UPMC SORBONNE UNIVERSITÉS

l'Observatoire de Paris — LERMA

Laboratoire d'Études du Rayonnement et de la Matière en Astrophysique et Atmosphères

cnrs dépasser les frontières

l'Observatoire de Paris

OCAPI Annual Meeting (Plateforme d'Observation de la Composition Atmosphérique Parisienne de l'IPSL)

Jussieu, Paris, France, 18 September 2017

TCCON-Paris station for atmospheric pollutant and GHG monitoring

Y. Té, P. Jeseck, D. Koshelev and C. Janssen

yao-veng.te@upmc.fr

Laboratoire d'Études du Rayonnement et de la Matière en Astrophysique et Atmosphères
UMR 8112, UPMC/CNRS/Observatoire de Paris/IPSL
Case 76, 4 Place Jussieu, 75005 Paris, France

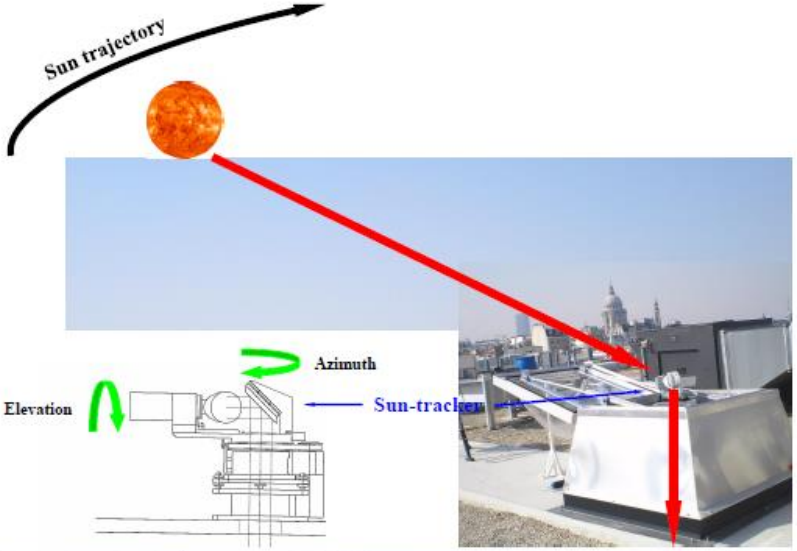
Station QualAir Jussieu

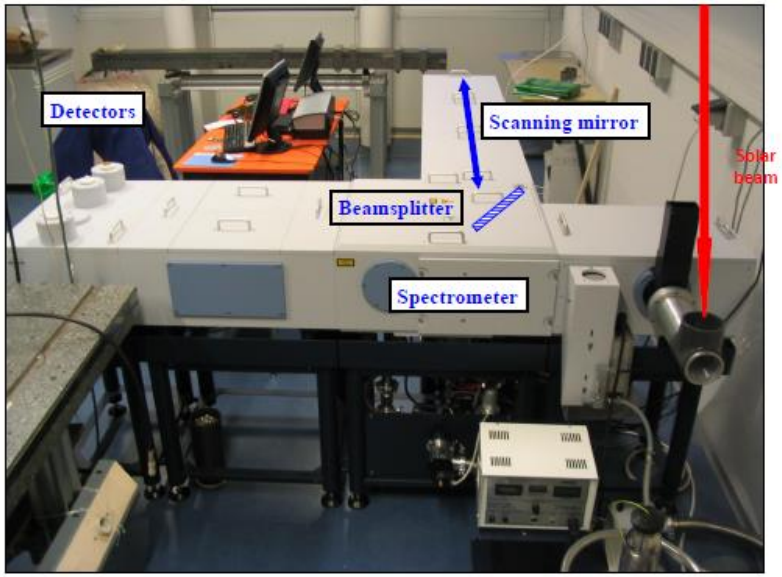
TCCON total carbon column observing network

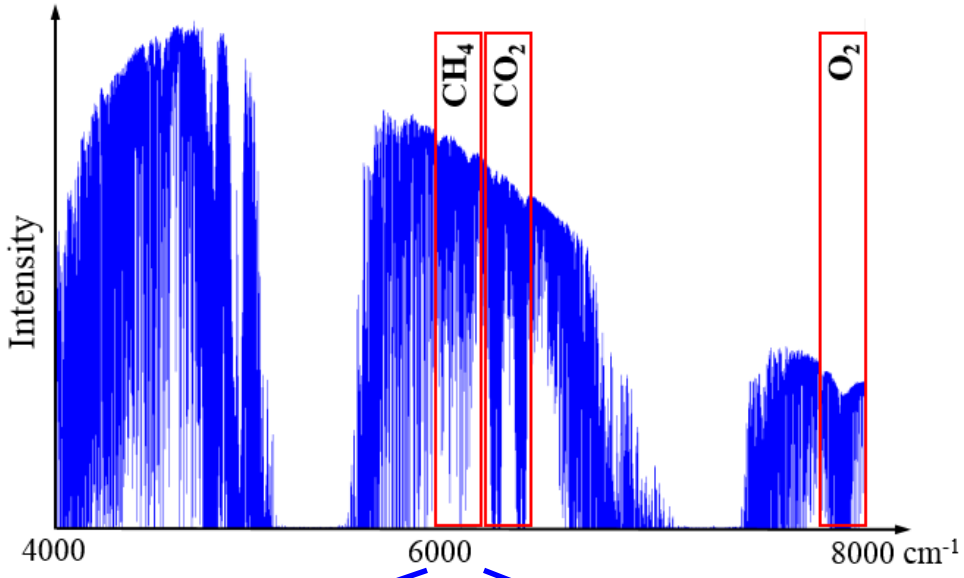
Sciences de l'environnement — Institut Pierre Simon Laplace

