Slide 1

Informing Policy Relevant Background from Observations: Characterizing Ozone Levels in North America from Ozonesonde and Surface Observations

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Comments to the CASAC Ozone Review Panel

May 19, 2011

What about background ozone?

- We don't measure PRB –
  so what do we measure?
- Can we measure "background" ozone at a North American location like Trinidad Head, California?
- What are the characteristics of North American "background" ozone?

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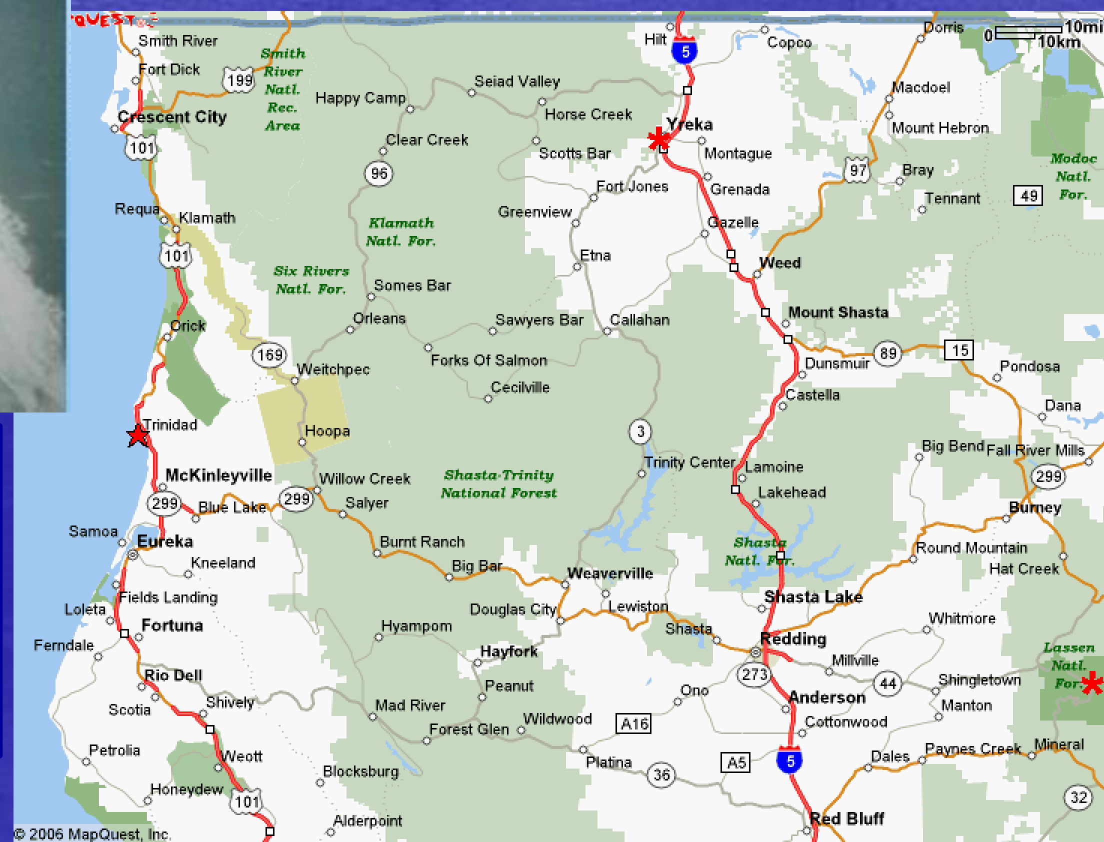
Location of the NOAA Trinidad Head Observatory



Conclusion: Trinidad Head is a well exposed site in a relatively remote location.

