

Recent results on tropospheric composition sounding using IASI measurements

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CENTRE NATIONAL D'ÉTUDES SPATIALES

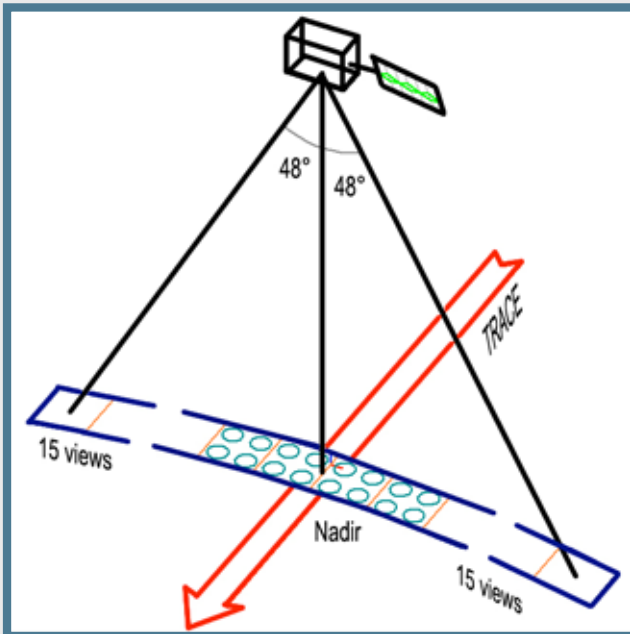


Outline

- Trace gas measurements with IASI
- 3 examples of operational applications

IASI advantages for monitoring trace gases

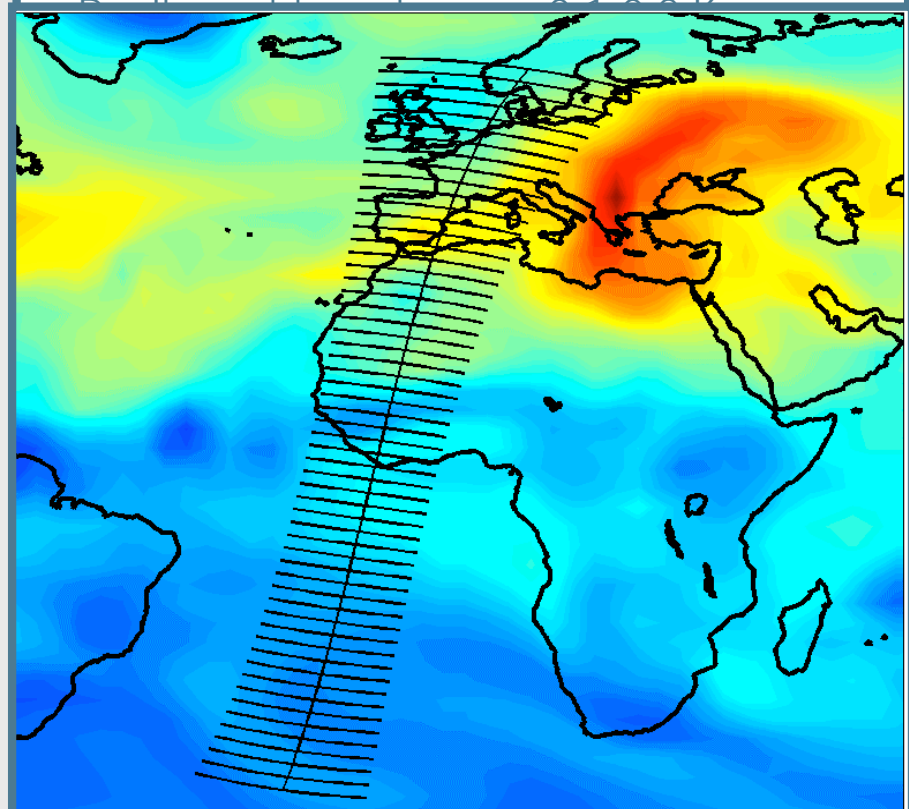
MetOP



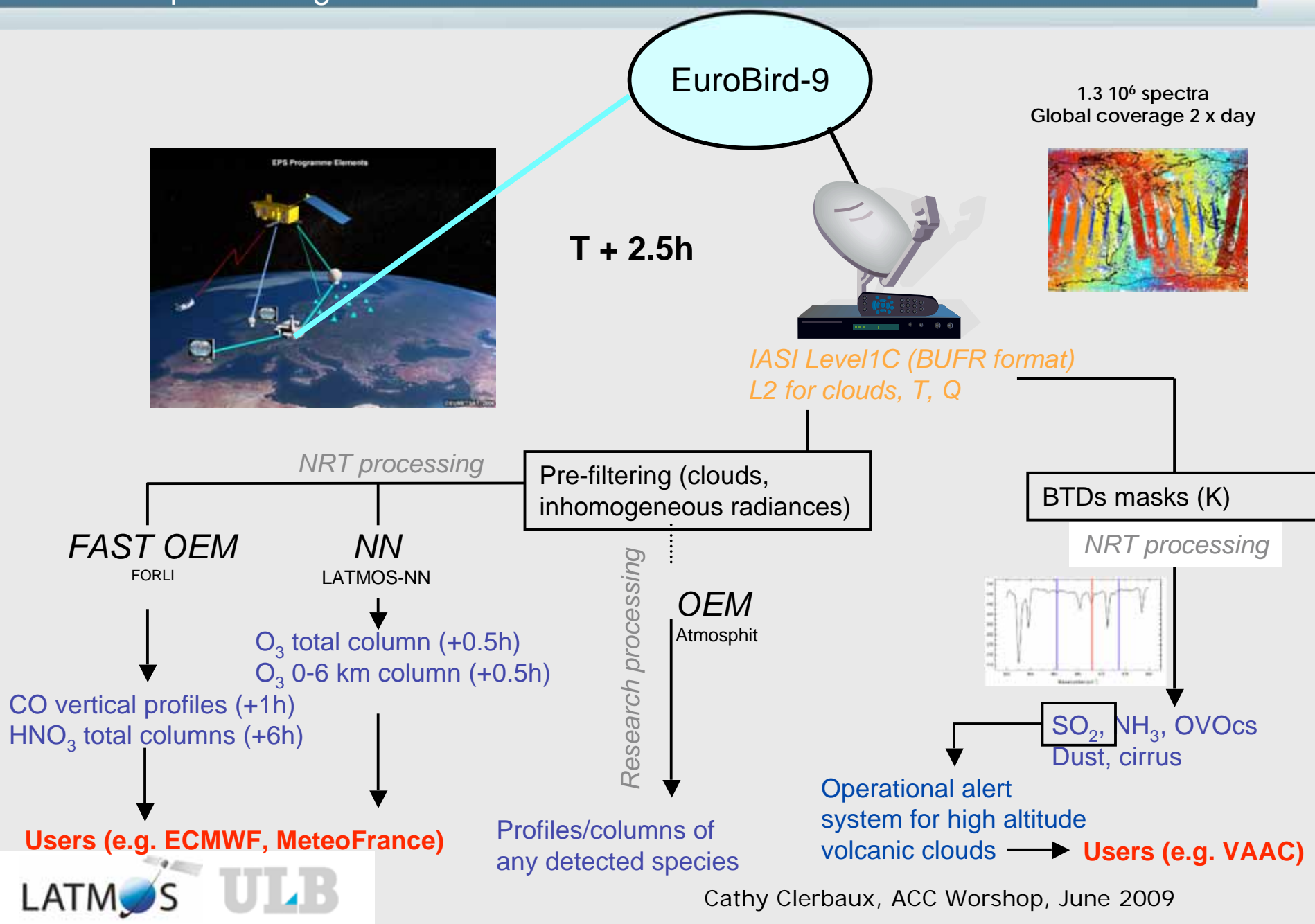
**Global coverage twice daily
+ small ground pixel size
+ broad spectral coverage
+ medium spectral resolution
+ high radiometric performances**

