



*Observational-based Assessment of Contributions to
Southwest U.S. Maximum Ozone Concentrations*

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Retired from:

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Today:

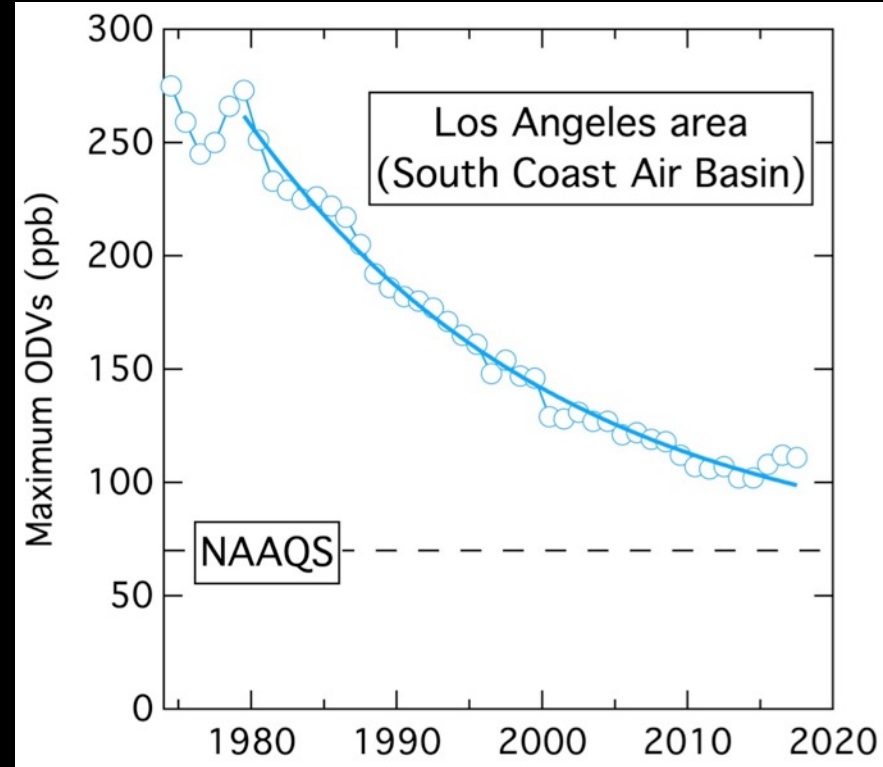
1. Briefly review Ozone National Ambient Air Quality Standard
2. Briefly review two 2017 papers
3. Differentiate between U.S. background and U.S. anthropogenic contributions to maximum ozone concentrations
4. Discuss some implications for Air Quality policies

Ozone National Ambient Air Quality Standard (NAAQS)

In 2015 the U.S. NAAQS for ozone was lowered to 70 ppb

Based on the ozone design value (ODV) - Annual 4th highest daily maximum 8-hour concentration, averaged over 3 years (98th percentile of 6 month ozone season)

After 6 decades of air quality improvement effort, ozone in Los Angeles still exceeds NAAQS.



Review two 2017 papers

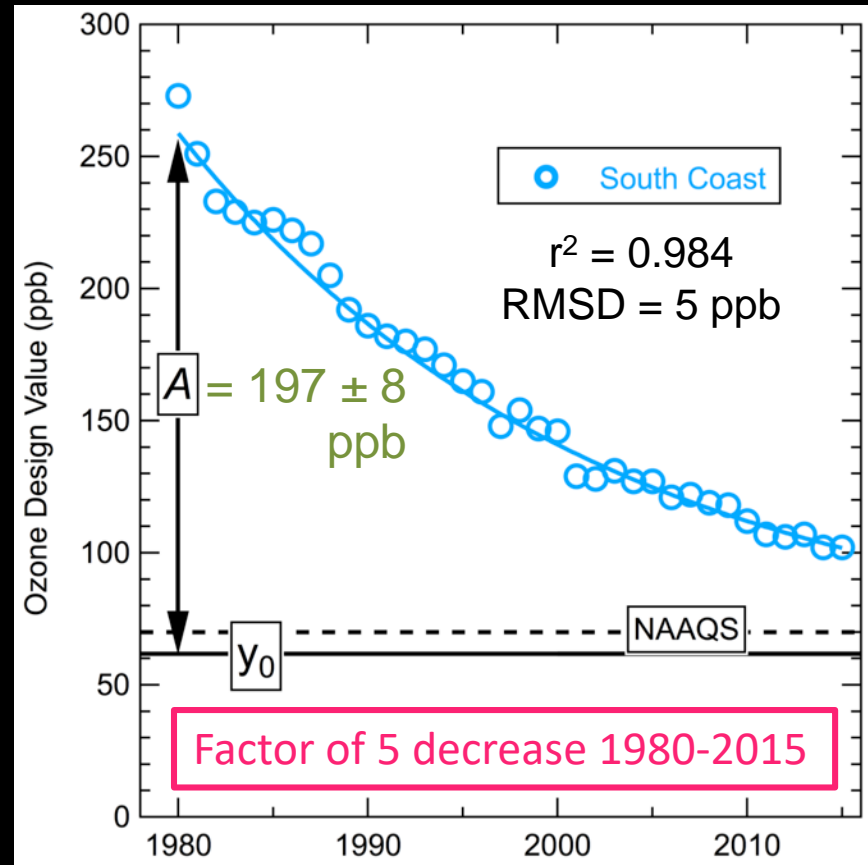
Parrish et al. [2017] estimated the U.S. background ODV: $y_0 = 62.0 \pm 1.8$ ppb (i.e., the ODV if U.S. anthropogenic ozone precursor emissions were reduced to zero), and ...