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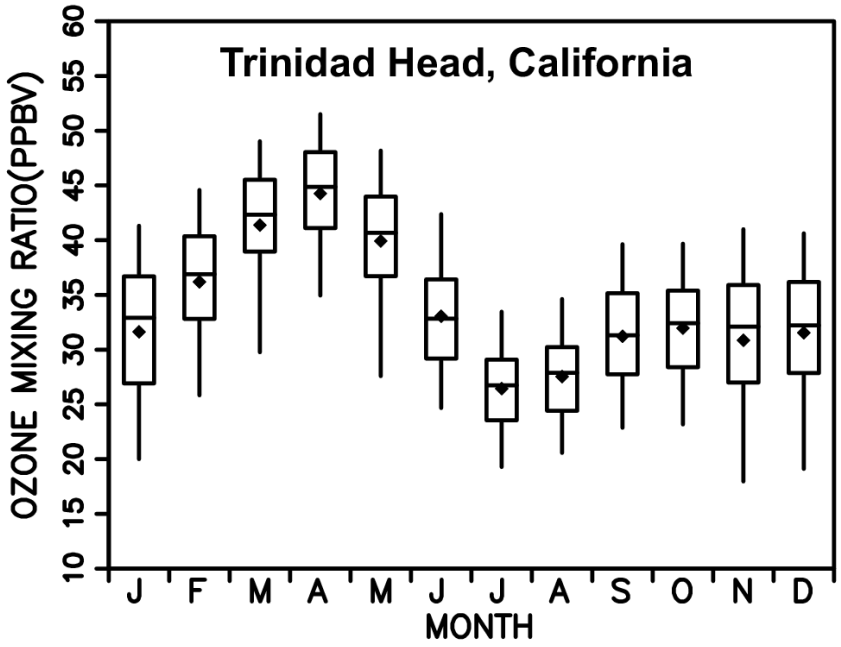
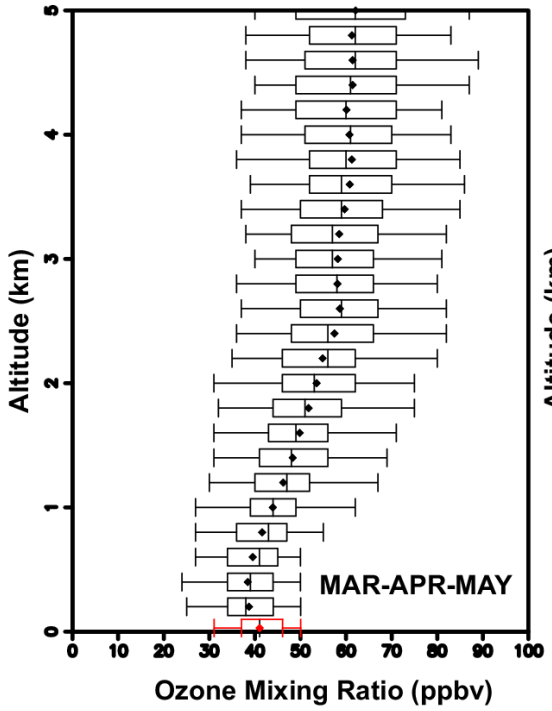
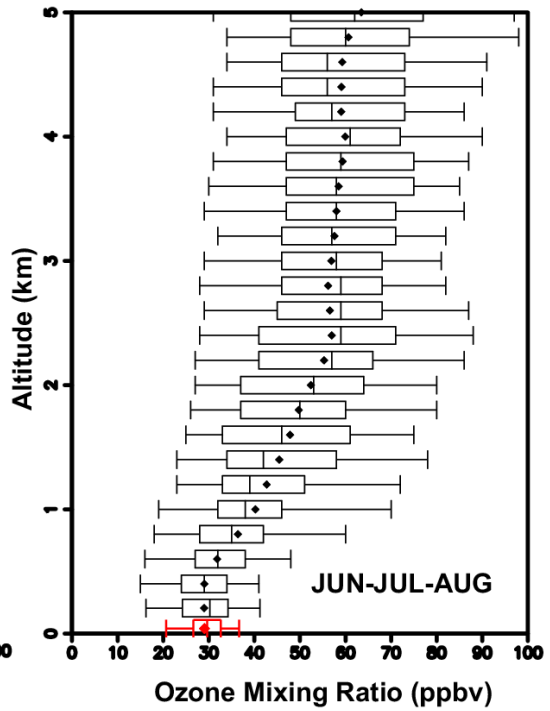
Surface (daytime) and profile ozone at Trinidad Head







Diamond = Mean
Horizontal/Vertical Line Inside Box = Median
Box = Inner 50th Percentile (25th & 75th)
Whiskers = Inner 90th Percentile (5th & 95th)
Red = Surface Values Superimposed on the Profile.

Conclusion:

1) Average spring daytime (or 8-hr max) surface ozone at Trinidad Head is ~43 ppb. 25% of the hourly avgs. >45 ppb.
2) Above the boundary layer (~2 km) avg. O_3 is ≥50 ppb in spring and summer.

