# Exceptional Events Waiver Request

# For Exceptional $PM_{2.5}$ Events between May 28 and June 2, 2010 and July 12 and July 18, 2010 at the State Office Building in Fairbanks, Alaska

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## Introduction

Fairbanks is the second largest city in Alaska. It lies in the Fairbank North Star Borough (FNSB), which covers an area of 7,361 square miles and has a population of approximately 99,200[1.] Fairbanks is situated on the banks of the Chena River in the upper Tanana Valley in the interior region of the state. North of the city are low hills that border the Tanana Valley (Figure 1).

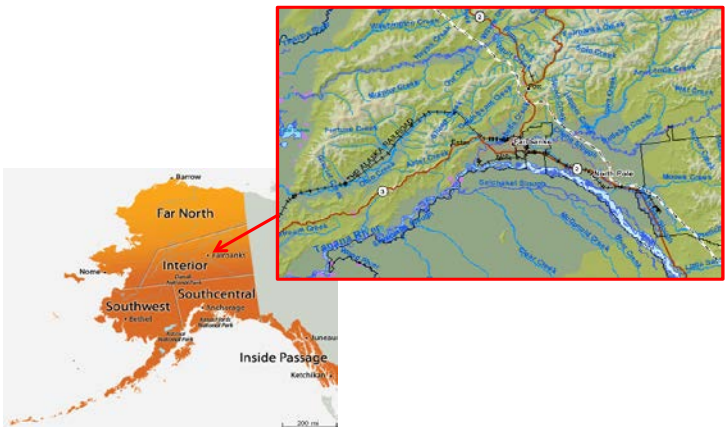



Figure 1: Map of Alaska and inset showing Tana Valley, Fairbanks, and North Pole

Interior Alaska experiences average winter temperatures ranging between -2°F and -19°F and average summer temperatures between 53°F and 72°F. Temperatures have been recorded as low as -78°F in mid-winter, and as high as 93°F in summer. Average annual precipitation is 11.3 inches and ice fog is common during the winter. Fairbanks experiences 21 hours of direct sunlight between May 10 and August 2 each summer, and less than four hours of direct sunlight between November 18 and January 24 each winter.

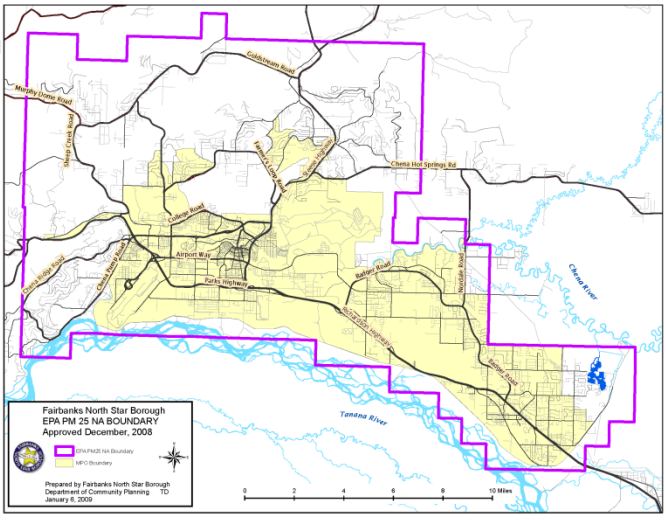



Figure 2: Map of $PM_{2.5}$ non-attainment area in Fairbanks North Star Borough; purple lines indicate boundary

In December of 2009, the Environmental Protection Agency (EPA) designated 244 square miles (3.3%) and with an estimated population of over 85,000 (Figure 2) residents (88%) of the FNSB as a $PM_{2.5}$ non-attainment area. The non-attainment area encompasses the cities of Fairbanks and North Pole. During the summer months (May through September), the main source of elevated $PM_{2.5}$ concentrations is smoke from wildland fires. During the winter months (October through March), local home heating emissions are the dominant $PM_{2.5}$ source[2], to a much greater extent than industrial or mobile source emissions.

During the summer of 2010, specifically on four days in May, June and July 2010, the

[1] http://www.co.fairbanks.ak.us/
[2] http://dec.alaska.gov/air/anpms/comm/fbks1_pm.htm

fine particulate monitor located in downtown Fairbanks recorded elevated concentrations of $PM_{2.5}$ from wildland fire smoke in the interior of Alaska. ADEC has prepared this document as part of its Exceptional Events Waiver Request (EEWR) to exclude these four days of air quality data the 05/29/10, 06/01/10, 07/13/10 and 07/16/10 from regulatory decisions pursuant to section 319(b)(3)(B) of the Clean Air Act.

During the summer wildland fire season in 2010, the Fairbanks North Star Borough operated two separate technologies to measure $PM_{2.5}$ concentrations at the State Office Building (SOB), the Federal Reference Method (FRM) Thermo Electron Partisol 2000 and a semi continuous Met One BAM 1020. The concentrations displayed in Figure 3 are hourly concentrations measured with a Met One BAM 1020. The instrument did not meet the EPA's Federal Equivalent Method criteria, so the data cannot be used for regulatory actions. ADEC and the Fairbanks North Star Borough staff mainly use the BAM 1020 data for issuing air quality advisories. For this analysis, the data from the BAM 1020 are only used for a qualitative discussion of the event and are considered supporting documentation. The FRM sampler collects a 24-hour integrated averaged, while the semi continuous BAM 1020 records hourly averages. The hourly data were correlated to the FRM data for coincident 24 consecutive hours i.e., midnight to midnight local standard time for days when the FRM was operated. During the summer months (multiple years) both instruments showed an excellent correlation, with a correlation coefficient $r^2$ of 98.6 (Appendix C).

The FRM air quality sampler (Partisol 2000) located at the State Office Building (SOB) site, AQS ID 02-090-0010-88101, in downtown Fairbanks and at North Pole elementary school AQS ID 02-090-0033 recorded elevated $PM_{2.5}$ concentrations that were caused by smoke originating from wildland fires in Interior Alaska. Because there were multiple fires and because it is not possible to separate the impacts from individual fire events, ADEC combined the documentation for all four days into one EEWR.

This EEWR follows the steps outlined in the Exceptional Events Rule and includes:

- a brief description of the event,
- evidence supporting the natural origin of the events,
- evidence that the events could not have been reasonably controlled or prevented,
- data showing that the event affected air quality,
- data showing that the $PM_{2.5}$ concentrations exceeded historical fluctuations,
- evidence supporting a clear, causal relationship between the events and air quality impacts, and
- evidence that there would not have been an exceedance(s) but for the events.

## Description of the Event

The first part of the event began in late May 2010 and lasted through early June. In mid July 2010 the smoke again increased and another occurrence of high $PM_{2.5}$ concentrations was recorded. In July, the Toklat fire that caused the high concentrations in May/Jun, now renamed the Toklat2 fire, flared up and increased in size. In addition, the newly ignited Willow Creek fire located just south-west of Fairbanks, contributed to the increased smoke. The Clear Causal section provides a detailed fire, meteorology and smoke description. Samples collected by FNSB staff from the Federal Reference Method (FRM) monitor every three days according to EPA's national monitoring schedule document the impacts to the area caused by the event. The FRM at the State Office Building (SOB) and North Pole Elementary School (NPES) sites in downtown Fairbanks and North Pole area collected samples that had elevated $PM_{2.5}$ concentrations on four of 17 sample days beginning May 28, 2010 and ending July 16, 2010. Table 1 lists the four dates and the $PM_{2.5}$ concentrations from those dates.

Table 1: 24-hour $PM_{2.5}$ concentrations FRM in $\mu g/m^3$ at the Fairbanks SOB and NPES site

| Date | $PM_{2.5}$ concentration | |
|---|---|---|
| | SOB | NPES |
| 05/29/2010 | 21.8 | 13.4 |
| 06/01/2010 | 23.4 | 23.9 |
| 07/13/2010 | 44.5 | 22.7 |
| 07/16/2010 | 21.3 | 2.6 |
| Exceedances indicated in bold font. | | |

While not all four 24-hour concentrations exceeded the 24-hour of National Ambient Air Quality Standard (NAAQS), all were at least twice as high as levels typical of times with no wildland fire smoke. During non-wildfire summer months in the Fairbanks area, the maximum 24 hour average $PM_{2.5}$ concentrations range between 3 and 6 $\mu g/m^3$ [3]. Figure 3 24-hr summer $PM_{2.5}$ shows the two spikes in $PM_{2.5}$ associated with the fires in late May/early Jun and again in July.

ADEC flagged all concentrations above 15 $\mu g/m^3$ during this period. Some of the fires impacting the interior of Alaska ignited at the beginning of May and continued to burn throughout the entire period. Because smoke from multiple fires caused the elevated $PM_{2.5}$ concentrations, ADEC decided to treat all the days listed in Table 1 as one event. Daily $PM_{2.5}$ concentrations varied with meteorological conditions and fire growth or suppression. Wind direction and the proximity of the relatively small (13,766 acres) Willow Creek fire were the most important components. Although the $PM_{2.5}$ concentrations varied, the cause of the elevated $PM_{2.5}$ levels

[3] For more background information see the EEWR for 2009 (sections: The Event Was Natural & $PM_{2.5}$ Concentrations Exceeded Historical Fluctuations)
http://www.dec.state.ak.us/air/am/am_projects.htm

throughout the entire period was wildland fire smoke. See the Clear Casual Relationship section for a detailed breakout of fire area, smoke ($PM_{2.5}$) activity.

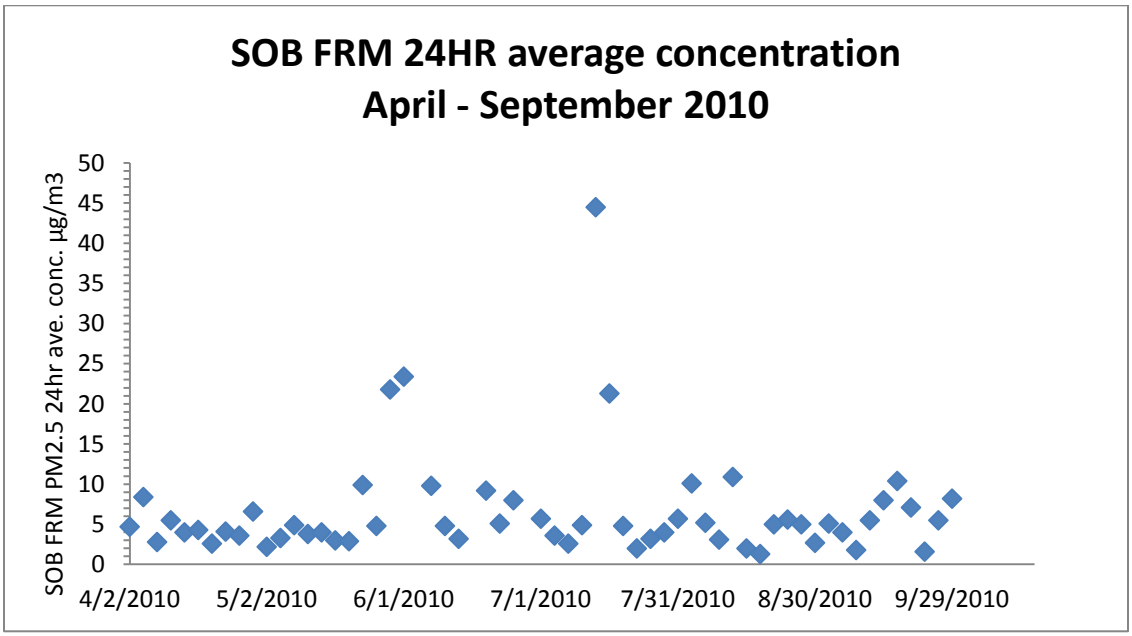



Figure 3: State Office Building (SOB) 24-hr $PM_{2.5}$ April through September 2010

During the summer wildland fire season in 2010, the Fairbanks North Star Borough operated three separate technologies to measure $PM_{2.5}$ concentrations, the Federal Reference Method (FRM) Thermo Electron Partisol 2000 (one at SOB site and one at NPSE site), a semi continuous Met One BAM 1020 (SOB site) and semi continuous TEOM (NPES site) on two sites the State Office Building and North Pole Elementary School site (NPES). Two separate technologies measured $PM_{2.5}$ concentrations at the NPSE, the Federal Reference Method (FRM) Thermo Electron Partisol 2000 and a semi continuous TEOM, the instrument did not meet the EPA's Federal Equivalent Method criteria, so the data cannot be used for regulatory actions. Two separate technologies measured $PM_{2.5}$ concentrations at the SOB site, the Federal Reference Method (FRM) Thermo Electron Partisol 2000 and a semi continuous Met One BAM 1020. The concentrations displayed in Table 1 are hourly concentrations measured with a Met One BAM 1020 at the SOB site. The instrument did not meet the EPA's Federal Equivalent Method criteria, so the data cannot be used for regulatory actions. ADEC and the Fairbanks North Star Borough staff mainly use the BAM 1020 data for issuing air quality advisories. For this analysis, the data from the BAM 1020 are only used for a qualitative discussion of the event and are considered supporting documentation. The FRM sampler collects a 24-hour integrated averaged, while the semi continuous BAM 1020 records hourly averages. The hourly data were correlated to the FRM data for coincident 24 consecutive hours i.e., midnight to midnight local standard time for days when the FRM was operated. During the summer months both instruments showed an excellent correlation, with a correlation coefficient $r^2$ of 98.6 (Appendix C3).

# 2010 Fire Season Weather Summary

**(The entire section of 2010 Fire Season Weather Summary is quoted from Alaska Fire Service)**

Summary

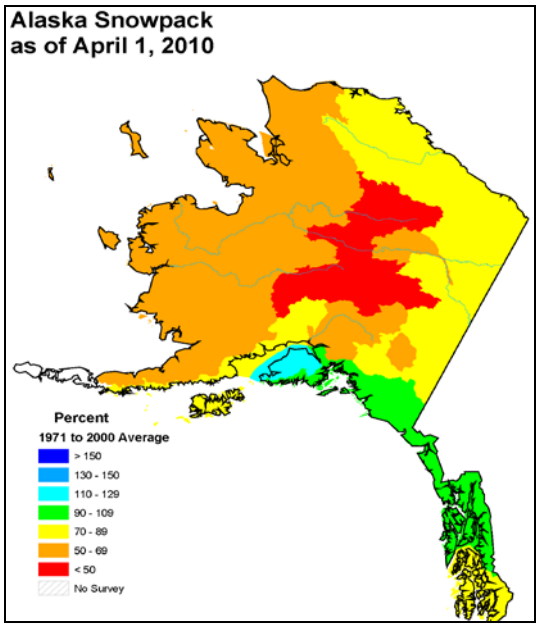
The 2010 fire season was at the mercy of extremely variable weather conditions. April saw the season off to an early start with warm, dry weather, drought conditions from the previous fall, and snowmelt occurring at least a week earlier than normal across much of the Interior. May was hot and dry, with a lightning surge at the end of the month which quickly ramped up fire activity. June cooled off and saw some rain across much of the state, forcing the activity to the north and west by the end of the month. July's widespread rains brought flooding to the eastern Interior and moderated most fires statewide. Fire activity gradually became confined to the Yukon Flats, where big swings in the August weather, and a couple of warm weeks in the middle of September, kept fuels burning sporadically through freeze-up.

Season Forecast

The forecast for the 2010 fire season was to be off to a busy start in the Interior, but settle into a normal pattern during June, leading to an overall "normal" year. The forecast was driven by the subsurface drought conditions and light snowpack, but tempered with the fact that the ENSO phase was to turn to that of La Nina over the summer. Indeed, this is the trend that occurred, and the 1.12 million acres burned falls on the high side of the normal category.

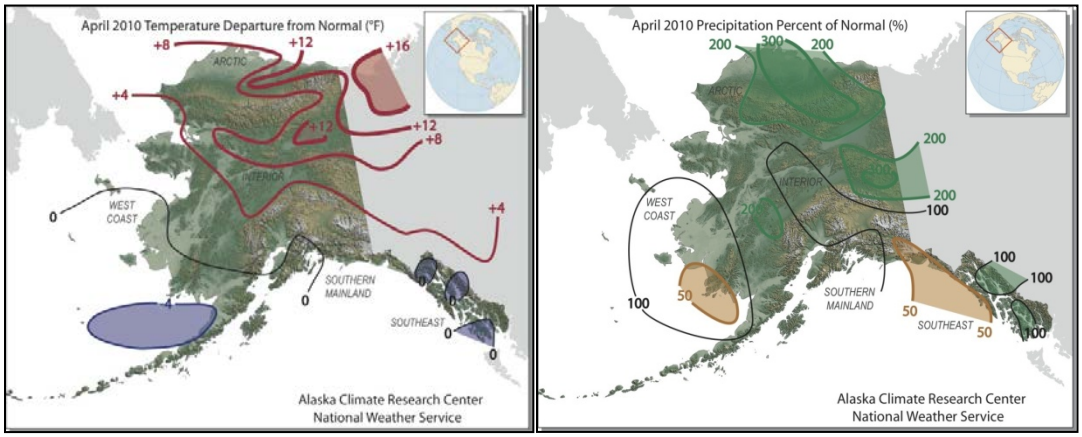
Spring Snowpack

The winter of 2009-2010 was notable for its lack of snow in the Interior. Snow survey sites indicated 50 - 70% of the average snowpack across the western third of the state, 70 - 90 % across the northern and eastern third, and less than 50% in the central Interior. Although winter snowpack is not directly related to the severity of the following fire season, it does affect initial conditions in the spring. The dry winter was followed by a very warm spring, with dry conditions compounding the situation south of the Alaska Range. April's snow melt was at least a week earlier than normal across the state. These factors combined for an early, busy start to fire season in Alaska. Holdover fires particularly on the Tanana Flats and north of Denali National Park showed the high fire potential that was out there.



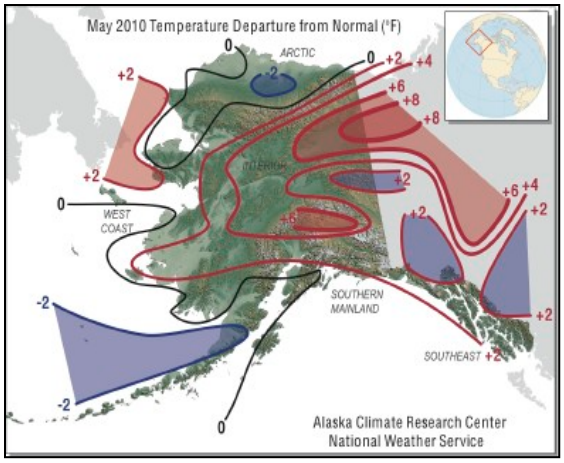
April

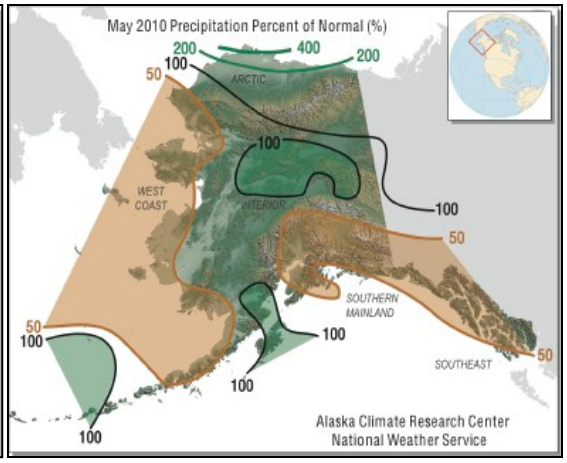
April was quite warm, with temperatures in Fairbanks hitting high temperatures nearly 20 degrees above normal for several days mid-month; a record high for April 19th was set at 66 F. All of the month's precipitation fell as rain in Fairbanks, leaving the snowpack without a trace of the normal 3.4 inch contribution for that month. Across South Central, conditions were quite different. Though Anchorage temperatures were near normal, the 14 inches of snow more than doubled their expected average snowfall for the month. Temperatures in the Yukon Flats averaged as much as 12 degrees above normal.




May

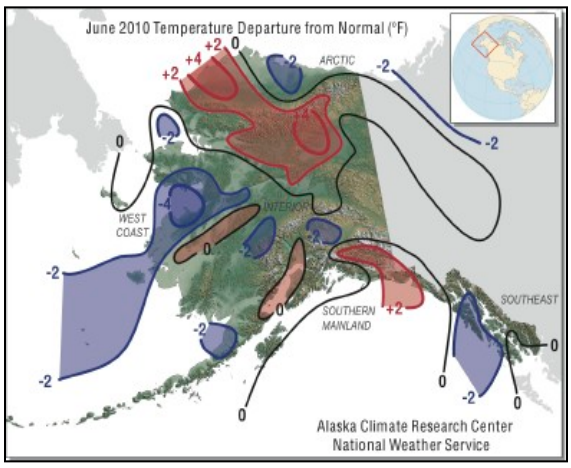
May continued unseasonably warm weather in the Interior; Fairbanks had the 3rd warmest May on record. May 26th and 27th in Fairbanks set new high temperature records of 80 and 82 F. McGrath set new high temperature records for four consecutive days from May 27th - 30th, all around 80 F. Record highs stretched down to South Central, where Cordova (May 28th) and Anchorage (May 29th) hit record highs of 76 and 75 F. Into the Upper Yukon River Valley average temperatures were again warm at 6 to 8 degrees above normal. Simultaneously, precipitation amounts statewide were on the light side, with the largest deficit across South Central and the Panhandle, with less than 50% of May's average rainfall. The last week of May also brought the first widespread lightning activity. Though there was precipitation with the lightning, the ground was dry enough for many new starts over the span of a week, mainly in the northeast McGrath Area and southern Tanana Zone. Some of these fires were short lived, but several lasted into August.

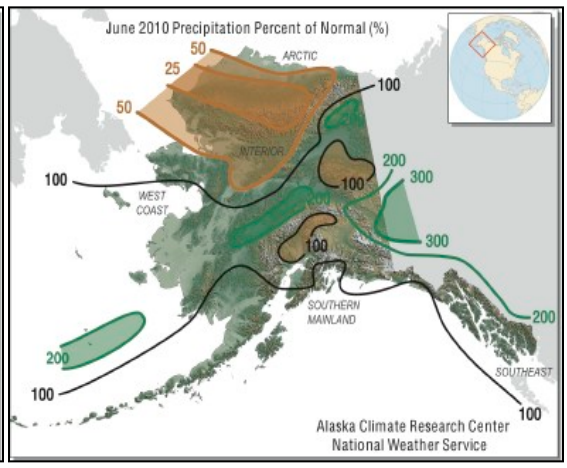



June

June was distinctive as being very near normal through most of the state with temperatures and precipitation fairly close to the long term averages. Around the middle of the month and again at the end, moderate to heavy rains fell across the eastern Interior. Meanwhile, in the northwest, conditions dried out and warmed up, with most of that region receiving less than 50% of its normal precipitation. Nome's daily temperatures averaged about 3 degrees above normal. It was around the 24th of June that lightning activity increased to the west, and fire activity spiked in the Galena zone, and stayed high for the next two weeks. The area around the Noatak and Kobuk Rivers was the focus of most of the activity.

