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Advances in Atmospheric Science and Applications

OMI/Aura, SCIAMACHY/Envisat and GOME2/MetopA Sulphur Dioxide Estimates; the case of Eastern Asia.

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Summary of talk

- The aim of this work, within the MarcoPolo project.

- The SCIAMACHY/Envisat, OMI/Aura and GOME2/MetopA SO_2 algorithms and products.

- The sources of SO_2 loading in China.

- Trend analysis and source monitoring.

- The next steps.

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The MarcoPolo Project

- **M**onitoring and **A**ssessment of **R**egional air quality in **C**hina using space **O**bservations; a **P**roject **O**f **L**ong-term sino-european co-**O**peration.

- http://www.marcopolo-panda.eu

- Collaborative Project of FP7-Space (EU)

- Start: January 2014

- Duration: 3 years

- Objectives:
  - To provide air quality information to scientists, policy makers and the general public.
  - To provide air quality information consisting of ground and space-based observations, an up-to-date emission inve   quality modeling results.
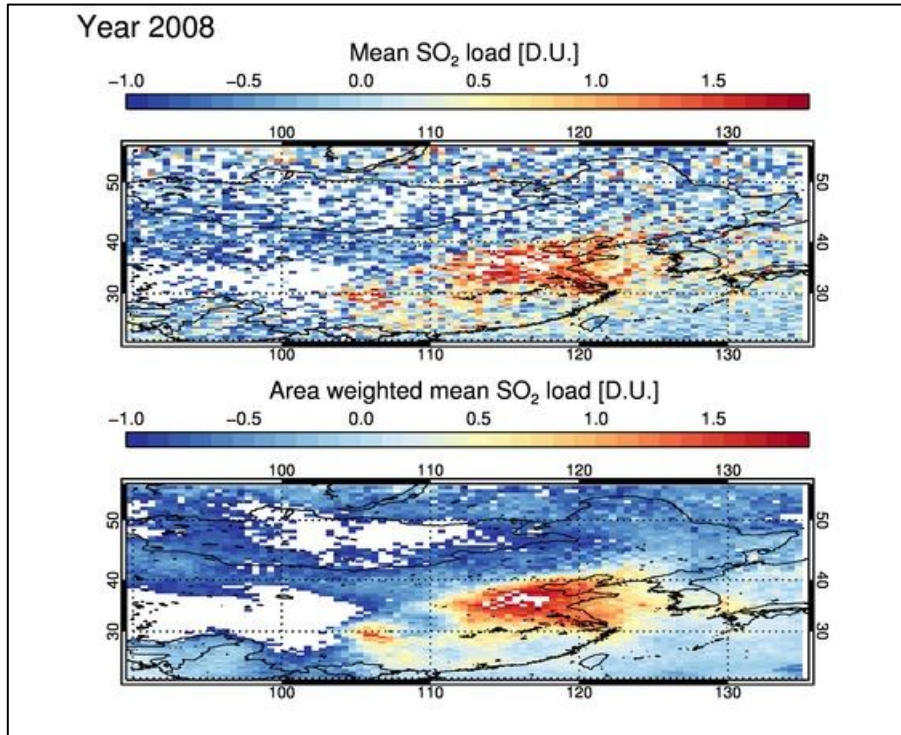
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- Existing SO_2 data from SCIAMACHY/Envisat, GOME-2/MetopA and OMI/Aura have been collected and undergone initial quality assurance analysis.

- The spatio-temporal evolution of sulphur dioxide from 2004 till today over China is examined for two different algorithms for each of the satellite instruments.