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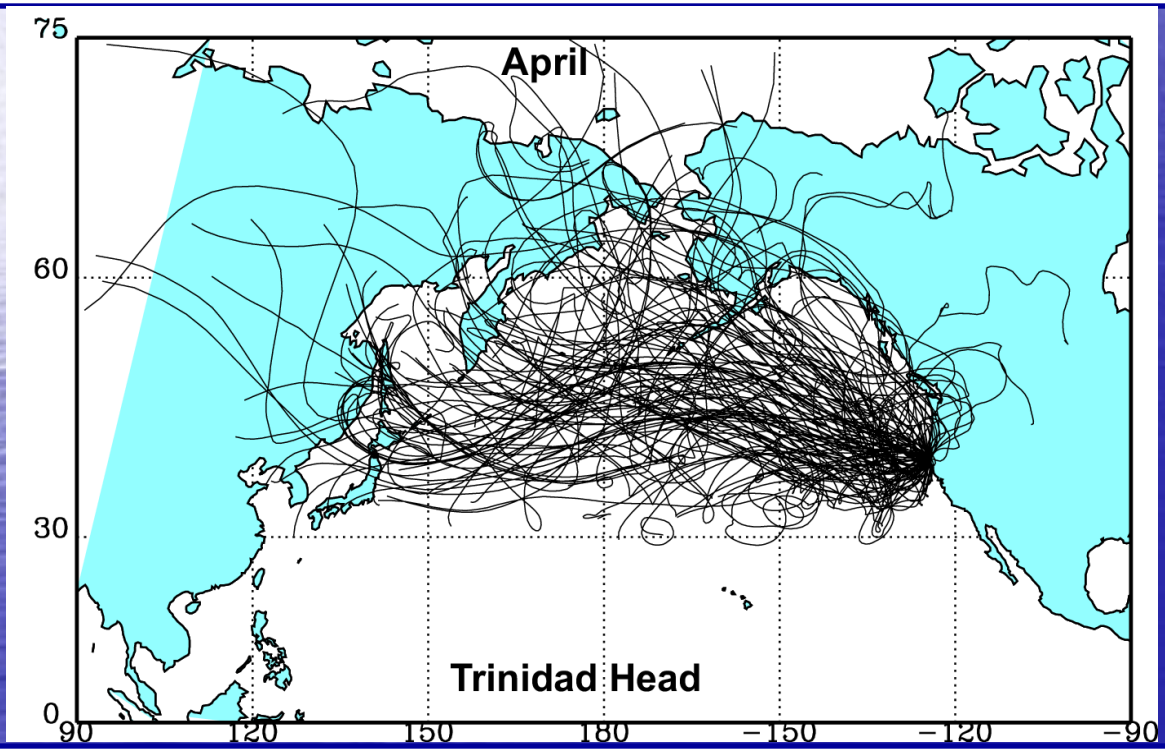
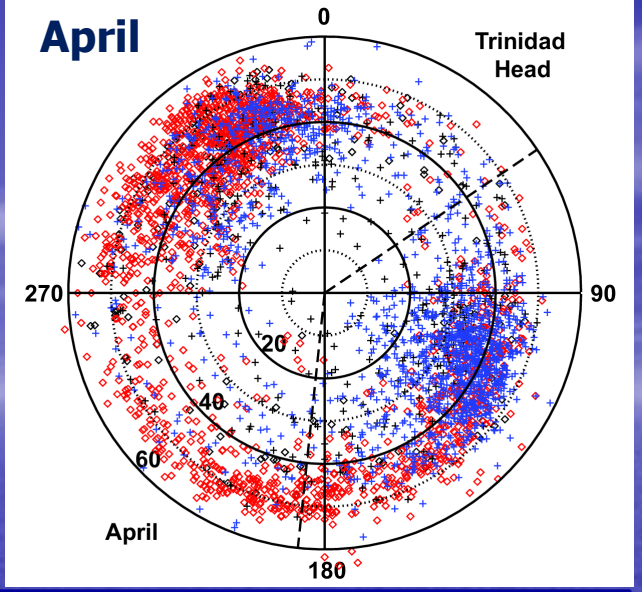
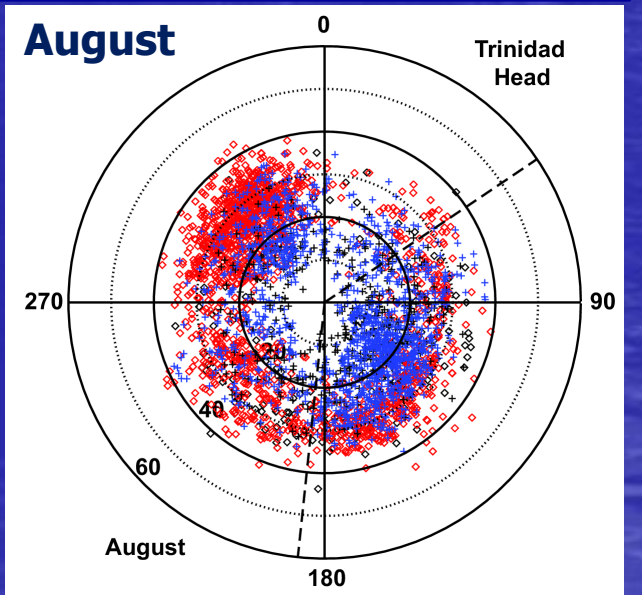
Is ozone measured at Trinidad Head Representative of PRB conditions?

