ORIGIN OF BACKGROUND OZONE IN SURFACE AIR OVER THE UNITED STATES: CONTRIBUTION TO POLLUTION EPISODES

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THE PROBLEM

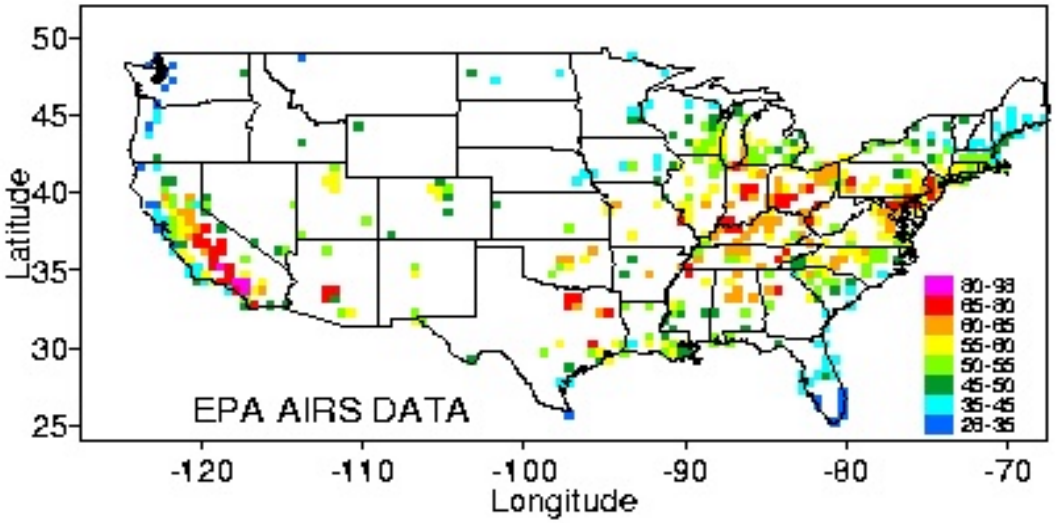
- **Ozone in surface air over the U.S. in summer includes a 20-50 ppbv background transported from outside the continental boundary layer**
  - **Evidence from O3 vs. (NOy-NOx) correlations, frequency distributions, measurements at clean sites, models.**
- **Nineteenth-century observations (Europe) indicate 5-10 ppbv O_3, preindustrial models calculate 10-20 ppbv O_3.**
- **What is the origin of the present-day background, and how does it contribute to pollution episodes?**

GEOS-CHEM GLOBAL 3-D MODEL OF TROPOSPHERIC CHEMISTRY: APPLICATION TO SUMMER 1995 SIMULATION OF REGIONAL O_3 POLLUTION IN THE U.S.