- Overpass files at requested locations, at known point SO2 sources [cities, power plants, smelters, etc.] as well as monthly and yearly gridded data are to become available to the official MarcoPolo site.
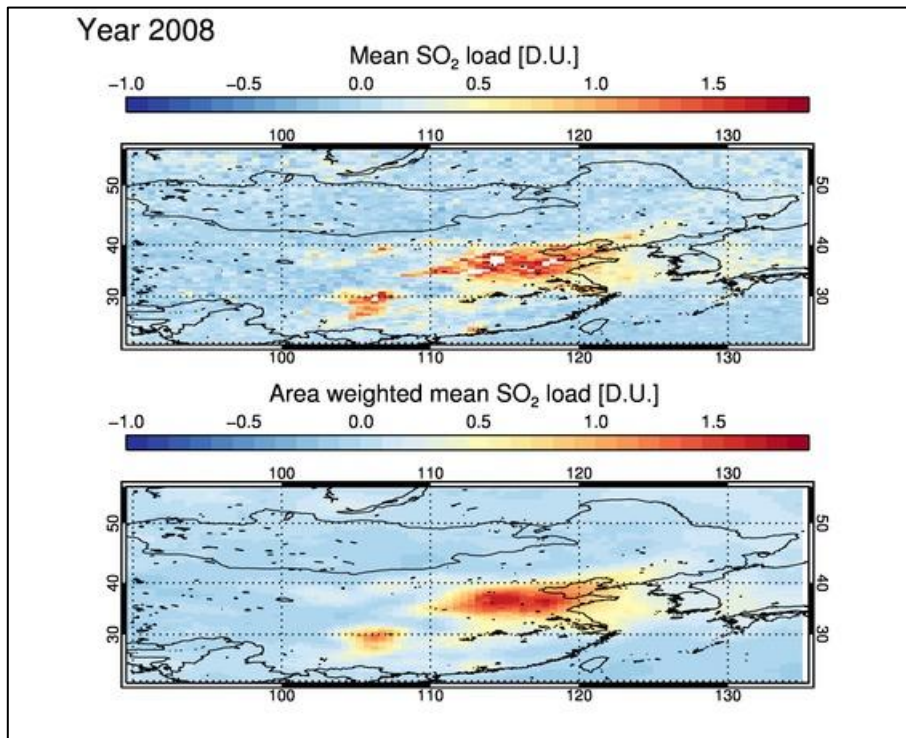
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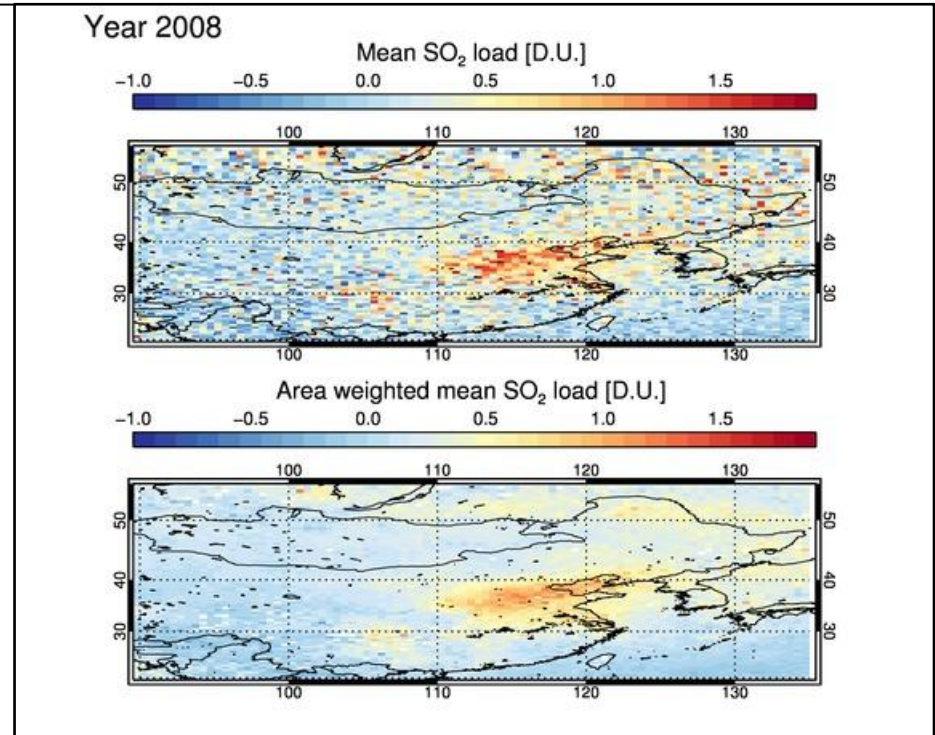
Operational SCIAMACHY/Envisat total SO_2 column data retrieved with the SGP 5.02 processor and distributed from the ESA Earth OnLine site at https://earth.esa.int.

