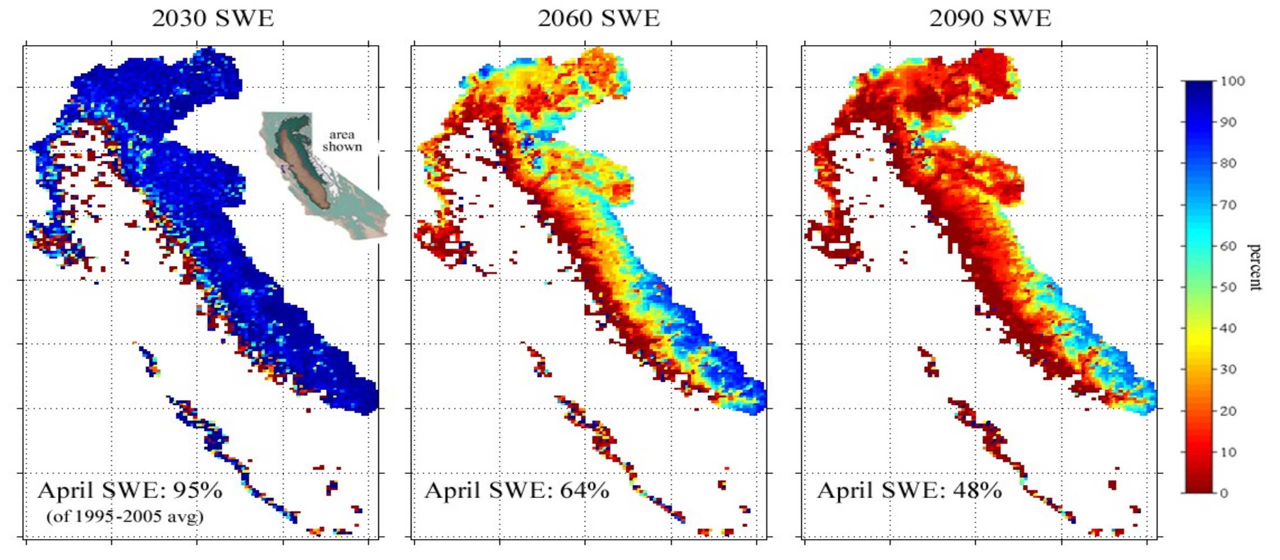
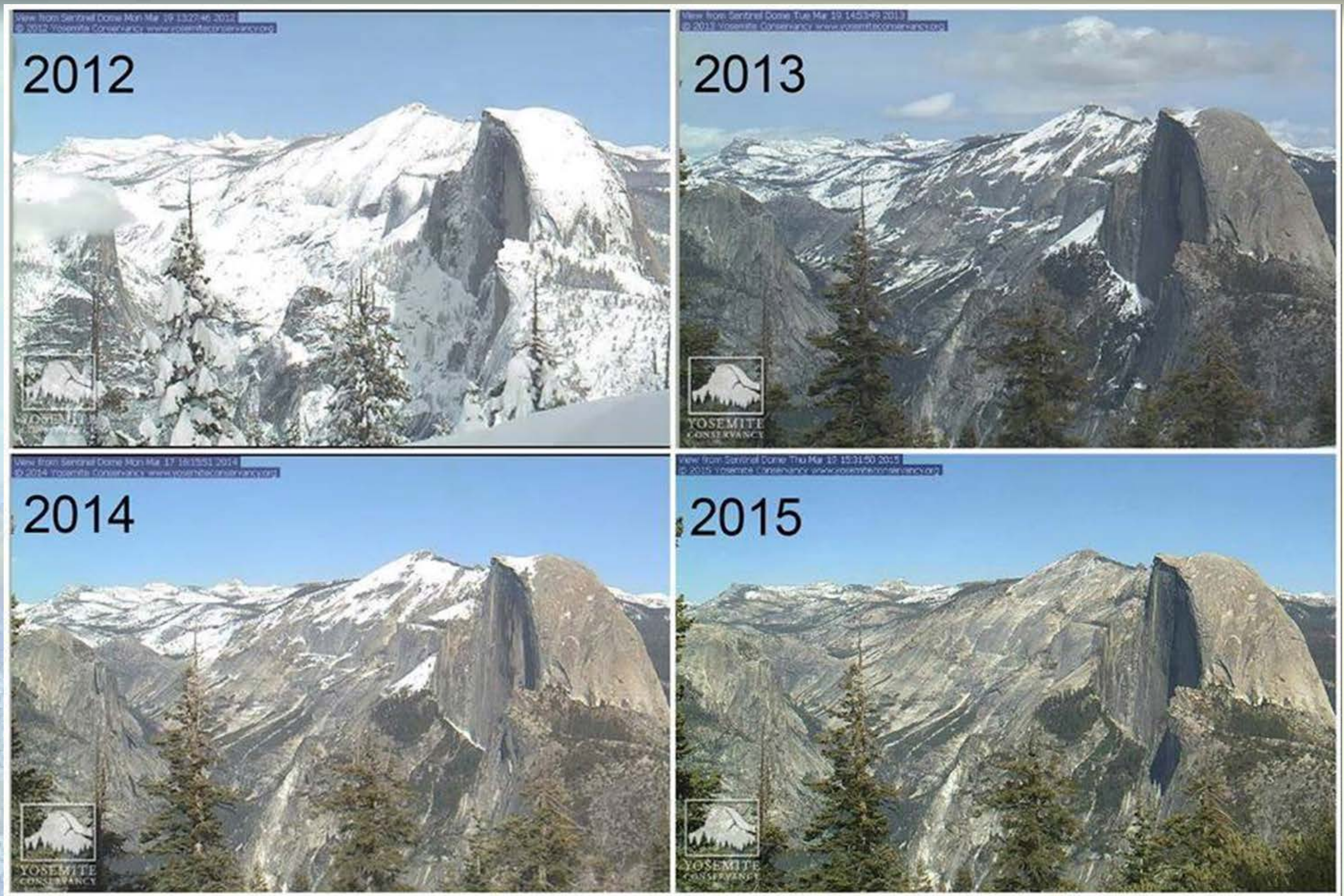
Winter Meteorology: Dispersion Challenges and Opportunities



Joint IASC/CARPA Meeting
Sacramento, May 2015
Dar Mims, Meteorologist
California Air Resources Board

Disclaimer: Positions and views expressed here represent draft guidance and/or staff recommendations and not Agency policy

