Aura OMI observations of global SO$_2$ and NO$_2$ pollution from 2005 to 2013

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Key improvements in OMI NO$_2$ and SO$_2$

- **Significant improvements in retrieval quality** –
  - Improved spectral fitting of OMI NO$_2$ removes 20%-40% of the stratospheric biases with other satellite measurements. **New NO$_2$ version planned for release next year**
  - New PCA SO$_2$ algorithm uses full spectral content from OMI, reduces noise by half and removes biases (artifacts)
  - **New Version 2 OMI SO$_2$ dataset will be released this fall**

- **Maximal data continuity between instruments** –
  - Both OMI NO$_2$ and SO$_2$ algorithms can benefit new missions: SNPP/OMPS, TROPOMI, GEMS and TEMPO
  - no need to develop instrument-specific radiance data correction schemes

- **Maximal sensitivity** -
  - PCA SO$_2$ detection limit for point sources is half the current PBL algorithm

- **Flexibility** –
  - PCA SO$_2$ fitting window can be easily adjusted to optimize sensitivity under different conditions: from small anthropogenic signals to largest volcanic plumes.
  - NO$_2$ fitting window can be expanded to UV wavelengths (OMPS)
Regional trends in OMI new SO$_2$ and NO$_2$ : 2005-2013
OMI SO\textsubscript{2} and NO\textsubscript{2} time series

• SZA < 70\textdegree
• Cross-track CCD rows 6-23 (excluding row anomaly for all years) ;
• Snow-free observations (according to the IMS data* product);
• SCD-O\textsubscript{3}<1500 DU, VCD_SO\textsubscript{2}<15 DU
• Additional volcanic filtering: all days removed which, over that region and considering all years, had a daily 99.9\textsuperscript{th} percentile value greater than X,
  – where X=5 DU for Eastern North America,
    8 DU for Eastern Europe and India,
    10 DU for China –
these thresholds are obtained using the 99.9 percentile daily regional time series.
For consistency removed the same volcanic days in NO\textsubscript{2} product

**SO₂**

**NO₂**

Eastern US

Graphs showing the changes in SO₂ and NO₂ concentrations from 2005 to 2013. The graphs display the concentration levels of SO₂ and NO₂ (in DU) over the years, with a map of the Eastern US in the background.

**Change in SO₂ [%]**

**Change in trop. NO₂ [%]**
Eastern Europe

2005-2007

SO₂

2011-2013

Maritsa Iztok (Bulgaria)

Etna Volcano
Eastern Europe: Time series for Maritsa Iztok

SO\(_2\) and NO\(_2\) levels and changes from 2005 to 2013.
India

2005-2007

SO₂

2011-2013

Pronunciation: chuht-tihs-guhr

Chhattisgarh

Power plants / smelter

Vertical Column Density [DU]
India

2005-2007

2011-2013

NO₂

Chhattisgarh

Power plants / smelter

Pronunciation: chuht-tihs-guhr

Vertical Column Density [10^{15} \text{ cm}^{-2}]

NO₂

Chhattisgarh

Vertical Column Density [10^{15} \text{ cm}^{-2}]

Chnage in trop. NO₂ [%]

Year

2005 2006 2007 2008 2009 2010 2011 2012 2013

0

10

20

30

40

Year

Chnage in trop. NO₂ [%]
Time series: India (Chhattisgarh)

SO₂

NO₂

Trop. NO₂ [DU]

Change in SO₂ [%]

Change in trop. NO₂ [%]

Year
Eastern China: Time series

SO$_2$

Year
2005 2006 2007 2008 2009 2010 2011 2012 2013
SO$_2$ [DU]

NO$_2$

Trop. NO$_2$ [DU]

Change in SO$_2$ [%]

Change in trop. NO$_2$ [%]
Summary

**Eastern USA**

- **SO\(_2\) (Ohio Valley)**
- **NO\(_2\) (NY-NJ-PHI-BAL)**

**Eastern Europe (Maritsa Iztok, Bulgaria)**

**India (Chhattisgarh)**

**Eastern Asia (Eastern China)**