF are representative of their areas. If not, this concern should be addressed with the Predictive Services Meteorologist.

FMOs must work with Weather Station Owners/Managers to determine snow-free dates for CFFDRS startup. This information must be passed on to the Predictive Services Meteorologist as soon as possible.

7. RAWS/Radio Shop Personnel

RAWS stations are maintained by Radio Shop personnel from NPS, BLM, FWS and the Regional Fuels Coordinator for USFS stations. There are agreements in place to minimize costs and share annual maintenance duties on these stations. Since the State of Alaska does not have personnel to provide maintenance, they pay the three agencies to maintain their stations. Annual maintenance is ideally accomplished prior to fire season, but when stations fail during the season, funds must be allocated to repair a station. Funding should be coordinated with the FMO prior to contacting the appropriate Radio Shop. Predictive Services meteorologists should be made aware of any station issues and informed of repair timelines.

FAA and NWS stations are maintained by those agencies. To report outages at these stations, contact the Predictive Services meteorologists who can follow up with the appropriate contacts.

8. Jurisdictional Agency Administrators

NPS, BLM, FWS, BIA, USFS, and DNR representatives need to fund and support their portions of the RAWS network for this system to provide quality data and remain functional. There must be agreement on the usage of the CFFDRS FWI system and the AKFF website for Alaska fire planning and operations.

VI. Future Needs

- Alaska Fire and Fuels (AKFF):
  - Continue to provide funding to maintain and upgrade the AKFF website. Continue funding to maintain the existing RAWS network and upgrade stations as required.
  - Modify rulesets for existing LANDFIRE CFFDRS fuels map for use in AKFF and other applications.
- Alaska Lightning Detection System:
  - Continue efforts with University of Fairbanks and NASA to normalize the historical lightning dataset, taking into account detection system changes.
  - Investigate Lightning Ignition frequency.
- LANDFIRE:
  - Continue to work on improving existing vegetation type classification and fuel model crosswalk in Alaska.
- Research Needs:
  - Improve on seasonal BUI forecast from UAF researchers.
  - Lightning ignition potential, monthly lightning climatologies, seasonal lightning forecast, and lightning occurrence predictions.
  - Human Ignition Potential.
  - Continue to support snow cover assessment map service.
  - Implementing ensemble weather forecasting out to 14 days.
  - Overwinter assessment study on DC/BUI and overwintering probabilities.
  - Incorporate automated gridded fire behavior products.
  - Synthesis on satellite heat detects and how they can be used for fire danger.
- Analysis:
  - Develop Seasonality Charts for FDRAs AK15 through AK 18. The approach used for interior AK is likely inappropriate due to a lack of satellite heat detects and a different type of fire regime.
  - Analyze the Fire Weather Index (FWI) using the updated FWI2025 methodology across all available historical weather data statewide. Compare the findings with existing indices to evaluate whether the breakpoints and adjective ratings remain valid with the implementation of the new FWI2025 system.
  - Assess the feasibility of implementing the FWI2025 methodology as an interagency standard statewide.
  - Consider the implications of MODIS data becoming unavailable in the future and develop a plan to incorporate VIIRS data into future analyses.
  - Improve analysis for areas outside the Interior of Alaska such as, the Kenai Peninsula, Southwest Alaska, Southeast Panhandle, and tundra areas.

- Continue exploring options for rating fire danger in Tundra.
- Continue to improve FEMS datasets by inputting data through AKFF throughout the fire season.
- Continue improving the automated statewide preparedness level tool for Alaska. Provide decision makers with timely, useful, and easy to access information.

VII. Appendices

Appendix A: Topography

Alaska is the westernmost extension of the North American Continent **(Figure 27)**. Its east-west span covers 2,000 miles, and from north to south a distance of 1,100 miles. The State's coastline, 33,000 miles in length, is 50 percent longer than that of the conterminous United States. In addition to the Aleutian Islands, hundreds of other islands, mostly undeveloped, are found along the northern coast of the Gulf of Alaska, the Alaska Peninsula, and the Bering Sea Coast. Alaska contains 375 million acres of land and many thousands of lakes.

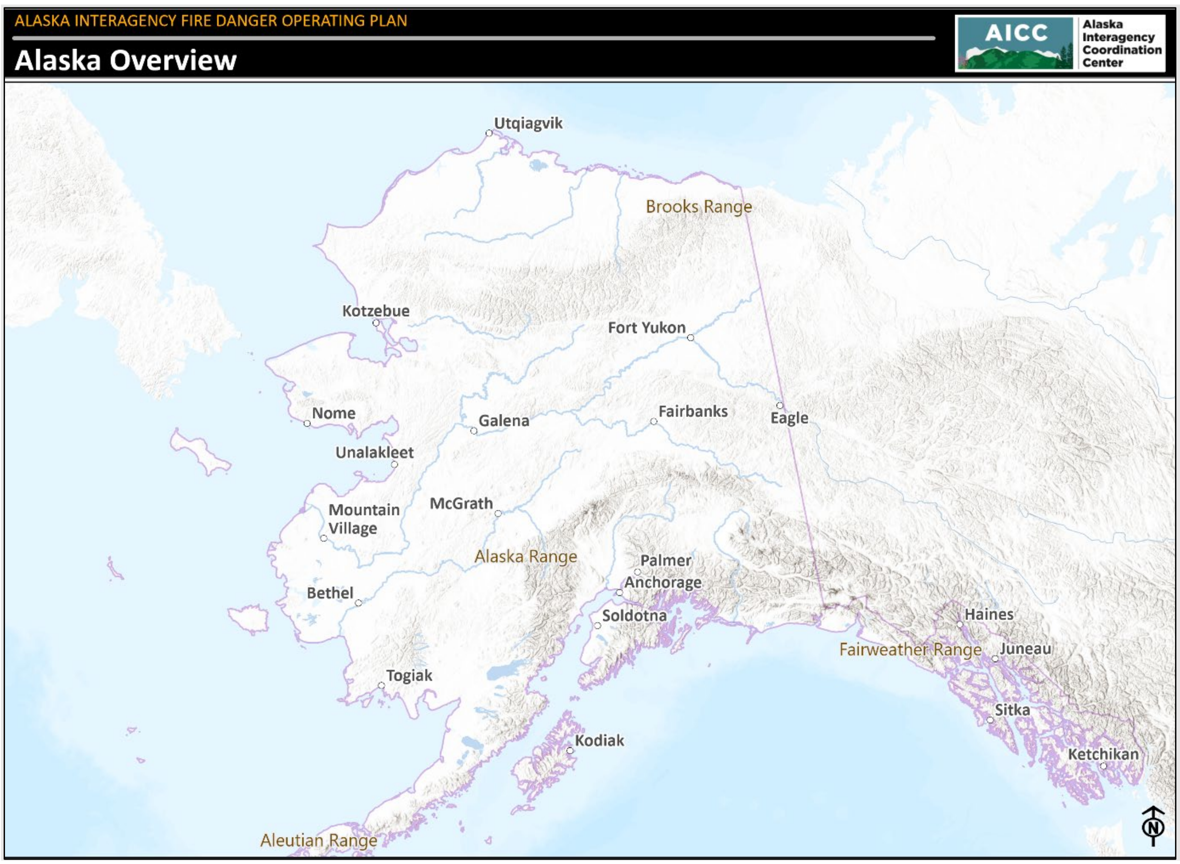


Figure 27: Alaska Topography

There are 12 major rivers plus three major tributaries of the Yukon, all of which drain two-thirds of the State. Four rivers, the Yukon, Stikine, Alek, and Taku, can be classed as major international rivers.

The two longest mountain ranges are the Brooks Range, which separates the Arctic region from the Interior, and the Alaska-Aleutian Range, which extends westward along the Alaska Peninsula and the Aleutian Islands, northward about 200 miles from the Peninsula, and then eastward to Canada. Other shorter but important ranges are the Chugach Mountains which form a rim to the central north Gulf of Alaska, and the Wrangell Mountains lying to the northeast of the Chugach Range and south of the Alaska Range. Both shorter ranges merge with the St. Elias Mountains, extending southeastward through Canada and across southeastern Alaska as the Coast Range. Numerous peaks more than 10,000 feet are found in all but the Brooks Range. The highest peak (20,320 feet above sea level) in the North American Continent, Denali, is in south-central Alaska. Many other peaks tower above 16,000 feet, however, nearly all the inhabited sections of the state are at 1,000 feet elevation or less.

Appendix B: Vegetation

Leslie Viereck, a plant ecologist with the Institute of Northern Forestry, and others began developing a comprehensive, statewide [Alaska vegetation classification](#) system in 1976 (published in 1992) that has become a standard reference in the field. The classification is based, as much as possible, on the characteristics of the vegetation itself and is designed to categorize existing vegetation, not potential vegetation. A hierarchical system with five levels of resolution is used for classifying Alaska vegetation. The system, an agglomerative one, starts with 888 known Alaska plant communities, which are listed and referenced **(Figure 28)**. At the broadest level of resolution, the system contains three formations – forest, scrub, and herbaceous vegetation.

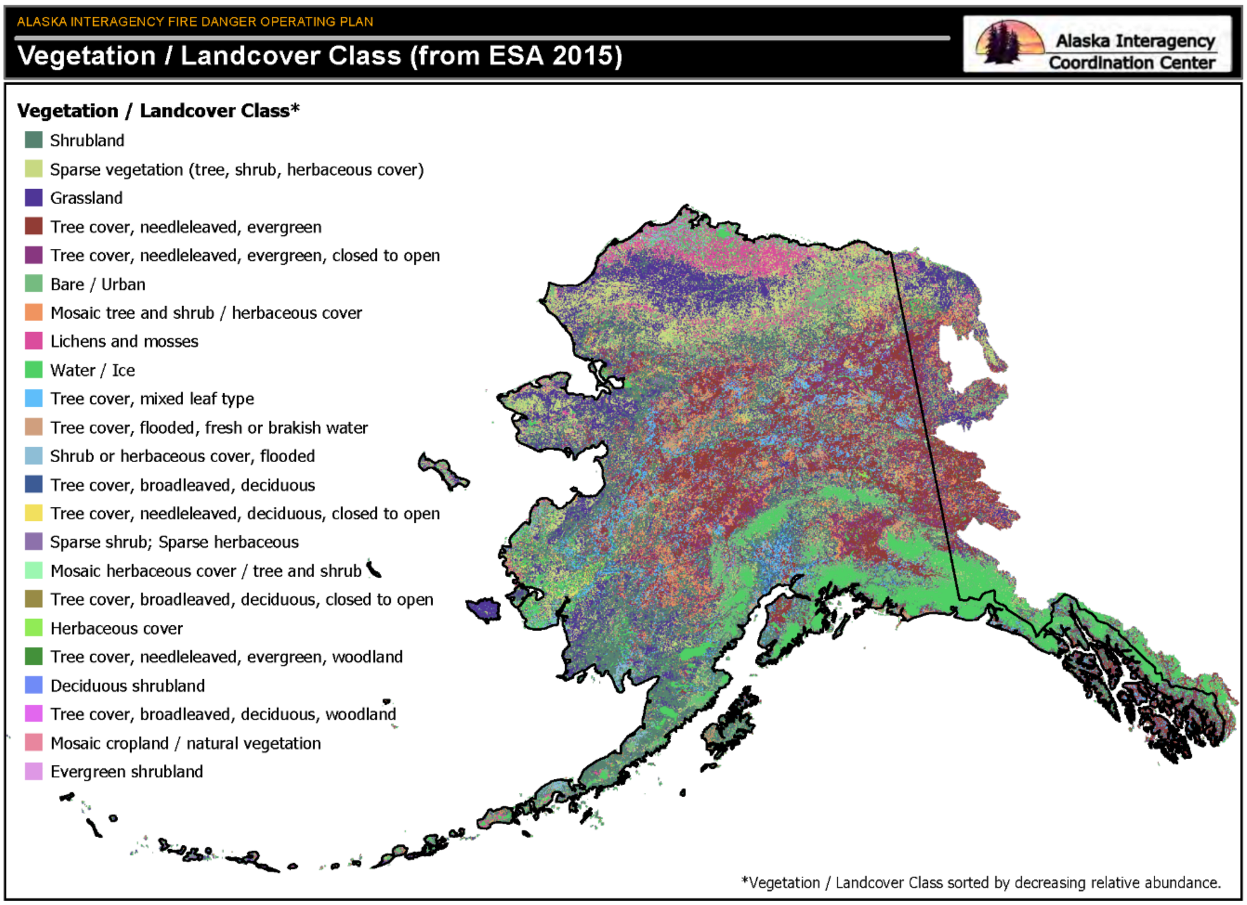


Figure 28: Alaska Vegetation

Permafrost is a major factor in the geography of Alaska. It is defined as a layer of soil at variable depths beneath the surface of the earth in which the temperature has been below freezing continuously for at least two years. It exists where summer heating fails to penetrate to the base of the layer of frozen ground. Permafrost covers most of the northern third of the state. Discontinuous or isolated patches also exist over the central portions in an overall area covering nearly another third of the state. No permafrost exists in South Central and the southern coastal portions including southeastern Alaska, the Alaska Peninsula, and the Aleutian Chain.

Appendix C: Climate

Climate divisions are subdivisions of states having roughly consistent climatological behavior within them. Compared to larger regional values, they represent a more local climate signal, but without the "noisiness" or sensitivities of single-station climate records. The 48 CONUS states have 344 climate divisions between them. Rhode Island has only one (statewide) climate division. Some larger CONUS states have 10 climate divisions. Alaska has 13 climate divisions **(Figure 29)**. More information is available from NOAA.

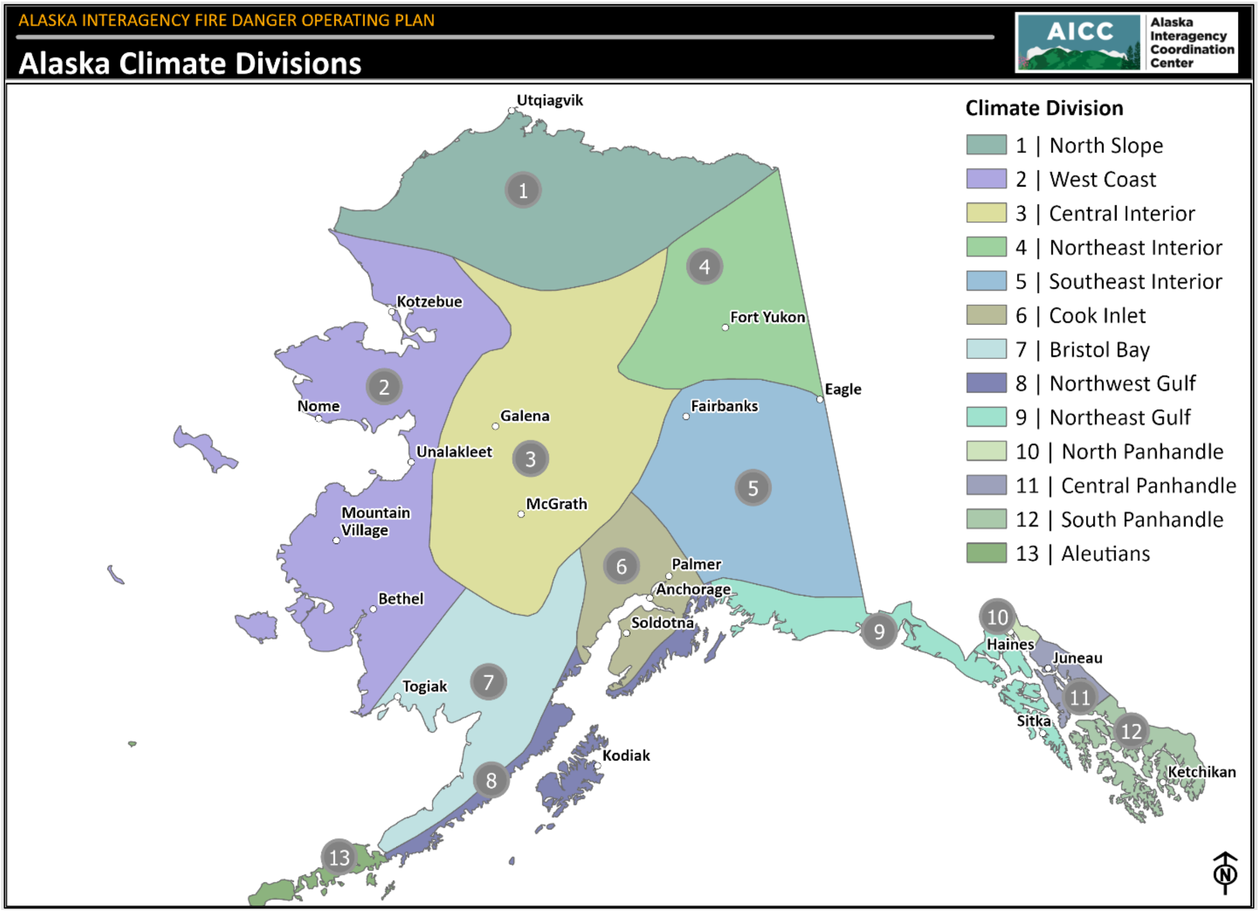


Figure 29: Alaska Climate Divisions

Appendix D: Fire Danger Rating Area Descriptions

See **Figure 30** below for a map of the Alaska Fire Danger Rating Areas (FDRAs).

1. AK00: North Slope

This includes the North Slope and the north side of the Brooks Range. Average precipitation is less than 10 inches annually. Very little fire activity occurs here, though there is evidence of some large fires in the last century. More recently, the Anaktuvuk River fire in September 2007 burned about 256,000 acres. Weather in this FDRA tends to be cool, rarely exceeding low 60-degree temperatures and is not particularly conducive to fire activity due to its far north latitude and resultant cool climate. If high pressure does set in, fuels dry quickly as vegetation is primarily tundra.

2. AK01E: Eastern Tanana

This includes the Upper Tanana Valley, the northern slopes of the far eastern Alaska Range and the southern hills of the most eastern Yukon-Tanana Uplands. Weather on the valley floor can be significantly different from that in the hills on either side. Overall, summer weather is warm (70s to low 80s) and dry, with thunderstorms a possibility for much of June and July. Annual average precipitation on the valley floor is less than 12 inches. Vegetation is predominantly boreal forest. This area is prone to strong Chinook winds year-round due to southerly flow over the Alaska Range which can lead to rapid fire spread.

3. AK01W: Western Tanana

This includes the Middle Tanana Valley, which is wider here than upriver. The bulk of Interior Alaska's population resides in this zone, including the communities of Fairbanks and Delta. Annual precipitation amounts are 15-20 inches. Summer weather is generally warm (upper 70s to mid-80s) and dry, with wet and/or dry thunderstorms a possibility for much of June and July. Vegetation is predominantly boreal forest. This area is prone to strong Chinook winds at any time of year due to the southerly flow over the Alaska Range which can lead to rapid fire spread.

4. AK02: Upper Yukon

This area includes the wide plains of the Yukon Flats, the southern slopes of the eastern Brooks Range and the northern portion of the eastern Yukon-Tanana Uplands. Much of the Yukon Flats, and many of the surrounding hills to the north and east, have very low annual precipitation amounts, averaging less than 10 inches. This area is prone to the hottest temperatures in the state during June and July, getting into the mid-80s on sunny days. Afternoon thunderstorms are likely, though the associated precipitation is often quite spotty with little impact on fire behavior. The Yukon Flats are one of the last parts of the state to receive season-ending rains and often enter the winter months on the dry side. Boreal forest is the main vegetation. Lowlands can be quite wet.

5. AK03N: Northern Tanana

This area includes the Upper Koyukuk Valley and the southern slopes of the central Brooks Range. The southern boundary cuts from the Dalton highway, westward through the Ray Mountains. Overall, the FDRA is hilly, though a large swath through the center is flat lowlands south of the Koyukuk River itself. Precipitation varies with elevation but ranges from 15-25 inches annually. Temperatures may be significantly cooler here than its adjacent FDRA directly to the south (AK03S), though light or southerly winds may still lead to hot summer afternoons, with temperatures in the upper 70s to low 80s. Thus, thunderstorms are less common than some other parts of the Interior, but still likely in June and July.

6. AK03S: Southern Tanana

Positioned immediately south of AK03N, it includes many hills and rivers and is referred to as the Central Interior as a whole. Its southern edge comprises the northern side of Denali National Park and Preserve, including the main access road to the park. Denali itself lies along the southern boundary. The north side of the great mountain still tends towards the dry side, so overall precipitation amounts in fire prone areas are between 15-25 inches, with wettest conditions in the south. Temperatures can reach into the low 80s at times. Thunderstorms are likely in summer, with varying amounts of rain. This area is prone to strong Chinook winds due to southerly flow at any time of year over the Alaska Range which can lead to rapid fire spread.

7. AK04: Koyukuk and Upper Kobuk

The Kobuk and Noatak River drainages are the primary areas of concern for fire in this area. The Kobuk follows the southern side of the western extent of the Brooks Range. The Selawik National Wildlife Refuge (NWR) encompasses a large, flat wetland in the southern part of this region. The average precipitation in this area varies quite a bit based on elevation. Topography is key to weather here; low-lying areas average around 12 inches of rain, while higher elevations in the Brooks Range get up to 30 inches of rain per year. Though this area may be damper than more eastern regions, it can be quite dry in the summer for weeks at a time. Vegetation tends to be more tundra than boreal forest, though it is more mixed through the southern half of the region. Though temperatures are cooler than farther east, afternoon highs can still reach into the upper 70s fairly frequently.

8. AK05: Middle Yukon

The middle portion of the Yukon River flows through this area, with the Koyukuk River flowing into it from the northeast. The heart of this region is low-lying and generally flat, with hills along all sides. Precipitation is generally between 12 and 20 inches, and though warm temperatures (upper 70s and low 80s) and thunderstorms occur in the summer, conditions are more moderated here than farther eastward due to proximity to the west coast. Boreal forest dominates most of the area.

9. AK06: Seward Peninsula

This is a hilly peninsula that helps block the warmer waters of the Bering Sea from interacting with the colder water of the Chukchi Sea. It is prone to strong winds and is breezy even on the calmest days. Temperatures tend to be mild as a result, rarely getting out of the 60s, and though thunderstorms can develop, they are less associated with air mass instability and more with frontal movement. Average rainfall is less than 12 inches in the north, and around 20 inches in the south. Vegetation types are a mix of both tundra and taiga.

10. AK07: Lower Yukon

Capturing where the Yukon River flows southward along the Nulato Hills and up to where it makes its final west turn for the coast, this area also encompasses the Innoko River drainage and even the headwaters of the Nowitna River in its northeastern corner. The bulk of this area is comprised of the lower wetlands of the Innoko NWR. Average annual rainfall is 15-20 inches, and vegetation is boreal forest in the hills to the west, and mixed taiga and grasses for most of the rest of the area. Temperatures vary a lot, with upper 70s and low 80s common inland, while flatter areas towards the coast tend to stay in the 60s or below. Thunderstorms are more common inland, but a damper air mass usually ensures these storms are damper than more interior areas.

11. AK08: Yukon-Kuskokwim Delta

Including much of the west coast, this area wraps from just south of the Seward Peninsula southward through the widespread delta areas of the Yukon and Kuskokwim Rivers. Almost all this flat land is vegetated by tundra, and though precipitation amounts still tend to the dry side (less than 20 inches per year), the damper air mass tends to keep thunderstorms from forming and keeps temperatures cool (50s and 60s) all summer long.

12. AK09: Kuskokwim Valley

In the east, the western slopes of the western Alaska Range reaching over 7,000 ft. and well above fire prone landscapes. The middle of the FDRA follows the upper half of the Kuskokwim River through the middle of the region and out the west side. Some of these areas are low lying and flat where many rivers and streams come together, while other areas are quite hilly. On the west side, the middle portion of the Kuskokwim Mountains are captured, with some of the northern peaks of the Kilbuck Mountains to the south. Annual precipitation amounts are between 15 and 20 inches, though the Alaska Range and Kilbuck Mountains may see closer to 30 inches. Summertime thunderstorms are common, and precipitation amounts vary greatly. Summers are generally warm with interior areas getting into the upper 70s and areas closer to the coast staying in the 60s.

13. AK10: Bristol Bay and AK Peninsula

This FDRA captures the Aleutian Range in the east to the Ahklun Mountains of the southern Kuskokwim Mountains. Between them is a large area of lowlands, mainly from the deltas of the Nushagak and Kvichak Rivers. From there, this FDRA follows the Alaska Peninsula westward, about as far as Port Heiden (57°N). South and west of this point are not included in any FDRAs because fire activity is extremely rare. The western boundary of this area comprises the Bristol Bay Coastline. Though cool (50s and 60s) and damp weather is common around this area, the Bristol Bay side of the Alaska Peninsula tends to be a lot drier (20 inches of annual rainfall) than the east side (near 50 inches). There are also several areas in a rain shadow on the west side of the Aleutian Range. The downslope effect, due to the predominant easterly winds, keeps this area warmer (low 70s) and quite dry. The Ahklun Mountains and many of the hills in the north and south are boreal forest, with more shrub vegetation in the lower lying areas.

14. AK11: Susitna Valley

This area encompasses the Susitna Valley and the surrounding mountains on the west and north (southern west and central Alaska Range), and east (Talkeetna Mountains) sides. There is a population in this area that is generally confined to the Glenn Highway corridor. Historically this area has a low fire load; however, periodic large fires have resulted in a high number of values lost. Summertime temperatures can be quite warm, getting into the upper 70s and low 80s. Afternoon wet thunderstorms do occur periodically, mainly over the mountains. Vegetation is mainly boreal forest. Northerly wind events are one of the most dangerous fire spreading factors in this FDRA.

15. AK12: Copper River Basin

Though the Copper River Valley is the heart of this area, there is a lot of mountainous terrain to the east and south, comprising the Wrangell St. Elias and Chugach Mountains. Temperatures can get quite hot (upper 70s to mid-80s) in the heart of the Copper River Valley during the summer months, and afternoon thunderstorms are quite common. Though fuels often seem ripe for burning here, large wildfires have historically tended to be uncommon despite these dry fuels. The Copper River Basin typically has elevated indices late into the fall, compared to most FDRAs. The mountains to the south and east tend to be too wet for fire concerns, though some of the valleys can have high fire danger. Vegetation is generally boreal forest and tundra at some of the higher elevations. Annual precipitation amounts are 10-20 inches on the valley floor and up into the Chitina River Basin, though the mountains just to the north and south easily see over 50 inches a year.

16. AK13: Matanuska Valley/Anchorage

This is one of the smallest FRDAs, but it is the most populous area of the state. Made up of mostly boreal forest and wetlands, including the narrow Matanuska River Valley and surrounding mountains, the flats of the Anchorage area and the Chugach Mountains to the east. Topography plays a huge role in the weather here, and though summers tend to be mild, temperatures can get into the upper 70s and low 80s and afternoon thunderstorms may form. There is a rain shadow on the west side of the mountains, which makes for markedly drier conditions in that area. Annual average precipitation is near 20 inches in most of the populated areas, though the mountains in the east receive upwards of 50 inches. Strong Chinook winds due to southeasterly flow over the Chugach Mountains can occur at any time of year, which can lead to rapid fire spread.