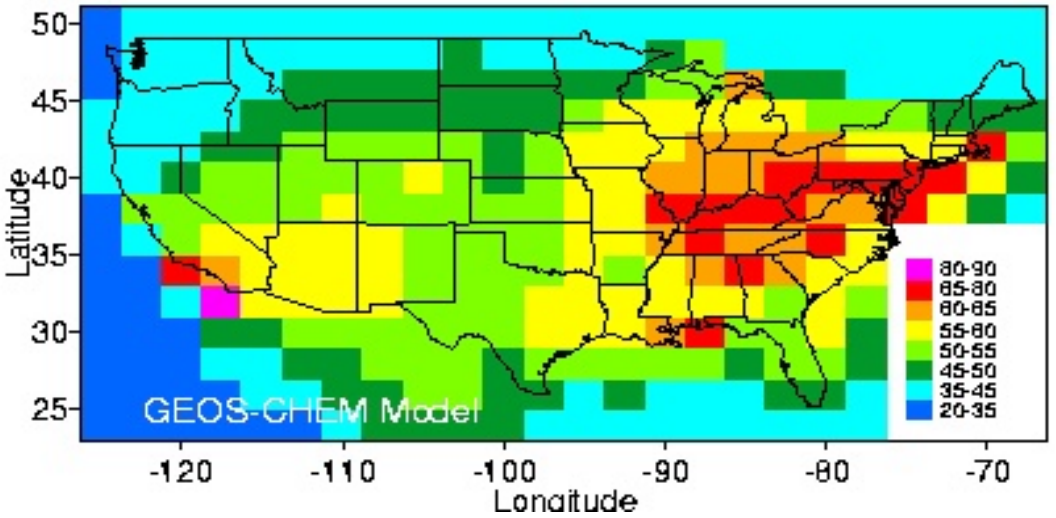
AIRS, SOS, NARSTO-NE observations

- **Assimilated meteorological observations from NASA DAO**
- **2^ox2.5^o horizontal resolution, 26 vertical layers**
- **120 chemical species to describe tropospheric O3-NOx-hydrocarbon chemistry; aerosol effects on chemistry, radiation**
- **SAMI July 1995 emission inventory for eastern U.S.**

SUMMER 1995 AFTERNOON OZONE IN SURFACE AIR OVER THE U.S.

