

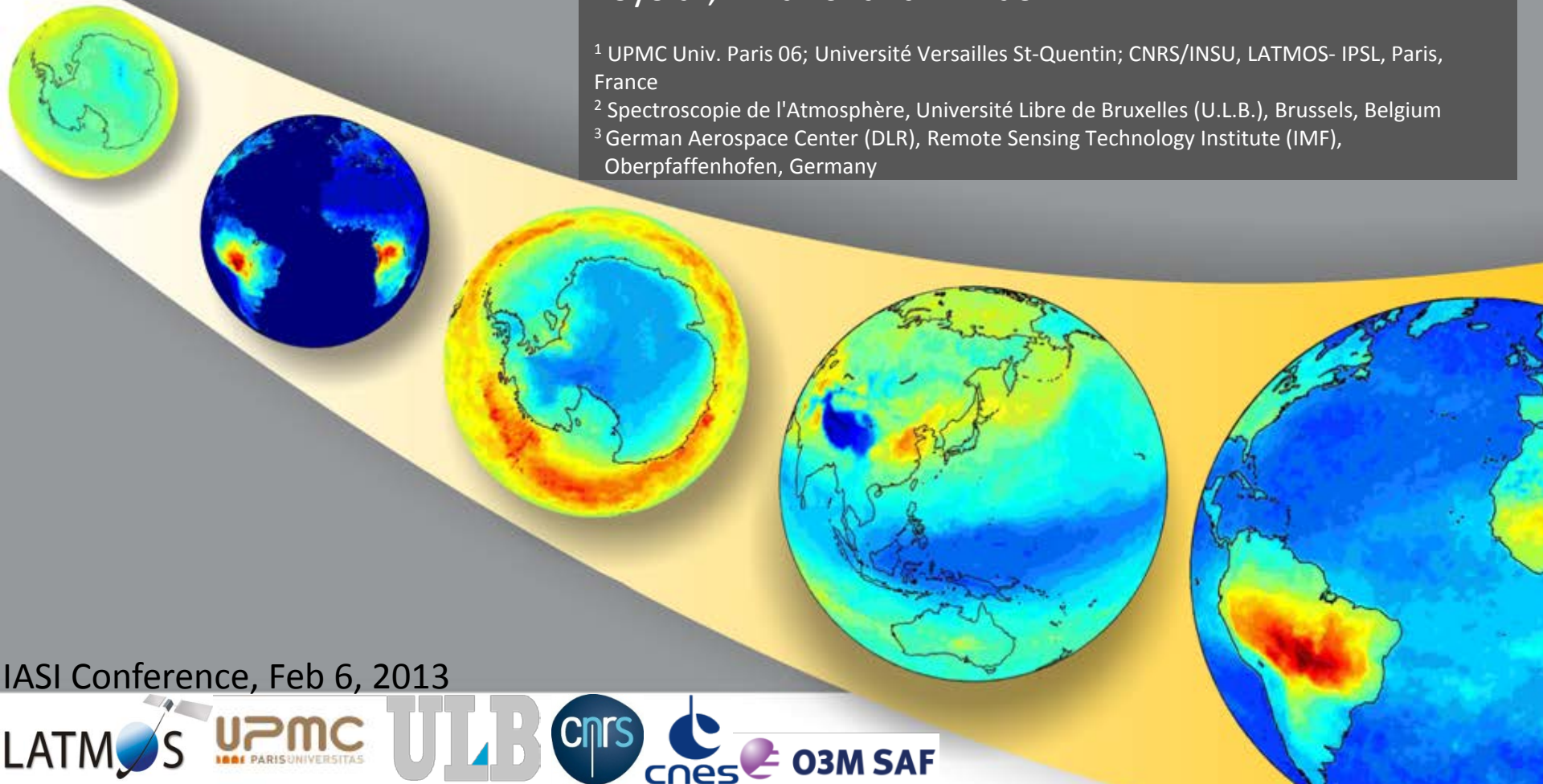
Tropospheric Ozone and Nitrogen Dioxide Measurements in Urban and Rural Regions as Seen by IASI and GOME-2

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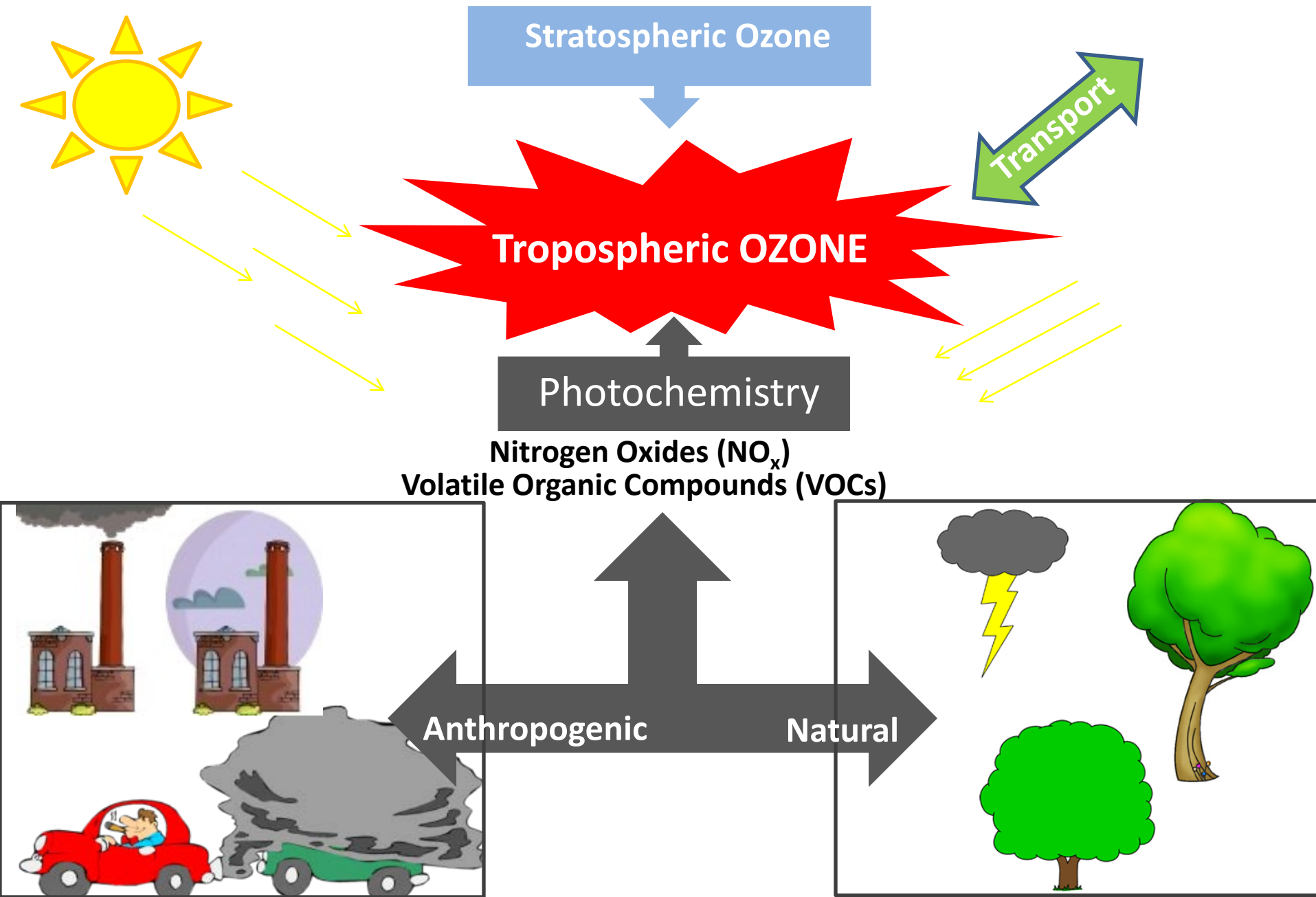
¹ UPMC Univ. Paris 06; Université Versailles St-Quentin; CNRS/INSU, LATMOS- IPSL, Paris, France

² Spectroscopie de l'Atmosphère, Université Libre de Bruxelles (U.L.B.), Brussels, Belgium

