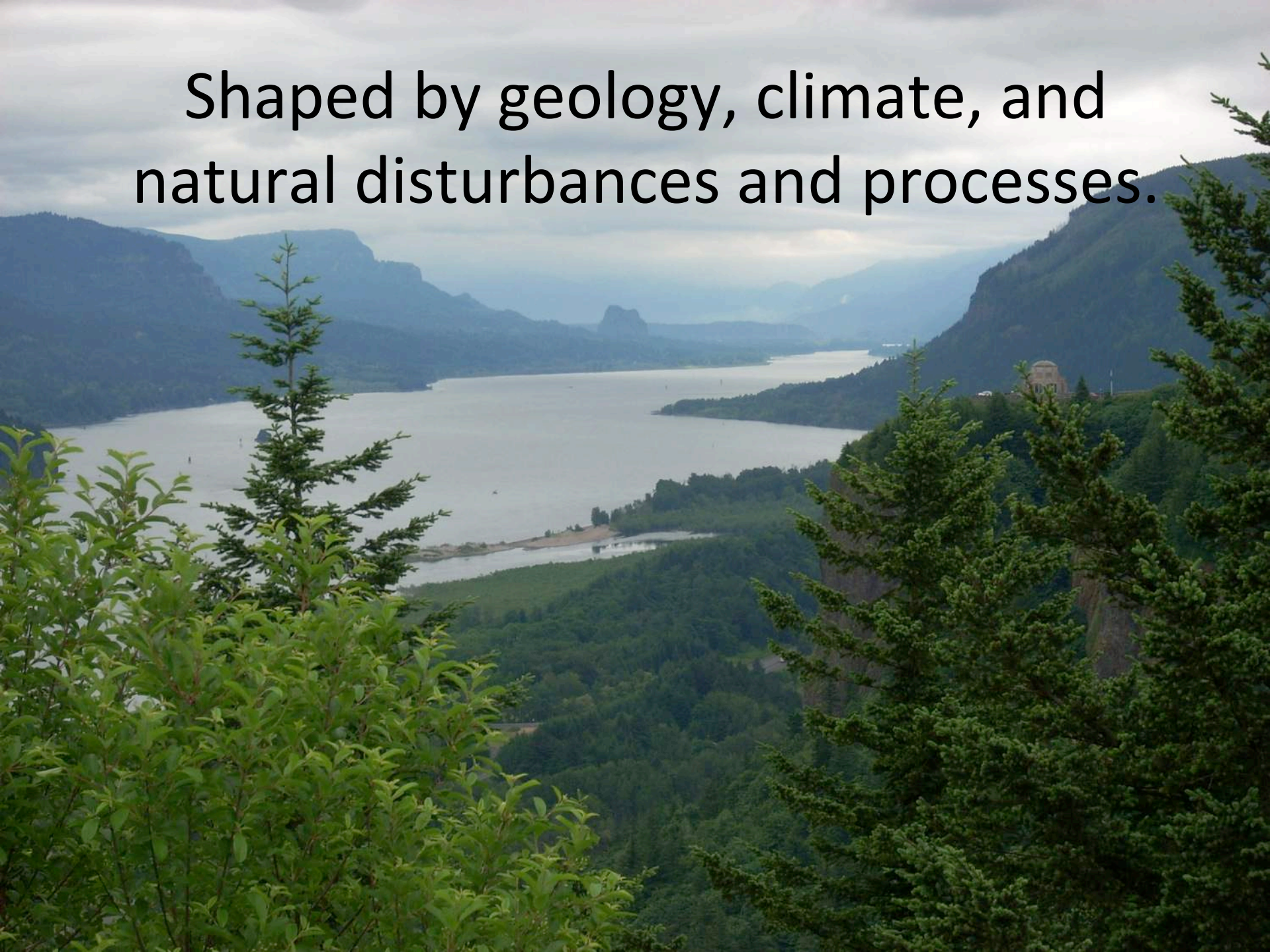
Forest Health and the benefits of a 4/3 km domain expansion into Oregon

Rick Graw, Susan O'Neill, and Janice Peterson
USDA Forest Service

To sustain the health, diversity, and productivity of the nation's forests and grasslands to meet the needs of present and future generations


Shaped by geology, climate, and
natural disturbances and processes.

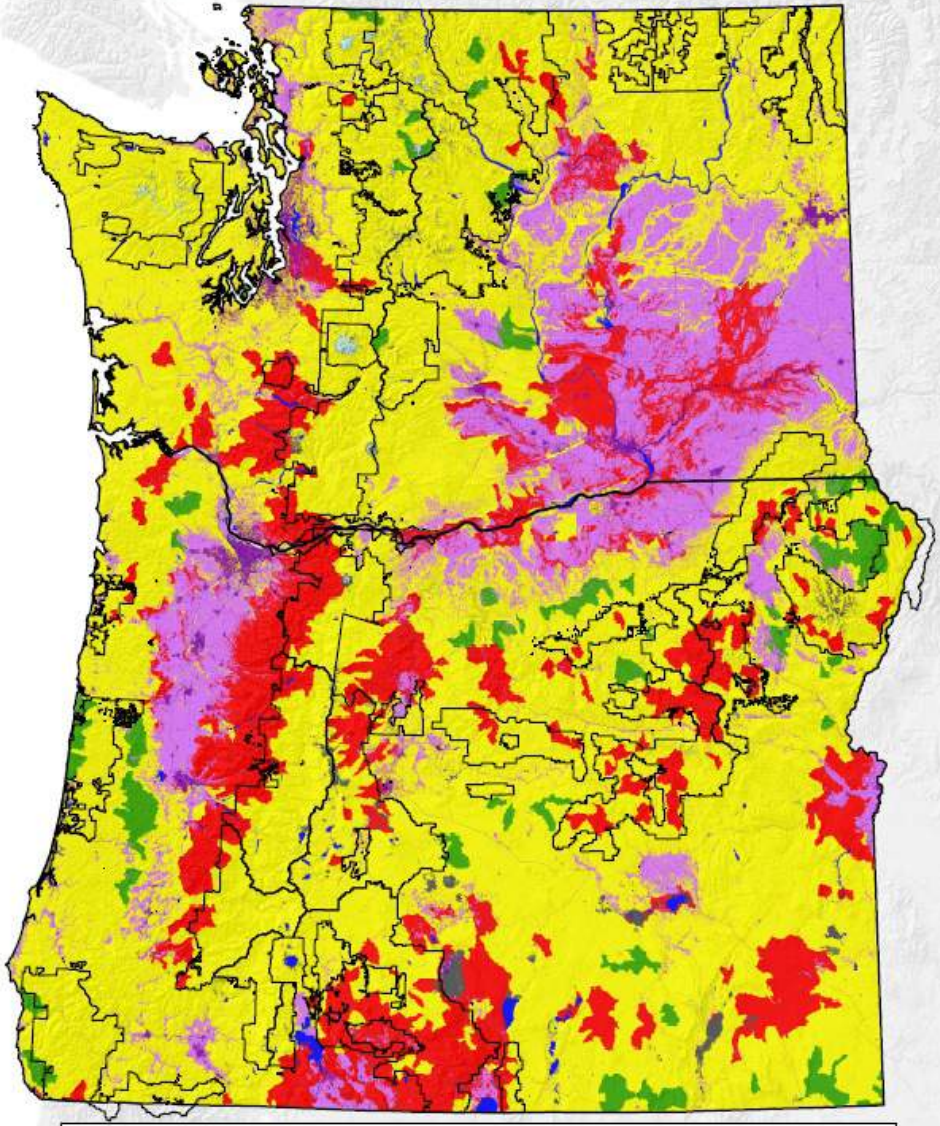
Post-European Settlement

Growing human population and changing demographics

100 years of aggressive fire suppression

- Modified natural role of fire
- More fuels on the ground
- More trees per square acre

Fire Regime Condition Class of Washington and Oregon



Climate Change

- Temperatures are warming.
- Fuels are getting drier.
- Fires are increasing in size, and severity.
- Increasing rain on snow events.
- Changes in hydrologic flows.

Acres burned by Wildfire in the Western United States

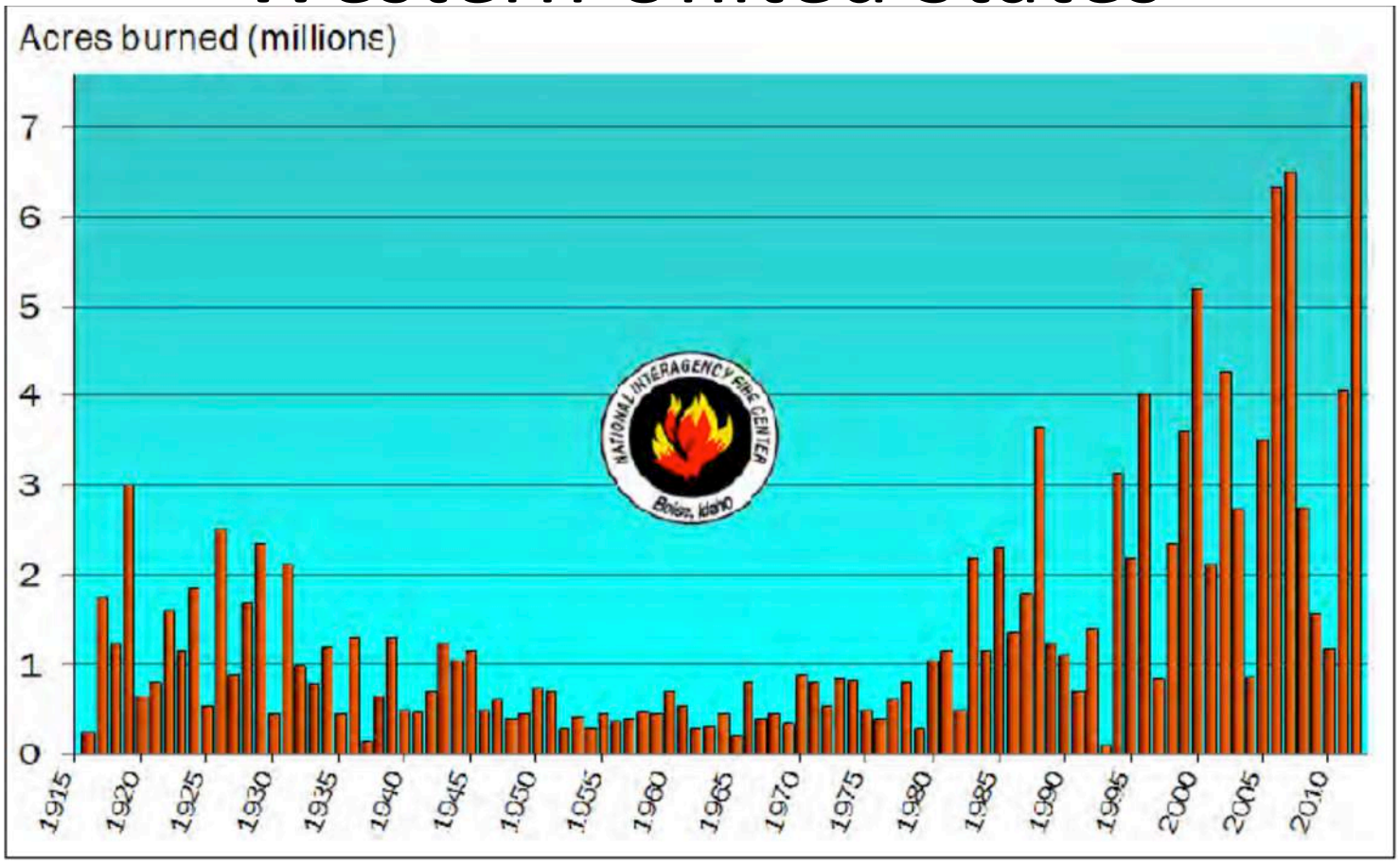
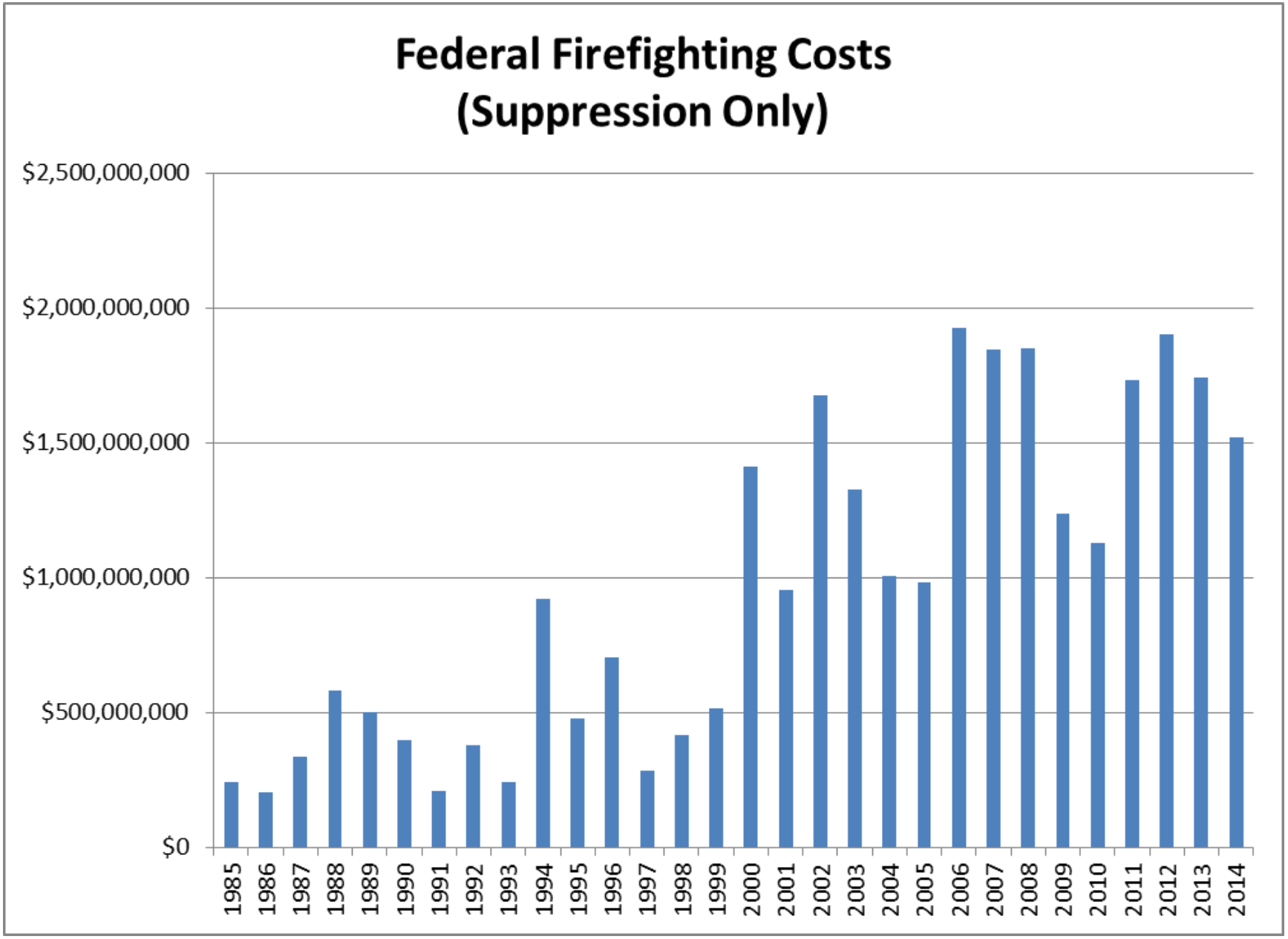


Figure 1. Acres burned by wildfires in eleven Western states, 1916 2012 (Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, Oregon, Utah, Washington, and Wyoming). Source data: National Interagency Fire Center; 1916-2000 data published in *Flames in Our Forest: Disaster or Renewal?* (Arno, S.F. and Allison-Bunnell, S., Island Press, Washington, D.C., 2002, Figure 2.1, p 21); 2002-2012 data available at http://www.nifc.gov/fireInfo/fireInfo_statistics.html


Federal Firefighting Costs
(Suppression Only)
$2,500,000,000
$2,000,000,000
$1,500,000,000
$1,000,000,000
$500,000,000
$0
1985
1986
1987
1988
1989
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1992
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1996
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2000
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2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014

Okanogen
Complex Fire
Wenatchee
Complex Fire
Washington
Yakima Complex
Fire
Table Mountain
Complex Fire
Mt. Ranier
Mt. St. Helens
Cascade Creek

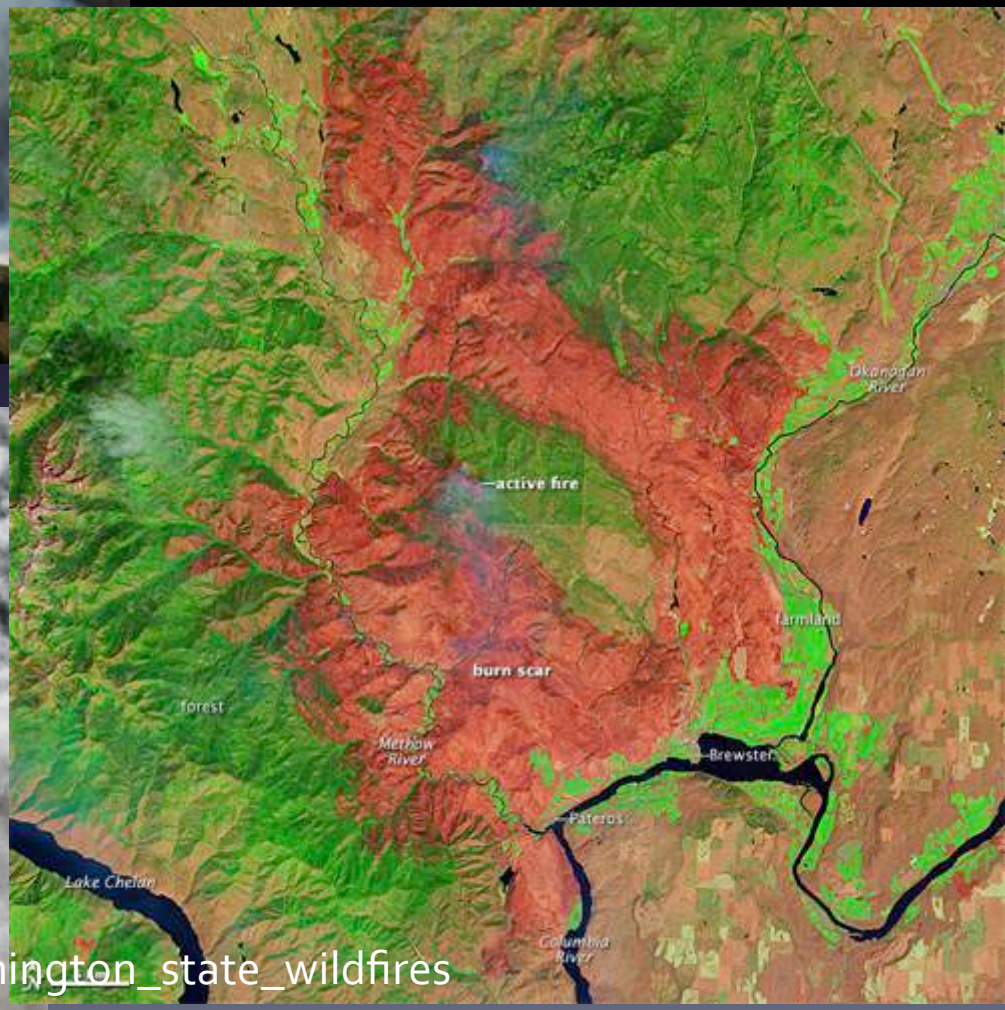
2014 Washington Smoke Impacts

Site	No. of Days in the Unhealthy Category	No. of Days in the Very Unhealthy Category	No. of Days in the Hazardous Category	Total
Naches	13	1	0	14
Chelan	16	3	5	24
Clarkston	26	12	8	46
Colville	18	7	6	31
Ellensburg	15	4	2	21
Kennewick	23	2	0	25
Leavenworth	18	12	13	43
Mesa	19	2	0	21
Moses_Lake	25	4	2	31
Omak	27	11	8	46
Pullman	22	9	2	33
Ritzville	18	5	0	23
Rosalia	21	2	0	23
Spokane	51	16	2	69
Toppenish	25	12	2	39
Twisp	17	11	6	34
Walla_Walla	19	0	0	19
Wenatchee	21	9	7	37
Winthrop	23	6	4	33
Yakima	35	3	0	38

Wildland Fire Smoke Response

- Goal: Public Health and Safety
- Multiple agency effort
- Daily coordination calls
- Monitoring
- Modeling
- Recommended actions
- Public outreach – blogs, social media, trap lines, community meetings, etc.