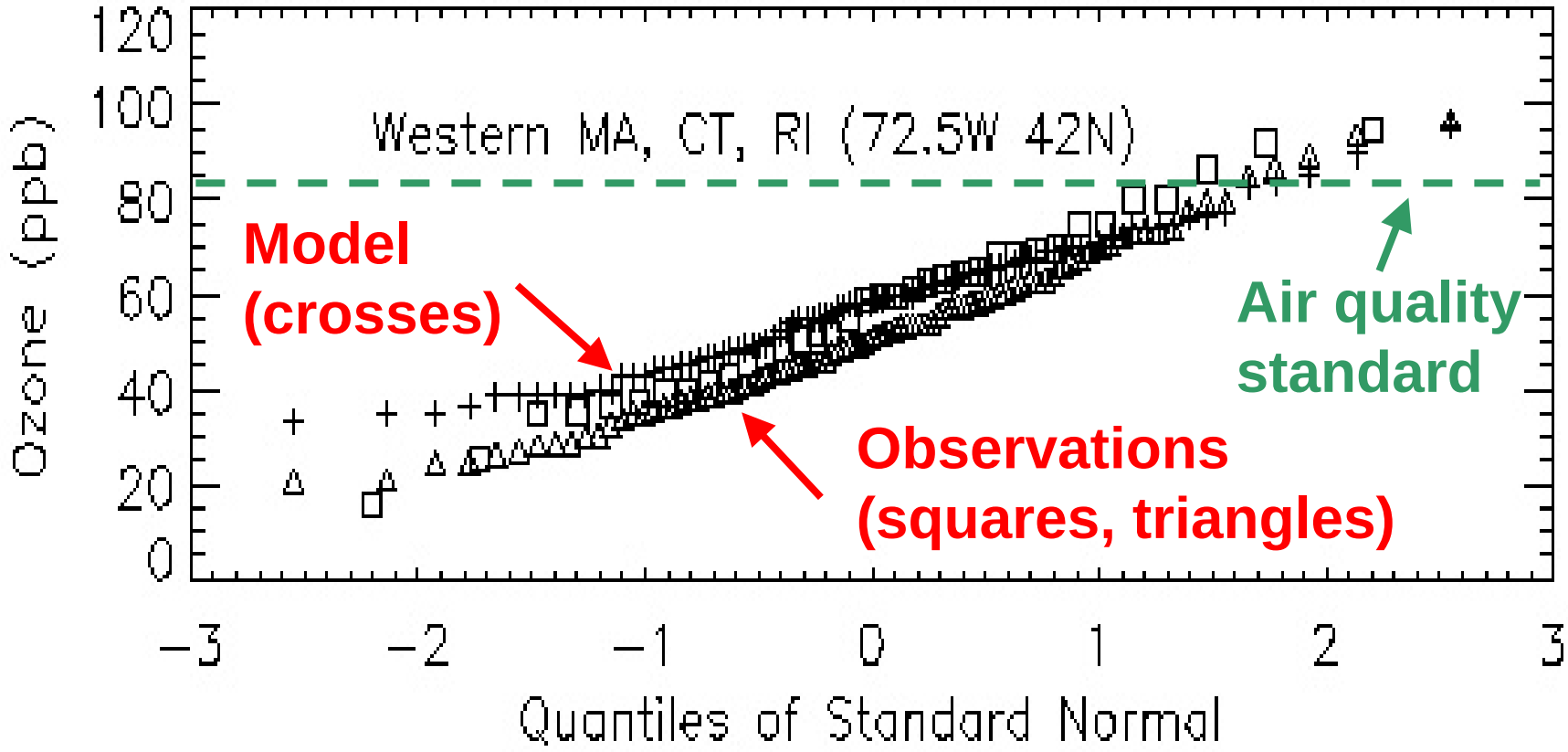


AIRS observations

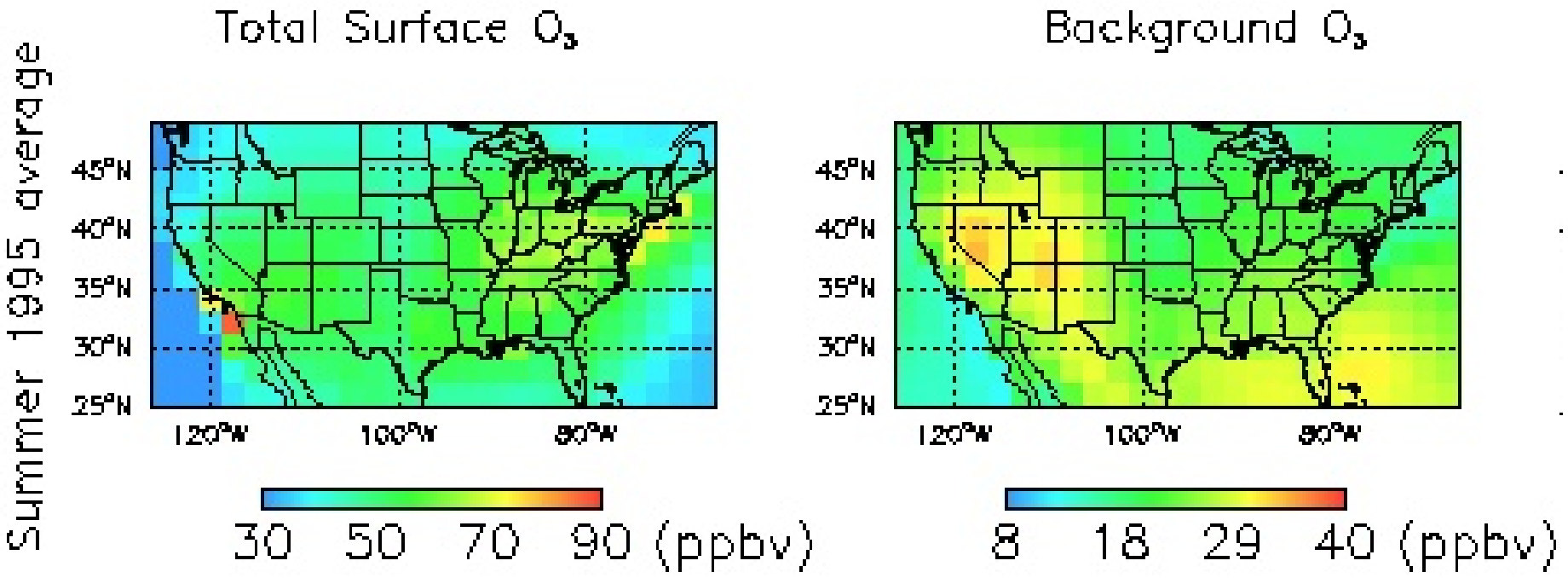


GEOS-CHEM
(r^2 = 0.4, bias=3 ppbv)

