Profiles and Trends of Tropospheric Ozone

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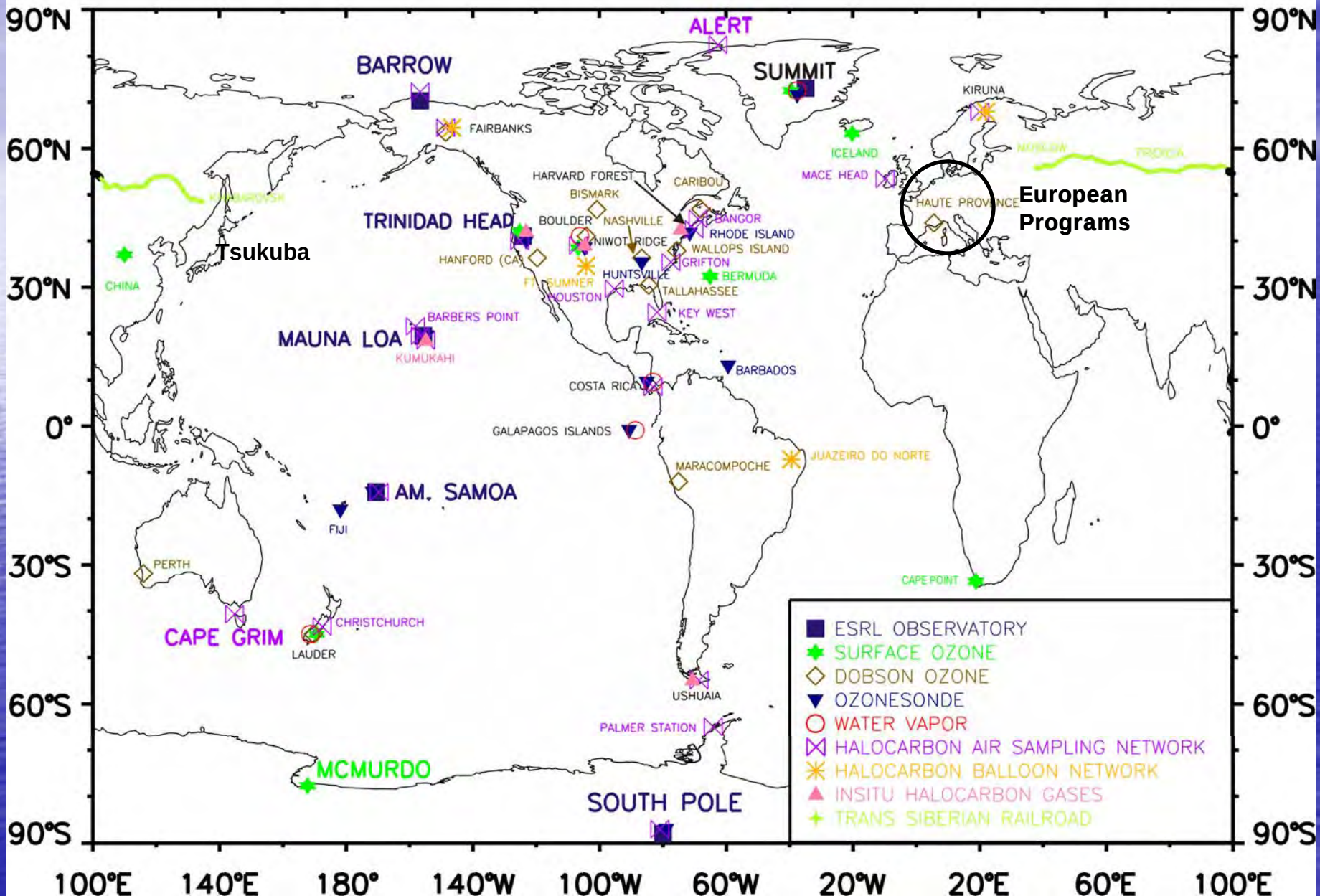
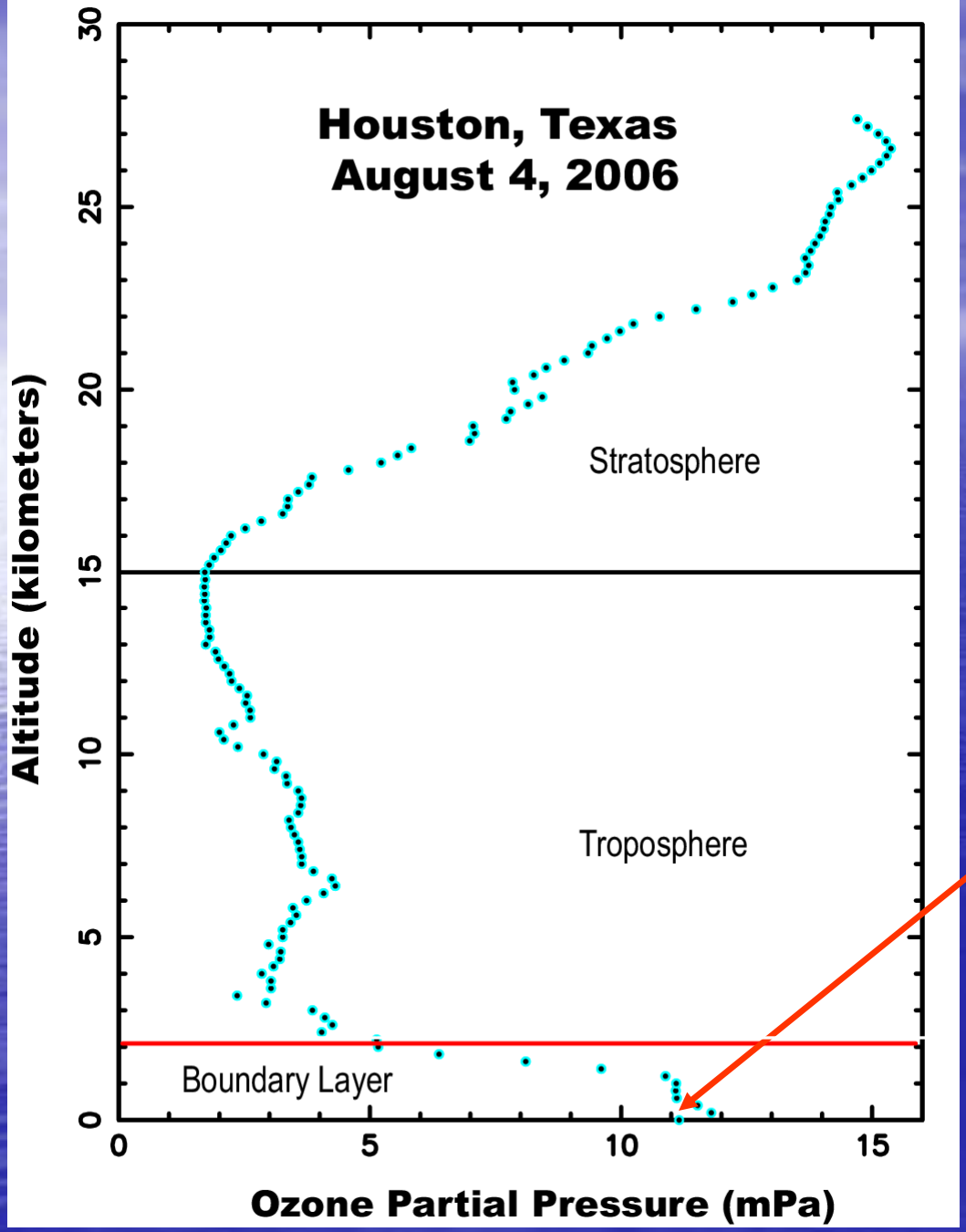
ESRL Ozone and Halocarbon Network





