Alaska Fire & Fuels User Guide

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Introduction

Alaska Fire & Fuels ([Navigate to the AKFF Home Page](#)) is the Alaska interagency Fire Weather (FWI) and Fire Behavior (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 collected is stored in a database and is available for historic queries and data downloads as needed.

The red banner at the top and the brown menu bar at the bottom are common to nearly all views of AKFF. There are 5 primary functional pages that can be accessed from either this Homepage or from the brown menu bar at the bottom: the AKFF Map, Tables, Graphs, Tools, and Download

There are also several key links provided to resources of the Alaska Interagency Coordination Center (AICC), the Alaska Fire Science Consortium (AFSC), the National Weather Service (NWS), and Mesowest itself.

The AKFF Map

The AKFF Map display is the best way to examine the spatial distribution of values for individual weather and FWI elements. It allows the display of organizational associations with protection, jurisdictional, weather forecast and predictive service boundaries and offers event context with the most recent 36 hours of lightning, all currently active fires, MODIS and VIIRS detections.

The Pieces and Parts

The figure below highlights all significant references and controls for the Map View.
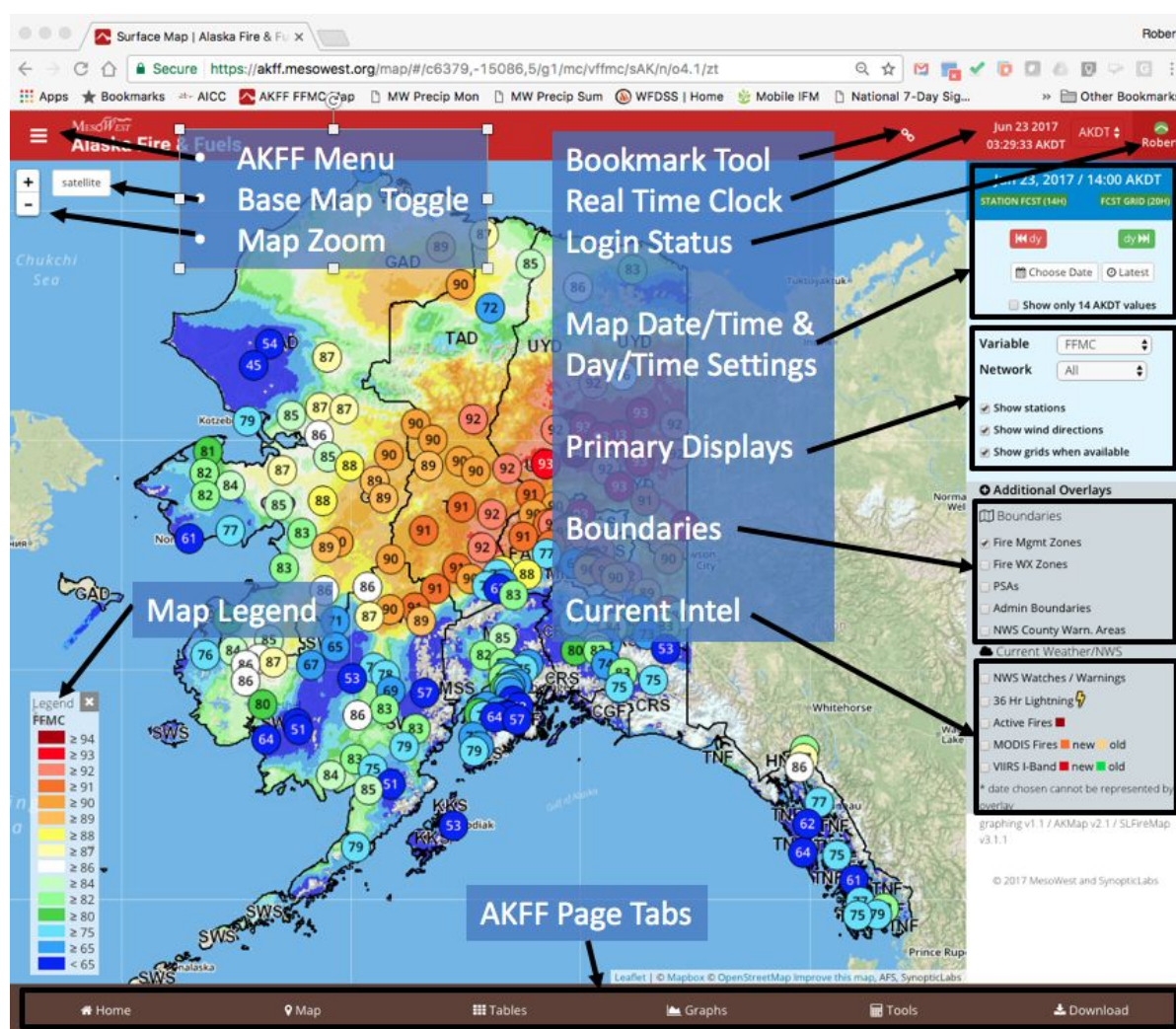
In the upper left corner of the map, there are three user controls:

- A familiar set of *zoom controls* displayed as plus ("+") and minus ("-") buttons
- A *Base Map Toggle* that lets you view a topo map or imagery as the map background.
- Access to the *Main AKFF system menu*.

Continuing across the top ribbon to the right, there several additional items of interest:

- A *Bookmark Tool* that will be discussed later in the section *Browsers and Bookmarks*
- A *real time clock* for reference. The user can set the time zone for all system displays.
- Finally a *login*, used primarily by system administrators.

Along the right margin, there is a control panel that allows the user to select and deselect different sets of information:

- First is a block of *date/time information* and controls. The date/time displayed there references the weather and FWI information currently displayed. Just below it, there are indicators for the source of station and grid information. This points out whether the display is observed or forecast. The user can scroll back and forward with red and green day and hour buttons. The hour buttons only are available for items found in the hourly datasets. And below that, a checkbox allows users to display only data maintained as part of the daily 1400 AKDT FWI record.
- Second is a block of *Primary Displays* that helps control the display of primary weather and FWI data. Users can select the display variable from a drop down pick list. Users can select and deselect display of stations, grids, and a wind vector showing the direction of wind flow. Selecting an individual station on the screen brings up a station detail box that will be discussed later.
- There are a set of 5 *Boundaries* that can be selected for display or deselected to hide. These can take time to load because they are shared from another source. Consider leaving these unselected by default.
- At the bottom of the control panel are 5 *Current Intel* items providing near real time information about the fire situation across the state. Fire Weather Watches and Red Flag Warning areas, if any exist, are highlighted when the *Watches/Warnings* box is checked. A checkbox for *36 hour lightning* provides for display of recent lightning activity detections.   Origin locations for *Active Incidents* can be toggled on and off. When displayed, users can select individual incidents to display an *Administrative Summary* and, optionally *More information* about the incident situation. Below that, users have access to display of recent fire detections from MODIS and VIIRS satellites.

