



Impact of the 2008 Great Recession on NOx emissions in US large cities

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The Great Recession:

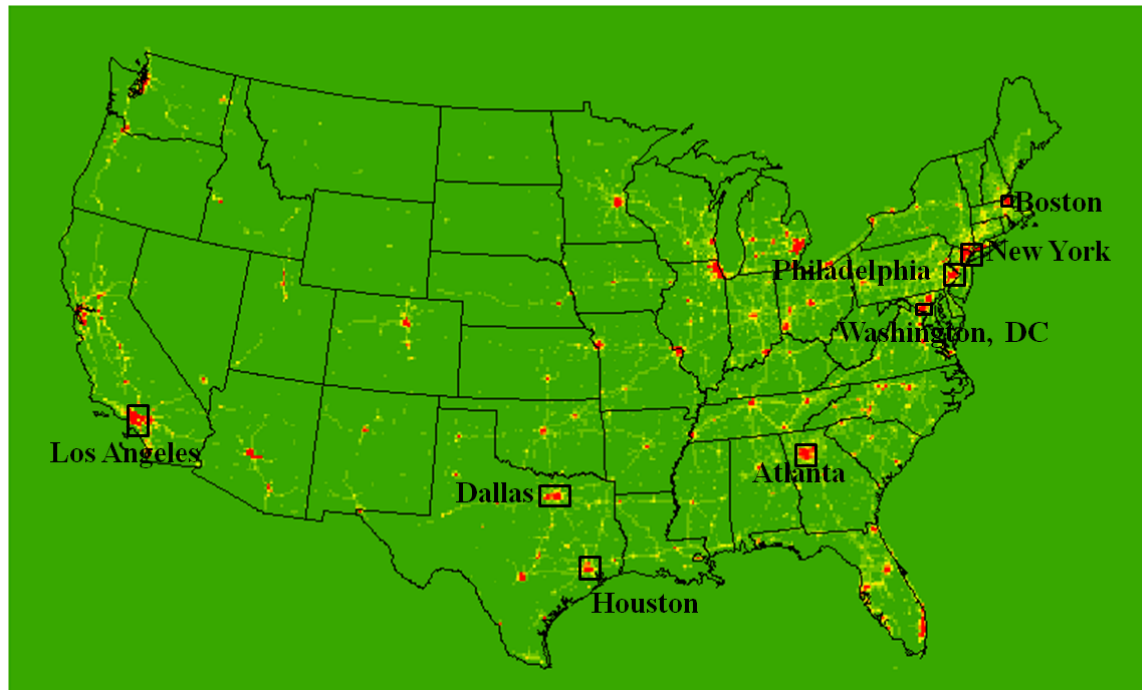
- ❖ **Cause: Bursting of the housing bubble in 2007, followed by a subprime mortgage crisis in 2008;**
- ❖ **Impacts:**
 - **Unemployment rate: 4.7% in Nov 2007 → 10.1% in Oct 2009.**
 - **Poverty rate: 12% → 16% (50 millions);**
 - **GDP: contract by 5.1%;**
- ❖ **Worst economic recession since the Great Depression**

Question: What does it mean to Air Quality?



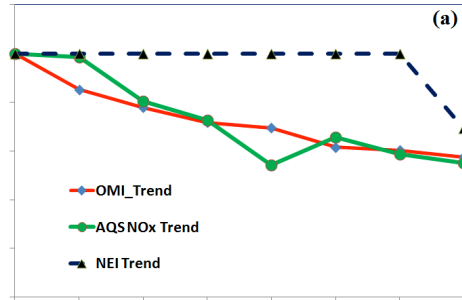
Research Approach

- ❖ **Data sources**
 - Satellite remote sensing (OMI-Aura).
 - Ground monitoring (EPA AQS);
 - Emission inventories (ARL NAQFC emissions);
- ❖ **Deriving the trend:** $(Y2 - Y1) / Y1 \times 100\%$
- ❖ **Selection of urban areas**

