Alaska Interagency Fire Danger Operating Plan

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Alaska Interagency Fire Danger Operating Plan

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Alaska Interagency Fire Danger Operating Plan

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I. Introduction

A. Purpose

The public, industry, and our own agency personnel expect the interagency wildland fire management agencies to implement appropriate and timely decisions, which result in safe, efficient, and effective wildland fire management actions. This plan documents a decision-making process for agency administrators, fire program managers, fire operations specialists, dispatchers, agency cooperators, and firefighters by establishing interagency planning and response levels using the best available scientific methods and historical weather/fire data.

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 has proven to correlate well to the Alaska fire environment. This plan provides a science-based tool for interagency fire managers to incorporate a measure of risk associated with decisions which have the potential to significantly compromise safety and control of wildland fires.

Interagency policy and guidance require numerous unit plans and guides to meet preparedness objectives.

This Fire Danger Operating Plan (FDOP) guides the application of decision support tools (such as CFFDRS) at the local level. This FDOP is supplemental to the Alaska Interagency Mobilization Guide, the Alaska Interagency Wildland Fire Management Plan (AIWFMP) and unit fire management plans. It documents the management of a fire weather station network and describes how fire danger ratings will be applied to local unit fire management decisions.

The decision points identified and documented in the Alaska FDOP are implemented as fire business thresholds and may be described in supplemental action plans developed by jurisdictional and protecting agencies. These plans are described in Chapter V. These plans may include agency specific policy requirements or other agency specific needs.

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 (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 5120 - Fire Management - Preparedness
- Bureau of Land Management – H-9211 - 1 - Fire Planning Handbook
- National Park Service – Manual 18, Chapter 5 – Preparedness
- Fish and Wildlife Service – Fire Management Handbook, Chapter 10 - Preparedness

C. Operating Plan Objectives

- Provide an interagency tool for agency administrators, fire managers, dispatchers, agency cooperators, and firefighters to correlate fire danger ratings with appropriate fire business decisions in fire danger planning areas.
- Delineate fire danger rating areas (FDRAs) in fire danger planning areas with similar climate, vegetation, and topography.
- Describe the use of the interagency fire weather-monitoring network consisting of Remote Automated Weather Stations (RAWS) that comply with NFDRS Weather Station Standards (PMS 426-3) and supplementary weather stations not maintained to National Fire Danger Rating System (NFDRS) standards that provide data needed to calculate CFFDRS indices.
- Determine climatological breakpoints and fire business thresholds through analysis and summarization of an integrated database of historical fire weather, CFFDRS fire indices, fire heat, and fire occurrence data. Document thresholds and breakpoints for use in subordinate plans.
- Define roles and responsibilities in making fire preparedness decisions, managing weather information, and briefing fire suppression personnel regarding current and potential fire danger.
- Determine the most effective methods for fire managers to communicate potential fire danger to cooperating agencies, industry, and the public.
- Identify seasonal risk analysis criteria and establish general fire severity thresholds.
- Develop and document an online seasonal trend analysis tool for Alaska.
- Identify and document future program needs.

D. Alaska Fire Management Overview

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 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.

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

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.

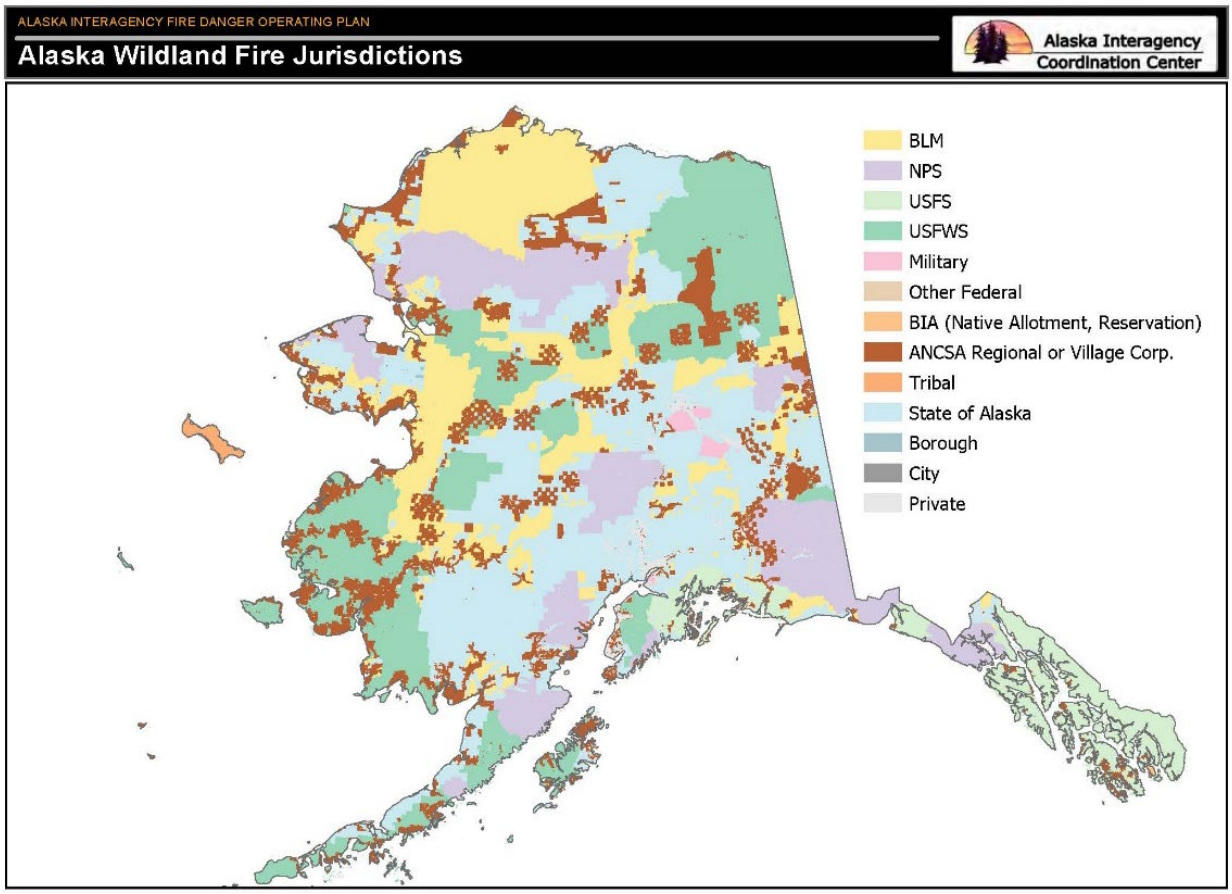


Figure 1: Alaska Wildfire Jurisdictions

2. Protecting Agencies

Protecting agencies provide wildfire 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 jurisdictional agency. Agreements and operating plans delineate services and billing procedures in accordance with state and federal laws.

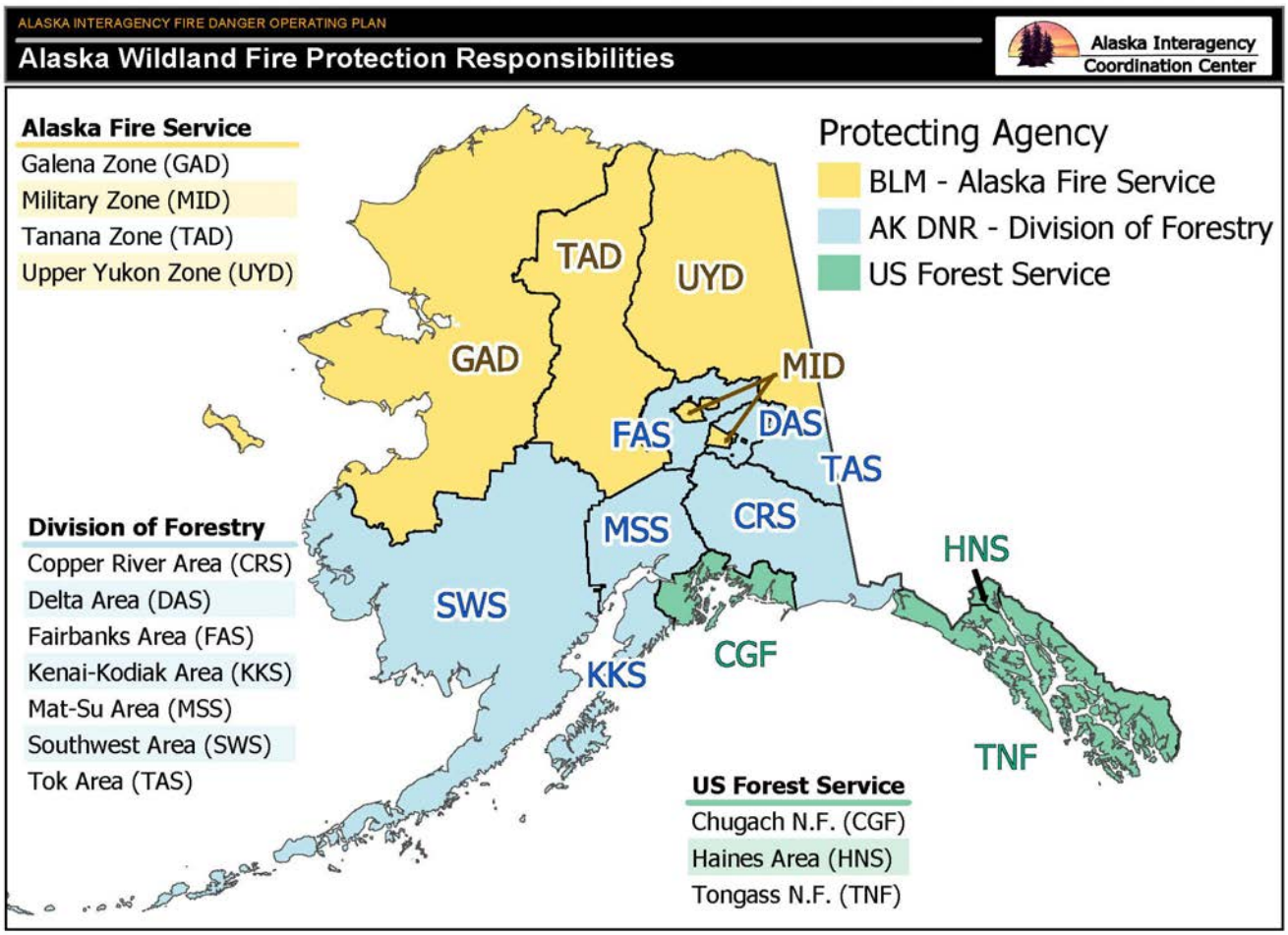


Figure 2: Alaska Wildfire Protection Areas

E. CFFDRS Fire Weather Index (FWI) System Overview

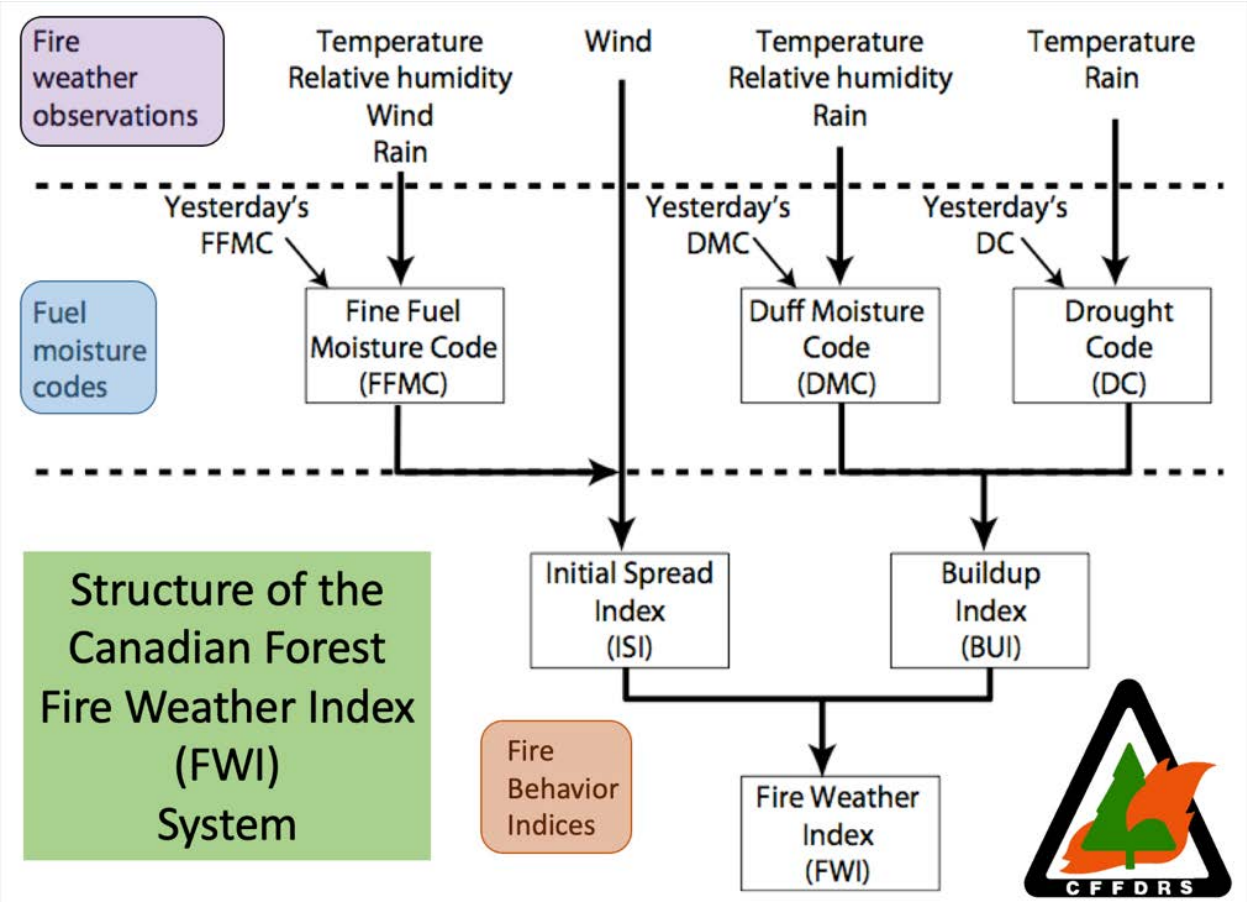


Figure 3: Structure of the CFFDRS Fire Weather Index System (FWI)

The Canadian Forest Fire Weather Index (FWI) 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 fuels, plus the effect of wind on fire behavior. The FWI system is probably best explained as a bookkeeping 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, collected nominally at 1400 AKDT for each observing location, to produce daily FWI codes and indices (**Figure 3**).

F. Alaska Fire Season Overview

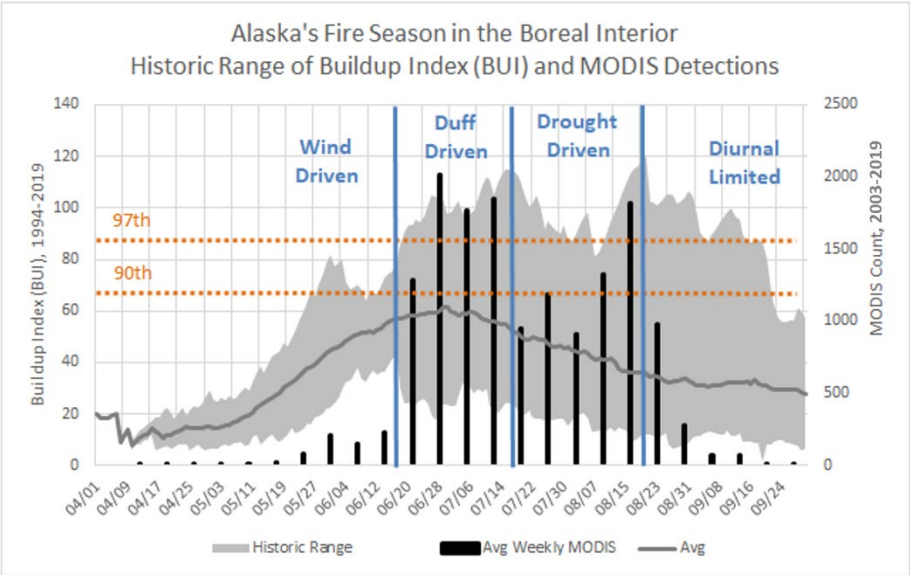


Figure 4: Alaska fire season as described by the Buildup Index (BUI)

MODIS (Moderate Resolution Imaging Spectroradiometer) is an instrument aboard the Terra and Aqua satellites that identifies heat sources and has been effectively used in Alaska. **Figure 4** demonstrates the correlation between the Buildup Index (Average BUI) which is used to represent the typical trend in seasonal landscape flammability, and the Median Weekly MODIS heat detection count which is used as a proxy for fire growth.

In the 1990s, with emphasis on the boreal Interior, Dan Burrows, AFS Tanana Zone FMO, developed an undated document entitled *Preattack Planning* that provides a representation of seasonality for the fire year in Alaska. Those seasons include:

- **Wind-Driven Stage** begins in early April and corresponds generally to the period before full green-up when the soils are still cold and dead grasses and litter within and around communities are favorable for ignition of primarily initial attack fires and for incidents with rapid spread and growth.
- **Duff-Driven 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 and immediately adjacent subsurface litter and duff fuels. 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.
- **Cumulative Drought Stage** begins in the middle of July and reflects less common later season fire growth potential and 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 may exhibit a high resistance to extinguishment. Severe drought indices can lead to fires that overwinter and re-initiate the following spring.
- **Diurnal Effect 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. Short burning periods/windows and high humidity recovery at night limit the spread potential for these fires. Significant fire activity during this period was historically

considered to be unusual but has occurred in some more recent fire seasons including: 2004, 2005, 2009, 2010, 2013, and 2019.

Though the seasonality described above is related primarily to the boreal forests if Interior Alaska, the day length effects, and phenology tend to occur in this pattern throughout the state. In addition, while these seasons are referred to repeatedly in the analysis section, the typical dates referenced are different from ones identified in the original Burrow's characterization.

The Energy Release Component (ERCy) is the National Fire Danger Rating System (NFDRS2016) index analogous to BUI. Its trend peaks earlier than the historical peak of Alaska's fire season. In addition, the maximum ERCy trend does not show the peaks in flammability that are associated with periods of maximum fire growth as represented by BUI (**Figure 5**).

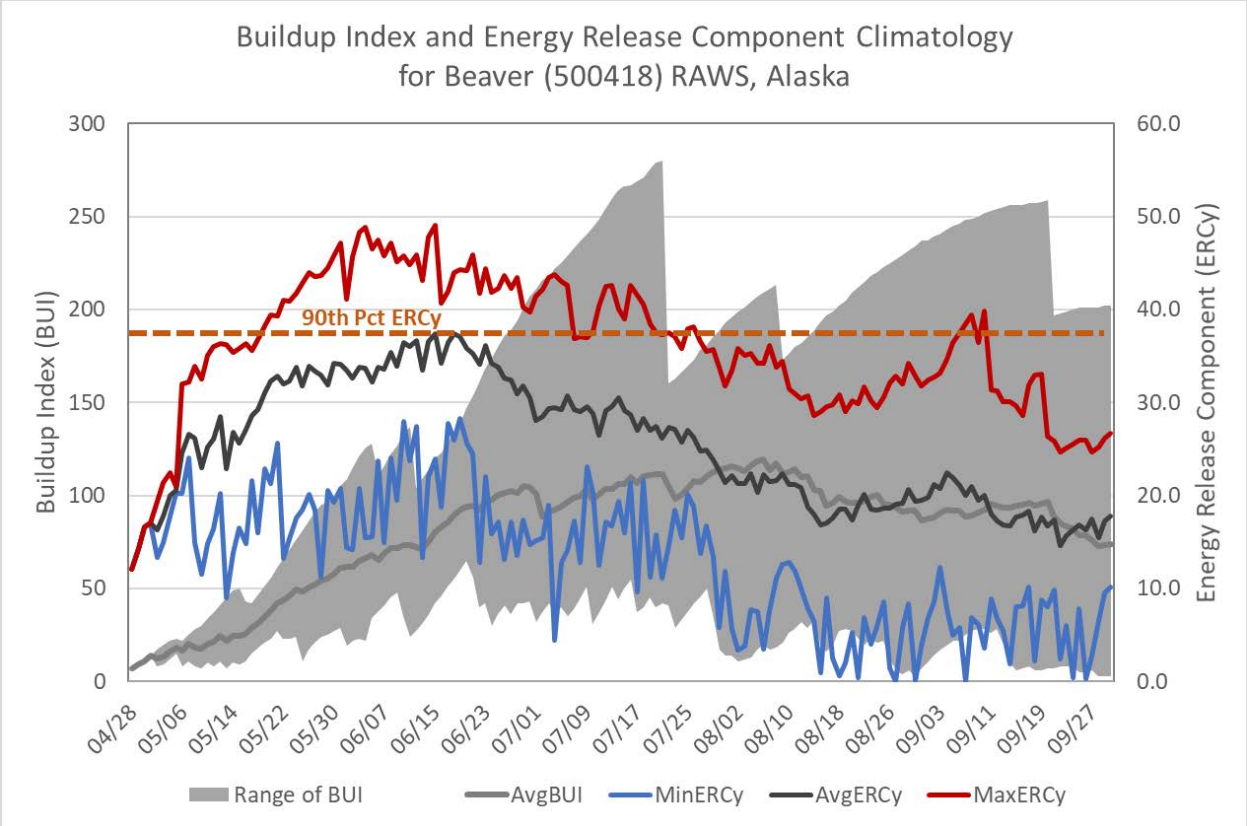


Figure 5: Tracking seasonality with Buildup index (BUI) versus Energy Release Component (ERC)

G. Fire Occurrence:

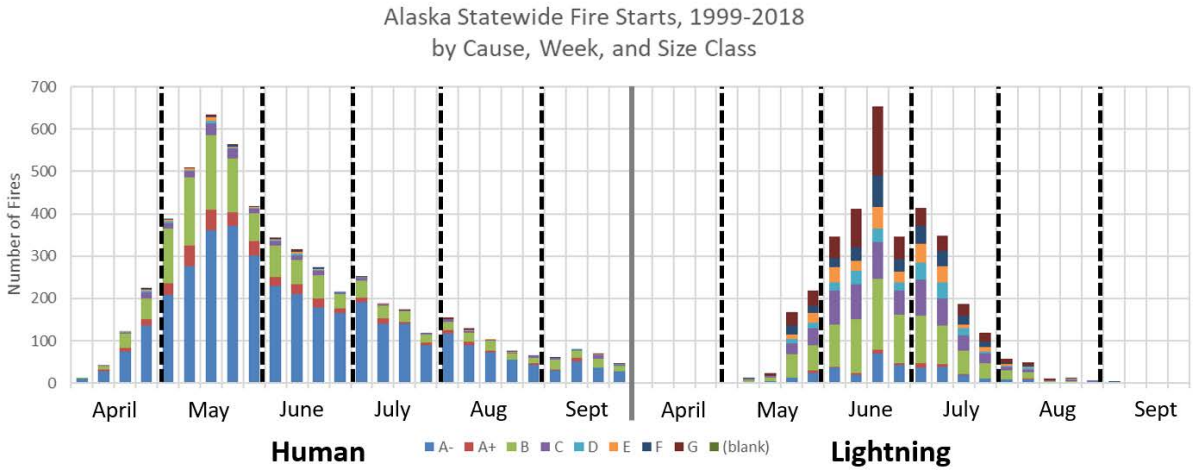


Figure 6: Alaska Fire Occurrence Seasonality

As shown in **Figure 6**, fire occurrence is easily related to seasonality, suggesting segmentation of the data for fire danger analysis.

Human ignitions generally begin to increase in frequency in early April, primarily along the road system in south central Alaska, Fairbanks, Delta and Tok. They peak in mid-May, begin to fall off steadily as green-up increases, and continue through the summer. Some human-caused occurrence continues to be observed into October, though it is infrequent. On a Predictive Service Area (PSA) basis (see **Figure 14**), the seasonal distribution of human ignitions suggests the appropriate period for focus of pre-suppression activities such as prevention and daily readiness and response actions.

- The bulk of human-caused ignitions fall within size class A (less than ¼ acre). The majority are less than 0.1 acre, which is the smallest size that can be input as a reportable fire.
- The number of class B and class C fires due to human ignitions peaks during the month of May, suggesting greater flammability conditions than at other times of the year along the road system.
- Activity shown throughout much of the season suggests a need for some minimum response capability throughout the fire season.

Lightning ignitions are born of convective storms that, as shown here, generally do not begin until the later part of May. 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 Effect Season. Note also that there are relatively few Size Class A lightning fires throughout the year because most are not actively suppressed.

- As the weather and fuel conditions warm and dry in late May and into June, frequency of lightning ignitions increases rapidly for all fire size classes.
- The number of lightning ignitions in the largest fire size classes (E, F, and G) peaks at the beginning of the Duff Driven Season. Much of the lightning activity, and area burned in 2015, were precipitated by storms in the last half of June.
- Frequency of lightning ignitions declines rapidly in the Drought Driven Season, precisely because drought is an exceptional event. Convective storms decline due to cooling atmosphere, and mid-summer rains generally moderate fuelbed conditions.

Though the Alaska Interagency Fire History Database includes records dating back to 1940, analysis of fire weather, fire ignitions, and fire growth will date back only to 1999, providing 20 years of information

for the development of this FDOP in 2020. This dataset is used instead of the USFS Research Data Archive to take advantage of most current data available.

Ignitions highlight the needs for pre-suppression actions such as prevention, daily readiness, and initial response. Fire growth statistics, represented here as acres burned, show how those ignitions respond to variability in the landscape and its flammability.

