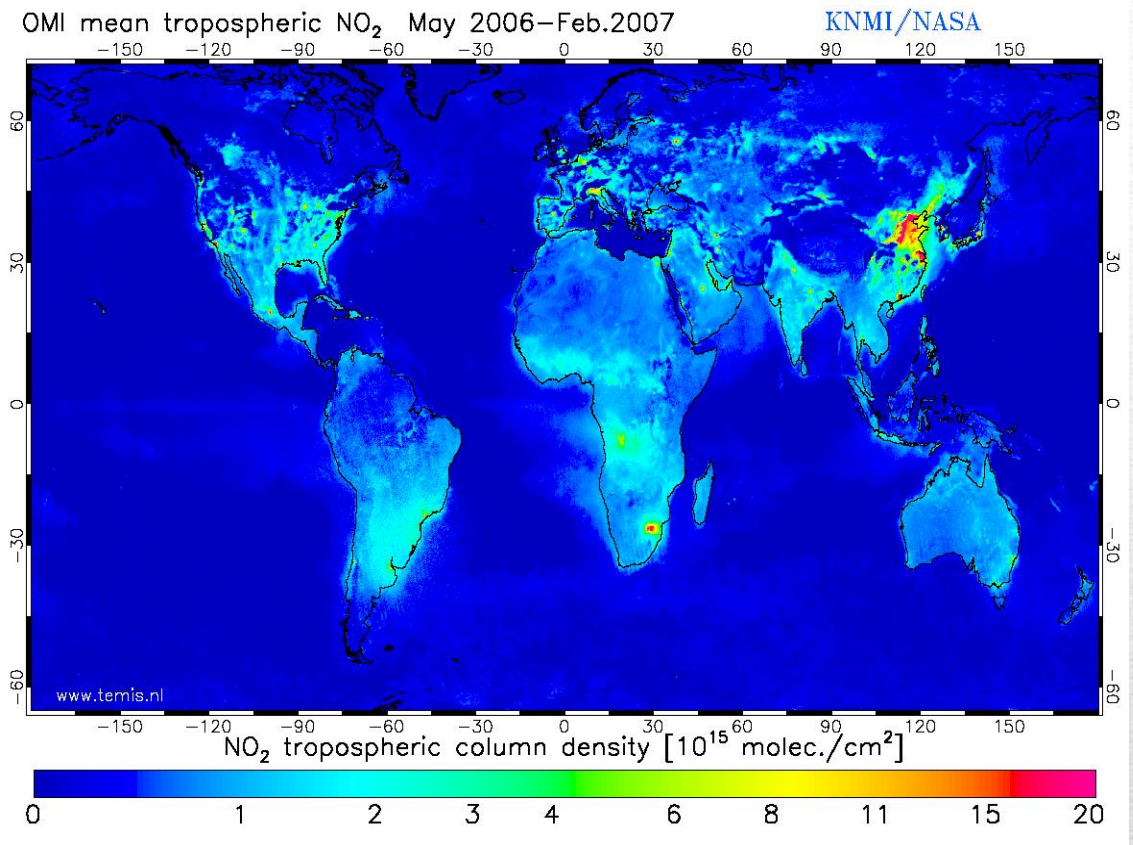
Time Series Analysis of NO_2 Emission in a Global and Local Scale using OMI NO_2 Product

Mukesh Subedee and Yan Yan

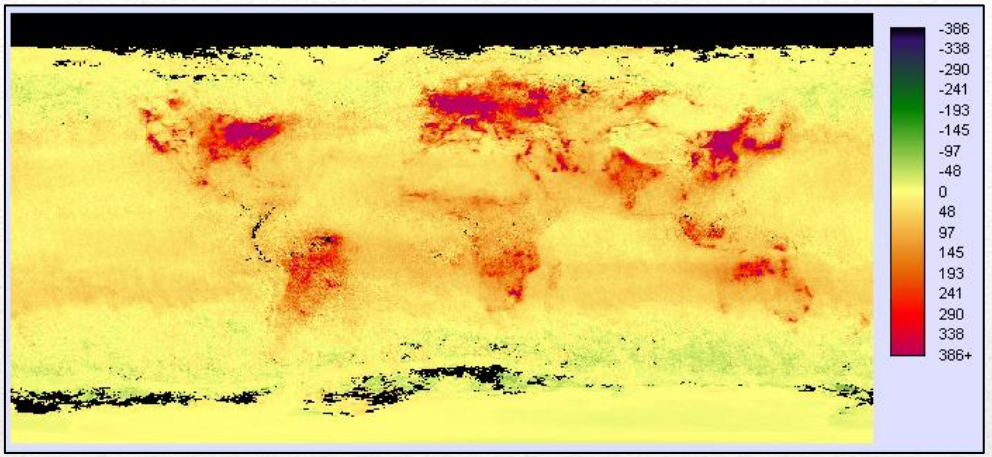
Introduction

- Nitrogen dioxide (NO_2) - a key component of urban air pollution.
- NO_2 degrades local air quality
- Emitted into troposphere by both anthropogenic and natural sources
- Effects in human health and environment