Carlton Complex
Washington State 2014
250,000 acres

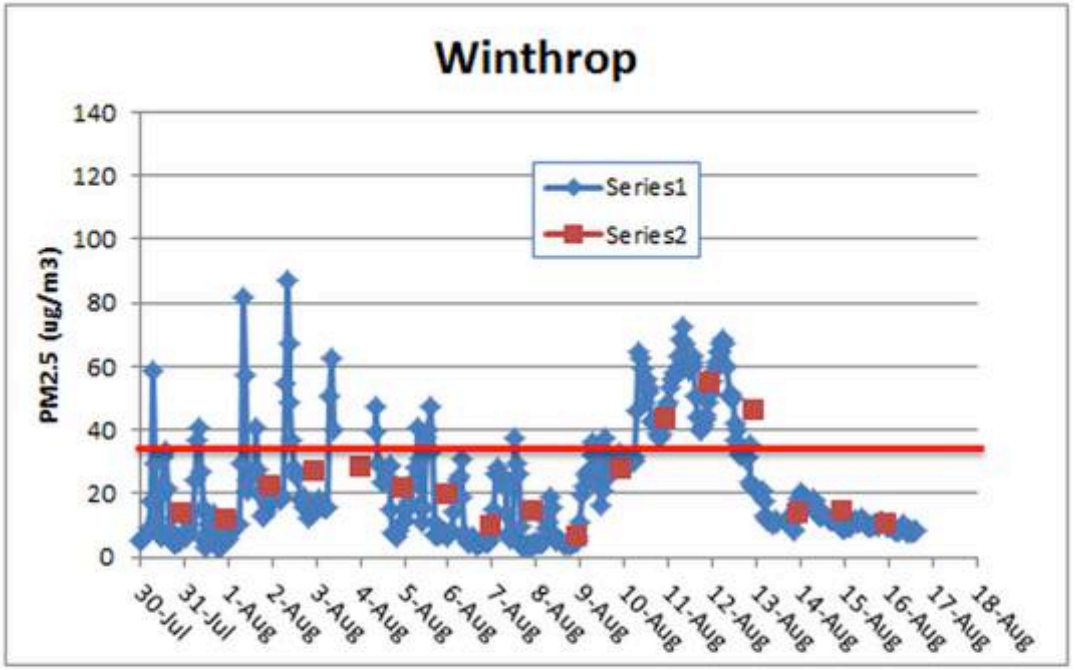


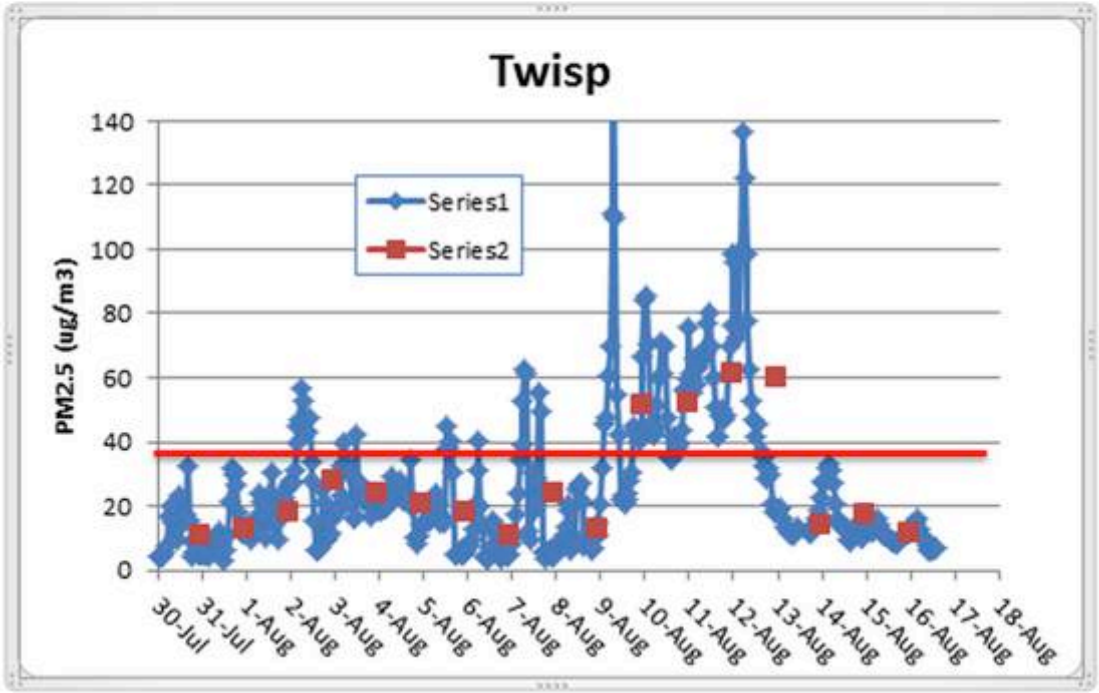
Carlton Complex August 2014

Washington Smoke Blog

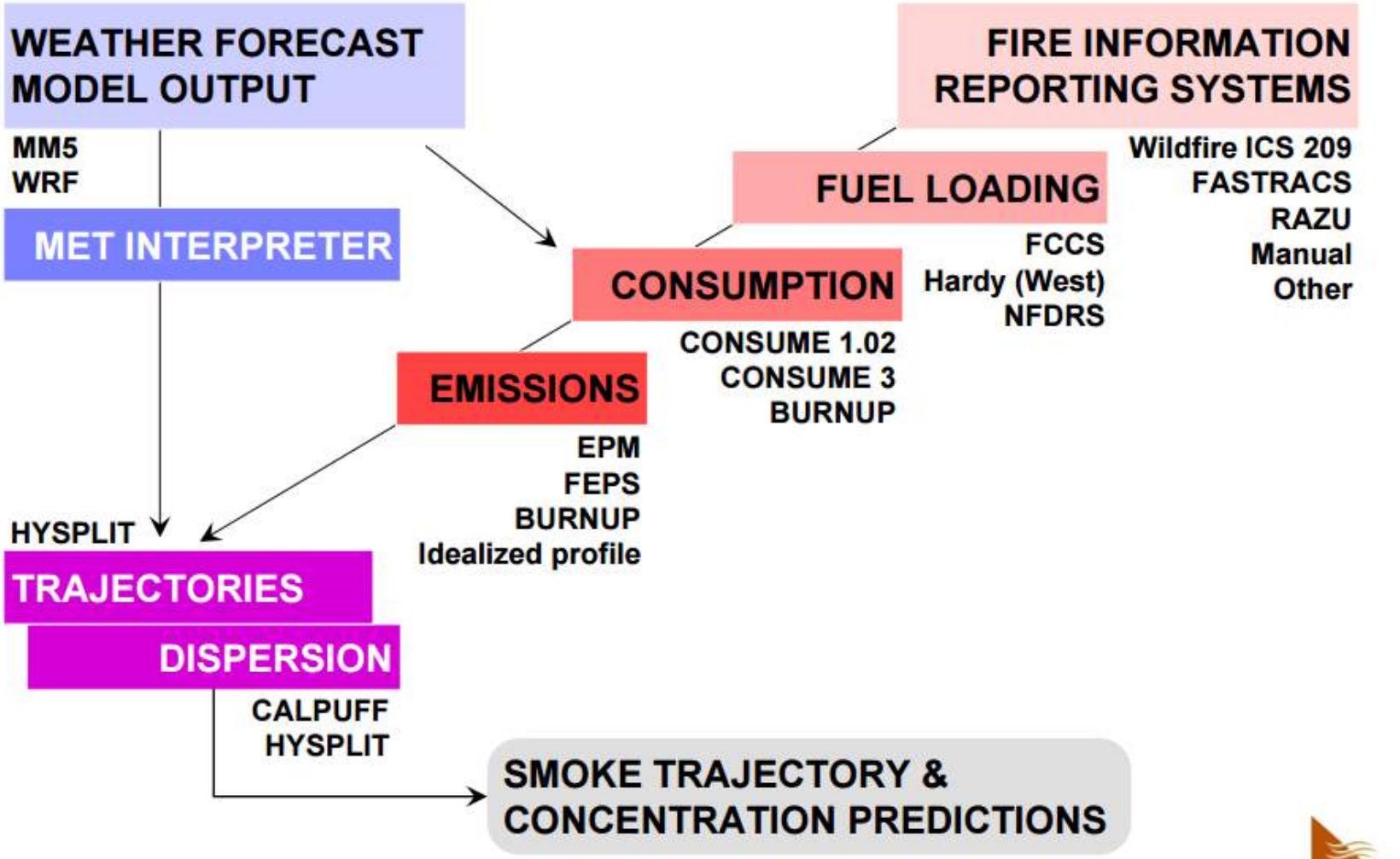
On this gorgeous, clear day with no smoke, let's take a look at the differences between two air quality monitors located less than 9 miles apart in the same Methow Valley. The blue graphs indicate 1-hr average concentrations of PM2.5 while the red data points are 24-hr averages. Note that while the 24-hr values trended rather similar for the two sites (expected as they are spatially close) the peak 1-hr values differed greatly!