The U.S. anthropogenic ODV enhancement has been decreasing exponentially:

$$ODV = y_0 + A e^{-(year-1980)/\tau}$$

$$\tau = 21.9 \pm 1.2 \text{ years}; y_0 \text{ constant}$$

This exponential decrease is our marker for U.S. anthropogenic ozone contribution



Review two 2017 papers

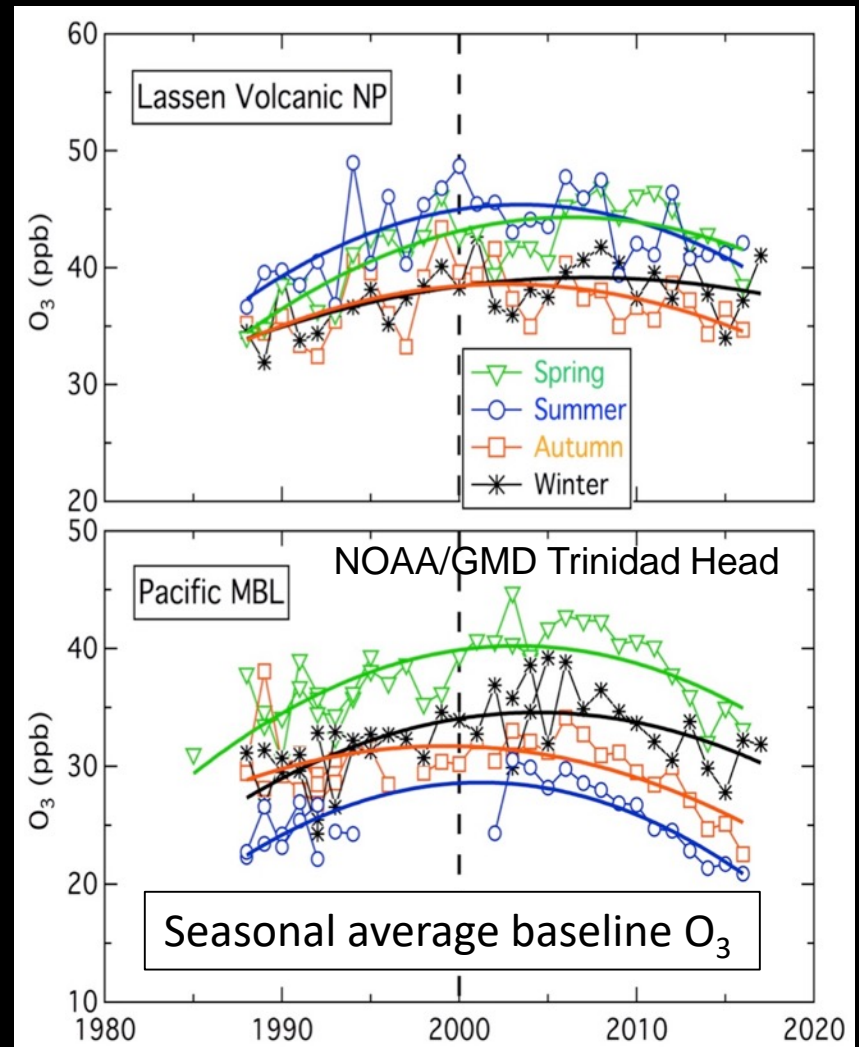
Parrish, Petropavlovskikh and Oltmans [2017] quantified the long-term changes in baseline ozone concentrations at U.S. west coast (i.e., the primary source of U.S. background ODV)

Quadratic polynomial fits

Fit maxima: 1999-2007

This increase -> maximum -> decrease is our marker for background ozone contribution

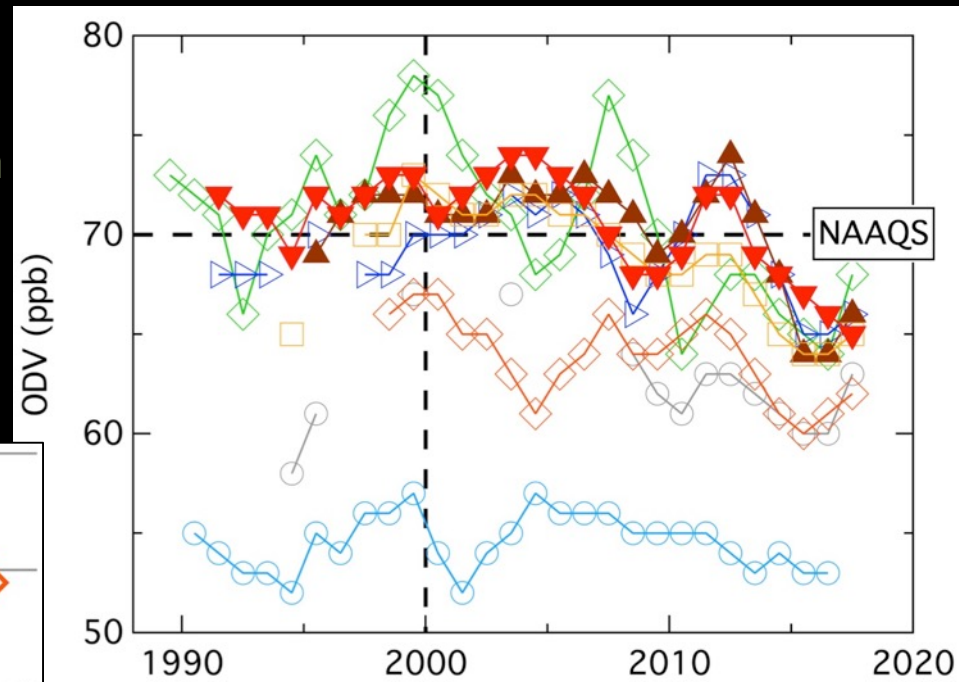
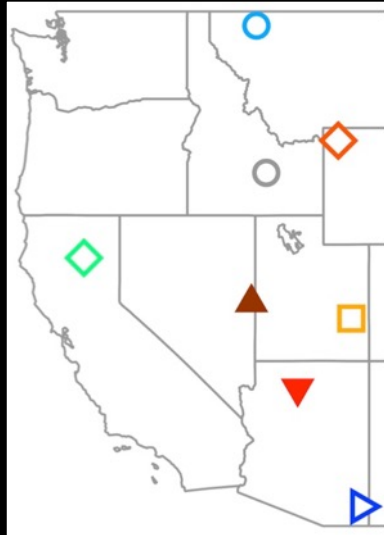
Parrish et al, Reversal of Long-Term Trend in Baseline Ozone Concentrations at the North American West Coast, *GRL*, 2017



