

International and interstate transport of O_3 in Yuma and impact from NO_x emissions

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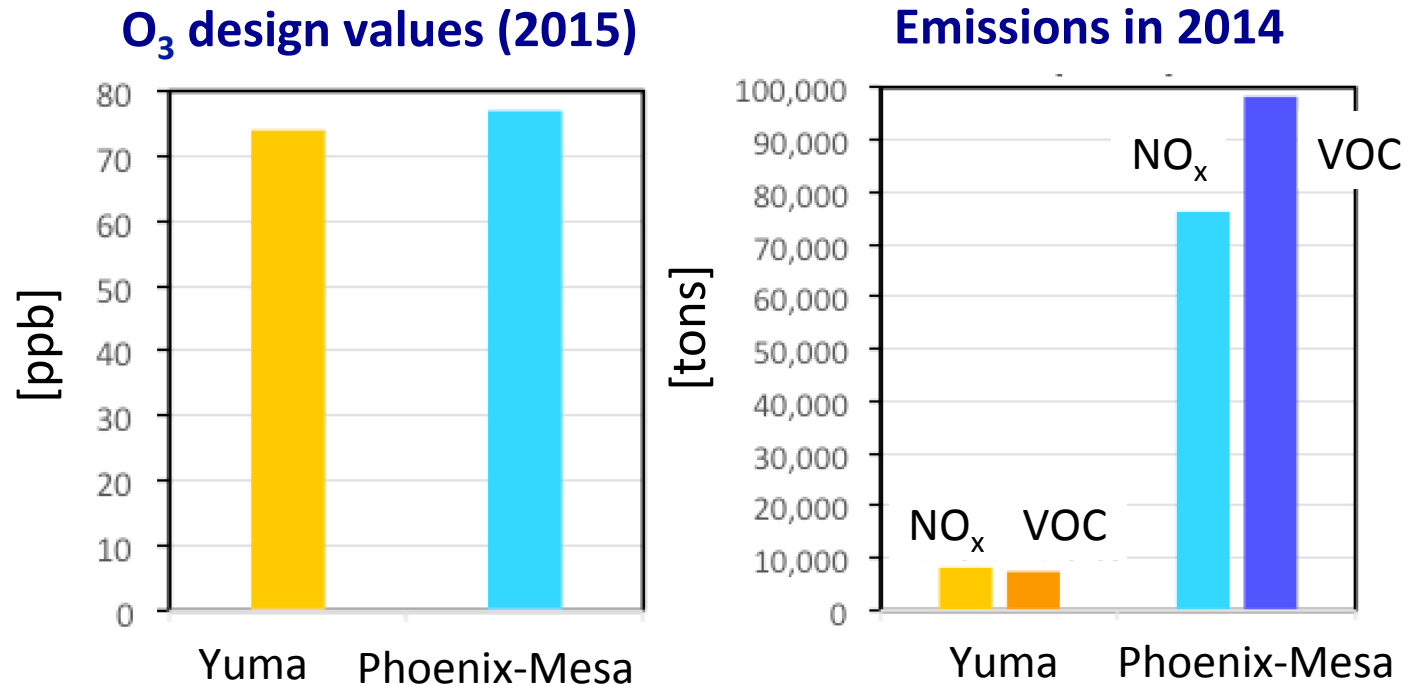
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Yuma is located near the borders of California and Mexico