Posted by Mike Broughton, FWS, ARA

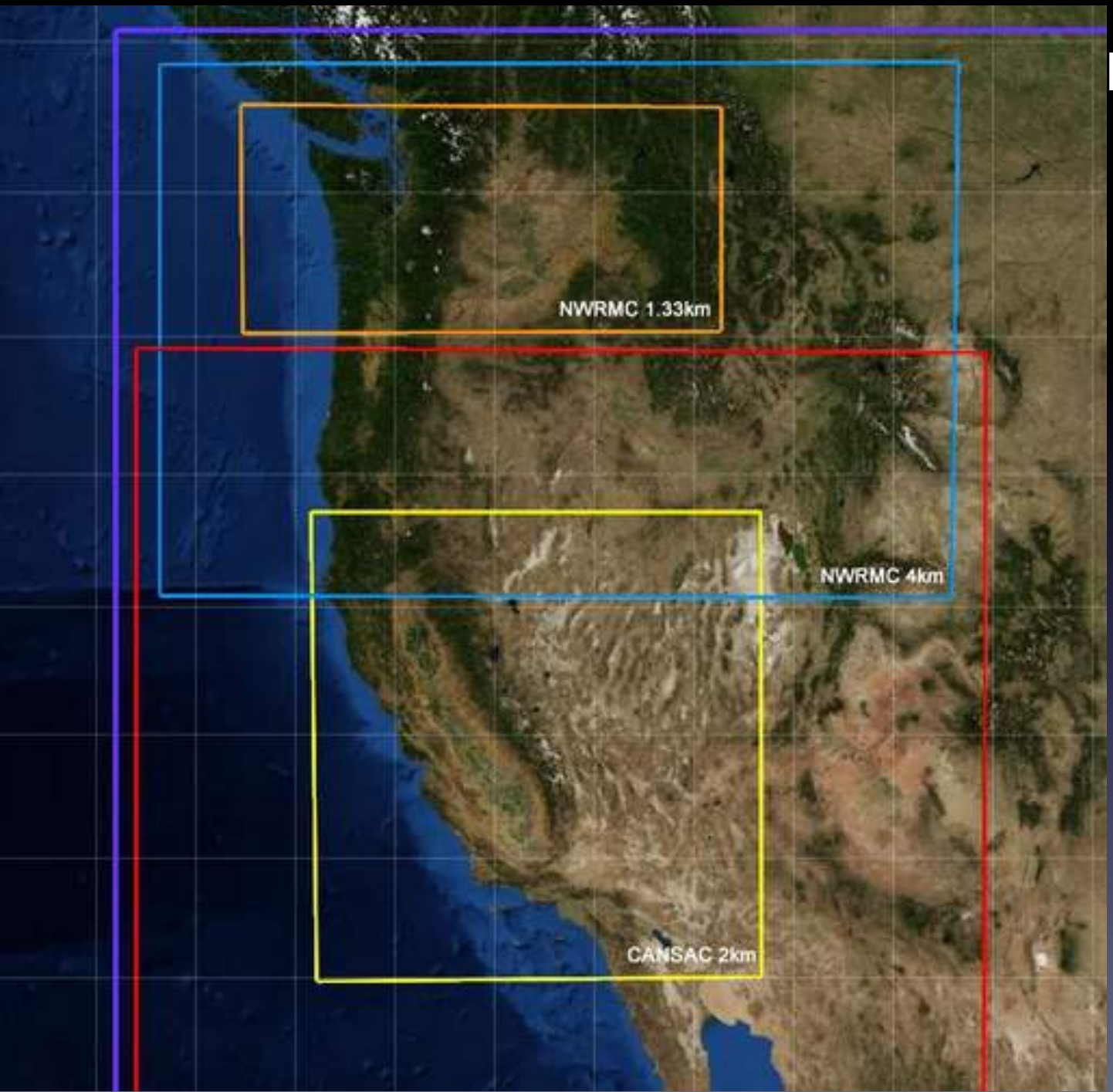




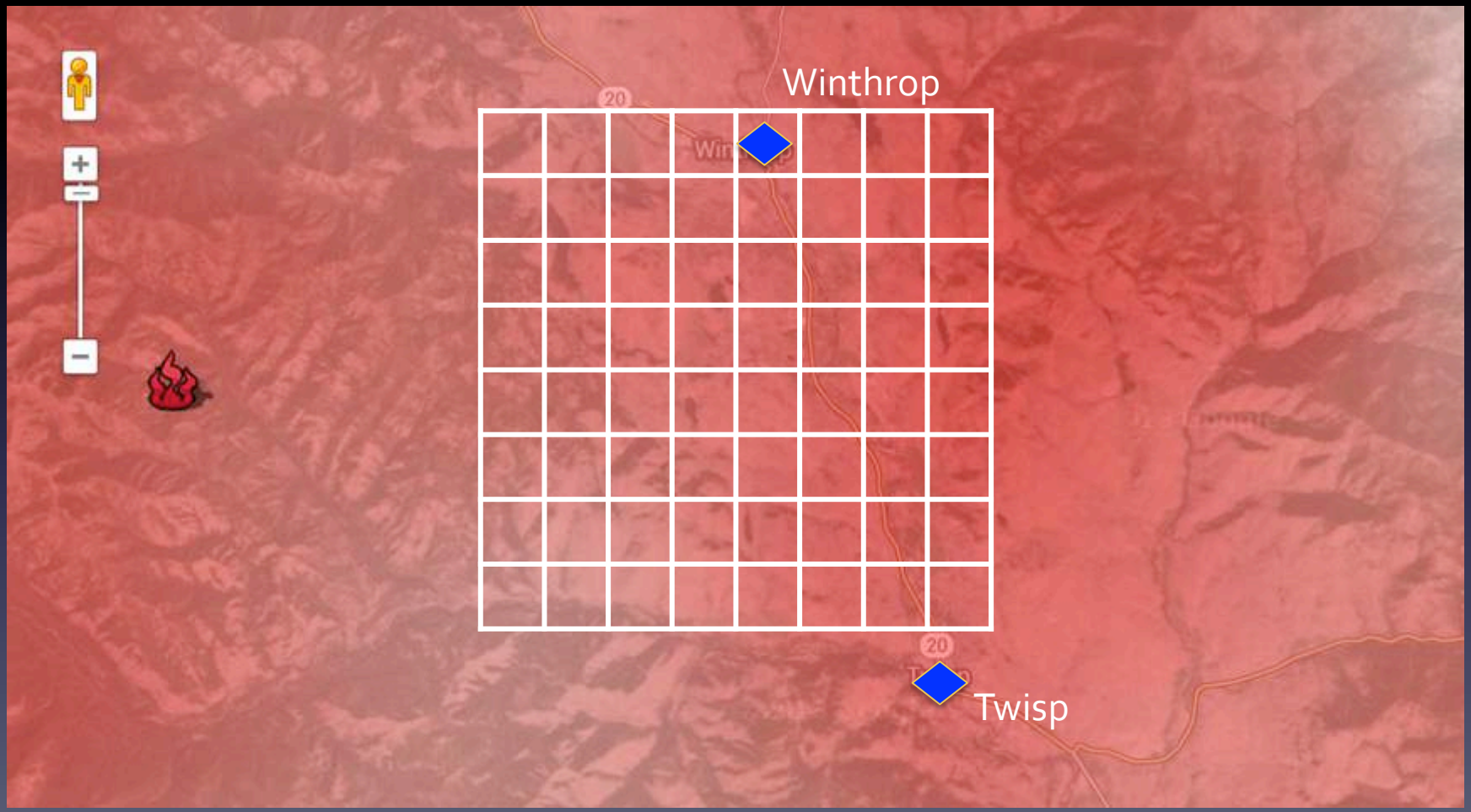
BlueSky Framework



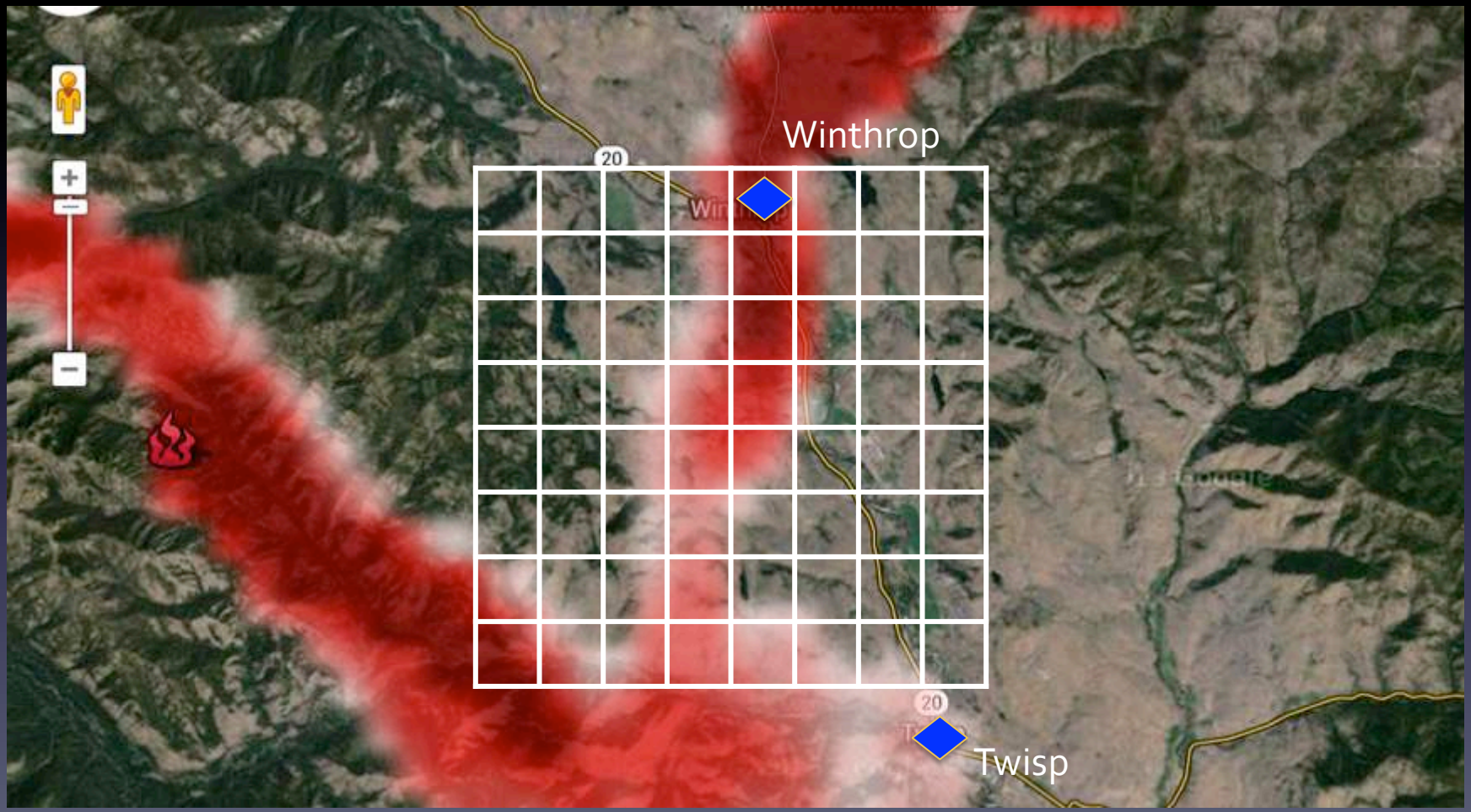
Meteorological Modeling Domains



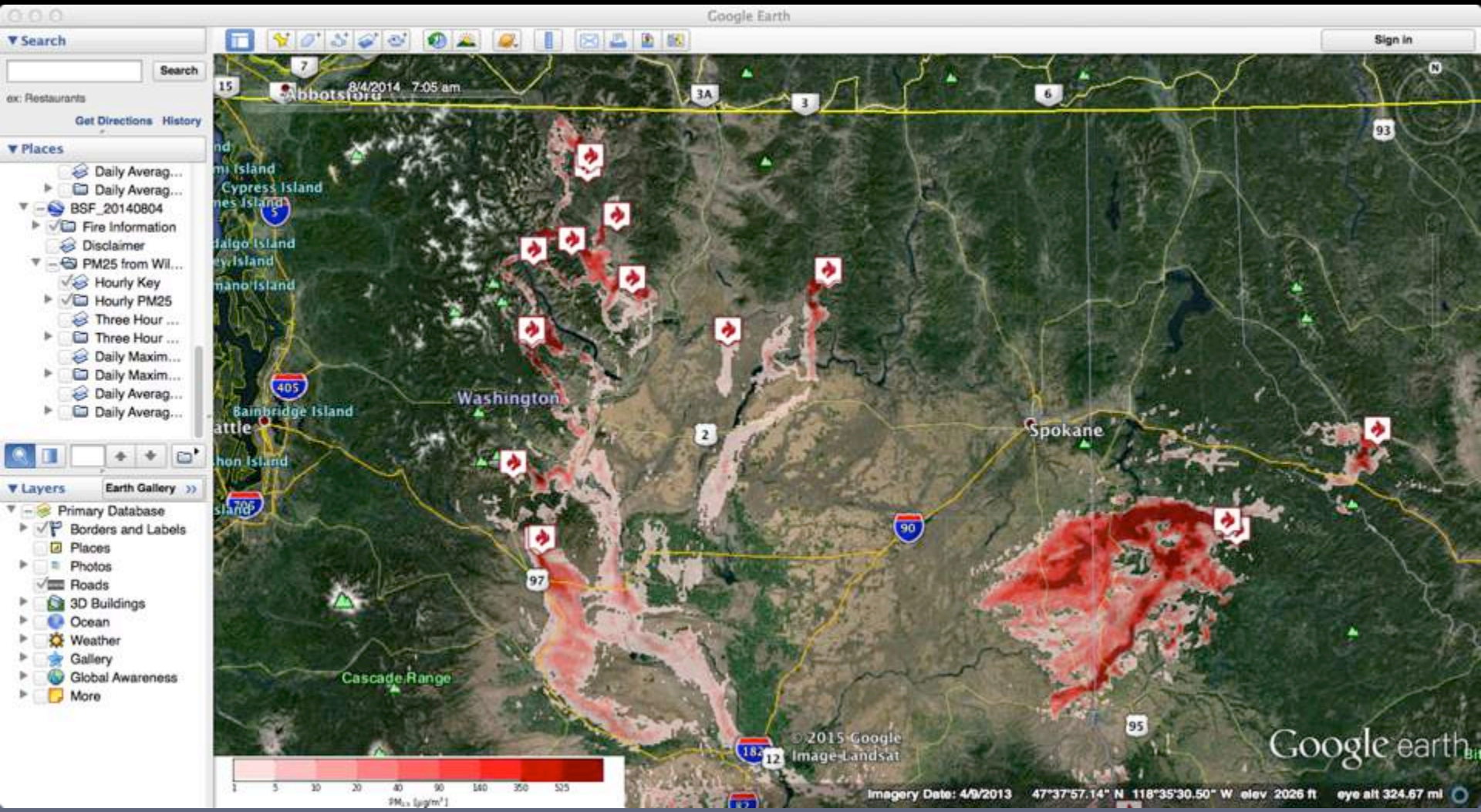
Carlton Complex, 8/4/2014 6am, 12 km Domain



Carlton Complex, 8/4/2014 6am, 1.33 km Domain

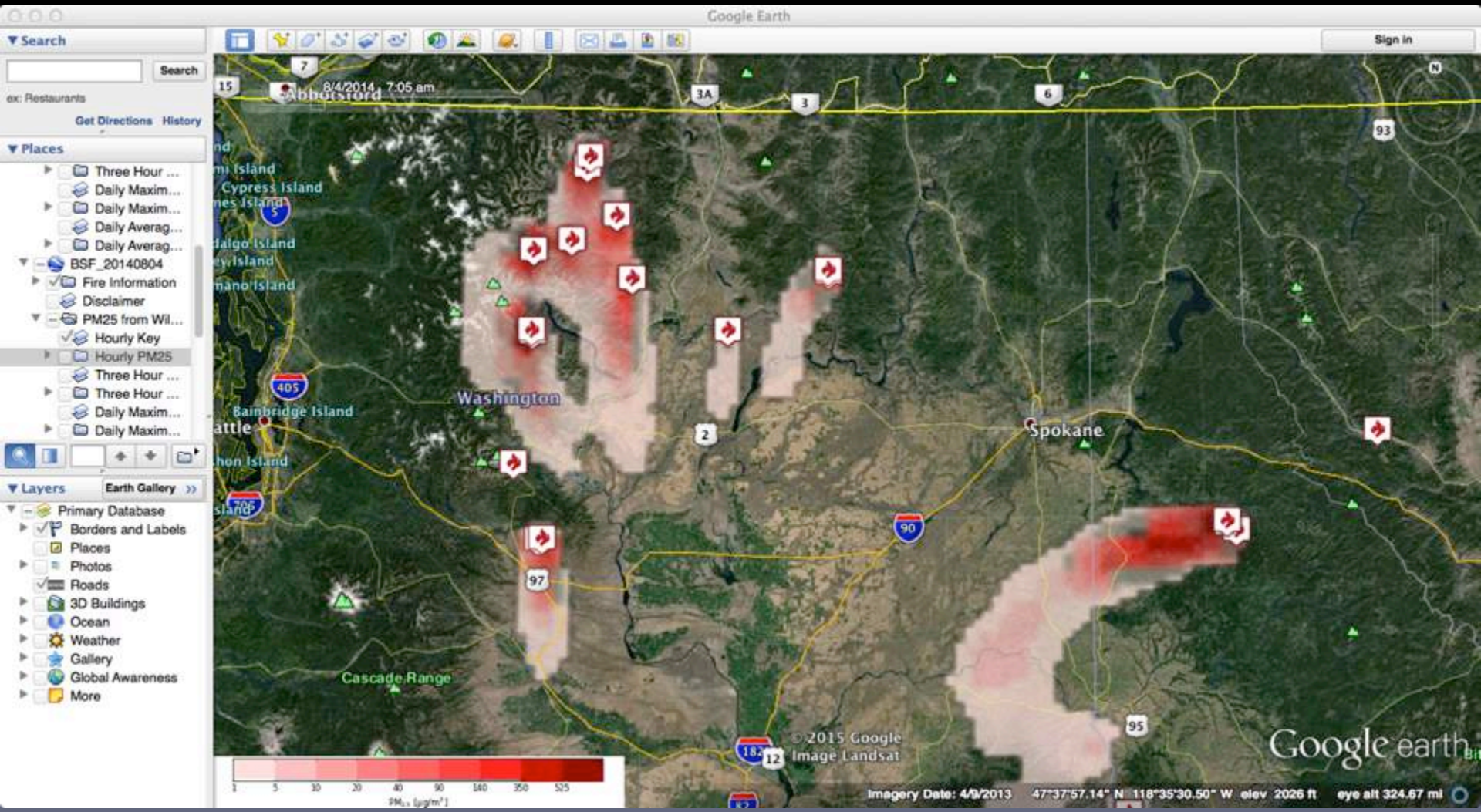


BlueSky PM2.5 from Wildfires
1.33 km UW WRF Domain
8/4/2014 7am PT

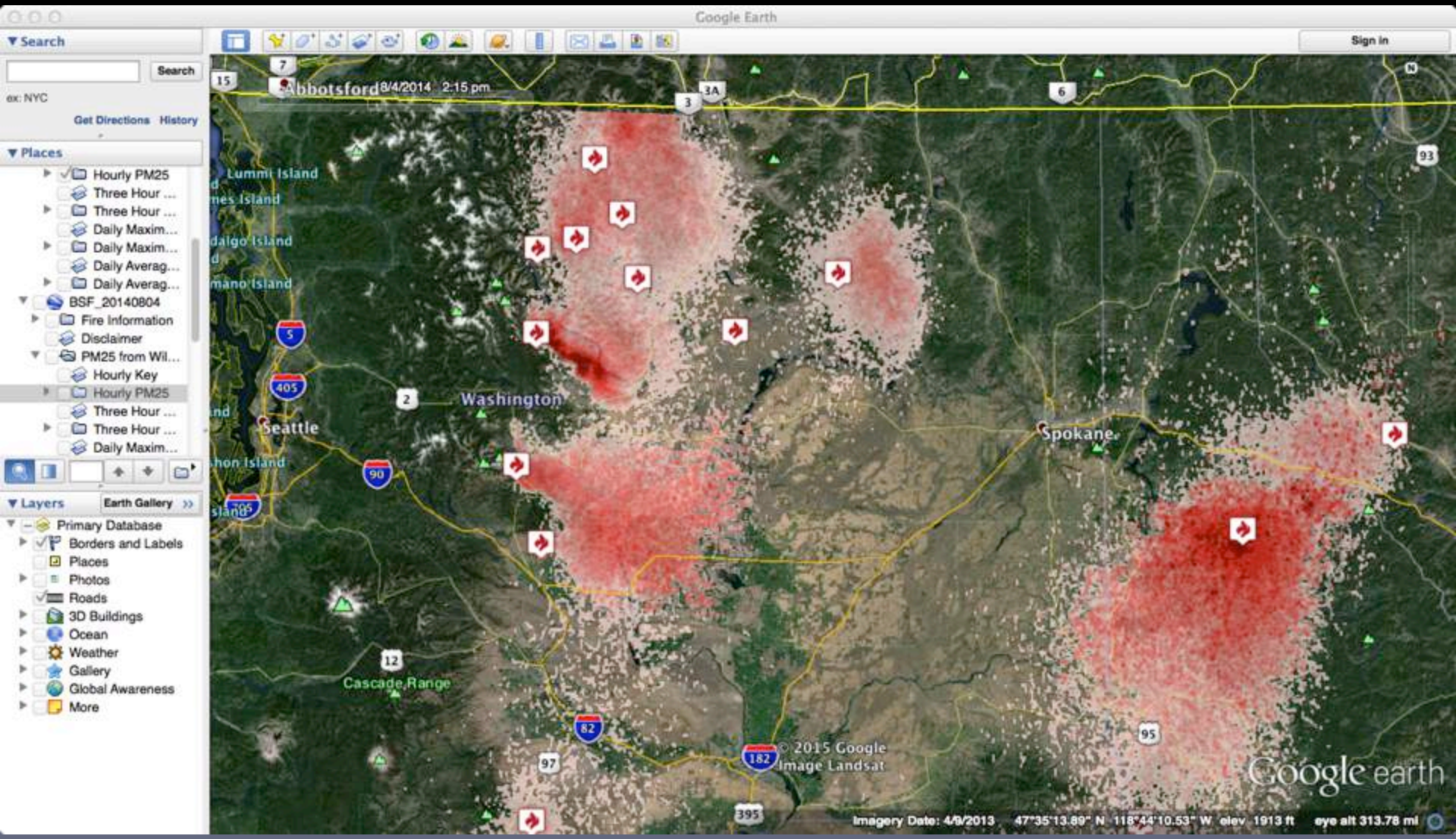


BlueSky PM2.5 from Wildfires
4 km UW WRF Domain
8/4/2014 7am PT

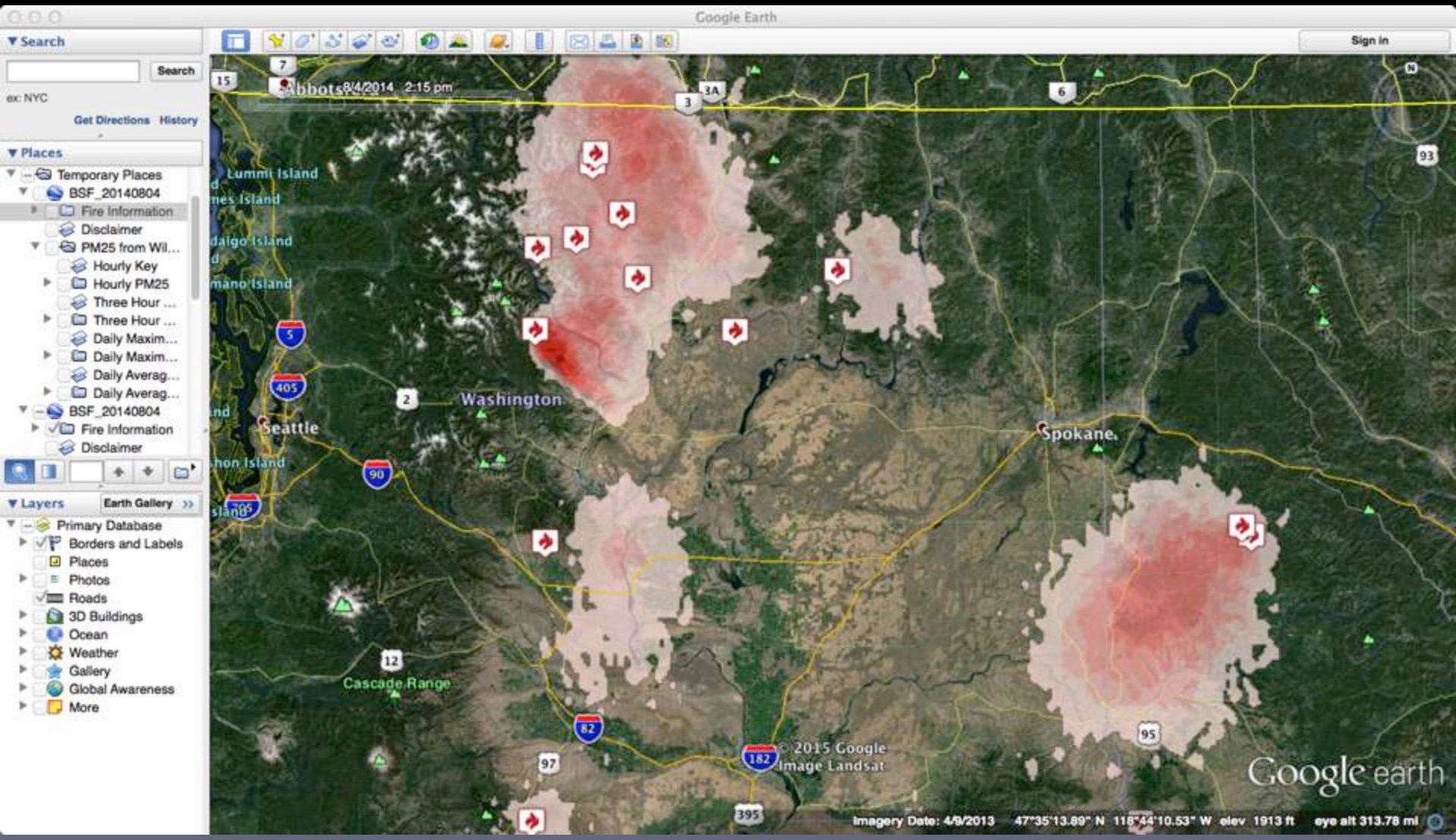
BlueSky PM2.5 from Wildfires
12 km NWS NAM Domain
8/4/2014 7am PT