SCIAMACHY/Envisat total SO_2 column data generated within the Support to Aviation Control Service service hosted by the Belgian Institute for Space Aeronomy and distributed by http://sacs.aeronomie.be/.
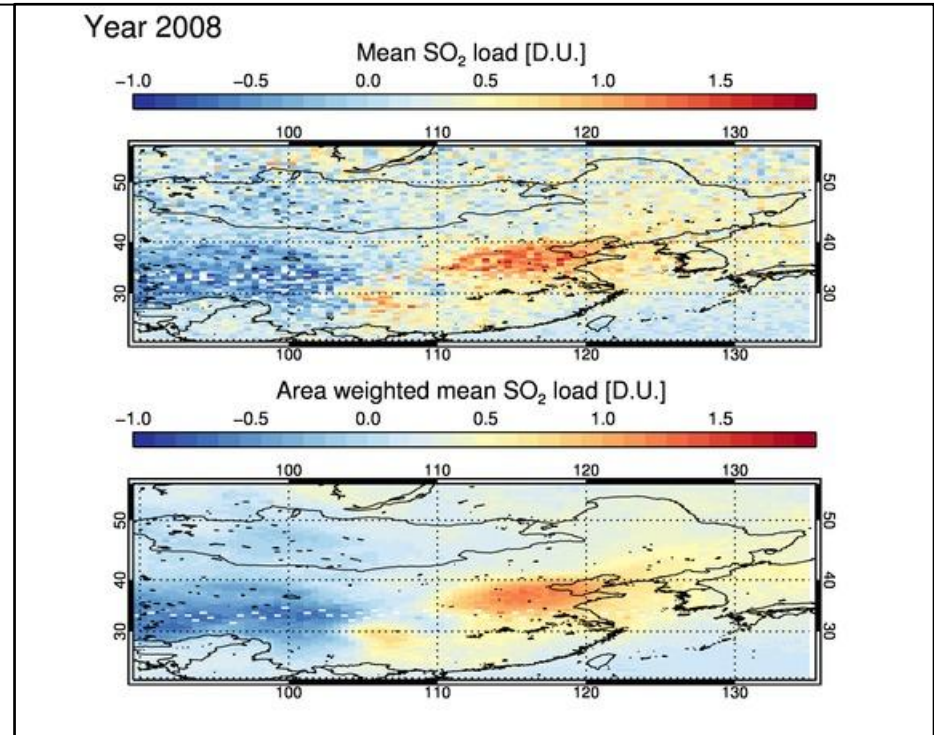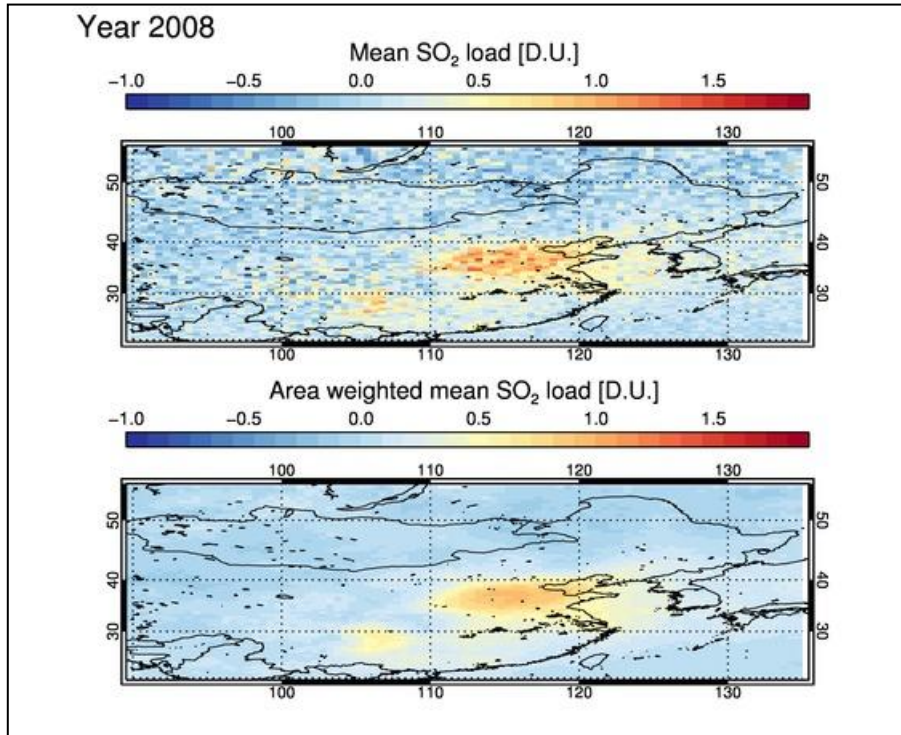
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OMI/Aura [2004-2014]
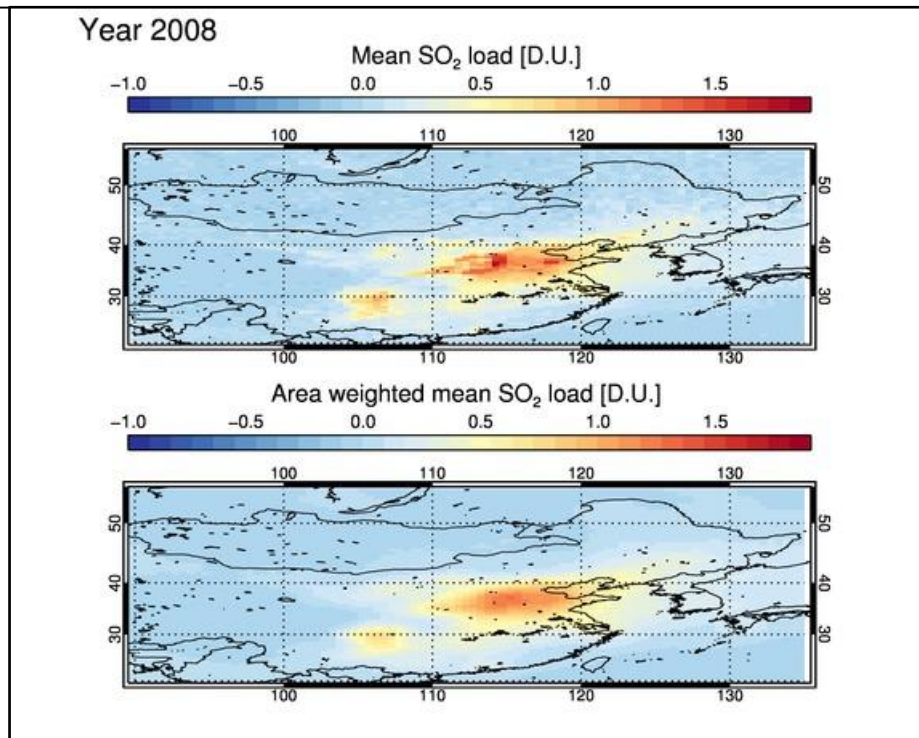
Operational OMI/Aura collection 3, v1.2.0, total SO_2 column data generated and distributed by NASA and the Aura Data Validation Center, http://avdc.gsfc.nasa.gov/.