17. AK14: Kenai Peninsula

The Peninsula consists of lowlands to the west, and the Chugach Mountains to the east and south. There is a high population density, along the major road corridors of the Sterling and Seward Highways. Some of the vegetation is boreal forest with some wetlands in the northwest corner of the peninsula and a temperate rainforest along the coast. Large areas of spruce forests have recently been converted to grasslands following spruce bark beetle outbreaks. Prior to green-up these grass fuels can be highly flammable. Annual average precipitation is 20-30 inches in most areas, with well over 50 inches in the mountains. Temperatures vary, with coastal areas remaining in the 60s while inland areas can see upper 70s with a few low 80s. There is a rain shadow on the west side of the mountains, which makes for markedly drier conditions in that area. Strong Chinook winds due to southeasterly flow over the Chugach Mountains can occur here at any time of year, which can lead to rapid fire spread.

18. AK15: Northern Panhandle

Most of the panhandle is well-timbered rainforest with very little fire activity, but this area has some dry valleys in the northernmost part that not only funnel winds but also tend to be quite a bit drier than the rest of Southeast Alaska. The northern panhandle is often considered to have the highest potential for fire occurrence in southeast Alaska. The annual average precipitation in the Chilkat, Chilkoot, and Taiya River Valleys is around 40 inches. Other areas exceed 80 inches in an average year. Temperatures are generally cool in the 60s with high humidities, however there are instances where upper 80s are observed for several days in a row with RHs into the low 20s. Fire occurrence is low, and lightning is uncommon.

19. AK16: Central Panhandle

A well-timbered rainforest with annual precipitation over 80 inches leads to very little fire activity in this part of Southeast Alaska. Some portions of this area receive well over 150 inches of precipitation in a typical year. Temperatures and humidities are moderate due to the coastal influence. Like FDRA AK15, it is possible to have hot, dry weather for up to one or two weeks in the summer. This week or two of drying can lead to receptive fine fuels, grasses, or finer activity timber slash, that can experience fire activity. Fire occurrence is low, and lightning is uncommon.

20. AK17: Southern Panhandle

A well-timbered rainforest with annual precipitation over 80 inches for most areas leads to very little fire activity in this part of Southeast Alaska. Again, temperatures and humidities are usually moderate due to the marine presence, though it is possible to have hot, dry weather for up to one or two weeks. This week or two of drying can lead to receptive fine fuels, grasses, or finer activity timber slash, that can experience fire activity. Recently, temperatures into the upper 80s have been observed for several consecutive days in the last few summers. Fire occurrence is low, and lightning is uncommon.

21. AK18: Kodiak

Kodiak Island is a mountainous, verdant, well-treed island on the western side of the Gulf of Alaska. Fire activity is usually very low, there is increased potential towards the end of August, which is typically the driest month for the area. Summertime temperatures tend to be in the 50s and 60s, and significant rainfall events occur throughout the summer, which contributes to the annual average precipitation of over 60 inches. Vegetation ranges from tall spruce forests to scrubby brush in the low areas along the coast. Fire occurrence is low, and lightning is uncommon.

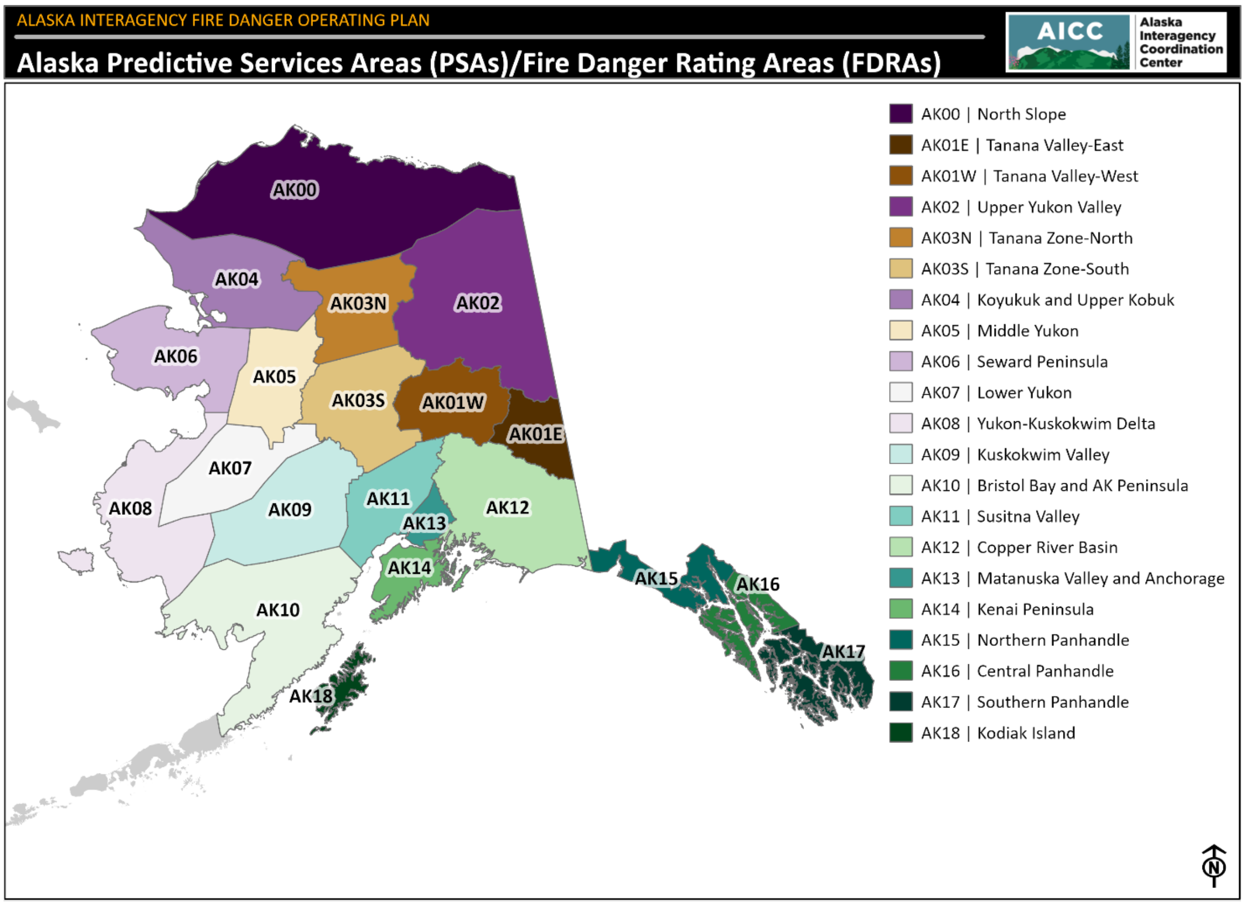


Figure 30: Map of Alaska Predictive Service Areas that were adopted and used as Fire Danger Rating Areas for fire analyses in the Alaska Interagency Fire Danger Operating Plan.

Appendix E: Historical Modified Conversion Dates

Table 8: Modified Historical Fire Management Option Conversion Dates.

Year	Conversion Date(s)	Rationale
1995	***July 7***	
1996	July 10	Except for the Kenai and Mat-Su areas
1997	***July 4*** July 10	Upper Yukon Zone Only Remaining Areas
1998	July 10	With exceptions at local levels
1999	July 10	Except for Shaw Creek and Good Pasture in Delta Area and all AFS
2000	July 10	
2001	July 10	
2002	July 10 ***July 23***	Except for Kenai and Mat-Su Areas Kenai and Mat-Su Areas
2003	July 10	
2004	***July 20*** ***July 29***	SW AK only converted. All remaining areas of the State
2005	July 10	
2006	July 10	
2007	July 10 ***July 20***	Except for Kanuti Refuge Kanuti Refuge
2008	July 10	Except for Kanuti Refuge
2009	***July 21***	
2010	July 10	
2011	***July 6***	
2012	July 10	
2013	July 10	
2014	July 10	
2015	***July 17***	
2016	July 10	
2017	July 10	
2018	July 10	
2019	***July 18***	
2020	July 10	
2021	July 10	
2022	***July 19***	
2023	July 10	
2024	July 10	

Appendix F: ASR – Spring Adjective Class Rating Analysis

The individual Alaska fire agencies utilize a variety of decision support tools for prepositioning resources, staffing plans, prevention and education actions, severity requests, etc. Most of the robust analysis of fire danger and weather attributes in Alaska are intentionally focused on the Duff-Driven Stage, the peak of fire season. The Duff-Driven Stage contains the peak of the historic observations for lightning fire starts and fire growth records, depicted by MODIS detects. The pre-green up portion of the fire season, the Wind-Driven Stage, contains relatively few historical records of fire growth (MODIS) due to aggressive initial attack and relatively low burnable fuel load. However, there are relatively abundant records of fire occurrence (primarily human fire starts) in specific areas of Alaska, therefore, only fire occurrence data is utilized in the ASR-Spring Adjective Class Rating analysis.

The Wind-Driven Stage of fire season is generally defined by when most of the ground surface becomes snow free in the spring until green-up occurs. Snow-free date varies each season, for the purposes of this analysis the pre-green up period is defined as April 1 – May 31.

Fire Management Decisions:

The State of Alaska legislature has declared April 1 the official beginning of the Alaska fire season. Fire resource availability varies by fire agency, geographical area, and yearly staffing fluctuations. Fire managers need to make decisions regarding preparing employees for the season or being available to respond to a new incident. Ensuring fire resources are available during periods of increased potential for fire starts is the first fire management decision. Potential fire growth effects the level, or amount of, and type of fire resources needed to be successful in the initial action. Ensuring the right amount and type of resources are available on a given day to have a high probability of success is the second fire management decision.

When selecting variables such as (adjective class ratings, weather parameters and FWI codes and indices, there must be consideration for the fire management decision being made (potential fire occurrence and potential fire growth). Ideally, these parameters should not have extreme variability from day to day but should be a reasonable representation of the potential for fire occurrence and growth in the current environment. Fire occurrence data is adequate for most regions of Alaska, but potential growth using MODIS or VIIRS is not well represented during the pre-green up period or in tundra fuel types.

Methods to Determine Adjective Class Rating Variables:

Refining the selection of variables (adjective rating classes, weather parameters, etc.) to address the fire management decisions involved seven steps:

1. Compile known variables that have a good correlation with fire occurrence (Decision 1).
2. Compile known variables that have a good correlation with fire growth (Decision 2).
3. Refine the compiled list of variables based on effectiveness of each variable between April 1 – May 31 (Ground conditions during pre-green up).
4. Perform a Goodness of Fit analysis in Fire Family Plus for temperature and FWI components to determine the greatest correlation with fire occurrence (Goodness of Fit – FireFamilyPlus).
5. Select variables with high fire occurrence correlation.
6. Select variables with high fire occurrence and fire growth correlation.
7. Select variables with high fire occurrence and represents short term drought conditions.

Decision 1: Potential Fire Occurrence Inputs

The Sub-Region Summer Adjective Class Rating threshold analysis (ASR – Summer) indicated that fire occurrence potential was well described using 1400 Temperature (Temp), Duff Moisture Code (DMC), Fire Weather Index (FWI), Buildup Index (BUI), and Fine Fuel Moisture Code (FFMC). In addition, less than 8% of fire occurrence were observed at the GAR adjective class rating of Low during the pre-green up period between 1999 – 2018. During that same analysis period approximately 31% of fire occurrence were observed at a GAR of Moderate.

Decision 2: Potential Fire Growth Inputs

The ASR – Summer threshold analysis and GAR indicated that fire growth potential was well described using 1400 Temperature (Temp), Duff Moisture Code (DMC), Fire Weather Index (FWI), Buildup Index (BUI), Fine Fuel Moisture Code (FFMC), and Initial Spread Index (ISI).

Ground Conditions During Pre-Green Up

Shortly after snow free conditions, surface fuels cure rapidly (FFMC), yet the dead moss (represented by DMC) and upper duff (represented by DC) may take time to thaw. The dead moss will typically thaw first, and the upper duff will thaw sometime after that. Effectively, until these fuels layers thaw, they do not directly contribute to the available fuel bed in the fire environment. Each spring also has variability in the amount of moisture that is trapped in these layers depending on how wet the preceding fall was upon freeze-up. The DMC and DC, contributing to the BUI, are questionable in their ability to reflect conditions on the ground. DMC, the highest layer in the fuel profile, and earliest to thaw, would likely be the most representative of available fuel conditions through the pre-green up period.

Goodness of Fit – FireFamilyPlus

Using a statewide FireFamilyPlus database with fires associated with stations and organized into the Alaska FDRAs, a simple analysis was completed for the goodness of fit **(Figure 31)**. The Chi Sq. and R (L) Sq. for each FDRA was recorded for the pre-green up period (April 1 – May 31, 1999-2018). The mean and median Chi Sq. for Temperature (ATF) had one of the lowest values (best score) and the mean and median R (L) Sq. was the highest recorded (best score). In addition, other variables that performed well included FFMC, DMC, ISI and FWI. BUI performed the least well in terms of Chi Sq. and the DC performed the least well in terms of R (L) Sq. This goodness of fit analysis, in addition to the questionable ability to represent ground conditions, at least in the early portions of the pre-green up period, prompted removing the DC and BUI from further analysis. RH had the best median Chi Sq. performance but the second lowest R (L) Sq. performance. Despite RH performing well, the historic use of RH directly in fire danger analysis in Alaska is limited. RH was not utilized in the creation of SAR and GAR, or previous Alaska specific fire danger rating criteria thus was rejected from further analysis.

Fire Day 4/1-5/31	Chi Sq. ATF	R (L) Sq. ATF	Chi Sq. RH	R (L) Sq. RH	Chi Sq. FFMC	R (L) Sq. FFMC	Chi Sq. DMC	R (L) Sq. DMC	Chi Sq. DC	R (L) Sq. DC	Chi Sq. ISI	R (L) Sq. ISI	Chi Sq. BUI	R (L) Sq. BUI	Chi Sq. FWI	R (L) Sq. FWI
PSA 00	N/A No Fir	N/A No Fir	N/A No Fir	N/A No Fir	N/A No Fir	N/A No Fir	N/A No Fir	N/A No Fir	N/A No Fir	N/A No Fir	N/A No Fir	N/A No Fir	N/A No Fir	N/A No Fir	N/A No Fir	N/A No Fir
PSA 01E	**11.5**	0.73	15	0.58	25.2	0.4	**7.3**	0.81	**11.5**	0.74	**6.6**	0.85	**10.3**	0.78	**10.4**	0.77
PSA 01W	**3.2**	0.97	**19.3**	0.81	36.8	0.69	29.1	0.72	28.1	0.58	**15.8**	0.87	**28.4**	0.71	**7.7**	0.95
PSA 02	12	0.72	**10.2**	0.49	**11.8**	0.67	**11**	0.83	**9**	0.74	13.9	0.65	12.5	0.82	**5.5**	0.89
PSA 03N	**4.7**	0.76	8.2	0.01	**5.1**	0.1	9.5	0.41	**5.4**	0.65	**7**	0.02	16.1	0.36	**5.2**	0.23
PSA 03S	12.5	0.71	**7.7**	0.6	**5.9**	0.8	**8.9**	0.86	**5.2**	0.84	**9.8**	0.64	12.4	0.81	10.7	0.81
PSA 04	**1.9**	0.75	12	0.17	5.9	0.22	**4.7**	0.65	**1.9**	0.3	**4**	0.22	**0.8**	0.91	5.4	0.44
PSA 05	15.1	0.73	**3.3**	0.85	20.6	0.45	**5.3**	0.83	**7.9**	0.49	**10.4**	0.69	11.7	0.66	**7.5**	0.46
PSA 06	**0**	1	2	0	**0.2**	0.95	**1.9**	0.57	2	0.16	**1.7**	0.41	**0.6**	0.85	4.5	0.31
PSA 07	**8.4**	0.79	13	0.52	**4.2**	0.86	16.9	0.22	**8.7**	0.04	14	0.42	**12.4**	0.28	**7.3**	0.56
PSA 08	**9.7**	0.59	**6.1**	0.56	**7.5**	0.68	13	0.33	**4.9**	0.58	11.3	0.51	**7**	0.59	13.6	0.58
PSA 09	**8.9**	0.85	**10.9**	0.67	13.1	0.7	**8.2**	0.79	**8**	0.67	15.6	0.53	**5.9**	0.84	13.1	0.78
PSA 10	**4.8**	0.55	**3**	0.4	**5.8**	0.26	**6.3**	0.32	15.3	0.18	14.3	0.19	**5.4**	0.37	13.8	0.27
PSA 11	11.5	0.68	**6.8**	0.81	21.4	0.45	**5.8**	0.65	**6.6**	0.41	13.3	0.61	**5.3**	0.69	**5.6**	0.83
PSA 12	**5.7**	0.66	**6.7**	0.45	**9.3**	0.37	**4.8**	0.44	**7.3**	0.08	10.1	0.36	10	0.22	15.6	0.34
PSA 13	**8.9**	0.9	**7.6**	0.89	37.7	0.65	**35.9**	0.47	66.4	0.12	**33.6**	0.55	40.7	0.38	**17.7**	0.8
PSA 14	**8.7**	0.93	**6.2**	0.89	**33.5**	0.57	37.5	0.72	47.1	0.61	**13.5**	0.8	37.2	0.71	**16.1**	0.88
PSA 15	**2.1**	0.37	6	0.2	**2.3**	0.15	3.6	0.01	**3.3**	0	**3.3**	0.17	11.4	0	**2.9**	0.15
PSA 16	**7.7**	0.68	12.3	0.61	**9.7**	0.55	14.6	0.43	12	0.41	**4.1**	0.75	**11.5**	0.49	**3.7**	0.83
PSA 17	6.6	0.43	**2**	0.44	**2.2**	0.54	**0.3**	0.97	**2**	0.65	4.6	0.26	**0**	0.99	3	0.53
PSA 18	**3.9**	0	**4.7**	0.43	**0.4**	0.6	22.9	0	13.8	0	**7.3**	0.41	26.9	0.01	**8.5**	0.27
Median	8.1	0.73	7.2	0.54	8.4	0.56	8.6	0.61	8.0	0.45	10.3	0.52	11.5	0.68	7.6	0.57
Mean	7.4	0.69	8.2	0.52	12.9	0.53	12.4	0.55	13.3	0.41	10.7	0.50	13.3	0.57	8.9	0.58
Max	15.1		19.3		37.7		37.5		66.4		33.6		40.7		17.7	
Min	0.0		2.0		0.2		0.3		1.9		1.7		0.0		2.9	
# Top 5	15		13		13		12		14		12		11		12	

Figure 31: FireFamilyPlus Chi Sq. and R(L) Sq. Summary for ASR – Spring Analysis by FDRA.

The goodness of fit analysis supports the selection of Temp, FFMC, DMC, ISI and FWI. The 1400 Temperature and FFMC were selected for representing fire occurrence. The ISI and FWI were selected to represent fire growth. The DMC represents short term drought conditions and provides daily stability in adjective class thresholds. The GAR was added for its utility of low fire occurrence in the Low adjective rating class. **Note:** All adjective rating classes, weather parameters and FWI codes and indices have demonstrated utility in predicting both fire occurrence and growth potential. To simplify this adjective class system no attempt was made to further refine the weather parameters and FWI input variables by A or Alaska Sub-Region Class Area.

Methods to Determine Fire Danger Class Rating Area:

Originally, the ASR – Spring threshold analysis (see methods below) was conducted at the statewide level. While this method had utility for statewide decision-making purposes and ease of use statewide, the disproportional number of weather observations and fire occurrences in populated areas biased the statewide results and significantly decreased the conditional frequency in the less populated PSAs. While conducting threshold analysis was considered at the FDRA level, that was similarly rejected due to the complexity of use by the fire program offices. The Alaska Sub-Region Class Areas, areas already identified in the 2020 Alaska AIFDOP, better aligned with the fire program offices, would provide better continuity with the Alaska Sub-Region adjective class rating system.

Methods to Determine Adjective Class Rating Thresholds:

Using conditional frequency as the basis for establishing ASR – Spring adjective class rating thresholds attempts to maximize the number of weather/FWI observations in the lowest adjective rating class (1 – Low) with the fewest number of fire observations (Ignition Days/occurrence) while simultaneously minimizing the number of weather/FWI observations with the greatest number of fire observations at the highest adjective rating class (5 – Extreme). The target percentage of weather/FWI observations for each class is as follows: Class 1 – Low = 50%; Class 2 – Moderate = 25% (50th percentile); Class 3 – High = 15% (75th percentile); Class 4 – Very High = 7% (90th percentile); Class 5 – Extreme = 3% (97th percentile). See **Figure 31** for the results.

The pre-green up analysis for each ASR – Spring adjective class began with establishing the upper threshold for each variable in class 1 (Low). As discussed above, GAR class 1 (Low) alone is a good indicator of low potential for fire occurrence. All GAR class 1 observations were added to class 1 (Low), regardless of the values of any other weather/FWI variable. Each variable with a GAR class 2 (Moderate), was incrementally raised until 50% of the observations for each Alaska Sub-Region Area during the pre-green up period was in class 1. The variable selected to raise the value at each incremental adjustment generally had the greatest number of weather or FWI variable observations with the least number of ignition days (i.e., has the lowest conditional frequency). Once the weather or FWI variable threshold was raised, then the conditional frequency was often recalculated for all weather/FWI variables and the next weather or FWI variable, with the lowest conditional frequency, upper threshold was raised. **Note:** If the total number of observations with a GAR of class 1 and class 2 did not total at least 50% of the observations needed for ASR – Spring adjective rating class then GAR class 2 and class 3 (High) were analyzed through the incremental increasing the variable process to create ASR – Spring adjective class 1.

Analysis for ASR – Spring class 2 (Moderate) included all observations, regardless of GAR class, not identified as ASR – Spring adjective class 1. Like the process in establishing the upper weather or FWI variable threshold in class 1, for class 2 each variable was incrementally raised until 25% of the observations for each Alaska Sub-region during the pre-green up period was in class 2. This process was replicated for class 3 (High, 15% of observations) and class 4 (Very High, 7% of observations). All observations not identified in the incremental upper threshold raising process for class 1-4 are classified as class 5 (Extreme). **Table 3** indicates the ASR – Spring adjective class rating thresholds for each Alaska Sub-Region Class Area. **Note:** No fire occurrence in FDRA 00 during the April 1st – May 31st analysis period prohibited conditional frequency analysis for FDRA 00. The ASR – Spring thresholds for FDRA 00 are a result of the initial statewide ASR – Spring adjective class conditional frequency analysis results.

Methods to Determine Adjective Class Rating Thresholds (2024 Update):

In 2024 the ASR – Spring Adjective class thresholds (**Table 3**) were reanalyzed and resulted in a simplification of the criteria for each adjective class. Use of the new criteria no longer incorporates the GAR adjectives classes as inputs into the Low, Moderate or High ASR-Spring classes. The ASR-Spring Adjective Class was developed for each Alaska Sub-Region Adjective Class Area by analyzing MODIS Day, VIIRS Day and Fire Occurrence (from April 1 – May 31). The lowest ranking temperature and/or CFFDRS variable establishes the Adjective Class Rating for that observation location (**Table 3**).

- Develop distributions of All Days (4/1-5/31), Growth Days (i.e., any day where at least one MODIS and VIIRS detection was observed during a 24-hr period) and Growth Events (i.e., the number of MODIS and VIIRS detects per day) for the five weather/FWI criteria identified for the ASR Sub-Region (See **Table 3**). This requires associating all daily weather observations by station with FDRAs, ASR-Sub-Groups, fire occurrence, MODIS Day, MODIS Detect, VIIRS Day and VIIRS Count.
- Calculate the conditional frequency (CF) (for fire occurrence, VIIRS Day and MODIS Day) of all values (group to the nearest integer) of each weather/FWI variable. Average the conditional frequency between the fire occurrence CF, VIIRS Day CF and MODIS Day CF.
- The lowest value of each weather/FWI variable (e.g., 1400 ATF, FFMC, DMC, ISI, FWI) for the ASR-Sub-group is placed in class 1 (Low). Recalculate the conditional frequencies. Incrementally place the next higher weather or FWI variable with the lowest average conditional frequency value into class 1 (Low). The variable selected to raise the value at each incremental adjustment generally had the greatest number of weather or FWI variable observations with the least

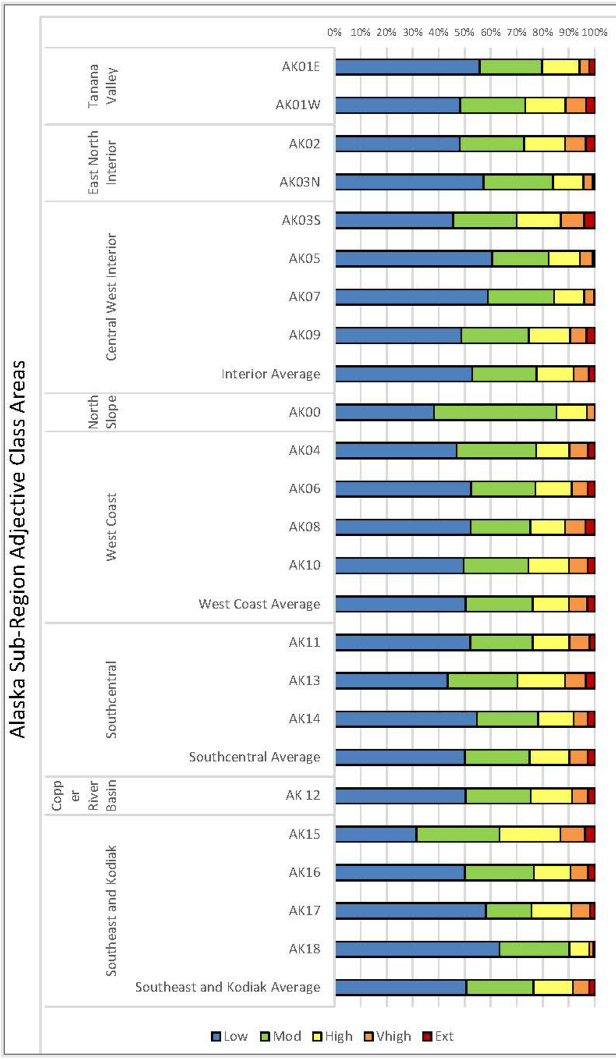
number of fire occurrence, MODIS Days and VIIRS day (i.e., has the lowest average conditional frequency). Continue the incremental raising of each weather/FWI variable with the lowest average conditional frequency until approximately 50% of all observational are placed in class 1 (Low).