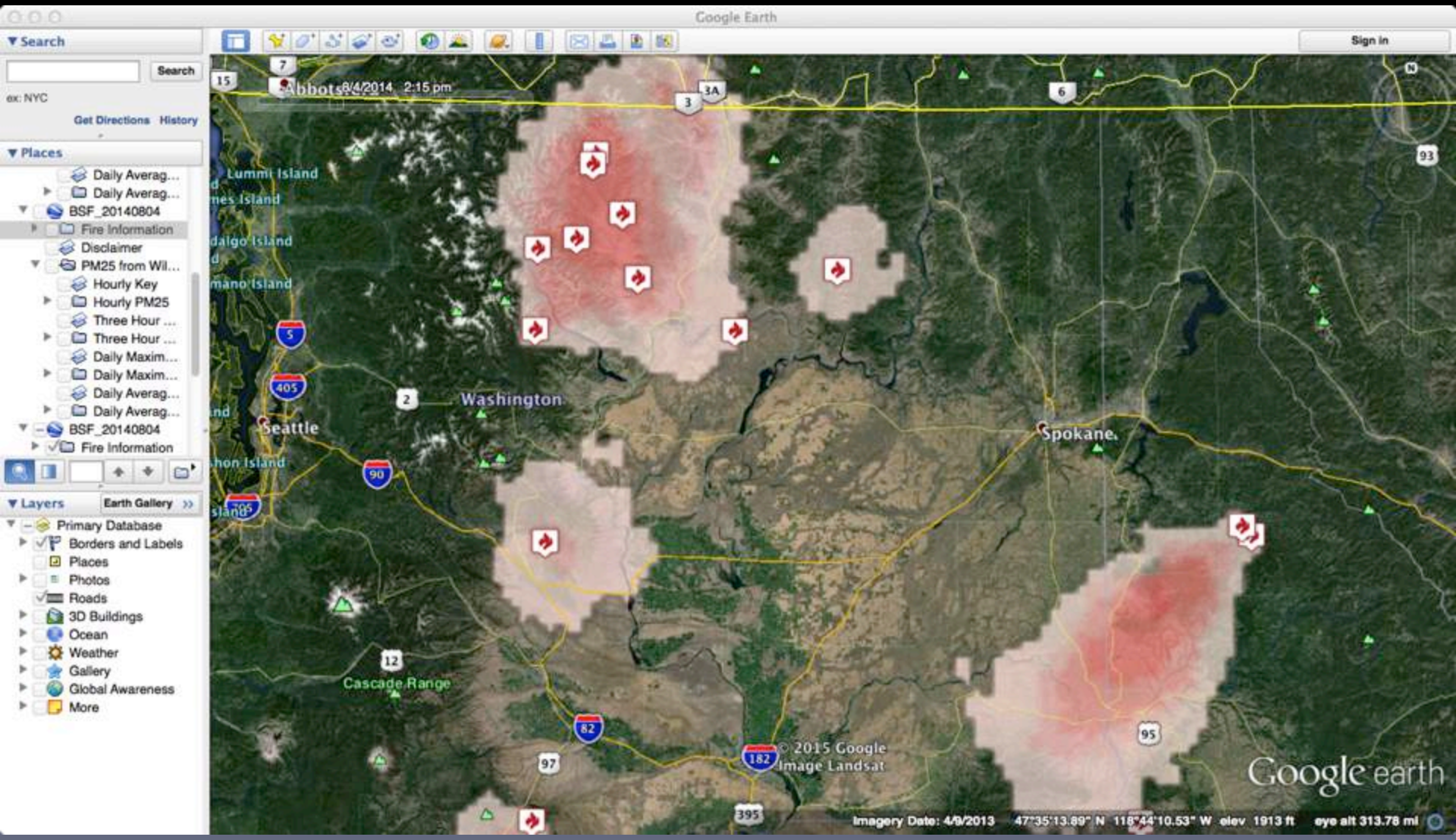
BlueSky PM2.5 from Wildfires
1.33 km UW WRF Domain
8/4/2014 2pm PT



BlueSky PM2.5 from Wildfires
4 km UW WRF Domain
8/4/2014 2pm PT



BlueSky PM2.5 from Wildfires
12 km NWS NAM Domain
8/4/2014 2pm PT



Consequences of Past Management Practices

- Larger and more costly fires
- Loss of life, property, and wildlife habitat
- Ecosystems which may not adapt to future range of variation

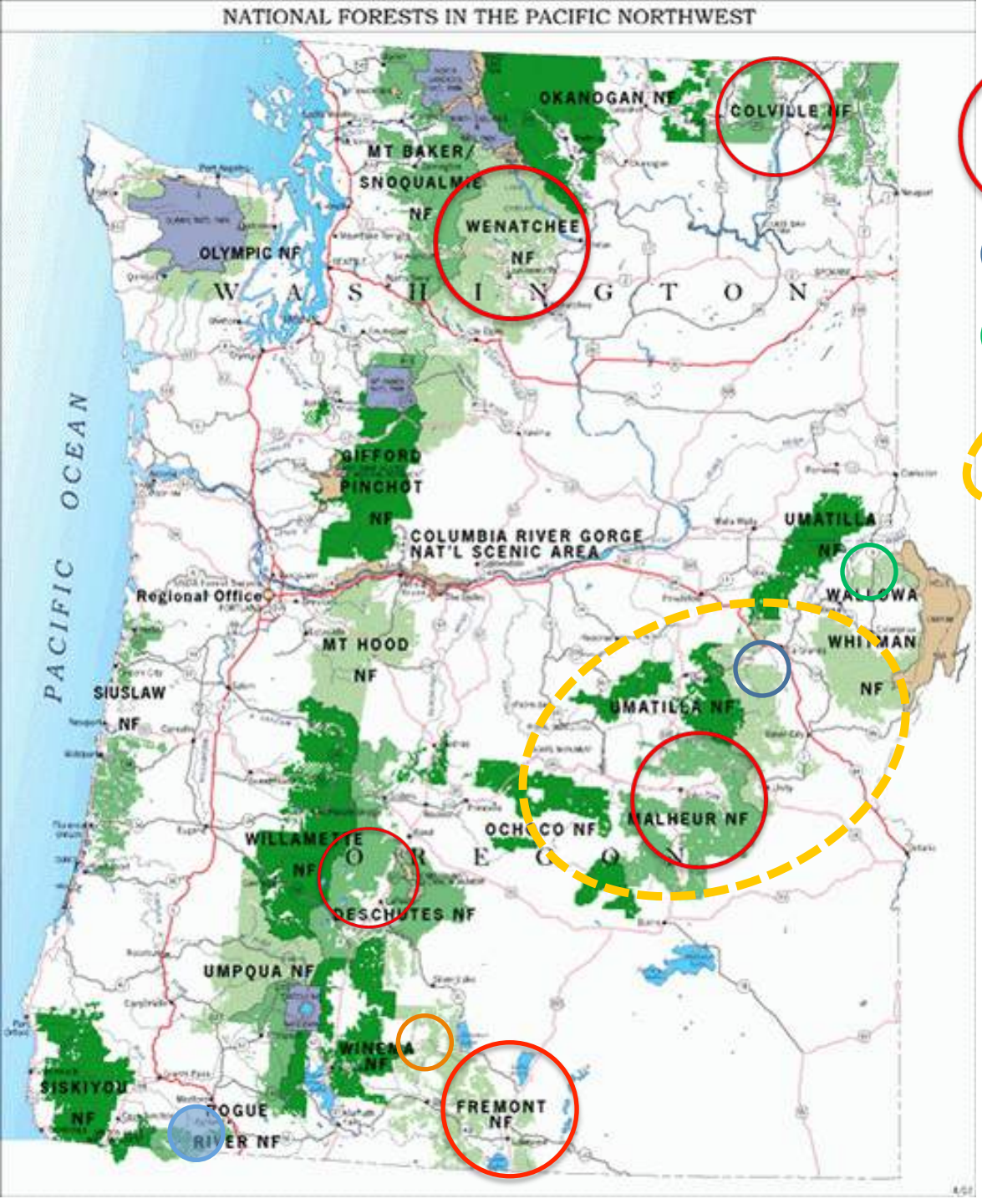
“ If we continue to operate and execute forest management programs at our current pace, large scale wildfire will be the dominant signature across the landscape.

In contrast, if we ramp up the program of work, we will have the opportunity to change wildfire behavior. We are making progress in that direction.”

Kent Connaughton
Regional Forester
US Forest Service Pacific Northwest Region

National Cohesive Wildland Fire Management Strategy: Goals

1. **Restore and maintain landscapes**: Landscapes across all jurisdictions are resilient to fire-related disturbances in accordance with management objectives.
2. **Fire-adapted communities**: Human populations and infrastructure can withstand a wildfire without loss of life and property.
3. **Wildfire response:** All jurisdictions participate in making and implementing safe, effective, efficient risk-based wildfire management decisions.



CFLR PROJECTS

East Face

Lower Joseph

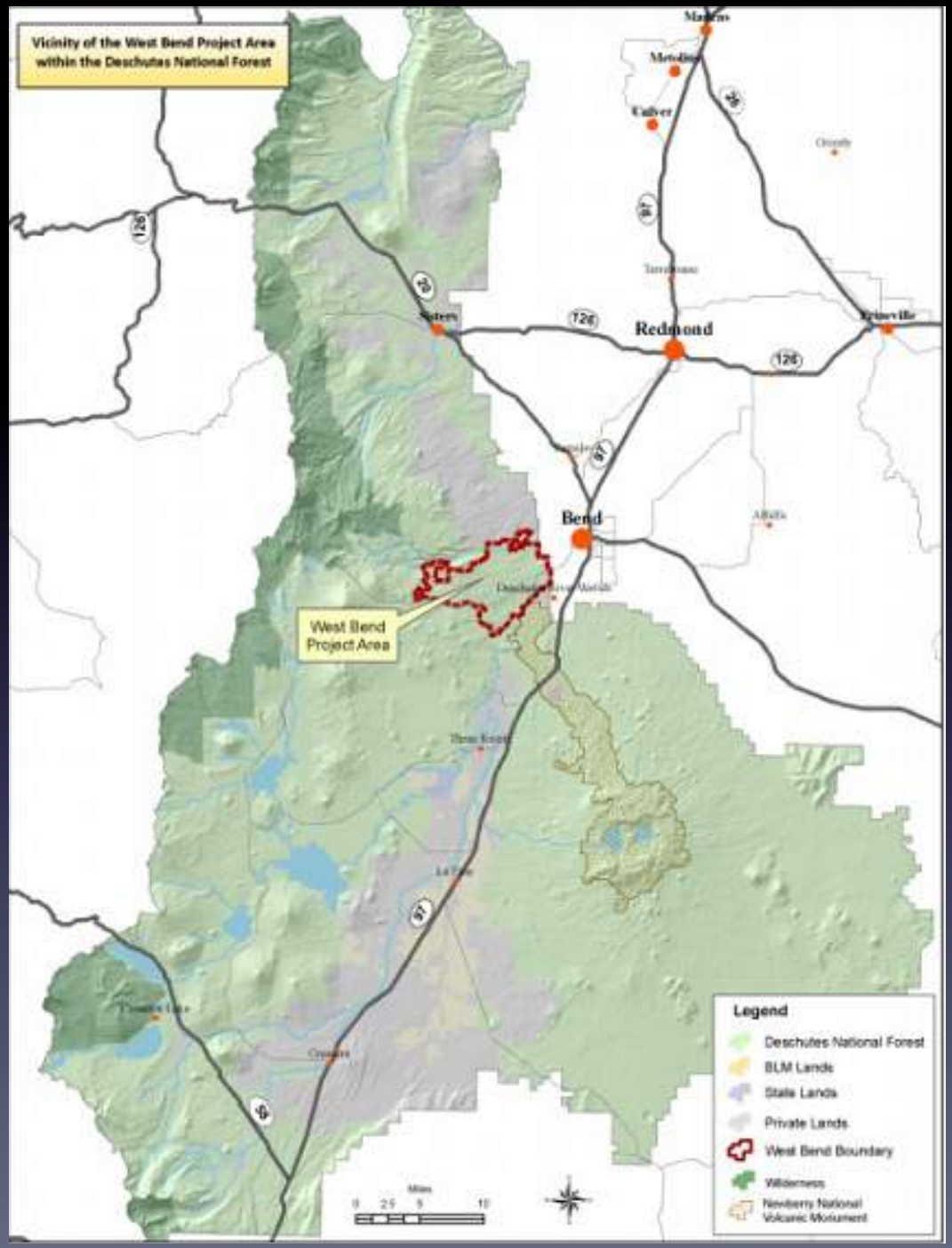
Dry Forest Restoration

BlueJay – FreWin NF

AFR - RoSis

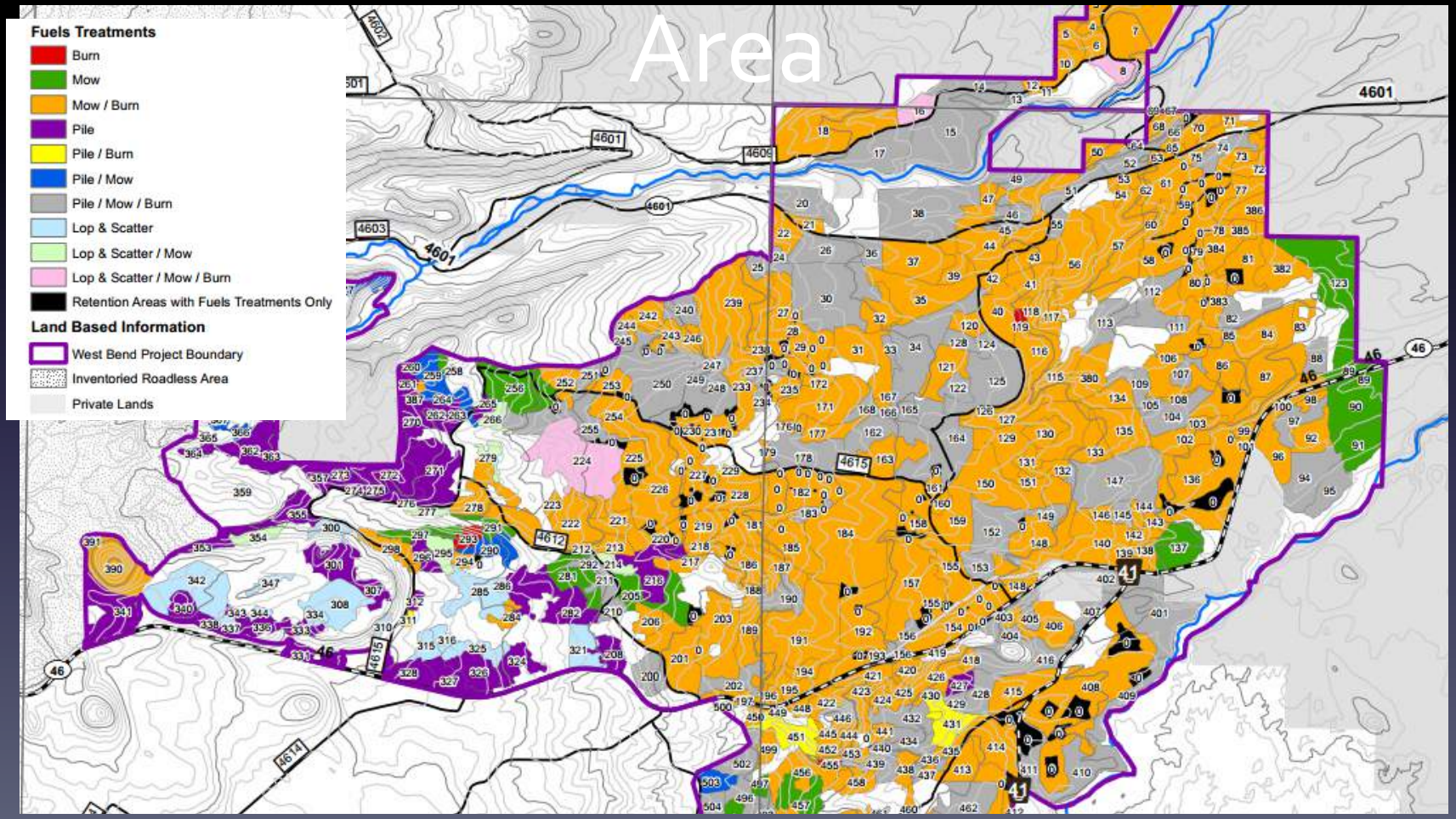
Anticipated substantial increases in Forest Restoration work that would be producing prescribed burning projects in R6. This is an incomplete display, as every forest is accelerating restoration with project-level planning, but is intended to show known larger scale efforts currently underway.