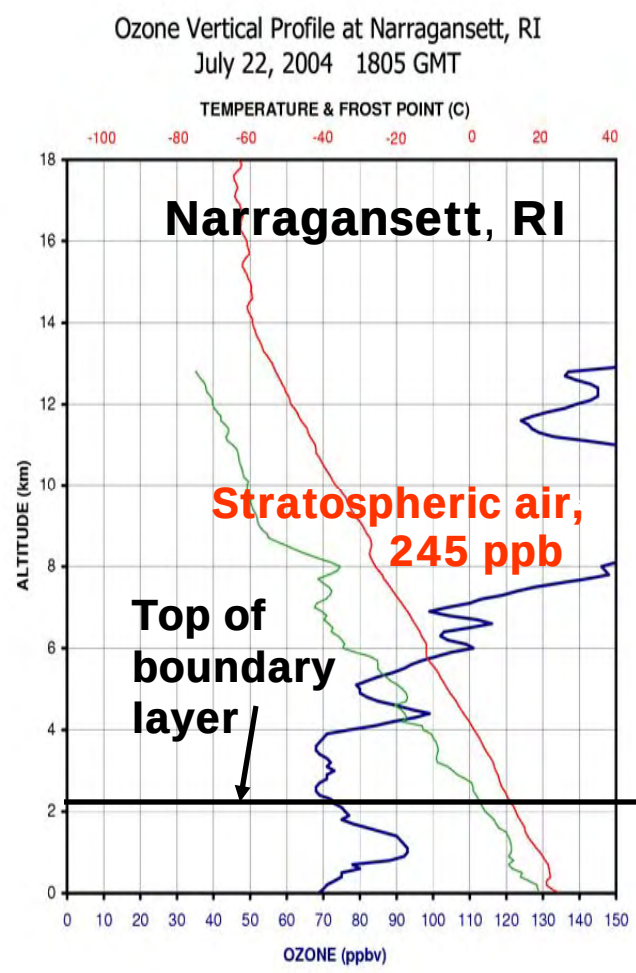
Ozone profile from Houston, Texas in August 2006 obtained with an **ozonesonde**.

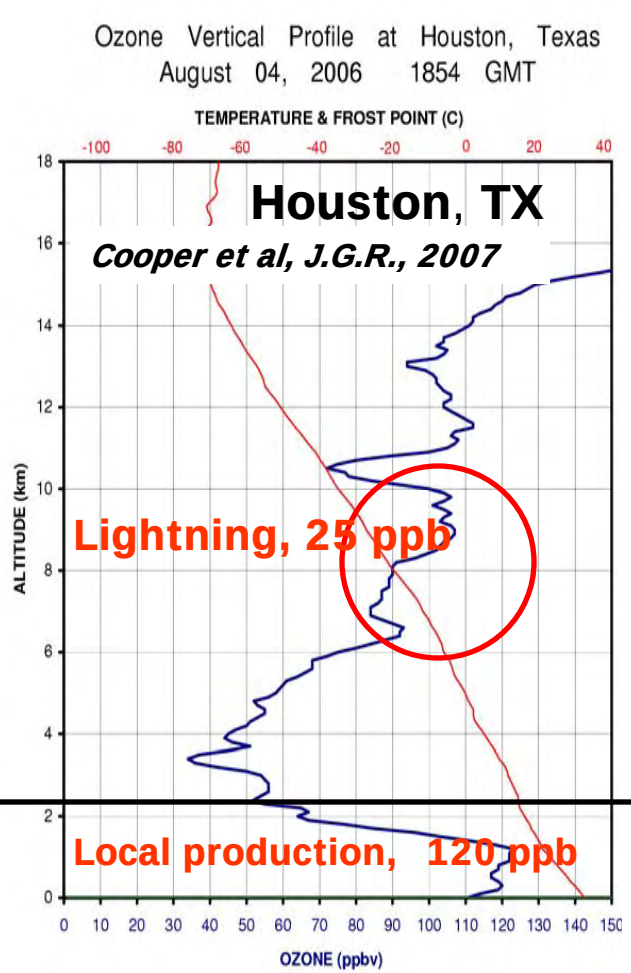
The polluted **boundary layer** is thin in relationship to the rest of the atmosphere.

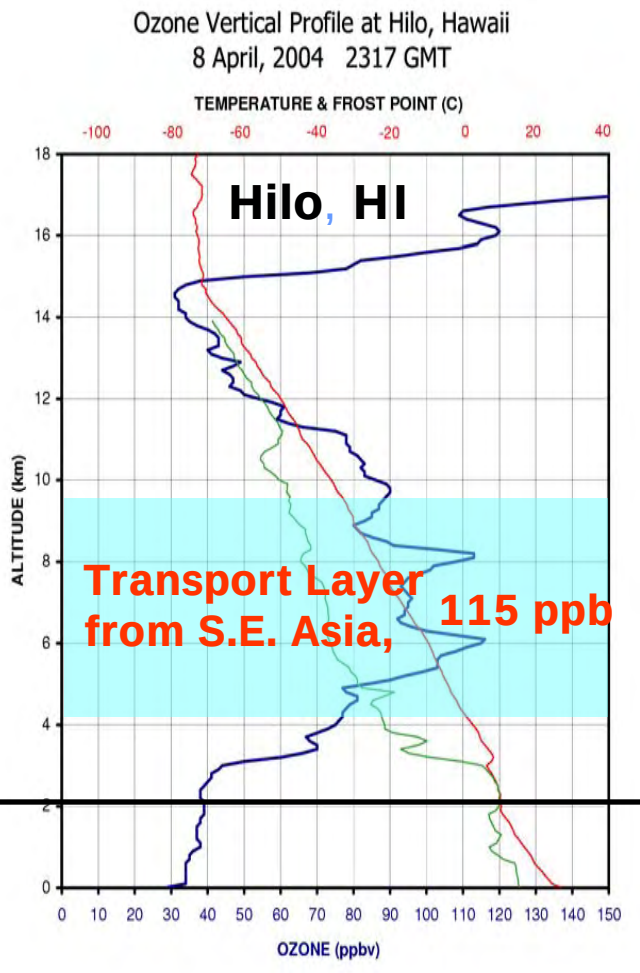
What is the relationship between tropospheric ozone and air quality?

- **Air quality is usually associated with ground level ozone.**
- **Ozone measured at a particular site may have contributions from several sources.**
  1. Ozone formed **photochemically** relatively **nearby** from emitted ozone precursors.
  2. Ozone formed **regionally** and transported to the site.
  3. **Long-range transport for 1,000s of miles**.
  4. Ozone from higher altitudes from natural sources such as **lightning** and the **stratosphere**.

