

# A Cascade Ozone Rendezvous

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# Introduction

- The Puget Sound Region occasionally experiences elevated ozone events during the summer months. The number and concentration of these events is just enough to exceed the ozone standard by a few ppb
  - With little room for uncertainty, decision makers needed to probe the ozone network to gather additional data with limited resources
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# In a nutshell...



During the summers of 2007-2009 several small survey's were conducted in Washington State in an attempt to get "snapshots in time" of ground level ozone concentrations

# The surveys attempted to ...



Demonstrate to decision makers alternative tools that could be used to assess the ozone monitoring network using limited resources

# Survey objectives

- Determine the performance of smaller, portable analyzers
- Collect ozone data that was comparable to the rest of the ozone data collected in the monitoring network
- Determine if higher ozone concentrations are occurring with relation to the “perimeter”



# What the surveys were not designed to do.....

- Demonstrate equivalency of the portable ozone analyzer
  - Determine NAAQS attainment/non attainment for the region
- 

In 2007, one analyzer, one motor  
and a prayer



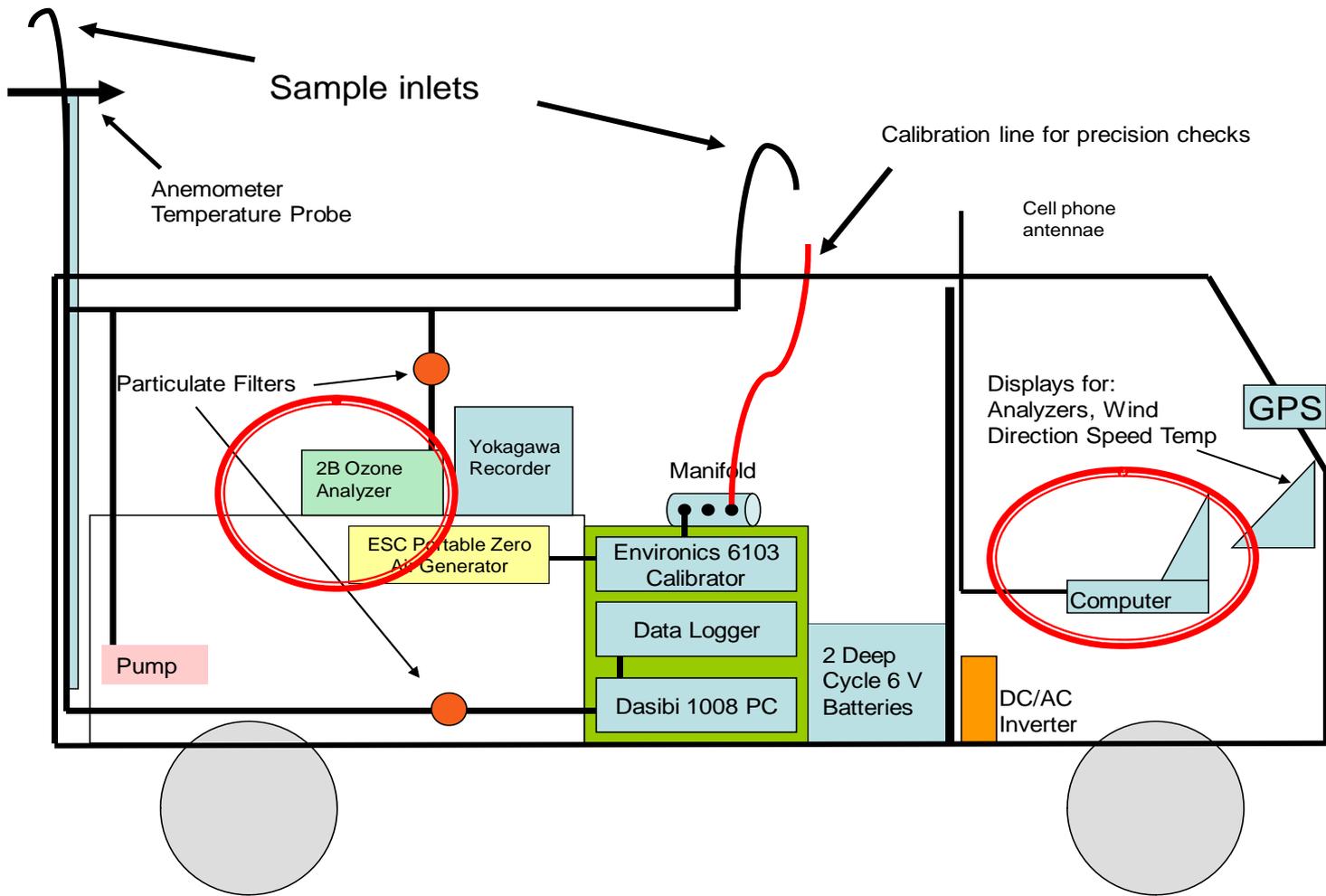
Sent on a mission with insurmountable  
odds and little chance of success

# *“One Analyzer”*

- ▶ 2B Technologies Model 202
- ▶ Lightweight (4.7 lbs)
- ▶ Easy to operate
- ▶ Records and stores data
- ▶ Low power needs
- ▶ 120 or 12 volts
- ▶ Survey instrument. Not on the List of EPA Designated Reference and Equivalent Methods



# "One Motor"



# The Graded Approach

- The US EPA OAQPS developed a four-tiered graded approach for developing Quality Assurance Project Plans based on the data collection objectives
- This study would be of short duration and results used to evaluate and select choices for possible future air monitoring. The Mobile Ozone Survey was graded Category 3

# "The Prayer"

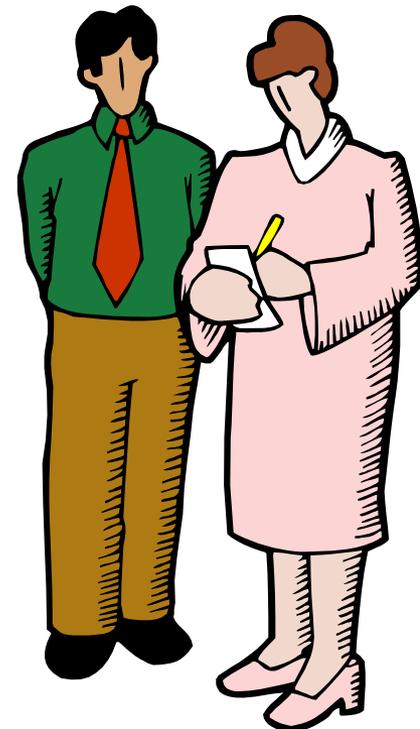
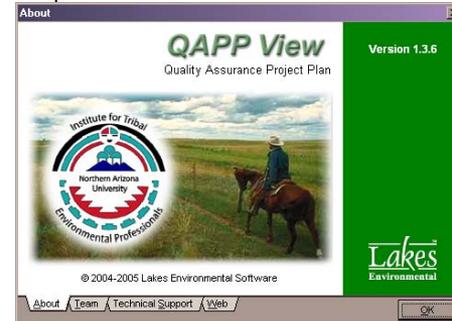
## Quality Assurance Project Plan (QAPP)

- Though only a small project a QAPP was written before the project began
- Outlined Data Quality Objectives
- Listed Data Quality Indicators
- Was sent to management to comment and sign

**EPA** Quality Assurance  
Handbook for Air  
Pollution Measurement  
Systems

Volume II

Ambient Air Quality  
Monitoring Program



# Data Quality Objectives

- Demonstrate that the data collected by the van is comparable to data collected at sites in the ozone network
  - Measure precision of the analyzer
  - Demonstrate that the data collected is representative of the area
- 

# Comparability

- The portable analyzers' response must compare within 5 ppb of a network analyzer
- Frequent checks of the van vs. analyzer's in the network were to be made



# Independent Assessment

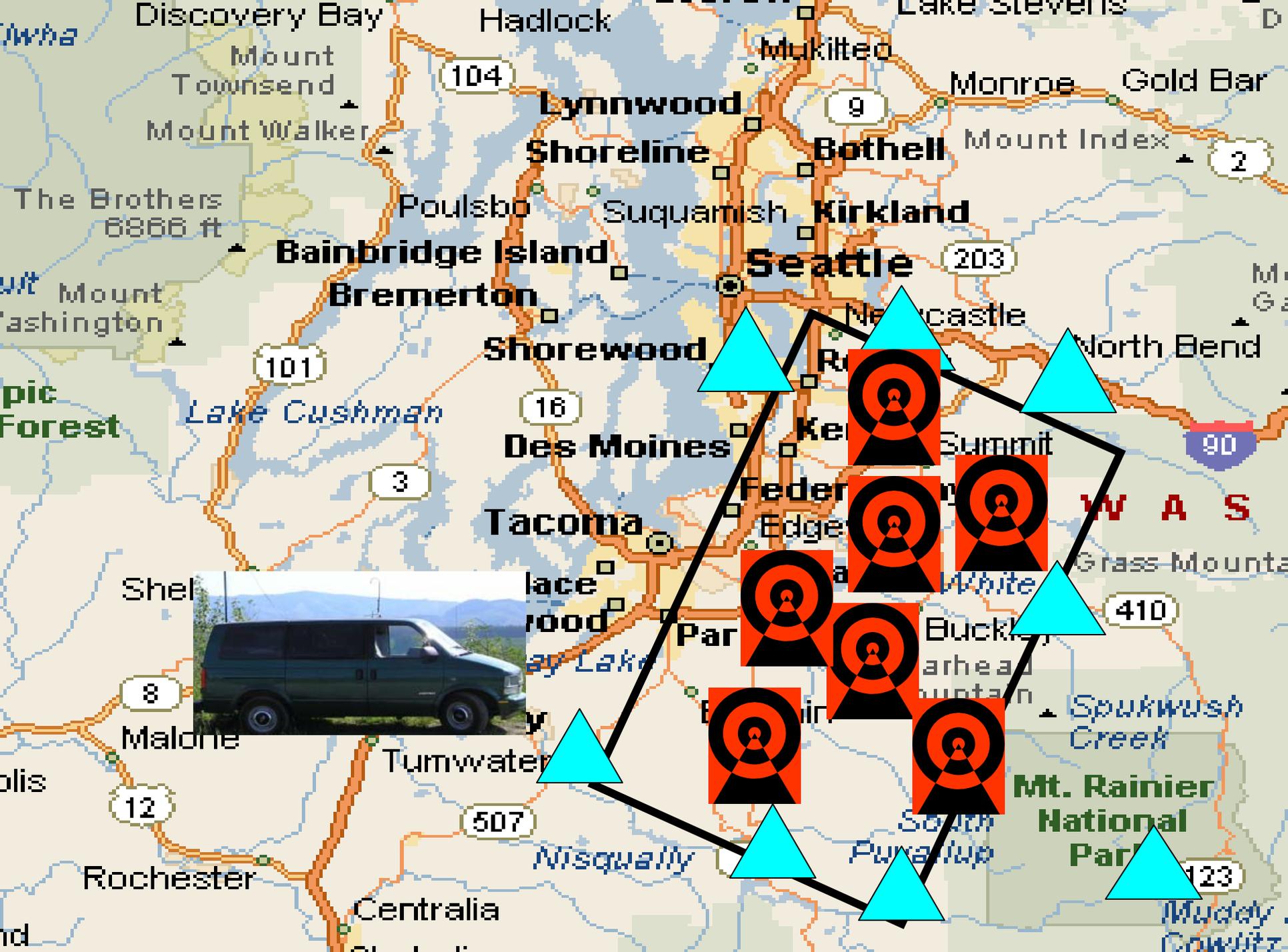
An independent audit would be performed and the analyzer must agree within 7% of “true”



# Designated Targets

- Emphasis was in Pierce, King and Thurston counties
- Secondary targets included counties in central and eastern Washington
- Several reconnaissance missions across the State