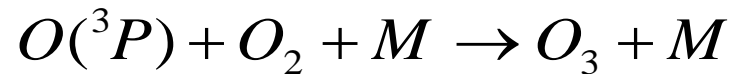
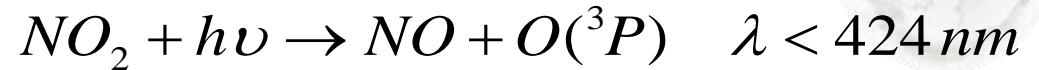
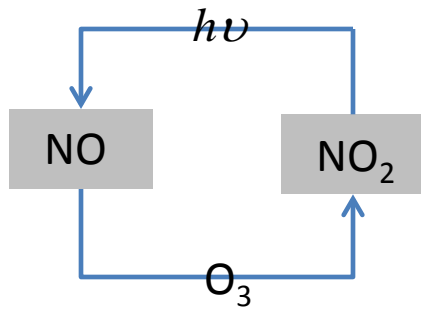
³ German Aerospace Center (DLR), Remote Sensing Technology Institute (IMF), Oberpfaffenhofen, Germany



IASI Conference, Feb 6, 2013



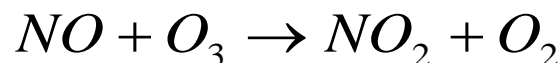
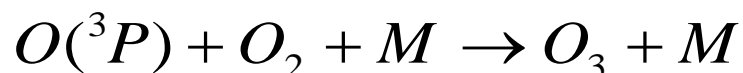
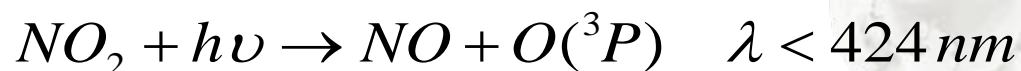
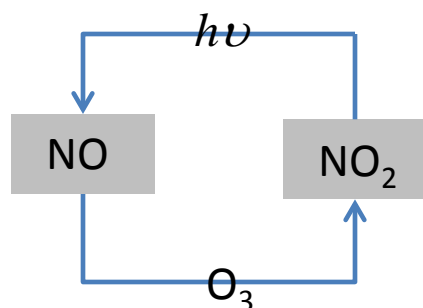
Photostationary state: cycling
has no net effect on ozone



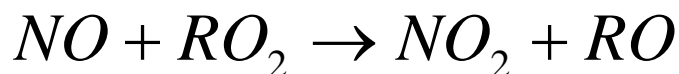
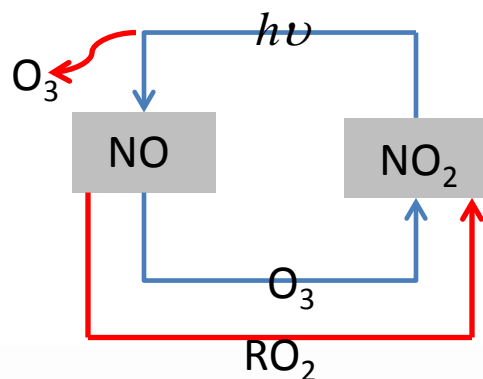
**An additional pathway is needed to convert NO to NO₂
without destroying O₃**

Gaz Phase Chemistry of Tropospheric Ozone

Photostationary state: cycling
has no net effect on ozone

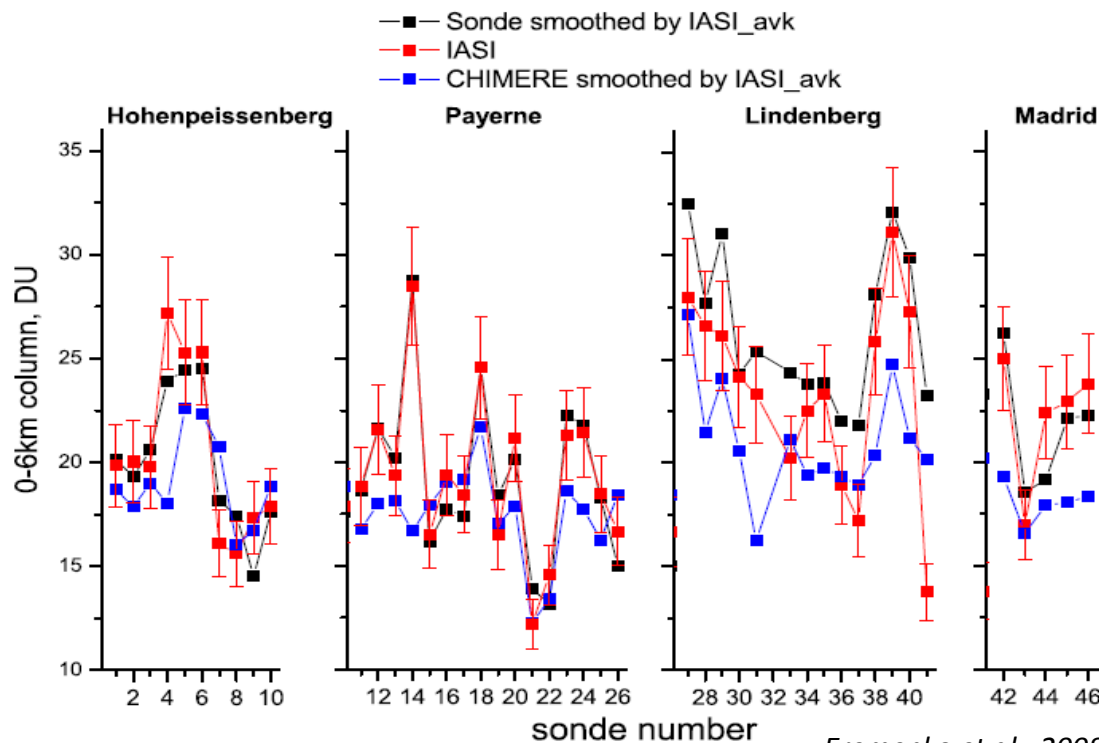


**Presence of peroxy radicals, from the oxidation of VOCs
(hydrocarbons and aldehydes) disturbs O₃-NO-NO₂ cycle**



leads to net production of ozone

Measuring tropospheric O_3 on a city scale is a challenging task to be accomplished with satellites because of the horizontal and vertical resolution of the instrument.



Eremenko et al., 2008

Eremenko et al. [2008] and *Dufour et al.* [2010] have shown that it is possible to study, with infrared sounders, the variation of the tropospheric O_3 column around cities in particular.

Strategy

Nine cities in the Northern Hemisphere with high anthropogenic emissions



Study duration: 2008-2011

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Nine cities in the Northern Hemisphere with high anthropogenic emissions



**Wind
Directions:
ECMWF**

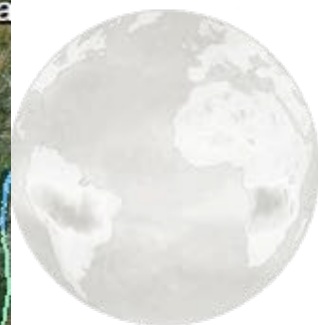
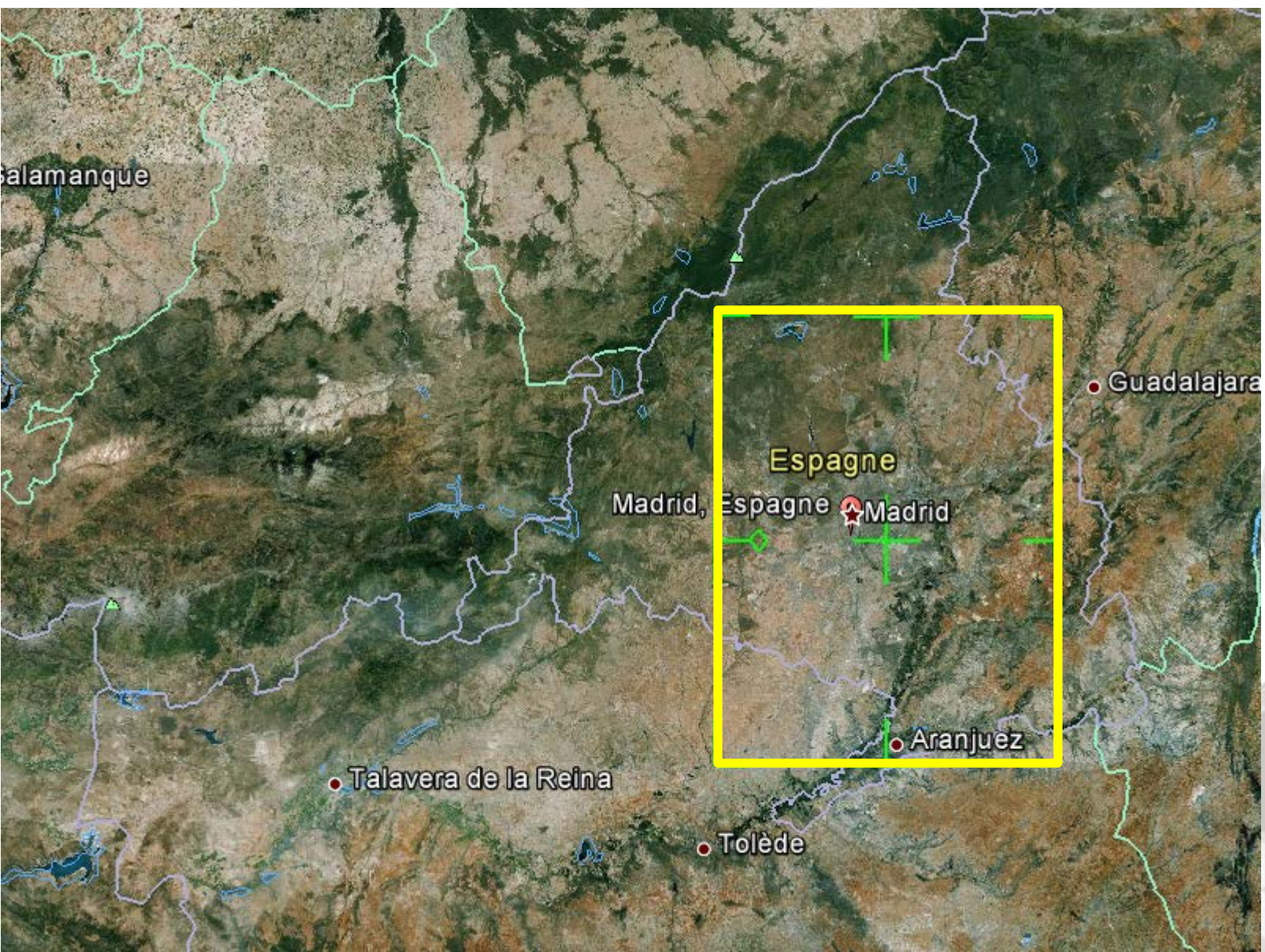
ERA-interim