IASI

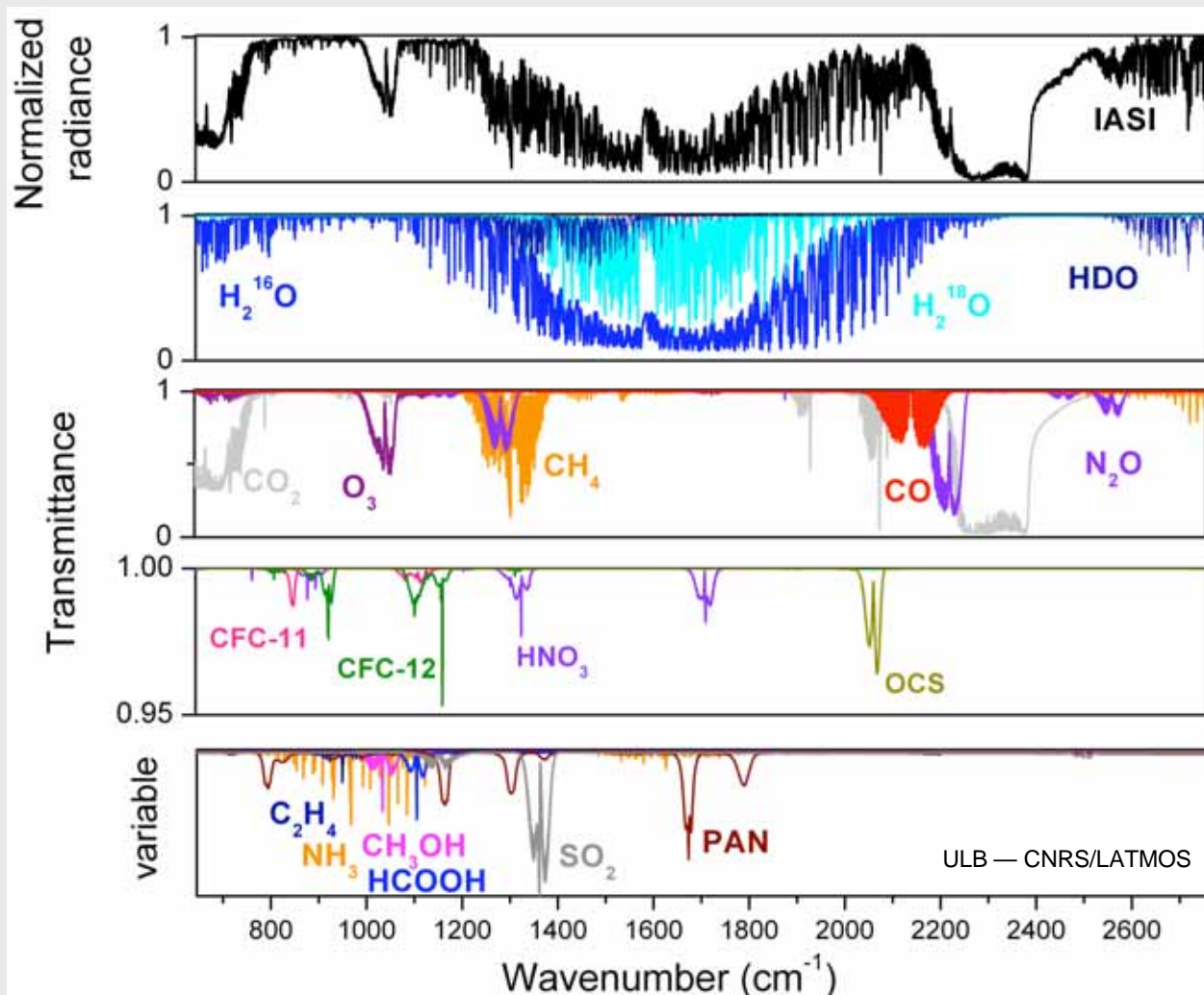
- Nadir looking FTS
- 120 spectra along the swath (2400 km)
- 12 km pixel x 4 @ nadir
- Spectral coverage = $645\text{--}2760\text{ cm}^{-1}$
- Spectral resolution = 0.5 cm^{-1}



IASI processing at ULB and LATMOS/IPSL



IASI processing at ULB and LATMOS/IPSL



IASI chemistry products

NRT

Research

H_2O , HDO , H_2^{18}O ;