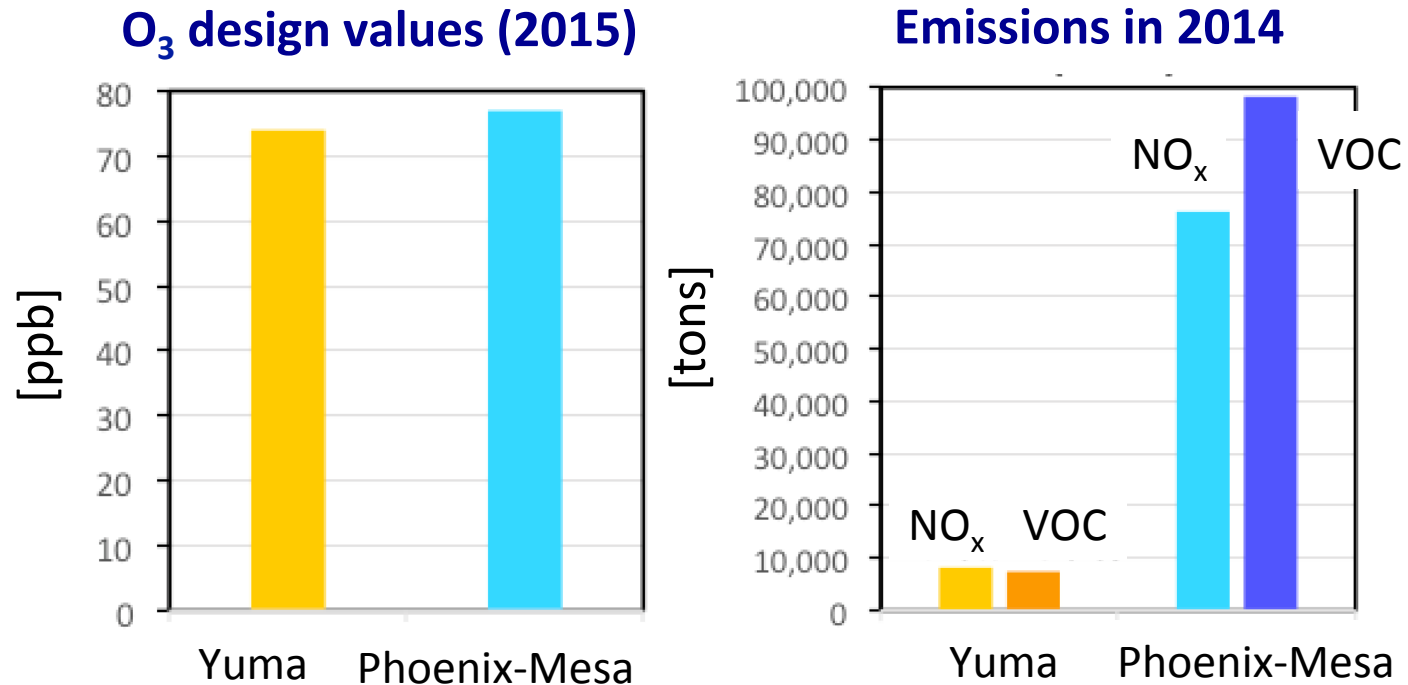


Two 8-Hour O₃ (2015) Non-attainment Areas in Arizona



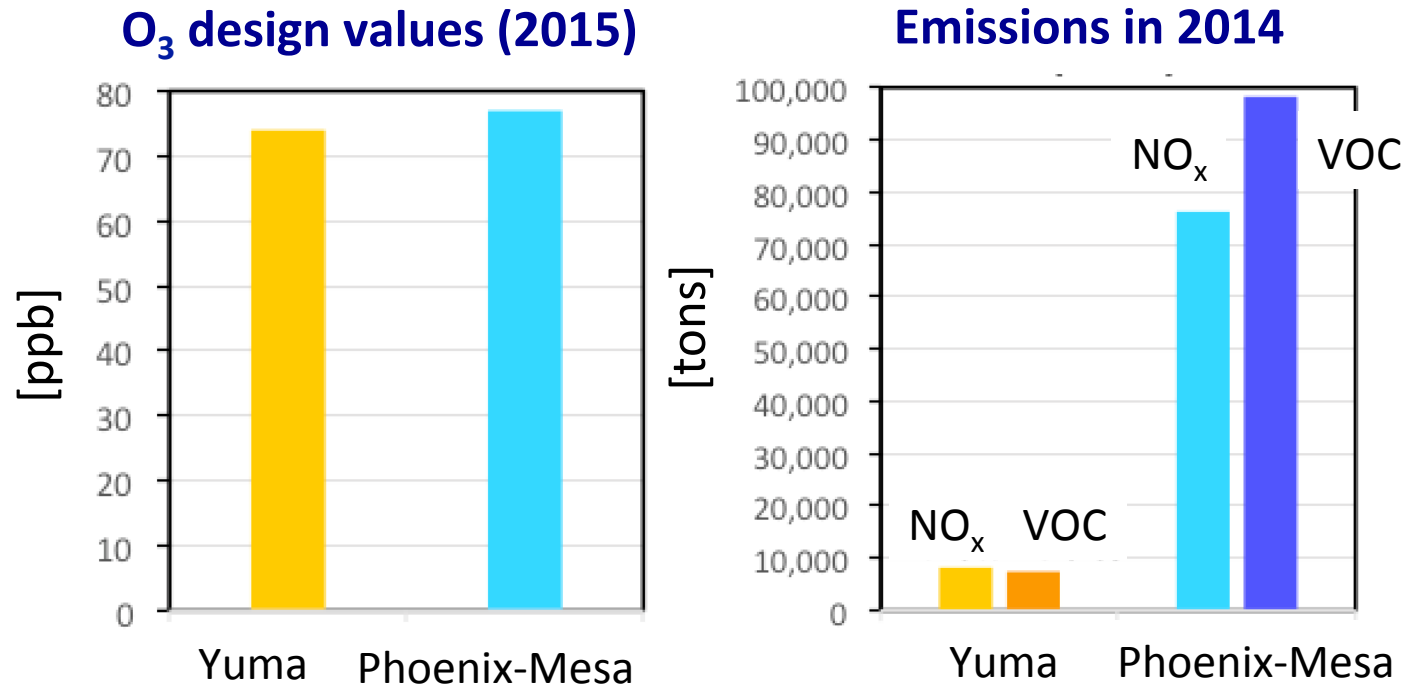
- Similar O₃ design value: Yuma (72 ppb), Phoenix (76 ppb).
- Population: Yuma is 6.6% of population in Phoenix (2017).

