(Slide) My name is Sam Oltmans and I am a Research Associate at the Cooperative Institute for Research in the Environmental Sciences at the University of Colorado in Boulder. I am speaking on my own behalf.

Thank you for this opportunity to present recent developments, both from an observational and modeling perspective, in our understanding of background ozone and its relevance in determining an ozone standard as part of the National Ambient Air Quality Standards process. In the previous review of the ozone standard culminating in the current form of the standard with a maximum daily 8-hour average of 75 ppb, background ozone (or as it was referred to as “policy relevant background”) was based solely on an atmospheric modeling exercise from a single global model. At that time, empirical observations representing background ozone suggested levels higher than those determined by the model, but these were not given significant weight by the EPA and its Clean Air Scientific Advisory Committee (CASAC) in determining background ozone levels.

As part of the review of the ozone standard currently underway, the Intergrated Science Assessment (or ISA) refers to several terms to designate background ozone including North American Background and U.S. Background. The term “Policy Relevant Background” or PRB used in earlier discussions has generally been abandoned. This is a positive step since it at least implies that background ozone can be assessed from relevant observations rather than being simply a model construct. Consideration of U.S. Background reflects the reality that the U.S. has no regulatory control of pollution sources beyond its borders. Recent studies, including our own, have shown that several key sites at or near the west coast of the U.S. regularly provide observational data that represent background ozone levels. Two sites that have been extensively studied include Trinidad Head, a marine boundary layer site in northern California, and Mount Bachelor, a higher altitude location in Oregon. (Slide) At Trinidad Head, springtime daily 8-hour maximum ozone concentrations exceed 45 ppb one quarter of the time. At Mt. Bachelor, May ozone levels are higher than 60 ppb 25% of the time. These observations suggest that background ozone could be a substantial contribution at sites where ozone is measured near the current NAAQS standard of 75 ppb or if a lower standard were implemented. I will show that recent modeling results also support this conclusion.

In the current Integrated Science Assessment, a comparison of the model-derived background ozone values at Trinidad Head from the most recent version of the global photochemical model used for determining background ozone for the Assessment is significantly lower than observed values (Slide). This suggests background ozone is underestimated in the model since at Trinidad Head ozone levels under conditions representative of background are almost always higher than non-background conditions.

Recent work led by Dr. Meiyun Lin at the Geophysical Fluid Dynamics Laboratory (GFDL) and Princeton University and collaborators including myself is a major advance within the modeling framework in the ability to quantify the contributions to background ozone. {I have included a copy the publication in my written remarks.}

This new work by Lin and coauthors published last year dramatically reinforces the important contribution of North American background ozone, including a significant stratospheric component, on 8-hour average concentrations at or near current air quality standard levels. (Slide) In particular, during the spring and early summer, background ozone over the western U.S. is routinely elevated by input from the stratosphere and other contributions. These findings emphasize the need to provide a balanced view on the contributions to background ozone and a proper attribution of background ozone in determining human health and welfare risk.

Unlike the modeling work used in EPA assessments, the GFDL AM3 Global Chemical Transport Model explicitly simulates O_3 variability in the lower stratosphere and its dynamic coupling with the troposphere, as opposed to using a parameterized formulation or a climatological stratosphere. Based on the AM3 model, estimates of stratospheric impacts on springtime surface O_3 over the western U.S. are generally higher on average, and up to 2–3 times greater during the intrusions, than previous model estimates. This finding is in notable contrast to prior work concluding that stratospheric influence on surface ozone concentrations is rare. The Lin analysis implies that during springtime background ozone will influence surface ozone concentrations in the U.S. Mountain West such that the O_3 National Ambient Air Quality Standard may regularly be violated.

It should also be pointed that these findings show that the influence of O_3 transported from the stratosphere is not limited to episodes categorized as “exceptional events”. Stratospheric O_3 intrusions that lead to an “exceptional event”, in other words an exceedance of the standard by a naturally occurring event, are one example of O_3 transported from the stratosphere to ground level. However, the contribution from the stratosphere to background O_3 levels at more modest levels is very significant and also plays an important role in high ozone events. This contribution to background levels is important in assessing human health and welfare risk.

