

#### PARIS DIDEROT







Ozone maximum over the North China Plain and North China

Ozone maximum in late spring/early summer (May/June)

Export from China during springtime

# Variability and Short-term Trends of Lower and Upper Tropospheric Ozone over the North China Plain from IASI Observations

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### Abstract

Important progresses in the field of atmospheric ozone sounding from space have been accomplished during the last decade. The lower troposphere is now available from IASI with a maximum of sensitivity between 3 and 4 km. We use satellite observations from IASI on boar the MetOp satellites to evaluate the short-term trends of tropospheric zone over the North China Plain (NCP) for the period 2008-2015. The availability of two semi-independent columns of ozone from the surface up to 12 km allow ones to derive ozone trends for the lower (surface to 6 km a.s.l) and the upper troposphere (6 to 12 km a.s.l). Monthly variations show a maximum in late spring/early summer (May, June) in the lower troposphere. Short-term trends are calculated from deseasonalized monthly variations. Preliminary results show negative trend in the lower troposphere whereas a positive trend is observed in the upper troposphere. If the negative trend a paperas to be significant in the lower troposphere, the positive trend in the upper troposphere remains poorly significant over such a short period. The consistency between the two in-flight IASI instruments aboard MetOp-B is discussed. The IASI derived trends are compared to independent in situ observations provided by ozone sounding at Beijing.





#### **IASI-A/IASI-B** consistency

n lower and upper tropospheric columns over the NCP were calculated over the co of IASI-A and IASI-B, i.e. from February 2013 to December 2015. A slight bias of + 0.56 DU/+2,5% (IASI-B being larger) is found for the lower troposphere A unsignificant bias (-0.007 DU) is found for the upper troposphere

sitive trends only significant during

IASI-B monthly means reported in the Figures are corrected from these biases

### Short-term trends over the North China Plain – 2008-2015



ethod for deseasonalization of the time

- > Significant negative trend (-0.15 DU/yr) in the lower troposphere (p=1e-4) > Unsignificant positive trend (+0.12 DU/yr) in the upper troposphere (p=0.2) for such a short period > Changing trends for NO<sub>2</sub> since 2011 → impact on ozone ?

~ -5%/yr during springtime and wintertime not significant during summertime

Interannual variability by season

The negative trends observed during spring- and wintertime question about possible changes of the impact of troposphere/stratospere exchanges on the lower tropospheric gzone.

## Timeseries from ozonesonding at Beijing (preliminary results)

summertime



Monthly timeseries from ozonesondes measured in Beijing suggest a negative trend but with a larger amplitude than those from IASI. Due to changes in the instrumentation during the time period, an intercalibration of the instruments is needed to conlude firmly.



M. Eremenko, G. Dufour, G. Foret, C. Keim, J. Orphal, M. Beekmann, G. Bergametti, and J.-M. Flaud: "Tropospheric ozone distributions over Europe during the heat wave in July 2007 observed from infrared Nadir spectra measured by IASI", *Geophysical Research Letters* 35, doi:10.1029/2008G(IJ04803, 2008. G. Dufour, M. Eremenko, J. Orphal, J.-M. Flaud, IASI observations of seasonal and day-to-day variations of tropospheric ozone over three highly populated areas of China: Beijing, Shanghai, and Hong Kong, *Atmos. Chem. Phys.*, 10, 3787-3801, 2010. G. Dufour, M. Eremenko, J. Griesfeller, B. Barret, E. LeFlochmeor, C. Clerbaux, J. Hadji-Lazaro, P.-F. Coheur, and D. Hurtmans, Validation of three scientific corone products retrieved from IASI spectra using ozonesondes, Atmos. Neas. Tech., 5, 611-630, 2012.