

# Attribution of Haze Report Update and Web Site Tutorial

Implementation Work Group Meeting  
March 8, 2005

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# Outline

- AoH Phase I Report comments and updates
- AoH Phase II description and schedule
- AoH Phase II recommendations
- AoH web site tutorial

# Summary of Comments

<b>Comment Type</b>	<b>Examples</b>	<b>No.</b>
Modeling uncertainty issues	CMAQ model performance Explanation of TSSA Tags/“Other”	10
Major Clarifications (expansion or addition of sections)	Glossary of acronyms/chemicals Modeling discussions (esp. TRA) Tribal role in WRAP	18
Summary products: revisions/titling/footnotes	Make figures “stand alone” Better resolution	8
Phase II Issues	Attribution results for other species 2018 projections/control strategies	5
Web site revisions	Reduce number of pages/link	3
Residence time maps	(Will send comments to DRI)	3
Minor clarifications	Sentence revisions	45
Typos	Oops	20
Compliments	Many liked the figures and tables	7
Other	Consistency issues in terminology	9

# TSSA Tags (**Red** Tags Used in Phase I)

Types	Source Category	Notes
ICON	<b>ICON</b>	<b>Initial Concentration</b>
BCON	<b>BCON</b>	<b>Boundary Concentration</b>
Emissions	<b>MV_*</b>	<b>Mobile sources from any state (on-road)</b>
	<b>BG_*</b>	<b>Biogenic sources from any state</b>
	<b>RD_*</b>	<b>Paved + unpaved road dust from any state</b>
	<b>NR_*</b>	<b>Non-road sources from any state</b>
	<b>PN_*</b>	<b>Point sources from any state</b>
	<b>AR_*</b>	<b>Area sources from any state</b>
	<b>WF_*</b>	<b>Wildland fire from any state</b>
	<b>AG_*</b>	<b>Agricultural fire from any state</b>
	<b>RX_*</b>	<b>Prescribed fire from any state</b>
	<b>ET_*</b>	<b>Total emissions from any state</b>
	<b>*_WRAP</b>	<b>Any type of source category emissions from WRAP domain</b>
Others	<b>OTHER</b>	<b>Any sources other than all of the above</b>

# Explanation of TSSA “Other” Category

- “Other” category should represent all the non-mobile, non-point source contributions for the species precursor under consideration ( $\text{SO}_2$  or  $\text{NO}_x$ )
- Since mobile and point sources represent 80% of the  $\text{SO}_2$  and  $\text{NO}_x$  WRAP emissions, the “Other” contributions are expected to be approximately 20%
- Additional sources of “Other” contributions may be:
  - Accumulated model errors (mass is not conserved at each model step)
  - Pacific off-shore emissions not accounted for in the “interim” EIs, but TRA shows ~10% - 65% contribution for sulfate

# Geographic Distribution of “Other” Contributions

<b>Range of “Other” Contribution</b>		<b>States Affected</b>
High	~50 – 70%	Northwest Washington, Northern California, Southern Oregon
Medium	~30 – 45%	Southern California, Northern Oregon, Idaho, Montana, North Dakota, South Dakota, Wyoming, Nevada
Low	~10 – 30%	Colorado, Utah, Arizona, New Mexico

# Additional Tables

- TSSA results for sulfate and nitrate (percent contribution to modeled total mass, based on 20% worst model days)
- TSSA results for sulfate and nitrate separated into mobile and point categories
- TSSA results for sulfate and nitrate (contribution in  $Mm^{-1}$  and % to measured aerosol extinction)
- TRA results for sulfate (percent contribution to measured total mass, based on 20% worst measured days)

# Tables of Attribution Results (1)

TSSA results for sulfate and nitrate  
(percent contribution to total)

TSSA Analysis  
Attribution Results for SO<sub>4</sub> (%)  
Based on 20% Highest Modeled Extinction Days  
2002

Class I Area	State	Site Code	IMPROVE Code	AZ	CA	CO	ID	MT	NV	NM	ND	OR	SD	UT	WA	WY	Mex
Group 1																	
Mount Rainier National Park	WA	MORA1	MORA1	0	0	0	0	0	0	0	0	2	0	0	71	0	0
Glacier Peak Wilderness Area	WA	GLPE	NOCA1	0	1	0	1	1	1	0	0	3	0	0	46	0	0
North Cascades National Park	WA	NOCA1	NOCA1	0	1	0	0	0	0	0	0	2	0	0	29	0	0
Olympic National Park	WA	OLYM1	OLYM1	0	0	0	0	0	0	0	0	2	0	0	45	0	0
Pasayten Wilderness Area	WA	PASA1	PASA1	0	2	0	1	1	1	0	0	7	0	0	38	0	0
Alpine Lakes Wilderness Area	WA	SNPA1	SNPA1	0	1	0	0	0	0	0	0	4	0	0	63	0	0
Spokane Tribe of Indians	WA	SPOK1	SPOK1	0	1	0	3	2	1	0	0	7	0	0	56	0	0
Goat Rocks Wilderness Area	WA	GORO	WHPA1	0	1	0	1	0	1	0	0	7	0	0	58	0	0
Mount Adams Wilderness Area	WA	MOAD	WHPA1	0	1	0	1	0	1	0	0	12	0	0	54	0	0

TSSA results for sulfate and nitrate  
separated into mobile and point categories