(Slide) In summary, the work of Lin and coauthors shows that background ozone contributes on average about 40 ppb to measured ozone in the Mountain West during the spring and early summer when measured levels exceed about 60 ppb. A significant portion of the time background ozone exceeds 50 ppb under high measured ozone conditions. With these relatively high contributions from background ozone, an ozone standard needs to be set at a level that allows regulatory controls of prescursor emissions to achieve success in meeting the standard. At a standard less than 70 ppb, achieving the standard over a broad portion of the western U.S. with current background ozone levels would be very difficult. It should be noted that while high background ozone levels are a particular problem for the western U.S., conditions exist in other parts of the country during some times of the year when background contributes significantly to ozone under exceedance or near exceedance conditions. Based on these recent results, the EPA and the Ozone Panel of CASAC should take cognizance of the underestimates of background levels described in the Integrated Science Assessment Document and utilize the more realistic estimates of background ozone available. These more realistic estimates should be used when developing the Human Health Risk and Exposure Assessment, Welfare Risk and Exposure Assessment, and Policy Assessment Documents that will play a role in the determination of the recommended ozone health and welfare standards.

References:

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Informing North American Background Ozone from Observations and Recent Modeling Results

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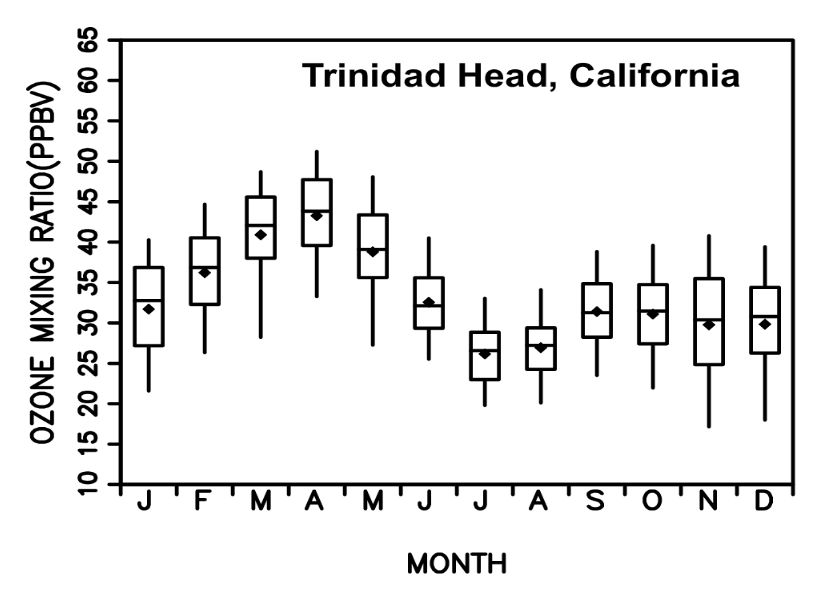
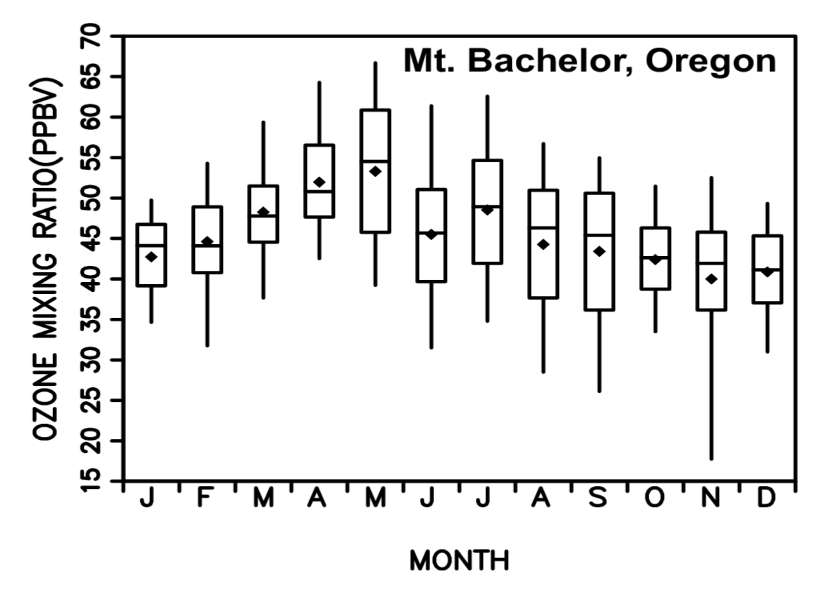
Surface ozone at Trinidad Head and Mt. Bachelor under conditions representative of background ozone

