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\textsubscript{2} and NO\textsubscript{2} : 2005-2013
OMI SO$_2$ and NO$_2$ time series

- SZA < 70°
- Cross-track CCD rows 6-23 (excluding row anomaly for all years);
- Snow-free observations (according to the IMS data* product);
- SCD-O$_3$<1500 DU, VCD_SO$_2$<15 DU
- Additional volcanic filtering: all days removed which, over that region and considering all years, had a daily 99.9$^{th}$ 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$_2$ product

Eastern Europe

2005-2007

SO₂

2011-2013

Maritsa Iztok (Bulgaria)

Etna Volcano
Eastern Europe: Time series for Maritsa Iztok

SO$_2$

Change in SO$_2$ [%]

Year

Change from 2005 [%]

SO$_2$, NO$_2$
India

SO₂

2005-2007

2011- 2013

Power plants / smelter

Chhattisgarh

Pronunciation: chuht-tihs-guhr

Change in SO₂ [%]

Year

0 20 40 60 80 100

Vertical Column Density [DU]

70° E 80° E 90° E

30° N 20° N 10° N

Change in SO₂ [%]

Year

2005 2006 2007 2008 2009 2010 2011 2012 2013
India

2005-2007

NO$_2$

Chhattisgarh

2011-2013

Power plants / smelter

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

Change in trop. NO$_2$ [%]

Year

Pronunciation: chuht-tihs-guhr
Time series: India (Chhattisgarh)

**SO$_2$**

- **Year**
- **SO$_2$ [DU]**

**NO$_2$**

- **Year**
- **Trop. NO$_2$ [DU]**

**Change in SO$_2$ [%]**

- **Year**
- **Change in %**

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

- **Year**
- **Change in %**
Eastern Asia

2005-2007

2011-2013

SO\textsubscript{2}

Volcano

Vertical Column Density [DU]
Eastern Asia

2005-2007

2011-2013

NO$_2$

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

Vertical Column Density [$10^{15}$ cm$^{-2}$]
Summary

Eastern USA

Eastern Europe (Maritsa Iztok, Bulgaria)

India (Chhattisgarh)

Eastern Asia (Eastern China)