TSSA Analysis  
Attribution Results for SO<sub>4</sub> (%)  
Separated into Mobile and Point Source Categories  
Based on 20% Highest Modeled Extinction Days  
2002

Class I Area	Site Code	IMPROVE Code	State	AZ		CA		CO		ID		MT		NV		NM		ND		OR		SD		UT		WA		
				mb	pt	mb	pt	mb	pt	mb	pt	mb	pt	mb	pt	mb	pt	mb	pt	mb	pt	mb	pt	mb	pt	mb	pt	mb
Group 1																												
Mount Rainier National Park	MORA1	MORA1	WA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	36	35
Glacier Peak Wilderness Area	GLPE	NOCA1	WA	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	27	19
North Cascades National Park	NOCA1	NOCA1	WA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	19	10
Olympic National Park	OLYM1	OLYM1	WA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	28	17
Pasayten Wilderness Area	PASA1	PASA1	WA	0	0	1	1	0	0	1	1	0	1	0	1	0	0	0	0	0	2	5	0	0	0	0	16	22
Alpine Lakes Wilderness Area	SNPA1	SNPA1	WA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	33	30
Spokane Tribe of Indians	SPOK1	SPOK1	WA	0	0	0	0	0	0	2	1	1	1	0	1	0	0	0	0	0	2	6	0	0	0	0	16	40
Goat Rocks Wilderness Area	GORO	WHPA1	WA	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	5	0	0	0	0	27	31
Mount Adams Wilderness Area	MOAD	WHPA1	WA	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	3	9	0	0	0	0	25	29

# Tables of Attribution Results (2)

## TSSA results: contribution by sulfate and nitrate to aerosol extinction

### TSSA Analysis

SO<sub>4</sub> Contribution to Aerosol Extinction on the 20% Highest Extinction Days  
2002

Class I Area	State	Site Code	IMPROVE Code	CA		ID		OR		SD		UT		WA	
				Mm <sup>-1</sup>	%	Mm <sup>-1</sup>	%	Mm <sup>-1</sup>	%	Mm <sup>-1</sup>	%	Mm <sup>-1</sup>	%	Mm <sup>-1</sup>	%
Group 1															
Mount Rainier National Park	WA	MORA1	MORA1	0.0	0	0.0	0	0.5	1	0.0	0	0.0	0	14.8	31
Glacier Peak Wilderness Area	WA	GLPE	NOCA1	0.2	1	0.1	0	0.5	1	0.0	0	0.0	0	7.7	24
North Cascades National Park	WA	NOCA1	NOCA1	0.1	0	0.1	0	0.3	1	0.0	0	0.0	0	4.8	15
Olympic National Park	WA	OLYM1	OLYM1	0.1	0	0.0	0	0.4	1	0.0	0	0.0	0	8.4	20
Pasayten Wilderness Area	WA	PASA1	PASA1	0.1	0	0.1	0	0.6	2	0.0	0	0.0	0	3.1	10
Alpine Lakes Wilderness Area	WA	SNPA1	SNPA1	0.1	0	0.1	0	0.6	1	0.0	0	0.0	0	10.9	21
Spokane Tribe of Indians	WA	SPOK1	SPOK1	0.1	0	0.4	1	1.0	1	0.0	0	0.0	0	8.1	10
Goat Rocks Wilderness Area	WA	GORO	WHPA1	0.1	0	0.1	0	0.6	3	0.0	0	0.0	0	5.5	24
Mount Adams Wilderness Area	WA	MOAD	WHPA1	0.1	0	0.1	0	1.1	5	0.0	0	0.0	0	5.2	22