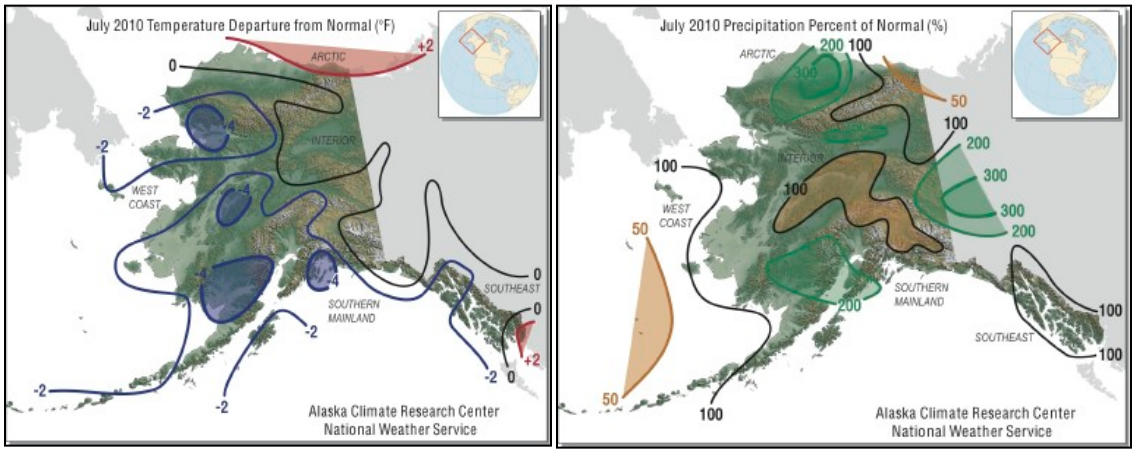



July

July was considerably cooler and wetter in the eastern Interior, where copious amounts of precipitation caused catastrophic washouts along the Taylor Highway around July 12th. This was only the beginning of a long rainy stretch for that area; Eagle received over 4 inches of rain in a 20-day period, more than doubling their normal July precipitation. Even as far west as Fairbanks and Anchorage, rainfall amounts were nearly 180% of normal. In contrast, the northwestern part

of the state remained hot and dry, allowing fire activity to continue. Temperatures in the Noatak and Kobuk River Valleys maxed out in the mid 80s about this time.[4]

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[4] The entire section of 2010 Fire Season Weather Summary is quoted from Alaska Fire Service http://fire.ak.blm.gov/predsvcs/weather.php

## The Event was Natural

Wildfires are a common occurrence in Alaska where, on average, 932,823 acres burn annually. More than 90% of the area consumed lies in Interior Alaska, where the summers are relatively warm and dry and where wildfires ignited by lightning periodically burn the spruce, birch, and cottonwood dominated forests. Summers with above normal temperatures generate more convection, resulting in more thunderstorm development and more lightning strikes. (G.Wendler, et al., Climatology of Alaskan wildfires with special emphasis on the extreme year 2004, Springer-Verlag 2010).

The Alaska Fire Service determines the cause of each fire at the time the fire occurs and Alaska Interagency Coordination Center (AICC) May was hot and dry, with a lightning surge at the end of the month which quickly ramped up fire activity. June cooled off and saw some rain across much of the state, forcing the activity to the north and west by the end of the month. (2010 Fire Season Weather Summary, http://fire.ak.blm.gov/predsvcs/weather.php ).

During the summer of 2010 there were 686 wildfires burning a total of 1,125,499 acres[5]. The acreage burned was the fifth highest of the past 10 years. The fire season began at the end of March, with the majority of reported fires occurring May, June, and July in the northern half of the state. In 2010, there were also 21 prescribed fires conducted, burning a total of 22,136 acres. Most prescribed burns occurred in May 2010 and were conducted by/for the military. (2010 Alaska wildfire Emissions Inventory, BLM) (Figure 4, Figure 5)

[5] There is a difference in the number of fires and the total acreage between the Emissions Inventory and the AICC 2010 Annual Report. EI = 686 fires and 1,125,499 acres, AICC = 688 fires and 1,125,419 acres. This difference is not significant to this Exceptional Event Request.

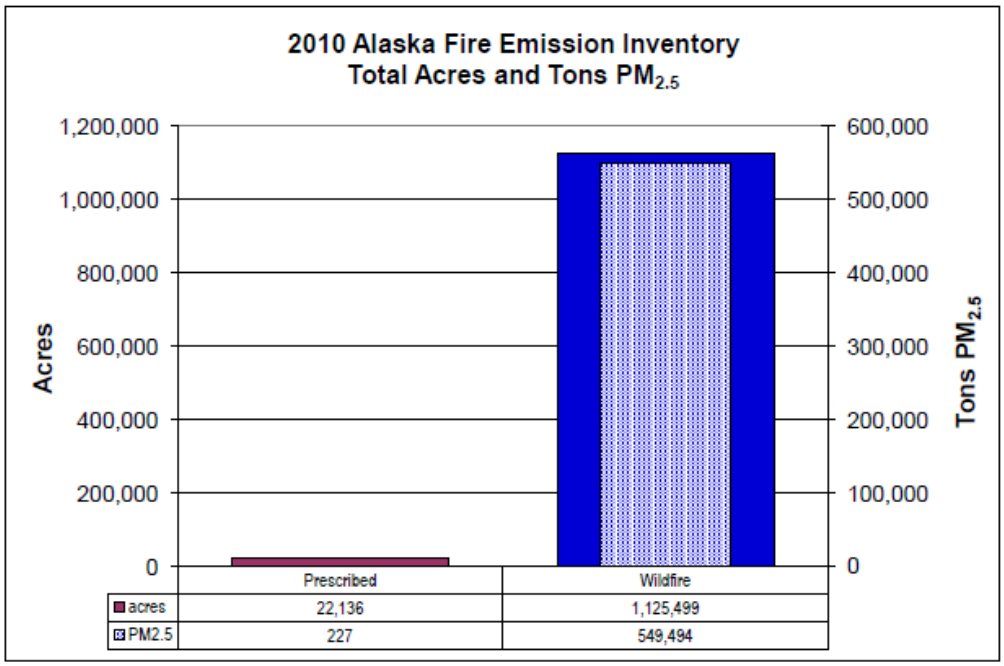



Figure 4: The number of acres burned and the tons of $PM_{2.5}$ produced for both fire types (prescribed and wildfire) during the 2010 season. (2010 Alaska wildfire Emissions Inventory, BLM)

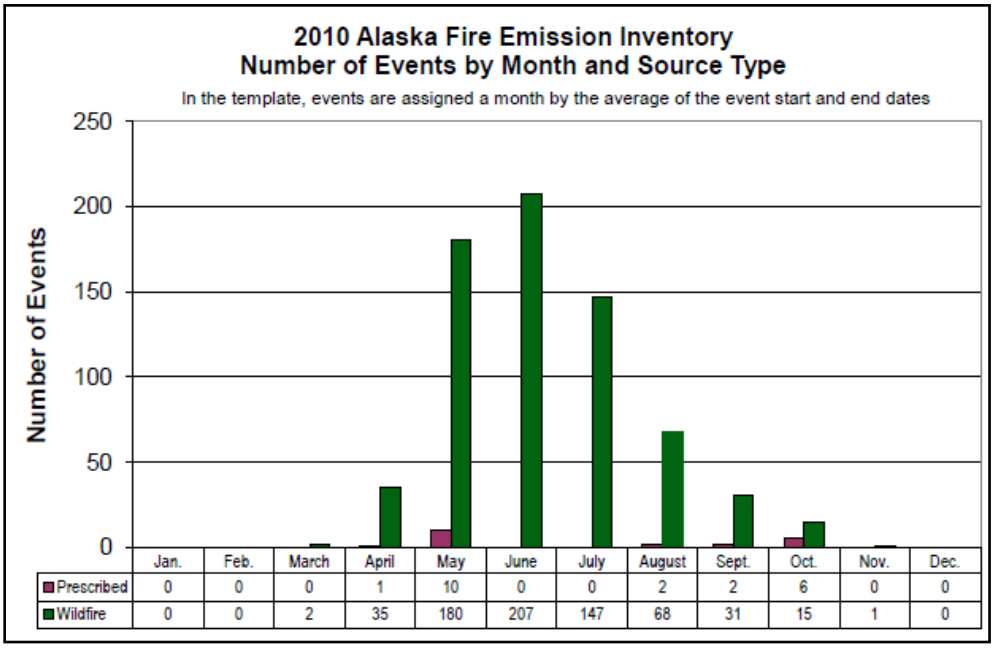



Figure 5: The total number of wildfires in 2010, by month and type of fire, prescribed or wildfire (2010 Alaska wildfire Emissions Inventory, BLM).

Table 2: Data from 2010 Alaska Wildfire Emissions Inventory

| Year | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|
| Prescribed Burns (acres) | 626 | 9,110 | 21,761 | 4,081 | 3,740 | 22,136 |
| Prescribed Burns ($PM_{2.5}$ tonnage removed) | 231 | 200 | 8,230 | 454 | 172 | 227 |
| Wildfires (acres) | 4,663,802 | 260,142 | 649,415 | 103,649 | 2,951,598 | 1,125,499 |
| Wildfires ($PM_{2.5}$ tonnage removed) | 2,018,884 | 93,449 | 261,660 | 62,876 | 1,597,149 | 549,494 |

The Wildfire Emissions Inventory (ADEC, 2011) documents that most prescribed fire occurred in May 2010 and were conducted by / for the military (Table 2).

Table 3: Multi Year Average Fire Information

| | 1999-2008 | | 2000 - 2009 | | 2010 | |
|---|---|---|---|---|---|---|
| | # fires | acres | # fires | acres | # fires | acres |
| 5-year average | 512 | 2,451,813 | 476 | 1,724,101 | | |
| 10-year average | 462 | 1,702,277 | 467 | 1,896,894 | | |
| annual | | | | | 686 | 1,125,499 |

## The Event was not Reasonably Controllable or Preventable

The events described above were not reasonably controllable or preventable by the State for several reasons. First, authority over fire protection areas is split into three major jurisdictions (Figure 6, Table 4), so that smoke from fires outside the state's jurisdiction can impact state lands. Second, the events were caused by meteorological conditions (dry weather, high fuel load, lightning strikes as described above in the 2010 Fire Season Summary from the Alaska Fire Service) over which the State has no reasonable control.

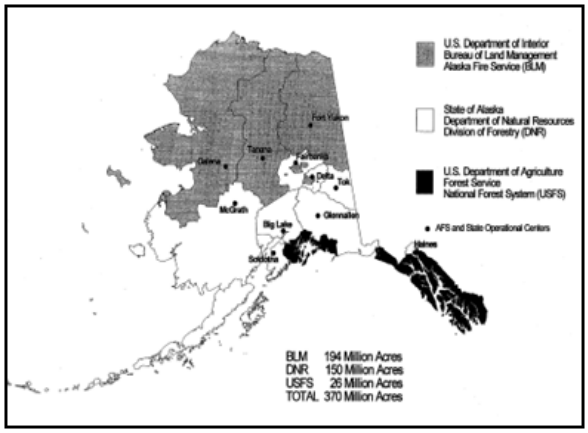



Figure 6: Alaska Wildland Fire Protection Areas

**Statewide**
**Fires and Acres Burned by Protection Agency and Management Option**

| Agency | | Critical | Full | Modified | Limited | Total |
|---|---|---|---|---|---|---|
| Alaska Fire Service | fires | 8 | 56 | 80 | 184 | 328 |
| | acres | 428.9 | 273,660.0 | 117,663.3 | 464,836.2 | 856,588.4 |
| State of Alaska | fires | 224 | 59 | 13 | 34 | 330 |
| | acres | 18,053.6 | 22,448.0 | 23,239.8 | 205,077.0 | 268,818.4 |
| U.S. Forest Service | fires | 17 | 4 | 1 | 8 | 30 |
| | acres | 9.9 | 1.0 | 0.1 | 1.2 | 12.2 |
| Total Fires | | 249 | 119 | 94 | 226 | 688 |
| Total Acres | | 18,492.4 | 296,109.0 | 140,903.2 | 669,914.4 | 1,125,419.0 |

Table 4: Fire statistics by protection agency and management option in 2010 (See footnote 3)

The two major natural precursors to an extensive fire season in Alaska are some sort of natural ignition source and dry meteorological conditions. As pointed out the in section above, the large number of cloud-to-ground lightning strikes was the ignition source; and lightning cannot be reasonably controlled or prevented. Neither can the second precursor, dry meteorological conditions, be reasonably controlled or prevented. The winter of 2009-2010 was notable for its lack of snow in the Interior. Snow survey sites indicated 50 - 70% of the average snowpack across the western third of the state, 70 - 90 % across the northern and eastern third, and less than 50% in the central Interior. Although winter snowpack is not directly related to the severity of the following fire season, it does affect initial conditions in the spring. The dry winter was followed by a very warm spring, with dry conditions compounding the situation south of the Alaska Range. April's snow melt was at least a week earlier than normal across the state. These factors combined for an early, busy start to the fire season in Alaska. Holdover[6] fires particularly on the Tanana Flats and north of Denali National Park showed the high fire potential that was out there. The average daily maximum temperature set a new record high for the months of April and May in Fairbanks.

[6] Definition: A fire that remains dormant for a day or two before flaring up. Dry lightning storms often cause holdover fires. www.erh.noaa.gov/gyx/firewx_definitions.html. In 2010 there were two fires that started the year before.

**State of Alaska Protection**
**Fires and Acres Burned by Region/Area and Management Option**

| Area | | Critical | Full | Modified | Limited | Totals |
|---|---|---|---|---|---|---|
| **Northern Region** | | | | | | |
| Copper River | fires | 7 | 3 | 0 | 2 | 12 |
| | acres | 2.9 | 0.3 | 0.0 | 0.6 | 3.8 |
| Delta | fires | 28 | 6 | 1 | 2 | 37 |
| | acres | 31.9 | 21,901.6 | 0.4 | 5,379.0 | 27,312.9 |
| Fairbanks | fires | 72 | 22 | 4 | 11 | 109 |
| | acres | 38.5 | 509.4 | 2,232.8 | 8,675.8 | 11,456.5 |
| Tok | fires | 11 | 2 | 2 | 1 | 16 |
| | acres | 17,935.0 | 1.8 | 14.6 | 0.5 | 17,951.9 |
| **Southern Region** | | | | | | |
| Anchorage-Matsu | fires | 77 | 11 | 1 | 0 | 89 |
| | acres | 35.5 | 9.5 | 1,692.7 | 0.0 | 1,737.7 |
| Kenai-Kodiak | fires | 27 | 5 | 0 | 1 | 33 |
| | acres | 7.7 | 4.3 | 0.0 | 65.0 | 77.0 |
| Southwest | fires | 1 | 8 | 5 | 17 | 31 |
| | acres | 2.0 | 19.5 | 19,299.3 | 190,956.1 | 210,276.9 |
| Haines | fires | 1 | 2 | 0 | 0 | 3 |
| | acres | 0.1 | 1.6 | 0.0 | 0.0 | 1.7 |
| **Total Fires** | | 224 | 59 | 13 | 34 | 330 |
| **Total Acres Burned** | | 18,053.6 | 22,448.0 | 23,239.8 | 205,077.0 | 268,818.4 |

Figure 7: Fires and Acres Burned by Region / Area and Management Option in 2010 (2010 Alaska Fire Statistics, BLM)

The very dry conditions, the large number of ignition sources (lightning) and the remoteness of Alaska make it nearly impossible to control these fires. Because of the remoteness and inaccessibility of most areas in Alaska, fire fighting is very expensive and time consuming and fires are often monitored only (NOA, Critical Weather patterns of US, 1999). In fact, many of these fires cannot be controlled or extinguished by human intervention and are only extinguished with the onset of wet weather.

The State, the federal land management agencies, and Alaskan tribes developed an interagency plan, the Alaska Interagency Wildland Fire Management Plan (AIWFMP), to address controlling wildland fires. The AIWFMP requires an annual, pre-season land manager(s)/owner(s) review of the fire protection needs on lands under their management authority. Once fire protection needs are determined, the lands are placed in the Critical, Full, Modified, or Limited management option. Option selections are based on land manager/owner(s) values to be protected as well as land and resource management objectives.

The fire management strategies selected vary from initial attack and sustained suppression efforts in the critical and full management areas to surveillance in the limited management areas. This categorization and ensuing prioritization ensures that: (1) human life, private property, and identified resources receive an appropriate level of protection with available firefighting resources, (2) the cost of the suppression effort is commensurate with values identified for protection, and (3) the ability of land manager(s)/owner(s) to achieve their individual management objectives is optimized.

The AIWFMP also stresses that lightning-caused wildland fires are an important component of the boreal forest and arctic tundra ecosystems, and the complete exclusion of these fires is neither ecologically sound nor economically feasible. The natural role of fire in the environment must be tempered by the need to protect human life and health, private property, developments, and certain valued natural and cultural resources.

During the fire season, availability of suppression resources may become limited due to commitments to numerous initial attack assignments and/or large fires. The pre-fire season assignment of management options establishes priorities for allocation of suppression forces and substantially improves the cost-effectiveness of wildland fire management.

A large portion of the state has been declared as Modified or Limited Maintenance. The Modified management option is intended to be the most flexible option available to land managers/owners. The intent of the Modified management option is to provide a higher level of protection when fire danger is high, probability of significant fire growth is high, and probability of containment is low. A lower level of protection is provided when fire danger decreases, potential for fire growth decreases, and the probability of containment increases. This option should reduce commitment of suppression resources when risks are low. This option also provides increased flexibility in the selection of suppression strategies when risks are high. The Modified option provides a management level between Full and Limited. Unlike Full management areas, the intent is not to minimize burned acres, but to balance acres burned with suppression costs and to accomplish land and resource management objectives.

The Limited management option allows for even less active fire intervention. This category recognizes areas where the cost of suppression may exceed the value of the resources to be protected, the environmental impacts of fire suppression activities may have more negative impacts on the resources than the effects of the fire, or the exclusion of fire may be detrimental to the fire-dependent ecosystem. The Limited management option reduces both long-term suppression risks and costs by reducing the frequency of large fires that may burn out of boundaries of Limited management regardless of the suppression effort. It also reduces current suppression costs and makes suppression goals more attainable in years of drought and intense fire activity. The Limited management option may also be chosen for areas where fire occurrence is essential to the biodiversity of the resources protected and the long-term ecological health of the land. Suppression actions may be initiated to keep a fire within the boundary of the management option or to protect identified higher value areas/sites. Site-specific areas that warrant higher levels of protection may occur within Limited management areas. Appropriate

suppression actions to protect these sites will be taken when warranted, without compromising the intent of the Limited management area.

ADEC has implemented the following mitigation strategies to prevent fires and protect public health. Prior to the fire season, mitigation is carried out in accordance with the Alaska Enhanced Smoke Management Plan (ESMP) and ADEC 18 AAC 50, Air Quality Control. ADEC provides a clear and equitable regulatory basis for smoke management in Alaska through the ESMP. ADEC is responsible for reviewing controlled burns for resource management, for reviewing and approving land clearing applications, and for issuing controlled burn approvals. ADEC also ensures that controlled burn applications comply with state air quality regulations (18 AAC 50.065) and ESMP guidelines. While reduction of fuel loads is an important control factor, the ESMP clearly states:"Evaluating potential dispersion of smoke emissions from a project is the single most important component of an effective ESMP." All controlled burns for resource management or land clearing that are greater than 40 acres in one year must have an approved burn permit. Further, the permit states that the Responsible Authority must notify ADEC at least 24 hours in advance, obtain a favorable dispersion forecast from the National Weather Service, and approval from the ADEC meteorologist. The ADEC meteorologist is responsible for ensuring air quality standards are not violated during controlled burns. While these controlled burns reduce the fire fuels load, they cannot entirely eliminate the risk.

ADEC issues Air Quality Advisories in accordance with ADEC 18 AAC 50, Air Quality Control guidance to further protect public health during periods of poor air quality. The ADEC meteorologist issued 5 advisories related to wildland fire smoke between May 28th and August 19, 2010. ADEC issued 2 of these 5 advisories for the Central Interior which includes Fairbanks. All other advisories were issued for the Yukon Flats and Upland areas which are northeast of Fairbanks. (Appendix B)

## The Event Affected Air Quality

The $PM_{2.5}$ 24-hour concentrations measured at the Fairbanks SOB site reflect the unusual fire conditions during the event. Table 5 lists the 24-hour $PM_{2.5}$ concentrations of samples collected by the FRM quality monitor from May through August; 2010.The $PM_{2.5}$ concentrations were significantly higher than the normal average of 3 to 6µg/$m^3$ for summer days without wildland fire smoke. The concentrations (as measured by the FRM) exceeded the 24-hour NAAQS once on July 13th, 2010 at the Fairbanks SOB site. Three days had 24-hour averaged concentrations above 15µg/$m^3$ but below the NAAQS. During the month of May through July the $PM_{2.5}$ concentration was fluctuating from higher than average to exceedance (21.3-44.5 µg/$m^3$), with the highest value of 44.5 µg/$m^3$, occurred on July 13, 2010 (Table 5).

Table 5: Fairbanks SOB site 24-hour $PM_{2.5}$ concentrations
Red font indicates an exceedance of the NAAQS, bold font indicates additional high values flagged by ADEC.

| Date | $PM_{2.5}$ concentration [µg/$m^3$] | Date | $PM_{2.5}$ concentration [µg/$m^3$] |
|---|---|---|---|
| May, 2010 | | June, 2010 | |
| 02 | 2.2 | 01 | 23.4 |
| 05 | 3.3 | 04 | No data |
| 08 | 4.9 | 07 | 9.8 |
| 11 | 3.8 | 10 | 4.8 |
| 14 | 4 | 13 | 3.2 |
| 17 | 3 | 19 | 9.2 |
| 20 | 2.9 | 22 | 5.1 |
| 23 | 9.9 | 25 | 8 |
| 26 | 4.8 | | |
| 29 | 21.8 | | |
| July, 2010 | | August , 2010 | |
| 01 | 5.7 | 03 | 10.1 |
| 04 | 3.6 | 06 | 5.2 |
| 07 | 2.6 | 09 | 3.1 |
| 10 | 4.9 | 12 | 10.9 |
| 13 | 44.5 | 15 | 2 |
| 16 | 21.3 | 18 | 1.3 |
| 19 | 4.8 | 21 | 5 |
| 22 | 2 | 24 | 5.6 |
| 25 | 3.2 | 27 | 5 |
| 28 | 4 | 30 | 2.7 |
| 31 | 5.7 | | |

Figure 8: Toklat/ Toklat 2 fire, located east of the Kantishna River in a limited management option area

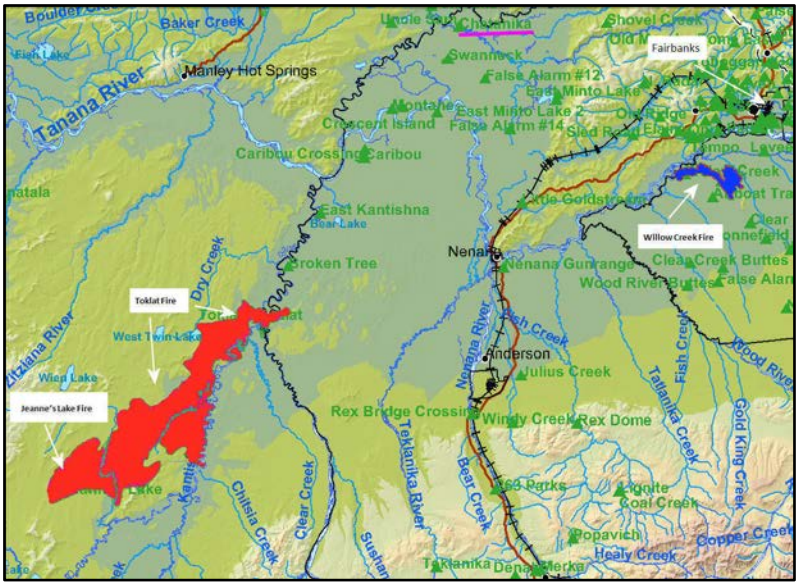



Figure 9: Fires in relation to Fairbanks. Willow Creek Fire is 8-13 miles and Toklat Fire is 75 miles at the northern end from Fairbanks.

