

The First European TCCON station in megacity

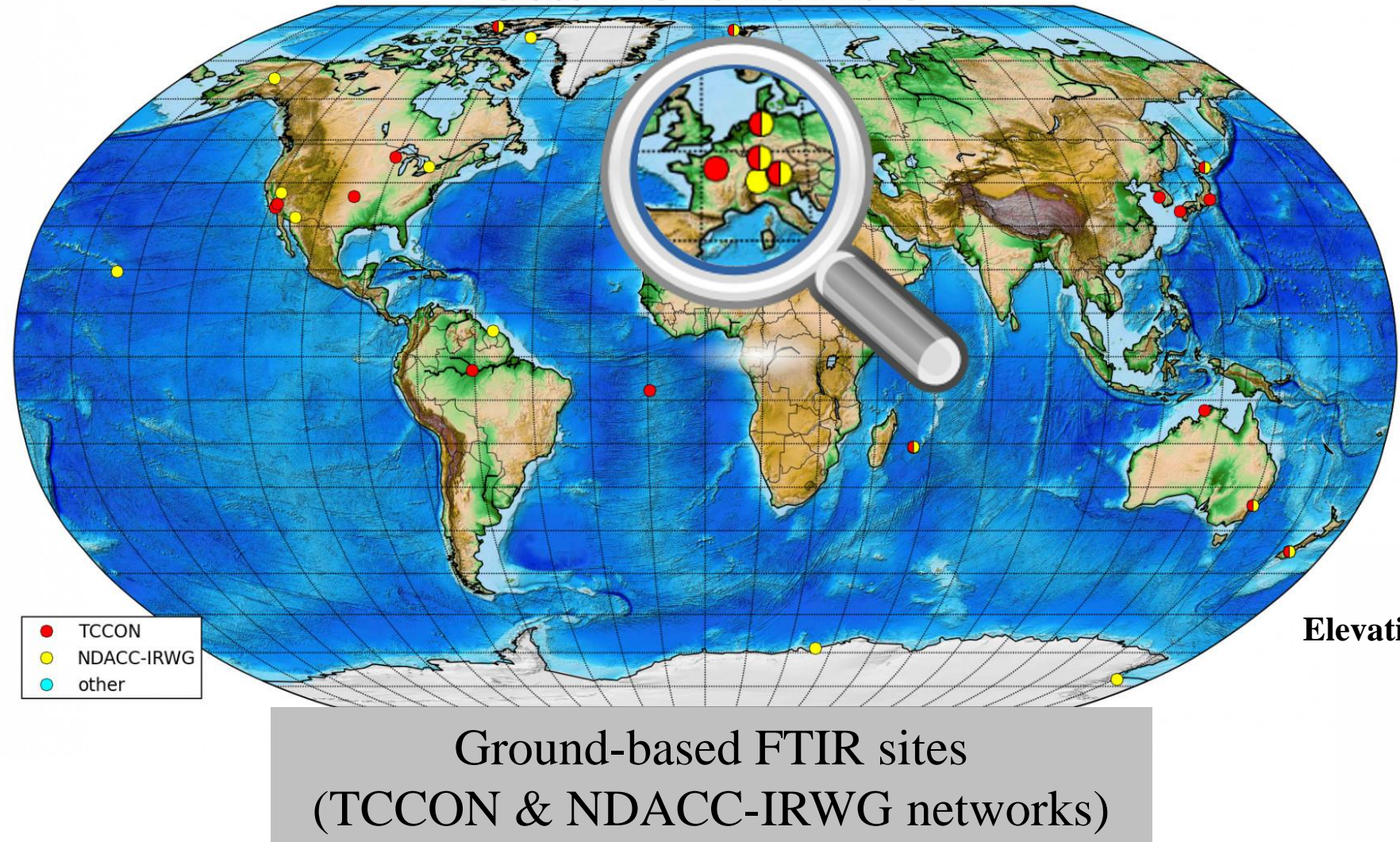
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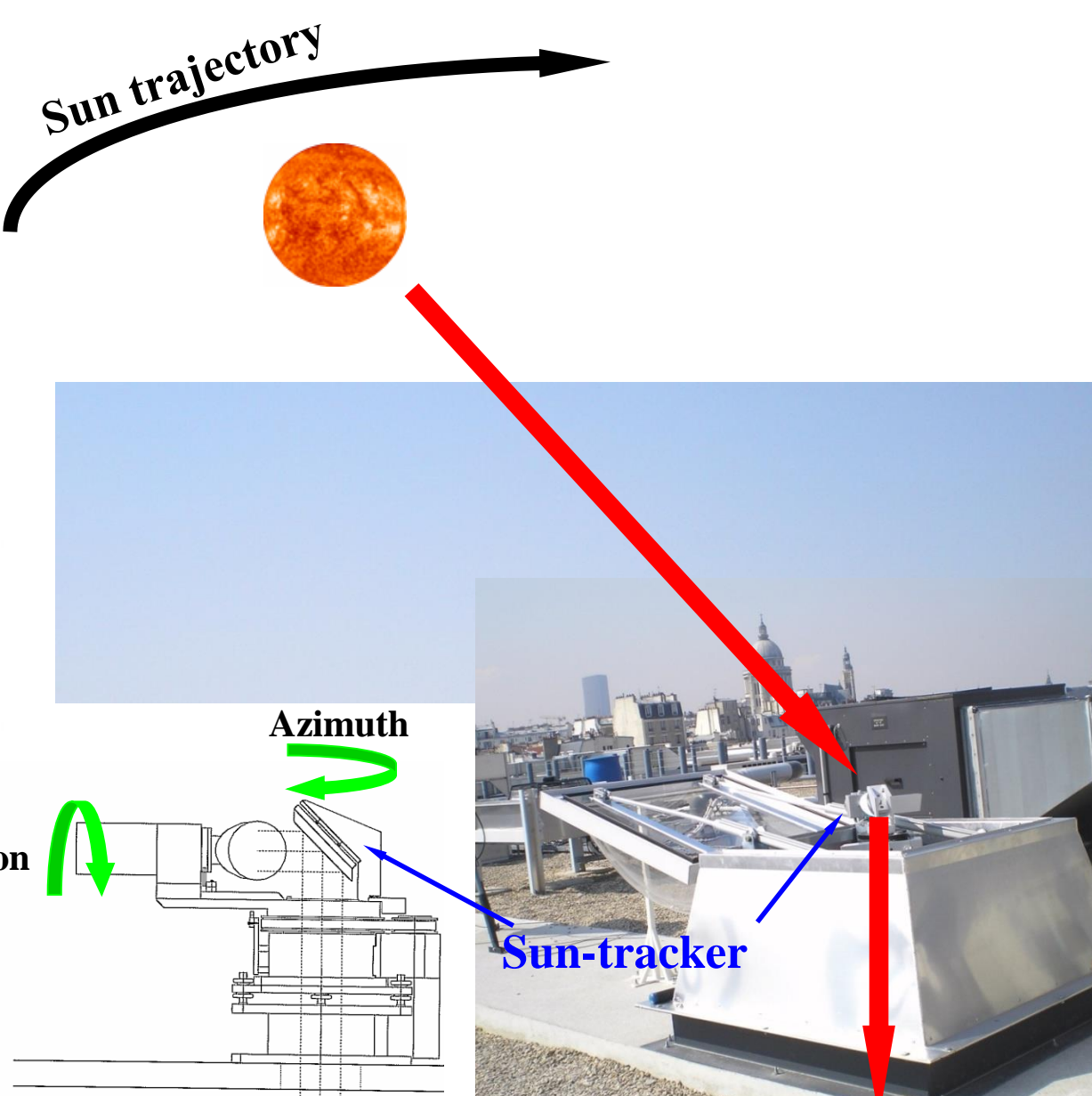
TCCON-Paris site