At the bottom, there are two additional map page features, a *legend* at the bottom left that can be moved or closed and a brown *menu bar* at the bottom that facilitates navigation between major functional sections of AKFF.

Additional Map Features

Station Detail

When users select an individual weather station from the map, a station detail box is displayed providing additional detail and access to other services in and outside AKFF.
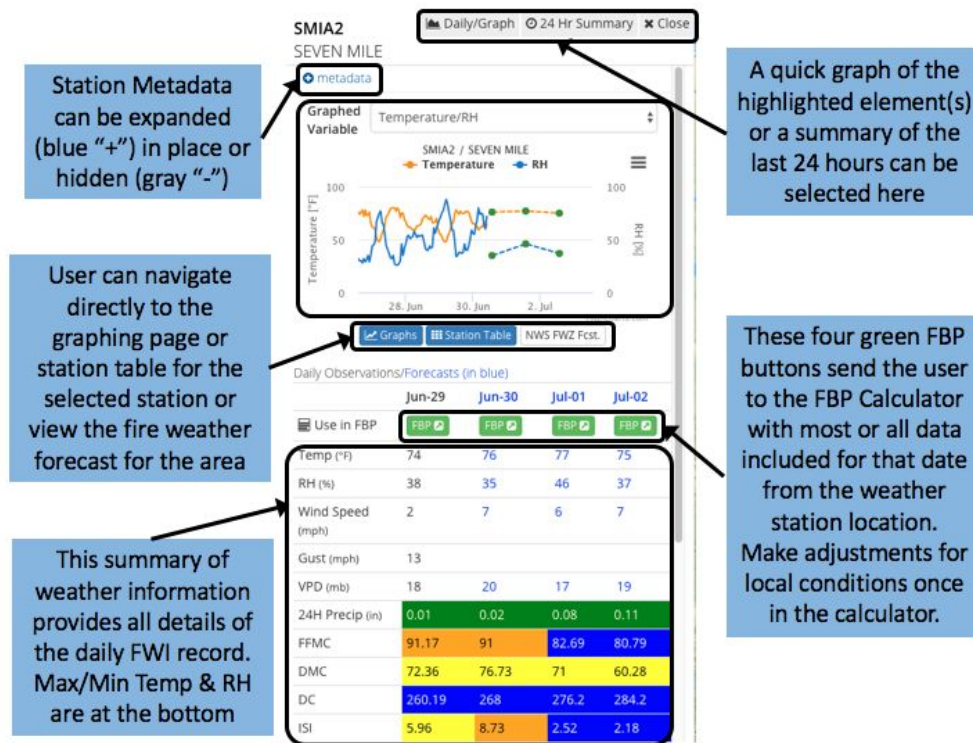
Grid Weather/FWI, Lightning and Fire Detect Detail

Grid backgrounds, lightning and Satellite (MODIS/VIIRS) fire detections may be selected individually from the map to display the value or the time that has passed since the detection.
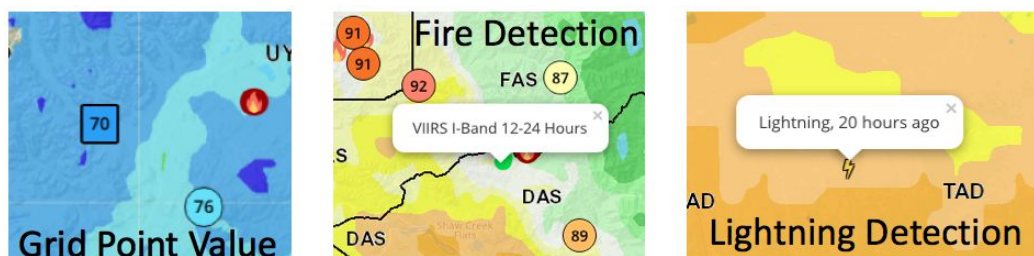
Incident Detail

Incident detail is provided by the Alaska Interagency Coordination Center ArcGIS Server/Geocortex Web Mapping Services. AKFF displays active incidents with a flame icon on the map. ***Incidents highlighted with a dark red circle are those with information updated in the last 2 days.***
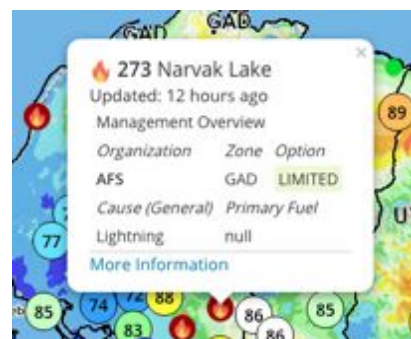
Hovering over an incident marker will display the fire number, name and the age of the most recent update. Selecting an incident displays an administrative summary.

Within the Administrative Summary box, there is a link, entitled *More Information,* that will display a more comprehensive incident summary that is shown below here

This comprehensive summary includes information about:

- The standard response management option including CRITICAL, FULL, MODIFIED, and LIMITED.
- The current incident strategy, including **Monitor** and **Staffed.**
- FWI and fire danger for locations <75 miles away for the date of last update
- ***Management Information***: Incident location and administrative responsibility
- ***Latest Behavior/Status***: Current incident size and cost, as well as concerns for nearby structures
- ***Origin Details:*** Specific location, cause, and other details about the fire's discovery
- Additional Details: Additional references to map tiles, legal description and technical references such as the IRWIN ID.

This information can be used to reference incident situation in real time and context, relating fire weather and fire potential to assessments.

Table Displays

FWI Daily Forecast Summary Table

This display is most like what users have been accustomed to from the previous AICC FWI system. However, it incorporates observations and forecasts into a single table.