Back trajectories (10-day) to Trinidad Head for days in April with hourly avgs. ≥50 ppbv





Trinidad Head surface ozone separated by day (10-21 LST - red) and night (22-09 LST - blue).



Conclusion: During the daytime – Very frequently.
At night – Some of the time.

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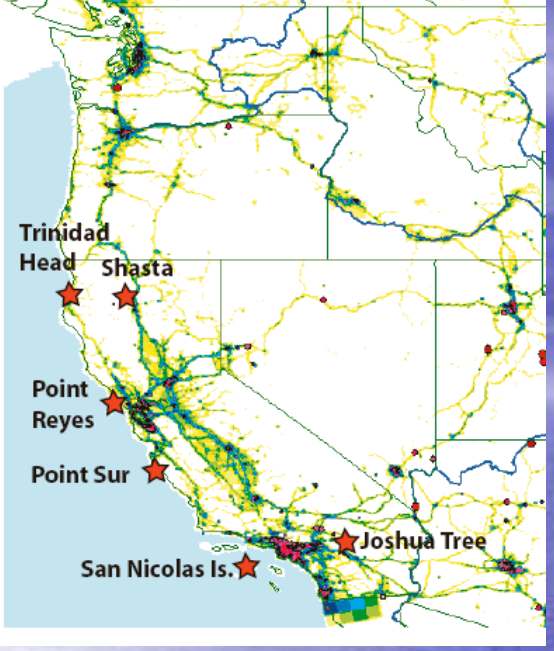
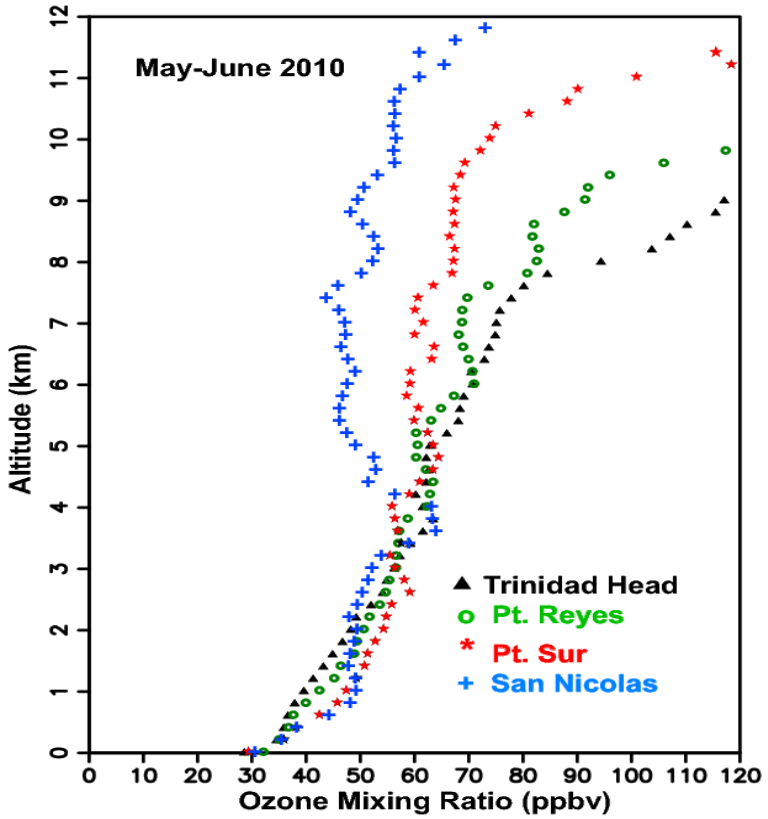
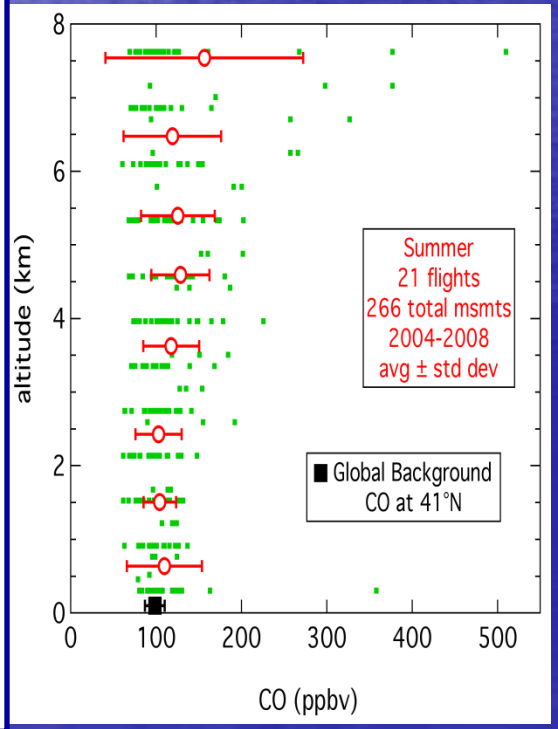