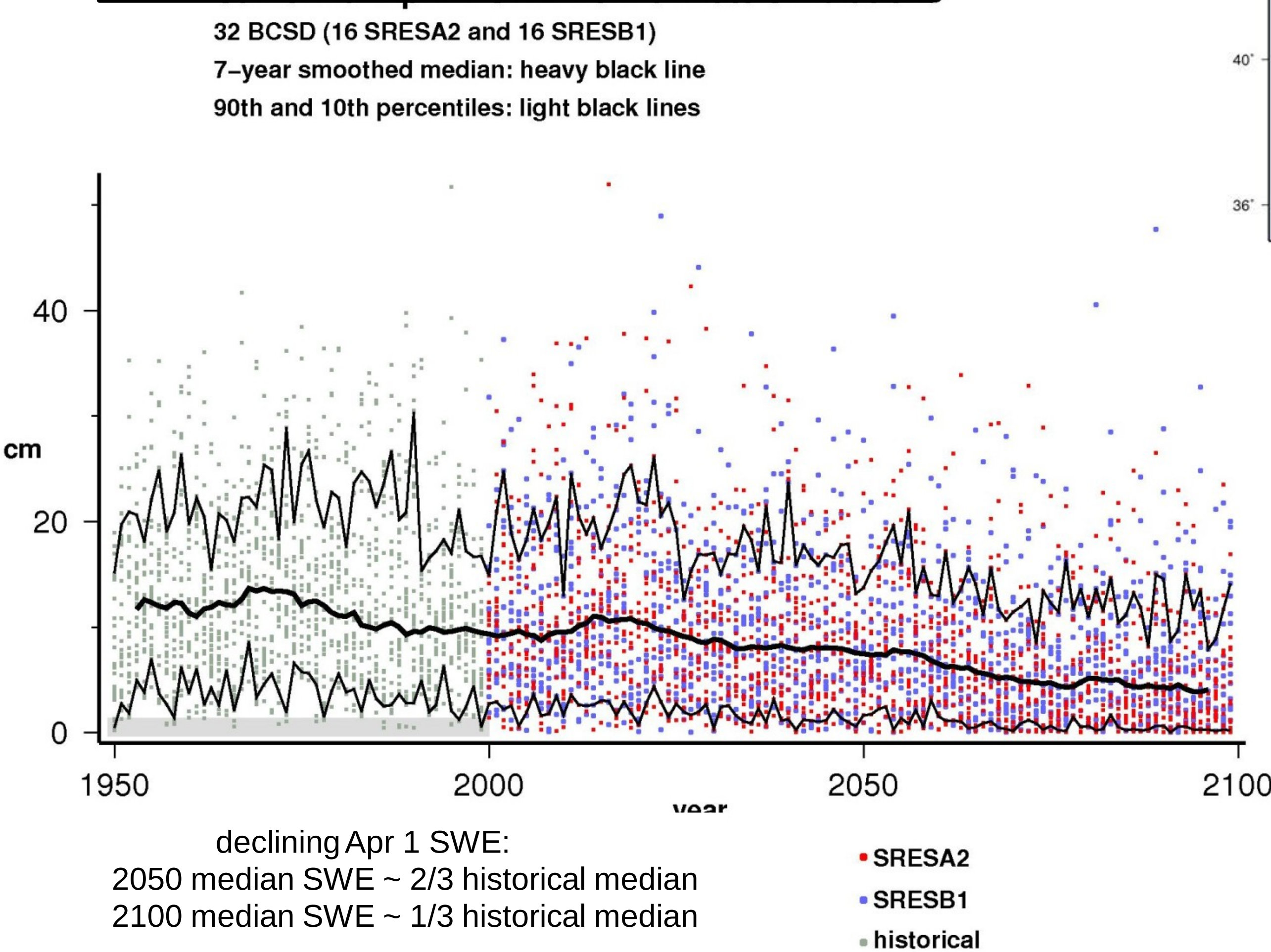
Four years of drought.



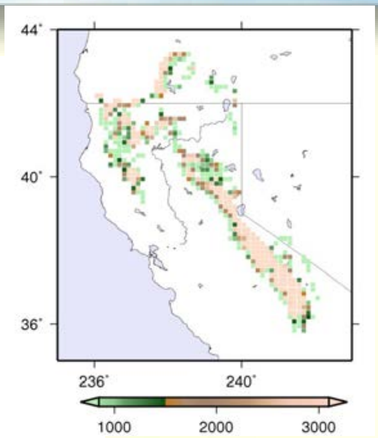
Projected reduction in California's spring snow pack under a warmer climate

VIC model estimates indicate ~25% loss per C°

Sierra Nevada Spring Snow Water Equivalent

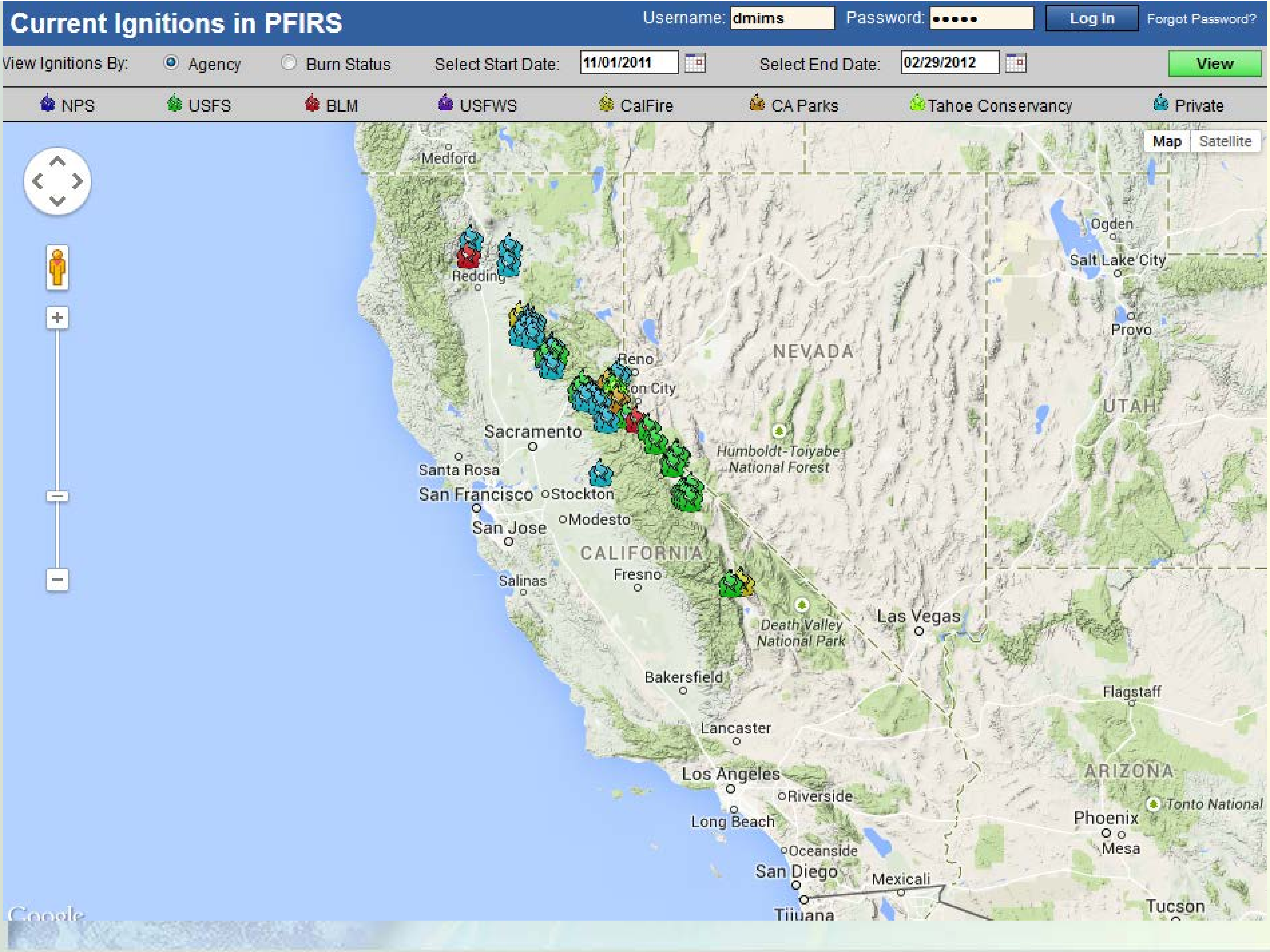


declining Apr 1 SWE:
2050 median SWE ~ 2/3 historical median
2100 median SWE ~ 1/3 historical median



warming-reduction of snow pack will add to water management challenges.