The LERMA ground-based Fourier Transform Spectrometer (FTS-Paris) is located in downtown Paris at the **campus Pierre et Marie Curie of Sorbonne Université**. The spectrometer (Bruker IFS-125HR) is associated with a sun-tracker installed on the roof terrace to perform **solar absorption observations**. Since September 2014, FTS-Paris is part of TCCON, dedicated to greenhouse gas observation (Total Carbon Column Observing Network). The TCCON-Paris station provides rare **hot spot** measurements and contributes to **satellite instrument validation**.

Global FTS network 2015



Ground-based FTIR sites (TCCON & NDACC-IRWG networks)

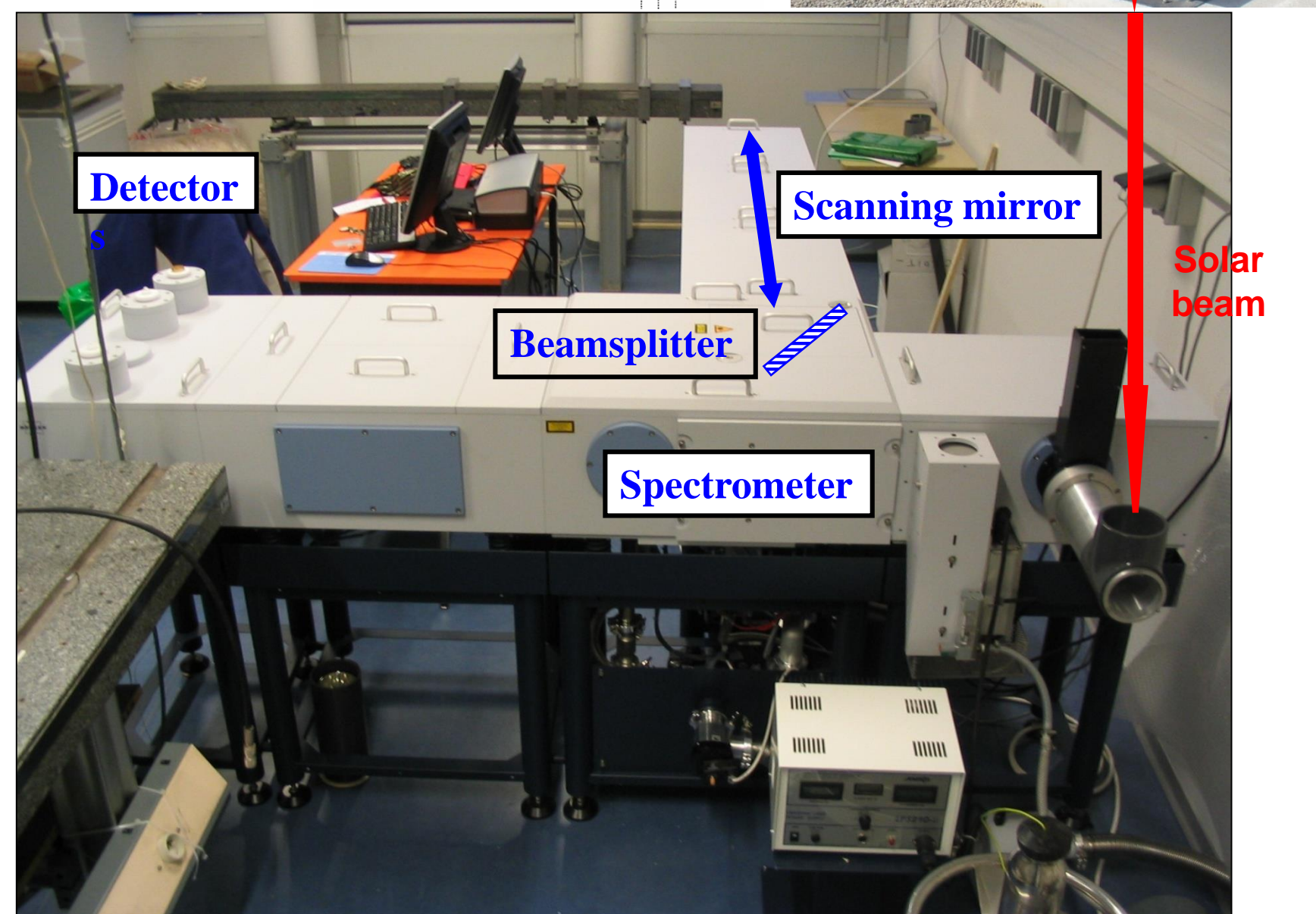


IR configuration

Internal source	Globar or tungsten lamp
Beamsplitter	KBr : 450 - 4800 cm ⁻¹ CaF ₂ : 1850 - 14000 cm ⁻¹
Entrance window	KBr : 450 - 25000 cm ⁻¹ CaF ₂ : 1850 - 14000 cm ⁻¹
MCT detector	D* > 2.5x10 ¹⁰ cmHz ^{1/2} W ⁻¹
InSb detector	D* > 1.5x10 ¹¹ cmHz ^{1/2} W ⁻¹
InGaAs detector ⁽⁺⁾	NEP < 5x10 ⁻¹² W/Hz ^{1/2}
HBr & N ₂ O cells	NDACC Ref. #80 & #26
HCl cell ⁽⁺⁾	TCCON Ref. #15