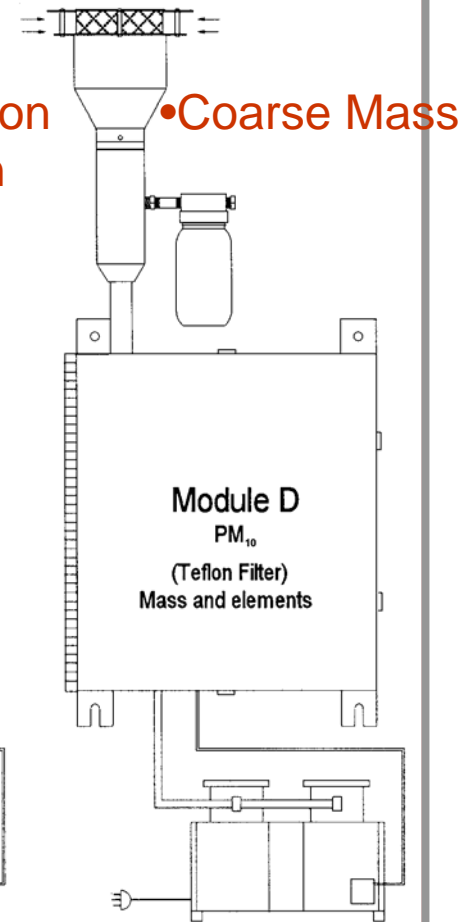
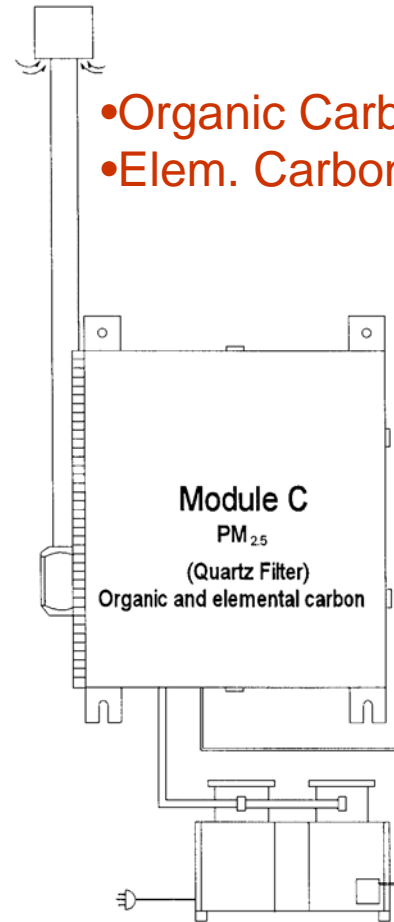
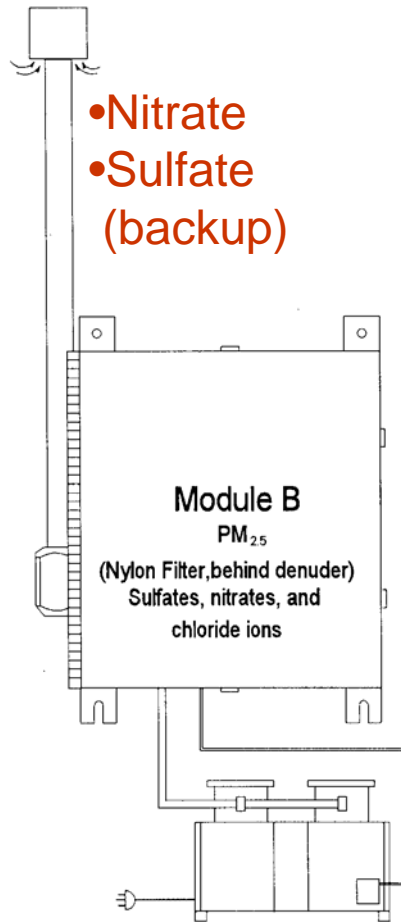
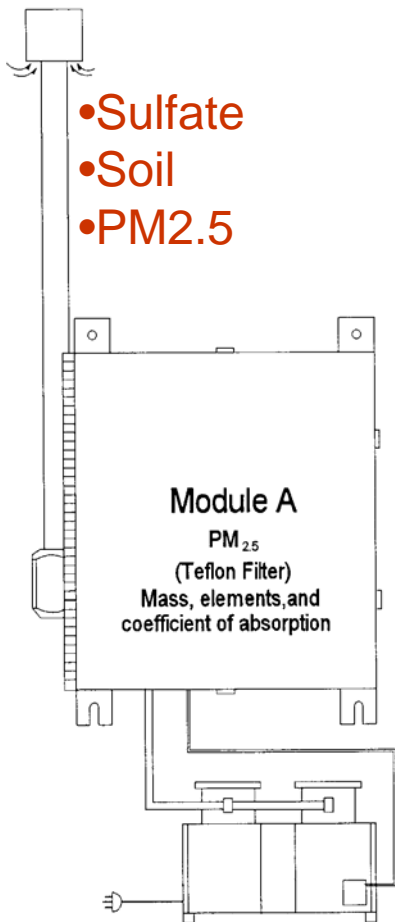
## TRA results for sulfate (percent contribution to total)

Trajectory Regression Analysis  
Attribution Results for 20% Highest SQ<sub>4</sub> Days  
(Zero-Intercept Method)  
2000 - 2002

Class I Area	State	Site Code	IMPROVE Code	AZ	CA	CO	IA	ID	KS	MN	MT	NE	NV	NM	ND	OK	OR	SD	TX	UT	WA	WY	NWUS	NEUS
Group 1																								
Mount Rainier National Park	WA	MORA1	MORA1	SW	SW	SW	NE	0	SE	NE	NW	NE	SW	SW	NE	SE	-1	NE	SE	SW	51	NW	0	0
Glacier Peak Wilderness Area	WA	GLPE	NOCA1	SW	SW	SW	NE	0	SE	NE	NW	NE	SW	SW	NE	SE	-1	NE	SE	SW	29	NW	0	0
North Cascades National Park	WA	NOCA1	NOCA1	SW	SW	SW	NE	0	SE	NE	NW	NE	SW	SW	NE	SE	-1	NE	SE	SW	29	NW	0	0
Olympic National Park	WA	OLYM1	OLYM1	SW	SW	SW	NE	5	SE	NE	NW	NE	SW	SW	NE	SE	-2	NE	SE	SW	62	NW	-4	0
Pasayten Wilderness Area	WA	PASA1	PASA1	SW	SW	SW	NE	0	SE	NE	NW	NE	SW	SW	NE	SE	1	NE	SE	SW	33	NW	2	6
Alpine Lakes Wilderness Area	WA	SNPA1	SNPA1	SW	SW	SW	NE	0	SE	NE	NW	NE	SW	SW	NE	SE	-5	NE	SE	SW	48	NW	0	0
Spokane Tribe of Indians	WA	SPOK1	SPOK1	SW	SW	SW	NE	1	SE	NE	NW	NE	SW	SW	NE	SE	13	NE	SE	SW	42	NW	4	0
Goat Rocks Wilderness Area	WA	GORO	WHPA1	SW	SW	SW	NE	-1	SE	NE	NW	NE	SW	SW	NE	SE	-1	NE	SE	SW	64	NW	1	0
Mount Adams Wilderness Area	WA	MOAD	WHPA1	SW	SW	SW	NE	-1	SE	NE	NW	NE	SW	SW	NE	SE	-1	NE	SE	SW	64	NW	1	0

