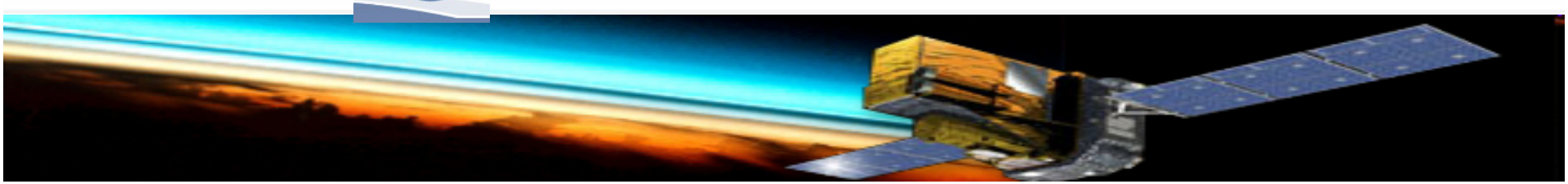
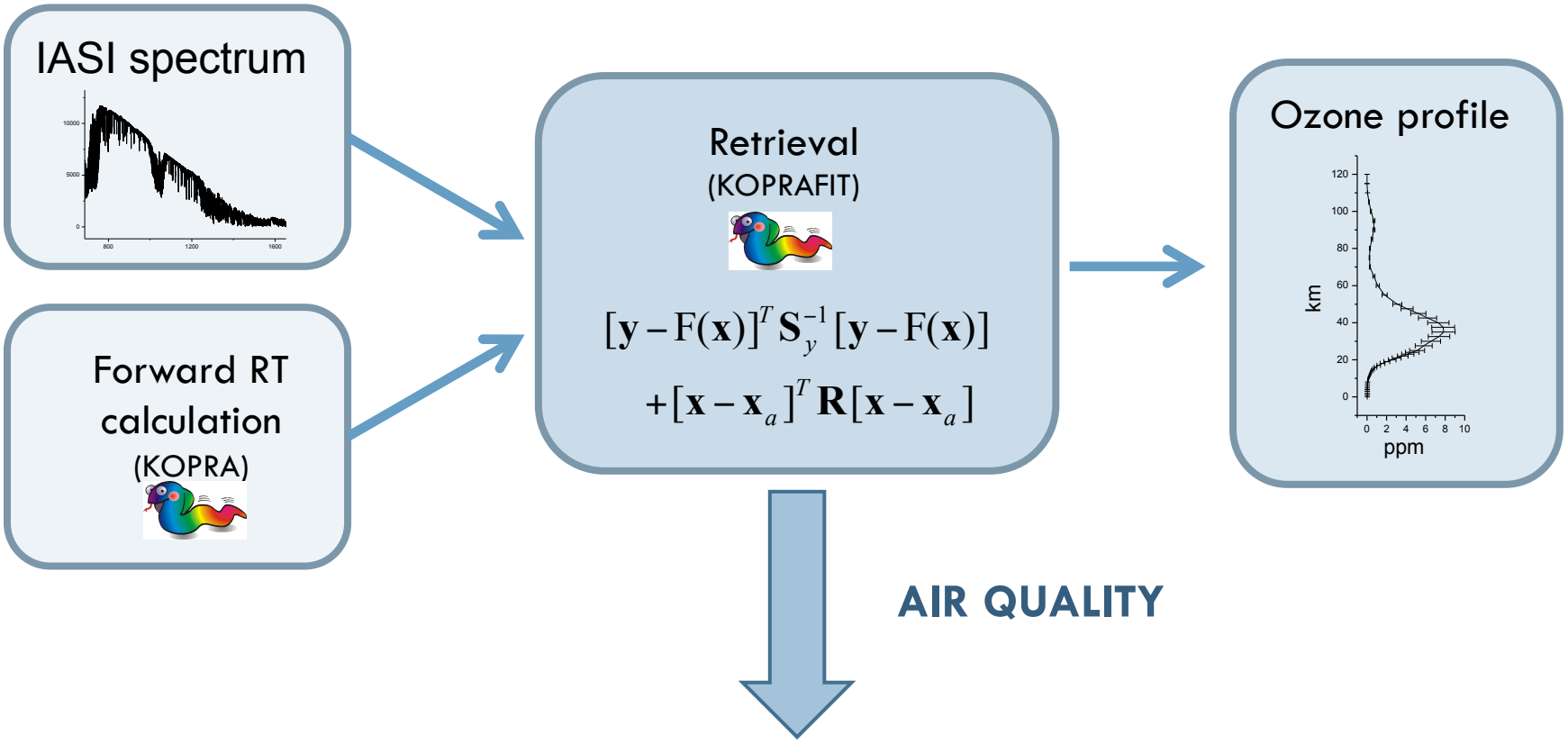
Springtime variability of tropospheric ozone over Eastern Asia: respective role of cyclones and pollution as determined from IASI

G. Dufour, M. Eremenko, J. Cuesta, C. Doche, G. Foret, M. Beekmann, A. Cheiney, Y. Wang*, Z. Cai*, Y. Li*, M. Takigawa**, Y. Kanaya**, J.-M. Flaud



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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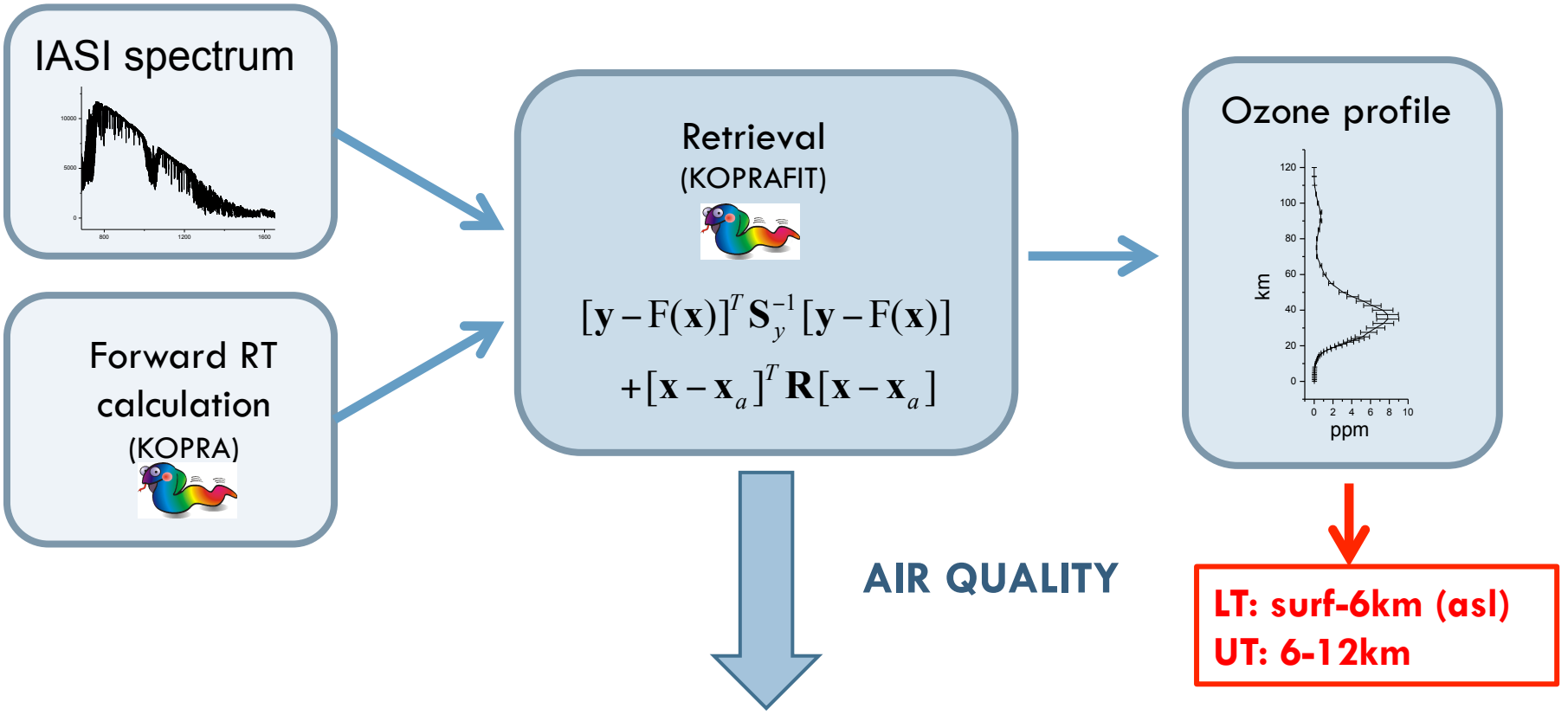