- The next higher value of each weather/FWI variable (e.g., 1400 ATF, FFMC, DMC, ISI, FWI) for the ASR-Sub-group is placed in class 2 (Moderate). Recalculate the conditional frequencies. Incrementally place the next higher weather or FWI variable with the lowest average conditional frequency value into class 2 (Moderate). Continue the incremental raising of each weather/FWI variable with the lowest average conditional frequency until approximately 75% of all observational are placed in class 1 or 2(Low or Moderate, respectively).
- The next higher value of each weather/FWI variable (e.g., 1400 ATF, FFMC, DMC, ISI, FWI) for the ASR-Sub-group is placed in class 3 (High). Recalculate the conditional frequencies. Incrementally place the next higher weather or FWI variable with the lowest average conditional frequency value into class 3 (High). Continue the incremental raising of each weather/FWI variable with the lowest average conditional frequency until approximately 90% of all observational are placed in class 1 thru 3 (Low thru High).
- The next higher value of each weather/FWI variable (e.g., 1400 ATF, FFMC, DMC, ISI, FWI) for the ASR-Sub-group is placed in class 4 (Very High). Recalculate the conditional frequencies. Incrementally place the next higher weather or FWI variable with the lowest average conditional frequency value into class 4 (Very High). Continue the incremental raising of each weather/FWI variable with the lowest average conditional frequency until approximately 97% of all observational are placed in class 1 thru 4 (Low thru Very High).
- All remaining values of each weather/FWI variable are placed in class 5 (Extreme).

Results:

Using the conditional frequency criteria alone the ASR – Spring Adjective class performed better in the Boreal Forest and Non-Boreal Forest FDRAs for fire occurrence compared with the GAR. **Figure 42** illustrates the mean conditional frequencies for each adjective class between the GAR, ASR-Spring, SAR, and ASR – Summer for the Boreal Forest and Non-Boreal Forest FDRAs.

Figures 44-48 (Appendix I) indicates the conditional frequencies for each FDRA for the ASR-Spring Adjective classes. No fire occurrence in FDRA 00 during the April 1st – May 31st analysis period results in a conditional frequency of 0.0 for all Classes. During most years snow-free dates are significantly later in the North Slope FDRA than the rest of the state.



Low	Mod	High	Vhigh	Ext	ASR - Spring Adjective Class	
56%	24%	14%	4%	2%	AK01E	Tanana Valley
48%	25%	15%	8%	3%	AK01W	
48%	25%	16%	8%	3%	AK02	East North Interior
57%	27%	12%	4%	1%	AK03N	
46%	24%	17%	9%	4%	AK03S	Central West Interior
61%	22%	12%	5%	1%	AK05	
59%	26%	12%	4%	0%	AK07	
49%	26%	16%	6%	3%	AK09	
53%	25%	14%	6%	2%	Interior Average	
38%	47%	12%	3%	0%	AK00	North Slope
47%	31%	13%	7%	3%	AK04	West Coast
52%	25%	14%	6%	3%	AK06	
52%	23%	13%	8%	4%	AK08	
50%	25%	16%	7%	3%	AK10	
50%	26%	14%	7%	3%	West Coast Average	
52%	24%	14%	8%	2%	AK11	Southcentral
43%	27%	18%	8%	3%	AK13	
55%	24%	14%	5%	3%	AK14	
50%	25%	15%	7%	3%	Southcentral Average	
50%	25%	16%	6%	3%	AK 12	Copper River Basin
31%	32%	23%	10%	4%	AK15	Southeast and Kodiak
50%	27%	14%	7%	3%	AK16	
58%	18%	15%	7%	2%	AK17	
63%	27%	8%	2%	1%	AK18	
51%	26%	15%	7%	2%	Southeast and Kodiak Average	

Figure 32: ASR—Spring Observations (2003-2022) by Adjective Class

The mean conditional frequency of fire occurrence for all FDRAs indicates that the Alaska Sub-Region Adjective – Spring Rating Criteria is very effective in all FDRAs (**Figure 32**) showing progressive frequencies of Ignition Days from low to extreme classes:

- The mean likelihood of a fire occurrence with a low rating is approx. 1%.
- The mean likelihood of a fire occurrence with a moderate rating is generally around 2%.
- The mean likelihood of a fire occurrence with a high rating is approximately 4%.
- The mean likelihood of a fire occurrence with a very high rating is approximately 6%.
- The mean likelihood of a fire occurrence with an extreme rating is approximately 9%.

Conclusion

The Alaska Sub-Region Spring Adjective Class Rating system can be a useful decision tool in Alaska fire danger rating system from April 1 to May 31. The ASR – Spring adjective rating system performed surprisingly well regarding progressively increasing conditional frequencies. Conducting this type of analysis could result in better distributed condition frequencies if the analysis were completed at the FDRA level. Finally, the vapor pressure deficit (VPD) was not available in the dataset utilized for this analysis. There is evidence that VPD could improve the performance of this danger rating system analysis. Future work on fire danger rating should evaluate the VPD through the Best-fit portion of this analysis and potential include the VPD in future Alaska Fire Danger Rating System products.

Note: The Alaska Sub-Region Adjective Class system (ASR-Spring and ASR-Summer) was designed as a statewide product by the National Park Service, Deputy Regional Fire Management Officer, Larry Weddle.

Appendix G: Spruce Adjective Rating (SAR) Validation Analysis

In 2024 an updated validation analysis was completed for SAR adjective classes using conditional frequencies. Conditional frequencies were calculated utilizing VIIRS Day and VIIRS Detections (2012-2022) and MODIS Day and MODIS Detections (2002-2022). The analysis was completed to evaluate the current effectiveness in regard to MODIS and VIIRS detections. See **Figures 34-37** below and **Appendix I** for additional information regarding the results of the analysis.

Inputs

Fire Growth (MODIS and VIIRS active fire detections) database, daily FWI database, and legacy FWI thresholds.

Methodology

Conditional frequency analysis of Fire Growth Days and individual Fire Growth records for the period of 2003-2022 (June 1 thru September 31) by FDRA:

- Develop distributions of All Days (6/1-9/31), Growth Days (i.e., any day where at least one MODIS and VIIRS detection was observed during a 24-hr period) and Growth Events (i.e., the number of MODIS and VIIRS detects per day) by adjective class (Low to Extreme), producing a table of frequencies by adjective class in each dataset (MODIS Day, MODIS Detect, VIIRS Day and VIIRS Detect data sets).
- Divide the subtotals in each of the 5 adjective classes (Low, Moderate, High, Very High, and Extreme) from the Growth Days and Growth Events by the subtotals from the All-Days distribution.
- Compare conditional frequencies in the tables and evaluate prospective thresholds.

This conditional frequency analysis was conducted on the Spruce adjective classes to validate their efficacy in representing trends in potential of fire growth. This analysis is conducted using the FWI, MODIS Fire Growth Days, MODIS Growth Detects, VIIRS Growth Days and VIIRS Growth Detect Days for the period 2003-2022.

This comparison of MODIS growth days for individual FDRAs within the boreal interior ecoregion shows that the Spruce Adjective Rating (SAR) criteria are very effective in showing progressive frequencies from low to extreme classes **(Figure 33):**

- The likelihood of a growth day with a low rating is less than 1%.
- The likelihood of a growth day with a moderate rating is generally around 3%.
- The likelihood of a growth day with a high rating is about 9%.
- The likelihood of a growth day with a very high rating approach 21%.
- The likelihood of a growth day with an extreme rating is over 31%.

This comparison of MODIS growth detects for individual FDRAs within the boreal interior ecoregion shows that the spruce criteria is also very effective in showing progressive frequencies from low to extreme SAR classes **(Figure 34):**

- The likelihood suggests less than 0.1 detects for low days.
- The likelihood suggests about 0.5 detects for moderate days.
- The likelihood suggests 2 detects for high days.

- The likelihood suggests more than 8 detects for very high days.
- The likelihood suggests more than 20 detects for extreme days.

This comparison of VIIRS growth days for individual FDRAs within the boreal interior ecoregion shows that the Spruce Adjective Rating (SAR) criteria are very effective in showing progressive frequencies from low to extreme classes **(Figure 35):**

- The likelihood of a growth day with a low rating is 1%.
- The likelihood of a growth day with a moderate rating is generally 3%.
- The likelihood of a growth day with a high rating is about 9%.
- The likelihood of a growth day with a very high rating approach 21%.
- The likelihood of a growth day with an extreme rating is over 31%.

This comparison of VIIRS growth detects for individual FDRAs within the boreal interior ecoregion shows that the spruce criteria is also very effective in showing progressive frequencies from low to extreme SAR classes **(Figure 36):**

- The likelihood suggests less than 0.2 detects for low days.
- The likelihood suggests about 1.6 detects for moderate days.
- The likelihood suggests 4.3 detects for high days.
- The likelihood suggests more than 21 detects for very high days.
- The likelihood suggests more than 56 detects for extreme days.

Conditional frequency analysis coupled with the FWI thresholds identified in **(Table 1)** produce a set of criteria for defining daily fire danger during the most active seasons across the boreal landscape. This includes primarily the Duff-Driven Stage and the Drought-Driven Stage, though the higher likelihood for large fire growth in the Wind-Driven Stage also seems to be well reflected in this set of criteria.

There is insufficient data in the MODIS fire growth database to conduct conditional frequency analysis in the panhandle and south-central FDRAs. However, an analysis of the fire occurrence (ignitions) data, enhanced with identification of additional growth days from daily growth records for the Kenai Peninsula, suggests that the SAR criteria are effective throughout the forested landscapes of Alaska.

Spruce Adjective (2003-2022 MODIS Day. Conditional Frequency)

	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK09
Low	0.005	0.004	0.013	0.012	0.012	0.009	0.009
Mod	0.011	0.008	0.030	0.045	0.044	0.038	0.040
High	0.033	0.032	0.097	0.118	0.111	0.122	0.086
Vhigh	0.148	0.102	0.207	0.247	0.274	0.227	0.247
Ext	0.408	0.125	0.364	0.434	0.288	0.239	0.306

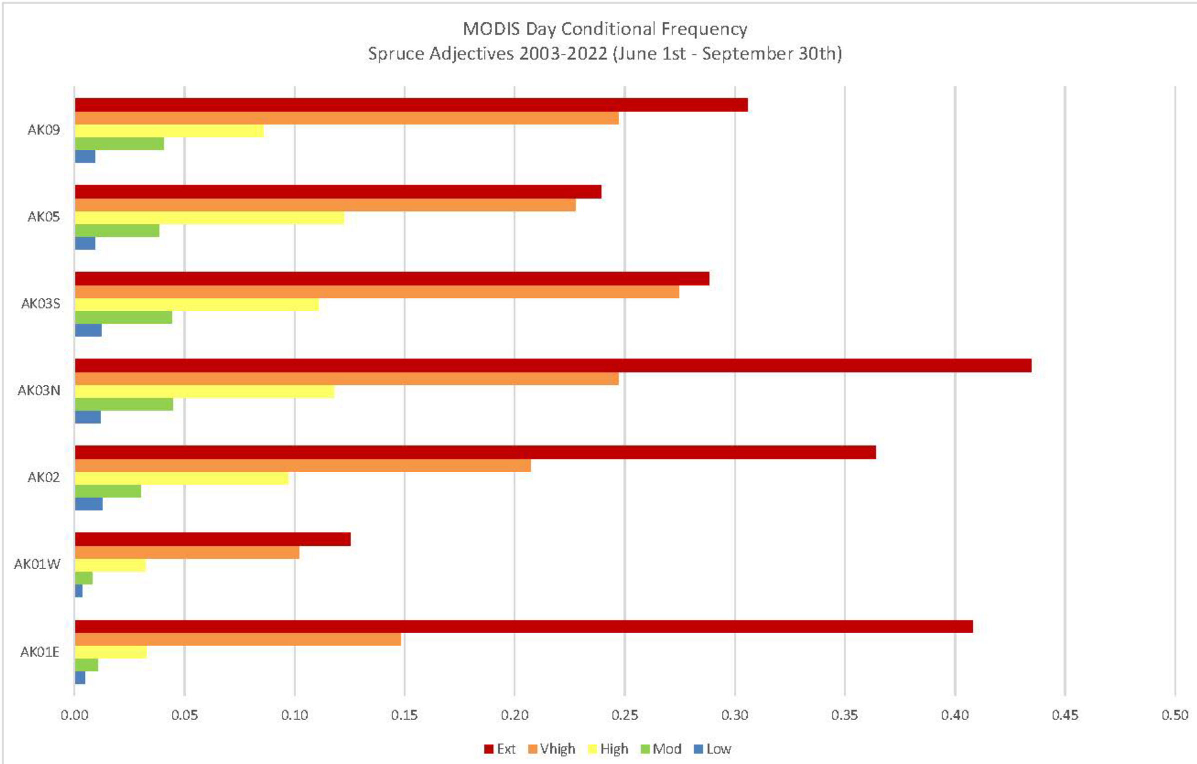


Figure 33: MODIS Observation Day by Spruce Adjective Rating Conditional Frequency

Horizontal bar graph showing MODIS Day conditional frequency by Fire Danger Rating Area and Spruce Adjective Class (low through extreme).

Spruce Adjective (2003-2022 MODIS Detect. Conditional Frequency)

	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK09
Low	0.061	0.034	0.151	0.109	0.123	0.122	0.100
Mod	0.055	0.060	0.481	0.493	0.448	0.781	1.099
High	0.344	0.375	2.002	2.231	2.525	4.497	1.783
Vhigh	6.477	3.033	8.913	11.466	11.201	9.232	7.039
Ext	18.852	6.040	31.640	37.221	15.218	10.870	22.972

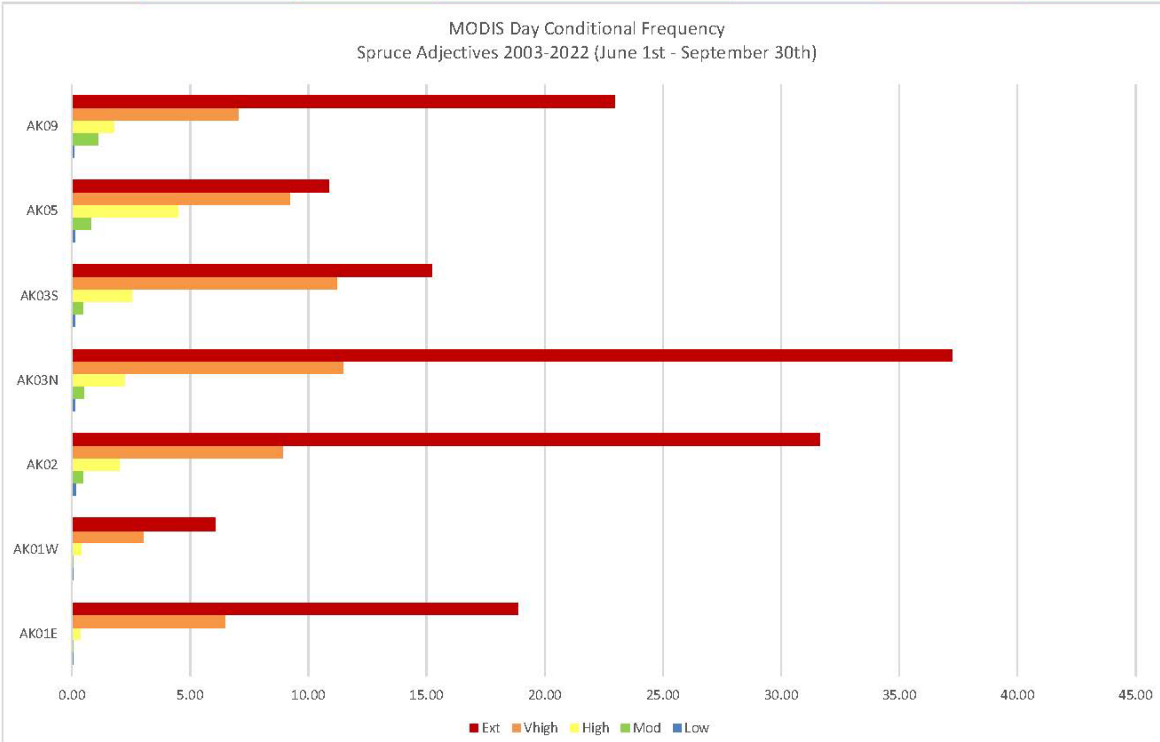


Figure 34: Spruce Adjective Rating MODIS Detects Conditional Frequency

Spruce Adjective (2012-2022 VIIRS Day. Conditional Frequency)

	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK09
Low	0.005	0.005	0.011	0.011	0.015	0.010	0.012
Mod	0.013	0.008	0.025	0.041	0.046	0.033	0.045
High	0.030	0.029	0.070	0.111	0.141	0.131	0.109
Vhigh	0.147	0.087	0.160	0.250	0.290	0.235	0.275
Ext	0.469	0.089	0.217	0.475	0.285	0.235	0.383

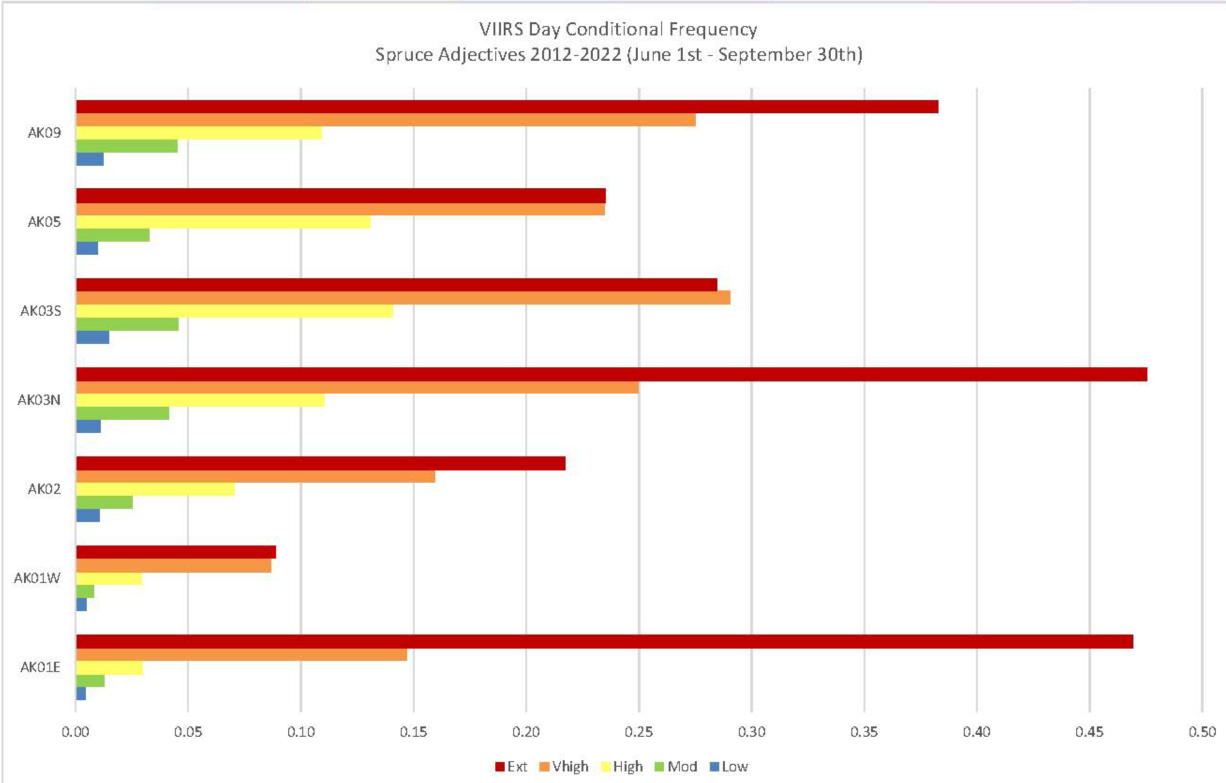


Figure 35: Spruce Adjective Rating VIIRS Growth Days Conditional Frequency

Spruce Adjective (2012-2022 VIIRS Detect. Conditional Frequency)

	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK09
Low	0.025	0.112	0.191	0.230	0.414	0.182	0.397
Mod	0.101	0.119	0.465	1.345	1.902	0.799	6.410
High	0.661	0.754	3.101	5.525	8.018	4.016	8.166
Vhigh	4.288	5.701	15.716	23.744	37.016	34.430	27.527
Ext	33.947	8.490	34.860	136.934	65.755	24.500	88.062

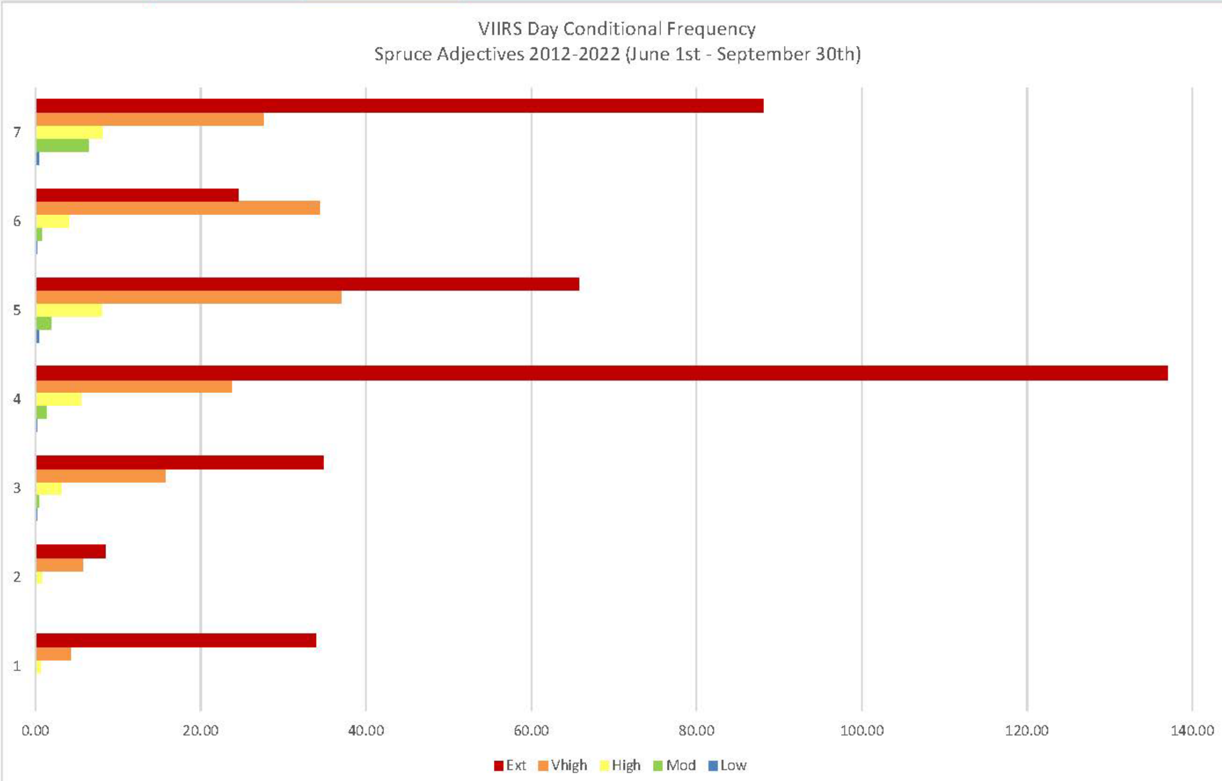


Figure 36: Spruce Adjective Rating VIIRS Detects Conditional Frequency

Appendix H: ASR – Summer Adjective Class Rating Analysis

In 2024 the ASR - Summer Adjective threshold analysis using conditional frequencies was completed. Results utilizing fire occurrence, VIIRS Day and MODIS Day conditional frequency analysis indicated a significant improvement compared to the original threshold analysis therefore the thresholds for the ASR-Summer Adjective were updated (See **Table 5**).

Inputs

Fire Occurrence, Fire Growth (MODIS and VIIRS active fire detections) database, and daily FWI database.

Methodology

Conditional frequency analysis of Fire Occurrence, Fire Growth Days (VIIRS and MODIS) and individual Fire Growth records for the period of 2003-2022 (June 1 thru September 31) by FDRA:

- Develop distributions of All Days (6/1-9/31), Growth Days (i.e., any day where at least one MODIS and VIIRS detection was observed during a 24-hr period) and Growth Events (i.e., the number of MODIS and VIIRS detects per day) for the three weather/FWI criteria identified for the ASR Sub-Region (See **Table 5**). This requires associating all daily weather observations by station with FDRAs, ASR-Sub-Groups, fire occurrence, MODIS Day, MODIS Detect, VIIRS Day and VIIRS Count.
- Establish the lowest value of each weather/FWI variable where the VIIRS Detect and MODIS detect begin to peak (highest counts of MODIS and VIIRS begin). These values serve as the initial target for the beginning of adjective class 4.
- Calculate the conditional frequency (CF) (for fire occurrence, VIIRS Day and MODIS Day) of all values (group to the nearest integer) of each weather/FWI variable. Average the conditional frequency between the fire occurrence CF, VIIRS Day CF and MODIS Day CF.
- The lowest value of each weather/FWI variable (e.g., 1400 ATF, DMC, FWI) for the ASR-Sub-group is placed in class 1 (Low). Recalculate the conditional frequencies. Incrementally place the next higher weather or FWI variable with the **lowest** average conditional frequency value into class 1 (Low). The variable selected to raise the value at each incremental adjustment generally had the greatest number of weather or FWI variable observations with the least number of fire occurrence, MODIS Days and VIIRS Day (i.e., has the lowest average conditional frequency). Continue the incremental raising of each weather/FWI variable with the lowest average conditional frequency until approximately 50% of all observational are placed in class 1 (Low).
- The next higher value of each weather/FWI variable (e.g., 1400 ATF, DMC, FWI) for the ASR-Sub-group is placed in class 2 (Moderate). Recalculate the conditional frequencies. Incrementally place the next higher weather or FWI variable with the **lowest** average conditional frequency value into class 2 (Moderate). Continue the incremental raising of each weather/FWI variable with the lowest average conditional frequency until approximately 75% of all observational are placed in class 1 or 2 (Low or Moderate, respectively).
- The next higher value of each weather/FWI variable (e.g., 1400 ATF, DMC, FWI) for the ASR-Sub-group is placed in class 3 (High). Recalculate the conditional frequencies. Incrementally place the next higher weather or FWI variable with the **lowest** average conditional frequency value into class 3 (High). Continue the incremental raising of each weather/FWI variable with the lowest average conditional frequency until approximately 90% of all observational are placed in class 1 thru 3 (Low thru High).**Note:** Towards the end of the incremental placing variables into

class 3 (High) the value of each weather/FWI variable should be approaching or near the threshold value identified for the ASR Sub-Region where the VIIRS Detect and MODIS detect begin to peak (highest counts of MODIS and VIIRS begin)

- The next higher value of each weather/FWI variable (e.g., 1400 ATF, DMC, FWI) for the ASR-Sub-group is placed in class 4 (Very High). Recalculate the conditional frequencies. Incrementally place the next higher weather or FWI variable with the lowest average conditional frequency value into class 4 (Very High). Continue the incremental raising of each weather/FWI variable with the lowest average conditional frequency until approximately 97% of all observational are placed in class 1 thru 4 (Low thru Very High).
- All remaining values of each weather/FWI variable are placed in class 5 (Extreme).

Note: A complete set of methodologies, procedures and the database will reside on the Fire Danger Operating Committee Teams SharePoint Site.

Results

Figure 37 compares frequency of Ignition Days (days that a new fire was discovered) for individual FDRAs and shows that the ASR – Summer Adjective Class Rating Criteria is very effective in all FDRAs, showing progressive frequencies of Ignition Days from low to extreme classes:

- The likelihood of a fire igniting on a day with a low rating is less than 1%.
- The likelihood of an Ignition Day with a moderate rating is generally around 1%.
- The likelihood of an Ignition Day with a high rating is about 3%.
- The likelihood of an Ignition Day with a very high rating approach 5%.
- The likelihood of an Ignition Day with an extreme rating about 9%.