**Tropospheric
O₃:
IASI**

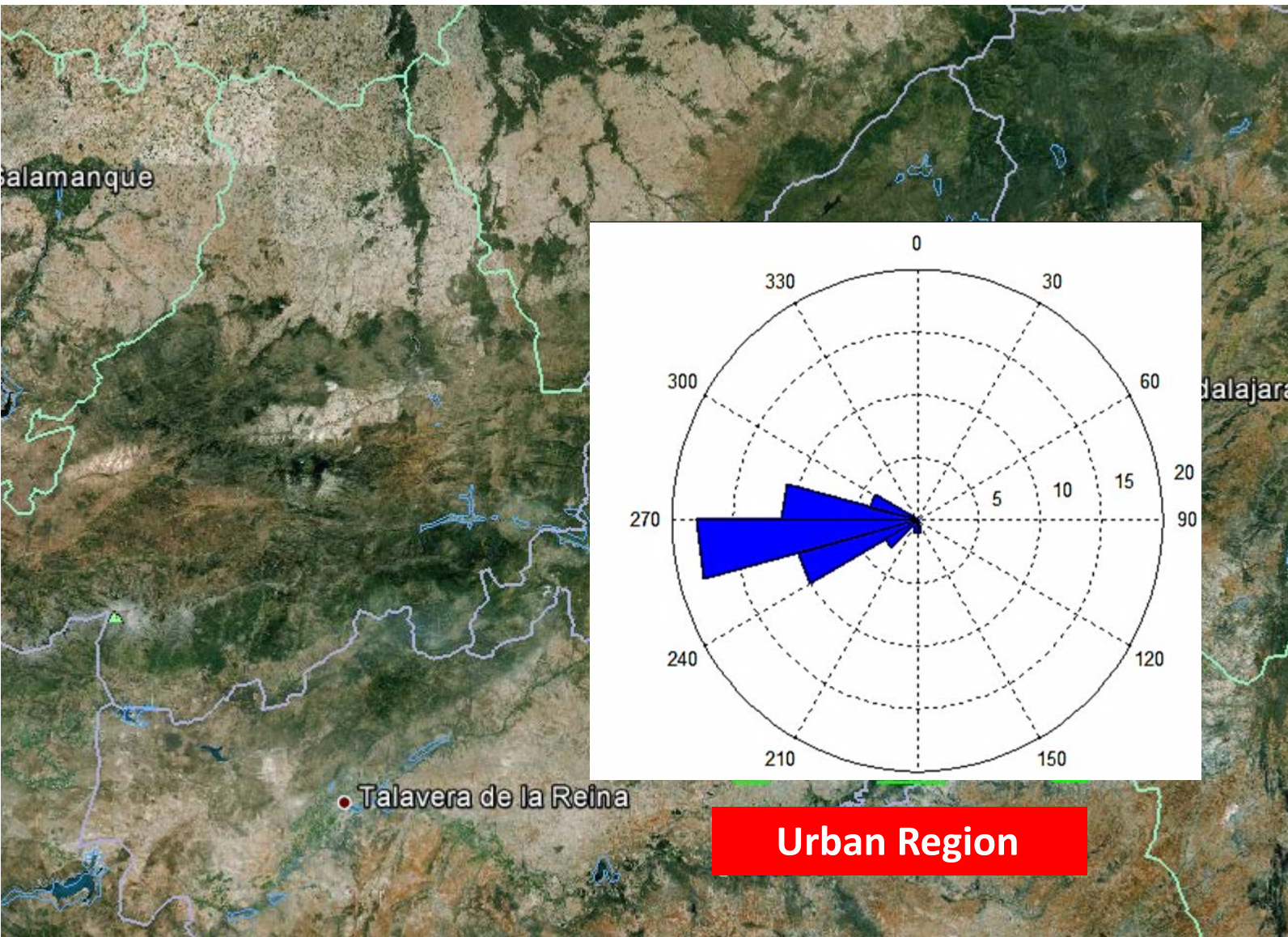
FORLI-O₃

**Tropospheric
NO₂:
GOME-2**

O3M-SAF

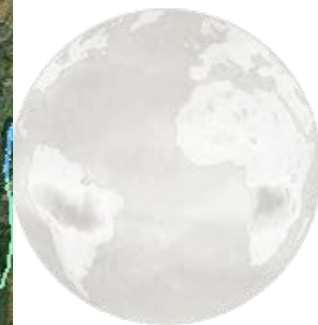
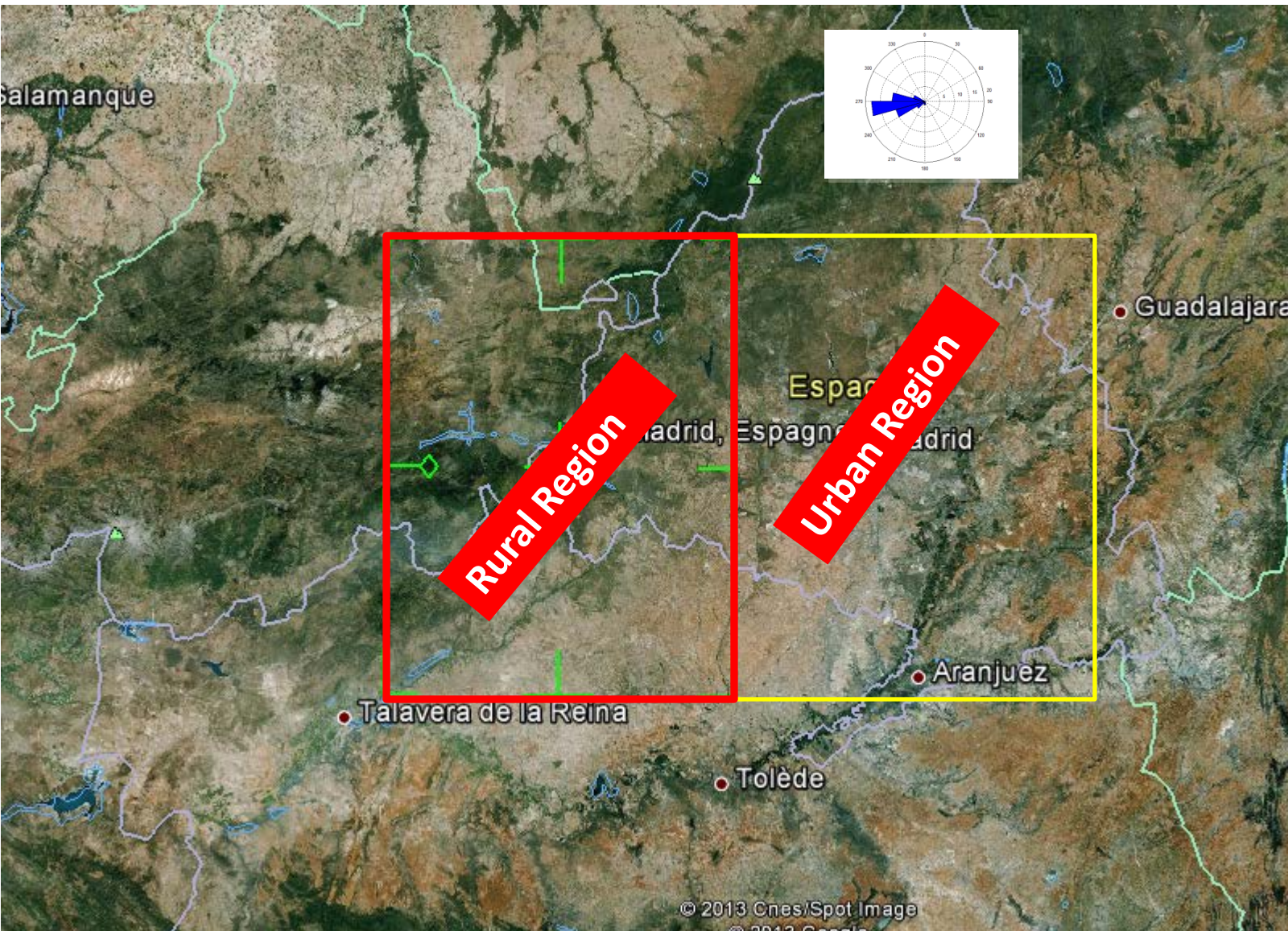