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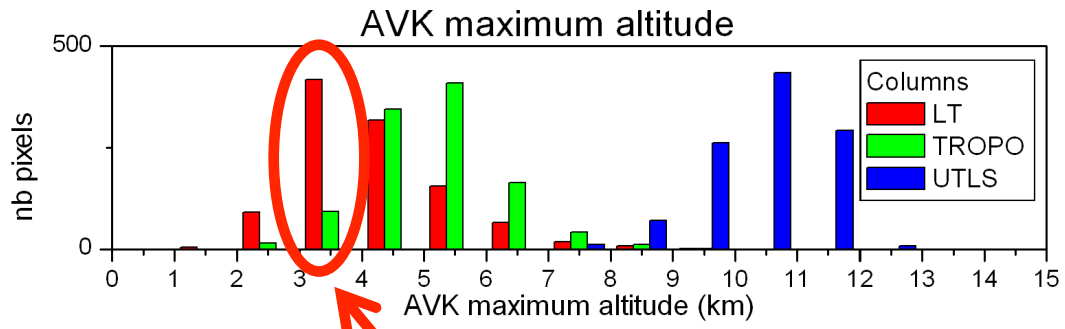
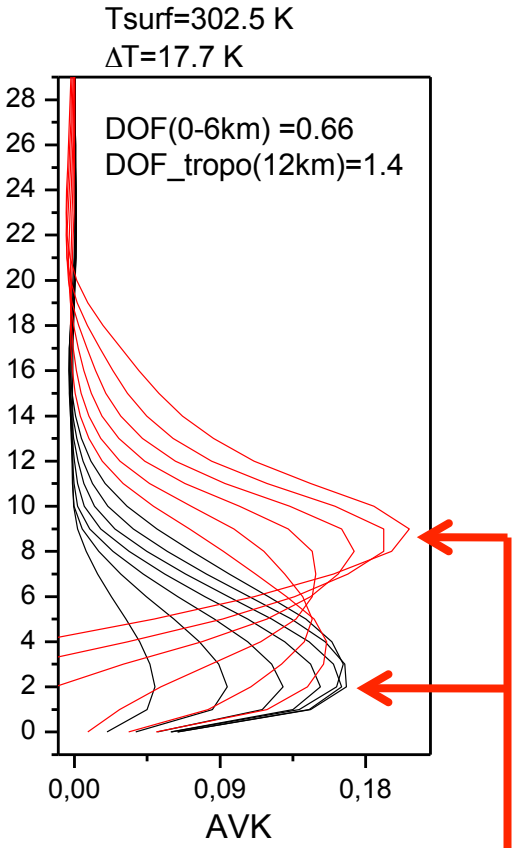
Performances of the LISA ozone product



Dufour et al., 2012

Sensitivity maximum at 3 km



Possibility to disciminate between **LT and UT** when thermal conditions are favorable

Dufour et al., 2010

All the results are presented for the morning overpass of IASI

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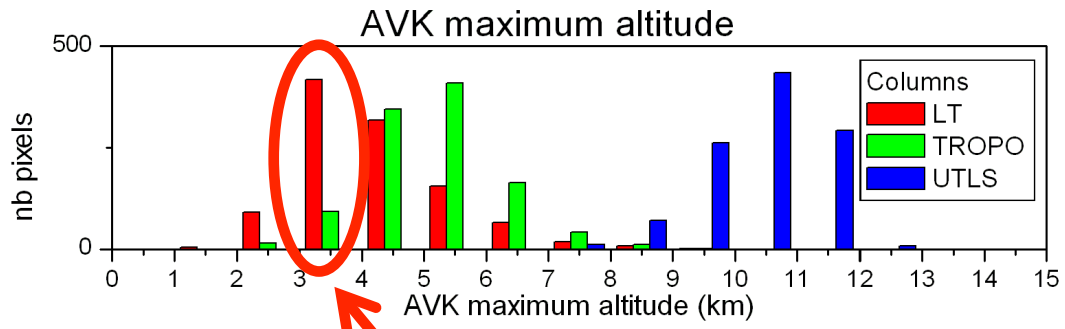

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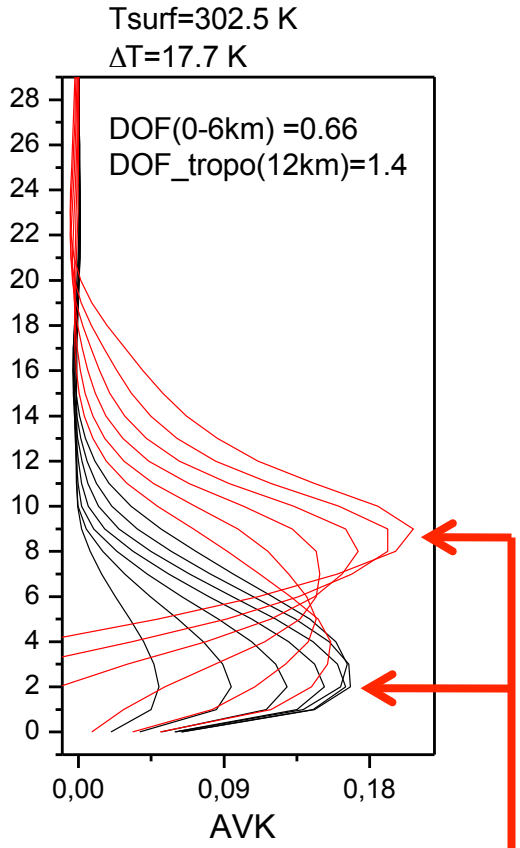


Possibility to disciminate between **LT and UT** when thermal conditions are favorable

Dufour et al., 2010

Ozonesonde validation (lower troposphere)

