California's Regional Haze Plan

California Environmental Protection Agency

Air Resources Board

December 15, 2008
Sacramento, CA
WORKSHOP/WEBCAST

Workshop Logistics

1. Purpose and Components of Regional Haze Plan
2. Current Visibility: Nature of the Problem
3. California's Progress Strategy
4. Reasonable Progress Goals and Future Steps
5. Questions and Answers

Email questions to: sierrarm@arb.ca.gov

Conference line: 888-790-3420 code 69226


Joshua Tree National Park


John Muir Wilderness


Yolla Bolly Middle Eel


Point Reyes National Seashore

All photographs from National Park Service or U.S. Forest Service websites

1. Purpose and Components of Regional Haze Plan

- Regional Haze Program Background
- Regional Haze Plan Elements
- Western Regional Process
- California's 29 Class 1 Areas


Joshua Tree National Park


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Yolla Bolly Middle Eel


Point Reyes National Seashore

All photographs from National Park Service or U.S. Forest Service websites

Regional Haze Program Background

- Pollution in the atmosphere degrades visibility – known as “Regional Haze”
- Regional Haze Rule adopted by U.S. EPA in 1999
- Reduce Regional Haze at most treasured National Parks and Wilderness Areas (Class 1 Areas)
- Achieve Natural Conditions Visibility by 2064
- 156 Class 1 Areas nationwide; 29 in California

Regional Haze Plan Elements


Redwoods National Park


Lassen Volcanic National Park


Point Reyes National Seashore


Desolation Wilderness

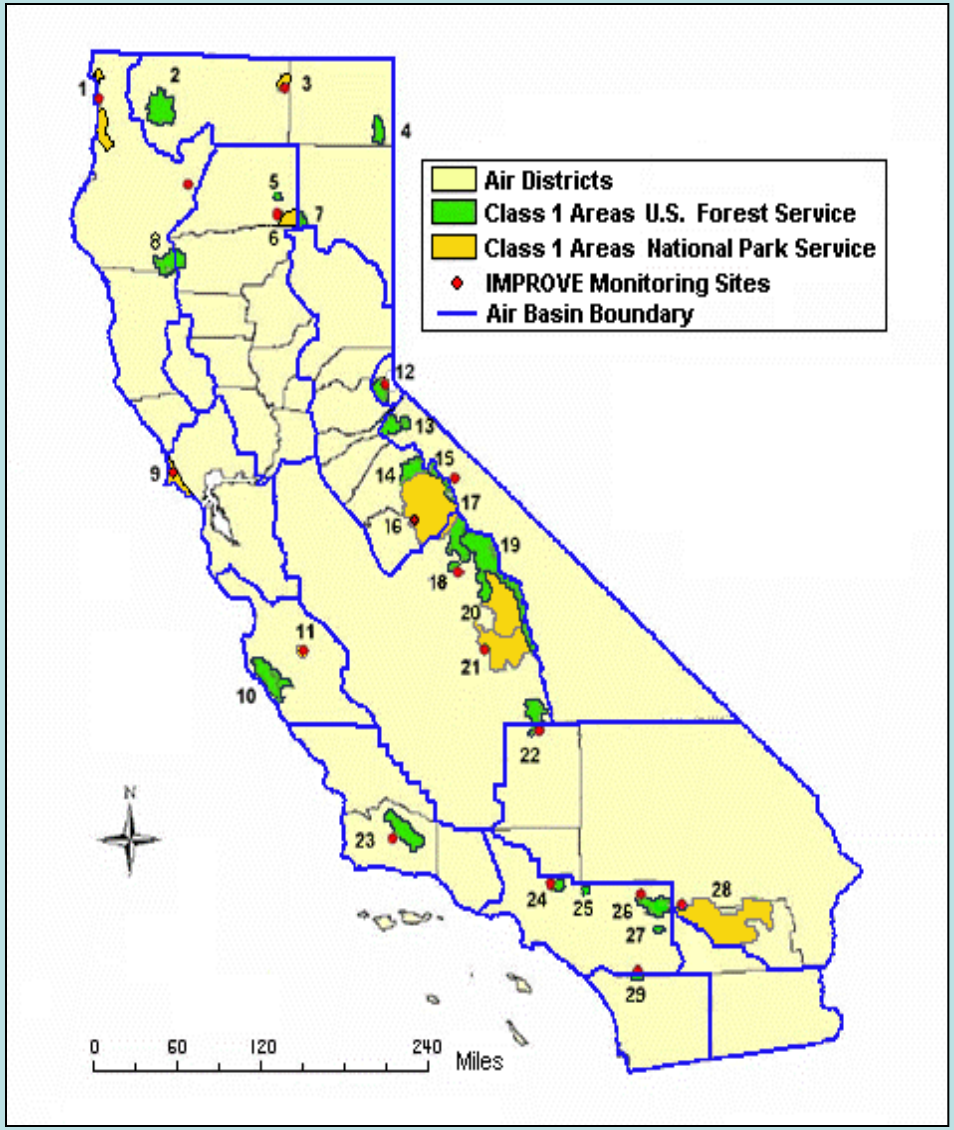
- Establish Natural and Baseline Visibility Conditions
- Long Term Control Strategy for Sources of Haze Pollutants
- Set Reasonable Progress Goals for 2018
- Monitoring Strategy and Evaluation of Progress
- Continued Consultation with Land Managers, States, & Tribes
- Mid-Course Reviews and Plan Revisions

Western Regional Process

- **Participation in Western Regional Air Partnership (WRAP)**
  - Facilitated consultation
  - Monitoring Data Analysis
  - Emissions Inventory
  - Regional Modeling for 2018
- **California Consultation Process**
  - Participation in WRAP
  - Discussions with neighboring states
  - Federal Land Managers meetings

www.wrapair.org

California Class 1 Areas



1. Redwood National Park
2. Marble Mountain Wilderness Area
3. Lava Beds Wilderness Area
4. South Warner Wilderness Area
5. Thousand Lakes Wilderness Area
6. Lassen Volcanic National Park
7. Caribou Wilderness Area
8. Yolla Bolly Middle Eel Wilderness Area *
9. Point Reyes Wilderness Area
10. Ventana Wilderness Area
11. Pinnacles Wilderness Area
12. Desolation Wilderness Area
13. Mokelumne Wilderness Area
14. Emigrant Wilderness Area
15. Hoover Wilderness Area
16. Yosemite National Park
17. Ansel Adams Wilderness Area
18. Kaiser Wilderness Area
19. John Muir Wilderness Area
20. Kings Canyon National Park
21. Sequoia National Park
22. Dome Land Wilderness Area *
23. San Rafael Wilderness Area
24. San Gabriel Wilderness Area
25. Cucamonga Wilderness Area
26. San Gorgonio Wilderness Area *
27. San Jacinto Wilderness Area
28. Joshua Tree Wilderness Area
29. Agua Tibia Wilderness Area

** Portions of these Class 1 Areas are managed by the federal Bureau of Land Management*

2. Current Visibility: Nature of the Problem

- **Technical Terminology and Current Conditions**
- **Factors Influencing Regional Haze**
- **Regional Analysis in California**