With multiple days for nearly 200 stations, the table can be quite large and requires time and internet bandwidth to process and display. It is recommended that users filter stations according to their area of interest, limit their choice of observation and forecast, and bookmark the table when they have it as preferred. This will speed up displaying the table significantly.

Once in this table, users should develop familiarity with filters and additional settings. Using PSAs or FWZs instead of Management Zone for filtering may help focus attention on stations nearest to a given fire.

Station FWI Data Table

The Station FWI Data Table is the place to go for complete detail about weather observations and forecasts, daily and hourly FWI codes and indices, and other derived information. It includes:

- Display of daily observations for one station at a time for up to 90 days, up to and including the date identified in the URL (web address).
- Three days of daily forecast records that follows the most current observation.
- Hourly data is available as an expanded display. Any number of days can be expanded or contracted as the user wishes, by simply clicking on or off the "hrly" button.

These tables for individual stations are accessible from:

- The map page by first clicking on the station bubble on the map and then selecting the green station table button from the station table box that is displayed there.
- The FWI Daily Forecast Summary table by clicking the station identifier in the left column.
- Straight from the Tabular page

Station Metadata Table

The station metadata table allows the user to see the current status of stations in their area. It includes station identifiers, location, elevation, and administrative associations. Users can filter the table to see just the stations in their fire management zone, fire weather forecast zone, or predictive service area.

Station status in this table is classified in four categories:

- ACTIVE stations are collecting data, calculating FWI codes and indices and displaying data on the map
- STOPPED stations are collecting weather data and displaying data on the map, but not calculating FWI codes and indices.
- QCSTOPPED stations are collecting weather data, but not calculating FWI codes and indices or displaying data on the map.
- INACTIVE stations are not collecting data because they are not expected to be operational during the season.

ACTIVE, STOPPED, and QCSTOPPED stations will have a new row inserted in the archive for every single day and hour of a calendar year in which they are listed as active. If no data are being reported, then the inserted rows are empty for that station.

INACTIVE stations are listed separately at the bottom of the page, and include discontinued RAWS locations like GIRDWOOD and old manual stations such as TOK. It's unlikely that any of these stations will operate in the future.

Graphing AKFF Information

The graphing tool is used to display information from the AKFF database of surface observations for the purpose of comparing trends for a weather or FWI variable over time and comparing conditions among stations. There are excellent explanations and user tips on the page itself, many of which are repeated here. So go and graph.

The easiest way to get started with a graph for a given station is to select the Graph button from the station detail box on the Map Page (see Map section above). That will take you to the Graph page with that station graphed for Temperature and RH. However, you also can edit the station selection from the graph controls on the graph page itself.

Here is what the Graph Page looks like and what the user can control on it:
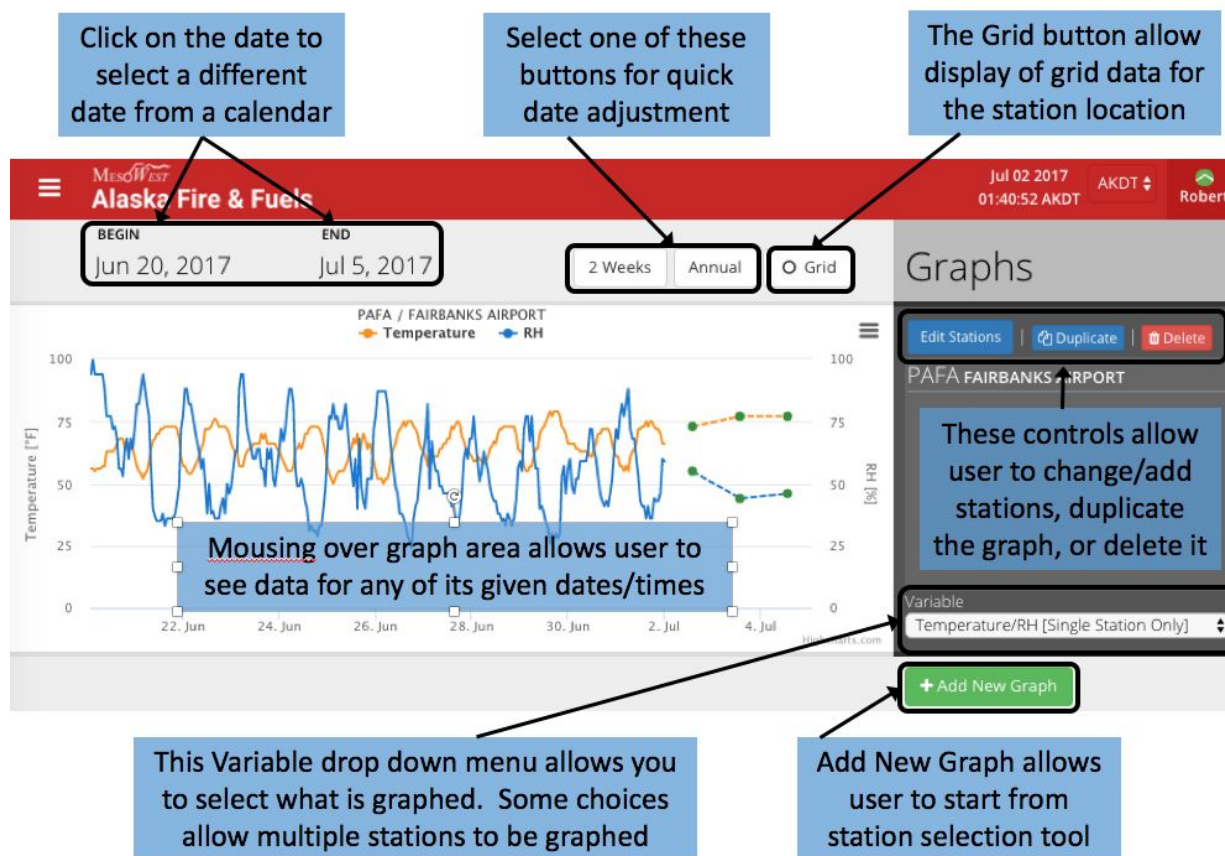
Though there is no bookmark tool for the Graph Page, you can save the web address (URL) by saving it as a bookmark or creating a shortcut on the desktop. These methods are described later in the user guide. From those, the entire graph setup can then be recalled simply.