Midlatitude estimated bias : < 2.5%

Error estimate : ~15%

Dufour et al., 2012

All the results are presented for the morning overpass of IASI

Springtime O_3 Variability in China: Scientific Motivations

China

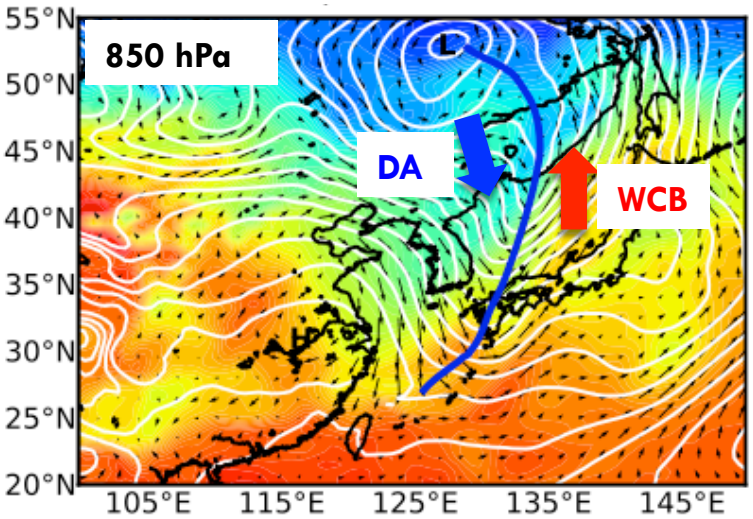
- one the largest polluted region worldwide
- Interesting region to test capabilities of satellites to probe pollutants

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



WCB: Warm Conveyor Belt → uplifting of pollutants from the PBL towards the free troposphere

DA: Dry Airstream → downward transport from UTLS towards LT (stratospheric intrusion)

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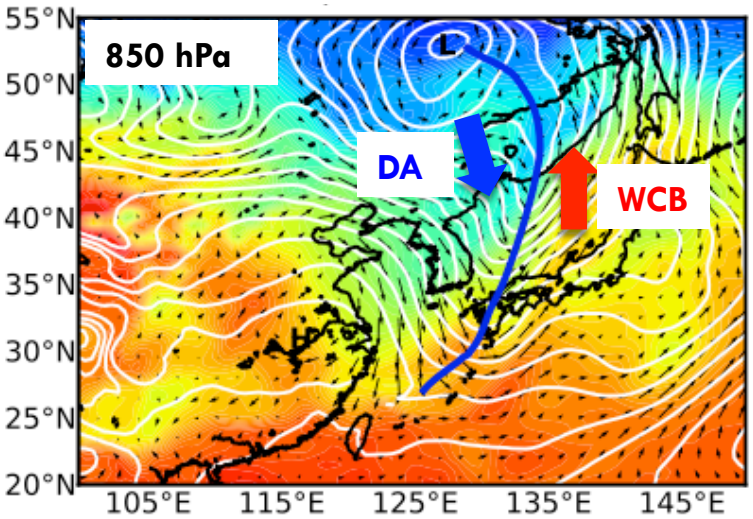

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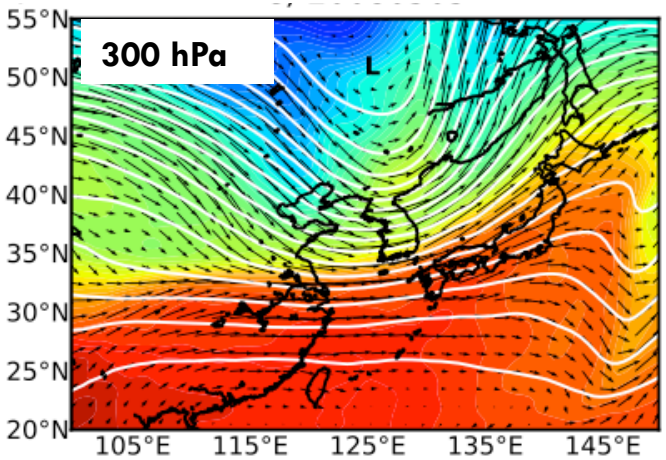
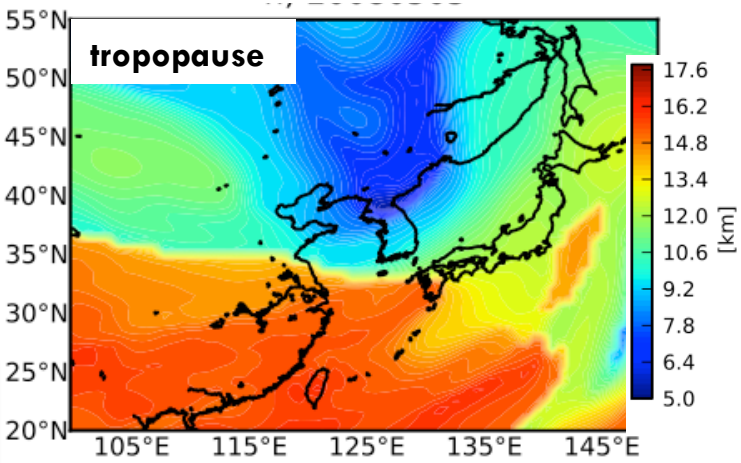


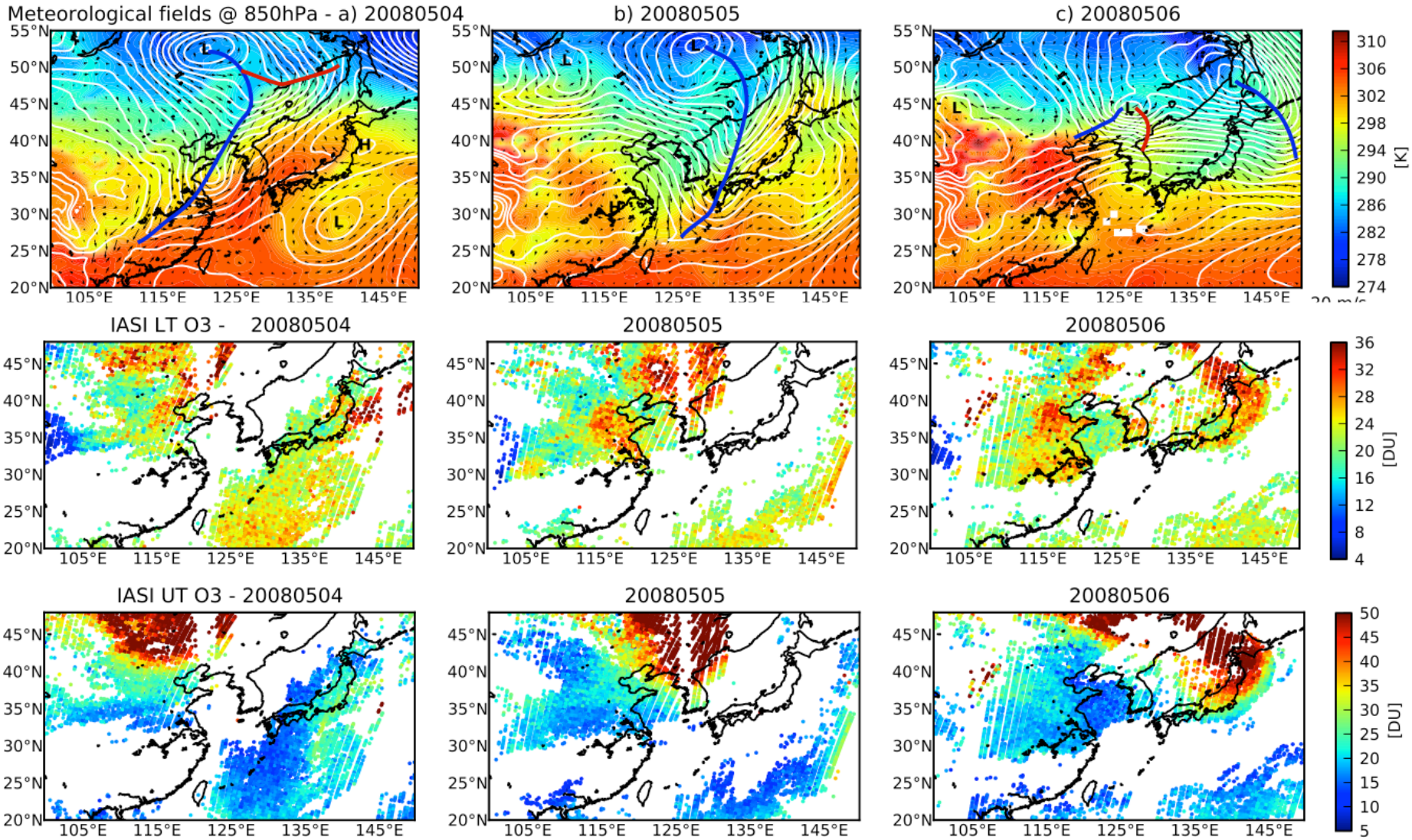
Polar air masses

- 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)