Joshua Tree National Park


John Muir Wilderness


Yolla Bolly Middle Eel


Point Reyes National Seashore

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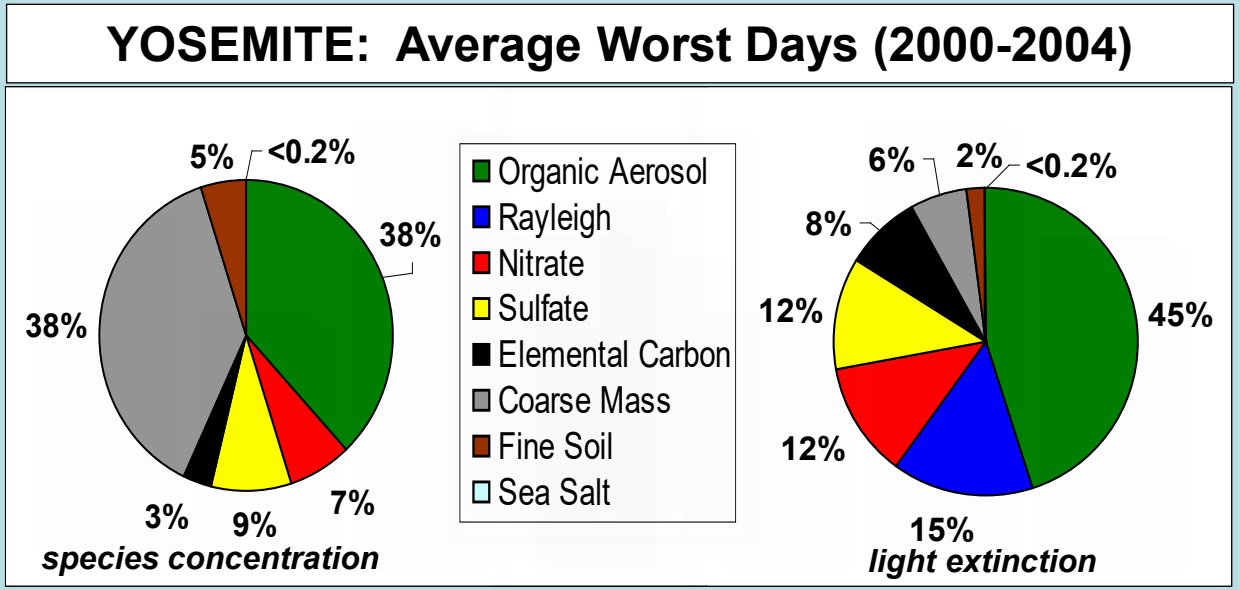
Technical Terminology - 1

New Aspects of Familiar Air Pollutants

- Pollutants scatter and absorb light (light extinction)
- Particulate species measurements used to estimate light extinction
- Each haze pollutant species has a different light extinction capability
- Also natural scattering of light by gases, called Rayleigh scattering



Technical Terminology - 2

- **Haze measured in deciviews**
  - –Extinction of each species summed to get total light extinction
  - –Natural log of total extinction provides value in deciviews
- **17 monitors used to represent visibility at California's 29 Class 1 Areas**
- **Parameters evaluated at each monitor**
  - –Baseline Conditions: current conditions 2000-2004
  - –Baseline monitoring data used to calculate 20% Best and Worst Days
  - –Natural Conditions: statistical calculation of deciview from natural sources

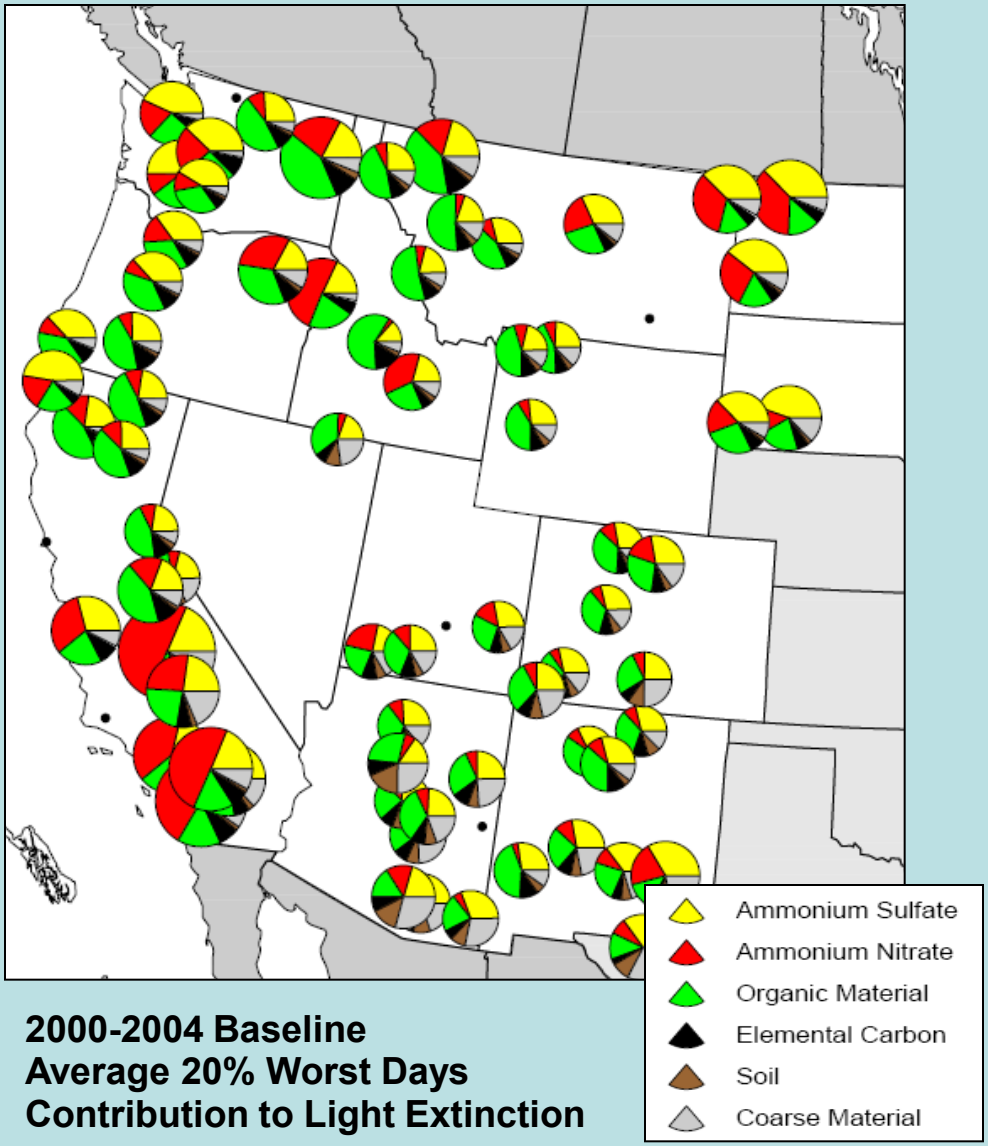
Current Conditions

Monitor	Class 1 Area	Worst (dv) baseline	Worst (dv) natural	Best (dv) baseline
	NORTHERN			
LABE	Lava Beds NP South Warner WA	15.1	7.9	3.2
LAVO	Lassen Volcanic NP Caribou WA Thousand Lakes WA	14.1	7.3	2.7
TRIN	Marble Mountain WA Yolla Bolly-Middle Eel WA	17.4	7.9	3.4
	SIERRA			
BLIS	Desolation WA Mokelumne WA	12.6	6.1	2.5
HOOV	Hoover WA	12.9	7.7	1.4
YOSE	Yosemite NP Emigrant WA	17.6	7.6	3.4
KAIS	Ansel Adams WA Kaiser WA John Muir WA	15.5	7.1	2.3
SEQU	Sequoia NP Kings Canyon NP	25.4	7.7	8.8
DOME	Dome Lands WA	19.4	7.5	5.1
	SOUTHERN			
SAGA	San Gabriel WA Cucamonga WA	19.9	7	4.8
SAGO	San Gorgonio WA San Jacinto WA	22.2	7.3	5.4
JOSH	Joshua Tree WA	19.6	7.2	6.1
AGTI	Agua Tibia WA	23.5	7.6	9.6
	COASTAL			
REDW	Redwood NP	18.5	13.9	6.1
PORE	Point Reyes WA	22.8	15.8	10.5
RAFA	San Rafael WA	18.8	7.6	6.4
PINN	Pinnacles WA Ventana WA	18.5	8.0	8.9