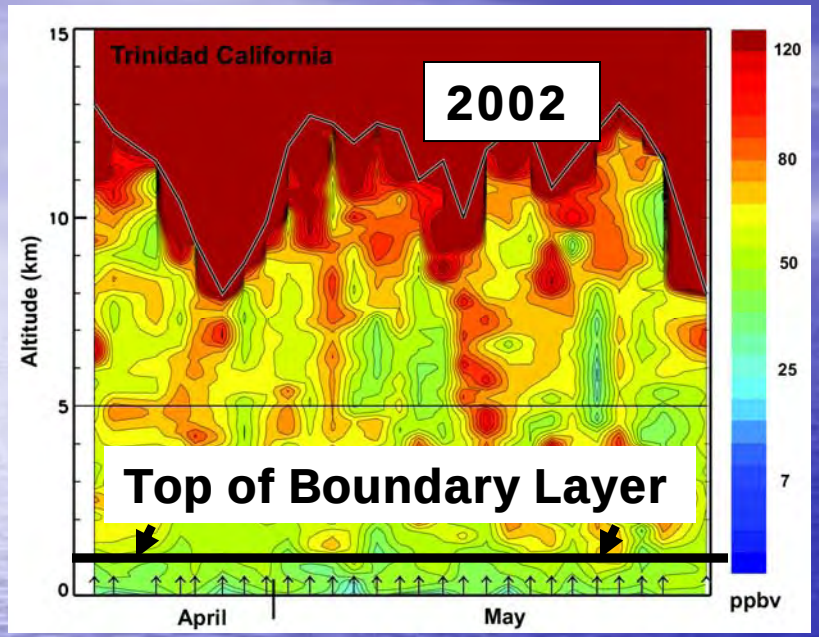
Ozone sources: stratospheric injection, local production, lightning, and long-range transport