Graph Begin and End Dates

- Time periods can be specified. Spanning multiple years may produce unexpected results.
- There are two quick period selections, 2 Weeks for the most recent two weeks and Season for the entire current fire season (Mar 1 - Sep 30).
- The user can drag the mouse on a computer, or pinch-zoom on a touch device, to zoom in on a specific time period on a plotted graph. This functionality is also available on embedded graphs shown from maps and tables as well.

Variable Selection

There are a set of variable selections that are identified as "(single station only)", while the remaining variable options are for single variables.

- *Single station only* graphs provide display of variables in combination or a variable with its climatological context (max/avg/min)
- Single variable graphs provide the user to graph multiple stations in combination.

Grid: Comparing grid values at weather station locations

Use the Grid button to toggle on/off display of RTMA/NDFD/RFC-derived point location observations and forecasts for comparison to the direct observations made by that station. Grid data can only be shown when these rules are satisfied:

- One station is being viewed in a particular graph (all compliant graphs will load gridded data, but any one graph must be showing only one station)

- The date span is less than 25 days — which is the same period restricted for displaying hourly data for variables which observe hourly. When grids are not available, the button isn't selectable; hovering the cursor over it will show a red circle with a line through it.

- Only certain variables are available as grids, these include temperature, RH, wind speed, precip, FFMC, ISI, DC, DMC, BUI and FWI. Whether hourly versions of any of these variables are available depends on the system.

Grid-derived point values will be shown as a faded version of the station-derived value.

Note: There will be differences between the station and grid point values displayed on the graph, reinforcing differences seen on the map. Some of the difference can be related to their independent observation and/or estimation. However, there are differences that are artificial. These are explained in some detail later in the section on System Sources and Standards.

Browsers and Bookmarks

As a web-based system, AKFF provides easy access to a considerable range of weather and Fire Weather Index (FWI) information. Because each display method (map, table, graph) is highly configurable and requires some sophisticated features, users are afforded a few tools to help them work within their computer system.

Most users have more than one browser available on their computer.

- Among them, Internet Explorer (IE) is very common. Many prefer it because user settings, including favorites, are stored with their windows login. These favorites are available every time IE is started. However, older versions of it (before 11) do not support all AKFF features and are no longer fully supported by Microsoft.
- Chrome and Firefox are common alternatives, however browser configurations are stored with specific browser logins that are not maintained with the machine login. If users have problems with Internet Explorer when using AKFF, or would prefer to use another browser, user defined URLs can be saved to the desktop and stored with their windows login. Simply click and drag the URL to the desktop where a shortcut will be saved and can be edited if necessary.

AKFF provides a *Browser & Internet Check* tool to evaluate their browser compatibility. It can be found on the AKFF Tools Page under System Monitoring at the bottom of the page. It provides only general review of your browser and internet connection, but negative indicators could point to issues with your browser version.

AKFF Browser & Internet Check
Let's make sure you can use and access all of the resources of AKFF.

Internet Access

Test	Result	Requirement
API - jsonp	good	Old-style AKFF data access
API - cors	good	Accessing AKFF data
Static Content Server Access	good	Static content (styles, scripts, etc..) from distributed origins.

Critical Browser Features
These are things your browser brings to the game which we require for AKFF to work properly

Test	Result	Requirement
CORS Requests	good	Modern request format to the API
JSON	good	Ability to decode and encode the language we use for data transmission
WebGL	good	Rendering engine for grids on the map
RGBA Color Specification	good	Method for specifying colors
SVG Graphics (regular and inline)	good	How we render dynamic and interactive graphs and markers

Critical Loaded Libraries

Test	Result	Requirement
Moment	good	Date/time functions
SLnav	good	Side bar interaction
Google Analytics	good	How we track user interaction

A link tool that defines a URL that will reproduce the current state of the display is found on the top AKFF ribbon. This URL can be used to define a bookmark (or favorite) that the user can call to restore the view. URLs for map and table views can be defined and used in browser bookmarks/favorites.

The Map Page is highly configurable. It can remember:

- The current Map (zoom) View so that the user can return immediately to that view with a bookmark
- What mode (daily or hourly) and what primary variable to display
- Inclusions of stations, grids, and wind vectors
- Overlay boundaries and features to include
- Date and Timing: generally leave this one unchecked if you want to see the current conditions
- What station networks to display

The Daily FWI Forecast Table display is also configurable to make it easy for users to return to the list of stations that interest them in particular with a browser bookmark or favorite:

- Most users want to return to the current situation regularly when viewing the Daily FWI Forecast Table. For that use, the upper link is configured without a date. It can be saved as a bookmark or as a shortcut on the desktop. ***NOTE: it may be necessary to edit the date out of the bookmark or shortcut once it is saved.***

- If, however, the user wants use a URL to refer to a specific date and set of stations in a decision document or other reference, the lower link includes the date reference.

FWI and FBP calculators

AKFF provides CFFDRS calculators that allow users to apply information from weather station locations and adjust input elements to fit local conditions.

Fire Weather Index Calculator

AKFF provides a separate tool for users to look at and evaluate. Though it cannot be accessed directly from a weather station detail box on the map page or from a table page, it functions best once a weather station is selected. The user must know the AKFF ID to select a station.

Initializing the FWI Calculator:
1. Set the **Month** properly for the current assessment and select **"daily" or "hourly"**
2. Select the **weather station (using the AKFF ID)**, the **date range** and select **download**
3. Important! Set the **initial moisture codes** across the top line (use values from day prior to first day displayed.). Don't forget **BUI** and **GFMC** values there if doing hourly edits.

Edit Weather Record
1. Daily records include Temp, RH, Windspeed, and 24-hr Precipitation. Hourly records include 1-hr precip totals instead and add Solar Radiation for GFMC calculation.
2. Individual daily or hourly records may be deleted or added.

FWI fuel moisture codes and fire behavior indices update as soon as any inputs are changed. The user can then use the results from any record (line) to complete a FBP assessment using the purple FBP button to the right.

Fire Behavior Prediction Calculator

This FBP calculator is best accessed from the station detail box for a weather station the user feels is representative of conditions at a fire location. There are green FBP buttons below each date referenced there.

Selected in this way, the FBP calculator is displayed with a completed result using default information. It usually needs to be edited.

- Location (lat/long) should be changed from the weather station location to the fire location.
- Slope and surface default to "no slope." This should be confirmed or edited
- Windspeed and direction default to the weather station. Confirm or edit with local observation or forecast
- Default duration is for 1 hour. Confirm or change to another duration time (up to 6 hrs).