## $PM_{2.5}$ Concentrations Exceeded Historical Fluctuations (HF)

The forecast for the 2010 fire season was to be off to a busy start in the Interior, but settle into a normal pattern during June, leading to an overall "normal" year. The forecast was driven by the subsurface drought conditions and light snowpack, but tempered with the fact that the ENSO phase was to turn to that of La Nina over the summer. Indeed, this is the trend that occurred, and the 1.12 million acres burned falls on the high side of the normal category (Figure 10).

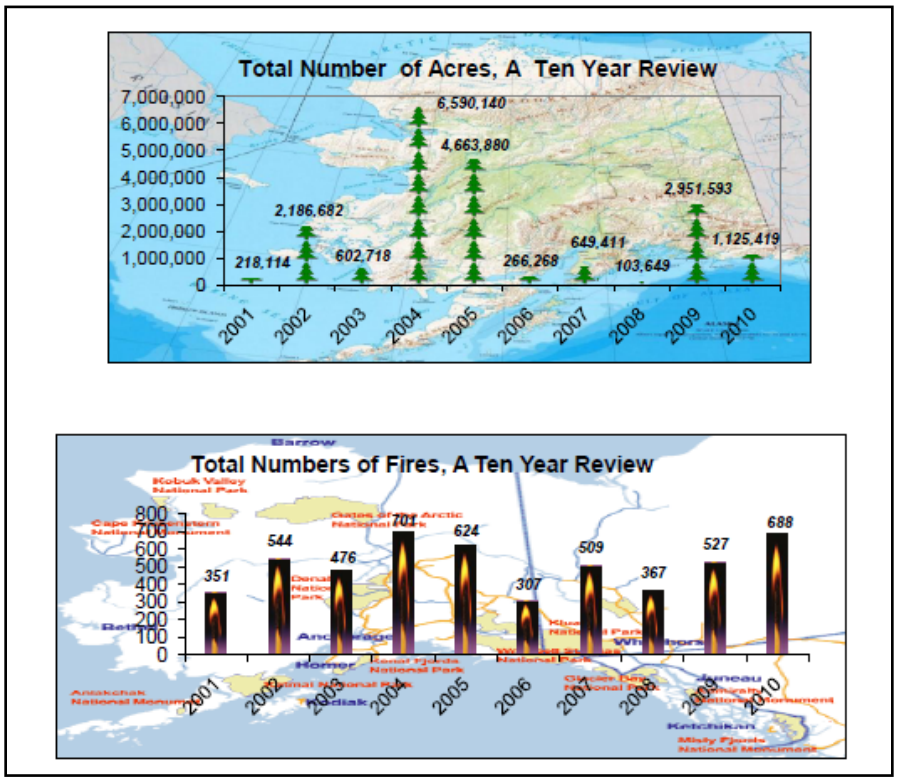



Figure 10: Acreage burned and number of wildland fires in 2001 -2010. (2010 Alaska Fire Statistics, BLM)

Although wildland fires occurred in the summer of 2010, the average summer Partisol 2000 (FRM) $PM_{2.5}$ levels measured at the SOB site in Fairbanks were not significantly high (7.2µg/$m^3$) in comparison to average concentrations during the low fire years of 2001 (6.0 µg/$m^3$) and 2008 (3.2 µg/$m^3$) (Table 6). The is because the increase in $PM_{2.5}$ concentrations from the fire smoke were not extremely high on a 24-hr basis and did not last for a long period of days.

Table 6: Average $PM_{2.5}$ concentration from June-September for select years

| Year | Average $PM_{2.5}$ concentration June-September ($\mu g/m^3$) |
|---|---|
| 2001 | 6.0 |
| 2008 | 3.2 |
| 2010 | 7.2 |

Wildfires occur in Alaska every year, primarily between June and September. The number of wildfires and the area burned each year vary due to meteorological conditions and locations of fires. Wildfires are at a minimum during years of wet meteorological conditions and can be quite extensive in years with dry to exceptionally dry conditions. Long periods of dry conditions in May and June set the system in motion by allowing extensive areas of wild lands to accumulate fire fuels. The high fuel loads and dry conditions lead to wildfires when a weather front approaches the interior and numerous lightning strikes occur.

Wildland fires are a recurring event in Interior Alaska. In the last 11 years the average acreage burned by wildfire in Alaska is 1,673,406 acres each year. However, the annually acreage burnt can vary greatly, from as low as 43,965 in 1995 to 6,523,816 in 2004 (Table 7).

Table 7: Wildfire History of Alaska 2000 – 2010, The last 11 years of fire data from the 'Alaska Fire Season 2010 Wildland Fire Summary and Statistics Annual'[7]

| Year | Acres burned | # Fires |
|---|---|---|
| 2000 | 756,296 | 369 |
| 2001 | 218,113 | 351 |
| 2002 | 2,186,682 | 544 |
| 2003 | 602,146 | 465 |
| 2004 | 6,523,816 | 696 |
| 2005 | 4,649,597 | 624 |
| 2006 | 270,539 | 305 |
| 2007 | 649,411 | 506 |
| 2008 | 103,299 | 368 |
| 2009 | 2,951,592 | 527 |
| 2010 | 1,125,419 | 688 |

The fire season started early in the year of 2010. A comparison of weather early in the season for a low fire season (2001) and 2010 indicates why conditions were favorable for fires early in 2010. The monthly summaries below indicate that late May and early June were the driest and

[7] Wildland Fire Summary and Statistics Annual Report – AICC , Alaska Fire Season 2010

warmest part of the year and coincides with the largest fire, the Toklat fire, and most numerous fires of the year. The monthly climate summaries below are from the Geophysical Institute in Fairbanks.[8]

The low fire year of 2001 was a cool wet year. According the May 2001 Climate Summary from the University of Fairbanks Geophysical Institute, "Fairbanks experienced cooler temperatures with normal precipitation in May. The average temperature of 44.5°F is 4.1°F below normal. Although no record temperatures were set, the maximum for the month was 67°F (27th) and the minimum was 20°F (3rd). Total precipitation of 0.62 inch (water equivalent) is just 2 percent above normal. However, snowfall totaled 7.0 inches, which is 6.3 inches above normal with daily snowfall records set on the 4th (3.2 inches) and 5th (2.9 inches), respectively.

May of 2010 was very different than the low fire year of 2001, especially the warm temperatures near the end of the month. The May 2010 Climate Summary from the University of Fairbanks Geophysical Institute states: "The average temperature for the month in Fairbanks was 54°F, which is 5.2°F above the mean, the third warmest May on record. The high temperature was 82°F on the 27th, and the low was 29°F on the 6th. Only 0.24" of precipitation was recorded, which is 40% below normal for the month. A small storm front blew through the area on the 5th, dropping a trace of snow that disappeared by the 6th. Winds averaged 4.6 mph and the highest gust was 29 mph on the 18th".

June 2010 continued the warm temperatures during the early part of the month with the highest monthly temperature on the 2nd. The June 2010 Climate Summary from the University of Fairbanks Geophysical Institute states: "The average temperature for the month in Fairbanks was 59.8°F, which is close to the normal average temperature of 60.3°F. The high temperature was 79°F on the 2nd, and the low was 46°F on the 14th. A total of 1.35" of precipitation was recorded, which is close to normal for the month. Winds averaged 3.7 mph and the highest gust was 30 mph on the 1st".

The weather in July 2010 was not conducive to large or numerous fires. The key to the fire smoke caused $PM_{2.5}$ exceedance on the 13th was not so much the size of the fire as the location of the fire. The July 2010 Climate Summary from the University of Fairbanks Geophysical Institute states: "The average temperature for the month in Fairbanks was 62.6°F, just slightly below the average July temperature of 63.0°F. The high temperature was 85°F on the 9th, and the low was 47°F on the 28th. A total of 3.11" of precipitation was recorded, which is 76% greater than normal for the month. From the 10th through the 31st Fairbanks recorded rainfall on all but four days, unusual for this time of year. The highest one-day total was 1.35" on the 21st, of which, 1.15" fell in just one hour, between 3 and 4pm, a new 1-hour record rainfall" for Fairbanks.

[8] http://climate.gi.alaska.edu/AKCityClimo/AK_Climate_Sum.html

Winds averaged 3.9 mph and the highest gust was 33 mph on the 17th: The summary above highlights the warm 1st week and the subsequent rainy weather and explains why the smoke impact was limited to a very short time period.

Figure 11 is a comparison of the $PM_{2.5}$ concentrations for each fire season for the years 2000 to 2011. ADEC defined the fire season as the period from June 1st through August 31st for each year since these dates included all $PM_{2.5}$ exceedances and the major fire periods.
"Fire years" or those years where there are many fires happened on more than one occasion during this period. These fires impact the $PM_{2.5}$ concentrations in Fairbanks, Alaska. The summer of 2004 was the worst fire year, since record keeping, in Alaska. The data are not completely displayed on this graph since it is such an outlier. If the data were displayed the upper (green) box would be over 280 and the whisker would be well over 700. This would make all other years of data virtually unreadable due to the small size the other boxes would be when displayed.

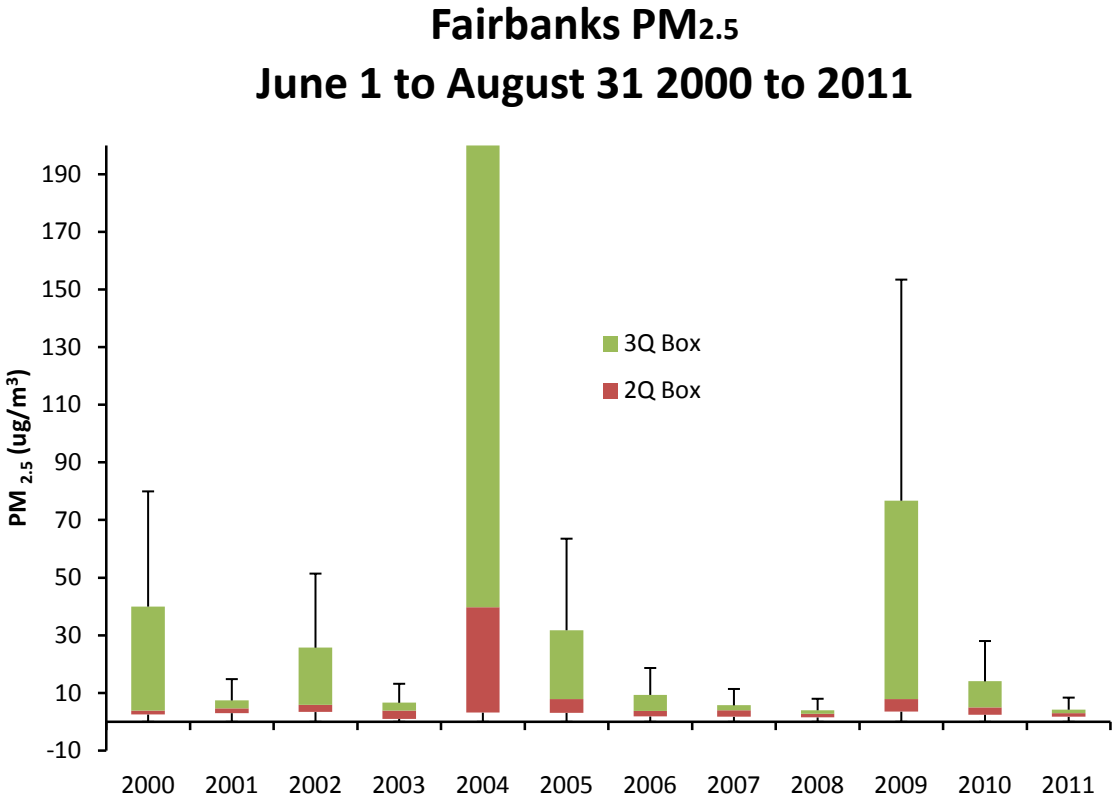



Figure 11: Fairbanks PM2.5 for the fire seasons for the years 2000 to 2011. The upper box (green) represents data from the median to the 90 percentile. The lower (red) boxes represent data from the median down to the 10th percentile. The "whiskers" indicate the values between the top (bottom) of the box, 90th (10th) percentile to the highest (lowest) values (supporting data in Appendix C7).

2010 is the sixth largest impact year during this period. Years with little or small fires can be seen in 2001, 2003, 2008 and 2011. The acreage burned in 2010 was above average but not as

significant as the years where there were large fires such as 2000, 2002, 2004 and 2005. However, the location of the fires in relationship to Fairbanks ensured that smoke would impact the area. This is especially true of the Willow Creek fire, a relatively small fire but only 8 miles southwest of the Fairbanks International Airport runway and just 13 miles southwest of downtown Fairbanks where the $PM_{2.5}$ monitors are located. See Figure 12.

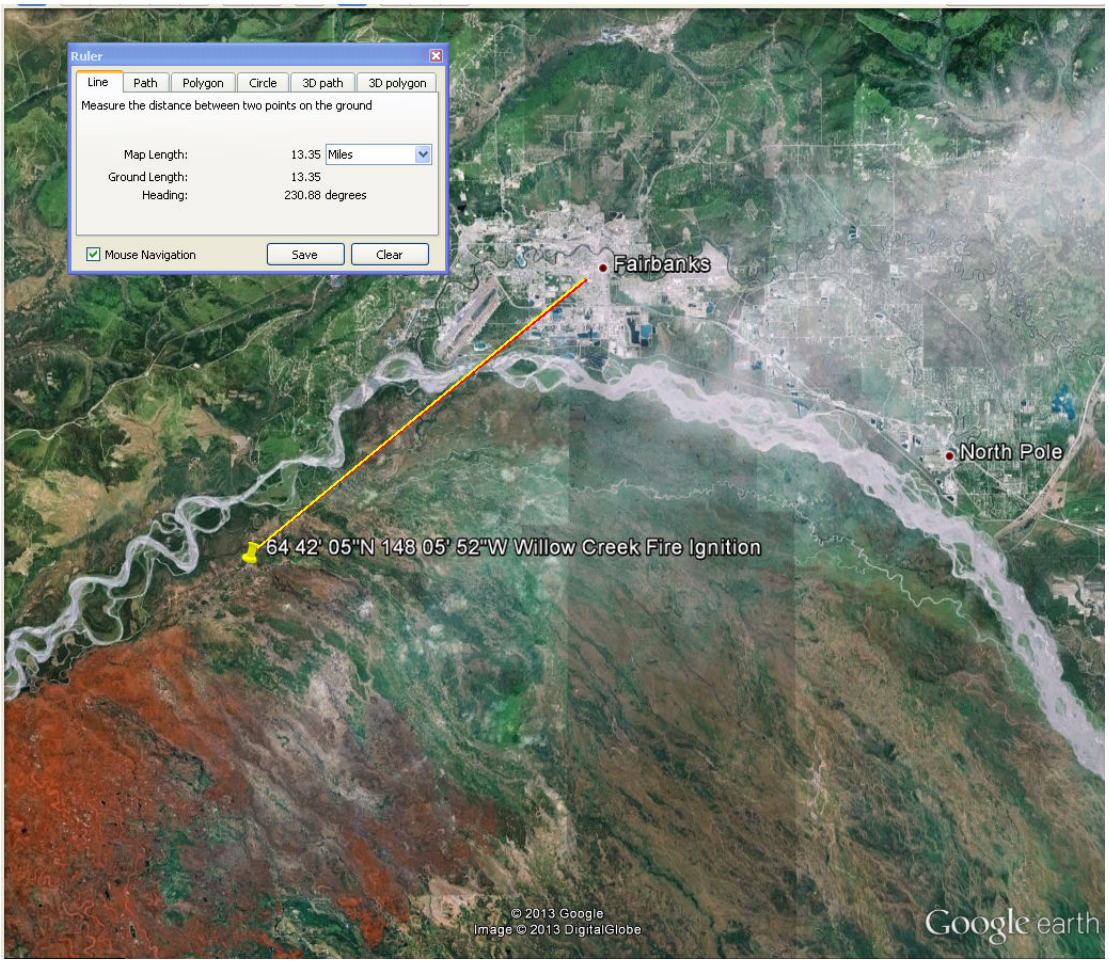



Figure 12: Distance from Willow Creek Fire to Fairbanks

## Clear Casual Relationship

This section establishes the clear casual relationship between the smoke from the wildland fires in the Interior of Alaska during the summer of 2010 and the $PM_{2.5}$ concentrations in Fairbanks measured between May 29, 2010 and June 2, 2010 and then again between July 12 and July 18, 2010. The following section will describe the major fires impacting air quality in Fairbanks during these periods. This will include a daily description of fire locations, measured $PM_{2.5}$

concentrations, HYSPLIT backward trajectory forecasts, meteorological observations and other pertinent data for each day as need to show origin and extent of fire smoke. These products will be arranged in chronological order on a day-to-day basis and shown for each day of the event. Along with these products will be a narrative detailing the development or changes from one day to the next.

Description of major fires

There were a total of 688 wild land fires in Alaska in 2010 and a total of 1,125,419 acres burned. The total acreage is close to the average acreage burned annually in Alaska for the last 11 years. The cause of the $PM_{2.5}$ exceedances in the summer of 2010 were more related to the location of the fires in relation to Fairbanks than the number of fires that occurred. The largest fires that impacted the air quality in Fairbanks were the Toklat Fire in the May-June time period and Toklat2 Fire and the Willow Creek Fire in July. The Toklat fire, later named the Toklat2 Fire was the largest fire with 188,807 total acres. The Willow Creek Fire was much smaller at only 13,766 acres but it close location to Fairbanks contributed to a $PM_{2.5}$ on July 13, 2010. The July Event section below documents a detailed description of how these two fires impacted Fairbanks in early July.

Table 8 provides a summary of the dates the fires were burning and the total acreage burned by the end of the summer.

Figure 13 is a map overview of where the fires were located in relation to Fairbanks. The Toklat, later the Toklat2 fire, southwest of Fairbanks was the largest fire of the summer of 2010 and is shown in Figure 13 as red. This fire was a holdover fire from the 2009 summer. These fires burned between May 16 and August 13 (Alaska Fire Season 2010, Wildland Fire Summary and Statistics Annual Report – AICC). The Willow Creek fire ignited July 12, 2010 and was active until Aug 16, 2010. Total acreage burned was 13,766 acres (Table 8, shown in Figure 13 as blue).

Table 8: Major fires in the vicinity of Fairbanks, Alaska, summer 2010

| Fire Name | Ignite Date | Total Acreage |
|---|---|---|
| Toklat/Toklet2 | May 16, 2010 | 188,807 |
| Jeannes Lake | May 27, 2010 | Combine with Toklat2 Jun 3 |
| Willow Creek | June 10, 2010 | 13,766 |
| Chitanatala | May 26, 2010 | 35,978 |
| Casaden Ridge | May 27, 2010 | 15,178 |
| Frying Pan Creek | May 25, 2010 | 1975 |
| Sucker River | May 20, 2010 | 397 |

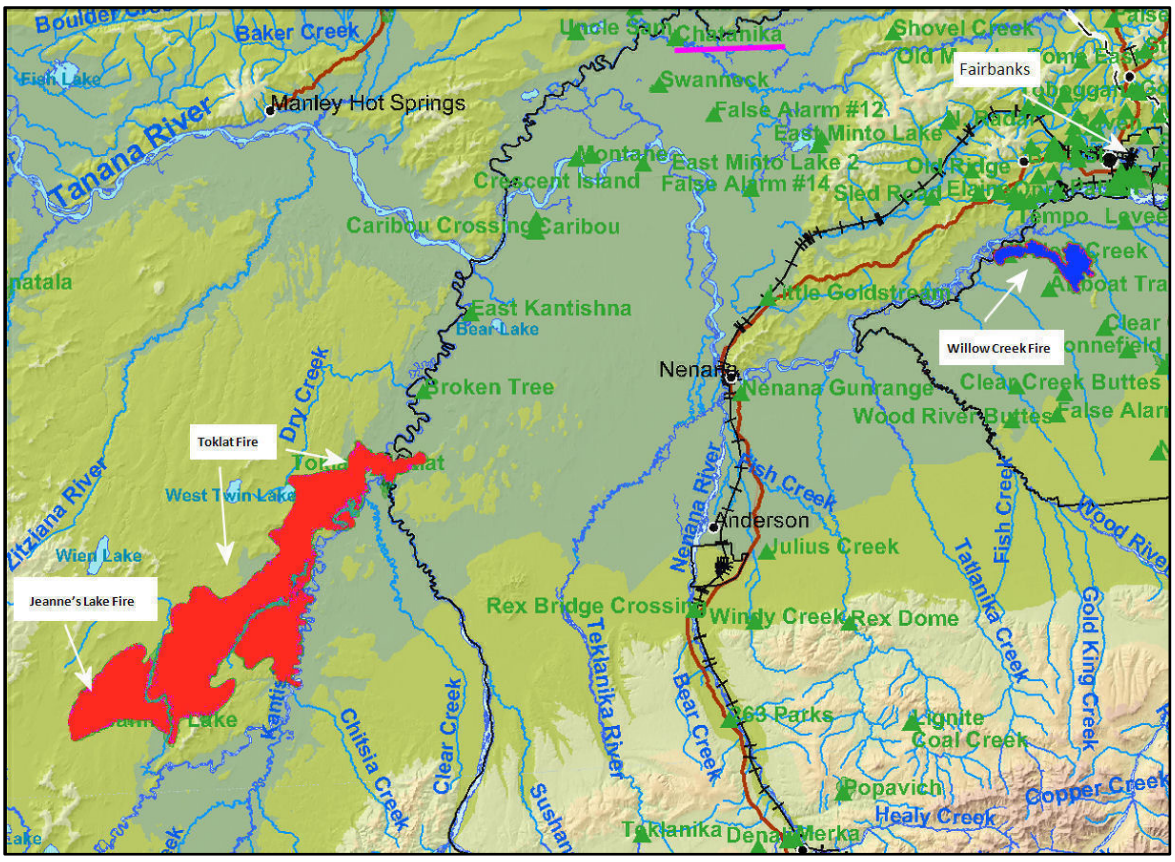



Figure 13: Outlines of fires southwest to west to northwest of Fairbanks that impacted air quality, in the summer of 2010. Red = Toklat and Toklat2, Blue = Willow Creek, Chitanatala pink underline Other fires from the AICC display
http://afsmaps.blm.gov/imf_firehistory/imf.jsp?site=firehistory