wca 1/29/15



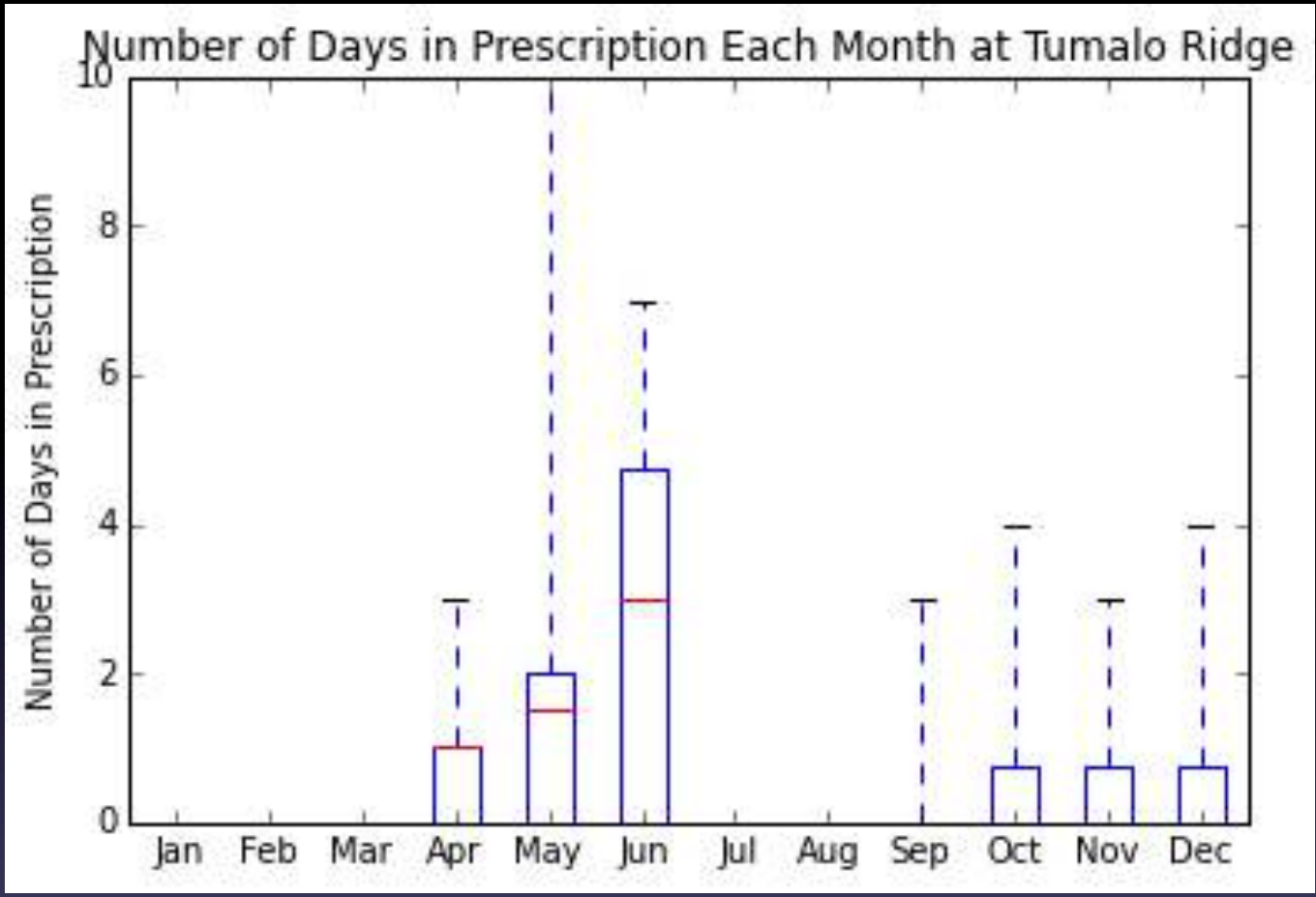
West Bend Vegetation Management Project Location

Fuel Treatments in the West Bend Vegetation Management Project



Meteorological and Fuel Moisture Parameters

Parameters	Low	High	Minimal Acceptable moisture parameters for outside area critical holding point.
Air Temperature (°F)	40	80	n/a
Relative Humidity (%)	20	40	n/a
Mid-flame Wind Speed (mph)	0	8	n/a
1-hr Fuel Moisture (%)	5	10	5
10-hr Fuel Moisture (%)	6	12	6
100-hr Fuel Moisture (%)	7	14	7
1000-hr Fuel Moisture (%)	n/a	n/a	15
Live Fuel Moisture (%)	n/a	n/a	30



- Average = 9 days/year to burn, before smoke management considerations.
- Range = 2 to 22 day/year

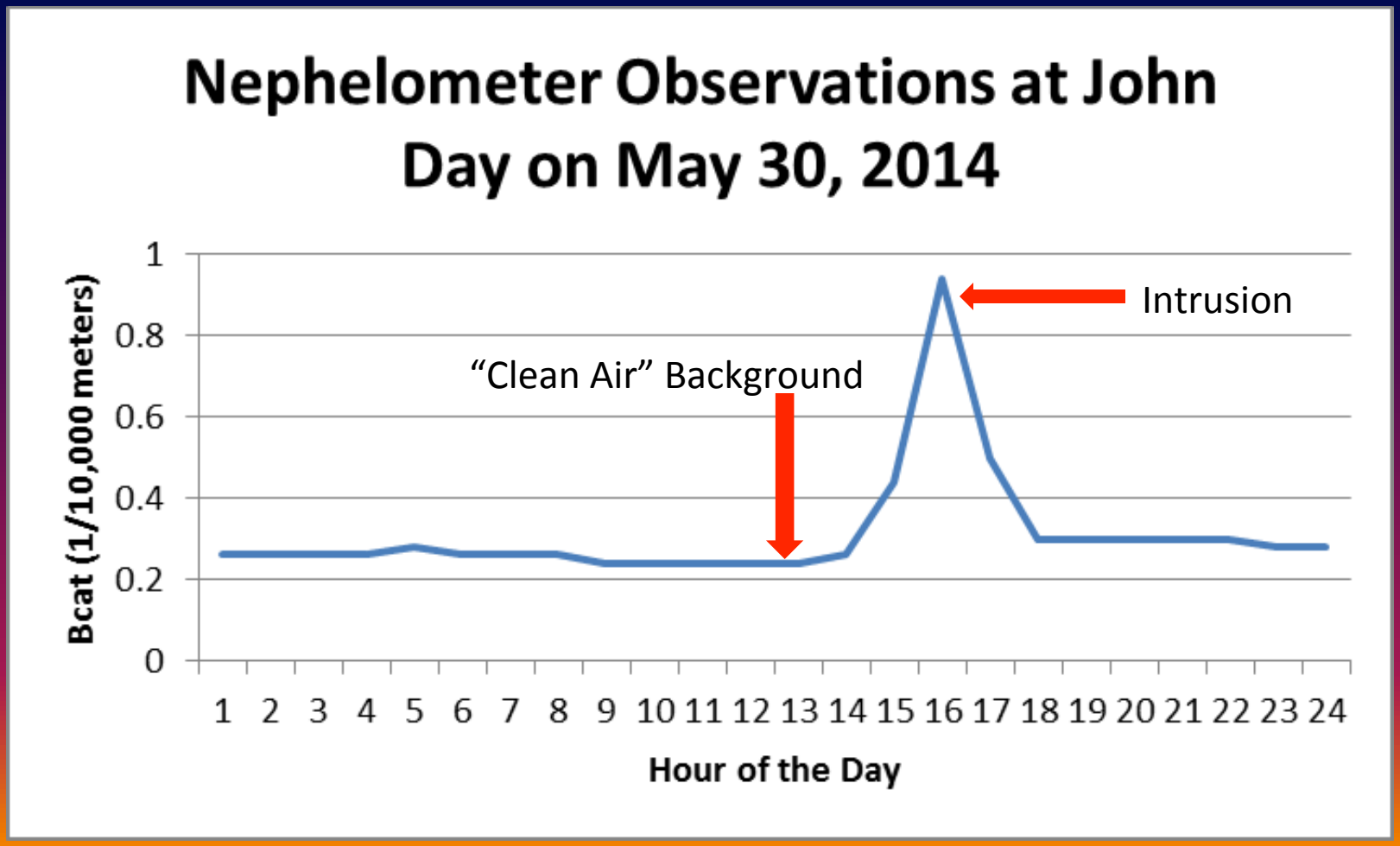
- Goal: 19,000 acres to burn in 10 years
- Therefore: 211 acres/burn opportunity

State Smoke Management Plans

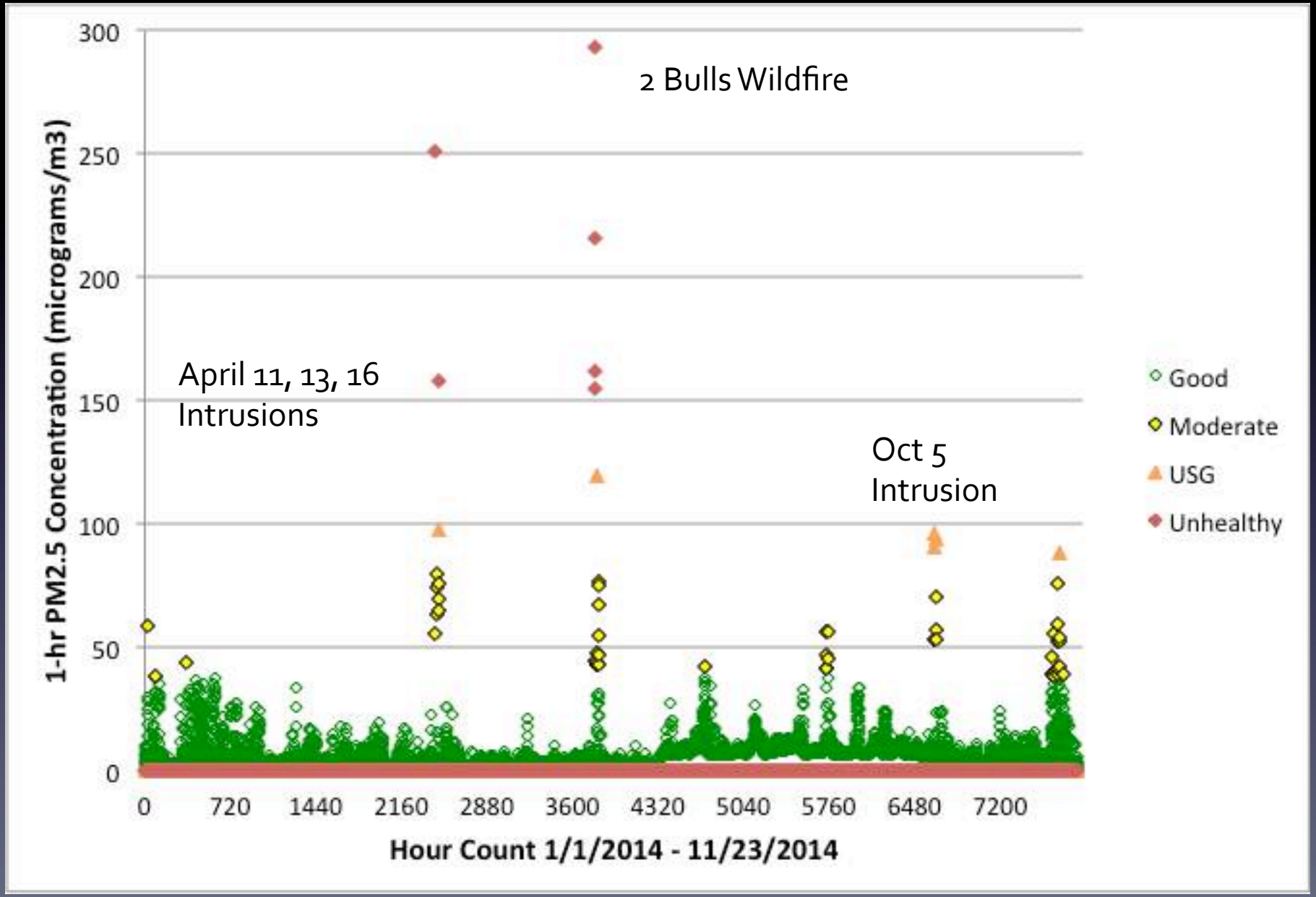
	WA	OR	CA
Avg. Wildfire Acres burned/yr	176,502	442,980	579,308
Avg. Prescribed Fire Acres/yr	18,144	101,281	66,702
Goal of Smoke Management Rules (SMP)	Provide a limited burning program	Maximize burning and minimize smoke intrusions	Provide increased opportunities for prescribed burning while minimizing smoke impacts on the public.
Smoke Restrictions	Smoke intrusions, including 2000 ft. above ground level. No weekend burning during summer and on key holidays	Smoke intrusions, ground level only Voluntarily keep main plume out of Class I areas	Minimize smoke impacts on smoke sensitive areas, avoid cumulative smoke impacts, and prevent public nuisance Special provisions for Rx burning in the WUI.

Example of a Smoke Intrusion

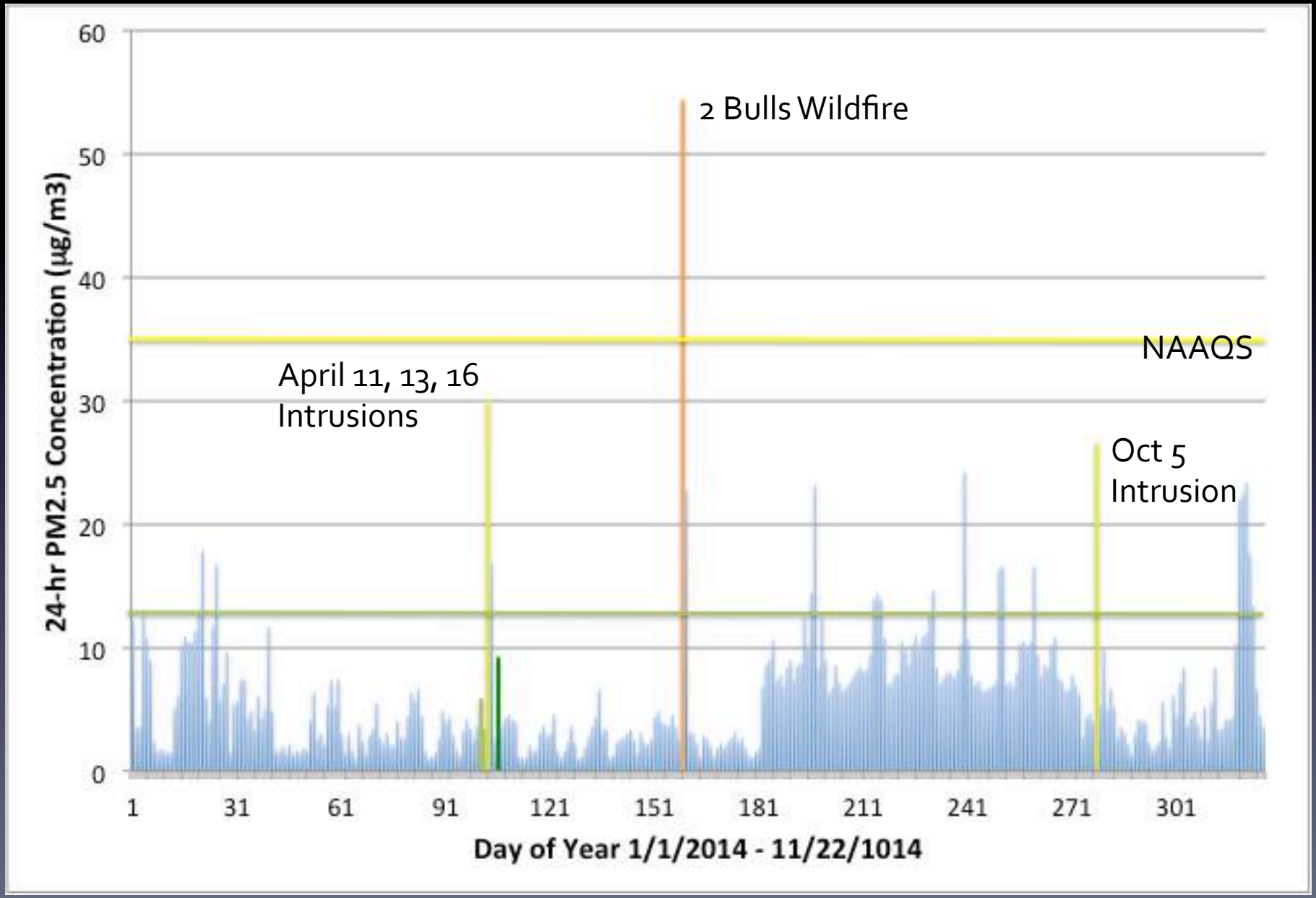
Based upon 1-hour above the "clean air background "
(i.e., the average nephelometer reading for the 3-hour period prior to the