What do vertical profiles say about ozone reaching the California coast?



Vertical profiles of carbon monoxide measured in flasks collected on aircraft flights above Trinidad Head CA. The green pts give the individual obs and the red circles indicate avgs and standard deviations .

Conclusion: Air flowing into Trinidad Head represents the Pacific "background" .



Average ozone mixing ratio profiles at four sites making ozonesonde observations during the IONS 2010-CalNex Campaign in May-June 2010.

Conclusion: In the lower troposphere (<4 km) average ozone amounts are similar along the California coast.

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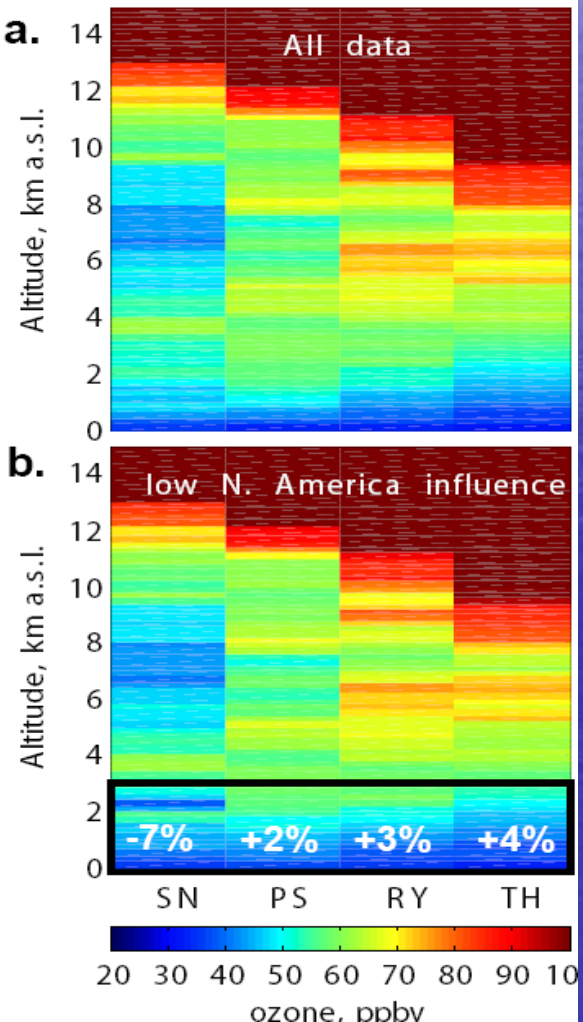
What influences tropospheric ozone levels at the California coast?