⁽⁺⁾ Equipments supported by LEFE/INSU

The FTS-Paris and all other equipments were financed by UPMC and LERMA



FTS-Paris with its sun-tracker (For details see Té *et al.*, 2010 & 2012)

Atmospheric species

Retrieval strategy

⇒ Improvement of the determination of CO₂ by coupling different *in situ* and remote sensing techniques (PhD work, Koshelev *et al.*, EGU, 2018)

Megacity impact

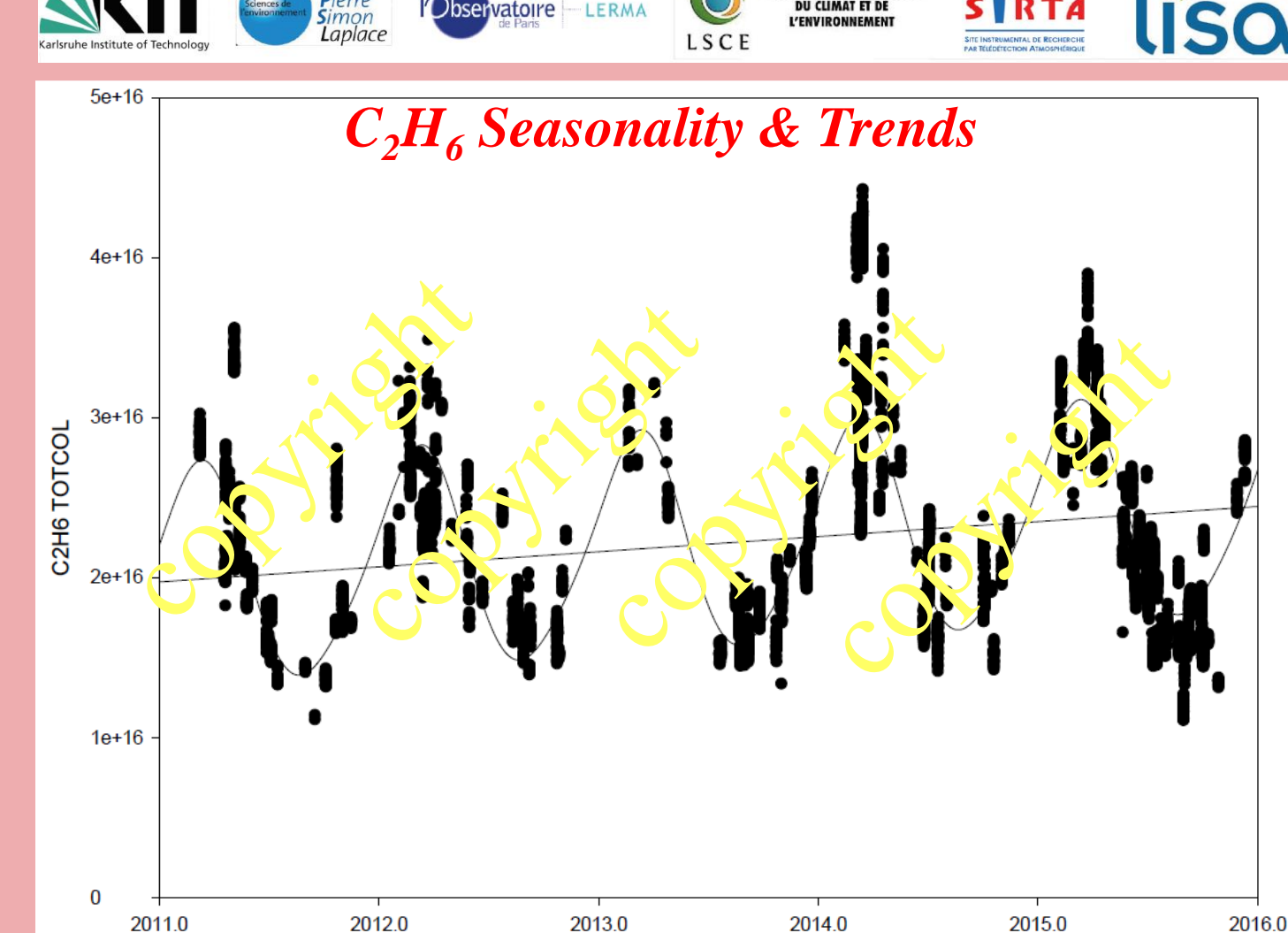
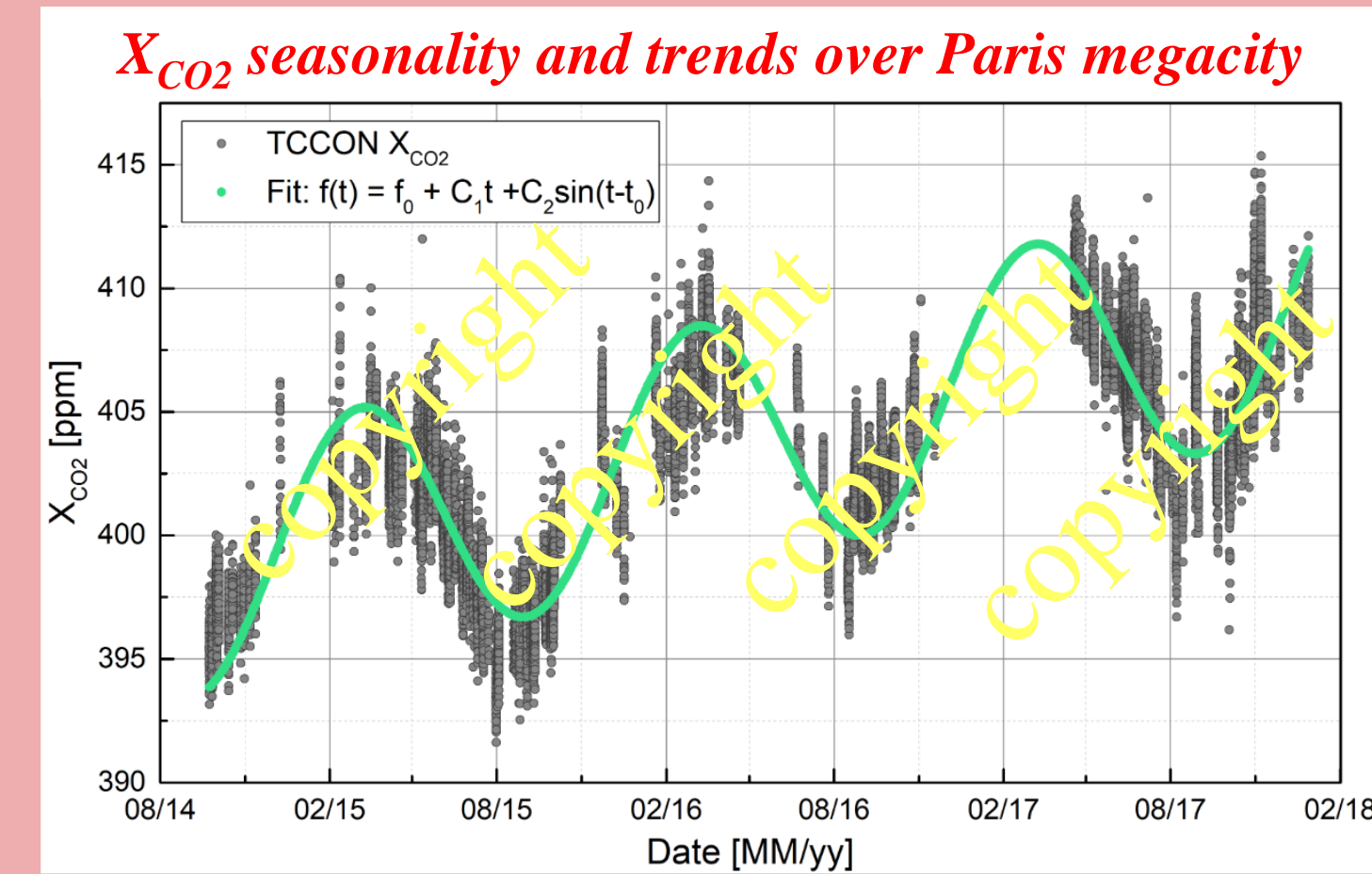
⇒ COCCON@Paris campaign in 2015 (Vogel *et al.*, submitted to AMT, 2018)
⇒ Regional emission flux characterization
⇒ Megacity impact on atmospheric composition
⇒ Super TCCON site (Paris & Orléans)