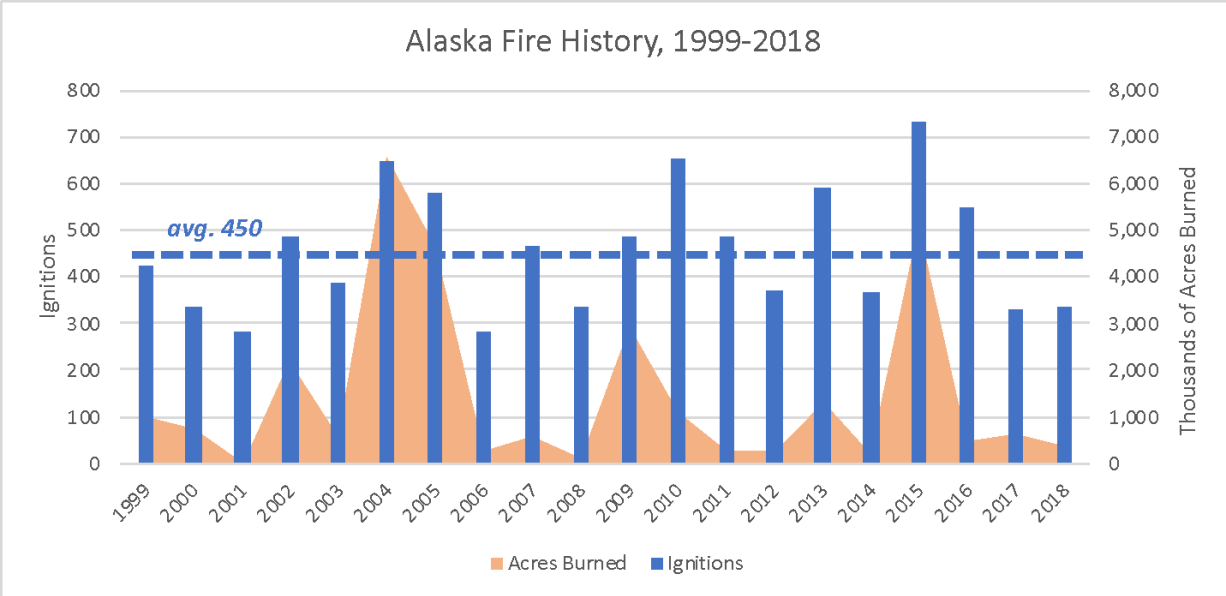


Figure 7: Alaska Fire History 1999-2018

Statewide wildfire incidents over the 20 years from 1999 to 2018 include over 9,000 fires. **Figure 7** shows that the low years in 2001 and 2006 saw less than 300 starts, while 2015 sets the record with 730 fires. These numbers are small for the size of the burnable landscape when compared to western CONUS frequencies.

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 average numbers of ignitions, 2002 and 2009 had a typical number of fires. However, lower than average ignitions do tend to produce lower acreage totals.

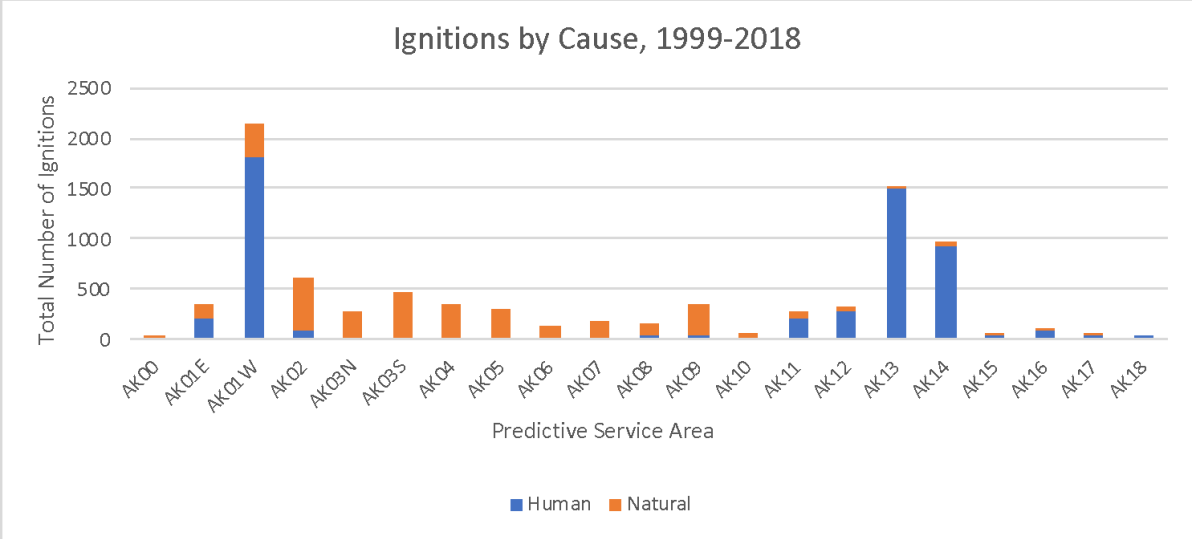


Figure 8: Alaska Ignitions by Cause, 1999-2018

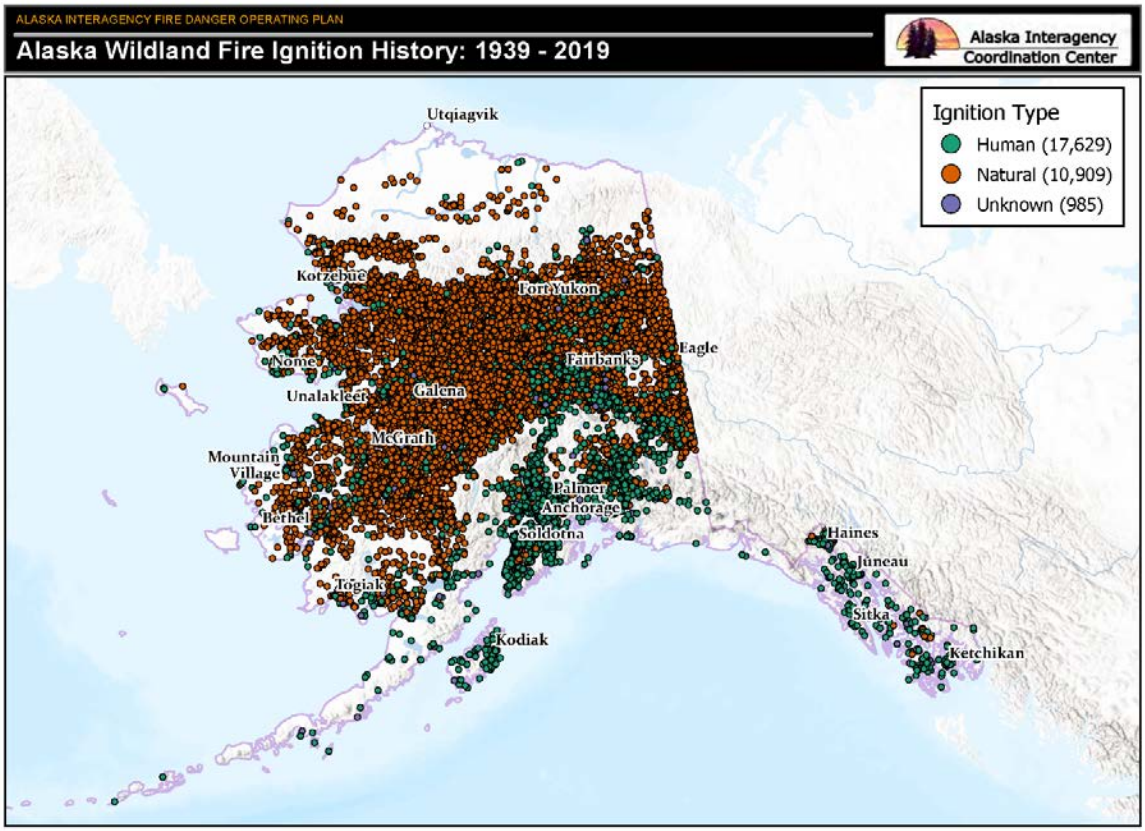


Figure 9: Alaska Wildland Fire Ignition History Map

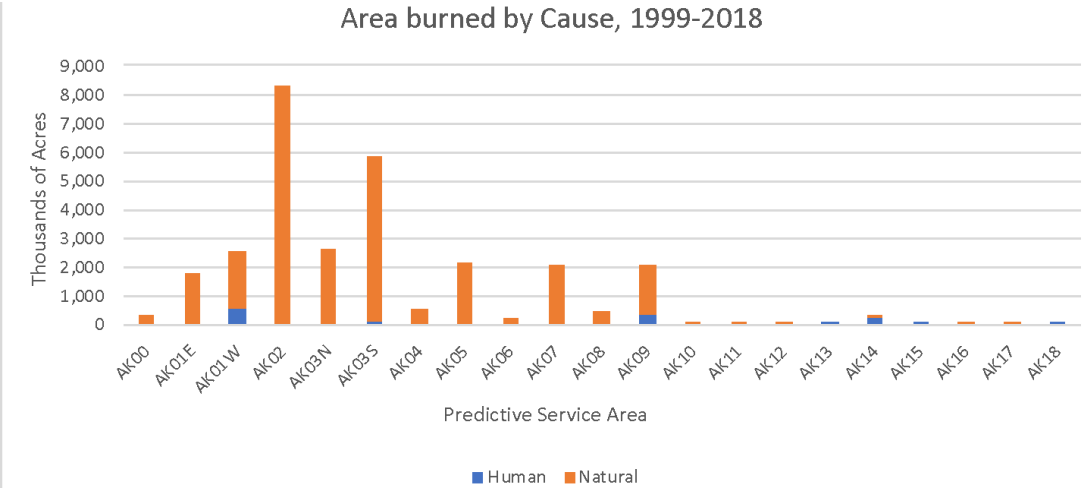


Figure 10: Alaska Area Burned by Cause, 1999-2018

Ignitions are distributed unevenly both geographically and by cause. 5,651 (62%) of the total number of fires are human caused, while 3391 (38%) are primarily from lightning caused natural ignitions. **Figure 8** shows human caused ignitions in blue and natural (primarily lightning caused) ignitions in orange. It is clear that the areas protected by Alaska Division of Forestry (generally PSAs AK01E, AK01W, AK11, AK12, AK13, and AK14) show 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. Note that some ignitions in remote areas (especially in western and northern Alaska) are not discovered and others are not reported for various reasons.

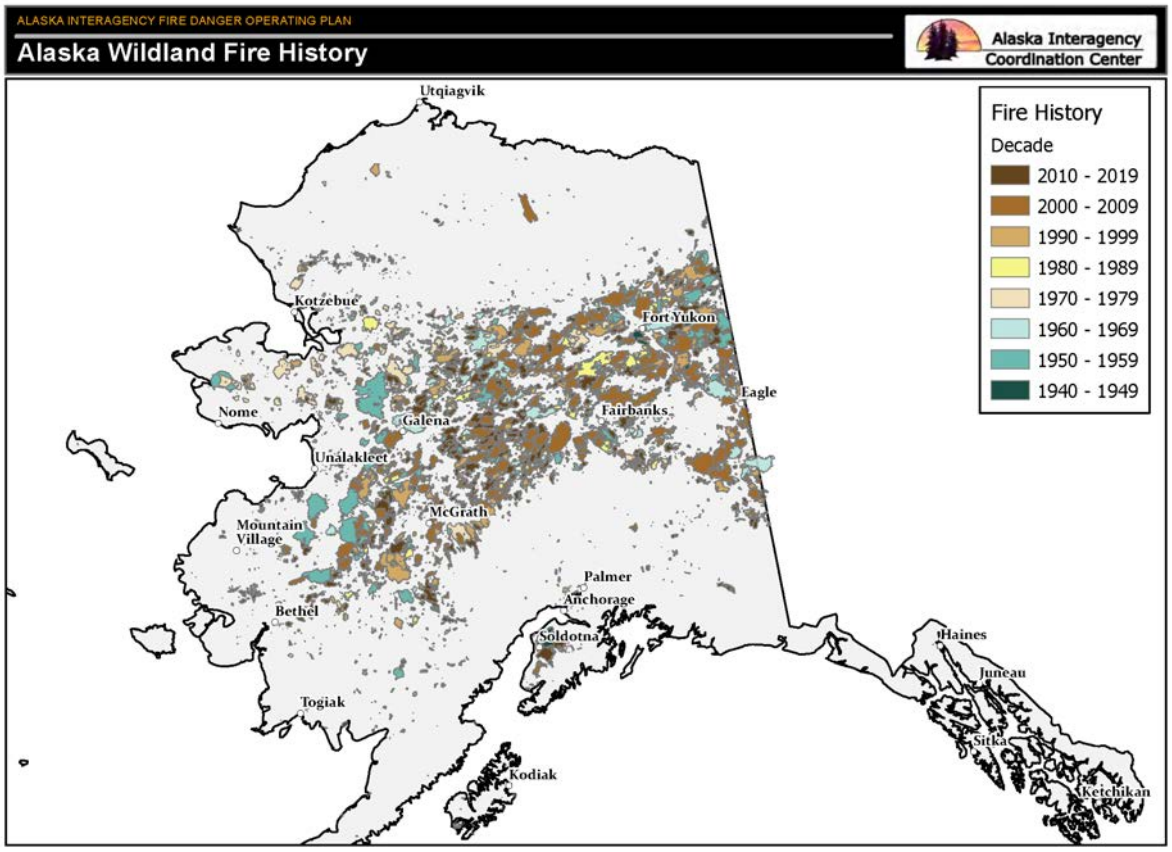


Figure 11: Alaska Area Burned by Decade 1940-2019

Area burned, as shown in **Figure 10** and **Figure 11**, highlights different distinctions. Most of the area burned comes from lightning ignitions and in the boreal interior landscape. AK01E, AK01W, AK02, AK03N, AK03S, AK05, AK07, and AK09 include 25.8 million (87%) of 29.7 million acres burned over the 20-year period.

H. Alaska Fuels Overview

In 2001 the USGS divided Alaska into 32 major ecosystems. Those major ecosystems can be generalized in to nine broad ecoregions based on climate parameters, vegetation response and disturbance processes as shown in **Figure 12**. You can clearly see the Interior boreal forest, where a majority of 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.

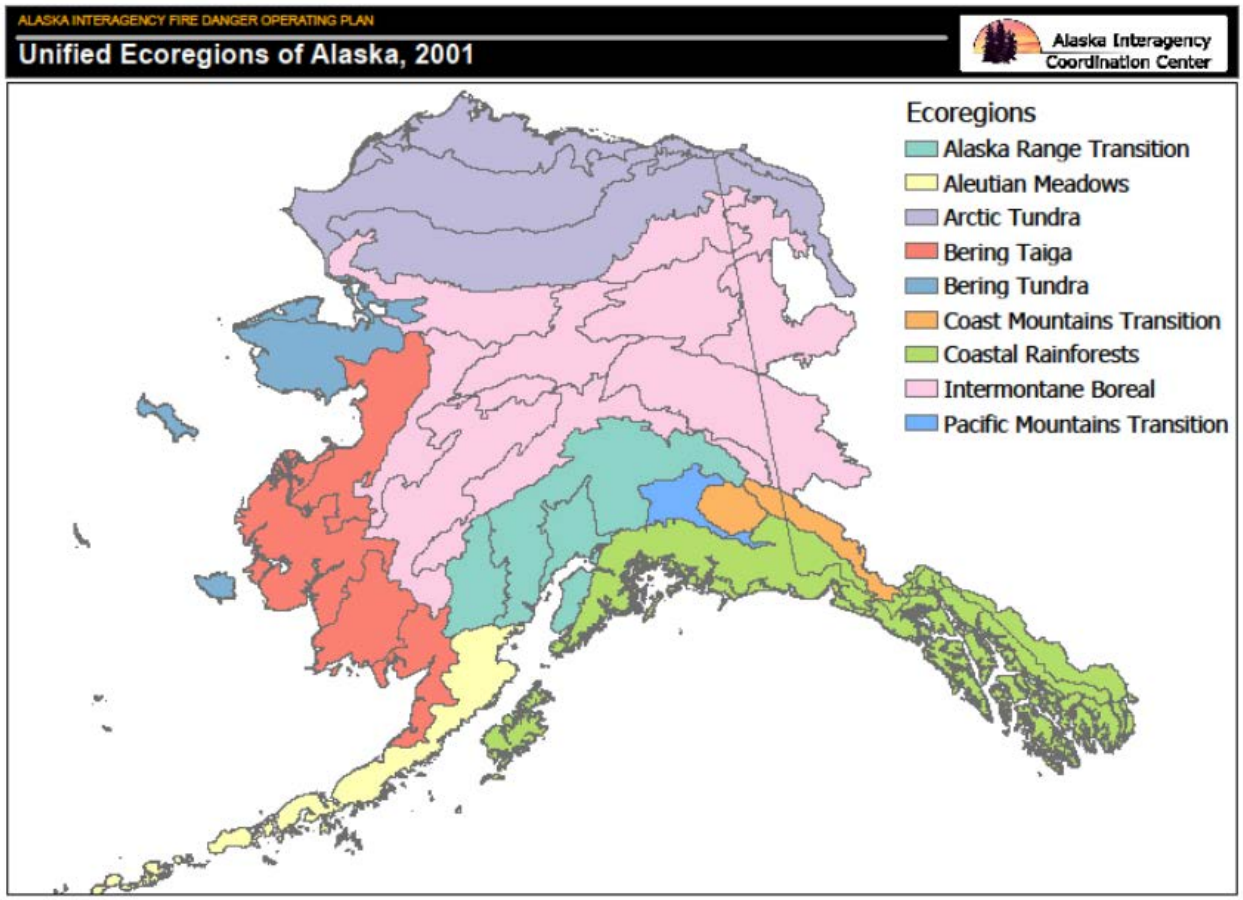


Figure 12: Alaska Ecoregions

Fuels within these ecosystems have been described using CFFDRS Fuel Types (https://www.nwcg.gov/publications/pms437/cffdrs/fire-behavior-prediction-system#TOC-FBP-Fuel-Types).

In general, black spruce (C-2) is considered the most flammable fuel type in Alaska. Hardwoods (D-1&2), mainly aspen and birch, are usually a barrier to fire spread except during extended fire seasons when fires are still burning during the Cumulative Drought Stage. Grass areas (O-1a & 1b) burn readily before green-up and are the major fuel supporting fire growth in the early Wind Driven Season. Alaska Fuel types are described in detail the *Fuel Model Guide to Alaska Vegetation*, https://www.frames.gov/catalog/56055 and are depicted in **Figure 13**.

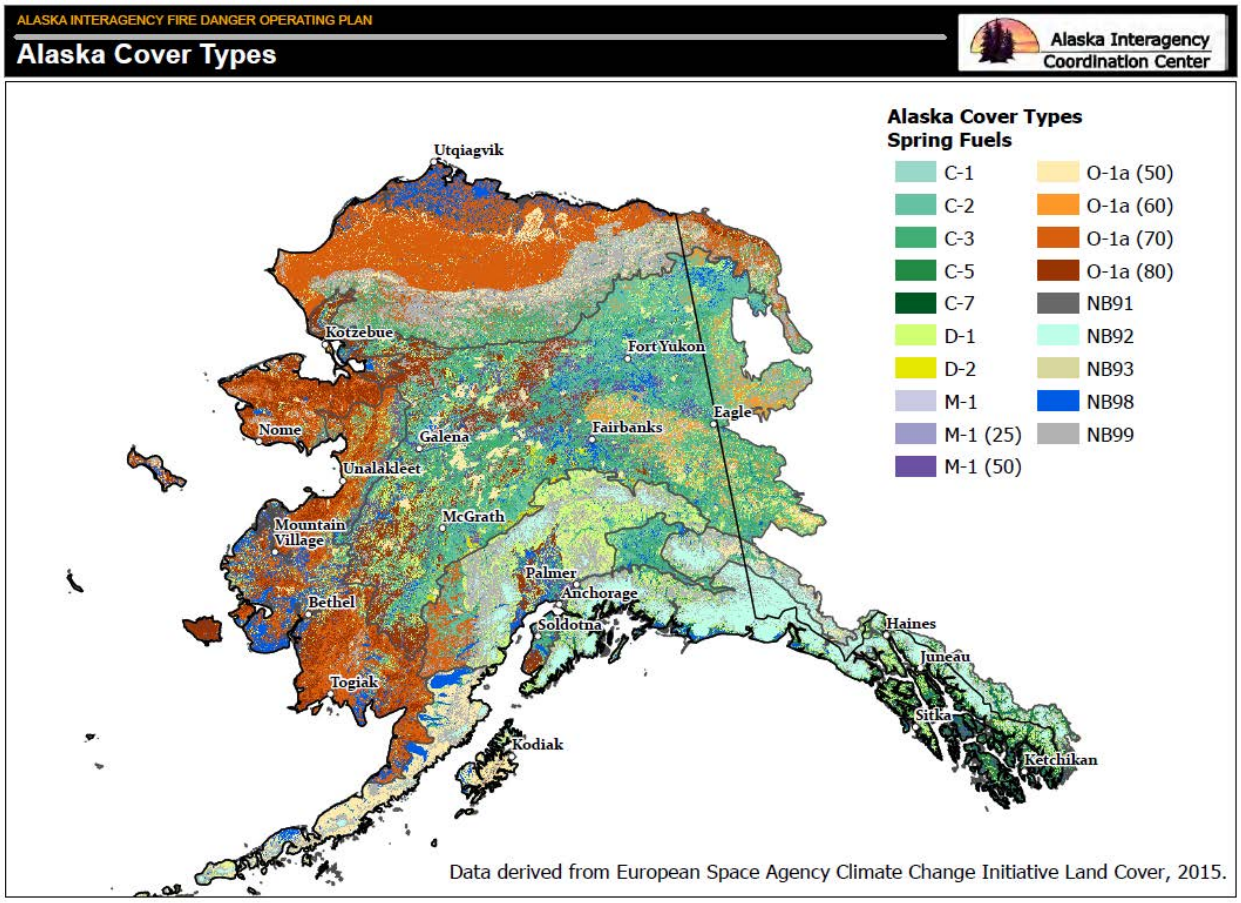


Figure 13: Alaska Cover Types

II. Fire Danger Rating Area Inventory

A. Fire Danger Rating Area Development

Fire Danger Rating Areas (FDRAs) were originally evaluated based on ecoregion and fire history. After further evaluation, PSAs were chosen to represent the FDRAs. Since all prior analysis and record keeping has been built around these areas, and the regions make sense for managing fire in Alaska (**Figure 14**).

In 2007, Predictive Services Meteorologists were tasked with generating PSAs that had relatively homogeneous fire danger. This was particularly challenging for Alaska, as each PSA required enough weather stations and fire history to make an analysis possible.

Existing fire management zone and fire weather zone boundaries provided a good starting point, because fire management issues and tactics were homogeneous, even if fire and weather were not. homogenous within the area, the fire management issues and tactics were. Several areas around the state originally did not have fire and/or weather data with a long enough history to provide analysis. These included the northern Brooks Range and North Slope, Kodiak Island, and many coastal areas. Later it was recognized that all areas must be included in a PSA. Coastal areas were absorbed into the nearest PSA. The North Slope and Brooks Range became AK00 and Kodiak Island became AK18.

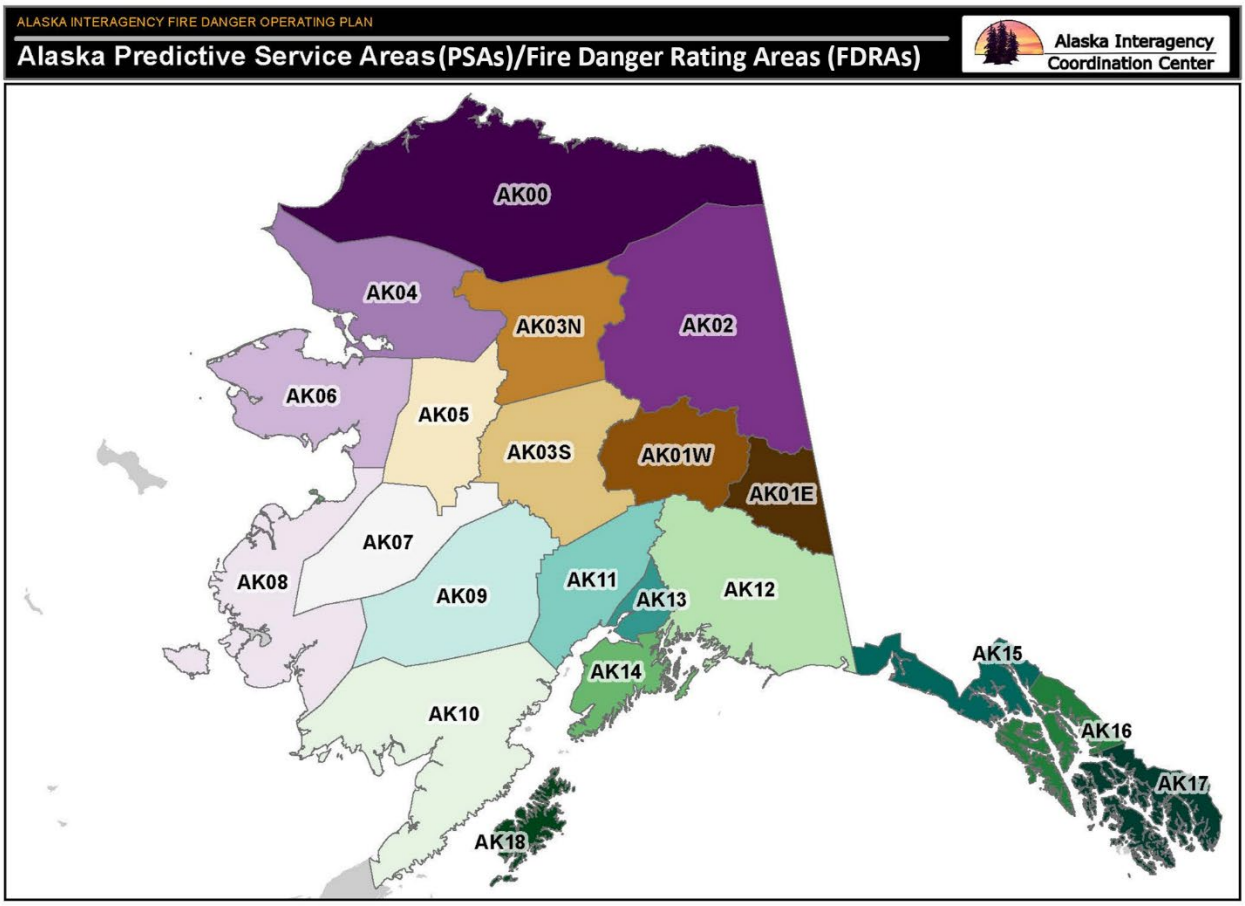


Figure 14: Alaska Predictive Service Areas (PSAs) / Fire Danger Rating Areas (FDRAs)

B. Predictive Service Area Descriptions

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. The most well-known is the Anaktuvuk River fire in September 2007, which burned about 256,000 acres. Weather in this PSA tends to be cool and not particularly conducive to fire activity. Vegetation is primarily taiga and tundra.