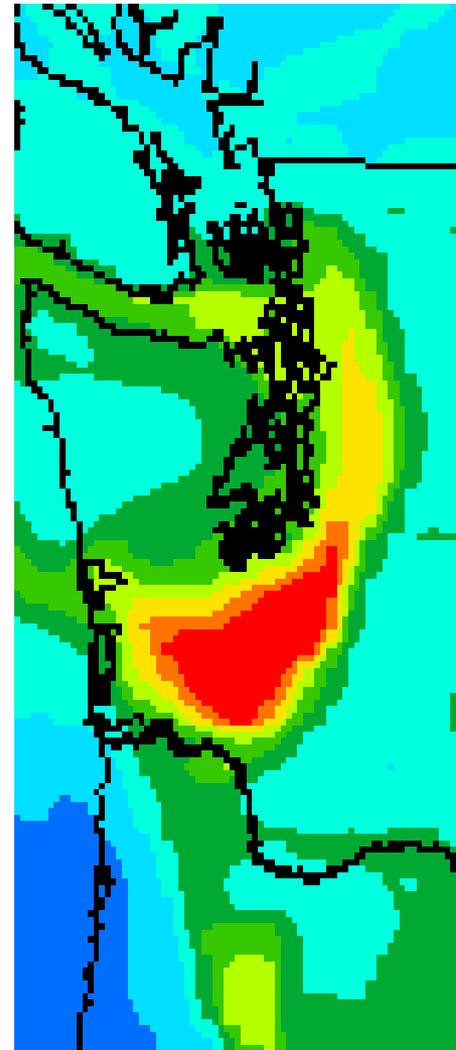


# An “arsenal” of tools for the attack

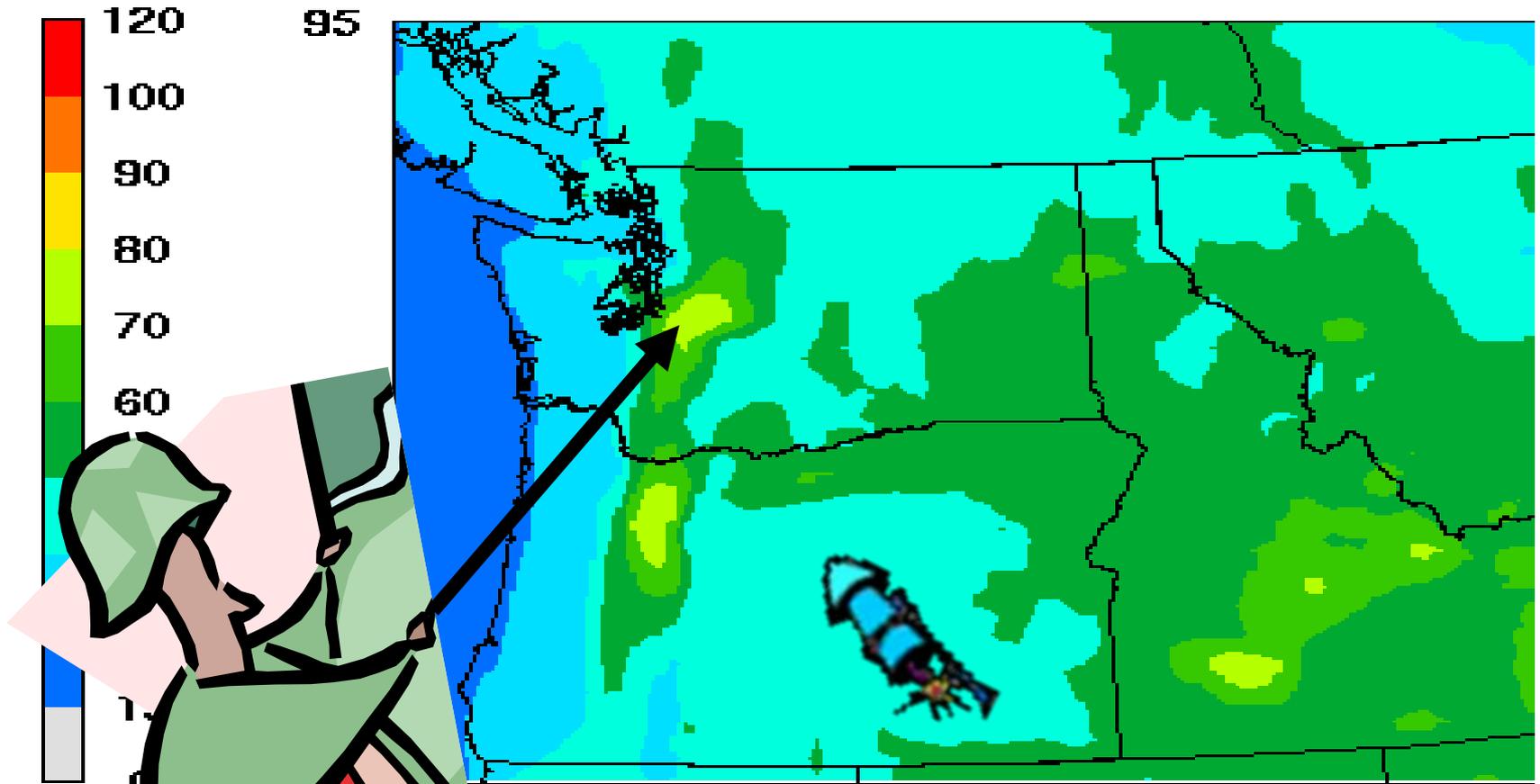
- Experimental ozone forecast model from NOAA National Weather Service Air Quality Forecast Guidance
  - Air Indicator Report for Public Awareness and Community Tracking (AIRPACT 3)
  - AIRNow-Tech Navigator
  - “Never leave home without them”
- 

# Selecting the target

- Consult the NOAA ozone forecast
- Perform quality check/compare demonstration precision
- Move van in area where ozone is expected to occur

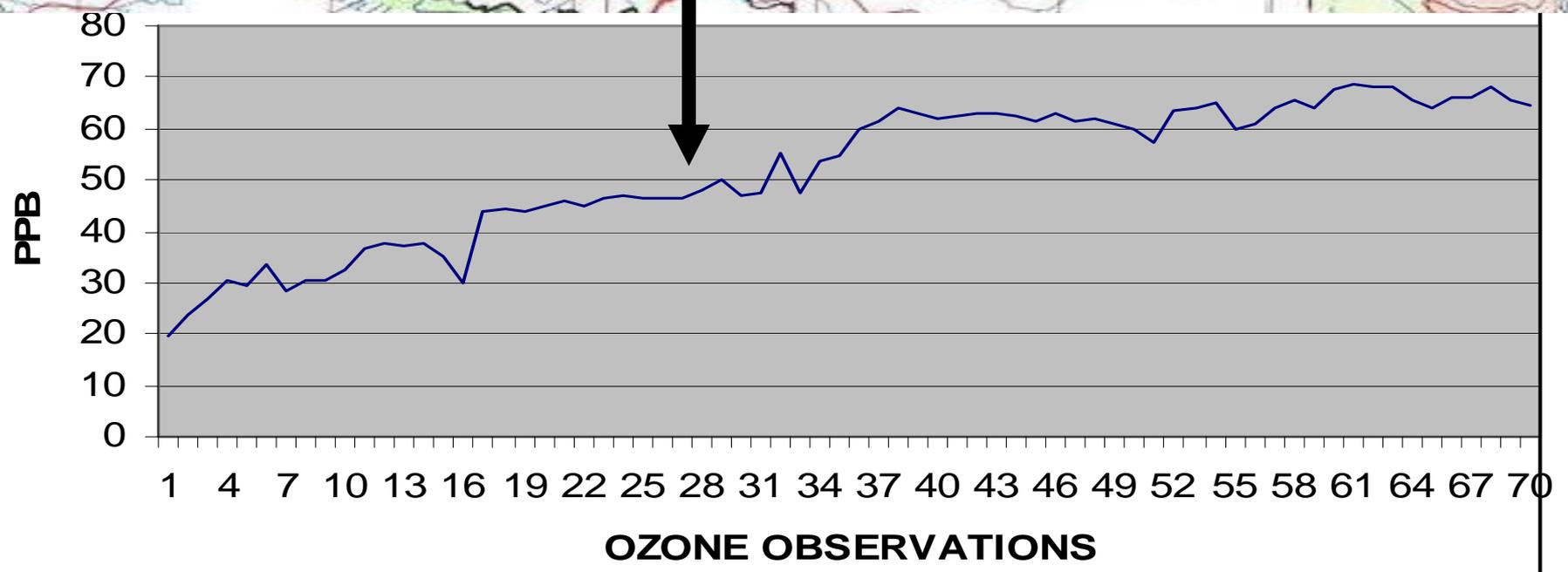
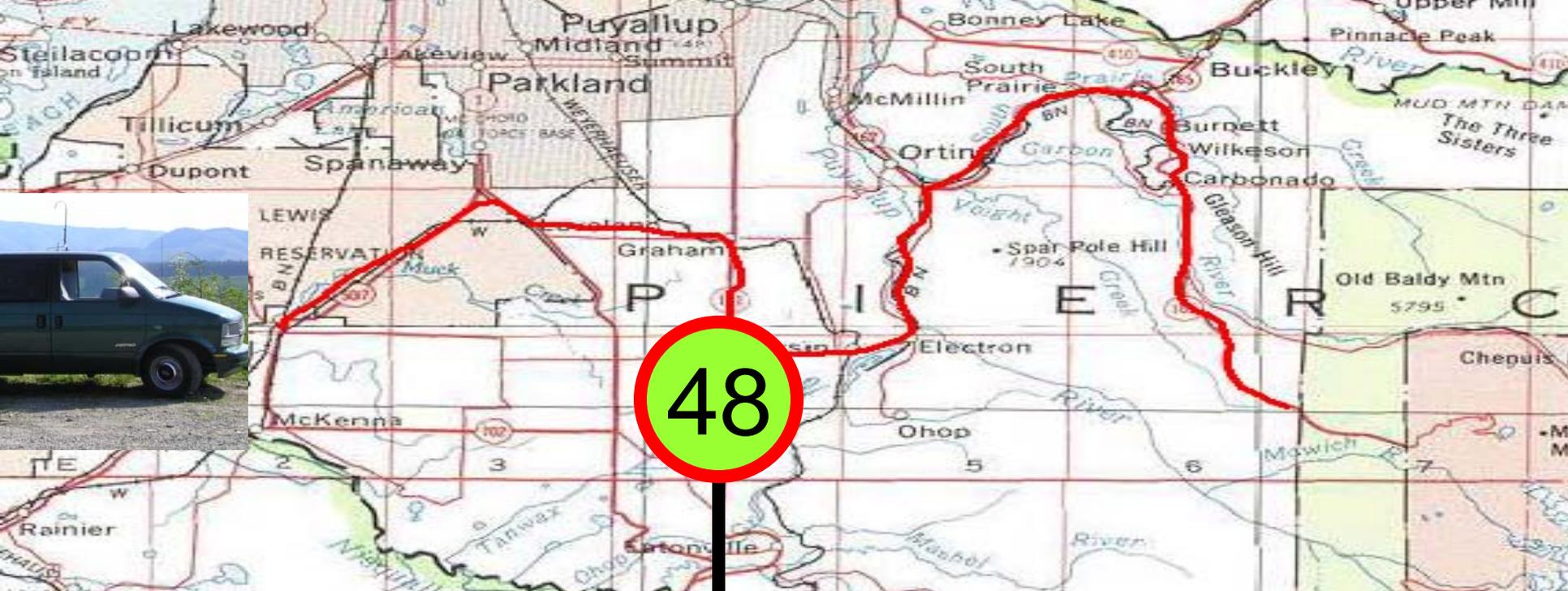


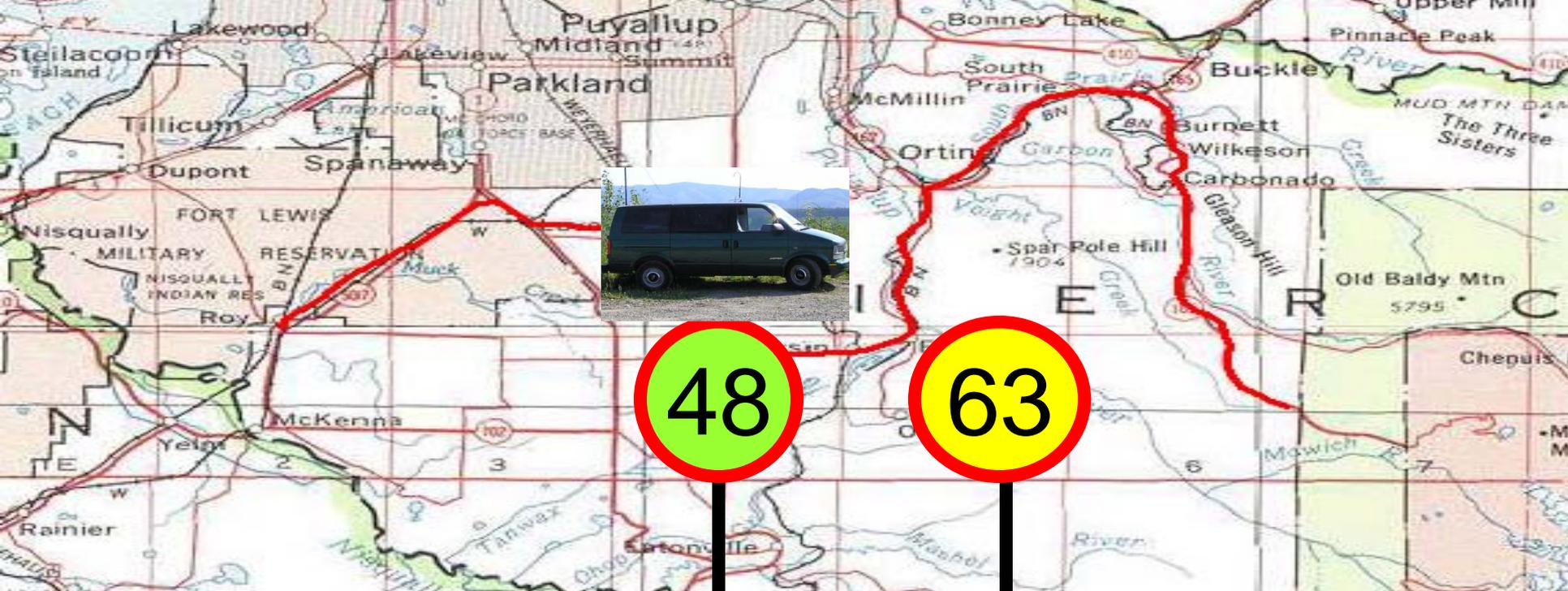
# July 4 Mission #7: Target: South Puget Sound



