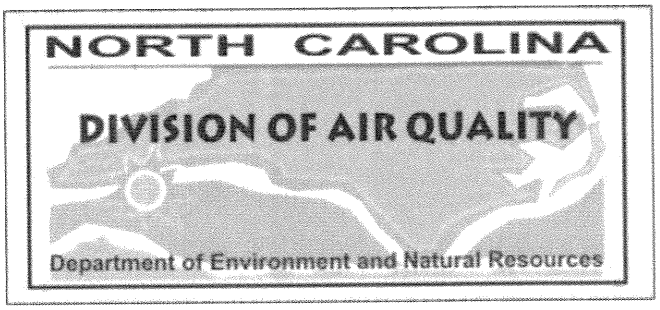
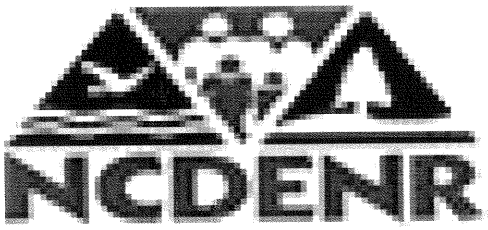


JUNE 14, 2007
EXCEPTIONAL EVENT
DEMONSTRATION PACKAGE

FOR THE

SPRUCE PINE
FINE PARTICLE
FEDERAL REFERENCE METHOD MONITOR
(371210001-88101-1)

December 14, 2007



A Division of the North Carolina Department
of Environment and Natural Resources
Mail Service Center 1641
Raleigh, North Carolina 27699-1641

TABLE OF CONTENTS

Spruce Pine FRM-$PM_{2.5}$ (No TEOM-$PM_{2.5}$ at Spruce Pine)
138 Highland Avenue
Spruce Pine, NC
Mitchell County
371210001-88101
6/14/07
61.04 $\mu g/m^3$
Recommended Flag - E: Forest Fire

DISCUSSION:

The North Carolina Division of Air Quality seeks EPA concurrence of the "E" flag (Forest Fire) for the Federal Reference Method (FRM) – PM2.5 monitor reading 61.04 micrograms per meter cubed ($\mu g/m^3$) on 6/14/07 at the Spruce Pine monitoring station.

Lightning sparked two fires in Burke County on Friday 6/8/07 at Dobson Knob and Shortoff Mountain. On Monday, 6/11/07, the particulate matter monitor at Spruce Pine, located Northwest of the fire locations, registered an unusually high concentration. Meteorological data show the prevailing winds were to the Northwest during this period. Computer modeling of wind and smoke plume trajectories show that the Spruce Pine monitor was directly impacted by the event. Plots of Forward and Backward trajectories are provided here for graphical evidence. In addition, these trajectories were superimposed on a map of the areas of interest using GIS software and are also included here for review. The following table provides concentration data ($\mu g/m^3$) for the Spruce Pine FRM PM-2.5 monitor for 6/14/07 and the periods immediately prior to and after the event. Also included in the table are concentrations data from two upwind sites which included FRM PM-2.5 as well as automated continuous TEOM PM-2.5. This comparative data shows that the PM-2.5 concentrations were nominally a factor of four lower than the value observed on 6/14/07.

Table 1 Comparative PM2.5 Data, ($\mu g/m^3$)

		Exceedance monitor		Upwind		Upwind	
		Spruce Pine		**Marion**		**Hickory**	
		FRM	TEOM	FRM	TEOM	FRM	TEOM
Pre Event, 6/2-6/8	3-day Avg	11.8	NA	12.5	11.7	8.09	13.5
	Max.	15.71	NA	17.46	15.3	12.67	18.9
	Min.	7.79	NA	7.96	9.7	9.71	10.3
6/14/07	**24 hr Avg**	**61.04**	**NA**	**17.17**	**17.1**	**14.38**	**16.0**
Post Event, 6/17-6/29	5-day Avg	14.76	NA	21.38	21.6	17.3	22.9
	Max.	17.75	NA	32.5	27.6	22.17	26.5
	Min.	10.08	NA	10.08	10.5	13.33	11.8

As can be seen from the table, the Pre- and Post-event (background) averages were very similar across all three sites.

NATIONAL FORESTS IN NORTH • CAROLINA

USDA FOREST SERVICE, 160A ZILLICOA STREET, ASHEVILLE, NC 28801

NEWS • RELEASE

Contact: Terry Seyden
828-231-4009
terryseyden@yahoo.com

For Immediate Release **June 10, 2007**

6/10

Lightning Starts Two New Fires Near Linville Gorge

Lightning started two new fires in the Linville Gorge area of the Pisgah National Forest late Friday afternoon. The fires are on national forest land in Burke County about six miles apart from each other. As of 10:00 am Sunday, the Dobson Knob fire, three miles north of Lake James, had burned over 250 acres. The Shortoff Mountain fire has burned about 125 acres on the east side of Linville River within the Linville Gorge Wilderness.

The fires are currently burning on national forest lands and no private lands or homes are threatened. State and federal helicopters and air tankers made water and retardant drops yesterday to help slow down the fires and are available today if needed. Two dozers are also being used to construct containment lines around the perimeter of the fires. Approximately 140 firefighters are now on the scene battling the two blazes, and more crews are en route.

The hot, dry weather the last two months in western North Carolina has created unusually high fire danger conditions for this late in the season. "The extended drought and a buildup of dead pines killed by southern pine beetle outbreaks have combined to cause these fires to burn much hotter and spread faster than what we normally see", said U.S. Forest spokesman Terry Seyden.

-more-

At this time the Forest Service does not have an estimate of when these two fires will be contained. Long range weather forecasts call for continued hot, dry conditions which will make it more difficult to bring these fires under control. "What we really need is an extended period of heavy, soaking rains, but unfortunately that's not in the forecast," Seyden added.

To ensure public safety, trails in the southern part of Linville Gorge Wilderness area will be closed until further notice. The public can check for updated fire information at the National Forests in North Carolina website http://www.cs.unca.edu/nfsnc.

###

CITIZEN-TIMES.com: Linville Gorge blaze claims 900 acresCITIZEN-TIMES.com
Linville Gorge blaze claims 900 acres

By Mike McWilliams (828-232-5953)
MMCWILLIAMS@CITIZEN-TIMES.COM
[Tuesday] June 12, 2007 12:15 am

LINVILLE GORGE – Two fires burning across the Linville Gorge area of Pisgah National Forest have consumed more than 900 acres, a U.S. Forest Service official said Monday.

U.S. Forest Service spokesman Terry Seyden said the Dobson Knob fire, three miles north of Lake James, has burned about 540 acres. As of 6 p.m. Monday, the second fire, on Shortoff Mountain, had burned about 700 acres, according to a Forest Service news release.

"Both fires continued to burn actively overnight," Seyden said Monday. "We've got more than 150 personnel working on the fires, and we're watching the weather closely."

Lightning sparked the two fires Friday [June 8, 2007] on National Forest land in Burke County. Dense smoke from the fires Monday afternoon hampered visibility and caused traffic congestion on U.S. 221 north of Woodlawn in McDowell County.

The hot, dry weather the last two months in Western North Carolina has created unusually high fire danger conditions for this late in the season, Seyden said. Seyden said the U.S. Forest Service has been working with state and local firefighters to battle the blazes. So far, private homes are not in harm's way, Seyden said.

On the Shortoff Mountain blaze, Seyden said crews would likely start back-burning in the next day or two to establish a perimeter line. Back-burning includes setting fires ahead of the active fire line to eliminate trees, bushes and other fuels for the main fire.

"We could easily be dealing with these fires for another week or two," Seyden said. "We're going to secure the lines, and we have aerial support, but long, sustained rains are what it's going to take to make sure these fires are out."
Staff writer Andre A. Rodriguez contributed to this report.

July 05, 2007 Fire Information 828-443-1668	**Fire Update**	National Forest in NC Pisgah National Forest Grandfather Ranger District Linville Complex

- The Linville Complex is located on the Pisgah National Forest, Grandfather Ranger District. Three wildfires, each started by lightning on June 8, 2007, comprise the complex. Total complex acreage is currently at 5,400 with 100% containment. There are 130 personnel assigned to the complex. This includes 4 hand crews, 2 helicopter, 4 engines and 2 dozers Air support from the North Carolina Division of Forest Resources is available if needed.

- The Linville Complex consists of:
  - Shortoff Mountain Fire – 4,517 acres in Linville Gorge Wilderness (contained)
  - Dobson Knob Fire – 816 acres (contained)
  - Cold Mountain Fire – 67 acres west (fire is out)

- **The trails north of and to include the Table Rock picnic area have been reopened. Mountain to the Sea Trail south of the Table Rock picnic area to include the Chimneys remains <u>closed</u> to the public.**

- **The western side off Forest Road 105, including Wiseman's View, is entirely open, as well as the north end of Linville Gorge. The only section closed is from Forest Road 99 on the eastern side of the Linville River to Shortoff Mountain, between the river and Forest Road 118.**

- Firefighters will continue to patrol and mop-up any hot spots and fell any snags that may pose a threat to firefighter and public safety on the Shortoff Mountain and Dobson Knob Fires. While the fires are now 100% contained they are not totally out. Until we receive a significant amount of rain fall ground fires will continue to burn and resurface in patches of unburned areas.

- The Cold Mountain Fire is considered out.

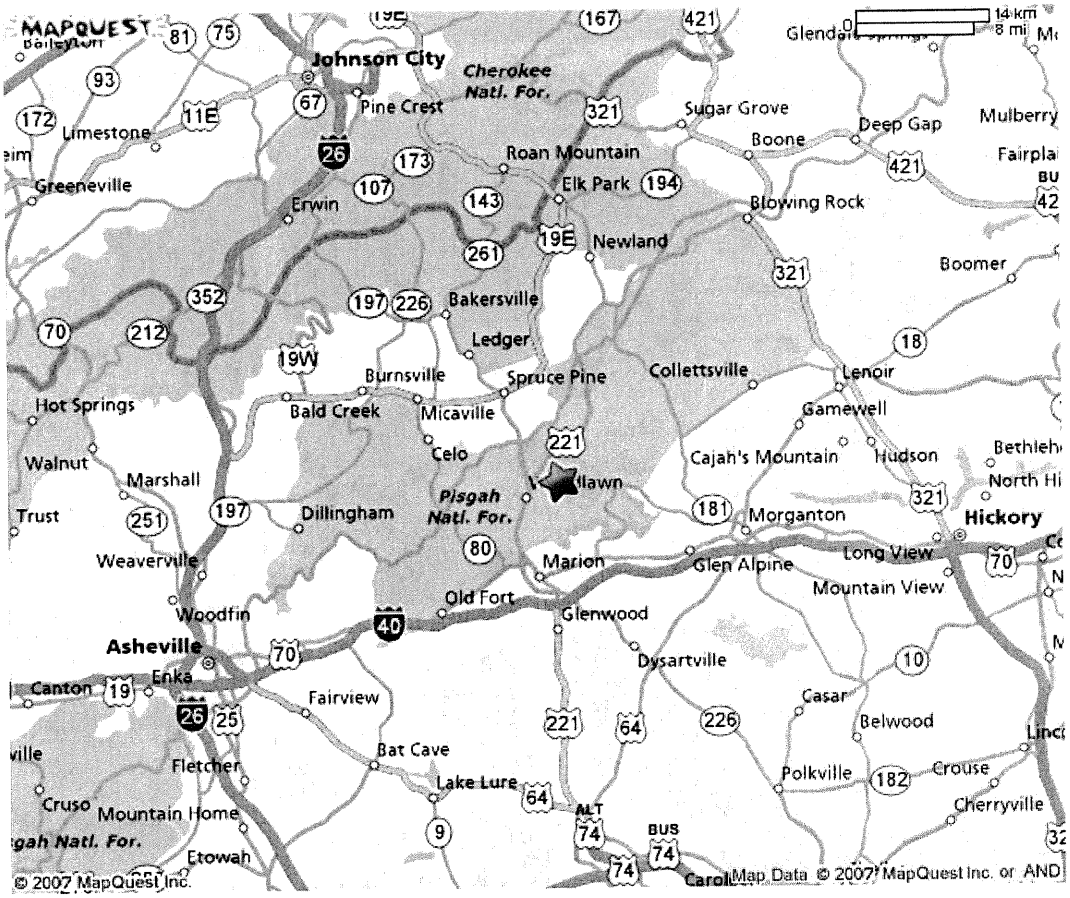
- Rehabilitation work will continue to include the public trails.