# IMPROVE Aerosol Sampler Systems

## IMPROVE Modular Aerosol Samplers



# How Clogged Filters Affect Data Sets

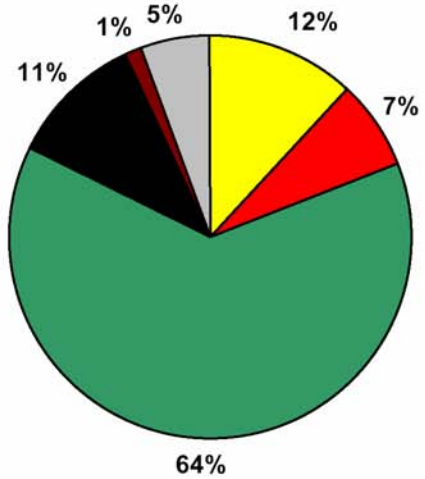
- If the A or D filter clogs during a fire event, fine soil and/or coarse mass will be missing from the data set
- If the conditions for data substitution are not met, these samples will be ignored under RHR guidelines
- However, these days may have significant contributions from other species, particularly organic and elemental carbon
- The average extinction of the 20% worst days can be significantly affected, as seen in the following examples from 2002

# Data set following RHR guidelines

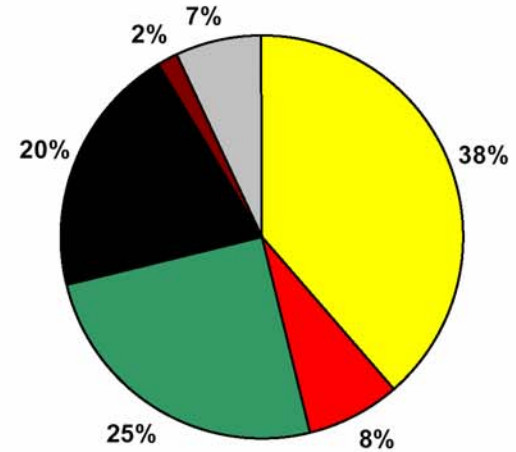
## MONITORING DATA

Crater Lake National Park, OR  
 2002 Reconstructed Extinction  
 CRLA1 Monitoring Data (every third day)

**20% Worst Visibility Days**  
 Aerosol Extinction\* = 68 Mm<sup>-1</sup> (22 to 217 Mm<sup>-1</sup>)

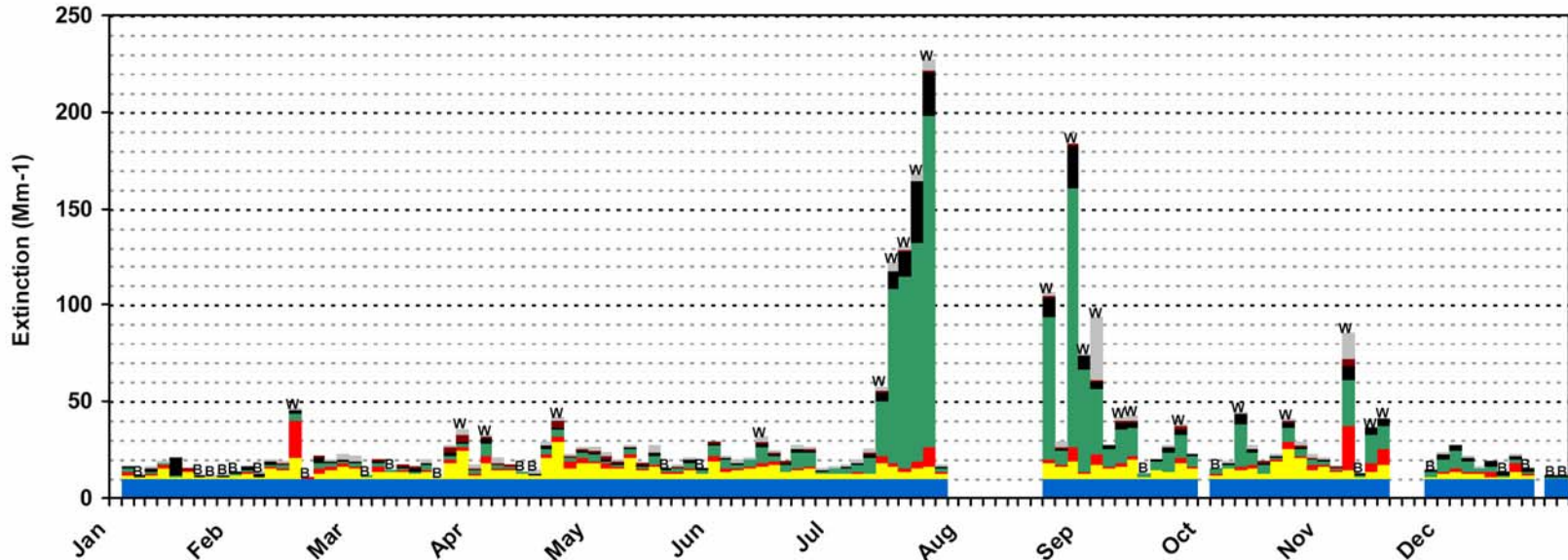


**20% Best Visibility Days**  
 Aerosol Extinction\* = 3 Mm<sup>-1</sup> (1 to 6 Mm<sup>-1</sup>)



- Coarse Material
- Soil
- Elemental Carbon
- Organic Material
- Ammonium Nitrate
- Ammonium Sulfate
- Rayleigh