*"Let's be careful, the flak will be heavy today!"*

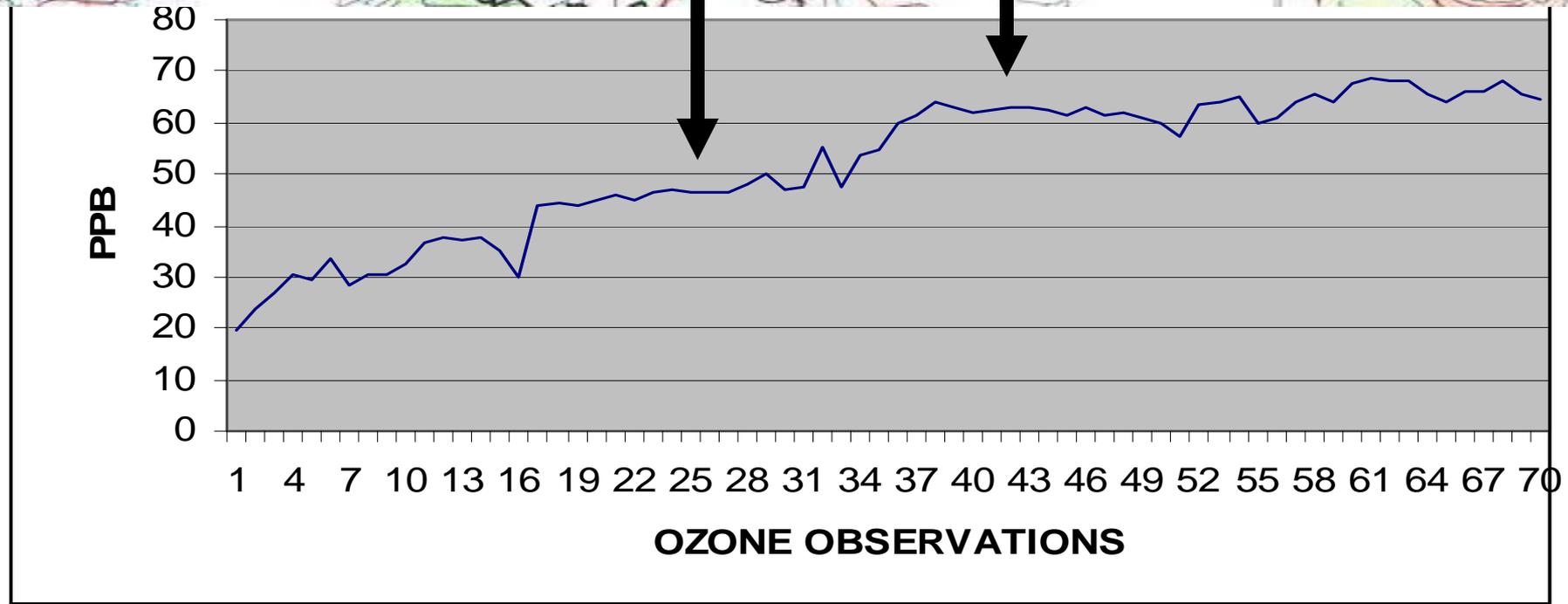


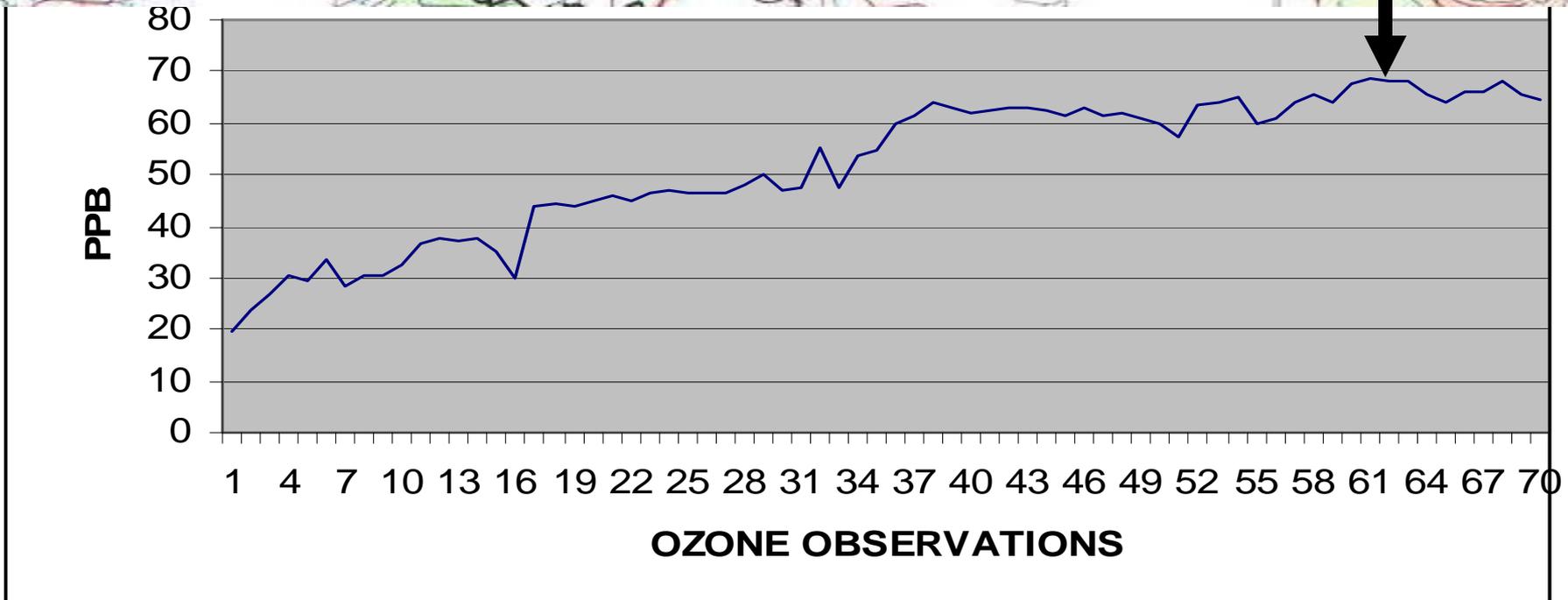
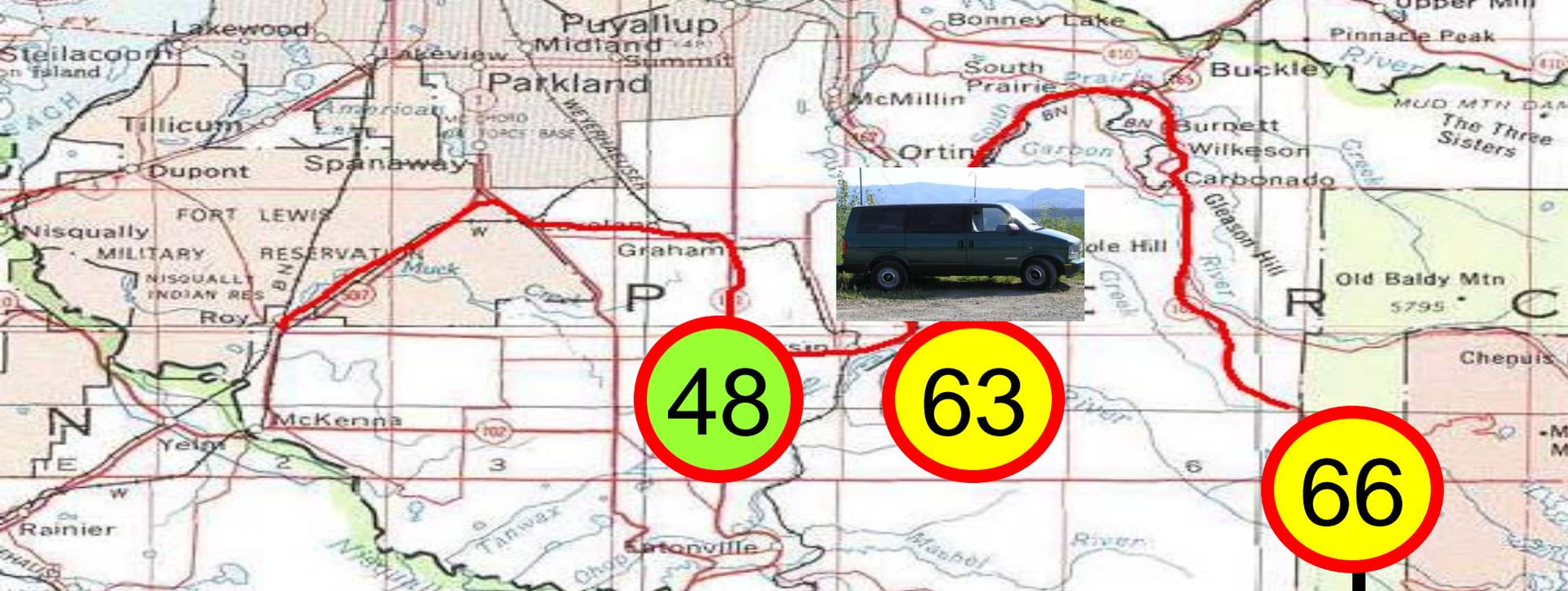