FBP Output Displays

- Map: By default, as shown above, this FBP calculator defaults to the map display showing a high resolution image of the location.

- Diagram and Table Displays show the same basic set of FBP results, though the table includes for size and shape estimates as well.

OUTPUTS			PRINT
Map	Diagram	Table	Text

Torching Fire (to the S)
Rate of spread 6.514 ch/hr
Flame Length 6.2 ft
Intensity 299.31 BTU/ft/sec
Fuel Consumption
Crown 0.7 ton/acre   Total 7.05 ton/acre
HEAD

↑ 5.57 ch

FIRE/Situation
Effective wind: 7 mph; ISI: 8.9
Surface Fuel Consumption: 6.35 ton/acre

1.77 ch →

FLANK
Surface Fire (to the E/W)
Rate of spread 2.075 ch/hr
Flame Length 3.49 ft
Intensity 85.88 BTU/ft/sec
Fuel Consumption
Crown 0 ton/acre   Total 6.35 ton/acre

↓ 0.08 ch

BACK
Surface Fire (to the N)
Rate of spread 0.09 ch/hr
Flame Length 0.82 ft
Intensity 3.73 BTU/ft/sec
Fuel Consumption
Crown 0 ton/acre   Total 6.35 ton/acre

OUTPUTS			PRINT
Map	Diagram	Table	Text

Effective Parameters

	Situation
Effective ISI	8.914
Effective Spread Direction	S
Effective Windspeed	7 mph

Fire Behavior

	Head	Flank	Back	
Rate of Spread	6.514	2.075	0.09	ch/hr
Rate of Spread at Period End	6.507	2.073	0.09	ch/hr
Flame Length	6.2	3.49	0.82	ft
Fire Intensity	299.31	85.88	3.73	BTU/ft/sec
Fire Type	I-Torching	S-Surface	S-Surface	
Spread Distance	5.571	1.775	0.077	ch

Fuel Consumption

	Situation
Surface Fuel Cons.	6.35 ton/acre

	Head	Flank	Back	
Crown Fuel Cons.	0.7	0	0	ton/acre
Total Fuel Cons.	7.05	6.35	6.35	ton/acre

Fire Size and Shape

	Situation
Length-to-Breadth	1.592
Elliptical Fire Area	1.575 Acres
Elliptical Fire Perimeter	0.18 mi
Rate of Perimeter Growth	17.095 ch/hr

- The text display remains, and is consistent with what is displayed for the FBP (Classic) results.

There is a PRINT button with this calculator, designed to print the text output. The user should consider using that feature to save it as a PDF for electronic documentation.

FBP (Classic)

This original interface is more comprehensive, allowing user to edit both FWI and FBP inputs within the same interface. It is more suited for advanced users who are seeking full control over the assessment, with need to adjust weather as well as fuel and terrain inputs.

Notice that user has ability to select weather station and its data and then adjust weather and/or yesterday's moisture codes to update FWI inputs with desired changes before moving to FBP.

Once in the FBP Portion, it generally is not prepared to complete the assessment without further input and will not provide a map or diagram display.

AKFF Downloads

AKFF provides a rich API (Application Programming Interface) for accessing data stored there. In addition, AKFF provides a user interface to obtain data commonly requested.

They include Station Metadata, Daily or Hourly station records, a special format 7-Day Outlook file, and a special format WIMS file. All are described further here.

As in many other displays in AKFF, users can filter on Fire Management Zone/Area, Fire Weather Zone, and/or PSA to narrow their request for data, or they can choose a particular station using Station ID.

Metadata

The station Metadata file is useful for associating location and administrative information with the daily and hourly fire weather and FWI records available.

Daily and Hourly Downloads

Daily and Hourly download requests provide users the opportunity to further filter their requests by prompting for a date range/date-hour range. Files are provided as comma delimited files that can be opened directly into excel or imported into other file formats.

7-Day Outlook

The 7-Day Outlook download is provided as a tool to support preparation of the National Predictive Services 7-Day Significant Fire Potential Outlook Map and Summary Description. It provides two options for the user, a 50th percentile (median) file for normal conditions, and a 75th percentile file for situations where extreme drought or uneven conditions suggest that potential is not represented by median representations. ***These are not stored in AKFF.***

Formatted as a CSV file intended for ingest as a NW file, shown here, it includes:

```
"AK04","06/30/2017","TMPF","65","64","67","70","64","58","64","57"
"AK04","06/30/2017","RELH","68","55","44","44","53","71","54","72"
"AK04","06/30/2017","WSPD","9","19","18","20","22","16","10","9"
"AK04","06/30/2017","FFMC","80","74","85","87","87","78","84","73"
"AK04","06/30/2017","DMC","40","40","32","33","46","44","47","45"
"AK04","06/30/2017","DC","225","228","223","231","250","257","264","270"
"AK04","06/30/2017","ISI","3","2","5","8","9","3","4","2"
"AK04","06/30/2017","BUI","56","56","47","49","63","61","64","62"
"AK04","06/30/2017","FWI","9","5","13","18","11","3","4","1"
"AK04","06/30/2017","SPRUCE","2","1","2","3","2","1","1","1"
"AK04","06/30/2017","GRASS","2","1","2","4","4","1","2","1"
"AK04","06/30/2017","FEN","1","1","1","2","1","1","1","1"
```

- The PSA (e.g. AK04)
- The Date of the most recent daily (1400 AKDT) observation
- The identifier for the Weather or FWI element for that line (e.g. FFMC). Most of these identifiers are recognizable as items stored in the AKFF database.
- Eight consecutive values for that element. These values represent the median values for consecutive days (1 day of observation and 7 days of forecast) for weather stations producing FWI values in the reported PSA.

One identifier, "FEN", represents the "dryness level" contribution to significant fire potential and is responsible for coloring each PSA (green, yellow, brown) on the national map and table.