National Visibility Goals by 2064

- Improve current Worst Days visibility to the deciview level of Worst Days at Natural Conditions
- Maintain current Best Days deciview level or improve it

Factors Influencing Regional Haze



2000-2004 Baseline
Average 20% Worst Days
Contribution to Light Extinction

WHAT

- Predominate species on Worst Days are “drivers”

WHEN

- Seasonal changes in drivers
- Unusual events cause spikes

WHERE

- Nearby sources or population centers
- Influence from other states
- International transport

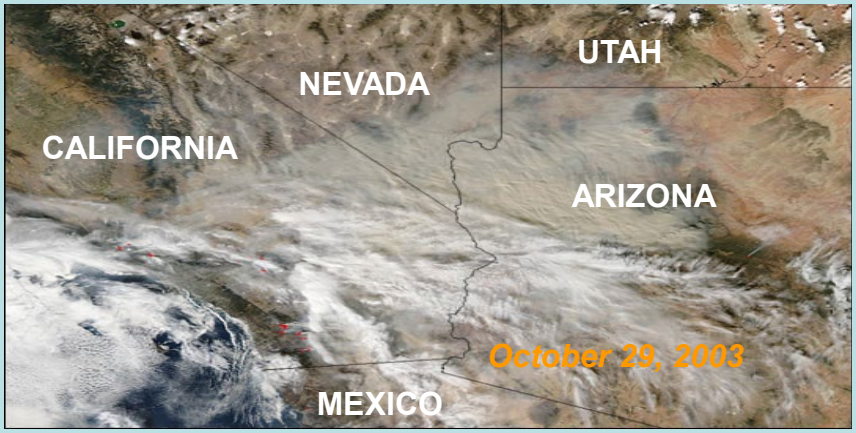
WHY

- Anthropogenic sources (mobile, stationary, area)
- Natural sources (wildfires, biogenics, wind, geologic)

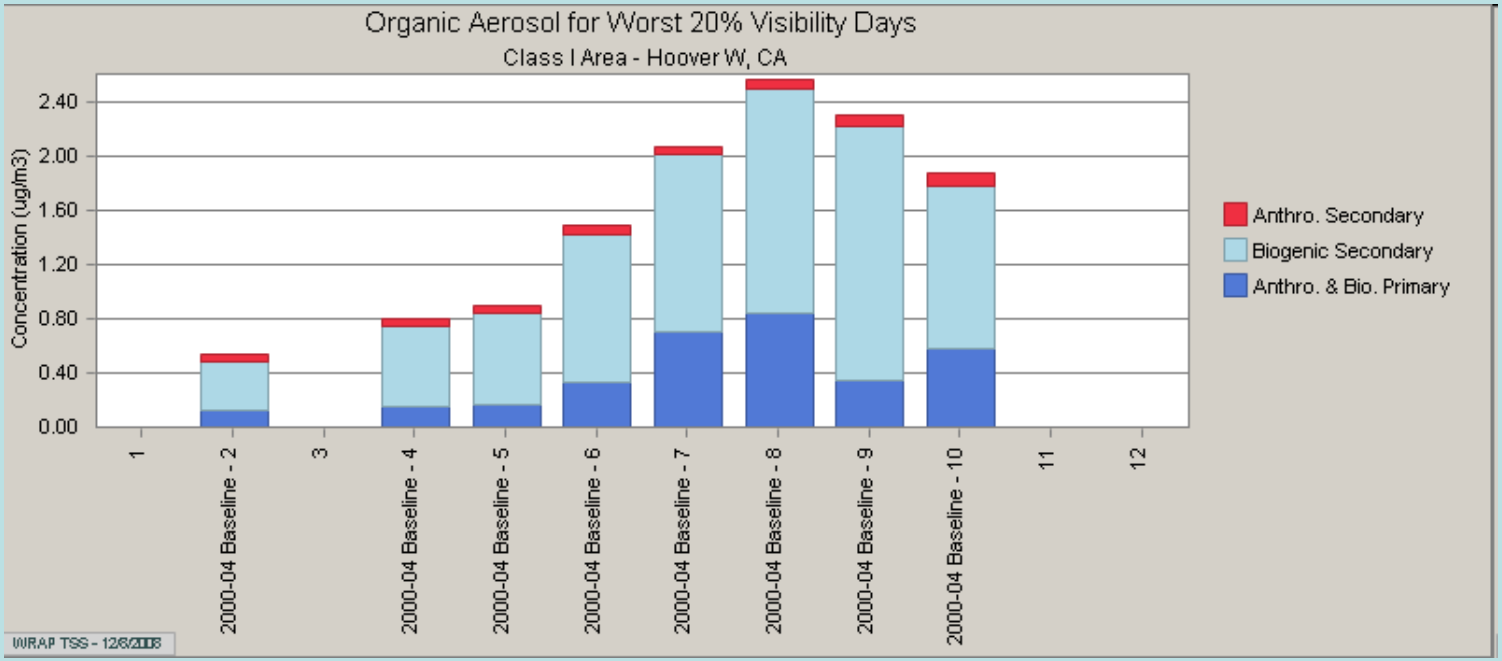
Natural Contributions: Smoke

- Wildfire smoke occurs every year at different susceptible locations
- Creates "spikes" of very high Organic Carbon readings for many days
- Huge spikes in natural fire season may skew Worst Day averages
- Transport and duration far-reaching

4 days later



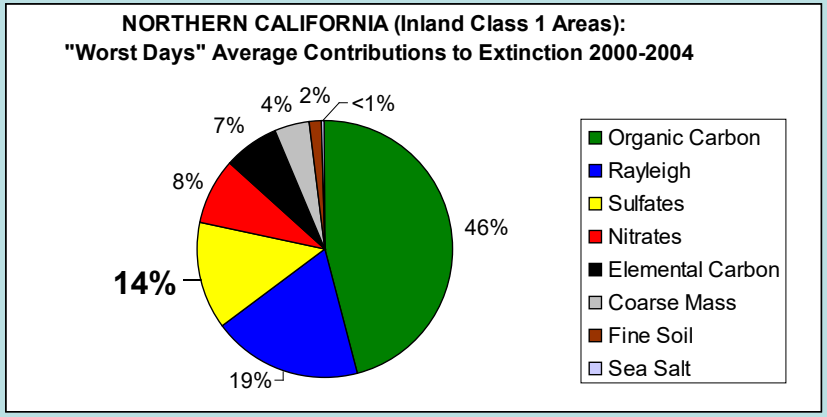
Natural Contributions: Biogenics

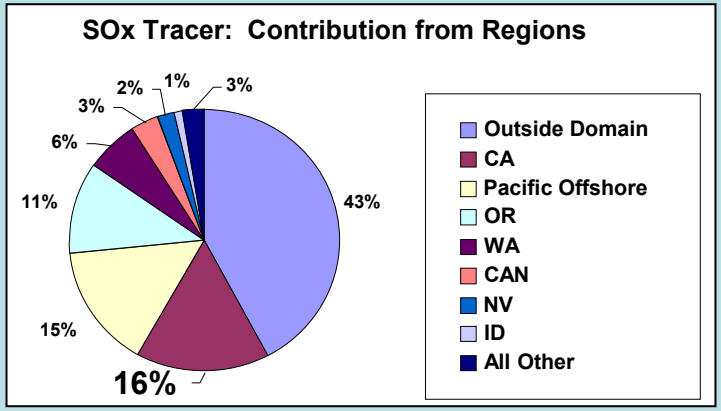


- Biogenic emissions peak in natural growth season (warm months)
- Significant contributor to measured organic carbon at many Class 1 Areas