Wind Analysis

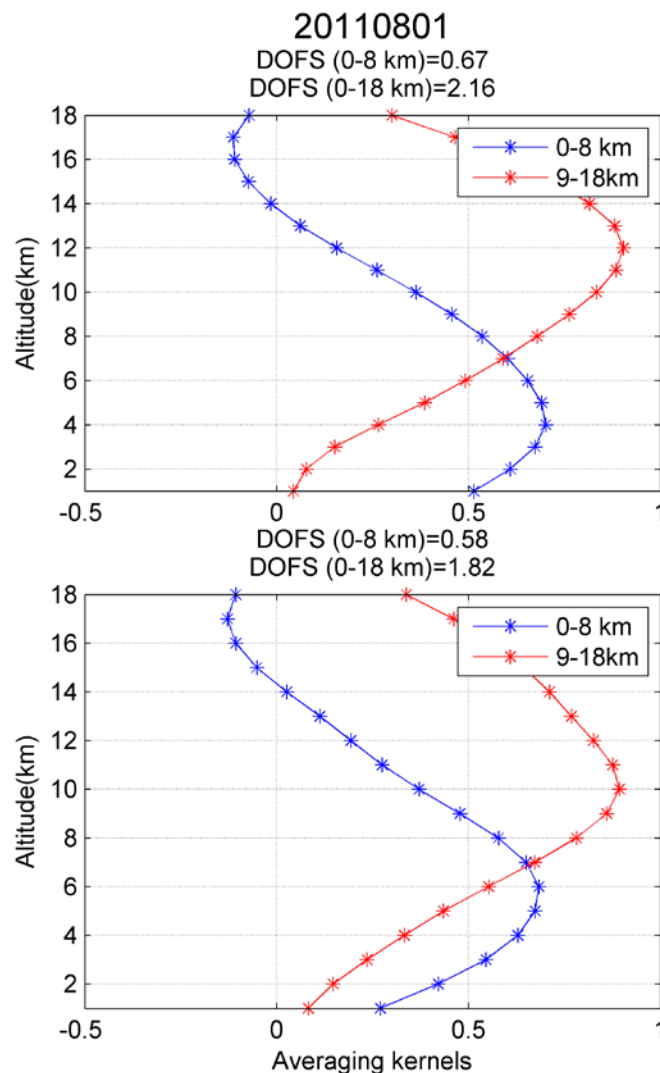
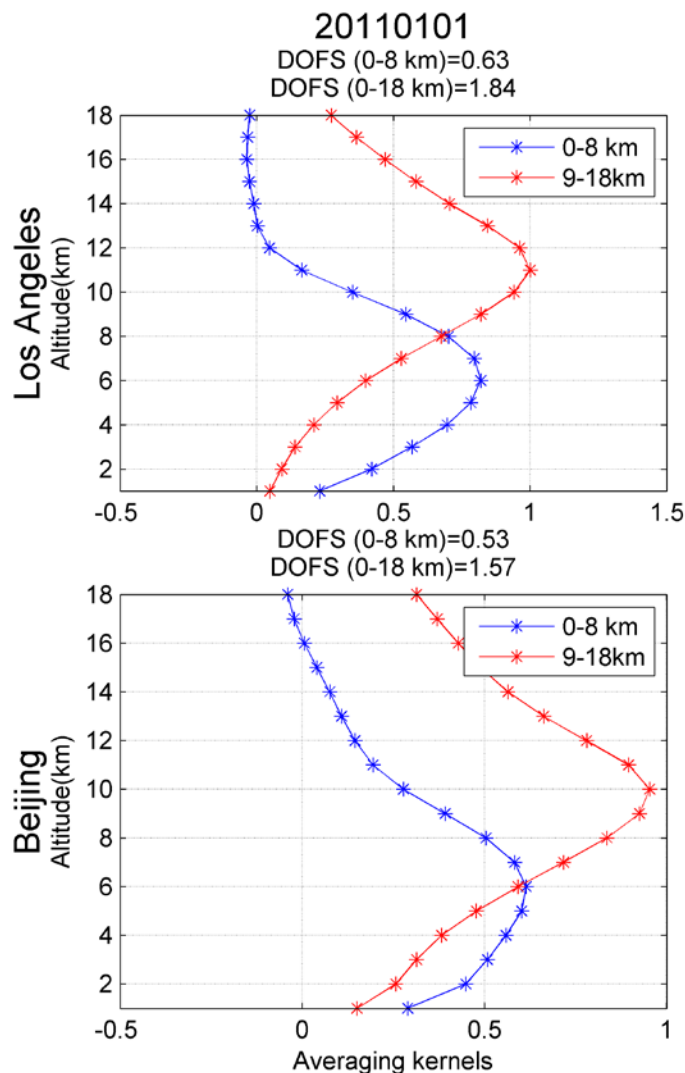


48 Monthly averaged wind direction angles between the surface and 350 hPa blowing from Madrid for the period of 2008-2011

Wind direction patterns used in this study are from ERA-Interim archive at ECMWF (u- and v-components of horizontal wind).



IASI Ozone Measurements

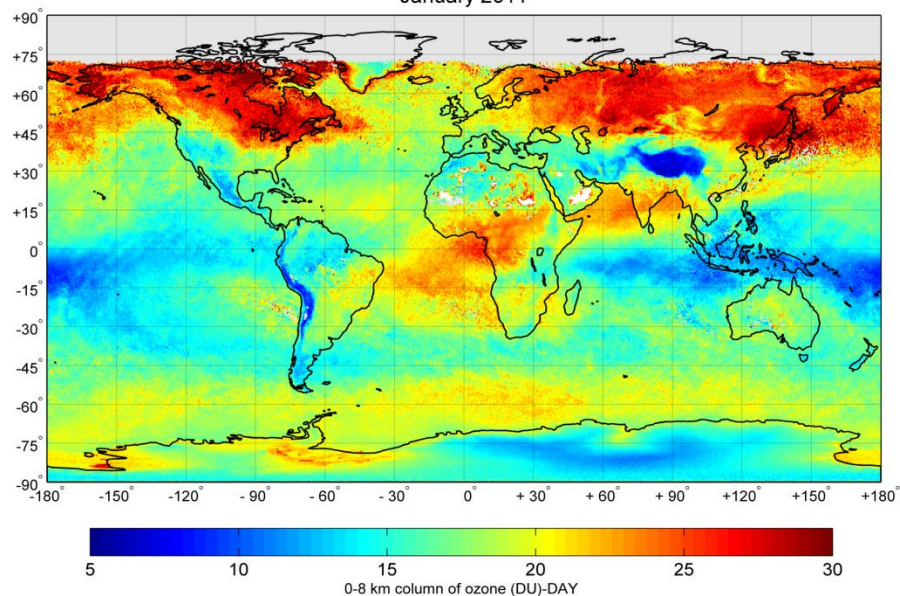


We chose the 0-8 km column because it provides > 0.5 pieces of information in the troposphere