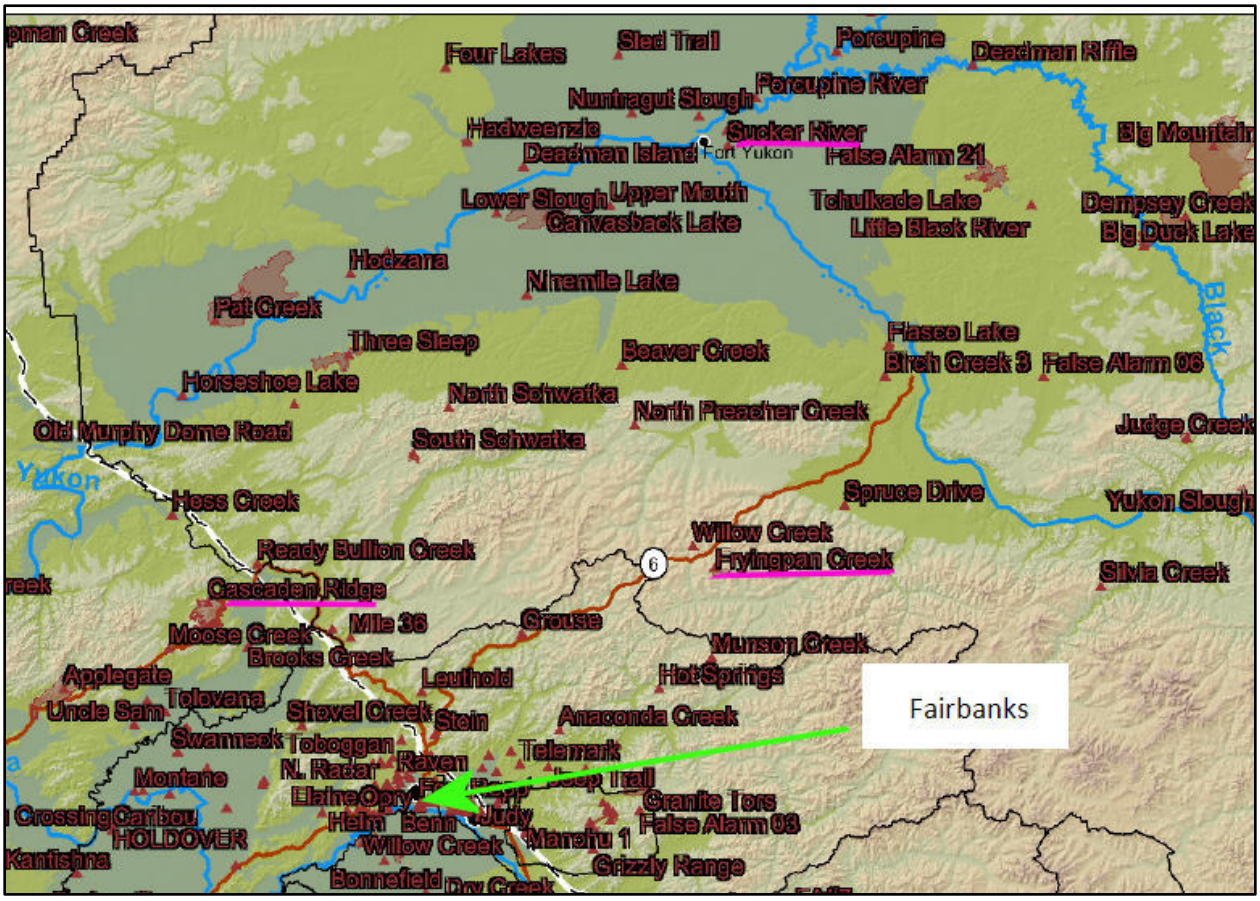



Figure 14 Fires to the north and northeast of Fairbanks burning during the May Jun event. Underlined in pink are the Sucker River, the Frying Pan Creek, and the Cascaden Ridge Fires

Daily breakdown of the event:

This daily changes in $PM_{2.5}$ concentrations in Fairbanks for the period May 28 – June 2, 2010 and July 12 – 18, 2010 are described by terrain maps, satellite imagery and modeling. The evidence presented for each day includes Moderate Resolution Imaging Spectroradiometer (MODIS) satellite imagery, Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model backwards trajectory forecasts overlaid on terrain maps and also overlaid on the MODIS imagery, and hourly $PM_{2.5}$ concentrations for each day. Supporting evidence from observational $PM_{2.5}$ data, meteorology and firefighting effort (manmade and natural) are used to describe each day in the period.

Observational $PM_{2.5}$ concentrations are from the State Office Building Federal Reference Monitor (FRM) and the co-located beta attenuation monitor (BAM). The FRM data are $PM_{2.5}$ 24-hour averaged filters run on a 1-in-3 day schedule. The co-located BAM data are hurly $PM_{2.5}$ concentrations used on non-FRM days

All weather observation data was downloaded from the National Climate Data Center (NCDC) and was subject to their quality control. (http://www7.ncdc.noaa.gov/CDO/dataproduct ). The MODIS imagery was downloaded from http://www.gina.alaska.edu/modis-gallery?year=2010. The HYSPLIT model information and model runs are available on line (http://www.arl.noaa.gov/HYSPLIT_info.php ).

$PM_{2.5}$ data underwent quality assurance and control by FNSB and ADEC staff and meet the requirements as defined in the State Quality Assurance Plan. ADEC provides oversight of FNSB data collection, processing, QA, and certifying all Fairbanks data entered into AQS, EPA's national ambient air monitoring database.

For this event, the first 24-hour $PM_{2.5}$ FRM concentration that was flagged occurred on May 29, 2010. The $PM_{2.5}$ 24-hour FRM filter sample data at the Fairbanks State Office sampler was 21.8µg/$m^3$ on May 29, 2010. See Appendix C for all available $PM_{2.5}$ data. Elevated 24-hour FRM $PM_{2.5}$ concentrations were recorded on May 29, June 1, July 13 and July 16.

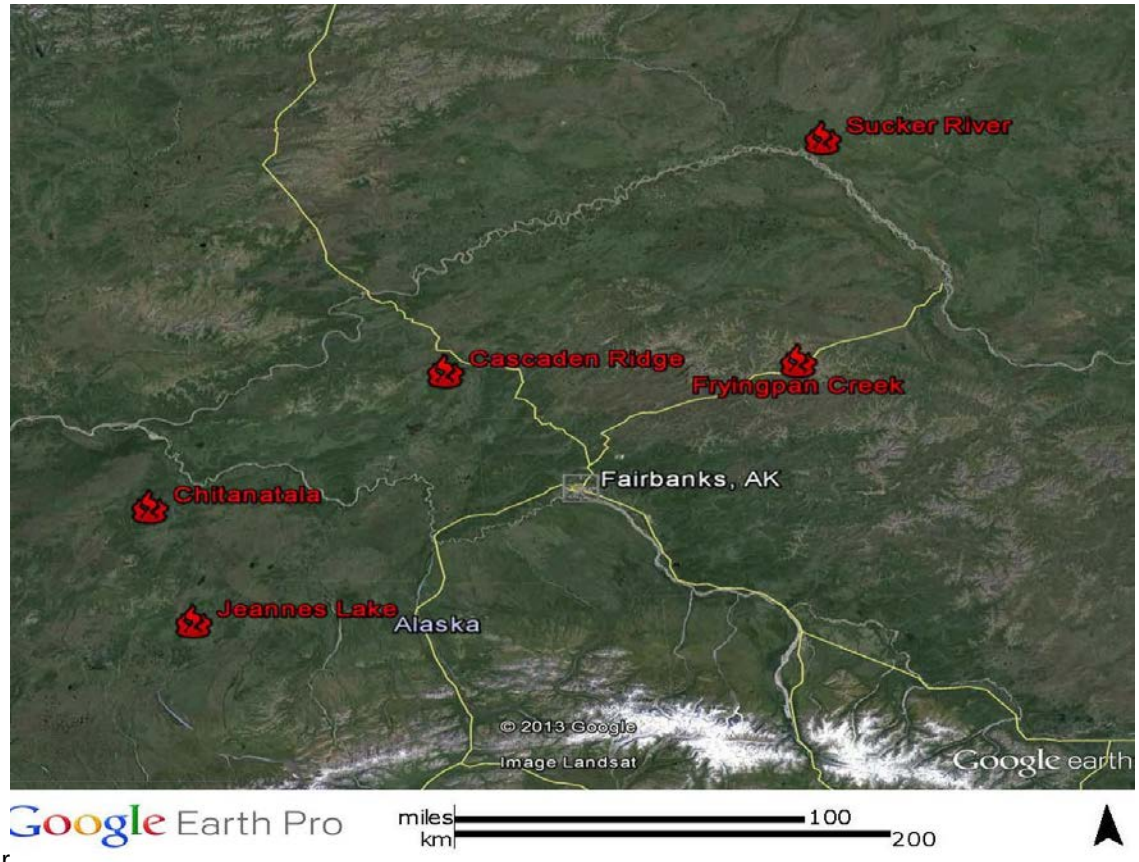
All days with $PM_{2.5}$ concentrations above 15µg/$m^3$ from May 29 – July 16, 2010 are being submitted as one exceptional event. Although the $PM_{2.5}$ concentrations varied, the cause of the increased $PM_{2.5}$ concentrations throughout the entire period remained wildfire smoke. Daily $PM_{2.5}$ concentrations varied depending on meteorological conditions and fire development or suppression. Wind direction (WD) and fire location were the most important components to predict high $PM_{2.5}$ concentrations.

June Event

Hot and dry weather in late May and early Jun created conditions that were conducive to wildfire development. This lead to the rekindling a 2009 holdover fire, named the Toklat fire for the year 2010. Numerous other fires were ignited by lightning around the same time period and contributed to the area wide smoke. Six of the largest of these fires were the Toklat2/Jeanne's Lake, Chitanatala, Casaden Ridge, Frying Pan Creek, and Sucker River fires. The smoke from these fires impacted Interior Alaska until June 5, 2010 when fronts moved through, bringing cooler temperatures and moisture. Table 9 and Figure 15 summarize the fires in that impacted Fairbanks air quality during the May/June event. Further discussion is in the daily summaries below.

Table 9: Fires and acreage by date
All fires cannot be flown everyday so the acreage reported may not change for 3 or 4 days and then take a sudden jump when the fire is again flown.

| | Acreage | | | | | |
|---|---|---|---|---|---|---|
| Start Date | Toklat Fire | Jeannes Lake Fire | Chitanatala Fire | Casaden Ridge Fire | Frying Pan Creek Fire | Sucker River Fire |
| 28-May-10 | 55,000 | 2,000 | 5,750 | 1,001 | 1,975 | 397 |
| 29-May-10 | 60,000 | 2,000 | 13,538 | 9,589 | 1,975 | 397 |
| 30-May-10 | 101,136 | 2,000 | 13,538 | 12,000 | 1,975 | 397 |
| 31-May-10 | 127,176 | 2,000 | 13,538 | 14,075 | 1,975 | 397 |
| 1 Jun 10 | 133,770 | 17,081 | 24,029 | 14,917 | 1,975 | 397 |
| 2 Jun 10 | 133,770 | 17,081 | 25,706 | 14,944 | 1,975 | 397 |
| Increase | 78,771 | 15,081 | 19,956 | 13,943 | 725 | 0 |
| | | | | | Total Increase | 128,476 |




Figur

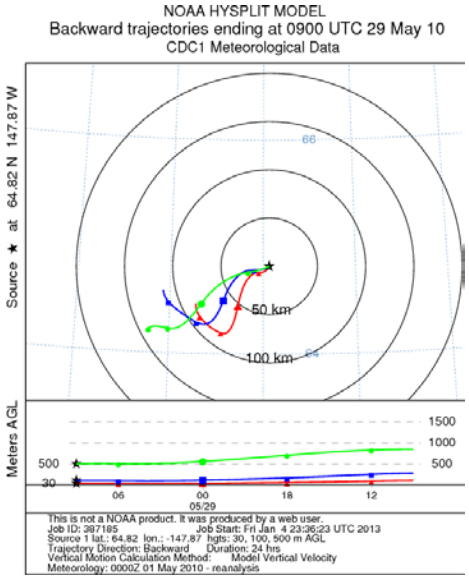
### May 28, 2010

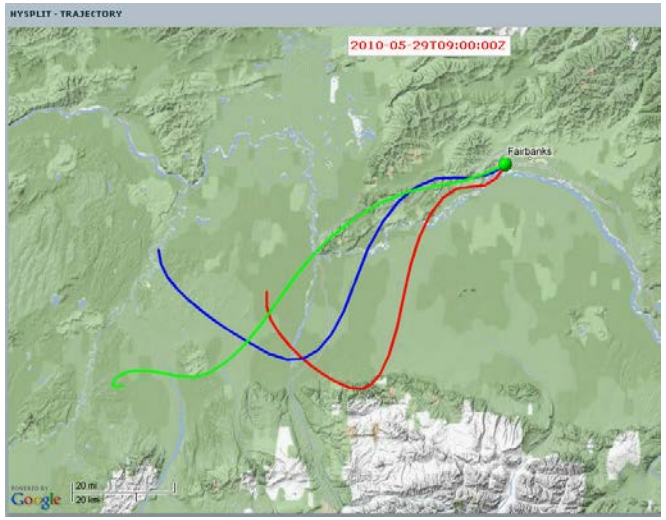
The first flagged daily concentration associated with this exceptional event was measured on May 29. However, to show continuity May 28, 2010 is presented. Figure 16a-d and Table 10, May 28, 2010 show the overall situation one day prior to the onset of dense smoke in Fairbanks. The May 28, 2010 MODIS imagery shows fires to the southwest, west, northwest and northeast of Fairbanks. Figure 13 shows the fires to the southwest and west of Fairbanks in late June and Figure 14 shows the fires to the north and north east of Fairbanks during the same time period. The smoke from these fires will build in the atmosphere and result in high concentrations of $PM_{2.5}$ beginning May 29, 2010.

The May 28 wind flow as seen in the HYSPLIT model plots Figure 20 a and b brings the air through an area of no fire activity and little smoke.

Table 10 summarizes the hourly observations for May 28, 2010. The code breakdown for these data is contained in Appendix D. These data show four hourly $PM_{2.5}$ concentrations above 15µg/$m^3$. These concentrations are elevated compared to non-fire periods but do not exceed the 24-hour NAAQS yet.

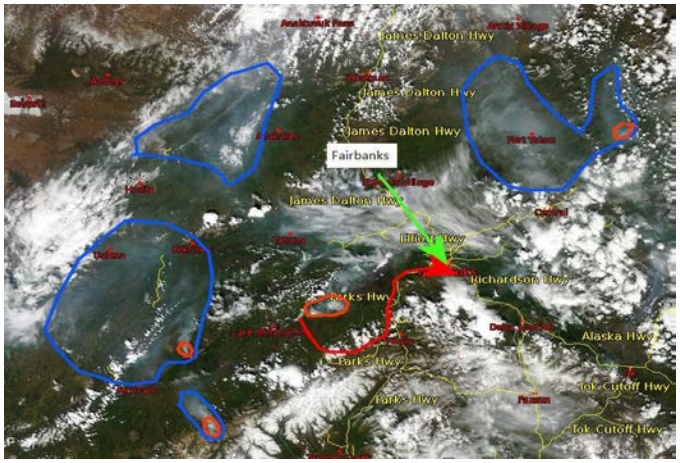
FRM filter, 24 HR $PM_{2.5}$ concentrations were not collected for this date. Secondary $PM_{2.5}$ 24 HR average was 9.2µg/$m^3$.




B. HYSPLIT Trajectory forecast on Google Earth map. Red = 30m, Blue = 100m, Green=500m

A. HYSPLIT Backwards Trajectory Forecast from May 29, 2010, 00LST backward to May 28, 2010, 00LST.




| 28 May | HRLY PM2.5 |
|---|---|
| 0:00 | 9.4 |
| 1:00 | 9.6 |
| 2:00 | 11.8 |
| 3:00 | 11.8 |
| 4:00 | 9.2 |
| 5:00 | 9 |
| 6:00 | 7.7 |
| 7:00 | 9.2 |

| 28 May | HRLY PM2.5 |
|---|---|
| 8:00 | 14.2 |
| 9:00 | 14 |
| 10:00 | 11.6 |
| 11:00 | 10.7 |
| 12:00 | 9 |
| 13:00 | 6 |
| 14:00 | 6.2 |
| 15:00 | 4.7 |

| 28 May | HRLY PM2.5 |
|---|---|
| 16:00 | 4 |
| 17:00 | 3 |
| 18:00 | 2.7 |
| 19:00 | 6.6 |
| 20:00 | 9 |
| 21:00 | 11.4 |
| 22:00 | 15.3 |
| 23:00 | 14.6 |

D. Hourly $PM_{2.5}$ for May 28, 2010

C. May 28, 2010, 12:05 PM LST MODIS imagery with 30m trajectory (red outline is fire, blue is smoke). Trajectories are directly from the HYSPLIT model except the 30m trajectory on MODIS imagery is hand drawn)

Figure 16: May 28, 2010 All end points/arrow heads terminate at Fairbanks, Alaska

Table 10: Hourly Observations for Fairbanks International Airport, May 28, 2010

| USAF | WBAN | YR--MODAHRMN (LST) | DIR (From) | SPD (MPH) | GUS (MPH) | VSB (SM) | WW | WW |
|---|---|---|---|---|---|---|---|---|
| 702610 | 26411 | 201005280053 | 50 | 6 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005280153 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005280253 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005280353 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005280453 | 10 | 5 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005280553 | 40 | 3 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005280653 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005280753 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005280853 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005280953 | 170 | 3 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005281053 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005281153 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005281253 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005281353 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005281453 | 200 | 9 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005281553 | 180 | 9 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005281653 | 180 | 8 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005281753 | 990 | 6 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005281853 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005281953 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005282053 | 300 | 10 | *** | 10 | 61 (Lgt Rain) | ** |
| 702610 | 26411 | 201005282153 | 360 | 9 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005282253 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005282353 | *** | 0 | *** | 10 | ** | ** |

## May 29, 2010

Figure 18 C, MODIS imagery for May 29, 2010 12:48LST shows a broad area of smoke oriented southwest to northeast approaching Fairbanks. This smoke has spread over the area in a complex pattern due to the passage of a very weak frontal boundary.

The HYSPLIT trajectory, May 29, 2010, Figure 18 a, and b also show the changing wind flow pattern associated with frontal passage.

Figure 17 is a 48-hour backwards trajectory and provides a longer time period trajectory in order to shows how the air particles traveled in circular direction.

Figure 18, surface weather observations, show winds from a southerly direction for most of the day. The winds then change to northerly near midnight with the passage of the weak front. Table 11 surface weather observations for May 29, 2010 indicated winds predominately from the northeast behind the weak front but with two to three hours of wind from the southeast from 1553LST to 1753 LST later in the day. These light and changing winds spread the smoke throughout the area bringing dense smoke over the monitoring site at the State building.

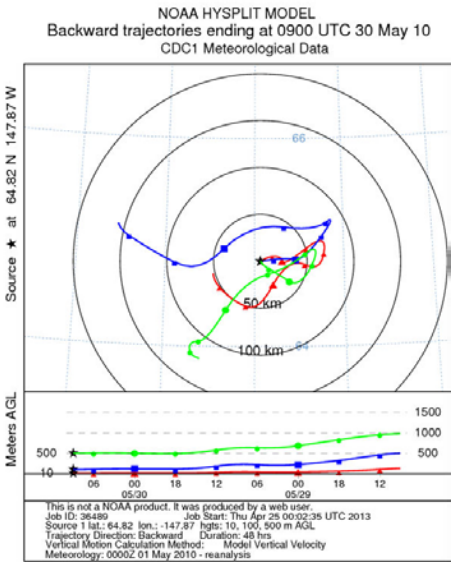
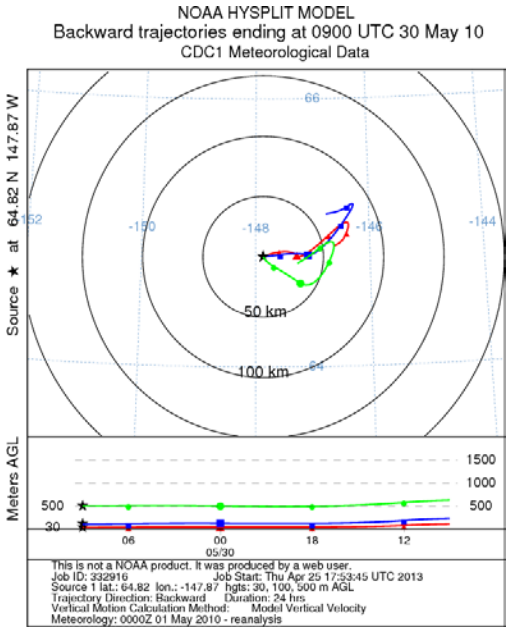
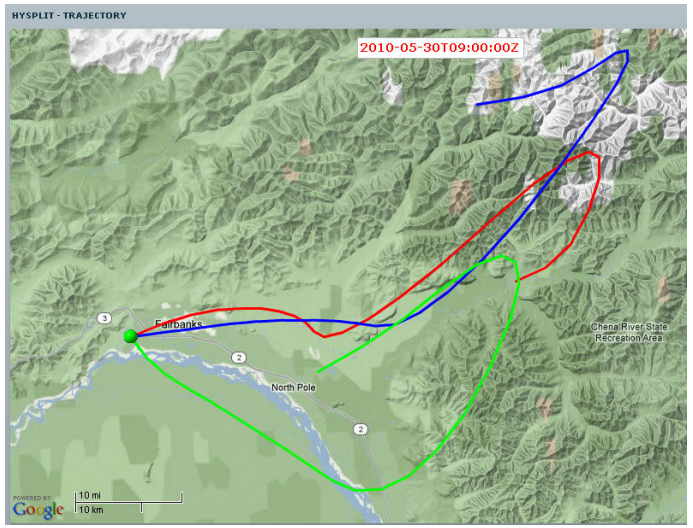



Figure 17: 48HR HYSPLIT backward trajectory

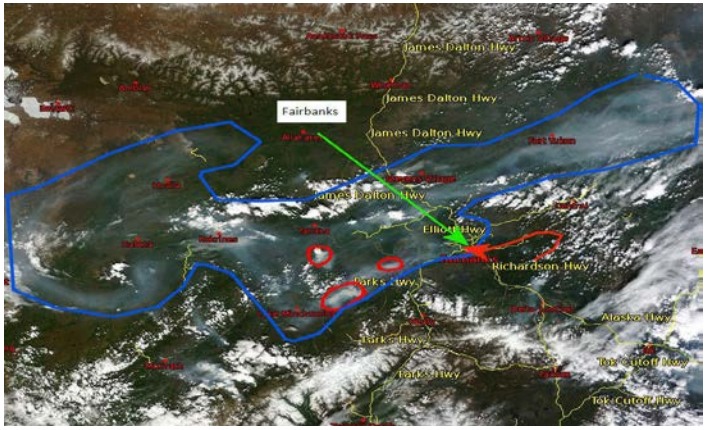
FRM filter, 24 hour $PM_{2.5}$ concentration was 21.8µg/$m^3$. Secondary $PM_{2.5}$ 24 hour average concentration was 23.3µg/$m^3$.