…besides effect on snow, warming will likely increase warm season water demands by humans and ecosystems.



Current Ignitions in PFIRS
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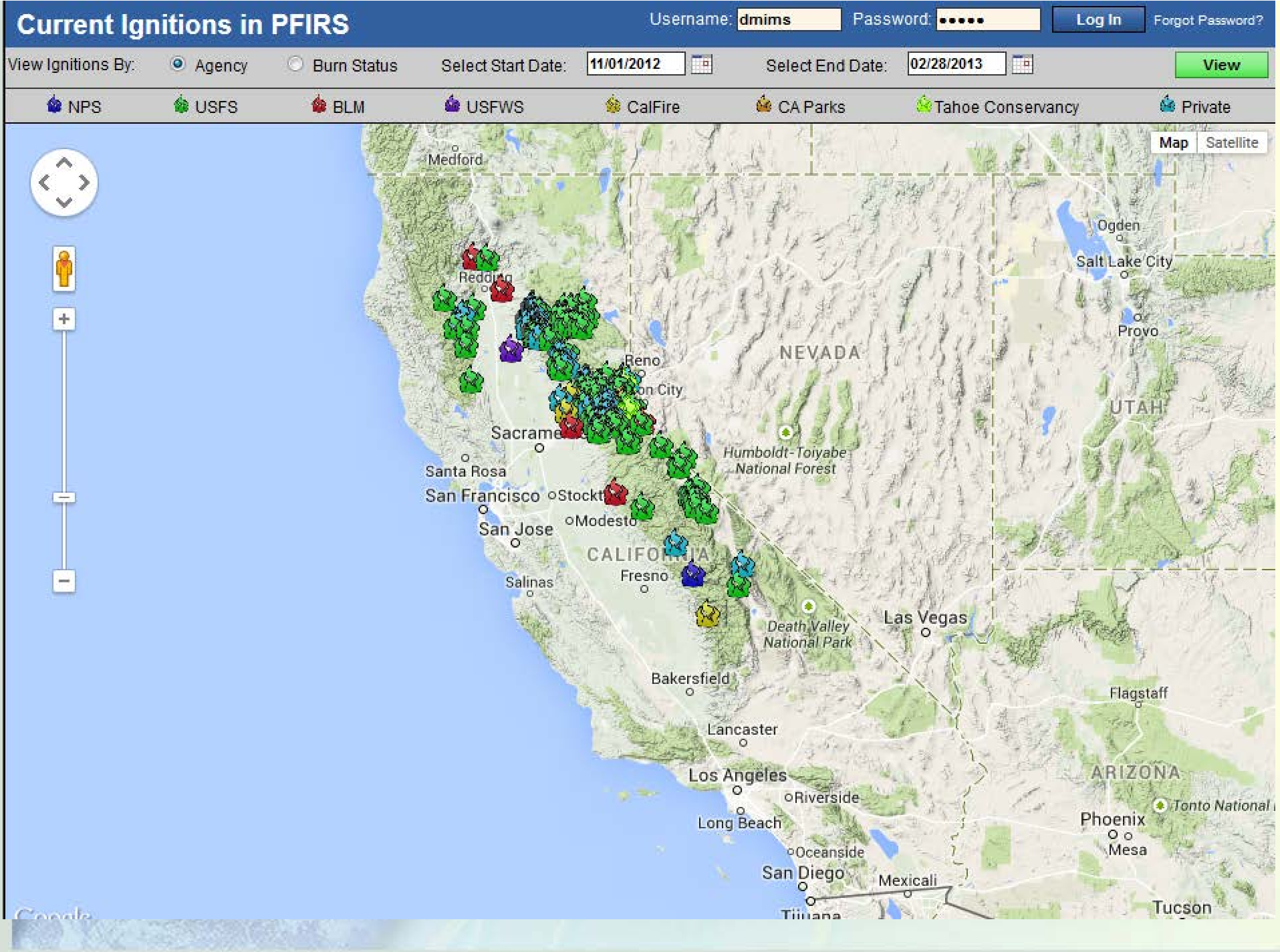
Password:
Log In
Forgot Password?
View Ignitions By:
Agency
Burn Status
Select Start Date: 11/01/2011
Select End Date: 02/29/2012
View
NPS
USFS
BLM
USFWS
CalFire
CA Parks
Tahoe Conservancy
Private
Map
Satellite
Medford
Redding
Reno
NEVADA
UTAH
Ogden
Salt Lake City
Provo
Sacramento
Santa Rosa
San Francisco
Stockton
Modesto
San Jose
CALIFORNIA
Fresno
Salinas
Humboldt-Toiyabe National Forest
Death Valley National Park
Las Vegas
Bakersfield
Lancaster
Flagstaff
ARIZONA
Los Angeles
Riverside
Long Beach
Oceanside
San Diego
Mexicali
Tijuana
Tonto National
Phoenix
Mesa
Tucson
Google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CalFire
CA Parks
Tahoe Conservancy
Private
Map
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Medford
Redding
Reno
Sacramento
Santa Rosa
San Francisco
Stockton
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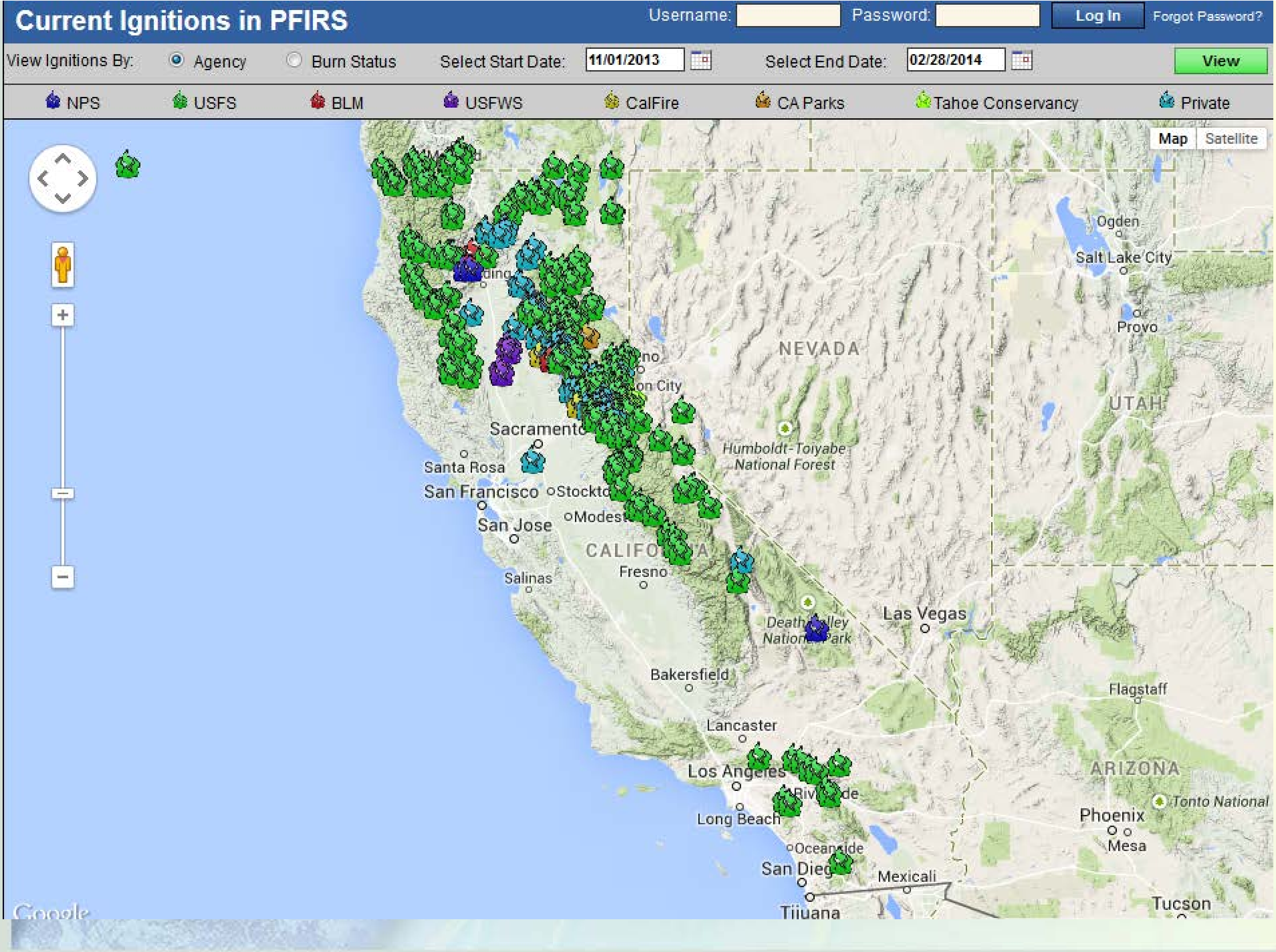

