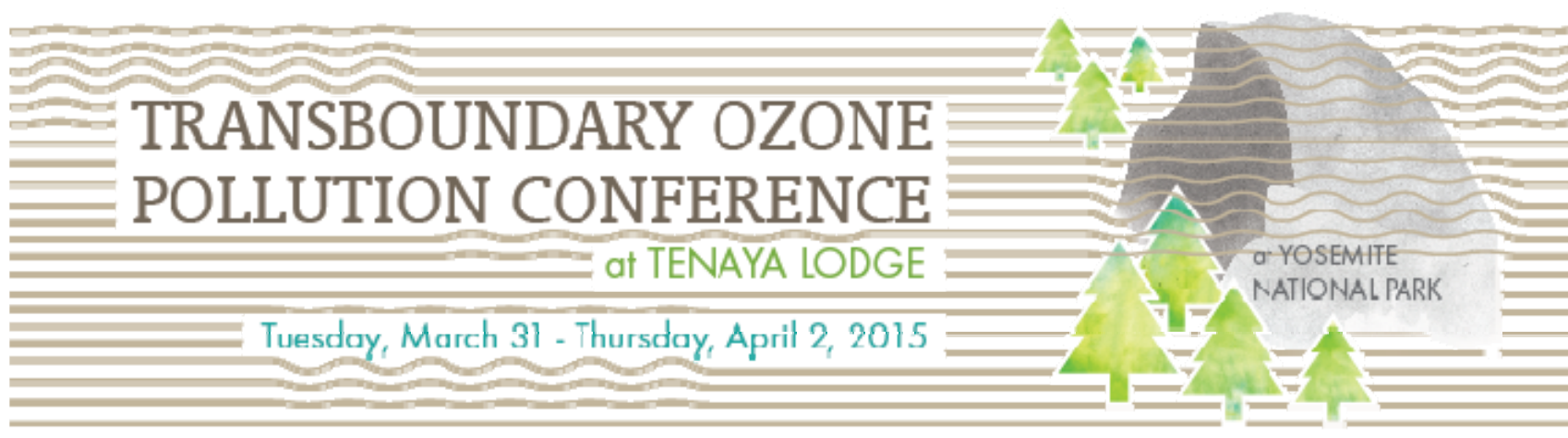


Messages from the March 31- April 2, 2015 Transboundary Ozone Pollution Conference



Lance Avey
Utah Division of Air Quality

2015 Transboundary Ozone Pollution Conference

- **Hosted by the San Joaquin Valley Air District and NASA's Air Quality Applied Science Team**
- **March 31 – April 2, 2015 at Yosemite National Park**

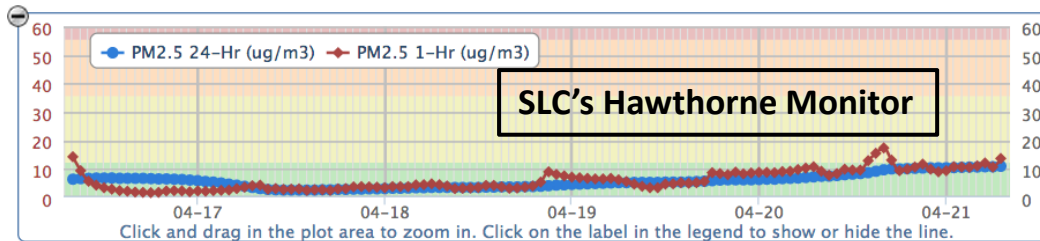
In-depth look at transboundary anthropogenic ozone (TAO) and its effect on the Western United States

- **Observations and Trends**
- **Global Modeling**
- **Nested and Mesh Modeling**
- **Remote Sensing (satellite and surface based)**
- **Policy and Air Quality Management**

Transboundary Ozone Pollution Conference

“Background” Ozone: ozone formed by processes that cannot be impacted by local controls

- Stratospheric transport
- Natural: biogenic, wildfire, lightning
- Global Methane Background
- **Non U.S. Anthropogenic – Transboundary Anthropogenic Ozone (TAO)**