A. HYSPLIT Backwards Trajectory Forecast from May 30, 2010, 00LST backward to May 29, 2010, 00LST.




B. HYSPLIT Trajectory forecast on Google Earth map. Red = 30m, Blue = 100m, Green=500m




C. May 29, 2010, 12:48 LST MODIS imagery with 30m trajectory (red outline is fire, blue is smoke). Trajectories are directly from the HYSPLIT model except the 30m trajectory on MODIS imagery is hand drawn.)

| 29 May | HRLY PM2.5 |
|---|---|
| 0:00 | 14 |
| 1:00 | 17.2 |
| 2:00 | 13.1 |
| 3:00 | 9 |
| 4:00 | 10.5 |
| 5:00 | 9.9 |
| 6:00 | 9.2 |
| 7:00 | 7.9 |

| 29-May | HRLY PM2.5 |
|---|---|
| 8:00 | 9.6 |
| 9:00 | 23.5 |
| 10:00 | 116 |
| 11:00 | 87 |
| 12:00 | 67.6 |
| 13:00 | 35.8 |
| 14:00 | 15.7 |
| 15:00 | 13.1 |

| 29-May | HRLY PM2.5 |
|---|---|
| 16:00 | 9.9 |
| 17:00 | 9.4 |
| 18:00 | 10.7 |
| 19:00 | 10.1 |
| 20:00 | 11.6 |
| 21:00 | 15.9 |
| 22:00 | 16.3 |
| 23:00 | 17 |

D. Hourly $PM_{2.5}$ for May 29, 2010

Figure 18: May 29, 2010 All end points/arrow heads terminate at Fairbanks, Alaska

Table 11: Hourly Observations for Fairbanks International Airport, May 29, 2010

| USAF | WBAN | YR--MODAHRMN (LST) | DIR (From) | SPD (MPH) | GUS (MPH) | VSB (SM) | WW | WW |
|---|---|---|---|---|---|---|---|---|
| 702610 | 26411 | 201005290053 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005290153 | 10 | 5 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005290253 | 60 | 3 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005290353 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005290453 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005290553 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005290653 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005290753 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005290853 | *** | 0 | *** | 9.1 | ** | ** |
| 702610 | 26411 | 201005290953 | *** | 0 | *** | 4 | 4(Smoke) | ** |
| 702610 | 26411 | 201005291053 | *** | 0 | *** | 2.5 | 4(Smoke) | ** |
| 702610 | 26411 | 201005291153 | *** | 0 | *** | 4 | 4(Smoke) | ** |
| 702610 | 26411 | 201005291253 | *** | 0 | *** | 5 | 4(Smoke) | ** |
| 702610 | 26411 | 201005291353 | *** | 0 | *** | 7 | ** | ** |
| 702610 | 26411 | 201005291453 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005291553 | 130 | 5 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005291653 | 120 | 3 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005291753 | 90 | 3 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005291853 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005291953 | 20 | 3 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005292053 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005292153 | 20 | 6 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005292253 | 20 | 3 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005292353 | 30 | 3 | *** | 10 | ** | ** |

## May30, 2010

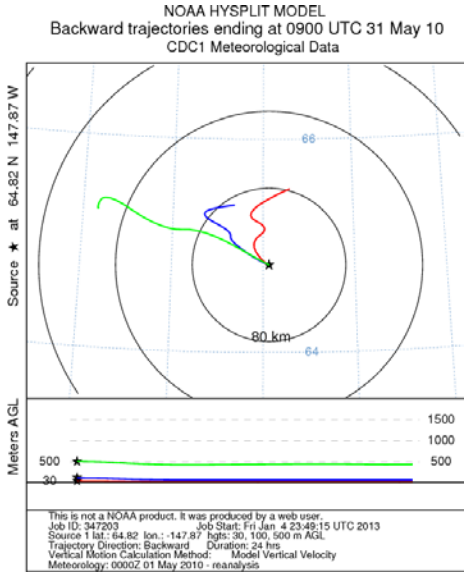
Figure 19 MODIS imagery for May 30, 2010 shows fires to the southwest and to the northeast of Fairbanks along with a large area of smoke covering the entire area.

The AICC Situation Report dated May 31, 2010 which covers the period up through May 30, gives the following description of the Toklat Fire to the southwest of Fairbanks: “Extreme fire behavior…” and “Runs through black spruce with flame lengths to 75 feet, column climbing to 10,000 feet were reported.” The AICC Situation Report also reported an increase in acreage from 60,000 acres to 101,136 acres – a 68% increase in size.

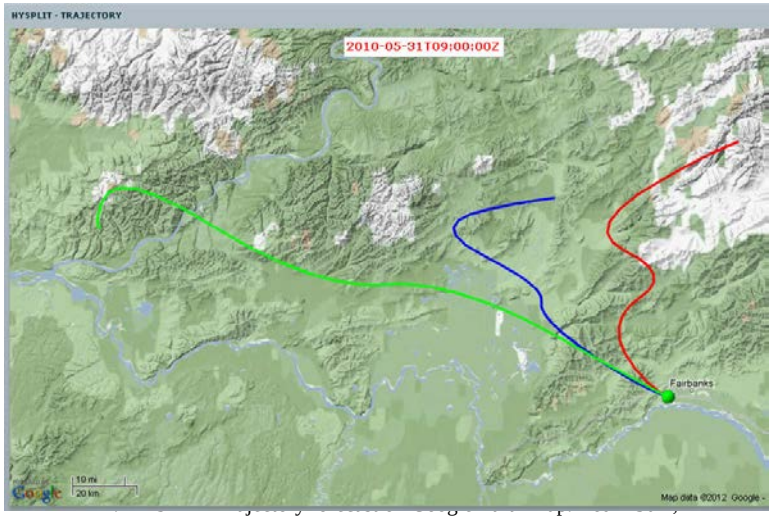
The HYSPLIT trajectory indicates low level smoke advection from the northeast while the higher levels flow becomes more northerly to northwesterly.

Table 12 Fairbanks International Airport hourly observations for May 30, 2010 show winds light from a north to northeast direction early in the day. The winds advected smoke into Fairbanks from the large fire to the north east. However, smoke encircles the entire area. The afternoon observations report smoke as a restriction to visibility.

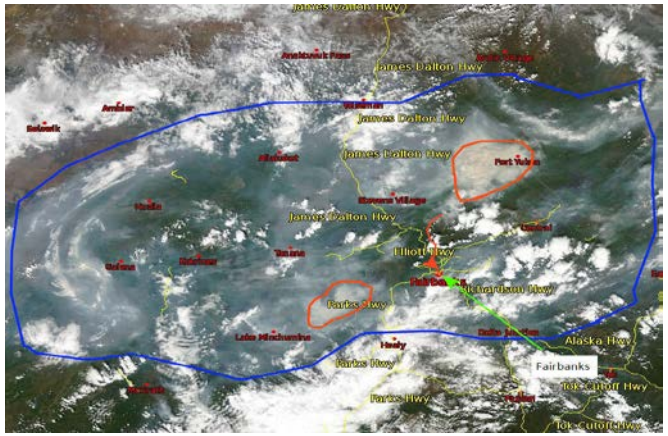
FRM filter, 24 HR $PM_{2.5}$ data is not available for this date. Secondary $PM_{2.5}$ 24 HR average was 32.3µg/$m^3$.




A. HYSPLIT Backwards Trajectory Forecast from May 31, 2010, 00LST backward to May 30, 2010, 00LST.




Blue = 100m, Green=500m




C. May 30, 2010 11:53 LST MODIS imagery with 30m trajectory (red outline is fire, blue is smoke). Trajectories are directly from the HYSPLIT model except the 30m trajectory on MODIS imagery is hand drawn)

| 30 May | HRLY PM2.5 |
|---|---|
| 0:00 | 22.6 |
| 1:00 | 14.6 |
| 2:00 | 15 |
| 3:00 | 16.3 |
| 4:00 | 15.5 |
| 5:00 | 15.7 |
| 6:00 | 19.6 |
| 7:00 | 20.4 |

| 30-May | HRLY PM2.5 |
|---|---|
| 8:00 | 25.8 |
| 9:00 | 42.7 |
| 10:00 | 56.1 |
| 11:00 | 60.9 |
| 12:00 | 60.3 |
| 13:00 | 53.5 |
| 14:00 | 52.5 |
| 15:00 | 43.2 |

| 30-May | HRLY PM2.5 |
|---|---|
| 16:00 | 10.7 |
| 17:00 | 11.1 |
| 18:00 | 36.4 |
| 19:00 | 36.4 |
| 20:00 | 34.3 |
| 21:00 | 37.9 |
| 22:00 | 37.5 |
| 23:00 | 36.9 |

D. Hourly $PM_{2.5}$ for May 30, 20109

Table 12: Hourly Observations for Fairbanks International Airport, May 30, 2010

| USAF | WBAN | YR--MODAHRMN (LST) | DIR (From) | SPD (MPH) | GUS (MPH) | VSB (SM) | WW | WW |
|---|---|---|---|---|---|---|---|---|
| 702610 | 26411 | 201005300053 | 360 | 9 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005300153 | 60 | 9 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005300253 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005300353 | 250 | 7 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005300453 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005300553 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005300653 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005300753 | 100 | 3 | *** | 9.1 | ** | ** |
| 702610 | 26411 | 201005300853 | 90 | 3 | *** | 9.1 | ** | ** |
| 702610 | 26411 | 201005300953 | *** | 0 | *** | 5 | 4(Smoke) | ** |
| 702610 | 26411 | 201005301053 | *** | 0 | *** | 4 | 4(Smoke) | ** |
| 702610 | 26411 | 201005301153 | *** | 0 | *** | 4 | 4(Smoke) | ** |
| 702610 | 26411 | 201005301253 | 150 | 7 | *** | 5 | 4(Smoke) | ** |
| 702610 | 26411 | 201005301353 | 160 | 5 | *** | 5 | 4(Smoke) | ** |
| 702610 | 26411 | 201005301453 | 190 | 5 | *** | 4 | 4(Smoke) | ** |
| 702610 | 26411 | 201005301553 | *** | 0 | *** | 7 | ** | ** |
| 702610 | 26411 | 201005301653 | 80 | 3 | *** | 10 | ** | ** |
| 702610 | 26411 | 201005301753 | 80 | 14 | 20 | 10 | ** | ** |
| 702610 | 26411 | 201005301853 | 80 | 8 | *** | 8 | ** | ** |
| 702610 | 26411 | 201005301953 | 130 | 8 | *** | 8 | ** | ** |
| 702610 | 26411 | 201005302053 | 120 | 7 | *** | 7 | ** | ** |
| 702610 | 26411 | 201005302153 | *** | 0 | *** | 7 | ** | ** |
| 702610 | 26411 | 201005302253 | 10 | 3 | *** | 7 | ** | ** |
| 702610 | 26411 | 201005302353 | 40 | 3 | *** | 6 | 4(Smoke) | ** |

### May 31, 2010

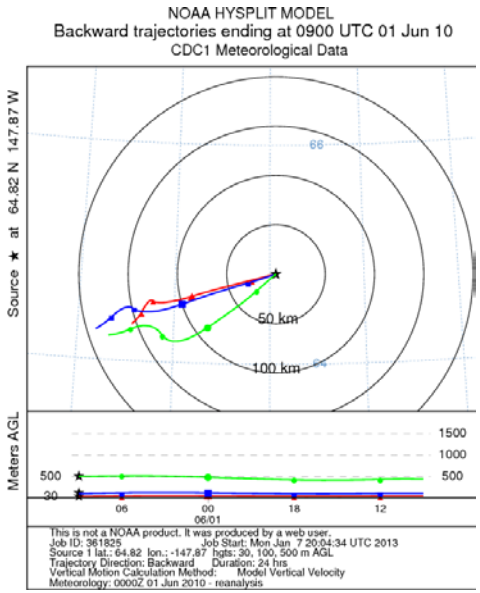
This day had the highest FRM $PM_{2.5}$ concentrations recorded for the period of this event, May 29 to Jun 3 2010. Figure 20 May 31, 2010 MODIS shows smoke in a wide band running from the southwest to the northeast and covering the Fairbanks area. The area of smoke coverage has increased from yesterday's image. This can be attributed to the increase in fire size as discussed in the analysis for May 30 above.

The AICC Situation Report dated June 1, 2010 which covers the period up through May 31, reported a "smoke inversion" and "moderating behavior" but also reported an increase in acreage of 27,040 acres from 101,136 acres to 127,176 acres.

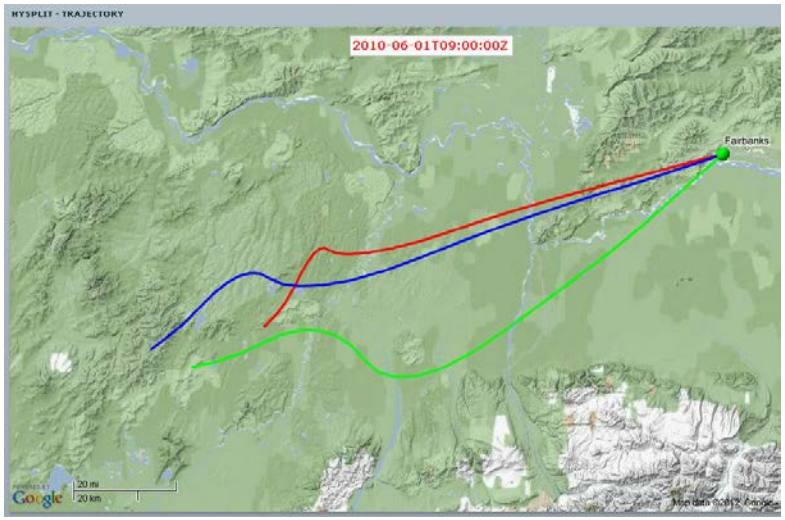
HYSPLIT trajectory shows flow from the west southwest which is advecting more smoke into Fairbanks from the Toklat fire.

Table 13 Hourly Observations for Fairbanks International Airport, May 31, 2010 report smoke as a restriction to visibility from midnight throughout the day up until the 2053LST.

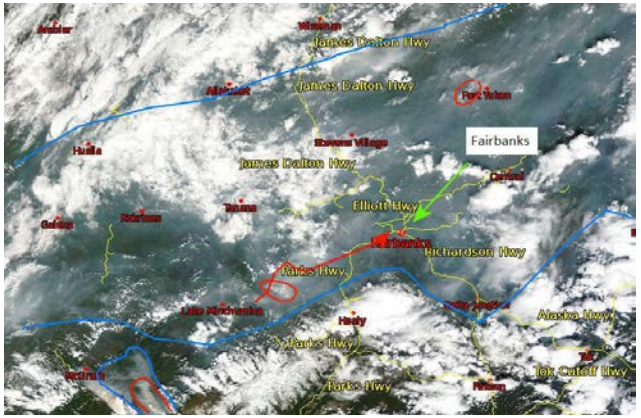
FRM filter, 24 HR $PM_{2.5}$ data is not available for this date. Secondary $PM_{2.5}$ 24 HR average was 47.5µg/$m^3$.




A. HYSPLIT Backwards Trajectory Forecast from June 1, 2010, 00LST backward to May 31, 2010, 00LST.




B. HYSPLIT Trajectory forecast on Google Earth map. Red = 30m, Blue = 100m, Green=500m




C. May 31, 2010, 12:35 LST MODIS imagery with 30m trajectory (red outline is fire, blue is smoke. Trajectories are directly from the HYSPLIT model except the 30m trajectory on MODIS imagery is hand draw.

| 31 May | HRLY PM2.5 |
|---|---|
| 0:00 | 43.3 |
| 1:00 | 44.4 |
| 2:00 | 37.9 |
| 3:00 | 39.3 |
| 4:00 | 36.9 |
| 5:00 | 48.3 |
| 6:00 | 48.1 |
| 7:00 | 55.5 |

| 31-May | HRLY PM2.5 |
|---|---|
| 8:00 | 78.9 |
| 9:00 | 90.7 |
| 10:00 | 87.3 |
| 11:00 | 61.3 |
| 12:00 | 60 |
| 13:00 | 45.1 |
| 14:00 | 49.2 |
| 15:00 | 49.8 |

| 31-May | HRLY PM2.5 |
|---|---|
| 16:00 | 33 |
| 17:00 | 42 |
| 18:00 | 41.8 |
| 19:00 | 36.3 |
| 20:00 | 34.5 |
| 21:00 | 22.4 |
| 22:00 | 27.3 |
| 23:00 | 26.3 |

D. Hourly $PM_{2.5}$ for May 31, 2010

Figure 19: May 31, 2010 All end points/arrow heads terminate at Fairbanks, Alaska

Table 13: Hourly Observations for Fairbanks International Airport, May 31, 2010

| USAF | WBAN | YR--MODAHRMN (LST) | DIR (From) | SPD (MPH) | GUS (MPH) | VSB (SM) | WW | WW |
|---|---|---|---|---|---|---|---|---|
| 702610 | 26411 | 201005310053 | 20 | 6 | *** | 6 | 4(Smoke) | ** |
| 702610 | 26411 | 201005310153 | 10 | 3 | *** | 6 | 4(Smoke) | ** |
| 702610 | 26411 | 201005310253 | *** | 0 | *** | 6 | 4(Smoke) | ** |
| 702610 | 26411 | 201005310353 | *** | 0 | *** | 6 | 4(Smoke) | ** |
| 702610 | 26411 | 201005310453 | 180 | 3 | *** | 6 | 4(Smoke) | ** |
| 702610 | 26411 | 201005310553 | 20 | 3 | *** | 6 | 4(Smoke) | ** |
| 702610 | 26411 | 201005310653 | 20 | 6 | *** | 6 | 4(Smoke) | ** |
| 702610 | 26411 | 201005310753 | 60 | 5 | *** | 6 | 4(Smoke) | ** |
| 702610 | 26411 | 201005310853 | *** | 0 | *** | 5 | 4(Smoke) | ** |
| 702610 | 26411 | 201005310953 | *** | 0 | *** | 5 | 4(Smoke) | ** |
| 702610 | 26411 | 201005311053 | *** | 0 | *** | 5 | 4(Smoke) | ** |
| 702610 | 26411 | 201005311153 | *** | 0 | *** | 5 | 4(Smoke) | ** |
| 702610 | 26411 | 201005311253 | *** | 0 | *** | 6 | 4(Smoke) | ** |
| 702610 | 26411 | 201005311353 | 60 | 3 | *** | 6 | 4(Smoke) | ** |
| 702610 | 26411 | 201005311453 | 990 | 5 | *** | 4 | 4(Smoke) | ** |
| 702610 | 26411 | 201005311553 | 200 | 14 | 21 | 6 | 4(Smoke) | ** |
| 702610 | 26411 | 201005311653 | 220 | 8 | 18 | 7 | ** | ** |
| 702610 | 26411 | 201005311753 | 230 | 7 | *** | 7 | ** | ** |
| 702610 | 26411 | 201005311853 | 240 | 5 | *** | 5 | 4(Smoke) | ** |
| 702610 | 26411 | 201005311953 | 110 | 5 | *** | 6 | 4(Smoke) | ** |
| 702610 | 26411 | 201005312053 | 110 | 8 | *** | 7 | ** | ** |
| 702610 | 26411 | 201005312153 | 50 | 3 | *** | 8 | ** | ** |
| 702610 | 26411 | 201005312253 | *** | 0 | *** | 8 | ** | ** |
| 702610 | 26411 | 201005312353 | *** | 0 | *** | 8 | ** | ** |

### June 1, 2010

On this date the fires begin to diminish due to damp weather conditions and fire suppression efforts by the Alaska Fire Service crews.

Figure 21 C, MODIS imagery shows fire and smoke to the southwest of Fairbanks. However the fire area actually burning and the smoke being released is less than the previous days. While the airborne smoke is still in present, it is now further north.

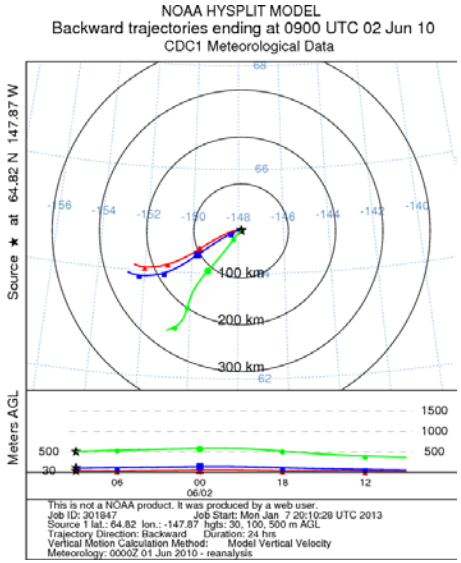
The HYSPLIT trajectory indicates flow from the southwest from the fires towards Fairbanks.

AICC Situation Report dated June 2, 2010 states “Fire spread moderated by weather patterns and smoke inversions. Smoke lifted…”

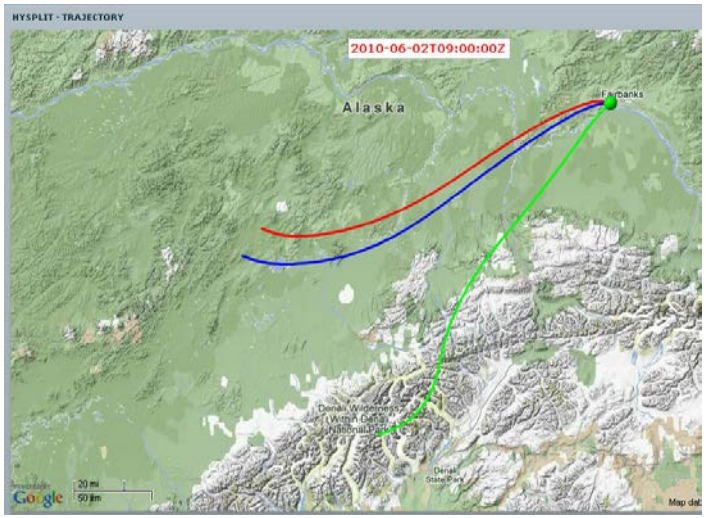
At the Fairbanks international Airport the hourly weather observations no longer report smoke as a restriction to visibility and show light rain on the 0353 LST hourly report.

The $PM_{2.5}$ concentrations vary through the day but show decreasing values after 14:00 LST. After that hour concentrations remained under 15µg/$m^3$.

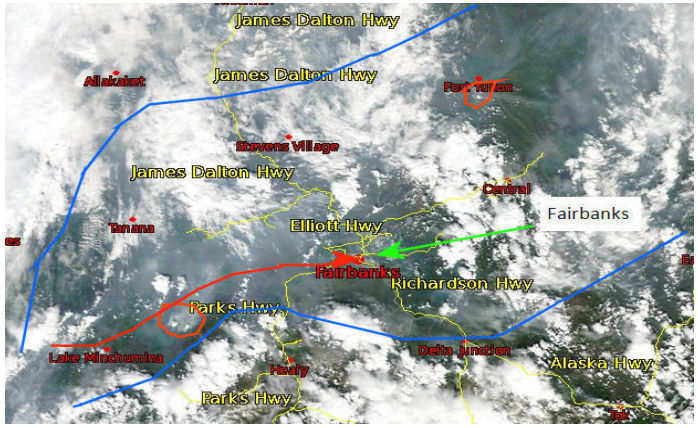
FRM filter, 24 hour $PM_{2.5}$ concentration was 23.4µg/$m^3$. Secondary $PM_{2.5}$ 24 hour average concentration was 24.3µg/$m^3$.