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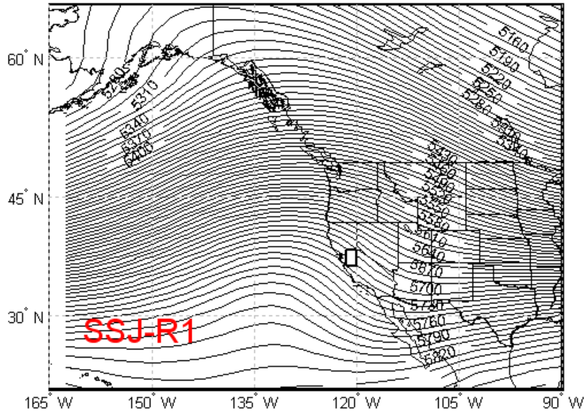
Google

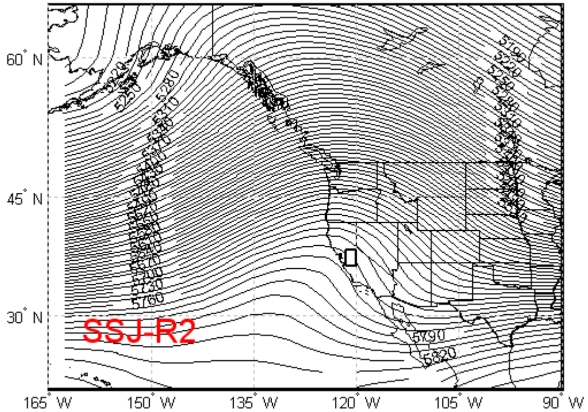
500-hPa geopotential height composites

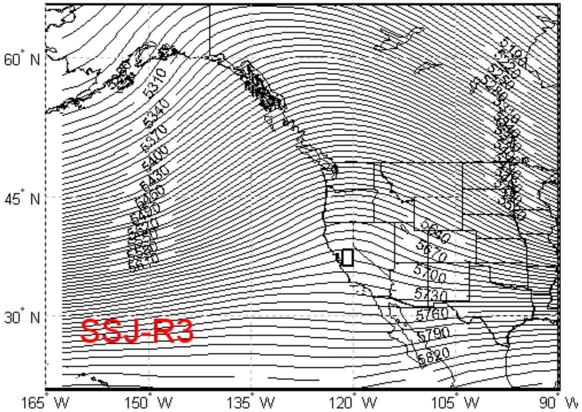
(1999-2007). Winter PM season (November 1 through March 31).

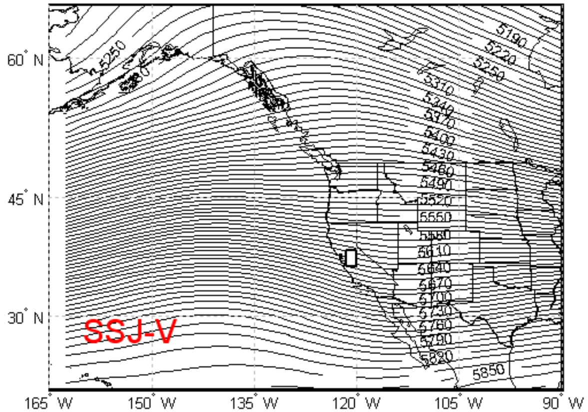
*Singh and Palazoglu 2012

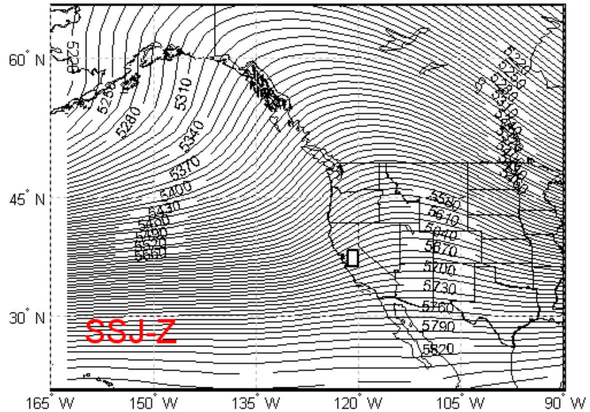
Anticyclonic clusters – SSJ-R1,SSJ-R2 and SSJ-R3 characterized by the aloft ridge.