OMI/Aura total SO_2 column data generated and distributed by the Belgian Institute for Space Aeronomy; P.I. Nicolas Theys. Theys, N., I. De Smedt, J. van Gent, et al., *J.G.R.*, 2015.
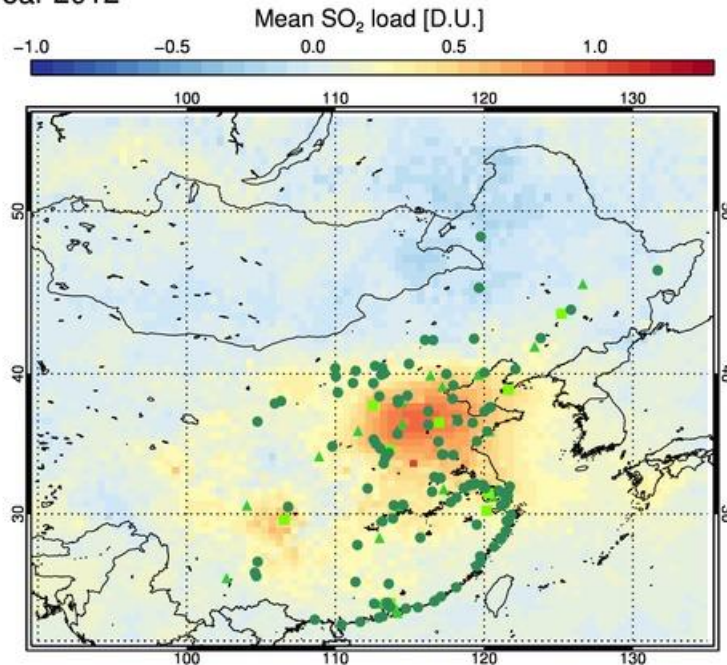
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GOME2/MetopA [2007-2014]

Operational GOME2/MetopA total SO_2 column data retrieved with the GDP 4.7 OTO algorithm within the EUMETSAT O3MSaf project and distributed by DLR at http://atmos.eoc.dlr.de/gome2/.

Operational GOME2/MetopA total SO_2 column data retrieved with the GDP 4.7 NTO algorithm within the EUMETSAT O3MSaf project and distributed by BIRA at http://sacs.aeronomie.be/.
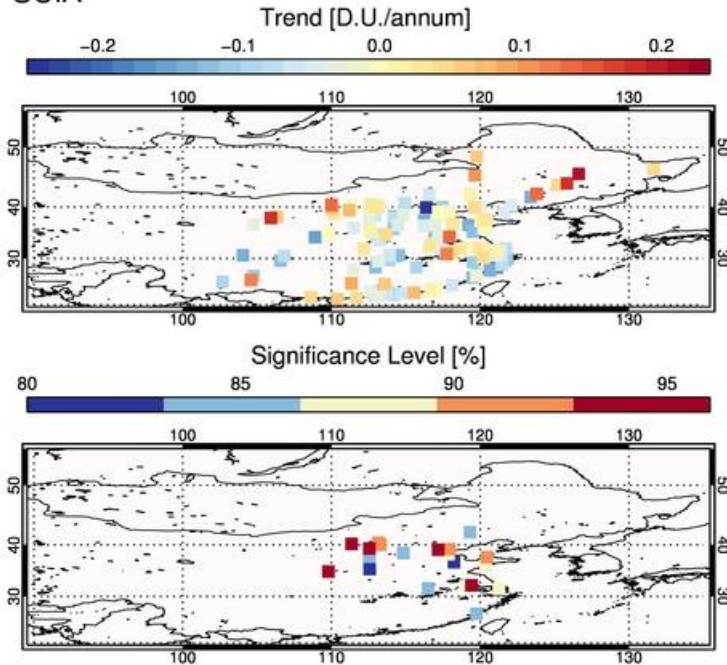
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Year 2012
Mean SO$_2$ load [D.U.]