Dufour et al., ACPD,2015

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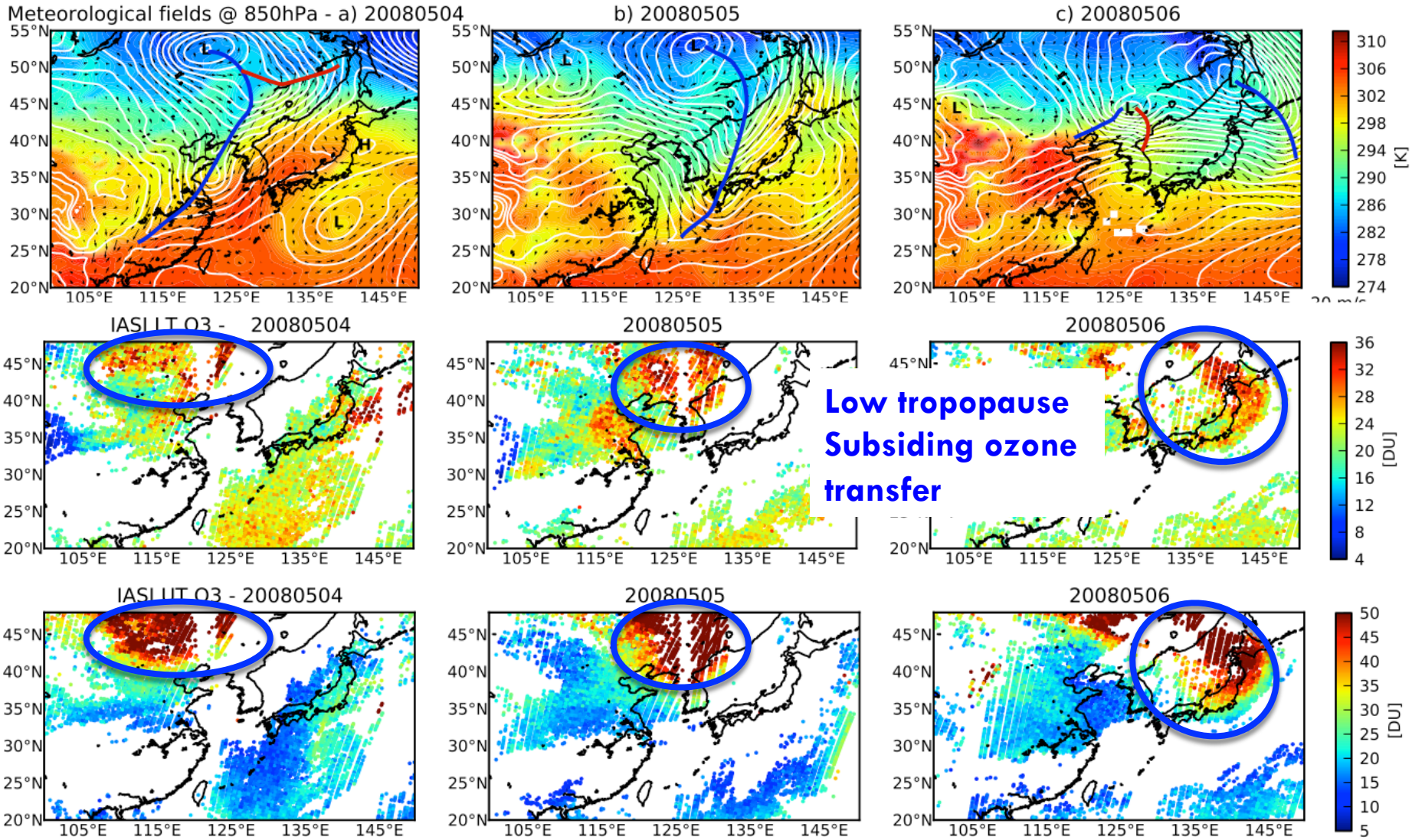
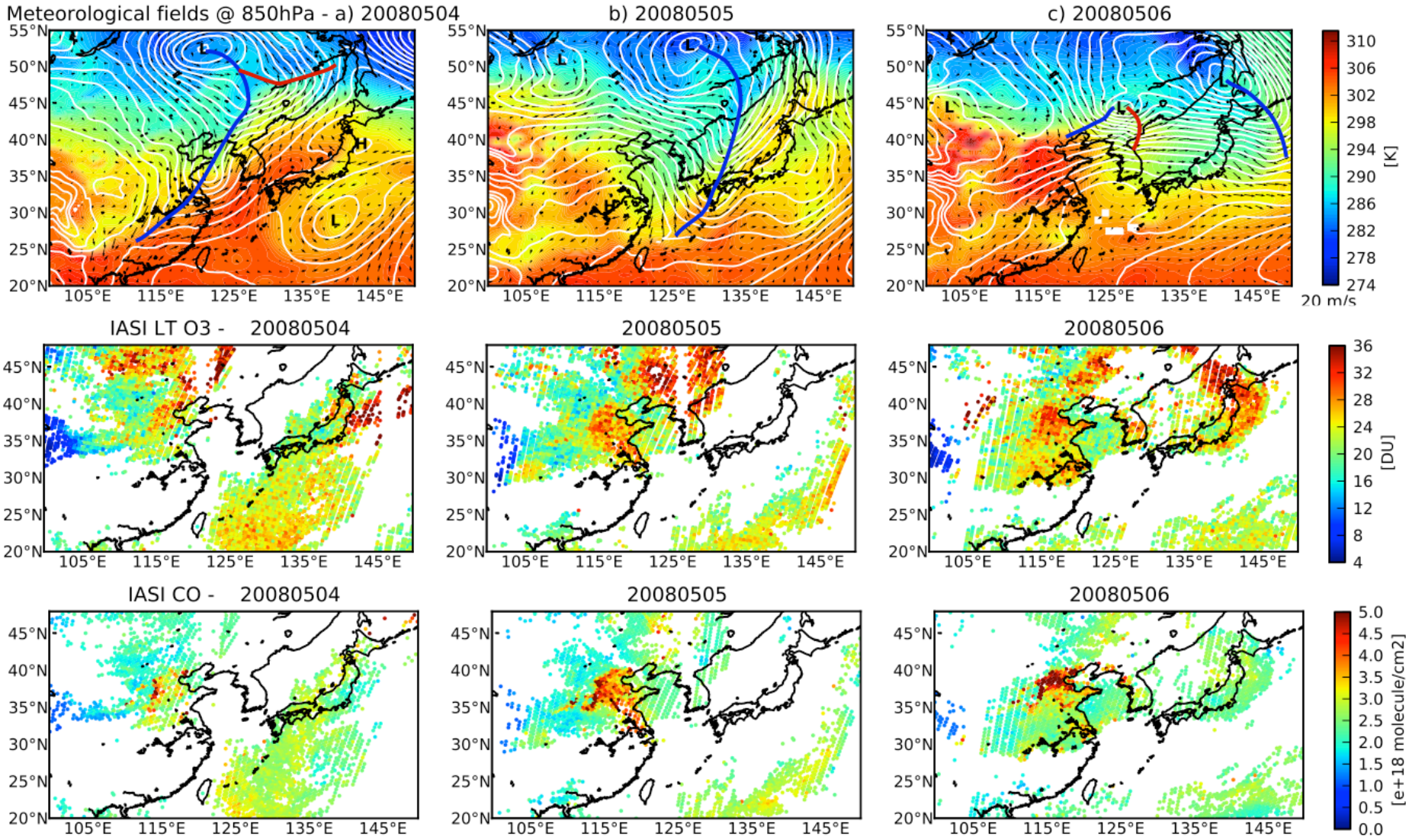