Bend Intrusions 1-hr PM2.5

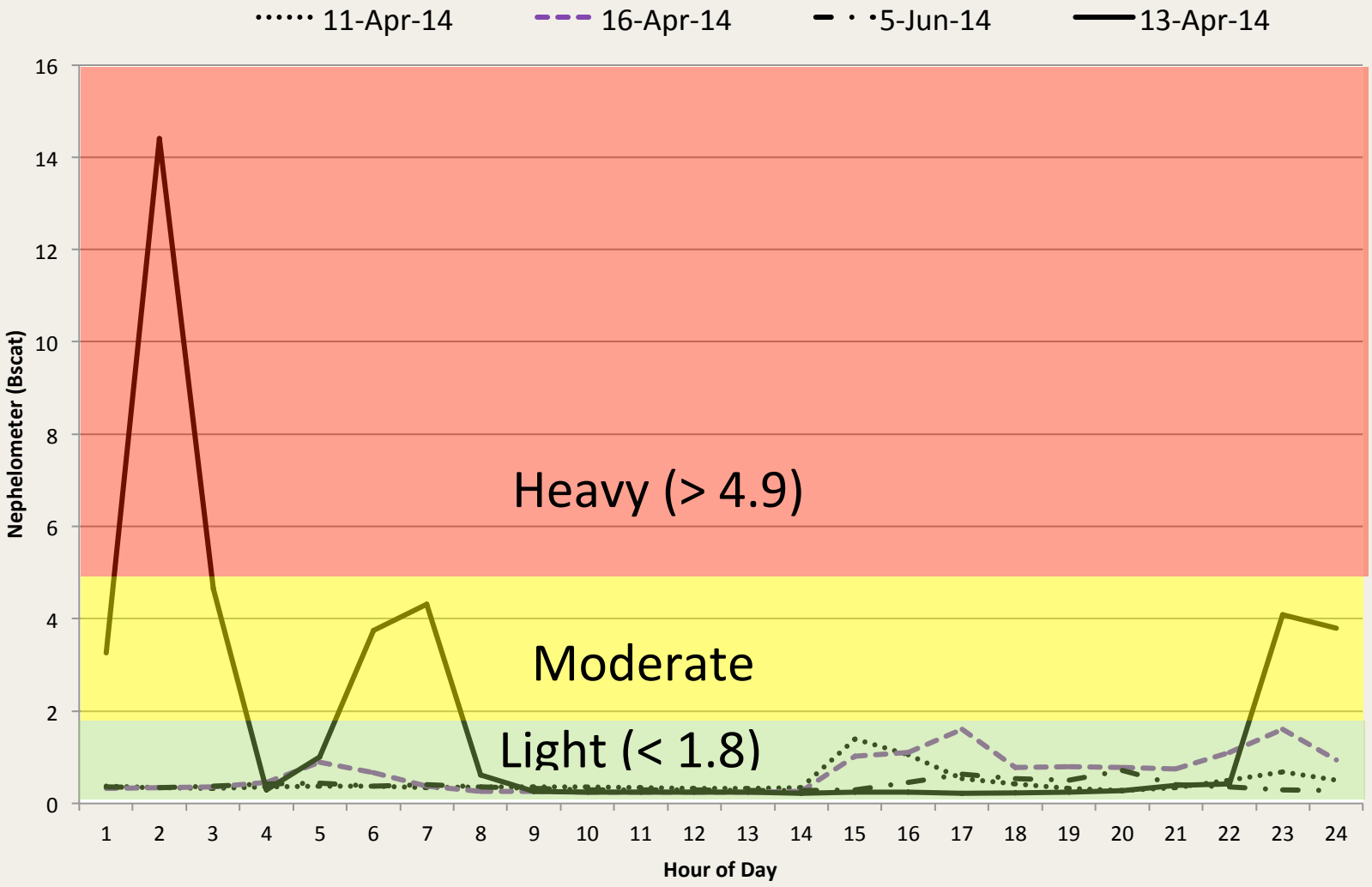


Bend Intrusions 24-hr PM2.5



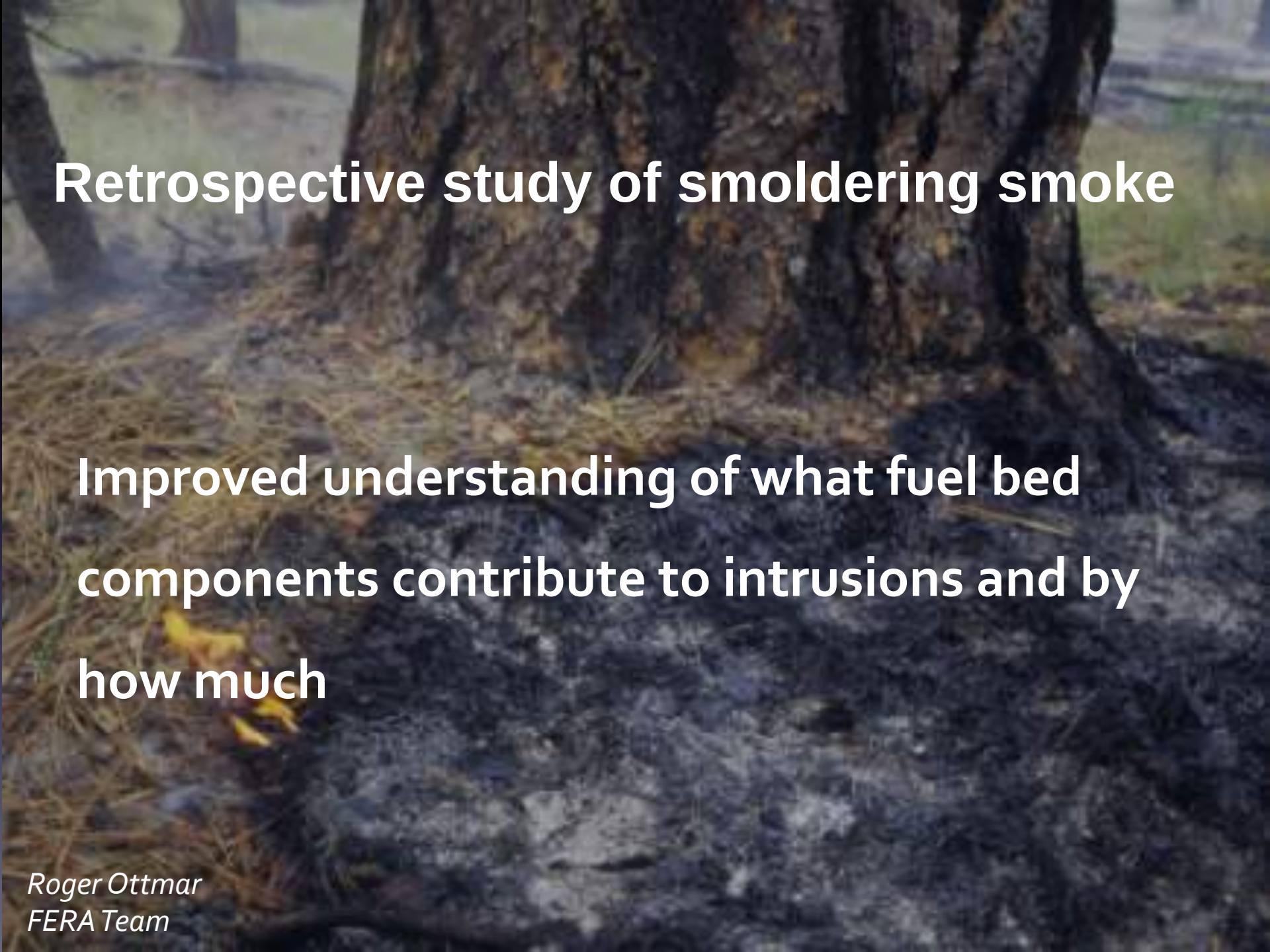
2014 Smoke Intrusions into Bend

Based upon 1-hour above the "clean air background "
(i.e., the average nephelometer reading for the 3-hour period prior to the incident)



Research Project

- Investigate fuel conditions leading to smoke incursions
- Investigate meteorological conditions leading to smoke incursions



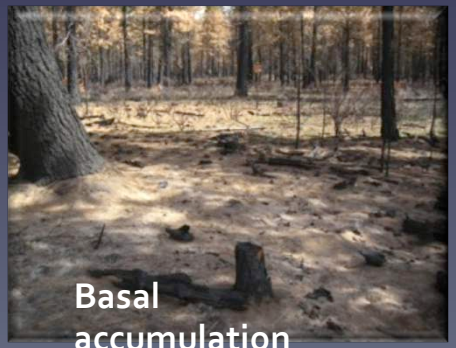
Retrospective study of smoldering smoke

Improved understanding of what fuel bed components contribute to intrusions and by how much

Roger Ottmar
FERA Team

Fuelbed Components that Contribute to Smoldering Smoke

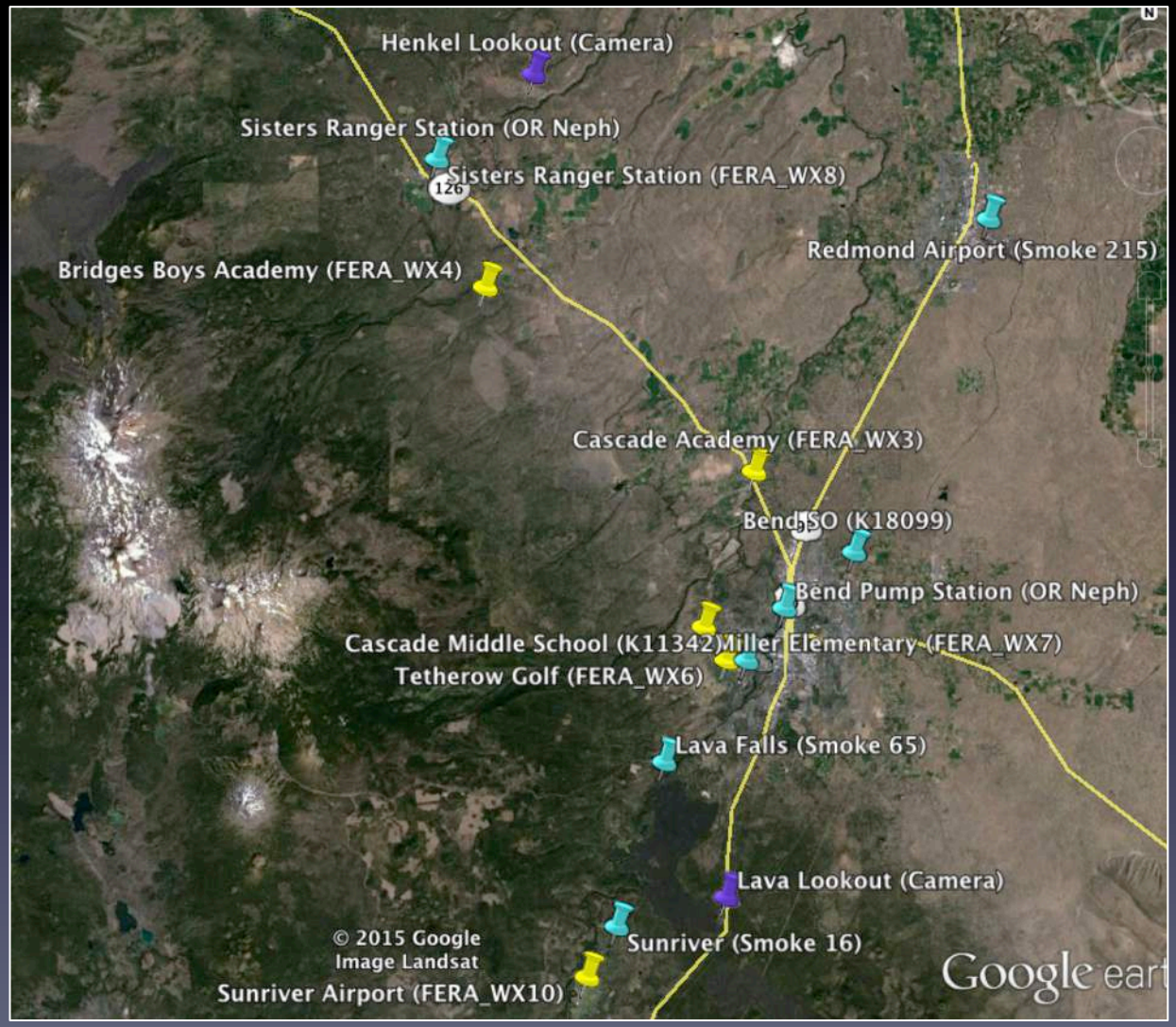
- **Smoldering fuel bed components**
  - Rotten stumps
  - Rotten logs
  - Basal accumulation
- No timing and duration of smoldering could be determined
  - can't say definitively they caused the intrusion
  - can say these smoldering fuels consumed



Roger Ottmar
FERA Team

Monitor Locations

- E-Samplers (blue)
- Meteorological Station (yellow)
- Camera (purple)
- Fall 2014
- Spring 2015



E-Sampler

Weather Station

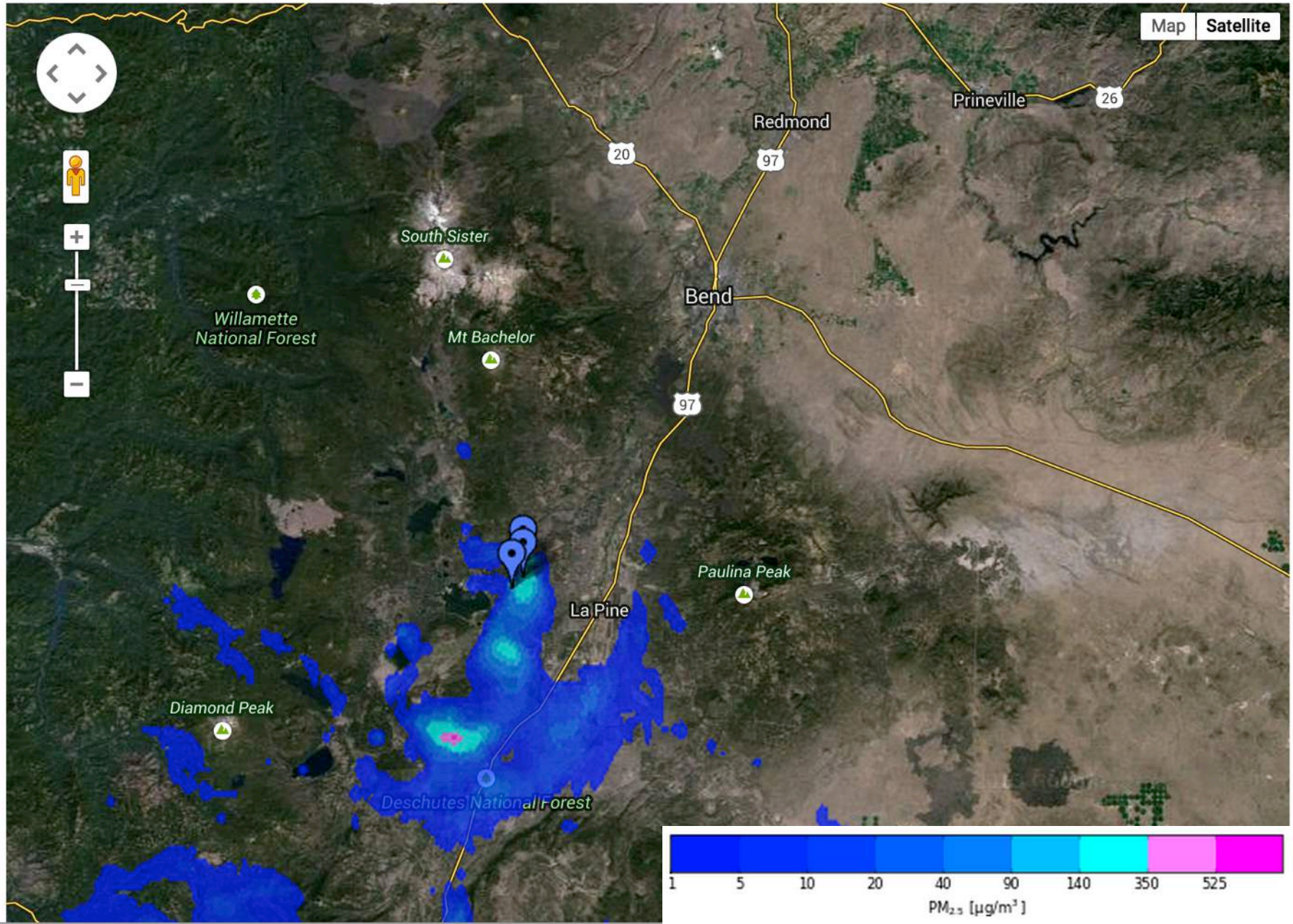
October 5, 2014 Smoke Intrusion

- 3 Rx fires SW of Bend
- Approximately 50 acres each
- Ignited from 11am-1pm PDT
- Maximum 1-hr PM2.5 concentration of 96 μg/m^3 at 2am, another peak of 94 μg/m^3 at 8am
- 24 hr average PM2.5 = 27 μg/m^3

- BlueSky Simulations
- HYSPLIT Trajectories
- 1-km NWS Fire Weather Domain
- 4-km PNW WRF Domain from University of Washington

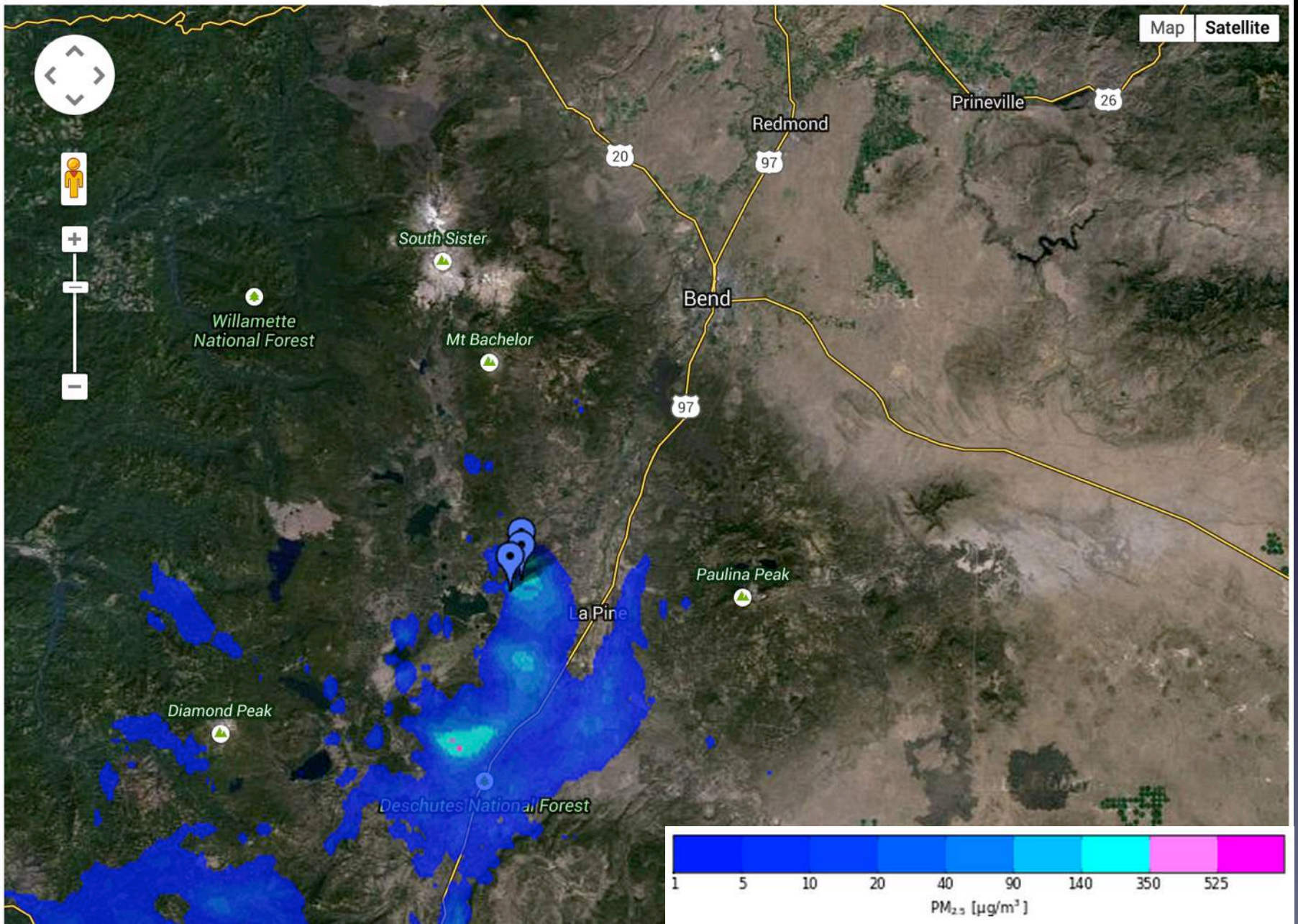
10/4/2014 22:00 Pacific Daylight Savings