Common processing for all satellites & algorithms
- SZA < 70, cloud fraction < 20% & max VCD < 15 D.U.
- Locations first gridded onto a 0.25 ° x0.25° grid.
- All SO2 measurements falling within three radii [20km, 40km & 60 km] are assigned to the grid cell.
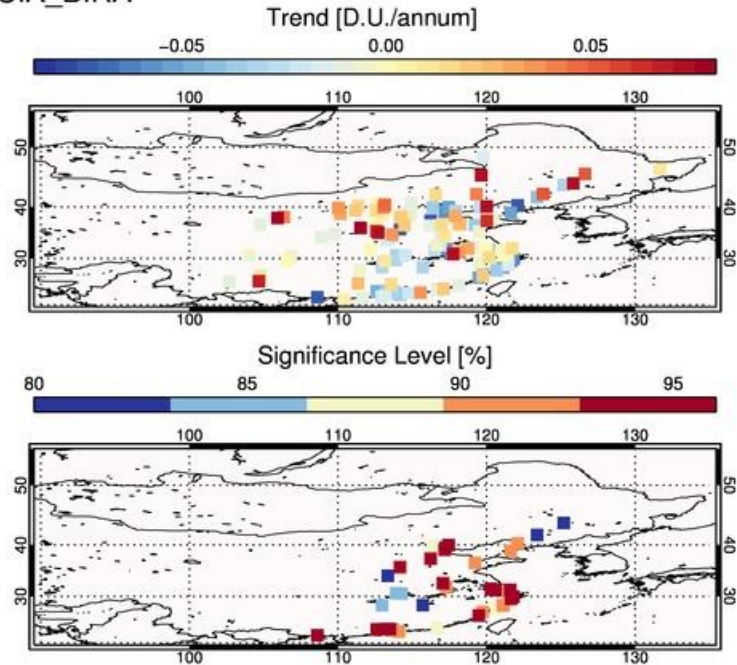- **115 power plants and 35 cities analysed**

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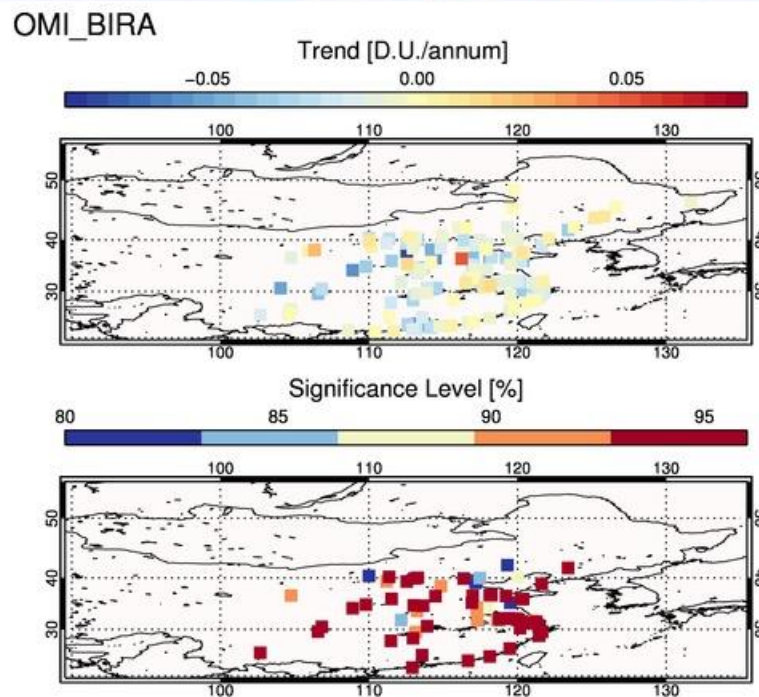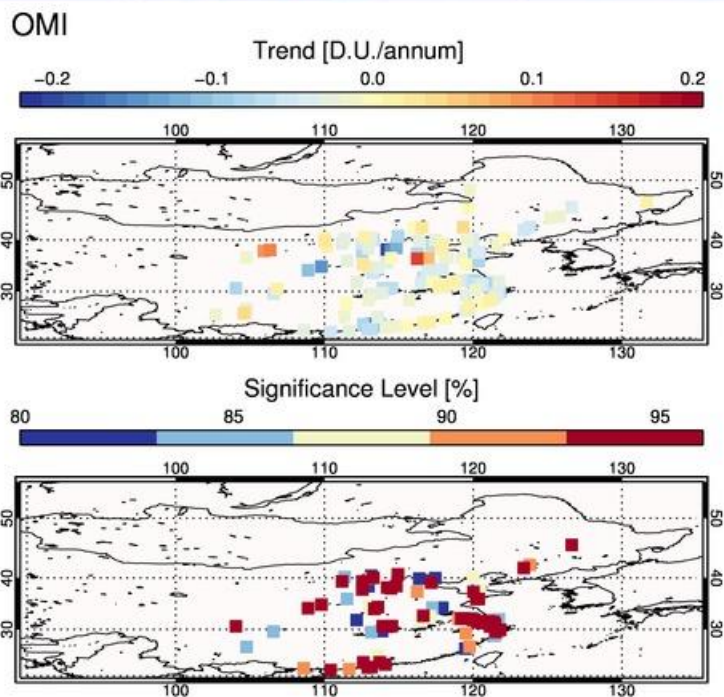8–12 June 2015 | University of Crete | Heraklion, Greece