WMO standard transfer

⇒ Column comparison with EM27/sun @ Karlsruhe, Paris and Orléans
⇒ MAGIC multi-instruments campaigns

Atmospheric species global study

⇒ HCHO harmonized study with BIRA (Université de Bruxelles) (Vigouroux *et al.*, AMTD, 2018)
⇒ C₂H₆ study (seasonality & trends) with IAG (Université de Liège)
⇒ OCS study (retrieval strategy) with National Center for Atmospheric Research
⇒ C₂H₆/CO ratio study (sources characterization) with NCAR



Satellite instrument and atmospheric modelling validation

FTS-Paris/IASI/CHIMERE comparison

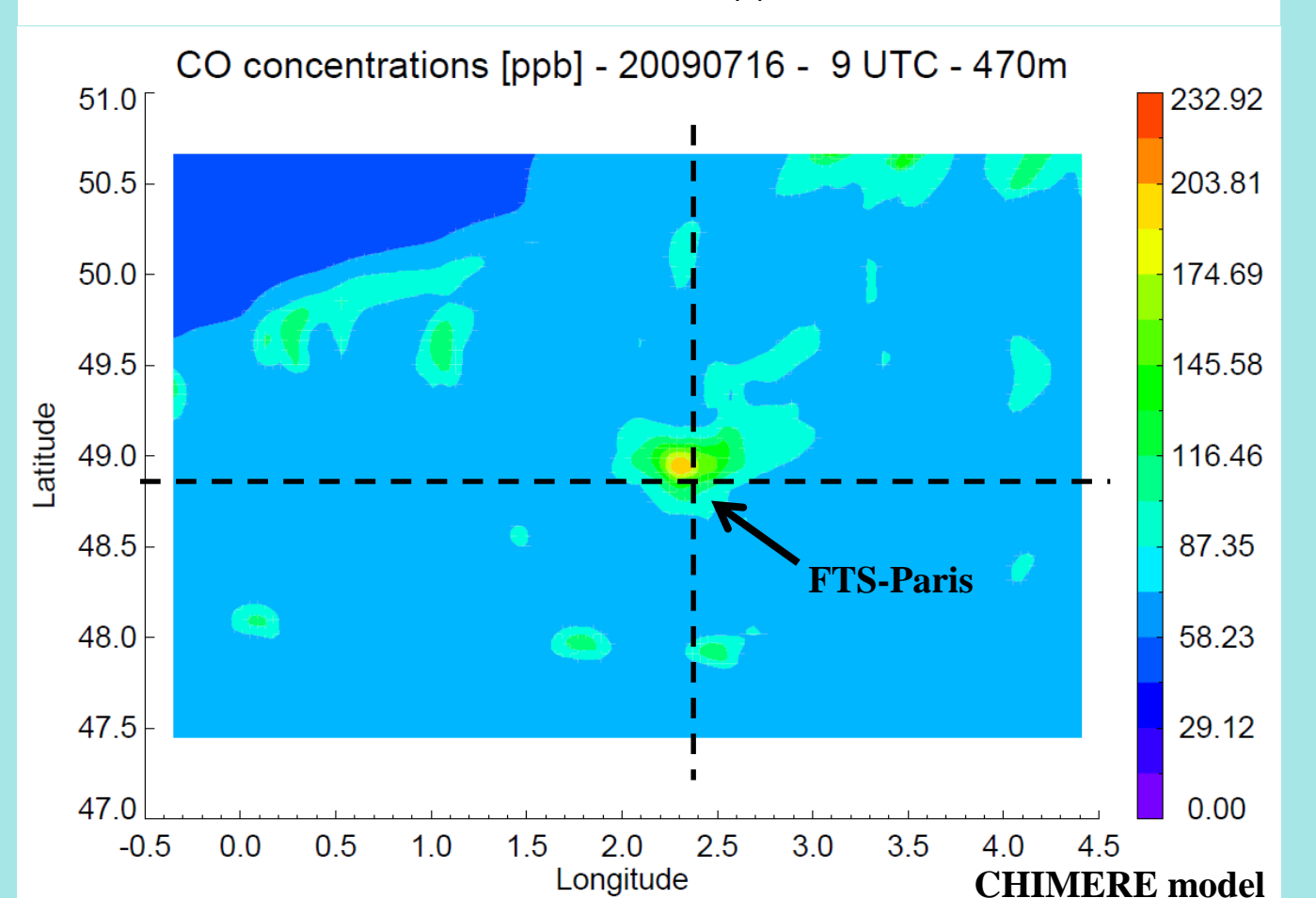
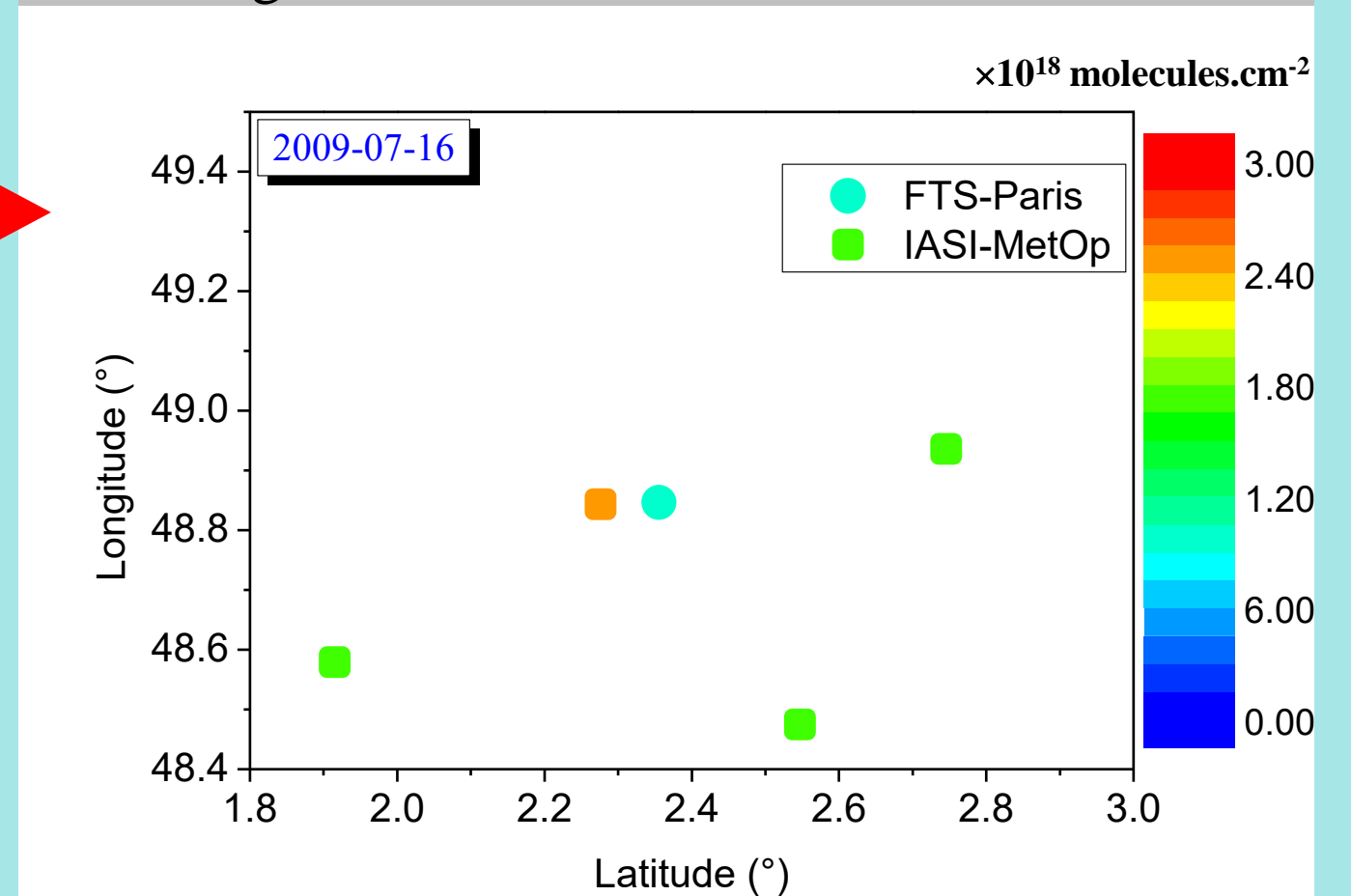
Date	FTS-Paris	IASI-a ^(*)	IASI-b ^(**)
2009-07-01	2.06±0.04	2.05±0.16	2.11±0.09
2009-07-13	1.73±0.02	2.23±0.09	2.73±0.11
2009-07-16	1.62±0.03	1.90±0.09	2.43±0.11
2010-02-16	2.45±0.05	2.40±0.14	2.53±0.14
2010-03-02	2.57±0.05	2.68±0.11	2.63±0.10
2010-07-07	1.95±0.05	2.15±0.10	2.09±0.10
2010-10-11	1.81±0.03	1.62±0.11	none
2011-03-08	2.77±0.05	2.35±0.12	2.44±0.10
2011-04-19	2.21±0.04	1.91±0.06	2.07±0.05
2011-04-20	2.38±0.03	2.18±0.07	2.22±0.05
2011-04-21	2.23±0.03	1.94±0.06	2.07±0.05
2011-04-22	2.15±0.06	1.93±0.06	none
2011-04-26	2.54±0.04	2.10±0.06	2.22±0.05
2011-05-04	2.83±0.04	2.48±0.06	none
2011-05-05	2.13±0.02	2.36±0.06	2.38±0.05
2011-05-06	2.33±0.05	none	none
2011-05-12	2.16±0.05	none	none
2011-05-13	2.35±0.03	2.28±0.05	2.26±0.05
2011-05-25	2.06±0.03	1.97±0.05	2.04±0.05

^(*) All morning overpasses around Ile de France (± 0.5° in latitude and in longitude corresponding to a 100 km × 100 km square region centred on QualAir platform location).
^(**) Overpasses inside Paris "downtown" (< ± 0.15° in latitude and in longitude).