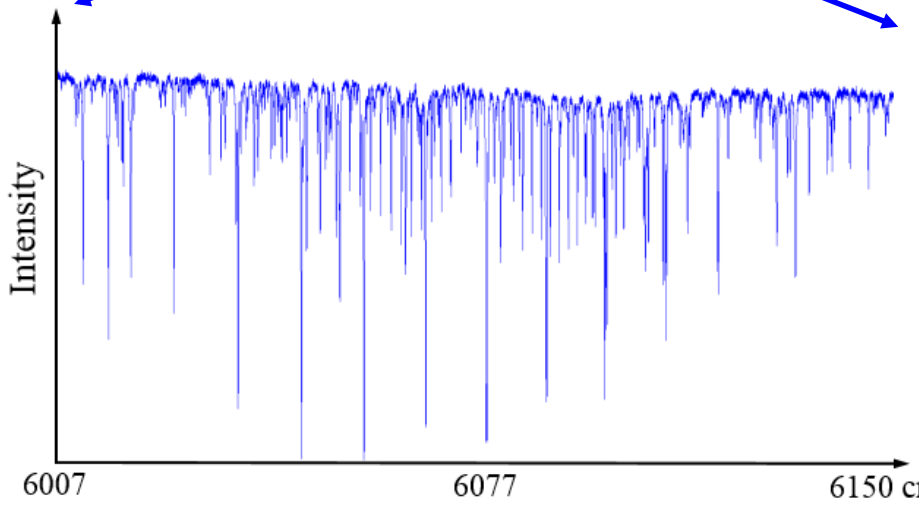
TCCON network

Solar absorption measurement using FTIR spectroscopy



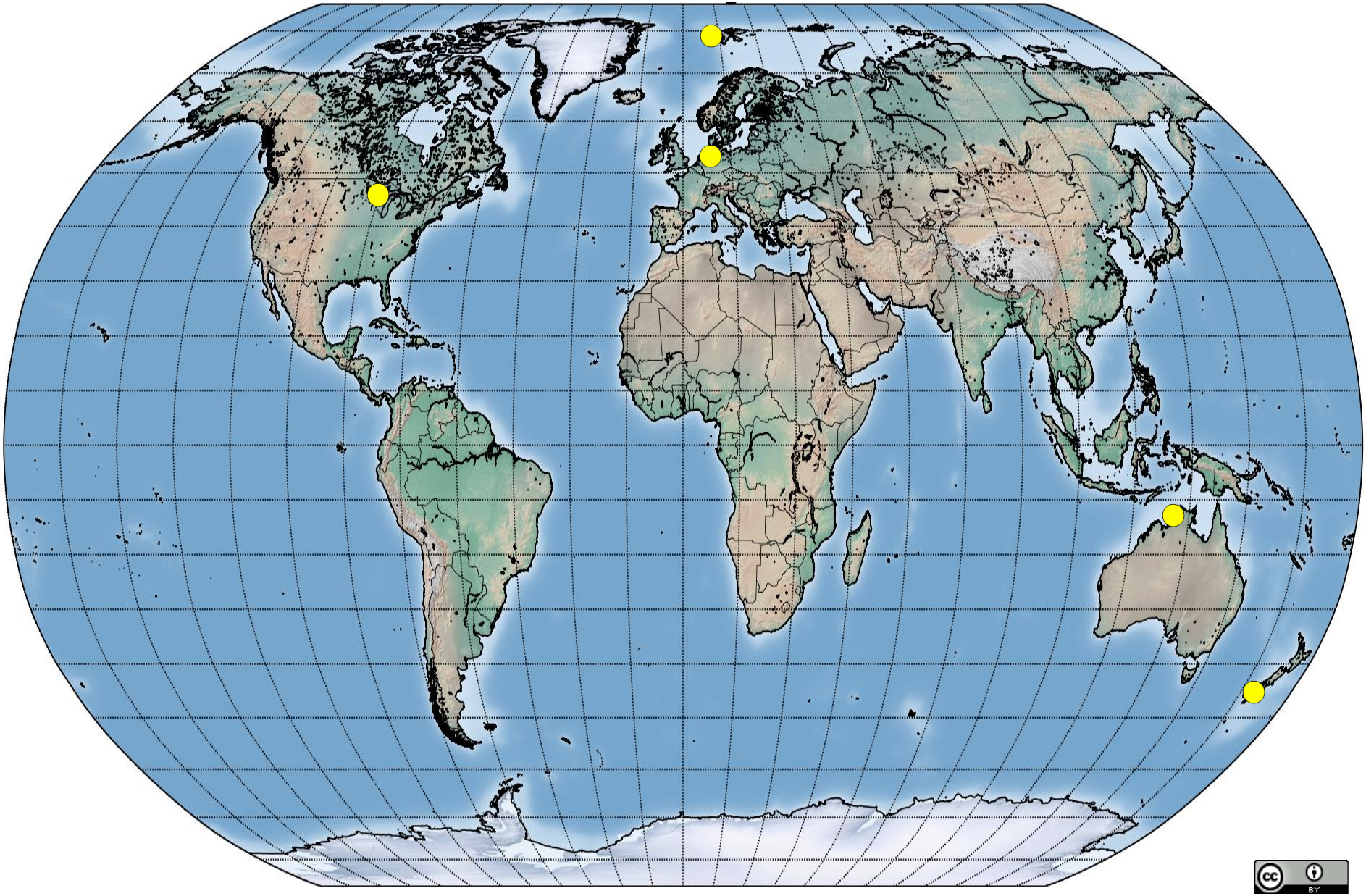






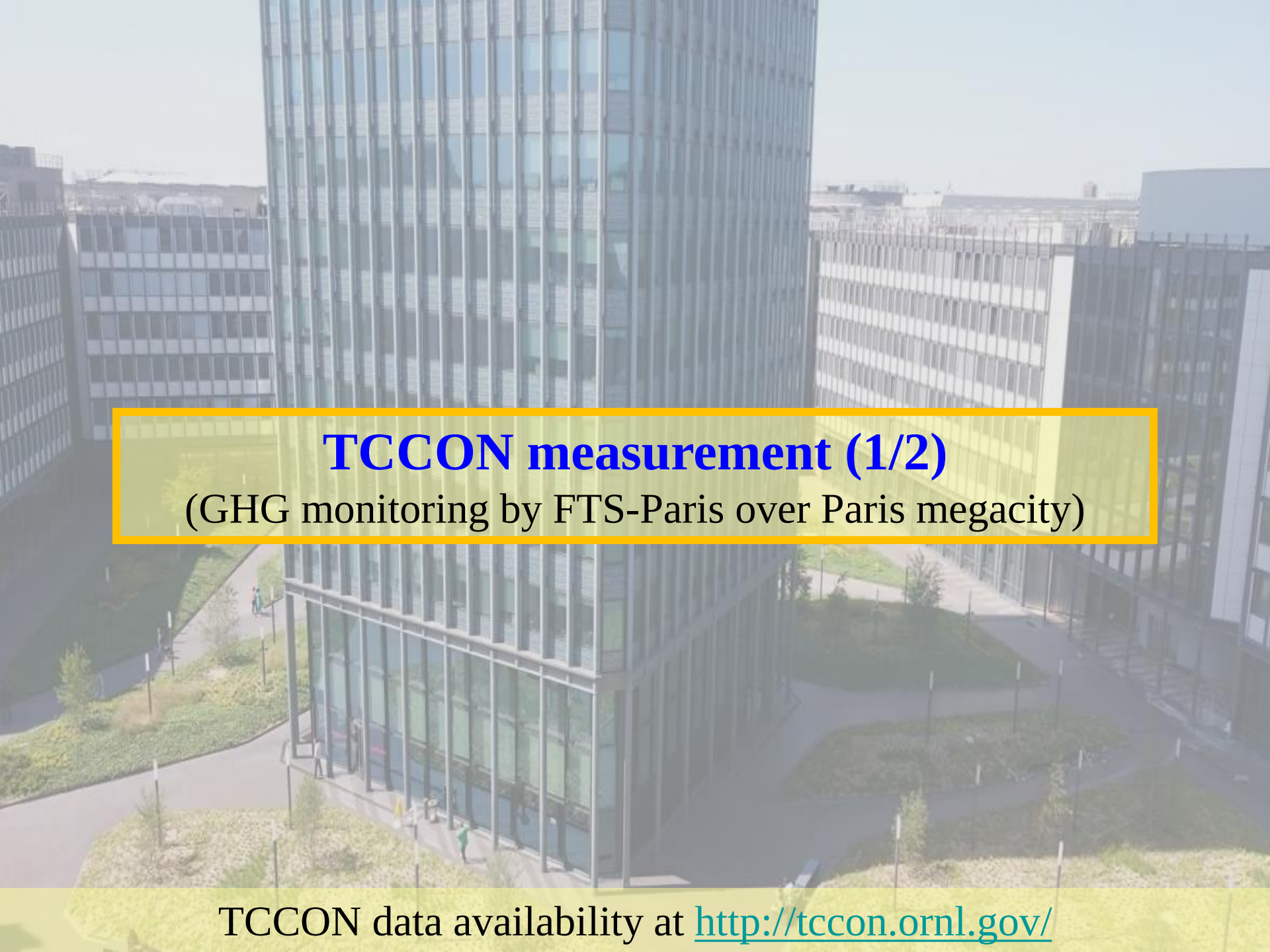
Dry-Air mole fractions of CO_2, CH_4, CO, N_2O, H_2O, HDO and HF

Total Carbon Column Observing Network (TCCON) 2005



Total Carbon Column Observing Network (TCCON) 2016

➔ Total Carbon Column Observing Network has grown enormously

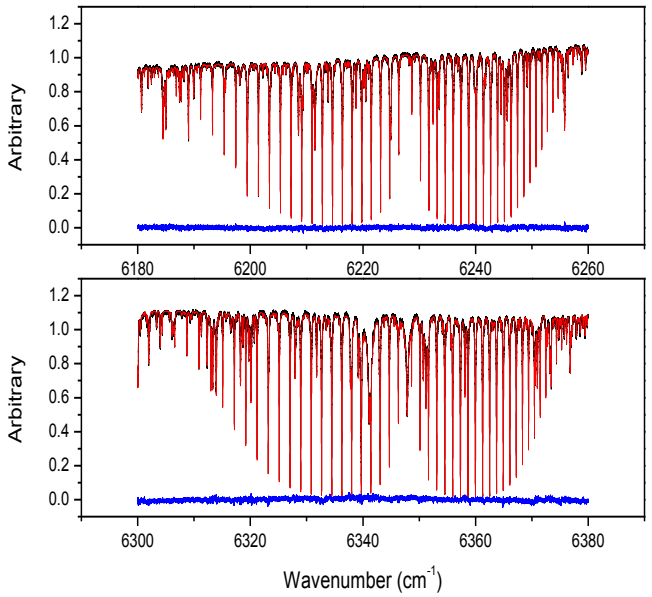


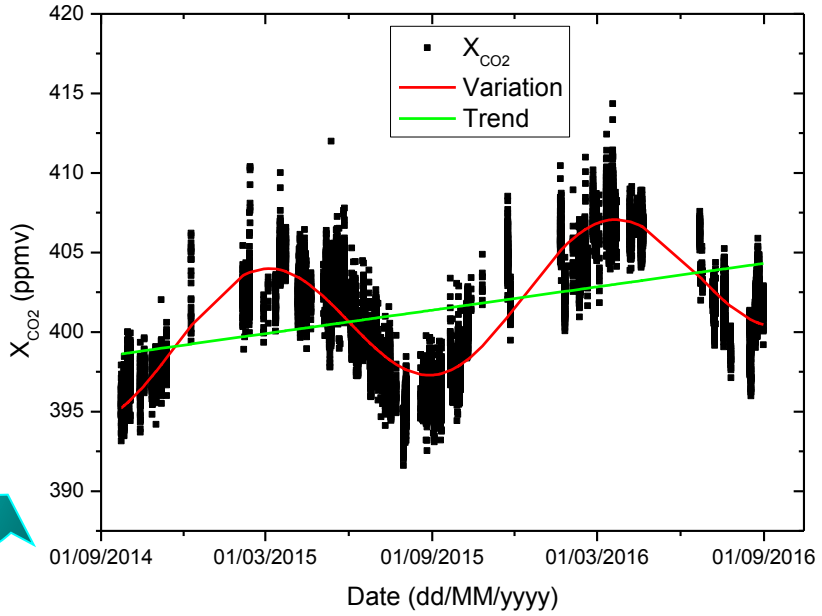
TCCON measurement (1/2)