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. The boundaries are nearly identical to the Tok Fire Management Area. Weather on the valley floor can be significantly different from that in the hills on either side. Overall, summer weather is warm and dry, with wet and/or dry 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 due to southerly flow over the Alaska Range which can lead to rapid unexpected fire spread.

AK01W: Western Tanana

This includes the Middle Tanana Valley, which is wider 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 and dry, with wet and/or dry thunderstorms a possibility for much of June and July. This area follows the boundaries of the Fairbanks and Delta Fire Management Areas. Vegetation is predominantly boreal forest. This area is prone to strong Chinook winds due to southerly flow over the Alaska Range which can lead to rapid unexpected fire spread.

AK02: Upper Yukon

This area includes the wide plains of the Yukon Flats, and 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, and though thunderstorms are likely, the associated precipitation is often quite spotty. The Yukon Flats are often one of the last parts of the state to receive ample end-of-season rains, and often enter the winter months on the dry side. Boreal forest is the main vegetation. Lowlands can be quite wet.

AK03N: Northern Tanana

This area's name derives from the fact that it follows the boundaries of the northern half of the Tanana Fire Management Zone. It 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 zone 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 PSA directly to the south, though light or southerly winds may still lend to hot summer afternoons. Thus, thunderstorms are less common than some other parts of the Interior, but still likely in June and July.

AK03S: Southern Tanana

This area follows the boundaries of the southern half of the Tanana Fire Management Zone. 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. Thunderstorms are likely in summer, with varying amounts of rain. This area is prone to strong Chinook winds due to southerly flow over the Alaska Range which can lead to rapid unexpected fire spread.

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 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 taiga than boreal forest, though it is more mixed through the southern half of the region.

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 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.

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 stronger winds, and is breezy even on the calmest days. Temperatures tend to be mild as a result, 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 type is mostly tundra and taiga.

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. Thunderstorms are not as common in the summer, but a damper air mass usually ensures these storms are damp, and temperatures are a bit cooler than more inland areas.

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 all summer long.

AK09: Kuskokwim Valley

This area is highly variable in topography and fire potential. In the west, the western slopes of the western Alaska Range reaching over 7,000 ft. and well above fire prone landscapes. The middle of the PSA 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 quite a bit. Summers are generally warm, although not as warm as parts of the eastern Interior.

AK10: Bristol Bay and AK Peninsula

Another widely varied area, this PSA captures the Aleutian Range in the east over 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 PSA follows the Alaska Peninsula westward, about as far as Port Heiden (57N). South and west of this point, fire activity is extremely rare, and not included in any of the PSAs. The western boundary of this area comprises the Bristol Bay Coastline. Though cool 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 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.

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 small population in this area that is generally confined to the Glenn Highway road 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 warm, with afternoon wet thunderstorms not as likely, especially over the mountains. Vegetation is mainly boreal forest.

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 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 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.

AK13: Matanuska Valley/Anchorage

This is one of the smallest PSAs, but it is the most populous area of the state. Made up of mostly boreal forest and some wetlands, this comprises 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 quite warm and afternoon thunderstorms may form on those occasions. 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. This area is prone to strong Chinook winds due to southeasterly flow over the Chugach Mountains which can lead to rapid unexpected fire spread.

AK14: Kenai Peninsula

This peninsula has lowlands to the west, and the Chugach Mountains to the east and south. There is a high population density, particularly in summer, along the major road corridors of the Sterling and Seward Highways. Most of the vegetation is boreal forest, with some wetlands in the northwest corner of the peninsula. Large areas of spruce forests have recently been converted to grasslands following spruce bark beetle outbreaks. Prior to greenup 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. There is a rain shadow on the west side of the mountains, which makes for markedly drier conditions in that area.

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 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 and high humidities, however there are instances where upper 80s are observed for several days in a row with RHs into the low 20s. Lightning is uncommon.

AK16: Central Panhandle

A well-timbered rainforest and an annual precipitation of 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, though it is possible to have hot, dry weather for up to one or two weeks in the summer. Lightning is uncommon.

AK17: Southern Panhandle

A well-timbered rainforest and an annual precipitation of over 80 inches for most areas leads to very little fire activity in this part of Southeast Alaska. Again, temperatures and humidities are moderate, though it is possible to have hot, dry weather for up to one or two weeks. Lightning is uncommon.

AK18: Kodiak

The “Emerald Isle” is a mountainous, verdant, well-treed island on the western side of the Gulf of Alaska. Though fire activity is usually very low, there is potential towards the end of August, which is typically the driest month for the area. Summertime temperatures tend to be cool, 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. Lichen can be present in tree canopy’s which is unusual for Alaska.

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 assessment of current and forecast 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 that decision support. This database is maintained within the Alaska Fire and Fuels (https://akff.mesowest.org) system. Annual summaries of recent fire seasons can be found on the AICC website at https://fire.ak.blm.gov/predsvcs/weather.php under Fire Season Summaries.

1. Alaska Fire and Fuels System (AKFF)

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 their fire potential each day. Data are collected and stored in a database; are displayed in tabular, graphical, and geospatial formats; and are available for historic queries and data downloads as needed. Details about data use and management for AKFF can be found in the System Sources and Standards section of the *Alaska Fire & Fuels Users Guide (*https://www.frames.gov/catalog/57473).

AKFF was jointly built using API web services by MesoWest & SynopticLabs teams. First developed in 2013 and funded by the Alaska Fire Service (AFS), it is now moving into the last year of a five-year contract. The key points of contact for the AKFF contract are:

- John Horel, University of Utah, Manager: john.horel@utah.edu
- Chris Galli, University of Utah, Developer: chris.galli@utah.edu
- Joe Young, University of Utah, Developer: joe.young@utah.edu
- Heidi Strader, AICC Predictive Services, Key User: heidi_strader@nps.gov
- Chris Moore, AICC Predictive Services, Key User: chmoore@blm.gov
- Eric Stevens, AICC Predictive Services, Key User: eric_stevens@nps.gov
- Robert Ziel, Alaska Fire Science Consortium, Fire Analyst, Key User: rhziel@alaska.edu
- Almeda Gaddis, Alaska Fire Service, Contracting Officer: agaddis@blm.gov

2. Alaska Fire and Fuels Seasonal Trend Analysis Tool

Alaska has developed an online Seasonal Trend Analysis Tool (**Figure 15**) that graphically represents fire potential by weather station or group of weather stations (https://fire.ak.blm.gov/predsvcs/fuelfire.php). 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 indexes as desired. The Trend Analysis Tool will be introduced to out-of-state firefighters at the Alaska Orientation and inbriefings.

The Seasonal Trend Analysis Tool based on the BUI are designed to be used in lieu of Fire Danger PocketCards (normally based on ERC) described in the *Interagency Standards for Fire and Fire Aviation Operations*. Although individual units or agencies may choose or be required to develop PocketCards, it is strongly recommended that PocketCards be considered supplemental to the Seasonal Trend Analysis Tool. This meets the intent of these types of products to accurately depict and provide understanding of fire potential.

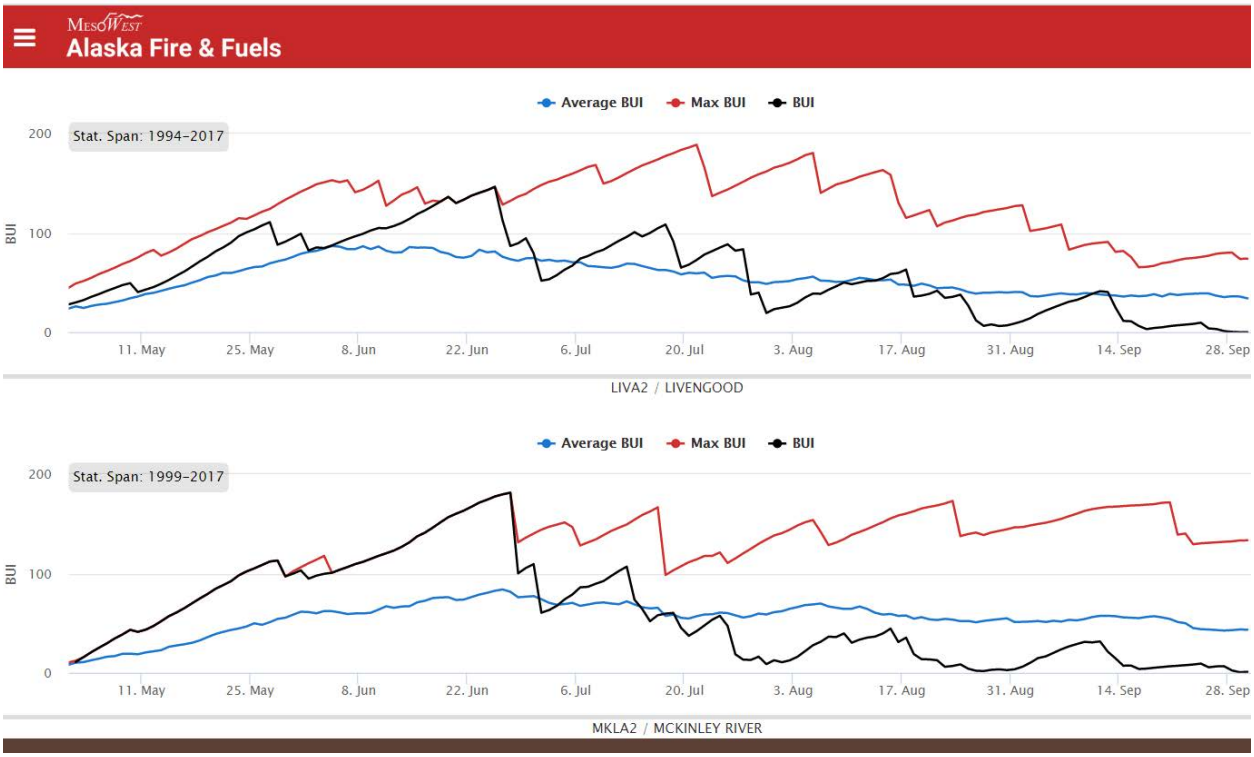


Figure 15: Alaska Fire and Fuels Seasonal Trend Analysis Tool

3. Alaska Weather Station Networks

AKFF provides data from more than 250 surface observing stations across the state (**Figure 16 right**). These locations come from a mix of agency 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 here https://akff.mesowest.org/tabular/metadata/ .

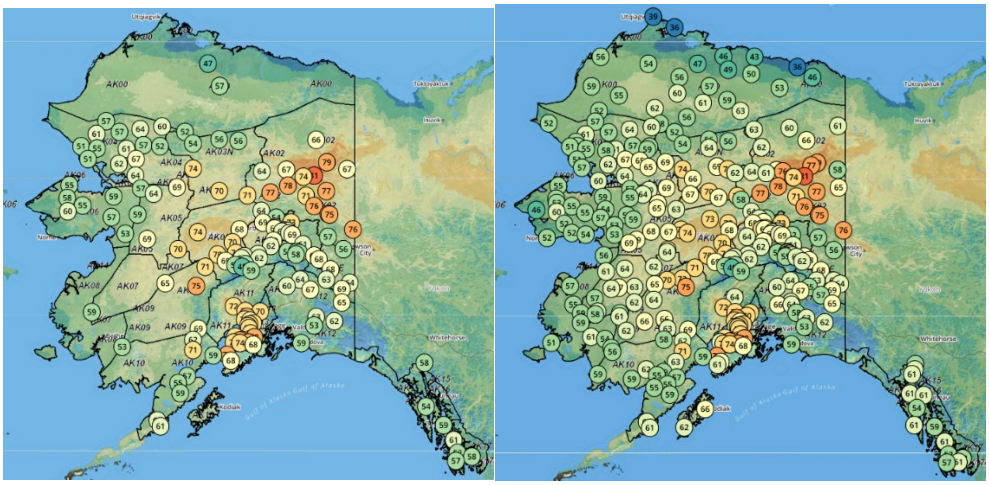


Figure 16: Alaska Fire and Fuels RAWS Network (left) & Extended Weather Station Network (right)

Traditionally, surface weather observations from a network of standard fire RAWS is collected and stored nationally at the USFS Weather Information Management System (https://famit.nwcg.gov/applications/WIMS). It is the source for NFDRS estimates for flammability and fire potential. This smaller WIMS network of approximately 80 RAWS stations (**Figure 16 left**) is used to support fire behavior analysis tools found within the Wildland Fire Decision Support System (WFDSS).

4. Red Flag Warnings and Fire Weather Watches

Red Flag Warnings (RFW) and Fire Weather Watches (FWW) are issued by the National Weather Service (NWS) to warn of critical fire weather conditions based on weather and fuels. NWS forecasters will make every effort to consult Predictive Services when Red Flag Warnings or Fire Weather Watches are considered. Predictive Services or a designated Regional Area Contact is responsible for determining if fuel conditions are consistent with issuing the Warning/Watch. This determination is made based on recent precipitation and drying events, the type and amount of fuel available, and a review of available current and forecast fire indices, among other factors. If consultation with Predictive Services is not possible, NWS forecasters will use the fuels conditions posted daily by Predictive Services as the basis for issuing a Warning or Watch when Red Flag Event conditions are anticipated. The decision-making process behind whether to issue a FWW/RFW is a collaborative process between AICC Predictive Services and NWS forecast offices.

AICC Predictive Services will be telephoned upon initial issuance of or changes to the Warning/Watch. If Predictive Services cannot be reached, NWS will call the Alaska Interagency Coordination Center (AICC) Initial Attack (IA) desk.

a) Red Flag Warnings

Red Flag Warnings are issued to warn of existing or impending weather conditions that may lead to extreme fire behavior on existing fires and/or for weather conditions that may lead to numerous new fire starts. Its issuance denotes a high degree of confidence that weather and fuel conditions consistent with Red Flag criteria (**Figure 17**) will occur within 48 hours. There are two types of Red Flag Warning Criteria:

- **Convective** – Criteria associated with thunderstorm development
- **Non-convective** – Criteria not associated with thunderstorm development. Non-convective criteria must be met in all categories (temperature, RH, and wind) for at least three observations either at one station or a combination such as one hour at three stations or two hours at one station plus one hour at another.

General non-convective Red Flag Warning criteria:

Temp ≥ 75°F	RH ≤ 25%	Wind ≥ 15 mph (sustained)

Exceptions to the non-convective Red Flag Warning criteria:

223- Deltana/Tanana Flats 226- Eastern AK Range	No temp criteria	RH ≤ 25%	Wind ≥ 30 mph (sustained)
Pre-green-up* in zones: 101- Anchorage 111- Matanuska Valley 121- Western Kenai 125- Western PWS	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 Criteria

Forecast LAL ≥ 4	Very dry fuels using adjective ratings with guidance from Predictive Services.

Figure 17: Alaska Red Flag Warning and Fire Weather Watch Criteria

b) Fire Weather Watches

A Fire Weather Watch should be issued 24 to 96 hours in advance of the expected onset of the criteria in **Figure 17**. The intent of a Fire Weather Watch is to alert users to the potential for Red Flag Event conditions a day or more in advance.

III. Fire Danger Analyses

A. Introduction to Analyses

1. CFFDRS Use in Alaska

With the adoption and implementation of the AIWFMP through the 1980s and 1990s and its fire response decision guidelines, fire managers faced critical decisions of both protection and financial liability for individual fires. Increasing awareness of both NFDRS and FWI systems led to the 1992 AWFCG decision to adopt the FWI system as Alaska's primary fire danger and decision support tool. The following factors contributed to that decision:

A Larger Network of Surface Weather Observation Locations compatible with FWI calculations

As stated in the Fire Weather, Fuel Moisture and Fire Behavior (**Section II.C**), the network of stations used for FWI calculations is much larger (~250 stations) and more effectively distributed than the network of WIMS RAWS (~80) alone. Only RAWS are used for NFDRS calculations.

National datasets are missing, inaccurate and/or ineffective in Alaska

The southernmost point in Alaska is about 5 degrees latitude farther north than CONUS (54 degrees N vs 49 degrees N) domains and nearly 6 degrees farther west (130.25 vs 124.5). That means that 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 product that includes Alaska effectively needs separate datasets and separate mapping domains, many of which do not exist for fire weather and fire potential applications.

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 national Quantitative Precipitation Estimates (QPE) are manually produced without sufficient radar data support in Alaska.

The national NWS Storm Prediction Center (https://www.spc.noaa.gov/) produces a variety of severe weather prediction tools, including one for severe fire potential. The SPC uses only a CONUS domain.

Many other efforts and products, if they include or produce information for Alaska, include it as part of a much lower resolution global domain. New products, such as the Evaporative Demand Drought Index (EDDI) and Stratified Precipitation Evapotranspiration Index (SPEI) are examples.

Climate Histories 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 reanalysis 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*. They reported, and many historic analyses that use them exhibit, 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 these climatologies ineffective in producing reference histories for fire danger fuel moisture and fire behavior indices. Further, they suffer from very coarse resolutions and significant reporting timelags.

Efforts are underway to identify best source reanalysis products and develop methodologies for downscaling to useful resolution and bias correction to improve utility as reference history for assessing current conditions and forecast products. A variety of Climate Reanalysis and Forecast Models cover global or at least continental datasets. However, many of these products exhibit important biases among at least their surface weather elements, rendering them ineffective in representing fuel moisture

and landscape flammability in both absolute values and seasonal trends. Notable among these is the North American Regional Reanalysis (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.

Many of these issues are manifested in poor forecast fire danger estimates from WIMS

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*, recommendations for using CFFDRS fuel moisture codes and fire behavior indices from the FWI system are used to provide objective guidance for initial settings for many analysis inputs into Wildland Fire Decision Support System (WFDSS) and the Interagency Fuel Treatment Decision Support System (IFTDSS). The 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. Legacy Alaska Fire Danger Rating

Alaska has a long tradition of monitoring fire danger conditions to inform decision-making within the framework of the AIWFMP. In 1994 AICC began maintaining weather data from weather stations outside of WIMS in order to estimate FWI codes and indices.

Over time, case studies and individual fire After Actions Reviews (AARs) helped refine the FWI outputs into a series of thresholds related to the different aspects of fire activity and fire behavior that firefighters encountered on the ground and in the office. **Table 1** summarizes the legacy of that continuous learning experience.

These thresholds are used to color maps and tables in AKFF and to provide interpretations to FWI observations and forecasts each day. Though the thresholds give insight to overall potential across landscapes and areas of responsibility, the need to be combined with specific fuels and terrain for the site using the FBP System to produce fire behavior interpretations when evaluating a specific fire situation.

Because of their familiarity and effectiveness, it is important to consider these thresholds when evaluating decision criteria and other rating tools. They were developed primarily for the Interior Alaska boreal forest and may need to be adjusted for tundra fire potential.

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.

Table 1: CFFDRS Indices Thresholds

B. Fire Occurrence Analyses

1. Fire Year Seasonality Impacts

The seasonality of ignitions is important, though the occurrence of new fires is stubbornly persistent throughout much of the year. It is probably more important to analyze the temporal and spatial distribution of human ignitions and the dates of event-driven human activity whenever and wherever that occurs. Analysis of ignitions will be important for day-to-day local pre-suppression decisions. There are additional factors unrelated to the weather and fuel conditions such as holidays and weekends that complicate Fire Danger analysis on human ignitions.

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 threat of significant fire growth.

2. Grass (Spring) Adjective - Human Caused Fire Occurrence Analysis

Human caused fires in Alaska are responsible for 62% of all fires in the state. Because these fires largely occur on lands protected by Alaska Division of Forestry, analysis and decision tools are heavily weighted to their needs.

In the spring of the year, area of concern for human-caused fire occurrence is constrained by cool soil, residual snow under forest canopy, and saturated wetlands. Under these circumstances, fires are usually controlled with initial attack and pose threats primary to values in the immediate vicinity. Large fire growth is not anticipated from these fires until later in the Wind Driven Season, when cumulative drying of both light grassy fuels and forest litter and duff increase intensity. Because those light fuels may not yet be fully greened up, ignition frequency remains elevated.

The human ignition problem is the primary reason that DOF offices are staffed and equipped for initial attack response. Burn permit administration and restriction are primary daily responsibilities at all local DOF offices. Each has developed criteria as a basis for daily permit restriction and requirement. The criteria developed in Delta, Fairbanks, Palmer, Soldotna, and Tok are the basis for the grass adjective criteria described below, especially in the spring of the year.

Human-caused fire frequency peaks in the spring, though some significant potential remains throughout much of the remaining fire season, and in rare cases continues into the winter months when low snow cover exposes dead grasses. Generally staffing for wildfires is not contemplated during the winter months.

Human-caused fire frequency peaks in the spring, though some significant potential remains throughout much of the remaining fire season, and in rare cases continues into the winter months when low snow cover exposes dead grasses.

Table 2 identifies criteria for Grass (Spring) Adjectives. These are of primary use in the spring where human-caused fire ignitions are a significant problem.

Spring – Grass Calibration

GRASS (Spring)	ISI < 2.0	ISI 2 to 5.9	ISI 6.0 to 7.9	ISI 8.0+
FFMC < 86.0	LOW	MODERATE	MODERATE	VERY HIGH
FFMC 86.0 to 91.9		MODERATE	HIGH	VERY HIGH
FFMC 92.0+ & FWI < 36.0			VERY HIGH	VERY HIGH
FFMC 92.0+ & FWI 36.0+				EXTREME

Table 2: Grass (Spring) Adjective Criteria

Inputs

The Grass Adjective analysis is based on Ignition, Ignition Days, and Daily FWI databases.

Methodology

This analysis was originally conducted to quantify breakpoints for issuing burn permits in the Fairbanks, Kenai, and Mat-Su DOF protection areas. In the Low and Moderate adjective classes, no restrictions are applied. Burning with restrictions is allowed in the High adjective class. In the Very High and Extreme adjective classes, no burning is allowed.

The analysis is based on legacy CFFDRS thresholds. It uses FFMC as a proxy for ignition potential and ISI as a proxy for expected fire growth. FWI is used to evaluate potential for extreme fire events.

The resulting Grass (Spring) Adjective is used mainly in the protection areas identified above during the spring when and where human caused fire ignitions are a significant problem. It is also considered for tundra landscapes, though it is not calibrated for tundra (**Table 2**).

3. Lightning Ignition Discovery Days Analysis

Existing ignition data sets tend to have gross errors in start dates due to the immense size of Alaska and lack of observations. Though MODIS detections are improving this data set, there are still errors that persist and are difficult to identify. There have been continual upgrades to the Alaska Lightning

Detection System (ALDS) operated by AFS. The largest upgrade occurred in 2012 when the system switched from Vaisala to Time of Arrival (TOA). This upgrade led to changes in the algorithms used to differentiate strokes and flashes. Analysis for 2012 showed that TOA observes 30% more lightning strikes. There are ongoing studies at UAF and NASA that are attempting to normalize the lightning database. There are also several researchers across the country who are studying the Alaska lighting database to build lightning climatologies for each month of the year as well as create a reliable seasonal lightning forecast.

C. Fire Growth Analyses

A standard methodology of decision point analysis includes defining an analysis area (FDRA), analyzing a period of historical fire danger rating indices and developing decision points based on historic fire occurrence (fire days), fire growth (fire size categories or MODIS) and/or multiple fires (number of fires/day). This methodology does not utilize case studies or research of fire initiation or fire growth. It emphasizes "best fit" analysis described by conditional frequency (ex. number of days a fire occurred / number of days a fire danger parameter is met). This method allows managers to annually adjust decision point thresholds to ensure that fire business decisions are most representative within the FDRA. It also allows managers to adjust thresholds to mimic interagency standards for climatological percentiles. This fire danger operating plan defines the FDRA boundaries as concurrent with the Predictive Services Area (PSA) boundaries.

1. MODIS Detections and Fire Growth

Traditional fire danger analysis with fire occurrence statistics is not able to identify days of significant growth nor the factors that are responsible for growth. However, since 2004, Alaska fire managers have been monitoring the daily frequency and location of MODIS active fire detects to evaluate day-to-day variability in fire growth for individual fires.

Historically, some fire occurrence analysis has been based on ignition day analysis and ignores subsequent growth days. However, area burned in Alaska is much less dependent on weather and fuel flammability conditions on the day fires start because many natural starts in limited protection areas are not initially suppressed and have opportunities to grow on subsequent days.