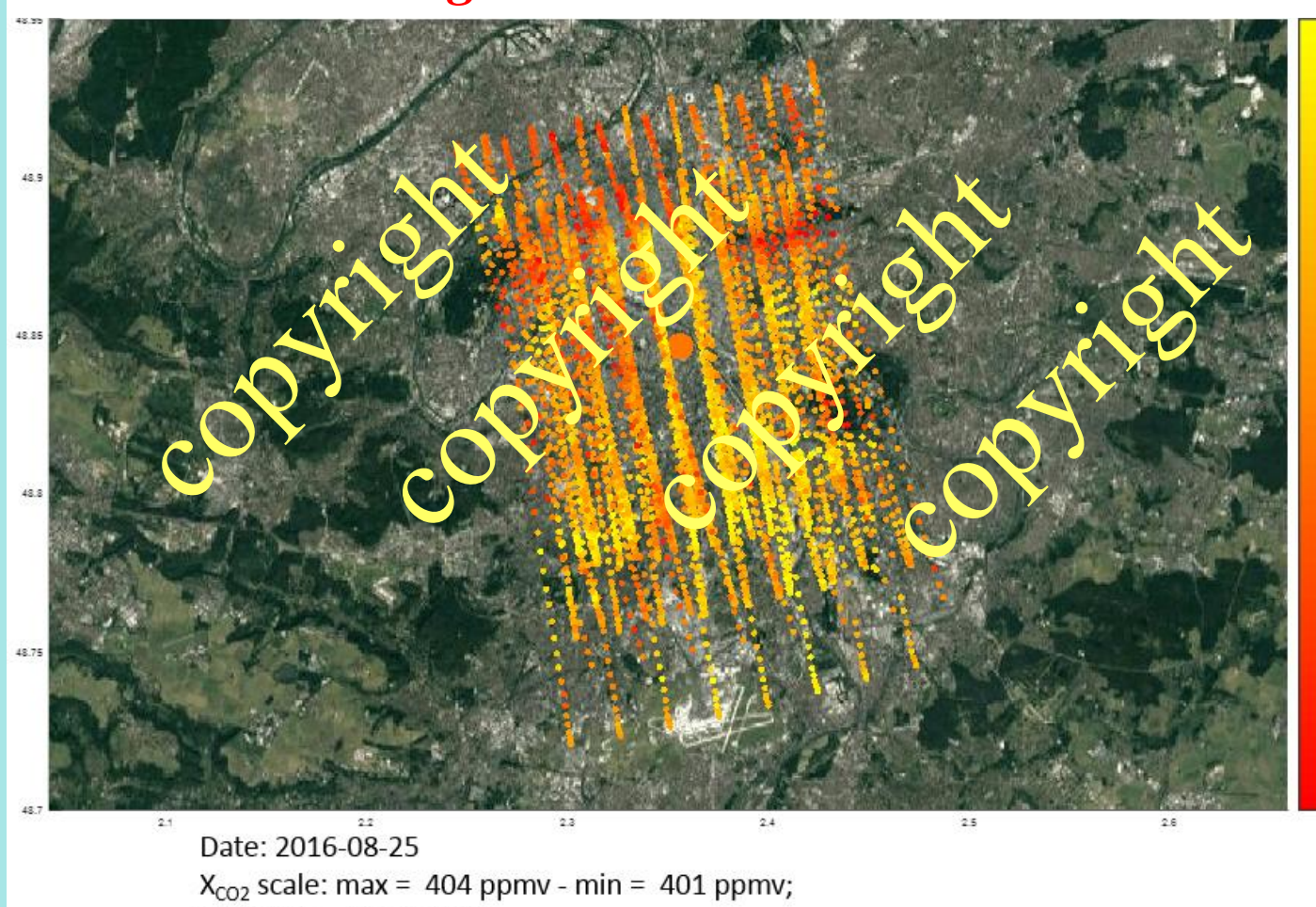
Space mission activities

⇒ Validation of OCO-2 (TCCON-Paris selected site for OCO-2 target mode) (Wunch *et al.*, AMT, 2017)
⇒ Validation of S5P for H₂CO, CH₄ & CO (Vigouroux *et al.*, & Sha *et al.*, EGU, 2018)
⇒ Validation of RemoTeC radiative transfer algorithm for OCO-2 data analysis (Wu *et al.*, AMT, 2018)
⇒ Contribution to upcoming space missions
- MicroCARB: Cal/Val L2
- MERLIN: Cal/Val L2
- Validation of GOSAT-2, OCO-3, GeoCARB, TanSat, Gaofen-5 ...

Figures from Té *et al.*, ATMOS, 2012



OCO-2 target mode over TCCON-Paris



Time-lag between surface and column CO seasonality

Total column seasonal variability

- ground-based FTS-Paris instrument
- satellite IASI and MOPITT
- good correlation between ground-based & satellite data