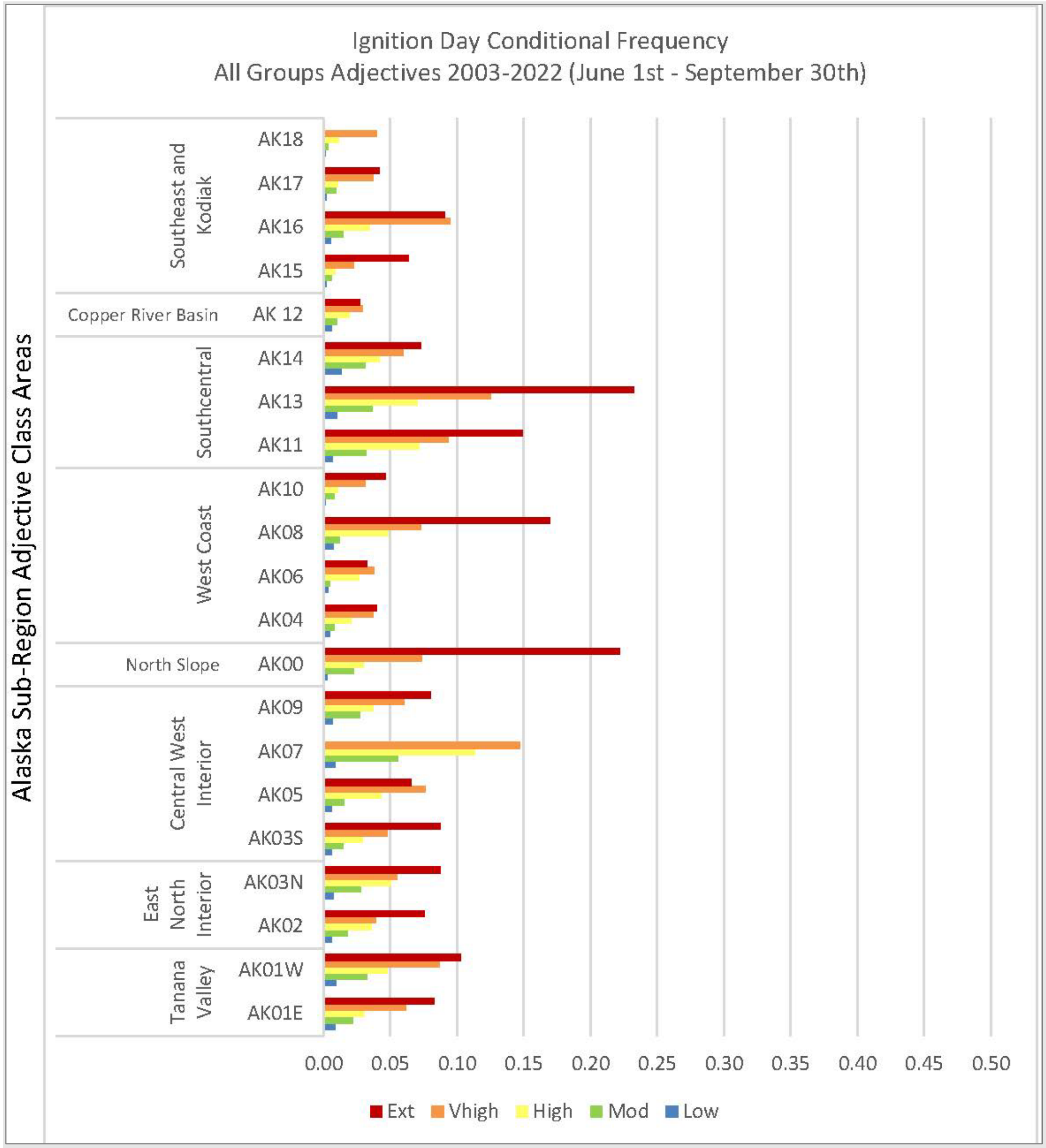


Figure 37: ASR – Summer Adjective Rating Ignition Day Conditional Frequency.

The following figures compare frequency of MODIS fire growth days (**Figure 38**) and VIIRS Fire Growth Days (**Figure 39**) for individual FDRAs. MODIS and VIIRS Fire Growth Days is any day where at least one MODIS or VIIRS detection was observed during a 24-hr period. It shows that the ASR – Summer Adjective Rating Criteria is very effective in most FDRAs, except in Southeast and Kodiak, showing progressive increasing frequencies of MODIS and VIIRS growth days from low to extreme classes.

MODIS Day

- The likelihood of a growth day with a low rating is less than 1%.
- The likelihood of a growth day with a moderate rating is generally around 2%.
- The likelihood of a growth day with a high rating is about 5%.
- The likelihood of a growth day with a very high rating approach 10%.

- The likelihood of a growth day with an extreme rating is over 20%.

VIIRS Day

- The likelihood of a growth day with a low rating is less than 1%.
- The likelihood of a growth day with a moderate rating is generally around 2%.
- The likelihood of a growth day with a high rating is about 5%.
- The likelihood of a growth day with a very high rating approach 10%.
- The likelihood of a growth day with an extreme rating is over 20%.

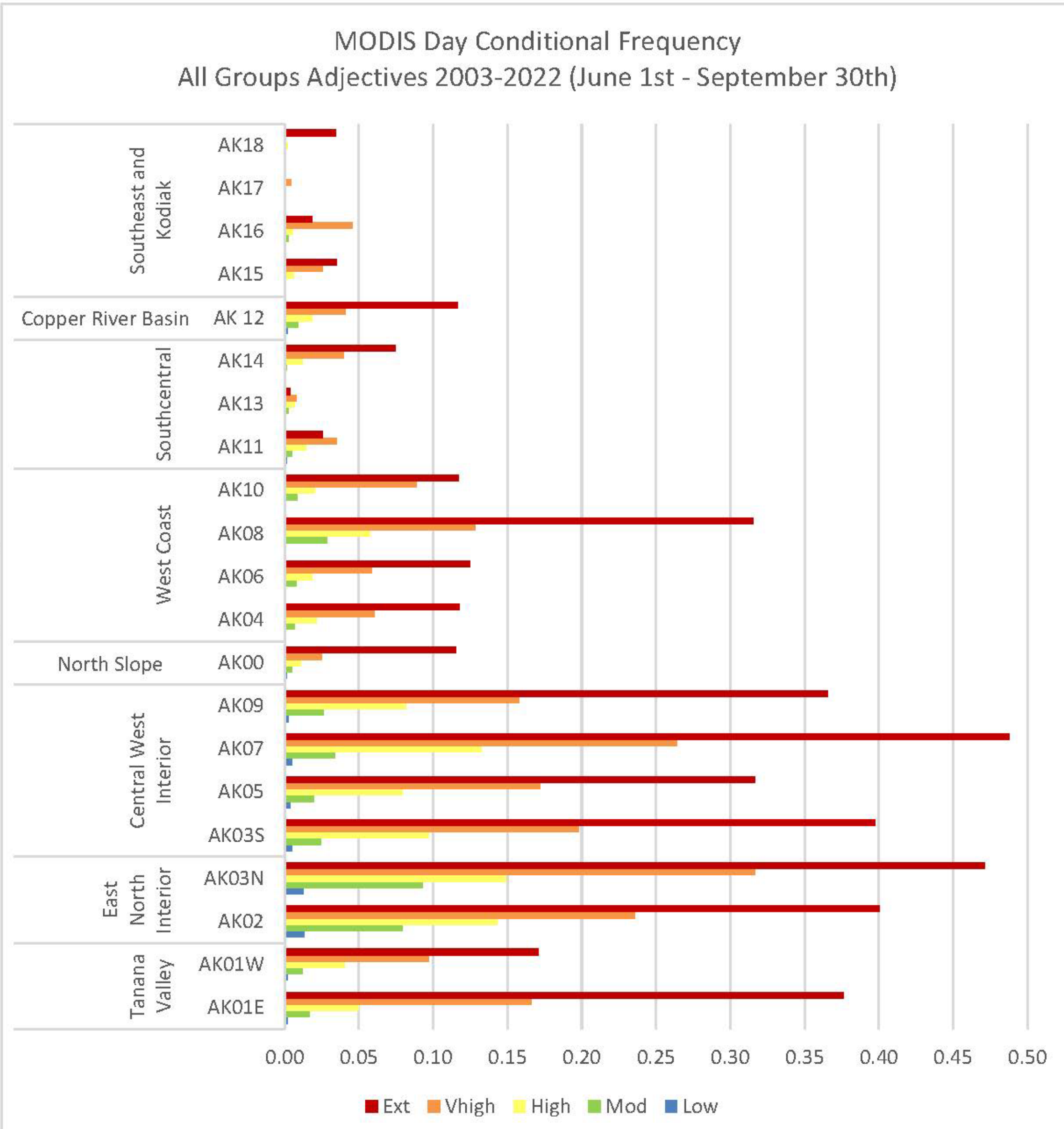


Figure 38: ASR – Summer Adjective Rating MODIS Day Conditional Frequency

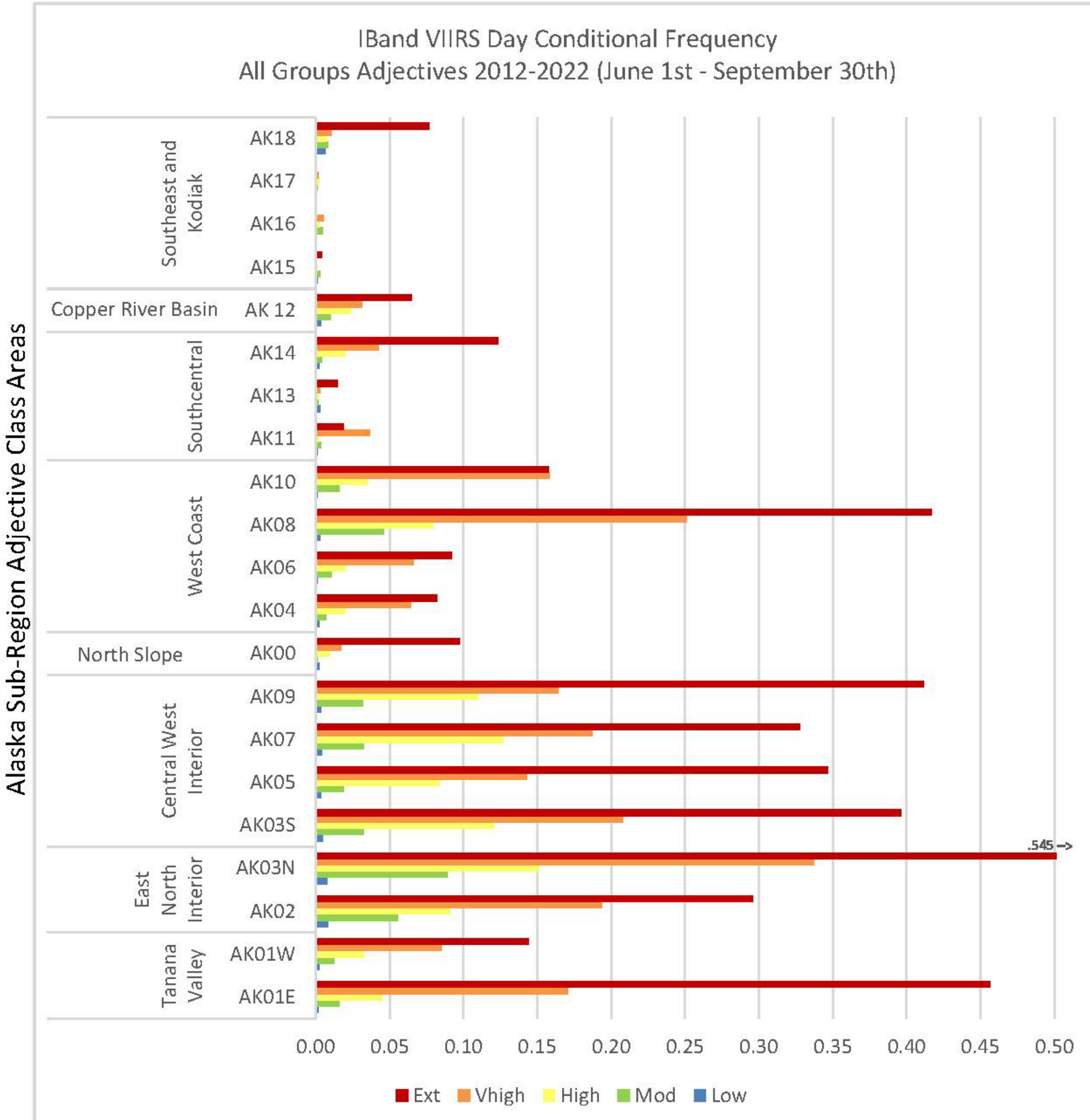


Figure 39: ASR-Summer Adjective Rating VIIRS Growth Days Conditional Frequency

The following figures **(Figures 40 and 41)** compare MODIS growth detects for individual FDRAs and VIIRS growth detects for individual FDRAs. MODIS and VIIRS growth detects are defined as the number of MODIS and VIIRS detects per day. It shows that the Alaska Sub-Region Adjective Rating Criteria is very effective in most FDRAs, excepting Southeast Alaska and Kodiak, showing progressive increasing frequencies of MODIS detects from low to extreme classes.

MODIS Detects:

- The likelihood suggests less than 0.02 detects for low days.
- The likelihood suggests about 0.32 detects for moderate days.
- The likelihood suggests about 1 detects for high days.
- The likelihood suggests more than 3 detects for very high days.

- The likelihood suggests more than 12 detects for extreme days.

VIIRS Detects:

- The likelihood suggests less than 0.05 detects for low days.
- The likelihood suggests about 1 detects for moderate days.
- The likelihood suggests about 2 detects for high days.
- The likelihood suggests more than 9 detects for very high days.
- The likelihood suggests more than 32 detects for extreme days.

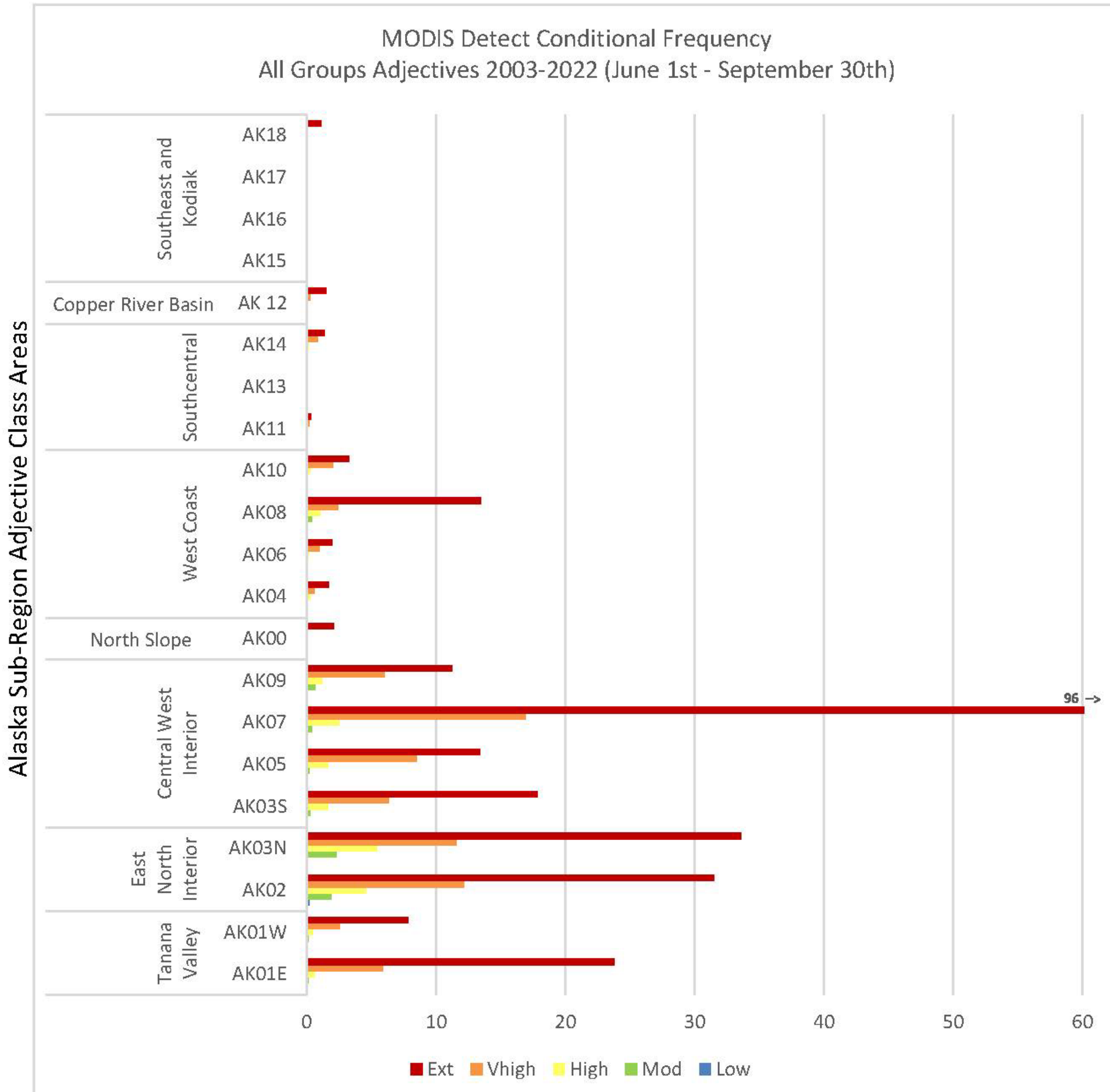


Figure 40: ASR – Summer Adjective Rating MODIS Detect Conditional Frequency.

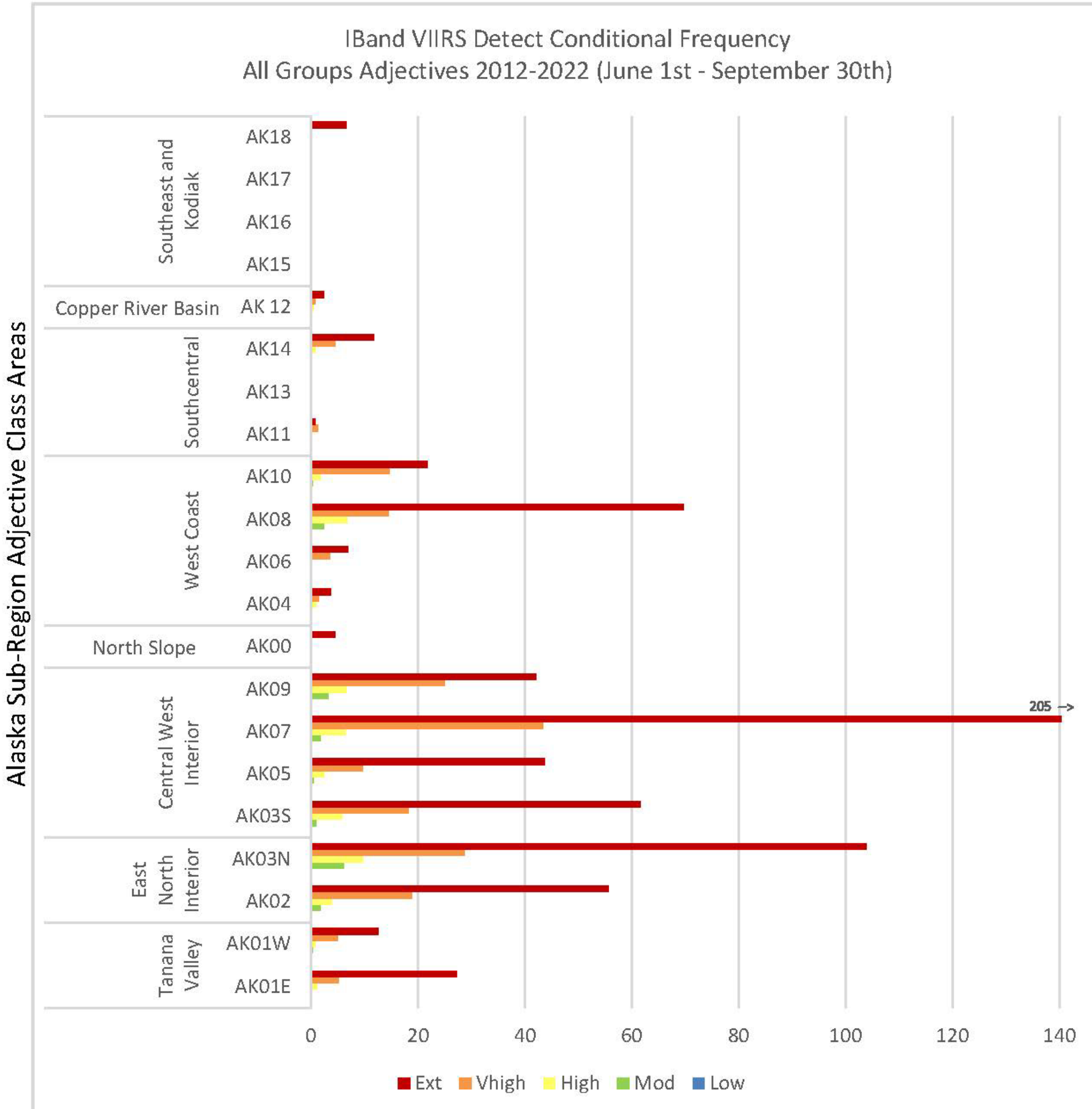


Figure 41: ASR-Summer Adjective Rating VIIRS Detects Conditional Frequency

Note: The Alaska Sub-Region Adjective Class system (ASR-Spring and ASR-Summer) was designed as a statewide product by the National Park Service, Alaska Region, Deputy Regional Fire Management Officer, Larry Weddle.

Appendix I: Conditional Frequency Analysis Results (2024)

In 2024 a validation analysis, using conditional frequency (CF), comparing historic satellite heat detection occurrence and frequency (VIIRS and MODIS) and fire occurrence with the recorded daily adjective class ratings (SAR, GAR, ASR-Spring and ASR-Summer) was completed. These selected wildfire variables were used to represent ignition, fire growth and magnitude of fire growth potential:

- Fire Occurrence as an indicator of ignition potential.
- MODIS Day and VIIRS Day as an indicator of potential for ignition and fire growth.
- Number of MODIS Detections and number of VIIRS Detections as an indicator of the magnitude for potential fire growth.

In general, like the NWCG Fire Danger Adjective Class Codes, an increasing adjective class rating (1 → 5) should indicate an increasing fire potential (ignition, growth, magnitude of growth, etc.). This analysis sought to review, from historical records (fire occurrence, MODIS Days, VIIRS Days, number of MODIS Detections, and number of VIIRS Detections) what happened in the analysis period in conditional frequencies by adjective class. For example, within a defined area (FDRA) and time period if there are 100 days where the GAR was recorded as High (Class 3) and 10 of those days at least one VIIRS detection was recorded (VIIRS Day) the resulting CF of VIIRS Days is .100 or 10% (CF .100 x 100 = 10%, 10% of the observations with an adjective class of High also had VIIRS Days). A method to evaluate the effectiveness is the lowest adjective class rating (Low – Class 1) should have the lowest conditional frequency (near zero) and the highest adjective class rating (Extreme —Class 5) should have the highest conditional frequency. In effect, evaluating if the lowest frequency of wildfire activity is recorded at the Low adjective class rating and if the highest frequency of wildfire activity is recorded at the highest (Extreme) adjective class rating.

Figure 42 below summarizes by Boreal Interior Forest FDRAs (FDRAs AK01E, AK01W, AK02, AK03N, AK03S, AK05 and AK09) and Non- Boreal Interior Forest FDRAs (all remaining FDRAs) the conditional frequency by adjective class for fire occurrence, MODIS Days, VIIRS Days, number of MODIS Detections, and number of VIIRS Detections. All adjective classes across nearly all wildfire parameters indicate the lowest CF at the Low adjective class rating and the highest CF at the Extreme adjective class rating.

Comparing the GAR to the ASR-Spring the GAR indicates the lowest CF for both the Boreal Interior Forest and Non- Boreal Interior Forest FRDAs for fire occurrence and IBand VIIRS Day at the Low (Class 1), therefore historically indicating the lowest fire occurrence MODIS Day and Iband VIIRS Day at the Low (Class – 1) GAR. This illustrates that at the Low rating the GAR is less likely to have a new ignition (fire occurrence) or a fire growth day (MODIS Day, Iband VIIRS Day) then the ASR-Spring at a Low rating. Comparing the GAR to the ASR-Spring the ASR-Spring indicates the highest CF for the Boreal Interior Forest and Non-Boreal Interior Forest FDRAs for fire occurrence and MODIS Day and Iband VIIRS Day at the Extreme (Class 5). This illustrates in the Boreal Interior Forest and Non- Boreal Interior Forest FDRAs at the Extreme rating the ASR-Spring is more likely to have new ignitions (fire occurrence) or a fire growth day (MODIS Day, Iband VIIRS Day) then GAR at the Extreme Rating.

While there are relatively few large fire growth days, as is illustrated by MODIS-Detects and IBand VIIRS Detects, in the analysis period (2003-2022, April 1 – May 31) there is evidence in the IBand VIIRS-Detects analysis that GAR, at the Extreme rating, is more likely to identify high magnitude growth days in the Non- Boreal Interior Forest FDRAs. This is illustrated with GAR having a CF value three times higher than the ASR-Spring CF value for the Non- Boreal Interior Forest FDRAs IBand VIIRS-Detect CF results.

A likewise comparison CF between the SAR and ASR-Summer illustrate where each of the adjective classes have the lowest CF at the Low rating and highest CF as the Extreme rating. The ASR-Summer has the lowest CF, or the same lowest CF value as SAR, for both Boreal Interior Forest FRDAs and Non-Boreal Interior Forest FDRAs at the Low (Class – 1) for all wildfire parameters. This illustrates that the ASR-Summer is the least likely to have ignition, growth days, or high magnitude growth days at the Low (Class – 1) adjective rating compared to SAR.

Comparing the SAR to the ASR-Summer the ASR-Summer indicates the highest CF for both the Boreal Interior Forest FDRAs and Non- Boreal Interior Forest FDRAs for fire occurrence, Iband VIIRS Day and MODIS Day at the Extreme (Class 5). This illustrates that the ASR-Summer is the most likely to have ignition and growth days at the Extreme adjective rating compared to SAR.

The SAR largely indicates the highest CF for both the Boreal Interior Forest FDRAs and Non- Boreal Interior Forest FDRAs for Iband VIIRS – Detect and MODIS – Detect at the Extreme (Class 5). This illustrates that the SAR is the most likely to experience the highest magnitude growth days at the Extreme adjective rating compared to ASR-Summer.