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SCIAMACHY trends [2004-2010]

SCIA

Trend [D.U./annum]

SCIA_BIRA

Trend [D.U./annum]

Significance Level [%]

Significance Level [%]

Significant Trend	Power plants	Cities
Positive	1	9
Negative	1	9

Significant Trend	Power plants	Cities
Positive	-	-
Negative	32	10

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OMI trends [2004-2014]

Significant Trend	Power plants	Cities
Positive	-	-
Negative	73	17

Significant Trend	Power plants	Cities
Positive	-	-
Negative	83	5

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GOME2 trends [2007-2014]
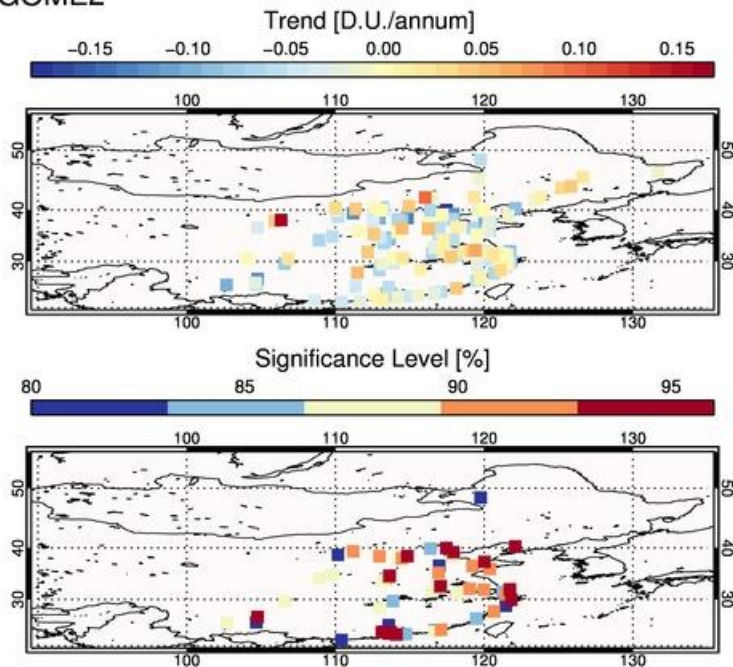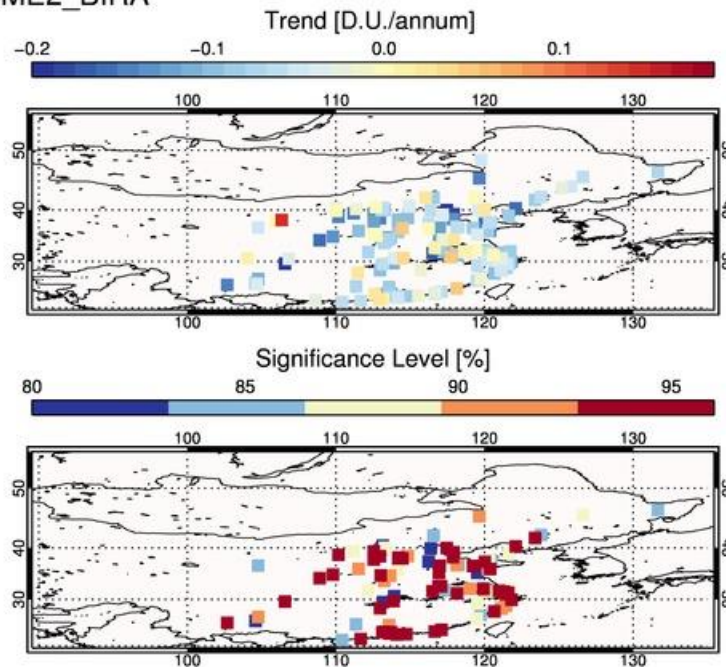
Significant Trend	Power plants	Cities
Positive	-	-
Negative	45	12