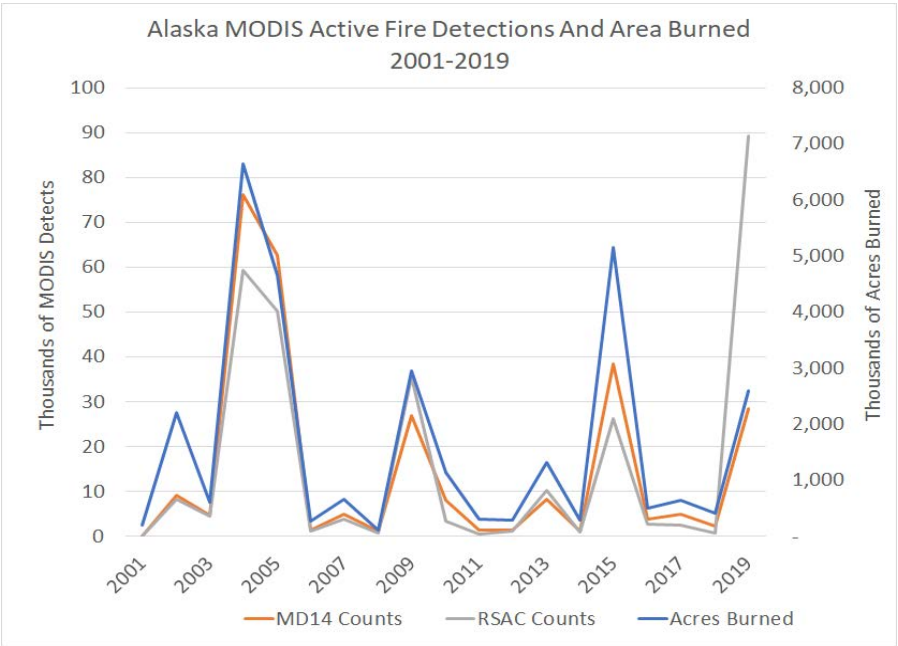


Figure 18: Alaska MODIS Detections and Area Burned

Figure 18 demonstrates the high degree of correlation between MODIS active fire detects and the area burned in Alaska over an 18-year period. These active fire detects have explicit locations (latitude/longitude) and date/time, providing a detail about growth events not otherwise available. Further, the database is substantial with over 257,000 individual records that can be associated with current weather conditions and fuel flammability over the analysis periods and areas.

It should be noted that the USFS Remote Sensing Application Center (RSAC) database for MODIS active fire detections is not the source for either "direct broadcast" reports for current activity or the reprocessed historic datasets used here. GINA (Geographic Information Network of Alaska) provides direct-broadcast data up to 2 hours earlier than RSAC. University of Maryland (http://modis-fire.umd.edu/) provides ready access to the reprocessed historic data in its most current form.

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

2. Fire Growth Seasonality

Figure 19 compares the area burned from both the ignition (fire occurrence) database and the fire growth (MODIS active Fire Detect) database. While the ignition database suggests that most acres burn in June, the growth database points out that there is a second peak in August when drought driven fires have contributed a similar share of burned area in a few exceptional events.

- Fire growth in the early Wind Driven Season is very small because ignitions are primarily human caused with aggressive initial attack response. The ground is usually cold, lowlands are generally waterlogged and snow remains in many areas. This limits fire growth and normally results in surface driven fires.
- Fire growth begins to increase significantly in late May, though major increase comes with the Duff Driven Season, when an increasing number of acres are from lightning fires that are not suppressed. This is normally the peak activity of the Alaska fires season.
- The decline in growth rates shown in July corresponds to an increased likelihood and significance of precipitation events. This indicates the transition from local needs to regional and national priorities.

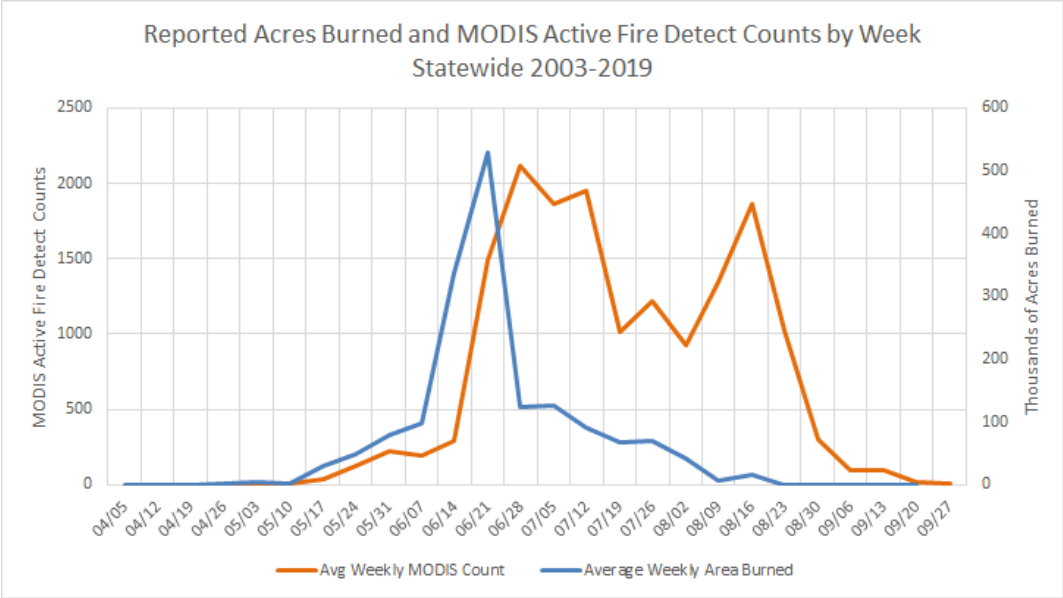


Figure 19: Acres Burned and MODIS Detections

3. Spruce (Summer) Adjective Rating

Since most of the area burned in Alaska occurs in the boreal interior, focus over the years has been on rating fire potential based on boreal conditions. Most of the sophisticated analysis and firm conclusions are related to fire growth potential and response needs in boreal areas. This analysis was initially conducted for the period from 2001-2013 in preparation for a paper presented at the Fire and Forest Meteorology Symposium in 2015 https://www.frames.gov/documents/catalog/ziel_et_al_2015_modeling-fire-growth-potential.pdf. Its conclusions can effectively be applied to forested regions throughout the state.

The Spruce (Summer) Adjective Rating criteria in **Table 3** represent the combination of current and cumulative conditions as a 5-class danger rating.

SPRUCE (Summer)	BUI < 40.0	BUI 40.0 to 59.9	BUI 60.0 to 89.9	BUI 90.0 to 109.9	BUI 110.0+
FFMC Less than 80.0	LOW	LOW	LOW	LOW	LOW
FFMC 80.0 to 81.9					MODERATE
FFMC 82.0 to 83.9				MODERATE	
FFMC 84.0 to 85.9		MODERATE	MODERATE		HIGH
FFMC 86.0 to 88.9	MODERATE		HIGH	HIGH	
FFMC 89.0 to 89.9	HIGH	HIGH		VERY HIGH	VERY HIGH
FFMC 90.0 to 91.9			VERY HIGH		
FFMC 92.0 to 92.9					
FFMC 93.0+ and Temp < 75.0			VERY HIGH if FWI is less than 36.0	VERY HIGH if FWI is less than 36.0	VERY HIGH if FWI is less than 28.0
FFMC 93.0+ and Temp 75.0 to 79.9		VERY HIGH if FWI is less than 40.0			
FFMC 93.0+ And Temp 80.0+	VERY HIGH if FWI <40 EXTREME if FWI is at least 40.0	EXTREME if FWI is at least 40.0	EXTREME if FWI is at least 36.0	EXTREME if FWI is at least 36.0	EXTREME if FWI is at least 28.0

Table 3: Spruce (Summer) Adjective Rating Criteria

These ratings are produced for each surface weather observing location where FWI codes and indices are calculated. They are indicated as a grid on the AKFF map.

- The primary criteria are FFMC and BUI, with individual thresholds drawn from the legacy thresholds identified above.
- 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.

Inputs

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

Methodology

Conditional frequency analysis of Fire Growth Days and individual Fire Growth records:

- Develop distributions of All Days, Growth Days and Growth Events by prospective criteria, producing a table of frequencies by class in each dataset
- Divide the subtotals in each class 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.

Conditional frequency analysis is conducted on the spruce (summer) adjective classes to confirm their efficacy in representing trends in the threats of fire growth. This analysis is conducted on the FWI, Growth Days, and Growth Detect databases for the period 2003-2018.

MODIS Day Conditional Frequency							
	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK09
Low	0.002	0.002	0.009	0.009	0.009	0.010	0.009
Mod	0.004	0.009	0.026	0.032	0.039	0.042	0.034
High	0.018	0.037	0.088	0.100	0.110	0.115	0.071
Vhigh	0.100	0.124	0.219	0.223	0.286	0.267	0.263
Ext	0.383	0.188	0.381	0.469	0.384	0.265	0.286

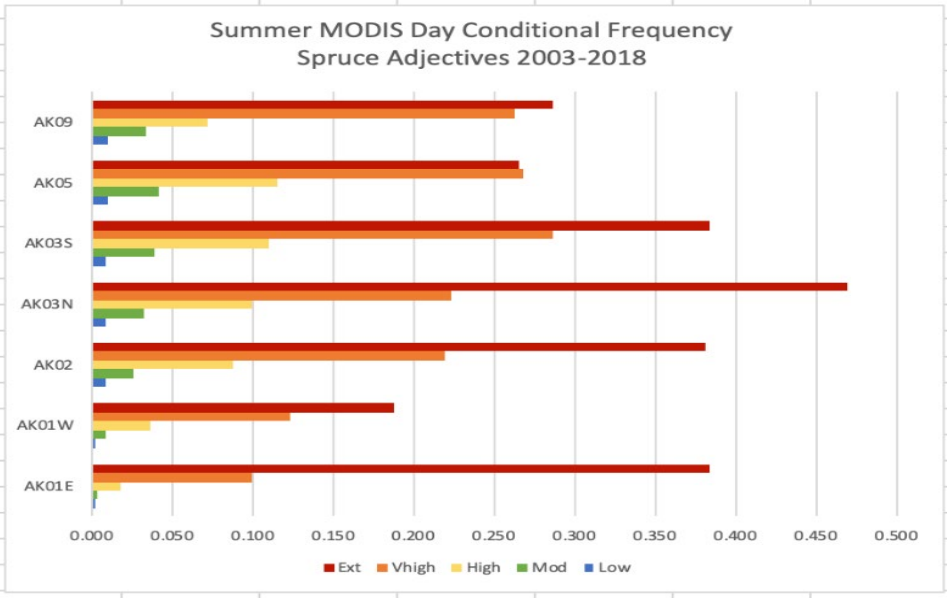


Table 4: Spruce (Summer) Adjective MODIS Day Conditional Frequency

This comparison of growth days for individual PSAs within the boreal interior ecoregion shows that the spruce criteria is very effective in showing progressive frequencies from low to extreme classes (**Table** 4):

- 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 10%
- The likelihood of a growth day with a very high rating approach 25%
- The likelihood of a growth day with an extreme rating is over 30%.

	MODIS Detect Conditional Frequency						
	AK01E	AK01W	AK02	AK03N	AK03S	AK05	AK09
Low	0.024	0.024	0.109	0.111	0.108	0.134	0.151
Mod	0.024	0.066	0.482	0.340	0.542	1.367	0.337
High	0.213	0.501	2.113	2.167	3.030	3.989	1.542
Vhigh	2.779	4.231	9.613	10.926	12.014	13.747	9.410
Ext	25.603	9.171	34.203	34.014	15.379	14.706	38.657

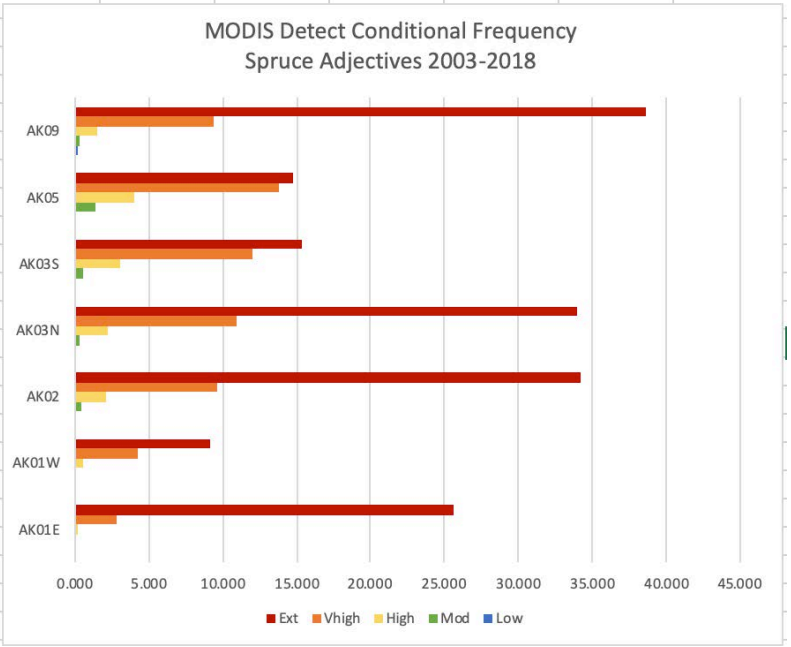


Table 5: Spruce (Summer) Adjective MODIS Detect Conditional Frequency

This comparison of growth detects for individual PSAs within the boreal interior ecoregion shows that the spruce criteria is also very effective in showing progressive frequencies from low to extreme classes (**Table 5**):

- The likelihood suggests less than 0.1 detect when day is in low.
- The likelihood suggests about 0.5 detects for moderate days.
- The likelihood suggests 2-4 detects for high days.
- The likelihood suggests more than 10 detects for very high days.
- The likelihood suggests more than 30 detects for extreme days.

Conditional frequency analysis coupled with the legacy 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 Season and the Drought Driven Season, though the higher likelihood for large fire growth in the Wind Driven Season also seems to be well reflected in this set of criteria.

There is insufficient data in the fire growth datasets to conduct conditional frequency analysis in the panhandle and south-central PSAs. However, analysis of the ignition dataset, enhanced with identification of additional growth days, for the Kenai Peninsula suggests that these criteria are effective throughout the forested landscapes of Alaska.

4. Tundra Landscape Analysis

There is considerable area burned from lightning ignitions on tundra landscapes (primarily AK04, AK06, and AK08) over the last 20 years. AK00, The North Slope, is also tundra but has different thresholds than tundra landscapes along the west coast of Alaska. Over 1.5 million acres have been reported, about 5% of the area burned across the state.

These preliminary tundra analysis findings are not yet implemented in any operational system. Future analysis should include examination of solar radiation, daily maximum temperature and minimum relative humidity, and daily maximum vapor pressure deficit.

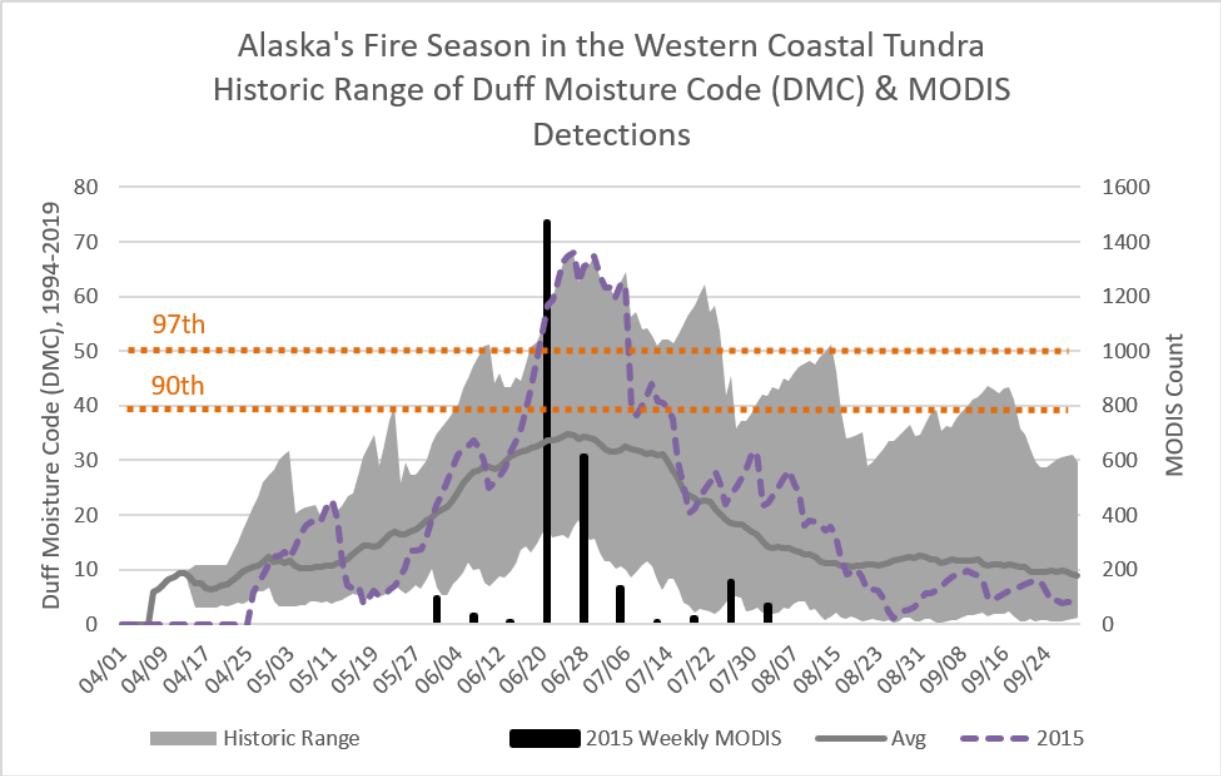


Figure 20: DMC and MODIS Detections for Western Coastal Tundra

CFFDRS system documentation suggests that DMC, at thresholds above 20 is a fair indicator of lightning fire problems. Mike Wotton of the Canadian Forest Service confirmed this with a statistical analysis of lightning frequency and lightning occurrence data after his visit in 2014.

In the summer of 2018, James White came to Fairbanks as a Hollings Scholar to study weather and climate. He chose to study weather and climate influences on significant fire events in the western tundra. His work is reported in a presentation recorded on October 5, 2018 (https://accap.uaf.edu/Fire_forecast). Because over 85% of the area burned is represented in only 61 individual size class G fires, he suggests using case studies of individual growth days for factor analysis. He concluded that:

- Synoptic wind speed estimates and mesoscale wind speed measurements at surface observation locations are poor indicators of variability in growth despite having generally higher winds than in other areas.
- High maximum temperatures and low minimum humidity associated with strong diurnal solar heating appear to be critical factors for predisposing fire growth.

- Under peak season sunny periods, tundra surface fuels can dry and rapidly increase in temperature, making them susceptible to ignition and spread.
- Synoptic factors include widespread above average temperature conditions above average, broad surface low pressure pattern, and weak localized 500mb ridge. These factors are consistent with solar heating being more important than synoptic winds.
- There may be some low-level dry air mixing down to the surface.

1. Inputs

Based on analysis and recommendations from James White, Air Temperature, Relative Humidity and FFMC were considered as current weather indicators. Max. Temp. and Min. R.H. are not available in the daily FWI databases, though they are available in the underlying AKFF system. Based on standard CFFDRS descriptions and analysis/recommendations by Mike Wotton, DMC is used as an indicator for cumulative drying and lightning fire potential.

2. Methodology

Conditional Frequency analysis of growth days using recommended short term and cumulative drying factors are compared.

Preliminary results suggest that Temperature, in combination with DMC, provides a more consistent trend than RH or FFMC. The conditional frequency table for Temperature and DMC is shown in **Table 6**.

ATFxDMC	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110-120	120-130	ATF C. Freq.
<50 or (blank)	0.000	0.000	0.001	0.000	0.020	0.008	0.000	0.000	0.167	0.000	0.000	0.000	0.000	0.001
50-54	0.000	0.000	0.002	0.000	0.021	0.043	0.000	0.136	0.111	1.500	0.000	0.000	0.000	0.004
55-59	0.000	0.003	0.008	0.006	0.037	0.019	0.103	0.050	0.286	0.231	0.500	0.000	0.000	0.008
60-64	0.000	0.005	0.010	0.038	0.059	0.078	0.074	0.119	0.174	0.538	0.200	1.000	0.143	0.025
65-69	0.000	0.016	0.024	0.107	0.068	0.147	0.173	0.149	0.259	0.188	0.222	0.000	0.000	0.058
70-74	0.013	0.044	0.065	0.087	0.113	0.194	0.173	0.241	0.222	0.400	0.250	0.333	0.000	0.103
75-79	0.053	0.116	0.099	0.178	0.141	0.275	0.229	0.294	0.474	0.353	0.286	0.500	0.000	0.186
80-84	0.000	0.083	0.042	0.185	0.233	0.138	0.143	0.313	0.500	0.000	1.000	3.000	0.000	0.209
85-89	0.000	0.000	0.000	0.000	0.125	0.250	0.500	0.000	1.000	0.000	0.000	2.000	0.000	0.222
90-94														
>100														
DMC C. Freq.	0.000	0.007	0.015	0.043	0.061	0.102	0.131	0.171	0.269	0.405	0.300	0.533	0.250	0.022

Table 6: Conditional Frequency for Air Temperature and DMC

- As suggested in Alaska CFFDRS legacy thresholds, there is little (<1%) likelihood of tundra fire growth when DMC is below 20.
- Temperatures below 60°F suggest very low (<1%) likelihood of tundra fire growth if DMC is not elevated to suggest cumulative drying.
- When daily temperature is above 70 and DMC is above 50, the likelihood of tundra fire growth grows to nearly 20%.

D. Fire Occurrence and Growth Analysis

1. Alaska Statewide Sub-Region Analysis

Conducting unique decision point analysis for each FDRA/PSA, while likely the most accurate method for developing FDRA decision point thresholds, is problematic considering the complex interagency fire management environment. Therefore, an alternative approach was developed for calculating adjective classes from post green-up to September 30th. This approach develops FDRA specific decision points, or groups FDRAs into climatologically similar sub-regionally areas based on specific criteria amongst a suite of weather and/or CFFDRS indices, or by functionally similar fire management regimes.

Figure 21 illustrates the grouping developed in 2019 due to similar climatology, then modified to reflect common fire organizations and response strategies.

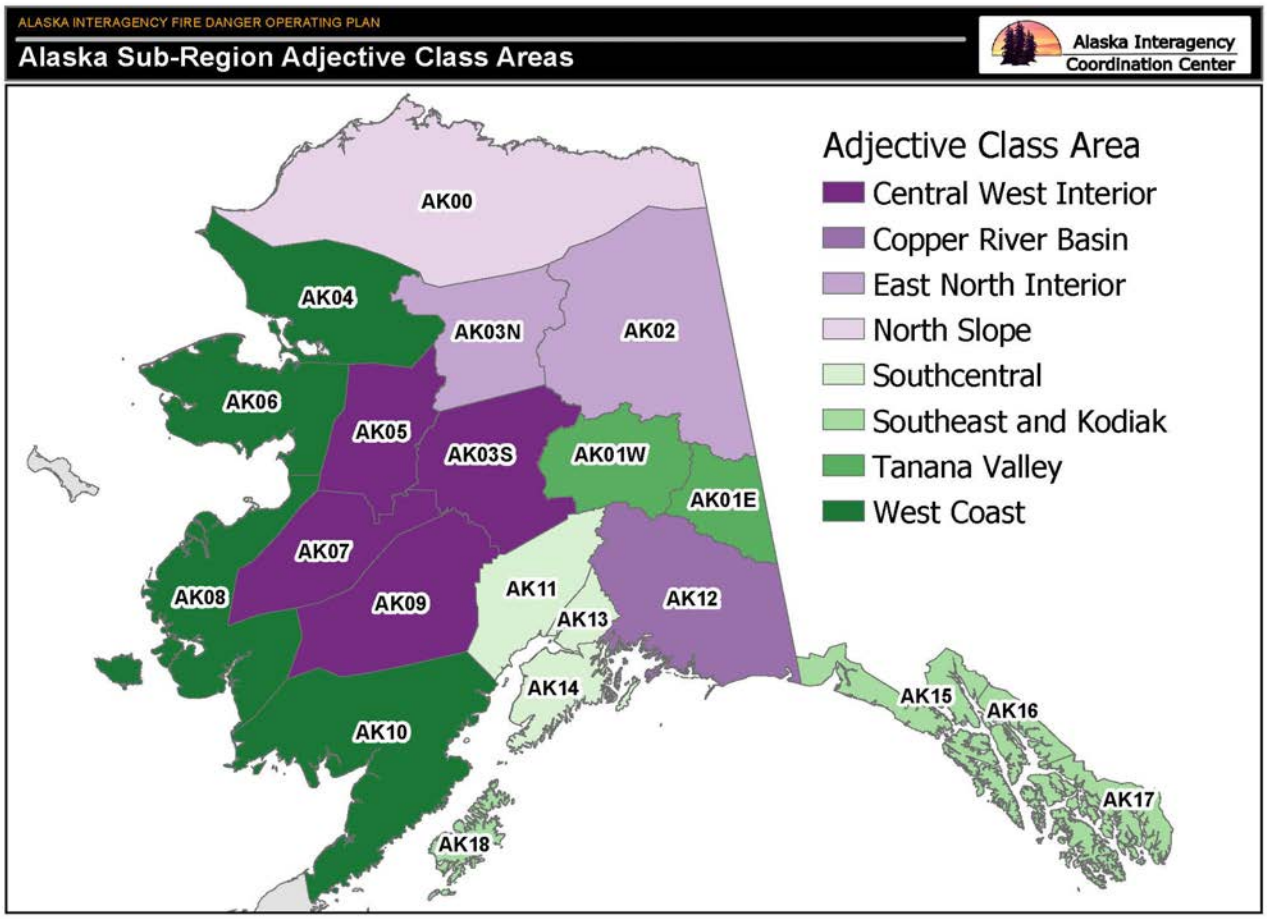


Figure 21: Alaska Sub-Region Adjective Class Areas

The adjective class thresholds in **Table 7** were developed for each Group, analyzing MODIS Day, MODIS Detections/Day and Fire Occurrence. The adjective class thresholds apply to all PSAs within the group. This adjective class is intended to be used as an alternative to the Spruce Adjective Class in the summer months (June 1st to September 15th). The grass adjective rating should be used prior to June 1st or full green up.

