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

Nickolay Krotkov$^1$, Can Li$^{1,2}$, Lok Lamsal$^{1,3}$, Edward Celarier$^{1,3}$, Sergey Marchenko$^4$, William H. Swartz$^5$, Eric Bucsela$^6$, Vitali Fioletov$^7$, Chris McLinden$^7$, Joanna Joiner$^1$, Pawan K. Bhartia$^1$, Bryan Duncan$^1$, Russ Dickerson$^8$

$^1$NASA Goddard Space Flight Center, $^2$ESSIC, University of Maryland College Park, $^3$GESTAR, University Space Research Association, $^4$Science Systems and Applications, Inc., $^5$Applied Physics Laboratory, John Hopkins University, $^6$SRI International, $^7$Environment Canada, Ontario CA, $^8$Department of Atmospheric and Oceanic Science, University of Maryland College Park

Aura STM College Park, MD
18 September 2014
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

![Map showing regional trends in SO$_2$ and NO$_2$.](image)

![Graph showing change from 2005% for SO$_2$ (Ohio Valley) and NO$_2$ (NY-NJ-PHI-BAL).](image)
OMI SO₂ and NO₂ 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-O₃<1500 DU, VCD_SO₂<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 NO₂ product

Eastern Europe

SO$_2$

2005-2007

2011-2013

Maritsa Iztok (Bulgaria)

Etna Volcano
Eastern Europe: Time series for Maritsa Iztok

SO\textsubscript{2}

Change in SO\textsubscript{2} [%]

Change from 2005 [%]

SO\textsubscript{2}, NO\textsubscript{2}

2005, 2013
Pronunciation: chuht-tihs-guhr
Pronunciation: chuht-tihs-guhr
Eastern Asia

2005-2007

2011-2013

SO$_2$

Volcano
Eastern China: Time series

SO$_2$

![SO$_2$ Time Series Graph]

NO$_2$

![NO$_2$ Time Series Graph]
Summary

Eastern USA

Eastern Europe (Maritsa Iztok, Bulgaria)

India (Chhattisgarh)

Eastern Asia (Eastern China)