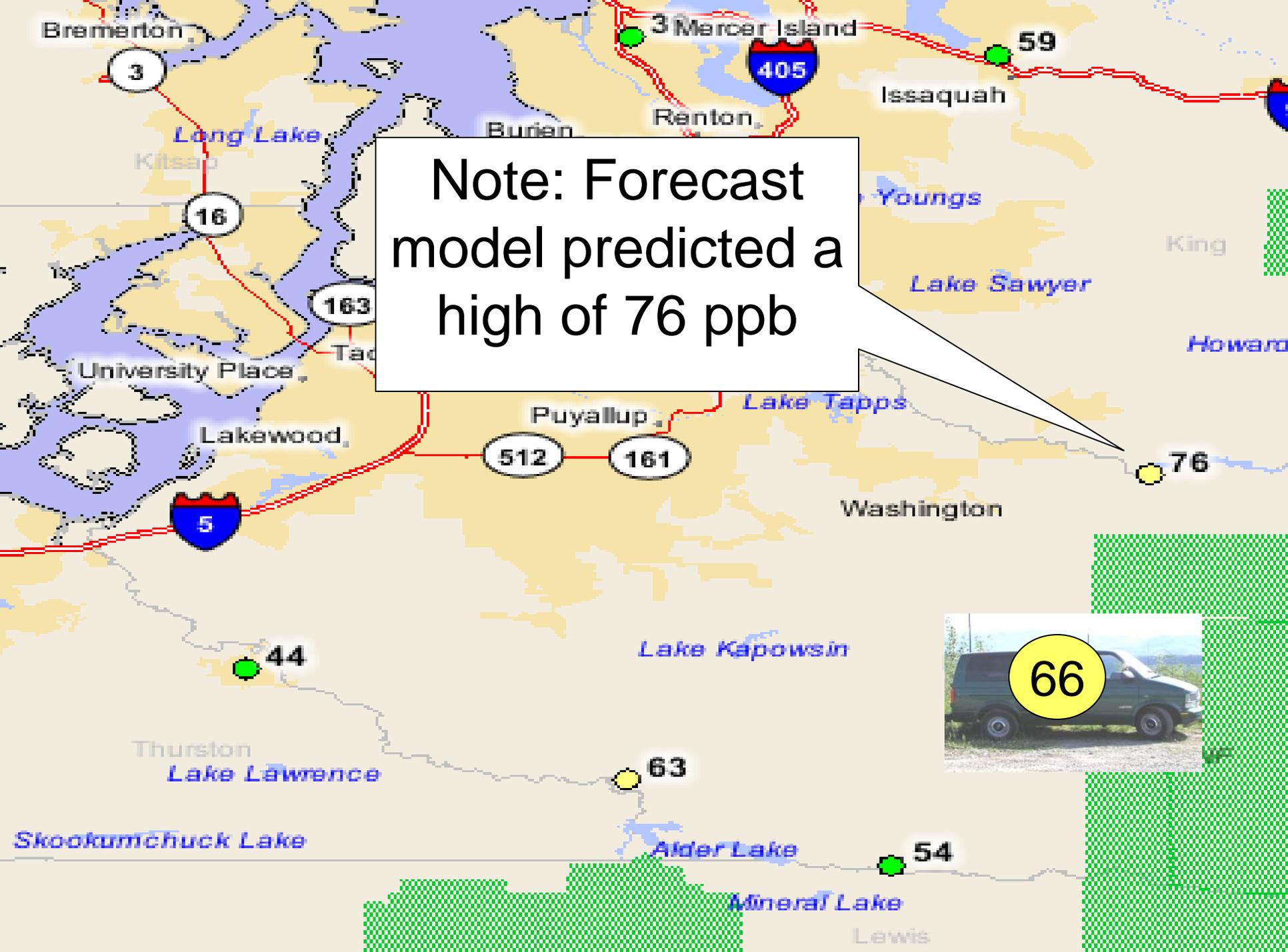


48

63







Note: Forecast model predicted a high of 76 ppb

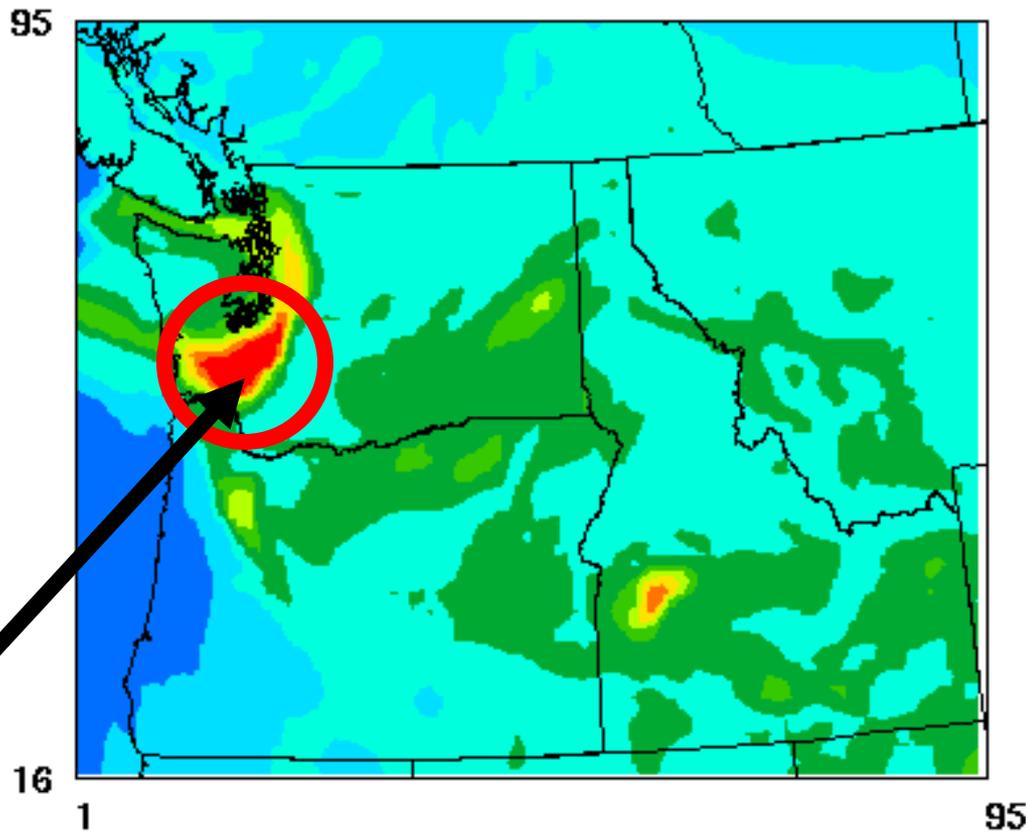
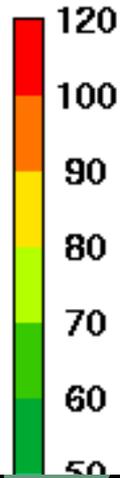


# Mission Critique

- The van was on target (near plume) and measured between existing network sites.
- No higher ozone values were found.
- AIRPACT predicted ozone concentration was on target (76 ppb vs. 76 ppb).



# July 11 Mission #10 Target: South Puget Sound

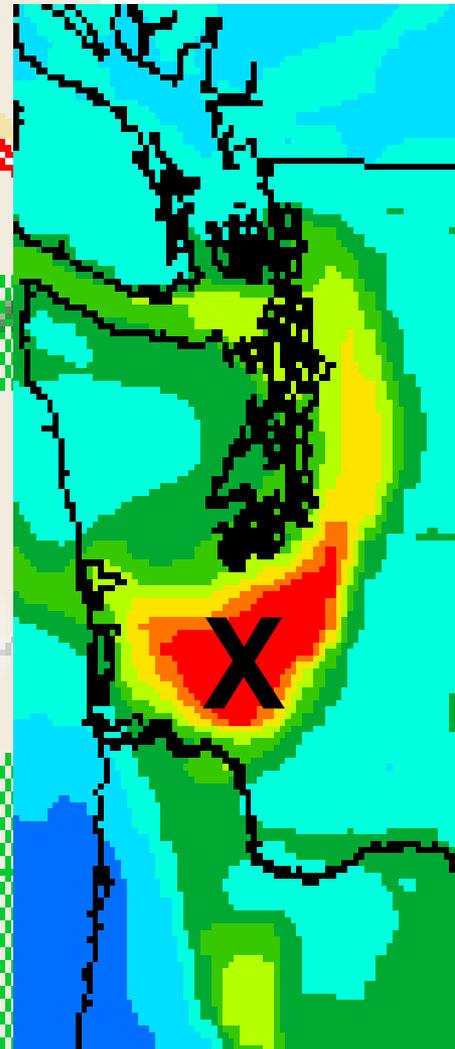
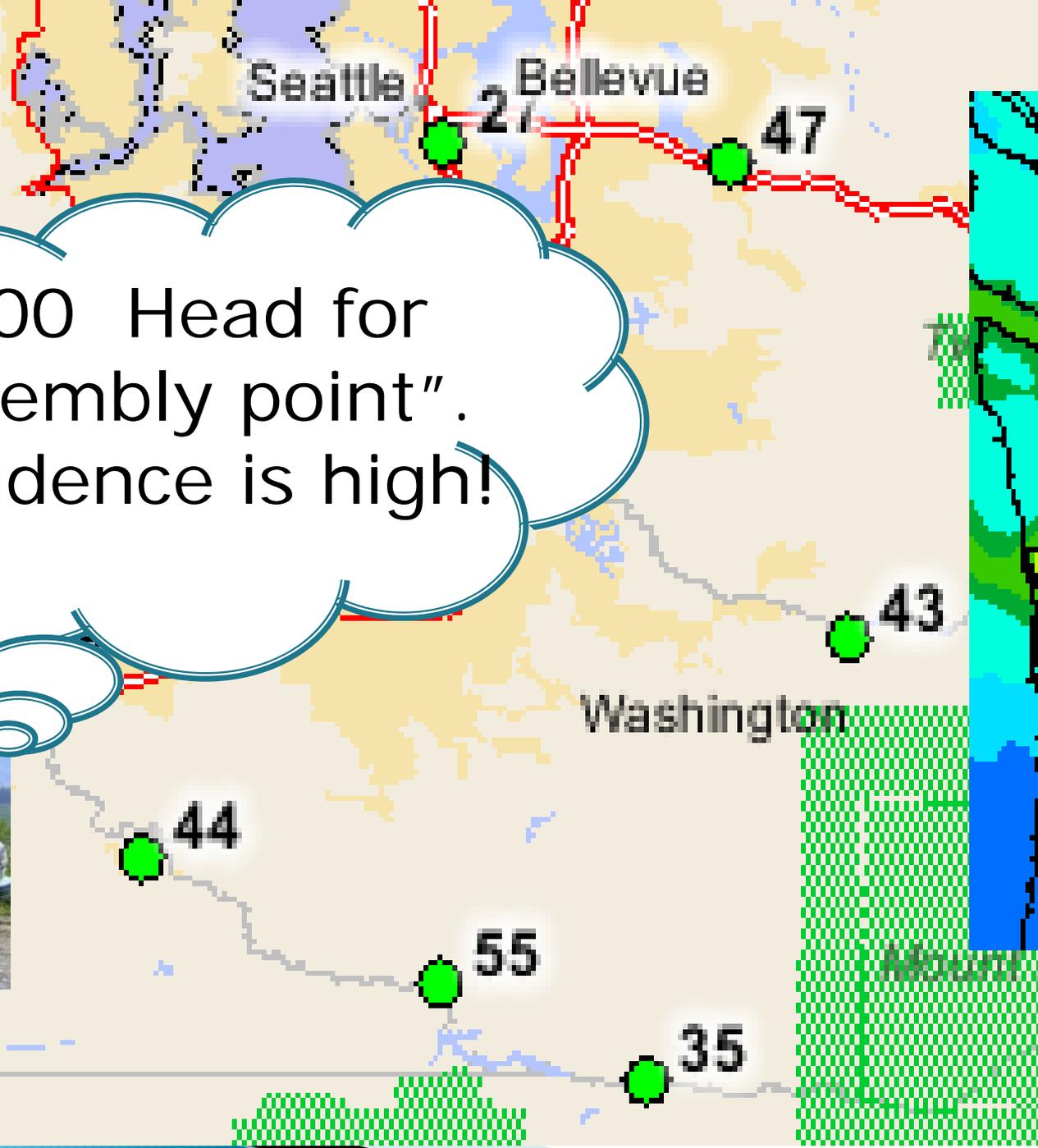


July 11, 2007 16:00:00 (PST)  
Min= 22 at (1,37), Max=117 at (17,58)

***"Today's target  
Good hunting!"***



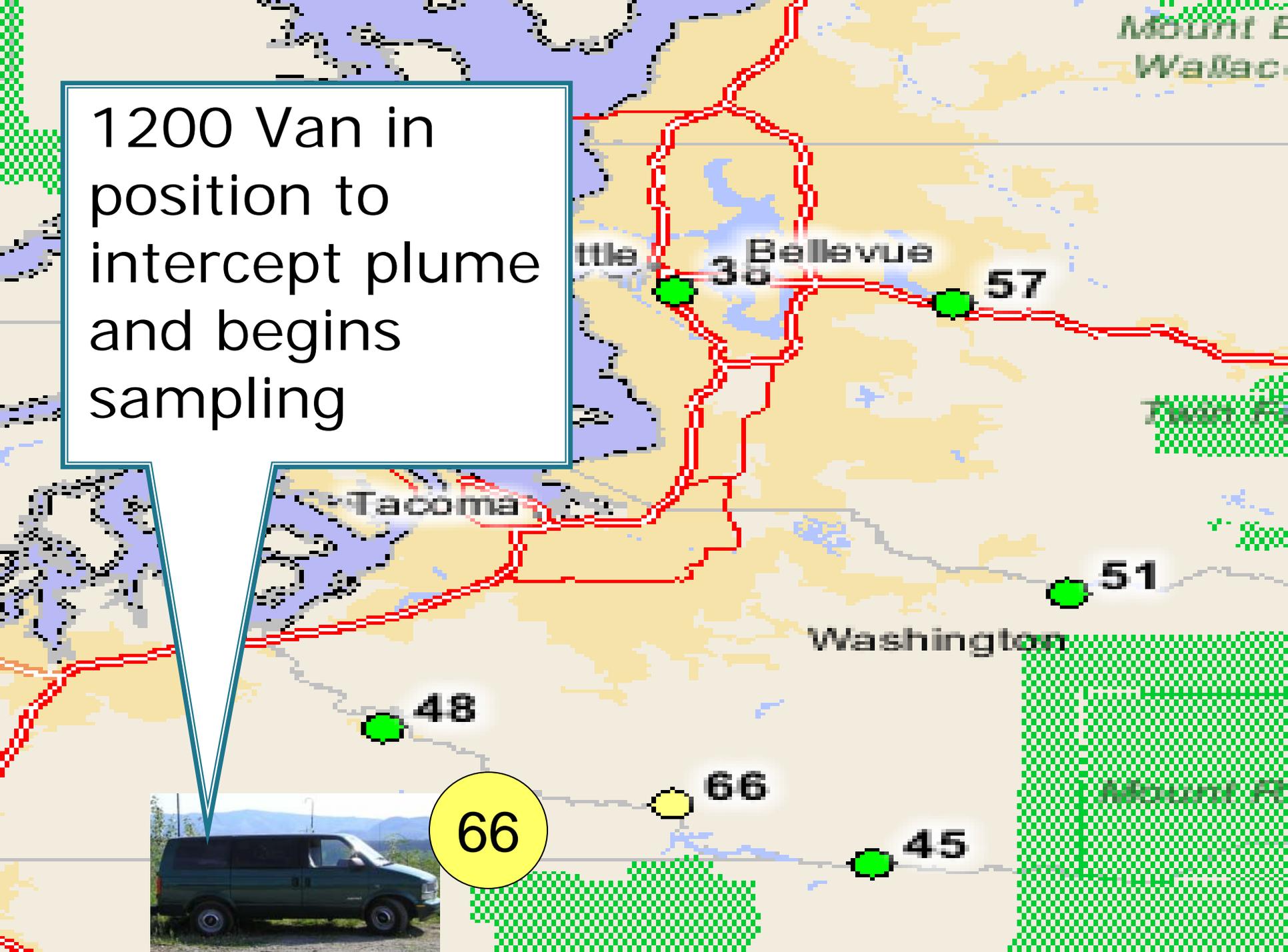
1100 Head for  
"assembly point".  
Confidence is high!