The lowest ranking weather/CFFDRS variable establishes the Adjective Class. For instance, assume Umiat Airfield is a station for determining the adjective class for PSA AK00. The weather/CFFDRS Variables for determining the adjective class in PSA 00 are temperature, DMC and FWI. On July 5th the July 6th forecast for Umiat Airfield is a temperature of 67 ˚F (Very high), DMC is 25 (Moderate) and the FWI is 17 (High). The lowest ranking variable is the DMC (Moderate), therefore the forecasted Adjective Class for July 6th is Moderate.

Group (PSAs)	Weather/CFFDRS Variables	Adjective Class*				
		Low	Mod	High	Vhigh	Ext
North Slope (AK00)	*1400 Temp (˚F)*	=< 60	>60 =<63	>63 =<66	>66 =<70	>70
	DMC	=< 19	>19 =<31	>31 =<42	>42 =<48	>48
	FWI	=< 12	>12 =<15	>15 =<20	>20 =<30	>30
Central West Interior (AK03S, AK05, AK07, AK09)	*1400 Temp (˚F)*	=< 51	>51 =<59	>59 =<67	>67 =<75	>75
	DMC	=< 11	>11 =<26	>26 =<40	>40 =<54	>54
	FWI	=< 2	>2 =<8	>8 =<13	>13 =<18	>18
Southeast and Kodiak (AK15, AK16, AK17, AK18)	*1400 Temp (˚F)*	=< 53	>53 =<61	>61 =<70	>70 =<78	>78
	DMC	=< 8	>8 =<14	>14 =<23	>23 =<35	>35
	FWI	=< 3	>3 =<6	>6 =<12	>12 =<25	>25
Tanana Valley (AK01E, AK01W)	*1400 Temp (˚F)*	=< 52	>52 =<60	>60 =<68	>68 =<75	>75
	BUI	=< 23	>23 =<40	>40 =<56	>56 =<79	>79
	FWI	=< 2	>2 =<7	>7 =<14	>14 =<24	>24
Copper River Basin (AK12)	*1400 Temp (˚F)*	=< 55	>55 =<62	>62 =<68	>68 =<74	>74
	BUI	=< 20	>20 =<41	>41 =<60	>60 =<83	>83
	FWI	=< 3	>3 =<10	>10 =<18	>18 =<24	>24
East North Interior (AK02, AK03N)	*1400 Temp (˚F)*	=< 59	>59 =<65	>65 =<71	>71 =<78	>78
	FFMC	=< 56	>56 =<80	>80 =<88	>88 =<91	>91
	DMC	=< 21	>21 =<40	>40 =<60	>60 =<78	>78
West Coast (AK04, AK06, AK08, AK10)	*1400 Temp (˚F)*	=< 48	>48 =<55	>55 =<62	>62 =<67	>67
	FFMC	=< 54	>54 =<75	>75 =<86	>86 =<89	>89
	DMC	=< 11	>11 =<19	>19 =<34	>34 =<50	>50
Southcentral (AK11, AK13, AK14)	*1400 Temp (˚F)*	=< 57	>57 =<61	>61 =<66	>66 =<75	>75
	FFMC	=< 59	>59 =<80	>80 =<87	>87 =<90	>90
	DMC	=< 14	>14 =<28	>28 =<42	>42 =<60	>60

* Select the Adjective Class of the lowest rated variable in the Group to represent the Group's overall Adjective Rating.

Table 7: Alaska Sub-Region Adjective Rating Criteria thresholds

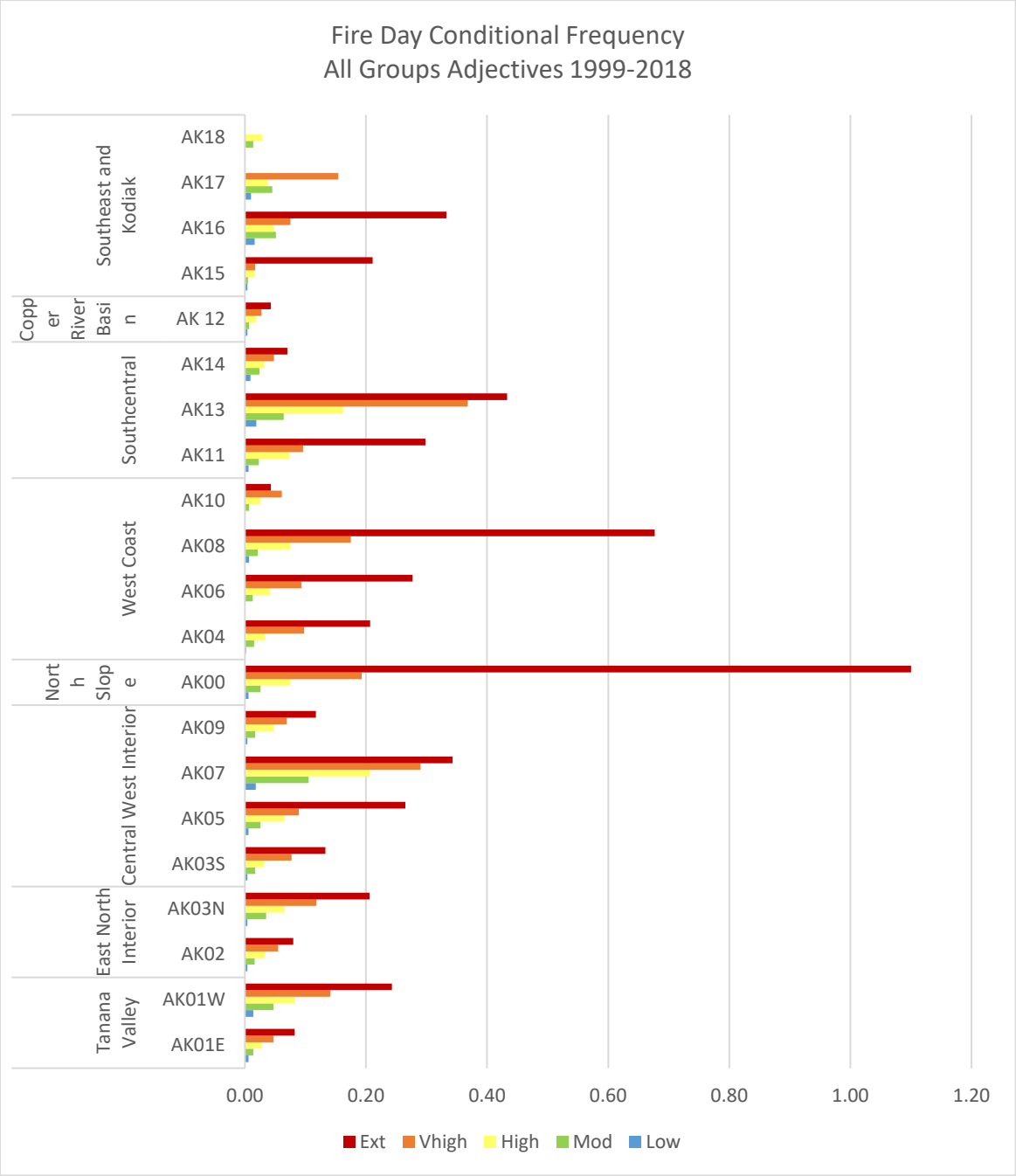


Figure 22: Alaska Sub-Region Adjective Fire Day Conditional Frequency

Figure 22 compares ignition days for individual PSAs and shows that the Alaska Sub-Region Adjective Rating Criteria is very effective in all PSAs, showing progressive frequencies of fire days from low to extreme classes:

- The likelihood of a fire day with a low rating is less than 1%.
- The likelihood of a fire day with a moderate rating is generally around 3%.
- The likelihood of a fire day with a high rating is about 5%
- The likelihood of a fire day with a very high rating approaches 10%.
- The likelihood of a fire day with an extreme rating is over 20%.

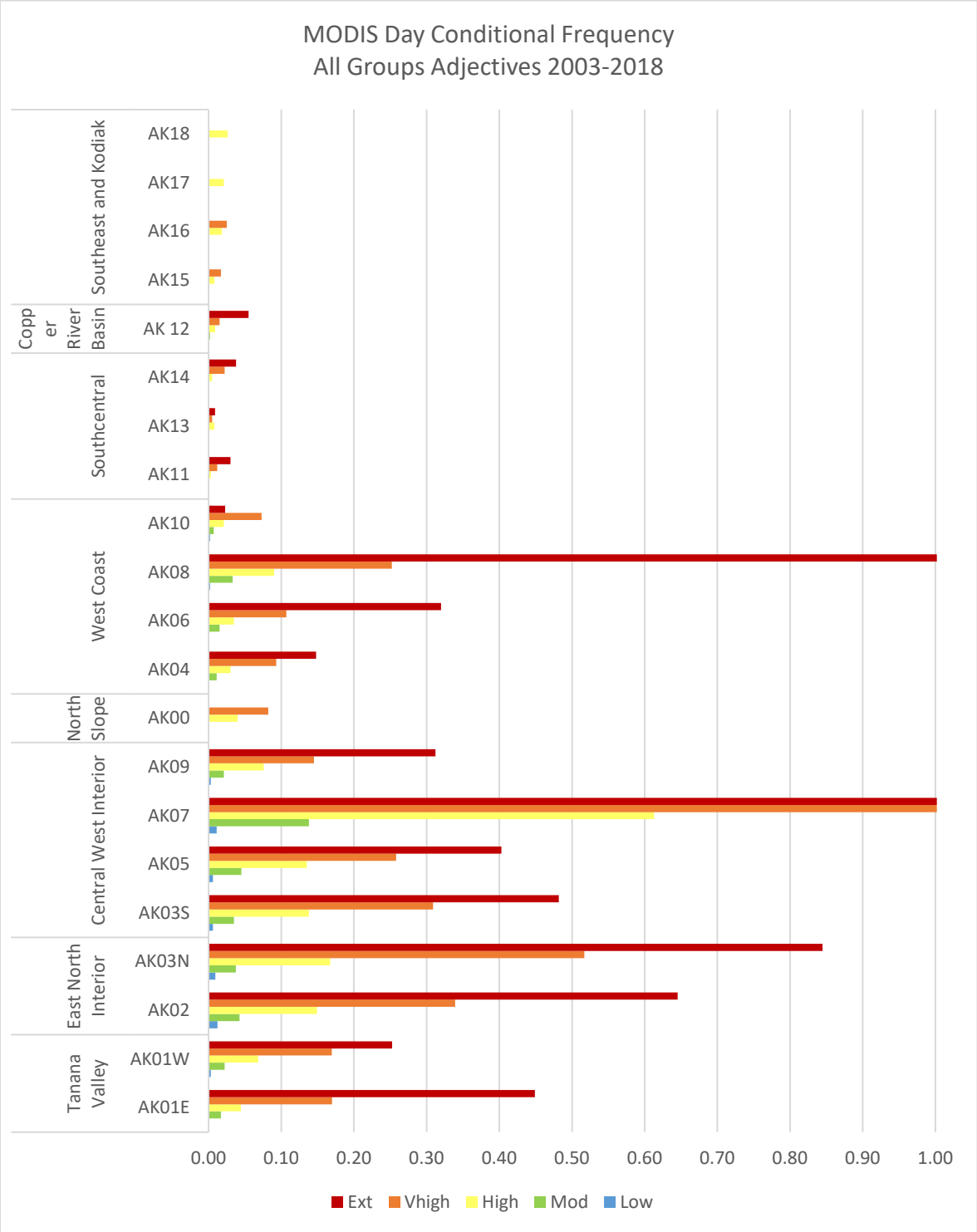


Figure 23: Alaska Sub-Region Adjective MODIS Day Conditional Frequency

Figure 23 compares growth days for individual PSAs. It shows that the Alaska Sub-Region Adjective Rating Criteria is very effective in most PSAs, excepting Southeast and Kodiak, showing progressive increasing frequencies of MODIS Growth Days from low to extreme classes.

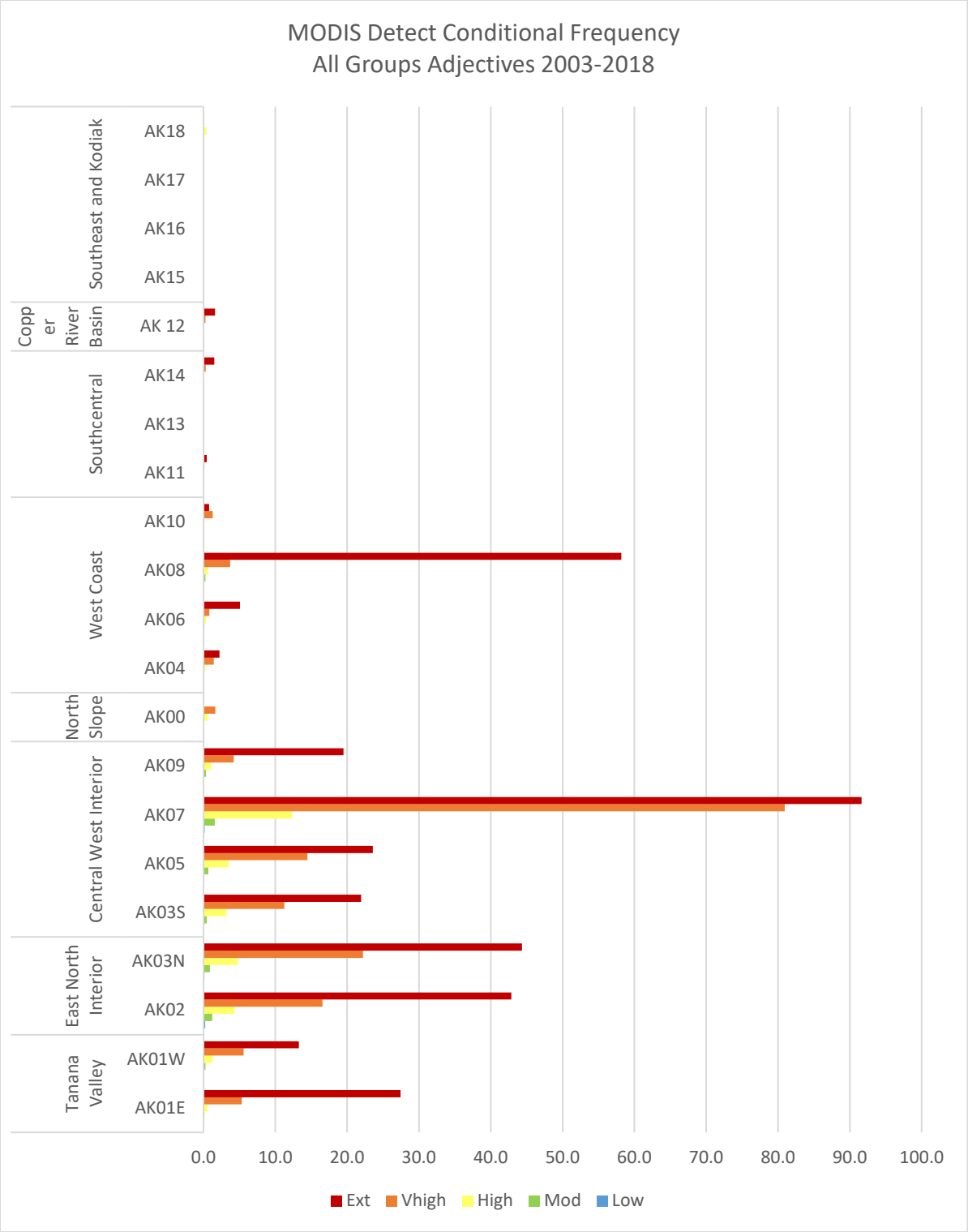
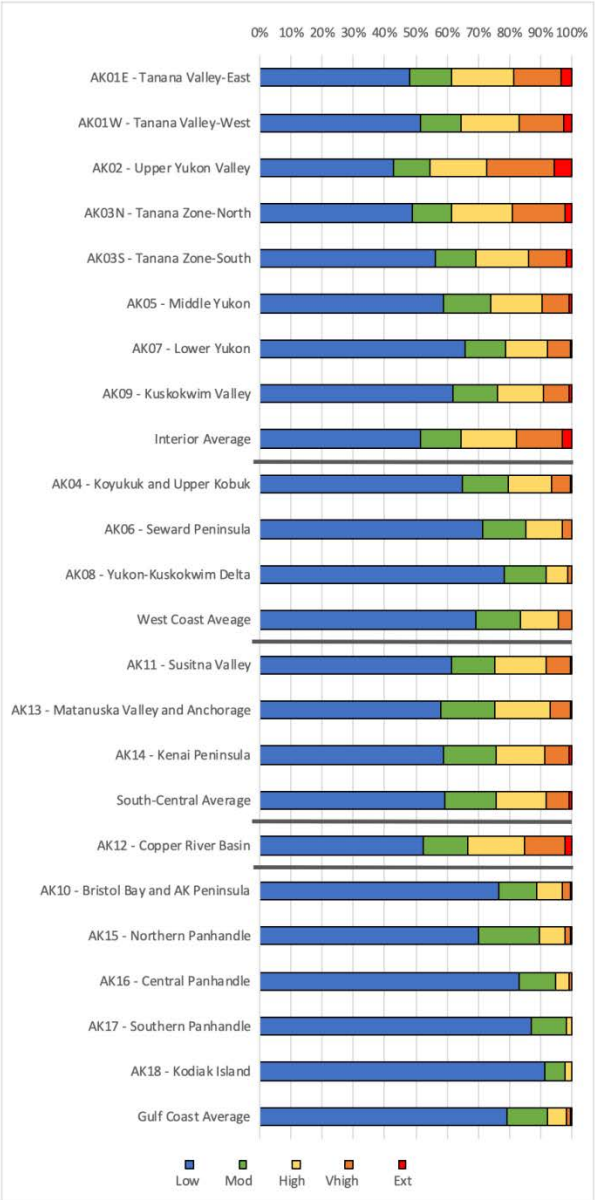


Figure 24: Alaska Sub-Region Adjective MODIS Detect Conditional Frequency

Figure 24 compares MODIS growth detects for individual PSAs. It shows that the Alaska Sub-Region Adjective Rating Criteria is very effective in most PSAs, excepting Southeast Alaska and Kodiak, showing progressive increasing frequencies of MODIS detects from low to extreme classes.

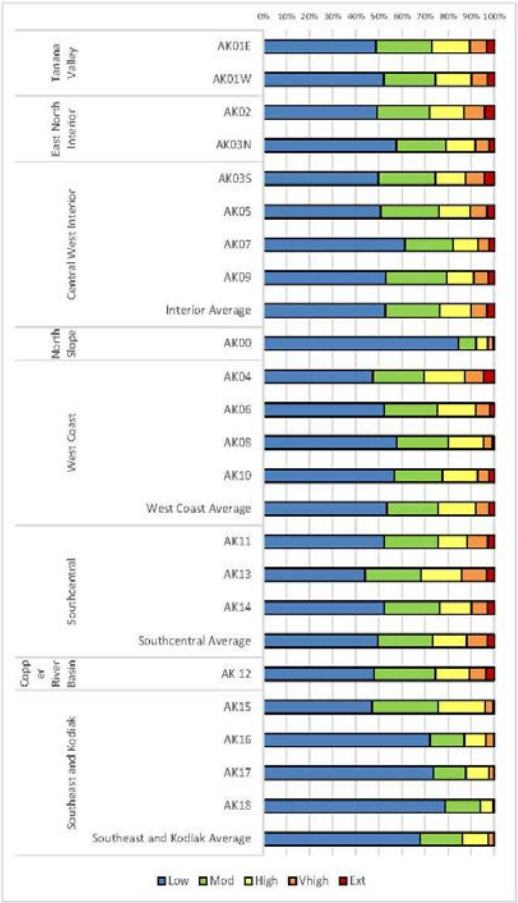
E. Climatological Percentile Analysis

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 normals. The resulting trends and totals of fire occurrence and growth are not amenable to percentile analysis and representation. However, the results in **Table 8** and **Table 9** may be useful in understanding decision frequencies.



Low	Mod	High	Vhigh	Ext	Spruce/Summer Adjective Ratings
48%	13%	20%	16%	3%	AK01E - Tanana Valley-East
52%	13%	19%	14%	2%	AK01W - Tanana Valley-West
43%	12%	18%	22%	6%	AK02 - Upper Yukon Valley
49%	12%	19%	17%	2%	AK03N - Tanana Zone-North
56%	13%	17%	12%	2%	AK03S - Tanana Zone-South
59%	15%	16%	9%	1%	AK05 - Middle Yukon
66%	13%	13%	8%	<1%	AK07 - Lower Yukon
62%	14%	15%	8%	1%	AK09 - Kuskokwim Valley
51%	13%	18%	15%	3%	Interior Average
65%	15%	14%	6%	<1%	AK04 - Koyukuk and Upper Kobuk
71%	14%	12%	3%	<1%	AK06 - Seward Peninsula
78%	13%	7%	1%	<1%	AK08 - Yukon-Kuskokwim Delta
69%	14%	12%	4%	<1%	West Coast Aveage
62%	14%	16%	8%	<1%	AK11 - Susitna Valley
58%	18%	18%	6%	<1%	AK13 - Matanuska Valley and Anchorage
59%	17%	16%	7%	1%	AK14 - Kenai Peninsula
59%	17%	16%	7%	1%	South-Central Average
53%	14%	18%	13%	2%	AK12 - Copper River Basin
77%	12%	8%	3%	<1%	AK10 - Bristol Bay and AK Peninsula
70%	19%	8%	2%	<1%	AK15 - Northern Panhandle
83%	12%	4%	1%	0%	AK16 - Central Panhandle
87%	11%	2%	0%	0%	AK17 - Southern Panhandle
92%	7%	2%	0%	0%	AK18 - Kodiak Island
79%	13%	6%	2%	0%	Gulf Coast Average

Table 8: Spruce Adjective Climatological Percentiles (1999-2018) for Duff and Drought Driven Seasons



Low	Mod	High	Vhigh	Ext		
49%	24%	16%	7%	3%	AK01E	Tanana Valley
52%	22%	16%	7%	3%	AK01W	
49%	23%	15%	9%	4%	AK02	East North Interior
58%	21%	13%	6%	2%	AK03N	
50%	25%	13%	8%	4%	AK03S	Central West Interior
51%	25%	14%	7%	3%	AK05	
61%	21%	11%	5%	2%	AK07	
53%	26%	12%	6%	3%	AK09	
53%	23%	14%	7%	3%	Interior Average	
84%	8%	5%	2%	0%	AK00	North Slope
47%	22%	18%	8%	5%	AK04	West Coast
52%	23%	17%	6%	2%	AK06	
58%	22%	15%	4%	1%	AK08	
57%	21%	15%	5%	2%	AK10	
53%	22%	16%	6%	2%	West Coast Average	
52%	23%	13%	9%	3%	AK11	Southcentral
44%	24%	18%	11%	3%	AK13	
52%	24%	14%	7%	3%	AK14	
49%	24%	15%	9%	3%	Southcentral Average	
48%	27%	15%	7%	4%	AK 12	Copper River Basin
47%	29%	20%	4%	1%	AK15	Southeast and Kodiak
72%	15%	9%	3%	0%	AK16	
74%	14%	10%	2%	0%	AK17	
79%	15%	5%	1%	0%	AK18	
68%	18%	11%	2%	0%	Southeast and Kodiak Average	

Table 9: Alaska Sub-Region Adjective Climatological Percentages (2003-2019) June 1 to Sept. 30th

F. Analysis Summary and Fire Danger Rating Level

In summary, the FDOP will utilize CFFDRS indices and weather parameters with five breakpoints to determine preparedness levels and adjective ratings. Additionally, other factors such as 7-day outlook, 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 Alaska Sub-Region Adjective, whereas fire business thresholds only were considered for the Spruce and Grass Adjectives and Tundra landscape analysis. The preparedness and staffing plans will be utilized to ensure agency personnel are properly prepared and staffed for lightning fires as well as human caused fires. To address human caused fires, the Jurisdictional Agency prevention plans, where applicable, will incorporate communication methods for reaching out to the public, industry and other entities to ensure awareness of fire danger and to provide educational tools to help deter future human caused fires for highly active recreational areas and periods.

A key distinction for the Alaska Interagency Fire programs is that not all fires are problems. Human caused fires are problems and are considered unwanted fires. Lightning caused fires occur naturally and are considered on a case-by-case basis to meet land management objectives. Lightning caused fire can be considered a problem if they threaten highly valued resources. This FDOP will implement Adjective Fire Danger Rating based upon fire business thresholds, not necessarily climatological percentiles.

This FDOP does not identify one method or criteria for informing decision tools, rather it identifies several interagency decision tool options and their applicability as identified in **Table 10**. (Note: These decision tools are not intended to replace existing decision tool systems. Instead, they offer a decision tool system that is applicable to all interagency fire organizations.)