Use these different long-term changes to differentiate between background and anthropogenic contributions to maximum ozone concentrations

Look at 8 National Park Service sites:

All at similar elevations
North to south positive gradient in ODVs



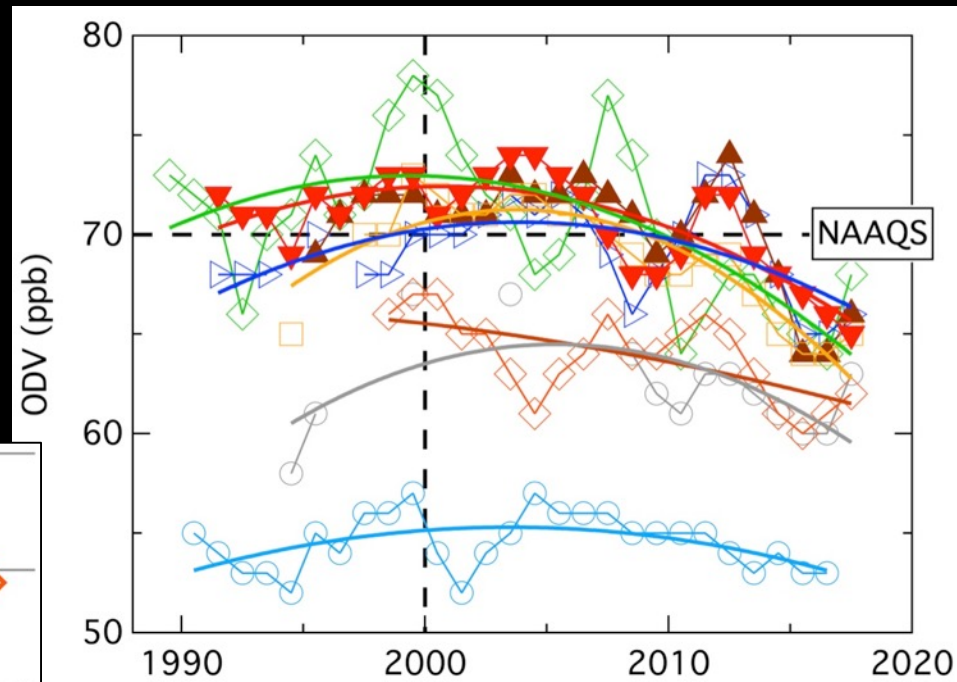
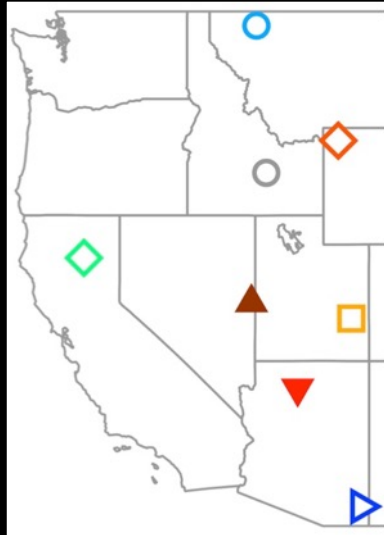
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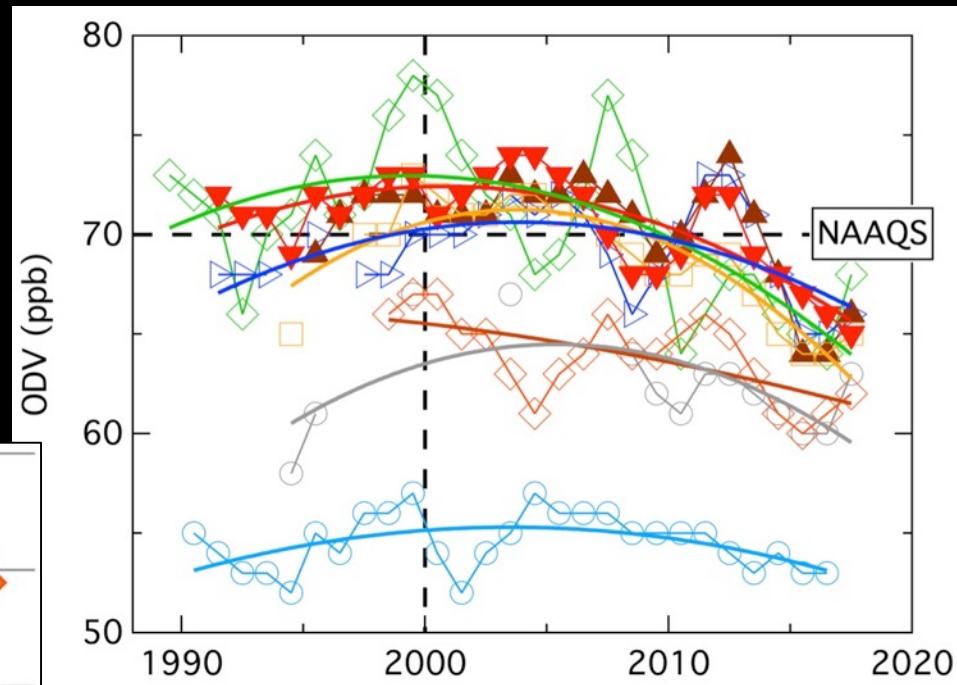
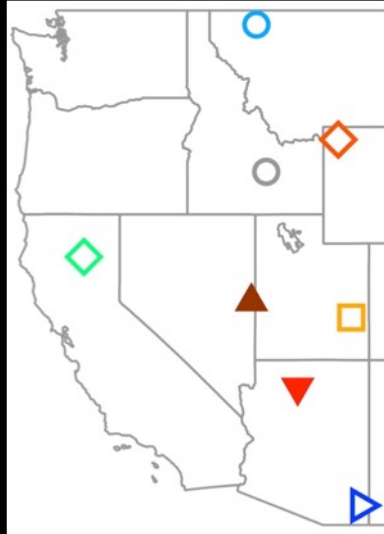
No statistically significant differences in fits to long-term changes (except Yellowstone NP)



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Look at 8 National Park Service sites:

Before ~ 2015 the maximum ODVs at the southern sites exceeded the 2015 ozone NAAQS