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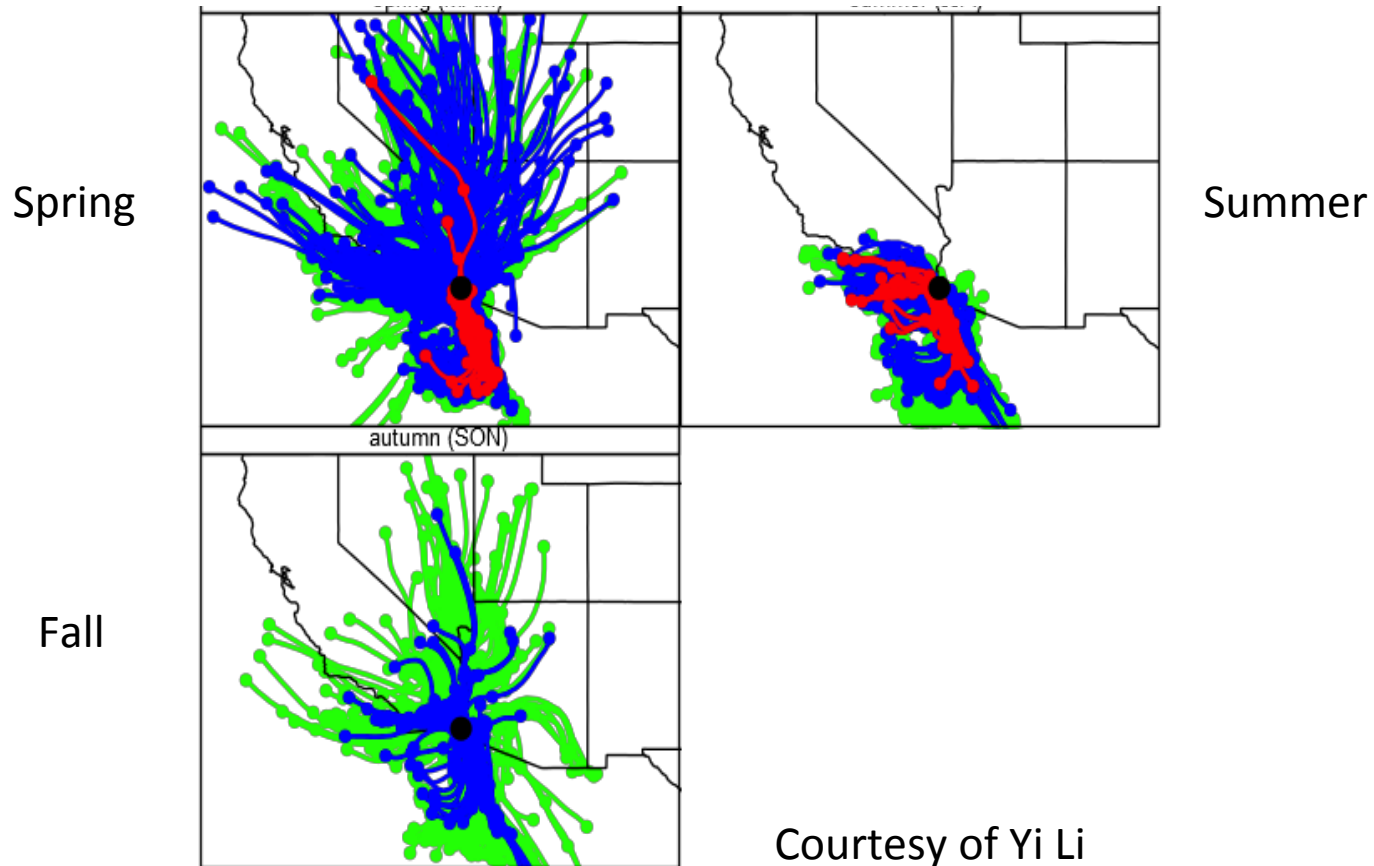
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- Population: Yuma is 6.6% of population in Phoenix (2017).
- 8 O₃ exceedances at Yuma Supersite in 2017.
- Question: Sources of O₃ in Yuma besides local emissions?