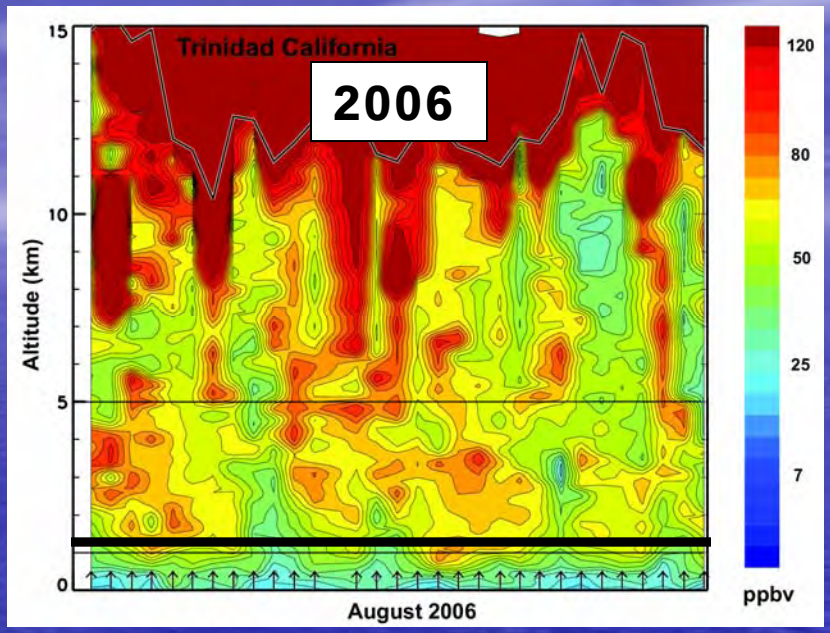


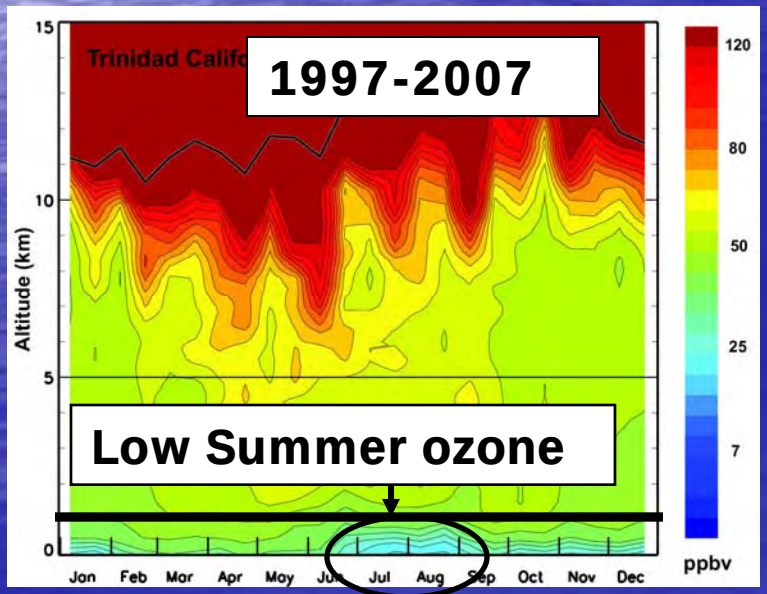


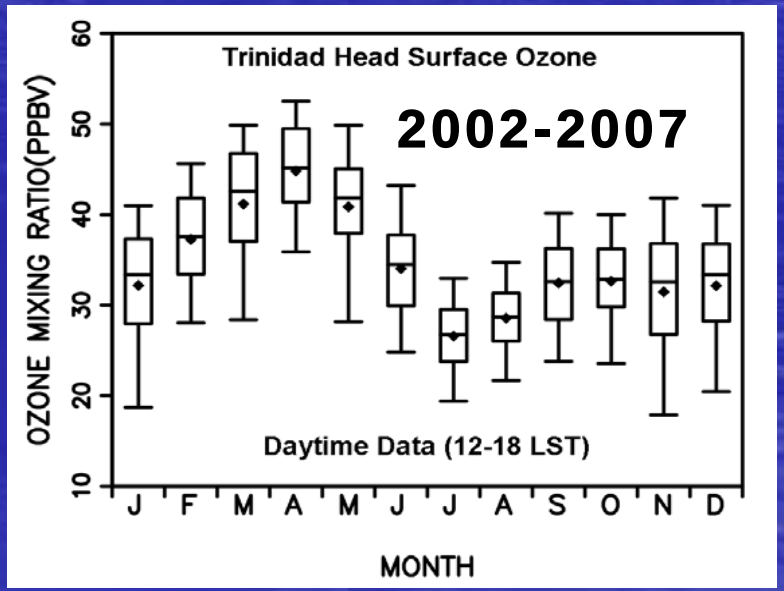


illustrating large variability with time and altitude

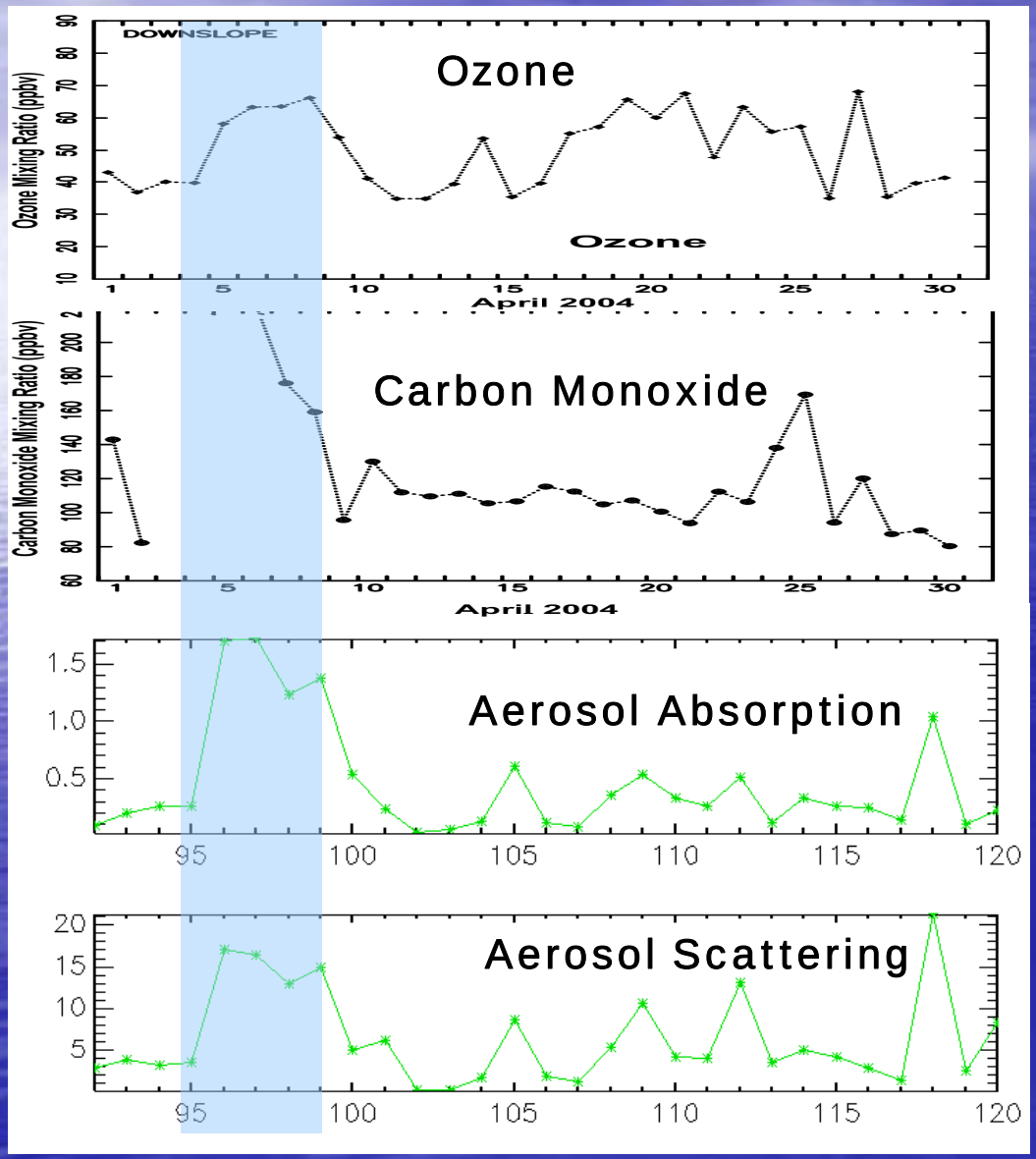


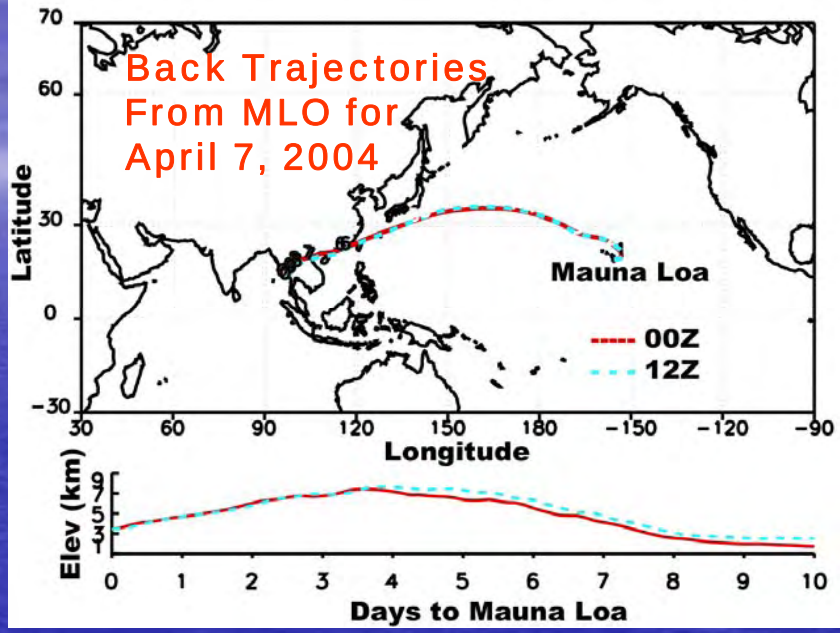


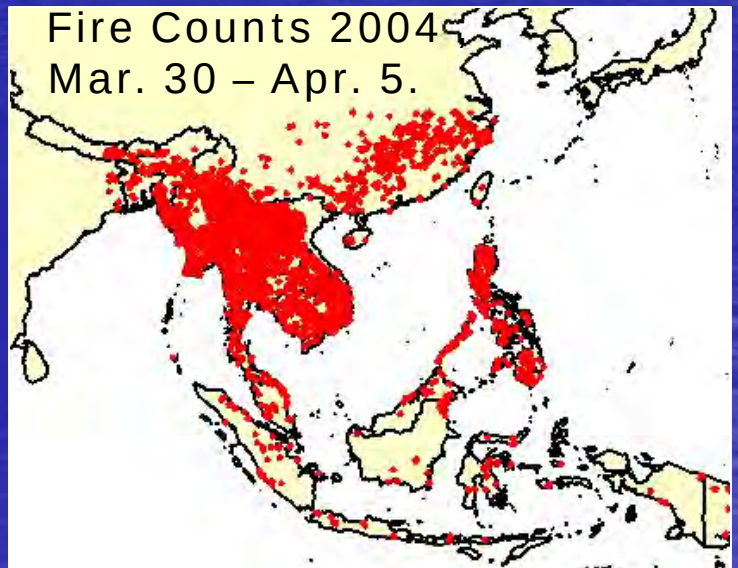




O_3, CO, absorption and scattering showing influence of Biomass burning in SE Asia and transport to Hawaii