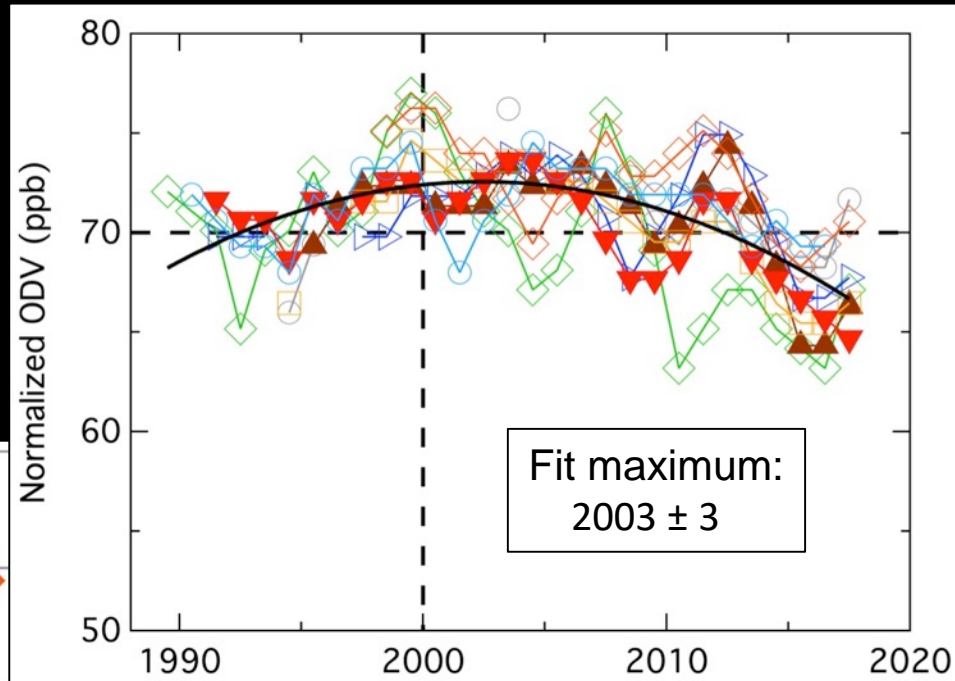
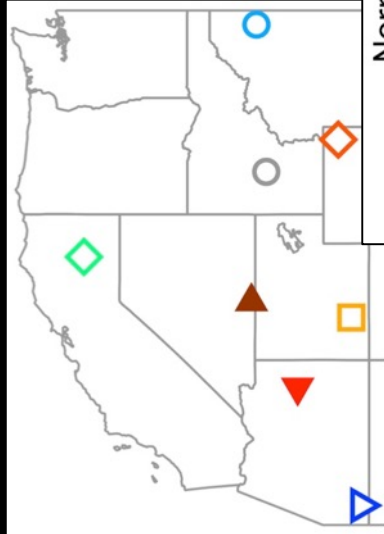


Use these different long-term changes to differentiate between background and anthropogenic contributions to maximum ozone concentrations

Look at 8 National Park Service sites:

Remove gradient by normalizing fit in 2000

Maximum of fit agrees with that found in GRL paper.



- Great Basin NP
- Grand Canyon NP
- Chiricahua NM
- Canyonlands NP
- Lassen NP
- Craters of the Moon NM
- Yellowstone NP
- Glacier NP

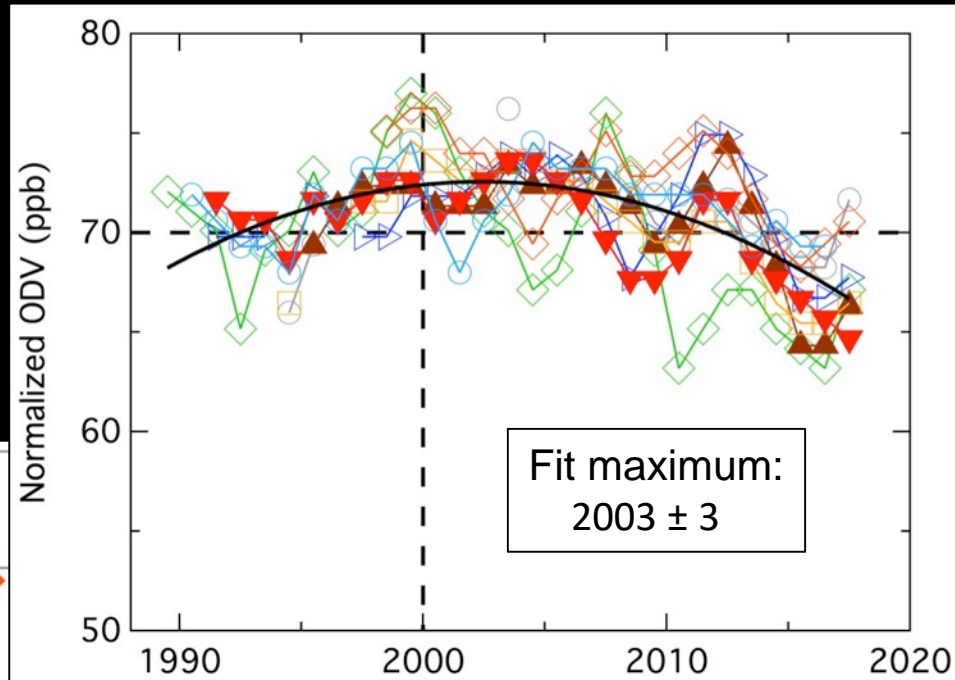
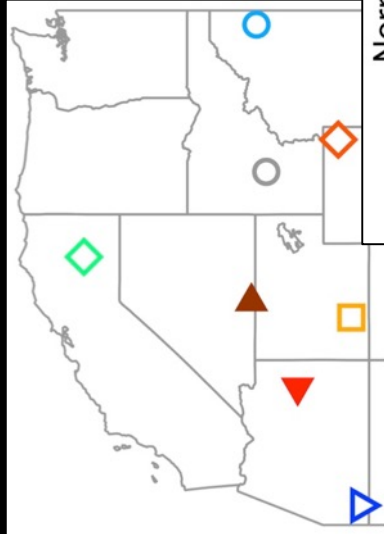
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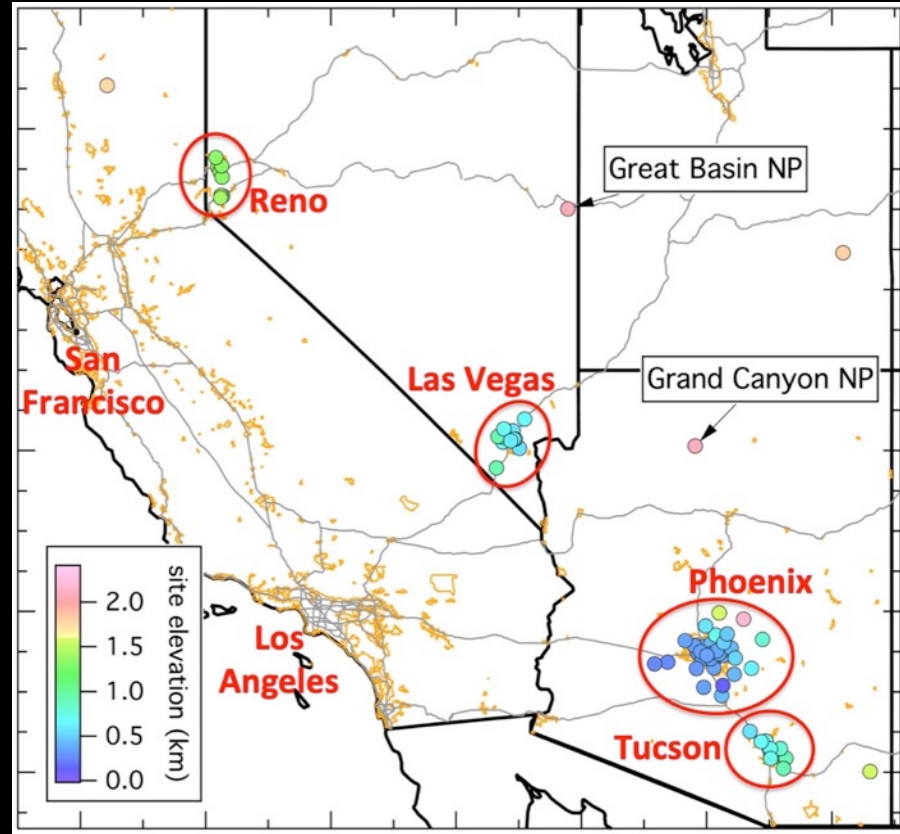
Maximum of fit agrees with that found in GRL paper.