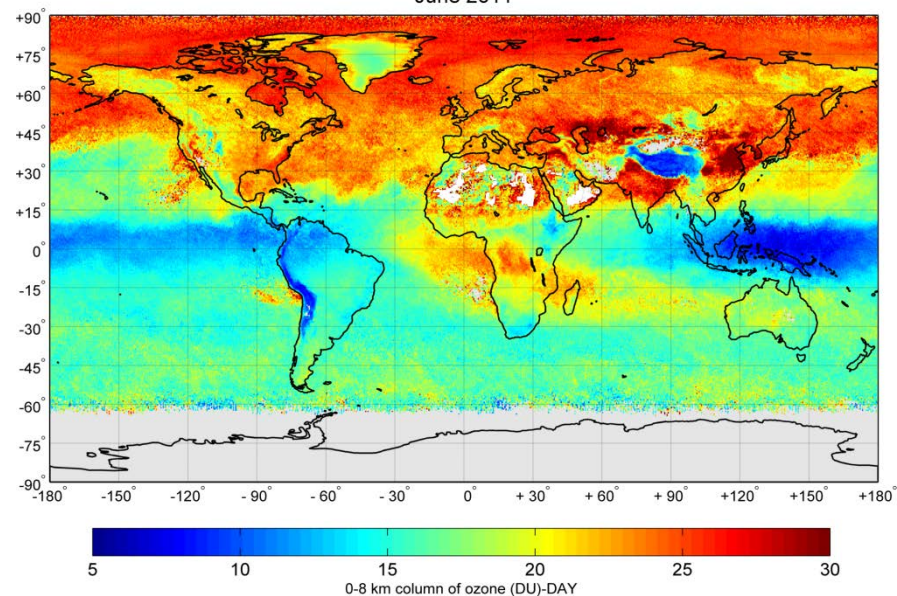
Global distributions of O_3 vertical profiles are retrieved in near real time using an exclusive radiative transfer and retrieval software for the IASI O_3 product, the Fast Optimal Retrievals on Layers for IASI (FORLI- O_3) [Hurtmans et al., 2012].

IASI Ozone Measurements

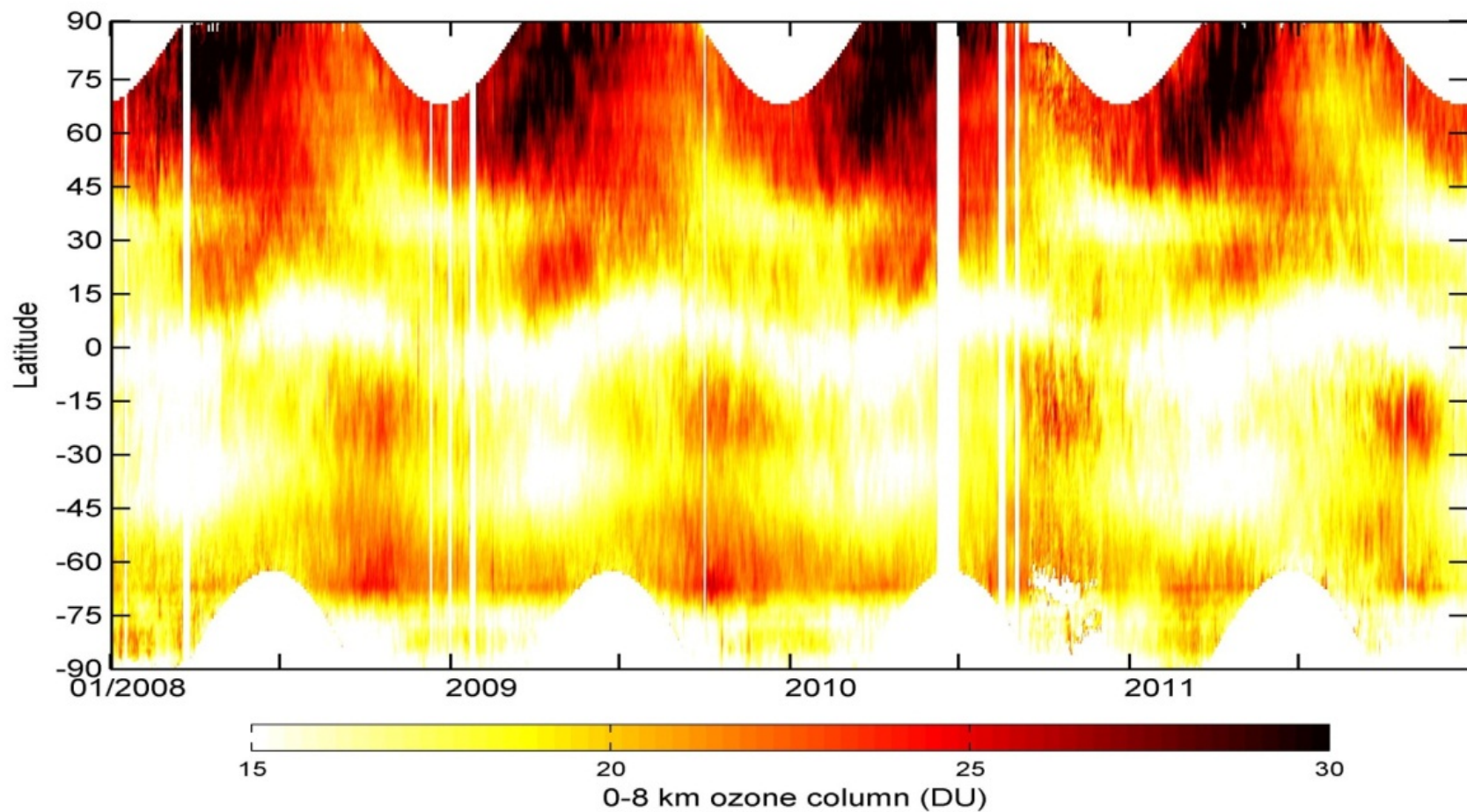
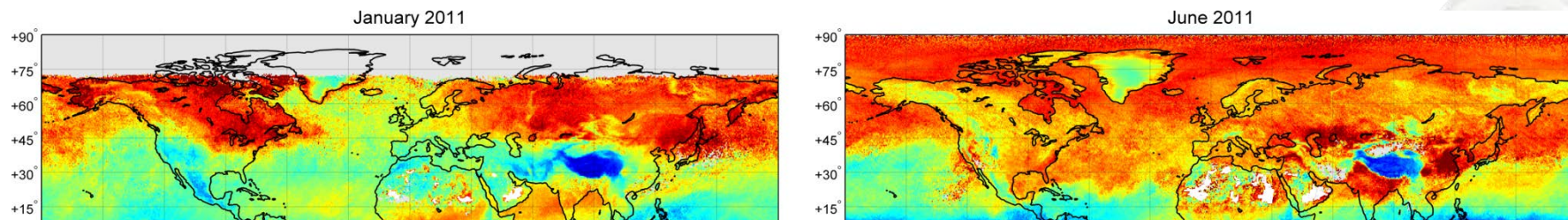
January 2011



June 2011



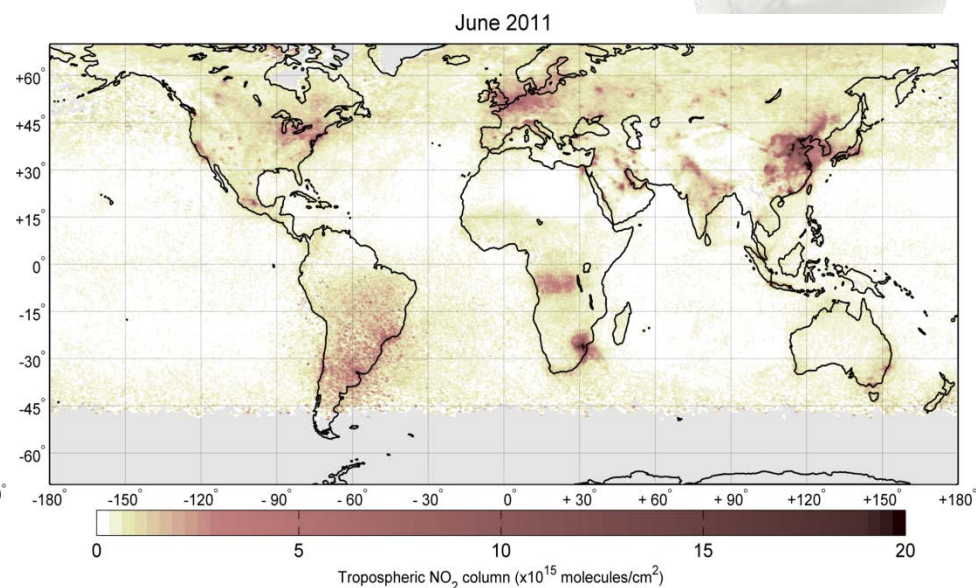
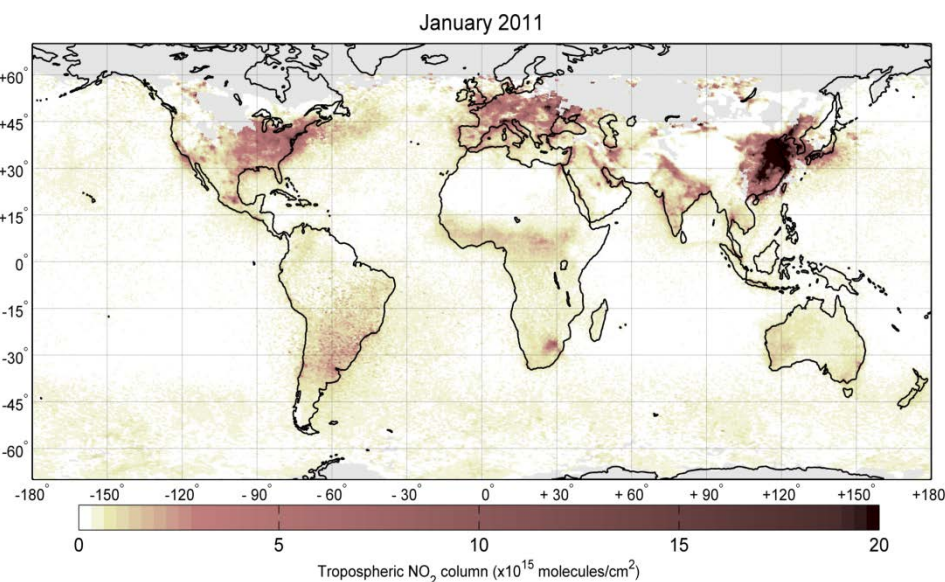
IASI Ozone Measurements