HYSPLIT 24 hours back trajectory of O₃ in Yuma



Hourly O₃ concentration at the start of back trajectory

0 – 50 ppb

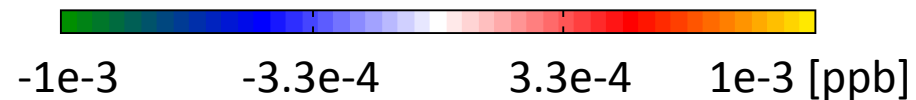
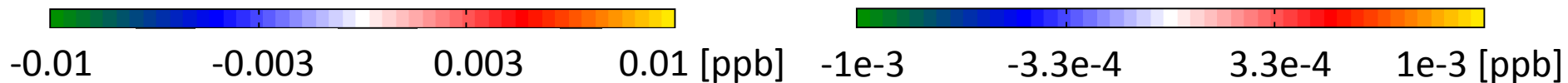
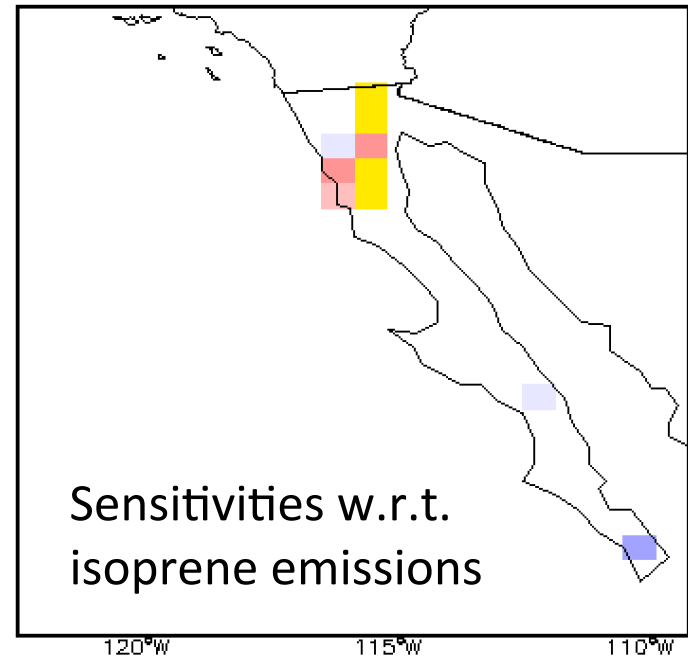
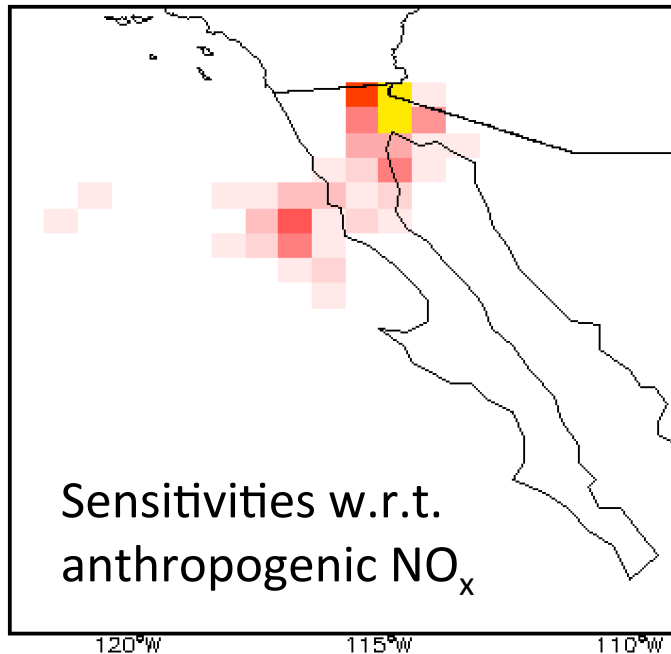
50 – 70 ppb

> 70 ppb

- High O₃ concentration mostly comes from the south and the west (2013 & 2014), suggesting international and interstate transport.

Sensitivity of Yuma O_3 to O_3 precursor emissions

Sensitivity of O_x at 16:00 on July 31st in Yuma to emissions in all of July

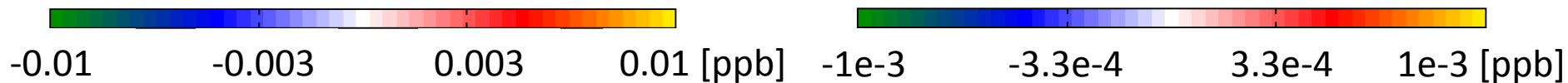
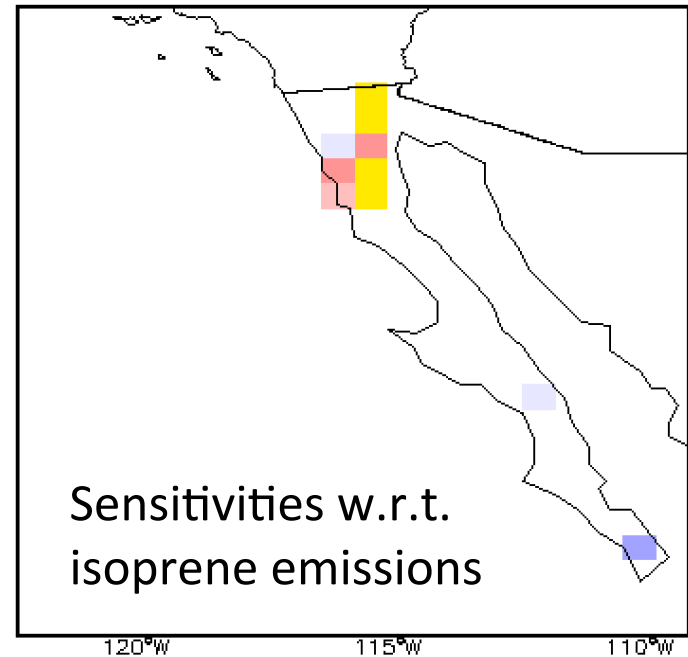
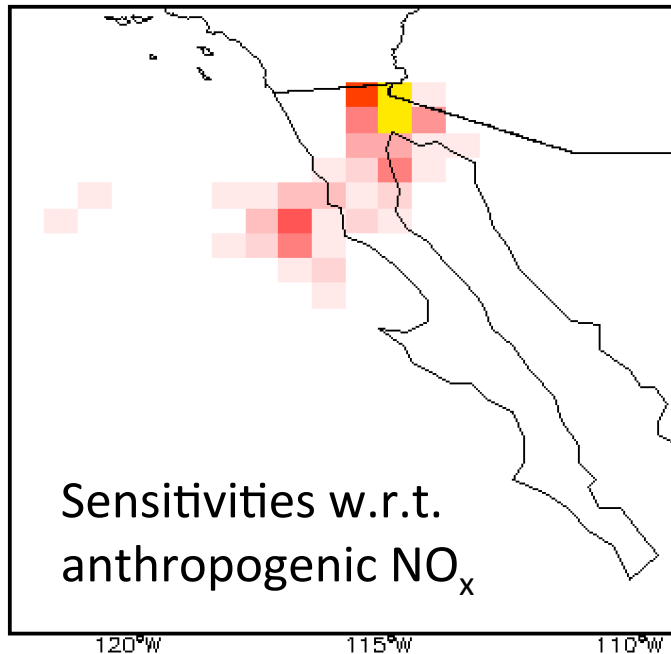