δD , $\delta^{18}\text{O}$ profiles

CO profiles
 O_3 Pcolumns

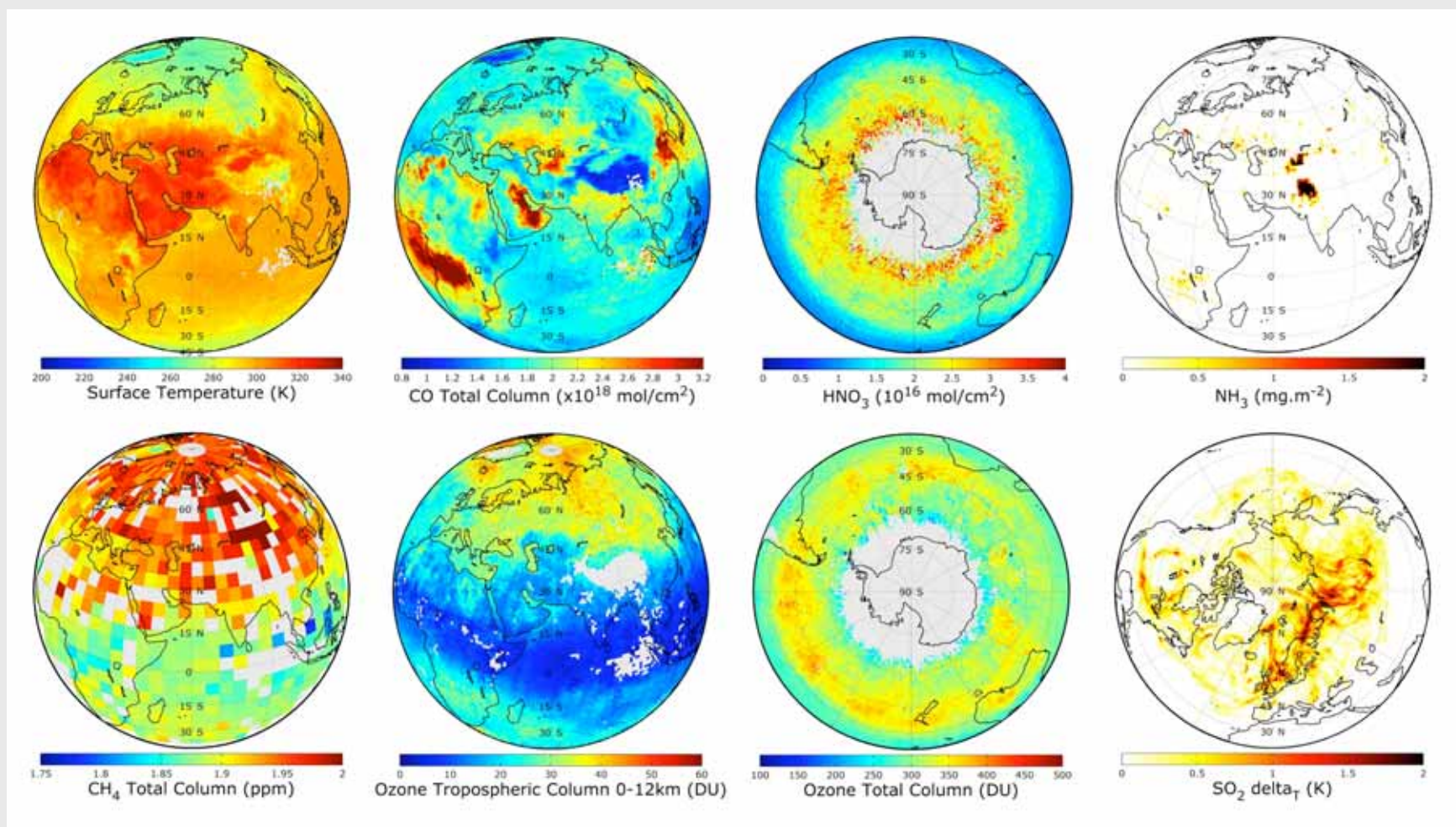
CH_4 profiles
 O_3 profiles

HNO_3 columns

SO_2

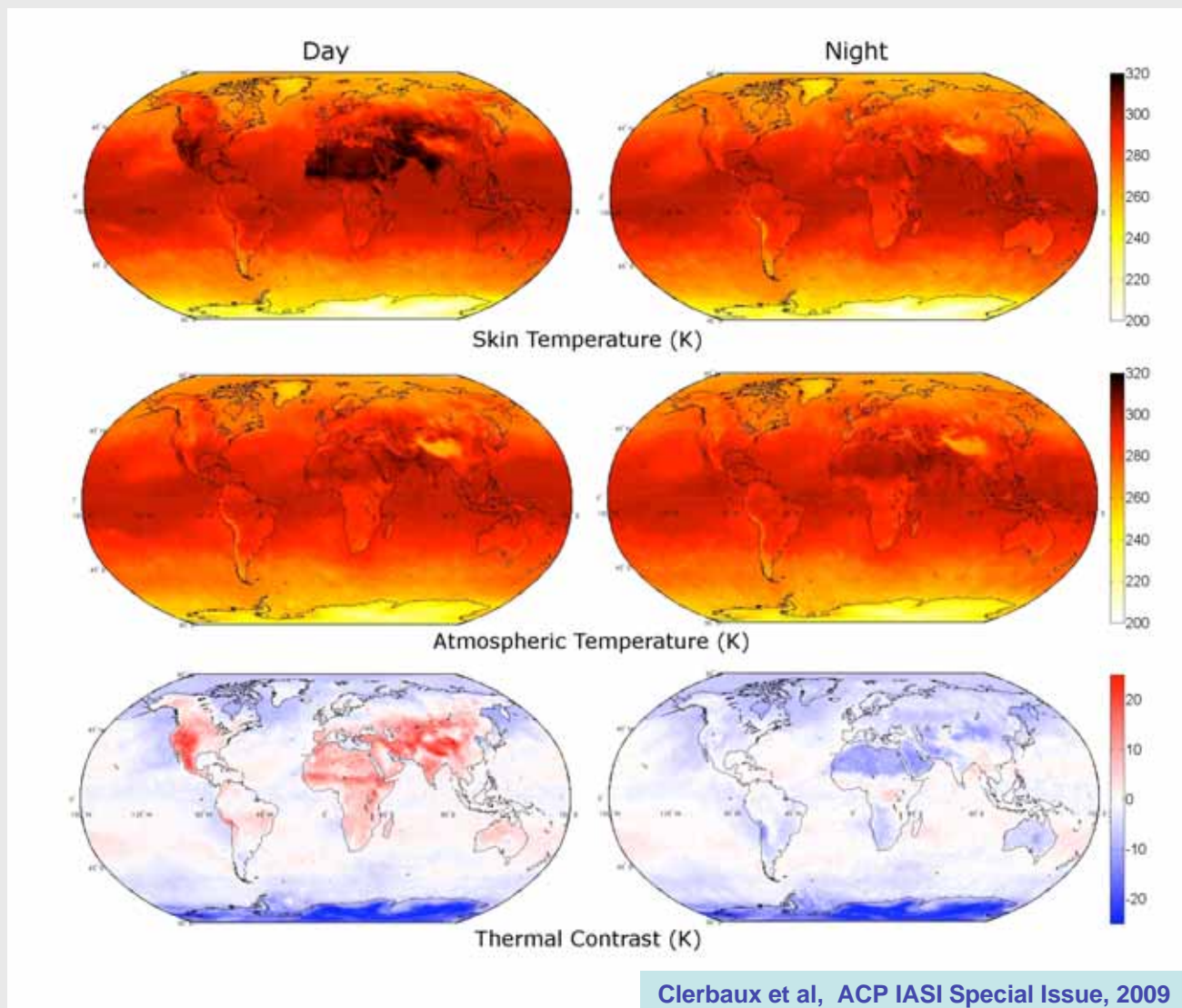
NH_3

Average 1°x1°, 10 days, 18-28 August 2008



Clerbaux et al, ACP IASI Special Issue, 2009

Thermal contrast – 1 month average (May 2008)



IASI/METOP – Operational applications

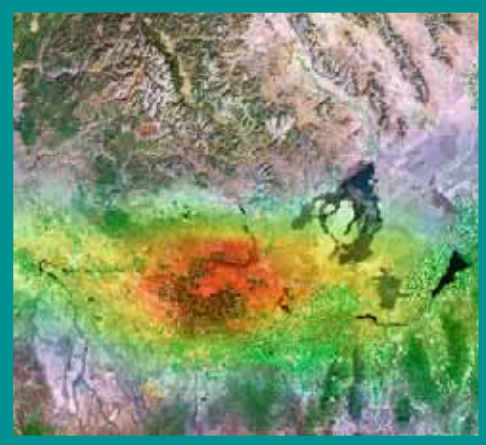
Pollution forecast



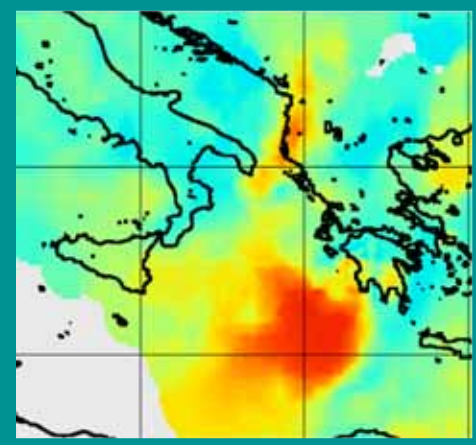
Fire detection



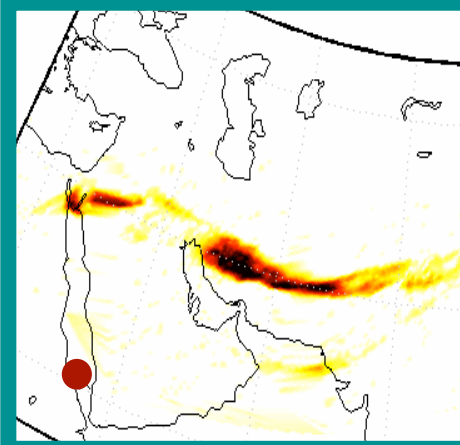
Volcanic plumes



Aerosol formation

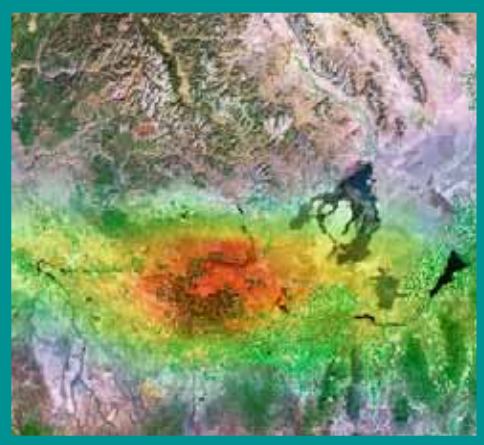


Long-range
pollution



Aviation threat

Pollution forecast



NH₃ sources

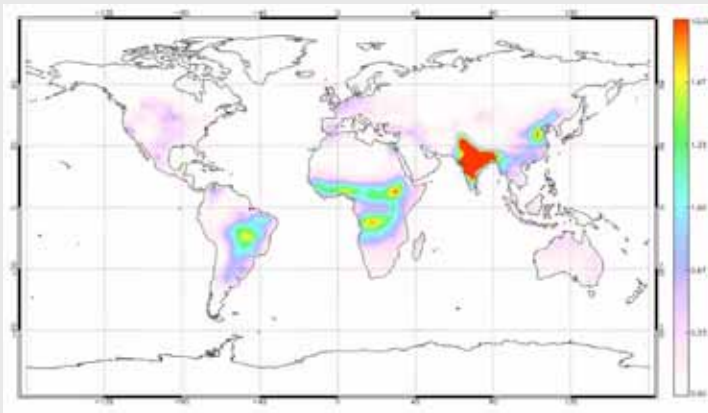
Relevance of atmospheric ammonia

- Dominant role in the nitrogen cycle (along with NO_x)
- Formation of fine particulate matter (→ Air Quality)
- Acidification and eutrophication of the ecosystem

Sources

- Agriculture (66%): fertilizers, livestock waste, crops
- Natural sources (21%): oceans, soils, vegetation
- Biomass burning (13%)

Growing population goes together with an ever increasing demand of fertilizers, leading only to increasing ammonia emissions



Lack of observations and inventories
Estimates of global annual ammonia emissions have errors over 50%