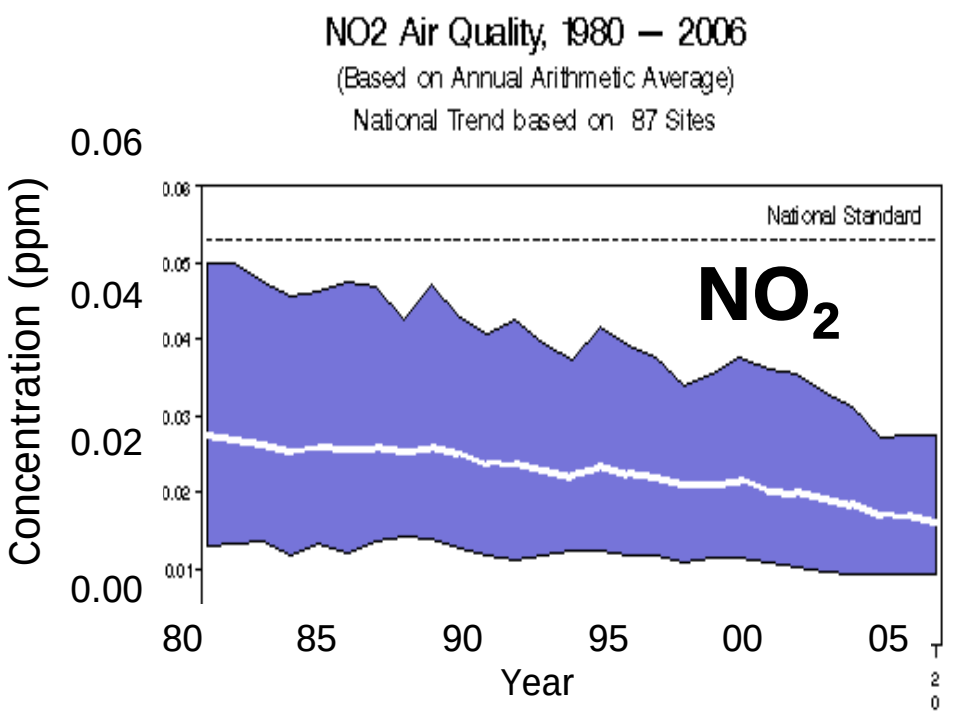


What do we know about long term changes in tropospheric ozone and their relation to air quality?

- It is expected that the largest impact on tropospheric ozone changes comes from emission of ozone precursors.
- At some locations this might be from precursors emitted long distances away (e.g. east Asian emissions on the U.S.)
- Ozone measured at a particular site may have contributions from several sources.
- What are some examples of records showing changes in tropospheric ozone?

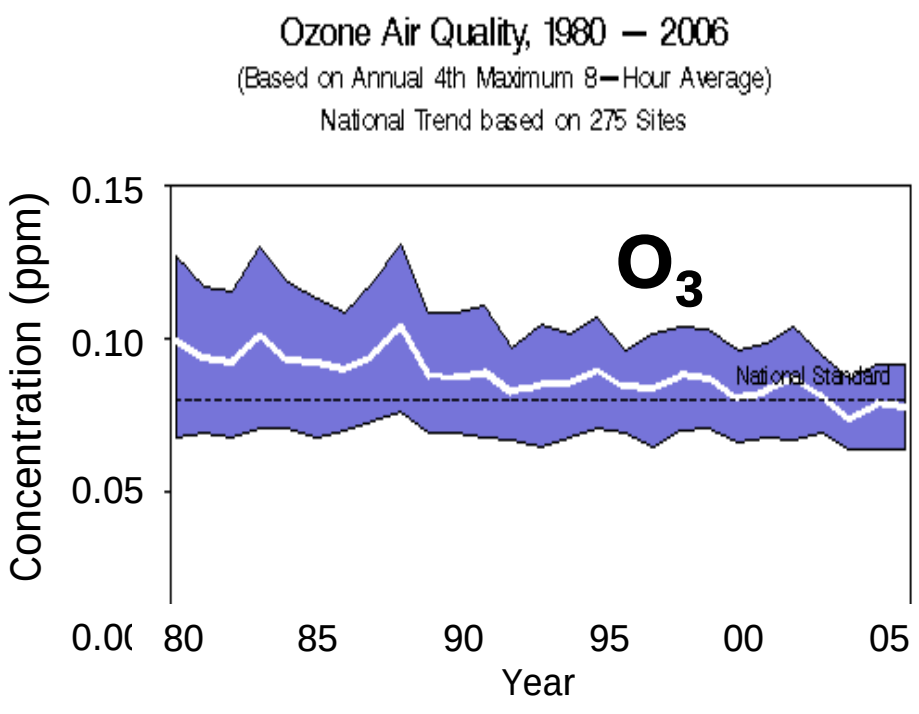
Changes in US ozone and NO_2 an important ozone precursor showing a decline in NO_2 emissions and a small decline in high ozone: 1980-2006.