Upper tropospheric O3 columns can be used as a dynamical indicator Dufour et al., ACPD,2015

Case study – 4-6 May 2008 (2/2)



Dufour et al., ACPD,2015

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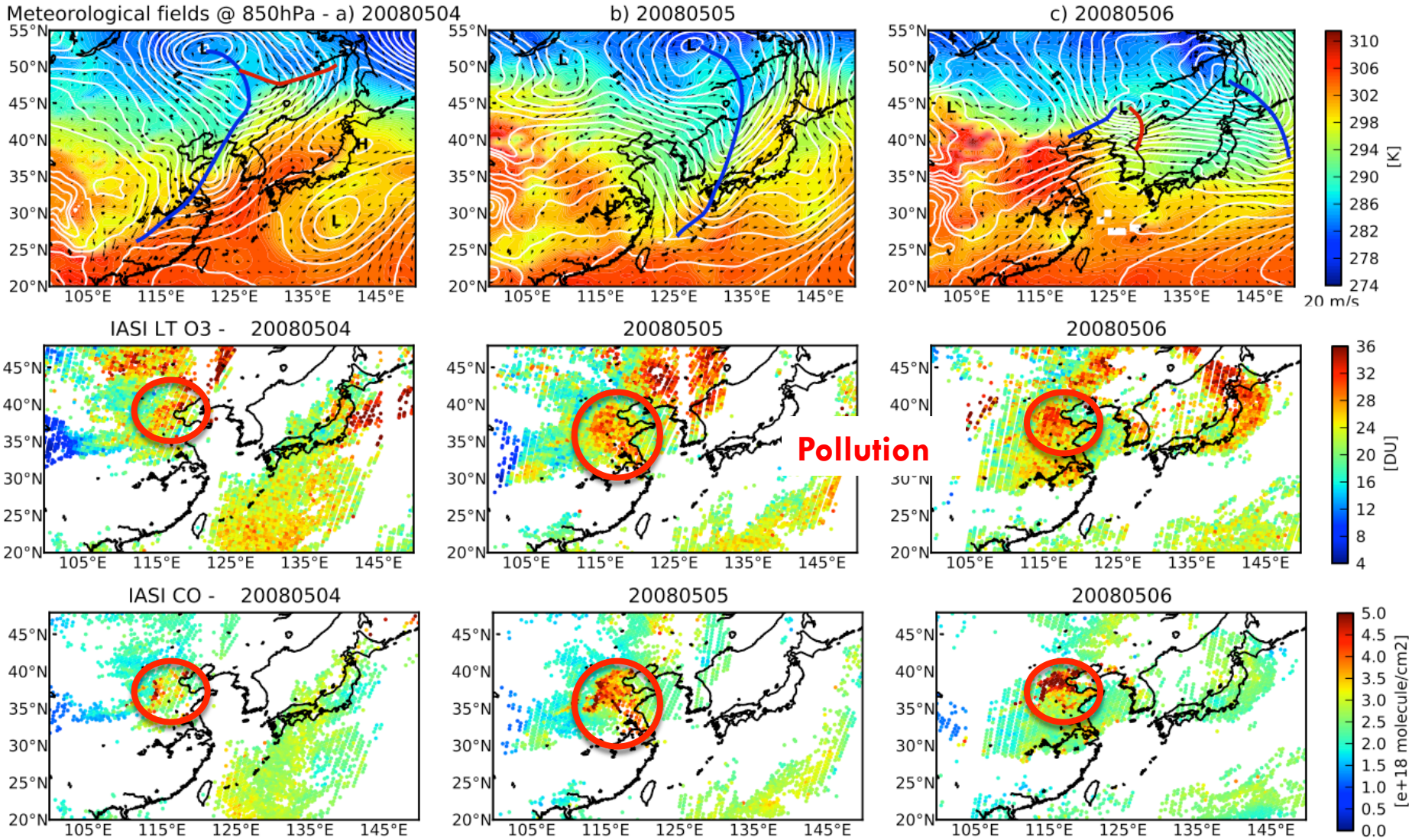
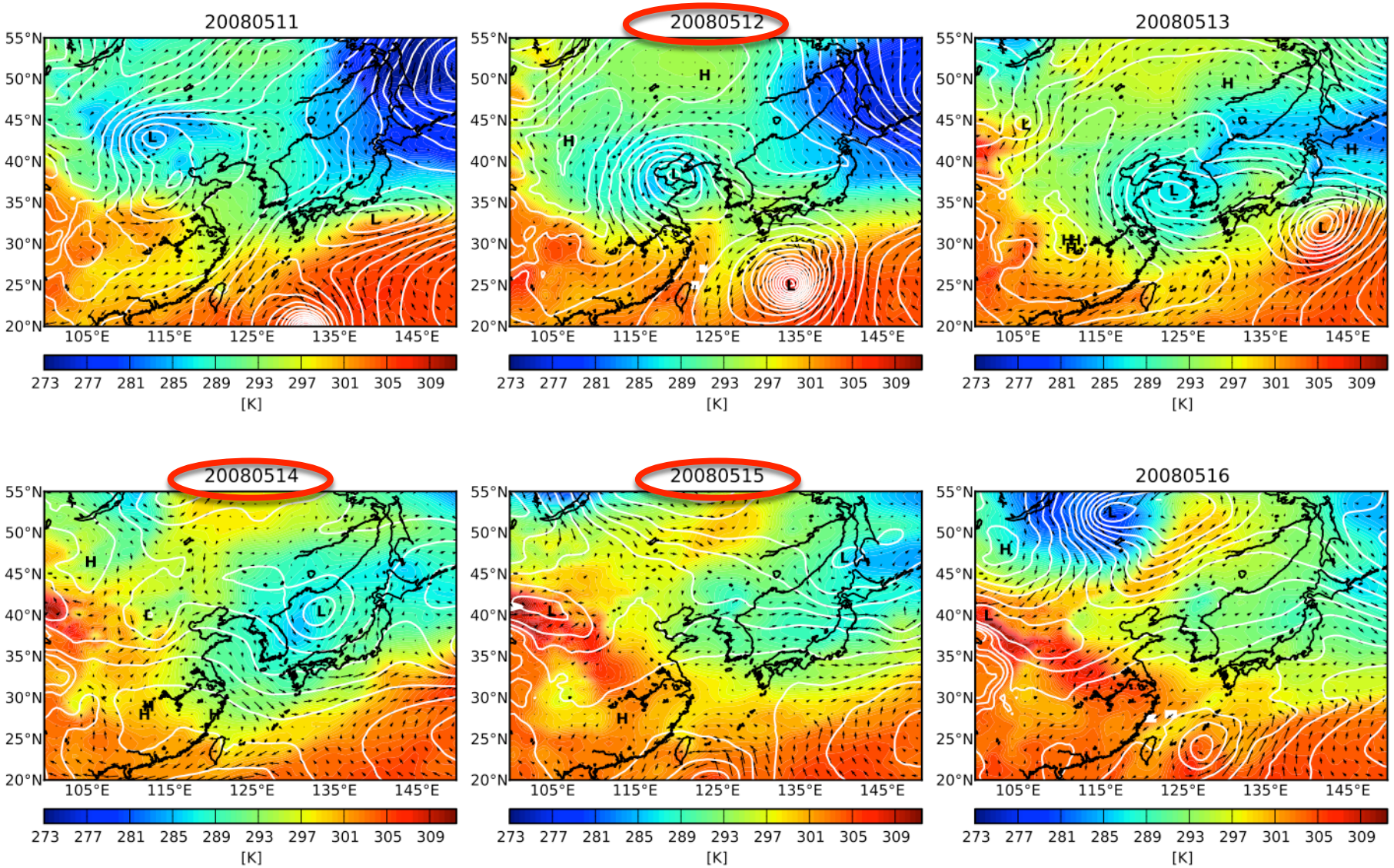