- **The threat of new fires continues to exist and the public is reminded that over the holiday weekend fireworks are not allowed on the Pisgah National Forest. The public should also be careful with campfires if they are camping on the Forest, and ensure their fire is never left unattended and is completely out when they leave their campsite.**

MAPQUEST

Dobson Knob
Nebo NC
US

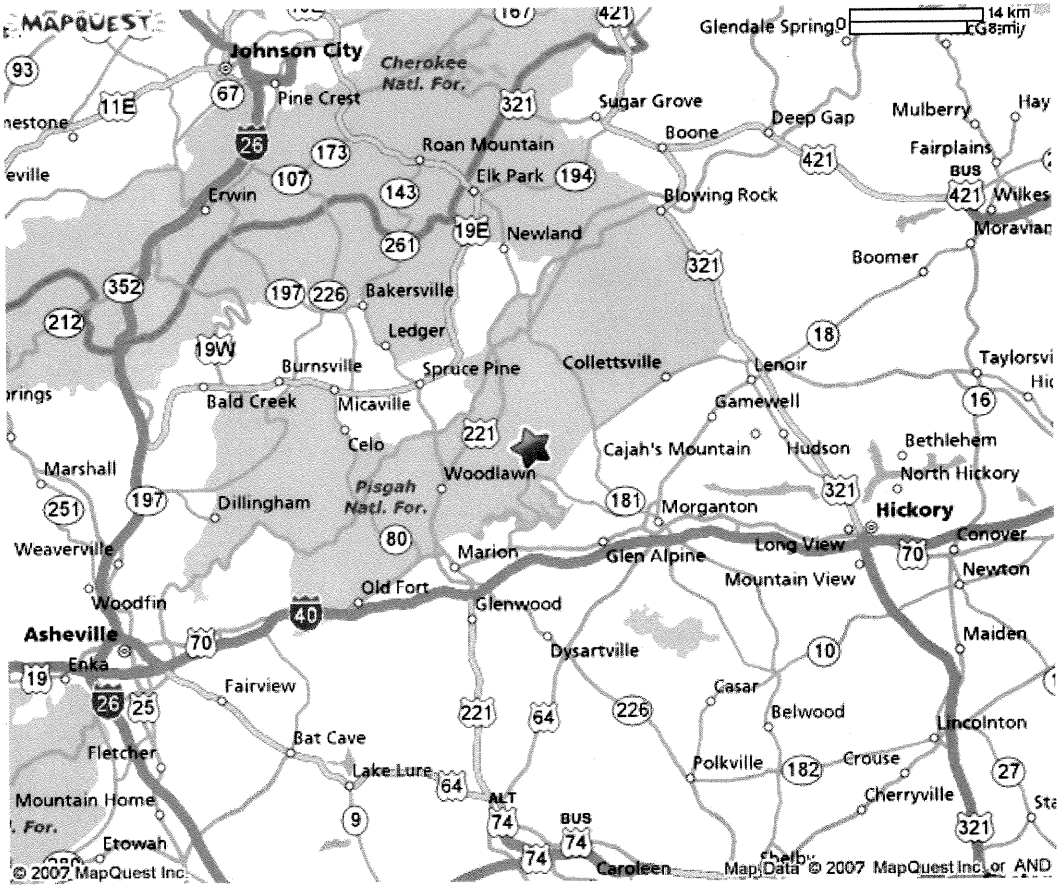
Notes:
Dobson Knob



MAPQUEST

Shortoff Mountain
Morganton NC
US

Notes:
Only text visible within note field will print.

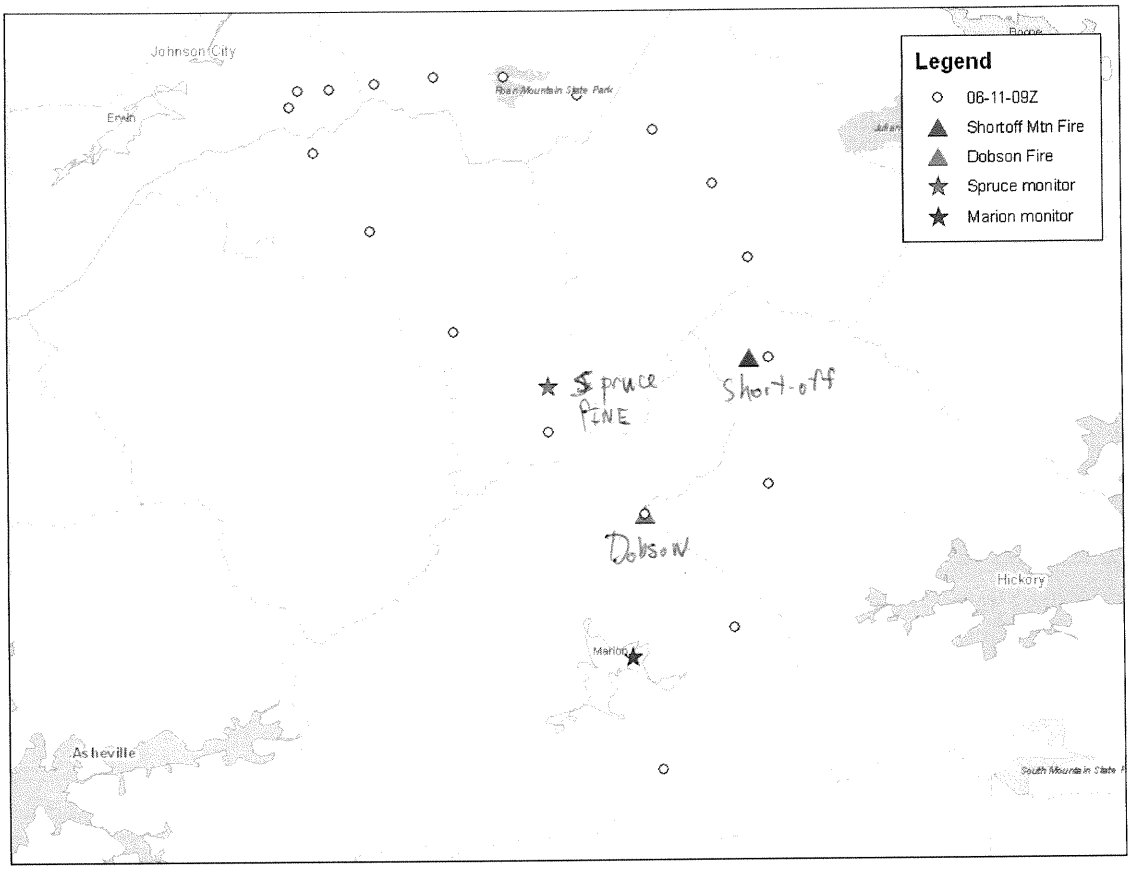


Time Conversion Table

Z Time (UTC)	Pacific Standard Time	Mountain Standard Time	Central Standard Time	Eastern Standard Time
00Z	4:00 PM	5:00 PM	6:00 PM	7:00 PM
03Z	7:00 PM	8:00 PM	9:00 PM	10:00 PM
06Z	10:00 PM	11:00 PM	12:00 AM	1:00 AM
09Z	1:00 AM	2:00 AM	3:00 AM	4:00 AM
12Z	4:00 AM	5:00 AM	6:00 AM	7:00 AM
15Z	7:00 AM	8:00 AM	9:00 AM	10:00 AM
18Z	10:00 AM	11:00 AM	12:00 PM	1:00 PM
21Z	1:00 PM	2:00 PM	3:00 PM	4:00 PM

Z Time (UTC)	Pacific Daylight Savings Time	Mountain Daylight Savings Time	Central Daylight Savings Time	Eastern Daylight Savings Time
00Z	5:00 PM	6:00 PM	7:00 PM	8:00 PM
03Z	8:00 PM	9:00 PM	10:00 PM	11:00 PM
06Z	11:00 PM	12:00 AM	1:00 AM	2:00 AM
09Z	2:00 AM	3:00 AM	4:00 AM	5:00 AM
12Z	5:00 AM	6:00 AM	7:00 AM	8:00 AM
15Z	8:00 AM	9:00 AM	10:00 AM	11:00 AM
18Z	11:00 AM	12:00 PM	1:00 PM	2:00 PM
21Z	2:00 PM	3:00 PM	4:00 PM	5:00 PM

History of "Z-time" (UTC,GMT,etc) by Harold Maybeck



The spatial relationship between the Spruce Pine and Marion monitoring stations to the Dobson and Short-off wildfires. Yellow line is one of many forward trajectories (at 100m height) from the Dobson fire.

STATE CLIMATE OFFICE OF NORTH CAROLINA
NC CRONOS Database
Data retrieval from NBUS - Busick for 2007-06-10 thru 2007-06-15 (6 days)
144 records for this period of record (100% data available)
Latitude: 35.77° **Longitude:** -82.19°

Date/Time (EST)	6.1m Wind Speed (10 min avg) (mph)	6.1m Wind Direction (10 min avg)	6.1m Wind Gusts (mph)
6/10/2007 0:00	0.9	North (7°)	4
6/10/2007 1:00	0.9	North (4°)	3
6/10/2007 2:00	0.9	North (8°)	4
6/10/2007 3:00	0.9	North Northeast (23°)	2
6/10/2007 4:00	0.9	North (7°)	3
6/10/2007 5:00	2	Northeast (42°)	4
6/10/2007 6:00	0.9	East Northeast (65°)	5
6/10/2007 7:00	0	Northwest (324°)	0
6/10/2007 8:00	2	East Northeast (74°)	5
6/10/2007 9:00	2	West (261°)	5
6/10/2007 10:00	4	Northwest (323°)	10
6/10/2007 11:00	4	Northwest (308°)	8
6/10/2007 12:00	4	Southwest (235°)	8
6/10/2007 13:00	2.9	South (172°)	8
6/10/2007 14:00	2.9	North Northwest (345°)	7
6/10/2007 15:00	2	West Southwest (242°)	7
6/10/2007 16:00	0.9	South (187°)	9
6/10/2007 17:00	2.9	West Northwest (294°)	9
6/10/2007 18:00	0.9	South (169°)	6
6/10/2007 19:00	0	North (359°)	4
6/10/2007 20:00	0	North Northwest (347°)	0
6/10/2007 21:00	0	West (261°)	0
6/10/2007 22:00	0	North Northwest (339°)	1
6/10/2007 23:00	0	West (262°)	0
6/11/2007 0:00	0	North Northwest (338°)	0
6/11/2007 1:00	0	North Northwest (332°)	0
6/11/2007 2:00	0	North Northwest (332°)	0
6/11/2007 3:00	0	North Northwest (332°)	0
6/11/2007 4:00	0	West Northwest (297°)	0
6/11/2007 5:00	0	Northwest (312°)	0
6/11/2007 6:00	0	Northwest (309°)	0
6/11/2007 7:00	0	Northwest (320°)	0
6/11/2007 8:00	0.9	West (265°)	6
6/11/2007 9:00	2.9	Northwest (313°)	7
6/11/2007 10:00	2	Northwest (308°)	5
6/11/2007 11:00	4.9	North (356°)	9
6/11/2007 12:00	4	West (265°)	9
6/11/2007 13:00	2.9	North Northwest (333°)	7
6/11/2007 14:00	4	Northeast (45°)	6
6/11/2007 15:00	2.9	South Southwest (209°)	6
6/11/2007 16:00	2.9	West Northwest (302°)	6
6/11/2007 17:00	2.9	North Northwest (328°)	7
6/11/2007 18:00	0	North Northeast (16°)	5
6/11/2007 19:00	0	North Northeast (30°)	4
6/11/2007 20:00	0	West Northwest (284°)	4
6/11/2007 21:00	0.9	West Northwest (288°)	1
6/11/2007 22:00	0	North Northwest (330°)	0
6/11/2007 23:00	0.9	West Northwest (302°)	1
6/12/2007 0:00	0	West Northwest (294°)	0
6/12/2007 1:00	0	West Northwest (287°)	0
6/12/2007 2:00	0	West (264°)	0