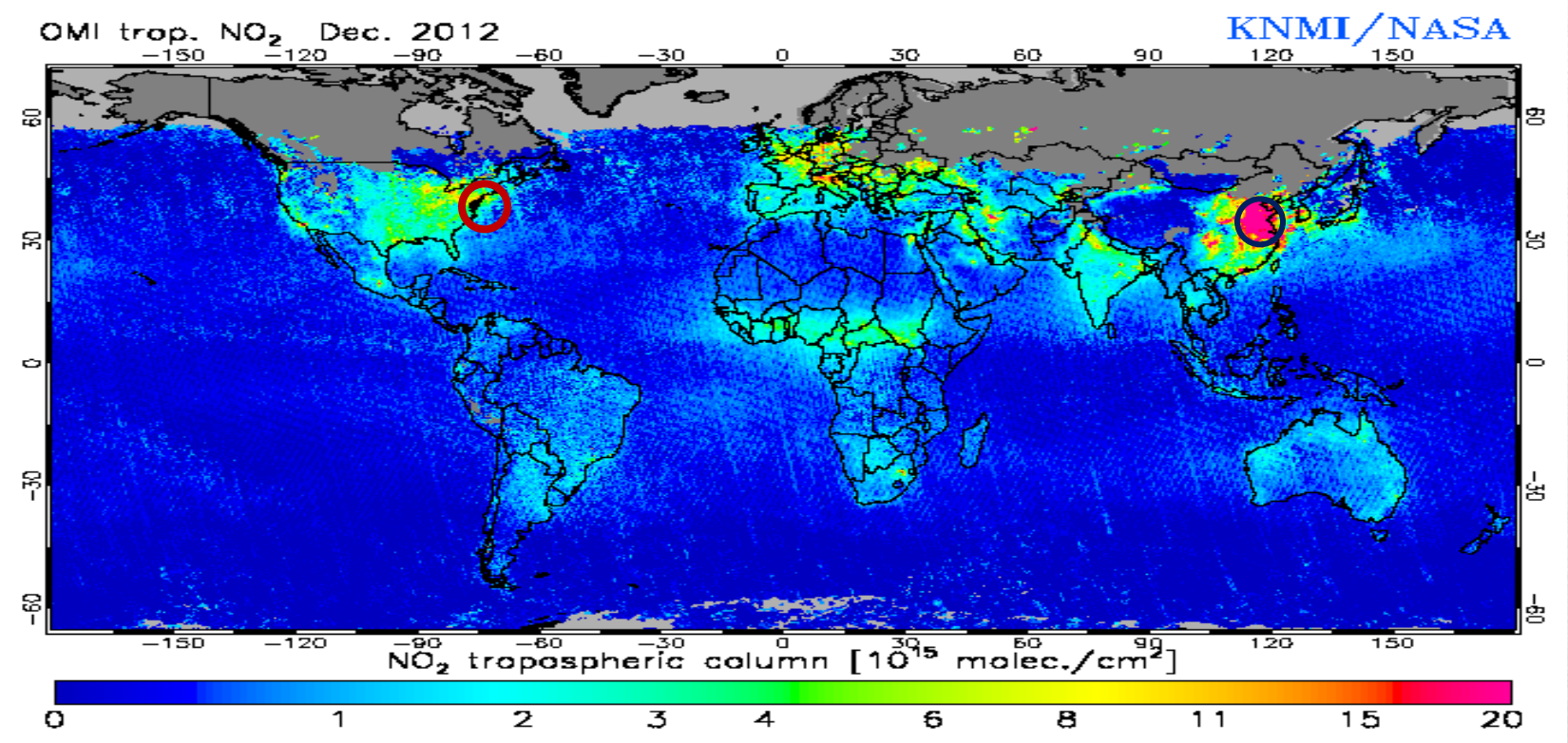
Introduction

Ozone Monitoring Instrument – onboard the Aura satellite, a wide-field imaging grating spectrometer, providing daily global coverage at a nadir point horizontal resolution of 13×24 km^2 since October 2004.



Objectives

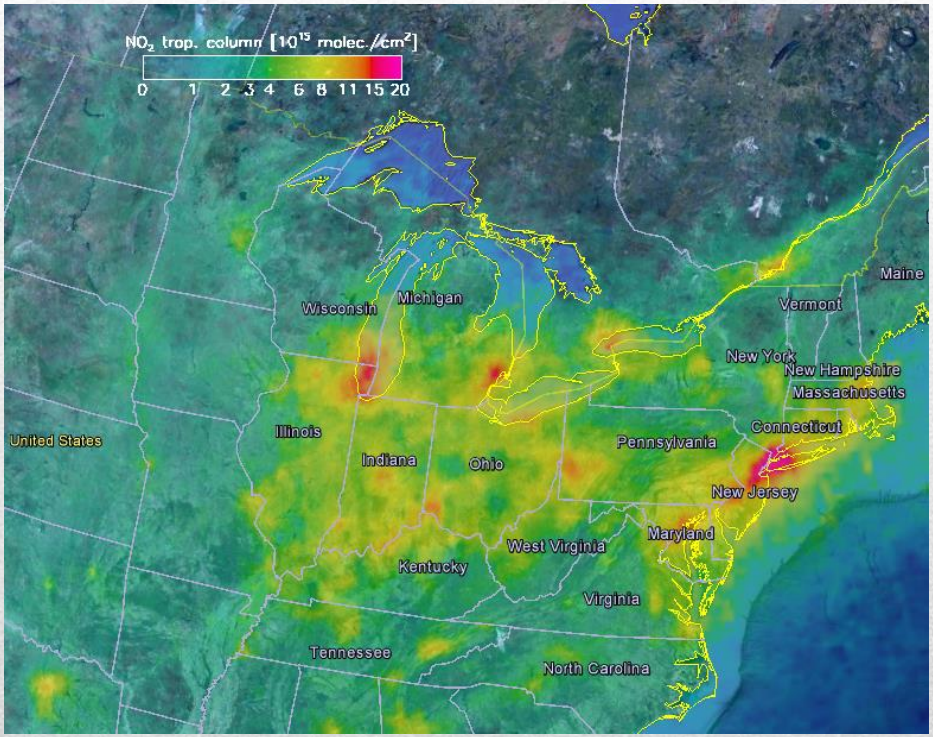
- Long-term and seasonal trend analysis of NO2 on a global scale to see the pattern of NO2 emission over the years from 2004 to 2013 using monthly data.
- Comparison of NO2 concentration in two mega cities - Beijing and New York, to understand NO2 trend in the local scale over the period of time.



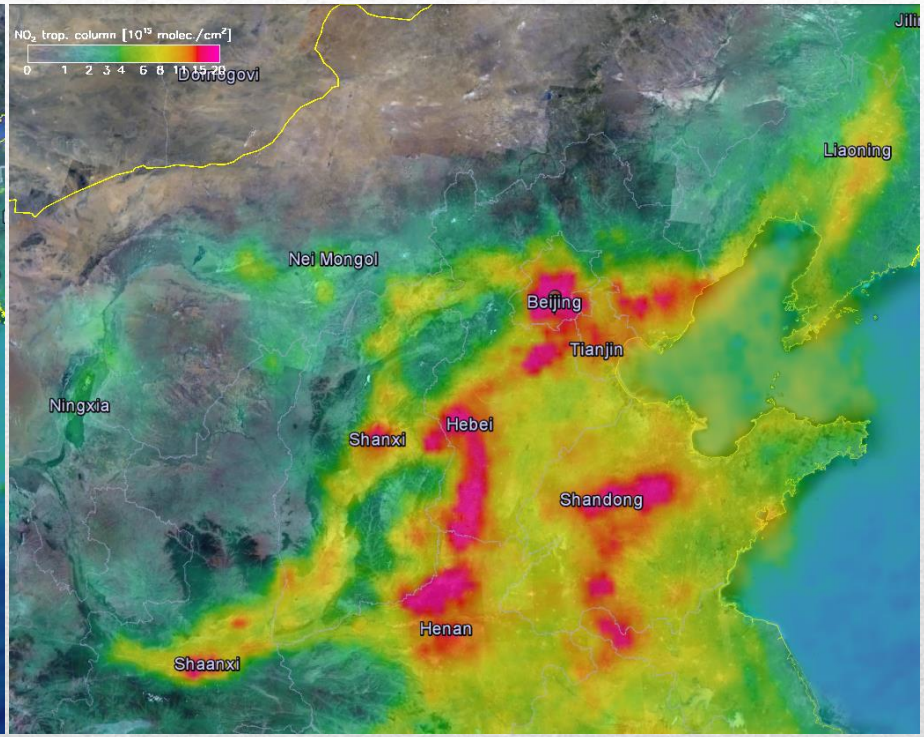
The tropospheric NO2 information has been retrieved from the OMI sensor. The OMI (DOMINO v2.0) monthly data will be used in the study. Due to the limitation of the OMI sensor, the dataset only covers the 60° N to 80° S area.