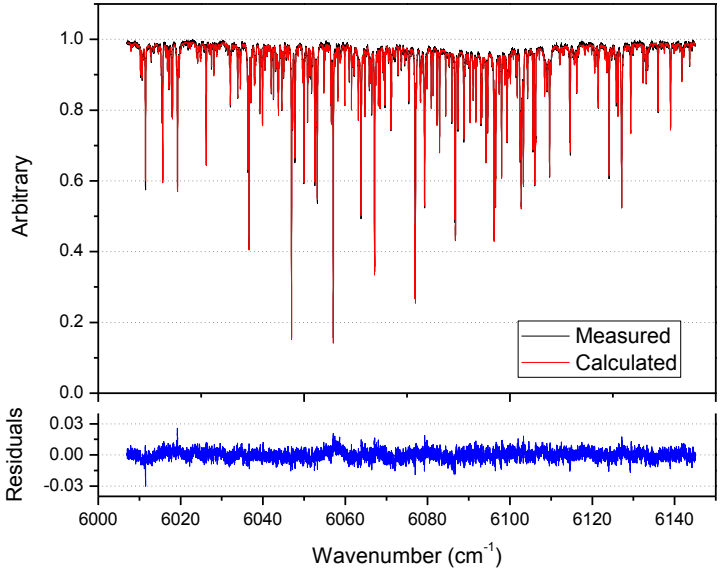
(GHG monitoring by FTS-Paris over Paris megacity)

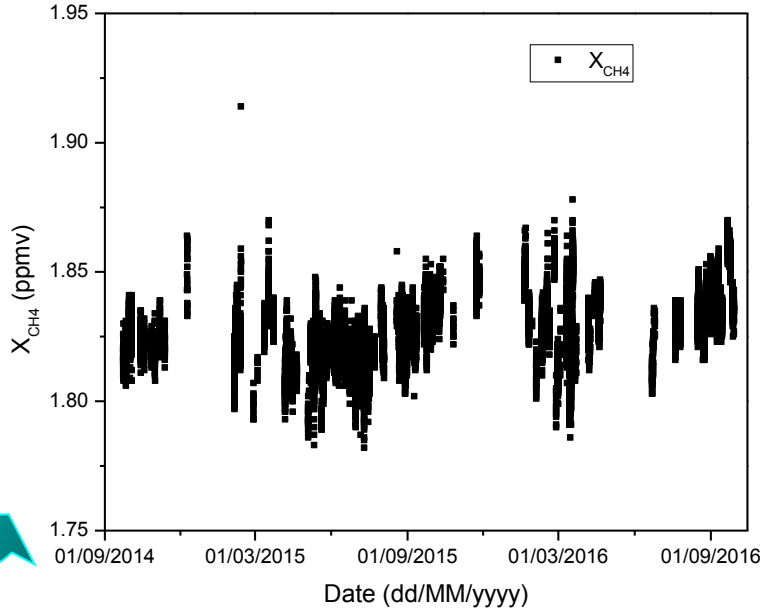
TCCON data availability at http://tccon.ornl.gov/