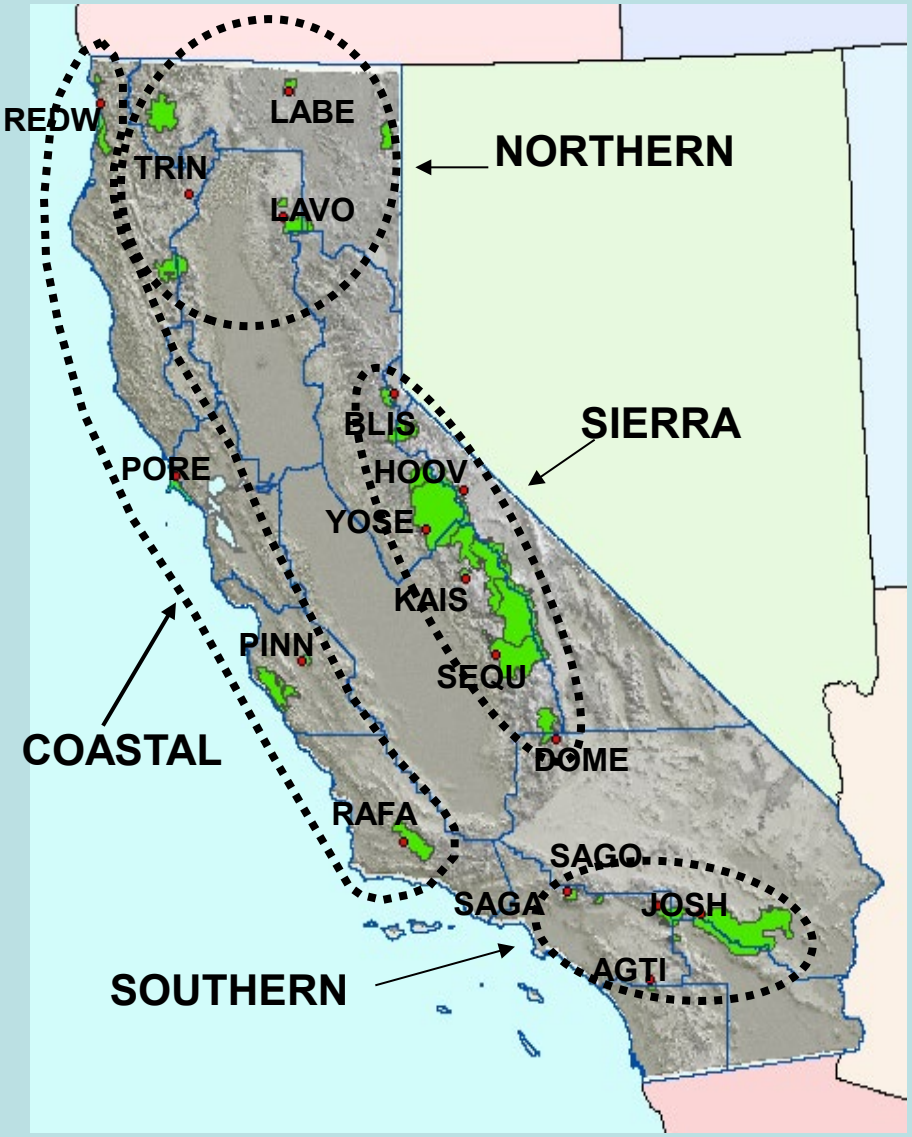
Out-of-State Influences: SOx

- Sulfates are one of the drivers of worst day haze at Class 1 Areas in Northern California, contributing 14% of the light extinction
- Modeling indicates that 84% is from out-of-state SOx sources