Study area

New York

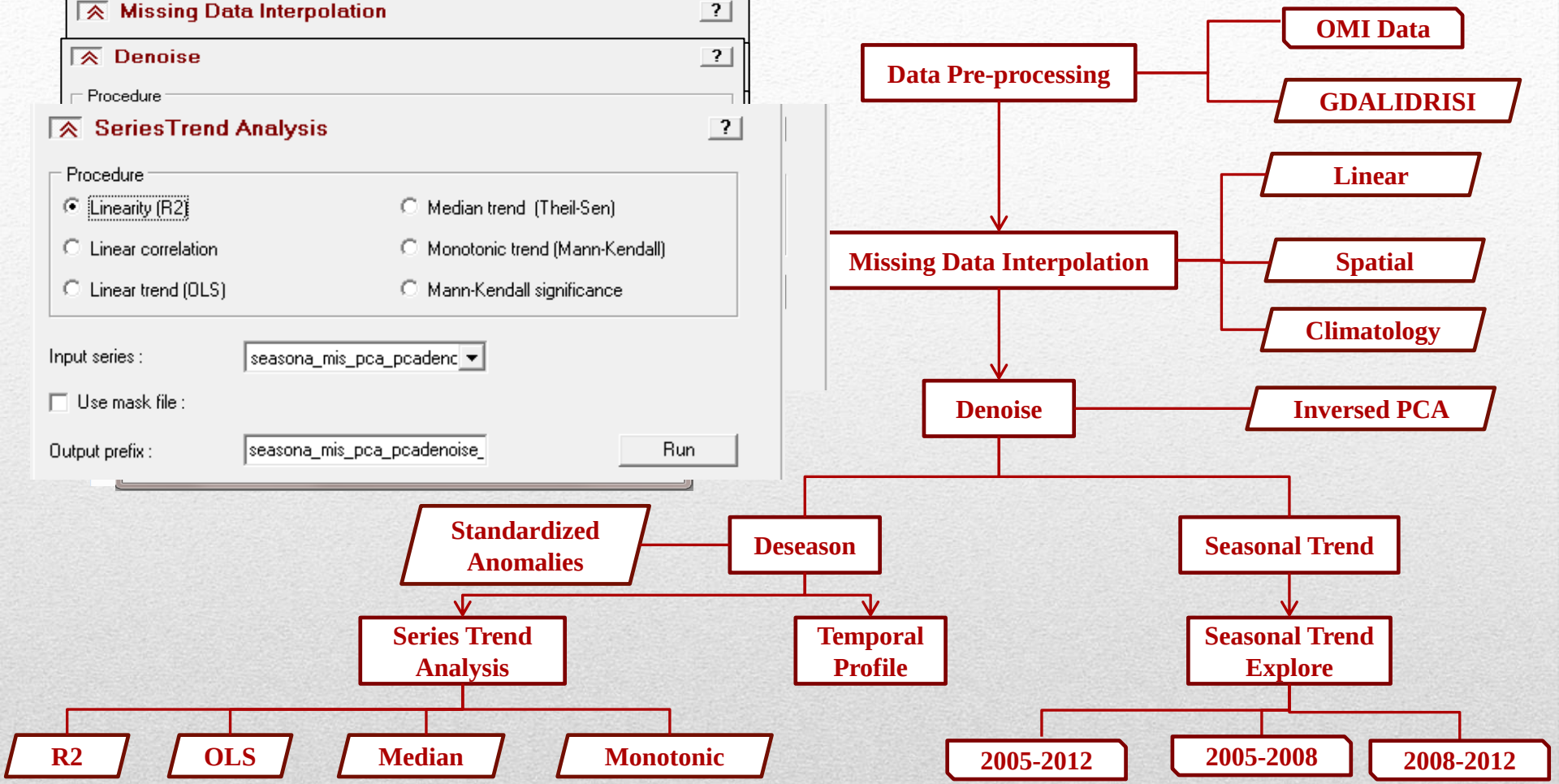


Beijing

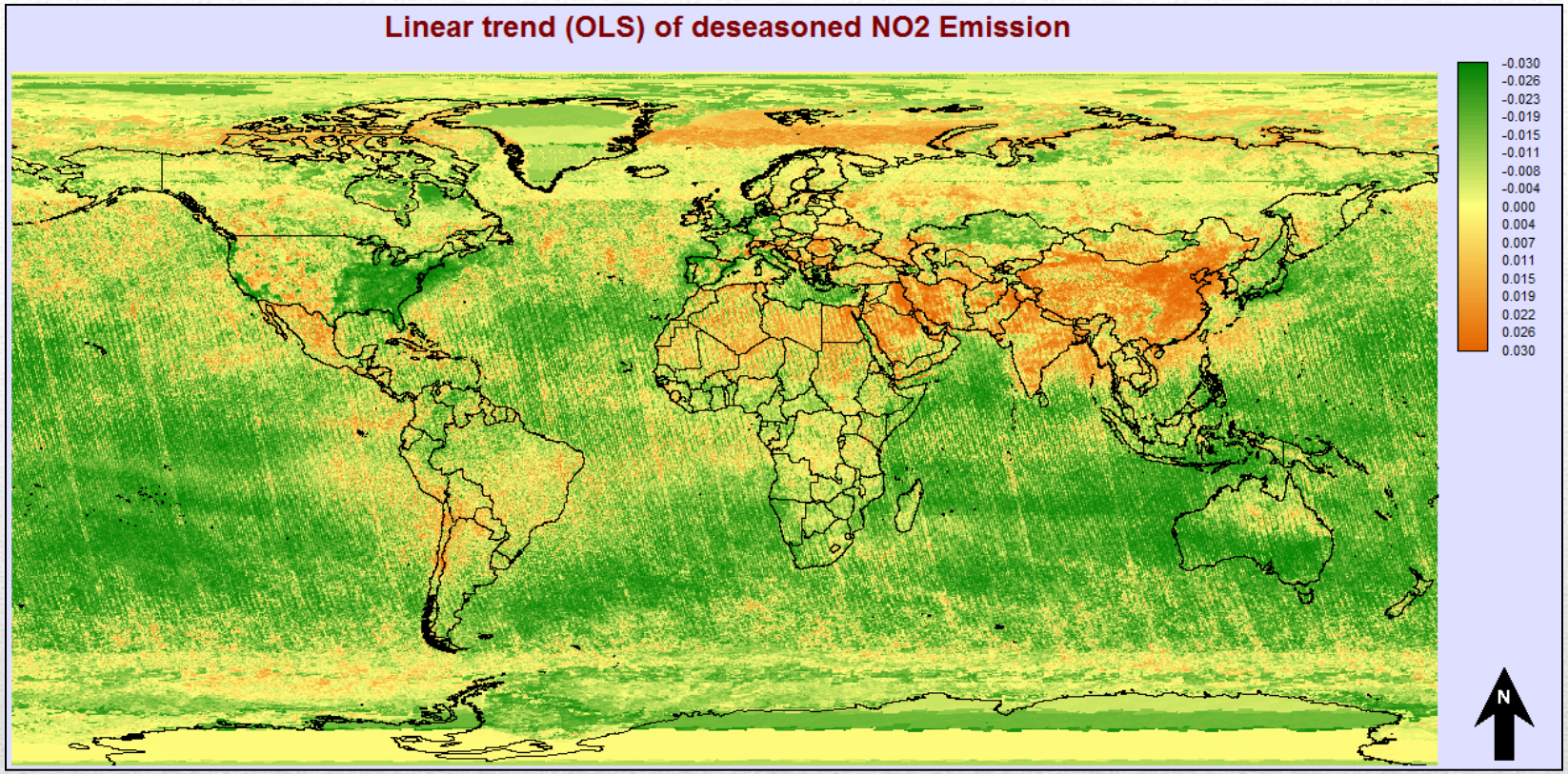


Study area

Missing Data Interpolation
Denoise
Procedure
SeriesTrend Analysis
Procedure
Linearity (R2)
Linear correlation
Linear trend (OLS)
Median trend (Theil-Sen)
Monotonic trend (Mann-Kendall)
Mann-Kendall significance
Input series :
seasona_mis_pca_pcadenc