\*Excludes Rayleigh Extinction



# Data set including clogged filter days

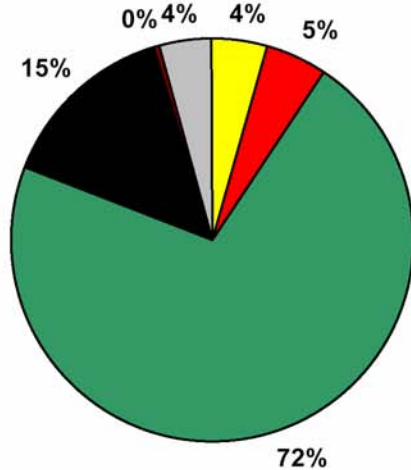
## MONITORING DATA

Crater Lake National Park, OR  
 2002 Reconstructed Extinction  
 CRLA1 Monitoring Data (every third day)

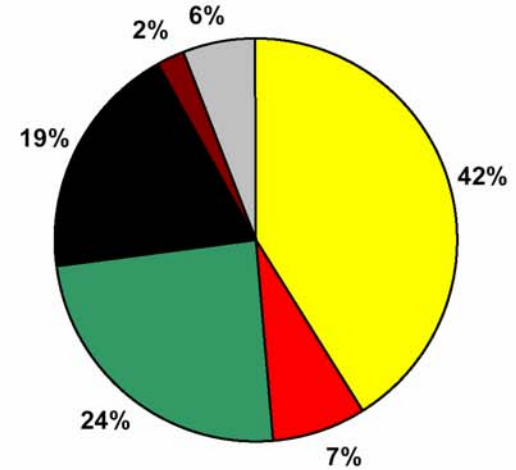
## "RAW" DATA

- No RHR data substitutions
- Includes available data from days with clogged filters

20% Worst Visibility Days  
 Aerosol Extinction\* = 149 Mm<sup>-1</sup> (31 to 414 Mm<sup>-1</sup>)

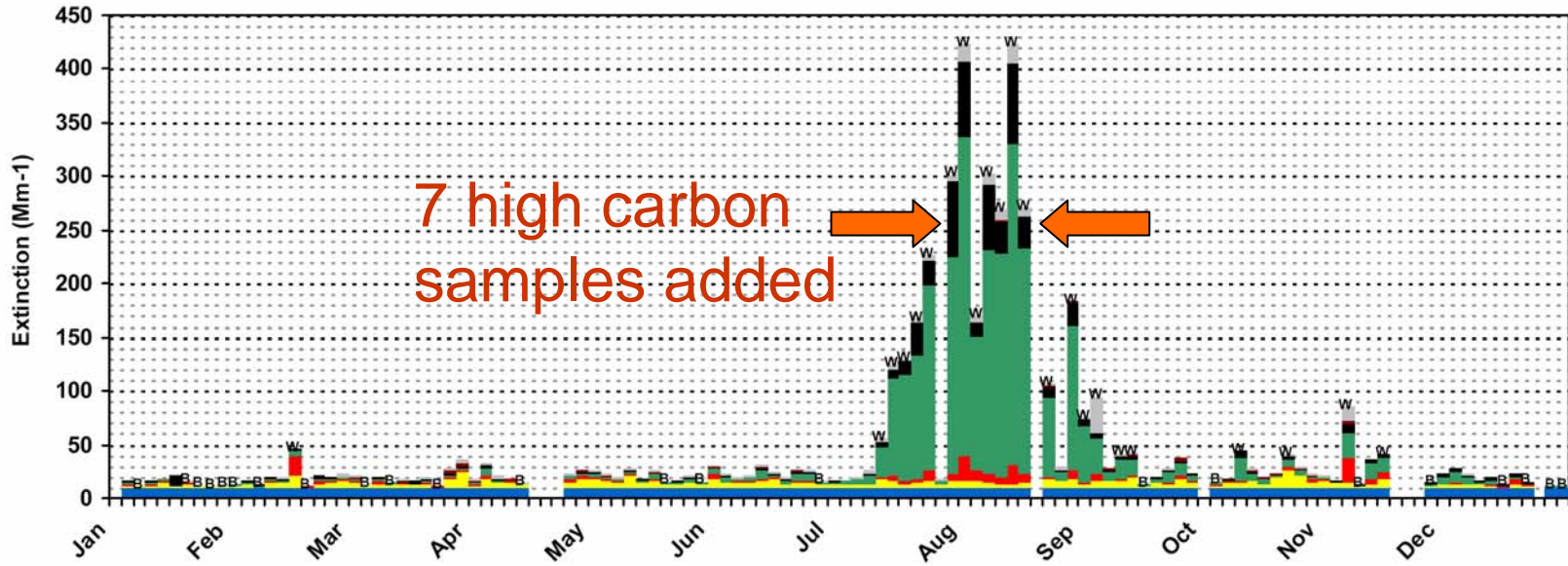


20% Best Visibility Days  
 Aerosol Extinction\* = 3 Mm<sup>-1</sup> (1 to 6 Mm<sup>-1</sup>)