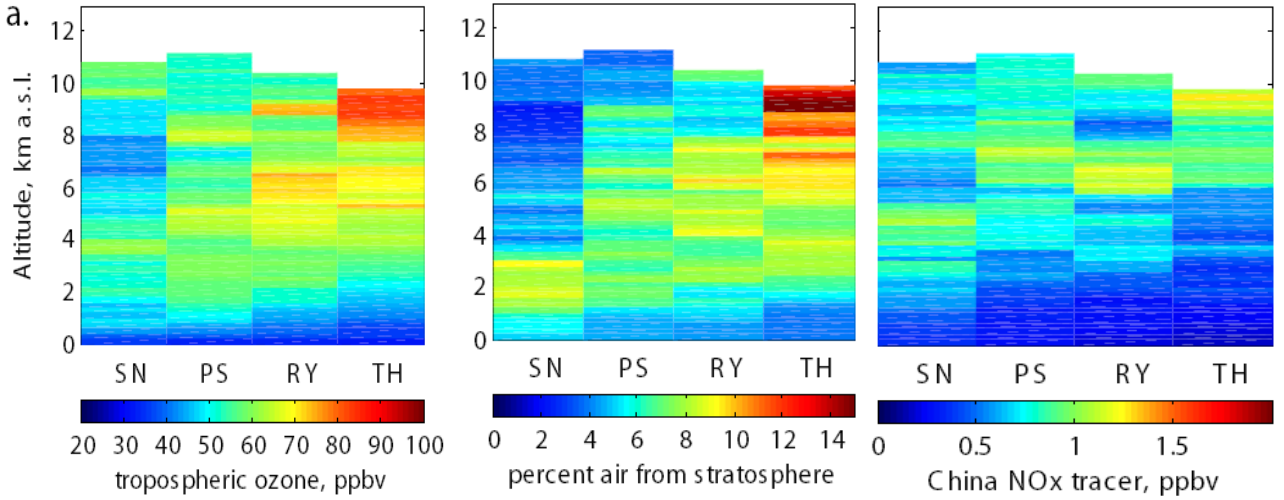
TH = Trinidad Head
RY = Point Reyes
PS = Point Sur
SN = San Nicolas Isl.

Conclusion (left panel): North American influence has an insignificant impact on lower trop O3 levels along the coast of CA.

Conclusion (below):
1) **Strat contribution increases at lower levels moving south.**
2) **Asian transport is felt most strongly above the boundary layer (~2 km)**



Tropsopheric Ozone (ppbv) | **Stratospheric Contribution (%)** | **Asian Transport (NOx Tracer – ppb)**



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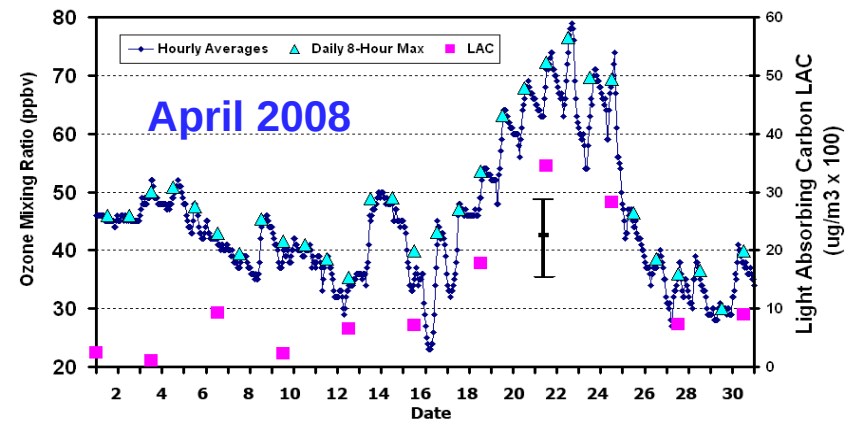
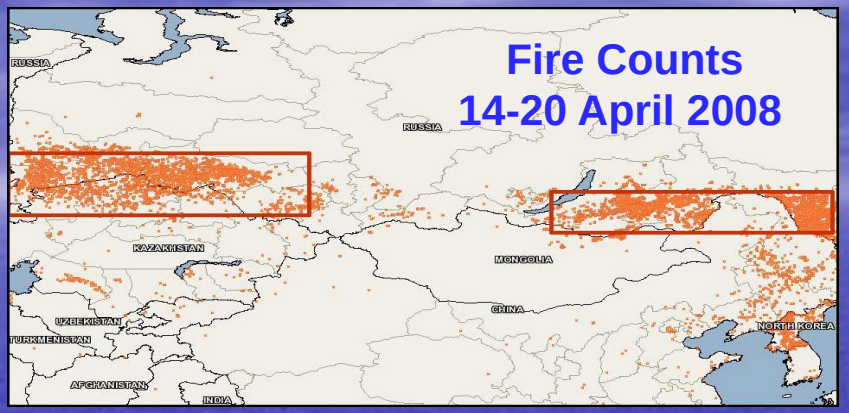
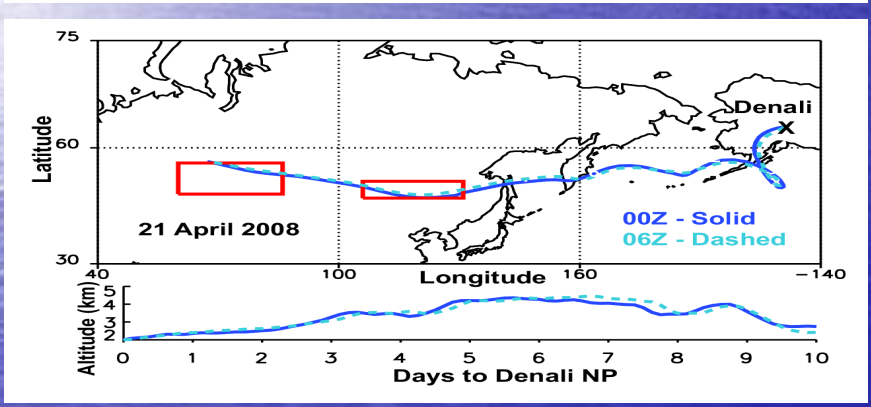
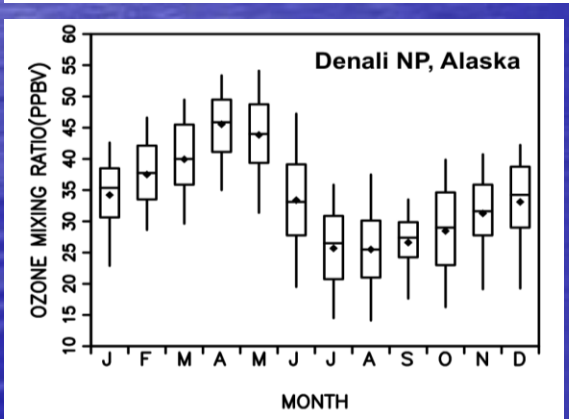
What can interior sites in North America tell us about PRB?