animation speed



10/4/2014 23:00 Pacific Daylight Savings

▶ || + - animation speed



10/5/2014 0:00 Pacific Daylight Savings

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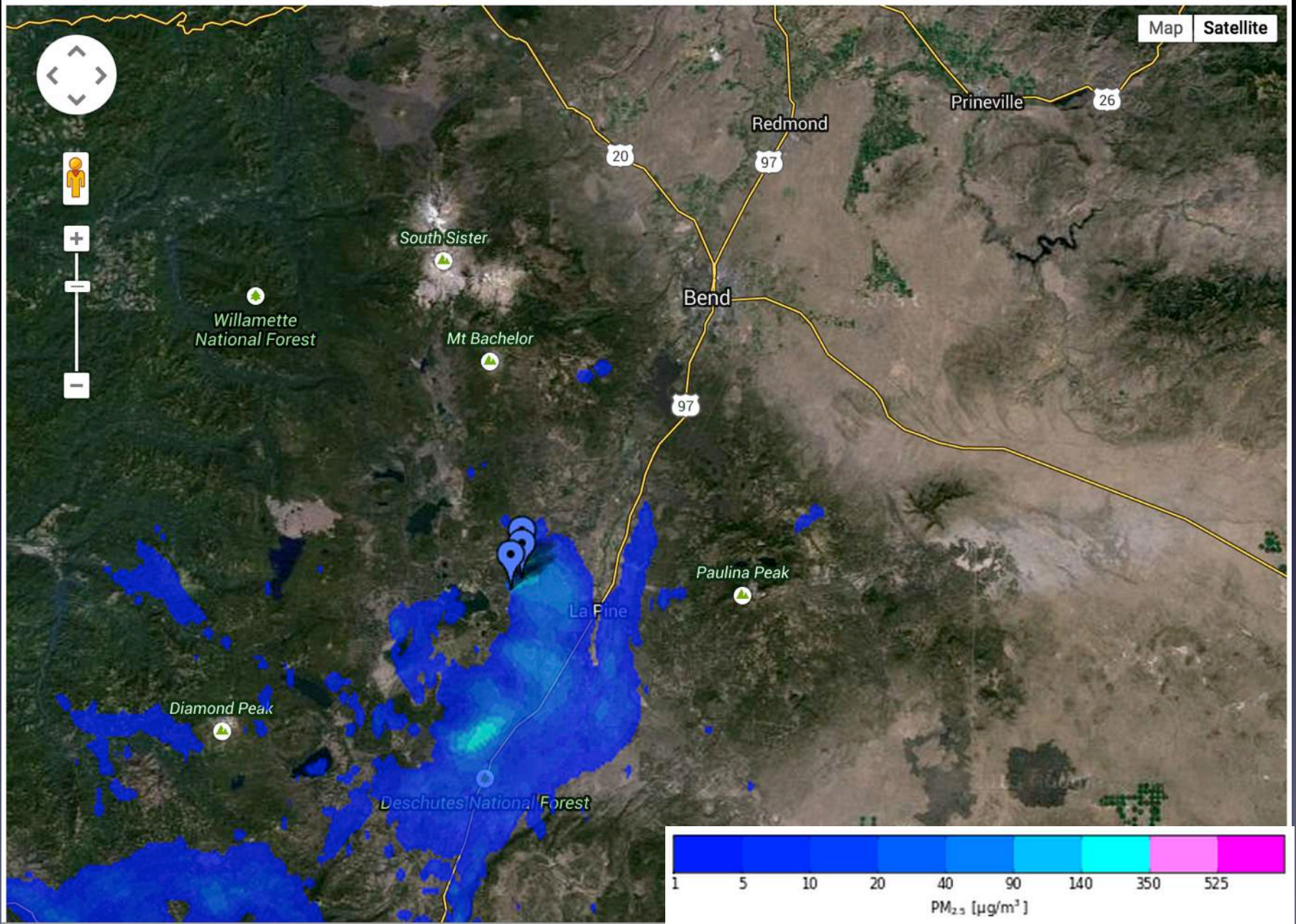

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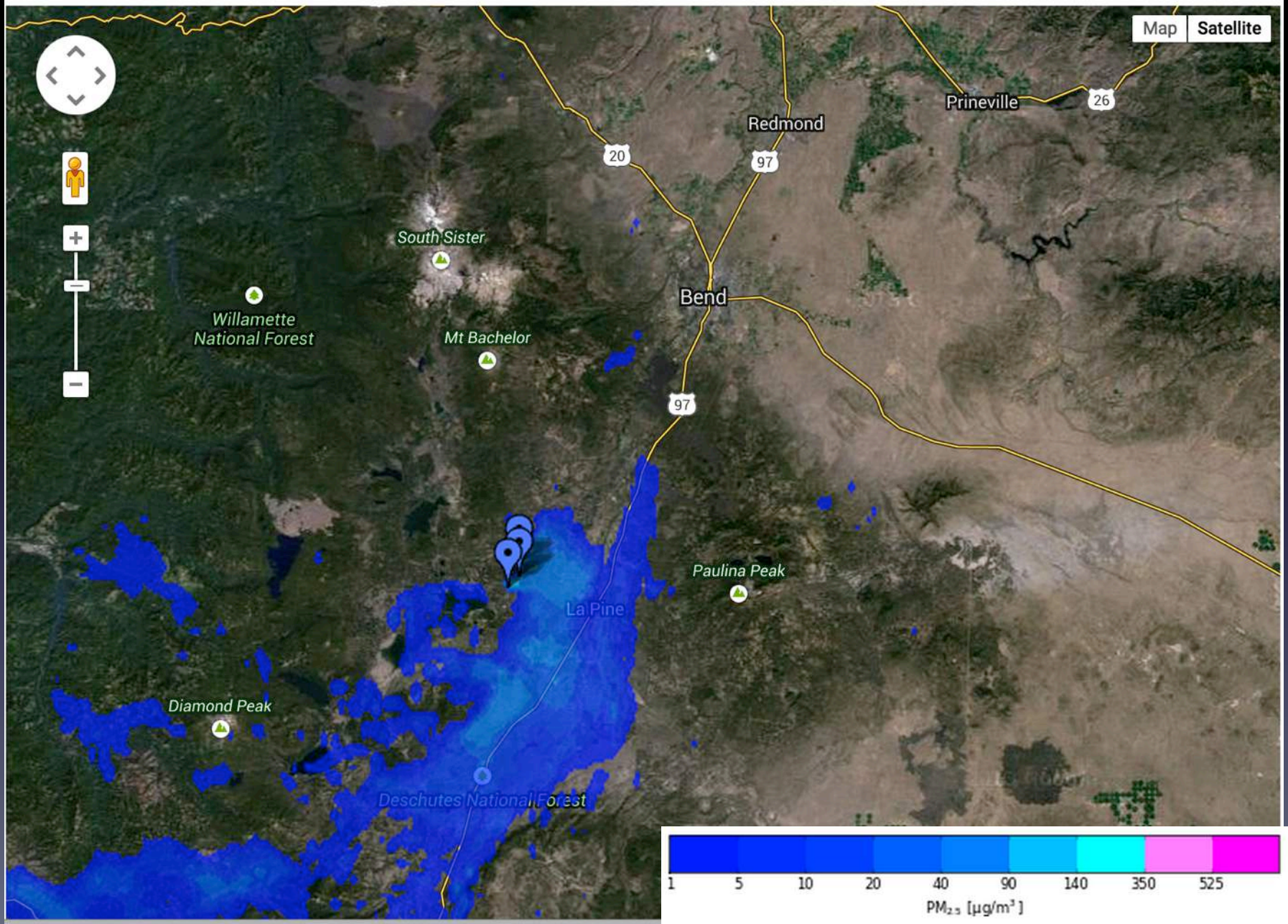

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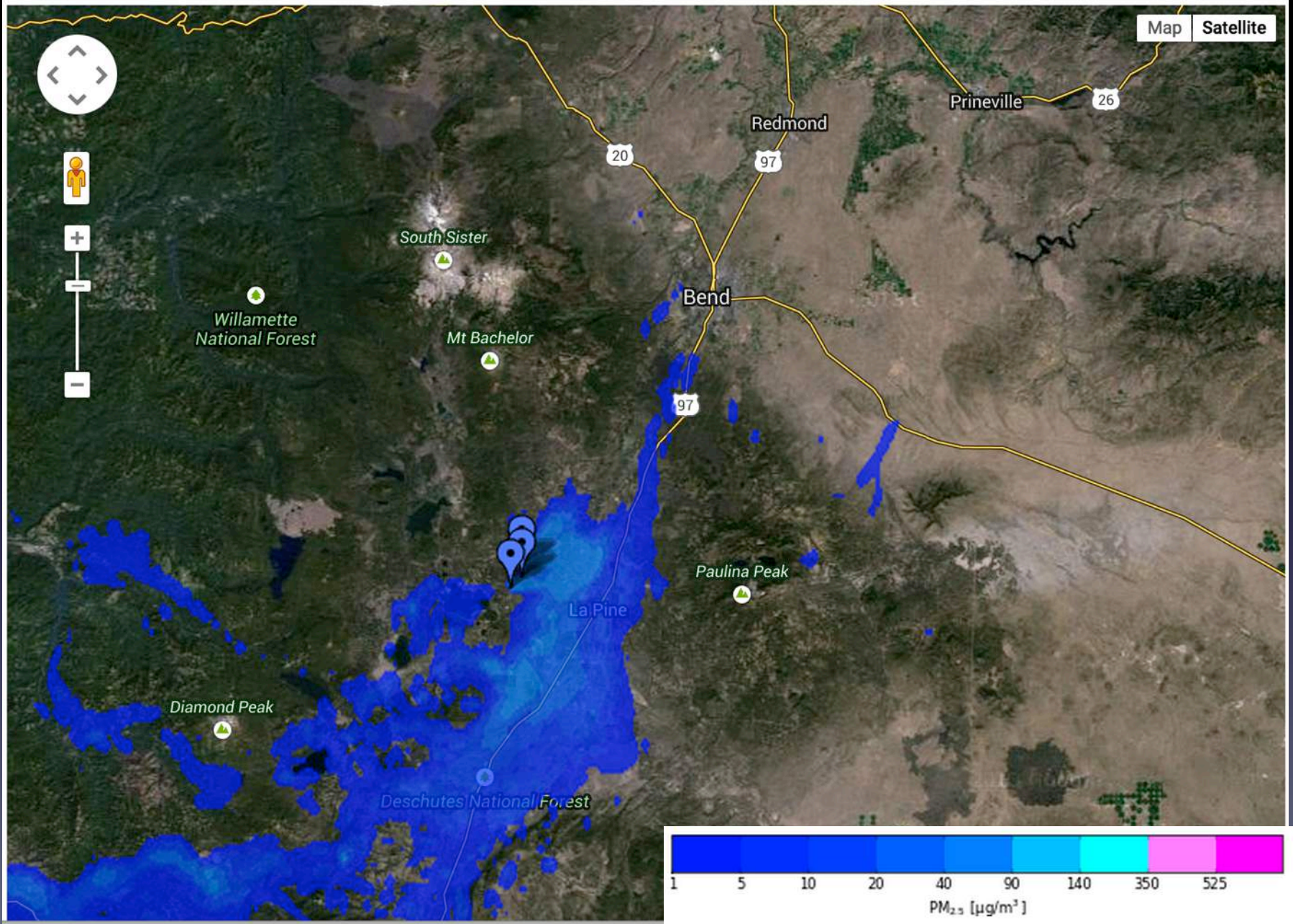

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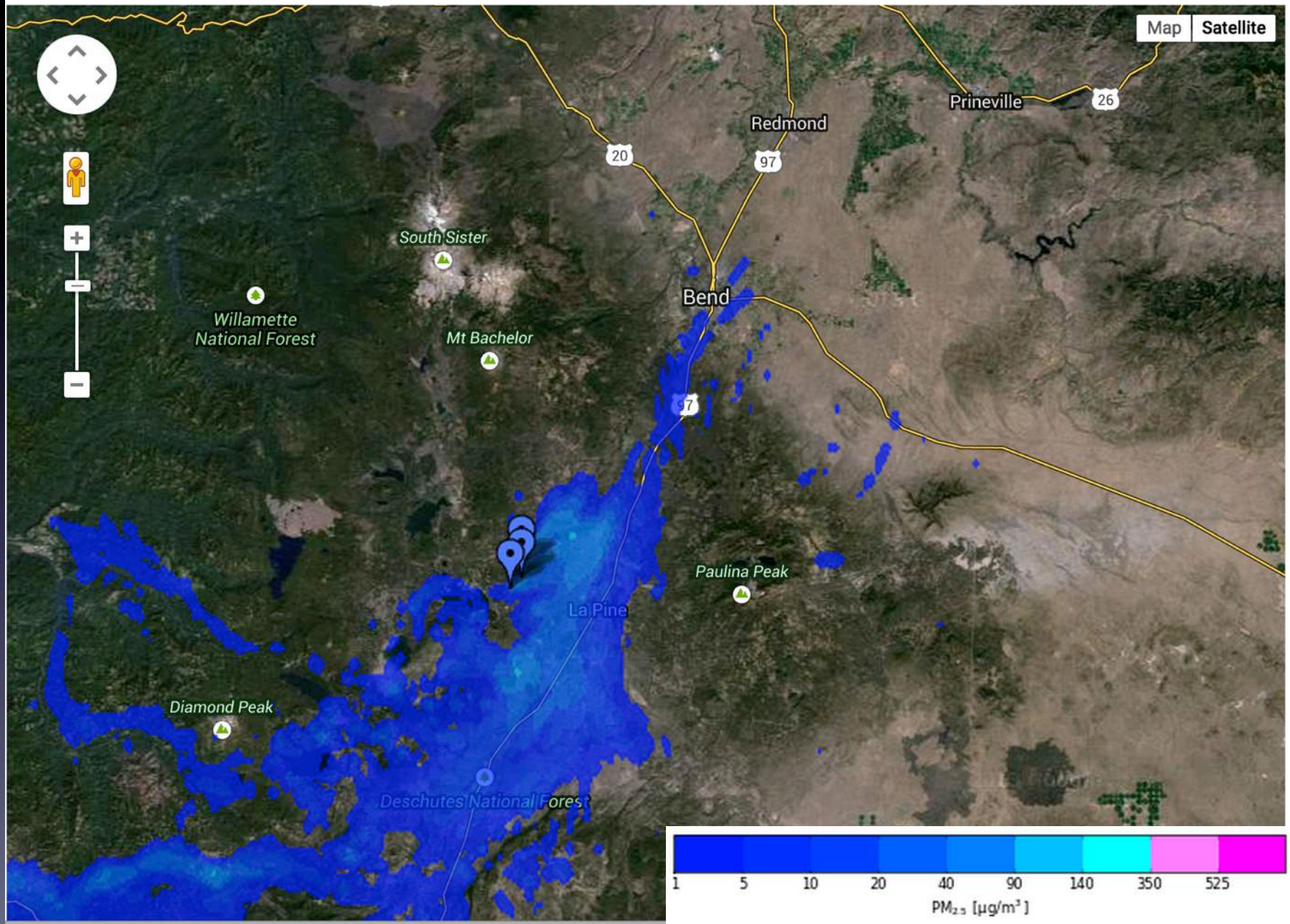
animation speed



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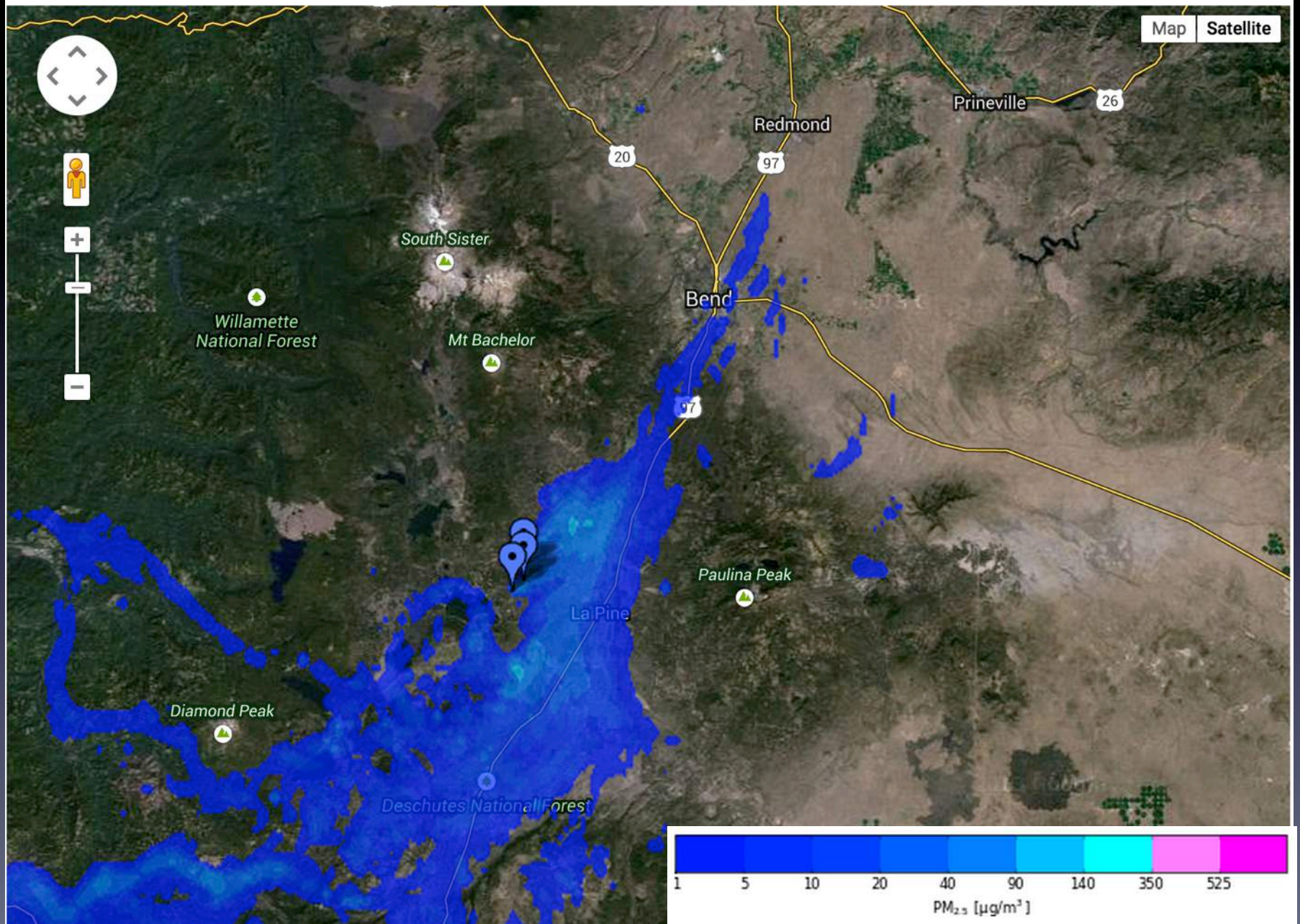
animation speed