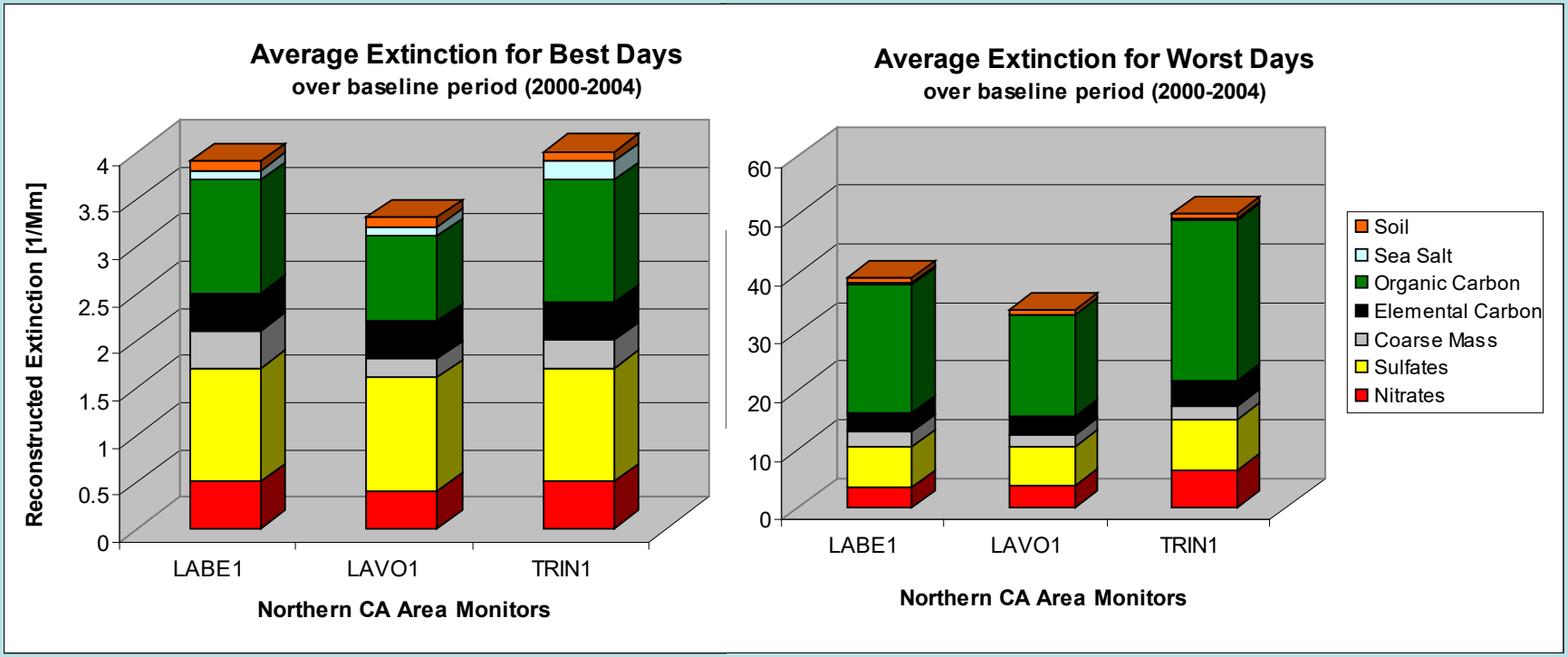
Regional Analysis in California



Four Sub-Regions

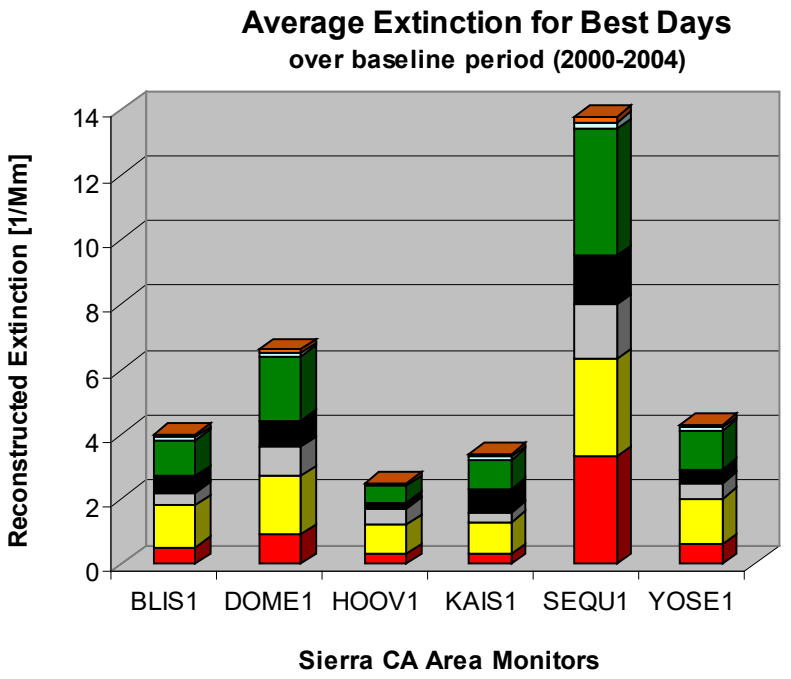
- Common source areas
- Similar pollutant "drivers" on worst days
- Influenced by similar meteorology and climate

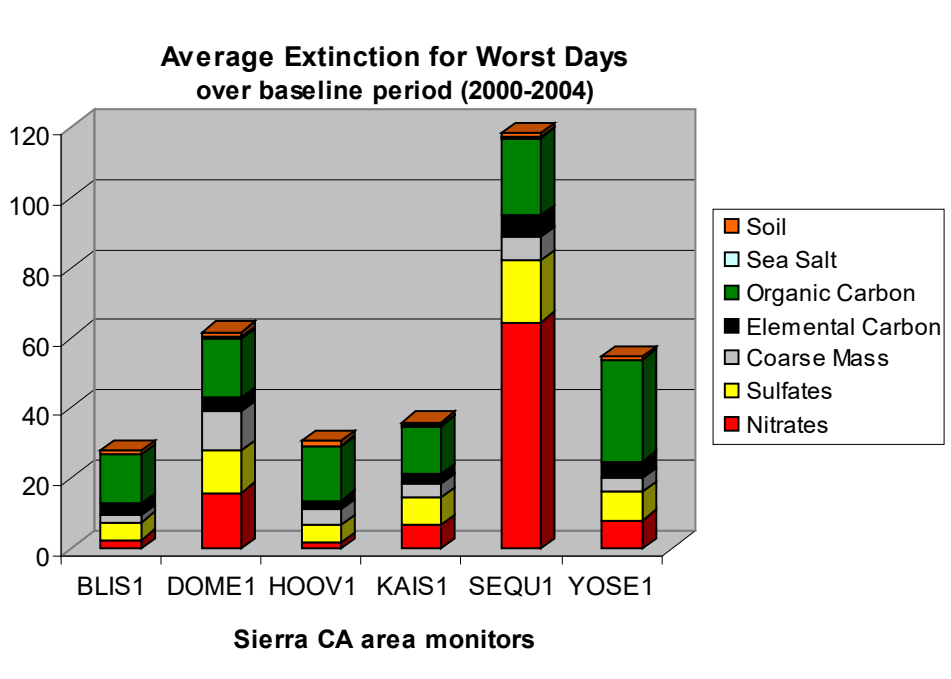
Northern California



- TOTAL light extinction ~ 10 times higher on Worst Days
- Organic Carbon clearly drives Worst Days
- Sulfates contribute more than nitrates on Best and Worst days
- California anthropogenic sources ~10% of light extinction on worst days

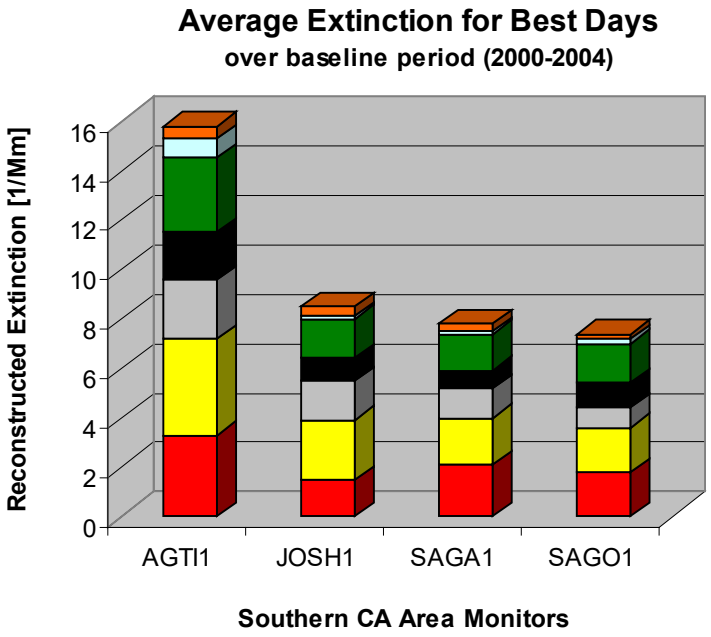
Sierra California

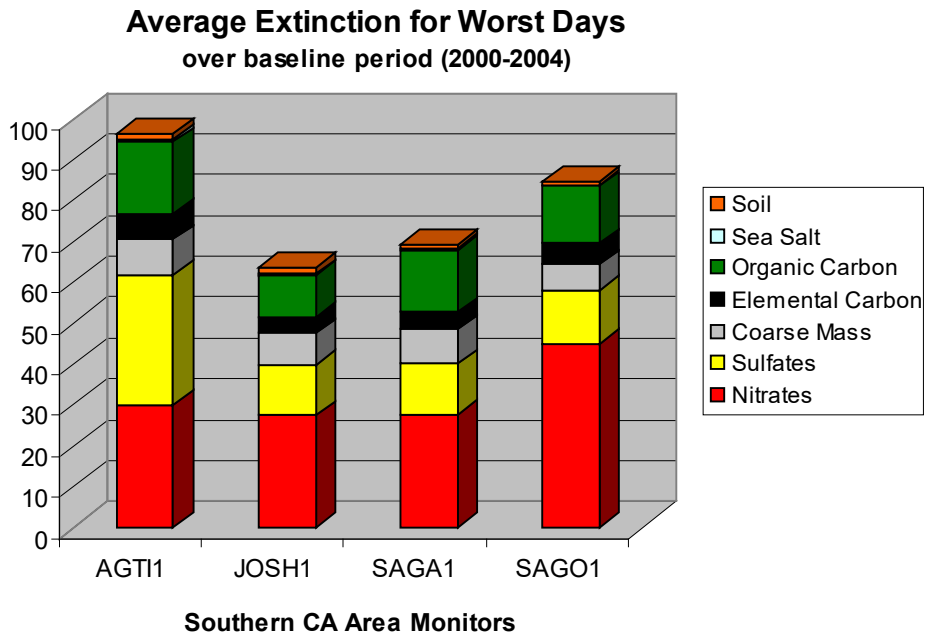




- TOTAL light extinction ~ 6-12 x higher on Worst Days
- Organic Carbon or Nitrates drive worst days
- Coarse Mass and Fine Soil from wind events
- California anthropogenic sources ~15 % of light extinction on worst days