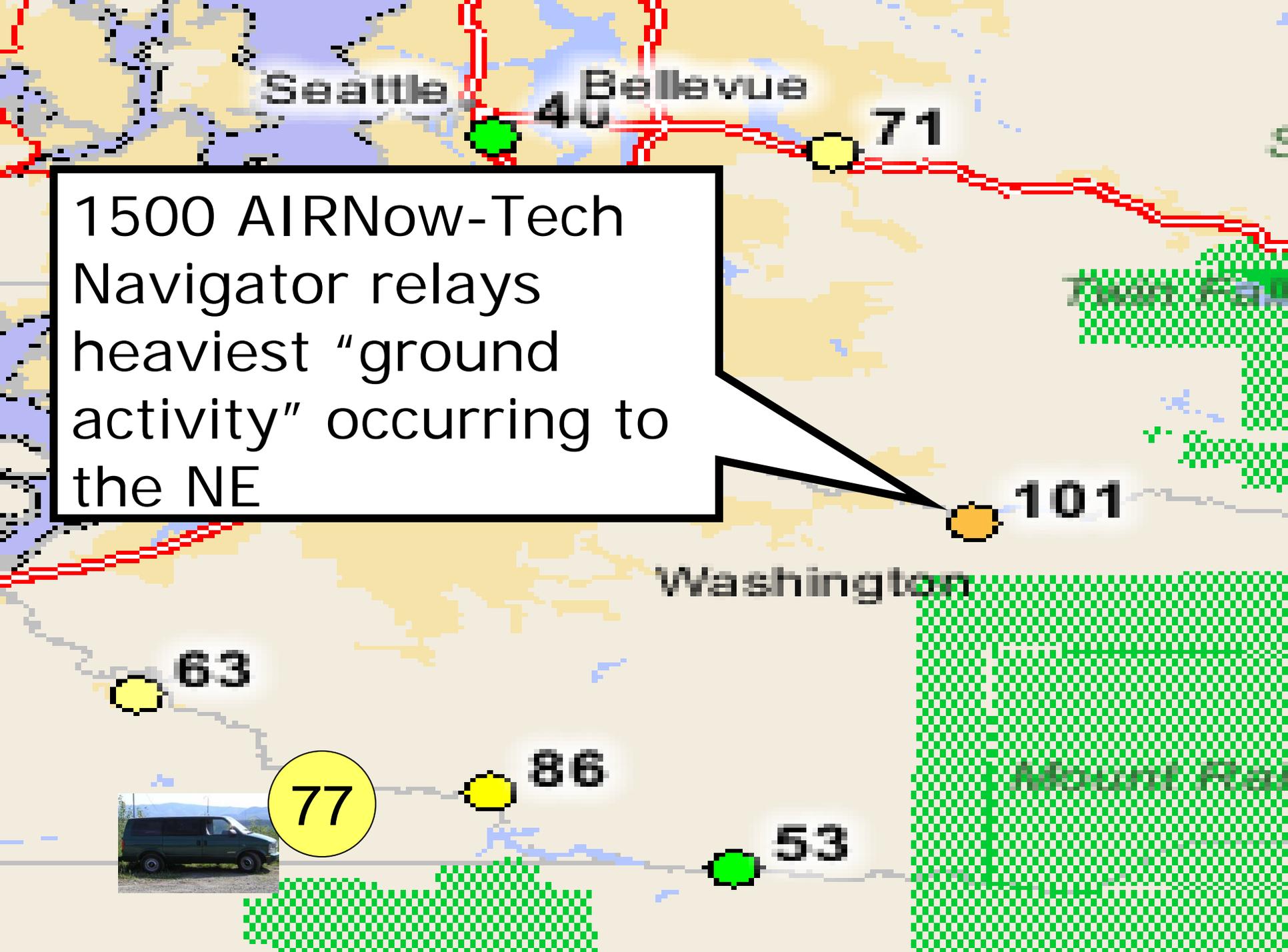
1200 Van in position to intercept plume and begins sampling



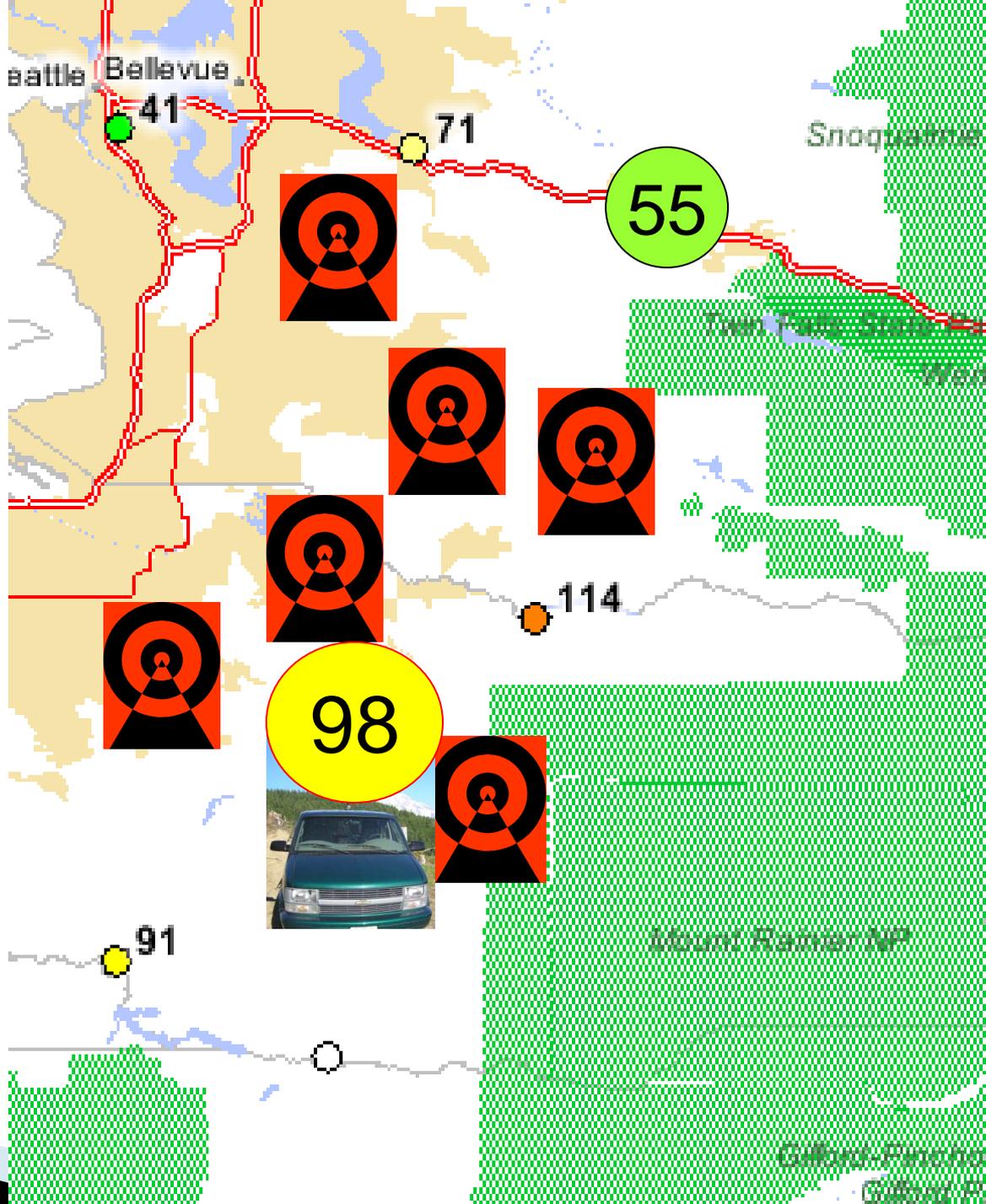
66



1500 AIRNow-Tech Navigator relays heaviest "ground activity" occurring to the NE



1600 AIRNow-Tech Navigator guides van to predetermined targets and to point of no return (Lima Delta)



# Mission Critique

- The van was in the “hot” spot and measured between the existing network sites.
- The plume was slightly NE of the area that was predicted.
- Unpredicted winds came from the SW.
- AIRPACT prediction was **on target** (114 ppb vs. 117 ppb).



# The Puget Sound Basin

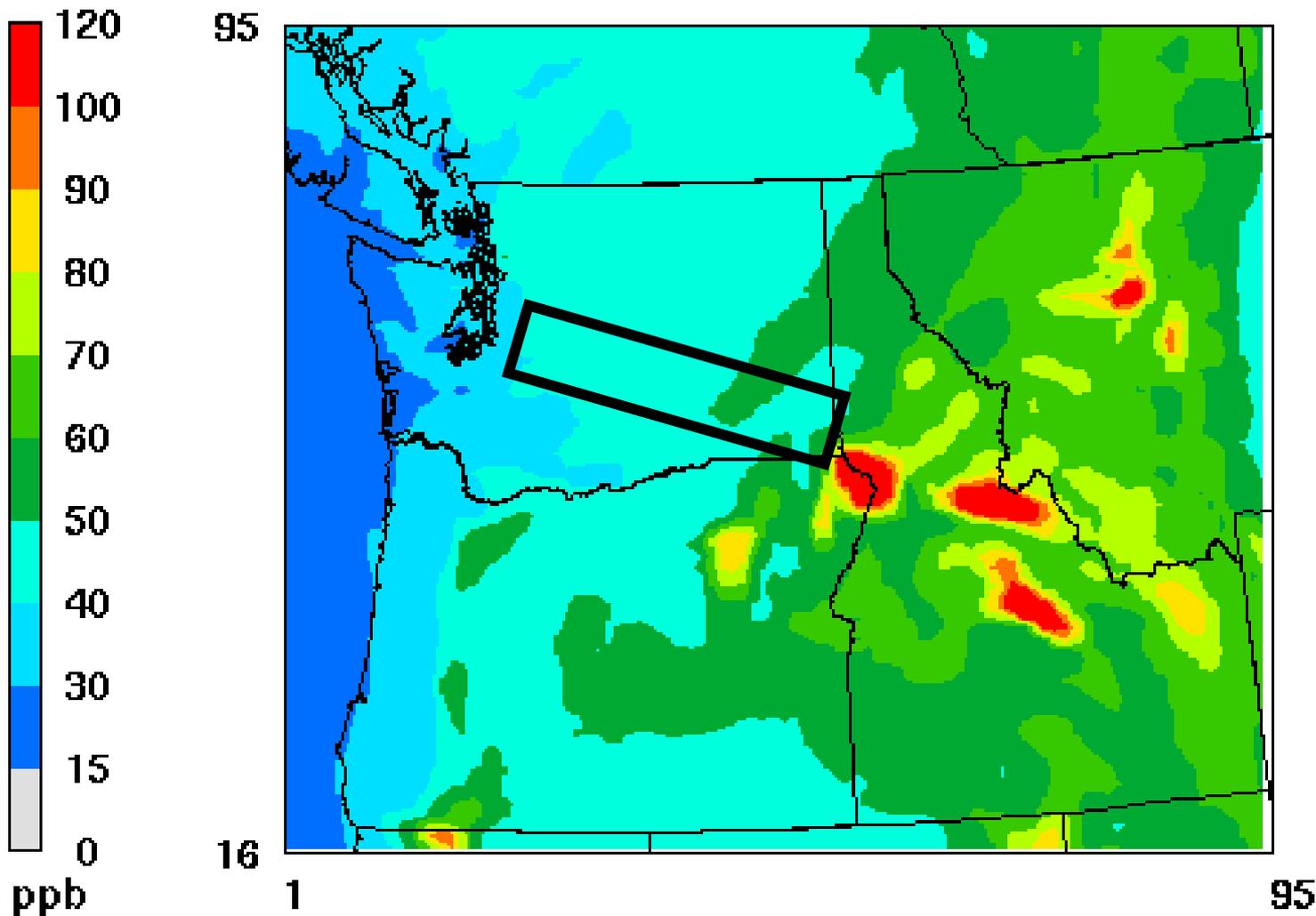
- Higher ozone concentrations were not found within the “perimeter”
- Confidence the highest concentrations occurring near Enumclaw
- Higher ozone concentrations may be occurring outside the “perimeter” in the “Outlands”