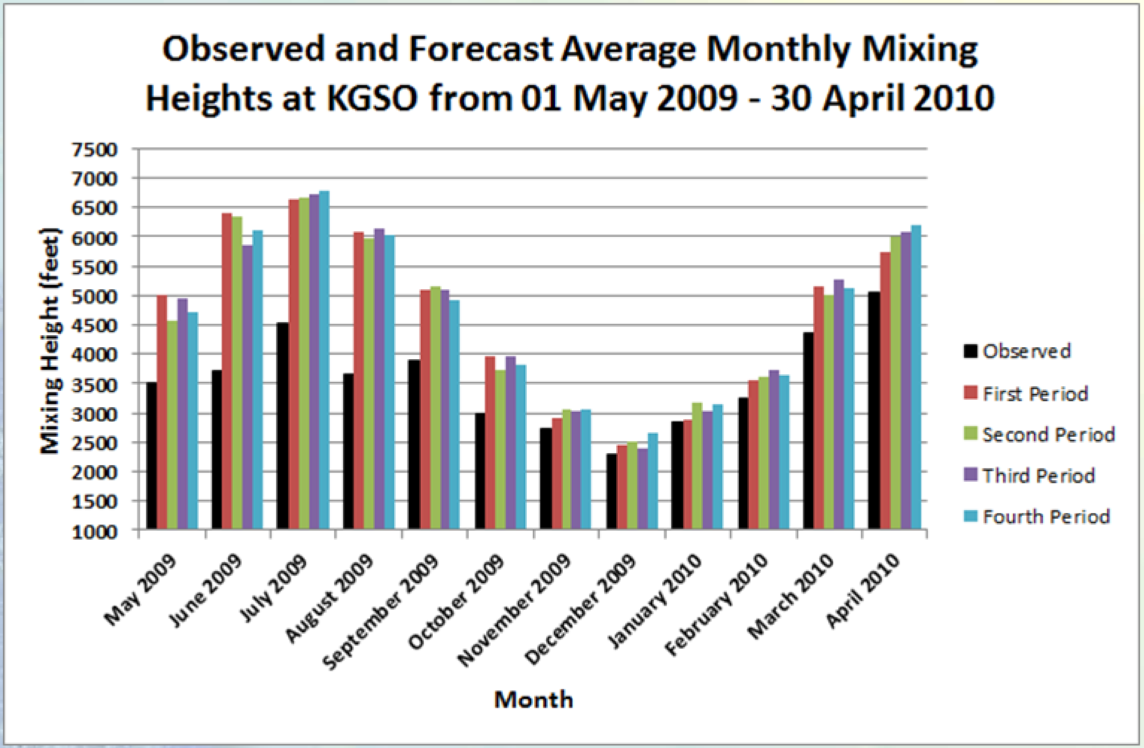




Cyclonic clusters – SSJ-V (trough) and SSJ-Z (storm) characterized by ventilated conditions.

Average Monthly Mixing Heights

The average monthly observed mixing heights during this one year period were greatest in April and smallest in December. This is similar to Garrett (1981) which showed a max in March and April and a minimum in December and January.



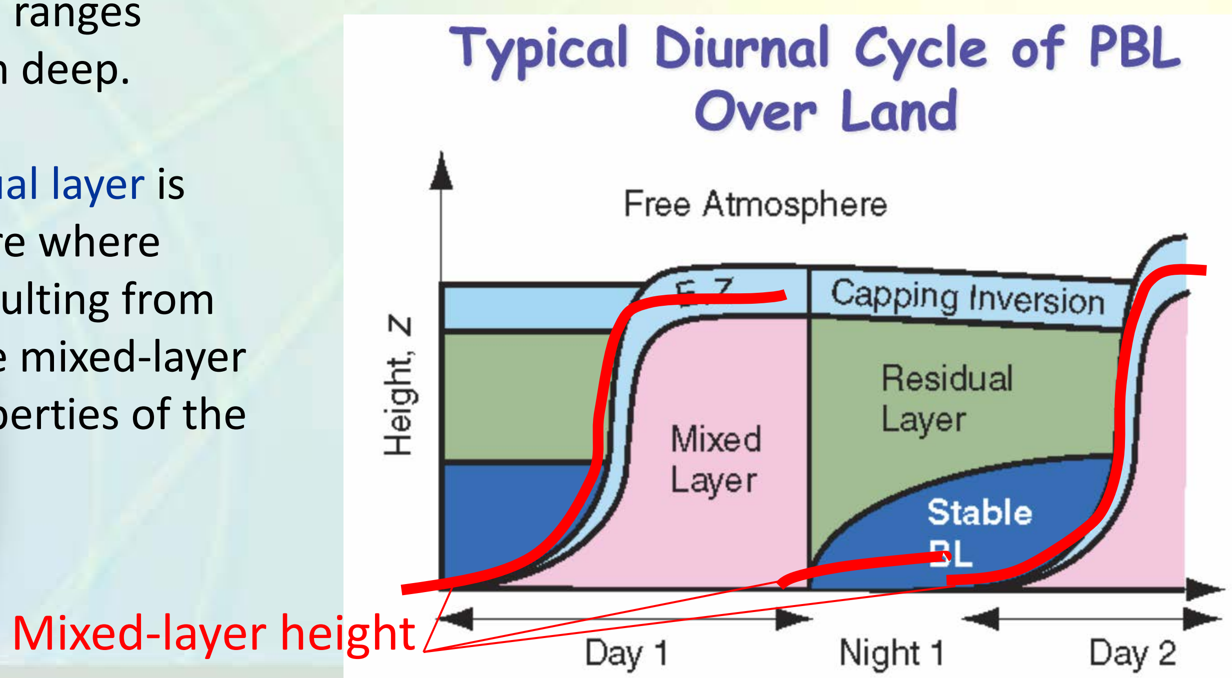
*Blaes , Badgett 2012: Improving Methods to Forecast Mixing Heights at the NWS Raleigh