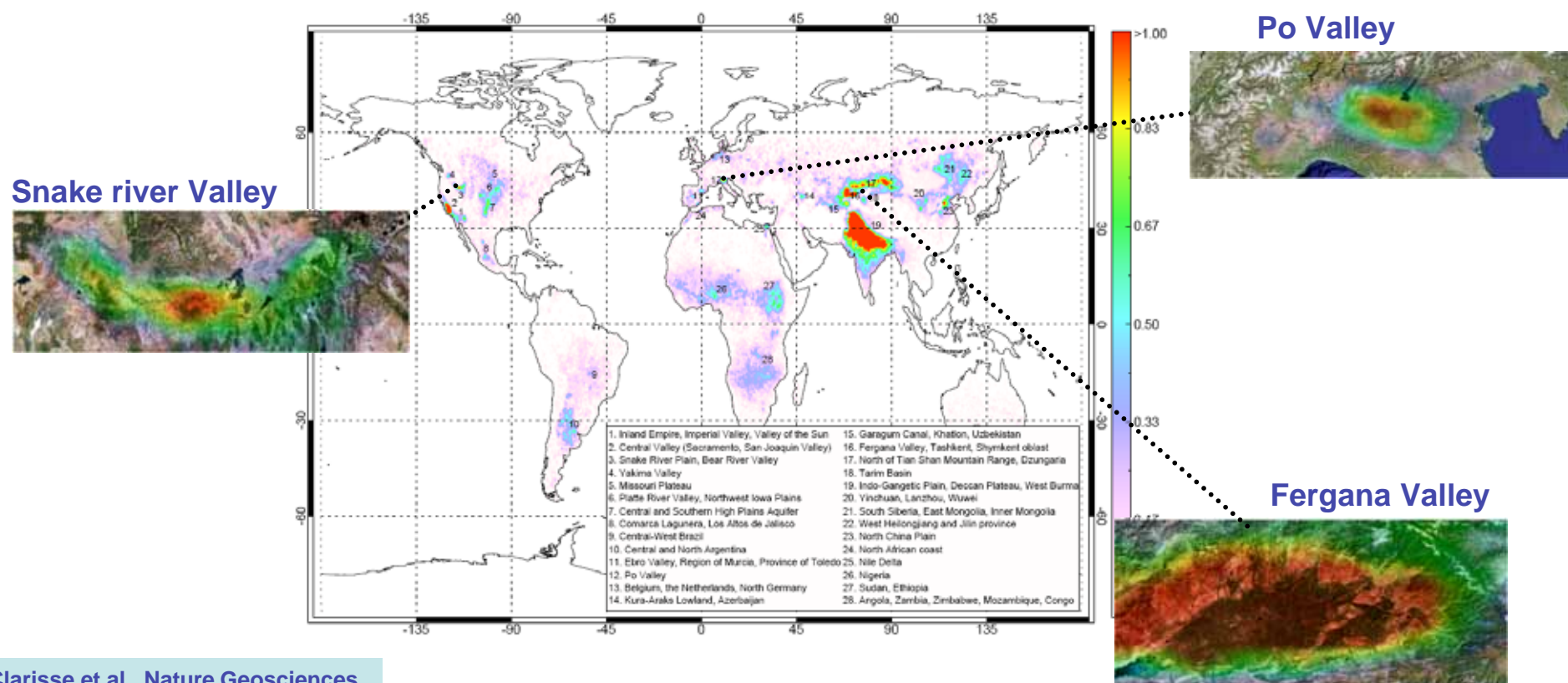
← 2000 distribution from TM5

Mapping atmospheric ammonia

NH₃ from IASI: 2008 average

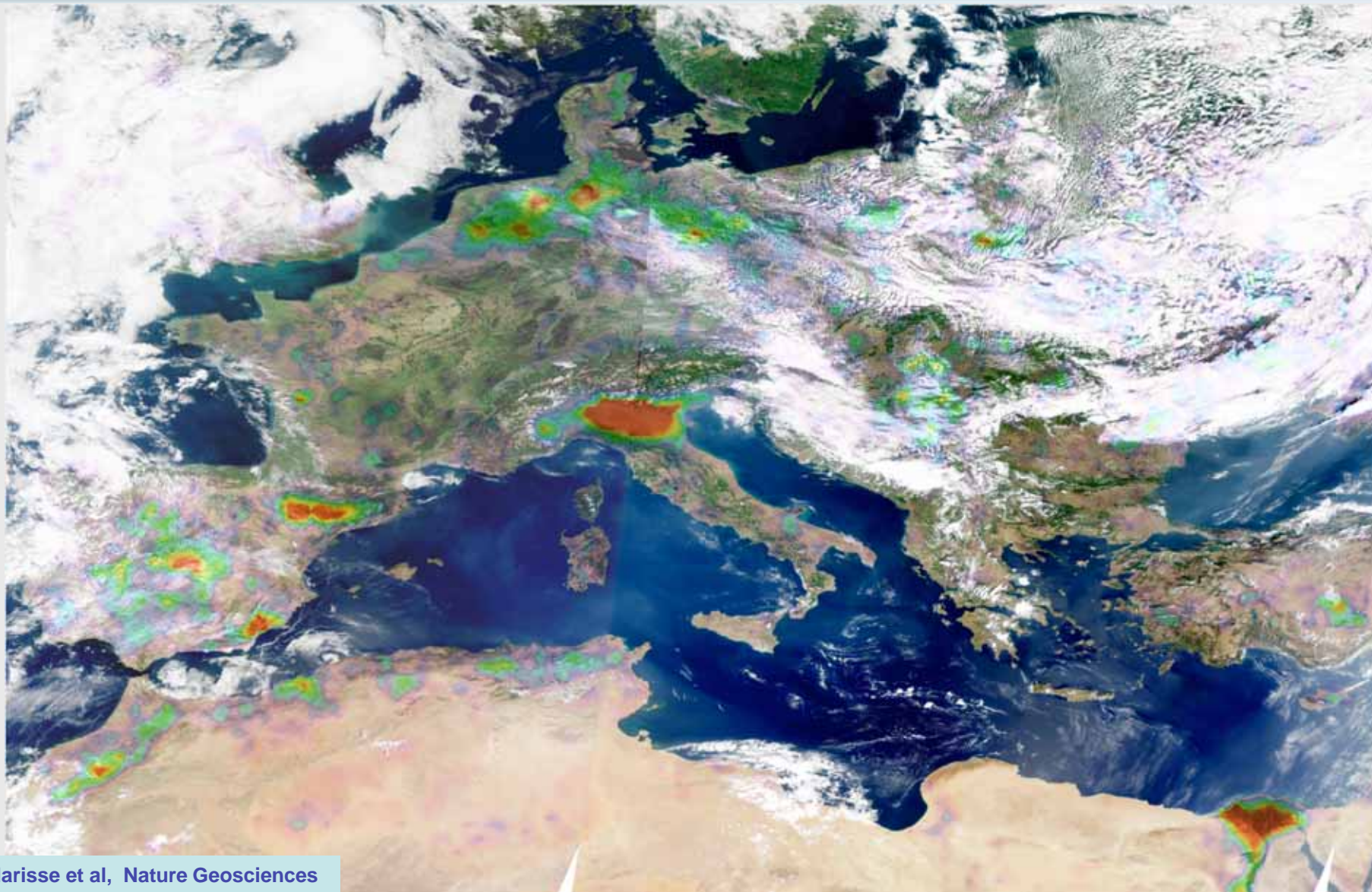
Mapping from local to global scale

→ 28 emission hotspots identified



Clarisse et al, Nature Geosciences

NH₃ from IASI: 2008 average

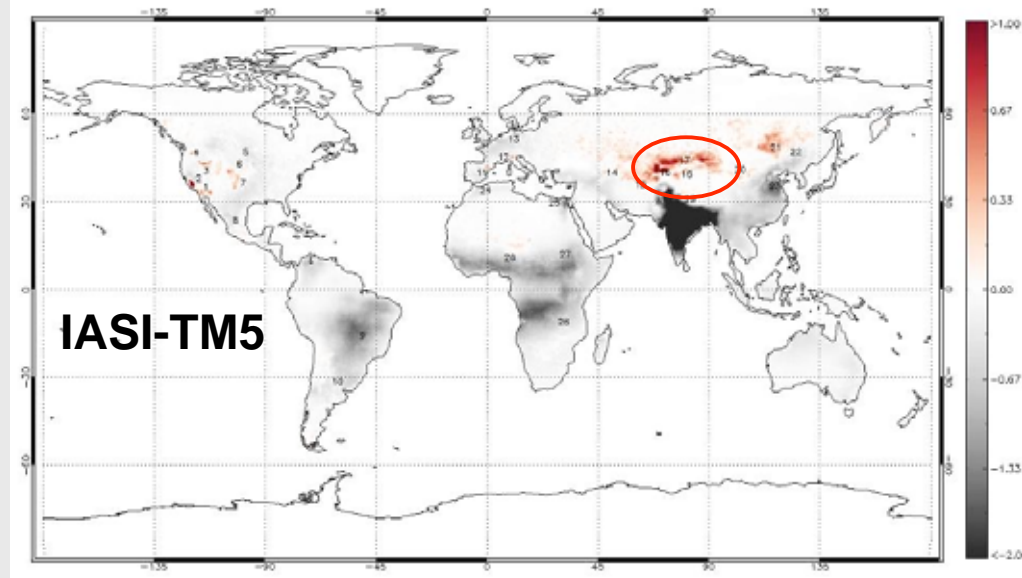
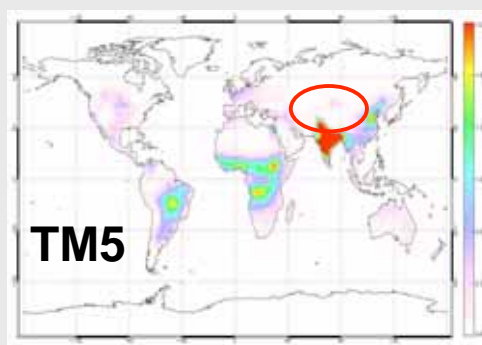
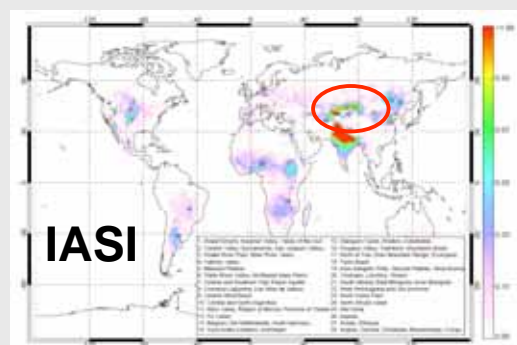


Clarisse et al, Nature Geosciences

Mapping atmospheric ammonia

NH₃ from IASI: 2008 average

Comparison with models



IASI > TM5

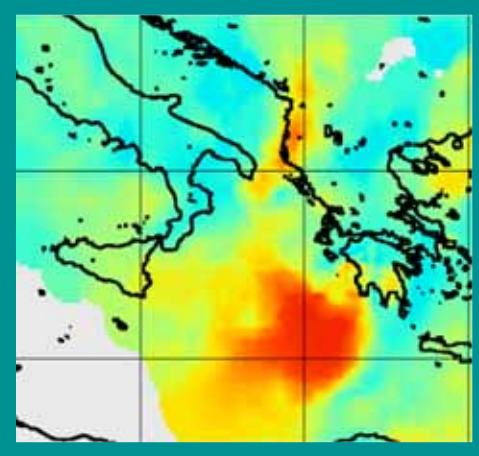
IASI < TM5

Missing emissions

Detection threshold
(Thermal contrast!)