LT O3 and CO enhancements: pollution indicator

Dufour et al., ACPD,2015

Case study – 12-15 May 2008



Dufour et al., ACPD,2015

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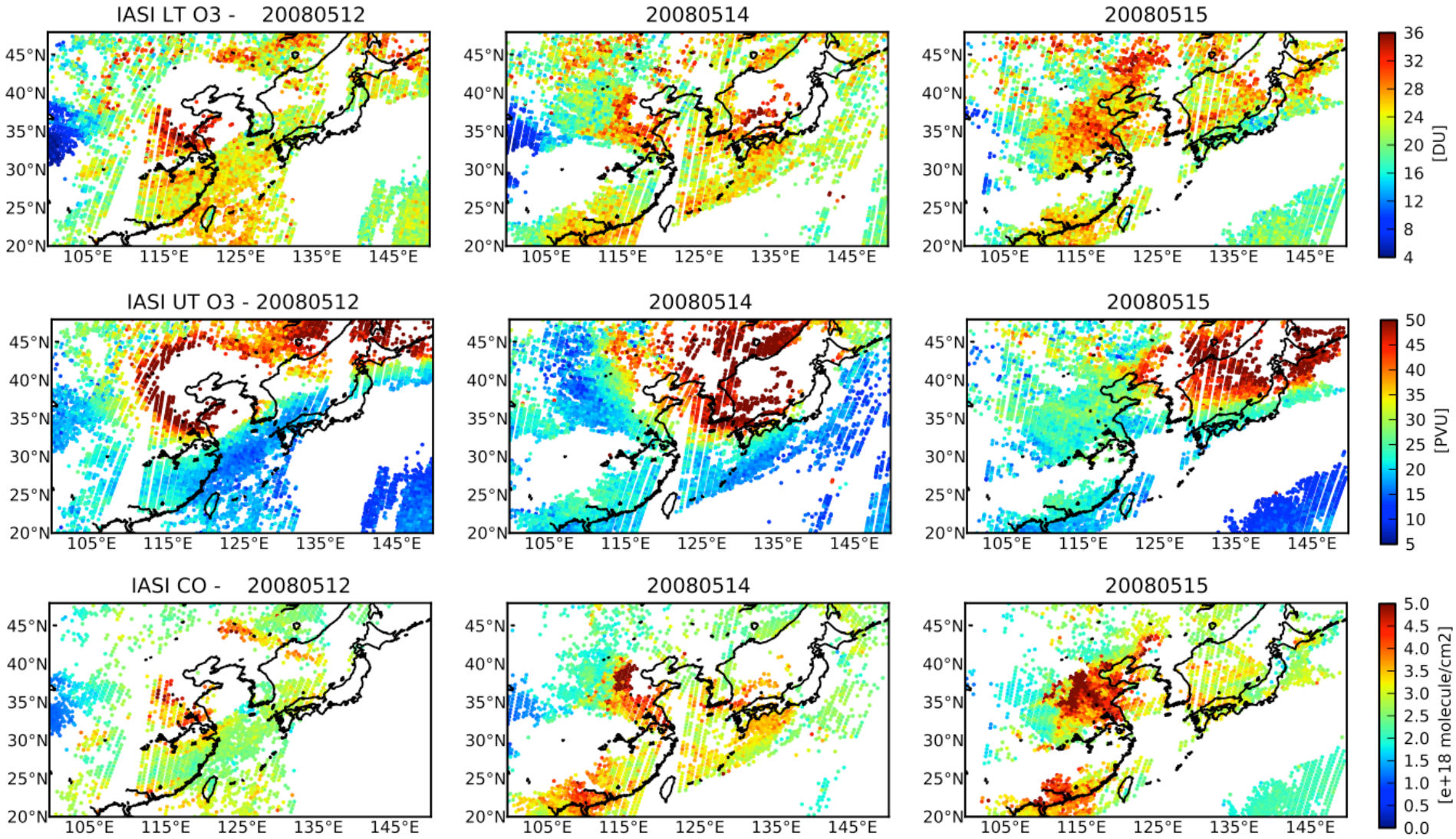

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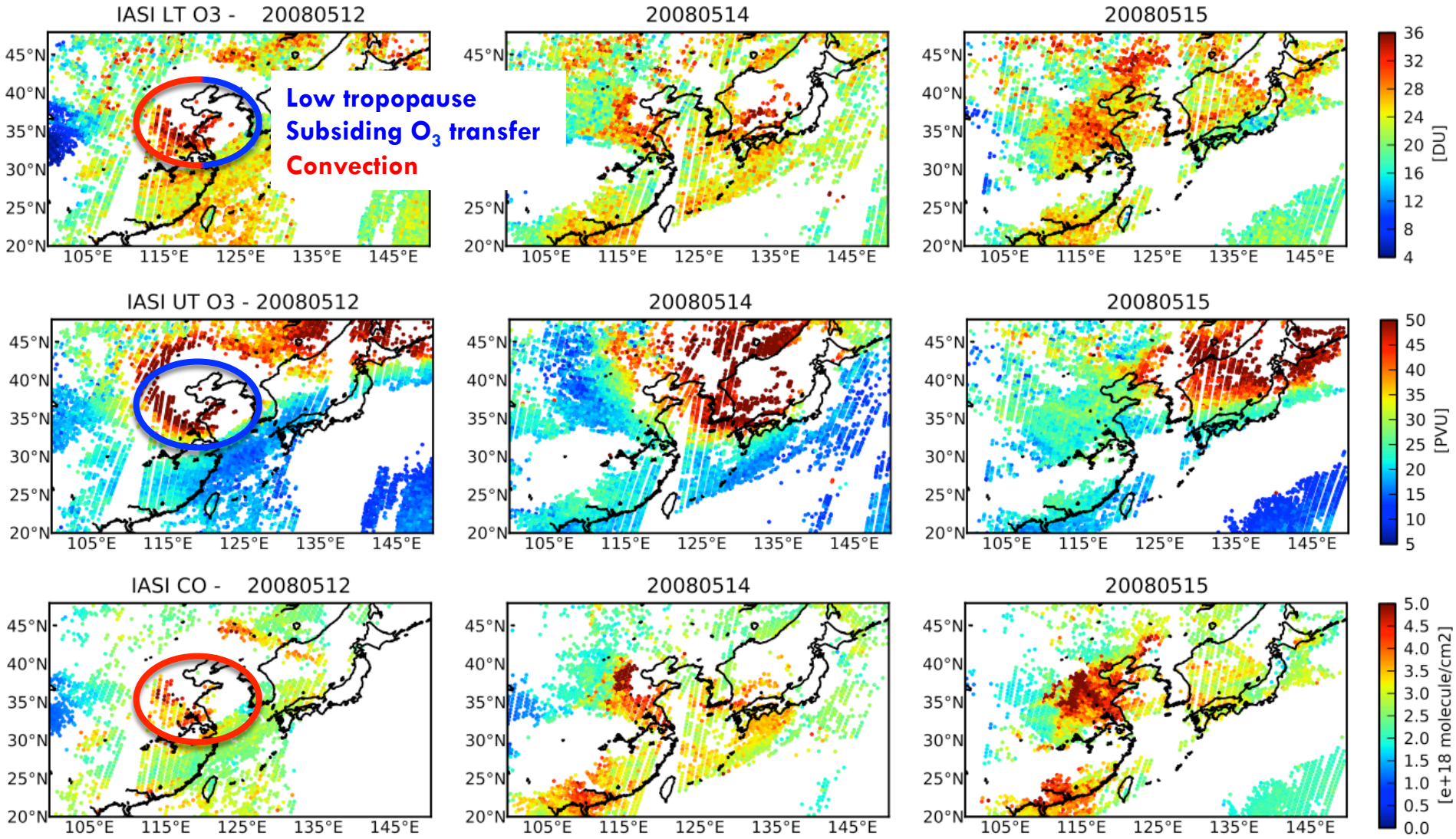