Salt Lake City – Smoke From Russian Wildfires (April 2015)



Images courtesy of:
<http://wasatchweatherweenies.blogspot.com>

Transboundary Ozone Pollution Conference Speakers

- *Owen Cooper, NOAA*
- David Parrish, University of Colorado/CIRES
- Ian Faloon, UC-Davis
- Daniel Jacob, Harvard and NASA Air Quality Applied Science Team Chair
- Lin Zhang, Peking University
- *Meiyun Lin, Princeton*
- Greg Carmichael, University of Iowa
- Jerome Fast, PNNL
- *Gabriele Pfister, NCAR*
- *Brad Pierce, NOAA*
- *Chris Emery, ENVIRON*
- *Tom Moore, WRAP*
- *Dan Jaffe, University of Washington*
- Kerry Drake, EPA Region 9
- Karen Magliano, CARB

Link to Presentations: <http://www.valleyair.org/topc/presentations.htm>

Transboundary Ozone Pollution Conference

Trends

- **Ozone has been trending down in the Eastern U.S. and trending up in the Western U.S. over the last 20 years**
 - **Especially at rural and higher elevation sites in the West**
 - **Overall U.S. emissions have decreased**
 - **Western Background has increased**
 - **Increasing Asian Emissions (TAO)**
 - **Upward trend in Wildfires**
 - **Global Circulation Patterns (Stratospheric Influence)**
 - **Asia's influence on Western US peaks in springtime when transport pathways are more prominent**

Transboundary Ozone Pollution Conference

Observations

- **How much of the surface ozone can be attributed to ozone originating from the free troposphere?**
- **Mauna Loa and Mt. Bachelor, OR are the only measurement sites of free troposphere air quality in the U.S.**
- **CALNEX/IONS/DISCOVER-AQ Campaigns**
- **Observational campaigns in the Sacramento and San Joaquin Valley targeting the entrainment process from the free atmosphere to surface**
 - **Debate over global models ability to handle the fine-scale processes important to Western US: complex topography, entrainment, marine layer dynamics**
 - **Challenges of observations campaigns**
 - **Expensive, requires measurements of numerous chemical species (both airborne and surface)**
 - **Even with a lot of measurements, tough to say how much ozone is from TAO or locally produced**

Transboundary Ozone Pollution Conference

Modeling of Long-Range Transport

- **Global Modeling from GEOS-Chem (Harvard Group) and GFDL's AM3 (Princeton – Meyiun Lin)**
- **Global models show Asian plumes impacting Western US**
 - Modeled Asian plumes often correlate well with satellite observations
- **Asian influence can contribute 5 to 10 ppb**
 - Larger contributions at elevated sites
- **Influence is largest in Intermountain West**
 - High elevation, deep boundary layer mixing
- **GEOS-Chem Modeling indicates that up to half of the ozone from Asia is produced during transport (important to correctly model PAN chemistry)**
- **Important to understand interannual climate variability and its influence on TAO**
 - La Nina years tend to see more stratospheric events of Western US
- **Need more model validation (satellites, observations)**

Transboundary Ozone Pollution Conference

Remote Sensing

- **Current satellites give a nice daily global scale of the certain species (ozone, NO₂)**
 - Good for tracking Asian Transport
 - May be used to constrain Boundary Condition for Regional Models
 - Low vertical resolution, have to look through the stratosphere for ozone
 - Temporal resolution is lacking
- **Surface LIDAR and ceilometers have benefited recent field campaigns**
- **Data assimilation of satellite data into global models shows potential**
- **Future Geostationary satellite observations of air quality (e.g., TEMPO) in the next few years**
 - Air quality plumes will have the potential to be tracked much like current weather satellites track thunderstorm development and movement