Use mask file :
Output prefix :
seasona_mis_pca_pcadenoise_
Run

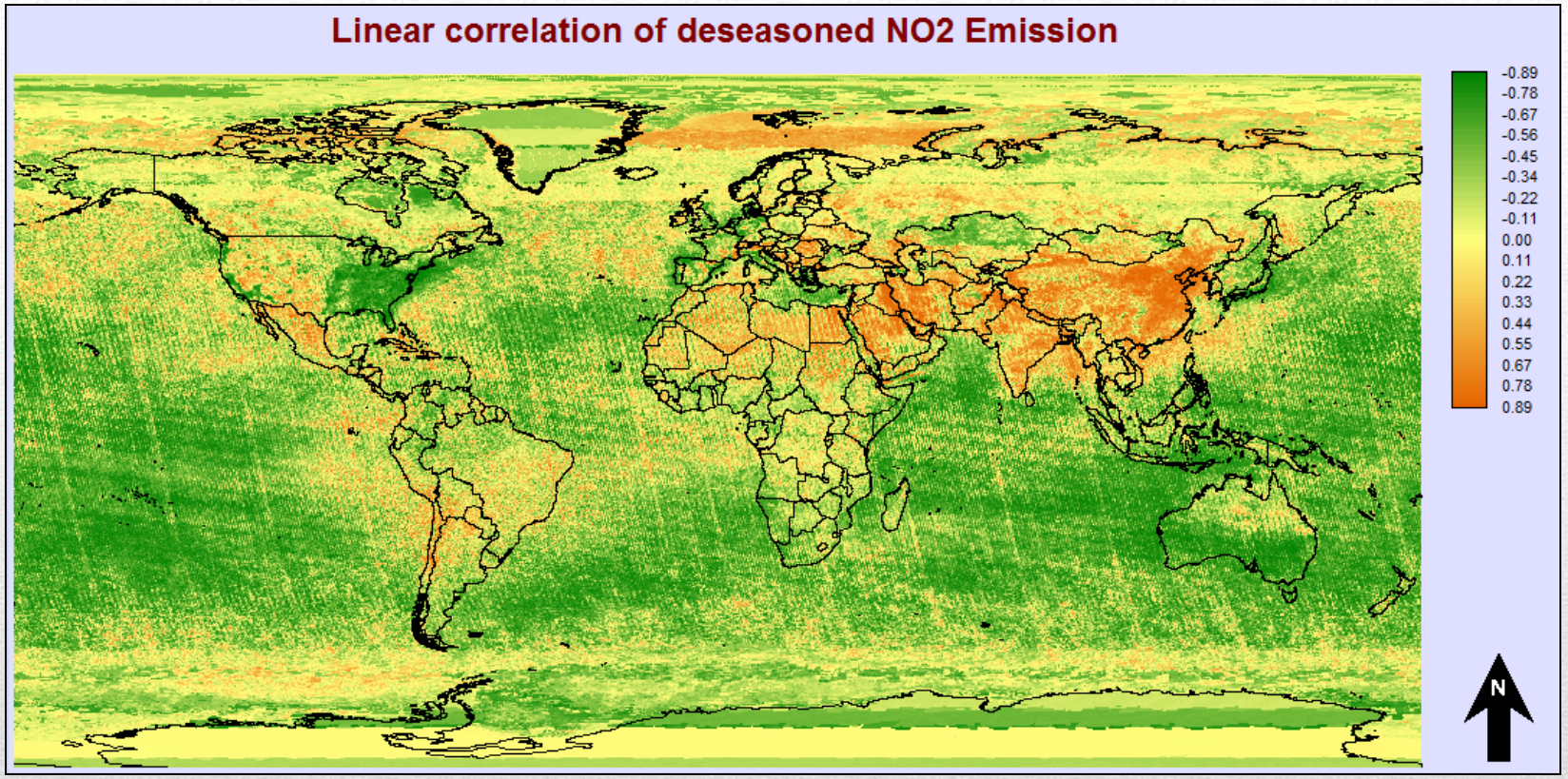

Data Pre-processing
OMI Data
GDALIDRISI
Missing Data Interpolation
Linear
Spatial
Climatology
Denoise
Inversed PCA
Standardized Anomalies
Deseason
Seasonal Trend
Series Trend Analysis
Temporal Profile
Seasonal Trend Explore
R2
OLS
Median
Monotonic
2005-2012
2005-2008
2008-2012