Source - http://www.epa.gov/airtrends/



US: 87 Sites, 1980-2006

1980 to 2006 : 41% decrease in National Average

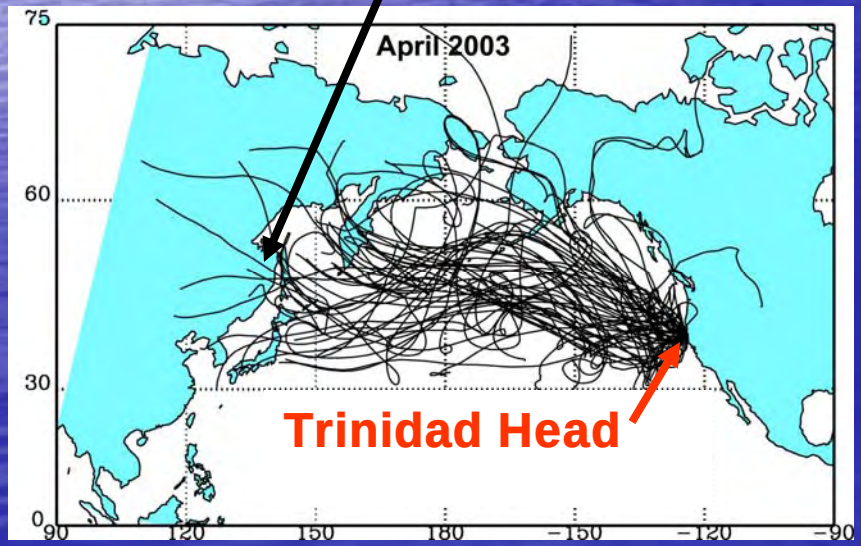


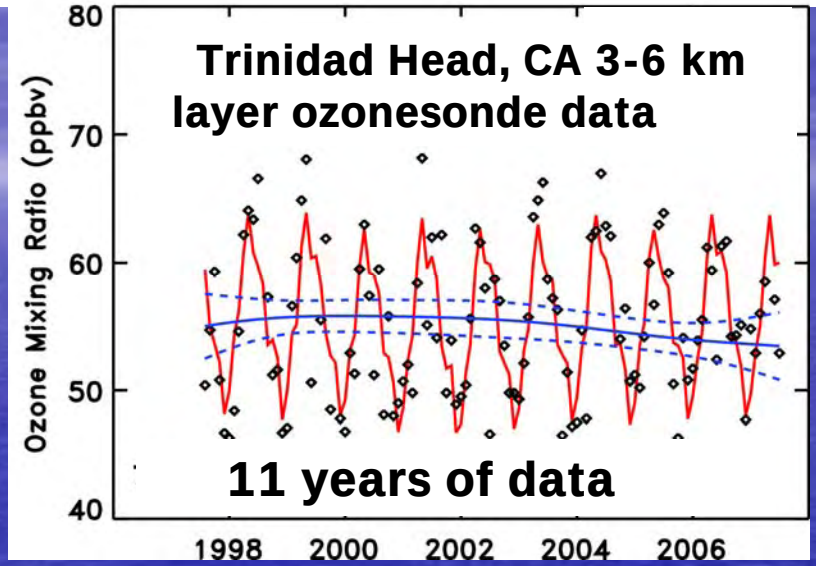
US: 287 sites, 1980-2006

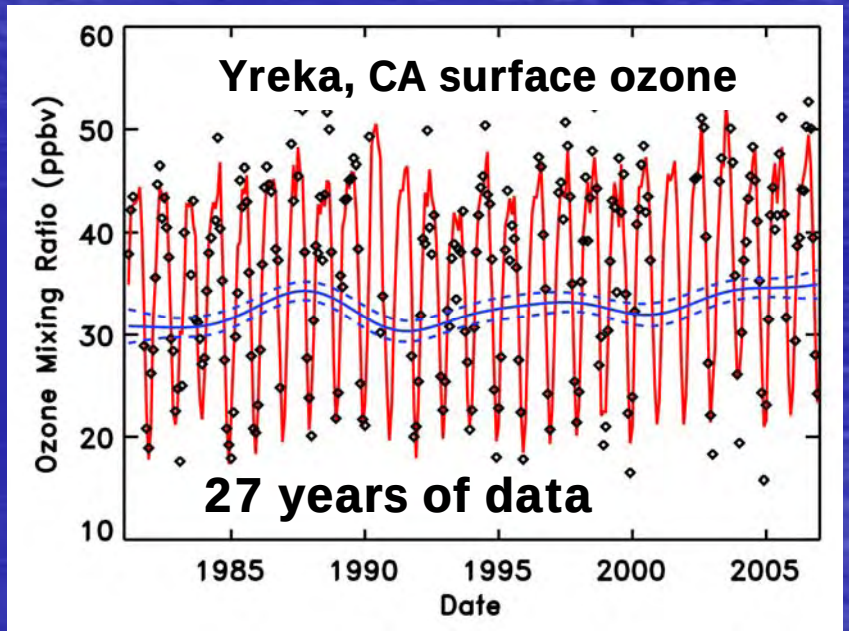
1980 to 2006 : 21% decrease in National Average

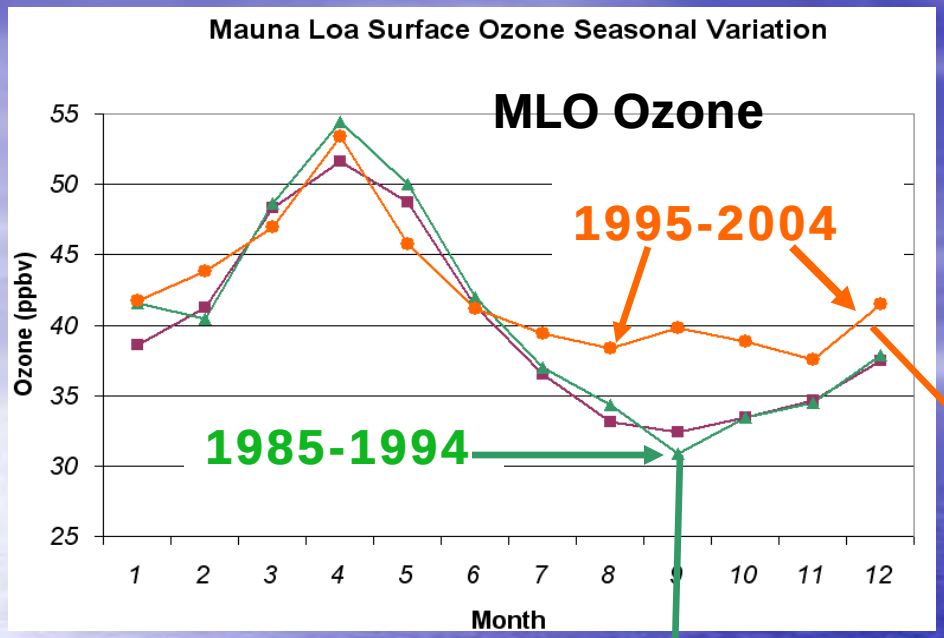
West Coast surface ozone and Trinidad Head ozonesonde profiles

10-day back trajectories to Trinidad Head, CA on days in April 2003 when ozone was ≥50 ppb. Air was generally from off Asia.