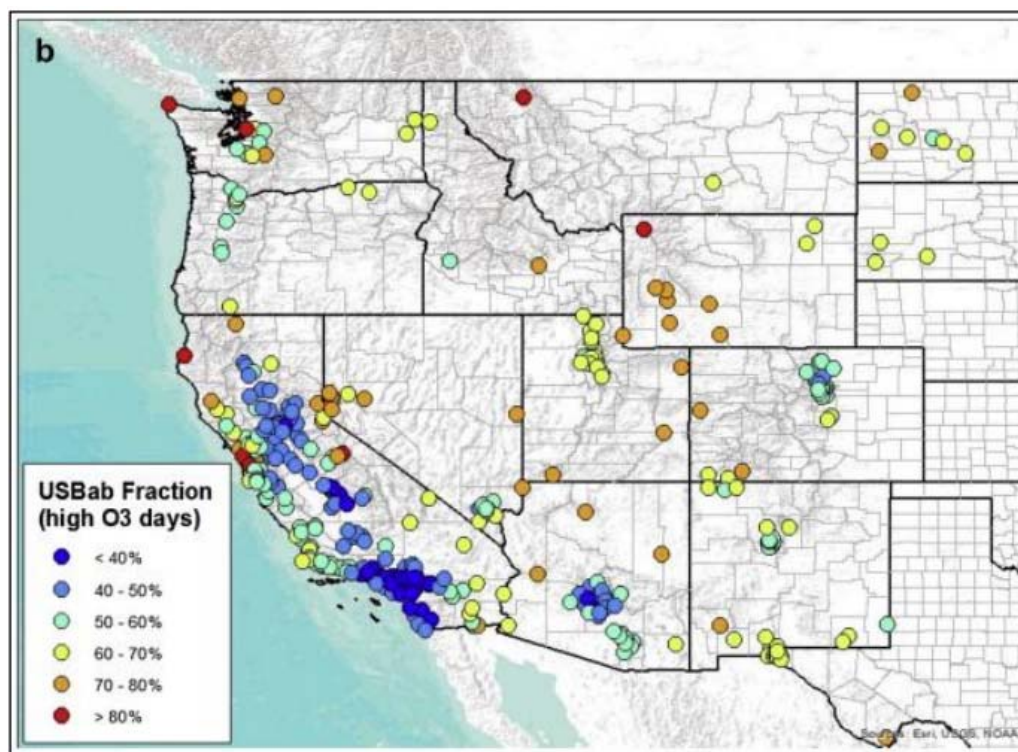
Transboundary Ozone Pollution Conference Policy and Air Quality Management

- **Implications of a lower Ozone NAAQS for the Western U.S.**
 - **Background Ozone becomes even more important**
 - **Need better understanding of TAO, Wildfires, Biogenics, Stratospheric Influence**
 - **Ozone will become a rural problem in the West**
 - **Ozone Season may be extended into Spring and Fall**

Transboundary Ozone Pollution Conference

Policy and Air Quality Management

- **Western US background fraction on high ozone days**
 - TAO has biggest impact in the Spring
 - What about Exceedance Days?
 - EPA modeling (*Dolwick et al, 2015; Atmospheric Environment*)
 - High Background at elevated rural sites and a few urban sites (SLC, Reno)



Transboundary Ozone Pollution Conference

Policy and Air Quality Management

- **Ozone Planning Needs for a Western State (e.g., Utah)**
 - **State Implementation Plans**
 - **Typical Urban Ozone**
 - **Rural Ozone**
 - **Wintertime Ozone**
 - **Transport**
 - **Demonstrations**
 - **Stratospheric Intrusions**
 - **Wildfires**
 - **TAO**
 - **Rural Transport Area**

**Does a State have the resources to complete all of the modeling and data analysis?
Especially if all Ozone SIPs may be due at same time
Ultimately, Utah wants to be confident that it implements solutions that work**

Transboundary Ozone Pollution Conference

A Utah Perspective

- **Ozone Planning Needs for a Western State – Difficulty with limited resources**
 - **Photochemical Modeling**
 - **Wildfire inventories – guessing most high ozone seasons were also high fire years**
 - **Boundary conditions from Global and Regional Modeling**
 - **Biogenic Modeling**
 - **Demonstrations**
 - **Stratospheric**
 - **WESTAR's Ozone B&T Working Group has had success**
 - **Wildfires**
 - **UW's Statistical Model**
 - **TAO?**