Method



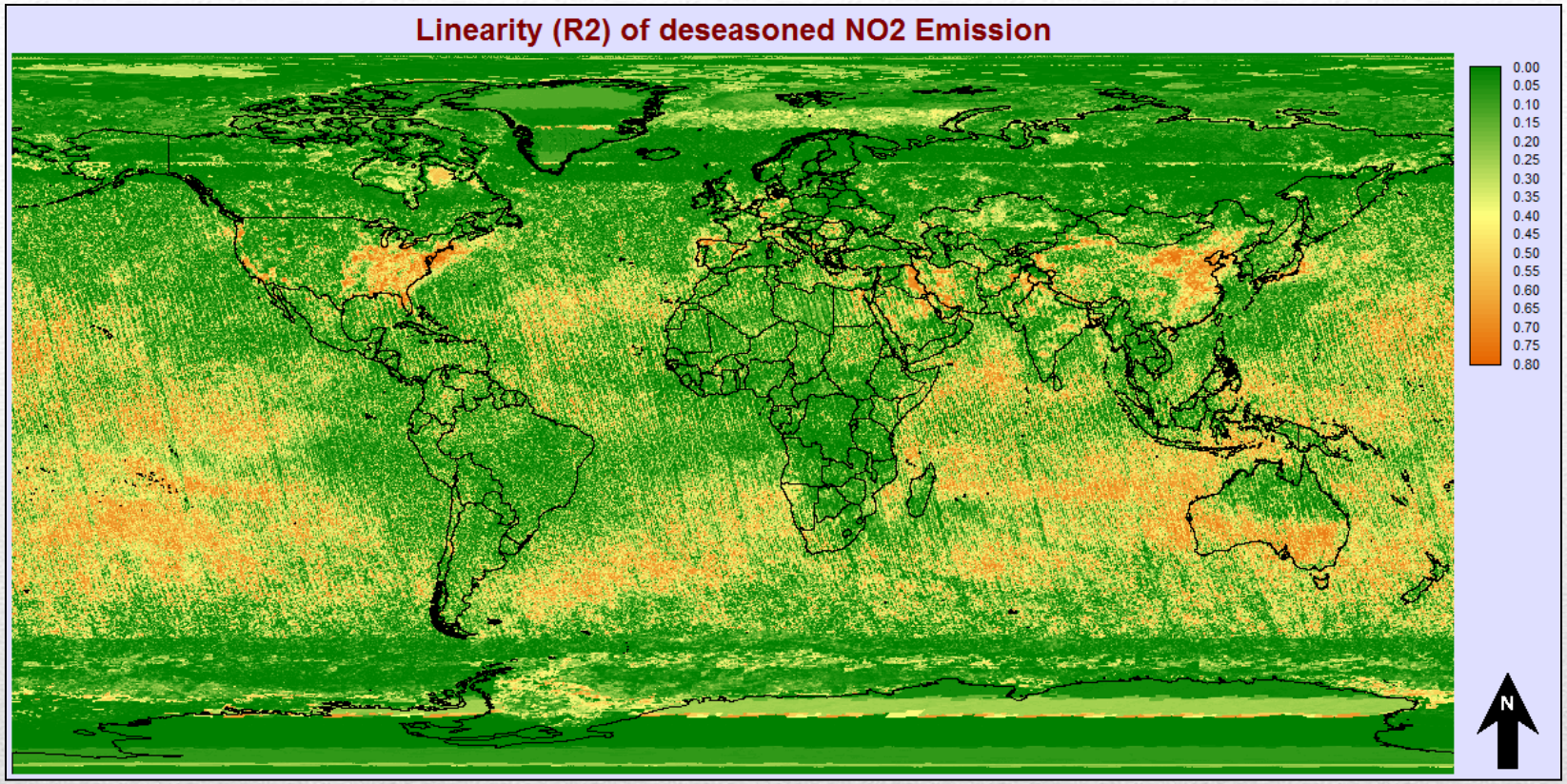
Linear Trend (OLS) result: shows the rate of change per month.