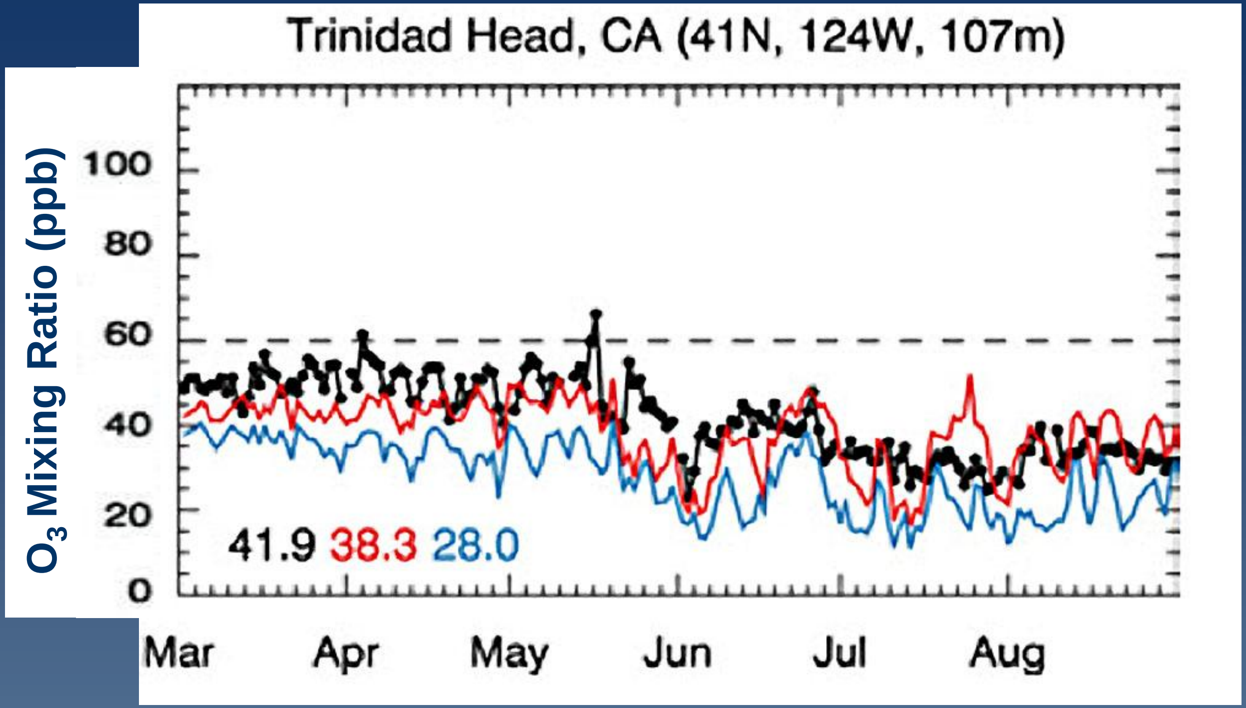




Diamond = Mean
Horizontal Line Inside Box = Median
Box = Inner 50th Percentile (25th & 75th)
Whiskers = Inner 90th Percentile (5th & 95th)

1) **Background ozone is thought of as only obtainable from models, however, there are sites that make observations under conditions representative of background.**
2) **At Trinidad Head (a marine boundary layer site) spring daytime (or 8-hr max) surface ozone exceeds 45 ppb 25% of the time.**
3) **At Mt. Bachelor (a higher altitude site) in May ozone levels exceed 60 ppb 25% ot the time.**