FREQUENCY DISTRIBUTION OF SURFACE p.m. O_3 IN WESTERN MASSACHUSETTS IN SUMMER 1995



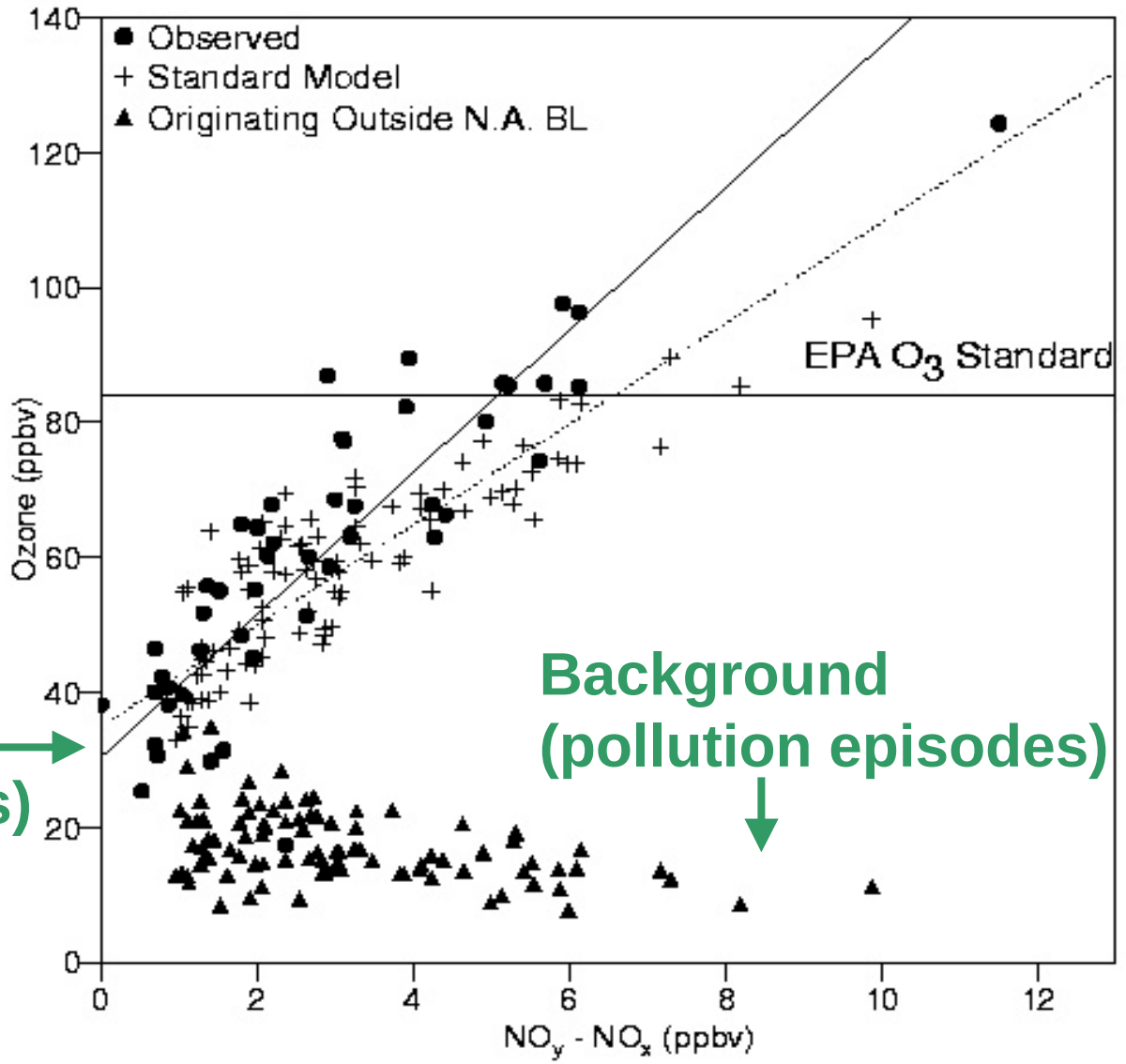
MEAN AFTERNOON OZONE BACKGROUND IN MODEL, SUMMER 1995



Background is tagged as ozone produced outside the N. American boundary layer (surface-700 hPa)

DEPLETION OF OZONE BACKGROUND DURING POLLUTION EPISODES (due to regional stagnation, short O_3 lifetime)