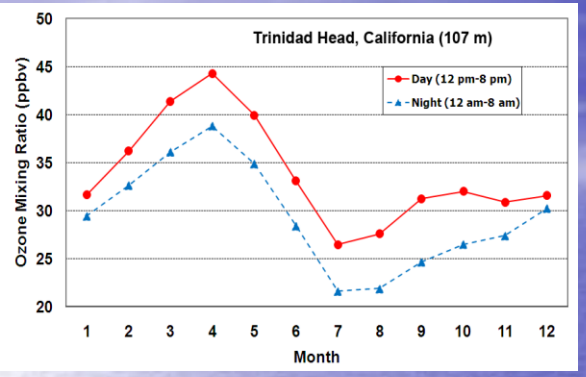
Influence of Eurasian Biomass Burning
Surface ozone at Denali NP, AK in April 2008
Peak hourly avg 78 ppb, 8-hr max of 75 ppb, 5-day avg >65 ppb associated with trajectory and ancillary constituents showing likely cause as major early fires in Eurasia.

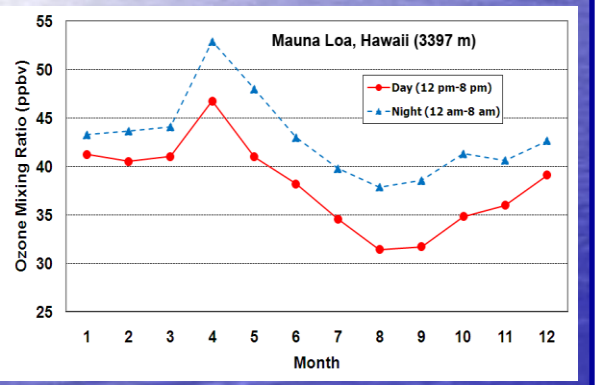


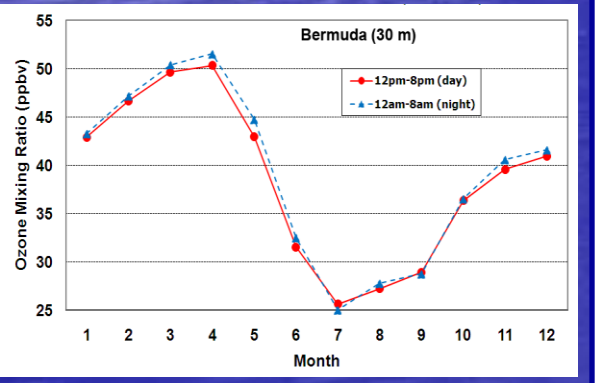
Conclusion: During spring Asian transport can have significant influence on lower trop O3 levels. Higher spring ozone amounts (April avg. ~45 ppb) have little North American influence and likely represent ozone levels of air flowing into North America.

Slide 9

What can interior sites in North America tell us about PRB?