No evidence for any U.S. anthropogenic contribution at any site!



Use these different long-term changes to differentiate between background and anthropogenic contributions to maximum ozone concentrations

Look at urban areas:

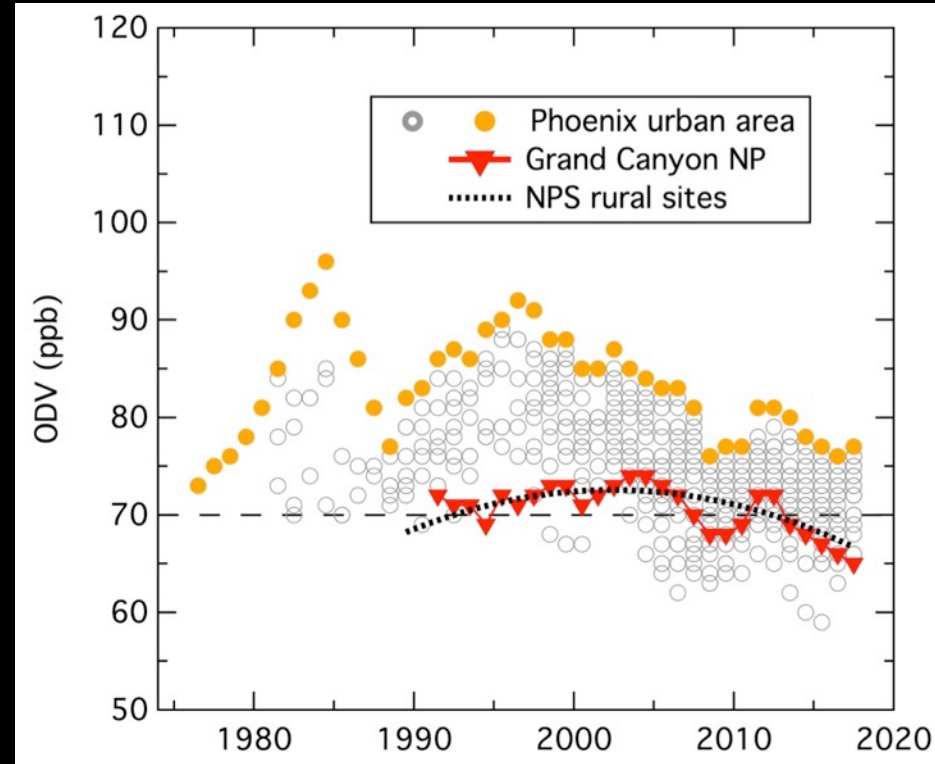


Use these different long-term changes to differentiate between background and anthropogenic contributions to maximum ozone concentrations

Look at urban areas:

Compare urban area with nearby NPS site, and fit to normalized NPS rural sites (dashed line).

Fit to difference between maximum urban ODVs and NPS rural fit.