TCCON X_{CO2} & X_{CH4}

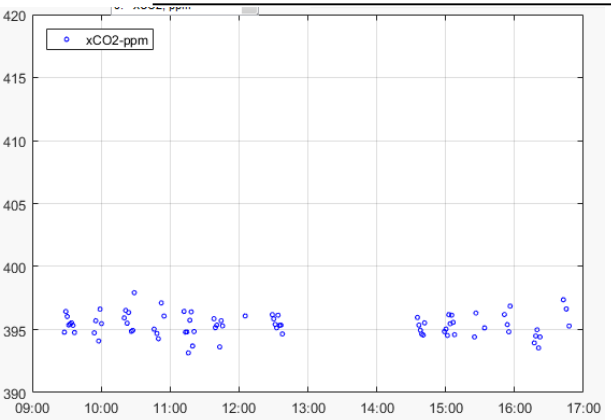


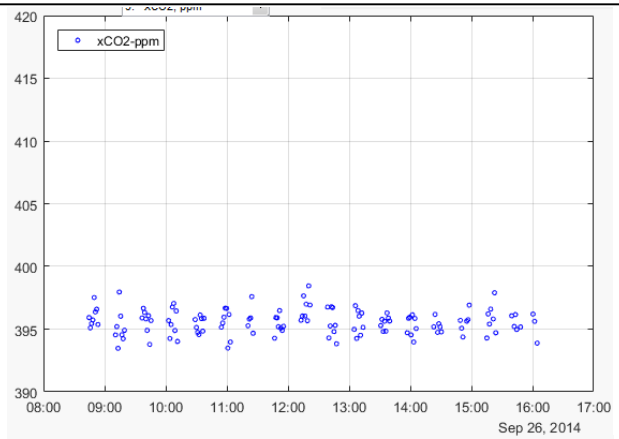


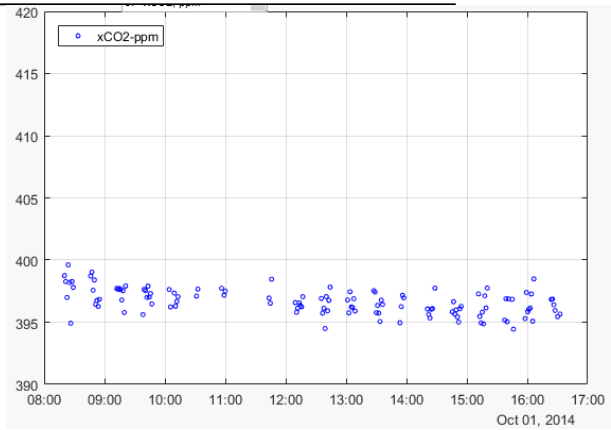


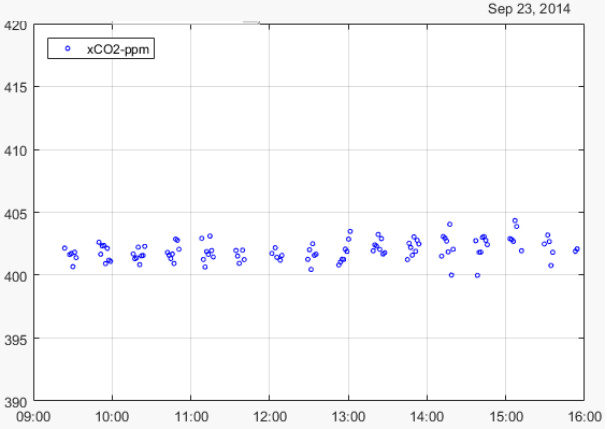


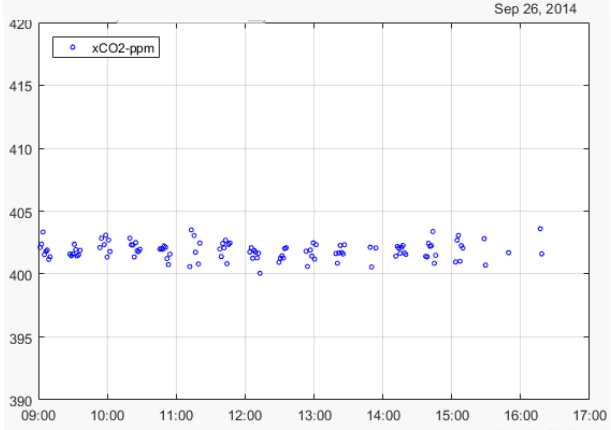
Examples of daily X_{CO2}

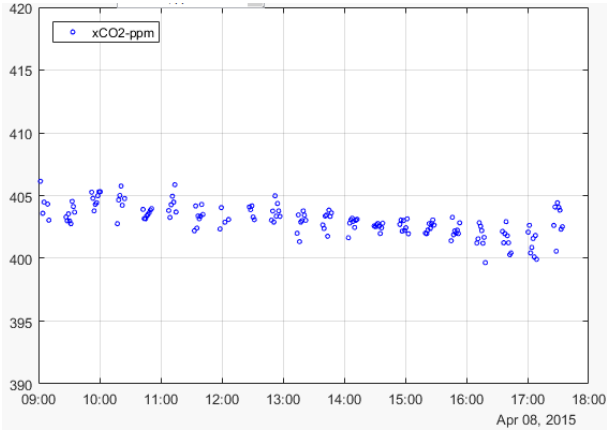


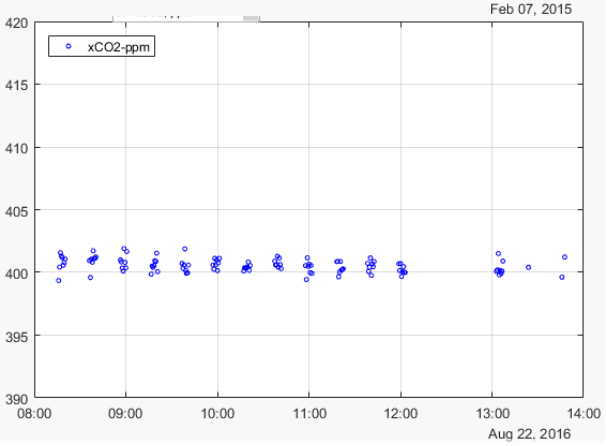


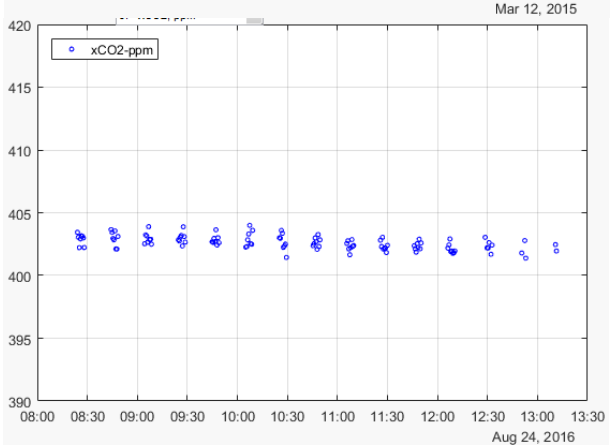


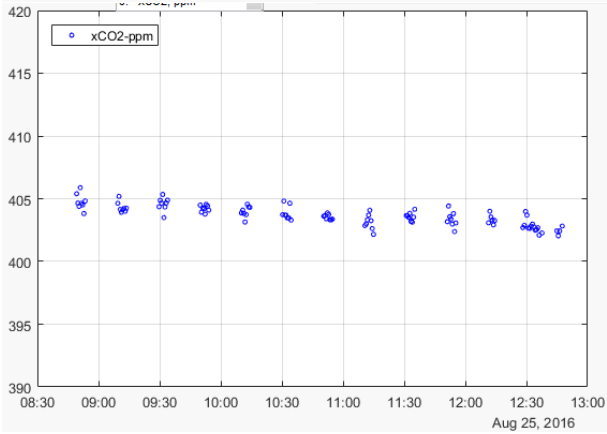




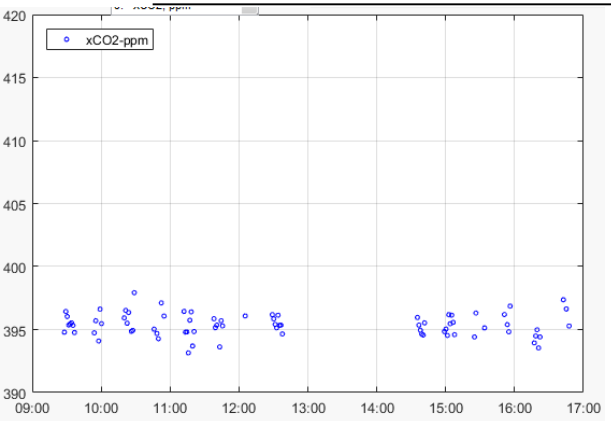


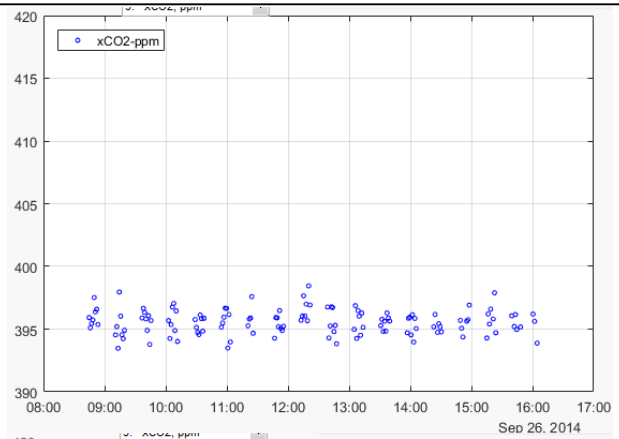


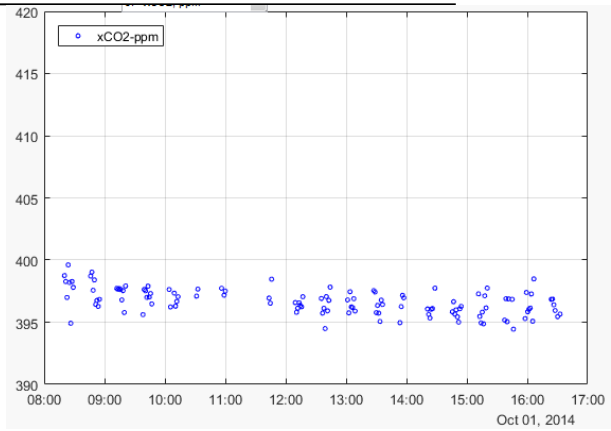


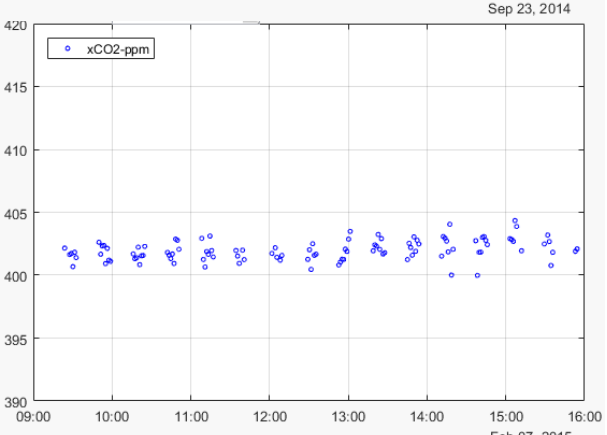


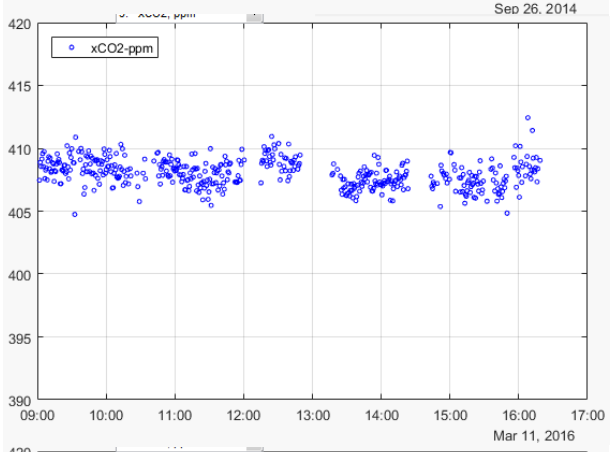
Examples of daily X_{CO2}

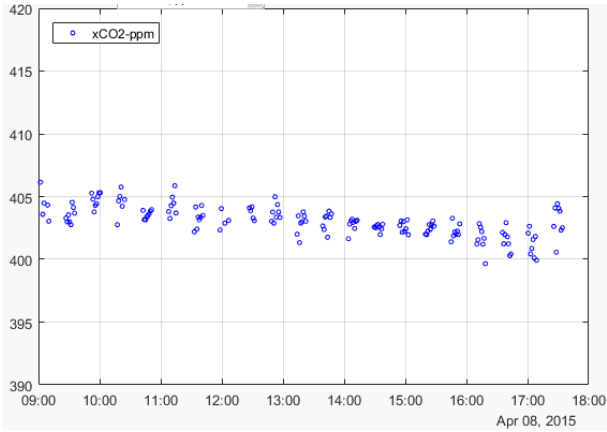