10/5/2014 5:00 Pacific Daylight Savings

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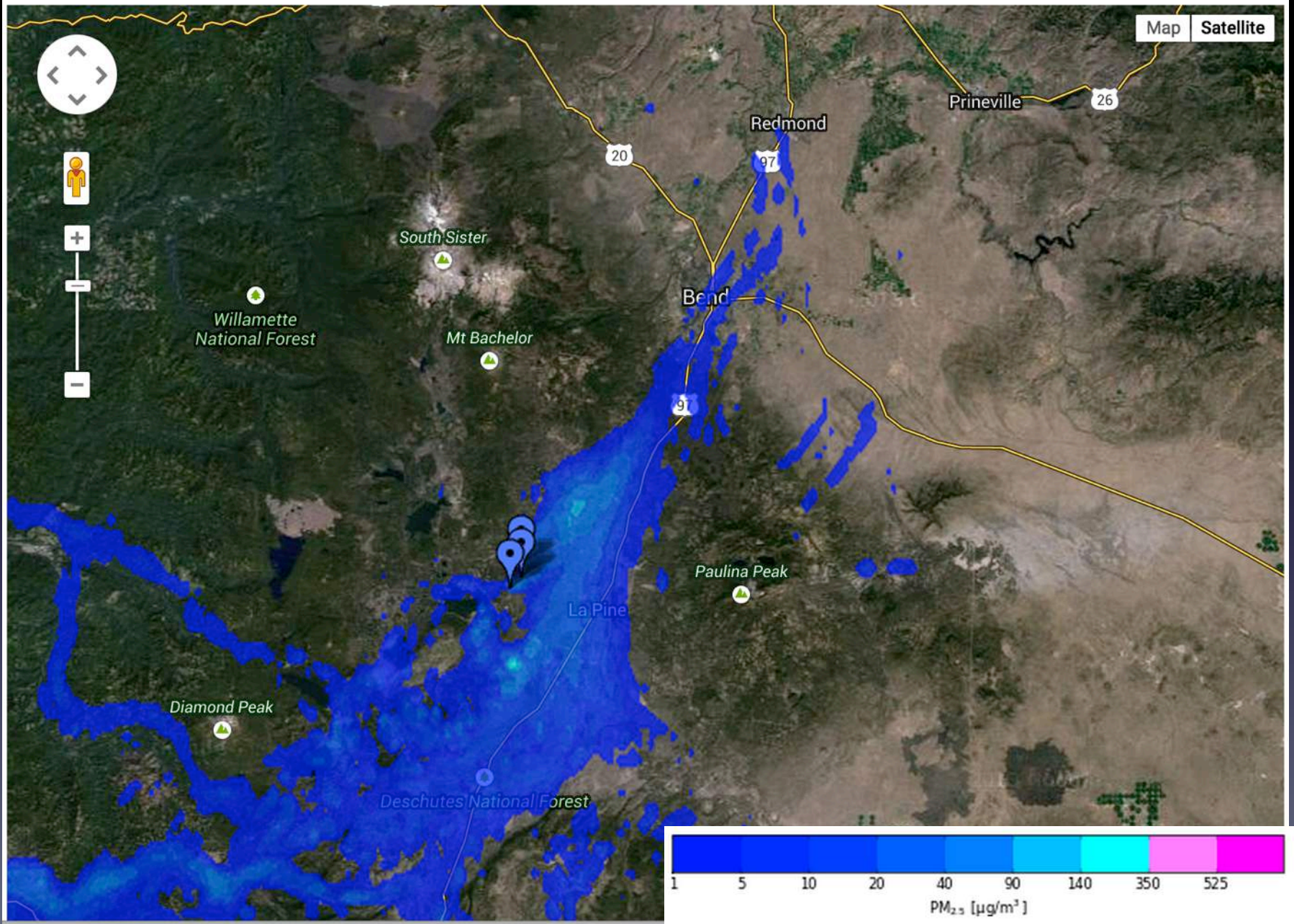
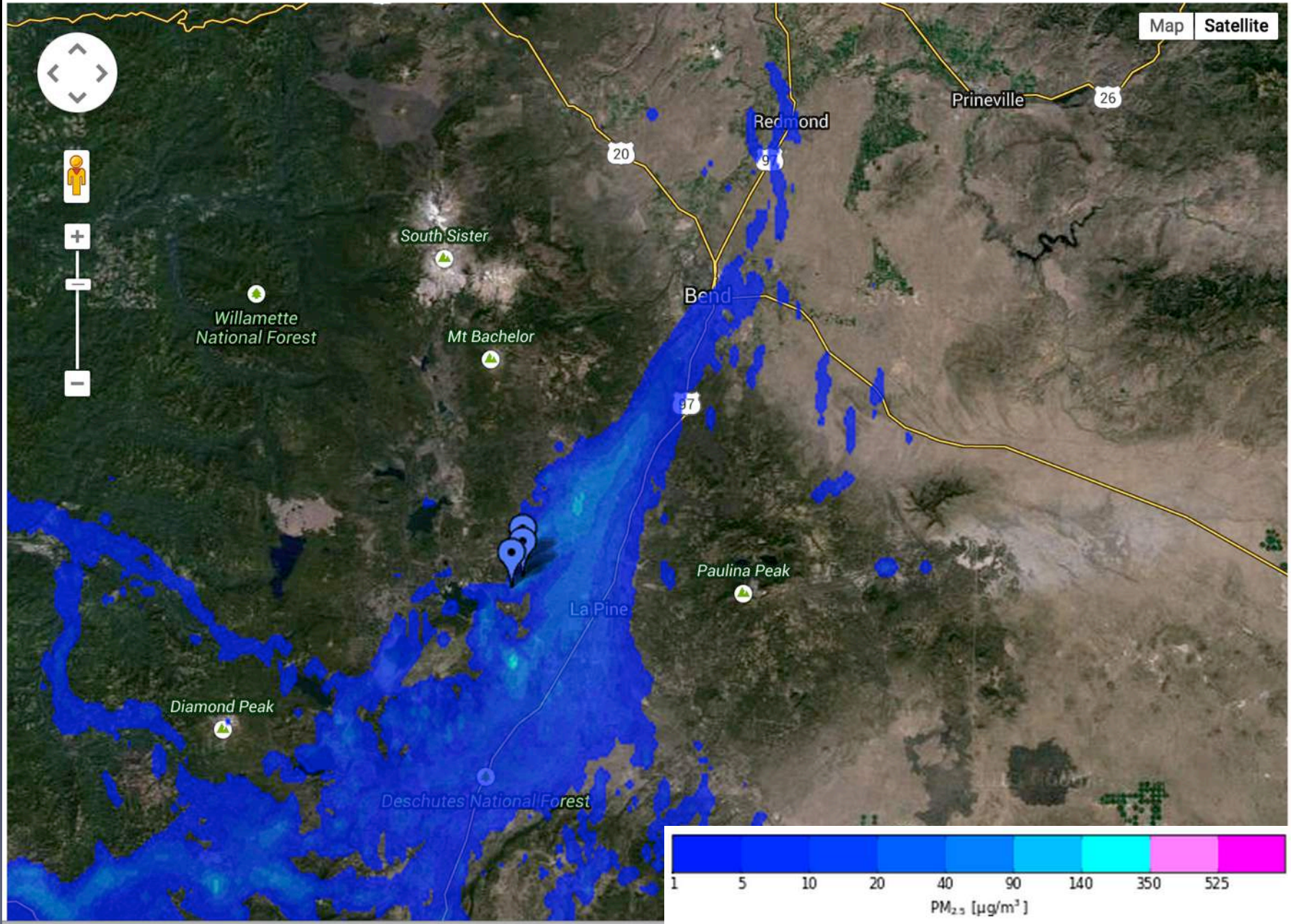


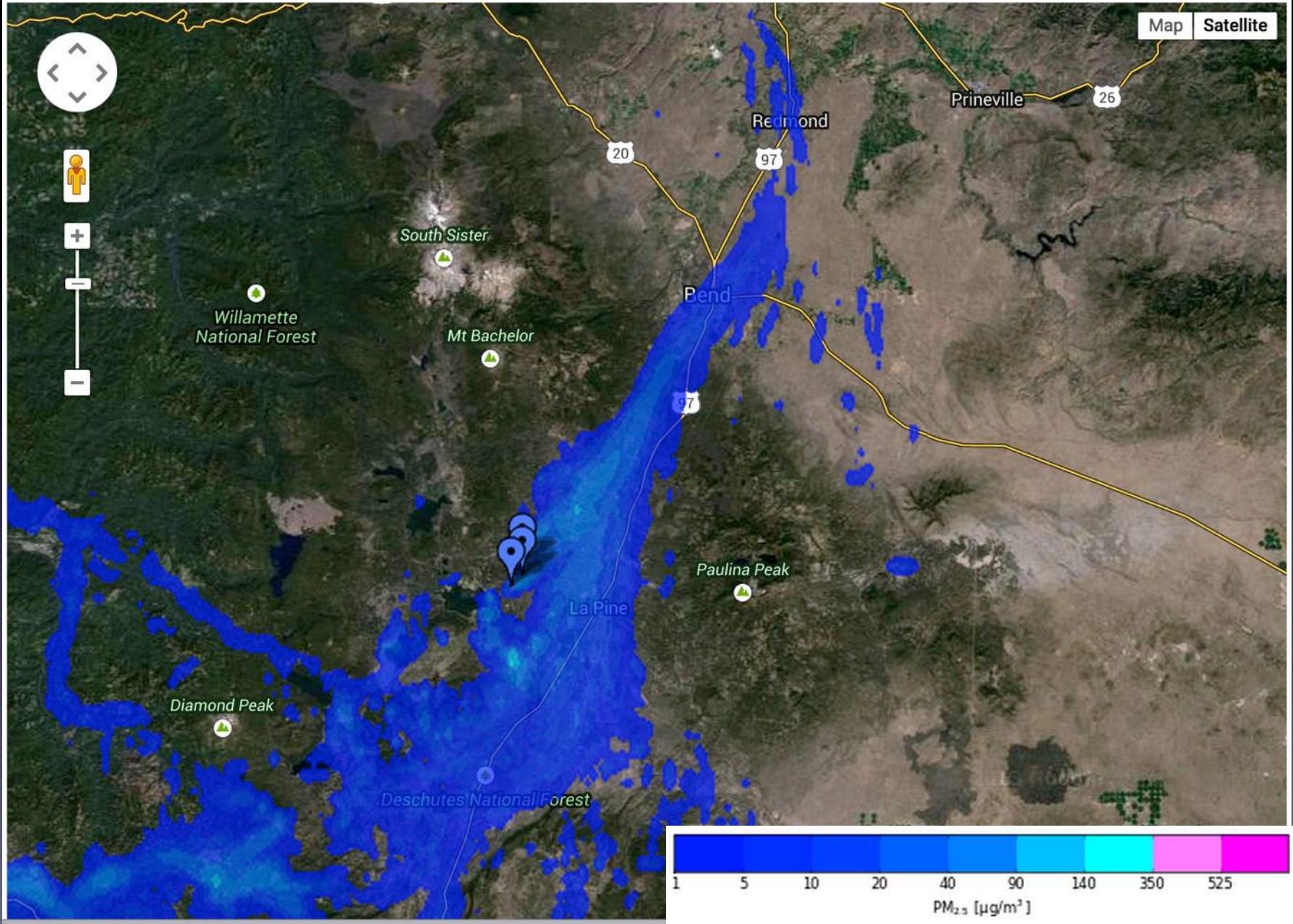
10/5/2014 6:00 Pacific Daylight Savings

▶ || + - animation speed



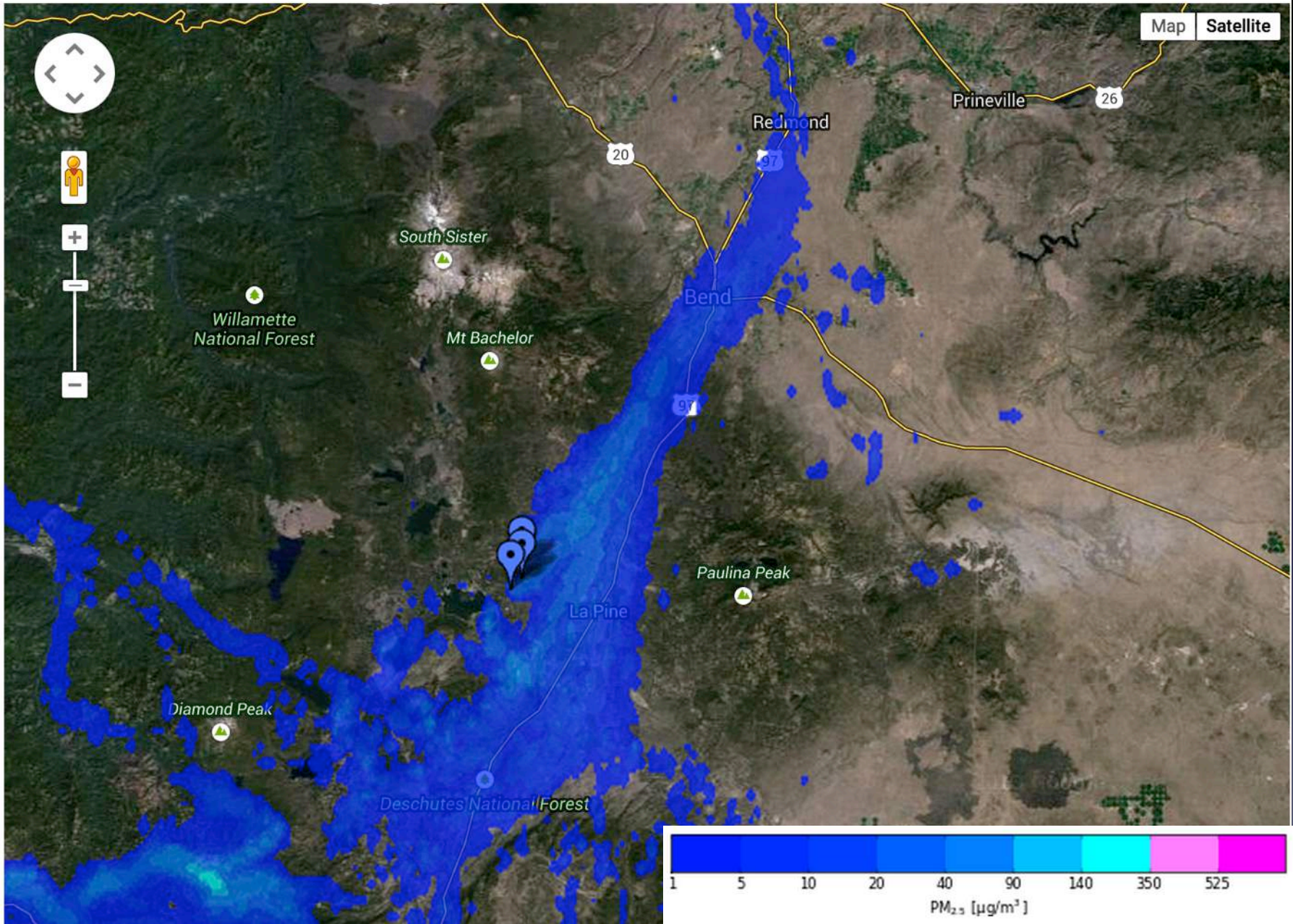
10/5/2014 7:00 Pacific Daylight Savings

animation speed



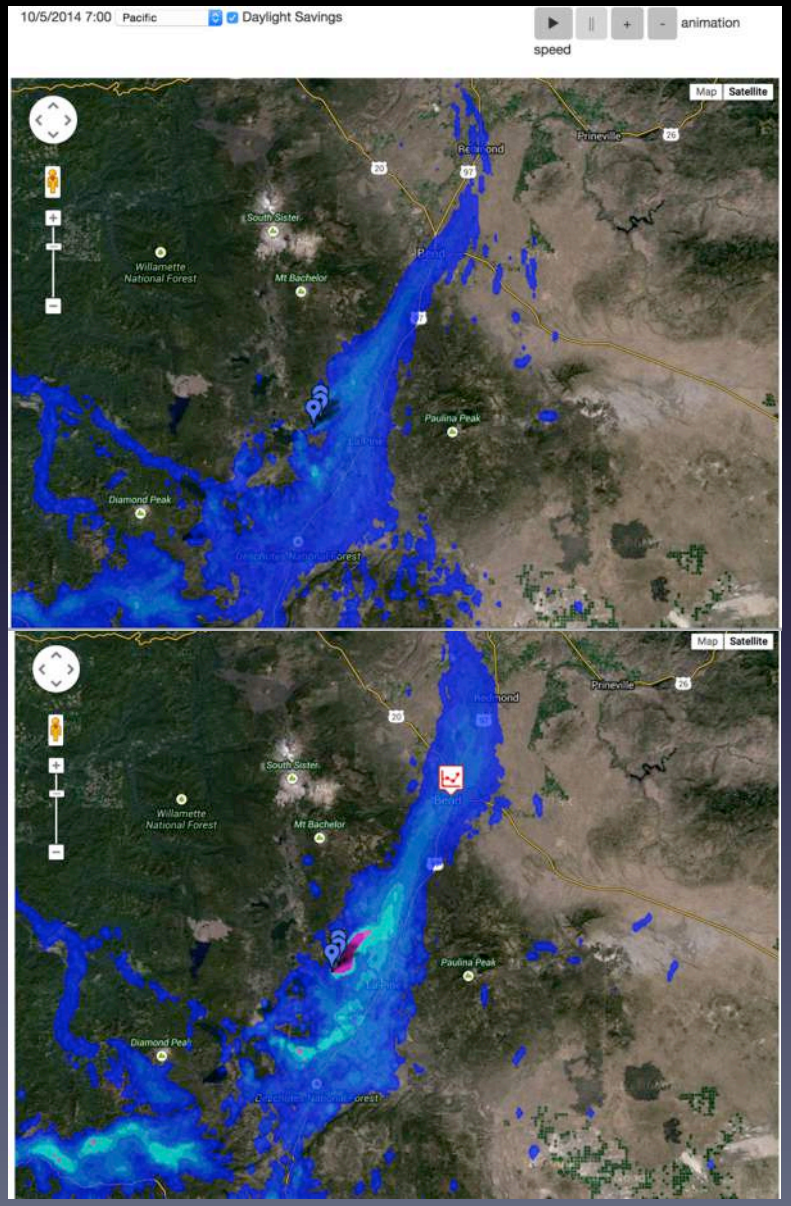
10/5/2014 8:00 Pacific Daylight Savings

animation speed



Smoke Modeling Results

- 1-km domain captured the timing of the smoke transport to Bend
- 1-km results did not simulate concentrations well (maximum of 12 μg/m^3)
- 4-km results did not simulate timing or concentrations well
- Increased the smoldering consumption 4 times
  - 1-km domain: Peak concentration of 37 μg/m^3
  - 4-km domain: Peak concentration did not change much (from 5 to 8 μg/m^3). Timing of smoke into Bend did not improve



Next Steps

- Analyze Meteorological data from Fall 2014
- Analyze Meteorological and Smoke data from Spring 2015
- Emphasis on drainage flows and possible recirculation patterns
- Corollary – High resolution meteorological domains appear to be of use (Wildfires and Rx fires).
  - Extension of the University of Washington 1.33km domain south through Oregon

West Bend
Courtesy: USFS

Thank you