Sensitivity footprint computed with GEOS-Chem adjoint model

- O_x in Yuma is most sensitive to NO_x and isoprene emissions in Mexico

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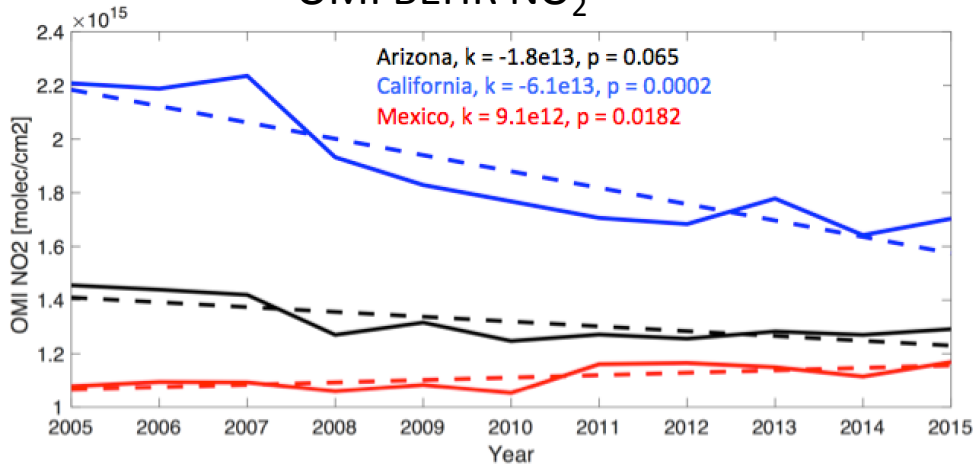


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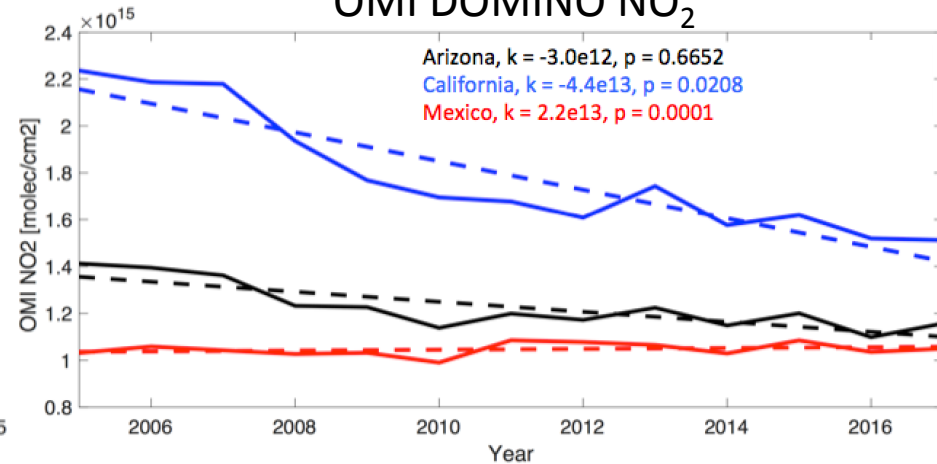
- O_x in Yuma is most sensitive to NO_x and isoprene emissions in Mexico
- Eliminating anthropogenic NO_x emission in Mexico reduces annual mean O_3 in Yuma by 5.3% - 6.4%

How O₃ precursors change?

