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

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Key improvements in OMI NO₂ and SO₂

• **Significant improvements in retrieval quality** –
  – Improved spectral fitting of OMI NO₂ removes 20%–40% of the stratospheric biases with other satellite measurements. **New NO₂ version planned for release next year**
  – New PCA SO₂ algorithm uses full spectral content from OMI, reduces noise by half and removes biases (artifacts)
  – **New Version 2 OMI SO₂ dataset will be released this fall**

• **Maximal data continuity between instruments** –
  – Both OMI NO₂ and SO₂ algorithms can benefit new missions: SNPP/OMPS, TROPOMI, GEMS and TEMPO
  – no need to develop instrument-specific radiance data correction schemes

• **Maximal sensitivity**
  – PCA SO₂ detection limit for point sources is half the current PBL algorithm

• **Flexibility** –
  – PCA SO₂ fitting window can be easily adjusted to optimize sensitivity under different conditions: from small anthropogenic signals to largest volcanic plumes.
  – NO₂ fitting window can be expanded to UV wavelengths (OMPS)
Regional trends in OMI new SO$_2$ and NO$_2$: 2005-2013

![Map and graph showing regional trends in OMI new SO$_2$ and NO$_2$ from 2005 to 2013.](Image)
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$^{\text{th}}$ 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

* Interactive multi-sensor snow and ice product, [http://www.natice.noaa.gov/ims/]
Eastern Europe

2005-2007

SO₂

2011-2013

Maritsa Iztok (Bulgaria)

Etna Volcano
Eastern Europe: Time series for Maritsa Iztok

SO$_2$

Change in SO$_2$ [%]

Change from 2005 [%]

SO$_2$, NO$_2$
India

2005-2007

2011- 2013

Chhattisgarh

Pronunciation: chuht-tihs-guhr

Power plants / smelter

Vertical Column Density [DU]

Chhage in SO₂ [%]

Year

2005 2006 2007 2008 2009 2010 2011 2012 2013

0 20 40 60 80 100

SO₂
NO$_2$

2005-2007

India

2011-2013

Chhattisgarh

Pronunciation: chuht-tihs-guhr

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

0 5 10 15

Year

Change in trop. NO$_2$ [%]

0 10 20 30 40

Change in trop. NO$_2$ [%]

Year
Time series: India (Chhattisgarh)

SO₂

NO₂

Trop. NO₂ [DU]

Change in SO₂ [%]

Change in trop. NO₂ [%]

Year

Year

Year

2005 2006 2007 2008 2009 2010 2011 2012 2013

2005 2006 2007 2008 2009 2010 2011 2012 2013

2005 2006 2007 2008 2009 2010 2011 2012 2013

2005 2006 2007 2008 2009 2010 2011 2012 2013
Eastern Asia

2005-2007

SO₂

2011-2013

Volcano
Eastern China: Time series

SO$_2$

NO$_2$

Chngae in SO$_2$ [%]

Chngae in trop. NO$_2$ [%]