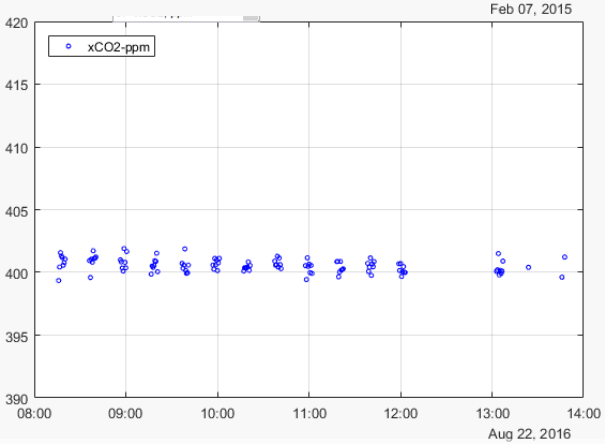


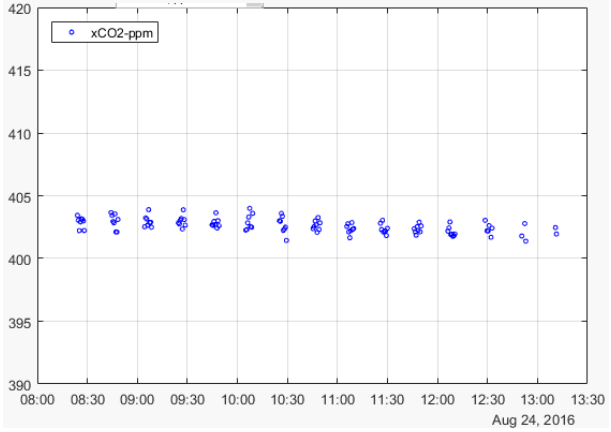


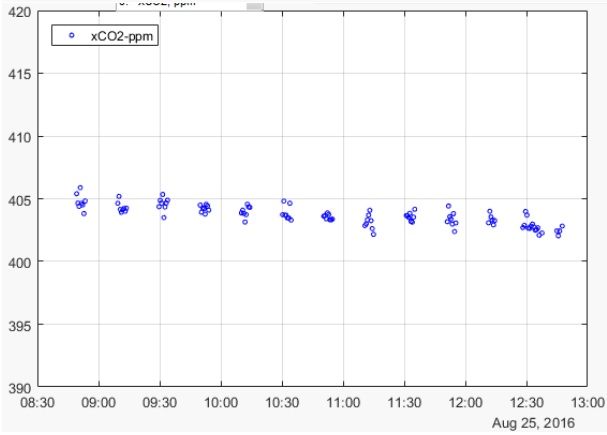












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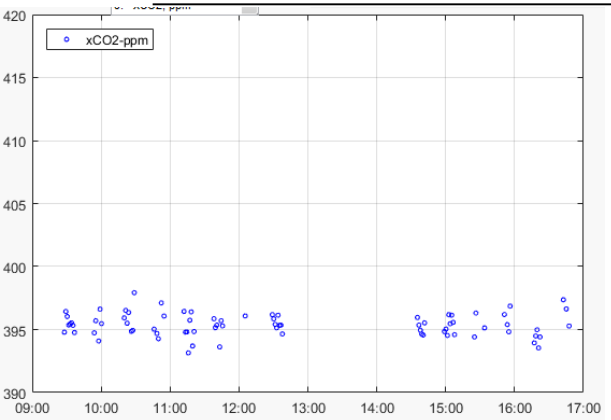
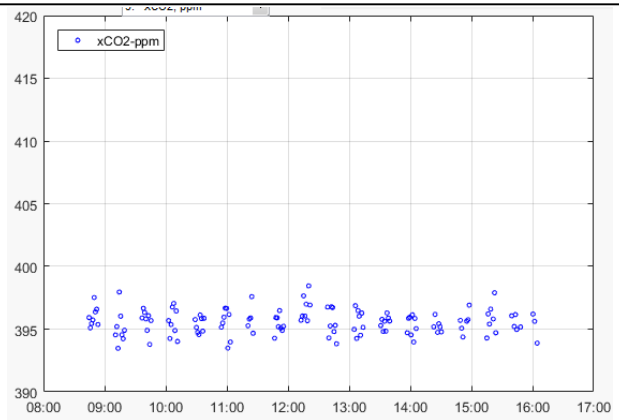
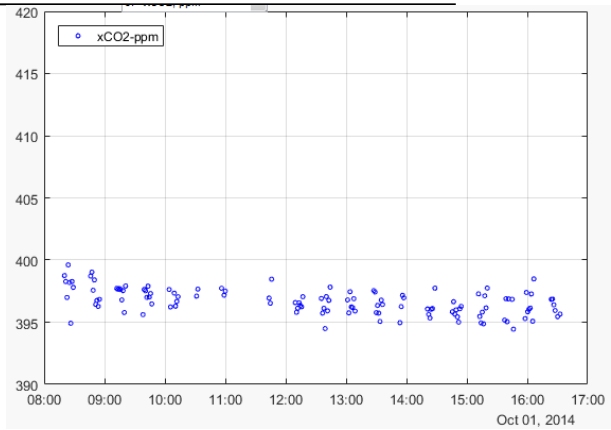
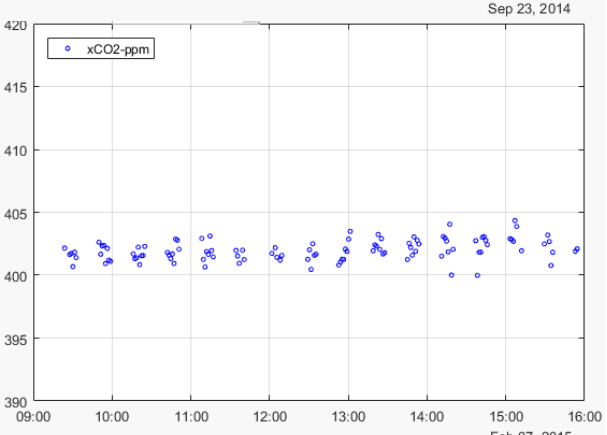
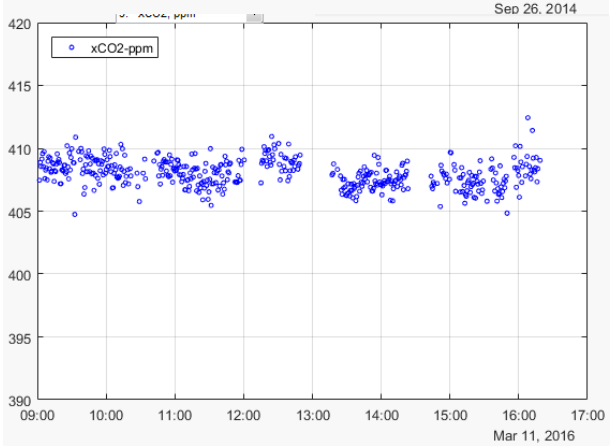
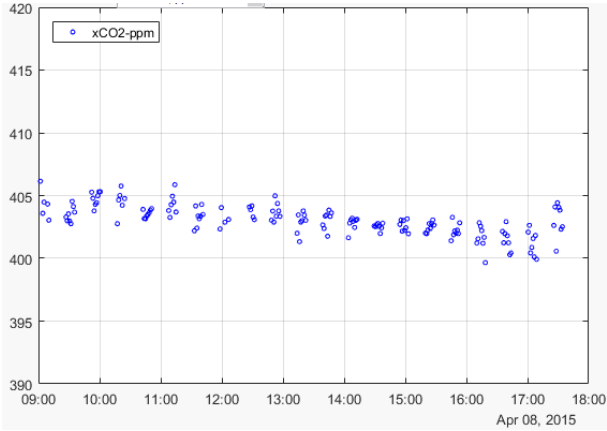


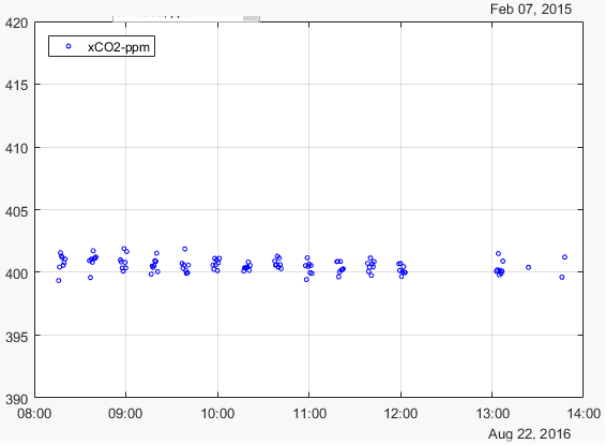


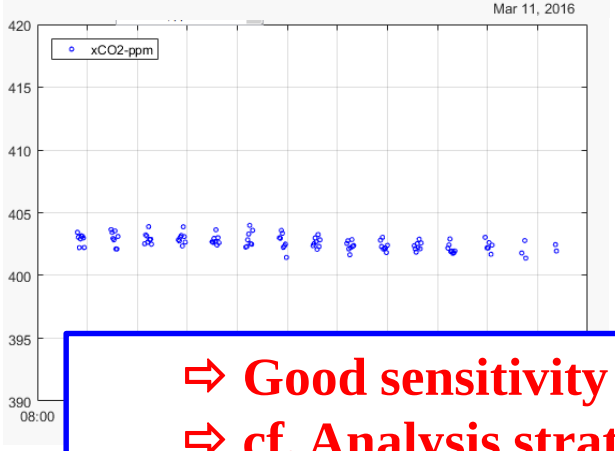


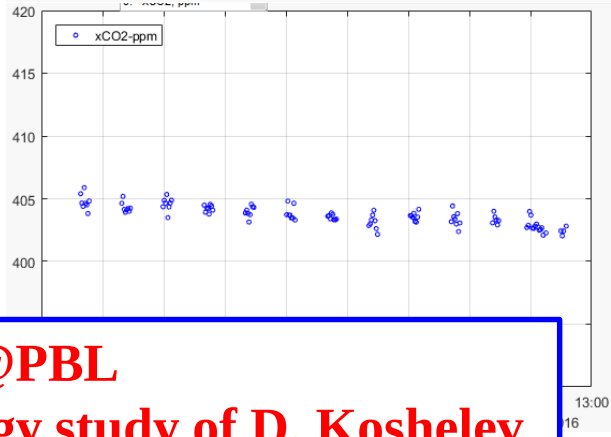












⇨ **Good sensitivity @PBL**

⇨ **cf. Analysis strategy study of D. Koshelev**

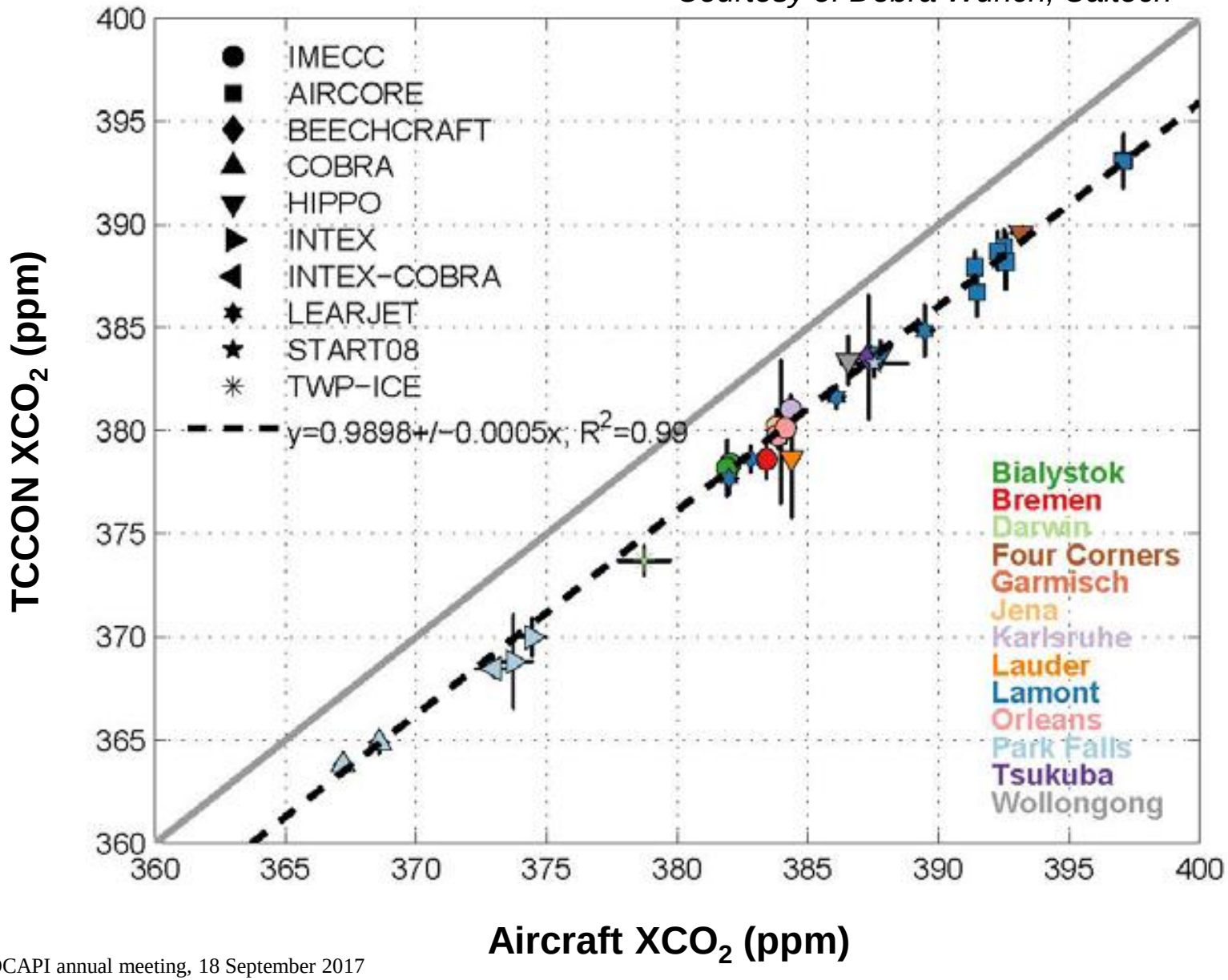
TCCON measurement (2/2)