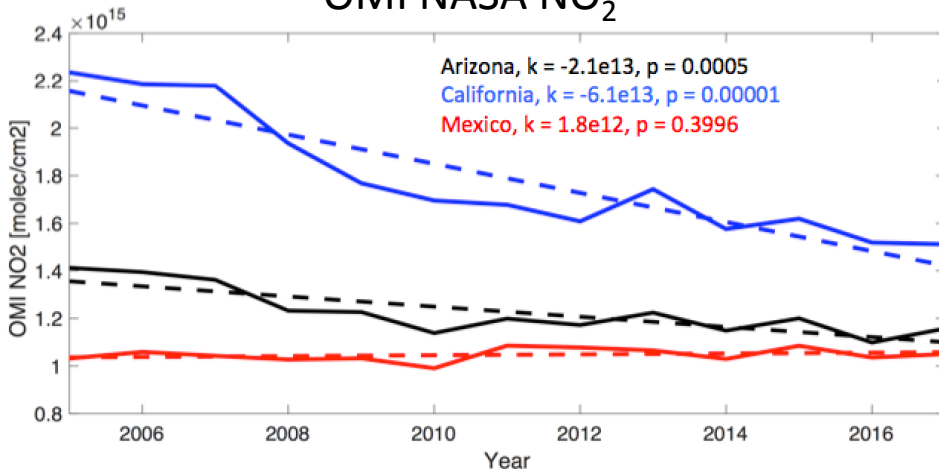
OMI BEHR NO₂



OMI DOMINO NO₂



OMI NASA NO₂

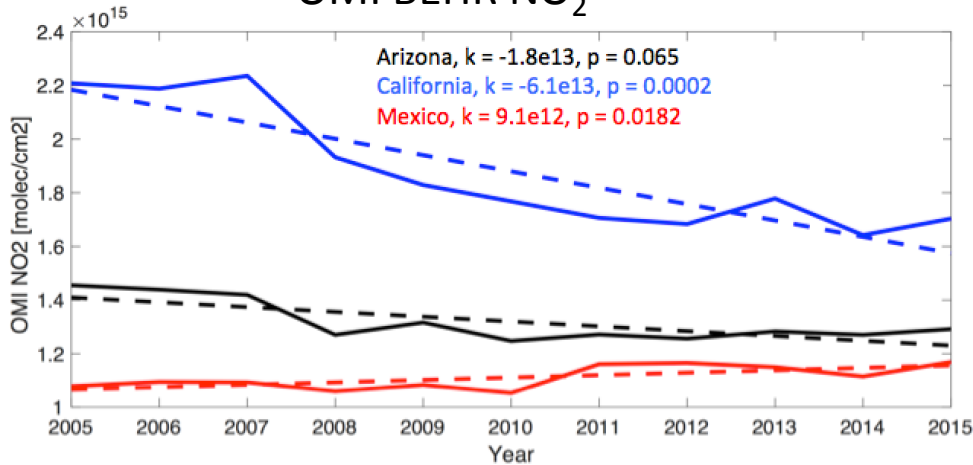


— Arizona
— California
— Mexico

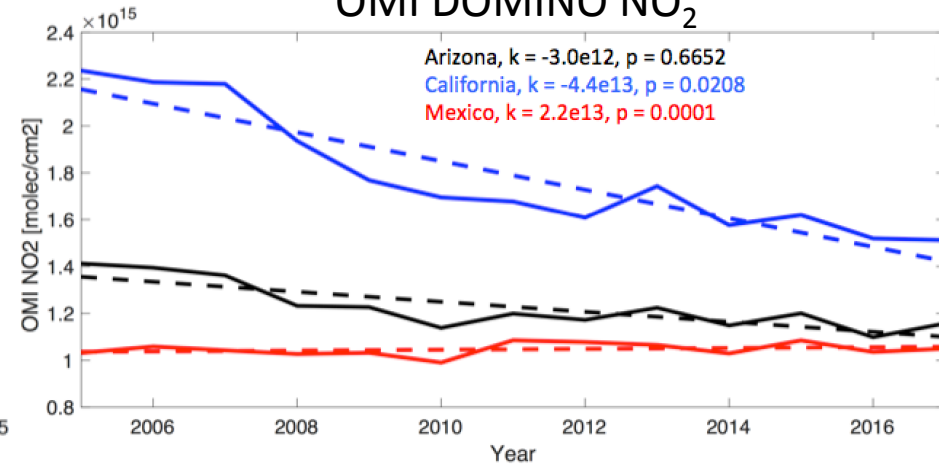
- NO₂ increases in Mexico in the BEHR and DOMINO products (statistically significantly).