IASI/METOP – Operational applications

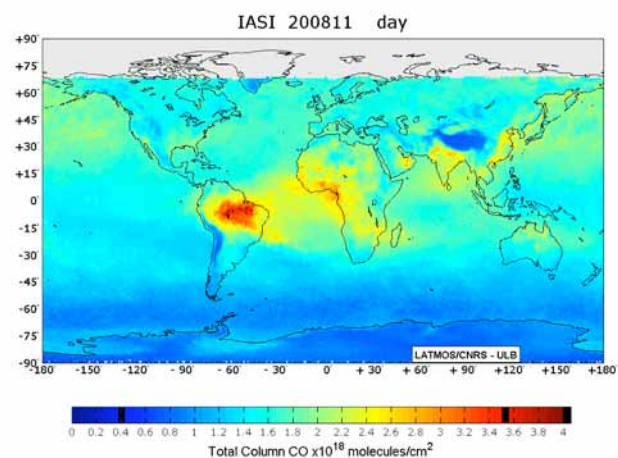
Fire detection



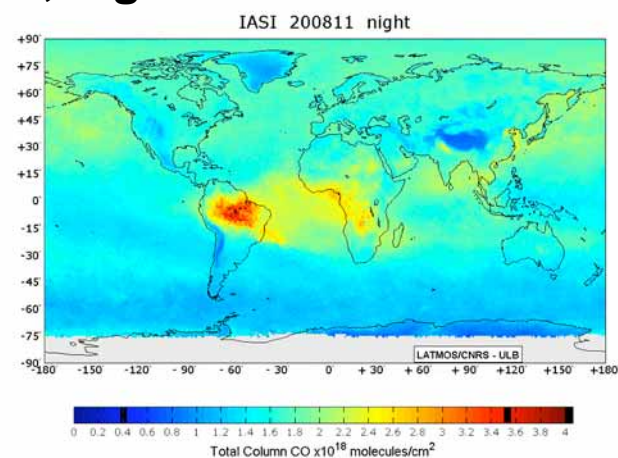
Long-range
pollution

Carbon monoxide from IASI

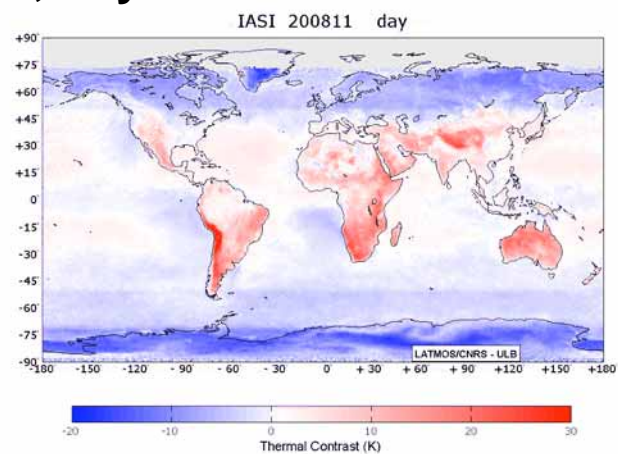
CO, day



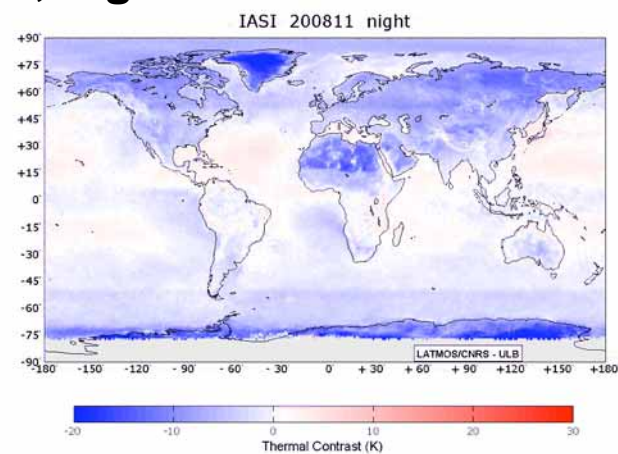
CO, night



TC, day

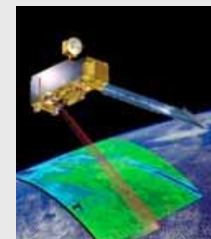
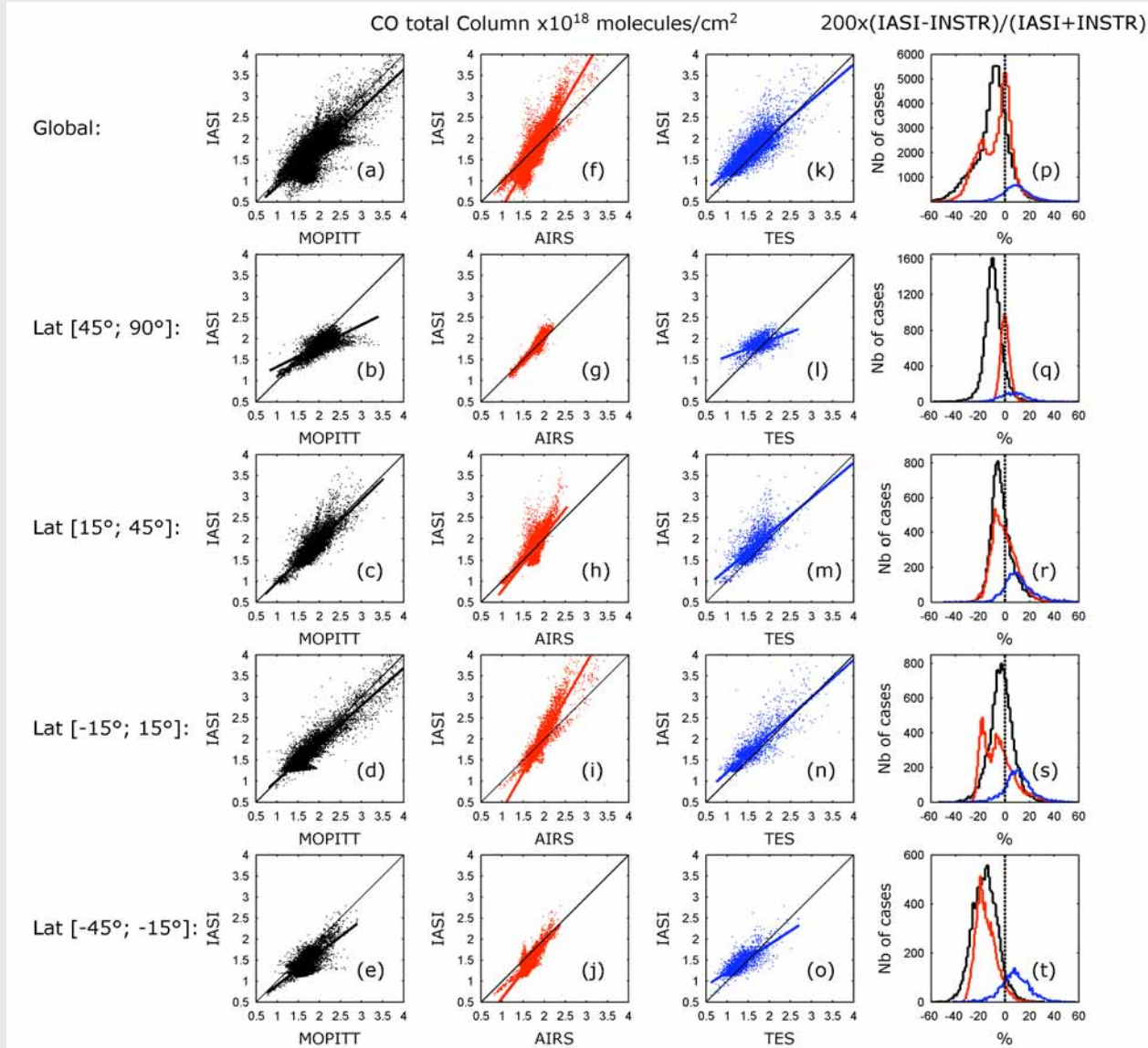