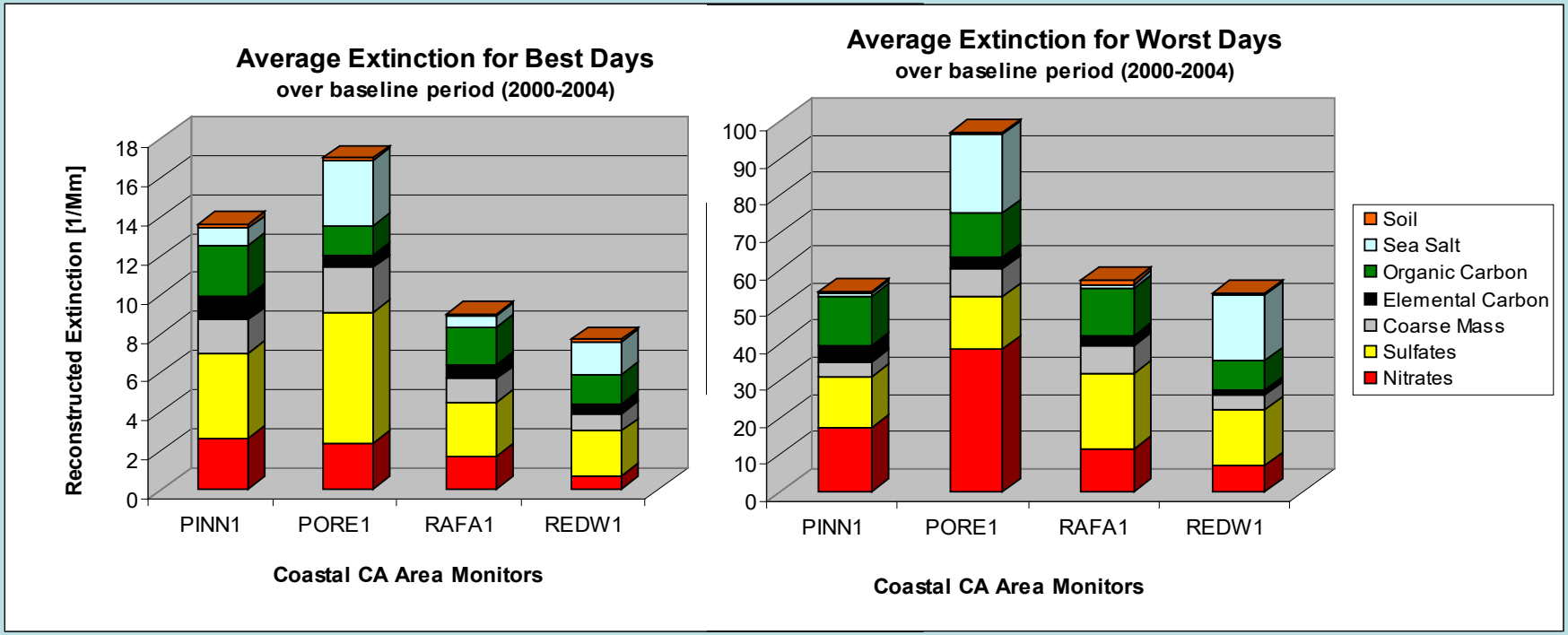
Southern California





- TOTAL light extinction ~6-12 x higher on Worst Days
- Nitrates drive worst days; sulfates and Organic Carbon also have roles
- Coarse Mass and Fine Soil from natural events
- California anthropogenic sources ~40% of light extinction on worst days

Coastal California



- TOTAL light extinction ~ 4-7 x higher on Worst Days
- Sea Salt and Sulfates more influence than elsewhere
- Nitrate very high in winter
- California anthropogenic sources ~ 20-30% of light extinction on worst days

3. California's 2018 Progress Strategy

- California's Control Strategy
- Regional Haze Rule Requirements
- Four-Factor Analysis
- Best Available Retrofit Technology


Joshua Tree National Park


John Muir Wilderness


Yolla Bolly Middle Eel


Point Reyes National Seashore

All photographs from National Park Service or U.S. Forest Service websites

California Programs

Local Control

- Stationary sources controlled by rules of 35 Air Districts
- Regular and Title V permit programs include PSD/NSR
- Incentive Programs

State Control

- State controls on-road & off-road mobile sources
  - California cars 99% cleaner
  - NOx emissions reduced by 40% statewide in 2018
- Diesel Risk Reduction
  - Diesel PM risk will be reduced by 85% in 2020
- Goods Movement
  - $1 billion bond to accelerate clean up by goods movement sources
- Consumer Products
  - VOC emissions from consumer products would be ~ 60% more in 2010 without the program
- Early introduction of Cleaner Fuels
  - Low-sulfur diesel fuel introduced early
- Incentive Programs
  - $170 million invested annually to clean up older sources

Required Strategy Considerations

Construction Activity Mitigation

- Local Fugitive Dust Control Programs
- State Off- and On-Road Vehicle Controls

Source Retirement

- Smog Check Breathe Easier
- Carl Moyer Program

Smoke Management Program

- EPA-Approved Enhanced Smoke Management Program (statewide)
- Class 1 Areas listed as Sensitive Receptors in Smoke Management Plans

Four-Factor Analysis

- **Reasonable progress based on four-factor analysis:**
  - Cost of compliance
  - Time necessary for compliance
  - Energy and non-air quality and environmental impacts
  - Remaining useful life for any affected sources

- **California rulemaking has embodied this four-factor analysis for decades**

Best Available Retrofit Technology

BART Criteria:

- Twenty-six source categories
- Units that came on-line between 1962 and 1977
- Potential to Emit >250 tons per year of haze pollutant precursors

California BART Process:

- 39 facilities with BART-eligible sources
- Sources at 31 facilities already at BART level of control
- Visibility impact modeling for sources at remaining 8
- Only 1 facility had greater than 0.5 deciview impact and required a BART determination

BART Determination

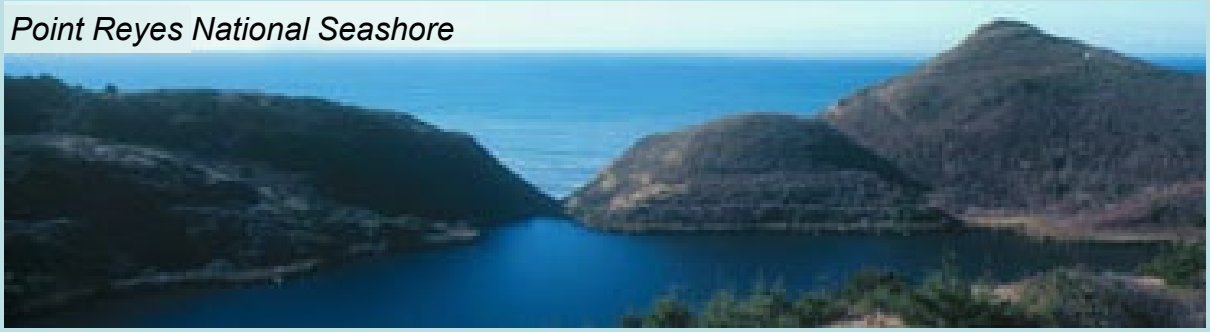
Valero Refinery (Benicia)

- Bay Area Air Quality Management District (BAAQMD) jurisdiction
- Only Point Reyes National Seashore had visibility impact

BART Determination

- New Main Stack to accommodate retrofits and reconstructions
- New SOx Scrubber reduces emissions by over 5000 tons per year
- Coincident reductions of NOx and PM10
- Controls to be implemented by 2012 through BAAQMD permit

Point Reyes National Seashore



4. Reasonable Progress Goals and Looking to the Future

- **Reasonable Progress Goals**
- **Future Planning Needs**
- **California Review Process**
  - Comments on Draft Plan
  - Hearing by the Board
  - Forward to U.S. EPA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California's Reasonable Progress Goals

- WRAP conducted modeling for 2018
- Visibility will improve on Worst Days at all sites
- Visibility will be maintained or improved on Best Days
- Degree of progress varies by haze species:
    - Nitrate progress substantial due to comprehensive NOx controls on mobile sources
    - Organic carbon decreases due to VOC controls, despite large contributions from wildfires and biogenics
    - Sulfates show slight reductions from SOx controls, despite significant impacts from outside California