O_3 vs. (NO_y-NO_x) At Harvard Forest, Massachusetts

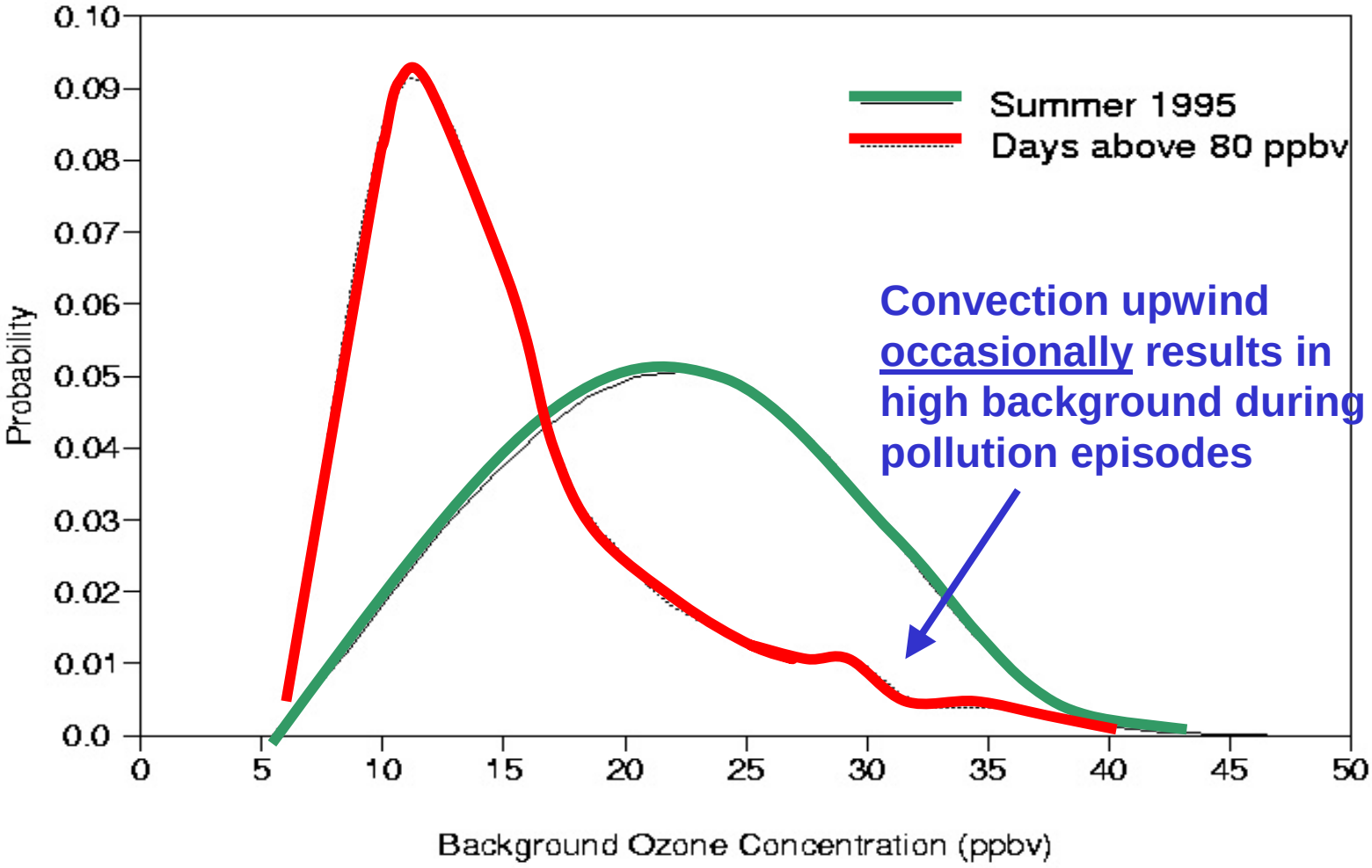


Background (clean conditions)

Background (pollution episodes)