Comparison of Observations with Model Results

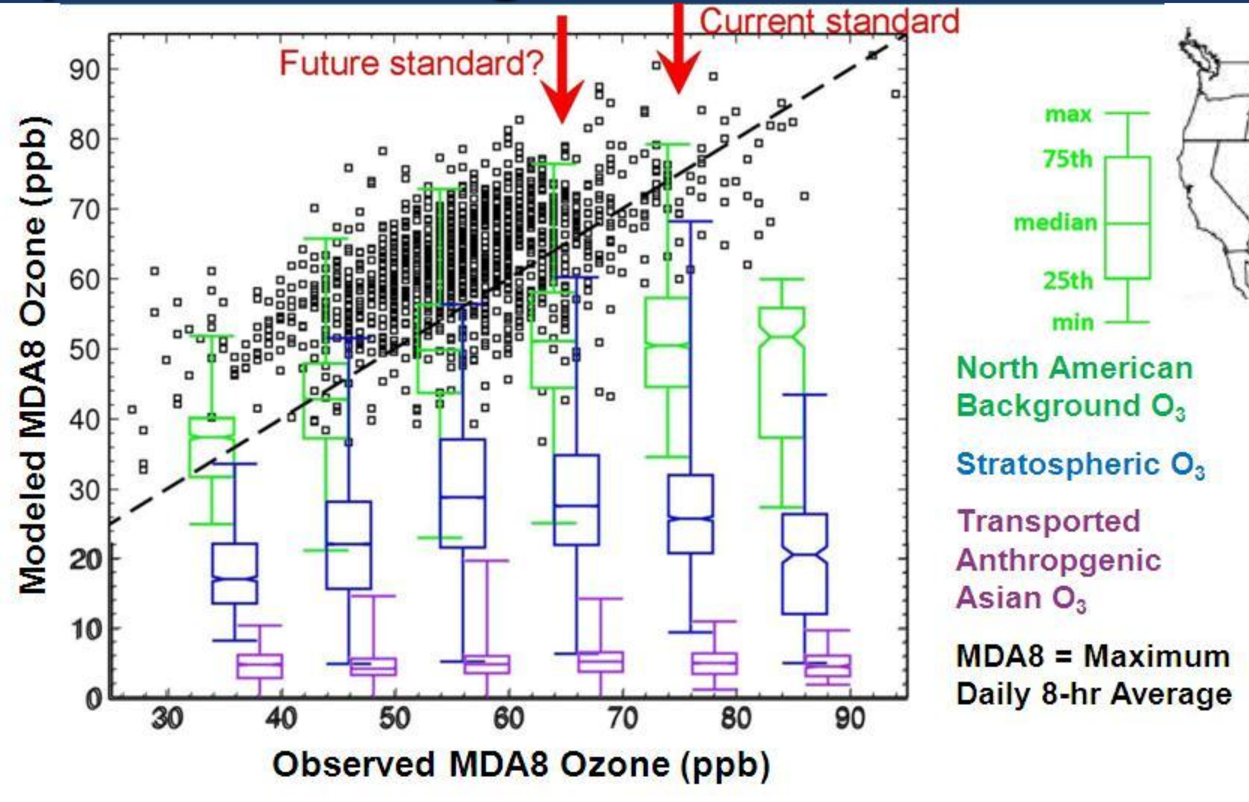


The modeled O_3 (red) is ~5 ppb less than observed (black) and background (blue) is ~10 ppb less than observed in the spring.

Comparison of daily maximum 8-h average O_3 predicted using GEOS-Chem at 0.5° × 0.667° with measurements at Trinidad Head, CA from March to August 2006. Source: US EPA (2012a).

This comparison suggests the model underestimates the background ozone levels since observed ozone at Trinidad Head under conditions representative of background is almost always higher than non-background conditions.

Comparison of Observations with Model Results: Impact of Background Ozone Over the Western U.S.



Other natural sources within North America such as wildfires also contribute to North American Background

- The GFDL AM3 model captures high O_3 events (>70 ppb).
- NA Background O_3 and its stratospheric component increases with increasing O_3 up to the level of the current standard.
- NA Background is largest in the 50-80 ppb range of observed O_3.
- Stratospheric O_3 contributes more than transported Asian anthropogenic O_3.

Final Points

- Observations at sites monitoring air entering the west coast of the U.S. <u>regularly</u> measure air under conditions representative of North American background – these measurements provide useful contraints on modeled background ozone.
- Current model estimates used by the EPA for estimating background ozone likely underestimate background over the western U.S.
- Unlike earlier work, recent model results suggest that background ozone has a greater contribution from stratospheric sources and that background can contribute substantially to measured ozone during high ozone events.
- Background ozone levels in the western U.S. leave limited opportunity for regulatory compliance for an ozone standard much below the current standard.