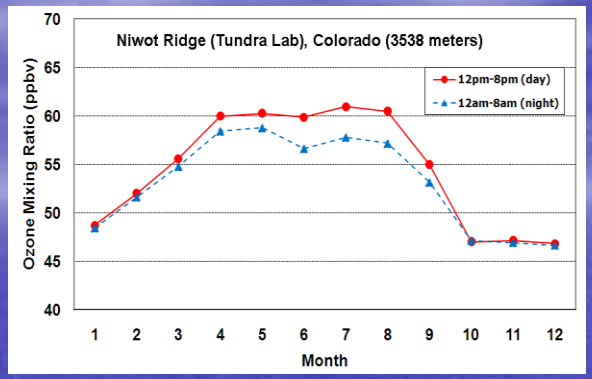


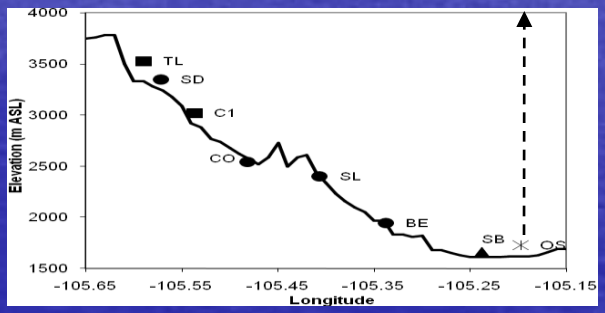


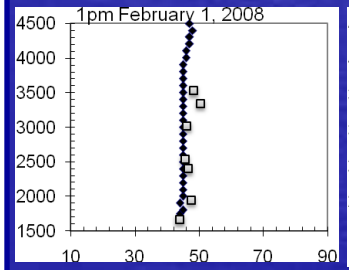


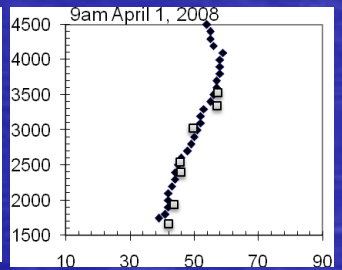
Examination of the diurnal cycle with season gives an indication of when local effects are causing this pattern.
-Trinidad Head – flow from ocean or land
-Mauna Loa, HI – downslope vs upslope flow
-Niwot Ridge, CO – downslope vs upslope; summer - strong local effects
-Bermuda – minimal local effects; no diurnal cycle.
-At Niwot Ridge extensive ancillary constituent data and comparison with ozonesondes (lower panels) indicates that "well mixed background" air dominates in winter and spring.

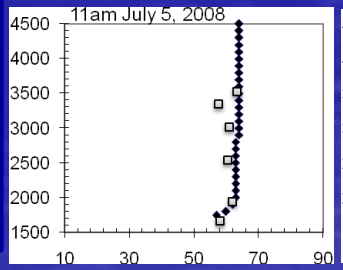
Conclusion: A variety of sites should be investigated for observational evidence to give a broader picture of "background" ozone levels.

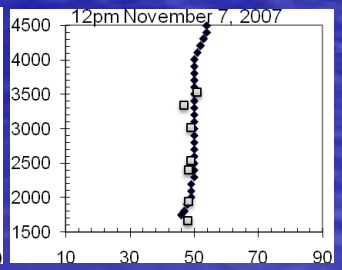












Conclusions

- Trinidad Head Observatory in N. California is a well located site for monitoring air entering the west coast of the U.S.
- Although it cannot be assumed that any site measures background ozone under all circumstances, an understanding of the measurement conditions at a site can yield important information on background ozone levels.
- Monthly average background ozone concentrations entering the west coast of the U.S. in the spring are in excess of 43 ppbv with daily 8-hour average amounts ≥50 ppbv with the number of hourly average concentrations ≥ 50 ppb for April varying over the range of 30 to 187 for the period 2002 to 2010. The range of maximum hourly average concentrations for the month of April over the period 2002-2010 is 54 to 65 ppb. This suggests background ozone levels may be somewhat higher than models predict.
- Intensive ozonesonde measurements during May-June 2010 confirm that Trinidad Head is representative of ozone levels in air entering the west coast of the U.S. and North America has minimal influence on ozone levels at the coast.

Conclusions (continued)

- Diverse processes influence ozone levels of air entering the west coast of North America. These sources are often intermixed in "background" ozone.
- Events such as biomass burning can produce large ozone enhancements that contribute to "background" ozone on an episodic basis and elevate average background values.
- At other western U.S. locations it is more difficult to identify conditions that well-represent background air, however, at particular times of the year background conditions are likely sampled at sites in which air parcels cross the North American continent. A number of sites should be investigated for potential observational information on background conditions.
- A broader perspective on "background" ozone can be provided using observations along with the PRB model construct for background ozone.