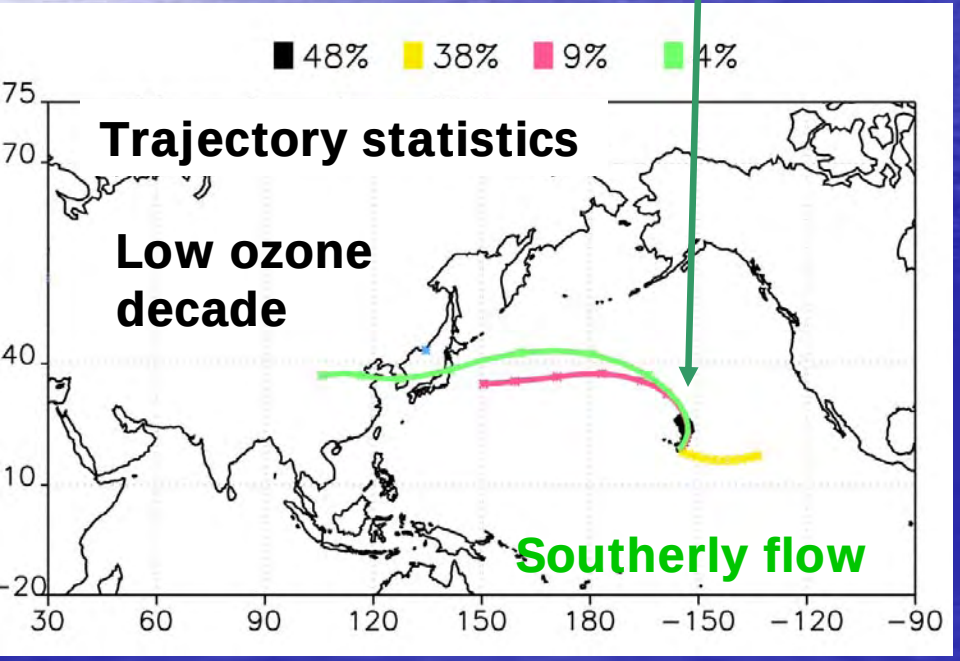


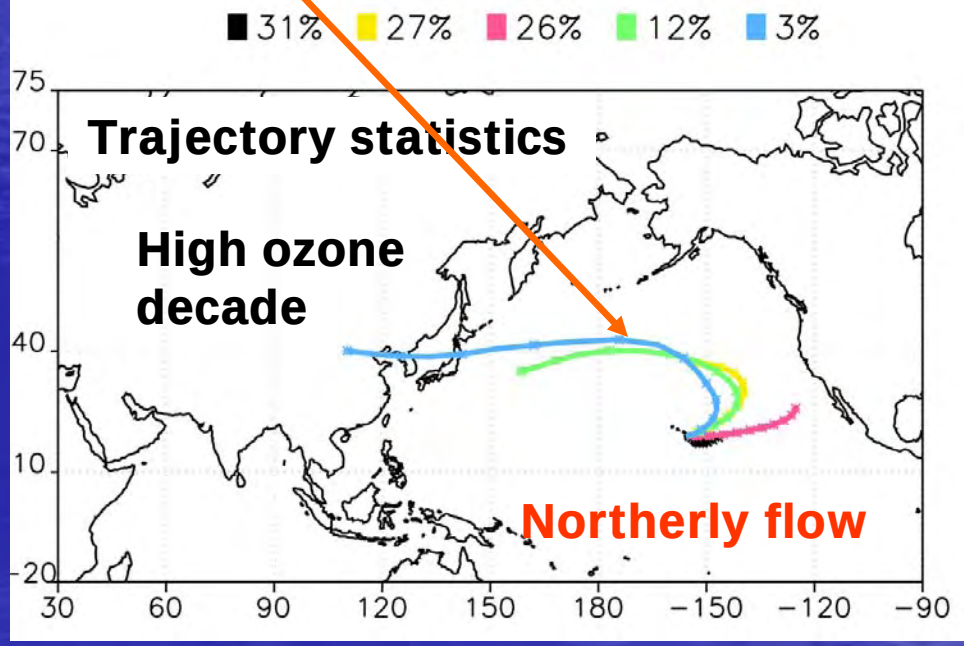


Decadal air flow patterns to Hawaii influence ozone.

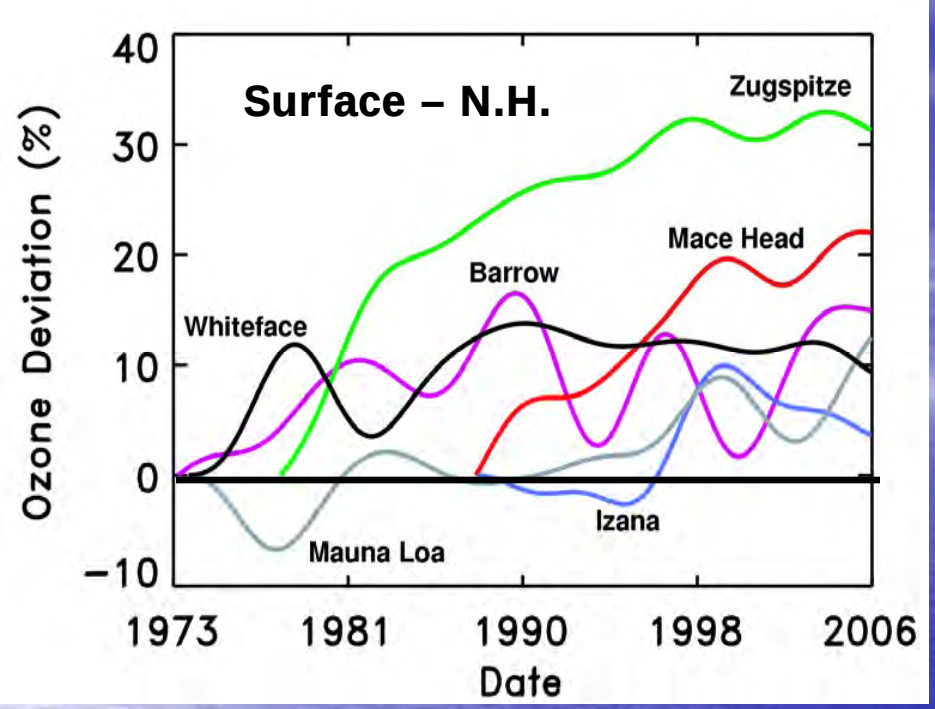
- Northerly flow: high ozone (1995-2004)

- Southerly flow: low ozone (1985-1994)

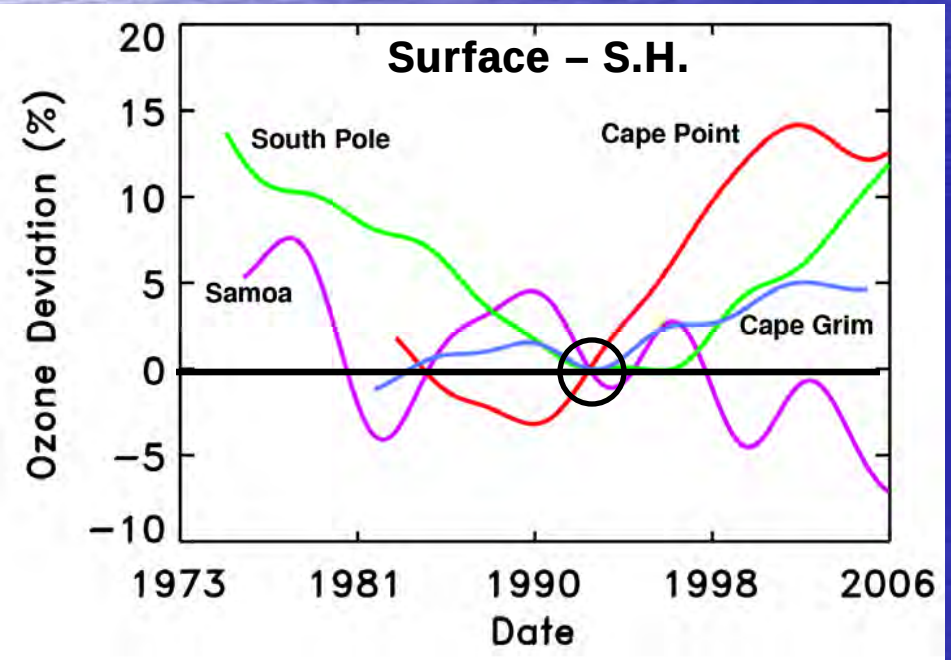


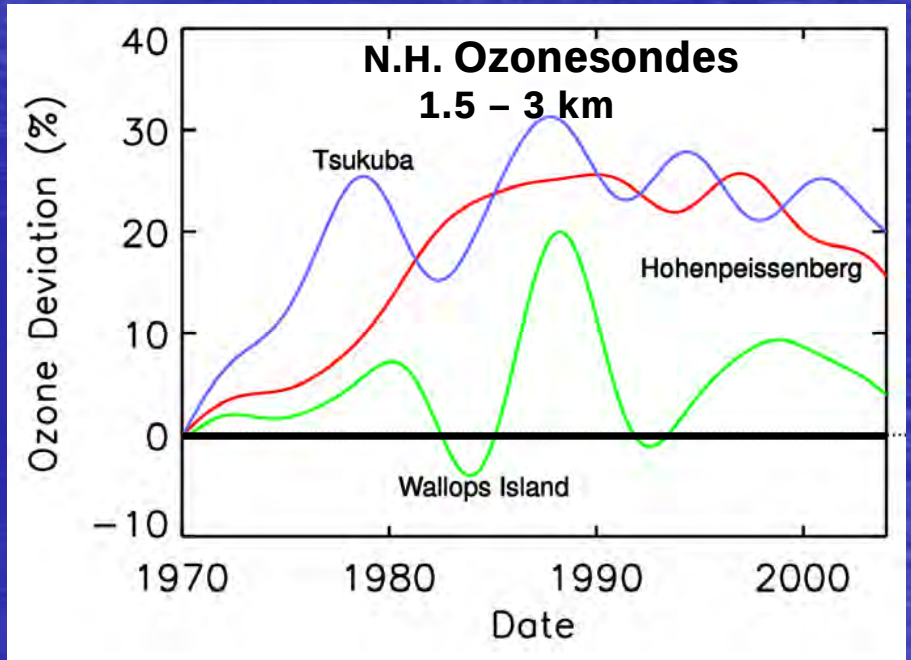


Trends from long term surface ozone and ozonesonde measurements in the N.H. and S.H.