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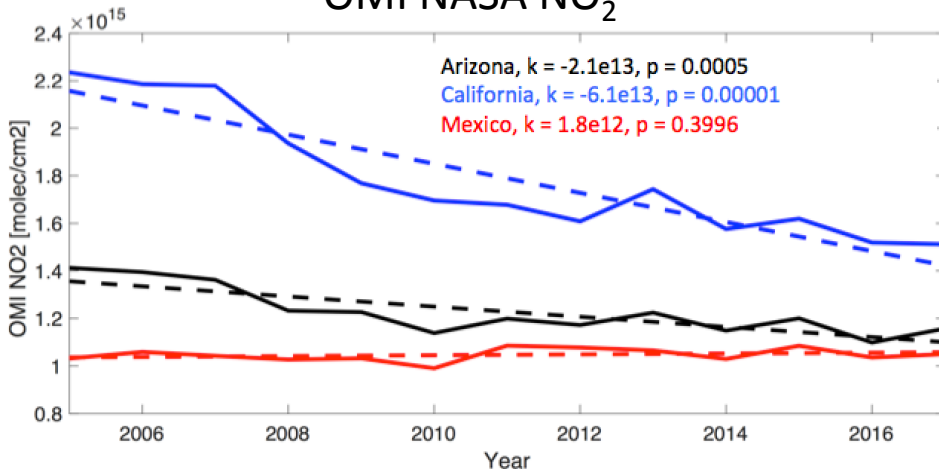
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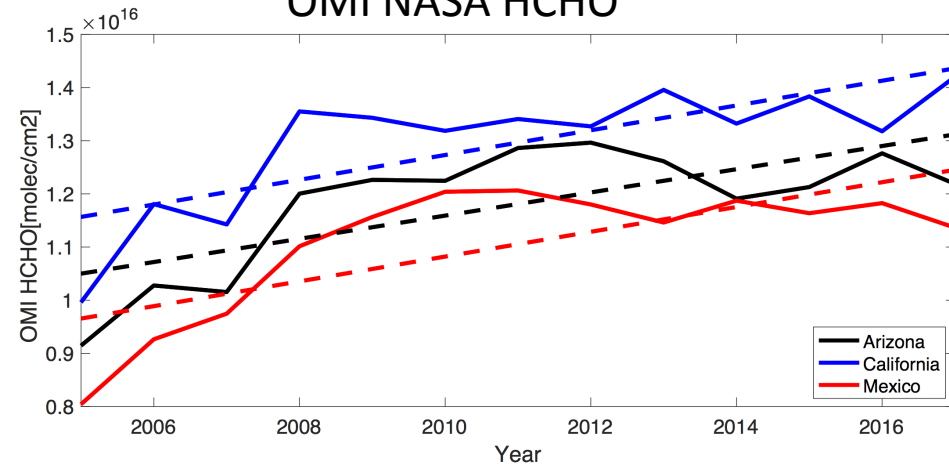
OMI DOMINO NO₂



OMI NASA NO₂



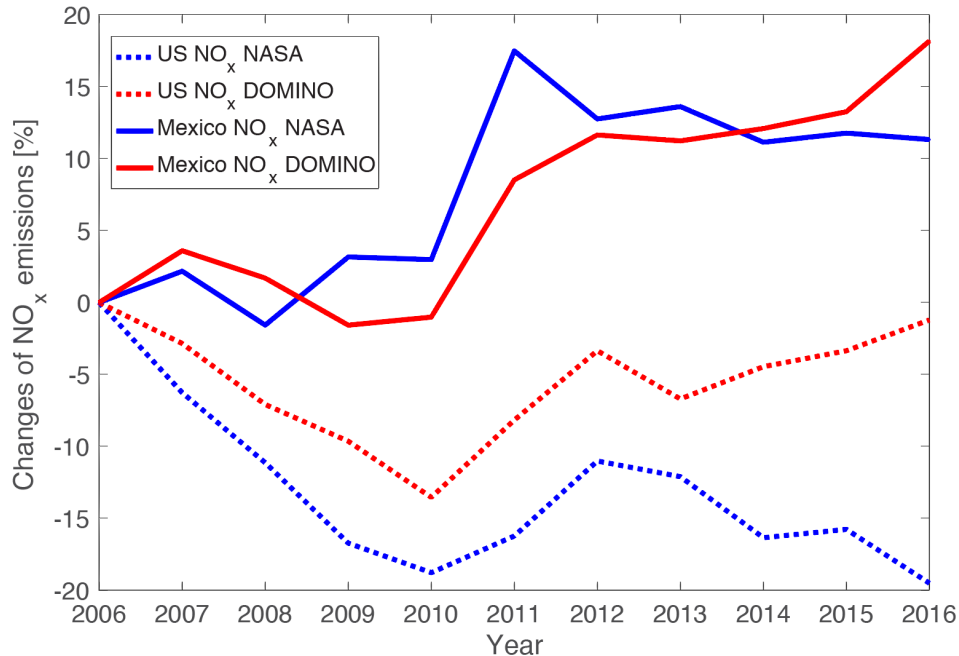
OMI NASA HCHO



- NO₂ increases in Mexico in the BEHR and DOMINO products.
- Zhu et al. [2017] shows increase of HCHO around Arizona is mainly due to changes in temperature.