A. HYSPLIT Backwards Trajectory Forecast from June 2, 2010, 00LST backward to June 1, 2010, 00LST.




B. HYSPLIT Trajectory forecast on Google Earth map. Red = 30m, Blue = 100m, Green=500m




C. June 1, 2010, 11:40 LST MODIS imagery with 30m trajectory (red outline is fire, blue is smoke. Trajectories are directly from the HYSPLIT model except the 30m trajectory on MODIS imagery is hand drawn.

| 1 Jun | HRLY PM2.5 |
|---|---|
| 0:00 | 21.9 |
| 1:00 | 27 |
| 2:00 | 20.4 |
| 3:00 | 23.9 |
| 4:00 | 27.1 |
| 5:00 | 34.7 |
| 6:00 | 29.7 |
| 7:00 | 27.3 |

| 1-Jun | HRLY PM2.5 |
|---|---|
| 8:00 | 30.6 |
| 9:00 | 30 |
| 10:00 | 28.7 |
| 11:00 | 53.3 |
| 12:00 | 40.1 |
| 13:00 | 42.5 |
| 14:00 | 29.3 |
| 15:00 | 12.9 |

| 1-Jun | HRLY PM2.5 |
|---|---|
| 16:00 | 11.1 |
| 17:00 | 10.7 |
| 18:00 | 12.9 |
| 19:00 | 12.6 |
| 20:00 | 14.6 |
| 21:00 | 14.6 |
| 22:00 | 13.3 |
| 23:00 | 13.8 |

D. Hourly $PM_{2.5}$ for June1, 2010

Figure 20: June1, 2010 All end points/arrow heads terminate at Fairbanks, Alaska

Table 14: Hourly Observations for Fairbanks International Airport, June 1, 2010

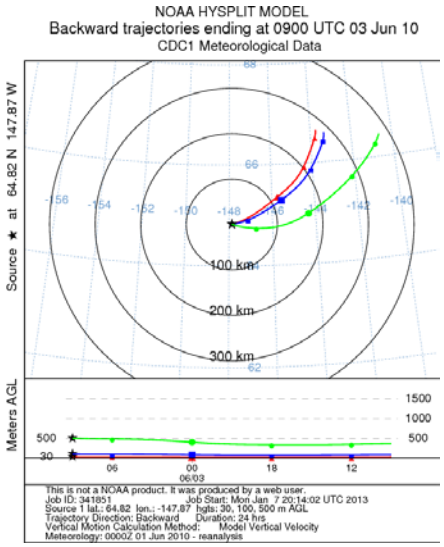
| USAF | WBAN | YR--MODAHRMN (LST) | DIR (From) | SPD (MPH) | GUS (MPH) | VSB (SM) | WW | WW |
|---|---|---|---|---|---|---|---|---|
| 702610 | 26411 | 201006010053 | *** | 0 | *** | 8 | ** | ** |
| 702610 | 26411 | 201006010153 | 360 | 6 | *** | 8 | ** | ** |
| 702610 | 26411 | 201006010253 | *** | 0 | *** | 8 | ** | ** |
| 702610 | 26411 | 201006010353 | 180 | 6 | *** | 7 | 61 (Lgt Rain | ** |
| 702610 | 26411 | 201006010453 | 360 | 3 | *** | 7 | ** | ** |
| 702610 | 26411 | 201006010553 | 10 | 6 | *** | 7 | ** | ** |
| 702610 | 26411 | 201006010653 | 40 | 6 | *** | 7 | ** | ** |
| 702610 | 26411 | 201006010753 | *** | 0 | *** | 7 | ** | ** |
| 702610 | 26411 | 201006010853 | 80 | 3 | *** | 7 | ** | ** |
| 702610 | 26411 | 201006010953 | *** | 0 | *** | 7 | ** | ** |
| 702610 | 26411 | 201006011053 | *** | 0 | *** | 7 | ** | ** |
| 702610 | 26411 | 201006011153 | *** | 0 | *** | 7 | ** | ** |
| 702610 | 26411 | 201006011253 | *** | 0 | *** | 7 | ** | ** |
| 702610 | 26411 | 201006011353 | 110 | 5 | *** | 7 | ** | ** |
| 702610 | 26411 | 201006011453 | 140 | 6 | *** | 7 | ** | ** |
| 702610 | 26411 | 201006011553 | 130 | 13 | *** | 8 | ** | ** |
| 702610 | 26411 | 201006011653 | 270 | 17 | 29 | 7 | ** | ** |
| 702610 | 26411 | 201006011753 | 310 | 9 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006011853 | 10 | 9 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006011953 | 50 | 7 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006012053 | 10 | 7 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006012153 | 350 | 7 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006012253 | 10 | 5 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006012353 | *** | 0 | *** | 10 | ** | ** |

## June 2, 2010

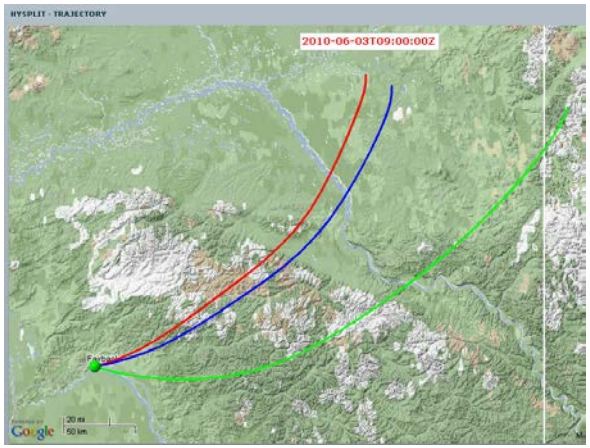
Figure 22, C MODIS imagery. The main large area of airborne smoke continues to move to the northwest as part of the high pressure cell. There remains some thin smoke over Fairbanks visible on the MODIS image. $PM_{2.5}$ concentrations will remain elevated but not as high as the previous days.

HYSPLIT trajectory indicates flow now if from the northeast around the bottom of the high pressure cell. The smoke in this direction is not as dense as the smoke that has been over Fairbanks.

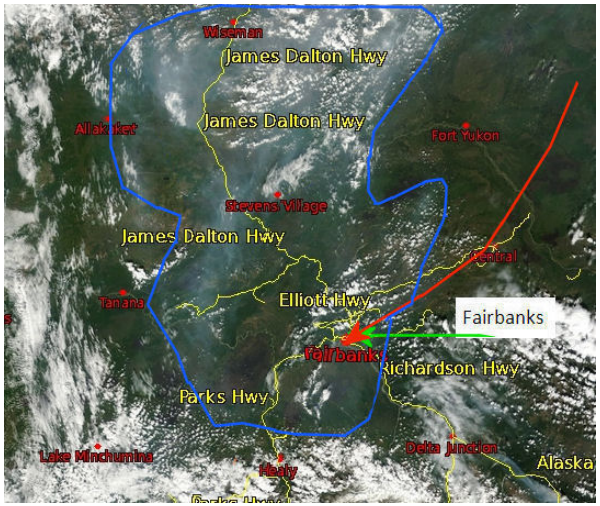
FRM filter, 24 HR $PM_{2.5}$ data is not available for this date. Secondary $PM_{2.5}$ 24 HR average was 16.6µg/$m^3$. Concentrations at the State Building in Fairbanks will remain elevated above natural background until Jun 5, 2010 but remain below the 35µg/$m^3$ daily standard.




A. HYSPLIT Backwards Trajectory Forecast from June 3, 2010, 00LST backward to June, 2 2010, 00LST.




B. HYSPLIT Trajectory forecast on Google Earth map. Red = 30m, Blue = 100m, Green=500m




C. June 2, 2010, 12:23 LST MODIS imagery with 30m trajectory (red outline is fire, blue is smoke. Trajectories are directly from the HYSPLIT model except the 30m trajectory on MODIS imagery is hand

| 2 Jun | HRLY PM2.5 |
|---|---|
| 0:00 | 15.7 |
| 1:00 | 17.8 |
| 2:00 | 17.4 |
| 3:00 | 17.4 |
| 4:00 | 16.5 |
| 5:00 | 16.1 |
| 6:00 | 24.1 |
| 7:00 | 20.9 |

| 2-Jun | HRLY PM2.5 |
|---|---|
| 8:00 | 20 |
| 9:00 | 19.8 |
| 10:00 | 20.2 |
| 11:00 | 18.7 |
| 12:00 | 16.8 |
| 13:00 | 18.9 |
| 14:00 | 19.4 |
| 15:00 | 16.5 |

| 2-Jun | HRLY PM2.5 |
|---|---|
| 16:00 | 16.5 |
| 17:00 | 16.8 |
| 18:00 | 13.8 |
| 19:00 | 11.4 |
| 20:00 | 9.9 |
| 21:00 | 9 |
| 22:00 | 10.9 |
| 23:00 | 13.1 |

D. Hourly $PM_{2.5}$ for June 2, 2010

Figure 21: June 2, 2010 All end points/arrow heads terminate at Fairbanks, Alaska

Table 15: Hourly Observations for Fairbanks International Airport, June 2, 2010

| USAF | WBAN | YR--MODAHRMN (LST) | DIR (From) | SPD (MPH) | GUS (MPH) | VSB (SM) | WW | WW |
|---|---|---|---|---|---|---|---|---|
| 702610 | 26411 | 201006020053 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006020153 | 70 | 5 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006020253 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006020353 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006020453 | 50 | 5 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006020553 | 40 | 3 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006020653 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006020753 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006020853 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006020953 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006021053 | 170 | 3 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006021153 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006021253 | 160 | 5 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006021353 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006021453 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006021553 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006021653 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006021753 | 70 | 10 | *** | 10 | 61 (Lgt Rain | ** |
| 702610 | 26411 | 201006021853 | 30 | 13 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006021953 | 30 | 9 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006022053 | 30 | 10 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006022153 | 350 | 7 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006022253 | 350 | 8 | *** | 10 | ** | ** |
| 702610 | 26411 | 201006022353 | *** | 0 | *** | 10 | ** | ** |

July Event

The July event was influenced by the May/June event. The dry and hot weather in late May and early Jun created conditions that were conducive to wildfire development. These conditions resulted in the rekindling a 2009 holdover fire. A holdover fire is a fire that smoldered through the winter and began to burn again the next fire season. This fire was named the Toklat Fire for the year 2010. The Toklat fire again produced significant smoke in the Fairbanks area in July. The increase in smoke and higher $PM_{2.5}$ concentrations for the July event also occurred in conjunction with the new Willow Creek fire that ignited on Jun 10, 2010. This fire began to impact air quality in Fairbanks on July 13, 2010. The Toklat fire – now renamed Toklat2 Fire also increased in size and added to smoke in the general area. HYSPLIT trajectories indicate the smoke from this fire would have moved towards Fairbanks.

The Willow Creek Fire was ignited by lightning on June 10, 2012. However this fire did not impact air quality in Fairbanks right away. The AICC Annual Report states: "Eight days later (*after ignition*)… the fire to be approximately 3 acres." However later "The fire continued to burn and was 660 acres by Jun 19th." The AFS conducted burnout operations and made plans to keep the fire south of the Tanana River. The Fire received precipitation intermittently over the next several days and was not a significant smoke producer for Fairbanks. On July 9th the fire became more active and was reported as"40% active perimeter and to be gaining acreage again." Between July 9 and 19th the fire continued to grow.

During the July event time, July 12 – 14, the Willow Creek Fire grew quickly. While the AICC Report for July 11 stated "There was minimal growth", the July 12th AICC Report states the fire exhibited "continuous crowning" and "an increase of 1000 acres" with "winds out of the southwest at 15 mph". On the day of the exccedance, 13 July the AICC Report shows the fire increased another 652 acres and described the fire as exhibiting "isolated torching, spreading southeast" and "1-2 foot flames…with winds out of the southwest at 3-7 mph". On July 14, light precipitation was reported at the fire and "winds continued out of the south/southwest at 5-7 mph".

The Toklat2 fire was flown on July 11 and the AICC Report describes the fire as "20% active perimeter" and "winds out of the south at 10-15 mph". The July 12th AICC report describes the Toklat2 fire as "1% active perimeter" with "single and group torching".

Although the Toklat2 Fire was not the main contributor to the exceedances in Fairbanks, it did contribute to the smoke in the area on the days leading up to the spike in activity at the Willow Creek Fire. The main cause of the smoke, and therefore poor air quality, in Fairbanks during this period was the location of the Willow Creek Fire – between 8-15 miles southwest of Fairbanks, along with the consistent wind direction from the southwest throughout the period. During this time period, the MODIS imagery was not very helpful in showing smoke because the weather was cloudy so the fires were not visible. However, the Willow Creek Fire was downwind throughout the period. Change in wind direction was not a major factor – the wind remained from the southwest through event.

Format Change for July Event:

Format for the June event 4-panel daily discussion included the MODIS imagery with the 30m trajectory added. This product was used to show flow from the fire to Fairbanks. However the July period was very cloudy and the fires are not visible on the MODIS imagery. Therefore, for the July event 4-panel discussion, an AICC fire map with the Willow Creek fire outlined will be used along with the 30m trajectory. Although the MODIS imagery is not used in the daily discussion they are included in Appendix D.

## July 12 2010

Fire Map with trajectory: The 30m trajectory shows the flow from the southwest along the western boundary of the fire outline.

HYSPLIT trajectory does not pass directly through the fire area. However the trajectory skirts the fire outline.

Meteorological observation and Skew-T data: Although the HYSPLIT 30m trajectory only crosses the extreme western of the fire outline, the key to the smoke movement, and therefore the PM2.5 concentrations is the micrometeorology. At night an inversion almost always sets up at Fairbanks doe to the mountains to the north and the relatively flat plain to the south.
On this day the inversion is not very deep and is only a $4^0$C in difference. Also note the southerly, turning southwesterly with height, wind flow, See Figure 23 and Table 16. These features would concentrate the smoke near the surface and also move the smoke around underneath the inversion to the western side of the fire into the trajectory path. However, on this day, the inversion was not strong enough to trap significant amounts of smoke/$PM_{2.5}$ and the maximum hourly $PM_{2.5}$ concentration was 14.6µg/$m^3$.

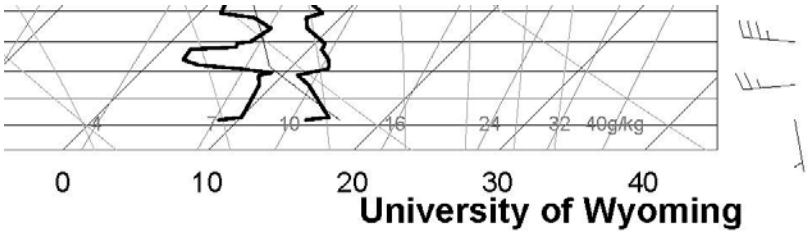
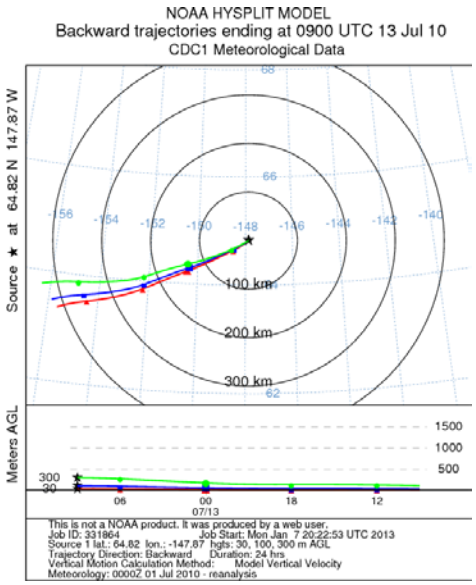



Figure 22 Lowest po

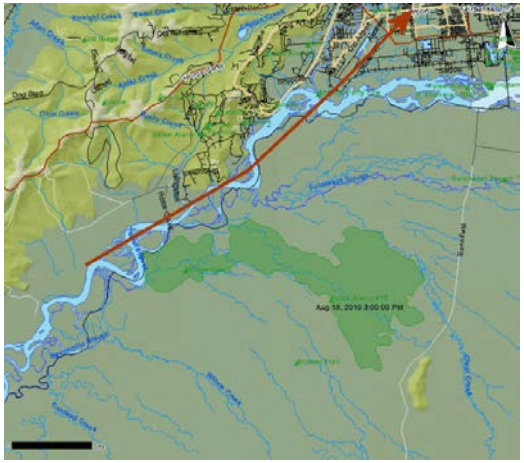
| University of Wyoming | | | Radiosonde | PAFA Fairbanks | |
|---|---|---|---|---|---|
| July 12, 12Z 2010 | | | 70261 | | |
| | PRES | HGHT | TEMP | DRCT | SKNT |
| | hPa | m | C | deg | knot |
| | 1000 | 53 | | | |
| | 990 | 138 | 14.6 | 170 | 4 |
| | 985 | 181 | 16 | 185 | 6 |
| | 970.7 | 305 | 15.2 | 230 | 11 |
| | | Inversion Thickness (m) | Temperature C Diff | | |
| | | 43 | 1.4 | | |

Table 16 Numeric data for the lower levels of the Fairbanks July 12, 2010/12Z (3:00AM) Skew-T

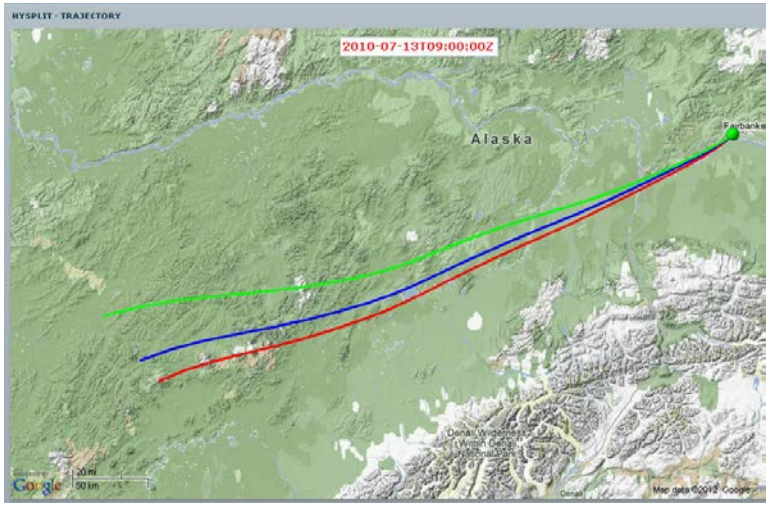
FRM filter, 24 HR $PM_{2.5}$ data is not available for this date. Secondary $PM_{2.5}$ 24 HR average was 6.7µg/$m^3$.




A. HYSPLIT Backwards Trajectory Forecast from July 13, 2010, 00LST backward to July 12, 2010, 00LST.



C. July 12, 2010 Willow Creek Fire map with 30m trajectory.




B. HYSPLIT Trajectory forecast on Google Earth map. Red = 30m, Blue = 100m, Green=500m

| 12 Jul | HRLY PM2.5 |
|---|---|
| 0:00 | 6.9 |
| 1:00 | 6 |
| 2:00 | 5.1 |
| 3:00 | 6.9 |
| 4:00 | 4.2 |
| 5:00 | 2.5 |
| 6:00 | 2.5 |
| 7:00 | 2.7 |

| 12-Jul | HRLY PM2.5 |
|---|---|
| 8:00 | 4.9 |
| 9:00 | 5.3 |
| 10:00 | 4.7 |
| 11:00 | 5.3 |
| 12:00 | 5.1 |
| 13:00 | 4.7 |
| 14:00 | 3.6 |
| 15:00 | 8.6 |

| 12-Jul | HRLY PM2.5 |
|---|---|
| 16:00 | 10.9 |
| 17:00 | 5.5 |
| 18:00 | 9.2 |
| 19:00 | 14.6 |
| 20:00 | 12 |
| 21:00 | 8.4 |
| 22:00 | 8.6 |
| 23:00 | 11.6 |

D. Hourly $PM_{2.5}$ for July 12, 2010

Figure 23: July 12, 2010 All end points/arrow heads terminate at Fairbanks, Alaska

Table 17: Hourly Observations for Fairbanks International Airport, July 12, 2010

| USAF | WBAN | YR--MODAHRMN (LST) | DIR (From) | SPD (MPH) | GUS (MPH) | VSB (SM) | WW | WW |
|---|---|---|---|---|---|---|---|---|
| 702610 | 26411 | 201007120053 | 990 | 7 | 16 | 10 | ** | ** |
| 702610 | 26411 | 201007120153 | 200 | 5 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007120253 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007120353 | 230 | 6 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007120453 | 240 | 8 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007120553 | 990 | 3 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007120653 | 990 | 8 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007120753 | 230 | 7 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007120853 | 240 | 8 | 18 | 10 | ** | ** |
| 702610 | 26411 | 201007120953 | 210 | 8 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007121053 | 240 | 14 | 20 | 10 | ** | ** |
| 702610 | 26411 | 201007121153 | 250 | 13 | 20 | 10 | ** | ** |
| 702610 | 26411 | 201007121253 | 990 | 8 | 17 | 10 | ** | ** |
| 702610 | 26411 | 201007121353 | 200 | 11 | 18 | 10 | ** | ** |
| 702610 | 26411 | 201007121453 | 990 | 10 | 17 | 10 | ** | ** |
| 702610 | 26411 | 201007121553 | 990 | 9 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007121653 | 270 | 6 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007121753 | 990 | 5 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007121853 | 990 | 6 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007121953 | 330 | 6 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007122053 | 300 | 6 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007122153 | 340 | 6 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007122253 | 10 | 5 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007122353 | *** | 0 | *** | 10 | ** | ** |

## July 13, 2010

Fire Map with trajectory: The 30m trajectory shows the flow from the southwest along the western boundary of the fire outline.

HYSPLIT trajectory does not pass directly through the fire area. However the trajectory skirts the fire outline.

Meteorological observation and Skew-T data: The key to the high concentrations on this day is the stronger inversion, 5.4 C. The highest hourly PM2.5 concentrations are reported in the morning hours at the occurrence of the strongest inversion. See Figure 26 D between 6:00 and 9:00AM.

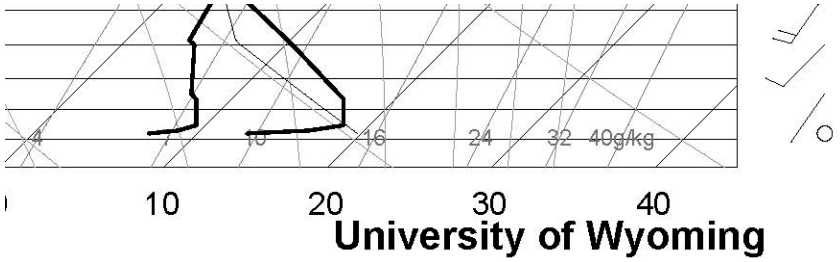
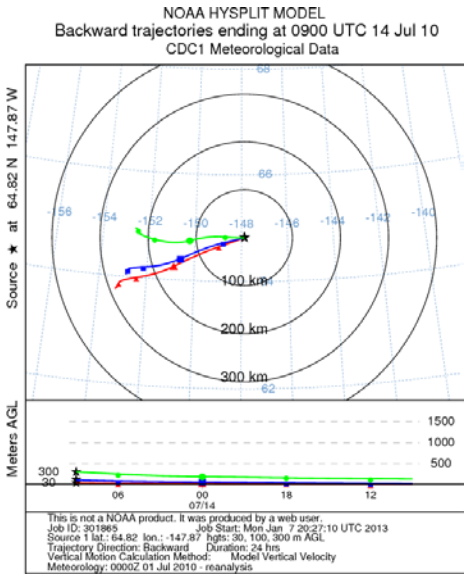



Figure 24: Lowest

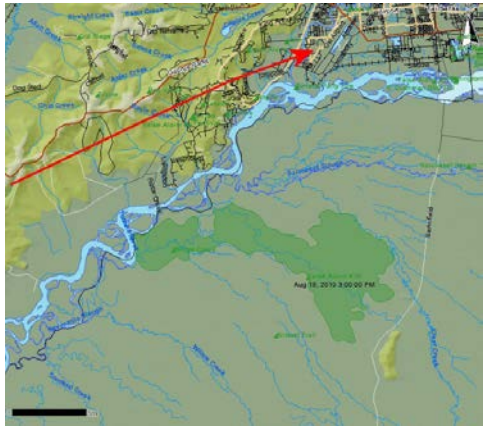
| University of Wyoming | | | Radiosonde | PAFA Fairbanks | |
|---|---|---|---|---|---|
| July 13, 12Z 2010 | | | 70261 | | |
| | PRES | HGHT | TEMP | DRCT | SKNT |
| | hPa | m | C | deg | knot |
| | 1000 | 51 | | | |
| | 990 | 138 | 13 | 0 | 0 |
| | 985 | 181 | 16.6 | 357 | 2 |
| | 976 | 259 | 18.4 | 353 | 6 |
| | 970.8 | 305 | 18.2 | 350 | 8 |
| | 936.7 | 610 | 16.9 | 245 | 1 |
| | | Inversion Thickness (m) | Temperature C Diff | | |
| | | 472 | 5.4 | | |

Table 18: Numeric data for the lower levels of the Fairbanks July 13, 2010/12Z (3:00AM) Skew-T

FRM filter, 24 hour $PM_{2.5}$ was 44.5µg/$m^3$. Secondary $PM_{2.5}$ 24 hour average was 45.7µg/$m^3$ at the co-located sensor and 22.7µg/$m^3$ at the North Pole Elementary Site (NPES).




