Springtime variability of tropospheric ozone over Eastern Asia: respective role of cyclones and pollution as determined from IASI

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IASI Ozone retrieval developped at LISA



maximum of information in the lower troposphere

- altitude-dependent regularization = Tikhonov+ altitude-dependent constrainers
 - minimize the error and maximize the degrees of freedom of the solution

details: Eremenko et al., 2008

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Performances of the LISA ozone product





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All the results are presented for the morning overpass of IASI



Springtime O₃ Variability in China: Scientific Motivations



China

- one the largest polluted region worldwide
- Interesting region to test capabilities of satellites to probe pollutants

Lower tropospheric ozone is maximum in May at the continental scale

Q: Which are the processes that drive the ozone enhancements and the daily variability as observed by IASI?

Q: Is IASI able to determine the role of natural (i.e. dynamic) and anthropogenic contributions to the observed variability?

Role of midlatitude cyclones on tropospheric ozone



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Polar air masses

- behind cold front
- northern part
- Low tropopauses

reversible subsiding and ascending ozone transfers affecting LT O_3 columns



Case study - 4-6 May 2008 (1/2)

Meteorological fields @ 850hPa - a) 20080504 b) 20080505 c) 20080506 55°N 310 50° 50°N 50° 306 302 45°N 45°N 45°N 298 40°N 40°N 40°N ²⁹⁴ 🔽 35°N 35°N 35°N 290 286 30°N 30°N 30°N 282 25°N 25°N 25°N 278 145°E 20 m/s 20°N 20°N 20°N 105°E 115°E 125°E 135°E 145°E 105°E 115°E 125°E 135°E 145°E 105°E 115°E 125°E 135°E IASI LT 03 - 20080504 20080505 20080506 36 45°N 45°N 45° 32 28 40°N 40°N 40°N 24 35°N 35°N 20 0 35°I 30°N 30°N 30° 16 12 25°N 25°N 25°N 8 20°N 20° 20°N 125°E 115°E 125°E 4 105°E 115°E 125°E 135°E 145°E 105°E 115°E 135°E 145°E 105°E 135°E 145°E IASI UT O3 - 20080504 20080505 20080506 50 45°N 45°N 45 45 40 40°N 40°N 40°N 35 30 [n 25 [] 35°N 35°N 35°N 30°N 30°N 30°N 20 15 25°N 25°N 25°N 10 20°N 20°N 20°N 135°E 145°E 5 125°E 125°E 105°E 115°E 125°E 135°E 145°E 105 115°E 105 115°E 135°E 145°E

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Upper tropospheric O3 columns can be used as a dynamical indicator Dufour et al., ACPD, 2015

Case study - 4-6 May 2008 (2/2)

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LT O3 and CO enhancements: pollution indicator

Case study - 12-15 May 2008



Dufour et al., ACPD,2015

45°N

40°N

35°N

30°N

25°N

20°N

105°E

115°E

IASI LT O3 - 20080512



N 105°E 115°E 125°E 135°E 145°E

IASI UT O3 - 20080512



IASI CO - 20080512



20080514





20080514

125°E



20080514

135°E











Longitudinal section: vertical distribution



Conclusions and perspective

- □ Good reliability of IASI observations for lower tropospheric ozone
- Multivariables analysis to identify the natural vs anthropogenic contribution to lower tropospheric ozone at a daily scale
 - North China, Korea and Japan affected by tropopause perturbation and downward transport behind cold front during springtime
 - North China Plain can be strongly affected by downward transport at the short timescale of frontal activity but more often photochemical production is dominant and mixed with dynamical processes during springtime

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IASI-GOME-2: LMTO3 + IASI LTO3 + UTO3 + CO



Free vs lowermost troposphere Access to the PBL in favorable cases

Acknowledgements