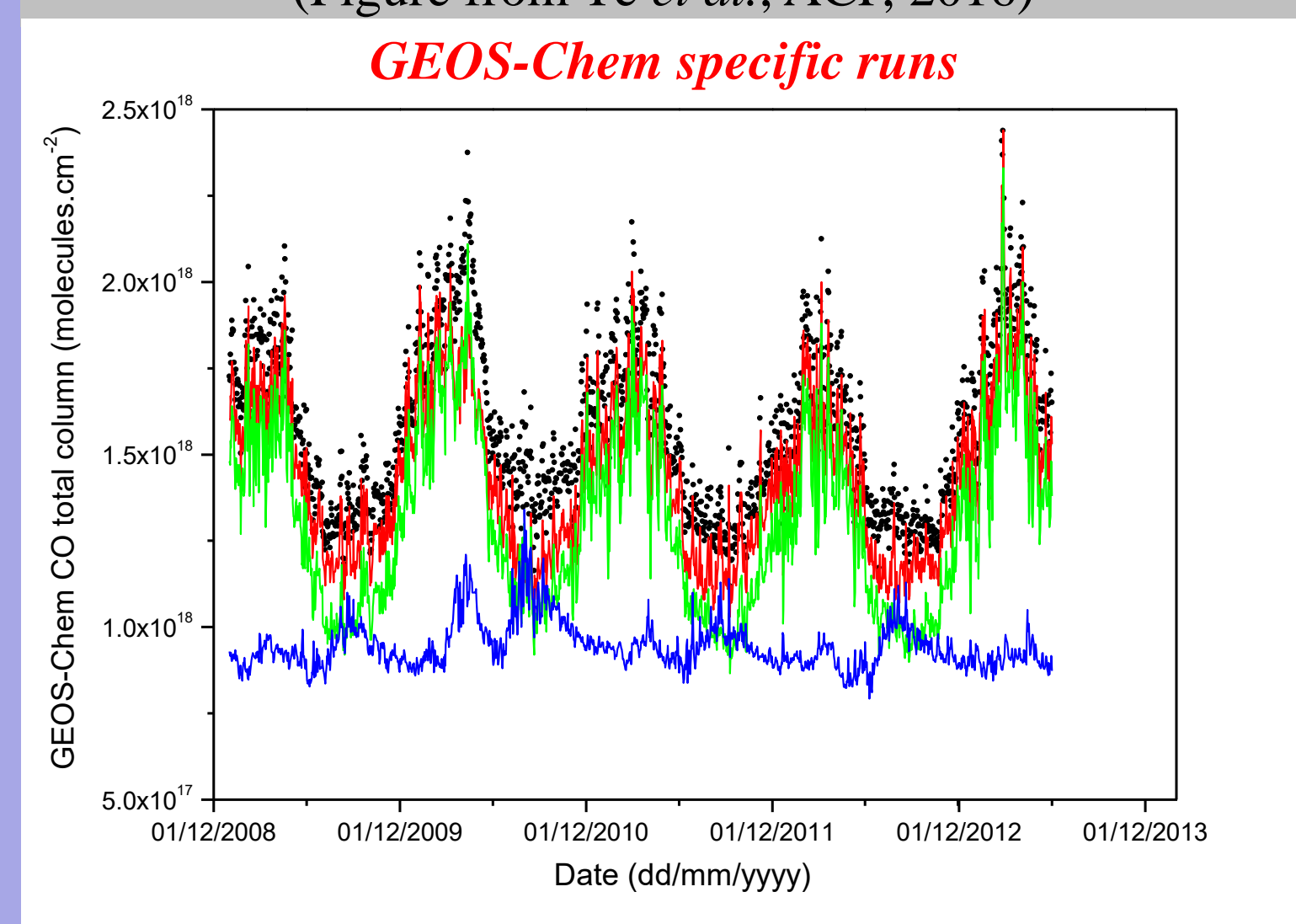
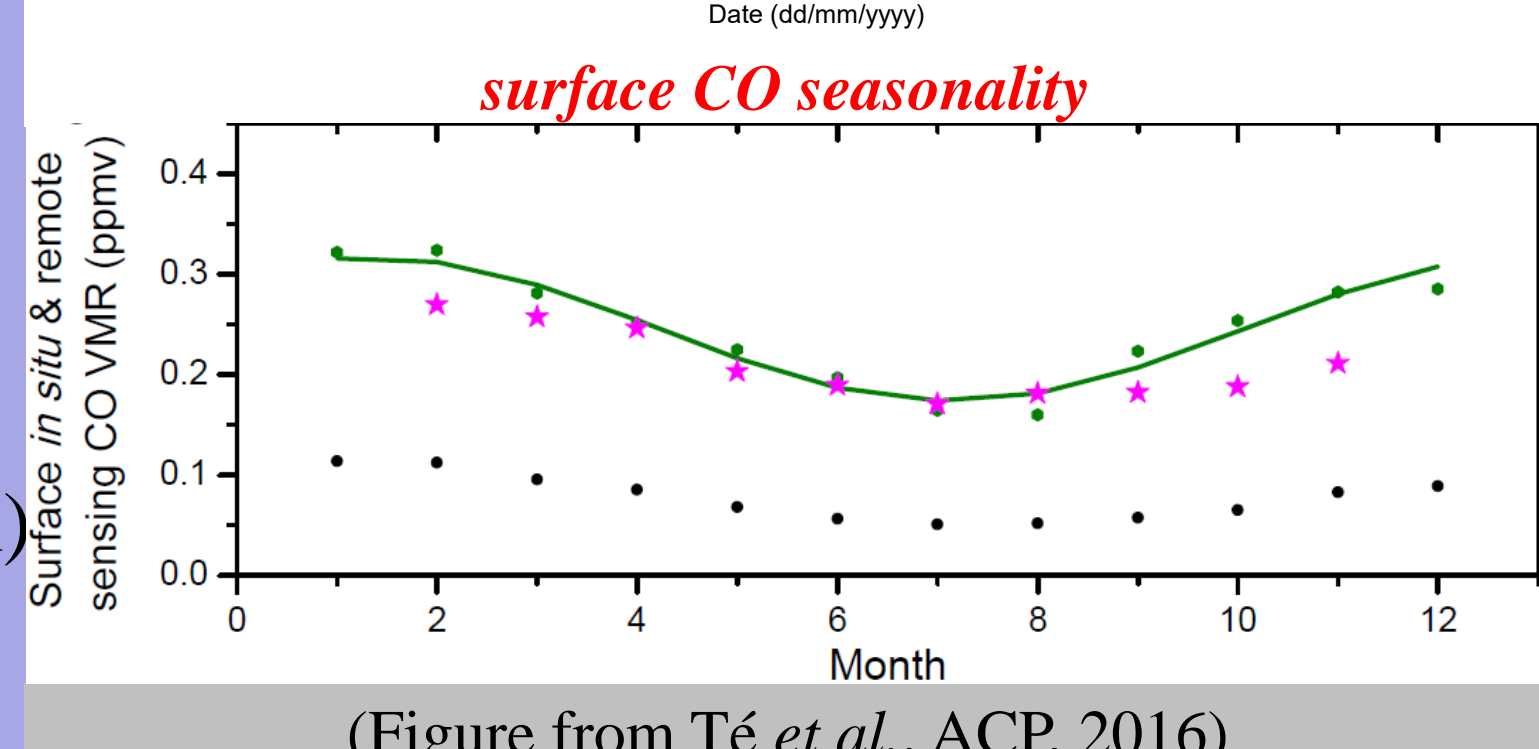