A. HYSPLIT Backwards Trajectory Forecast from July 14, 2010, 00LST backward to July 13, 2010, 00LST.



C. July 13, 2010 Willow Creek Fire map with 30m trajectory


B. HYSPLIT Trajectory forecast on Google Earth map. Red = 30m, Blue = 100m, Green=500m

| 13 Jul | HRLY PM2.5 |
|---|---|
| 0:00 | 12.6 |
| 1:00 | 11.8 |
| 2:00 | 11.4 |
| 3:00 | 11.4 |
| 4:00 | 11.6 |
| 5:00 | 11.6 |
| 6:00 | 99.1 |
| 7:00 | 214.8 |

| 13-Jul | HRLY PM2.5 |
|---|---|
| 8:00 | 250.3 |
| 9:00 | 151.2 |
| 10:00 | 52.6 |
| 11:00 | 34.9 |
| 12:00 | 20.2 |
| 13:00 | 18.7 |
| 14:00 | 16.3 |
| 15:00 | 13.8 |

| 13-Jul | HRLY PM2.5 |
|---|---|
| 16:00 | 13.5 |
| 17:00 | 15 |
| 18:00 | 14.2 |
| 19:00 | 15.5 |
| 20:00 | 19.2 |
| 21:00 | 27.6 |
| 22:00 | 20.7 |
| 23:00 | 28.9 |

D. Hourly $PM_{2.5}$ for July 13, 2010

Figure 25: July 13, 2010 All end points/arrow heads terminate at Fairbanks, Alaska

Table 19: Hourly Observations for Fairbanks International Airport, July 13, 2010

| USAF | WBAN | YR--MODAHRMN (LST) | DIR (From) | SPD (MPH) | GUS (MPH) | VSB (SM) | WW | WW |
|---|---|---|---|---|---|---|---|---|
| 702610 | 26411 | 201007130053 | 30 | 3 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007130153 | 350 | 6 | *** | 10 | 61 (Lgt Rain | ** |
| 702610 | 26411 | 201007130253 | 40 | 5 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007130353 | 40 | 8 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007130453 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007130553 | *** | 0 | *** | 5 | 4(Smoke) | ** |
| 702610 | 26411 | 201007130653 | 40 | 5 | *** | 4 | 4(Smoke) | ** |
| 702610 | 26411 | 201007130753 | 30 | 3 | *** | 6 | 4(Smoke) | ** |
| 702610 | 26411 | 201007130853 | 140 | 3 | *** | 6 | 4(Smoke) | ** |
| 702610 | 26411 | 201007130953 | *** | 0 | *** | 6 | 61 (Lgt Rain | 4(Smoke) |
| 702610 | 26411 | 201007131053 | 170 | 3 | *** | 7 | ** | ** |
| 702610 | 26411 | 201007131153 | 240 | 6 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007131253 | 990 | 6 | *** | 10 | 61 (Lgt Rain | ** |
| 702610 | 26411 | 201007131353 | 240 | 8 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007131453 | 240 | 5 | *** | 8 | 61 (Lgt Rain | ** |
| 702610 | 26411 | 201007131553 | 250 | 5 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007131653 | 270 | 6 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007131753 | 990 | 6 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007131853 | 230 | 5 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007131953 | 990 | 6 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007132053 | 230 | 6 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007132153 | 230 | 5 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007132253 | 200 | 5 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007132353 | 240 | 6 | *** | 10 | ** | ** |

## July 14, 2010

Fire Map with trajectory: The 30m trajectory shows the flow from the southwest along the western boundary of the fire outline.

HYSPLIT trajectory does not pass directly through the fire area. However the trajectory skirts the fire outline.

Meteorological observation and Skew-T data: The same pattern today as the last two day with an early morning inversion and light winds beneath the inversion and westerly winds above. The inversion today is weaker tan yesterday and the PM2.5 concentrations are lower.

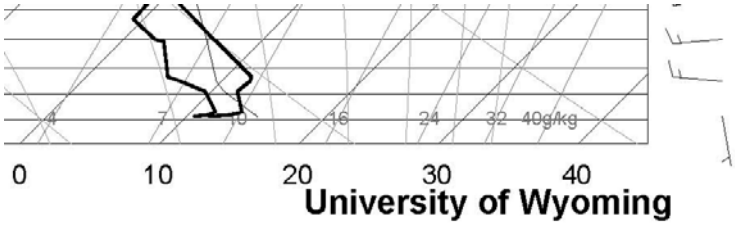
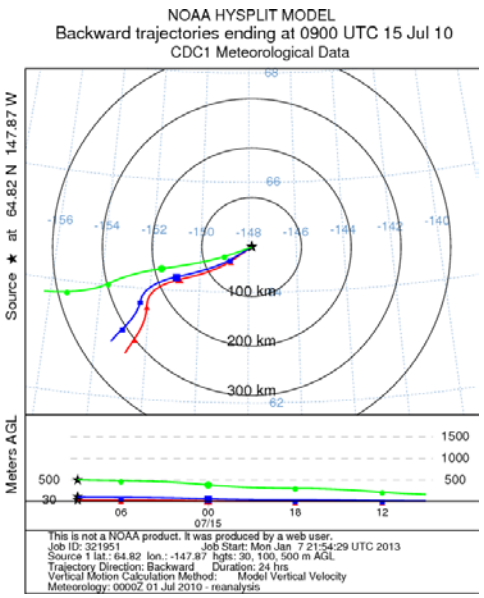



Figure 26: Lowest p

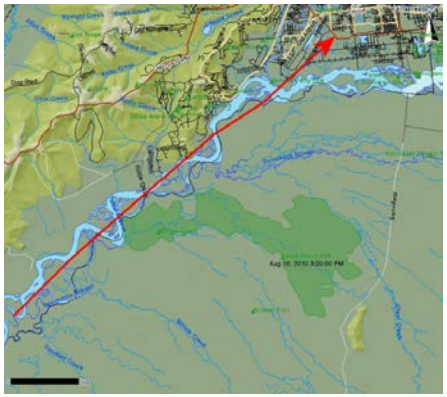
| University of Wyoming | | | Radiosonde | PAFA Fairbanks | |
|---|---|---|---|---|---|
| July 14, 12Z 2010 | | | 70261 | | |
| | PRES | HGHT | TEMP | DRCT | SKNT |
| | hPa | m | C | deg | knot |
| | 1000 | 79 | | | |
| | 993 | 138 | 11.6 | 170 | 3 |
| | 990 | 163 | 13 | 182 | 4 |
| | 984 | 215 | 13.6 | 207 | 6 |
| | 973.5 | 305 | 13.1 | 250 | 10 |
| | 944 | 564 | 11.8 | 267 | 17 |
| | | Inversion Thickness (m) | Temperature C Diff | | |
| | | 167 | 2.0 | | |

Table 20: Numeric data for the lower levels of the Fairbanks July 14, 2010/12Z (3:00AM) Skew-T

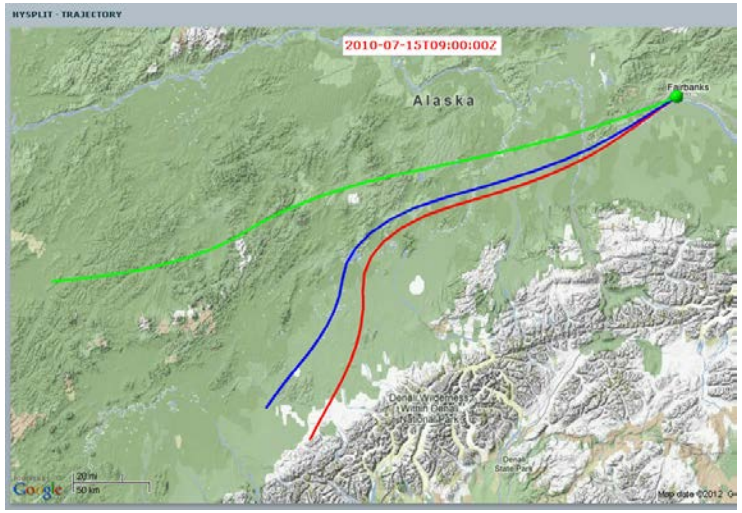
July 14 was not a scheduled sampling day, so FRM data are not available for this day. Secondary $PM_{2.5}$ 24 hour average concentration was 15.3µg/$m^3$.




A. HYSPLIT Backwards Trajectory Forecast from July 15, 2010, 00LST backward to July 14, 2010, 00LST.



C. July 14, 2010 Willow Creek Fire map with 30m trajectory




B. HYSPLIT Trajectory forecast on Google Earth map. Red = 30m, Blue = 100m, Green=500m

| 14 Jul | HRLY PM2.5 |
|---|---|
| 0:00 | 14.6 |
| 1:00 | 15.9 |
| 2:00 | 19.6 |
| 3:00 | 16.1 |
| 4:00 | 9 |
| 5:00 | 8.4 |
| 6:00 | 7.5 |
| 7:00 | 6 |

| 14-Jul | HRLY PM2.5 |
|---|---|
| 8:00 | 6.6 |
| 9:00 | 4.7 |
| 10:00 | 0.6 |
| 11:00 | 0.8 |
| 12:00 | 4.2 |
| 13:00 | 6.9 |
| 14:00 | 7 |
| 15:00 | 8.1 |

| 14-Jul | HRLY PM2.5 |
|---|---|
| 16:00 | 7.5 |
| 17:00 | 3.3 |
| 18:00 | 2.3 |
| 19:00 | 61.9 |
| 20:00 | 40.8 |
| 21:00 | 67.6 |
| 22:00 | 42.9 |
| 23:00 | 5.1 |

D. Hourly $PM_{2.5}$ for July 14, 2010

Figure 27: July 14, 2010 All end points/arrow heads terminate at Fairbanks, Alaska

Table 21: Hourly Observations for Fairbanks International Airport, July 14, 2010

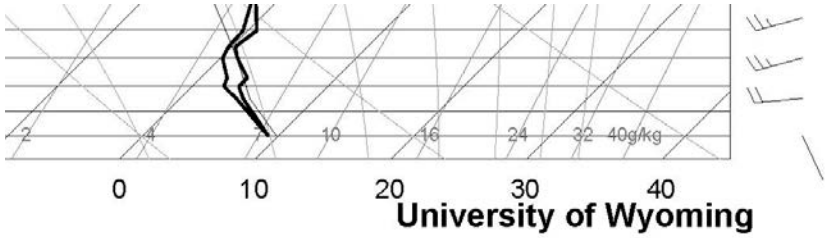
| USAF | WBAN | YR--MODAHRMN (LST) | DIR (From) | SPD (MPH) | GUS (MPH) | VSB (SM) | WW | WW | WW |
|---|---|---|---|---|---|---|---|---|---|
| 702610 | 26411 | 201007140053 | 220 | 3 | *** | 10 | ** | ** | 702610 |
| 702610 | 26411 | 201007140153 | 990 | 3 | *** | 10 | ** | ** | 702610 |
| 702610 | 26411 | 201007140253 | 230 | 6 | *** | 10 | ** | ** | 702610 |
| 702610 | 26411 | 201007140353 | 240 | 5 | *** | 10 | ** | ** | 702610 |
| 702610 | 26411 | 201007140453 | 200 | 5 | *** | 7 | ** | ** | 702610 |
| 702610 | 26411 | 201007140553 | 210 | 3 | *** | 7 | ** | ** | 702610 |
| 702610 | 26411 | 201007140653 | 240 | 8 | *** | 10 | ** | ** | 702610 |
| 702610 | 26411 | 201007140753 | 990 | 6 | *** | 10 | ** | ** | 702610 |
| 702610 | 26411 | 201007140853 | 250 | 8 | 21 | 10 | ** | ** | 702610 |
| 702610 | 26411 | 201007140953 | 250 | 15 | *** | 10 | ** | ** | 702610 |
| 702610 | 26411 | 201007141053 | 250 | 13 | *** | 10 | ** | ** | 702610 |
| 702610 | 26411 | 201007141153 | 250 | 16 | 25 | 10 | ** | ** | 702610 |
| 702610 | 26411 | 201007141253 | 260 | 10 | 22 | 10 | ** | ** | 702610 |
| 702610 | 26411 | 201007141353 | 290 | 11 | 25 | 10 | ** | ** | 702610 |
| 702610 | 26411 | 201007141453 | 280 | 16 | 26 | 10 | ** | ** | 702610 |
| 702610 | 26411 | 201007141553 | 270 | 14 | *** | 10 | ** | ** | 702610 |
| 702610 | 26411 | 201007141653 | 270 | 11 | *** | 10 | ** | ** | 702610 |
| 702610 | 26411 | 201007141753 | 240 | 8 | 16 | 10 | ** | ** | 702610 |
| 702610 | 26411 | 201007141853 | 210 | 8 | *** | 10 | ** | ** | 702610 |
| 702610 | 26411 | 201007141953 | 200 | 8 | *** | 6 | 61 (Lgt Rain | 4(Smoke) | 702610 |
| 702610 | 26411 | 201007142053 | 210 | 6 | *** | 6 | 61 (Lgt Rain | 4(Smoke) | 702610 |
| 702610 | 26411 | 201007142153 | 210 | 8 | *** | 5 | 61 (Lgt Rain | 4(Smoke) | 702610 |
| 702610 | 26411 | 201007142253 | 990 | 7 | *** | 7 | 61 (Lgt Rain | ** | 702610 |
| 702610 | 26411 | 201007142353 | 990 | 5 | *** | 10 | 61 (Lgt Rain | ** | 702610 |

## July 15, 2010

Fire Map with trajectory: The 30m trajectory shows the flow from the southwest along the western boundary of the fire outline.

HYSPLIT trajectory does not pass directly through the fire area. However the trajectory skirts the fire outline.

Meteorological observation and Skew-T data: The July 15/12Z Skew-T does not show an inversion. However the wind below the inversion is from 150 degrees which corresponds to a direction through the fire. The lower level winds from the southeast are still seen on the July 16 2010/00Z (July 15 2010 3:00PM AST). Highest concentration of $PM_{2.5}$ again occurred in the early morning hours.

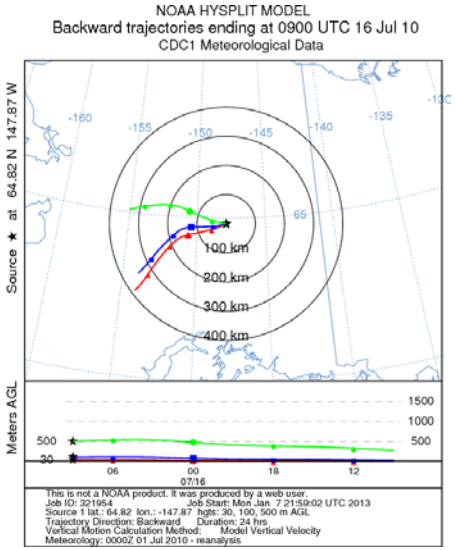



Figur ·T

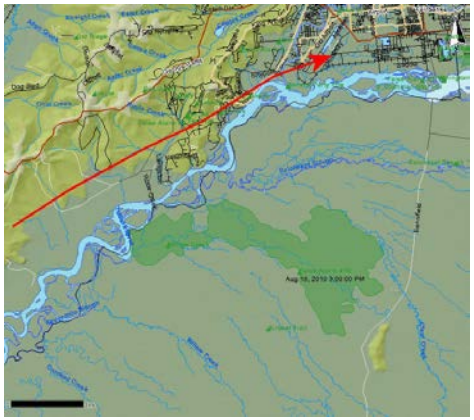
| University of Wyoming | | | Radiosonde | PAFA Fairbanks | |
|---|---|---|---|---|---|
| July 15, 12Z 2010 | | | 70261 | | |
| | PRES | HGHT | TEMP | DRCT | SKNT |
| | hPa | m | C | deg | knot |
| | 1000 | 138 | 9.2 | 155 | 2 |
| | 979.8 | 305 | 8 | 235 | 8 |
| | 944 | 610 | 5.8 | 265 | 13 |
| | 925 | 777 | 4.6 | 265 | 18 |
| | 909.5 | 914 | 3.8 | 260 | 18 |
| | | Inversion Thickness (m) | Temperature C Diff | | |
| | | N/A | N/A | | |

Table 22: Numeric data for the lower levels of the Fairbanks July 15, 2010/12Z (3:00AM) Skew-T

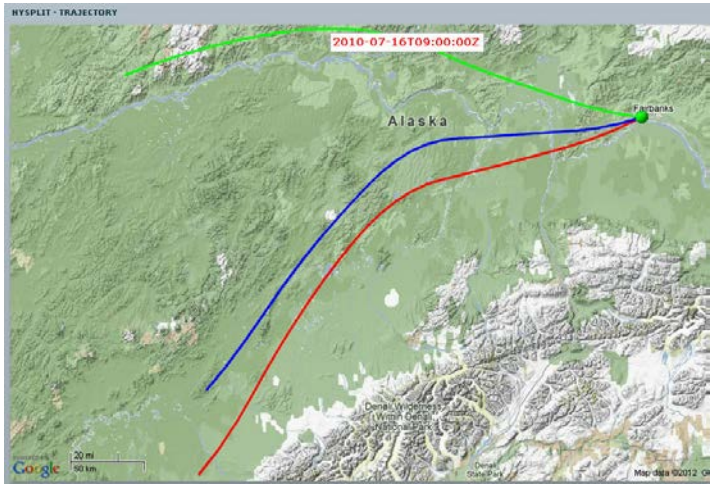
July 15 was not a scheduled sampling day, so FRM data are not available for this day. Secondary $PM_{2.5}$ 24 hour average concentration was 26.6µg/$m^3$.




A. HYSPLIT Backwards Trajectory Forecast from July 16, 2010, 00LST backward to July 15, 2010, 00LST.



C. July 15, 2010 Willow Creek Fire map with 30m trajectory




B. HYSPLIT Trajectory forecast on Google Earth map. Red = 30m, Blue = 100m, Green=500m

| 15 Jul | HRLY PM2.5 |
|---|---|
| 0:00 | 4.7 |
| 1:00 | 8.1 |
| 2:00 | 61.1 |
| 3:00 | 58 |
| 4:00 | 62.2 |
| 5:00 | 58.9 |
| 6:00 | 49 |
| 7:00 | 50.7 |

| 15-Jul | HRLY PM2.5 |
|---|---|
| 8:00 | 36.3 |
| 9:00 | 13.3 |
| 10:00 | 16.5 |
| 11:00 | 18.3 |
| 12:00 | 10.5 |
| 13:00 | 4.2 |
| 14:00 | 24.6 |
| 15:00 | 24.8 |

| 15-Jul | HRLY PM2.5 |
|---|---|
| 16:00 | 15.5 |
| 17:00 | 17.4 |
| 18:00 | 11.6 |
| 19:00 | 2.7 |
| 20:00 | 1.6 |
| 21:00 | 8.7 |
| 22:00 | 35.4 |
| 23:00 | 43.6 |

D. Hourly $PM_{2.5}$ for July 15, 2010

Figure 29: July 15, 2010 All end points/arrow heads terminate at Fairbanks, Alaska , Alaska

Table 23: Hourly Observations for Fairbanks International Airport, July 15, 2010

| USAF | WBAN | YR--MODAHRMN (LST) | DIR (From) | SPD (MPH) | GUS (MPH) | VSB (SM) | WW | WW |
|---|---|---|---|---|---|---|---|---|
| 702610 | 26411 | 201007150053 | 990 | 5 | *** | 8 | 61 (Lgt Rain | ** |
| 702610 | 26411 | 201007150153 | 210 | 6 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007150253 | 210 | 5 | *** | 9.1 | ** | ** |
| 702610 | 26411 | 201007150353 | *** | 0 | *** | 2 | 4(Smoke) | ** |
| 702610 | 26411 | 201007150453 | 200 | 3 | *** | 3 | 61 (Lgt Rain | 4(Smoke) |
| 702610 | 26411 | 201007150553 | 210 | 5 | *** | 5 | 4(Smoke) | ** |
| 702610 | 26411 | 201007150653 | 200 | 5 | *** | 4 | 4(Smoke) | 10 (Mist) |
| 702610 | 26411 | 201007150753 | *** | 0 | *** | 4 | 4(Smoke) | 10 (Mist) |
| 702610 | 26411 | 201007150853 | *** | 0 | *** | 6 | 4(Smoke) | 10 (Mist) |
| 702610 | 26411 | 201007150953 | 240 | 5 | *** | 6 | 10 (Mist) | ** |
| 702610 | 26411 | 201007151053 | 200 | 3 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007151153 | 250 | 6 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007151253 | 210 | 5 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007151353 | 990 | 3 | *** | 10 | 61 (Lgt Rain | ** |
| 702610 | 26411 | 201007151453 | 200 | 3 | *** | 10 | 61 (Lgt Rain | ** |
| 702610 | 26411 | 201007151553 | 200 | 6 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007151653 | 200 | 6 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007151753 | 990 | 6 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007151853 | 250 | 10 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007151953 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007152053 | 990 | 5 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007152153 | 210 | 6 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007152253 | 210 | 5 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007152353 | *** | 0 | *** | 10 | ** | ** |

## July 16, 2010

Fire Map with trajectory: The 30m trajectory shows the flow from the south-southwest through the fire area.

HYSPLIT trajectory passes directly through the fire area. Higher concentrations are a result especially between the hours of July 16, 0:00 to 9:00AM.

Meteorological observation and Skew-T data: The morning Skew-T shows calm winds at the lowest level and Fairbanks Airport surface observations show calm or light southerly winds. The trajectory today was clearly through the fire area. This resulted in high concentrations from midnight through 9:00AM AST.