Method	PSA Applicability	Seasonality	Indices	Additional Consideration
Spruce (Summer) Adjective	AK01E, AK01W, AK02, AK03N, AK03S, AK05, AK07, AK09. (Primarily boreal forest) Note: While this adjective has the most applicability in the boreal forest, the Spruce adjective class is a reasonably effective tool in most PSAs.	Post Green-up thru August / September	**Temp, FFMC, BUI and FWI**	*Strength* – Very good indicator of fire growth in the boreal forest. A good to reasonable indicator elsewhere. Decision point thresholds for adjacent PSAs match statewide. Currently calculated. Forecasts in AKFF available in grid, station and tabular format statewide. *Weakness* - Less effective as an indicator of fire occurrence. The second highest adjective class (Very High) tends to record more fire behavior then the highest adjective class (Extreme).
Grass (Spring) Adjective	All PSAs Note: Consider use in PSAs that are predominately tundra (i.e. AK04, AK06, AK08).	Snow free to Green-up Potentially useful in tundra throughout the fire season and non-tundra areas after leaf-off.	**FFMC, ISI and FWI**	*Strength* – Effective tool for pre green-up conditions for human caused fires. Decision point thresholds for adjacent PSAs match statewide. Currently calculated, with forecasts in AKFF available in grid, station and tabular format statewide. *Weakness* – High daily variability and only effective as a decision point in the shoulder seasons.
Tundra Analysis	AK04, AK06, AK08, … (Primarily tundra landscapes)	Fire Season	**Temp and DMC**	Note: This potential adjective is still in the development phase.

Method	PSA Applicability	Seasonality	Indices	Additional Consideration
Alaska Sub-Region Adjective	All PSAs	Post Green-up thru September 30.	Varies based on PSA or PSAs within Alaska Sub-Region group: **Temp, DMC and FWI** *Northslope* – AK00; *Central West Interior* – AK03S, AK05, AK07, AK09; *Southeast and Kodiak* – AK15, AK16, KK17, AK18 **Temp, BUI and FWI** *Tanana Valley* – AK01E, AK01W; *Copper River Basin* – AK12 **Temp, FFMC and DMC** *East North Interior* – AK02, AK03N; *West Coast* – AK04, AK06, AK08, AK10; *Southcentral* – AK11, AK13, AK14	*Strength* – Generally the highest indicator of potential for fire growth and fire occurrence. Decision points are near the 90% and 97% national climatological standards (BLM standard is 80% and 95%). Allows readily available internal and external communication regarding departure from historical normal conditions within Alaska Sub-Region group. Designed to be updated annually. Weakness – Decision point thresholds between Alaska Sub-Region groups are not seamless. Currently is not calculated, with forecasts in AKFF available in grid, station and tabular format statewide.

Table 10: Summary of Fire Danger Inputs to the Decision Tools

	Fire Occurrence		Iband VIIRS - Day		MODIS Day		Iband VIIRS - Detect		MODIS Detect	
	Boreal Forest PSAs	Non-Boreal Forest PSAs	Boreal Forest PSAs	Non-Boreal Forest PSAs	Boreal Forest PSAs	Non-Boreal Forest PSAs	Boreal Forest PSAs	Non-Boreal Forest PSAs	Boreal Forest PSAs	Non-Boreal Forest PSAs
Grass Adjective - April 1st - May 31st										
Low	0.002	0.002	0.003	0.001	0.003	0.000	0.0	0.0	0.0	0.0
Mod	0.007	0.013	0.001	0.003	0.004	0.000	0.0	0.0	0.0	0.0
High	0.008	0.022	0.005	0.001	0.010	0.000	0.1	0.0	0.0	0.0
Vhigh	0.022	0.073	0.010	0.004	0.007	0.001	0.3	0.0	0.1	0.0
Ext	0.006	0.000	0.006	0.000	0.006	0.000	0.5	0.0	0.2	0.0
Spruce Adjective - June 1st - September 30th										
Low	0.012	0.010	0.037	0.017	0.028	0.006	3.0	0.6	1.2	0.0
Mod	0.012	0.037	0.096	0.065	0.073	0.041	6.4	2.0	3.0	0.3
High	0.141	0.076	0.245	0.062	0.202	0.061	92.0	8.0	24.2	1.4
Vhigh	0.084	0.084	0.333	0.103	0.316	0.075	547.8	12.0	194.9	3.0
Ext	0.046	0.009	0.277	0.085	0.212	0.070	87.8	22.9	34.2	4.6
Alaska Sub-Region Adjective - June 1st - September 30th										
Low	0.003	0.005	0.013	0.013	0.009	0.003	0.5	0.1	0.2	0.0
Mod	0.026	0.020	0.102	0.035	0.075	0.013	7.8	1.0	2.7	0.1
High	0.068	0.044	0.233	0.061	0.190	0.052	33.4	4.4	10.8	0.7
Vhigh	0.169	0.075	0.329	0.072	0.268	0.078	172.5	11.2	49.9	2.0
Ext	0.118	0.140	0.431	0.067	0.402	0.060	590.4	7.4	213.8	1.8

Table 11: Conditional Frequency performance of the 2019 fire season for Grass (Spring) Adjective, Spruce (Summer) Adjective and Alaska Sub-region Adjective

G. Fire Slowing Criteria

Weather events that slow or stop fires can produce challenges for fire overhead and managers in Alaska. Rain events do not always signal the end of fire growth. 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 during a busy summer. This new tool 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.

The following table is an attempt to combine three factors and predict when a fire may become active again. BUI is used to summarize fuel dryness preceding the rain event. The amount of rain over 72 hours categorizes the weather event. An average 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. If the weather following the rain event is warmer than 70 degrees and drier than 30% RH, the number of days for the fuels to reach burnable conditions will be less. The resultant days may also differ depending on the portion of the fire season that the rain event occurs. The early part of the fire season is mainly wind driven, so lesser, shorter duration events will have greater effect on the fire activity, though dormant fuels will dry quickly. During the middle, or duff driven phase of fire season, the upper layers of duff are the main drivers of fire spread. This layer needs less rain but also less drying time before it becomes burnable again.

Tactical Analysis Tool

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 12: Tactical Analysis tool

Table results represent "days since end of rain event." It is a guideline that estimates drying based on the number of days reaching an afternoon temperature of 70F and RH of 30% after the rain event.

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 holds over. There 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 start to decline. DMC and DC, the two codes that make up BUI, need greater amounts of rain to decrease. Combination of larger rain amounts spread out over long time periods has the greatest effect on these codes and indices. Rain of short duration or less than .11 inches does not penetrate to the lower duff levels enough to moderate seasonal drying.
- **Forecast Weather**: Weather following the rain event will affect how much drying the fuels need until they become burnable again. Tactical decisions are normally revisited after rain events to reassess tactics, staffing levels, and assess values threatened by fire spread. Each weather station on https://akff.mesowest.org provides a three-day weather forecast that is updated every afternoon. A longer term seven day forecast is available for each Predictive Service Area (PSA) at https://psgeodata.fs.fed.us/forecast/#/outlooks?state=sideBySide&gaccId=1. These two products, coupled with weather forecasts, can help determine the outlook for the fire area.

This analysis will provide users with a helpful tool for determining potential for future fire growth. However, variations in fuels and conditions necessitate a careful thought process for each fire and each fire season. Staff at AICC Predictive Services welcomes thoughts and observations and is always willing to provide consultation and information on upcoming weather and its effect on fuels. Contact us at 907-356-5691.

H. Seasonality of Alaska PSAs

The charts in **Appendix E: Alaska PSA Seasonality Charts** provide historical ranges for BUI, Average BUI, and MODIS detections by week, framed in reference to the four phases of the Alaska fire season and two historically significant fire seasons for the PSA. Tracking seasonal progression will help place the current fire season in a well referenced historical context.

Term files for each PSA were created using available weather stations with at least ten years of data. Each PSA 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, https://www.frames.gov/documents/catalog/ziel_et_al_2015_modeling-fire-growth-potential.pdf . In circumstances when the BUI did not fall below 80 later in the fire season, an additional criterion (the FFMC falling below 88) was used to simulate the shortening days during the diurnal 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 lower 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. These values, in conjunction with the graphs, can give fire managers the opportunity to compare the current fire season BUI values to historic averages, and examine the current phase of fire season in relation to historic MODIS fire detection counts.

Historical season ending percentiles were calculated for each PSA based on available weather station data from the Alaska Fire and Fuels database. Season end dates were analyzed for each weather station for each year available in a PSA. These dates were then entered into the Term module in RERAP 7.03. As data for more years become available, the term files will be updated.

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 Business Analysis chapter of the Alaska FDOP may be implemented by local staffing plans. Existing unit staffing plans and associated decisions and planned actions include:

- Tanana Zone Staffing Plan
- Upper Yukon Zone Staffing plan
- Military Zone Staffing Plan
- 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
- 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 Staffing Guide

B. Preparedness Level

1. Preparedness Plan

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 Mobilization Guide and can be accessed on the National Interagency Coordination Center (NICC) web site (https://www.nifc.gov/nicc/mobguide/index.html).

The Alaska Preparedness Plan is included in Chapter 10 of the Alaska Interagency Mobilization Guide (AIMG) and can be accessed on the AICC web site (https://fire.ak.blm.gov/logdisp/aimg.php) Current breakpoints for statewide preparedness levels are identified in that document.

An automated tool incorporating Spruce Adjective Rating, Resource Availability, Seven Day Fire Potential, and current fire activity is currently being developed by AICC Predictive Services and is anticipated to be ready to roll-out for the 2021 fire season.

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

2. Prevention Plan

Prevention plans are a jurisdictional agency responsibility. They document the wildland fire 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 **Section III: Fire Danger Analyses** of the Alaska FDOP. Some jurisdictional units have developed local prevention plans. Contact local units for their current plans.

3. Restriction Plan

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 the fire danger, managers may impose fire restrictions or emergency closures to public lands. In Alaska, 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 (https://dnr.alaska.gov/burn) restricts open burning based on fire danger criteria. There are currently no documented processes for determining closures/restrictions for other agencies. In the future, decision points for when additional restrictions and/or closures should be considered may be identified and documented in the Alaska FDOP; any associated decisions and planned actions from future jurisdictional restriction plans will be referenced.

C. Response (or Dispatch) Level

1. Initial Response Plan

Initial response plans, also referred to as run cards or pre-planned response plans, specify the fire management response (e.g. number and type of suppression assets to dispatch) 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, potential, or specific values threatened by a fire. The *AIWFMP* (https://fire.ak.blm.gov/administration/asma.php) 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 are allowed to spread naturally across the landscape.

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, fire occurrence, 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 option and site designations annually. Management options may only be changed with the approval of all affected jurisdictional agencies; however non-standard responses may be implemented on specific incidents with Jurisdictional and Protecting Agency concurrence.

Four wildfire management options (**Critical, Full, Modified, Limited)** (see *AIWFMP* (https://fire.ak.blm.gov/administration/asma.php) are employed statewide by federal and state agencies, and Alaska Native groups in order 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.

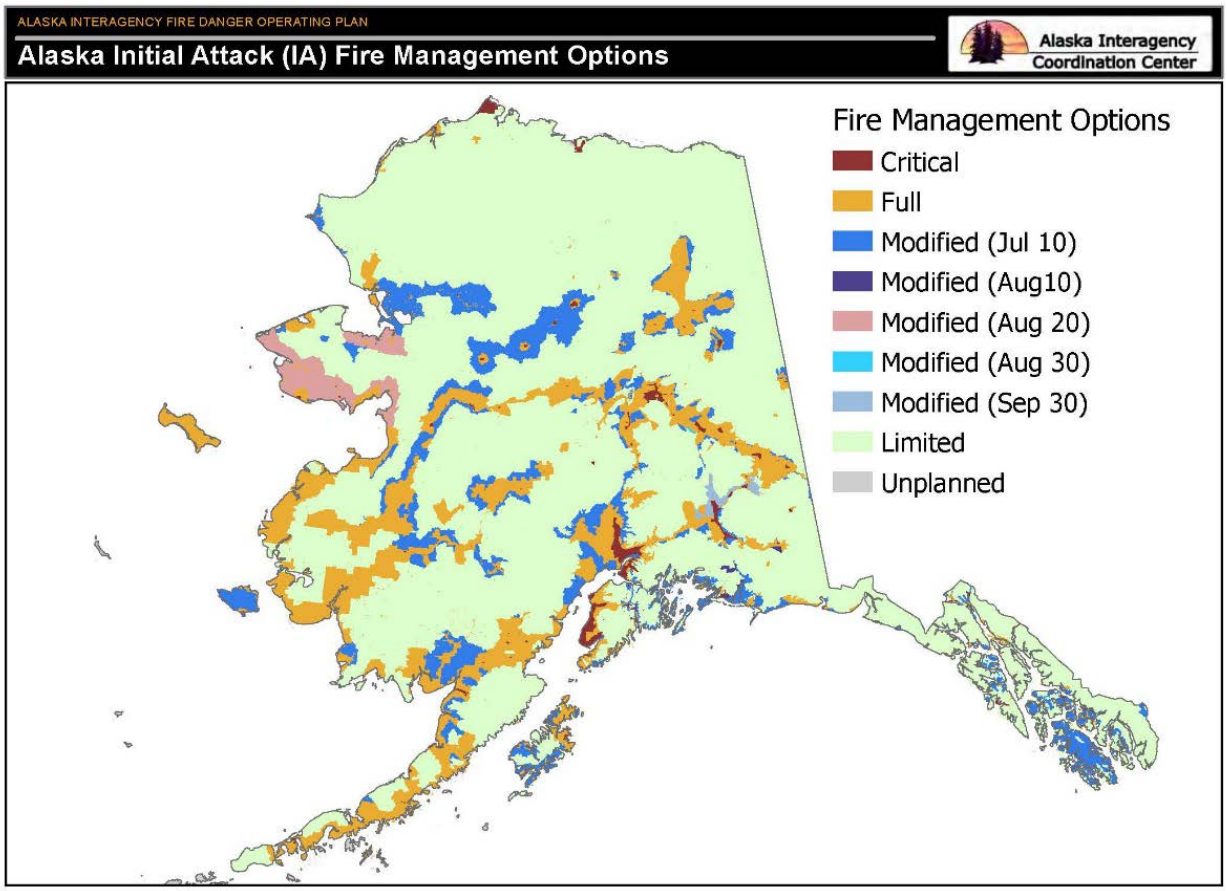


Figure 25: AIWFMP Fire Management Options

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 consideration of fire danger in the Management Options is reflected in the Modified Option Conversion Date (see **Section I.D: AIWFMP Modified Conversion Date**).

2. Mobilization Guides

Mobilization Guides identify standard procedures which guide the operations of multi-agency logistical support activity throughout the coordination system. Mobilization Guides are intended to facilitate interagency dispatch coordination, ensuring the timeliest and most cost-effective incident support services available are provided. Communication and cooperation between Units, Geographic Area Coordination Centers, State, Regional Offices and other cooperative agencies are addressed.

The National Interagency Mobilization Guide is located at the web site (https://www.nifc.gov/nicc/mobguide/index.html).

The Alaska Interagency Mobilization Plan Guide can be accessed on the AICC web site (https://fire.ak.blm.gov/logdisp/aimg.php).

D. AIWFMP Modified Conversion Date

The Conversion Date is when AWFCG votes to convert 36 million acres of Modified protection areas to Limited protection (see AIWFMP 3.2.3.3 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 season potential diminished. Based on a record of Conversion Dates from 1995 to the present, July 10 is the most utilized date when Conversion has occurred (see **Appendix D: Historical Modified Conversion Dates**). July 10 is commonly referred to as the Conversion Date, but that is incorrect. 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 one of the several conversion dates: July 10, August 10, August 20, August 30 or September 30. 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.
>
> 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 normally quickly follow conversion, they are not a guarantee. After the Conversion Date:

- The Alaska fire season is not over. New starts typically have less potential for large growth events. Even though hot, dry weather is possible it is less likely and usually for shorter periods. The likelihood of wildfires threatening values located in Modified protection 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.

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° West Longitude. Solar noon at 150° West 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 Predictive Service Area (PSA) to determine the average time after solar noon that the observations are taken. The results are graphed in **Figure 26**.

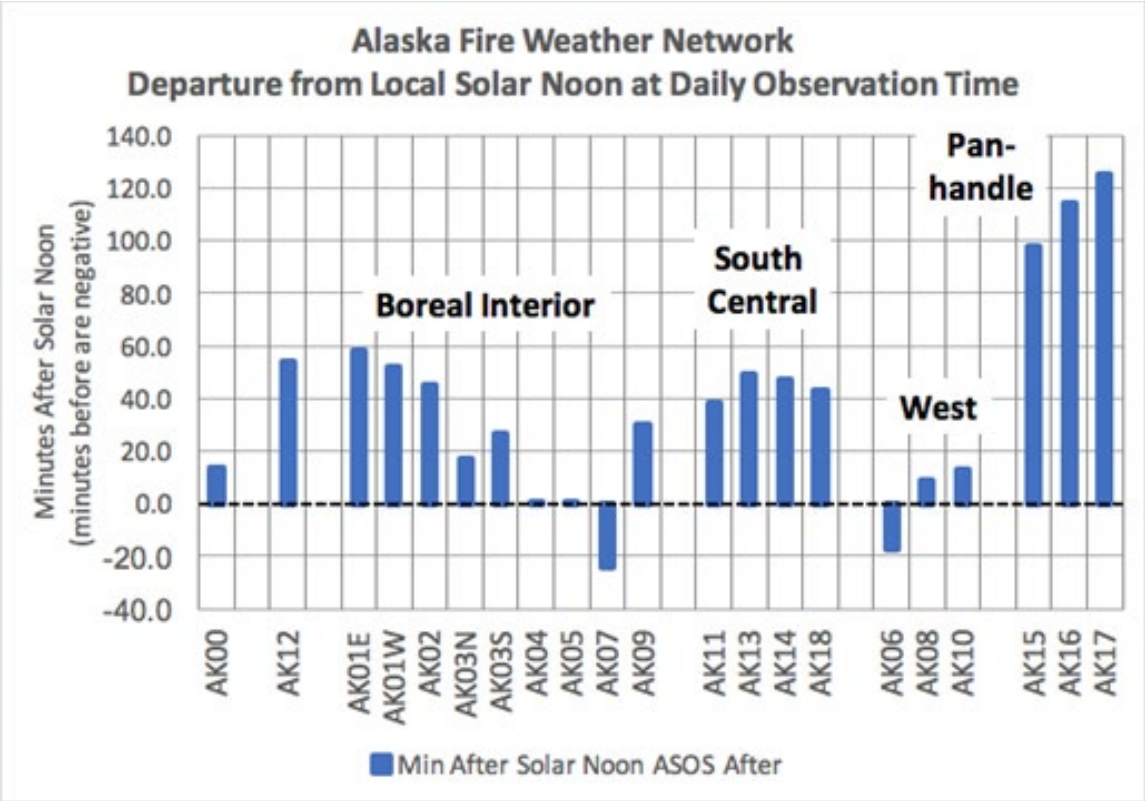


Figure 26: Departure from Solar Noon by PSA

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

The 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 PSAs 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

The 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 the 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 0z (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.

NWS NDFD products are timed to follow the update of global forecast models. Those models are updated 4 times a day at 0z (1600 AKDT), 6z (2200 AKDT), 12z (0400 AKDT), and 18z (1000 AKDT). NWS NDFD forecast grids are generally updated within a couple hours of 0z (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, 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.

These forecasted daily FWI weather values provide slightly higher temperatures and lower humidity, and somewhat 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 with WFDSS and IFTDSS. 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 on a regular or as needed basis:

- Canadian 290 is offered twice a year, once in the Interior and once south of the Alaska Range
- S-491 National Fire Danger Rating System and WIMS
- 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.

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/Assistant Manager

The Center Manager and Assistant are responsible for setting Statewide Preparedness Levels based on current and predicted fire activity and behavior.

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 Analyst can also assist in this data flow. Either the Meteorologist or the Fire 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 Meteorologists are the main focal point for weather station outages. They are able to document the issues within AKFF and contact the appropriate owners to discuss repair options.

The Meteorologists input snow-free dates (CFFDRS startup) and green-up dates (NFDRS input), and freeze dates (CFFDRS and NFDRS) into the appropriate platform (AKFF or WIMS). These dates are annually documented in a spreadsheet.

Though the Meteorologists 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 Meteorologists provide 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 much of this information is discussed.

c) Predictive Services Fire Analyst

The Fire Analyst provides analysis and decision support on an interagency basis to all wildland fire management agencies in Alaska. In addition, the Fire Analyst provides information for the daily weather briefing and or 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, and the National Fire Danger Rating System, assists with formal fire behavior and fire danger training, and provides fire behavior and fire danger guidance as needed.

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 https://fire.ak.blm.gov/content/Weather%20Folder/Weather%20Help%20Tools/Red%20Flag%20Criteria.pdf .

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 1200L 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 Predictive Services and wildland fire agencies. It describes required products, relationships and defines schedules for the entire fire season. https://www.weather.gov/media/arh/FireWxAOP_public.pdf

3. Fire Weather Station Managers

Stations are owned and operated by several different agencies, including, NPS, BLM, FWS, USFS, DNR, FAA, NWS, IRIS. Station owners must understand that station data may be used to inform weather, fuel, 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 (CFFDRS startup), green-up dates (NFDRS input), and freeze dates (CFFDRS and NFDRS). This information must be passed to the Predictive Services Meteorologist as soon as possible. Station management is described in detail in the *AKFF Station Management Guide*.

4. Data Managers

Each dispatch office is responsible for ensuring their station data is entered into WIMS correctly every day. Though WIMS data are not used operationally, they are used in WFDSS decision making. There is no way to upload AKFF data into the WFDSS tool, so WIMS data must be kept current for WFDSS use. It is imperative that dispatch offices input WIMS data consistently between April 1 and September 30, even during low fire danger/occurrence periods and report any suspicious or missing data to their Station Manager, FMO or the Predictive Services Meteorologist. 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 FDOP and for updating it every five years or as necessary.

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 several 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 (CFFDRS startup), green-up dates (NFDRS 78/88 input), and freeze dates (CFFDRS and NFDRS 78/88). This information must be passed 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, and FWS. 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. This should be sorted out with the FMO prior to contacting the appropriate Radio Shop.

FAA and NWS stations are maintained by those agencies. Their response time is generally rapid since most of their stations are used for air operations for the public. To report outages at these stations, call the FAA SOC at 1-800-478-2139.

8. Jurisdictional Agency Administrators

NPS, BLM, FWS, BIA, USFS, and DNR representatives all must agree to fund and support their portions of the RAWS network for this system to provide quality data. There also 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 Website
    - New functionality and maintenance
    - Continued maintenance and funding of the existing RAWS network
    - Display Alaska Sub region adjectives on AKFF
    - Produce a high-resolution CFFDRS fuels map for Alaska
    - Automated gridded fire behaviour products
- Alaska Lightning Detection System
    - Continue to maintain and upgrade the Alaska Lightning Detection System
    - Continue efforts to normalize the historical lightning dataset – taking in to account system changes over time.
- LANDFIRE
    - Continue to work on improving existing vegetation type classification in Alaska
- Research
    - Seasonal BUI forecast
    - Lightning Ignition Potential
    - Snow cover assessment tool
    - Implementing ensemble weather forecasting out to 14 days
    - Overwinter assessment study on DC/BUI and overwintering probabilities
- Analysis
    - 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
    - Improve WIMS datasets by inputting data through the shoulder seasons. (5/1-9/30)
    - Continue developing an automated statewide preparedness level tool for Alaska.
    - Provide decision makers with timely and useful information.

Appendix A: Topography

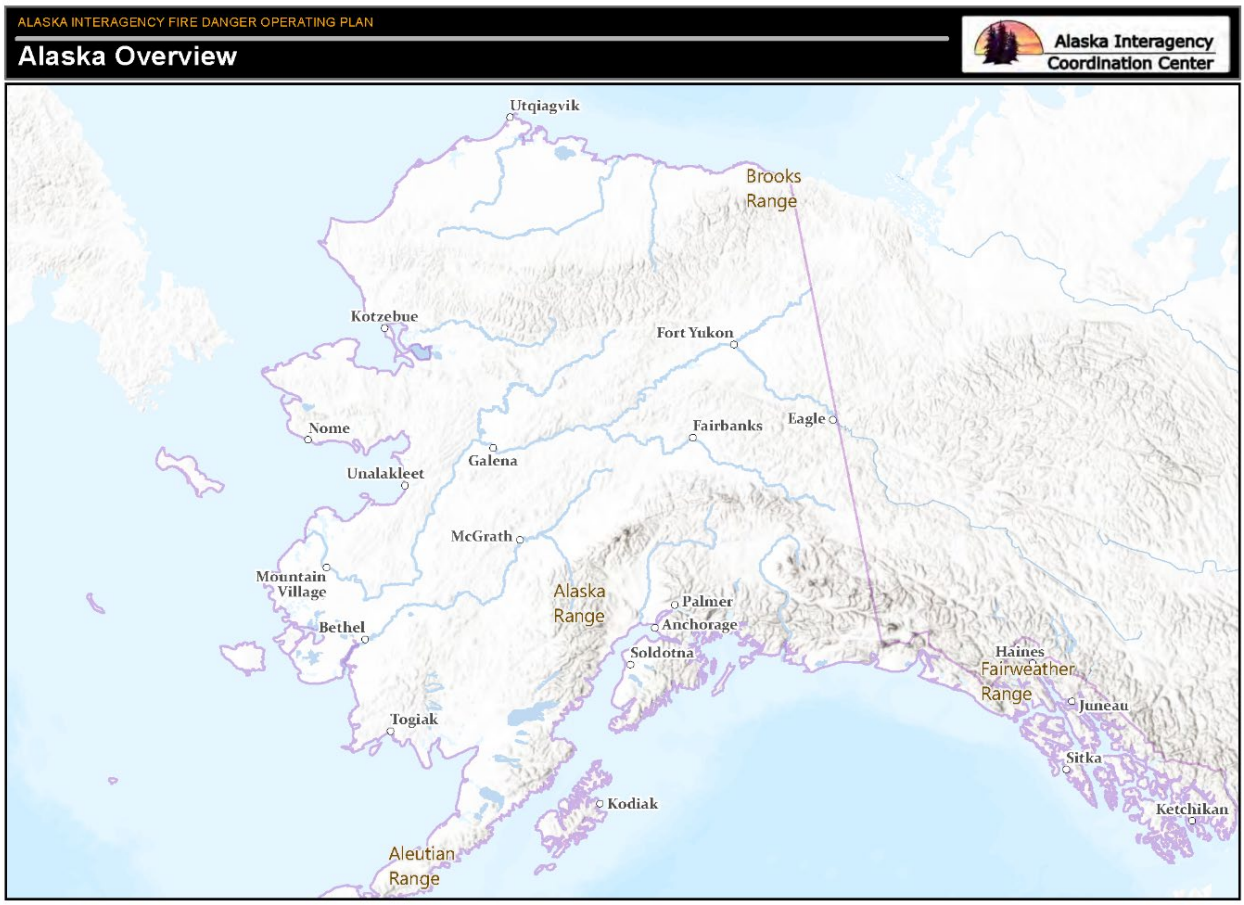


Figure 27: Alaska Topography

Alaska is the westernmost extension of the North American Continent. Its east-west span covers a distance of 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.