TC, night



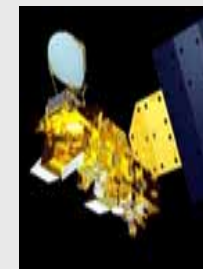
George et al, ACP IASI Special Issue, 2009

Carbon monoxide from IASI compared to other TIR instruments



MOPITT/TERRA

AIRS/AQUA

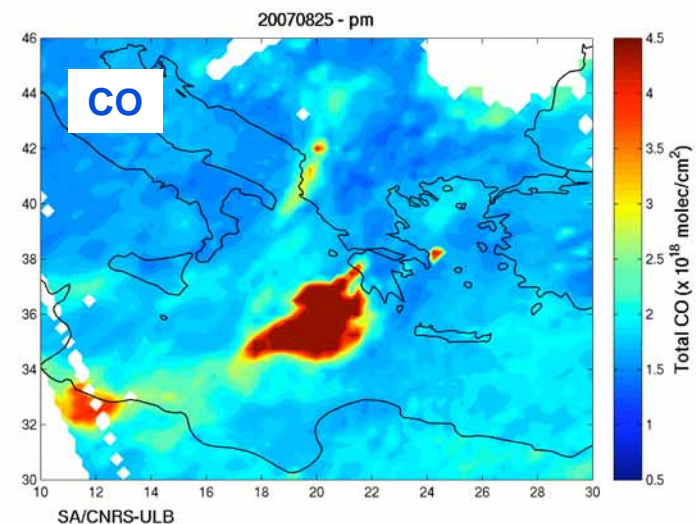
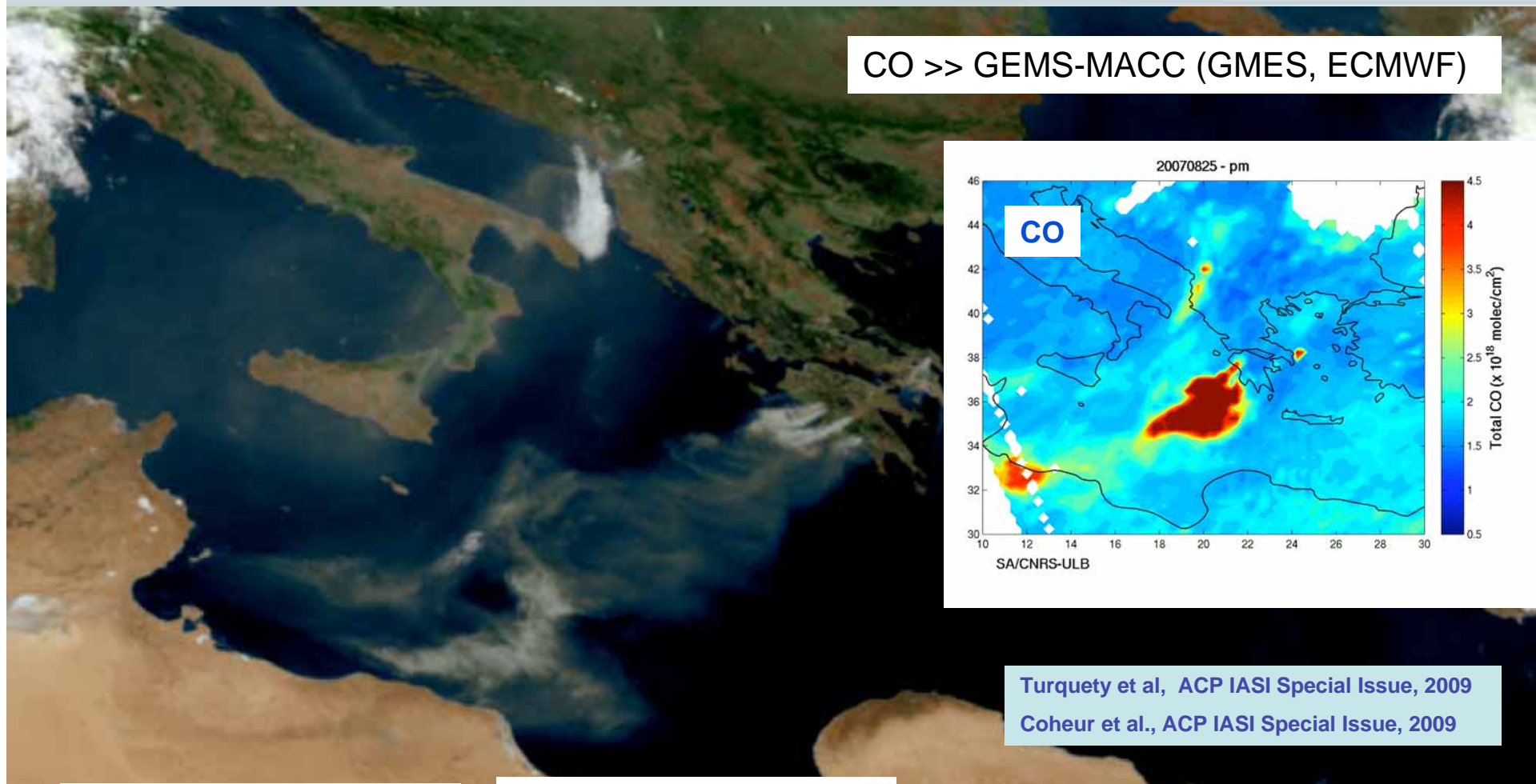


TES/AURA



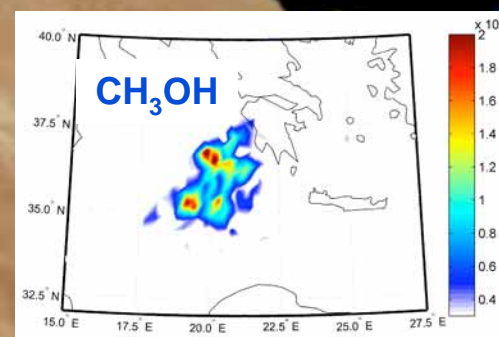
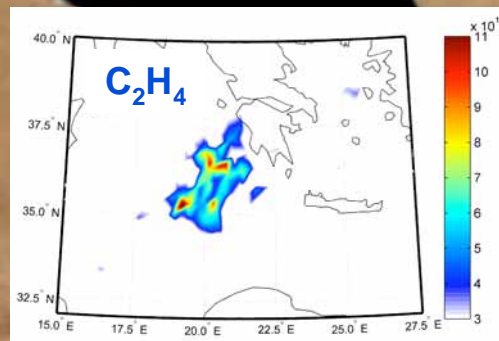
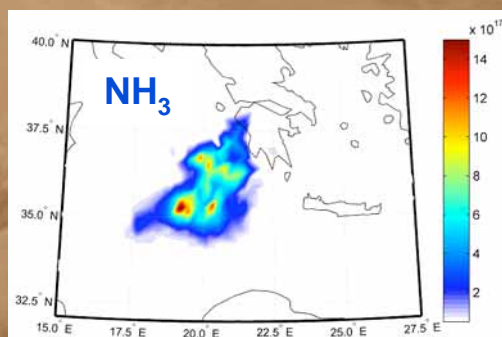
Greek fires, August 2007

CO >> GEMS-MACC (GMES, ECMWF)



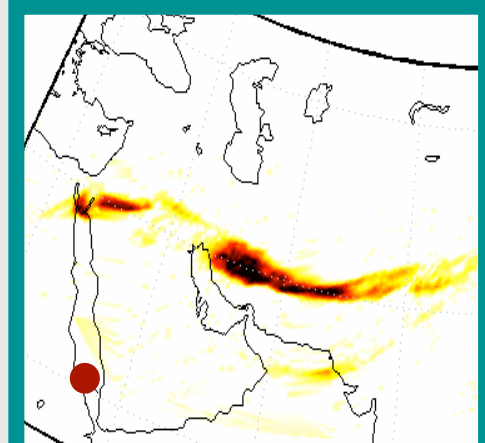
Turquety et al, ACP IASI Special Issue, 2009