# Central and Eastern Washington

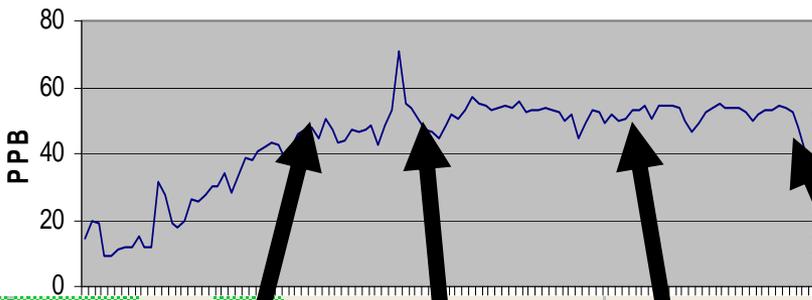
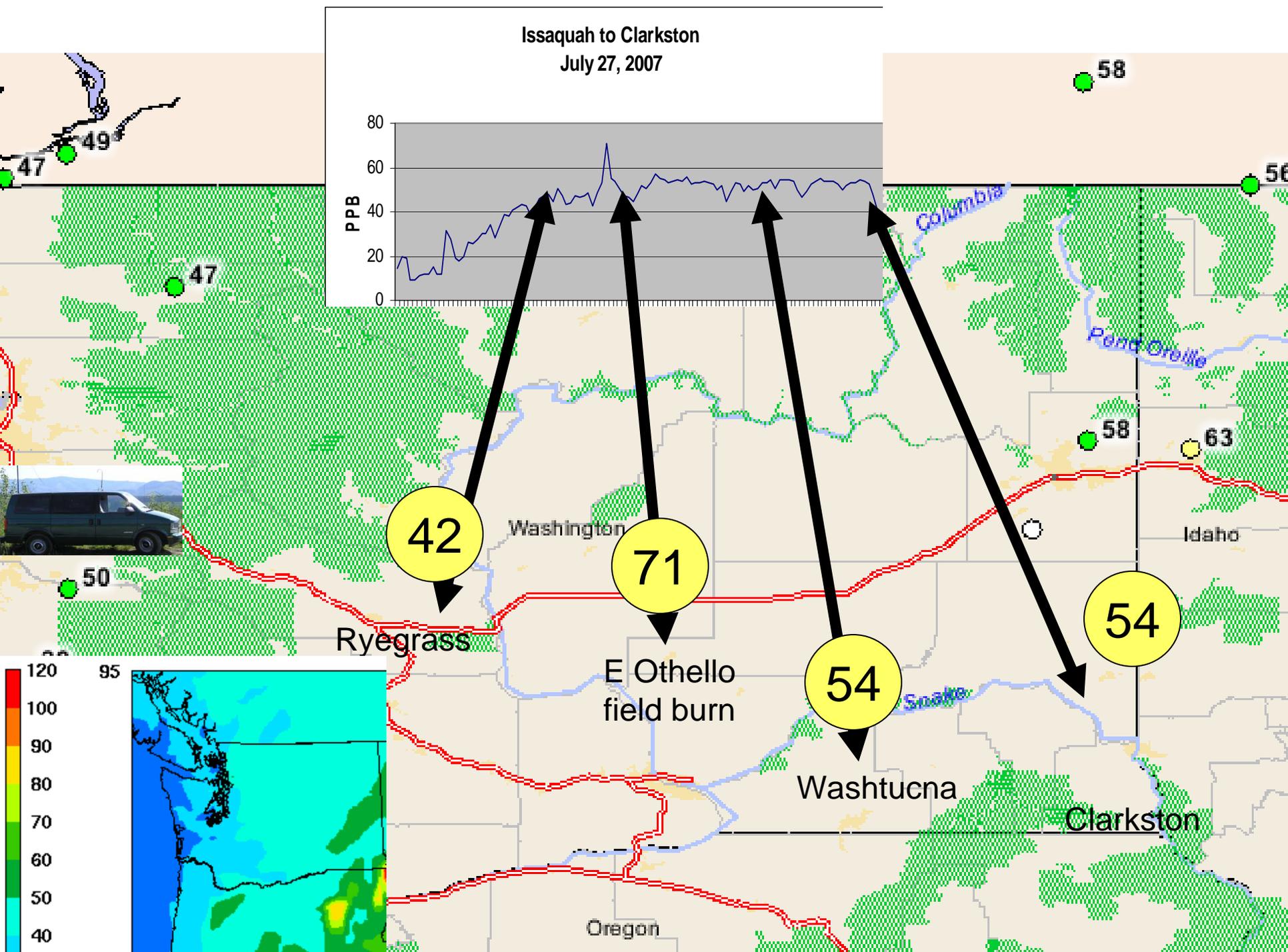
- ▶ Several transects made
- ▶ Ozone forecasts for the region were accurate showing highest ozone concentrations between 50 and 60 ppb

# July 27 AIRPACT 3 Predicts 40-50 PPB



July 27, 2007 16:00:00 (PST)  
Min= 20 at (16,83), Max=163 at (69,50)

Issaquah to Clarkston  
July 27, 2007

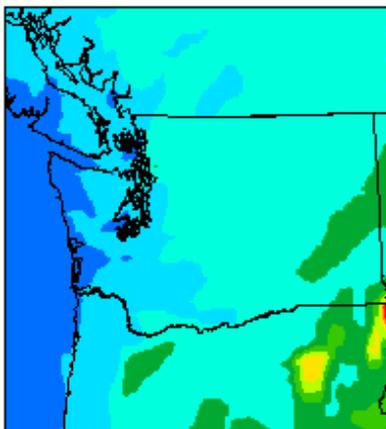
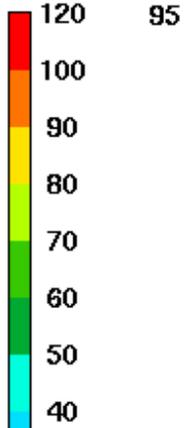


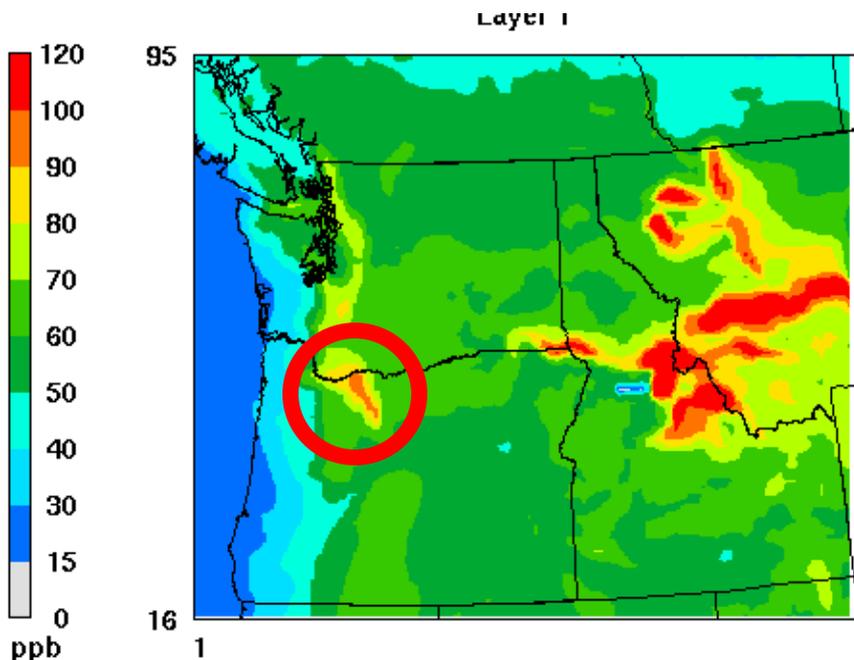
42

71

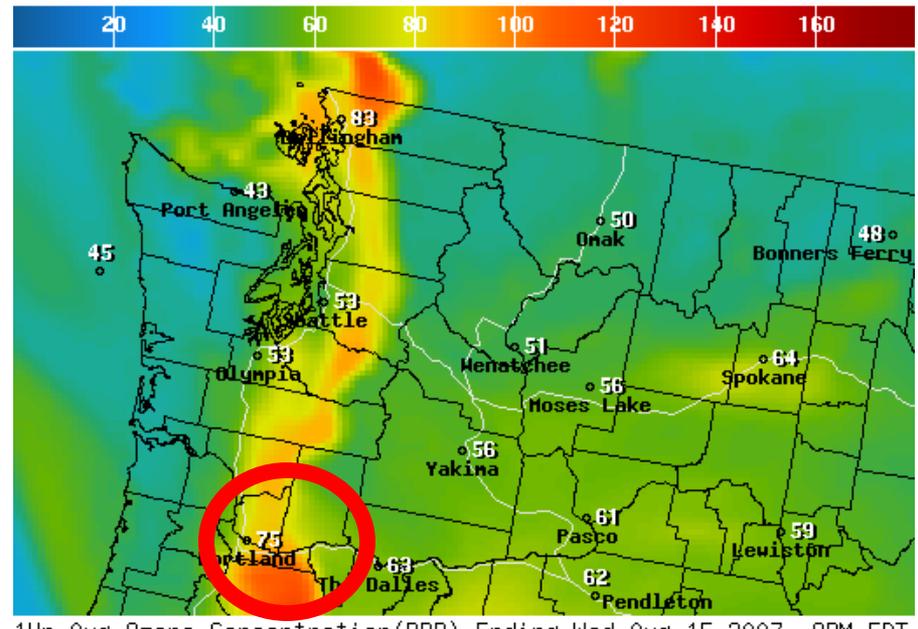
54

54





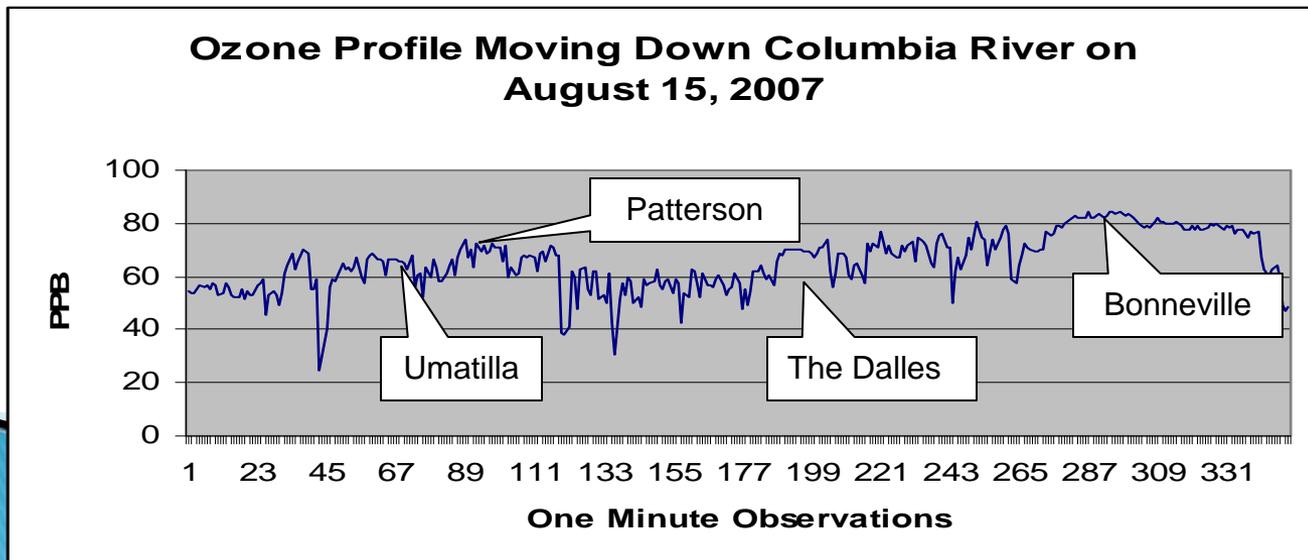
August 15, 2007 17:00:00 (PST)  
Min= 3 at (62,48), Max=158 at (69,52)