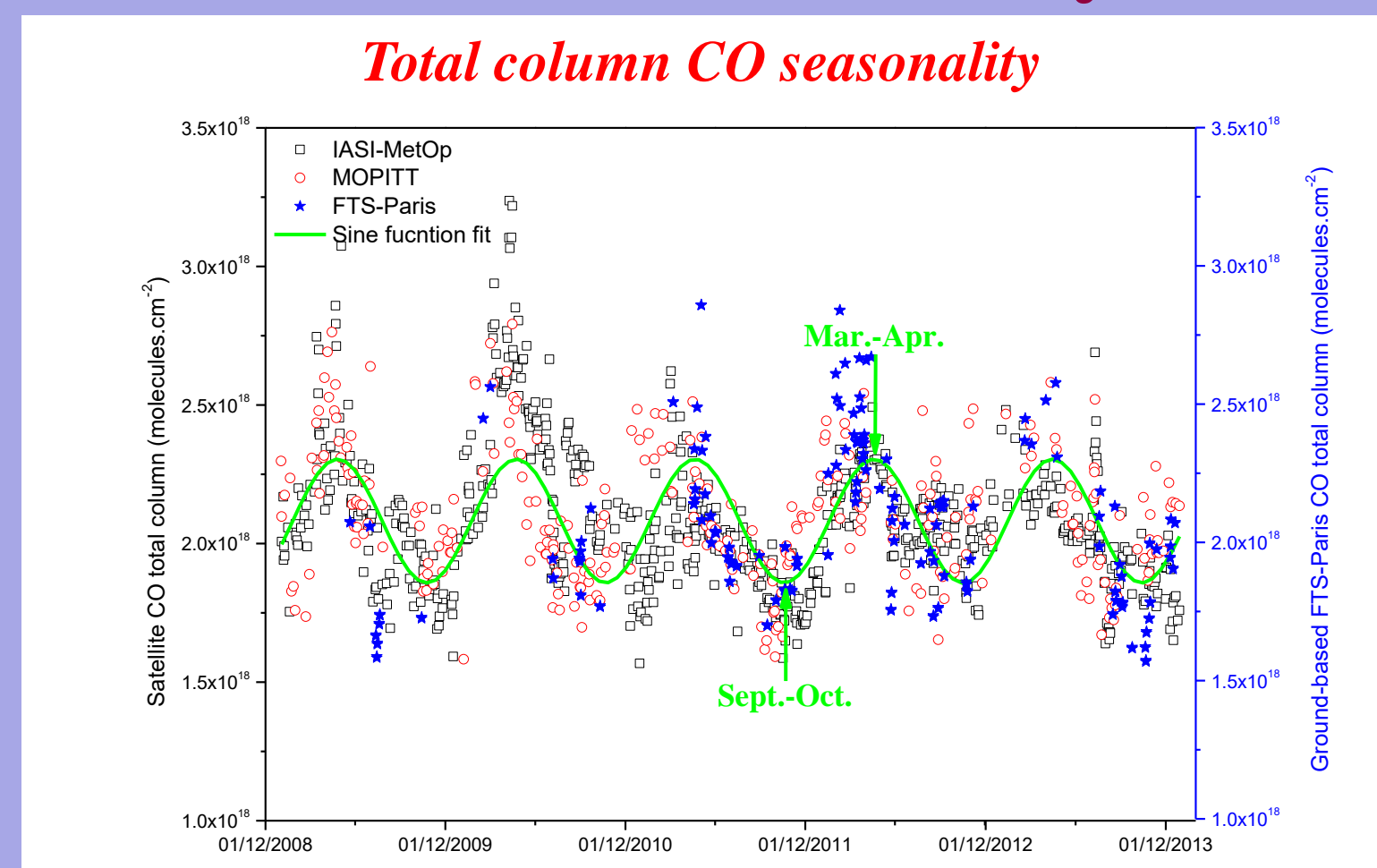
Free troposphere VS surface