State Climate office Busick

	WS	WD	Gust
6/13/2007 19:00	0.9	West (269°)	3
6/13/2007 20:00	0	North (7°)	3
6/13/2007 21:00	0	South (174°)	20
6/13/2007 22:00	0	South Southeast (147°)	1
6/13/2007 23:00	0	North Northeast (20°)	0
6/14/2007 0:00	0	North (351°)	0
6/14/2007 1:00	0	North Northwest (334°)	0
6/14/2007 2:00	0	North (10°)	0
6/14/2007 3:00	0	Northwest (318°)	0
6/14/2007 4:00	0	North Northwest (342°)	0
6/14/2007 5:00	0	Northwest (318°)	0
6/14/2007 6:00	0	North Northwest (342°)	0
6/14/2007 7:00	0	North Northwest (345°)	0
6/14/2007 8:00	0	North Northwest (329°)	0
6/14/2007 9:00	2	West (276°)	4
6/14/2007 10:00	2.9	West (268°)	8
6/14/2007 11:00	4	North Northwest (344°)	9
6/14/2007 12:00	4	North Northwest (327°)	9
6/14/2007 13:00	4	North Northwest (339°)	11
6/14/2007 14:00	2	Northeast (42°)	10
6/14/2007 15:00	0	Northwest (317°)	8
6/14/2007 16:00	0.9	Northwest (316°)	6
6/14/2007 17:00	2	East (92°)	4
6/14/2007 18:00	2	North Northwest (328°)	5
6/14/2007 19:00	0.9	North (355°)	4
6/14/2007 20:00	0	North (2°)	4
6/14/2007 21:00	2.9	North Northeast (12°)	11
6/14/2007 22:00	0	North Northeast (17°)	4
6/14/2007 23:00	2	North Northeast (16°)	4
6/15/2007 0:00	0	Northwest (321°)	2
6/15/2007 1:00	0	North Northwest (343°)	3
6/15/2007 2:00	0	West Northwest (296°)	3
6/15/2007 3:00	0	North (1°)	0
6/15/2007 4:00	0	East Southeast (103°)	0
6/15/2007 5:00	0	Calm or Variable	0

Grandfather 2007-06-10 → 2007 06-15

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6/13/2007 16:00	2
6/13/2007 17:00	2
6/13/2007 18:00	0
6/13/2007 19:00	0
6/13/2007 20:00	4.9
6/13/2007 21:00	2
6/13/2007 22:00	2
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6/14/2007 7:00	0.9
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6/14/2007 10:00	2
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6/15/2007 2:00	0
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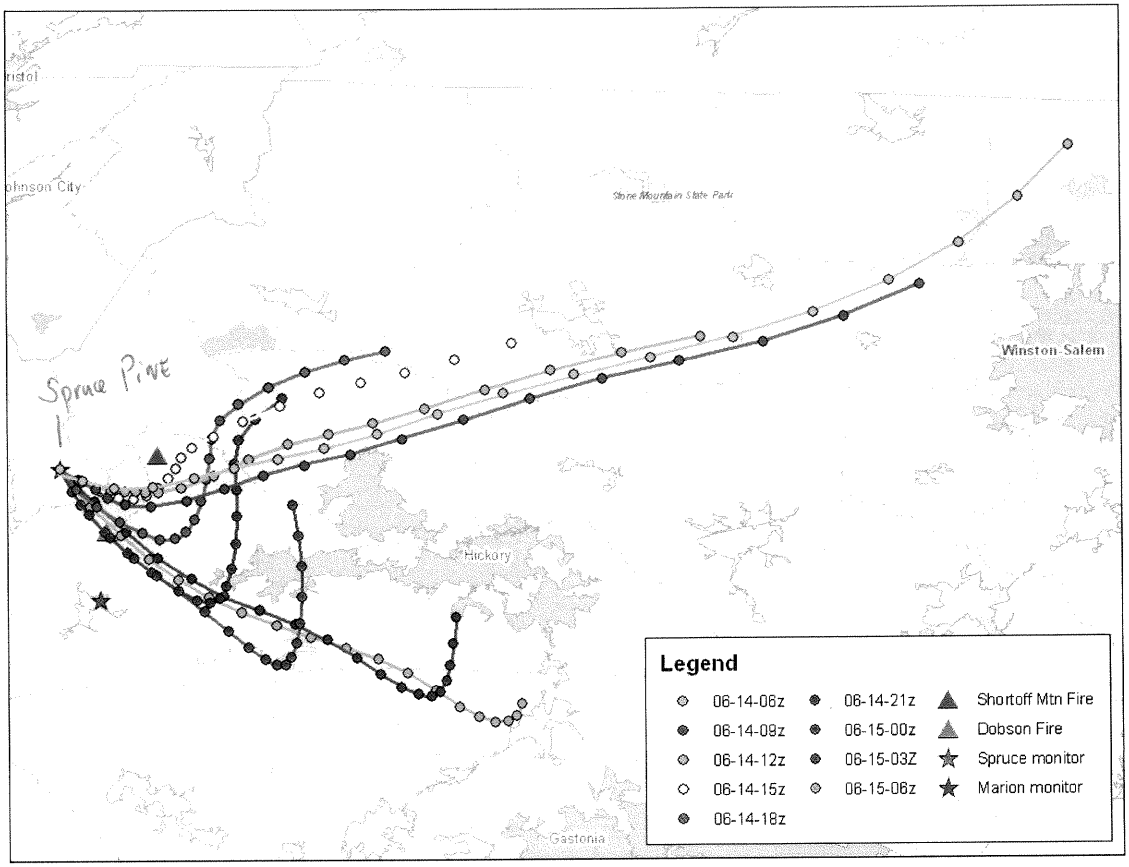
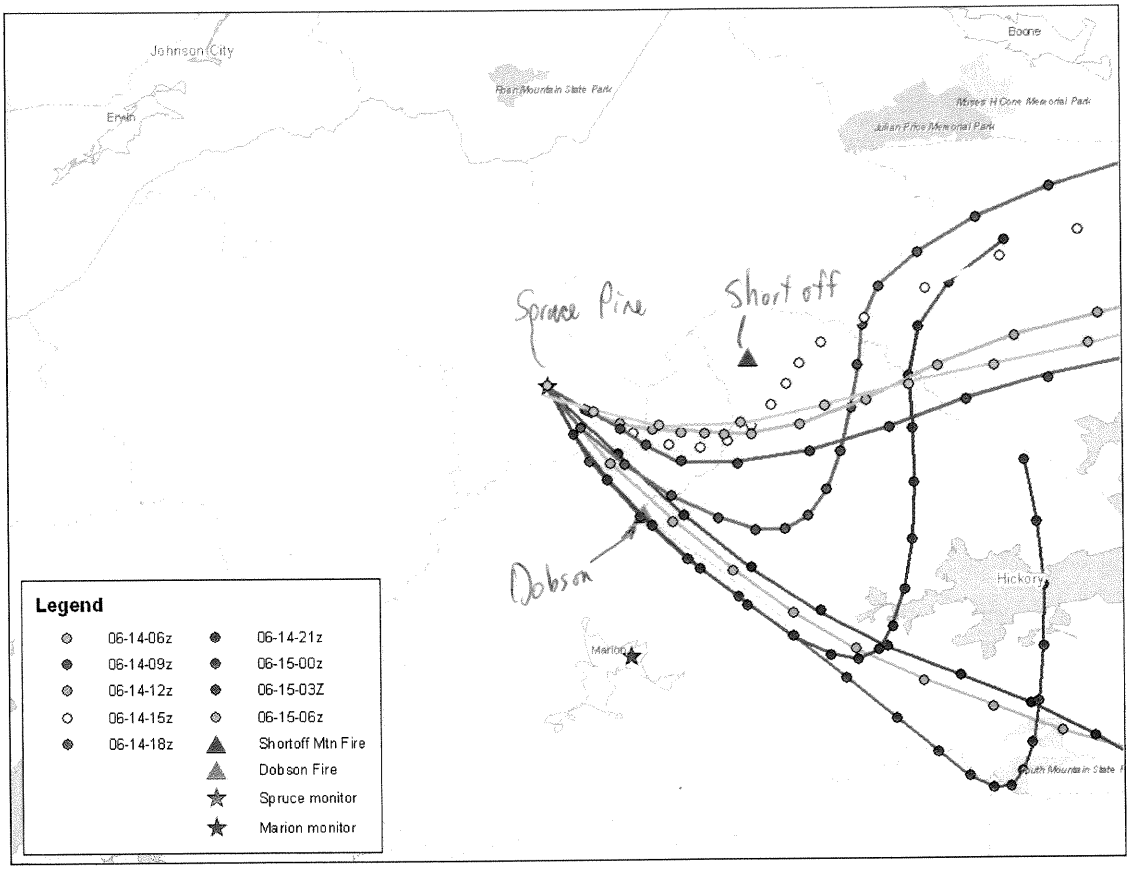
6/15/2007 4:00	0
6/15/2007 5:00	0
6/15/2007 6:00	0
6/15/2007 7:00	0
6/15/2007 8:00	0.9
6/15/2007 9:00	0.9
6/15/2007 10:00	0.9