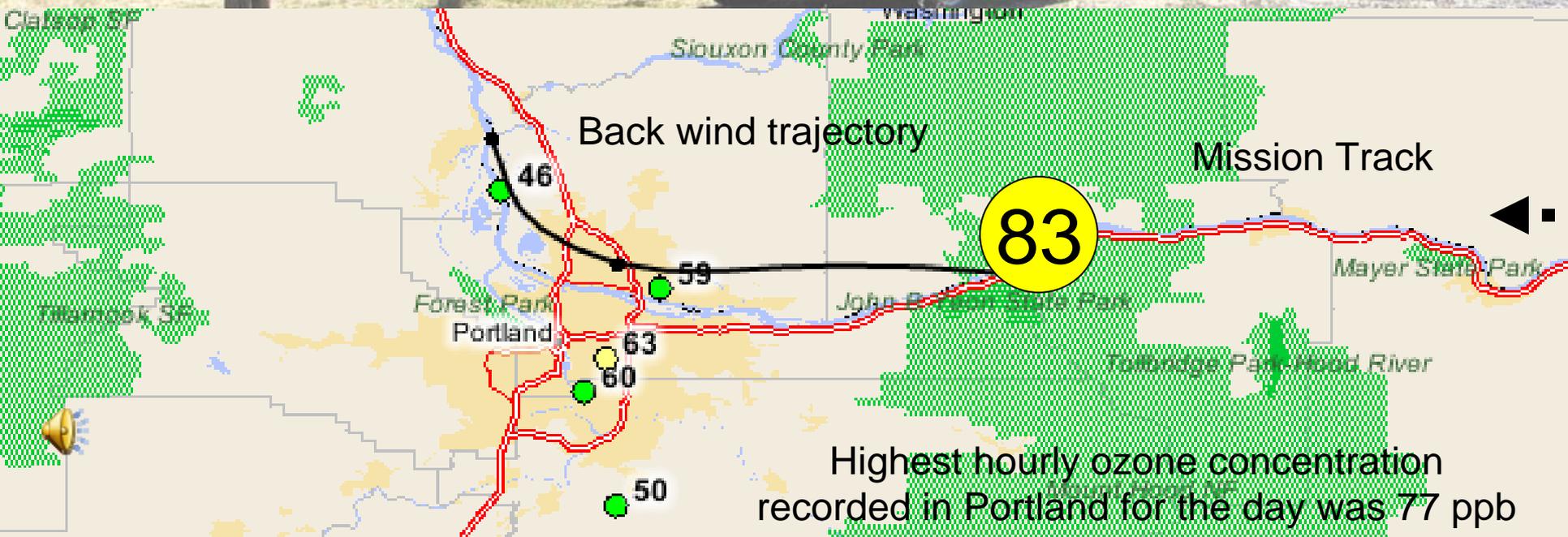


1Hr Avg Ozone Concentration(PPB) Ending Wed Aug 15 2007 9PM EDT  
Experimental (Thu Aug 16 2007 01Z)



National Digital Guidance Database  
12z model run Graphic created-Aug 15 1:34PM EDT





# Mission Critique

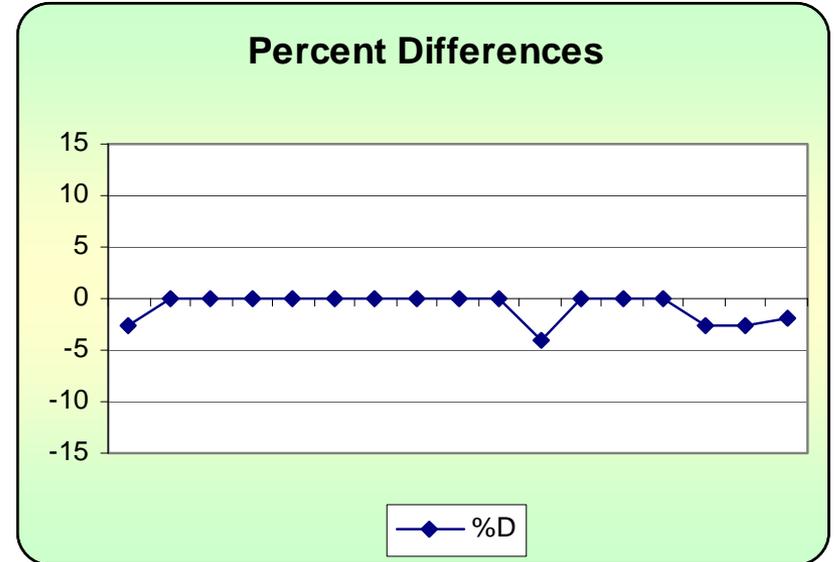
- The van intercepted the predicted plume as it moved east through the Gorge
- The ozone concentrations found in the Gorge was higher than what was recorded in Portland for the day
- The NOAA ozone forecast for Portland/Vancouver was **on target** (77 ppb vs. 77 ppb)



# Comparability (site comparison)



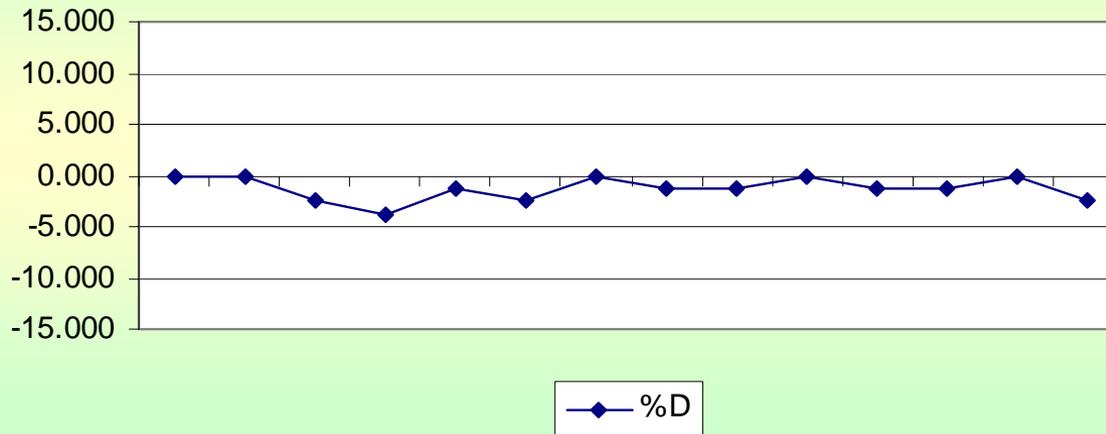
**< 1.5 %**



**EPA's Data  
Assessment  
Statistical Calculator**

# Precision (van O<sub>3</sub> standard)

## Percent Differences



< 2%

# National Performance Audit Program (True)

## PRELIMINARY OZONE AUDIT RESULTS

NPEP O3 Concentration (ppm)	Site Response (ppm)	Percent Difference
0.407	0.404	-0.7
0.179	0.178	-0.6
0.072	0.072	0.0
0.001	0.002	

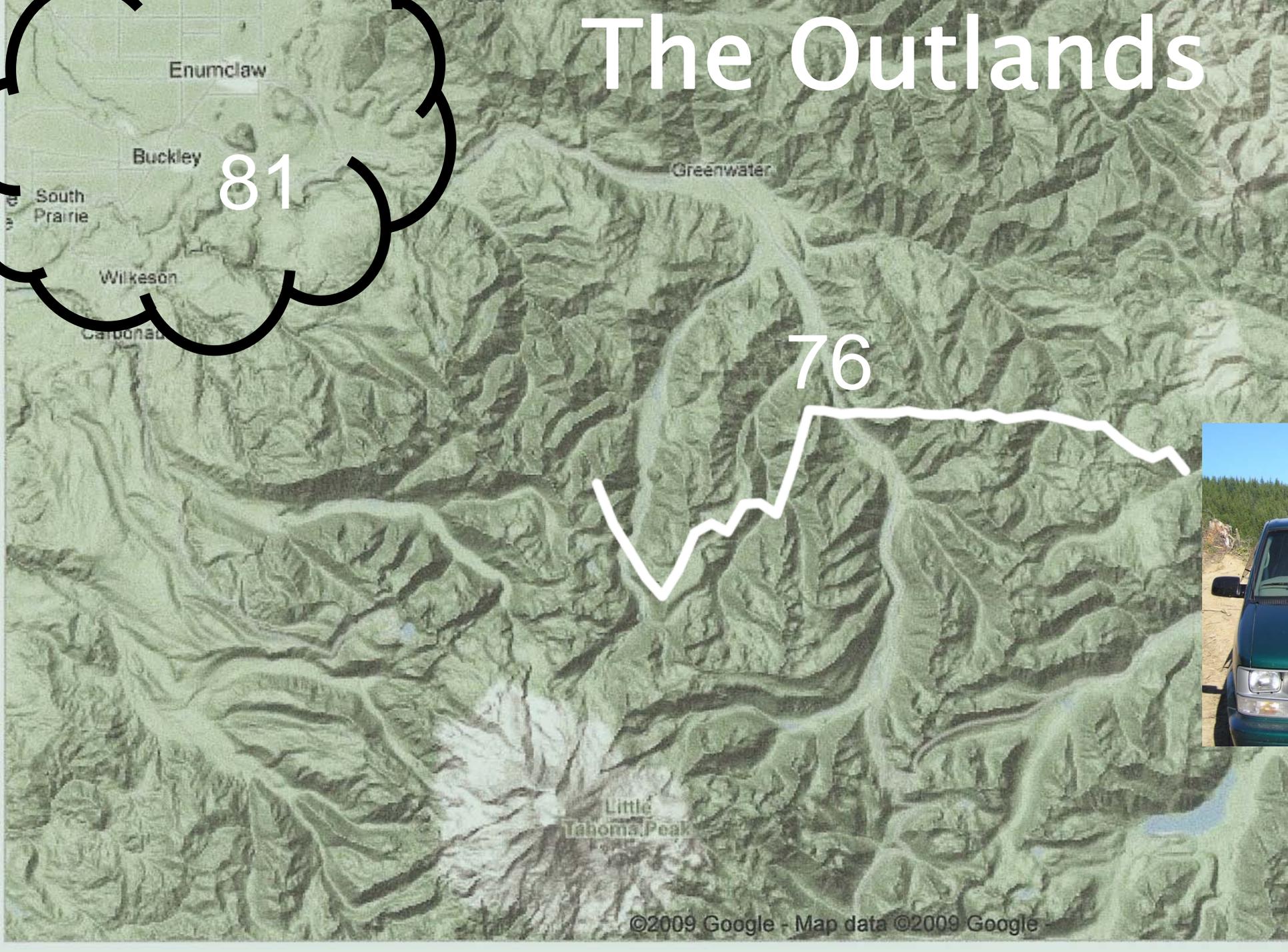


< 1%

# **Analyzer proves reliable in hostile conditions**

- Simple to operate
  - Subjected to heat and vibration
  - Well within Data Quality Indicator limits
  - Comparability was excellent
  - Passed independent EPA audit
  - It doesn't get any better than that!
- 

# The Outlands



81

76

# 2009 Survey

- The ozone monitoring sites that record the highest concentrations are situated against the Cascade foothills
  - Previous ozone studies using passive samplers documented elevated ozone concentrations in Puget Sound river valleys beyond the current ozone network perimeter
  - Take advantage of the portability of the 2B analyzer and the ozone forecast models to monitor in the “outland”. Sentinels dispatched to outposts
- 

# Sentinels

- Inspired by the Portable Ozone Monitors (POM) designed by Air Resources Specialist, Inc. and used by the National Park Service
- 2B analyzer in enclosure with fan powered by solar panels and batteries
- Manual calibration checks performed routinely