Significant Trend	Power plants	Cities
Positive	-	-
Negative	83	17

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Lingwu, Ningxia, China

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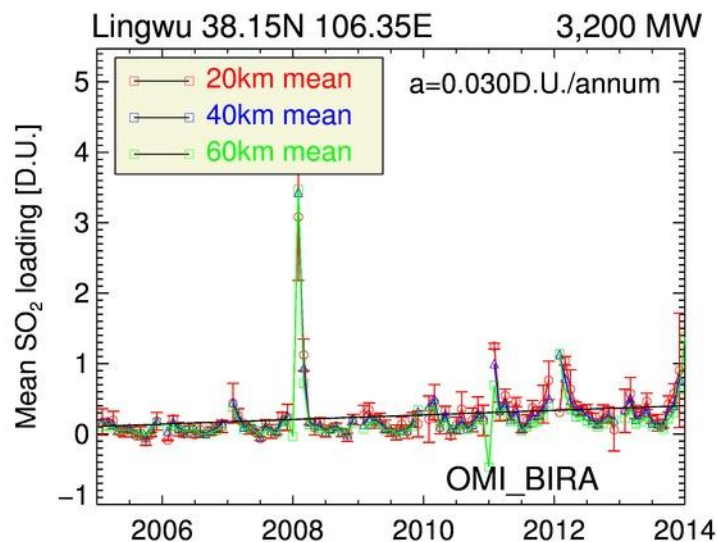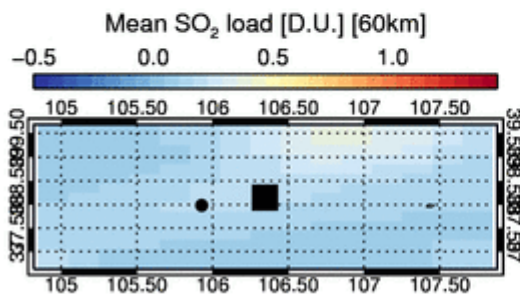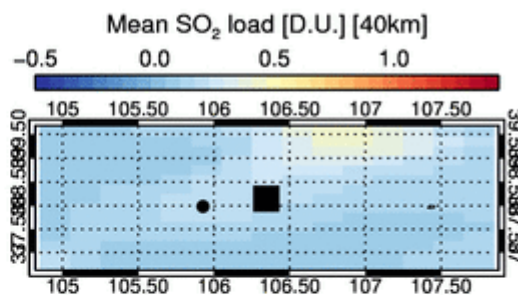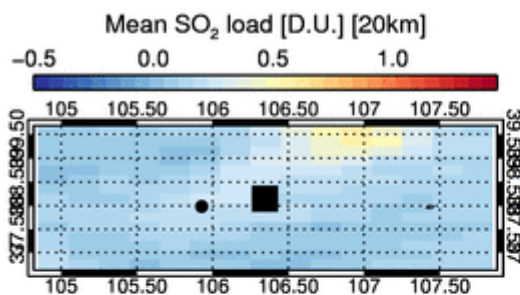
Pearl River Delta, South China