Result



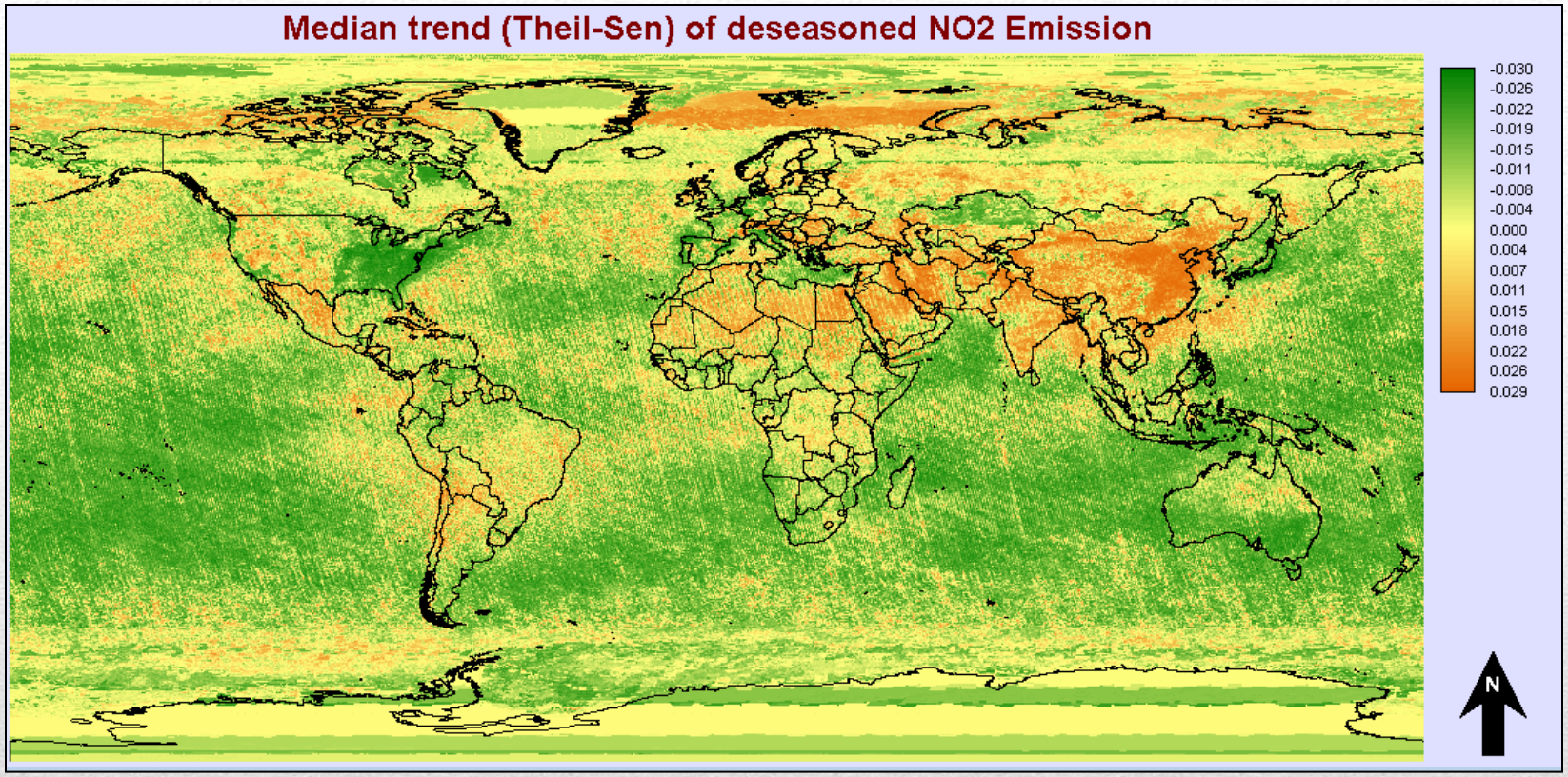
Linear Correlation result: linear correlation between the values of each pixel over time and a perfectly linear series.

Result



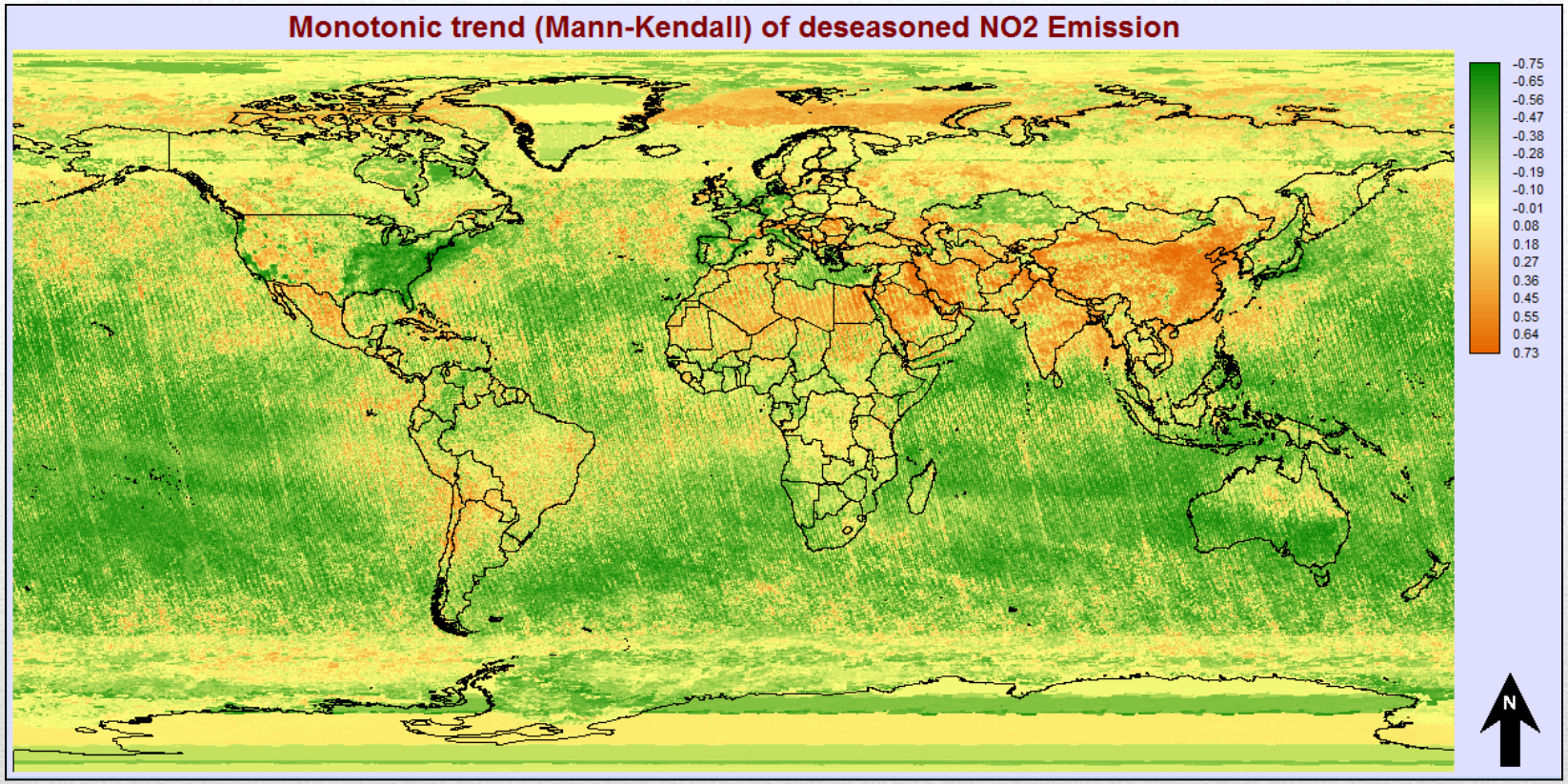
Linearity (R^2) result: shows the degree to which a linear trend is present.

Result



Median Trend result: also shows the rate of change per month. The result is very identical to OLS result.