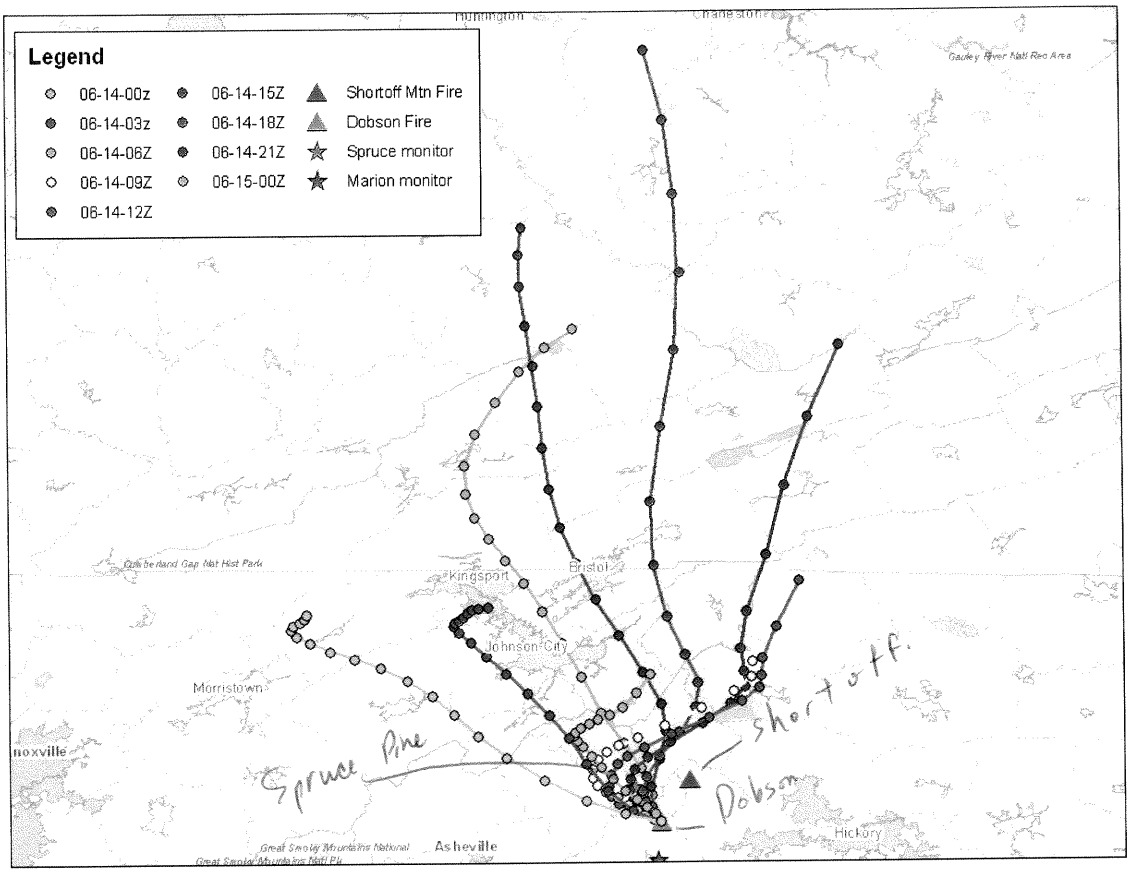
West Southwest (239°)	7
South (183°)	7
Southwest (236°)	3
South Southeast (168°)	3
Southeast (141°)	2
North Northwest (327°)	13
West Southwest (244°)	9
Northwest (310°)	4
Southeast (143°)	3
Southeast (124°)	4
South Southeast (156°)	3
North Northeast (22°)	3
Northwest (307°)	3
East Southeast (107°)	2
East Southeast (105°)	5
East (95°)	4
South Southeast (157°)	3
Southeast (128°)	3
East Southeast (116°)	3
North (349°)	7
North Northeast (30°)	5
North Northwest (348°)	8
North Northeast (28°)	6
North (352°)	9
Northeast (43°)	9
West Northwest (282°)	5
Northwest (311°)	3
East Northeast (62°)	4
Northwest (318°)	10
West (277°)	12
West Northwest (296°)	9
South (182°)	2
Southeast (136°)	2
Southeast (125°)	6
North Northwest (332°)	2
Northwest (316°)	0
North Northwest (329°)	1
Southeast (132°)	2
North (2°)	1
North Northeast (12°)	0
North Northwest (339°)	0
East Northeast (67°)	3
North Northeast (19°)	3
North (355°)	3



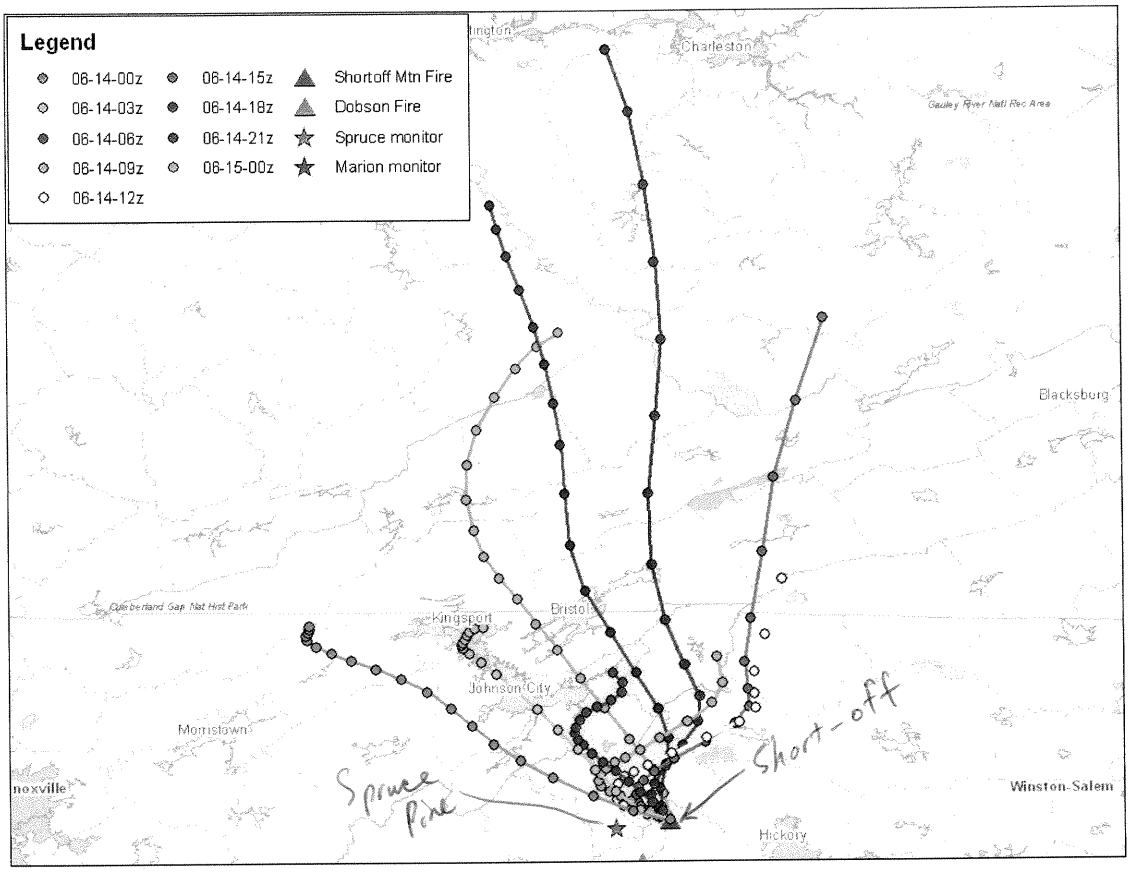
HYSPLIT back trajectories (50m) at Spruce Pine on 6-14-07 pass between the two fires and through the smoke to impact the monitor.



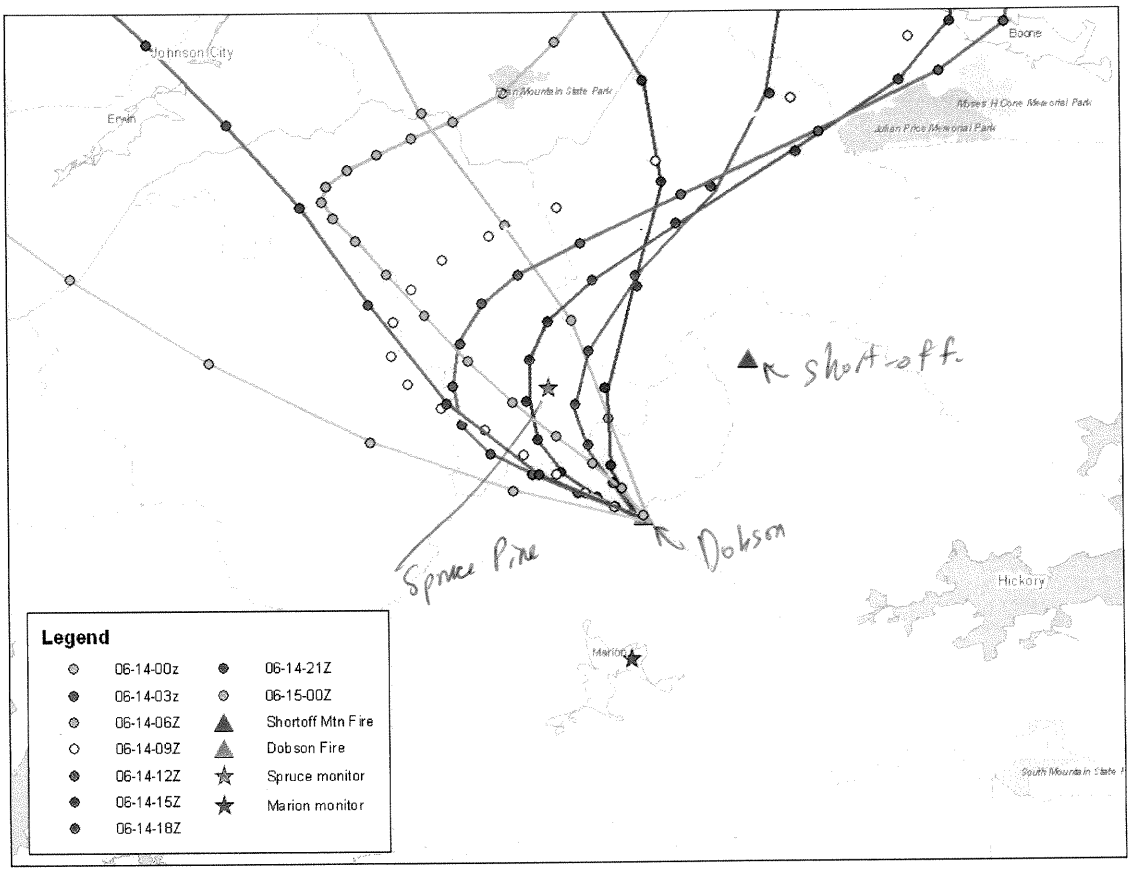
A zoomed version of the back trajectories on 6-14-07 at the Spruce Monitor.