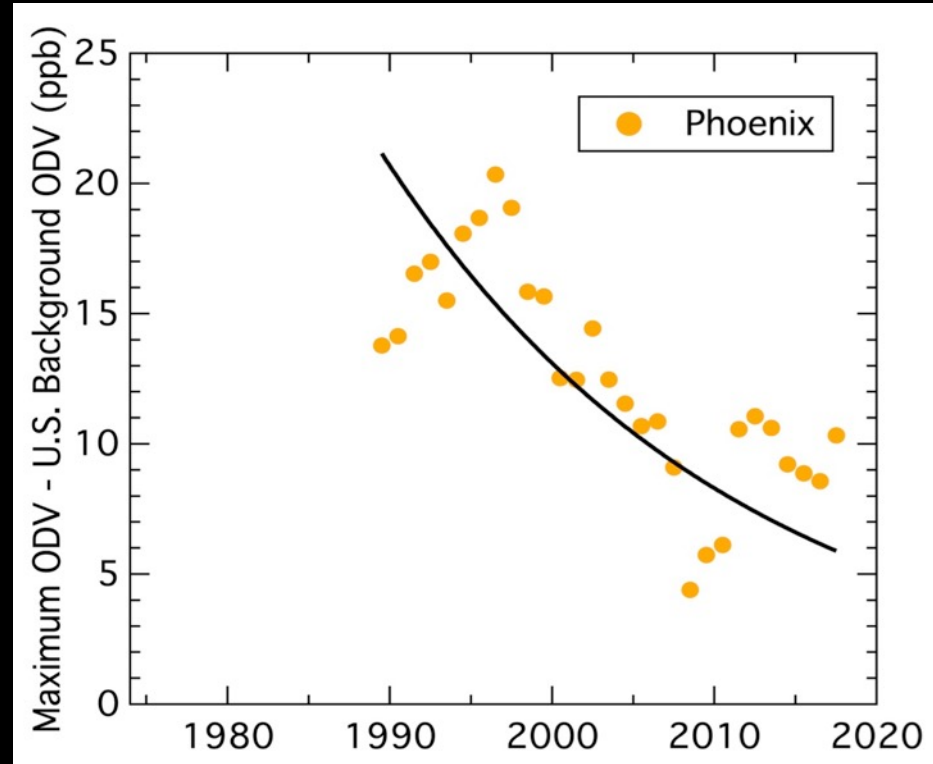
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$$ODV = y_0 + A e^{-(year-1980)/\tau}$$

y_0 set = to 0; τ set = to 21.9 years

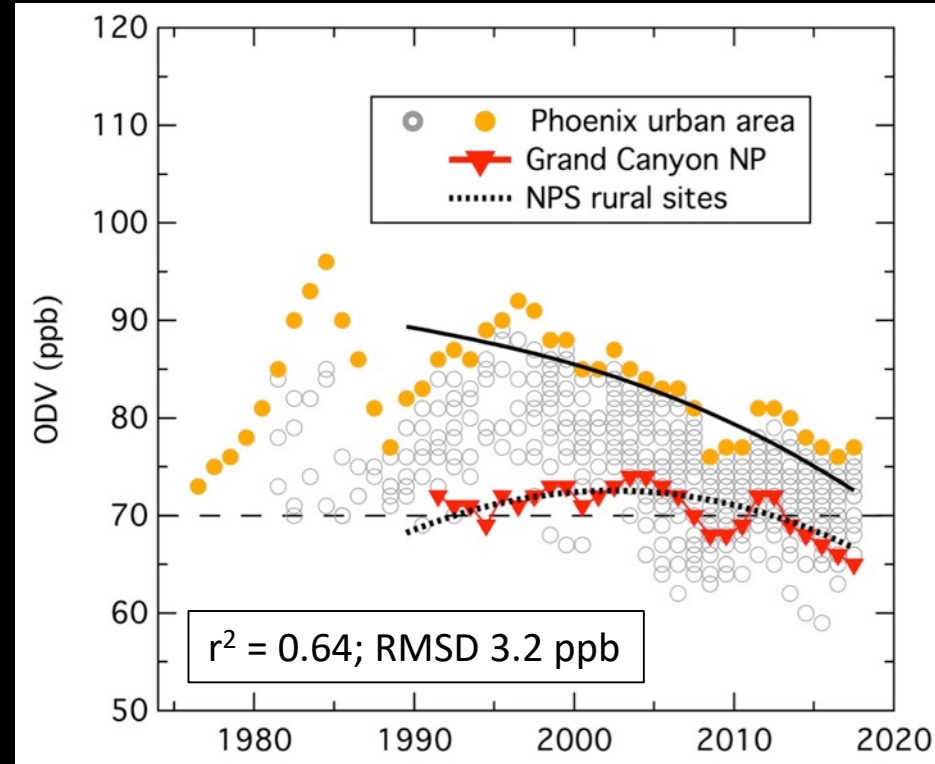


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Solid black line is fit to difference between maximum urban ODVs and NPS rural fit – Local anthropogenic contribution.