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Zhuhai, Guangdong, China

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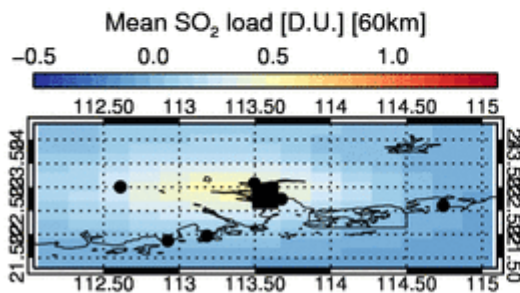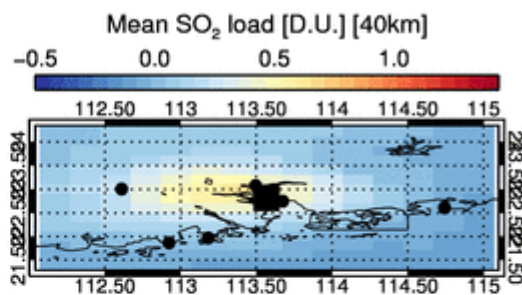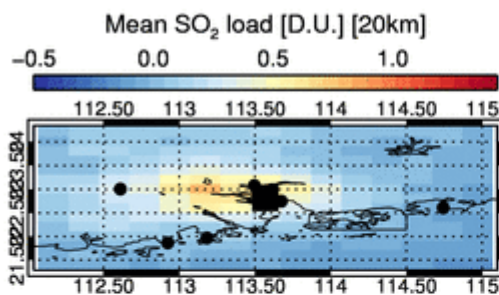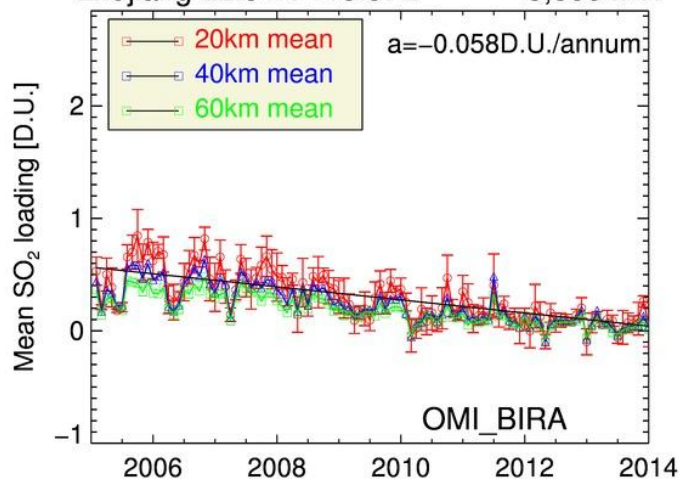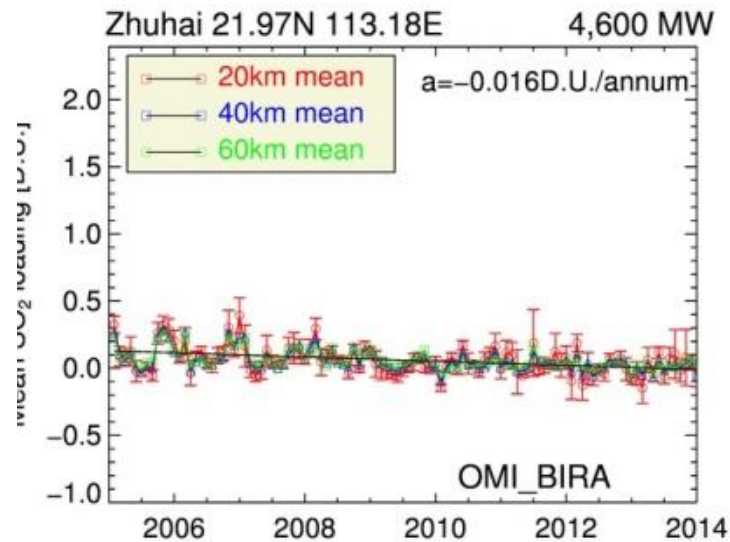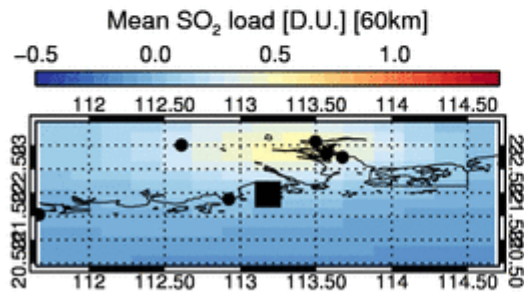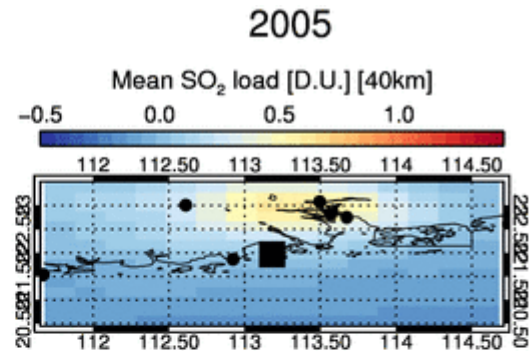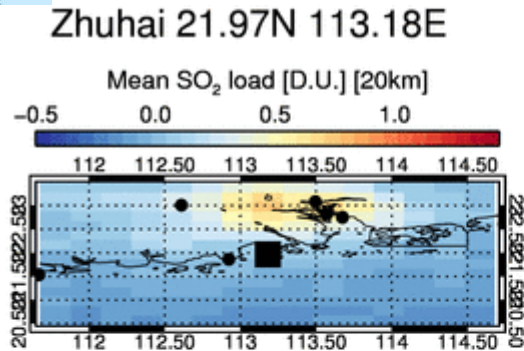
Take away messages

- Within the individual algorithm capabilities and particular instrumental characteristics, all of the SCIAMACHY/Envisat, OMI/Aura and GOME2/MetopA SO_2 measurements are able to demonstrate clearly the SO_2 loading across China.

- A large number of existing power plants and/or coal mining activity centres show an appreciable decrease in SO_2 emissions over the last decade due to economic stability.

- Conversely, developing regions show an increase in SO_2 loading due to the fast implementation of power plants without the regulatory environmental measures.

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- **Step 1: Estimation of SO$_2$ point emissions:**

- Using the Fioletov, et al., G.R.L., 2011 and Fioletov, et al. (2013), J.G.R., 2013 equations estimate the time evolution of the emissions of the point SO$_2$ sources.

- **Step 2: Estimation of SO$_2$ field emissions:**

- Using the Martin et al., 2003 & Jaeglé et al., 2005, method for calculating the a posteriori emission inventory we aim at yearly updated top-down emission fields for the entire region of Eastern Asia.

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