Rationale for Reasonable Progress Goals

- State programs achieve emission reductions well beyond national level
- Natural sources and sources outside of California cause significant visibility impairment
- Natural condition values are uncertain and may be underestimated
- Future control programs will provide continuing benefits for visibility:
  - PM2.5 and 8-Hour Ozone standards
  - Goods Movement
  - Diesel Risk Reduction
  - Greenhouse Gas Reduction Goals

Lava Beds National Monument

Future Planning Needs

- Continue with regional planning process
- Assess impacts of wildfire smoke and biogenic sources on Natural Conditions
- Work with federal government, states, and international organizations to address international shipping
- Continue ongoing consultation with Federal Land Managers
- Prepare mid-course review and Plan updates


South Warner Wilderness

Plan Review Process

- ARB accepting written comments during next 30 days
- Process for commenting on Plan in notice
- Scheduled for January 2009 Board Hearing
- If adopted by Board, submit to U.S. EPA for approval

California Condor at Pinnacles Wilderness Area

5. Questions & Answers

Email questions to:
sierrarm@calepa.ca.gov

Conference Call Line:
888-790-3420
code 69226

Website: http://www.arb.ca.gov/planning/reghaze/reghaze.htm

Contacts: Tina Suarez-Murias, (916) 323-1495, csuarezm@arb.ca.gov
Sylvia Zulawnick, (916) 324-7163, szulawni@arb.ca.gov

"I am far from the ways and pursuits of man…. I am with Nature in the grandest, most divine of all her earthly dwelling places . . . ."

John Muir, 1869

Back-up Slides

Joshua Tree National Park

HAZE ALGORITHM (*quick tutorial*)

The new equation for calculating TOTAL DAILY EXTINCTION weights the species concentrations measured at the IMPROVE monitors:

***b*Sulfate = 2.2 x f*S*(RH) x [small SO4] + 4.8 x f*L*(RH) x [large SO4]**
***b*Nitrate = 2.4 x f*S*(RH) x [small NO3] + 5.1 x f*L*(RH) x [large NO3]**
***b*Organic Material Carbon = 2.8 x [Small OM] + 6.1 x [Large OM]**
***b*Elemental Carbon = 10 x [EC]**
***b*Fine Soil = 1 x [Fine Soil]**
***b*Sea Salt = 1.7 x f*SS*(RH) [Sea salt]**
***b*Coarse Mass = 0.6 x [CM]**
***b*Rayleigh = (Site Specific factor, related to elevation, ranging from 7+ to 11+ in California)**
***b*Nitric Oxide = 0.33 x [NO2 (ppb)]**

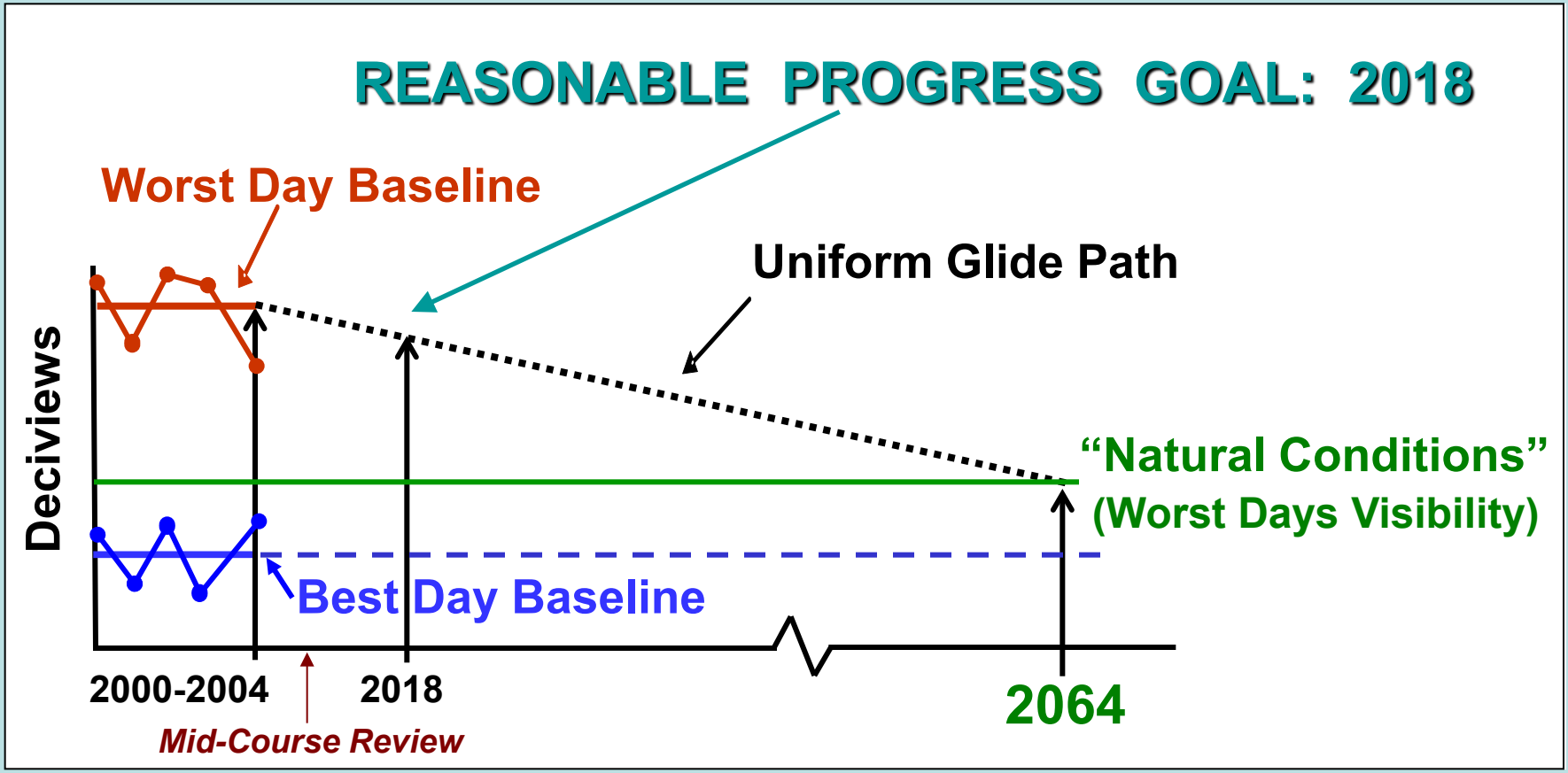
Then, the weighted extinction values are added together to get the total daily extinction or (*b*ext) for each day of measurement:

Total *b*ext = *b*Rayleigh + *b*Sulfate + *b*Nitrate + *b*EC +*b*OMC + *b*Soil + *b*CM + *b*SS + *b*NO2

The total extinction value is then converted by this logarithmic equation to obtain a deciview value:

deciview (dv) = 10 ln (Total *b*ext / 10)