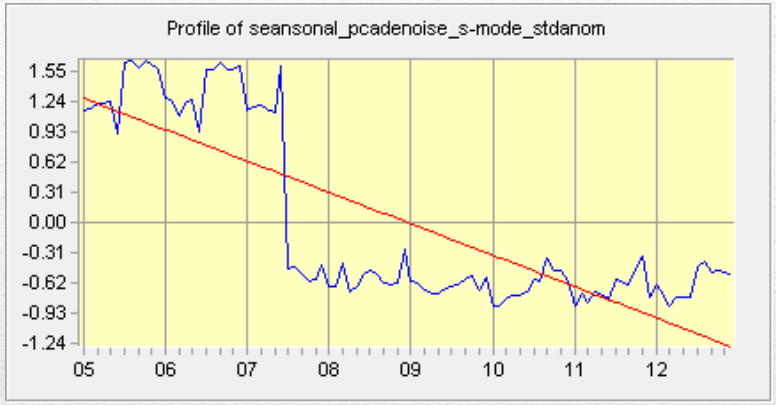
Result



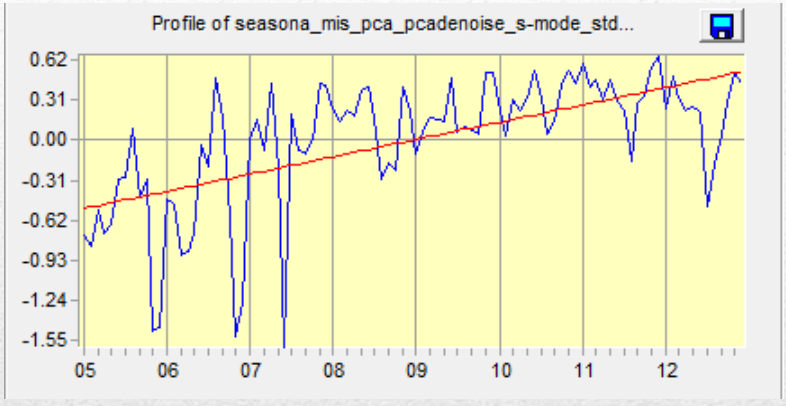
Monotonic trend result: shows how consistently is the trend increasing or decreasing. The higher positive value indicates a trend that continuously increases and never decreases.

Result

New York



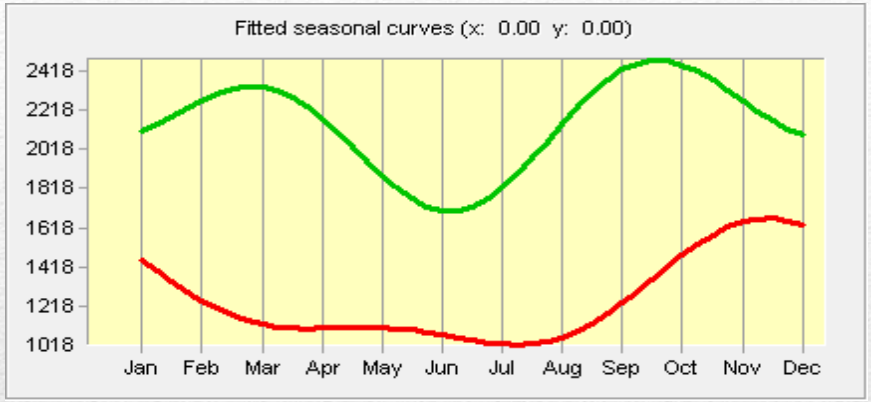
Beijing

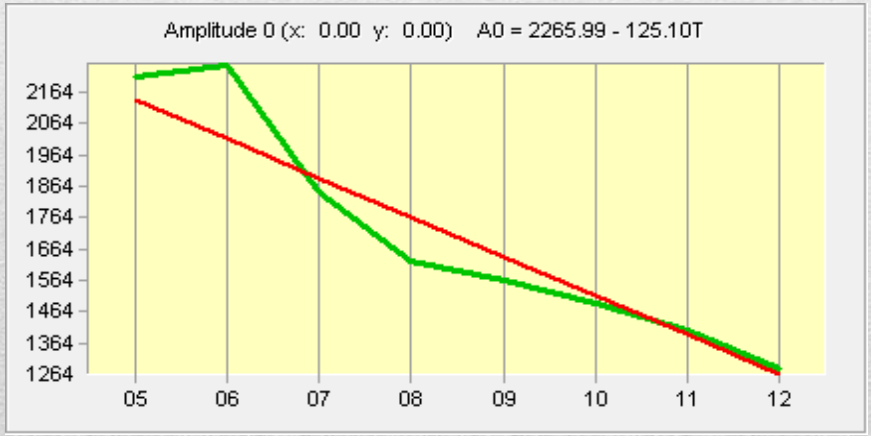


- US Environmental Protection Agency's (EPA) nitrogen oxides (NO_x) Budget Trading Program (NBP) in and PlaNYC (GreeNYC) in 2007
- During 2005- 2011 period, study has shown that NO2 emission has been highly increased (even doubled) in Beijing, and a significant decrease in the New York City (Hilboll et al. 2012).