Coarse Material  
 Soil  
 Elemental Carbon  
 Organic Material  
 Ammonium Nitrate  
 Ammonium Sulfate  
 Rayleigh

\*Excludes Rayleigh Extinction

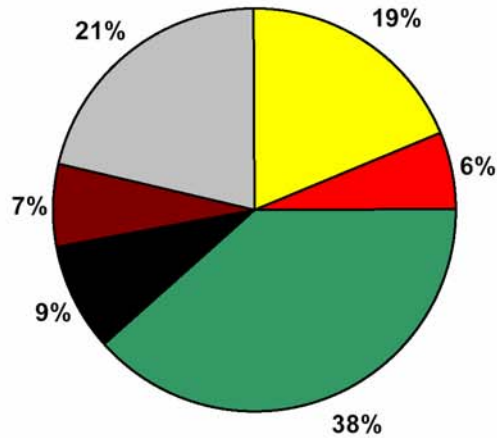


# Data set following RHR guidelines

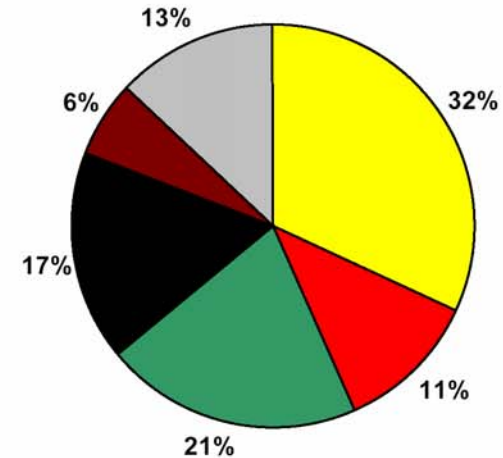
## MONITORING DATA

Petrified Forest National Park, AZ  
 2002 Reconstructed Extinction  
 PEFO1 Monitoring Data (every third day)

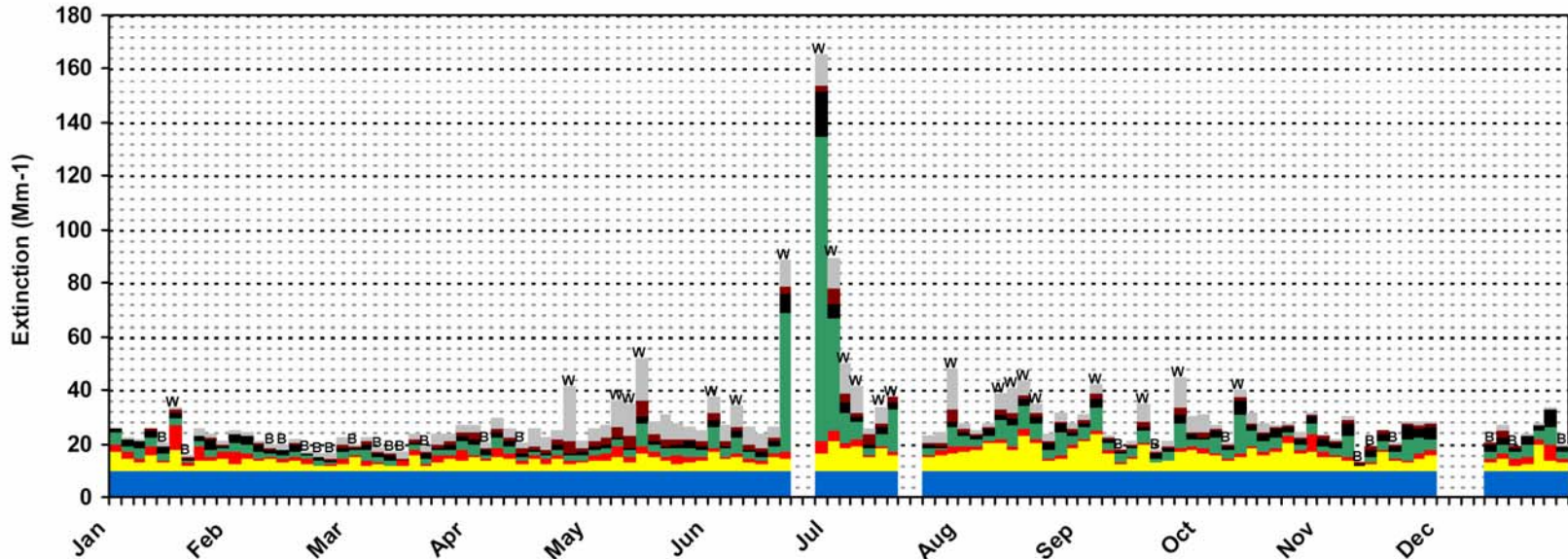
**20% Worst Visibility Days**  
 Aerosol Extinction\* = 40 Mm<sup>-1</sup> (24 to 155 Mm<sup>-1</sup>)