- FEN of 1 is derived from a SPRUCE value of 1 or 2
- FEN of 2 is derived from a SPRUCE value of 3
- FEN of 3 is derived from a SPRUCE value of 4 or 5

The first three forecast days correspond directly to values stored in the daily FWI database. Days 4 through 7 are also derived from the NWS NDFD forecast grids. However, after day 3, NDFD does not provide quantitative precipitation estimates. For those days, precipitation forecasts are derived from Probability of Precipitation (POP) as follows:

- POP of 35% to 54% is converted to .03" of precipitation, affecting only FFMC
- POP of 55% or more is converted to .10" of precipitation, affecting FFMC and DMC

WIMS

The WIMS download file is formatted to provide a means for importing AKFF data into Firefamily Plus or, perhaps in the future, uploading hourly data into WIMS.

The data is formatted as an FWX13 file which is defined here:

Navigate to a description of the WIMS FW13 file format

The file appears as this:

```
W13500741201707010800R0 50 90        0              0Y  213    6    0N
W13500741201707010900R0 48 93        0              0Y  213    2    0N
W13500741201707011000R0 51 93        0              0Y  213    1    3N
W13500741201707011100R0 50 93        0              0Y  213    2    3N
W13500741201707011200R0 48 95        0              0Y  213    5    0N
W13500741201707011300R0 48 94        0              0Y  213   16    0N
W13500741201707011400R0 49 97        0              0Y  213   33    0N
W13500741201707011500R0 52 95        0              0Y  213   49    0N
W13500741201707011600R0 60 82        0              0Y  213  136    2N
W13500741201707011700R0 67 65198     1              0Y  213  347    3N
W13500741201707011800R0 67 65242     1              0Y  213  219    3N
W13500741201707011900R0 69 62        0              0Y  213  236    2N
W13500741201707012000R0 76 47 40     2              0Y  213  578    6N
W13500741201707012100R0 78 40193     1              0Y  213  738    7N
W13500741201707012200R0 75 43 22     1              0Y  213  483    5N
W13500741201707012300R0 79 43        0              0Y  213  477    3N
W13500741201707020000R0 80 32        0              0Y  213  719    5N
W13500741201707020100R0 74 42 55     2              0Y  213  193    6N
W13500741201707020200R0 74 50        0              0Y  213  235    5N
W13500741201707020300R0 74 51        0              0Y  213  188    2N
W13500741201707020400R0 70 59        0              0Y  213  103    3N
W13500741201707020500R0 69 65        0              0Y  213   79    0N
W13500741201707020600R0 67 71        0              0Y  213   49    0N
W13500741201707020700R0 64 79        0              0Y  213   24    0N
W13500741201707020800R0 61 82 56     2              0Y  213    7    4N
W13500741201707020900R0 59 84        0              0Y  213    2    2N
```

While this may facilitate automated upload of hourly data into WIMS for ASOS network stations, it does not aid dispatchers in manual entry and edit of daily fire weather observations within the WIMS web interface.

Manual entry of the daily fire record requires collection of 1400 AKDT Temperature, RH, Windspeed, and 24-hr Precipitation Total. These are available from AKFF on the Station FWI Table or station detail on the Map. Additionally, it requires collection of 24 hr max and min values for Temperature and RH for the period from 1500 AKDT to 1400 AKDT. The best way to obtain required elements is to view the hourly records from either the Station FWI Table or the 24-hr summary from the station detail box on the Map. In both cases, make sure to select the correct date.

System Sources and Standards

What Information You See

CFFDRS FWI and FBP systems are simple and can operate on once-a-day observations collected consistently over the fire season. AKFF meets this requirement, capturing those and additional information on an hourly basis. Items with an asterisk (*) are collected for gridded analysis as well.

Weather Observations and Elements

To calculate FWI codes and indices, each observation must include:

- *Surface Temperature*
- *Surface Relative Humidity*
- *Surface Windspeed*
- *24hr accumulated Precipitation*

Additionally, AKFF obtains hourly observations from nearly all observing locations in Alaska. These include:

- Hourly precipitation total
- Wind Direction
- Gust Windspeed
- Solar Radiation

From these, additional information is derived, some once a day and others hourly.

- Vapor Pressure Deficit (VPD)

Finally, each daily and hourly record includes a time field, **Observed/Lead Time (O/LT)** that performs double duty, identifying the time of observation or forecast.

- When viewing an observation record, the O/LT displays the number of minutes before or after the stated hour that the observation was collected.
- When viewing a forecast record, the O/LT displays the number of hours before the stated hour that the forecast was produced.

CFFDRS FWI and FBP System Products

AKFF provides a database of FWI codes and indices estimated from surface observations dating back to 1994 at many locations. Hourly values have been kept since late 2014.

Daily FWI System Codes and Indices

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 at which the weather is recorded. It is based on the moisture content of three classes of surface forest 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 system consists of six components; three primary indexes, or codes, representing fuel moisture for each of the three fuel layers, two intermediate indexes representing rate of spread and fuel consumption, and a final index representing fire intensity as energy output per unit length of fire front.