Coheur et al., ACP IASI Special Issue, 2009



IASI/METOP – Operational applications

Volcanic plumes

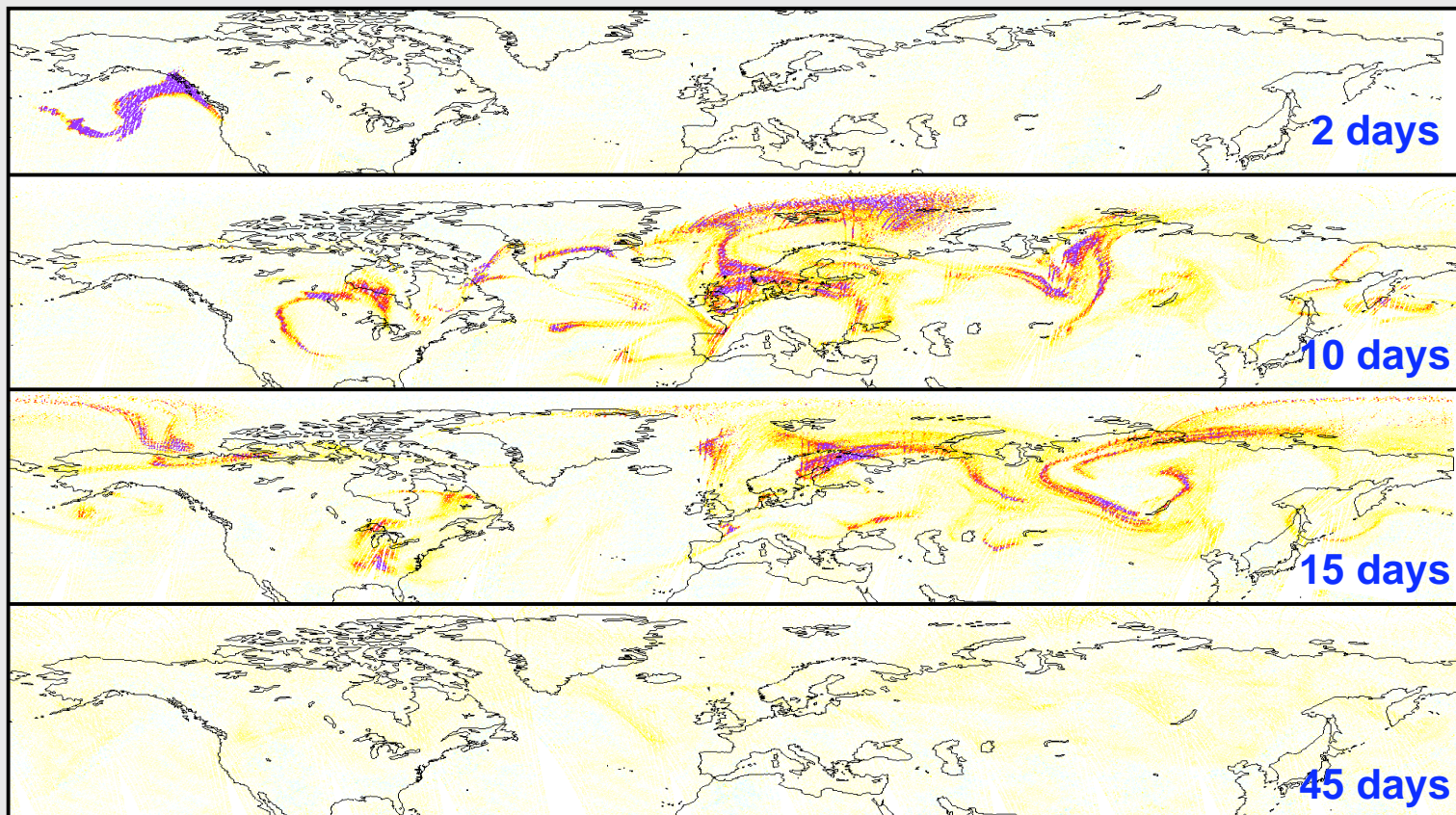


Aviation threat

Applications

Tracking transport and Chemistry

Kasatochi August 2008 Plume's altitude ~12-16 km



Applications

Operational alert systems:

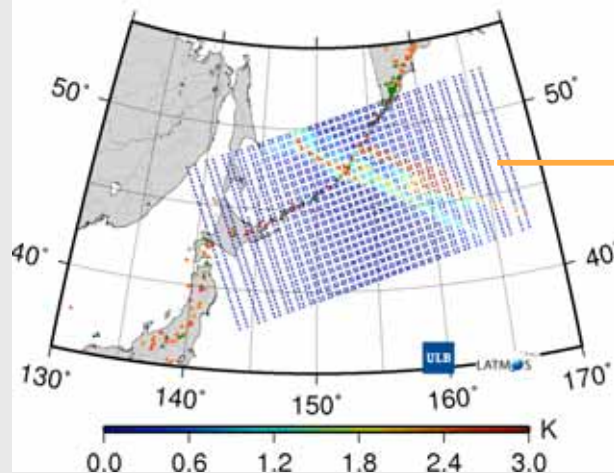
Identification and tracking of volcanic plumes

Provides alerts from BT differences in SO₂-v3 on BUFR basis (also e-mail system)

Useful for eruptions with emissions above the boundary layer

Extremely stable, without false alerts to now

SO₂ Alert 20090614.103857 (13763)



SARYCHEV. Îles Kouriles. Russie, erupted June 11

Location > 47.032890 160.445240

Value > 30.570024 K

#Points > 91

File > iasi_20090614_103857_metopa_13763_eps_o.l1_buf

Link: >

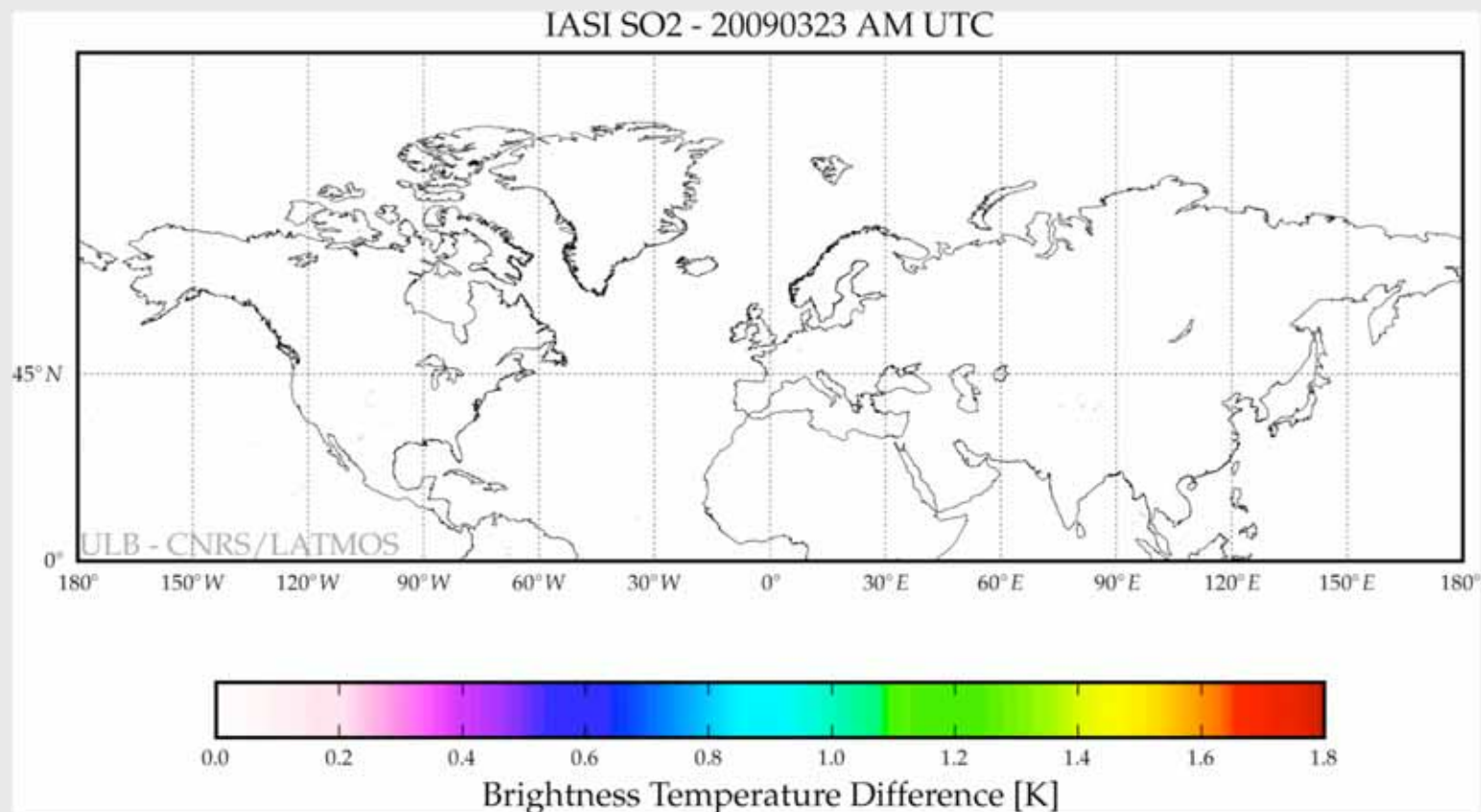
<http://cpm->

[ws4.ulb.ac.be/Alerts/index.php?NewYear=2009&NewMonth=06&sel_day=14&AlertList=SO2_iasi_20090614_103857_metopa_13763_eps_o.png](http://cpm-ws4.ulb.ac.be/Alerts/index.php?NewYear=2009&NewMonth=06&sel_day=14&AlertList=SO2_iasi_20090614_103857_metopa_13763_eps_o.png)