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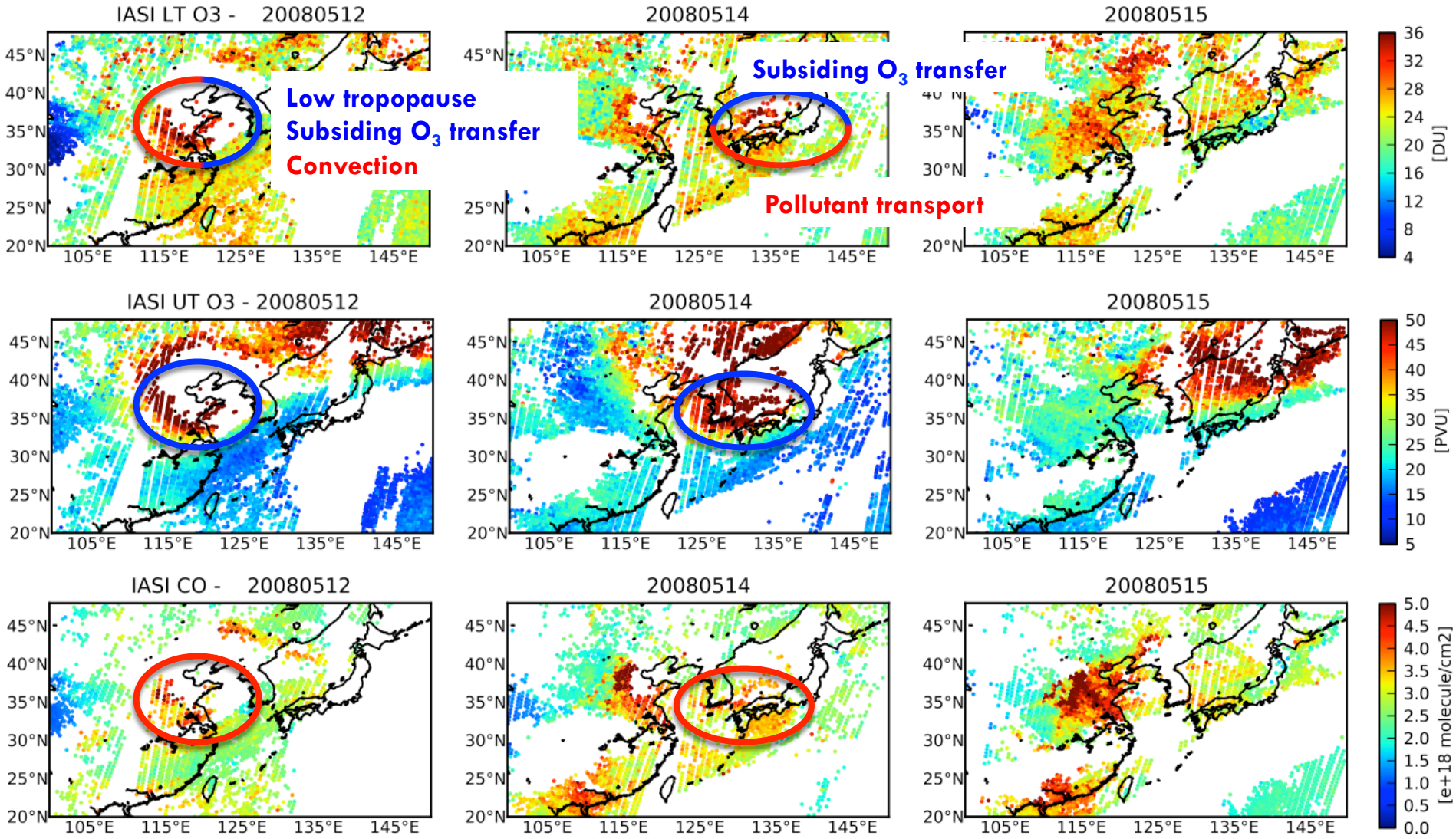