FFMC Surface layer 1 - 2 cm. deep
DMC Duff layer 5 - 10 cm. deep
DC Deep duff layer 10 - 20 cm. deep
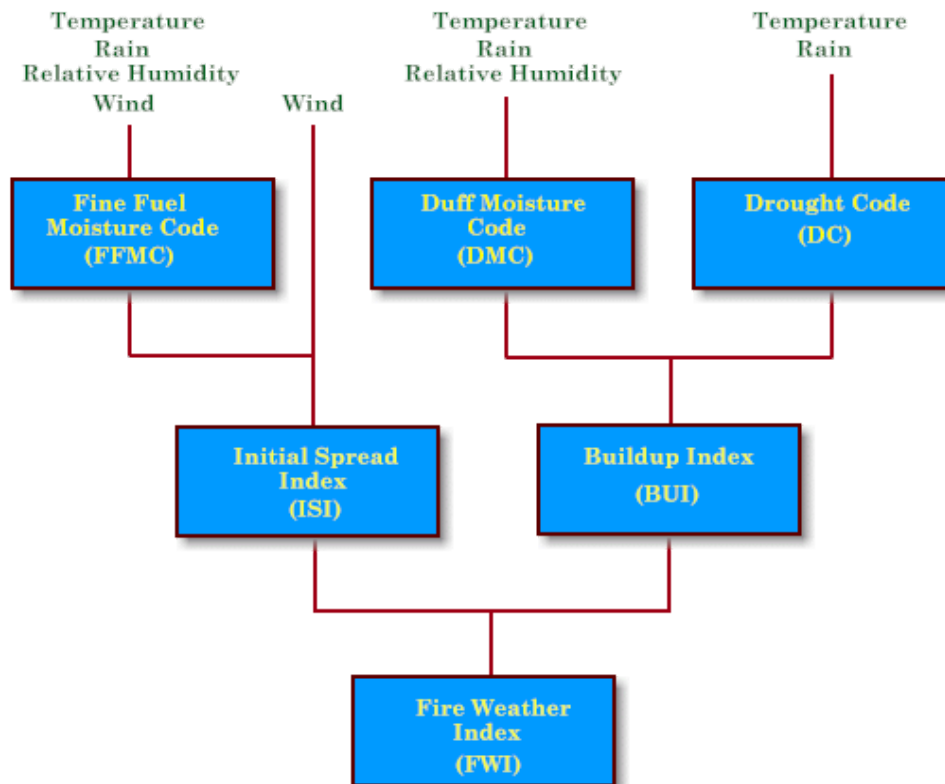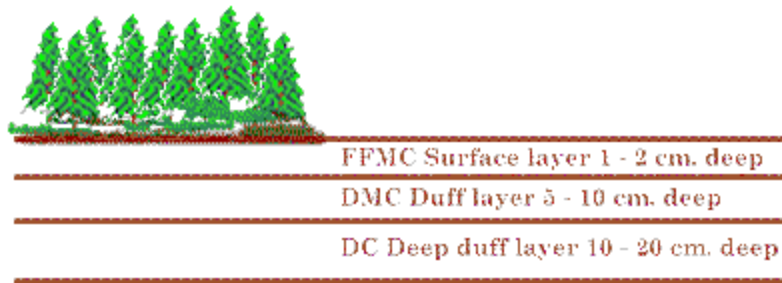
- ***Fine Fuel Moisture Code (FFMC)*** represents the moisture content of litter and cured fine fuels, 1-2 cm deep. It expresses the ease of ignition and fuel flammability. FFMC is sensitive to daily changes in temperature, rainfall, relative humidity, and wind speed. Time lag is 2/3 day, which means that it takes two thirds of a day for the fine fuels to react to a change in the weather.

- ***Duff Moisture Code (DMC)*** represents the moisture content of loosely compacted, decomposing organic matter, 5-10 cm. deep, which determines resistance to control. DMC is sensitive to temperature, rainfall, and relative humidity. Time Lag is 12 days.

- ***Drought Code (DC)*** represents the deep layer of compacted organic matter, 10-20 cm. deep, which determines resistance to extinguishment. It indicates seasonal drought and smouldering fires in deep duff or large logs. DC is sensitive to temperature and rainfall. Time lag is 52 days.

- ***Initial Spread Index (ISI)*** represents a numerical rating of fire spread immediately after ignition without the influence of variable fuel quantity (the fuel type isn't considered). It fluctuates with wind speed and time of day. ISI is a combination of FFMC and wind.

- ***Buildup Index (BUI)*** represents total fuel available for combustion. In the absence of rain, BUI fluctuates little throughout the day. BUI is a combination of DMC and DC.

- ***Fire Weather Index (FWI)*** represents the intensity of a spreading fire. FWI is a combination of ISI and BUI.

- ***Daily Severity Rating (DSR)*** provides a measure of control difficulty in terms of an earlier fire danger index. It derived from the FWI value, but is better suited for averaging and cumulating through the fire sason.

- ***Cumulative Daily Severity Rating (CDSR)***, or Seasonal Severity Rating, provides an effective means of comparing seasons as they progress.

Hourly FWI System Codes and Indices

The hourly outputs look similar, but are calculated with different processes and are used to show hour to hour variability and diurnal trends as the weather transitions from day to night and back.

- Hourly Fine Fuel Moisture Code (HFFMC)
- Hourly Initial Spread Index (HISI)
- Hourly Fire Weather Index (HFWI)
- Grass Fuel Moisture Code (GFMC)
- Grass Initial Spread Index (GISI)

Fire Behavior Prediction System (FBP)

FBP processes are available for incidental use in AKFF. Inputs, settings, and results are not stored in its database. Users are encouraged to document FBP displays themselves. The print feature provides functionality to support that. See the FWI and FBP tools section above.

Fire Danger Ratings

AKFF provides interpreted danger ratings that utilize the daily FWI record of weather observations, fuel moisture codes, and fire behavior indices.

Criteria for the Spruce (Summer) and Grass (Spring or Pre-Green) adjectives follow here.

Though there are no hard and fast rules about their use, they have been designed to evaluate the range of surface fuel and fire potential factors found in each location every day.

The Spruce (Summer) rating has been designed to represent fuel hazard, ignition, and fire growth potential in boreal forests over the bulk of the peak season, described by Dan Burrows (FMO, Tanana Zone, retired) as the "Duff-Driven" and "Drought-Driven" seasons between early June and Mid-August. Its higher ratings (VERY HIGH, EXTREME) are well correlated with significant fire events throughout the interior, south-central and panhandle regions.

The Grass (Spring or Pre-Green) rating is based on daily ignition and early spread potential associated with human activity around communities and along transportation corridors. Dan Burrows described this as the "Wind-Driven" season. These fires generally occur near communities that require protection of health, safety, and property values. Because dormant grass fuels are flashy, these ratings scale up rapidly as fine fuels dry and winds increase. But they represent only a small portion of the landscape in most of the boreal region.

The Grass rating may be applicable more broadly in the western and northern tundra regions.