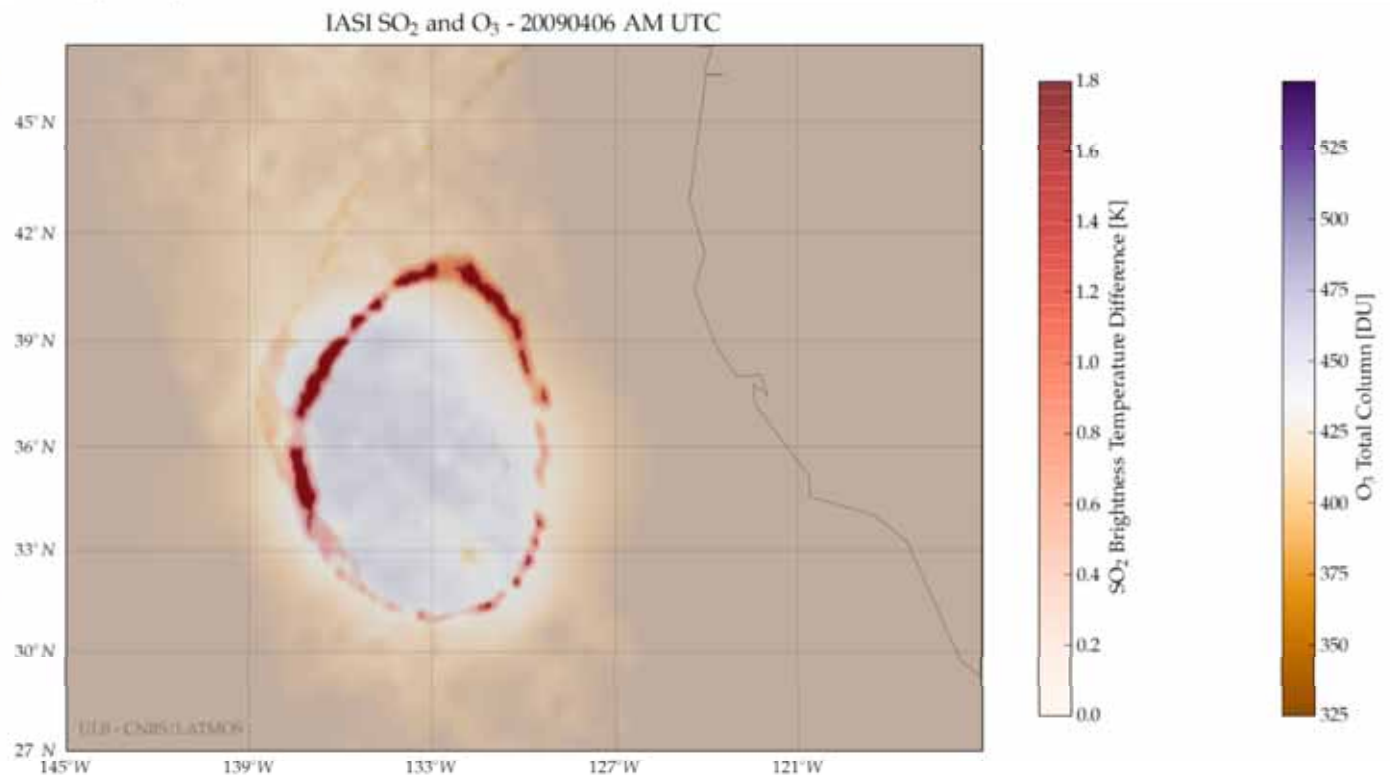
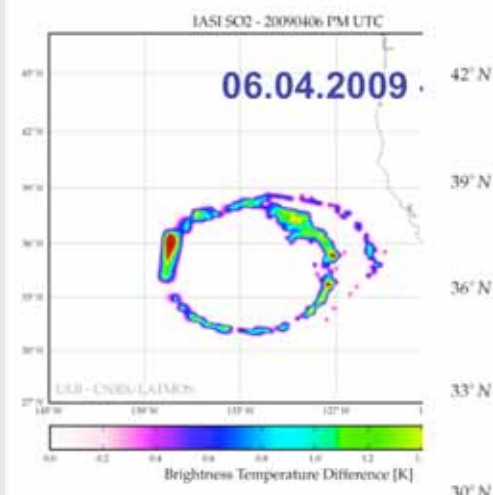
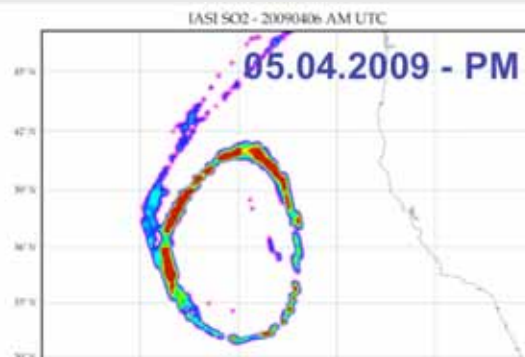
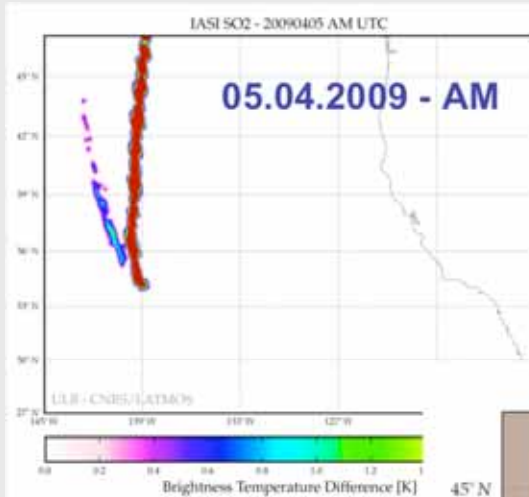
<http://cpm-ws4.ulb.ac.be/Alerts/>

Applications Tracking transport and Chemistry

Redoubt 23.03-04.04 2009



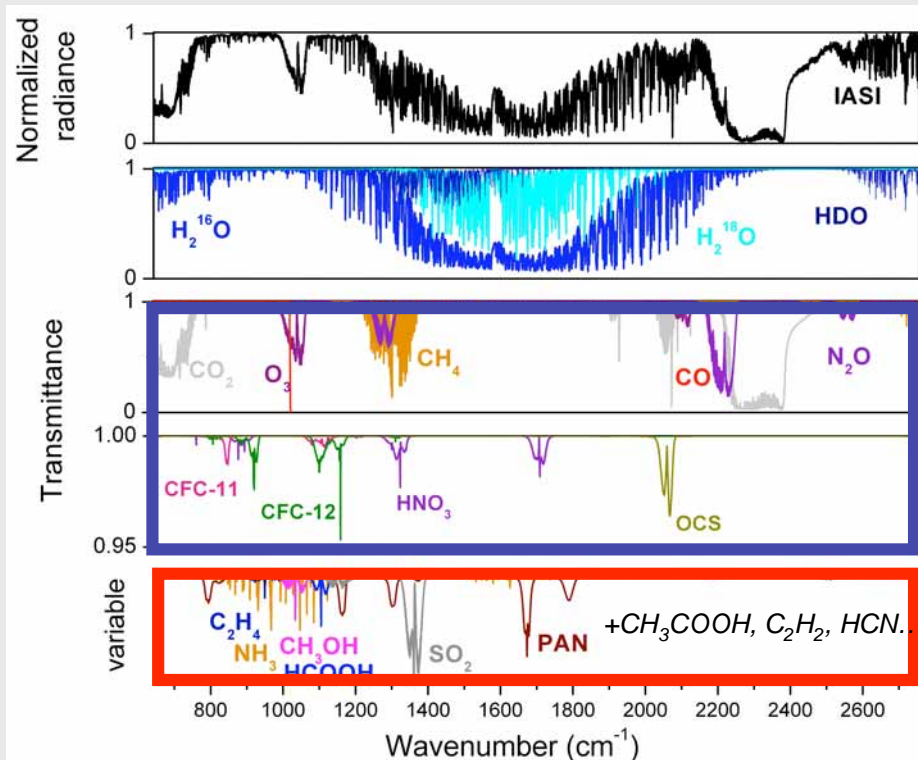
Redoubt April 2009 Tracking transport and Chemistry



Tropospheric composition measurements with IASI

Conclusions

IASI measures a dozen of species with a range of lifetimes, *routinely* and *globally* twice a day



Long-lived species (years)

→ **Climate**

+ CO, O₃ (months)

→ **Chemistry, AQ, Transport**

Short-lived species + aerosols (days)

→ **Chemistry, emission inventories**

- Operational applications starting (O₃ forecast, assimilation of CO; volcanic monitoring)
- New insights on emissions and chemistry (e.g. NH₃). Applicable to other species?

IASI ACP Special Issue

The IASI instrument onboard the METOP satellite: first results

Editor(s): A. Richter and T. Wagner

26 papers on line (ACPD).

http://www.atmos-chem-phys-discuss.net/special_issue82.html