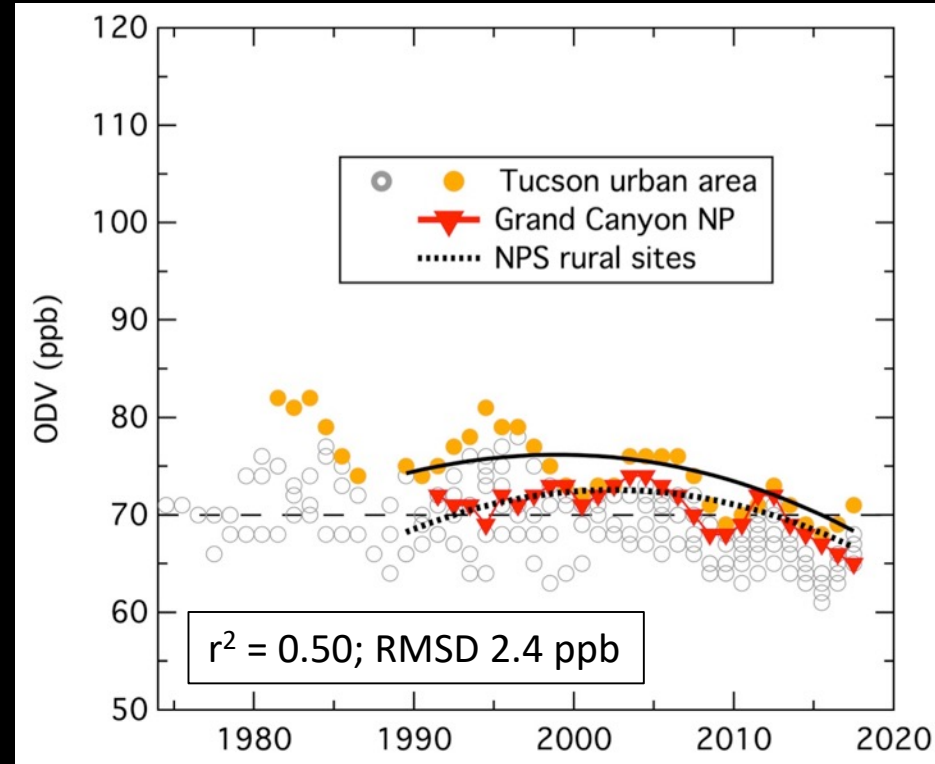


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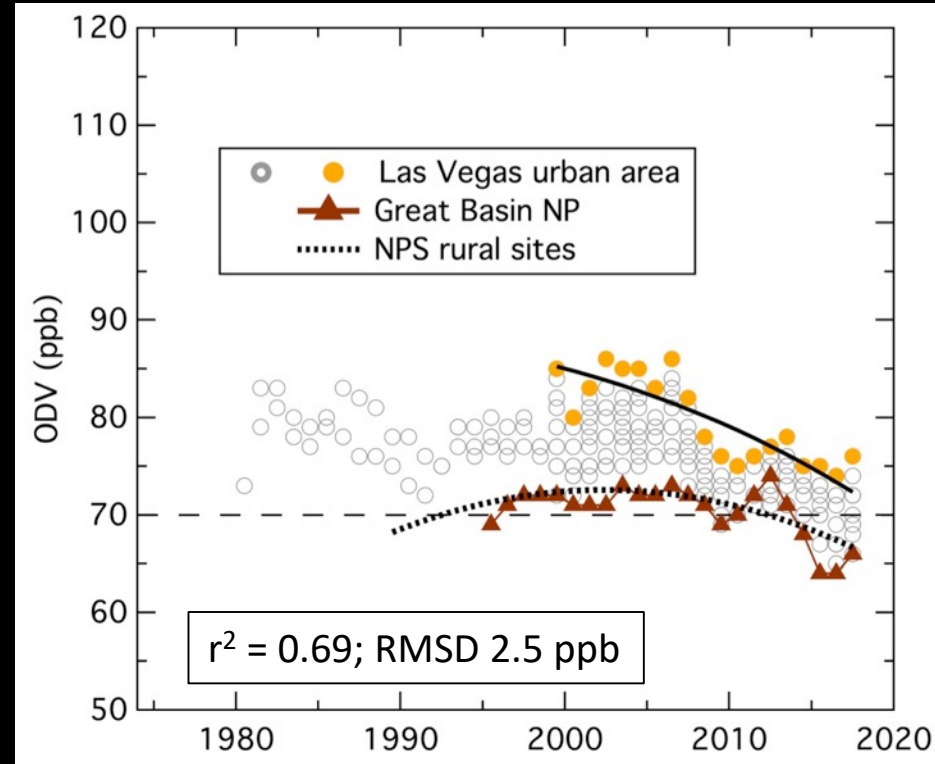


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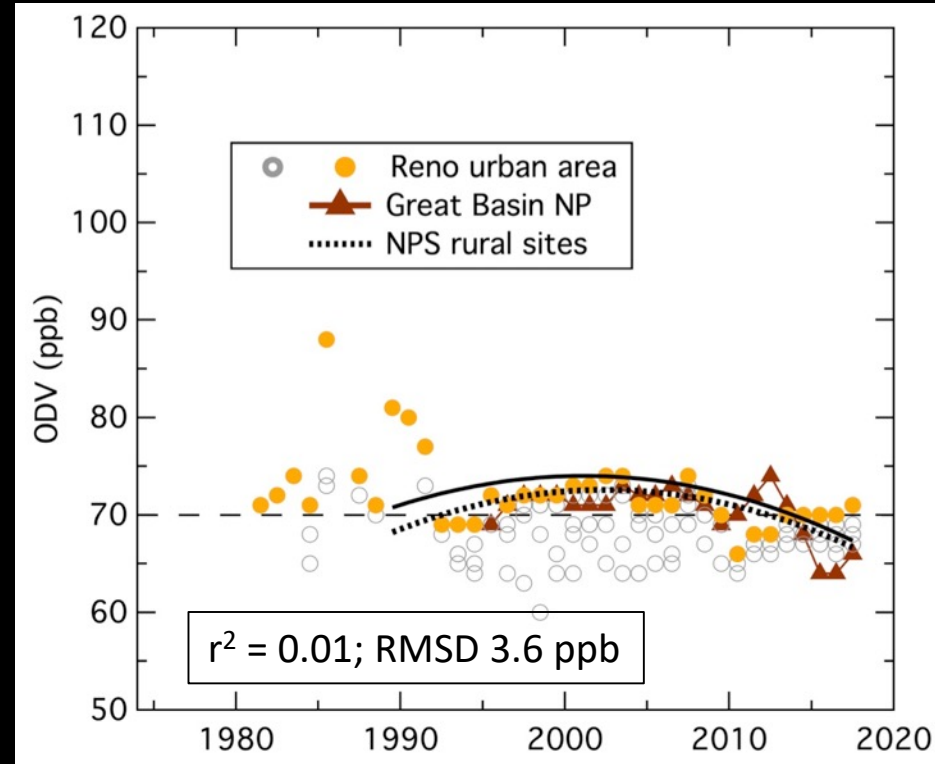
(New sites came online in 2000)