GOME-2 Nitrogen Dioxide Measurements

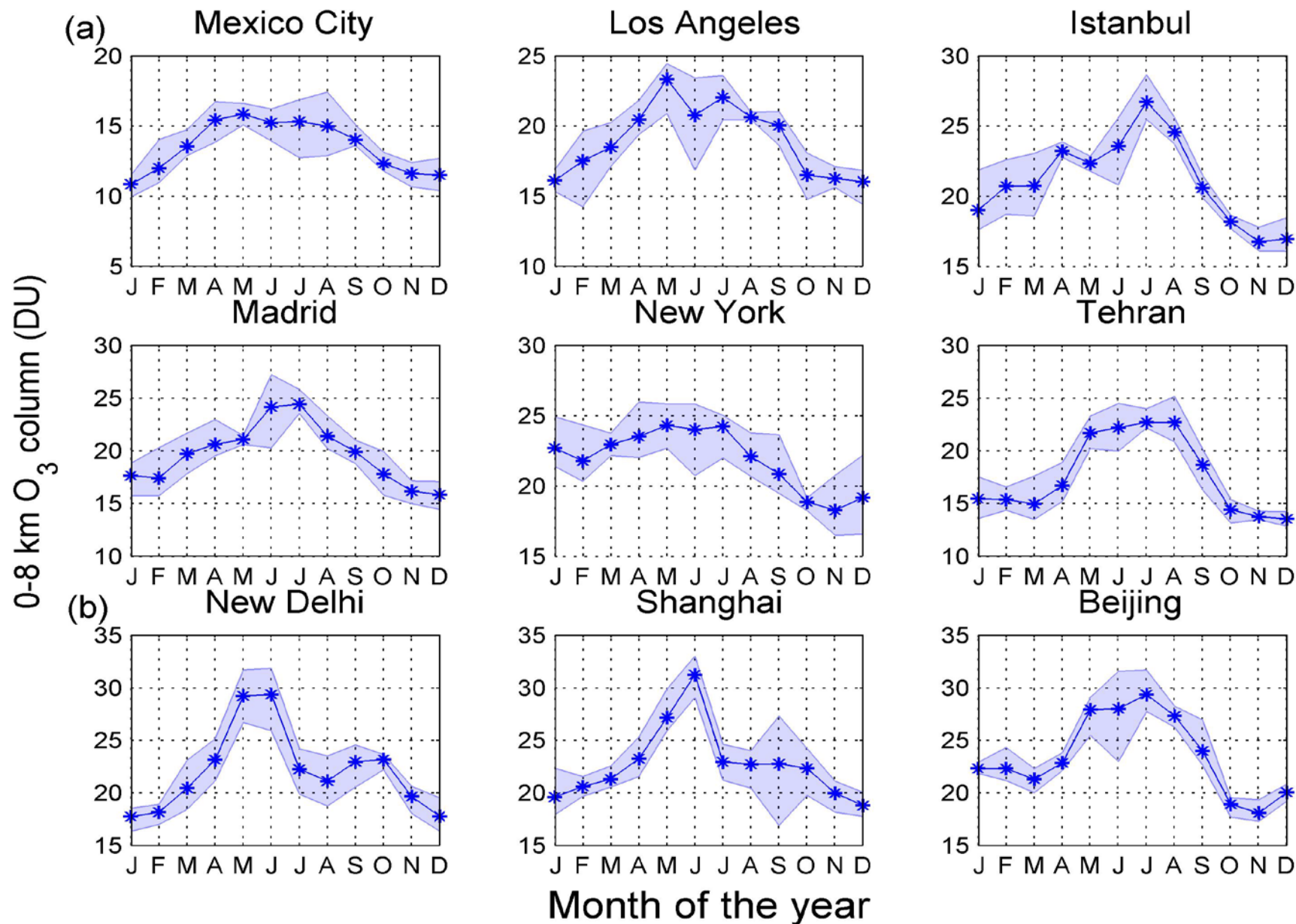
GOME-2

- On board of the MetOp-A platform like IASI
- Nadir-scanning UV/visible spectrometer
- Swath width of 1920 km
- Nominal ground pixel size of $80 \times 40 \text{ km}^2$ (global coverage every 1.5 days)

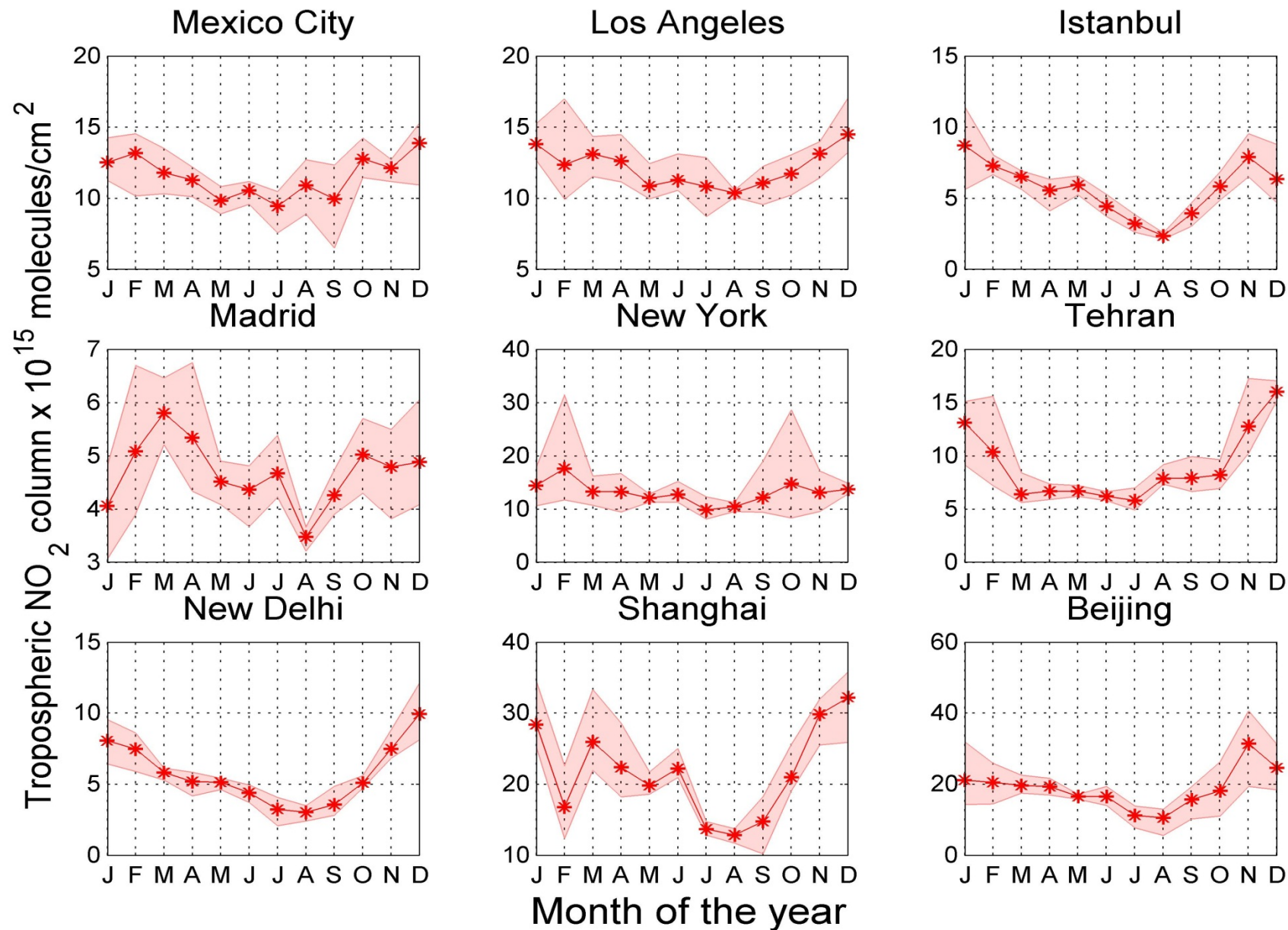


The operational tropospheric NO₂ product is provided by the German Aerospace center, in the framework of the EUMETSAT O3M-SAF