The planetary boundary layer or mixed-layer consists of three major parts

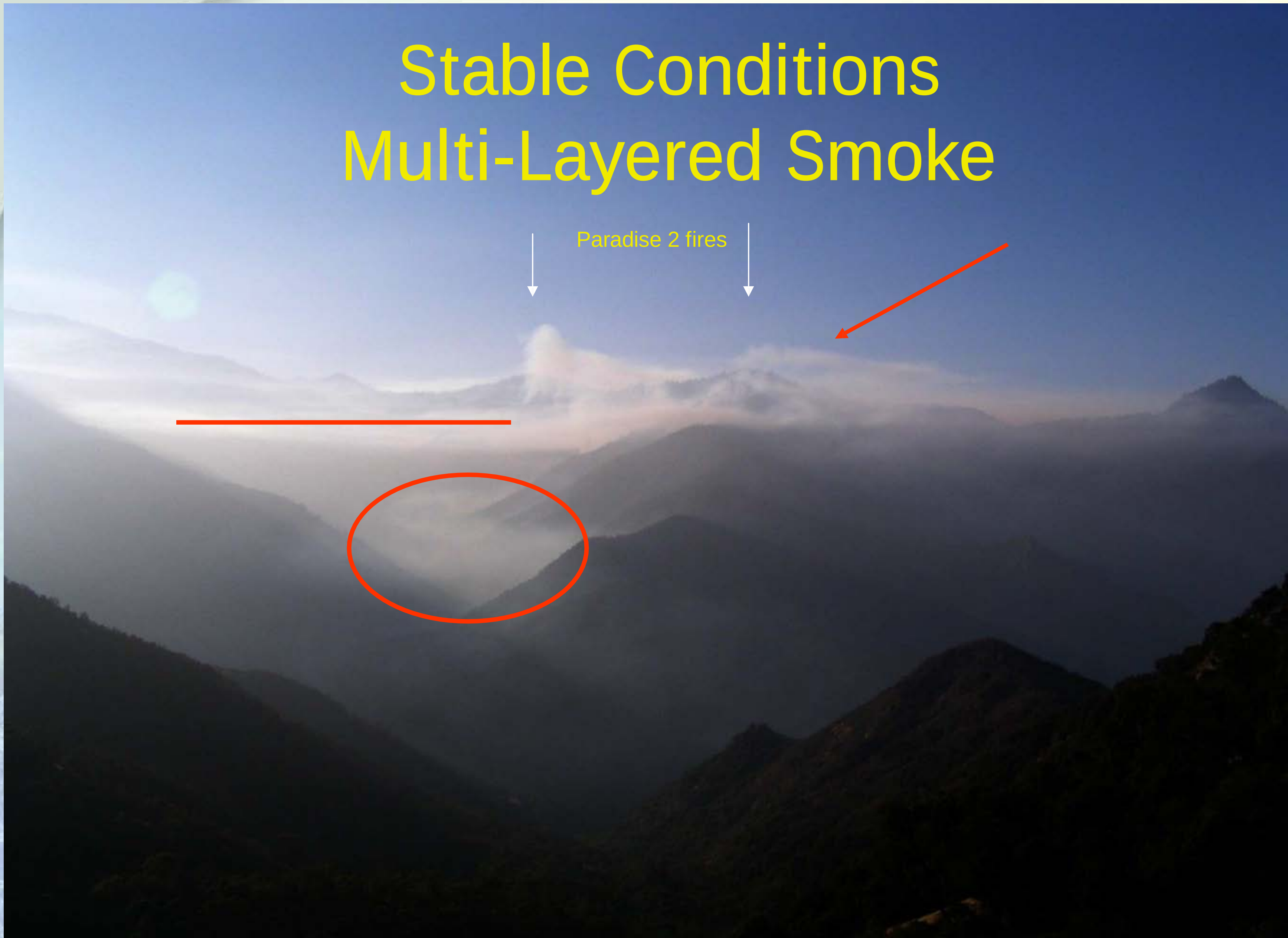
Convective mixed layer *Unstable conditions* with strong upward heat flux (typically during the day) from the surface and low wind speeds, the planetary boundary layer is associated with convective mixing. The depth of the mixed layer typically ranges from 1-3 km.

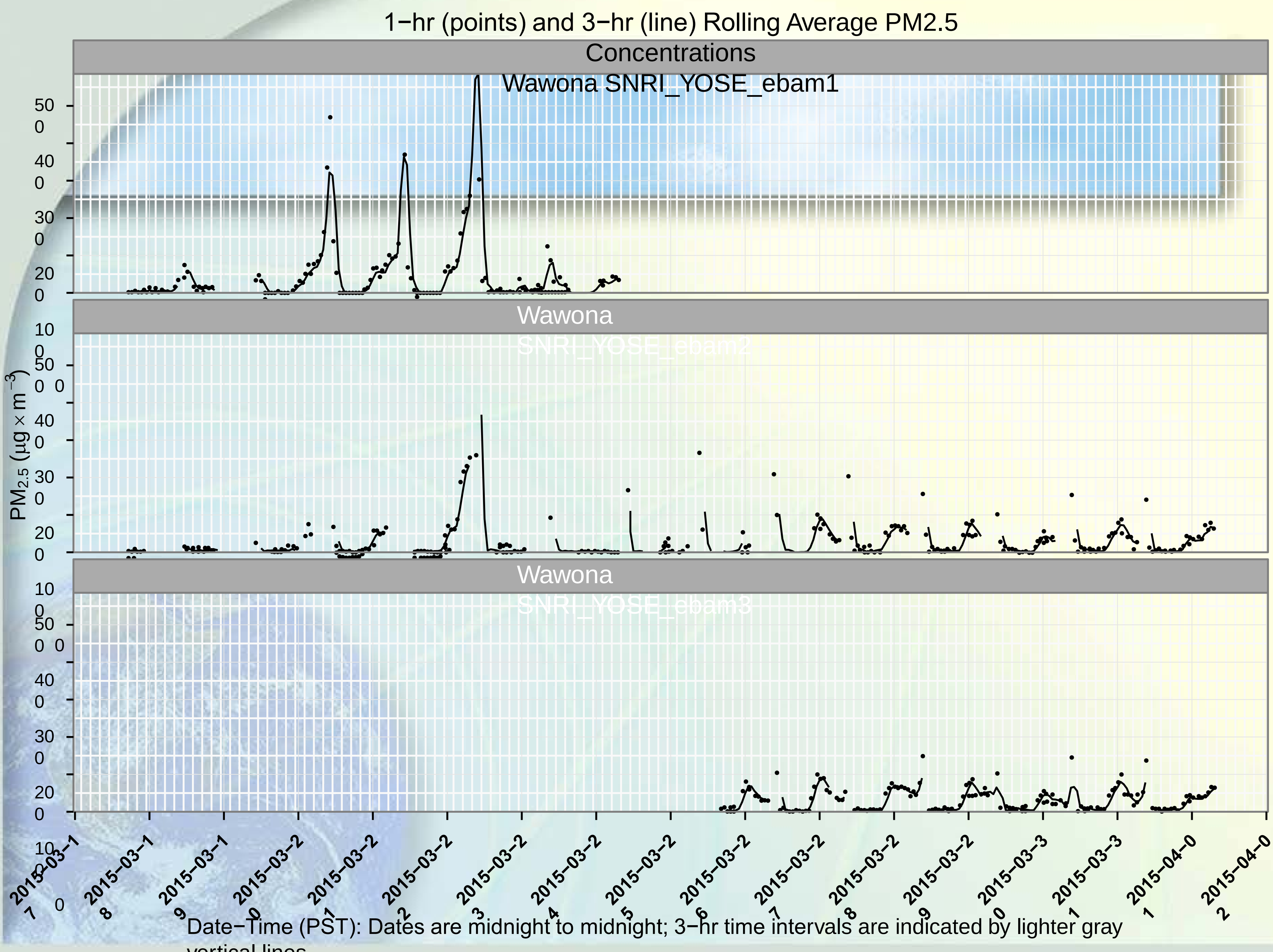
Nocturnal stable boundary layer - Radiational cooling of the air just above surface tends to create a low level inversion with relatively 'stable' conditions. The depth of the stable boundary layer and ranges from about 10 m to 500 m deep.

Residual layer - The residual layer is the part of the atmosphere where mixing still takes place resulting from the left-over of convective mixed-layer (CML) and has all the properties of the recently decayed CML.