(satellite validation)

TCCON data availability at http://tccon.ornl.gov/

Calibration of total column for XCO_2

Courtesy of Debra Wunch, Caltech



Relevance of TCCON for greenhouse gas measurements by satellites

SCIAMACHY

CO_2 and CH_4

Footprint 1800 km^2

GOSAT

CO_2 and CH_4

Footprint 87 km^2

OCO-2

CO_2

Footprint ~3 km^2

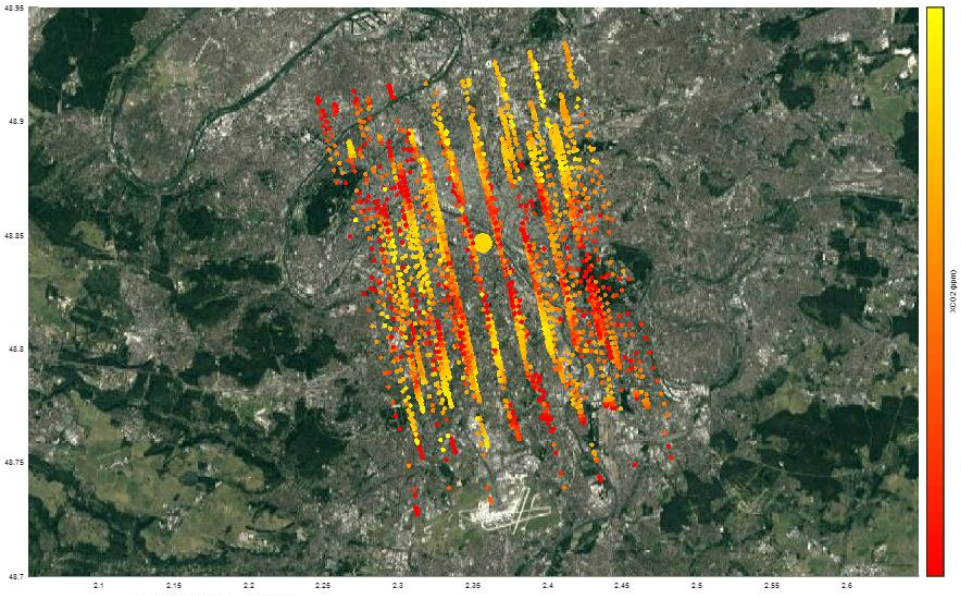
TANSAT

- Validation of satellite data (spatial bias, temporal drift)
- Indirect calibration of satellite data versus *in situ* standard of the World Meteorological Organisation (WMO)

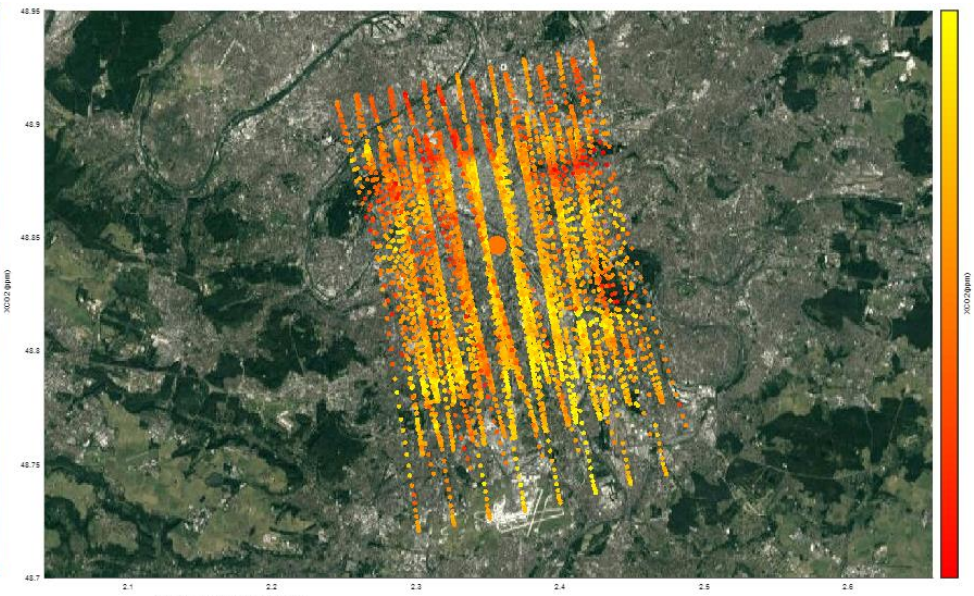
OCO-2 target mode @Paris

TCCON-Paris is a selected site for OCO-2 target mode since 2015

Wunch *et al.*, AMT, 2017



Date: 2016-03-11
X_{CO2} scale: max = 410 ppmv - min = 400 ppmv;
TCCON X_{CO2}: 408.2 ppmv

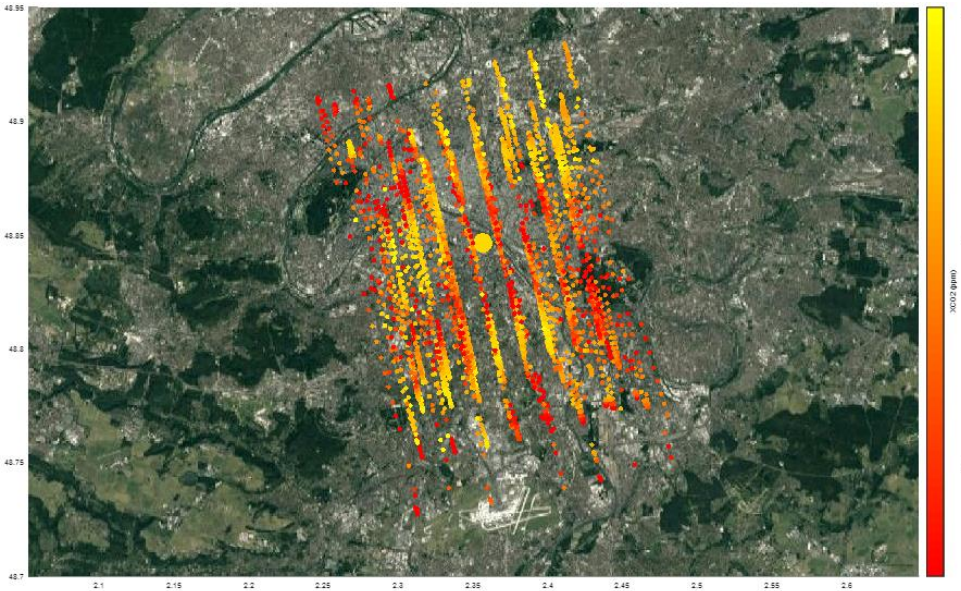


Date: 2016-08-25
X_{CO2} scale: max = 404 ppmv - min = 401 ppmv;
TCCON X_{CO2}: 403 ppmv