**20% Best Visibility Days**  
 Aerosol Extinction\* = 9 Mm<sup>-1</sup> (3 to 10 Mm<sup>-1</sup>)



Coarse Material  
 Soil  
 Elemental Carbon  
 Organic Material  
 Ammonium Nitrate  
 Ammonium Sulfate  
 Rayleigh  
 \*Excludes Rayleigh Extinction



# Data set including clogged filter days

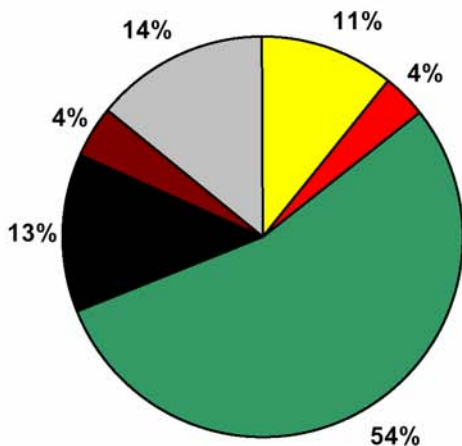
## MONITORING DATA

Petrified Forest National Park, AZ  
 2002 Reconstructed Extinction  
 PEFO1 Monitoring Data (every third day)

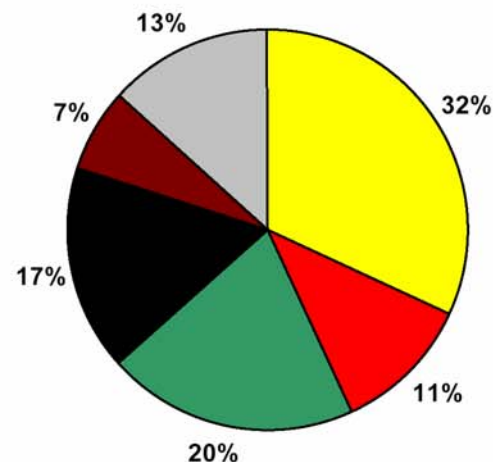
## "RAW" DATA

- No RHR data substitutions
- Includes available data from days with clogged filters

**20% Worst Visibility Days**  
 Aerosol Extinction\* = 67 Mm<sup>-1</sup> (24 to 395 Mm<sup>-1</sup>)

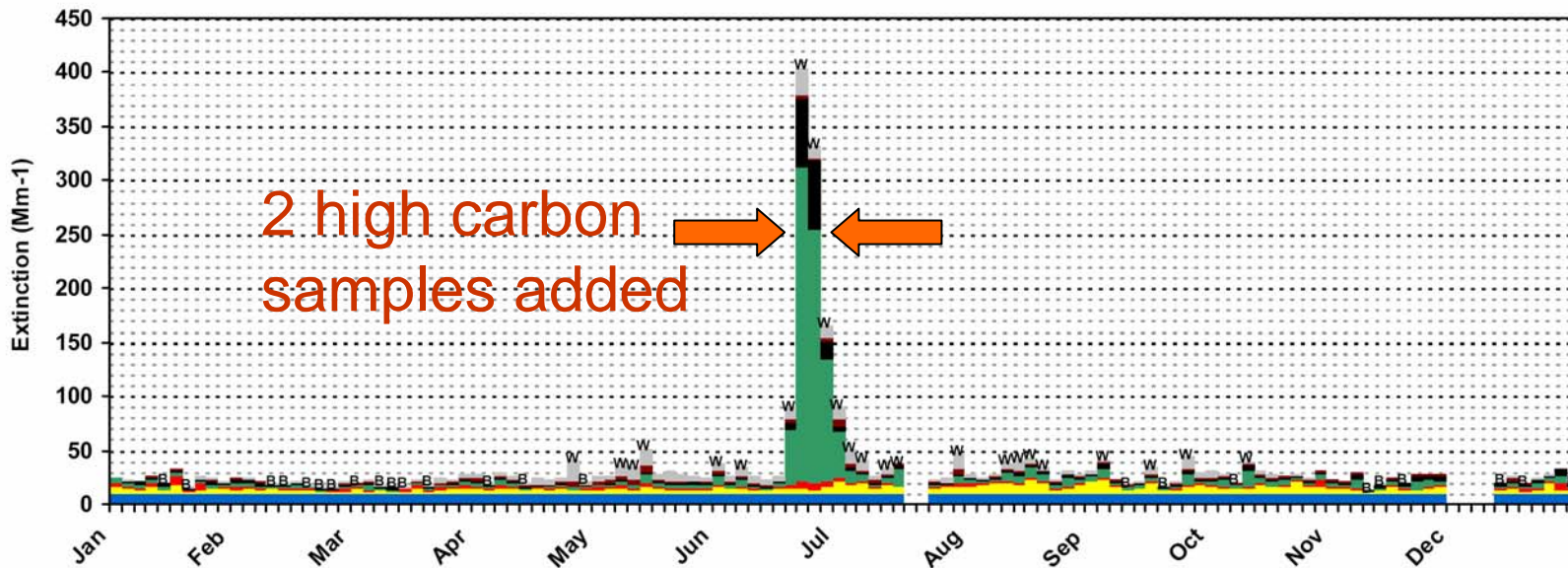


**20% Best Visibility Days**  
 Aerosol Extinction\* = 9 Mm<sup>-1</sup> (3 to 11 Mm<sup>-1</sup>)



- Coarse Material
- Soil
- Elemental Carbon
- Organic Material
- Ammonium Nitrate
- Ammonium Sulfate
- Rayleigh