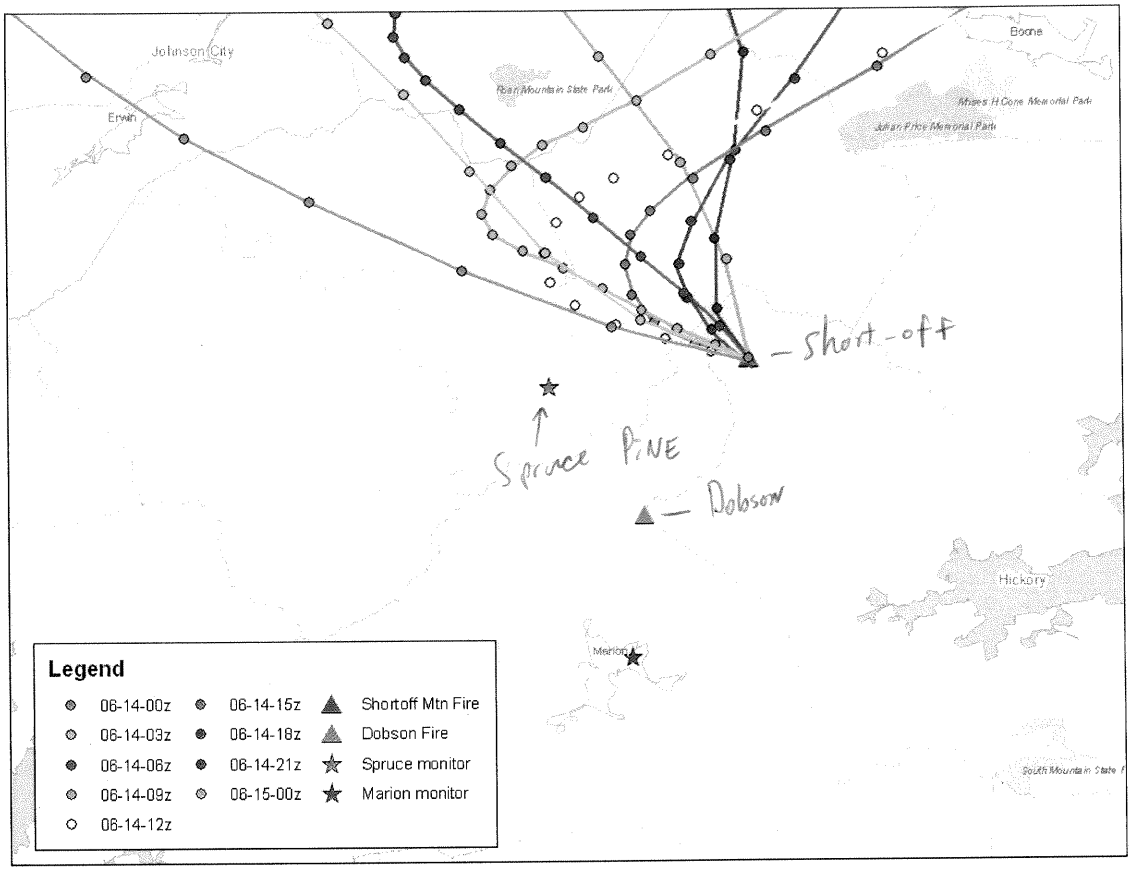
Several HYSPLIT forward trajectories (100m) from the Dobson fire smother the Spruce monitor with smoke on 6-14-07.



HYSPLIT forward trajectories (100m) from the Short-off fire are glancing the Spruce monitor on 6-14-07.

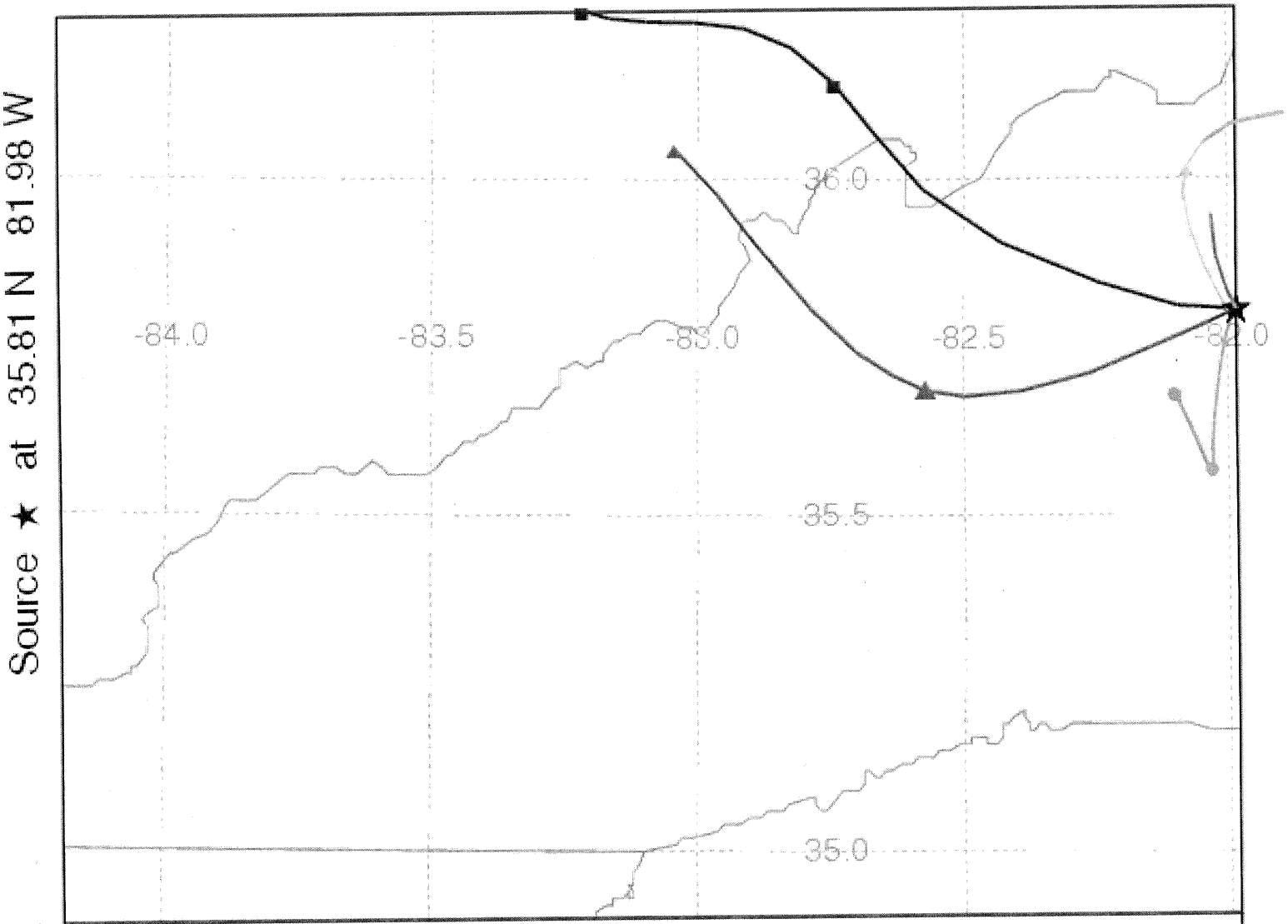


A zoomed version of the Dobson forward trajectories on 6-14-07.



A zoomed version of the Shortoff forward trajectories on 6-14-07.

NOAA HYSPLIT MODEL
Forward trajectories starting at 18 UTC 13 Jun 07
NAM Meteorological Data