Timeline & Terminology



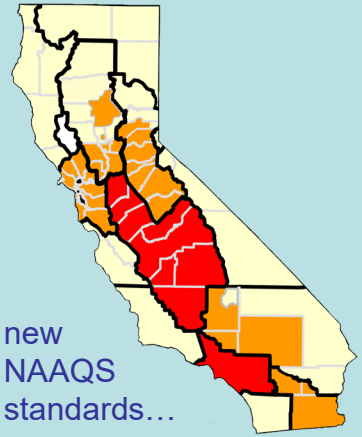
Reasonable Progress Goals

California Class 1 Areas *(Visibility*		Baseline	2018	2018 Worst	2064	Percent	Future Date	Current	2018
IMPROVE Monitor	Class 1 Area(s)	Worst Days	Worst Days RPG	Days URP	Natural Conditions Worst Day	Progress by 2018 towards Natural Conditions	to Reach Natural Conditions at Current Rate	Best Day Conditions	Best Day Projection
NORTHERN CALIFORNIA									
TRIN *(1014 m.)*	Marble Mountain Wilderness Yolla Bolly-Middle Eel Wilderness	17.4	16.4	15.2	7.9	11%	2137	3.4	3.2
LABE *(1460 m.)*	Lava Beds National Monument South Warner Wilderness	15.1	14.4	13.4	7.9	10%	2148	3.2	3
LAVO *(1733 m.)*	Lassen Volcanic National Park Caribou Wilderness Thousand Lakes Wilderness	14.1	13.3	12.6	7.3	12%	2123	2.7	2.5
SIERRA CALIFORNIA									
BLIS *(2131 m.)*	Desolation Wilderness Mokelumne Wilderness	12.6	12.3	11.1	6.1	5%	2307	2.5	2.5
HOOV *(2561 m.)*	Hoover Wilderness	12.9	12.5	11.7	7.7	8%	2186	1.4	1.3
YOSE *(1603 m.)*	Yosemite National Park Emigrant Wilderness	17.6	16.7	15.3	7.6	9%	2160	3.4	3.2
KAIS *(2598 m.)*	Ansel Adams Wilderness Kaiser Wilderness John Muir Wilderness	15.5	14.9	13.6	7.1	7%	2200	2.3	2.1
SEQU *(519 m.)*	Sequoia National Park Kings Canyon National Park	25.4	22.7	21.2	7.7	15%	2096	8.8	8.1
DOME *(927 m.)*	Dome Lands Wilderness	19.4	18.1	16.6	7.5	11%	2132	5.1	4.7
COASTAL CALIFORNIA									
REDW *(244 m.)*	Redwood National Park	18.5	17.8	17.4	13.9	15%	2096	6.1	5.8
PORE *(97 m.)*	Point Reyes National Seashore	22.8	21.3	21.2	15.8	21%	2069	10.5	10.1
PINN *(302 m.)*	Pinnacles Wilderness Ventana Wilderness	18.5	16.7	16	8	17%	2086	8.9	8.1
RAFA *(957 m.)*	San Rafael Wilderness	18.8	17.3	16.2	7.6	13%	2109	6.4	5.8
SOUTHERN CALIFORNIA									
SAGA *(1791 m.)*	San Gabriel Wilderness Cucamonga Wilderness	19.9	17.4	16.9	7	19%	2076	4.8	4.1
SAGO *(1726 m.)*	San Gorgonio Wilderness San Jacinto Wilderness	22.2	19.9	18.7	7.3	15%	2095	5.4	5
AGTI *(508 m.)*	Agua Tibia Wilderness	23.5	21.6	19.8	7.6	12%	2121	9.6	8.9
JOSH *(1235 m.)*	Joshua Tree National Park	19.6	17.9	16.7	7.2	14%	2106	6.1	5.7

2018 Progress Strategy

population growth and climate change…

urban/wildland interface pressures…



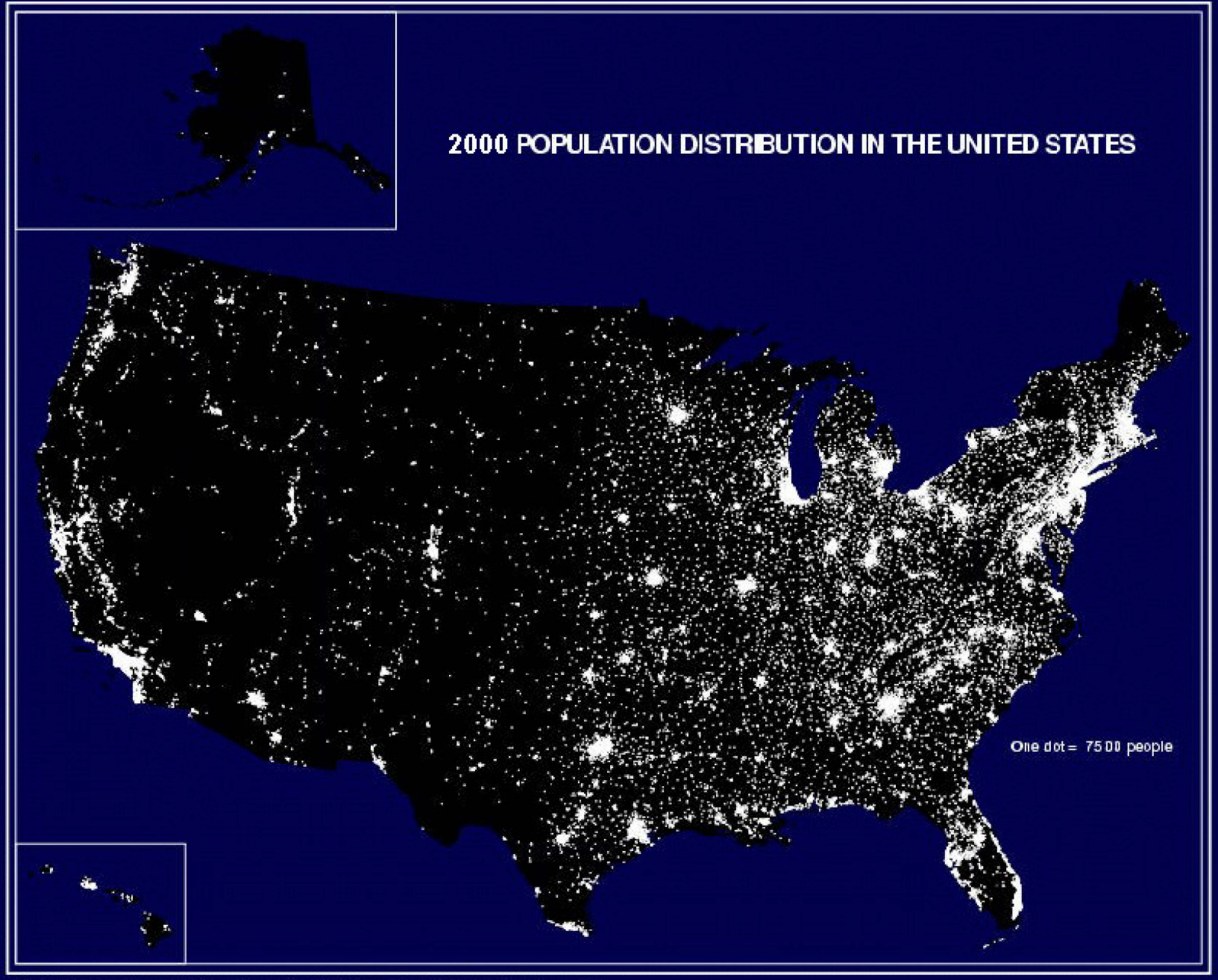
new NAAQS standards…

California Reasonable Progress Goals based on "Long-Term" Strategy for Initial Planning Period

- On-the-Books Ozone/PM controls modeled to give Reasonable Progress Goals for 2018
- Regional Haze Planning Process Requires continual update through Mid-Course Review every five years with Plan Revision every 10 years in future until Natural Conditions achieved

Strategy Building Blocks

- **California's Ongoing Nonattainment Emission Reduction Programs**
  - Federal health-based Standards
  - State health-based Standards
- **On-the-books Controls for PM and Ozone**
- **Regional Haze Rule Requirements**


2000 POPULATION DISTRIBUTION IN THE UNITED STATES
One dot = 7500 people
Prepared by Geography Division U.S. Department of Commerce Economics and Statistics Administration U.S. Census Bureau