Caution: Analyzing the conditional frequency results by summarizing results into the Boreal Interior Forest FDRAs and Non- Boreal Interior Forest FDRAs obscures the results at the individual FRDA scale. For instance, the GAR, from a conditional frequency perspective, performs extremely well in FDRAs AK11, AK13 and AK14 for fire occurrence (ignition potential) in the analysis period. See **Figures 43-47** below for a detailed comparison of conditional frequency analysis by FDRA and Adjective Class for fire occurrence, MODIS Days, VIIRS Days, MODIS # of Detections, and VIIRS # of Detections.

	Fire Occurrence		**Iband VIIRS - Day**		**MODIS Day**		**Iband VIIRS - Detect**		**MODIS Detect**	
	(2003-2022)		(2012-2022)		(2003-2022)		(2012-2022)		(2003-2022)	
	Boreal Interior PSAs	Non-Boreal Interior PSAs	Boreal Interior PSAs	Non-Boreal Interior PSAs	Boreal Interior PSAs	Non-Boreal Interior PSAs	Boreal Interior PSAs	Non-Boreal Interior PSAs	Boreal Interior PSAs	Non-Boreal Interior PSAs
Grass Adjective - April 1st - May 31st										
Low	0.008	0.006	0.002	0.001	0.004	0.001	0.0	0.0	0.0	0.0
Mod	0.013	0.018	0.004	0.003	0.006	0.003	0.0	0.0	0.1	0.0
High	0.022	0.030	0.004	0.006	0.012	0.007	0.1	0.1	0.1	0.1
Vhigh	0.034	0.049	0.009	0.010	0.022	0.013	0.2	0.2	0.3	0.1
Ext	0.048	0.082	0.036	0.010	0.065	0.013	0.3	3.5	1.3	1.1
Alaska Sub-Region Spring Adjective - April 1st - May 31st										
Low	0.010	0.009	0.003	0.001	0.003	0.001	0.0	0.0	0.0	0.0
Mod	0.021	0.022	0.005	0.003	0.009	0.004	0.1	0.0	0.1	0.0
High	0.035	0.036	0.007	0.006	0.019	0.006	0.1	0.2	0.1	0.1
Vhigh	0.057	0.061	0.013	0.016	0.041	0.025	0.4	0.3	0.7	0.4
Ext	0.062	0.105	0.030	0.030	0.102	0.052	0.5	1.1	2.2	1.3
Spruce Adjective - June 1st - September 30th										
Low	0.006	0.006	0.010	0.005	0.009	0.004	0.2	0.1	0.1	0.0
Mod	0.012	0.023	0.030	0.024	0.031	0.021	1.6	1.0	0.5	0.2
High	0.026	0.043	0.089	0.062	0.086	0.052	4.3	4.5	2.0	1.4
Vhigh	0.046	0.080	0.206	0.090	0.208	0.096	21.2	22.7	8.2	6.2
Ext	0.073	0.061	0.308	0.041	0.309	0.055	56.1	12.9	20.4	3.4
Alaska Sub-Region Summer Adjective - June 1st - September 30th										
Low	0.004	0.003	0.004	0.002	0.006	0.001	0.1	0.0	0.1	0.0
Mod	0.016	0.012	0.037	0.011	0.039	0.008	1.8	0.3	0.8	0.1
High	0.034	0.024	0.090	0.025	0.091	0.023	4.3	1.3	2.2	0.3
Vhigh	0.058	0.050	0.186	0.063	0.192	0.059	15.8	6.0	7.6	1.7
Ext	0.084	0.086	0.371	0.105	0.357	0.113	49.6	23.8	19.9	8.7

Figure 42: Summary Conditional Frequency performance of GAR, SAR, ASR – Spring, ASR – Summer for Interior Boreal Forest FDRA's and Non-Interior Boreal Forest FDRAs.

The following **Figures (43-47)**, for all individual FDRAs, identify the conditional frequencies for all adjective class levels (Low – Extreme) for GAR, SAR, ASR – Spring and ASR – Summer for fire occurrence, VIIRS Day, MODIS Day, VIIRS-Detect and MODIS-Detect. Depending on the wildfire variable(s) of interest (ignition, growth potential and/or magnitude of growth potential) the following tables can assist a program select an adjective class(s) that supports fire management decisions and/or planning in your area. In evaluating the following tables there are four main criteria to review.

1. Do the adjective class conditional frequency values in your FDRA(s) progressively increase from the Low to High to Extreme classes?
2. How low is the conditional frequency value in the Low adjective class level? Is it the lowest value? How high of a value is acceptable? (The higher the CF value the higher the likelihood of the wildfire variable event.)
3. How high is the conditional frequency value in the Very High and Extreme adjective class level? Are they the highest? How low of a value is acceptable? (The lower the CF value the lower the likelihood of the wildfire variable event.)
4. If your program is interested in more than one wildfire variable (ignition, growth potential and/or magnitude of growth potential), then repeat steps 1-3 above on the corresponding Figures.

Note: The GAR and ASR – Spring conditional frequencies are included in **Figures (44-47)**, however caution should be utilized when referencing these table for GAR and ASR-Spring as there are few satellite heat detections (VIIRS and MODIS) during the April 1st to May 31st analysis period.

2003-2022 Fire Occurrence (Conditional Frequency)

June 1st - September 30th

Spruce Adjective

	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK07	AK09	AK00	AK04	AK06	AK08	AK10	AK11	AK13	AK14	AK 12	AK15	AK16	AK17	AK18
Low	0.008	0.008	0.005	0.007	0.005	0.000	0.008	0.006	0.005	0.005	0.004	0.008	0.002	0.007	0.010	0.013	0.005	0.002	0.007	0.003	0.002
Mod	0.015	0.018	0.009	0.010	0.010	0.001	0.052	0.022	0.041	0.013	0.013	0.038	0.009	0.027	0.027	0.029	0.008	0.010	0.022	0.013	0.016
High	0.022	0.037	0.020	0.031	0.029	0.006	0.081	0.039	0.041	0.029	0.038	0.100	0.021	0.056	0.076	0.041	0.015	0.013	0.072	0.021	0.000
Vhigh	0.049	0.068	0.037	0.059	0.048	0.006	0.175	0.052	0.074	0.054	0.094	0.213	0.063	0.112	0.141	0.058	0.025	0.071	0.021	0.026	0.000
Ext	0.088	0.094	0.069	0.057	0.100	0.000	0.000	0.102	0.000	0.095	0.000	0.111	0.083	0.179	0.217	0.064	0.035	0.077	0.000	0.000	0.000

Alaska Sub-Region Adjective - Summer (2024)

	Tanana Valley		East North Interior			Central West Interior			North Slope		West Coast			Southcentral			Copper River Basin		Southeast and Kodiak		
	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK07	AK09	AK00	AK04	AK06	AK08	AK10	AK11	AK13	AK14	AK 12	AK15	AK16	AK17	AK18
Low	0.006	0.006	0.004	0.005	0.002	0.002	0.004	0.003	0.003	0.002	0.001	0.002	0.001	0.004	0.006	0.009	0.004	0.001	0.005	0.002	0.001
Mod	0.015	0.022	0.016	0.022	0.008	0.012	0.024	0.016	0.003	0.007	0.007	0.015	0.004	0.024	0.026	0.027	0.010	0.004	0.012	0.005	0.003
High	0.031	0.042	0.028	0.049	0.025	0.030	0.064	0.033	0.025	0.016	0.016	0.035	0.005	0.040	0.048	0.035	0.017	0.005	0.017	0.010	0.006
Vhigh	0.055	0.060	0.052	0.076	0.047	0.060	0.122	0.055	0.035	0.036	0.033	0.077	0.031	0.100	0.104	0.060	0.025	0.012	0.046	0.017	0.008
Ext	0.068	0.105	0.070	0.089	0.081	0.099	0.159	0.078	0.090	0.058	0.088	0.207	0.046	0.124	0.174	0.064	0.042	0.030	0.083	0.032	0.000

April 1st - May 31st

Grass Adjective

	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK07	AK09	AK00	AK04	AK06	AK08	AK10	AK11	AK13	AK14	AK 12	AK15	AK16	AK17	AK18
Low	0.012	0.021	0.000	0.011	0.001	0.006	0.000	0.003	0.000	0.000	0.000	0.005	0.002	0.009	0.041	0.020	0.003	0.001	0.005	0.002	0.003
Mod	0.021	0.036	0.004	0.007	0.006	0.008	0.018	0.010	0.000	0.004	0.005	0.012	0.003	0.041	0.069	0.051	0.011	0.006	0.009	0.001	0.016
High	0.017	0.064	0.011	0.005	0.009	0.033	0.010	0.014	0.000	0.008	0.000	0.065	0.003	0.074	0.133	0.085	0.014	0.011	0.022	0.000	0.000
Vhigh	0.047	0.101	0.017	0.008	0.011	0.014	0.059	0.040	0.000	0.010	0.005	0.054	0.013	0.096	0.229	0.084	0.020	0.006	0.057	0.025	0.026
Ext	0.097	0.111	0.017	0.000	0.042	0.000	0.000	0.071	0.000	0.000	0.000	0.000	0.000	0.444	0.405	0.292	0.000	0.000	0.000	0.000	0.000

Alaska Sub-Region Adjective - Spring (2024)

	Tanana Valley		East North Interior			Central West Interior			North Slope		West Coast			Southcentral			Copper River Basin		Southeast and Kodiak		
	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK07	AK09	AK00	AK04	AK06	AK08	AK10	AK11	AK13	AK14	AK 12	AK15	AK16	AK17	AK18
Low	0.017	0.035	0.002	0.004	0.001	0.005	0.004	0.003	0.000	0.000	0.000	0.005	0.001	0.018	0.053	0.033	0.005	0.001	0.004	0.002	0.002
Mod	0.025	0.072	0.006	0.009	0.008	0.013	0.010	0.013	0.000	0.004	0.003	0.011	0.004	0.051	0.101	0.063	0.016	0.004	0.012	0.004	0.020
High	0.043	0.104	0.018	0.026	0.007	0.018	0.043	0.026	0.000	0.010	0.012	0.040	0.008	0.096	0.139	0.085	0.020	0.007	0.011	0.000	0.026
Vhigh	0.099	0.127	0.033	0.000	0.014	0.056	0.172	0.071	0.000	0.009	0.000	0.067	0.020	0.110	0.231	0.097	0.019	0.013	0.061	0.018	0.040
Ext	0.077	0.096	0.044	0.000	0.053	0.071	0.667	0.096	0.000	0.025	0.029	0.125	0.009	0.143	0.237	0.060	0.038	0.000	0.080	0.054	0.000

Figure 43: Fire Occurrence - Conditional Frequency performance of GAR, SAR, ASR – Spring and ASR – Summer.

2012-2022 Iband VIIRS - Day (Conditional Frequency)

June 1st - September 30th

Spruce Adjective

	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK07	AK09	AK00	AK04	AK06	AK08	AK10	AK11	AK13	AK14	AK 12	AK15	AK16	AK17	AK18
Low	0.005	0.005	0.011	0.011	0.015	0.010	0.009	0.012	0.004	0.004	0.004	0.019	0.006	0.001	0.002	0.002	0.004	0.002	0.001	0.000	0.007
Mod	0.013	0.008	0.025	0.041	0.046	0.033	0.084	0.045	0.006	0.017	0.029	0.110	0.055	0.004	0.004	0.006	0.007	0.000	0.000	0.006	0.014
High	0.030	0.029	0.070	0.111	0.141	0.131	0.179	0.109	0.048	0.062	0.053	0.268	0.147	0.000	0.002	0.024	0.024	0.000	0.014	0.000	0.039
Vhigh	0.147	0.087	0.160	0.250	0.290	0.235	0.298	0.275	0.040	0.064	0.156	0.413	0.116	0.036	0.011	0.075	0.034	0.018	0.000	0.000	0.000
Ext	0.469	0.089	0.217	0.475	0.285	0.235	0.000	0.383	0.000	0.000	0.000	0.125	0.000	0.167	0.015	0.241	0.029	0.000	0.000	0.000	0.000

Alaska Sub-Region Adjective - Summer (2024)

	Tanana Valley		East North Interior			Central West Interior			North Slope		West Coast				Southcentral		Copper River Basin		Southeast and Kodiak		
	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK07	AK09	AK00	AK04	AK06	AK08	AK10	AK11	AK13	AK14	AK 12	AK15	AK16	AK17	AK18
Low	0.002	0.002	0.008	0.008	0.005	0.004	0.004	0.003	0.002	0.002	0.001	0.003	0.001	0.001	0.003	0.002	0.003	0.001	0.001	0.000	0.007
Mod	0.016	0.012	0.056	0.089	0.032	0.019	0.033	0.032	0.001	0.007	0.010	0.046	0.016	0.004	0.002	0.004	0.010	0.003	0.005	0.001	0.008
High	0.045	0.033	0.091	0.151	0.120	0.084	0.127	0.110	0.009	0.020	0.020	0.079	0.035	0.002	0.001	0.020	0.023	0.001	0.002	0.002	0.007
Vhigh	0.171	0.085	0.194	0.337	0.208	0.143	0.187	0.164	0.017	0.064	0.066	0.251	0.158	0.037	0.003	0.042	0.031	0.000	0.005	0.002	0.011
Ext	0.457	0.144	0.296	0.545	0.396	0.347	0.328	0.412	0.097	0.082	0.092	0.417	0.158	0.019	0.015	0.124	0.065	0.004	0.000	0.000	0.077

April 1st - May 31st

Grass Adjective

	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK07	AK09	AK00	AK04	AK06	AK08	AK10	AK11	AK13	AK14	AK 12	AK15	AK16	AK17	AK18
Low	0.005	0.004	0.000	0.000	0.002	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.004	0.000	0.000	0.001	0.000
Mod	0.008	0.016	0.001	0.000	0.000	0.000	0.004	0.002	0.000	0.002	0.000	0.009	0.002	0.000	0.006	0.006	0.003	0.000	0.003	0.000	0.004
High	0.000	0.014	0.007	0.000	0.003	0.000	0.000	0.004	0.000	0.000	0.000	0.050	0.000	0.000	0.014	0.013	0.000	0.008	0.000	0.000	0.000
Vhigh	0.008	0.033	0.011	0.000	0.000	0.000	0.000	0.010	0.000	0.007	0.000	0.051	0.005	0.026	0.008	0.016	0.008	0.000	0.000	0.005	0.017
Ext	0.050	0.033	0.000	0.000	0.000	0.000	0.000	0.167	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.136	0.000	0.000	0.000	0.000	0.000

Alaska Sub-Region Adjective - Spring (2024)

	Tanana Valley		East North Interior			Central West Interior			North Slope		West Coast				Southcentral		Copper River Basin		Southeast and Kodiak		
	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK07	AK09	AK00	AK04	AK06	AK08	AK10	AK11	AK13	AK14	AK 12	AK15	AK16	AK17	AK18
Low	0.004	0.014	0.001	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.004	0.001	0.000	0.004	0.003	0.002	0.000	0.000	0.001	0.000
Mod	0.007	0.021	0.003	0.000	0.000	0.000	0.006	0.004	0.000	0.003	0.000	0.005	0.003	0.000	0.008	0.007	0.004	0.000	0.000	0.000	0.005
High	0.004	0.035	0.011	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.036	0.000	0.000	0.009	0.016	0.009	0.003	0.006	0.000	0.000
Vhigh	0.018	0.027	0.021	0.000	0.000	0.000	0.000	0.028	0.000	0.015	0.000	0.076	0.004	0.000	0.007	0.020	0.014	0.000	0.000	0.000	0.083
Ext	0.053	0.035	0.064	0.000	0.000	0.000	0.000	0.061	0.000	0.000	0.000	0.056	0.022	0.267	0.000	0.041	0.000	0.000	0.000	0.038	0.000

Figure 44: IBand VIIRS Day Conditional Frequency performance of GAR, SAR, ASR – Spring and ASR – Summer.

2003-2022 MODIS - Day (Conditional Frequency)

June 1st - September 30th

Spruce Adjective

	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK07	AK09	AK00	AK04	AK06	AK08	AK10	AK11	AK13	AK14	AK 12	AK15	AK16	AK17	AK18
Low	0.005	0.004	0.013	0.012	0.012	0.009	0.010	0.009	0.003	0.004	0.004	0.013	0.004	0.002	0.001	0.001	0.003	0.003	0.001	0.000	0.000
Mod	0.011	0.008	0.030	0.045	0.044	0.038	0.069	0.040	0.022	0.021	0.024	0.061	0.031	0.007	0.005	0.004	0.006	0.012	0.027	0.001	0.004
High	0.033	0.032	0.097	0.118	0.111	0.122	0.217	0.086	0.054	0.059	0.052	0.142	0.085	0.012	0.005	0.014	0.016	0.021	0.028	0.005	0.016
Vhigh	0.148	0.102	0.207	0.247	0.274	0.227	0.445	0.247	0.037	0.101	0.150	0.328	0.086	0.032	0.007	0.051	0.044	0.047	0.021	0.000	0.000
Ext	0.408	0.125	0.364	0.434	0.288	0.239	0.000	0.306	0.000	0.143	0.000	0.222	0.042	0.143	0.000	0.123	0.095	0.000	0.000	0.000	0.000

Alaska Sub-Region Adjective - Summer (2024)

	Tanana Valley		East North Interior			Central West Interior			North Slope		West Coast				Southcentral		Copper River Basin		Southeast and Kodiak		
	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK07	AK09	AK00	AK04	AK06	AK08	AK10	AK11	AK13	AK14	AK 12	AK15	AK16	AK17	AK18
Low	0.002	0.002	0.013	0.013	0.005	0.004	0.005	0.002	0.001	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.002	0.001	0.000	0.000	0.000
Mod	0.016	0.012	0.079	0.093	0.025	0.020	0.034	0.026	0.005	0.007	0.008	0.028	0.009	0.005	0.002	0.001	0.009	0.001	0.002	0.000	0.000
High	0.050	0.040	0.143	0.149	0.097	0.079	0.133	0.082	0.011	0.021	0.019	0.057	0.020	0.014	0.007	0.012	0.018	0.006	0.005	0.001	0.002
Vhigh	0.166	0.097	0.236	0.317	0.198	0.172	0.264	0.158	0.025	0.060	0.059	0.129	0.089	0.035	0.008	0.040	0.041	0.025	0.046	0.004	0.000
Ext	0.377	0.171	0.400	0.471	0.397	0.316	0.488	0.366	0.115	0.118	0.125	0.315	0.117	0.026	0.004	0.075	0.116	0.035	0.019	0.000	0.034

April 1st - May 31st

Grass Adjective

	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK07	AK09	AK00	AK04	AK06	AK08	AK10	AK11	AK13	AK14	AK 12	AK15	AK16	AK17	AK18
Low	0.003	0.003	0.001	0.008	0.004	0.002	0.000	0.006	0.000	0.002	0.000	0.002	0.000	0.002	0.000	0.001	0.001	0.000	0.000	0.000	0.000
Mod	0.003	0.007	0.002	0.009	0.007	0.008	0.009	0.009	0.000	0.008	0.002	0.004	0.004	0.004	0.002	0.002	0.002	0.001	0.000	0.001	0.002
High	0.000	0.012	0.006	0.015	0.007	0.024	0.010	0.021	0.000	0.024	0.027	0.011	0.010	0.000	0.010	0.007	0.006	0.000	0.000	0.000	0.000
Vhigh	0.013	0.028	0.017	0.020	0.023	0.019	0.051	0.031	0.000	0.010	0.011	0.019	0.019	0.019	0.007	0.006	0.011	0.000	0.009	0.014	0.000
Ext	0.000	0.081	0.034	0.000	0.125	0.000	0.000	0.214	0.000	0.000	0.000	0.000	0.000	0.000	0.027	0.125	0.026	0.000	0.000	0.000	0.000

Alaska Sub-Region Adjective - Spring (2024)

	Tanana Valley		East North Interior			Central West Interior			North Slope		West Coast				Southcentral		Copper River Basin		Southeast and Kodiak		
	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK07	AK09	AK00	AK04	AK06	AK08	AK10	AK11	AK13	AK14	AK 12	AK15	AK16	AK17	AK18
Low	0.002	0.008	0.001	0.003	0.002	0.002	0.002	0.004	0.000	0.001	0.000	0.003	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000
Mod	0.001	0.012	0.004	0.020	0.005	0.013	0.010	0.010	0.000	0.015	0.000	0.003	0.005	0.006	0.005	0.003	0.004	0.000	0.000	0.000	0.000
High	0.013	0.027	0.010	0.026	0.013	0.028	0.022	0.019	0.000	0.005	0.006	0.010	0.011	0.000	0.002	0.006	0.006	0.002	0.000	0.002	0.009
Vhigh	0.025	0.049	0.043	0.043	0.014	0.067	0.172	0.043	0.000	0.028	0.026	0.025	0.013	0.009	0.013	0.010	0.028	0.000	0.015	0.014	0.000
Ext	0.062	0.065	0.061	0.200	0.148	0.000	0.333	0.181	0.000	0.000	0.059	0.036	0.064	0.143	0.026	0.025	0.030	0.000	0.000	0.018	0.000

Figure 45: MODIS Day Conditional Frequency performance of GAR, SAR, ASR – Spring and ASR – Summer.

2012-2022 Iband VIIRS - Detect (Conditional Frequency)

June 1st - September 30th

Spruce Adjective

	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK07	AK09	AK00	AK04	AK06	AK08	AK10	AK11	AK13	AK14	AK 12	AK15	AK16	AK17	AK18
Low	0.025	0.112	0.191	0.230	0.414	0.182	0.213	0.397	0.021	0.125	0.024	1.128	0.164	0.001	0.003	0.016	0.033	0.005	0.002	0.000	0.009
Mod	0.101	0.119	0.465	1.345	1.902	0.799	3.346	6.410	0.107	0.646	0.743	5.662	2.844	0.012	0.005	0.171	0.110	0.000	0.000	0.006	0.014
High	0.661	0.754	3.101	5.525	8.018	4.016	17.970	8.166	2.065	1.159	2.311	15.953	19.117	0.000	0.008	0.818	0.558	0.000	0.028	0.000	3.353
Vhigh	4.288	5.701	15.716	23.744	37.016	34.430	177.915	27.527	2.520	3.883	17.625	96.717	11.005	0.553	0.148	6.582	1.109	0.018	0.000	0.000	0.000
Ext	33.947	8.490	34.860	136.934	65.755	24.500	0.000	88.062	0.000	0.000	0.000	129.875	0.000	14.833	0.015	36.517	0.058	0.000	0.000	0.000	0.000

Alaska Sub-Region Adjective - Summer (2024)

	Tanana Valley		East North Interior			Central West Interior			North Slope		West Coast			Southcentral			Copper River Basin		Southeast and Kodiak		
	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK07	AK09	AK00	AK04	AK06	AK08	AK10	AK11	AK13	AK14	AK 12	AK15	AK16	AK17	AK18
Low	0.015	0.040	0.077	0.200	0.096	0.053	0.018	0.077	0.003	0.007	0.011	0.124	0.008	0.001	0.005	0.004	0.017	0.001	0.001	0.000	0.007
Mod	0.074	0.231	1.739	6.112	0.998	0.514	1.766	3.142	0.001	0.069	0.118	2.371	0.268	0.010	0.002	0.011	0.219	0.017	0.005	0.001	0.013
High	1.031	0.753	3.897	9.612	5.836	2.444	6.454	6.627	0.085	0.976	0.201	6.766	1.799	0.029	0.006	0.721	0.455	0.001	0.007	0.002	0.011
Vhigh	5.169	5.034	18.873	28.782	18.149	9.670	43.432	24.976	0.216	1.461	3.480	14.488	14.685	1.232	0.095	4.474	0.746	0.000	0.011	0.002	0.011
Ext	27.214	12.573	55.690	103.883	61.635	43.754	205.033	42.152	4.431	3.739	6.882	69.611	21.774	0.727	0.020	11.824	2.367	0.004	0.000	0.000	6.577

April 1st - May 31st

Grass Adjective

	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK07	AK09	AK00	AK04	AK06	AK08	AK10	AK11	AK13	AK14	AK 12	AK15	AK16	AK17	AK18
Low	0.016	0.056	0.000	0.000	0.015	0.000	0.000	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.004	0.000	0.000	0.001	0.000
Mod	0.077	0.084	0.001	0.000	0.000	0.000	0.007	0.002	0.000	0.002	0.000	0.068	0.090	0.000	0.007	0.479	0.003	0.000	0.003	0.000	0.004
High	0.000	0.108	0.089	0.000	0.031	0.000	0.000	0.350	0.000	0.000	0.000	1.633	0.000	0.000	0.039	0.120	0.000	0.058	0.000	0.000	0.000
Vhigh	0.032	0.679	0.103	0.000	0.000	0.000	0.000	0.387	0.000	0.007	0.000	1.011	0.046	0.112	0.011	1.371	0.012	0.000	0.000	0.005	0.017
Ext	0.050	0.367	0.000	0.000	0.000	0.000	0.000	1.667	0.000	0.000	0.000	0.000	0.000	0.000	0.000	48.636	0.000	0.000	0.000	0.000	0.000

Alaska Sub-Region Adjective - Spring (2024)

	Tanana Valley		East North Interior			Central West Interior			North Slope		West Coast			Southcentral			Copper River Basin		Southeast and Kodiak		
	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK07	AK09	AK00	AK04	AK06	AK08	AK10	AK11	AK13	AK14	AK 12	AK15	AK16	AK17	AK18
Low	0.015	0.128	0.001	0.000	0.007	0.000	0.000	0.004	0.000	0.000	0.000	0.044	0.045	0.000	0.007	0.004	0.002	0.000	0.000	0.001	0.000
Mod	0.077	0.192	0.050	0.000	0.000	0.000	0.011	0.186	0.000	0.003	0.000	0.024	0.062	0.000	0.014	0.010	0.004	0.000	0.000	0.000	0.005
High	0.048	0.477	0.022	0.000	0.027	0.000	0.000	0.000	0.000	0.000	0.000	0.518	0.000	0.000	0.014	2.491	0.009	0.020	0.006	0.000	0.000
Vhigh	0.018	1.108	0.412	0.000	0.000	0.000	0.000	1.178	0.000	0.015	0.000	2.443	0.009	0.000	0.021	2.030	0.035	0.000	0.000	0.000	0.083
Ext	0.079	1.515	0.277	0.000	0.000	0.000	0.000	1.333	0.000	0.000	0.000	0.444	0.261	1.133	0.000	13.049	0.000	0.000	0.000	0.038	0.000

Figure 46: IBand VIIRS Detects Conditional Frequency performance of GAR, SAR, ASR – Spring and ASR – Summer.