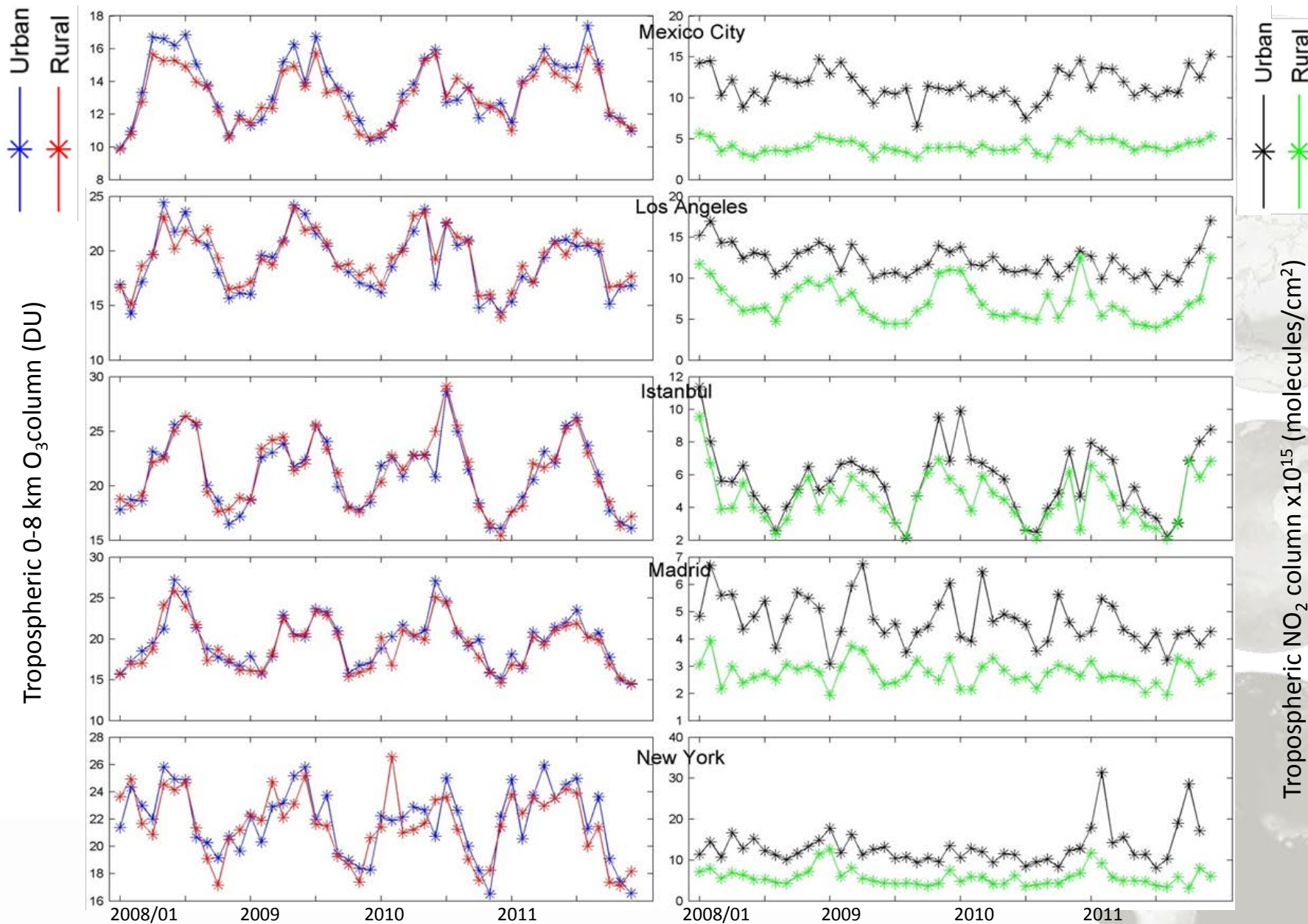
Seasonal Cycling of Ozone in Urban Regions