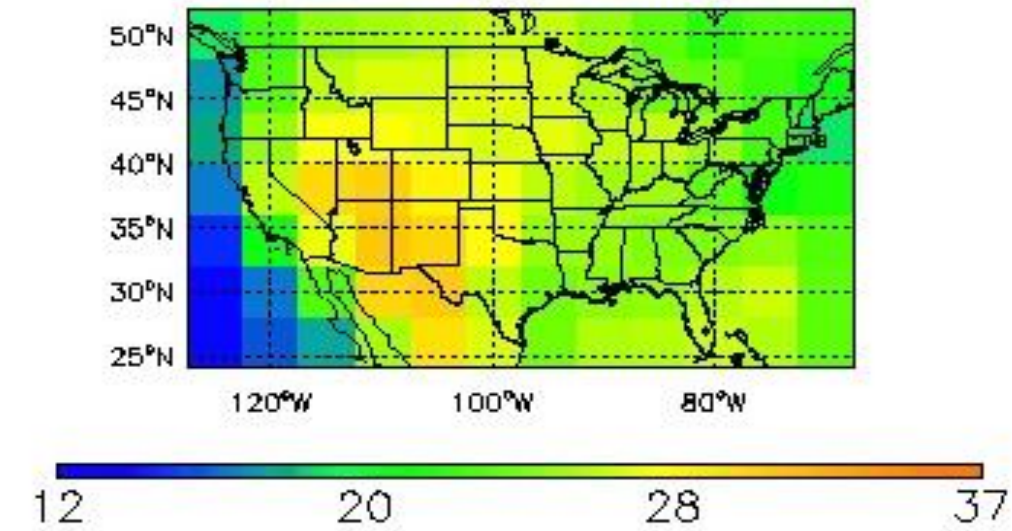
FREQUENCY DISTRIBUTION OF AFTERNOON BACKGROUND OZONE CONCENTRATIONS IN U.S. SURFACE AIR IN SUMMER 1995 (model)

summer ensemble vs. pollution episodes

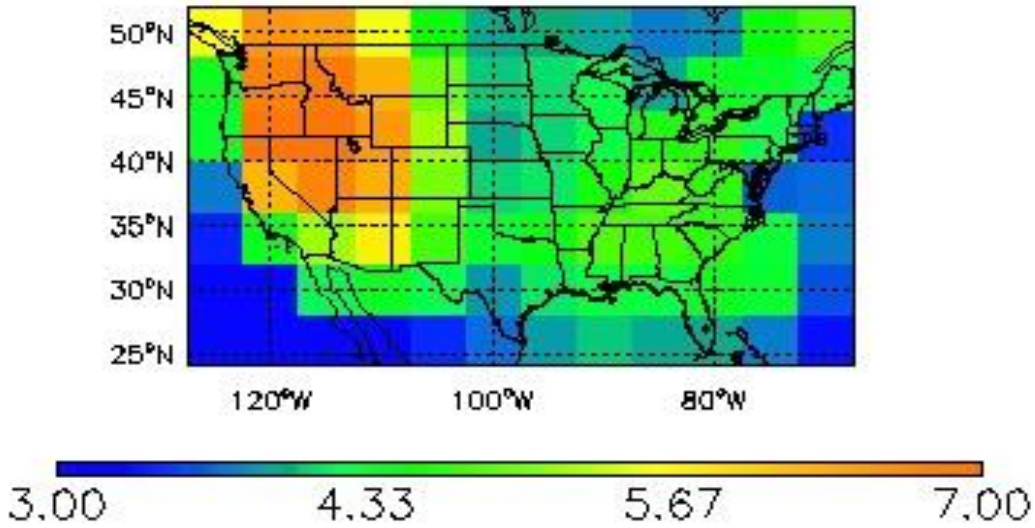


ASIAN/EUROPEAN POLLUTION ENHANCEMENT OF BACKGROUND OZONE IN U.S.