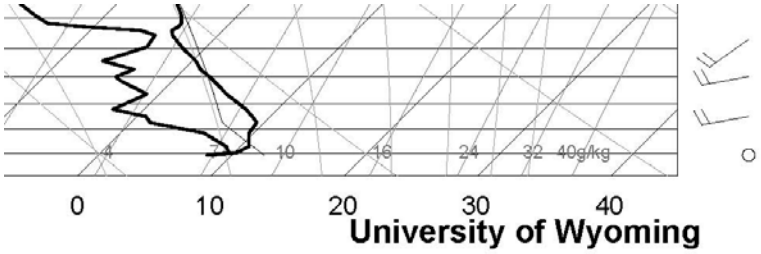
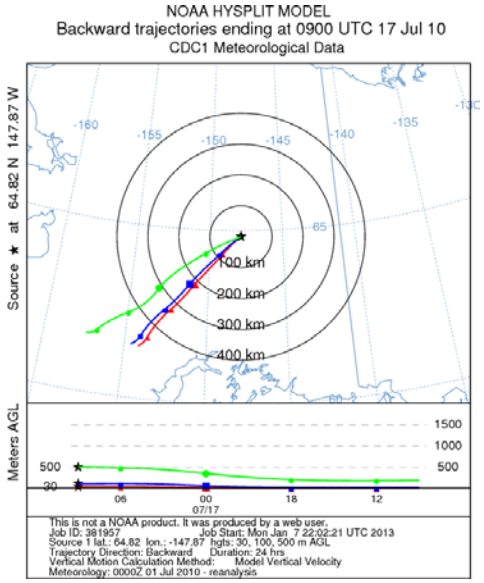



Figure 30: Lowest portion of the Fairbanks July 16 2010 12Z (3:00AM AST) Skew-T

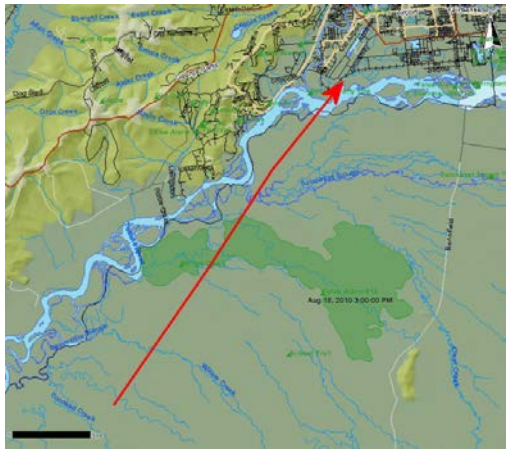
| University of Wyoming | | | Radiosonde | PAFA Fairbanks | |
|---|---|---|---|---|---|
| July 16, 12Z 2010 | | | 70261 | | |
| | PRES | HGHT | TEMP | DRCT | SKNT |
| | hPa | m | C | deg | knot |
| | 1004 | 138 | 8.4 | 0 | 0 |
| | 1000 | 164 | 9.8 | 250 | 5 |
| | 998 | 181 | 10.2 | 252 | 6 |
| | 986 | 282 | 10.6 | 263 | 12 |
| | 983.2 | 305 | 10.5 | 265 | 13 |
| | 958 | 522 | 9.6 | 261 | 18 |
| | | Inversion Thickness (m) | Temperature C Diff | | |
| | | 167 | 2.1 | | |

Table 24: Numeric data for the lower levels of the Fairbanks July 16, 2010/12Z (3:00AM) Skew-T

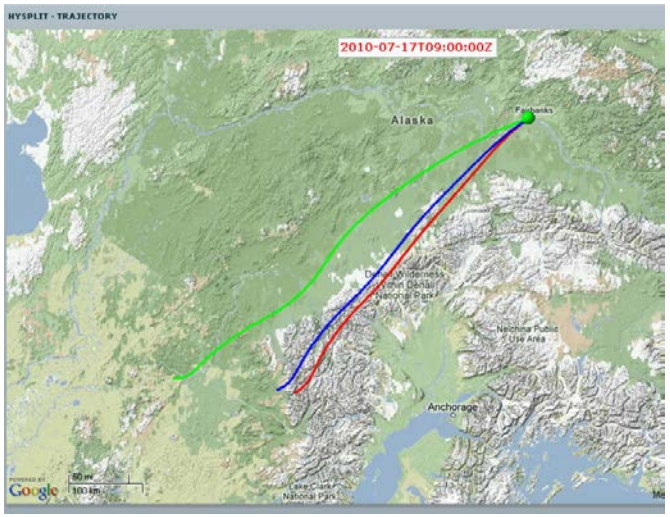
FRM filter, 24 hour $PM_{2.5}$ was 25.9µg/m$^3$. Secondary $PM_{2.5}$ 24 hour average was 21.3µg/m$^3$ at the co-located sensor.




A. HYSPLIT Backwards Trajectory Forecast from July 17, 2010, 00LST backward to July 16, 2010, 00LST.



C. July 16, 2010 Willow Creek Fire map with 30m trajectory




B. HYSPLIT Trajectory forecast on Google Earth map. Red = 30m, Blue = 100m, Green=500m

| 16 Jul | HRLY PM2.5 |
|---|---|
| 0:00 | 27.8 |
| 1:00 | 44.9 |
| 2:00 | 43.8 |
| 3:00 | 67.2 |
| 4:00 | 72.6 |
| 5:00 | 96.6 |
| 6:00 | 78.9 |
| 7:00 | 47.1 |

| 16-Jul | HRLY PM2.5 |
|---|---|
| 8:00 | 33.6 |
| 9:00 | 19.2 |
| 10:00 | 11.6 |
| 11:00 | 3 |
| 12:00 | 3.3 |
| 13:00 | 7.5 |
| 14:00 | 6.2 |
| 15:00 | 3.6 |

| 16-Jul | HRLY PM2.5 |
|---|---|
| 16:00 | 4.5 |
| 17:00 | 4.7 |
| 18:00 | 5.3 |
| 19:00 | 4.9 |
| 20:00 | 5.1 |
| 21:00 | 5.3 |
| 22:00 | 10.7 |
| 23:00 | 13.3 |

D. Hourly $PM_{2.5}$ for July 16, 2010

Figure 31: July 16, 2010 All end points/arrow heads terminate at Fairbanks, Alaska

Table 25: Hourly Observations for Fairbanks International Airport, July 16, 2010

| USAF | WBAN | YR--MODAHRMN (LST) | DIR (From) | SPD (MPH) | GUS (MPH) | VSB (SM) | WW | WW |
|---|---|---|---|---|---|---|---|---|
| 702610 | 26411 | 201007160053 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007160153 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007160253 | 200 | 5 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007160353 | 210 | 5 | *** | 2 | ** | ** |
| 702610 | 26411 | 201007160453 | *** | 0 | *** | 1.5 | 4(Smoke) | 10 (Mist) |
| 702610 | 26411 | 201007160553 | 190 | 3 | *** | 2 | 4(Smoke) | 10 (Mist) |
| 702610 | 26411 | 201007160653 | *** | 0 | *** | 2 | 4(Smoke) | 10 (Mist) |
| 702610 | 26411 | 201007160753 | 190 | 3 | *** | 3 | 4(Smoke) | ** |
| 702610 | 26411 | 201007160853 | 990 | 3 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007160953 | 240 | 8 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007161053 | 230 | 9 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007161153 | 260 | 13 | 21 | 10 | ** | ** |
| 702610 | 26411 | 201007161253 | 240 | 13 | 18 | 10 | ** | ** |
| 702610 | 26411 | 201007161353 | 290 | 10 | *** | 10 | 61 (Lgt Rain | ** |
| 702610 | 26411 | 201007161453 | 990 | 8 | 18 | 10 | ** | ** |
| 702610 | 26411 | 201007161553 | 220 | 10 | 16 | 10 | ** | ** |
| 702610 | 26411 | 201007161653 | 990 | 6 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007161753 | 990 | 7 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007161853 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007161953 | 270 | 11 | 24 | 10 | 61 (Lgt Rain | ** |
| 702610 | 26411 | 201007162053 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007162153 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007162253 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007162353 | *** | 0 | *** | 10 | ** | ** |

## July 17, 2010

Fire Map with trajectory: The 30m trajectory shows the flow from the south-southwest through the fire area.

HYSPLIT trajectory passes directly through the fire area. This results in higher PM2.5 concentrations in the morning again.

Meteorological observation and Skew-T data: The morning Skew-T shows calm winds at the lowest level and westerly winds above the shallow inversion. This would change later in the day. Fairbanks Airport surface observations show winds shifting from southerly to northerly between 1:00PM and 2:00PM AST. After the wind shift smoke was blown away from Fairbanks and $PM_{2.5}$ concentrations dropped rapidly. Significant $PM_{2.5}$ concentrations would not return after today.

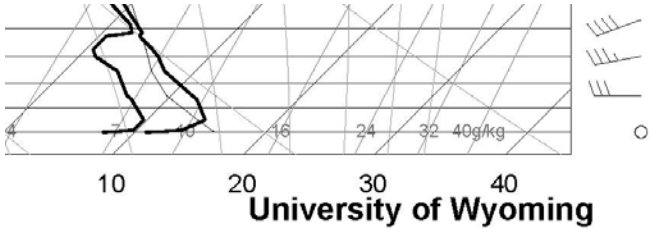
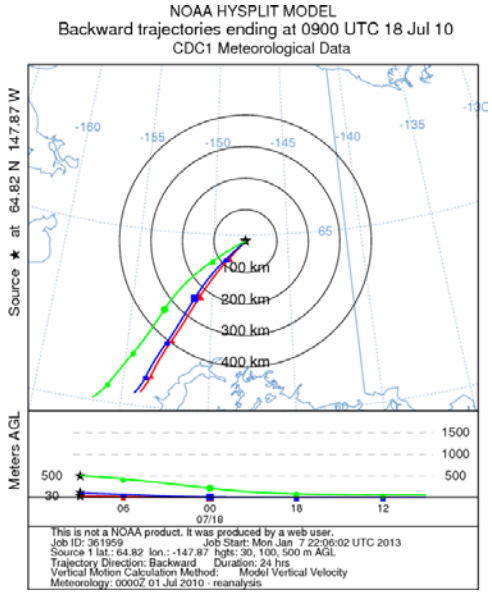



Figure 32: Lowest portion of the Fairbanks July 17 2010 12Z (3:00AM AST) Skew-T

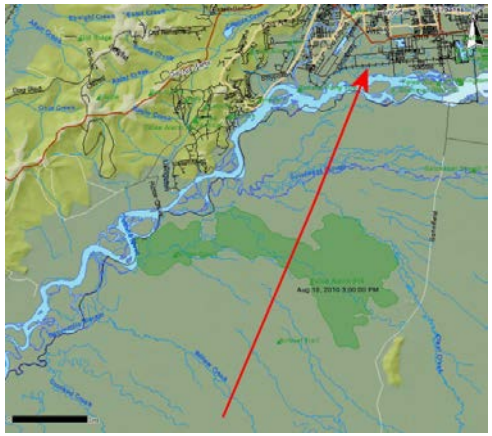
| University of Wyoming | | | Radiosonde | PAFA Fairbanks | |
|---|---|---|---|---|---|
| July 17, 12Z 2010 | | | 70261 | | |
| | PRES | HGHT | TEMP | DRCT | SKNT |
| | hPa | m | C | deg | knot |
| | 1000 | 138 | 10.8 | 0 | 0 |
| | 999 | 146 | 12 | 354 | 0 |
| | 996 | 172 | 13.4 | 338 | 2 |
| | 980.3 | 305 | 14.1 | 250 | 8 |
| | 974 | 360 | 14.4 | 254 | 11 |
| | 945.4 | 610 | 12.9 | 270 | 27 |
| | | Inversion Thickness (m) | Temperature C Diff | | |
| | | 222 | 3.6 | | |

Table 26: Numeric data for the lower levels of the Fairbanks July 17, 2010/12Z (3:00AM) Skew-T

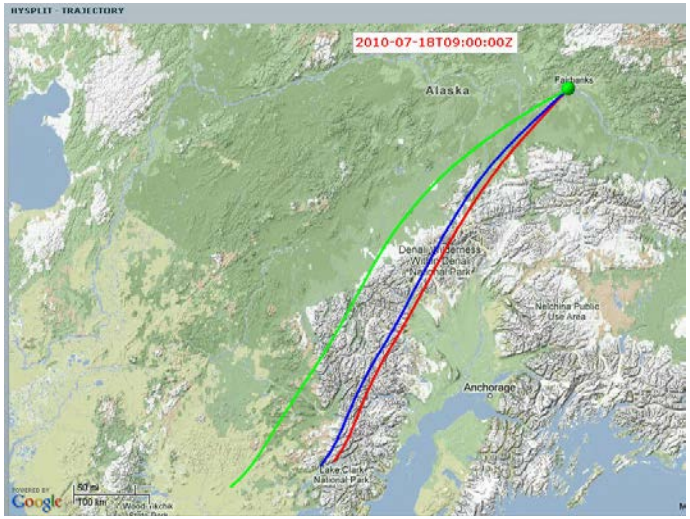
July 17 was not a scheduled sampling day, so FRM data are not available for this day. Secondary $PM_{2.5}$ 24 hour average concentration was 16.3µg/$m^3$.




A. HYSPLIT Backwards Trajectory Forecast from July 18, 2010, 00LST backward to July 17, 2010, 00LST.



C. July 17, 2010 Willow Creek Fire map with 30m trajectory




B. HYSPLIT Trajectory forecast on Google Earth map. Red = 30m, Blue = 100m, Green=500m

| 17 Jul | HRLY PM2.5 |
|---|---|
| 0:00 | 15.5 |
| 1:00 | 58.9 |
| 2:00 | 36 |
| 3:00 | 47.5 |
| 4:00 | 38.8 |
| 5:00 | 13.1 |
| 6:00 | 11.4 |
| 7:00 | 13.3 |

| 17-Jul | HRLY PM2.5 |
|---|---|
| 8:00 | 13.5 |
| 9:00 | 9.9 |
| 10:00 | 26.1 |
| 11:00 | 21.1 |
| 12:00 | 18.9 |
| 13:00 | 11.4 |
| 14:00 | 6.2 |
| 15:00 | 7.9 |

| 17-Jul | HRLY PM2.5 |
|---|---|
| 16:00 | 7.2 |
| 17:00 | 4.2 |
| 18:00 | 4.2 |
| 19:00 | 2.1 |
| 20:00 | 2.5 |
| 21:00 | 7 |
| 22:00 | 7.9 |
| 23:00 | 7.7 |

D. Hourly $PM_{2.5}$ for July 17, 2010

Figure 33: July 17, 2010 All end points/arrow heads terminate at Fairbanks, Alaska

Table 27: Hourly Observations for Fairbanks International Airport, July 17, 2010

| USAF | WBAN | YR--MODAHRMN (LST) | DIR (From) | SPD (MPH) | GUS (MPH) | VSB (SM) | WW | WW |
|---|---|---|---|---|---|---|---|---|
| 702610 | 26411 | 201007170053 | *** | 0 | *** | 7 | ** | ** |
| 702610 | 26411 | 201007170153 | 200 | 3 | *** | 9.1 | ** | ** |
| 702610 | 26411 | 201007170253 | *** | 0 | *** | 4 | 4(Smoke) | ** |
| 702610 | 26411 | 201007170353 | 200 | 5 | *** | 5 | 4(Smoke) | ** |
| 702610 | 26411 | 201007170453 | 210 | 5 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007170553 | 220 | 7 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007170653 | 230 | 7 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007170753 | 210 | 5 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007170853 | 240 | 7 | *** | 6 | 61 (Lgt Rain | 10 (Mist) |
| 702610 | 26411 | 201007170953 | *** | 0 | *** | 8 | 61 (Lgt Rain | ** |
| 702610 | 26411 | 201007171053 | 190 | 5 | *** | 6 | 4(Smoke) | ** |
| 702610 | 26411 | 201007171153 | 190 | 6 | *** | 7 | ** | ** |
| 702610 | 26411 | 201007171253 | *** | 0 | *** | 9.1 | ** | ** |
| 702610 | 26411 | 201007171353 | 130 | 9 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007171453 | 40 | 5 | *** | 10 | 95(TSTM) | 81(RW) |
| 702610 | 26411 | 201007171553 | 20 | 8 | *** | 10 | 17 (TSTM no Precip) | ** |
| 702610 | 26411 | 201007171653 | 330 | 16 | 28 | **** | ** | ** |
| 702610 | 26411 | 201007171753 | 40 | 3 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007171853 | 50 | 5 | *** | 10 | 61 (Lgt Rain | ** |
| 702610 | 26411 | 201007171953 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007172053 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007172153 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007172253 | *** | 0 | *** | 10 | ** | ** |
| 702610 | 26411 | 201007172353 | *** | 0 | *** | 10 | ** | ** |

### Summary of the July Event Period

This event can best be summarized as location, location, location. The wind direction held steady through the period and continuously adverted smoke into Fairbanks. The smoke, and therefore the $PM_{2.5}$ concentrations, during the smoke event period varied primarily due to increases and decreases in fire spread, suppression efforts, and strength and length of time shallow surface based inversions were present. Smoke continued in the area through the period but only resulted in a 24-hr PM2.5 exceedance on one day, July 13, 2010.

## There would have been no exceedance except for the event

As outlined in July Event daily discussion above, the July 13, 2010 exceedance was caused by a combination of smoke from the nearby Willow Creek fire, growth of the further away Toklat2 fire, and a predominately southwest wind for several days in a row.

In years when there were no fires, typical summertime $PM_{2.5}$ concentrations range within the single digit levels, see page 22. In 2010, Figure 3 shows that the 24-hr average $PM_{2.5}$ concentrations are below 11µg/$m^3$ for the period April 1, 2010 and September 30, 2012 except for the days when smoke impacted Fairbanks.

On July 13, 2010 there were no prescribed burns in the Interior of Alaska, nor anywhere else in the state. In fact as shown in Figure 5 there were no prescribed burns conducted on any day in June of July of 2012. Emission inventory data collected for the Fairbanks area indicate no large sources of $PM_{2.5}$ during the summer, except for wildfires (2008 and 2011 Alaska Wildfire Emissions Inventory). The major stationary sources operate year round and only marginally contribute to the $PM_{2.5}$ concentrations. A model run for the entire 2009 summer season showed no to low contribution of these sources to the summer time fine particulate matter levels. (Exceptional Events Waiver Request for Exceptional $PM_{2.5}$ Events between July 6 and August 8, 2009 at the State Office Building in Fairbanks, Alaska). Due to high cost of the modeling analysis ADEC decided not to contract another analysis for 2010. Area or local sources also do not create large enough emissions during the summer to reach concentrations near or above the NAAQS. Note: Wintertime exceedances in Fairbanks have been documented to consist of 60% - 80% of wood smoke from home heating devices[9]

[9] Ward, Tony et. al 2012

## Mitigation

DEC continues to work closely with Alaska Fire Service, the AICC and the Fire Weather Forecasters to ensure Air Quality Advisory Notifications are sent to the public as rapidly as possible. New in place procedures allow ADEC to send Air Quality Advisories via Twitter and email greatly reducing the time required to contact government agencies and the general public.

ADEC, the federal land management agencies, and Alaskan tribes developed an interagency plan, the Alaska Interagency Wildland Fire Management Plan (AIWFMP), to address controlling wildland fires. The AIWFMP requires an annual, pre-season land manager(s)/owner(s) review of the fire protection needs on lands under their management authority. In addition, responsibilities and actions taken to mitigate impacts of wildfire smoke are outlined in the "Alaska's Enhanced Smoke Management Plan for Prescribed Fire, Procedures Manual April 10, 2006." The purpose of the Enhanced Smoke Management Plan (ESMP) is to provide a clear and equitable regulatory basis for smoke management in Alaska. The ESMP also outlines procedures for monitoring ambient air quality in the event of a wildfire.

## Procedural Requirements

In accordance with the exceptional events rule 40 CFR §50.14(c)(2)(iii), four data points (May 29$^{th}$, June 1$^{st}$, July 13$^{th}$ and July 16$^{th}$ ) were flagged in the State's AQS data submission. ADEC requests that EPA exclude these flagged data points when determining compliance with the $PM_{2.5}$ NAAQS for the Fairbanks State Office Building site.

## Conclusions

This document describes the wildfires by location and acreage burned in Alaska in the summer of 2010. The cause of all these major fires was lightening ignition of very dry fuels caused by drought conditions. Both these causes are natural occurring and uncontrollable phenomena.

The smoke from these fires impacted the Fairbanks area and resulted in several days of increased smoke and $PM_{2.5}$ concentrations. Only one of the four days, July 13, 2010 was an exceedance of the 24-HR $PM_{2.5}$ NAAQS. These smoke impacted, natural event data should not be used in the determination of compliance with the NAAQS for Fairbanks and surrounding areas. It is clear that without the wildfires, $PM_{2.5}$ concentrations at the Fairbanks State Office Building site would have been much lower. Data from low fire years provide an estimate of background summer time $PM_{2.5}$ concentrations in the range of 3-6 $\mu g/m^3$ (Table 6), less than 20% of the $PM_{2.5}$ NAAQS.

These wildfires will reoccur and are not controllable. State of Alaska ESMP and Air Quality Advisory procedures adequately cover actions to be taken when these events occur.

## References:


- Draxler, R.R., and G.D. Hess, 1997: Description of the HYSPLIT_4 modeling system. NOAA Tech. Memo. ERL ARL-224, NOAA Air Resources Laboratory, Silver Spring, MD, 24 pp.
- Draxler, R.R., and G.D. Hess, 1998: An overview of the HYSPLIT_4 modeling system of trajectories, dispersion, and deposition. *Aust. Meteor. Mag.*, **47**, 295-308.
- Draxler, R.R., 1999: HYSPLIT4 user's guide. NOAA Tech. Memo. ERL ARL-230, NOAA Air Resources Laboratory, Silver Spring, MD.
- G.Wendler, et, Climatology of Alaskan wildfires with special emphasis on the extreme year 2004, Springer-Verlag 2010
- NOA, Critical Weather patterns of US, 1999
- Wildland Fire Summary and Statistics Annual Report – AICC , Alaska Fire Season 2010
- http://dec.alaska.gov/air/anpms/comm/fbks1_pm.htm
- http://www.dec.state.ak.us/air/am/am_projects.htm
- http://www.epa.gov/ttnnaaqs/standards/pm/data/HanleyandReff040711.pdf
- http://climate.gi.alaska.edu/AkCityClimo/2010/Jun/Jun_2010.html
- http://climate.gi.alaska.edu/AkCityClimo/2001/Jul/Jul_2001.html
- http://climate.gi.alaska.edu/AkCityClimo/2010/Jul/Jul_2010.html
- http://fire.ak.blm.gov/predsvcs/weather.php
- http://www.dec.state.ak.us/air/am/am_projects.htm
- 2010 Alaska Wildfire Emissions Inventory , BLM
- 2010 Alaska Fire Statistics , BLM
- Ward, Tony, et al., 2012. Source Apportionment of $PM_{2.5}$ in a Subarctic Airshed – Fairbanks, AK, *Aerosol and Air Quality Research* 12, 536-543.


If the paper used results from the on-line web version of HYSPLIT, please include the following references:

- Draxler, R.R. and Rolph, G.D., 2011. HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Website (http://ready.arl.noaa.gov/HYSPLIT.php). NOAA Air Resources Laboratory, Silver Spring, MD.
- Rolph, G.D., 2011. Real-time Environmental Applications and Display sYstem (READY) Website (http://ready.arl.noaa.gov). NOAA Air Resources Laboratory, Silver Spring, MD.
- Rolph, G.D., et al., 2009. Description and Verification of the OA Smoke Forecasting System: The 2007 Fire Season, *Weather and Forecasting*, **24**, 361-378.
- Stein, A.F., et al., 2009. Verification of the NOAA Smoke Forecasting System: Model Sensitivity to the Injection Height, *Weather and Forecasting*, **24**, 379-394.

## Abbreviations:

AICC Alaska Interagency Coordination Center
BL Boundary Layer
GDAS Global Data Assimilation System
GFS Global Forecast System
HYSPLIT HYbrid Single-Particle Lagrangian Integrated Trajectory
MODIS Moderate Resolution Imaging Spectroradiometer satellite imagery
NCEP National Centers for Environmental Prediction
AIWFMP Alaska Interagency Wildland Fire Management Plan
NAAQS National Ambient Air Quality Standard
FRM Federal Reference Method
FEM Federal Equivalent Method
WD Wind Direction
WS Wind Speed