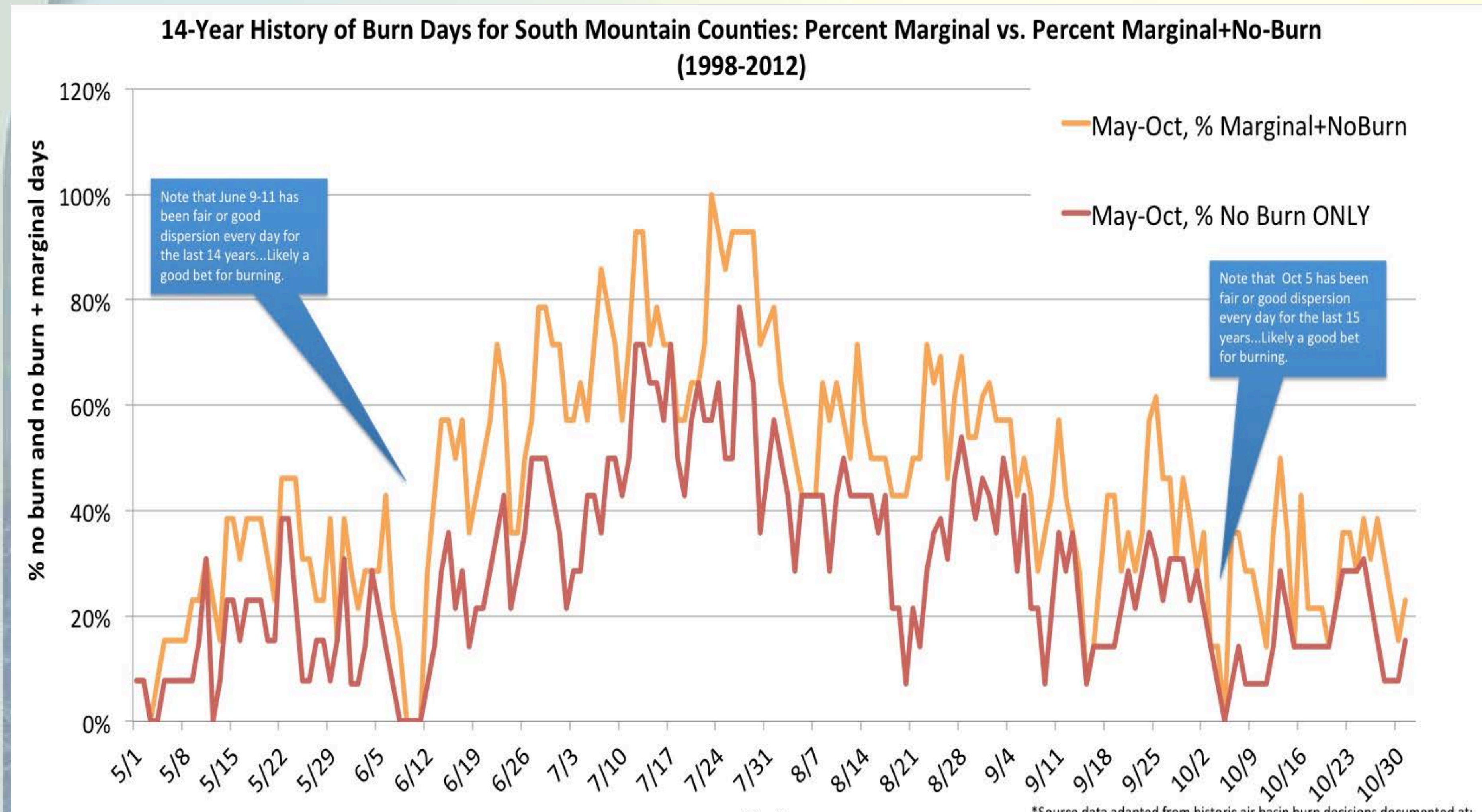


Stable Conditions
Multi-Layered Smoke




1−hr (points) and 3−hr (line) Rolling Average PM2.5 Concentrations
Wawona SNRI_YOSE_ebam1
Wawona SNRI_YOSE_ebam2
Wawona SNRI_YOSE_ebam3
PM2.5 (µg × m−3)
0
20
30
40
50
2015−03−1 7
2015−03−1 8
2015−03−1 9
2015−03−2 0
2015−03−2 1
2015−03−2 2
2015−03−2 3
2015−03−2 4
2015−03−2 5
2015−03−2 6
2015−03−2 7
2015−03−2 8
2015−03−2 9
2015−03−3 0
2015−03−3 1
2015−04−0 1
2015−04−0 2
Date−Time (PST): Dates are midnight to midnight; 3−hr time intervals are indicated by lighter gray vertical lines

