A Novel Method to Analyzing NO$_2$ Spatiotemporal Variability over Eastern China

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- EOF-EEMD is applied to both in situ measurements and chemical transport models (CTMs) to catch the patterns.
- Models could capture the spatial variability well.
- Models could capture the temporal patterns in general but the simulation of each pattern might not be accurate.
An advanced statistical method:
The combination of Empirical Orthogonal Function (EOF) and Ensemble Empirical Mode Decomposition (EEMD)

\[ X = \begin{pmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_2 & \cdots & x_{2n} \\ \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{pmatrix} \]

\[ X = VZ^{2n} \]

**EOF**
- Spatial distribution

**EEMD**
- Temporal variation

\[ V + Z \]

- Continuous observation
- Lack of representativeness
- Interfered by NOy (i.e. HNO_3, PAN, Nitrate)
- Sparse records

- Continuous value
- Wide coverage
- Discrepancy

(Huang et al., 1998)
Spatial Comparison between Observation and Models

GEOS-Chem

CMAQ

ppbv

0 8 17 26 35 >

ppbv

0 5 10 15 20 25 30 35 40 45 50
Temporal Comparison between Observation and Models

North China

- **obs** mean = 33.3
- **Geos-chem** mean = 20.0 r = 0.34
- **CMAQ** mean = 37.4 r = 0.42

East China

- **obs** mean = 31.5
- **Geos-chem** mean = 21.0 r = 0.49
- **CMAQ** mean = 32.4 r = 0.46
Revision of NOy:

\[
\frac{NO2_{obs}}{NO2_{true}} = \frac{NO2_m}{\sum(NO2 + HNO3 + PAN + R4N2 + N2O5)_m}
\]

Models could capture the daily variation but have a limited ability of capturing interdiurnal signal.


Thank you for your attention!