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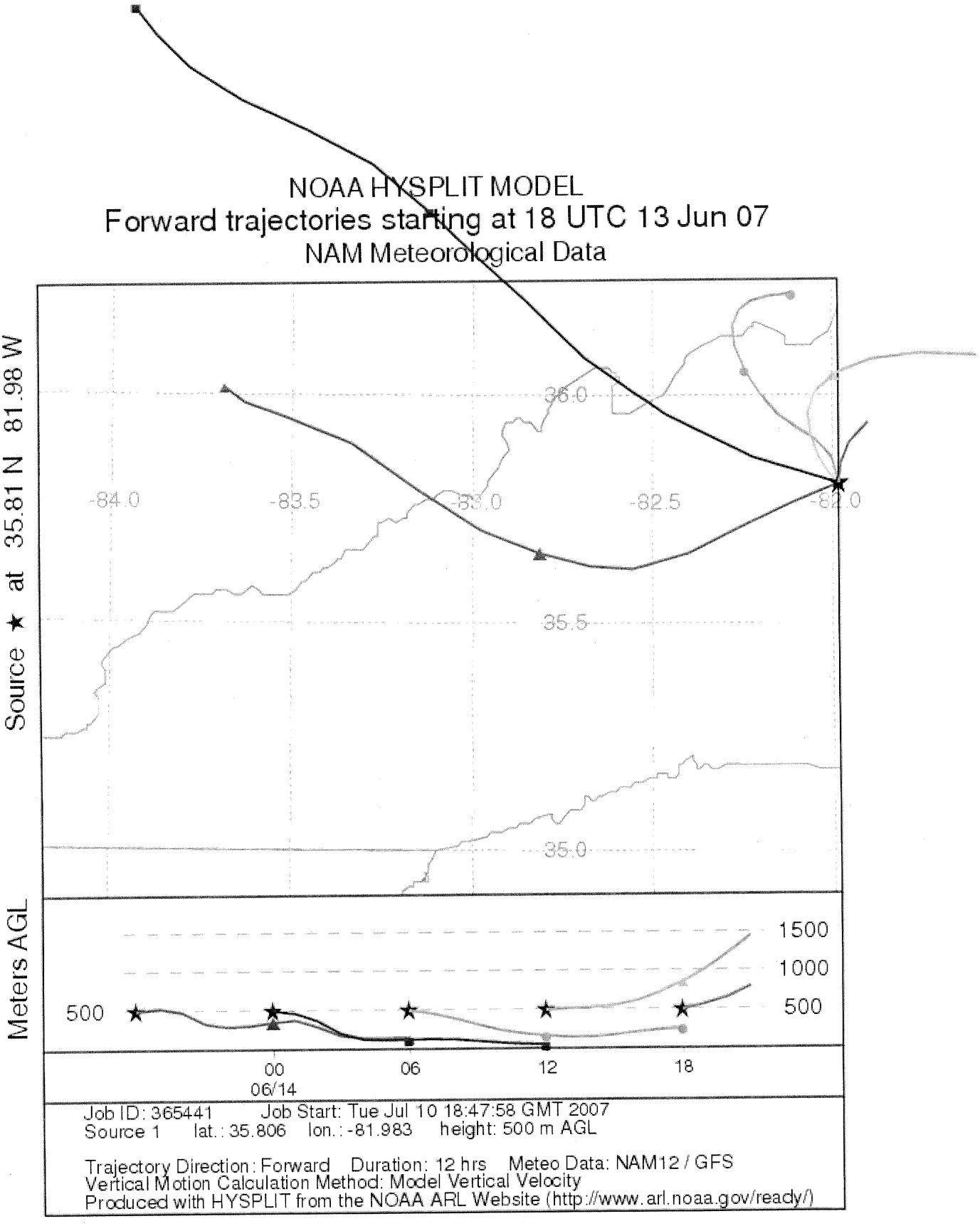
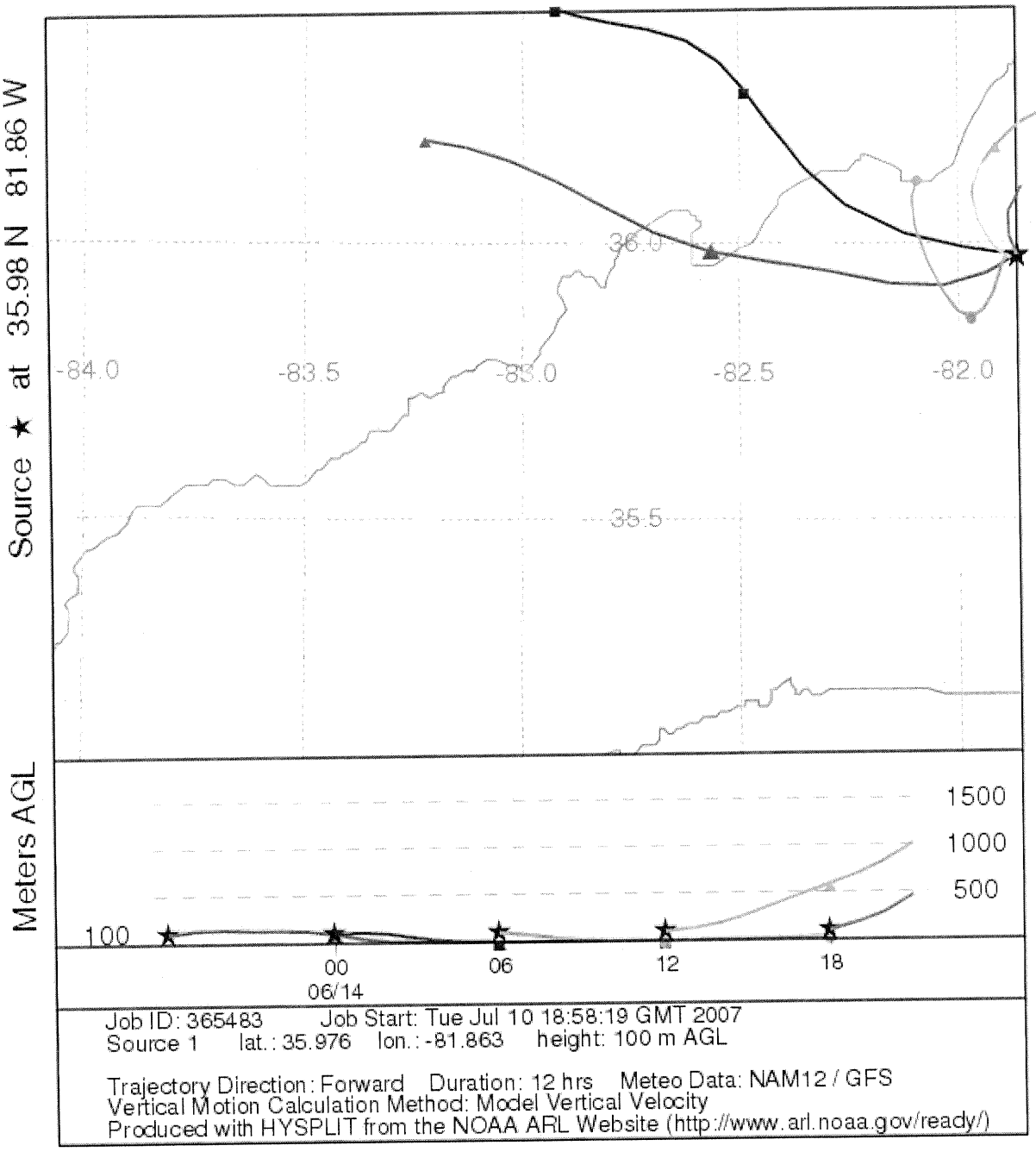
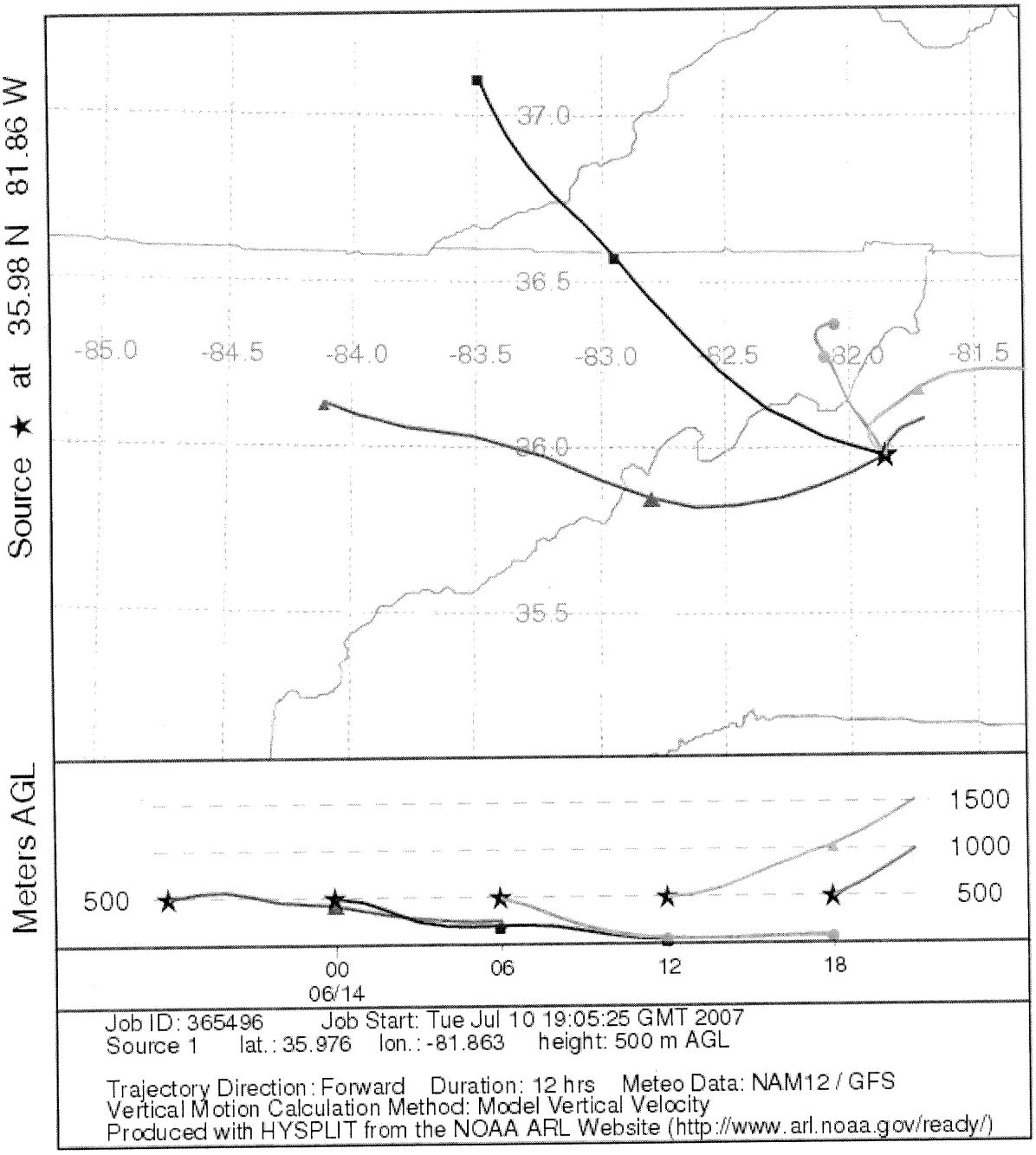
Trajectory Direction: Forward Duration: 12 hrs Meteo Data: NAM12 / GFS
Vertical Motion Calculation Method: Model Vertical Velocity
Produced with HYSPLIT from the NOAA ARL Website (http://www.arl.noaa.gov/ready/)


NOAA HYSPLIT MODEL
Forward trajectories starting at 18 UTC 13 Jun 07
NAM Meteorological Data
Source ★ at 35.81 N 81.98 W
Meters AGL
-84.0
-83.5
-83.0
-82.5
-82.0
36.0
35.5
35.0
1500
1000
500
500
00
06/14
06
12
18
Job ID: 365441 Job Start: Tue Jul 10 18:47:58 GMT 2007
Source 1 lat.: 35.806 lon.: -81.983 height: 500 m AGL
Trajectory Direction: Forward Duration: 12 hrs Meteo Data: NAM12 / GFS
Vertical Motion Calculation Method: Model Vertical Velocity
Produced with HYSPLIT from the NOAA ARL Website (http://www.arl.noaa.gov/ready/)

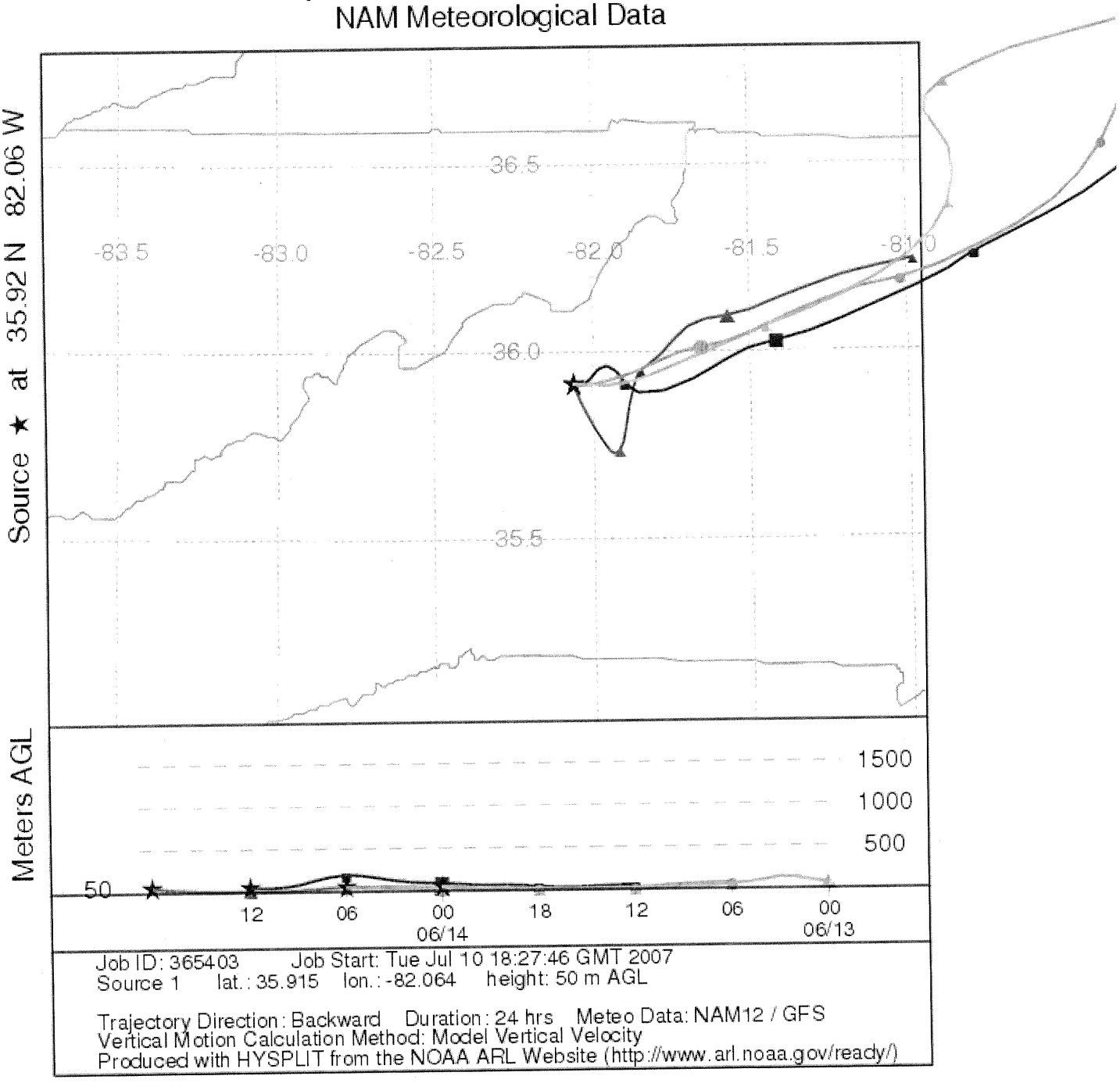
NOAA HYSPLIT MODEL
Forward trajectories starting at 18 UTC 13 Jun 07
NAM Meteorological Data



NOAA HYSPLIT MODEL
Forward trajectories starting at 18 UTC 13 Jun 07
NAM Meteorological Data