\*Excludes Rayleigh Extinction



# IMPROVE Sites with Clogged Filters in 2002

Site	Date	A	B	C	D
KALM1	5/5/2002				X
KALM1	5/8/2002				X
KALM1	5/11/2002				X
KALM1	5/14/2002				X
KALM1	5/17/2002				X
KALM1	8/9/2002	X			
KALM1	8/12/2002	X			
KALM1	8/15/2002	X	X		
KALM1	8/18/2002	X			
KALM1	8/21/2002	X			
KALM1	9/2/2002	X			
KALM1	9/5/2002	X			
KALM1	9/8/2002	X			
KALM1	9/11/2002	X			
LABE1	6/7/2002				X
LABE1	6/10/2002				X
LABE1	7/25/2002	X			
LABE1	7/28/2002	X			
LABE1	7/31/2002	X			
LABE1	8/15/2002	X	X		
LABE1	8/18/2002	X	X		
LABE1	8/30/2002	X	X		

Site	Date	A	B	C	D
CRLA1	7/31/2002	X			
CRLA1	8/3/2002	X			
CRLA1	8/6/2002	X			
CRLA1	8/9/2002	X			
CRLA1	8/12/2002	X			
CRLA1	8/15/2002	X			
CRLA1	8/18/2002	X			
TRIN1	7/28/2002	X			
TRIN1	8/9/2002	X			
TRIN1	8/15/2002	X			
TRIN1	8/18/2002	X			
TRIN1	8/21/2002	X			
REDW1	6/28/2002				X
REDW1	7/28/2002	X			
REDW1	8/9/2002	X			
YELL2	7/4/2002				X
YELL2	7/10/2002	X			
YELL2	7/13/2002	X			
PEFO1	6/22/2002	X			
PEFO1	6/25/2002	X			
SYCA1	7/19/2002				X
SYCA1	8/24/2002	X			

Site	Date	A	B	C	D
THRO1	8/6/2002	X			
THRO1	8/24/2002	X			
WEMI1	6/22/2002	X			
WEMI1	6/25/2002	X			
BOAP1	12/7/2002				X
BRCA1	4/5/2002	X			
PASA1	10/17/2002	X			

Non-WRAP sites

OKEF1	6/16/2002	X	X		
VILA1	6/19/2002	X	X		

# AoH Phase II Description

- Refine Phase I techniques for Phase II
- Reduce uncertainty in modeled data and attribution results
- Analyze differences between modeled results for 2002 and 2018 (base, scenarios)
- Develop additional approaches (e.g., receptor modeling, representativeness of 2002, trends analyses)
- Make data and analysis tools directly available to states and tribes via web site

# AoH Phase II (Tentative) Schedule

<b>Date</b>	<b>Milestone</b>
Mar – Jun 05	Evaluate recommendations for Phase II
Jun 05	First Phase II meeting – define requirements/schedule
Sep 05	AoH meeting – publish 2002 attribution results
Dec 05	AoH meeting – publish 2018 base case attribution results
Jan – Jul 06	AoH meetings – publish 2018 control scenarios' attribution results
May – Jul 06	States and Tribes conduct CIA-specific analyses
Aug 06	Publish AoH Phase II DRAFT report
Oct 06	Publish AoH Phase II FINAL report

# Overview of Phase II Recommendations

- Developed, reviewed, and accepted by ARS and the AoH Work Group
- Required steps – AoH should address these prior to or early in Phase II
- High priority – These are very important to Phase II success and are expected to have a significant impact on Phase II results
- Lower priority – These are important, but may not have as much impact on Phase II results, so AoH should address these as time, funds, and feasibility allow

# Recommendations – Required Steps

1. Use Phase I process as model for Phase II
2. Define data quality objectives for Phase II
3. Assess the relative quality and importance of 2002 and 2018 EIs
4. Determine the relative importance of the 6 visibility-impairing species measured by the IMPROVE network (2000-2004 baseline)
5. Define the Phase II methodology regarding the weight of evidence approach, attribution methods, and relevant control strategies

# Recommendations – High Priority

6. Develop EIs for Pacific off-shore shipping
7. To the degree possible, update EIs from outside the WRAP
8. Refine the TSSA method for a better understanding of contributions to the “Other” category
9. Broaden the scope of the TSSA analysis:
  - a) Tag other species by source category (like Phase I)
  - b) Tag all species regardless of source category; use EIs to derive contributions by source category
10. Define the application of CMAQ to estimating future visibility scenarios

# Recommendations – Lower Priority

11. Refine the method used for Class I area cluster analysis
12. Continue to improve emissions estimates related to windblown dust both within and outside of the WRAP
13. Expand and refine the TRA method:
  - a) Apply TRA to nitrate (DRI says we can't apply to carbon)
  - b) Apply TRA results for all states within WRAP
  - c) Apply TRA to review possible "edge effects"

# AoH Phase I Web Site Tutorial

- State and Tribal pages
  - State, tribal, and regional products
- Individual Class I area pages
  - Simulated air quality images
  - Aerosol summary products (monitored/modeled)
  - Source Apportionment Comparisons
- Links to WRAP data centers
  - Regional Modeling Center web site
  - Causes of Haze web site