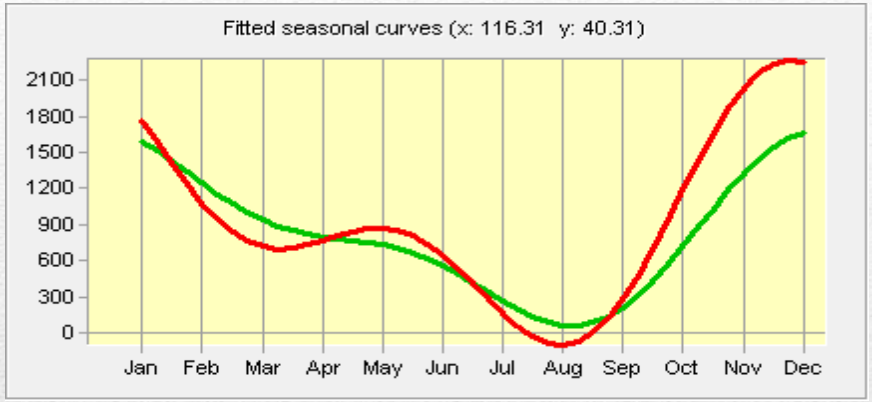
Results Temporal Profile

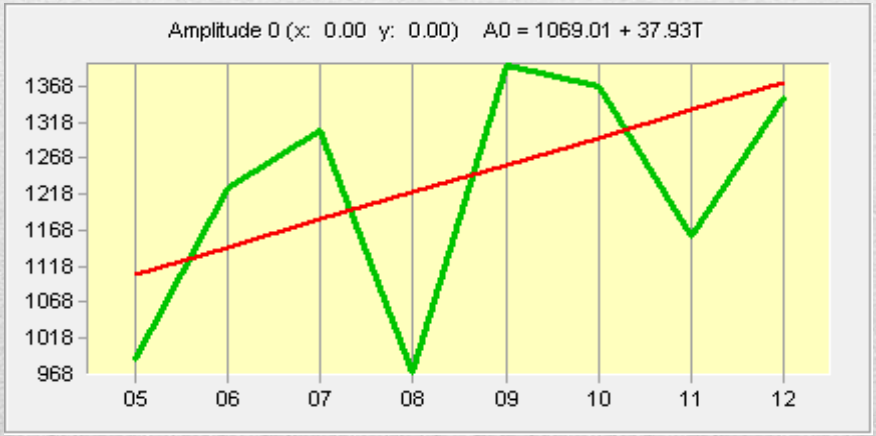
New York





Beijing

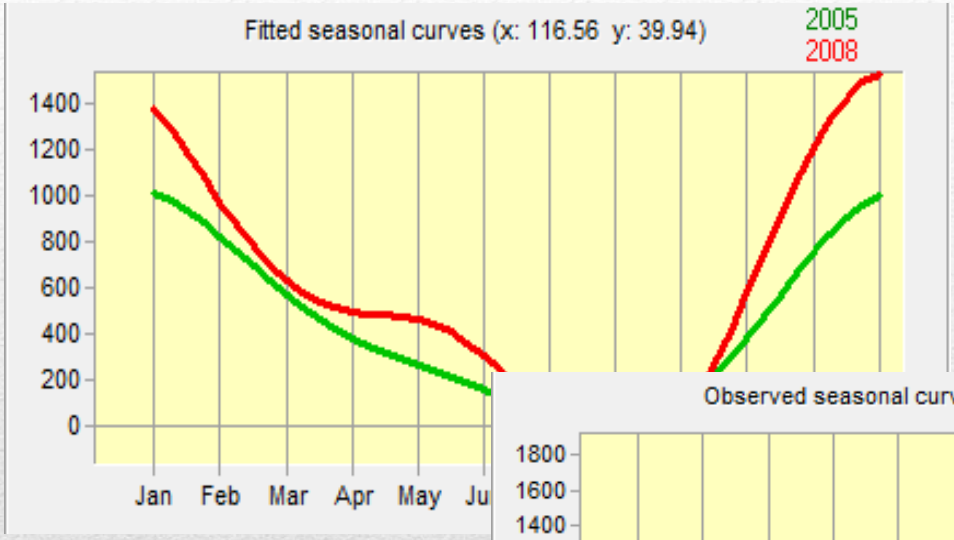


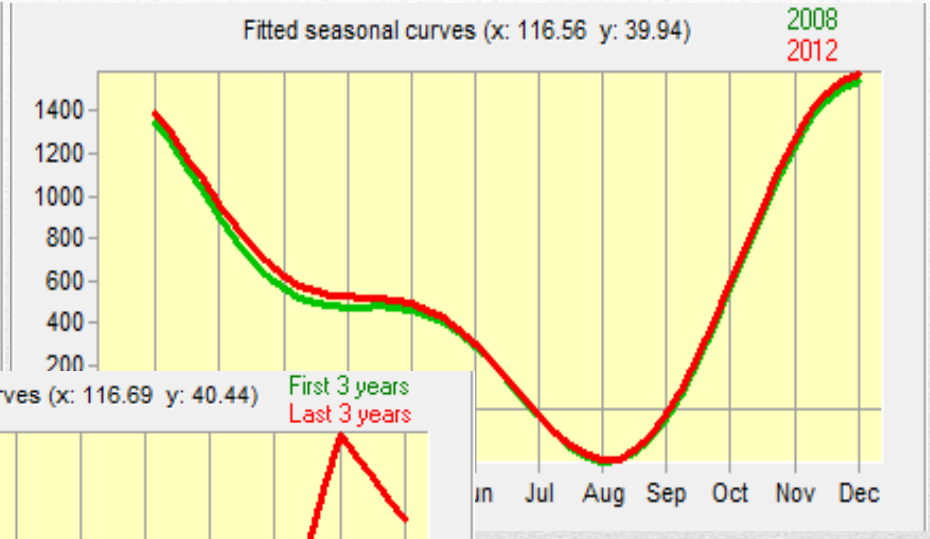


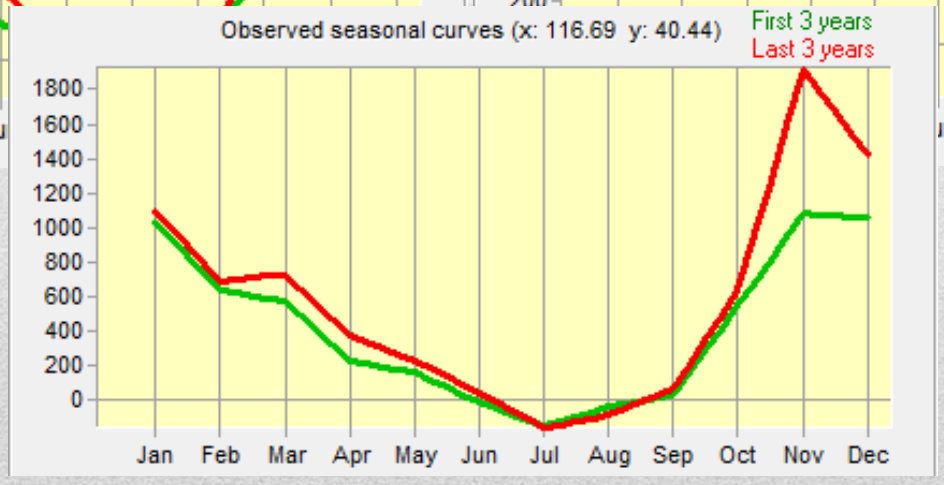
Results Seasonal Trend

2005-2008

2008-2012







Results Beijing Olympic

Conclusion

- Globally, greatest NO_2 emissions are from industrial and urban centers, with forest burning contributing a small amount in some seasons
- The strong seasonal pattern in NO_2 corresponds to greater heating and longer pollutant lifetime in winter
- Long-term trends: Emissions controls have successfully decreased NO_2 in some areas, while strong economic activity corresponds to increasing NO_2 in developing regions.
- The behavior of the government and public can effectively reduce the NO_2 emission.

Acknowledgement:

- Dr. Ron Eastman
- Nate Mietkiewicz
- Kevin Butler

Thank you!

Video