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, and northward about 200 miles from the Peninsula, 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 of these shorter ranges merge with the St. Elias Mountains, extending southeastward through Canada and across southeastern Alaska as the Coast Range. Numerous peaks in excess of 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, Mt. McKinley, is located in south-central Alaska. Many other peaks tower above 16,000 feet; however, nearly all of the inhabited sections of the State are at 1,000 feet elevation or less.

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 from a few several thousands of 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 a third of the State. No permafrost exists in the south-central and southern coastal portions including southeastern Alaska, the Alaska Peninsula, and the Aleutian chain. (https://wrcc.dri.edu/narratives/ALASKA.htm)

Appendix B: Vegetation

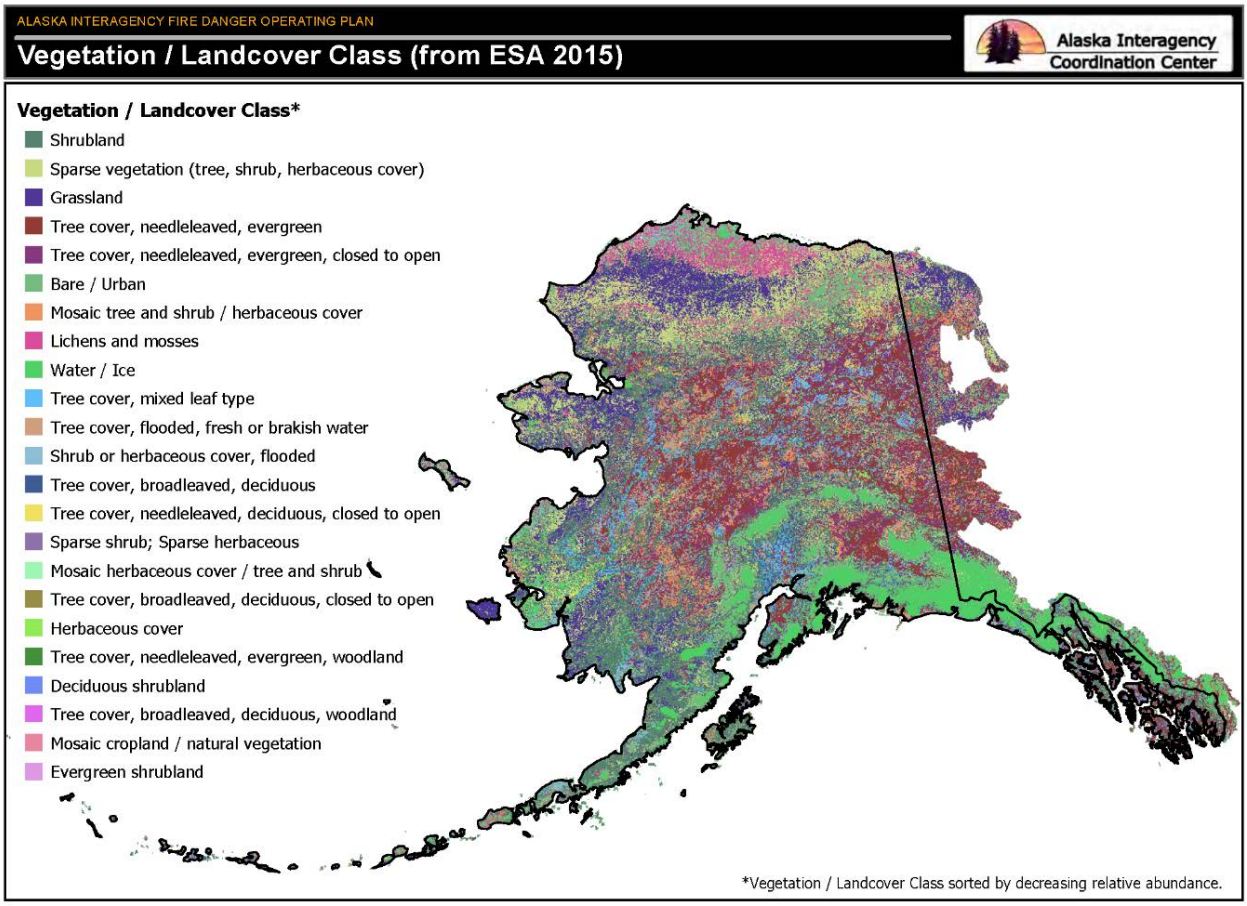


Figure 28: Alaska Vegetation

Leslie Viereck, a plant ecologist with the Institute of Northern Forestry, and others began developing a comprehensive, statewide Alaska vegetation classification system in 1976 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. At the broadest level of resolution, the system contains three formations - forest, scrub, and herbaceous vegetation. (https://www.fwspubs.org/doi/suppl/10.3996/122017-JFWM-104/suppl_file/10.3996122017-jfwm-104.s28.pdf).

Appendix C: Climate

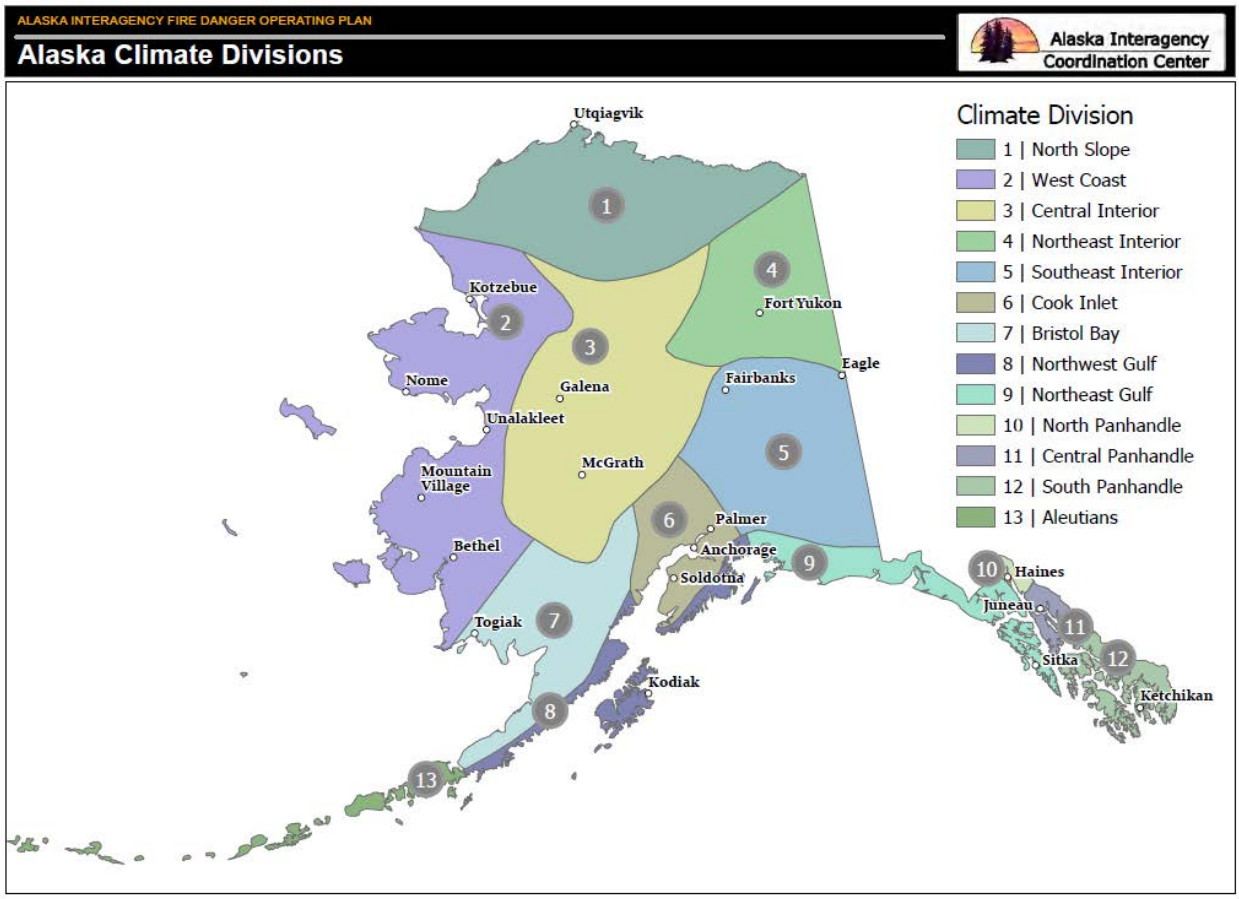


Figure 29: Alaska Climate Divisions

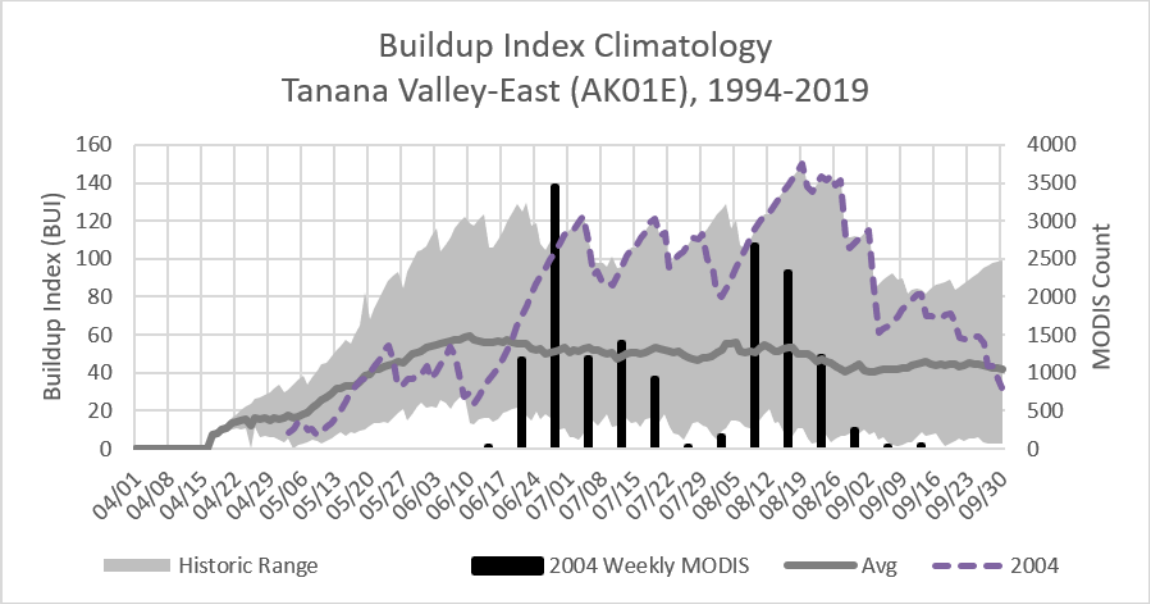
Climate divisions are subdivisions of states having roughly consistent climatological behavior within them. Compared to larger regional values, they represent a more local climate signal, but without the "noisiness" or sensitivities of single-station climate records. The 48 CONUS states have 344 climate divisions between them. Rhode Island has only one (statewide) climate division. Some larger CONUS states have 10 climate divisions. Alaska has 13 climate divisions. More information is available at https://www.ncdc.noaa.gov/news/climate-division-data-now-available-alaska.

Appendix D: Historical Modified Conversion Dates

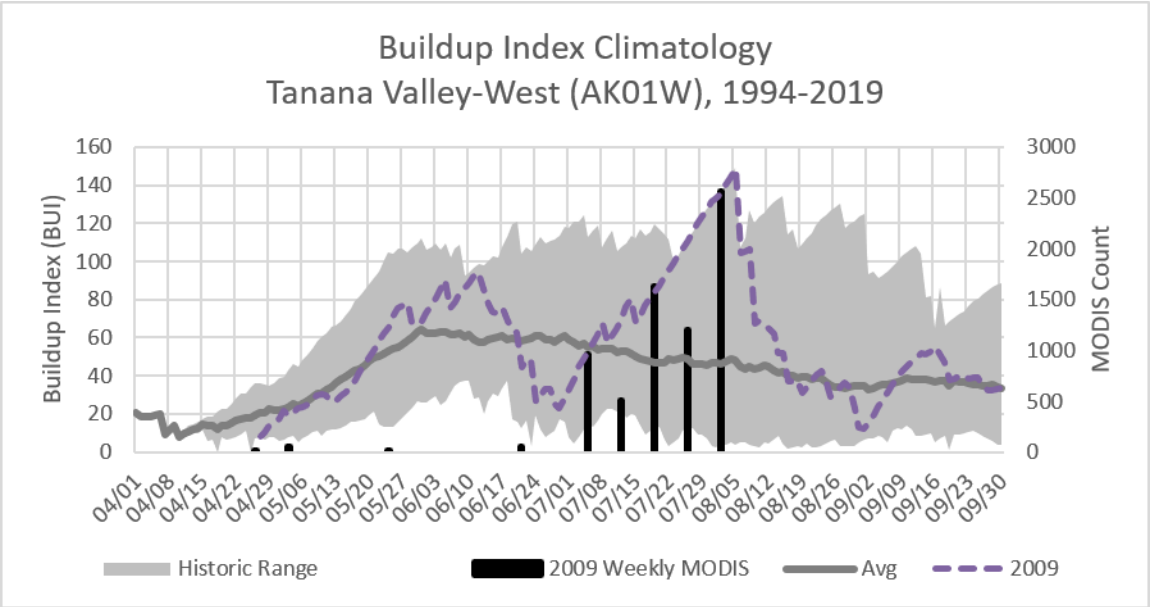
Year	Conversion Date(s)	Notes
1995	July 7	
1996	July 10	Except for the Kenai and Mat-Su areas
1997	July 4 July 10	Upper Yukon Zone Only Remaining Areas
1998	July 10	With exceptions at local levels
1999	July 10	Except for Shaw Creek and Good Pasture in Delta Area and all AFS
2000	July 10	
2001	July 10	
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	

Table 13: Modified Historical Fire Management Option Conversion Dates

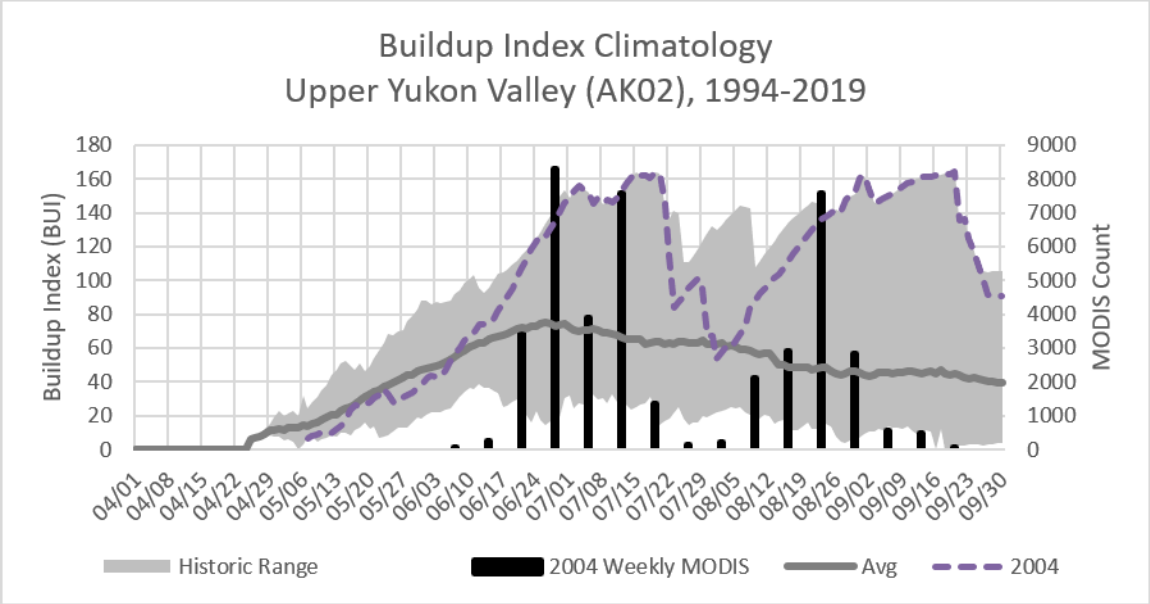
Appendix E: Alaska PSA Seasonality Charts



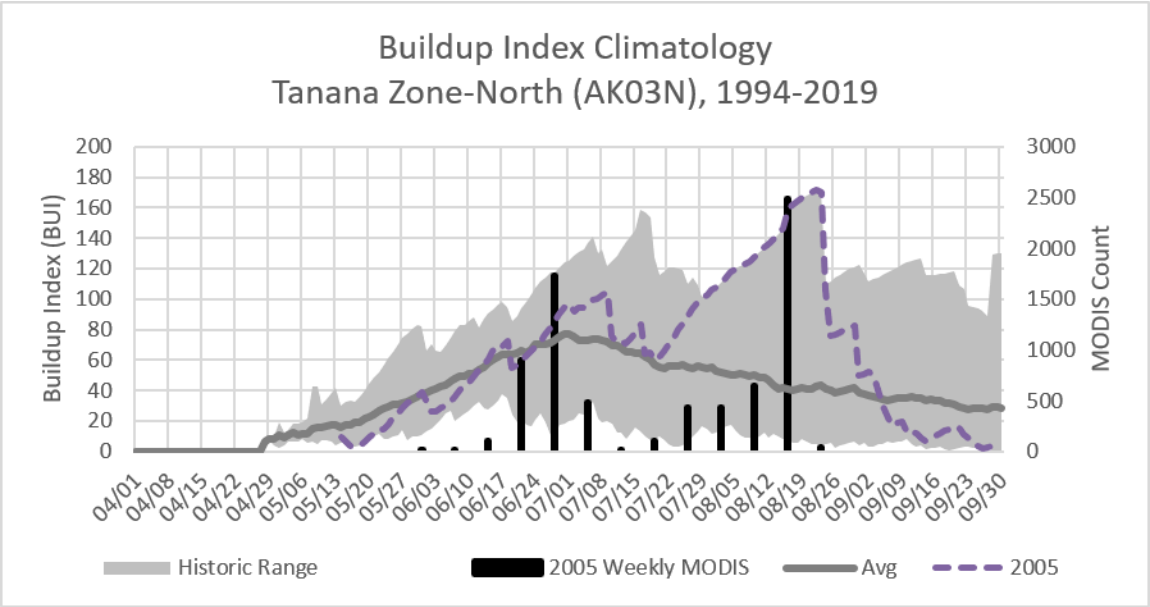
Percentile	Term Date	Season Characteristics
25%	7/10	Duff Driven- Resistance to control
50%	8/8	Cumulative Drought-Resistance to Extinguishment
75%	9/5	Diurnal-Short burn window, good RH recovery
90%	9/30	Diurnal-Short burn window, good RH recovery



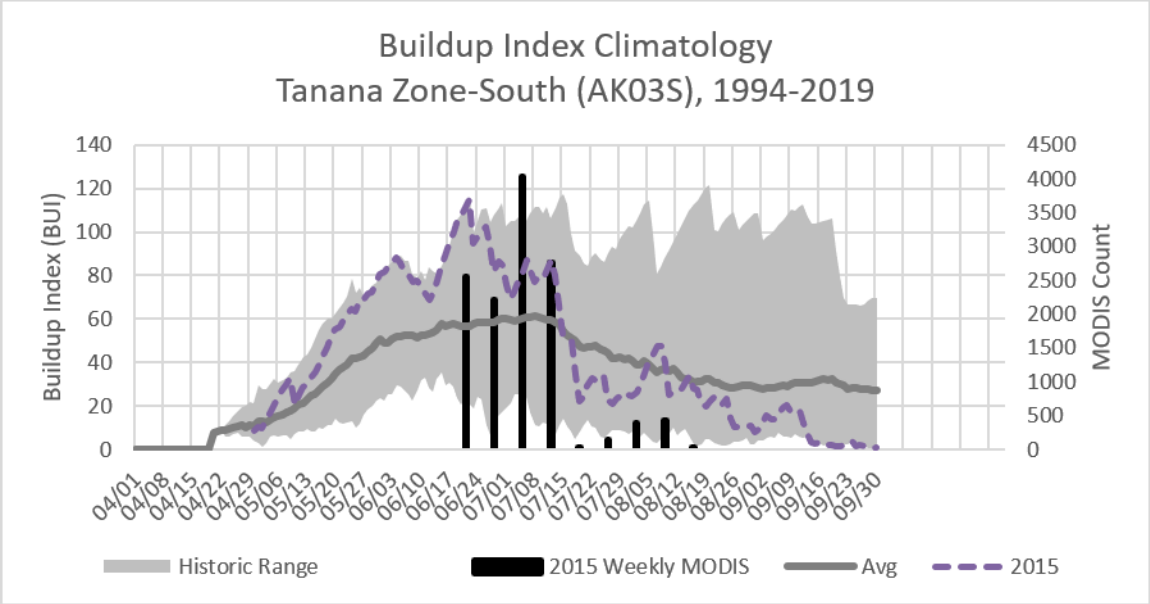
Percentile	Term Date	Season Characteristics
25%	7/3	Duff Driven - Resistance to control
50%	8/1	Cumulative Drought-Resistance to Extinguishment
75%	8/31	Diurnal – Short burn window, good RH recovery
90%	9/26	Diurnal – Short burn window, good RH recovery



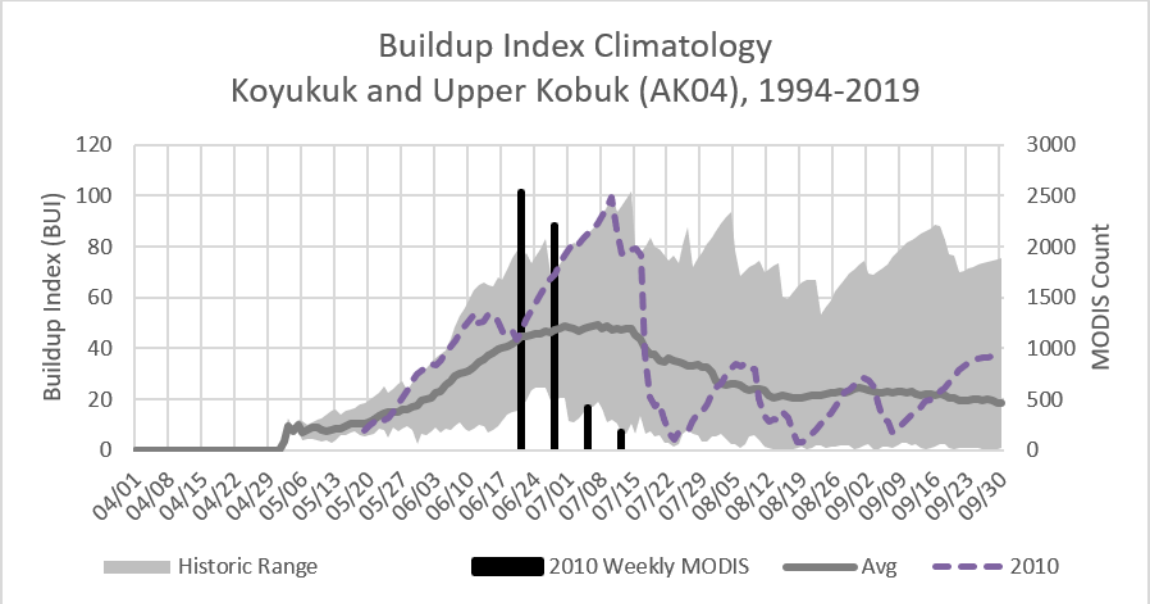
Percentile	Term Date	Season Characteristics
25%	7/25	Cumulative Drought-Resistance to Extinguishment
50%	8/19	Cumulative Drought-Resistance to Extinguishment
75%	9/11	Diurnal-Short burn window, good RH recovery
90%	9/30	Diurnal-Short burn window, good RH recovery