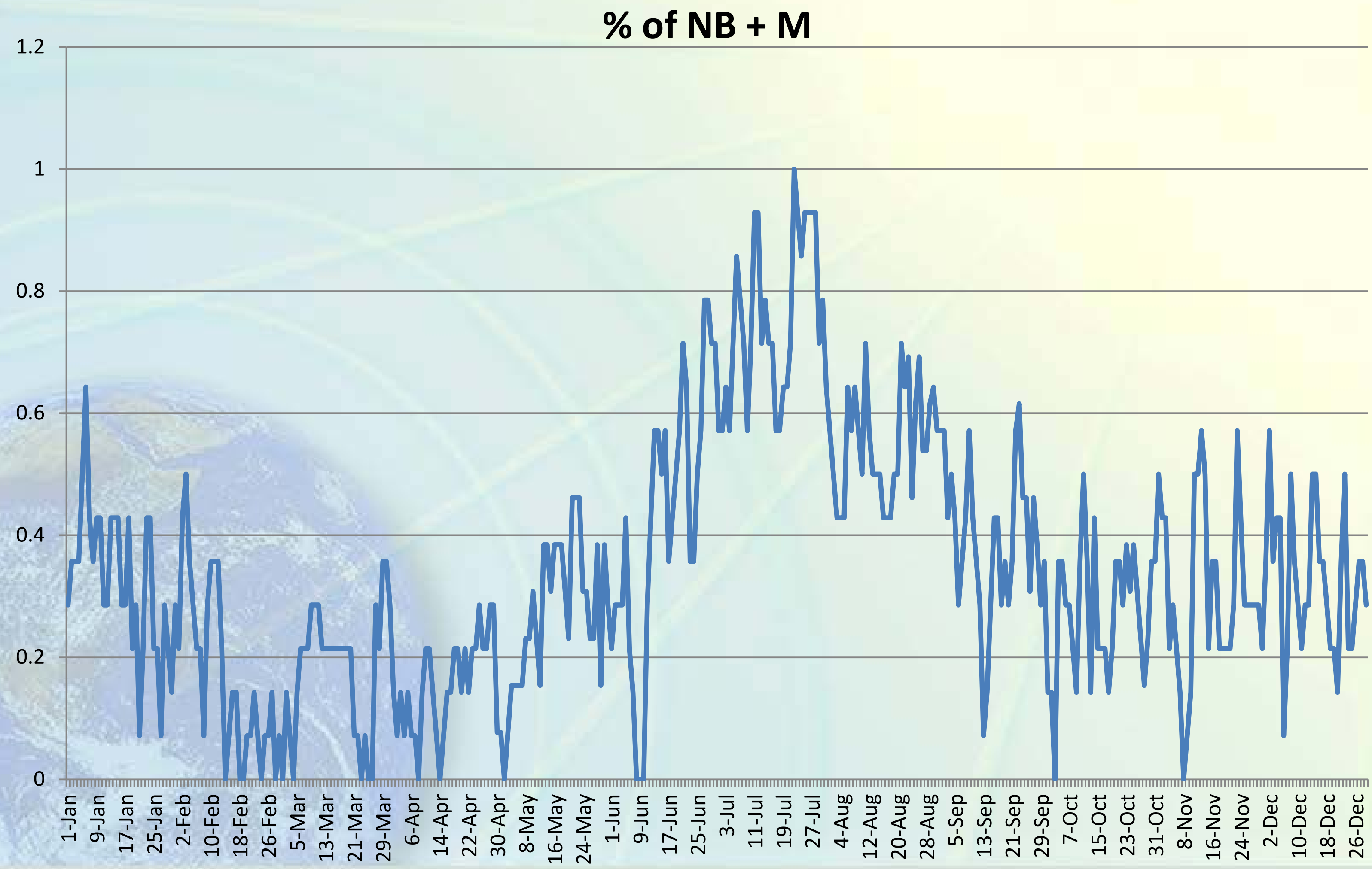
Tarnay's No Burn Day Statistics



*Source data adapted from historic air basin burn decisions documented at: http://www.arb.ca.gov/smp/histor/histor.htm

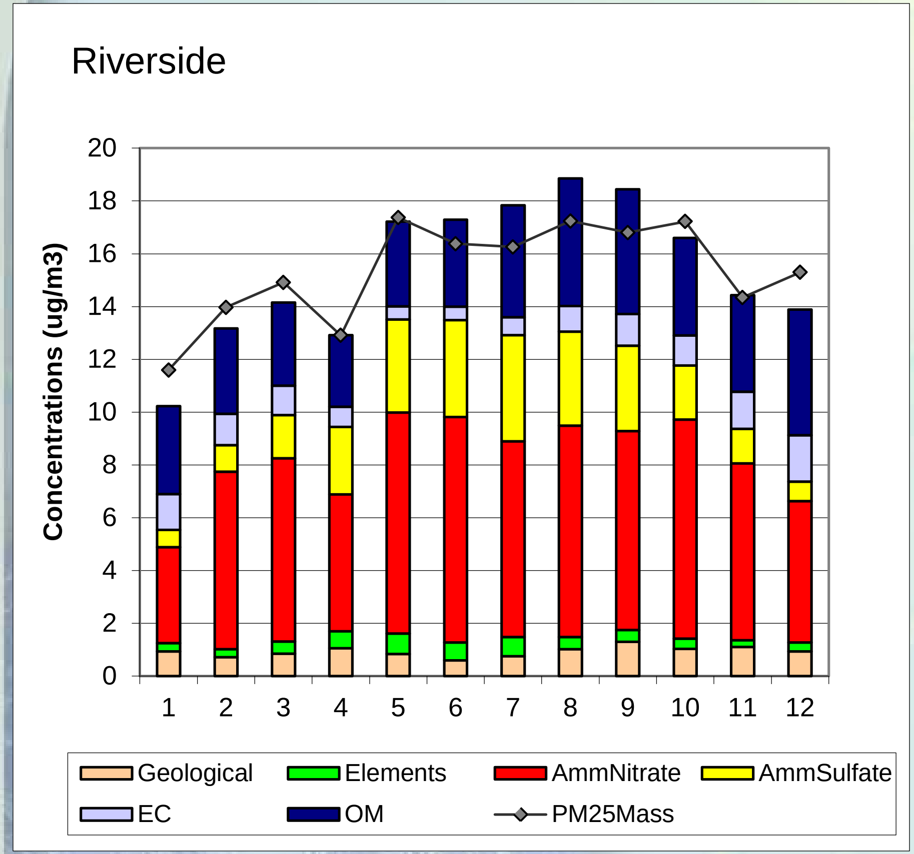
Tarnay's No Burn Day Statistics Extended

14 Year History in South Mountain Counties extended into Winter

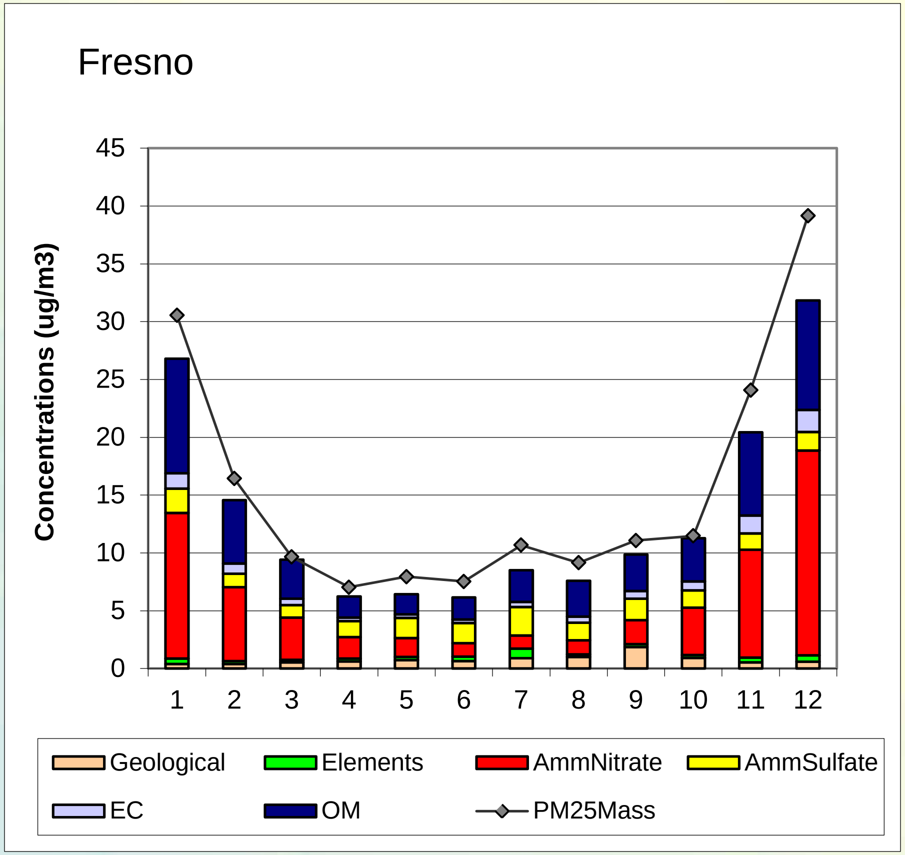


Seasonal Variation in PM2.5 Components

Los Angeles Area



San Joaquin Valley



EPA Sanctions

- Poor progress or un-approvable plan may result in EPA actions including:
  - Federal Implementation Plan (EPA controls steps toward attainment, loss of local control)
  - De-facto ban on new or expanding facilities
  - Sanctions (highway funds)
  - Section 185 fees
  - Failure to meet the ozone standard resulted in ~$29 MM fines to SJ
- Examples include SCAQMD 1982, Maricopa County, AZ 1994, Atlanta, Georgia 2002, New Mexico 2011, SJ 2011

Important Considerations

- Slope, Aspect and Fuels – Matter even more in winter
- How much – Limit the amount proportional to the dispersion
- Why – How important is this burn?
- More reliance on technical tools (Bluesky, CANSAC, etc)
- Need to work together to avoid the impacts - SMP