2003-2022 MODIS - No. of Detetection (Conditional Frequency)

June 1st - September 30th

Spruce Adjective

	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK07	AK09	AK00	AK04	AK06	AK08	AK10	AK11	AK13	AK14	AK 12	AK15	AK16	AK17	AK18
Low	0.061	0.034	0.151	0.109	0.123	0.122	0.086	0.100	0.009	0.029	0.018	0.215	0.030	0.003	0.001	0.003	0.006	0.004	0.001	0.000	0.000
Mod	0.055	0.060	0.481	0.493	0.448	0.781	1.111	1.099	0.045	0.220	0.248	0.921	0.469	0.007	0.006	0.021	0.015	0.013	0.029	0.001	0.004
High	0.344	0.375	2.002	2.231	2.525	4.497	11.407	1.783	0.932	0.621	0.729	2.135	2.315	0.014	0.006	0.237	0.107	0.021	0.036	0.005	0.500
Vhigh	6.477	3.033	8.913	11.466	11.201	9.232	59.401	7.039	1.185	1.483	3.506	17.869	2.102	0.150	0.026	0.791	0.114	0.047	0.021	0.000	0.000
Ext	18.852	6.040	31.640	37.221	15.218	10.870	0.000	22.972	0.000	1.667	0.000	38.111	0.042	4.250	0.000	3.813	0.144	0.000	0.000	0.000	0.000

Alaska Sub-Region Adjective - Summer (2024)

	Tanana Valley		East North Interior			Central West Interior			North Slope		West Coast				Southcentral		Copper River Basin		Southeast and Kodiak		
	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK07	AK09	AK00	AK04	AK06	AK08	AK10	AK11	AK13	AK14	AK 12	AK15	AK16	AK17	AK18
Low	0.005	0.013	0.195	0.105	0.044	0.032	0.030	0.026	0.003	0.002	0.004	0.029	0.002	0.001	0.000	0.001	0.003	0.001	0.000	0.000	0.000
Mod	0.161	0.114	1.937	2.297	0.292	0.212	0.384	0.634	0.005	0.033	0.046	0.408	0.050	0.007	0.003	0.003	0.026	0.001	0.002	0.000	0.000
High	0.614	0.496	4.576	5.427	1.663	1.659	2.476	1.174	0.038	0.266	0.115	1.046	0.264	0.025	0.008	0.130	0.064	0.007	0.005	0.001	0.002
Vhigh	5.894	2.544	12.171	11.599	6.340	8.518	16.919	6.014	0.078	0.589	0.972	2.417	2.056	0.197	0.019	0.847	0.305	0.027	0.055	0.004	0.000
Ext	23.812	7.861	31.520	33.573	17.813	13.415	94.963	11.247	2.115	1.702	2.003	13.489	3.296	0.355	0.008	1.368	1.501	0.035	0.019	0.000	1.103

April 1st - May 31st

Grass Adjective

	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK07	AK09	AK00	AK04	AK06	AK08	AK10	AK11	AK13	AK14	AK 12	AK15	AK16	AK17	AK18
Low	0.009	0.008	0.013	0.095	0.067	0.002	0.000	0.022	0.000	0.004	0.000	0.002	0.000	0.002	0.000	0.002	0.001	0.000	0.000	0.000	0.000
Mod	0.025	0.021	0.002	0.090	0.147	0.020	0.101	0.166	0.000	0.008	0.018	0.005	0.038	0.004	0.004	0.091	0.002	0.001	0.000	0.001	0.002
High	0.000	0.042	0.014	0.015	0.019	0.157	0.233	0.435	0.000	0.024	0.658	0.163	0.017	0.000	0.012	0.042	0.006	0.000	0.000	0.000	0.000
Vhigh	0.102	0.229	0.155	0.369	0.616	0.074	1.162	0.466	0.000	0.010	0.189	0.203	0.065	0.019	0.032	0.159	0.012	0.000	0.009	0.014	0.000
Ext	0.000	1.111	0.085	0.000	1.958	0.000	0.000	6.071	0.000	0.000	0.000	0.000	0.000	0.000	0.027	15.125	0.026	0.000	0.000	0.000	0.000

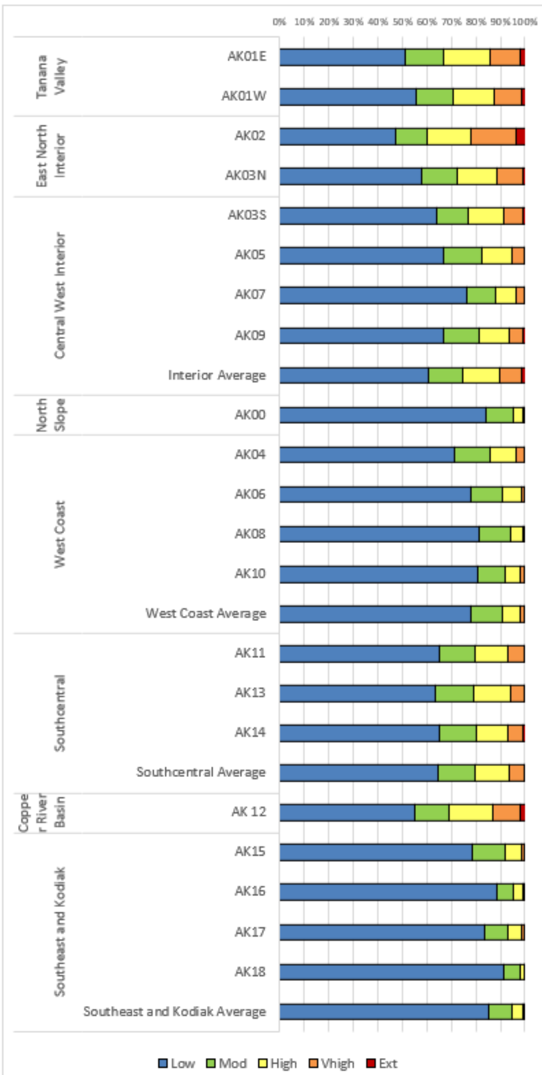
Alaska Sub-Region Adjective - Spring (2024)

	Tanana Valley		East North Interior			Central West Interior			North Slope		West Coast				Southcentral		Copper River Basin		Southeast and Kodiak		
	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK07	AK09	AK00	AK04	AK06	AK08	AK10	AK11	AK13	AK14	AK 12	AK15	AK16	AK17	AK18
Low	0.005	0.030	0.005	0.034	0.008	0.008	0.002	0.014	0.000	0.003	0.000	0.003	0.004	0.001	0.000	0.003	0.000	0.000	0.000	0.000	0.000
Mod	0.028	0.059	0.007	0.122	0.108	0.018	0.158	0.134	0.000	0.015	0.000	0.003	0.025	0.006	0.008	0.011	0.004	0.000	0.000	0.000	0.000
High	0.074	0.179	0.018	0.265	0.090	0.088	0.326	0.064	0.000	0.005	0.064	0.040	0.071	0.000	0.002	0.329	0.006	0.002	0.000	0.002	0.009
Vhigh	0.223	0.521	0.511	1.000	0.310	0.461	3.862	2.033	0.000	0.028	0.623	0.462	0.027	0.009	0.020	0.261	0.034	0.000	0.015	0.014	0.000
Ext	0.585	0.947	0.456	5.900	4.343	0.000	13.333	2.979	0.000	0.000	1.059	0.125	0.291	0.143	0.144	2.437	0.030	0.000	0.000	0.018	0.000

Figure 47: MODIS Detects Conditional Frequency performance of GAR, SAR, ASR – Spring and ASR – Summer.

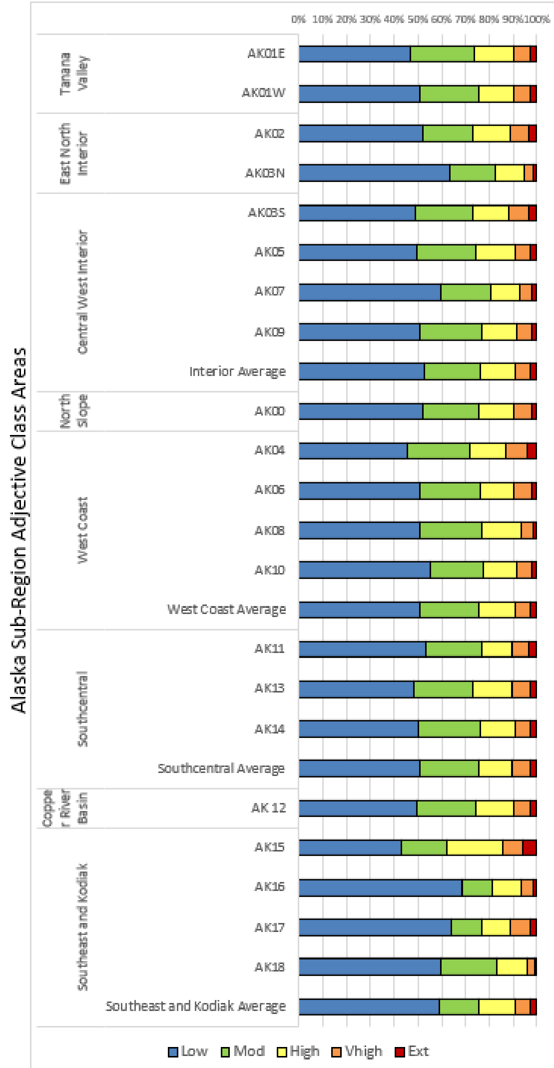
Appendix J: Climatological Breakpoint Analysis GAR, SAR and ASR-Spring and ASR - Summer

Alaska's climate and weather vary widely in both time and space, leaving the impact on wildfire potential very uneven across the state. Fire potential is driven by its extremes rather than its normal. The resulting trends and totals of fire occurrence and growth are not amenable to percentile analysis and representation. However, the results in **Figures 489-51** may be useful in understanding decision frequencies.



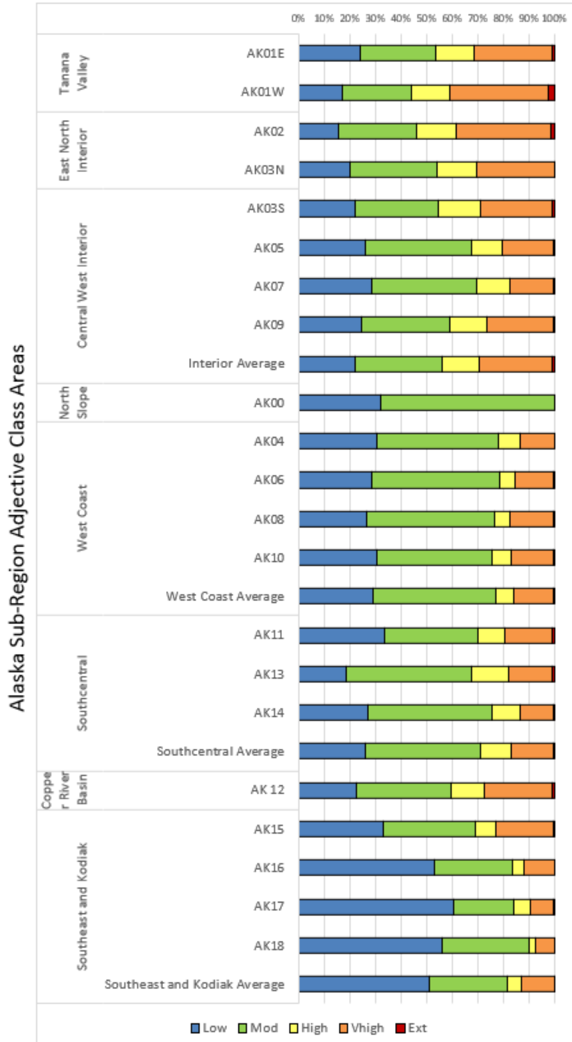
Low	Mod	High	Vhigh	Ext	Spruce Adjective Rating	
51%	16%	19%	12%	2%	AK01E	Tanana Valley
56%	15%	17%	11%	2%	AK01W	
47%	13%	18%	18%	4%	AK02	East North Interior
58%	14%	16%	10%	1%	AK03N	
64%	13%	14%	8%	1%	AK03S	Central West Interior
67%	16%	12%	5%	0%	AK05	
76%	12%	8%	3%	0%	AK07	
67%	14%	13%	5%	1%	AK09	
61%	14%	15%	9%	1%	Interior Average	
84%	11%	4%	1%	0%	AK00	North Slope (2019 Data only)
71%	15%	11%	3%	0%	AK04	West Coast
78%	13%	8%	1%	0%	AK06	
81%	13%	5%	1%	0%	AK08	
81%	12%	6%	2%	0%	AK10	
78%	13%	7%	2%	0%	West Coast Average	
65%	14%	14%	7%	0%	AK11	Southcentral
64%	15%	15%	5%	0%	AK13	
65%	15%	13%	6%	1%	AK14	
65%	15%	14%	6%	1%	Southcentral Average	
55%	14%	18%	12%	2%	AK 12	Copper River Basin
78%	13%	7%	1%	0%	AK15	Southeast and Kodiak
88%	7%	4%	1%	0%	AK16	
84%	9%	6%	1%	0%	AK17	
92%	7%	2%	0%	0%	AK18	
85%	9%	5%	1%	0%	Southeast and Kodiak Average	

Figure 48: Spruce Adjective Rating (SAR) Climatological Percentages by Breakpoints by FDRA from June 1 to September 30 (2003-2022).



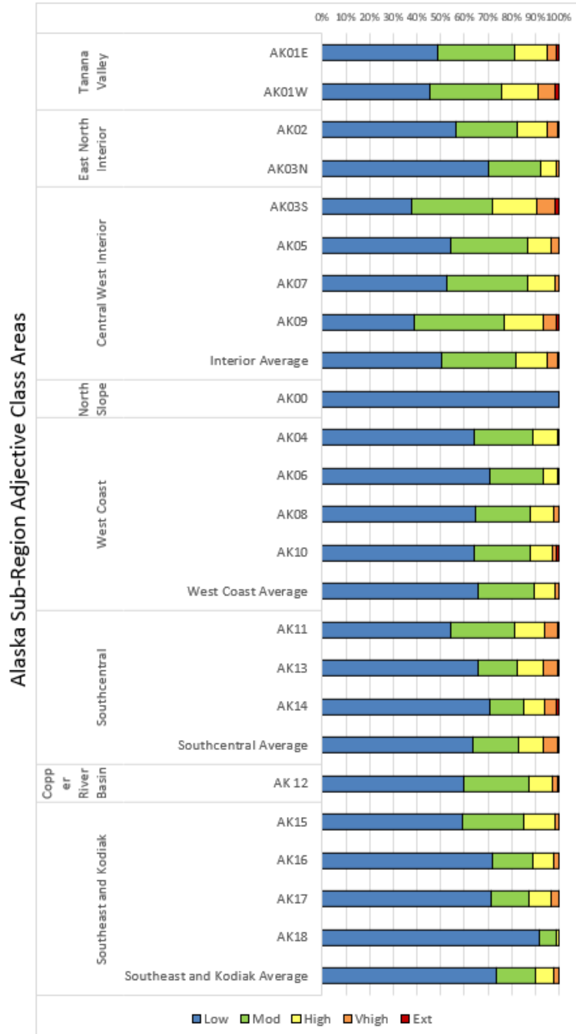
Low	Mod	High	Vhigh	Ext	ASR - Summer Adjective Rating	
47%	27%	17%	7%	3%	AK01E	Tanana Valley
51%	24%	15%	7%	3%	AK01W	
52%	21%	16%	8%	4%	AK02	East North Interior
64%	19%	12%	4%	1%	AK03N	
49%	24%	15%	8%	4%	AK03S	Central West Interior
50%	25%	17%	7%	3%	AK05	
59%	22%	12%	5%	2%	AK07	
51%	26%	14%	6%	2%	AK09	
53%	23%	15%	6%	3%	Interior Average	
52%	23%	15%	8%	2%	AK00	North Slope
46%	26%	16%	9%	4%	AK04	West Coast
51%	25%	14%	7%	2%	AK06	
51%	26%	17%	5%	1%	AK08	
55%	22%	14%	6%	2%	AK10	
51%	25%	15%	7%	3%	West Coast Average	
53%	24%	13%	7%	3%	AK11	Southcentral
48%	25%	16%	8%	3%	AK13	
50%	26%	15%	6%	3%	AK14	
51%	25%	15%	7%	3%	Southcentral Average	
50%	25%	15%	7%	3%	AK 12	Copper River Basin
43%	19%	24%	9%	6%	AK15	Southeast and Kodiak
69%	13%	12%	5%	2%	AK16	
64%	13%	13%	8%	3%	AK17	
60%	23%	13%	4%	1%	AK18	
59%	17%	15%	8%	3%	Southeast and Kodiak Average	

Figure 49: ASR - Summer Adjective Rating Climatological Percentages by Breakpoints by FDRA for June 1 to September 30 (2003-2022).



Low	Mod	High	VHigh	Ext	Grass Adjective Rating
24%	29%	15%	30%	1%	AK01E Tanana Valley
17%	27%	15%	39%	2%	AK01W
16%	31%	15%	37%	1%	AK02 East North Interior
20%	34%	15%	30%	0%	AK03N
22%	32%	16%	28%	1%	AK03S Central West Interior
26%	42%	12%	20%	0%	AK05
29%	41%	13%	17%	0%	AK07
24%	35%	14%	26%	0%	AK09
22%	34%	14%	29%	1%	Interior Average
32%	68%	0%	0%	0%	AK00 North Slope
31%	48%	8%	13%	0%	AK04 West Coast
29%	50%	6%	15%	0%	AK06
27%	50%	6%	17%	0%	AK08
31%	45%	7%	17%	0%	AK10
29%	48%	7%	16%	0%	West Coast Average
34%	37%	11%	19%	1%	AK11 Southcentral
19%	49%	14%	17%	1%	AK13
27%	49%	11%	13%	0%	AK14
26%	45%	12%	16%	1%	Southcentral Average
23%	37%	13%	26%	1%	AK 12 Copper River Basin
33%	36%	8%	23%	0%	AK15 Southeast and Kodiak
53%	30%	5%	12%	0%	AK16
61%	24%	6%	9%	0%	AK17
56%	34%	2%	8%	0%	AK18
51%	31%	5%	9%	0%	Southeast and Kodiak Average

Figure 50: Grass Adjective Rating (GAR) Climatological Percentages by Breakpoints by FDRA from April 1 to May 31 (2003-2022).



Low	Mod	High	VHigh	Ext	ASR- Spring Adjective Class	
49%	33%	14%	4%	1%	AK01E	Tanana Valley
46%	30%	15%	7%	2%	AK01W	
56%	26%	12%	4%	1%	AK02	East North Interior
70%	22%	7%	1%	0%	AK03N	
38%	34%	18%	8%	2%	AK03S	Central West Interior
54%	33%	10%	3%	0%	AK05	
53%	34%	11%	1%	0%	AK07	
39%	38%	16%	6%	1%	AK09	
51%	31%	13%	4%	1%	Interior Average	
100%	0%	0%	0%	0%	AK00	North Slope (2019 Data only)
64%	25%	10%	1%	0%	AK04	West Coast
71%	23%	6%	0%	0%	AK06	
65%	23%	10%	2%	0%	AK08	
64%	24%	9%	2%	1%	AK10	
66%	24%	9%	1%	0%	West Coast Average	
55%	27%	13%	6%	1%	AK11	Southcentral
66%	17%	11%	6%	1%	AK13	
71%	15%	8%	5%	1%	AK14	
64%	19%	11%	6%	1%	Southcentral Average	
60%	28%	10%	2%	0%	AK 12	Copper River Basin
59%	26%	13%	2%	0%	AK15	Southeast and Kodiak
72%	17%	9%	2%	0%	AK16	
71%	16%	9%	4%	0%	AK17	
92%	7%	1%	0%	0%	AK18	
74%	17%	8%	4%	0%	Southeast and Kodiak Average	

Figure 51: ASR-Spring Adjective Rating Climatological Percentages by Breakpoints by FRDA from April 1 to May 31 (2003-2022).

Appendix K: USFS use of CFFDRS.

Forest Service **Alaska Region** **P.O. Box 21628**
709 W. 9th Street
Juneau, AK 99802-1628

File Code: 5100 **Date: March 4, 2021**
Route To:

Subject: Canadian Forest Fire Danger Rating System

To: Forest Supervisors, Region 10

Approximately 30 years ago wildland fire management agencies in Alaska, including the U.S. Forest Service, began exploring the use of the Canadian Forest Fire Danger Rating System (CFFDRS) as an alternative to the National Fire Danger Rating System (NFDRS) for assessing wildfire potential. By 1994, CFFDRS indices were being calculated, distributed, and used for fire behavior predictions. Since initial exploration, CFFDRS has become the accepted interagency method for assessing flammability conditions and trends across all lands in Alaska.

This correspondence re-affirms the U.S. Forest Service use of CFFDRS as the primary tool in assessing fire danger and informing fire potential assessments in Region 10. The system's accessibility, through dedicated interagency training and a comprehensive online resource, Alaska Fire and Fuels (https://akff.mesowest.org/), has enabled the Forest Service and interagency partners to assess fire weather and fuel conditions throughout Alaska with accuracy. Prior, current, and future conditions are accessible for integration with national expectations and standards. Additionally national interagency expectations are delivered with developed products, cross-references where appropriate, and in-briefing materials that allow CFFDRS to inform programs such as the Wildland Fire Decision Support System (WFDSS) or produce pocket card equivalents with indices that are accurate for Alaska's unique fire environment.

While several factors led to the interagency adoption of CFFDRS, the key was finding an accurate system and developing appropriate tools in support of making the best decisions related to the distinct Alaska landscape. CFFDRS has proven to be that tool and is supported through Alaska Wildland Fire Coordinating Group and its participating agencies.

For additional information, please contact Mark Cahur, Forest Service Region 10 Fuels Program Coordinator at mark.cahur@usda.gov and 907-743-9452.

ALEX ROBERTSON Digitally signed by ALEX ROBERTSON
Date: 2021.03.04 09:46:28 -08'00'

Alex Robertson
Director, Fire, Fuels & Aviation Management
PNW & Alaska Regions, U.S. Forest Service

Enclosure: Why Alaska Fire Potential Assessments are Different

Cc: Earl Stewart, Jeff Schramm, Larry Pingel, Erick Stahlin, Bobette Rowe, Mark Cahur

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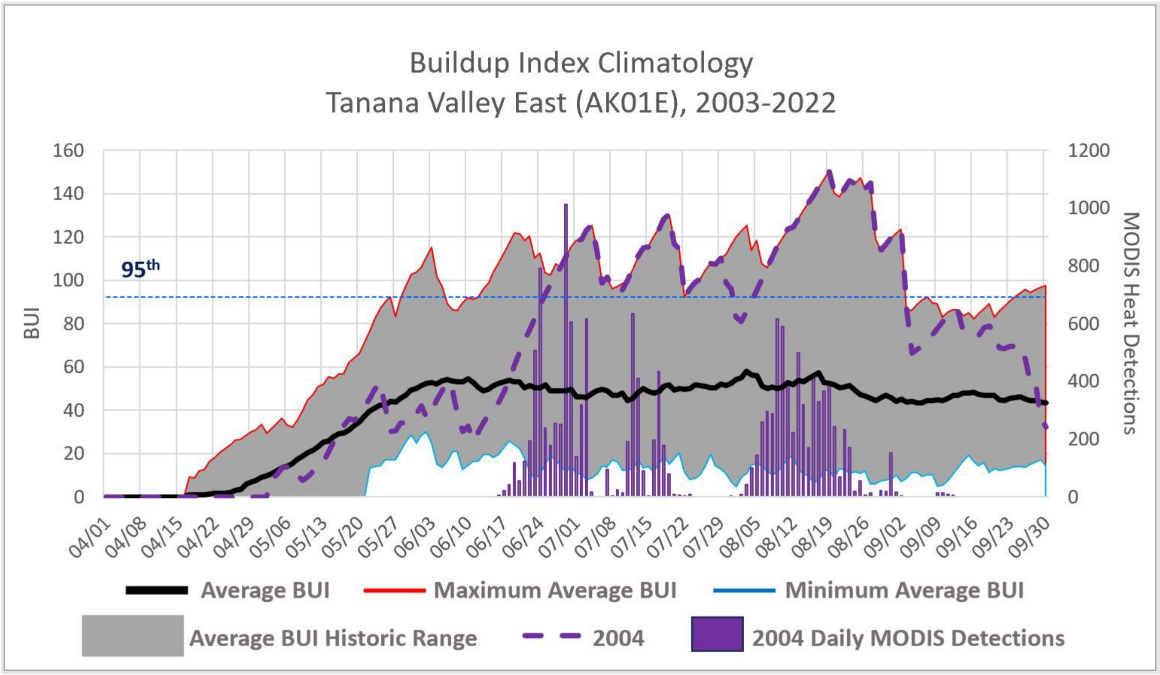
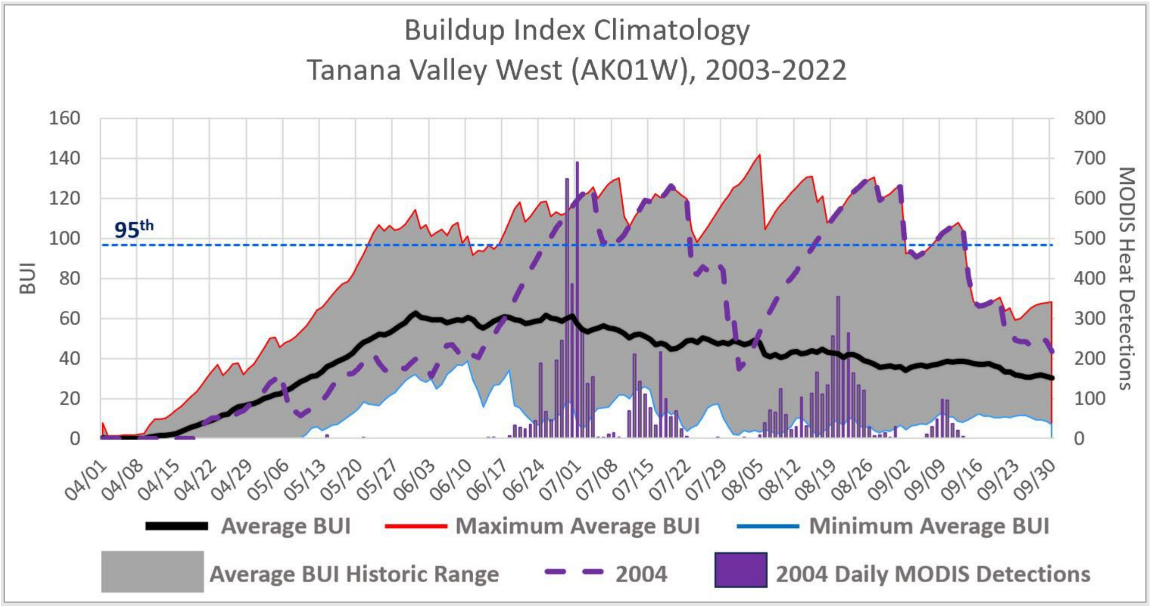
Appendix L: Alaska FDRA Seasonality Charts

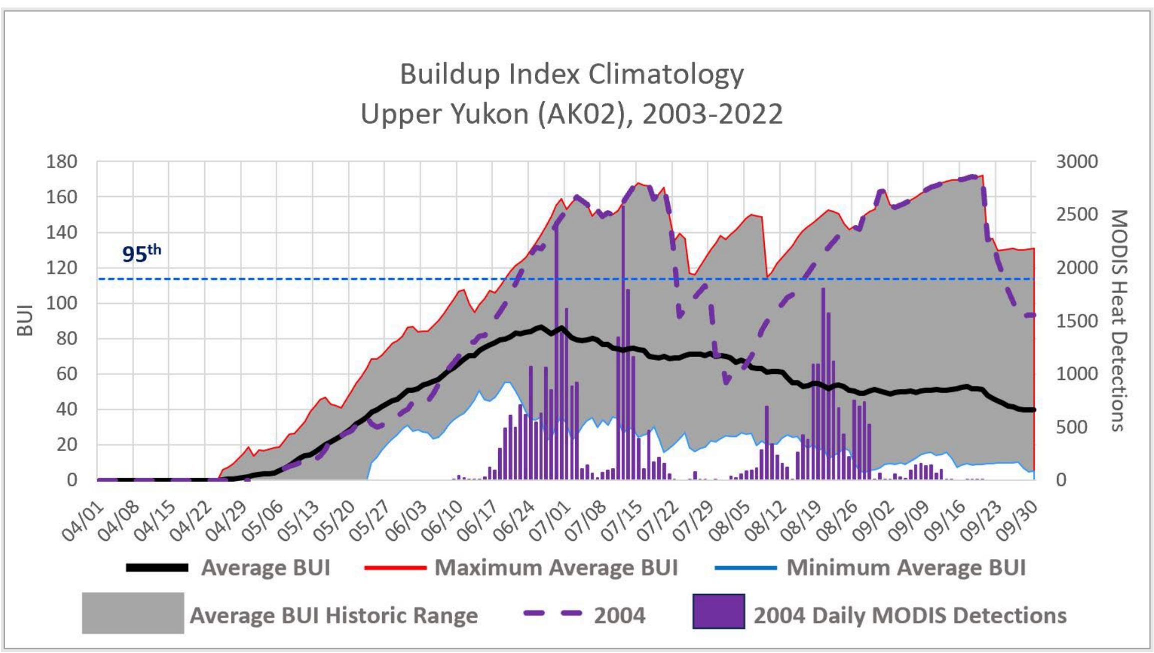
The following graphics display seasonality by Fire Danger Rating Area. It is important to recognize that the Buildup Index is displayed as an AVERAGE historic range, from multiple weather stations, over the 20 days on a given date. As averages, the maximum and minimum values displayed (top and bottom or ranges in graphic displayed in gray) do not represent all-time highs and lows. Additionally, the 95th percentile is also based on the average daily BUI. For each FDRA, MODIS detects, and average daily BUI are displayed for one of the more significant fire seasons in the given FDRA. These graphics provide value for evaluating and comparing fire seasons in and across FDRAs over the climatological period, but the values should not be used for operational staffing and severity thresholds in any given year.