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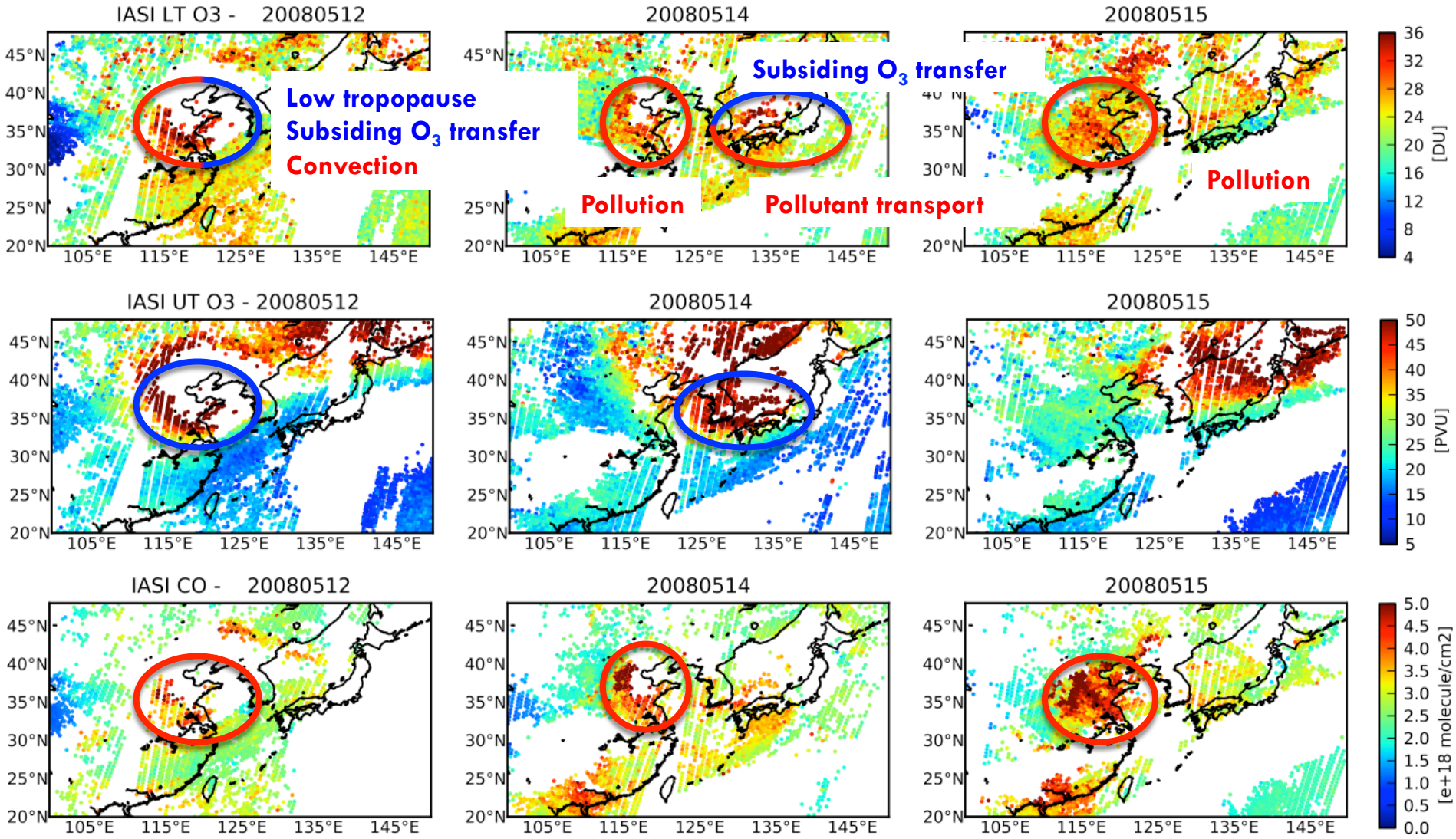
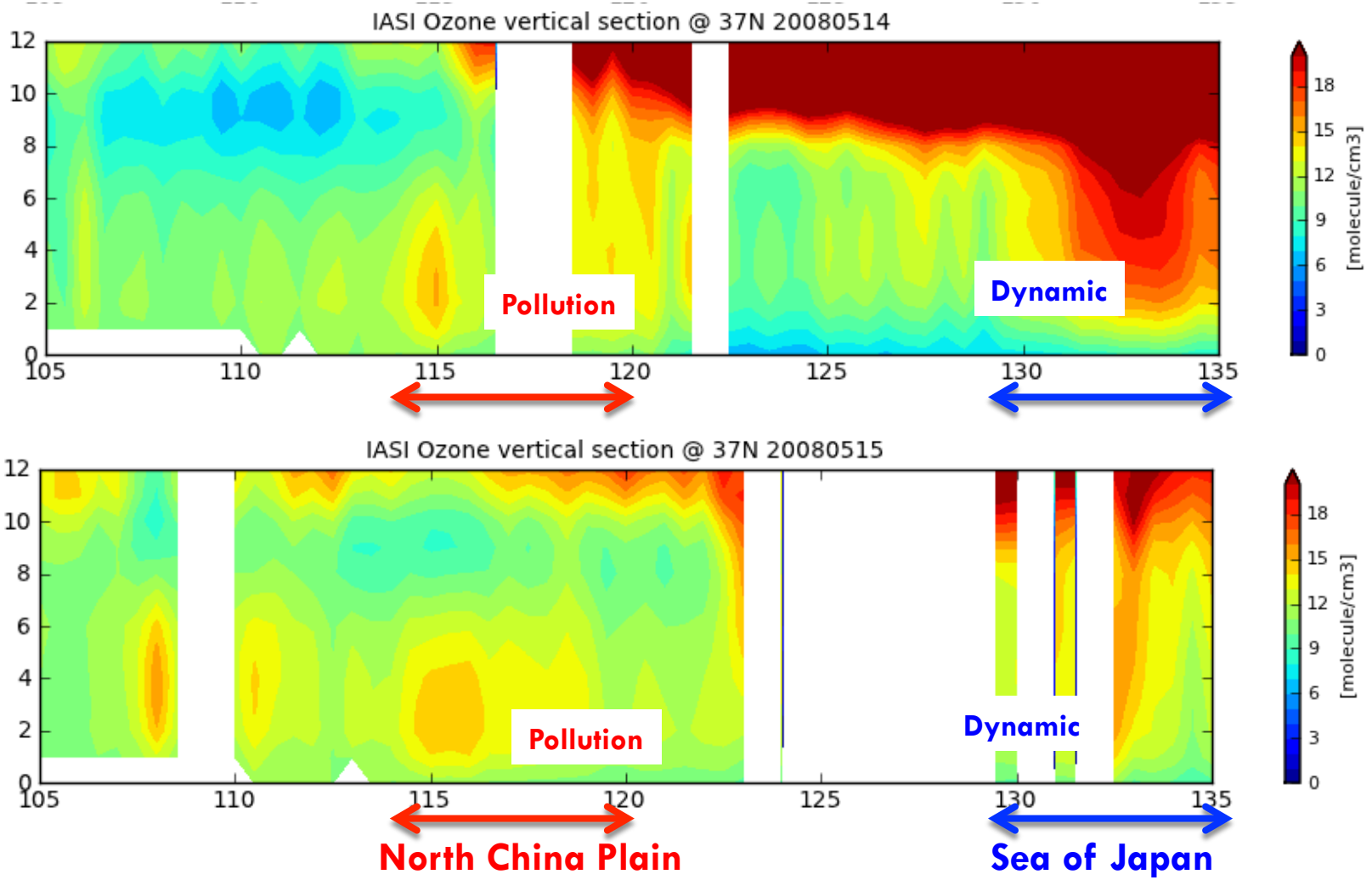


Dufour et al., ACPD,2015

Longitudinal section: vertical distribution



Dufour et al., ACPD,2015

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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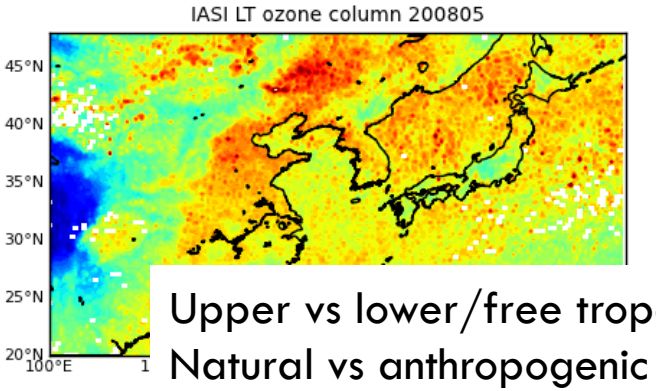
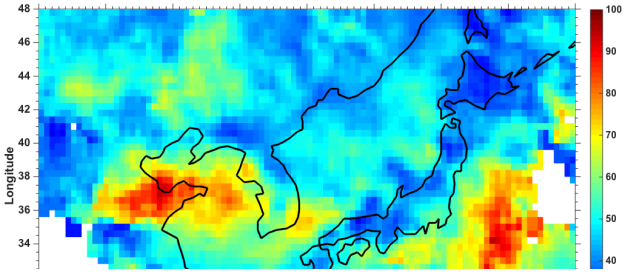
IASI : LTO3 + UTO3 + CO



Upper vs lower/free troposphere
Natural vs anthropogenic

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



Free vs lowermost troposphere
Access to the PBL in favorable cases

Acknowledgements