Mean model values, summer 1995 (4^ox5^o resolution)



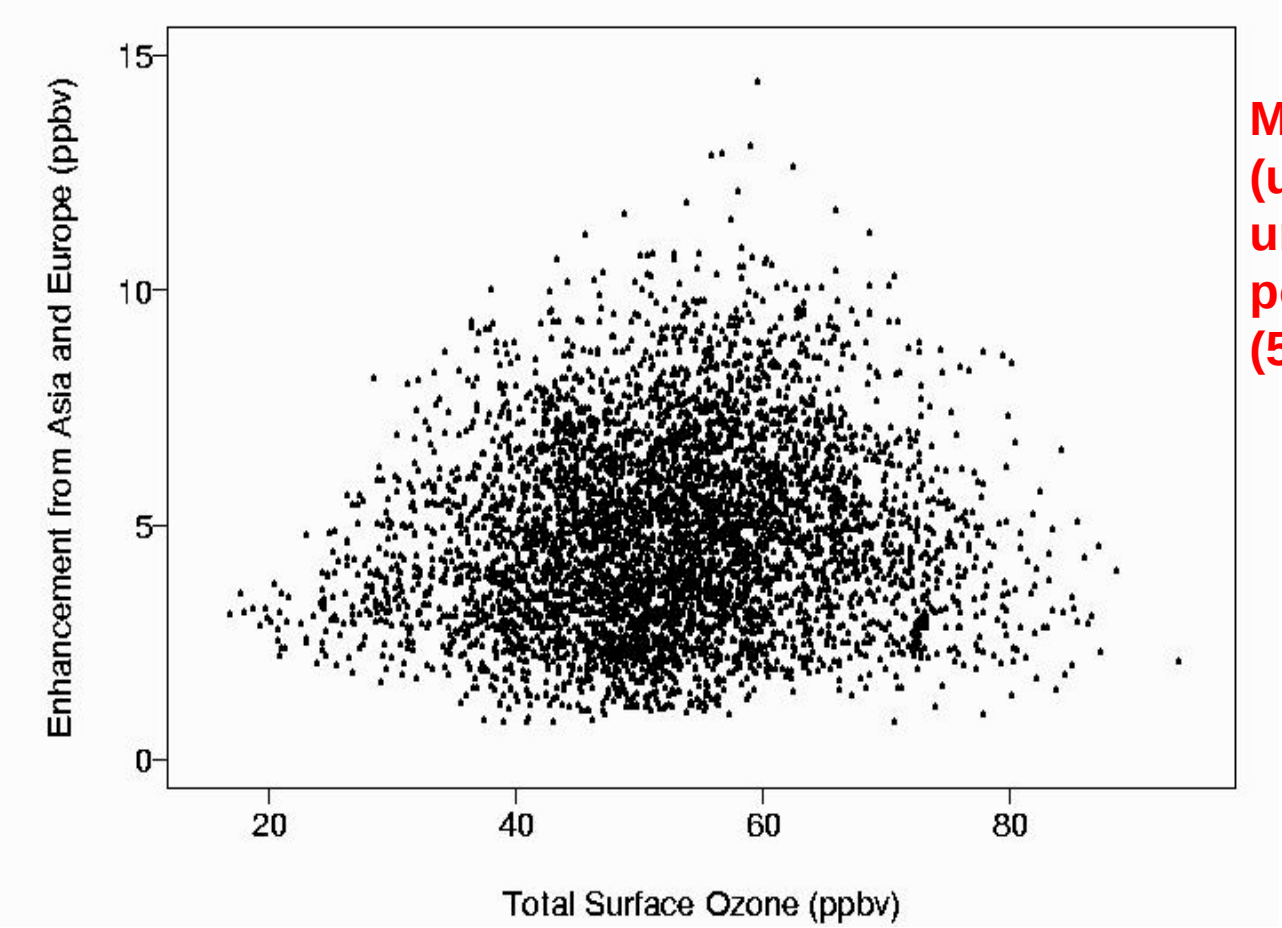
"Natural" background (no anthropogenic emissions of NO_x or NMHCs anywhere, but present-day CH_4)



Asian/European anthropogenic enhancement above natural background (no anthropogenic emissions in North America)

RANGE OF ASIAN/EUROPEAN POLLUTION OZONE ENHANCEMENTS OVER THE UNITED STATES

ensemble of model results, summer 1995



Max enhancements (up to 14 ppbv) under moderately polluted conditions (50-70 ppbv O3)

MAJOR CONCERN IF OZONE STANDARD WERE TO DECREASE TO 60 PPBV!