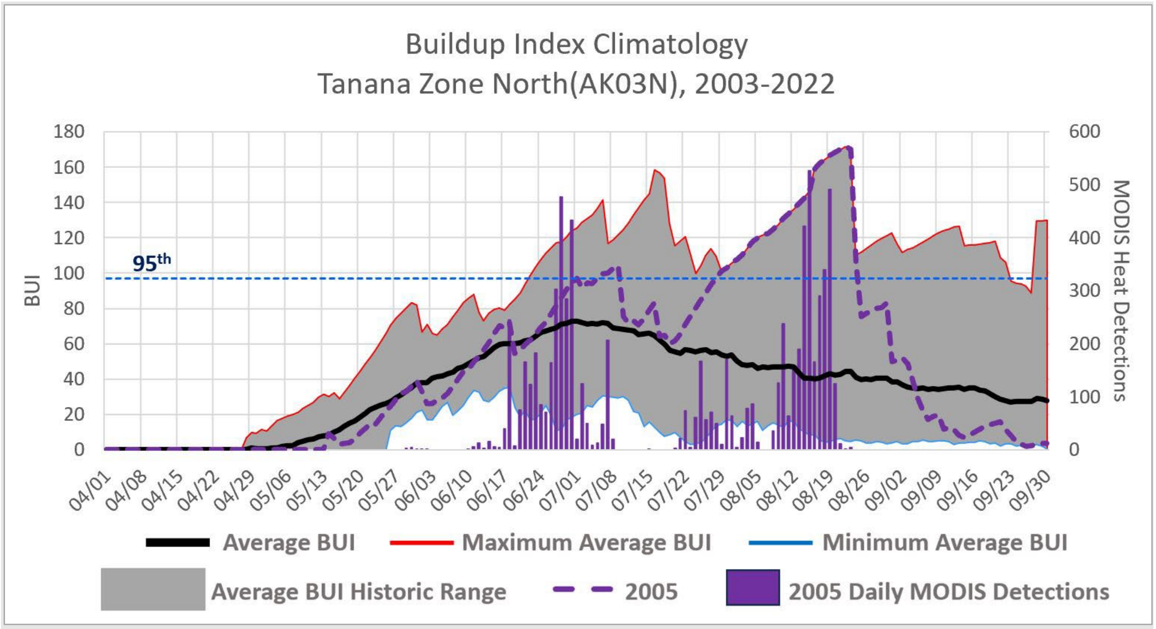
Percentile	Term Date	Season Characteristics
25%	6/20	Duff-Driven - Resistance to control
50%	8/2	Drought-Driven -Resistance to Extinguishment
75%	9/3	Diurnal-Limited - Short burn window, good RH recovery
90%	9/13	Diurnal-Limited - Short burn window, good RH recovery



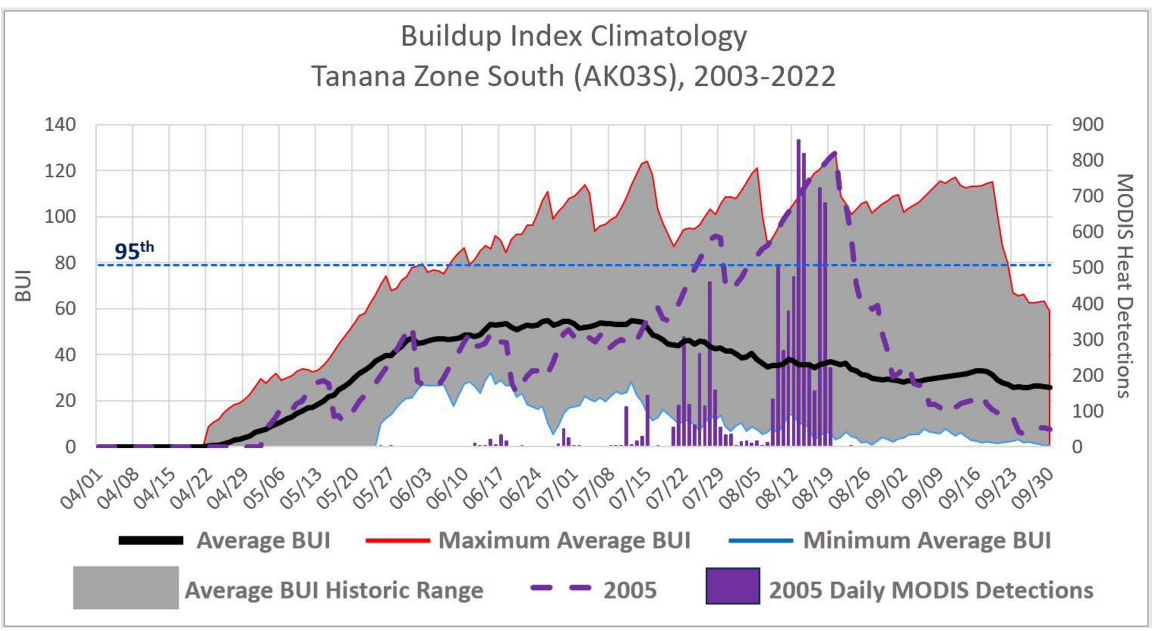
Percentile	Term Date	Season Characteristics
25%	6/11	Duff-Driven - Resistance to control
50%	7/4	Drought-Driven - Resistance to Extinguishment
75%	8/5	Diurnal-Limited - Short burn window, good RH recovery
90%	8/24	Diurnal-Limited - Short burn window, good RH recovery



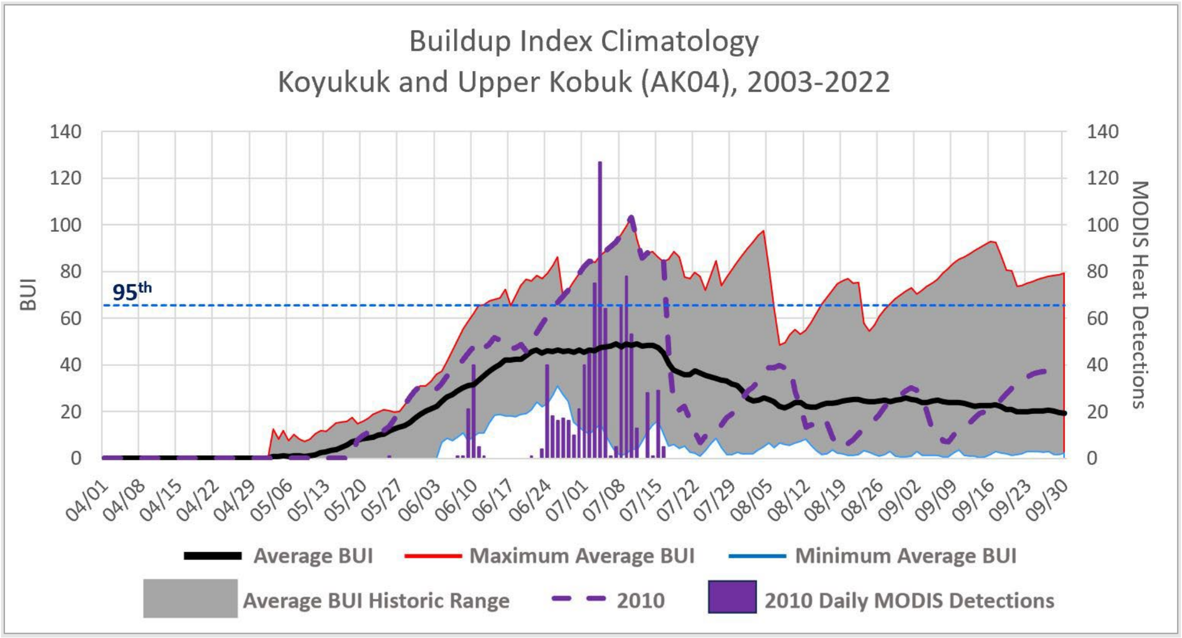
Percentile	Term Date	Season Characteristics
25%	7/10	Drought-Driven - Resistance to Extinguishment
50%	8/10	Drought-Driven - Resistance to Extinguishment
75%	8/28	Diurnal-Limited - Short burn window, good RH recovery
90%	9/16	Diurnal-Limited - Short burn window, good RH recovery



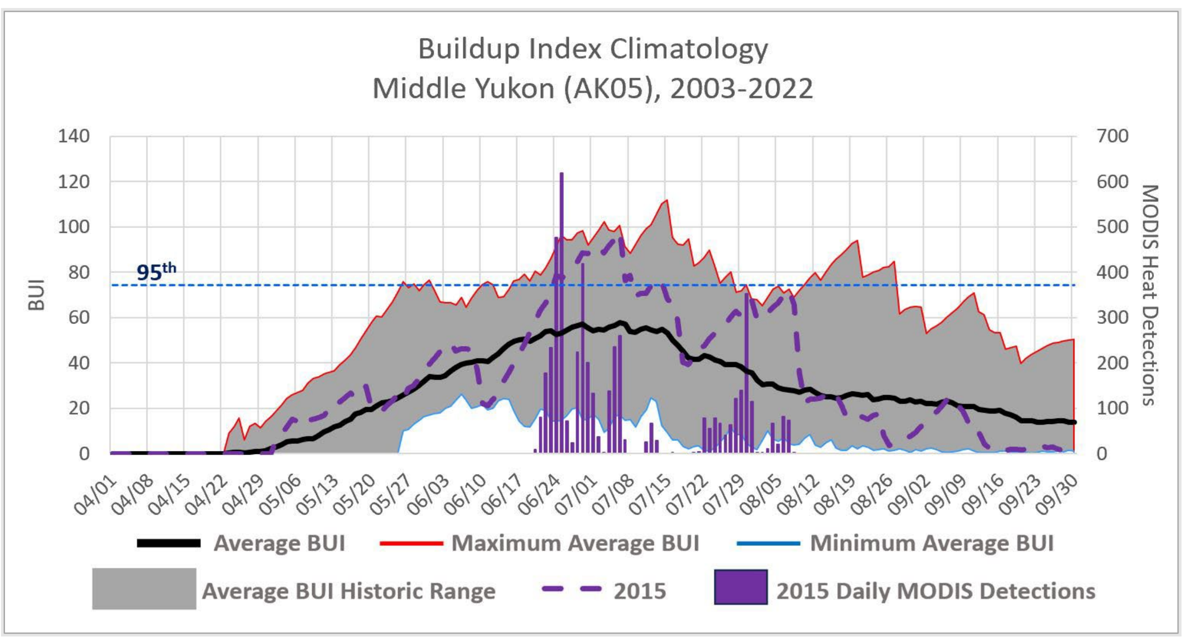
Percentile	Term Date	Season Characteristics
25%	7/1	Duff-Driven - Resistance to control
50%	7/26	Drought-Driven - Resistance to Extinguishment
75%	8/24	Diurnal-Limited - Short burn window, good RH recovery
90%	9/19	Diurnal-Limited - Short burn window, good RH recovery



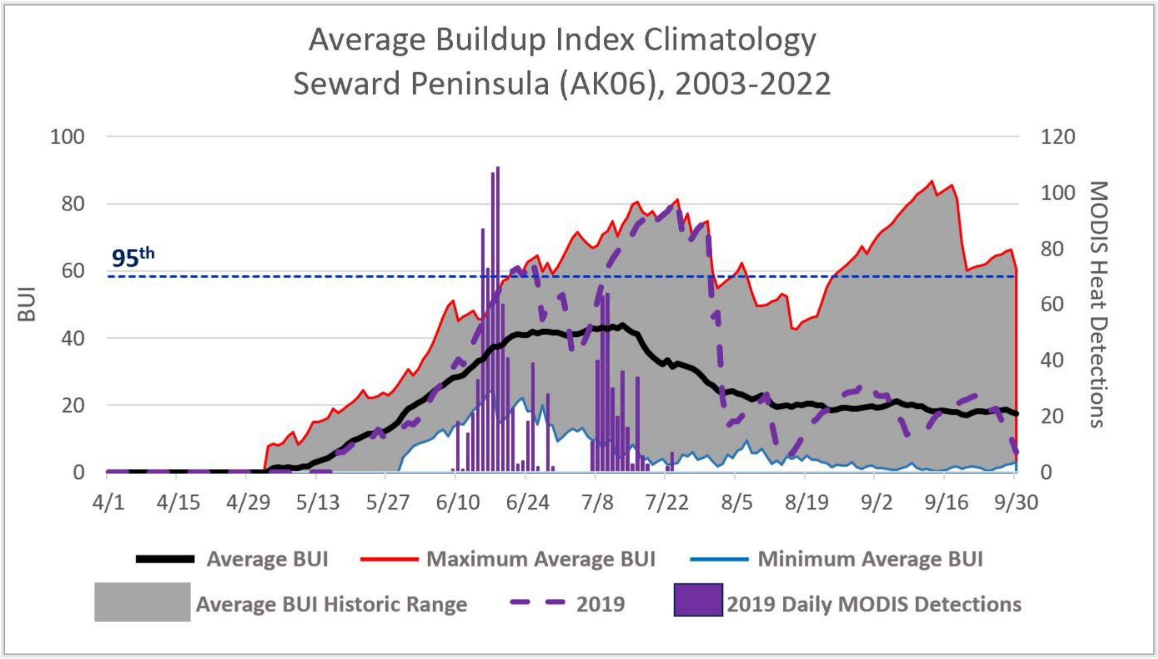
Percentile	Term Date	Season Characteristics
25%	6/24	Duff-Driven - Resistance to control
50%	7/11	Drought-Driven - Resistance to Extinguishment
75%	8/18	Drought-Driven - Resistance to Extinguishment
90%	8/24	Diurnal-Limited - Short burn window, good RH recovery



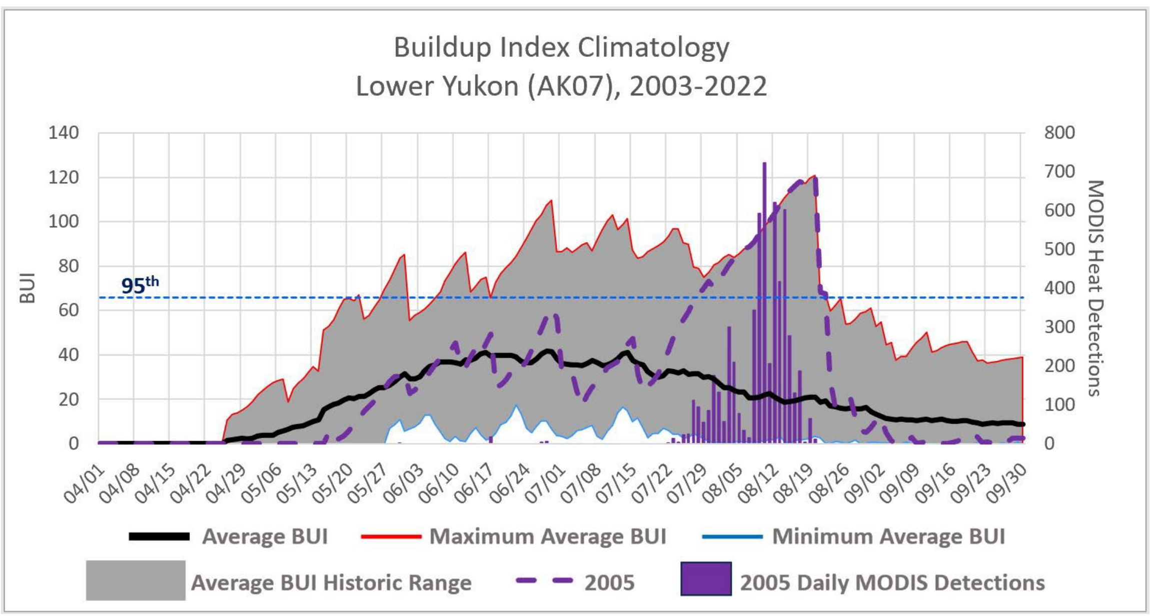
Percentile	Term Date	Season Characteristics
25%	6/28	Duff-Driven - Resistance to control
50%	7/14	Drought-Driven - Resistance to Extinguishment
75%	7/23	Drought-Driven - Resistance to Extinguishment
90%	8/8	Drought-Driven - Resistance to Extinguishment



Percentile	Term Date	Season Characteristics
25%	6/29	Duff-Driven - Resistance to control
50%	7/8	Drought-Driven - Resistance to Extinguishment
75%	7/22	Drought-Driven - Resistance to Extinguishment
90%	8/20	Drought-Driven - Resistance to Extinguishment

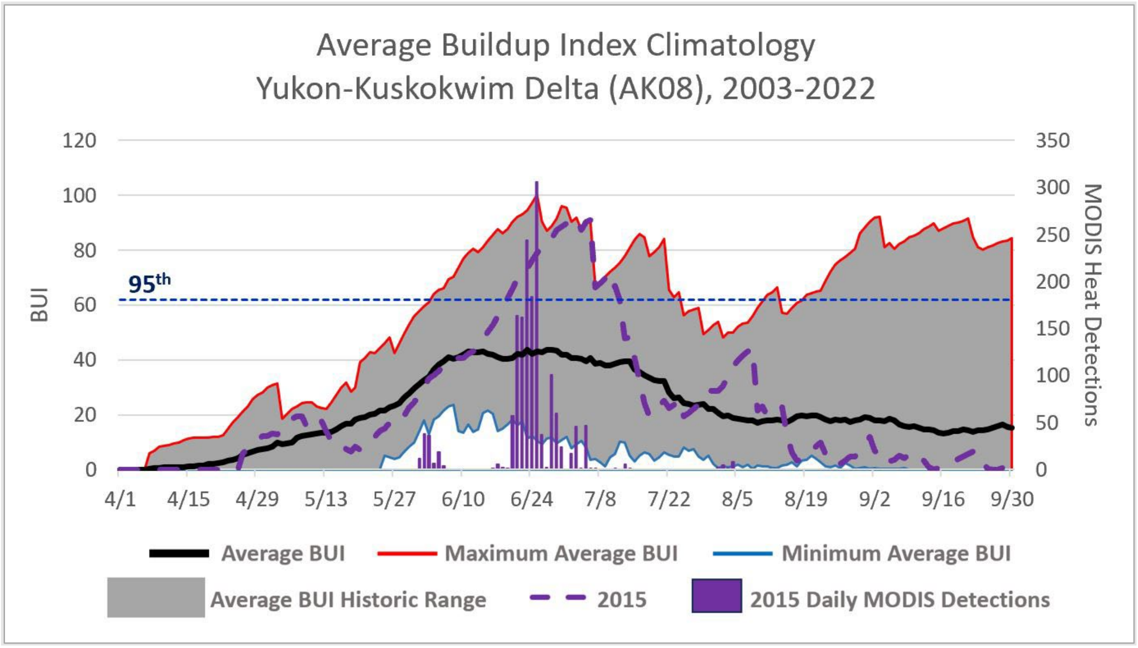


Percentile	Term Date	Season Characteristics
25%	6/25	Duff-Driven - Resistance to control
50%	7/8	Drought-Driven - Resistance to Extinguishment
75%	7/18	Drought-Driven - Resistance to Extinguishment
90%	8/3	Drought-Driven - Resistance to Extinguishment



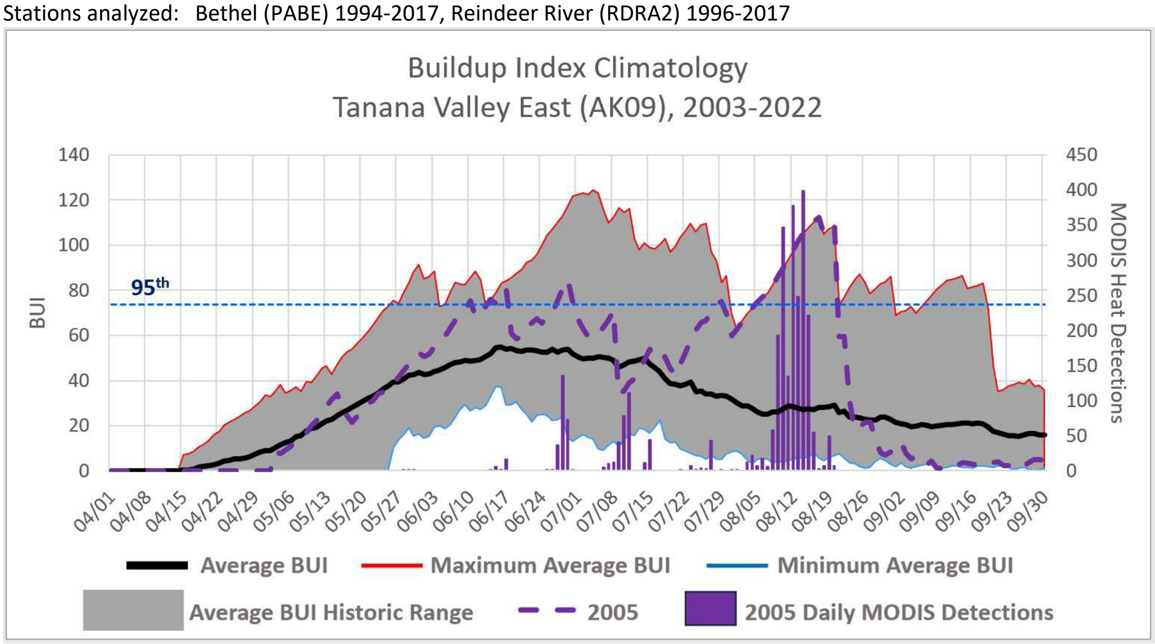
Percentile	Term Date	Season Characteristics
25%	6/16	Duff-Driven - Resistance to control
50%	6/29	Drought-Driven - Resistance to Extinguishment
75%	7/25	Drought-Driven - Resistance to Extinguishment
90%	8/12	Drought-Driven - Resistance to Extinguishment

Stations analyzed: Innoko Flats (NKOA2) 1994-2017
This station was included in analysis for AK09 and probabilities are combined for both FDRA's.