OCO-2 target mode @Paris

TCCON-Paris is a selected site for OCO-2 target mode since 2015

Wunch *et al.*, AMT, 2017



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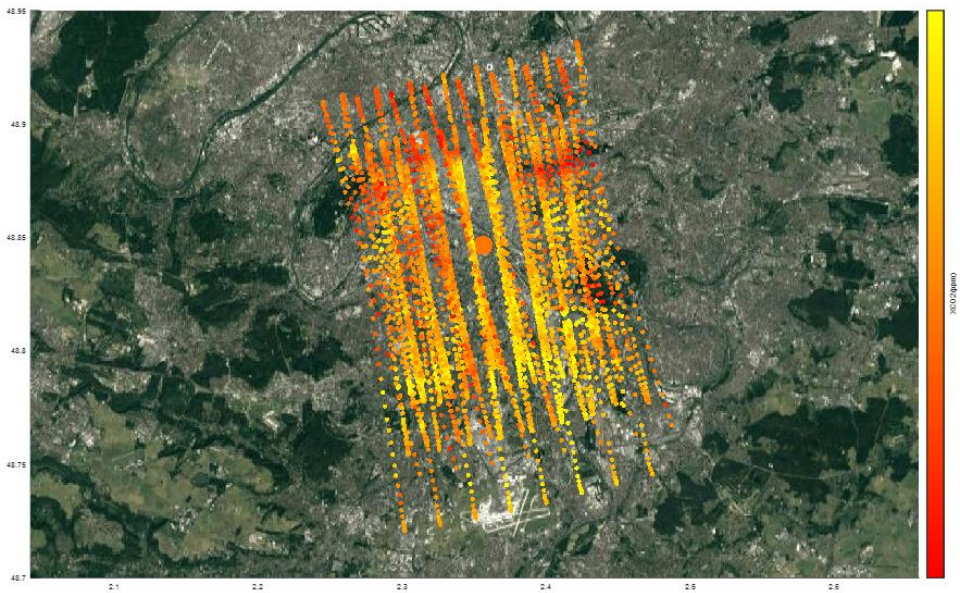

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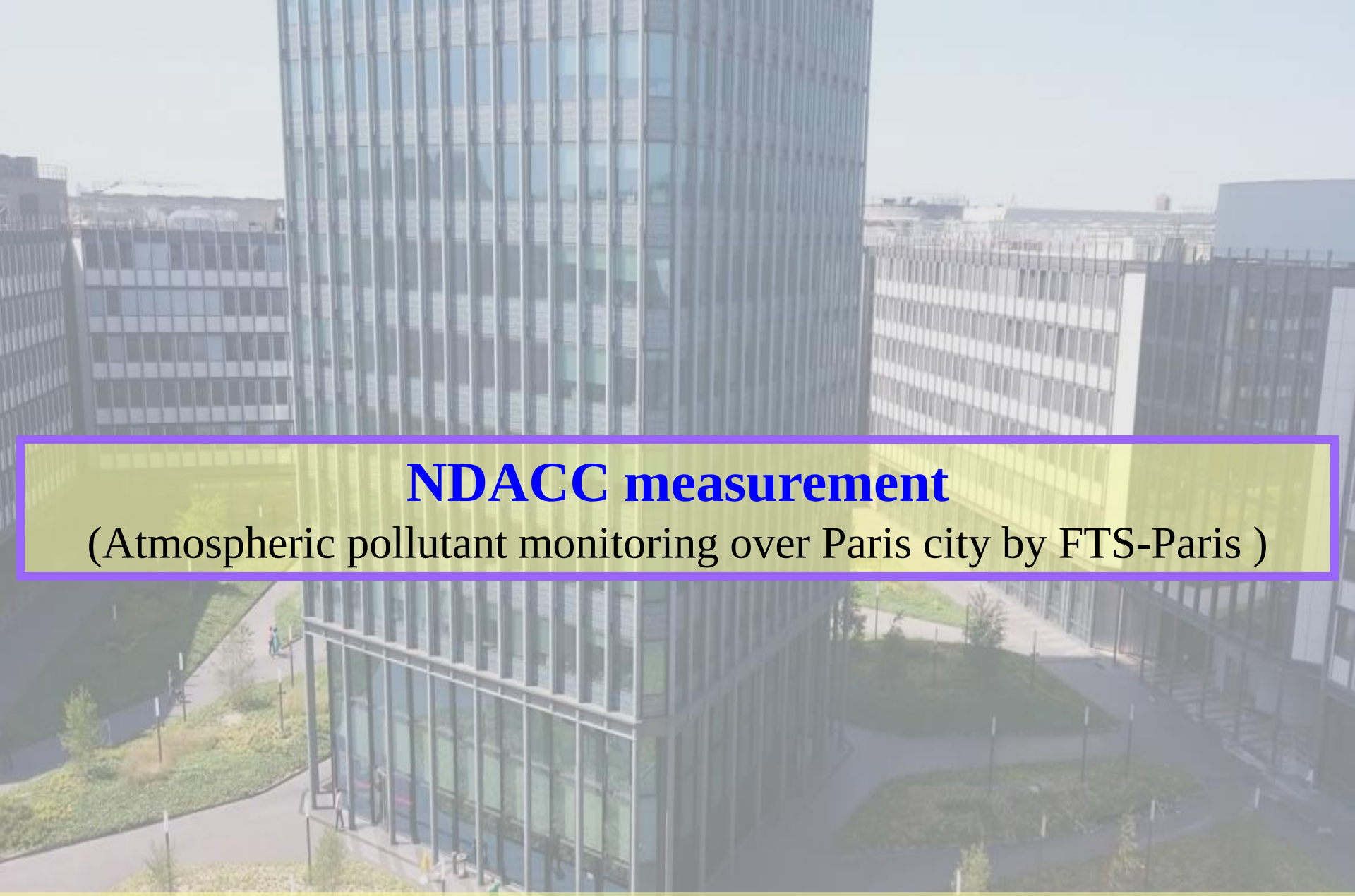
X_{CO2} scale: max = 404 ppmv - min = 401 ppmv;
TCCON X_{CO2}: 403 ppmv

⇒ **On-going OCO-2 target mode measurements**
⇒ **Contributions to the MicroCARB mission** (mission group, O_2 airglow)
⇒ **Future space missions : MERLIN, GOSAT-2, …**

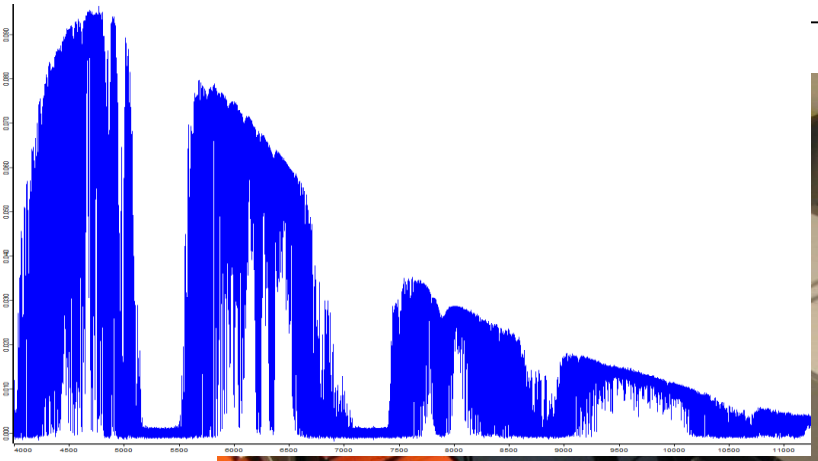


NDACC measurement

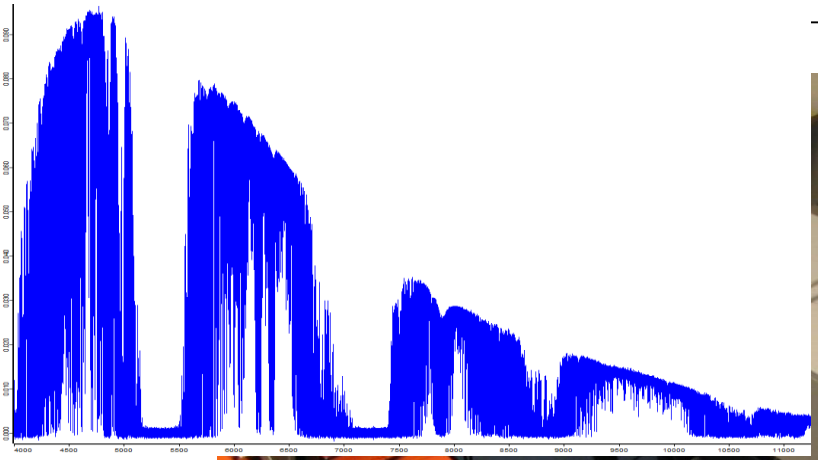
(Atmospheric pollutant monitoring over Paris city by FTS-Paris)

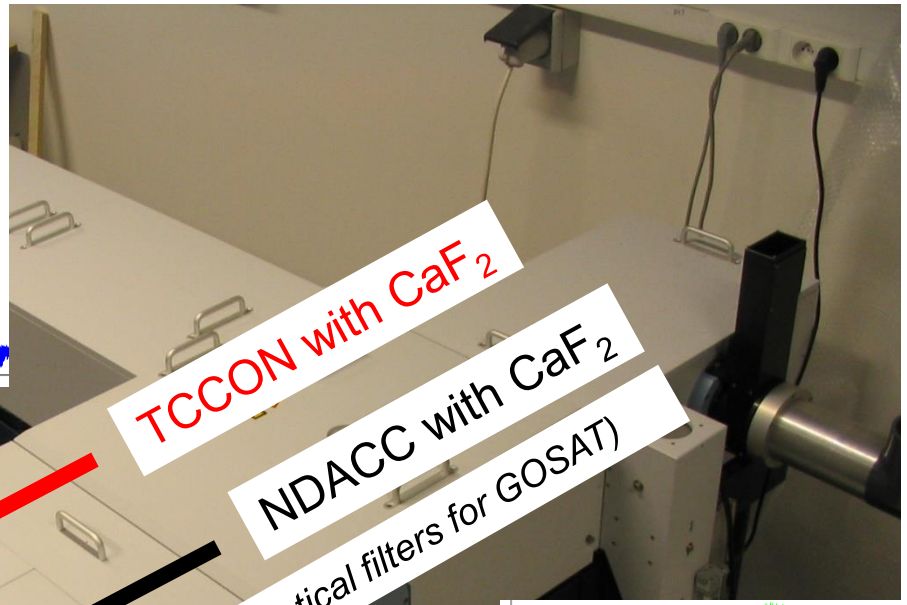
Many possible species: **CH_4**, **C_2H_6**, $ClONO_2$, **CO**, **HCl**, HF, HCN, **N_2O**, **O_3**, NO, **NO_2**, **OCS**, HNO_3, CCl_2F_2, ClO, COF_2, $HCClF_2$ ...