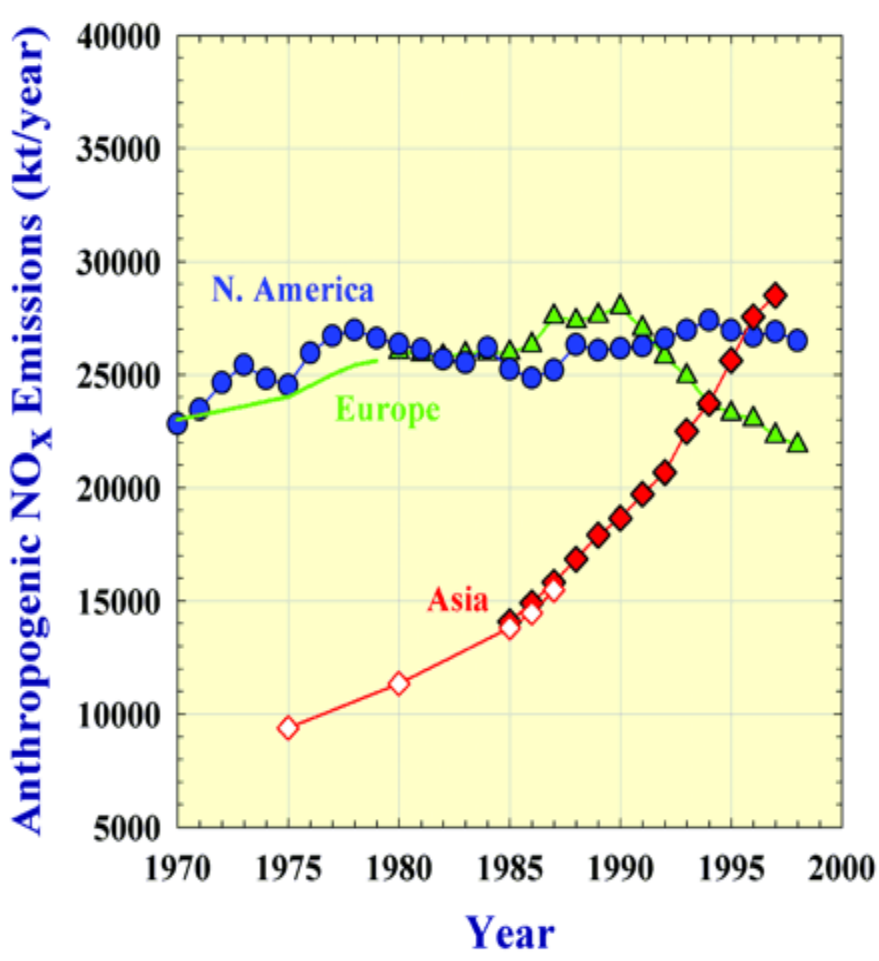


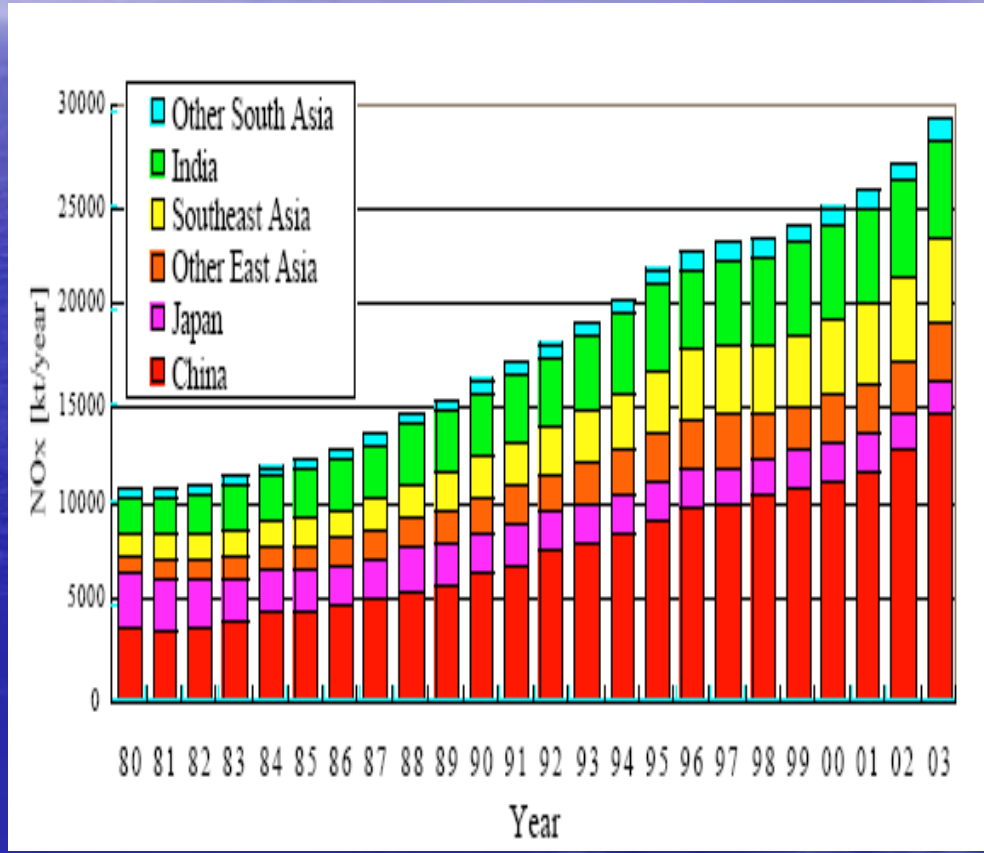
SIGNIFICANCE: There is no single pattern of change.





Emissions of NO_x ozone precursors are rising in Asia and are predicted to continue





Akimoto, H., Global air quality and pollution, Science, 302, 1716-1719, 2003.

Summary

- Long-term tropospheric ozone changes on a global basis show no hemisphere scale patterns.
- A variety of processes contribute to both the geographic distribution and vertical structure of longer-term O_3 changes.
- Tropospheric ozone increases may have slowed or reversed at locations where precursor emissions have declined (U.S. and Europe).
- The influence of Asian precursor emissions on tropospheric ozone on the west coast of the U.S. is still not clear.

Thank You For Your Time