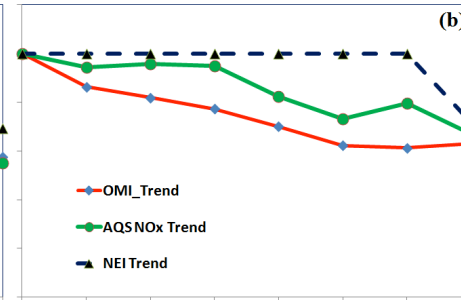


NOx Emission Trend: Satellite, Ground, and NEIs

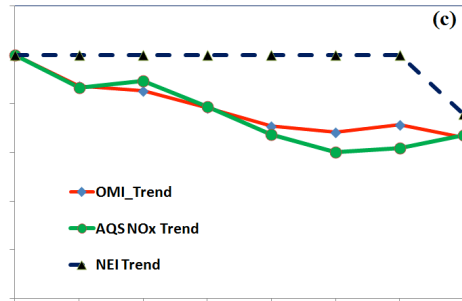
Atlanta



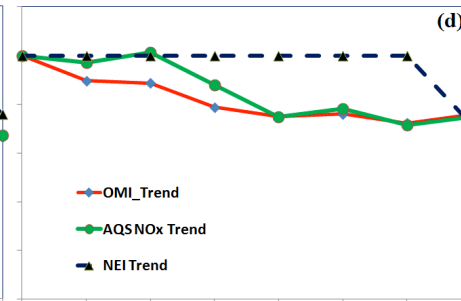
Boston



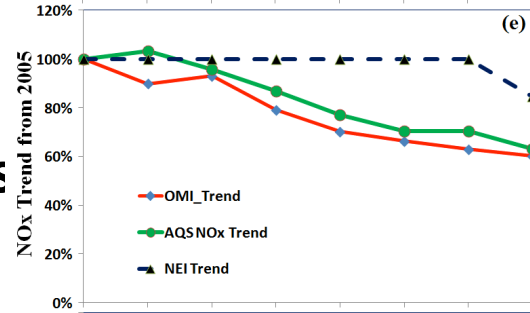
Dallas



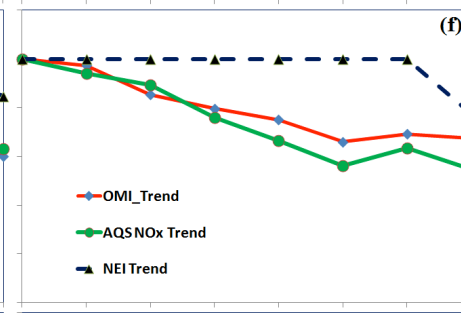
Houston



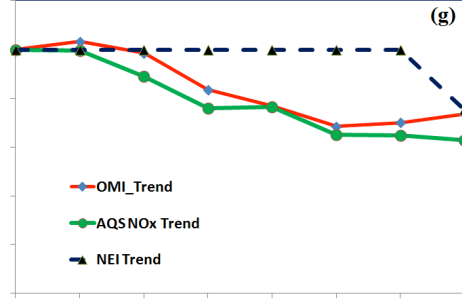
Los Angeles



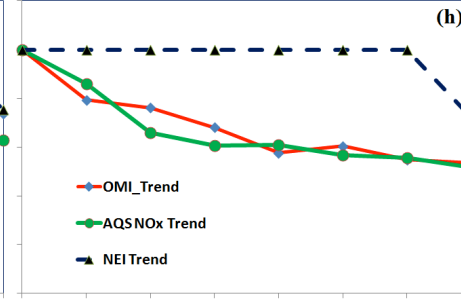
New York



Philadelphi



Washington,
DC



Year

NOx Changes

Prior to, during and after the Recession

Stage	Sources	Atlanta	Boston	Dallas	Houston	Los Angeles	New York	Philadelphia	Washington, DC	Mean
Before	OMI SP	-11.7	-9.4	-7.5	-5.7	-3.3	-7.5	-0.6	-12.3	-7.3
	AQS	-9.9	-2.1	-5.2	0.7	-2.0	-5.5	-5.5	-18.7	-6.0
During	OMI SP	-5.5	-7.5	-8.9	-7.9	-13.1	-6.2	-11.7	-13.0	-9.2
	AQS	-17.5	-7.0	-13.0	-14.0	-10.3	-13.6	-7.0	-3.7	-10.8
After	OMI SP	-6.0	-3.3	-2.1	0.4	-5.0	-3.2	-1.2	-2.3	-2.8
	AQS	1.4	-6.1	0.1	0.2	-6.4	-5.4	-6.1	-5.3	-3.4

- ❖ **Distinct regional difference;**
- ❖ **Consistent overall patterns from OMI and AQS;**
- ❖ **-6%/yr - -7%/yr prior to Recession;**
- ❖ **-9%/yr - -11%/yr during Recession;**
- ❖ **-3%/yr after Recession (Recovery?).**

Summary

- ❖ **Derived long-term urban NO_x trend from satellite (OMI) and ground observations (AQS);**
- ❖ **Revealed consistent NO_x responses to the 2008 Economic Recession by OMI and AQS (-6%, -10%, and -3% reduction per year before, during and after the Recession);**
- ❖ **The trend was not well captured by emissions used for national air quality forecasting;**
- ❖ **Demonstrated how to use space and ground observations to evaluate emission updates.**