Summer-Spruce Calibration

- Buildup Index & Fine Fuel Moisture Code are first factors
- Air Temp
- Fire Weather Index

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	LOW	LOW	LOW	LOW	MODERATE
FFMC 82.0 to 83.9	LOW	LOW	MODERATE	MODERATE	MODERATE
FFMC 84.0 to 85.9	LOW	MODERATE	MODERATE	MODERATE	HIGH
FFMC 86.0 to 88.9	MODERATE	MODERATE	HIGH	HIGH	HIGH
FFMC 89.0 to 89.9	HIGH	HIGH	HIGH	VERY HIGH	VERY HIGH
FFMC 90.0 to 91.9	HIGH	HIGH	VERY HIGH	VERY HIGH	VERY HIGH
FFMC 92.0 to 92.9	HIGH	HIGH	VERY HIGH	VERY HIGH	VERY HIGH
FFMC 93.0+ and Temp < 75.0	HIGH	HIGH	VERY HIGH	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	HIGH	VERY HIGH if FWI is less than 40.0	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 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

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

- Based primarily on *Fine Fuel Moisture Code (FFMC)* for ignition potential and *Initial Spread Index (ISI)* to assess expected fire growth.
- *Fire Weather Index (FWI)* used to evaluate potential for extreme fire events

Where the Information Comes From

Surface Weather Observations

- Surface Weather Observations are obtained from a variety of station networks through Mesowest itself. **RAWS stations** are maintained by fire and resource management agencies. **NWS stations** are found primarily at airports, and are maintained by the Federal Aviation Administration (FAA). **US Array** provides a new network of seismic and weather stations, maintained by the Incorporated Research Institutions for Seismology (iris.edu). Data associated with weather observing locations is stored with a latitude and longitude which allows it to be located in time and space.
- Weather observations for these point locations are captured by sensors at each location. Weather forecasts are obtained from the **National Weather Service (NWS) National Digital Forecast Database (NDFD)** for that particular location.

Analysis and Forecast Grids

- Gridded, or modeled, weather data is related to and calibrated from data associated with weather observing locations mentioned above, but is not directly derived from that data here. Observational (analysis) grids are obtained from the **Real-Time Mesoscale Analysis (RTMA)** and **NWS River Forecast Center (RFC) Quantitative Precipitation Estimate (QPE)**, while the gridded weather forecasts are obtained from the same NWS NDFD forecast mentioned above.

FWI codes and indices are produced for both surface location and gridded data types, though their calculations are completely independant of each other.

Observation and Forecast Timing

Observations at Point Locations

Weather observations for all ACTIVE, STOPPED, and QCSTOPPED stations are collected into the AKFF database for every day of the year.

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 there are three complicating factors. 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).

However, 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 actually 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 below:

Alaska Fire Weather Network
Departure from Local Solar Noon at Daily Observation Time
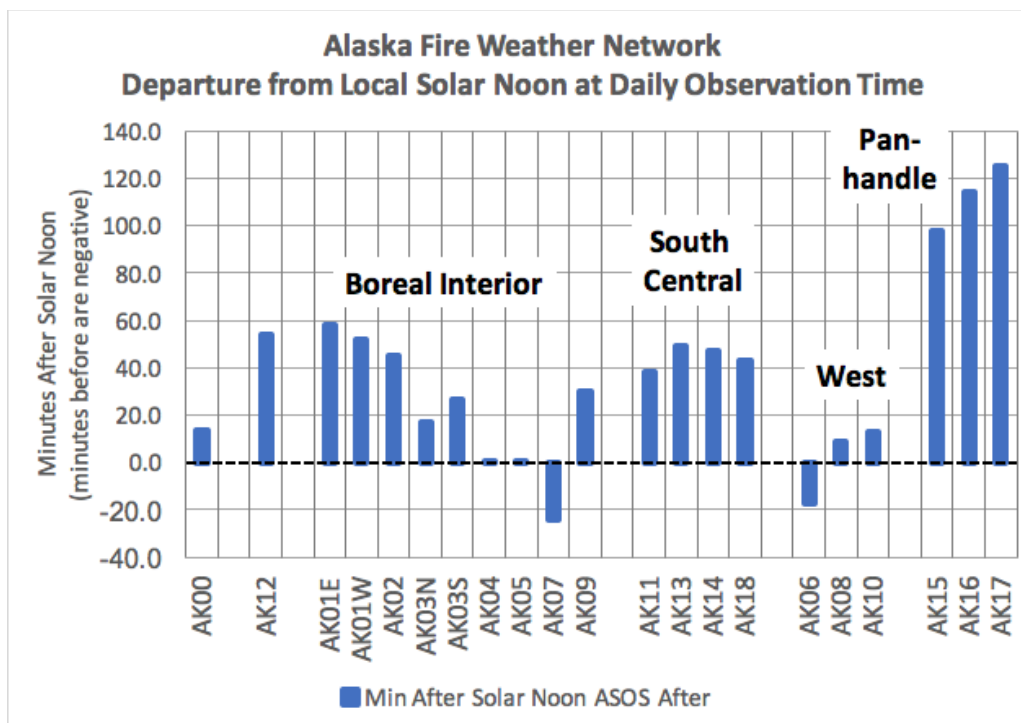
 As seen in the graph, average daily observation time, considering the longitude and reporting time factors, differs from PSA to PSA. Observations for the Boreal Interior and South-Central PSAs, nearest 150˚ West are generally about 40 minutes after solar noon. Western Alaska tundra PSAs are most nearly at solar noon. PSAs on the panhandle have observation times that are approaching 2 hours after solar noon. This is one of the challenges that comes with a single time zone that spans more than 30 degrees of longitude and reaches into 4 geographic times zones in its span.

The Weather Guide also recommends taking daily FWI observations up to 2 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.

Handling missing observation elements

Collection procedures miss observations for a variety of reasons. Communications protocols from stations and interpretation of the digital record sent are both responsible for lost data from time to time. Because FWIs require all 4 variables, in addition to prior day values, there are several procedures in place to recover missing values. In order of priority:

Missing temp/relh/wspd

1. Try again later (unusually high latency)
2. Try the earliest observation in 2300 UTC hour
3. Try the observation stored in the hourly table for 2100 UTC
4. Use the previous day's temperature (a persistence forecast)

Precipitation total will always include a value as the daily total. A zero (0) may mean that no hourly values was collected.

Daily FWI records may be edited using tools provided to system administrators.

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 and also collects the analysis for surface windspeed.

Gridded rainfall estimates, ***Quantitative Precipitation Estimates (QPE)***, are 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 1800 AKDT.

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 days FWI codes and indices, which can them 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. Each update includes surface weather forecasts every 3 hours and, therefore, 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 provide the daily FWI weather forecasts. These weather forecasts are used for gridded FWI calculations and, at the grid locations where the weather stations are found, for the point forecasts as well.

These forecasted daily FWI weather values provide slightly higher temperatures and lower humidity, as well as somewhat higher windspeeds 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 analysis 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.

Licenses, Credits and Acknowledgements

Most of the resources in AKFF do not require attribution, or, like the map, attribution is automatically included in the application itself. However, AKFF does use some resources that require (or appreciate) acknowledgement, and those messages follow here.

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The icon for marking fires on the map:

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