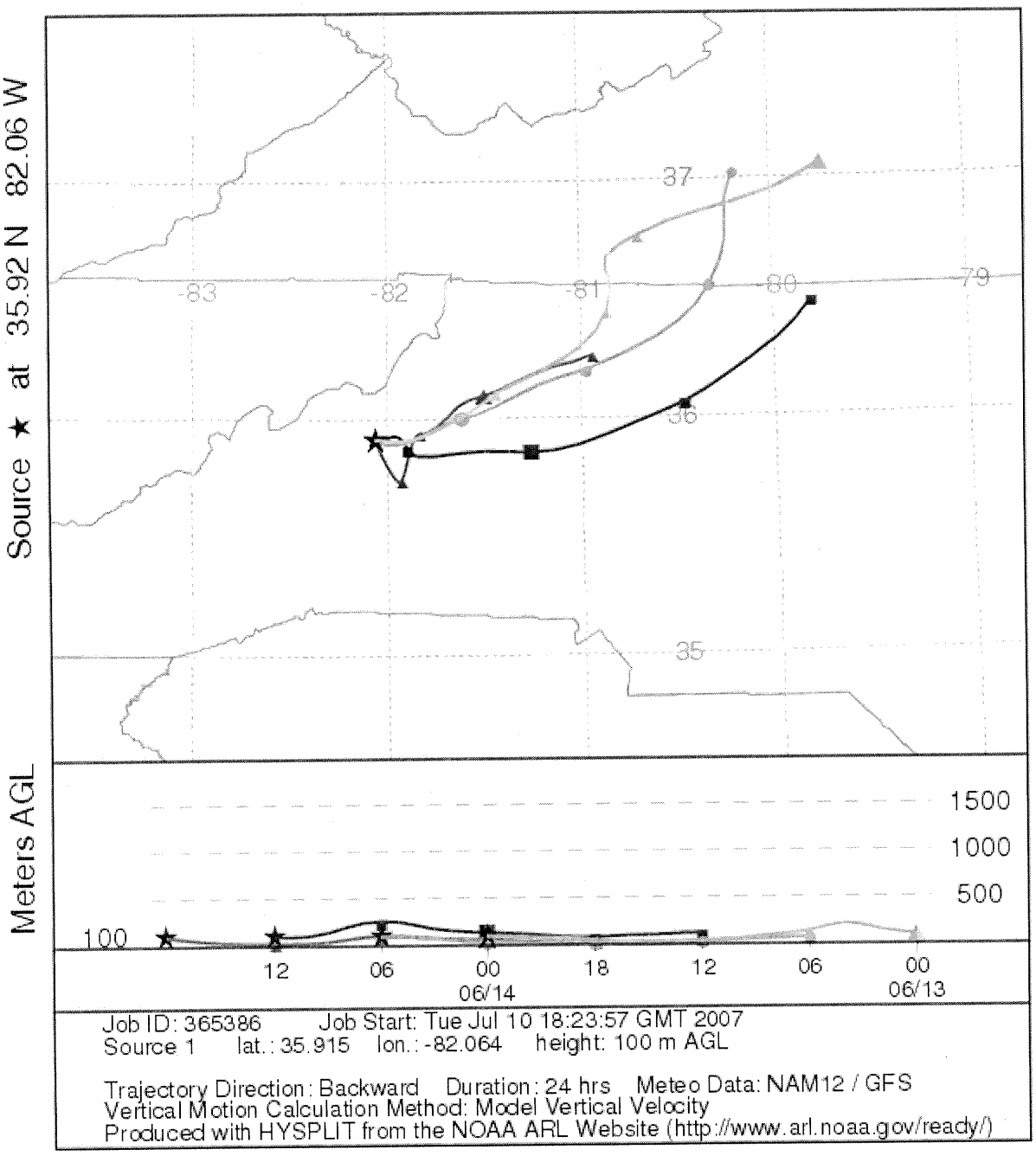
NOAA HYSPLIT MODEL
Backward trajectories ending at 18 UTC 14 Jun 07
NAM Meteorological Data



Job ID: 365403 Job Start: Tue Jul 10 18:27:46 GMT 2007
Source 1 lat.: 35.915 lon.: -82.064 height: 50 m AGL

Trajectory Direction: Backward Duration: 24 hrs Meteo Data: NAM12 / GFS
Vertical Motion Calculation Method: Model Vertical Velocity
Produced with HYSPLIT from the NOAA ARL Website (http://www.arl.noaa.gov/ready/)

NOAA HYSPLIT MODEL
Backward trajectories ending at 18 UTC 14 Jun 07
NAM Meteorological Data



PM 2.5 FRM Concentrations ug/m3

Site_ID1	371730002	371110004	371110004	371210001	371210001	370870010
Site_ID2	109	105	106	107	108	103
Region	ARO	ARO	ARO	ARO	ARO	ARO
Site	BY	MJ	MJ	SP	SP	WV
06/02/2007	24.96	17.46			15.71	21.58
06/05/2007	7.46	7.96	8.03		7.79	8.46
06/08/2007	10.17	12.21			11.83	8.87
06/11/2007	23.83	28.46	30.38		60.58	26.79
06/13/2007		32.50				
06/14/2007	15.12	17.17			61.04	11.21
06/17/2007	19.21	25.79	23.89		17.75	23.29
06/20/2007	7.62	10.08			10.08	8.67
06/23/2007	17.13		22.01		17.67	15.96
06/26/2007	15.58	14.71			13.62	17.92
06/29/2007	16.13	16.62	15.06		14.71	18.42
Average	15.72	18.30	19.87		23.08	16.12

PM 2.5 FRM Concentrations ug/m3

Site_ID1	370710016	370710016	370350004	370350006	370250004	370350005	371590021
Site_ID2	305	306	307	311	301	309	313
Region	MRO	MRO	MRO	MRO	MRO	MRO	MRO
Site	GM	GM	HC	HU	KA	RS	UR
06/01/2007			27.70				
06/02/2007	9.62		11.75				7.04
06/03/2007			5.29				
06/04/2007			11.21				
06/05/2007			8.25				9.04
06/06/2007			9.96				
06/07/2007							
06/08/2007	12.97		12.67				15.21
06/09/2007			9.71				
06/10/2007			17.92				
06/11/2007	17.66		25.08				17.92
06/12/2007			22.17				
06/13/2007			13.33				
06/14/2007	12.97		14.38				14.92
06/15/2007			14.81				
06/16/2007			21.83				
06/17/2007	23.64		25.12				25.83
06/18/2007			27.17				
06/19/2007			26.21				
06/20/2007	11.13		11.46				13.38
06/21/2007			15.21				
06/22/2007			21.46				
06/23/2007	18.12		20.00				17.00
06/24/2007			24.96				
06/25/2007			24.92				
06/26/2007	18.24		17.33				24.13
06/27/2007			26.92				
06/28/2007			20.63				
06/29/2007	13.72		17.58				15.29
06/30/2007			11.83				
Average	15.34		17.82				15.98

"Atypical" Analysis for 14 June 2007 Spruce Pine Exceedance

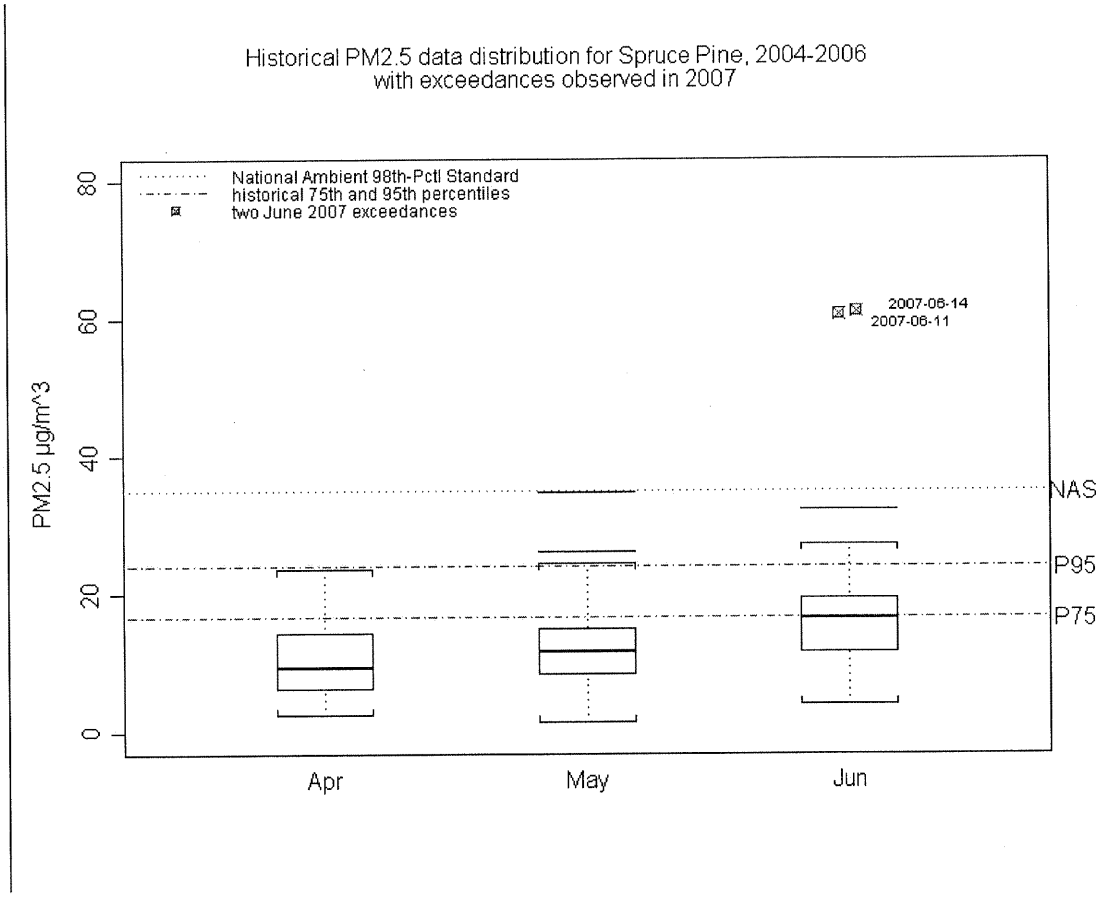


Figure 3.1 - shows "normal historical fluctuations" of PM2.5 data for the Spruce Pine monitoring station during the second calendar quarter in the form of boxplots for the individual *monthly* distributions with reference lines showing the historical levels of the 75th and 95th percentile levels as well as the level of the National Ambient 98th-percentile Standard (16.7 µg/m^3, 24.1 µg/m^3, and 35.0 µg/m^3 , respectively) .

EPA has discussed the possible use of the historical 75th and 95th percentiles as objective thresholds for favorable concurrence decisions [Federal Register: March 10, 2006 (Volume 71, Number 47)]. The historical 95th percentile level for this event is 24.1 µg/m^3. The 11 June 2007 exceedance exceeds the historical 95th percentile level by 152 percent. The 14 June 2007 exceedance exceeds the historical 95th percentile level by 153 percent.