- Same seasonality maxima between partial and total columns (FTS-Paris, IASI & GEOS-Chem)
- 2 month shift seasonality from surface CO measurement (CO11M, FTS-Paris & GEOS-Chem)

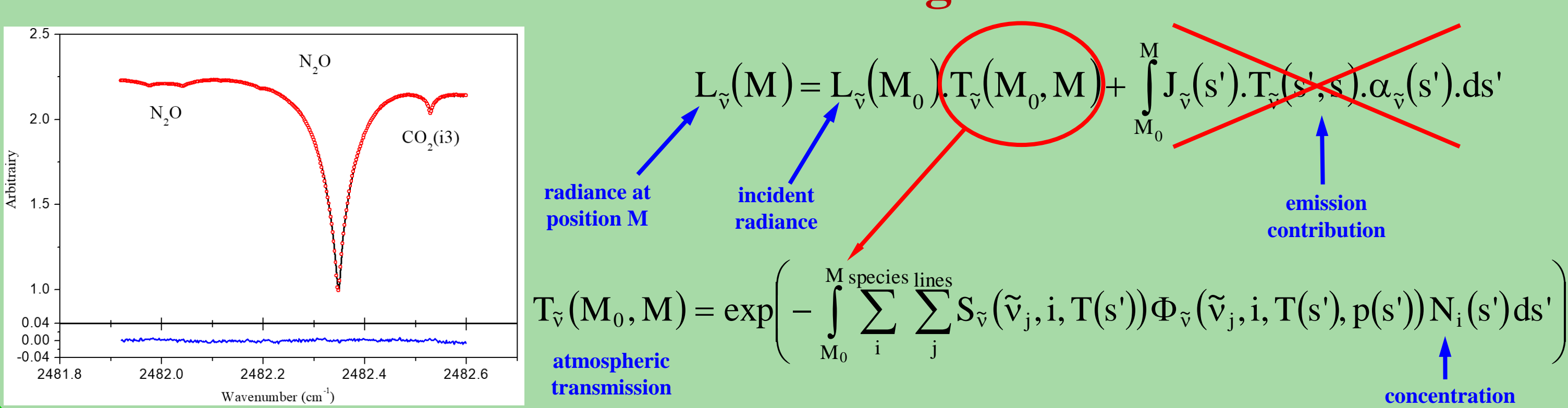
Identification of emission sources

- standard run
- run without biomass burning contribution
- run without biogenic contribution
- run without anthropogenic contribution

⇒ CO seasonality at Paris is driven by local anthropogenic emissions



Radiative transfer algorithm



References

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