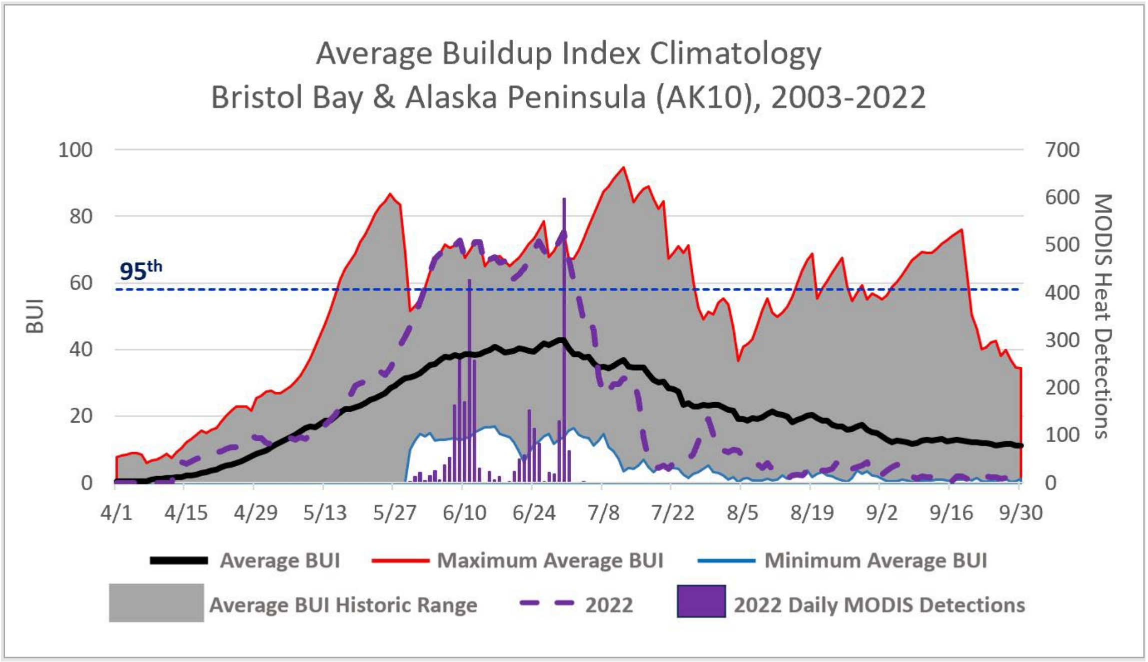


Percentile	Term Date	Season Characteristics
25%	6/13	Duff-Driven - Resistance to control
50%	7/1	Drought-Driven - Resistance to Extinguishment
75%	7/22	Drought-Driven - Resistance to Extinguishment
90%	7/28	Drought-Driven - Resistance to Extinguishment

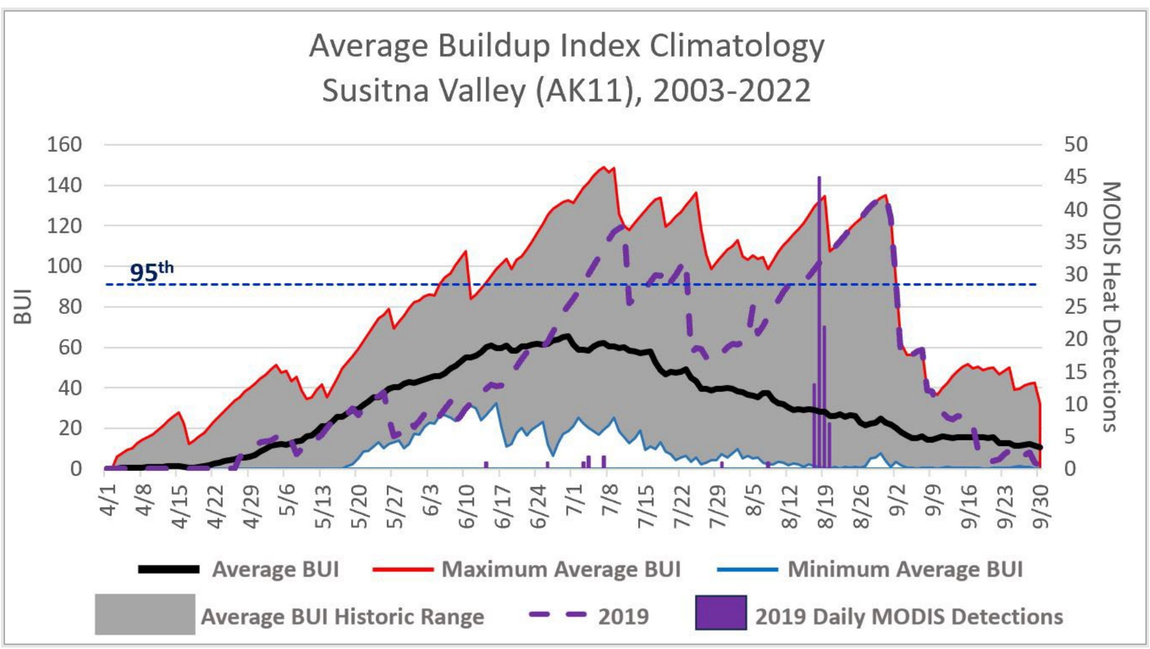
Stations analyzed: Bethel (PABE) 1994-2017, Reindeer River (RDRA2) 1996-2017



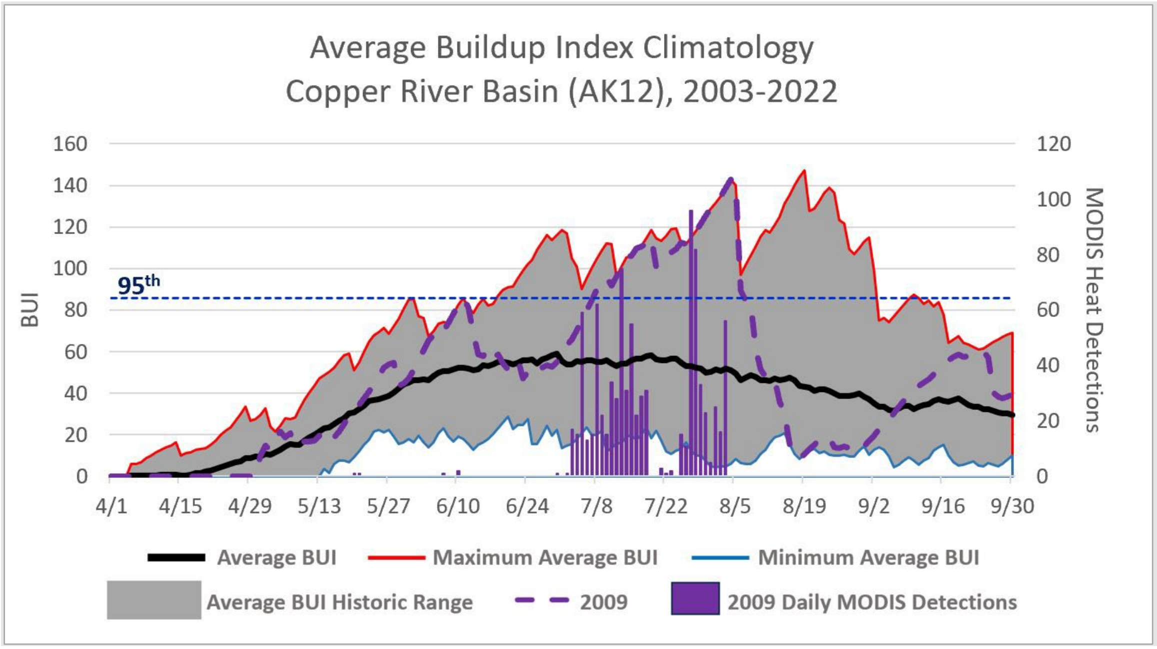
Percentile	Term Date	Season Characteristics
25%	6/19	Duff-Driven - Resistance to control
50%	6/30	Drought-Driven - Resistance to Extinguishment
75%	7/16	Drought-Driven - Resistance to Extinguishment
90%	8/2	Drought-Driven - Resistance to Extinguishment



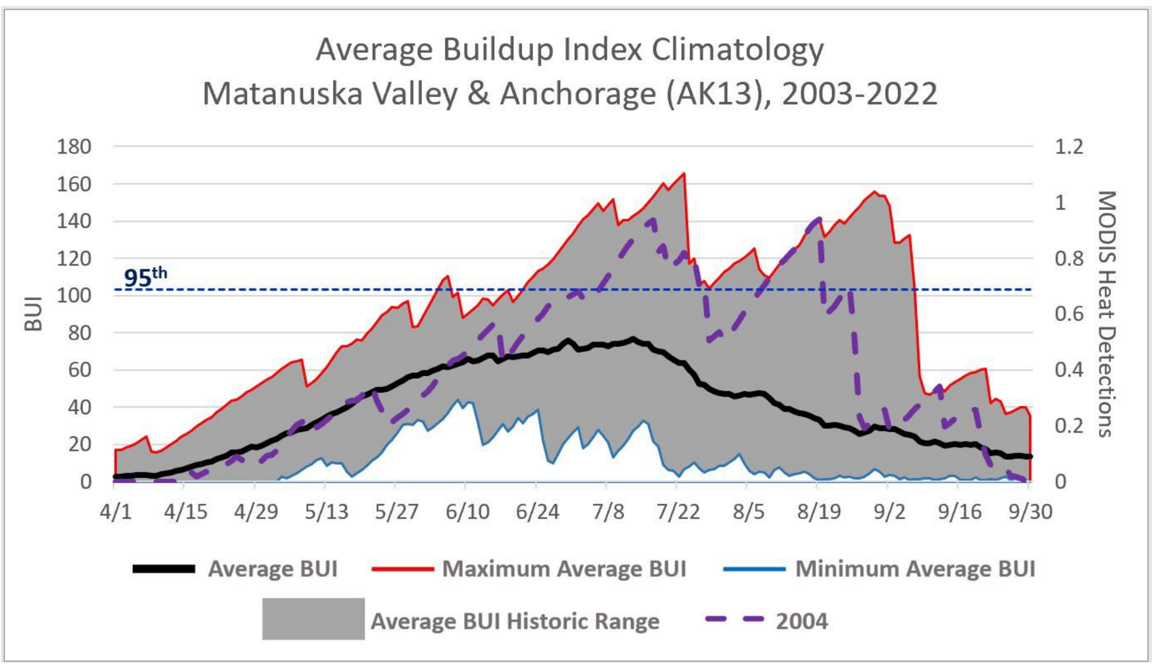
Percentile	Term Date	Season Characteristics
25%	6/21	Duff-Driven - Resistance to control
50%	7/1	Drought-Driven - Resistance to Extinguishment
75%	7/20	Drought-Driven - Resistance to Extinguishment
90%	8/12	Diurnal-Limited - Short burn window, good RH recovery



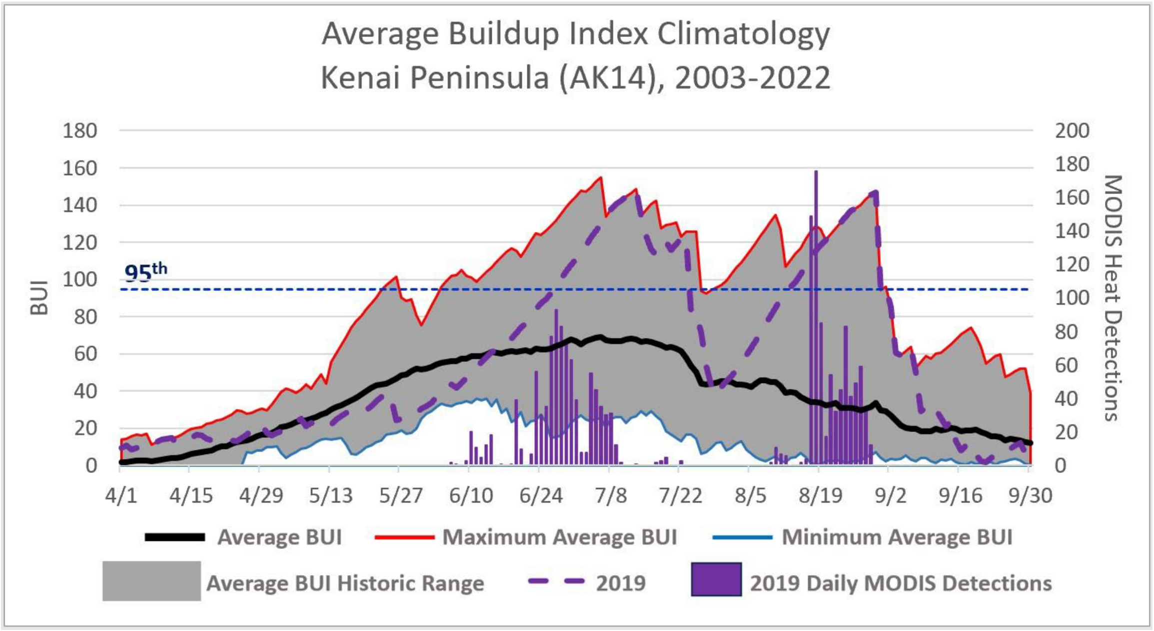
Percentile	Term Date	Season Characteristics
25%	6/29	Duff-Driven - Resistance to control
50%	7/14	Drought-Driven - Resistance to Extinguishment
75%	7/22	Drought-Driven - Resistance to Extinguishment
90%	8/10	Diurnal-Limited - Short burn window, good RH recovery



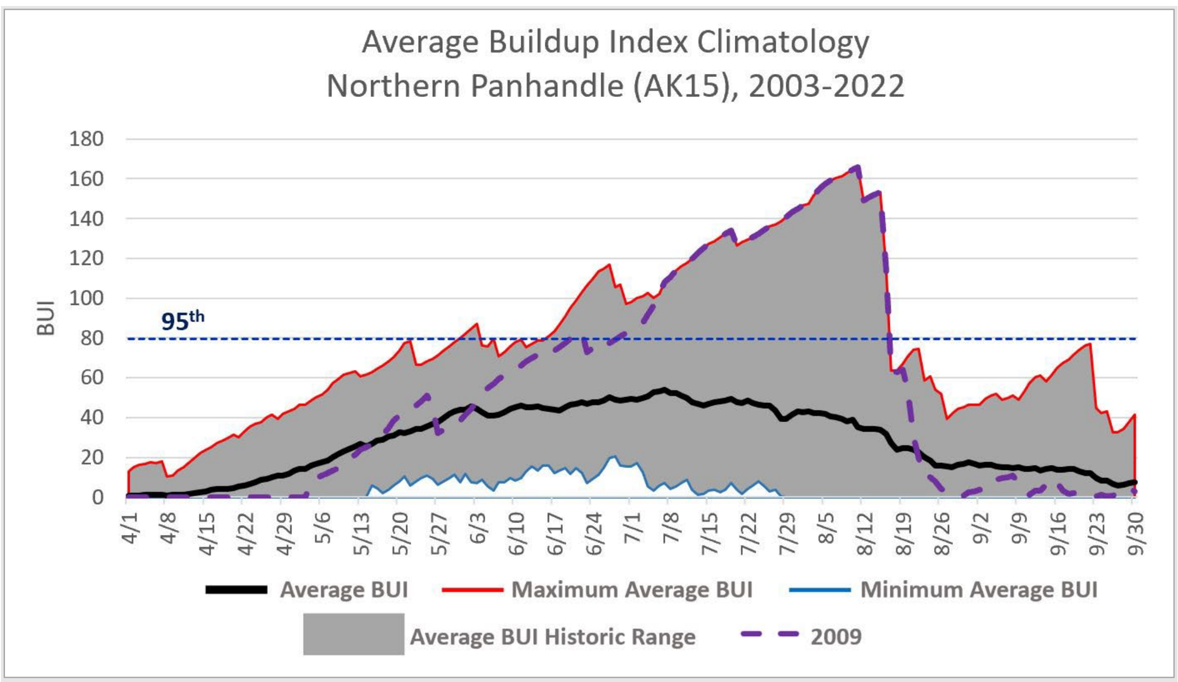
Percentile	Term Date	Season Characteristics
25%	7/5	Duff-Driven - Resistance to control
50%	8/1	Drought-Driven - Resistance to Extinguishment
75%	8/13	Diurnal-Limited - Short burn window, good RH recovery
90%	9/2	Diurnal-Limited - Short burn window, good RH recovery



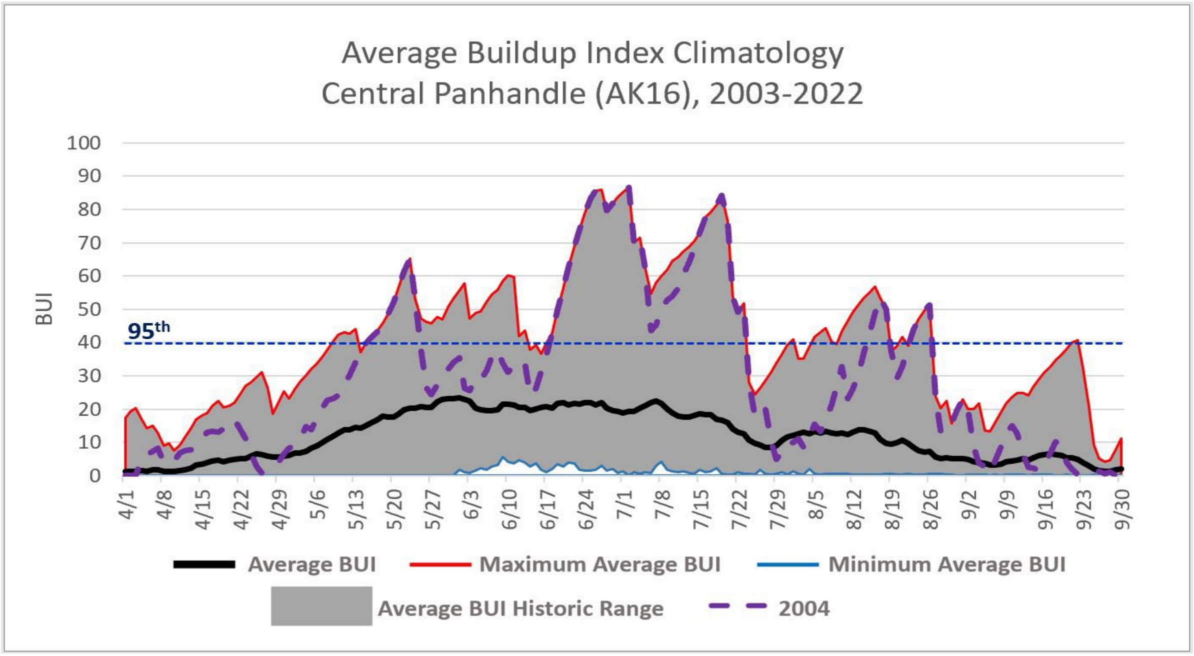
Percentile	Term Date	Season Characteristics
25%	6/28	Duff-Driven - Resistance to control
50%	7/16	Drought-Driven - Resistance to Extinguishment
75%	7/28	Drought-Driven - Resistance to Extinguishment
90%	8/13	Drought-Driven - Resistance to Extinguishment



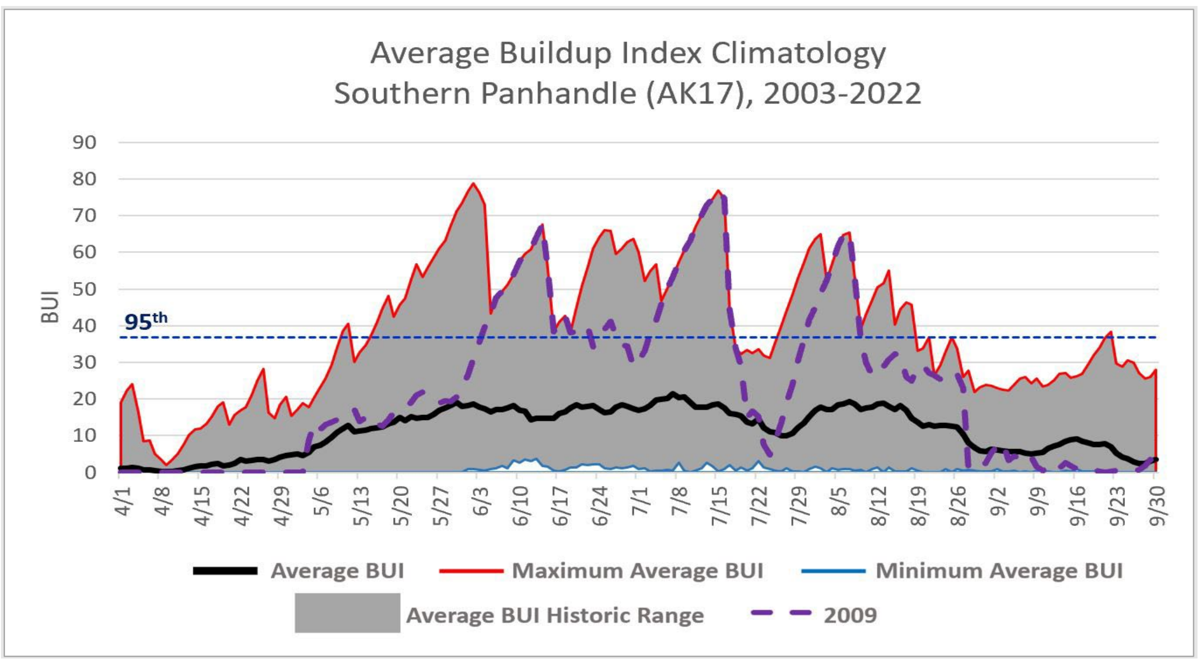
Percentile	Term Date	Season Characteristics
25%	6/30	Duff-Driven - Resistance to control
50%	7/16	Drought-Driven - Resistance to Extinguishment
75%	8/2	Drought-Driven - Resistance to Extinguishment
90%	8/15	Drought-Driven - Resistance to Extinguishment



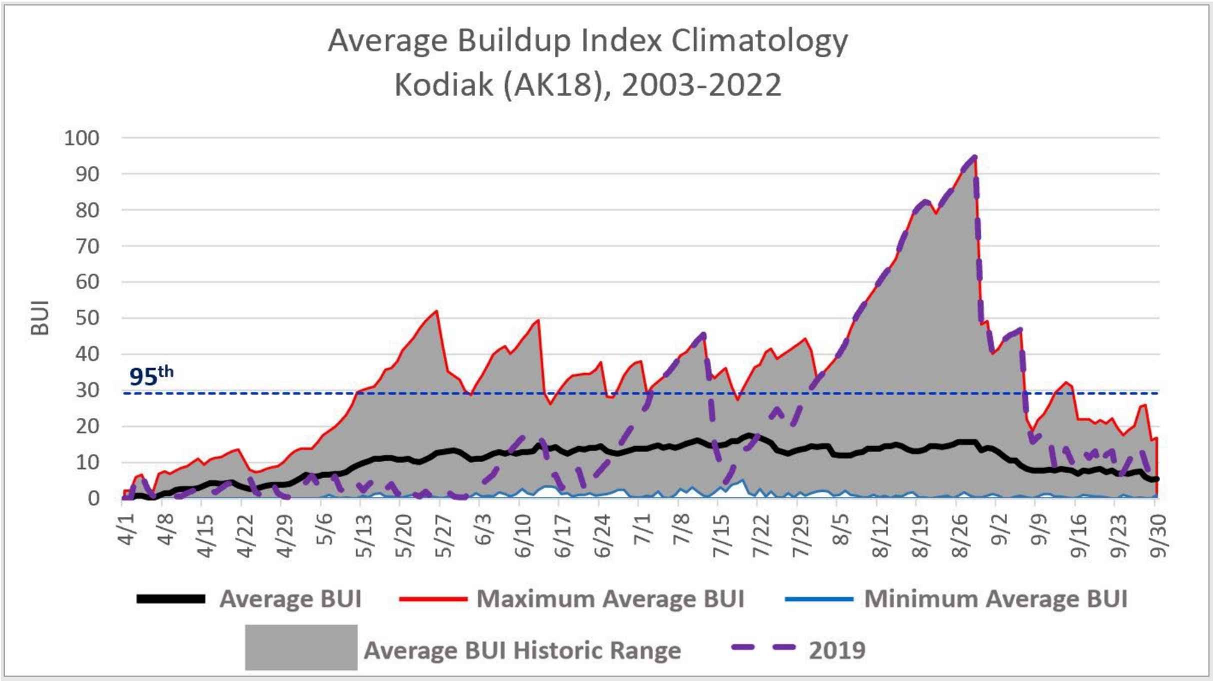
Percentile	Term Date	Season Characteristics
25%	6/28	Duff-Driven - Resistance to control
50%	7/16	Drought-Driven - Resistance to Extinguishment
75%	8/12	Drought-Driven - Resistance to Extinguishment
90%	8/23	Drought-Driven - Resistance to Extinguishment



Percentile	Term Date	Season Characteristics
25%	6/11	Duff-Driven - Resistance to control
50%	7/1	Drought-Driven - Resistance to Extinguishment
75%	8/5	Drought-Driven - Resistance to Extinguishment
90%	8/22	Drought-Driven - Resistance to Extinguishment



Percentile	Term Date	Season Characteristics
25%	7/7	Duff-Driven - Resistance to control
50%	7/18	Drought-Driven - Resistance to Extinguishment
75%	8/9	Drought-Driven - Resistance to Extinguishment
90%	8/15	Drought-Driven - Resistance to Extinguishment



Percentile	Term Date	Season Characteristics
25%	7/4	Duff-Driven - Resistance to control
50%	7/24	Drought-Driven - Resistance to Extinguishment
75%	8/17	Drought-Driven - Resistance to Extinguishment
90%	9/2	Drought-Driven - Resistance to Extinguishment

Appendix M: Summary of AIFDOP Changes

2024 Update of the 2019 Alaska Interagency Fire Danger Operating Plan

The Alaska Interagency Fire Danger Operating Plan (AIFDOP) is reviewed annually by the AWFCG (Alaska Wildland Fire Coordinating Group) Fire Danger Committee. Every 5 years, or sooner if deemed necessary by a majority of the Fire Danger Committee voting members, a comprehensive update (to include data re-analysis) will be completed and approved by all AWFCG members whose agency is participating in the AIFDOP. The prior comprehensive update was completed in 2019 with the creation of this interagency plan (though it was not approved until 2020).

The AIFDOP 2024 update (including re-analysis) has been completed by the Fire Danger Committee and is recommended for approval by the AIFDOP participating AWFCG members as of **June 3, 2024.**

The following updates were completed:

- Minor grammatical, punctuation, spelling, and format changes.
- Document edited for compliance with Section 508 of the Workforce Rehabilitation Act.
- Hyperlinks were updated where needed.
- Signature page was re-signed for the 2024 AIFDOP update.
- The update page was revised to capture changes from the 2024 update (re-analyses) and the AWFCG Fire Danger Committee Chair signature.
- Document was edited to improve readability and flow including moving figures and tables within the text, providing clarification on analysis processes, and updating standard processes.
- Ensured terminology was used consistently throughout the document (e.g., replaced PSA with FDRA).
- Updated all Maps through 2022 data.
- Added brief explanation of CFFDRS Fire Behavior Prediction (FBP) system in Chapter I.E. CFFDRS Overview.
- Better defined the four stages of the Alaska fire season and tied Chapter 1.F. Alaska Fire Season Overview in with Chapter III.G. Seasonality of Alaska Fire Danger Rating Areas and Appendix M.
- Updated text, figures, and maps in Chapter 1.G. Fire Occurrence with new data analyses for the period of 1999-2022.
- Refreshed language used to describe Chapter II.A. Fire Danger Rating Area Development. Moved Chapter II. B Fire Danger Rating Area Descriptions to an Appendix.
- Moved the map and development of the Alaska Sub-Region Adjective Class Areas from Chapter III.B.3 to Chapter II.B.
- Removed extraneous text from Chapter II.C.4 Fire Weather Watches and Red Flag Warning and updated Figure 17 for criteria.
- Updated description of CFFDRS FWI thresholds table (Table 1).
- Complete re-write and re-analysis of fire occurrence data, MODIS/VIIRS Days and Temperature/CFFDRS variables for ASR-Spring in Chapter III.B.3. The adjective class thresholds were updated and simplified (Table 3). Re-analyzed data shows significant improvement in reaching the target percentiles per adjective class.
- Added graphs comparing MODIS and VIIRS satellite heat detects.

- Included 2024 SAR validation results in Chapter III.C.2.
- Complete re-write and re-analysis of fire occurrence data, MODIS/VIIRS Days, MODIS/VIIRS detections per day and Temperature/CFFDRS variables for ASR-Summer in Chapter III.D.1. The ASR-Summer adjective class thresholds were updated (Table 5). Re-analyzed data shows significant improvement in reaching the target percentiles per adjective class.
- Complete re-write of Chapter III.E including summarizing results for the 2024 re-analysis of SAR, GAR, ASR – Spring, and ASR-Summer. Table 6 comparing adjective class rating systems was updated.
- Detailed methods for 2024 ASR – Spring thresholds were added to Appendix F.
- Appendix G was updated with 2024 SAR Validation Analysis and graphics.
- Appendix H was updated with 2024 ASR – Summer threshold analysis and graphics.
- Appendix I was added to incorporate 2024 conditional frequency analysis for GAR, ASR-Spring, SAR, and ASR-Summer.
- Added new ASR-Spring climatological breakpoint analysis and updated analysis for GAR, SAR, and ASR-Summer including all graphics to Appendix J.
- Climatologic breakpoints for GAR, SAR, ASR-Spring and ASR-Summer (by FDRA) were re-analyzed using data from 2003-2022 and updated in Appendix J.
- Continued progress on the Tundra Adjective Rating including new conditional frequency (CF) threshold validation analysis for Ignition Days and Growth Days (MODIS and VIIRS Days) using 2003-2022 data. New CF analysis was completed for Tundra ATF and DMC by MODIS Day, Fire Occurrence, and VIIRS Day. See Appendix K.
- All Seasonality Charts (one for each FDRA) were updated for 2003-2022, along with all the term filles (that show fire termination dates) in Appendix M.