"Atypical" Analysis for 14 June 2007 Spruce Pine Exceedance (Cont'd)

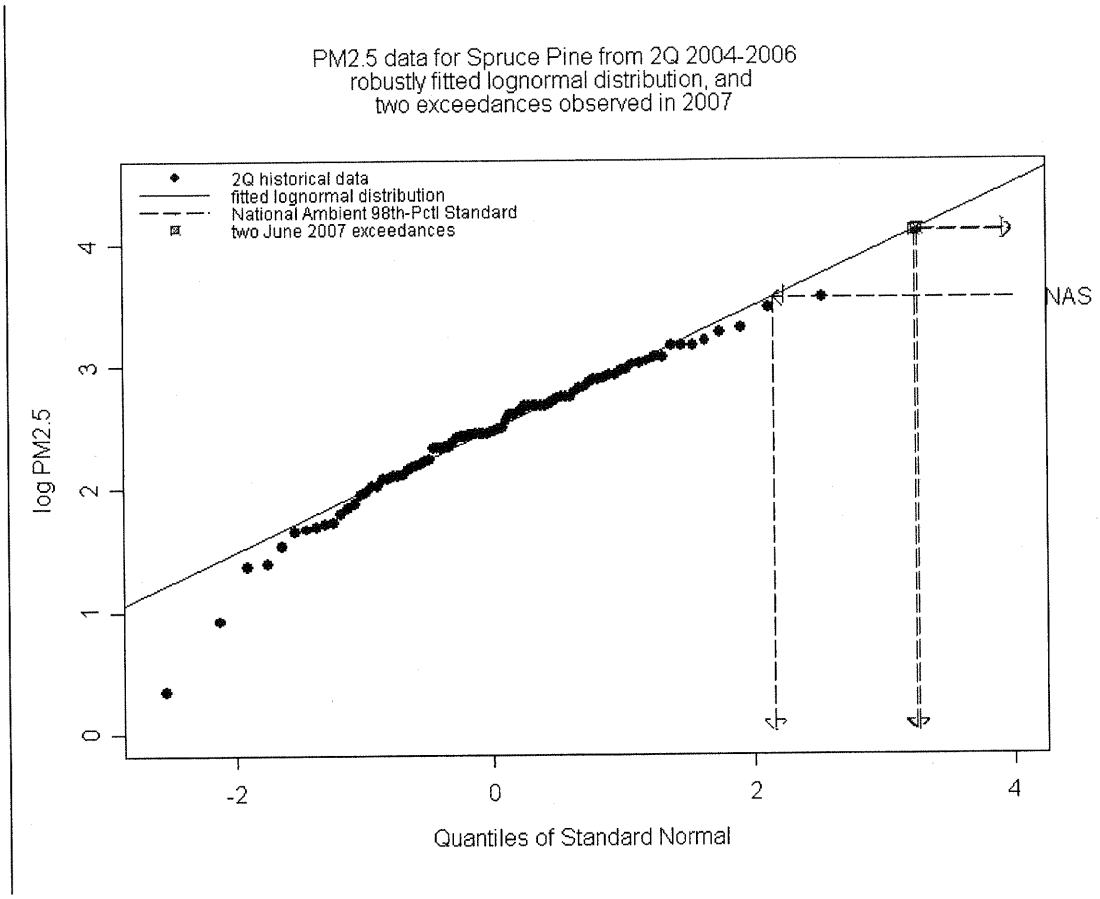


Figure 3.2 - shows "normal historical fluctuations" of PM2.5 data for the Spruce Pine monitoring station during the second calendar quarter in the form of a lognormal distribution quantile plot. Particulate pollution data are often well approximated by lognormal distributions. This graph shows the natural logarithms of the historical data (in log-μg/m^3 units) sorted from smallest concentration to largest concentration, plotted against the corresponding quantiles of a standard normal distribution. An *exact* lognormal distribution closely matching these data is shown as a diagonal straight line in the graph. The level of the National Ambient 98th-percentile Standard (y=3.56), the 11 June 2007 exceedance (y=4.10) and the 14 June 2007 exceedance (x=4.11) are shown as points on the lognormal distribution line, illustrating that expected probability of exceeding the level of the National Ambient 98th-percentile Standard in the absence of exceptional events is about 1.55 percent (2.16 standard deviations greater than the lognormal mean value), and the expected probability of "unexceptional data" exceeding either of the levels observed on 11 and 14 June 2007 is less than 0.6 percent (more than 3.25 standard deviations greater than the lognormal mean value).

The estimated parameters of the lognormal approximation are:

- median PM2.5 = 11.92
- mean PM2.5 = 13.50
- 98th pctl PM2.5 = 33.23

IV. "But For" Test: There would have been no exceedance or violation "but for" the event

-Executive summary-

To demonstrate that the wildfires at Dobson Knob and Shortoff Mountain caused an exceedance of the daily fine particle standard of 35 micrograms per cubic meter at the Spruce Pine monitor on June 14, 2007, we need to find a way to either estimate (1) what the fine particle concentration value would have been on June 14, 2007, if the wildfires had not been present or (2) how many fine particles the wildfires contributed to the fine particle concentration measured at the Spruce Pine monitor on June 14, 2007. Either approach should be sufficient to demonstrate that the wildfires caused this exceedance. There are several possible ways to approach either question. For the impact of these wildfires at Spruce Pine on June 14, 2007, we opted to develop a model using meteorological measurements to estimate what the fine particle concentration value would have been on June 14, 2007 at Spruce Pine if the wildfires had not occurred. A more detailed description of the model is provided below.

The model developed explains less than half of the observed variation in the fine particle concentrations in the dataset. As a result there is a large amount of uncertainty in the estimation of the fine particle concentration at Spruce Pine on June 14, 2007. However, we can use the value calculated by the model and the uncertainty calculated by the model for that value to calculate the maximum value that we would expect to see at Spruce Pine on June 14, 2007, with a certain probability. If we calculate the maximum expected value using a 99 percent probability and it is less than 35 micrograms per cubic meter, then there is at most a 1 percent probability that a value above the standard would have occurred at Spruce Pine on June 14, 2007, if there had not been wildfires in the area.

Using the developed model and calculating the maximum expected value using a 99 percent probability indicates that there is a 1 percent probability that a value exceeding 23.4 micrograms per cubic meter would have occurred at Spruce Pine on 6/14/2007. Thus, without the nearby wildfires, there is less than 1 percent probability that the National Ambient Air Quality Standard would have been exceeded on that day. As a result, we believe that the value of 61.0 micrograms per cubic meter, which exceeded the daily fine particle standard, would not have occurred at Spruce Pine if there had not been wildfires at Dobson Knob and Shortoff Mountain on June 14, 2007.

-Data description-

For each day in the 2nd quarter (2Q) of 2004, 2005, 2006 and 2007 on which there was a valid fine particle (PM2.5) concentration I acquired the following meteorological data to model the PM2.5 concentrations:

AT daily mean ambient temperature at the PM2.5 monitoring station
RH daily mean relative humidity at the PM2.5 monitoring station

WS24 daily arithmetic mean wind speed at NGRF, the United States Forest Service (USFS) met station at Grandfather [Mountain], NC.

VWD24 daily vector average wind direction at NGRF
WG24 daily mean wind gust speeds at NGRF
RN24 daily total precipitation at NGRF
RN24.lag1 previous day total precipitation at NGRF

-Linear Models-

WG24 was not available for 2Q2004, so I made two models:
-1- use all 4 years of data, but do not fit WG24 in the model
-2- use only 2005, 2006 and 2007 data and do fit WG24 in the model

-Method of analysis-

-1- Define a covariate for each exceptional event, setting its value at -1 on the the day of the event and 0 on all other dates. PM.e1 is the covariate for 06/11/2007 (actual concentration 60.6), and PM.e2 is the covariate for 06/14/2007 (actual concentration 61.0)

-2- Define the response variable PM2.5 as follows:

Response Variable "PM2.5"
= actual PM2.5 concentration, if there is not an exceptional event
= 0.0 if there is an exceptional event

-3- Fit linear models as defined in each model below. The coefficients associated with PM.e1 and PM.e2 are estimates of the expected concentrations that would have occurred if there had not been an exceptional event.

-4- Results

-4.1- Model 1 using 2004 data and not fitting WG24

Call: aov(formula = PM2.5 ~ AT + RH + WS24 + VWD24 + RN24 + RN24.lag1 + PM.e1 + PM.e2, data = SPtest.df, na.action = na.exclude)

Table 4.1.1 Residuals:				
Minimum	1st Quartile	Median	3rd Quartile	Maximum
-17.16	-3.119	-1.164e-016	1.741	20.42

Table 4.1.2 Coefficients:				
	Value	Standard. Error	t value	Probability (>|t|)
(Intercept)	-239.3077	86.3132	-2.7725	0.0066
AT	0.4420	0.1229	3.5960	0.0005
RH	0.3529	0.1232	2.8638	0.0051
WS24	-0.5368	0.4161	-1.2901	0.1999
VWD24	0.0005	0.0053	0.1042	0.9172
RN24	-0.8898	1.1647	-0.7640	0.4466
RN24.lag1	-3.0699	1.6378	-1.8744	0.0637
PM.e1	15.3187	5.4003	2.8366	0.0055
PM.e2	10.2719	5.6221	1.8271	0.0706

Residual standard error: 5.298 on 104 degrees of freedom
Multiple R-Squared: 0.3746
F-statistic: 7.786 on 8 and 104 degrees of freedom, the p-value is 3.82e-008

-4.2- Model 2 not using 2004 data and fitting WG24

Call: aov(formula = PM2.5 ~ AT + RH + WS24 + VWD24 + RN24 + RN24.lag1 + WG24 + PM.e1 + PM.e2, data = SPtest.df, na.action = na.exclude)

Table 4.2.1 Residuals:				
Minimum	1st Quartile	Median	3rd Quartile	Maximum
-17.93	-3.692	0.006094	2.776	17.43

Table 4.2.2 Coefficients:				
	Value	Standard. Error	t value	Probability (>|t|)
(Intercept)	-204.4483	101.6507	-2.0113	0.0479
AT	0.5755	0.1585	3.6319	0.0005
RH	0.3051	0.1443	2.1141	0.0379
WS24	4.3237	2.6302	1.6438	0.1045
VWD24	-0.0064	0.0079	-0.8098	0.4207
RN24	-0.5393	1.2784	-0.4219	0.6743
RN24.lag1	-3.8925	2.0356	-1.9122	0.0597
WG24	-1.8495	0.9000	-2.0550	0.0434
PM.e1	17.4130	5.7316	3.0381	0.0033
PM.e2	9.2996	6.0477	1.5377	0.1284

Residual standard error: 5.567 on 74 degrees of freedom
Multiple R-Squared: 0.4317
F-statistic: 6.247 on 9 and 74 degrees of freedom, the p-value is 1.615e-006
29 observations deleted due to missing values

-5- Discussion

Both of the linear models explain less than half of the observed variation in PM2.5 concentrations in the dataset, and there is accordingly a large amount of uncertainty in the

estimation of the two concentrations that were affected by exceptional events.

Let's report the estimates in the context of normal approximations. The expected values are as shown in the Coefficients tables, and 2.33* Std. Error defines a 99-percent upper bound under the observed uncertainty.

This means that "but for the exceptional events":

-5.1- under model 1 there is less than 1 percent probability that the concentrations would exceed:

PM.e1 = 15.3187 + 5.4003 x 2.33 = 27.90141 = 27.9
PM.e2 = 10.2719 + 5.6221 x 2.33 = 23.37141 = 23.4

-5.2- under model 2 there is less than 1 percent probability that the concentrations would exceed:

PM.e1 = 17.4130 + 5.7316 x 2.33 = 30.76764 = 30.8
PM.e2 = 9.2996 + 6.0477 x 2.33 = 23.39077 = 23.4