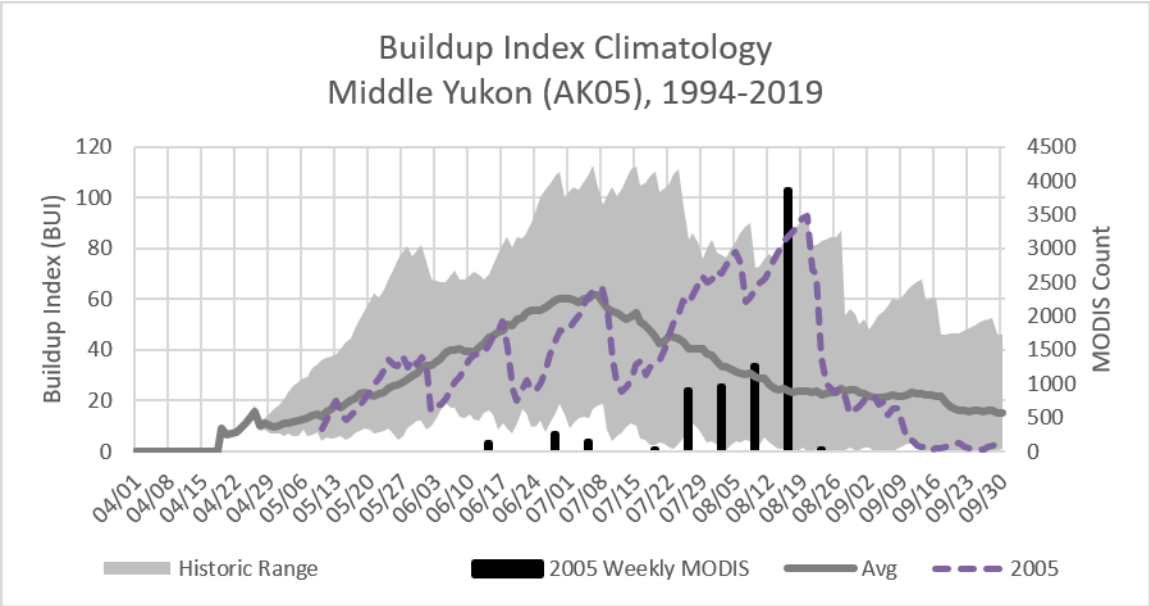
Percentile	**Term Date**	**Season Characteristics**
25%	7/16	Duff Driven-Resistance to control
50%	8/9	Cumulative Drought-Resistance to Extinguishment
75%	8/31	Diurnal-Short burn window, good RH recovery
90%	9/19	Diurnal-Short burn window, good RH recovery



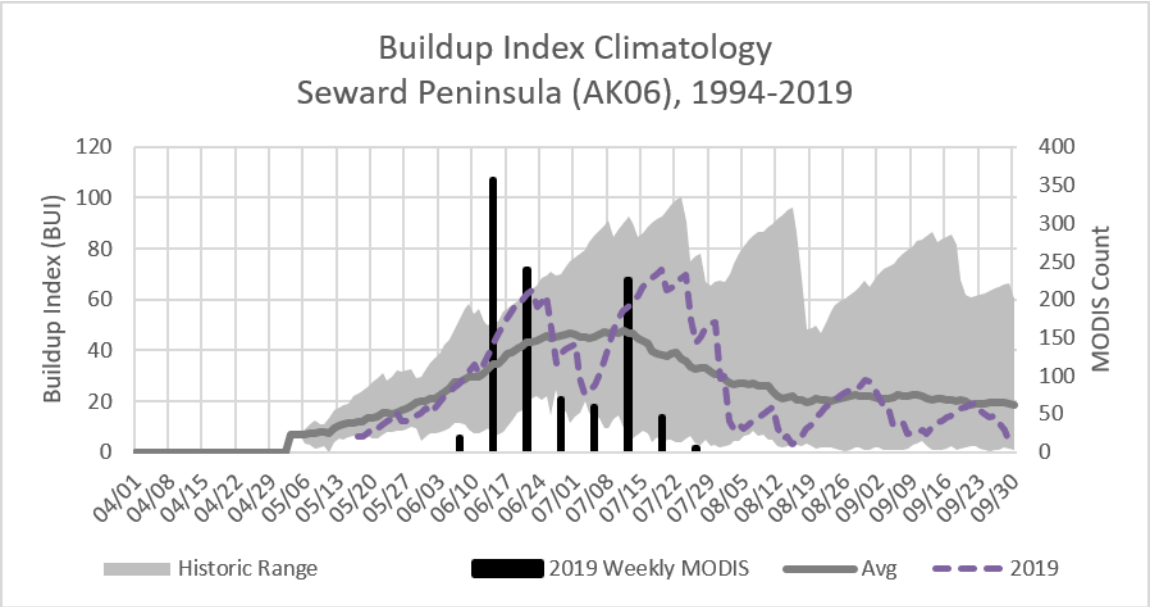
Percentile	Term Date	Season Characteristics
25%	7/6	Duff Driven-Resistance to control
50%	7/29	Cumulative Drought-Resistance to Extinguishment
75%	8/20	Cumulative Drought-Resistance to Extinguishment
90%	9/8	Diurnal-Short burn window, good RH recovery



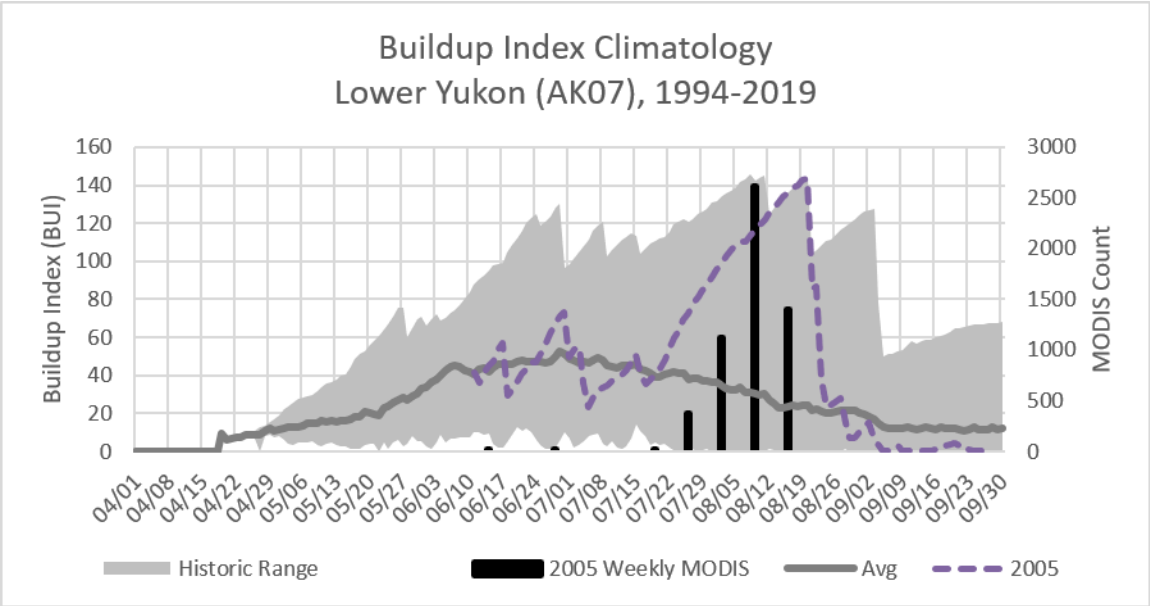
Percentile	Term Date	Season Characteristics
25%	7/9	Duff Driven-Resistance to control
50%	7/24	Cumulative Drought-Resistance to Extinguishment
75%	8/8	Cumulative Drought-Resistance to Extinguishment
90%	8/19	Cumulative Drought-Resistance to Extinguishment



Percentile	Term Date	Season Characteristics
25%	7/7	Duff Driven-Resistance to control
50%	7/22	Cumulative Drought-Resistance to Extinguishment
75%	8/5	Cumulative Drought-Resistance to Extinguishment
90%	8/16	Cumulative Drought-Resistance to Extinguishment

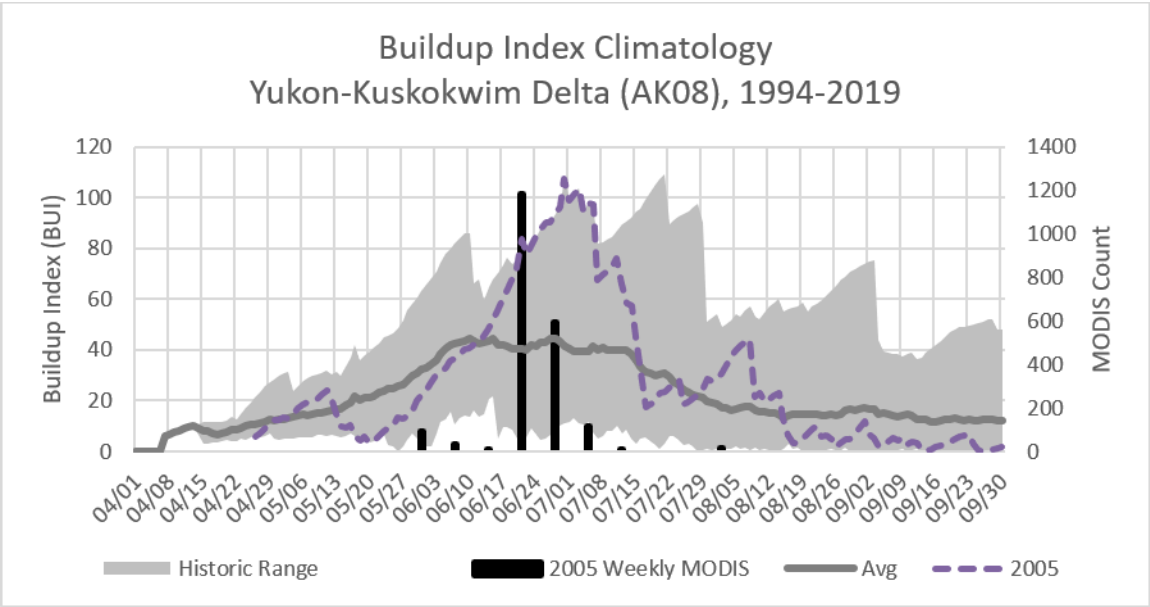


Percentile	Term Date	Season Characteristics
25%	7/10	Duff Driven-Resistance to control
50%	7/25	Cumulative Drought-Resistance to Extinguishment
75%	8/8	Cumulative Drought-Resistance to Extinguishment
90%	8/18	Cumulative Drought-Resistance to Extinguishment



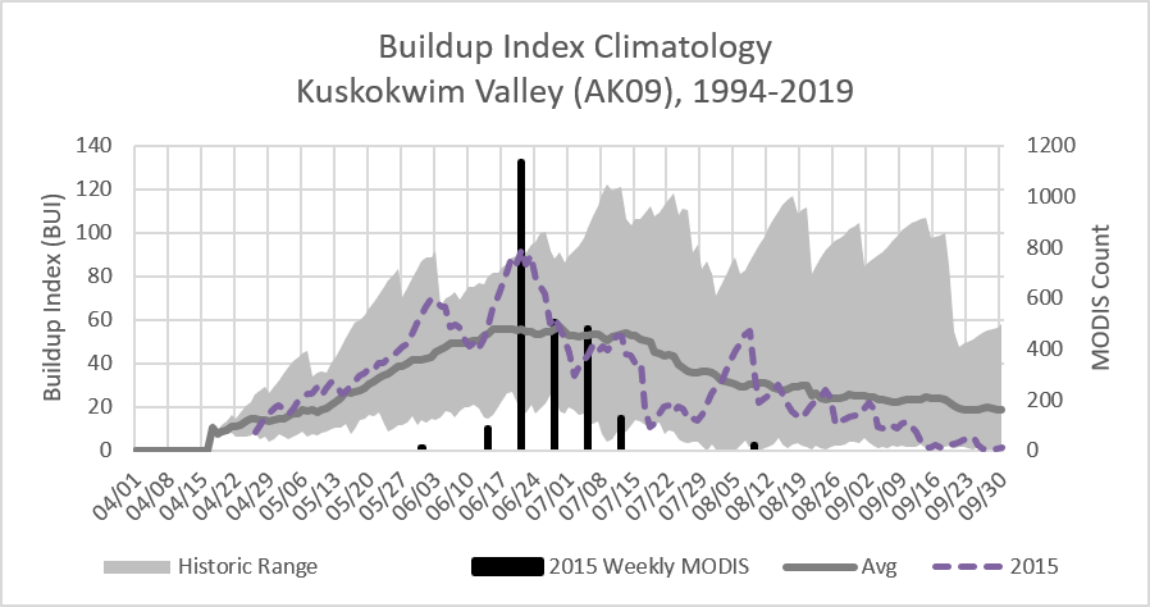
Percentile	Term Date	Season Characteristics
25%	7/2	Duff Driven-Resistance to control
50%	7/23	Cumulative Drought-Resistance to Extinguishment
75%	8/13	Cumulative Drought-Resistance to Extinguishment
90%	8/29	Cumulative Drought-Resistance to Extinguishment

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

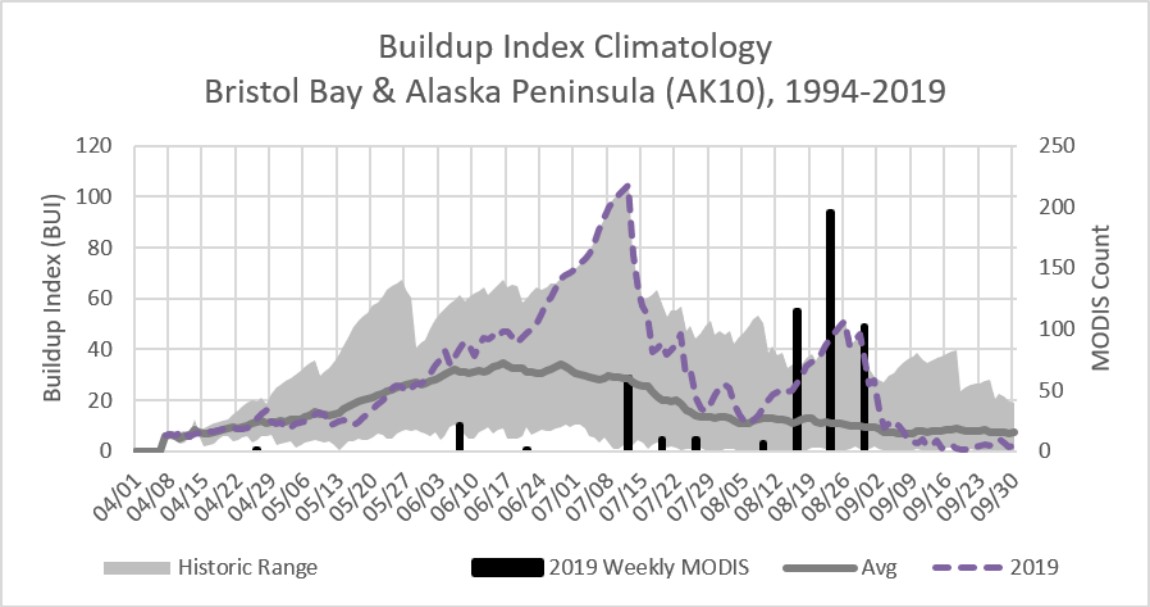


Percentile	Term Date	Season Characteristics
25%	7/2	Duff Driven-Resistance to control
50%	7/16	Cumulative Drought-Resistance to Extinguishment
75%	7/29	Cumulative Drought-Resistance to Extinguishment
90%	8/7	Cumulative Drought-Resistance to Extinguishment

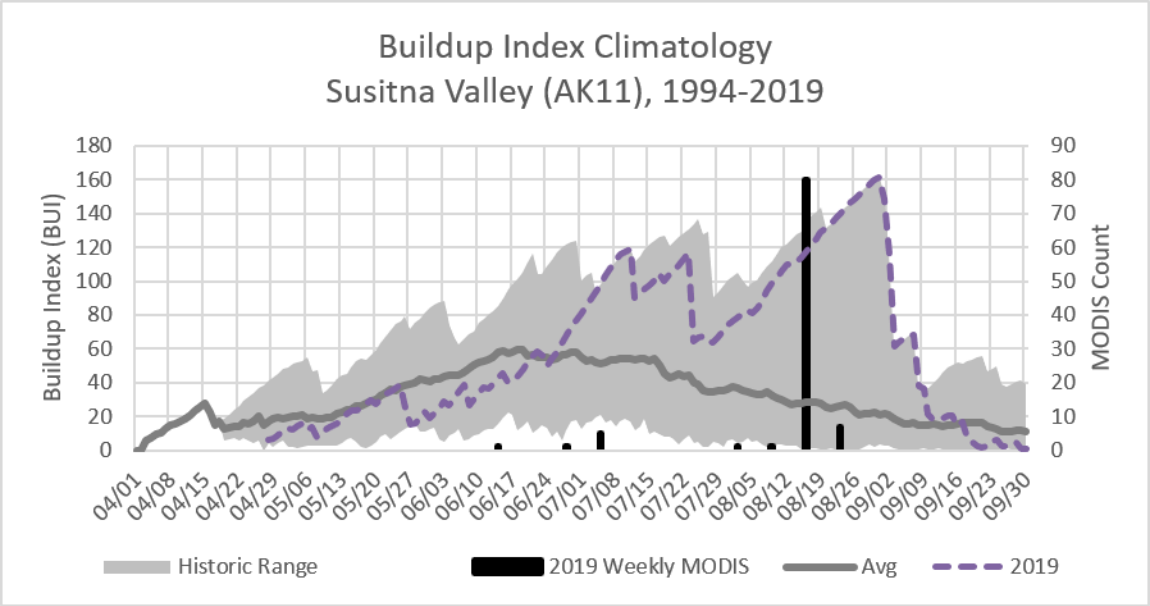
Stations analyzed: Bethel (PABE) 1994-2017, Reindeer River (RDRA2) 1996-2017



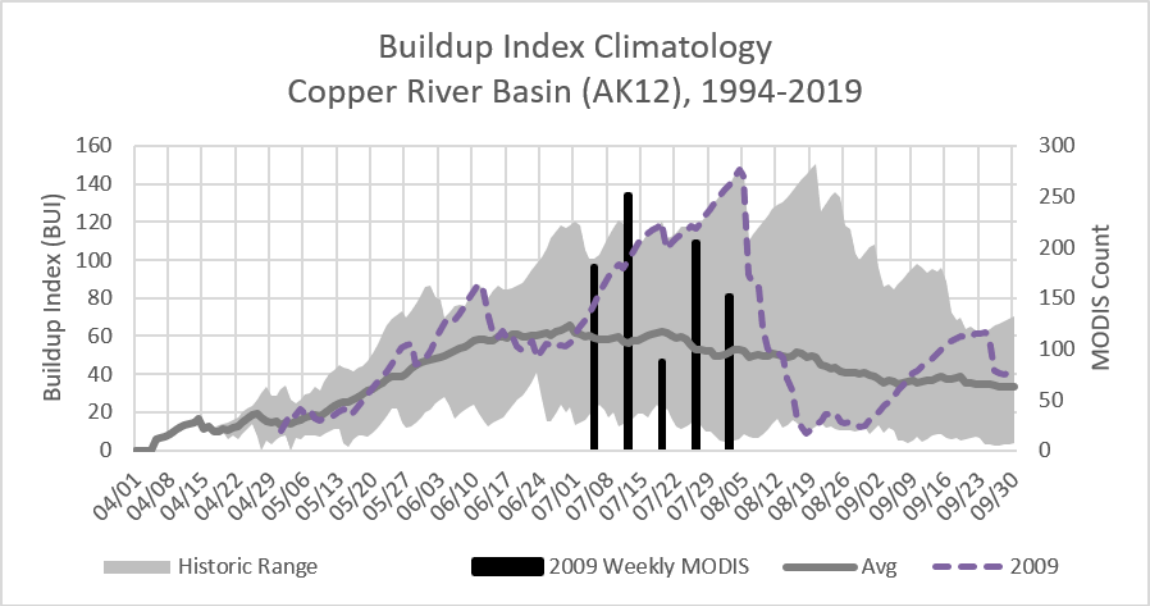
Percentile	Term Date	Season Characteristics
25%	6/29	Duff Driven-Resistance to control
50%	7/17	Cumulative Drought-Resistance to Extinguishment
75%	8/1	Cumulative Drought-Resistance to Extinguishment
90%	8/15	Cumulative Drought-Resistance to Extinguishment



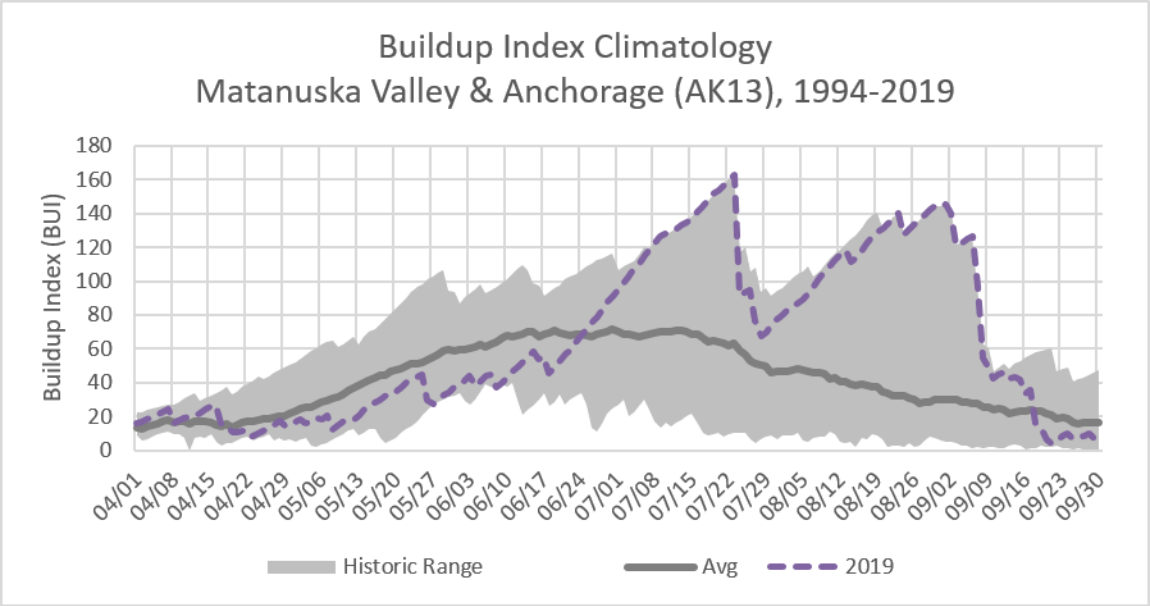
Percentile	Term Date	Season Characteristics
25%	7/1	Duff Driven-Resistance to control
50%	7/25	Cumulative Drought-Resistance to Extinguishment
75%	8/17	Cumulative Drought-Resistance to Extinguishment
90%	9/6	Diurnal-Short burn window, good RH recovery



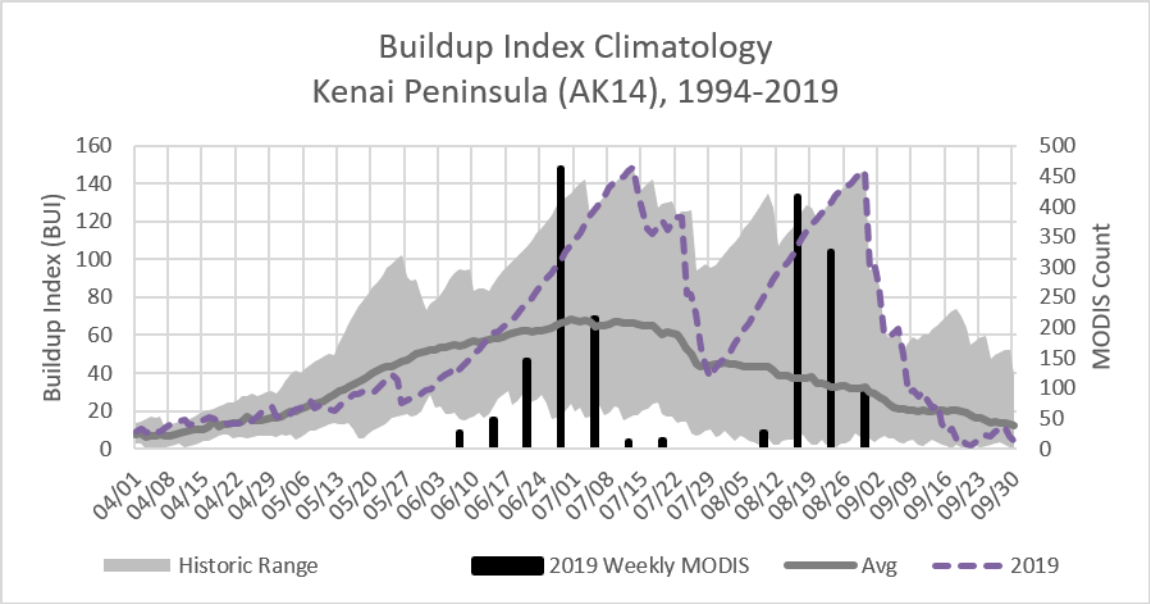
Percentile	Term Date	Season Characteristics
25%	6/28	Duff Driven-Resistance to control
50%	7/16	Cumulative Drought-Resistance to Extinguishment
75%	8/2	Cumulative Drought-Resistance to Extinguishment
90%	8/17	Cumulative Drought-Resistance to Extinguishment



Percentile	Term Date	Season Characteristics
25%	7/21	Duff Driven-Resistance to control
50%	8/11	Cumulative Drought-Resistance to Extinguishment
75%	9/1	Diurnal-Short burn window, good RH recovery
90%	9/17	Diurnal-Short burn window, good RH recovery



Percentile	Term Date	Season Characteristics
25%	6/30	Duff Driven- Resistance to control
50%	7/19	Cumulative Drought-Resistance to Extinguishment
75%	8/7	Cumulative Drought-Resistance to Extinguishment
90%	8/23	Cumulative Drought-Resistance to Extinguishment



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