Anthropogenic and meteorological impacts on O₃ changes

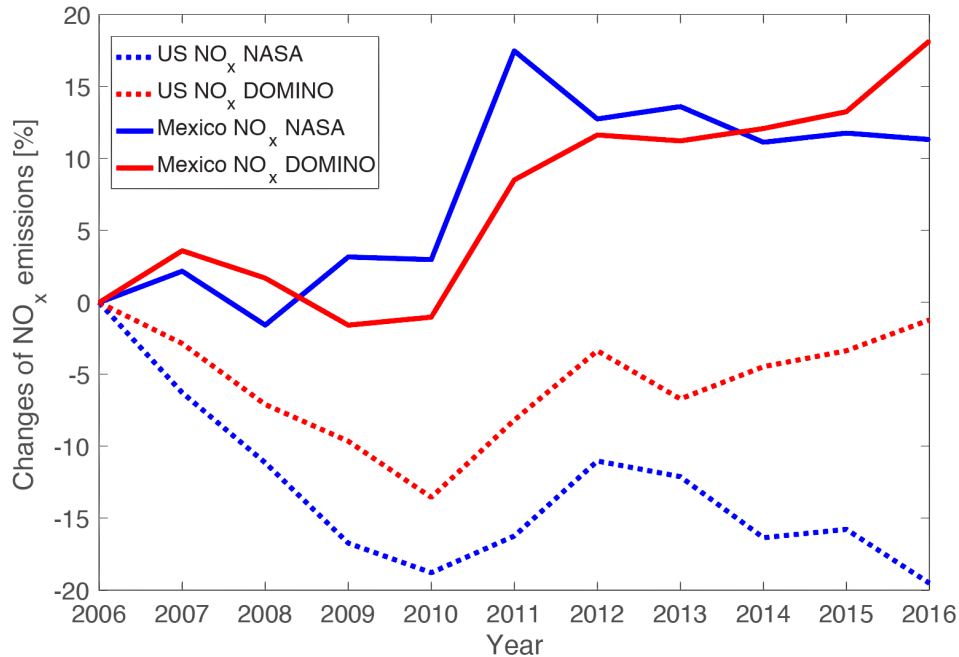
Changes in annual NO_x budget



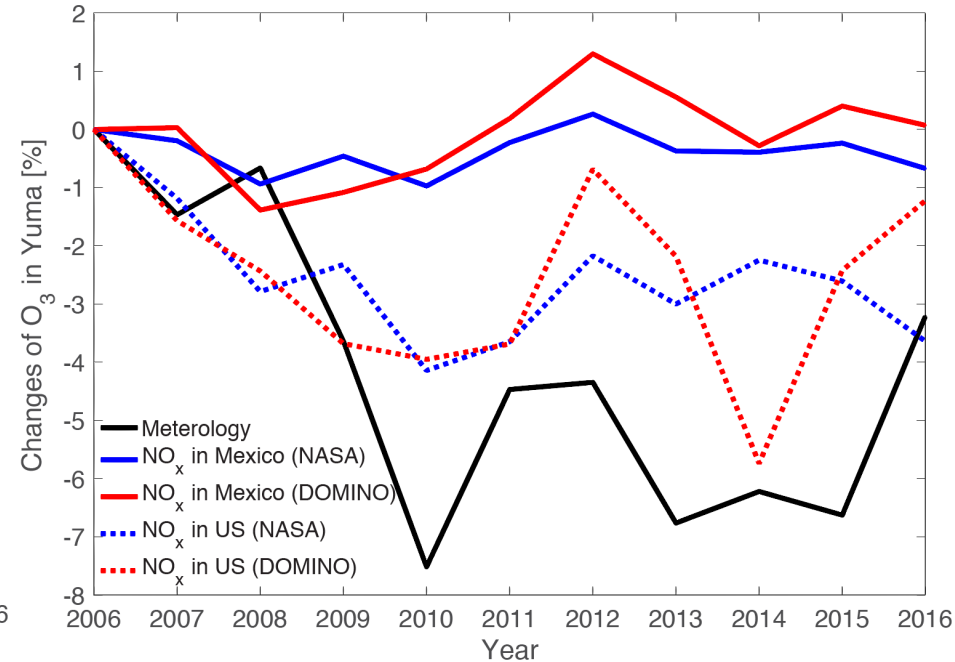
- NO_x emissions decrease by 19.5 – 26.3 % in the US and increase by 11.3 – 18.2 % in Mexico from 2006 – 2016.

Anthropogenic and meteorological impacts on O₃ changes

Changes in annual NO_x budget



Changes of summertime O₃ in Yuma



- NO_x emissions decrease by 19.5 – 26.3 % in the US and increase by 11.3 – 18.2 % in Mexico from 2006 – 2016.
- NO_x emissions in Mexico contribute to less than 1.4% changes in O₃.
- NO_x in US contribute to 0.7% - 5.7% decrease in O₃.
- Meteorology lead to up to 7.5% decrease of O₃ in Yuma.



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- **Summer average**: Trend of O_3 concentration in Yuma is more affected by meteorology and reduction of NO_x emissions in US than increasing NO_x emissions in Mexico – long-term health effects.



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- **Summer average**: Trend of O_3 concentration in Yuma is more affected by meteorology and reduction of NO_x emissions in US than increasing NO_x emissions in Mexico – long-term health effects.
- **Next steps:**
 - Distinguish transport of O_3 v.s. precursors
 - Trend of O_3 at exceedance days