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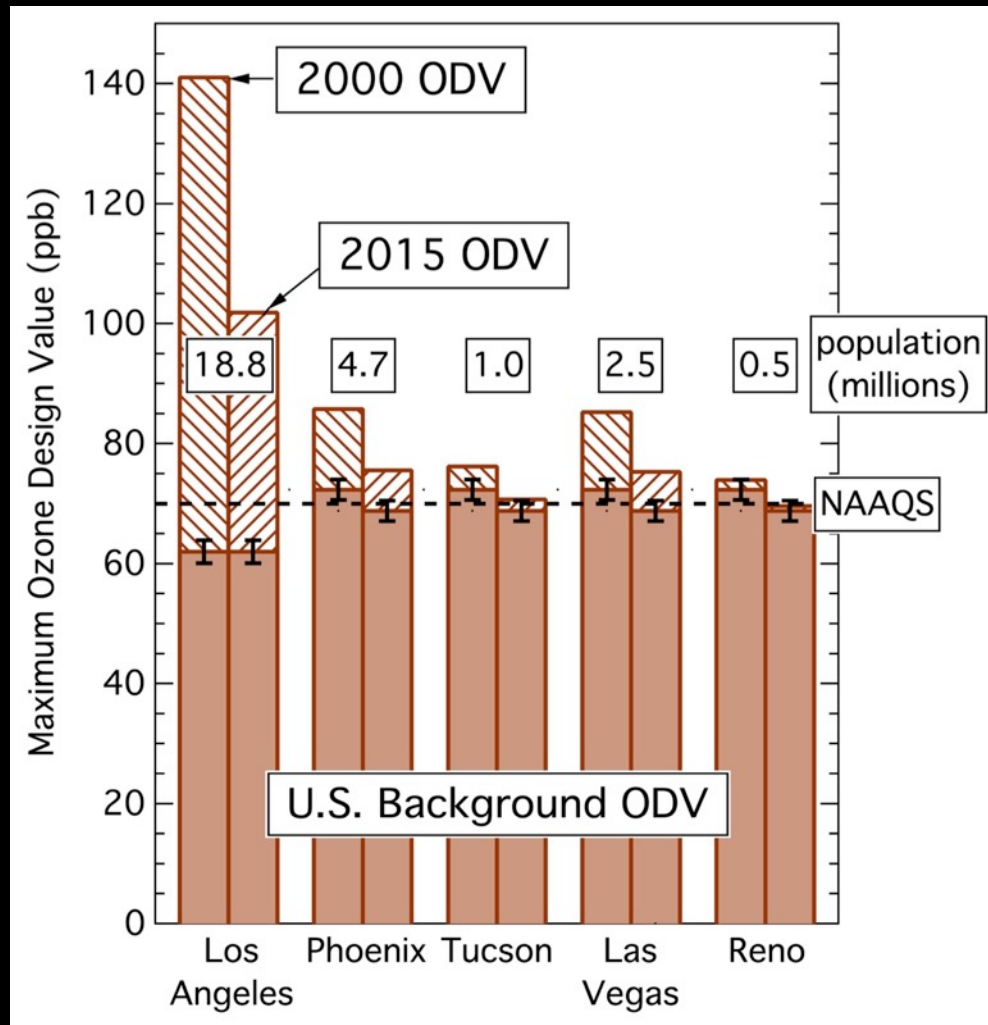
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Implications for Air Quality policies

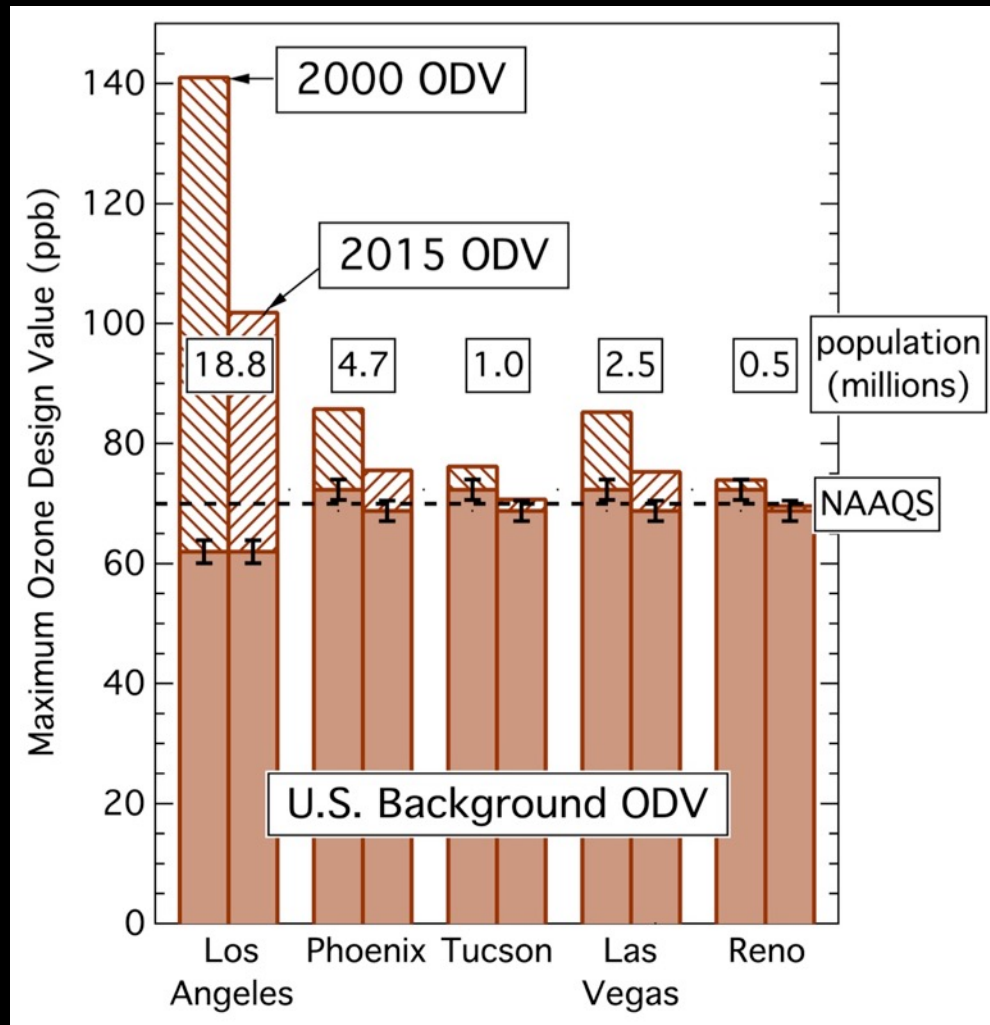
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U.S. background ODVs now constitute the majority of the maximum observed ODVs, even in the Los Angeles urban area



Implications for Air Quality policies

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Decreases in U.S. Background ODVs drive ODV decreases in SW U.S. urban areas

Thank you for your attention!