# Sentinels dispatched to outposts



Detail lasted from days to weeks



**79/73**

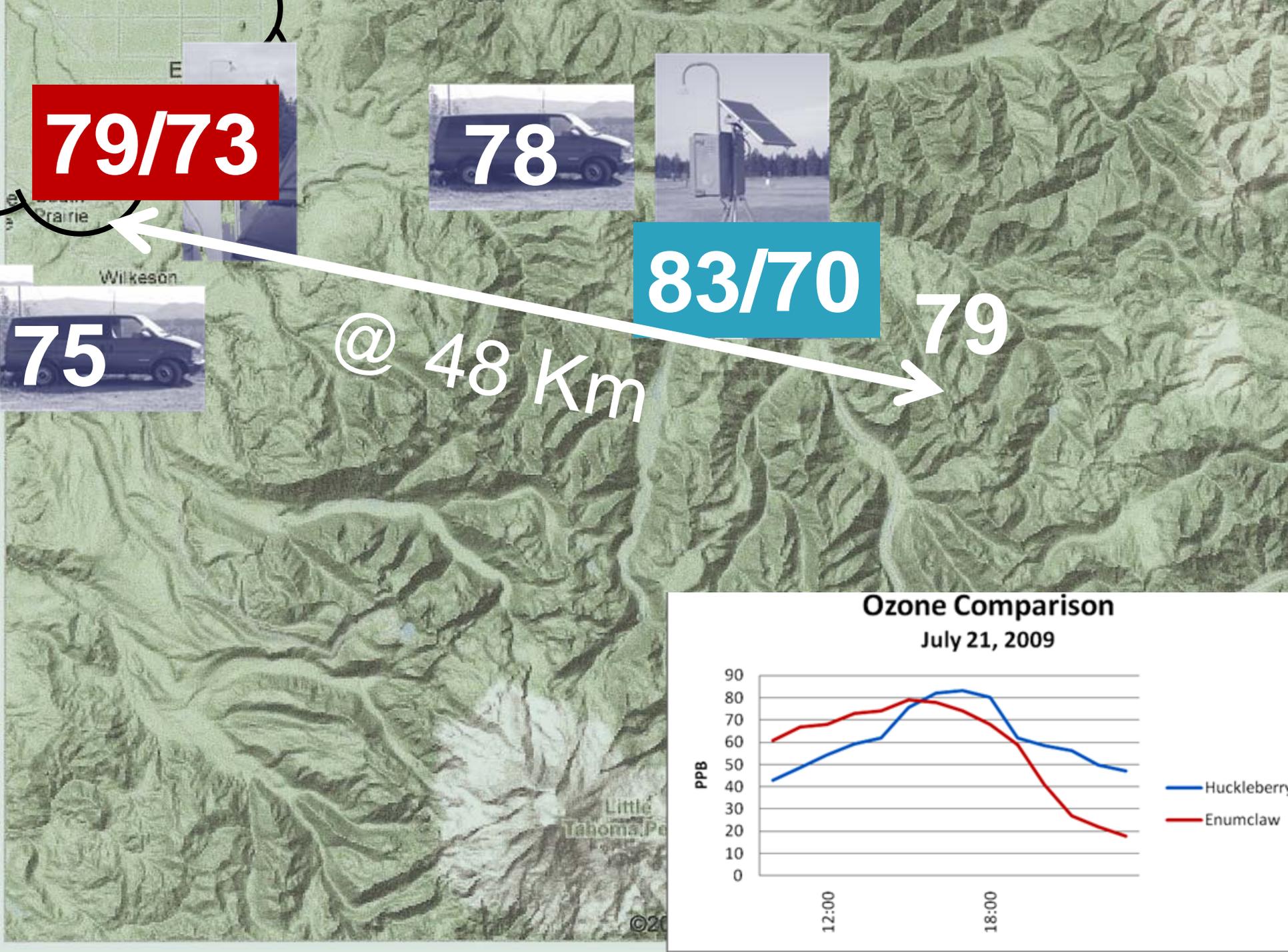


**83/70**



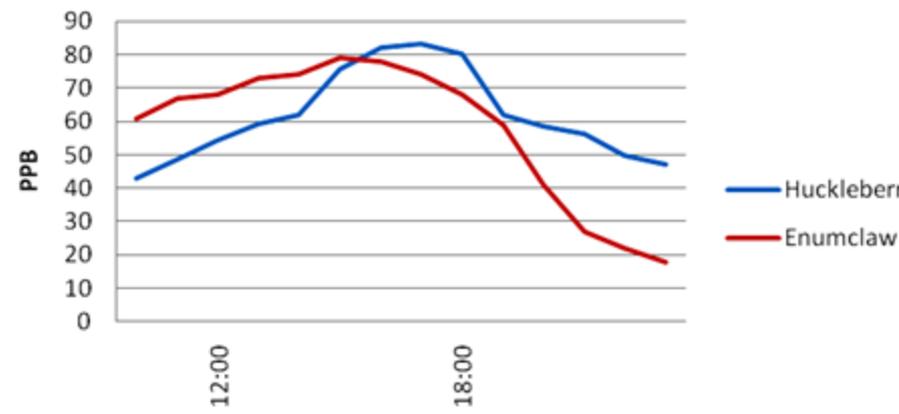
@ 48 Km

**79**



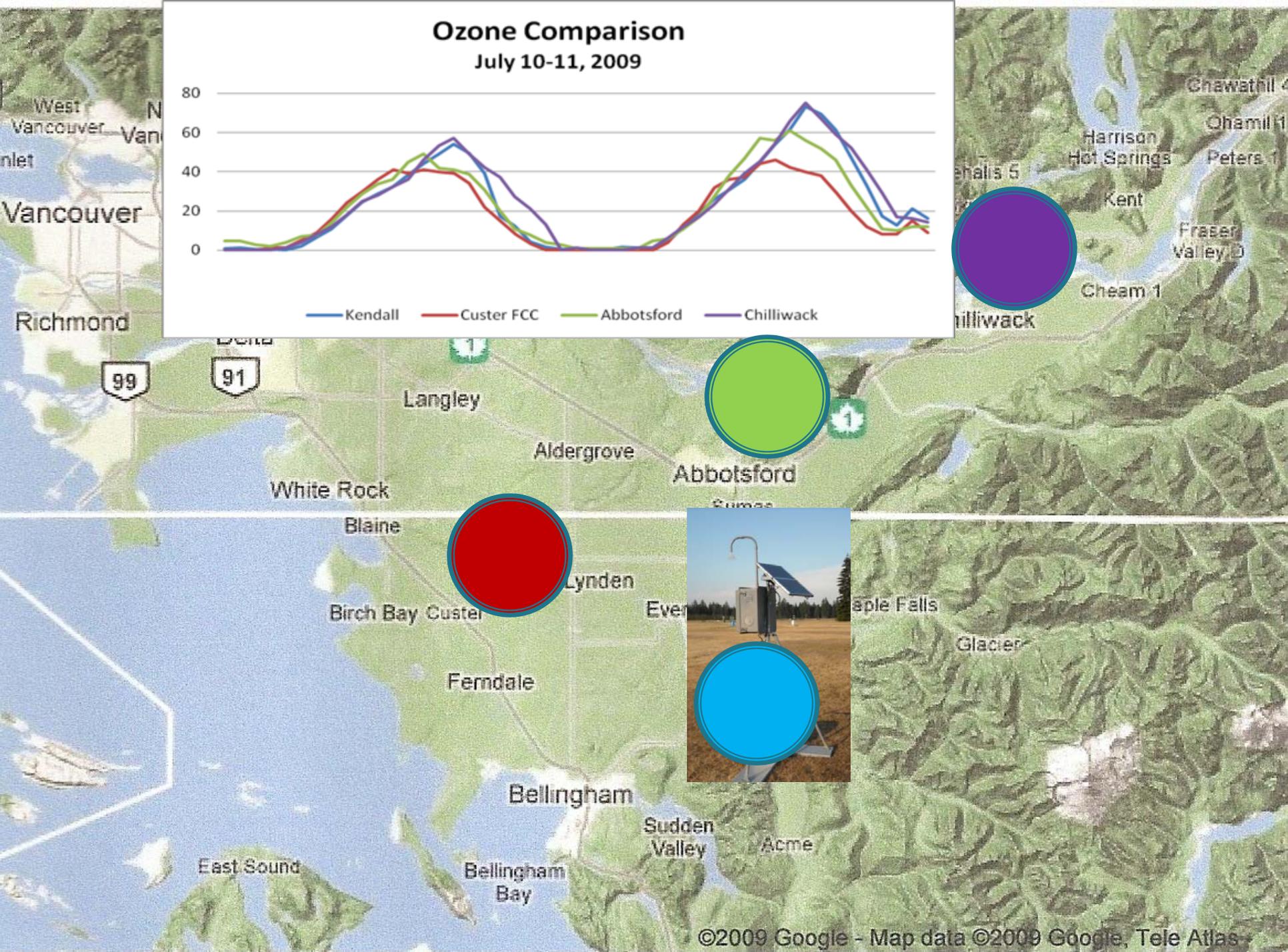
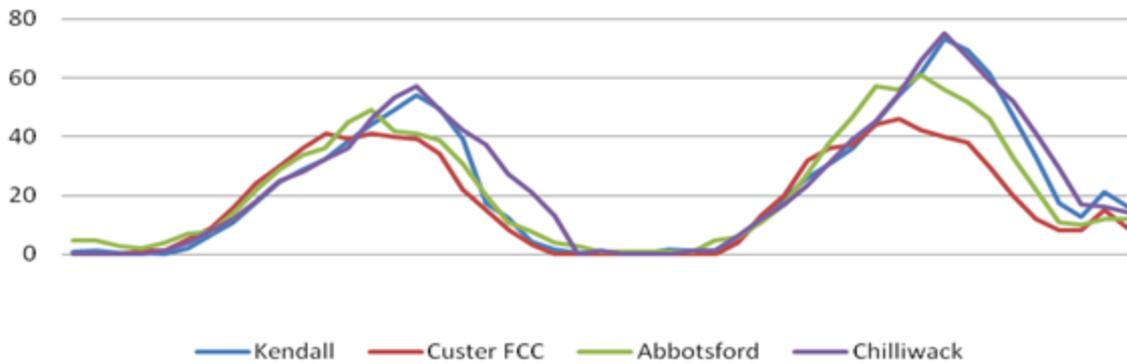
### Ozone Comparison

July 21, 2009



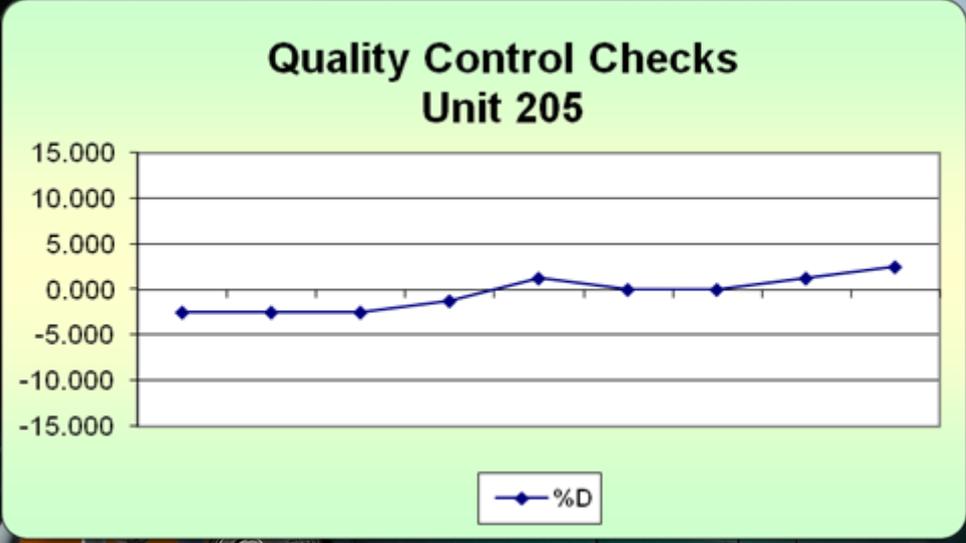
# Ozone Comparison

July 10-11, 2009



Frequen

checks



# Accomplishments

- Confirmed that the highest ozone concentrations are occurring along the perimeter of the ozone monitoring network
- Answered questions concerning the location of ozone monitors
- Demonstrated model forecasts for regions of eastern Washington appear accurate
- Demonstrated additional tools decision makers can use to assess their ozone monitoring network



# In a nutshell...



- Ozone concentrations measured by “non-regulatory” ozone analyzers during the survey contain little measurement uncertainty
- Decision makers can be confident when using the survey data to assess the ozone monitoring network

- The portable analyzers can be used to help define local forecast models for areas where no monitoring is currently being done
- The flexibility/cost of the instrument can be valuable in investigating before establishing a more permanent monitoring station



# Special thanks to the “ground support”

- Mark Shanis and Mike Papp  
*USEPA Office of Air Quality Planning and Standards*
- Melinda Ronca–Battista  
*Tribal Air Monitoring Support Center*
- Chris Hall and Scott Dubble  
*USEPA Region 10*
- *AIRNow Tech, NOAA and AIRPACT*