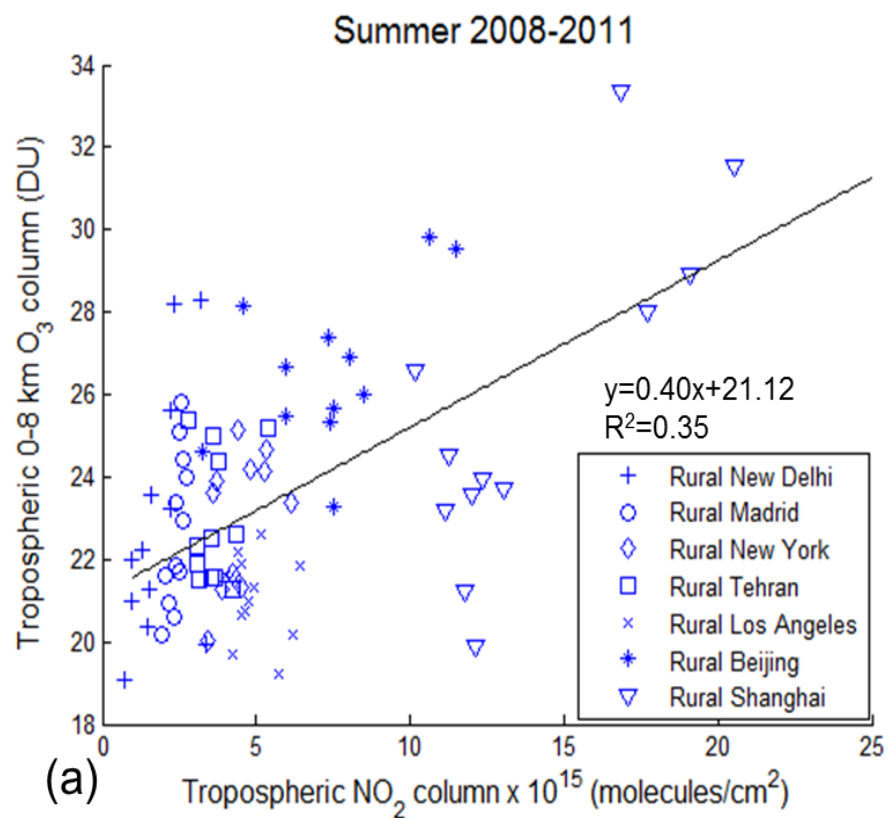


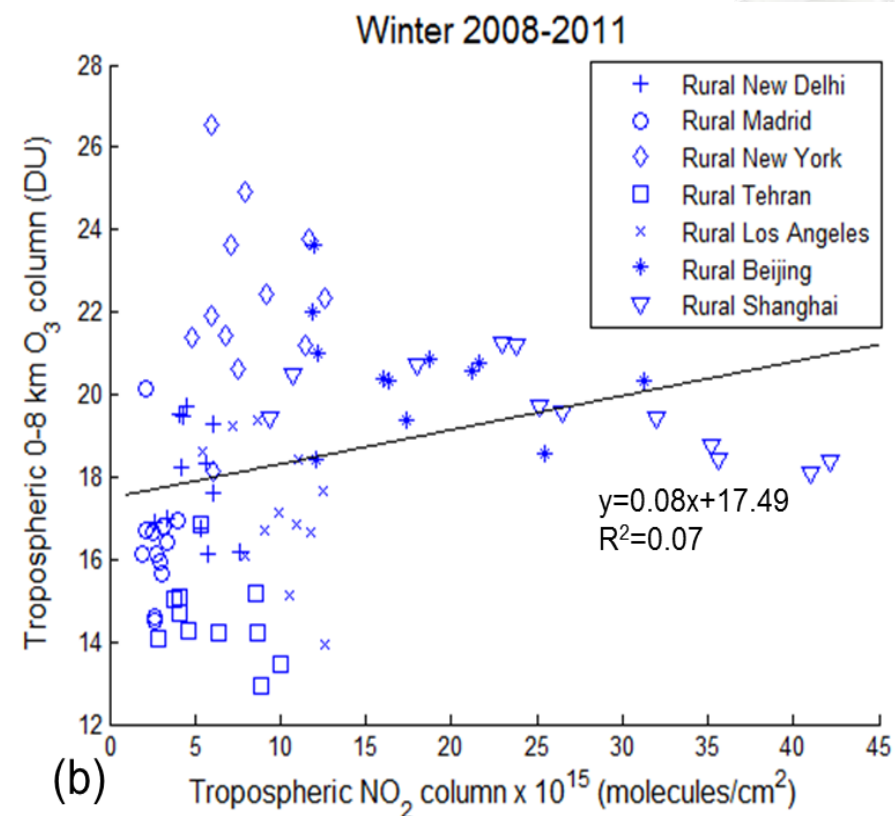
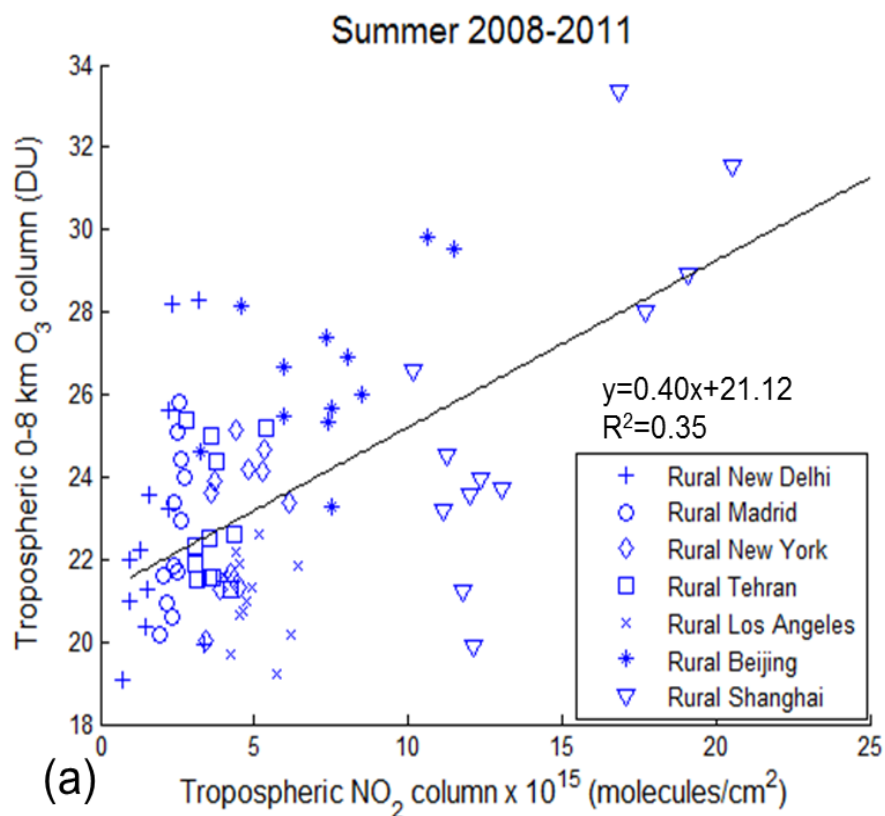
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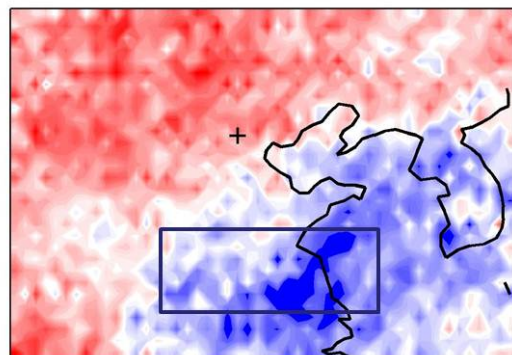
Tropospheric O₃ and NO₂ in rural regions



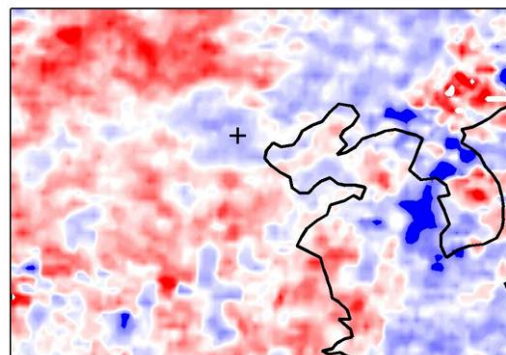
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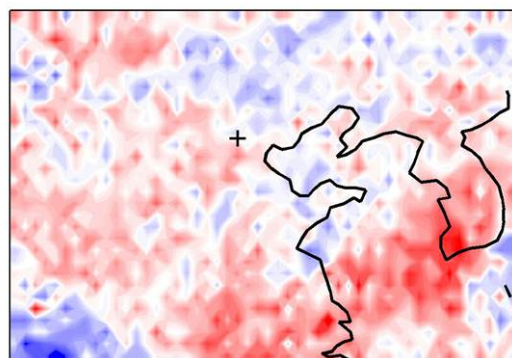
Case Study of the 2008 Olympic Games



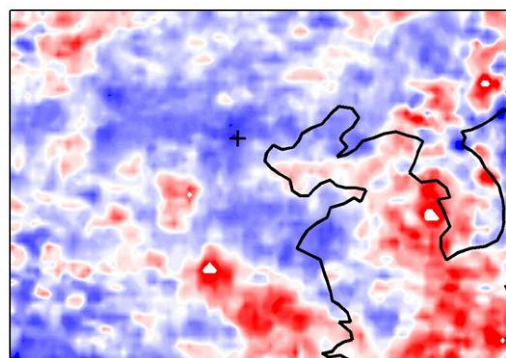
July



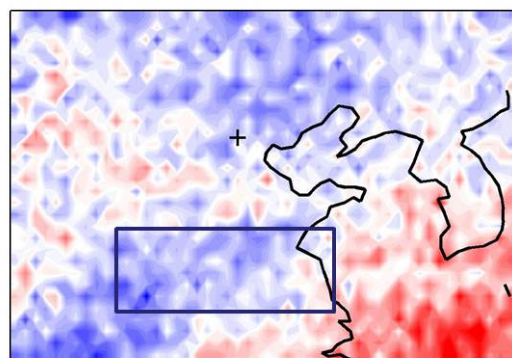
Beijing Location is indicated with a "+" marker.



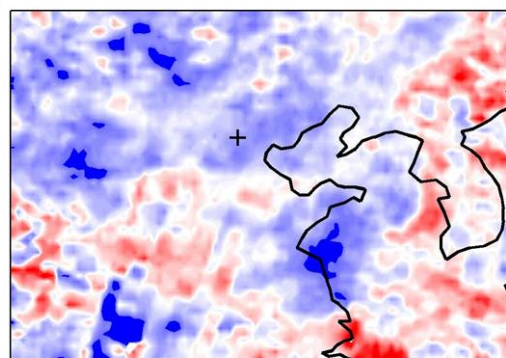
August



Large decrease in NO_2 , while a no significant decrease for O_3



September



Large decrease for O_3 in the rectangular box in July and September

-20 -15 -10 -5 0 5 10 15 20
% change in the 0-8 km O_3 column (DU)

-60 -40 -20 0 20 40 60
% change in the tropospheric NO_2 column
($\times 10^{15}$ molecules/ cm^2)

Summary and Conclusions

Four years of tropospheric O_3 and NO_2 observations provided by the IASI and GOME-2 mission are analyzed:

- Consistent seasonal behavior of tropospheric O_3 , with a peak in spring due to stratospheric intrusion and another higher one in summer due to the photochemical production.



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- This work is thus a new step showing that infrared satellite spectrometers, such as IASI, are capable to track pollution by tropospheric O_3 on a city scale and provide relevant information for air quality studies.

Thank you!



Panthéon- 17 juin 2004



Panthéon - 9 juin 2004

http://www.airparif.asso.fr/_pdf/dossier_ozone.pdf

**For more info please check:
*Safieddine et al., 2013 (submitted to JGR)***