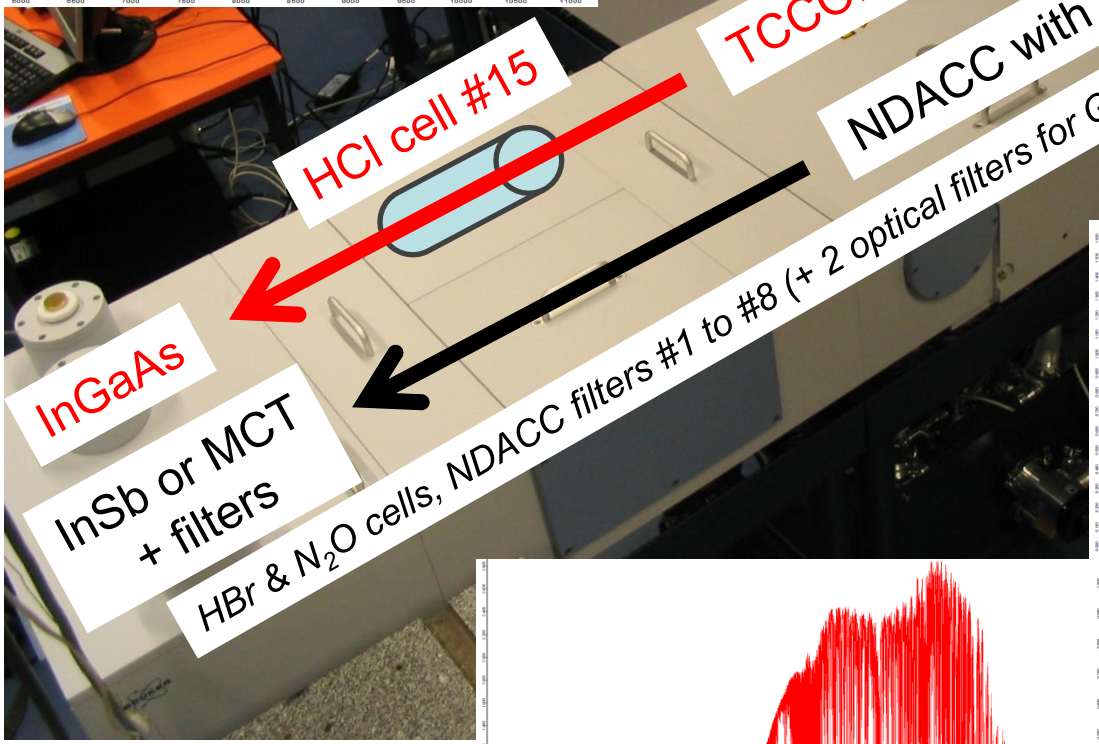
TCCON & NDACC configurations

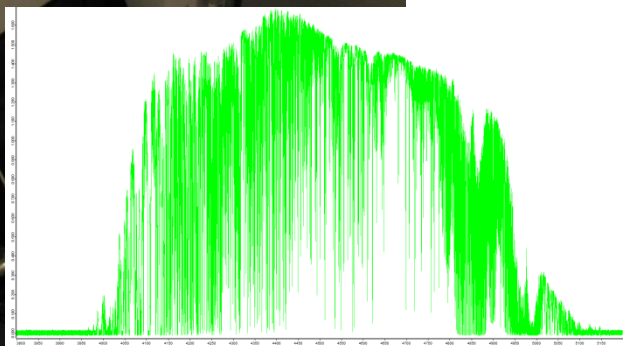


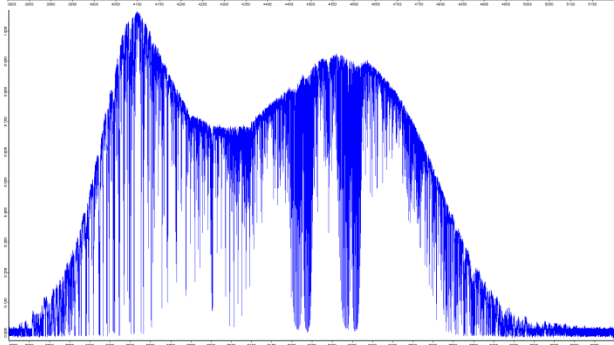
TCCON & NDACC configurations



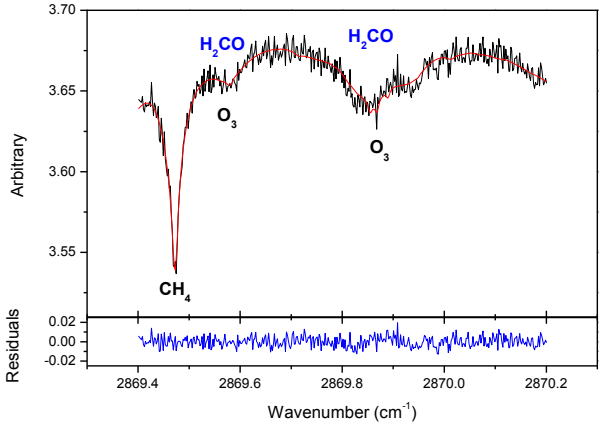


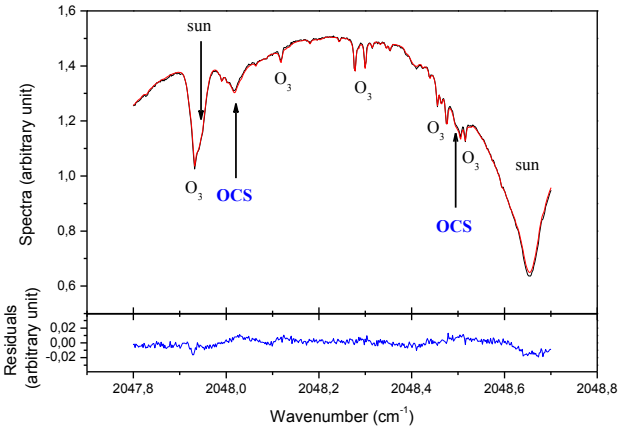


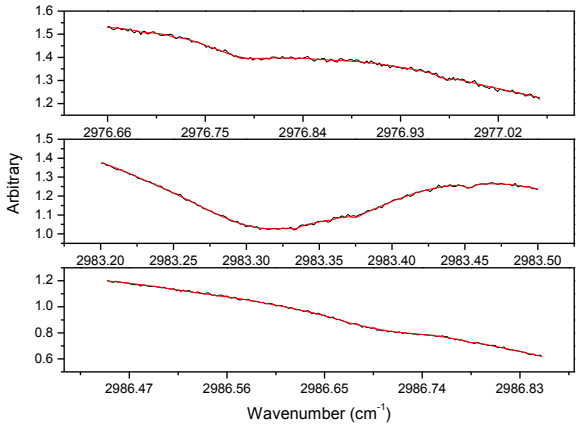




Atmospheric pollutant retrieval and study





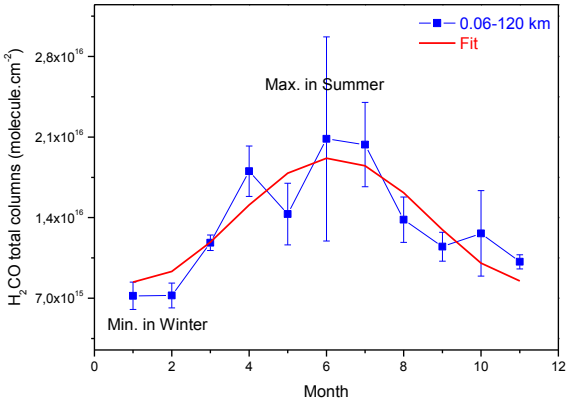


➔ **Seasonal variability and trend monitoring**

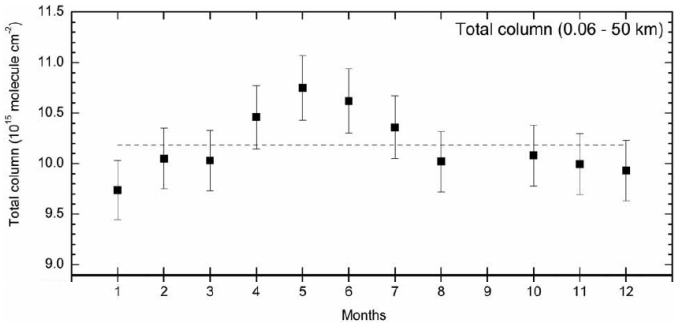
- ⇒ H_2CO
- ⇒ OCS
- ⇒ C_2H_6
- ⇒ CO
- ⇒ CH_4
- ⇒ N_2O, …

➔ **Scientific Collaborations**

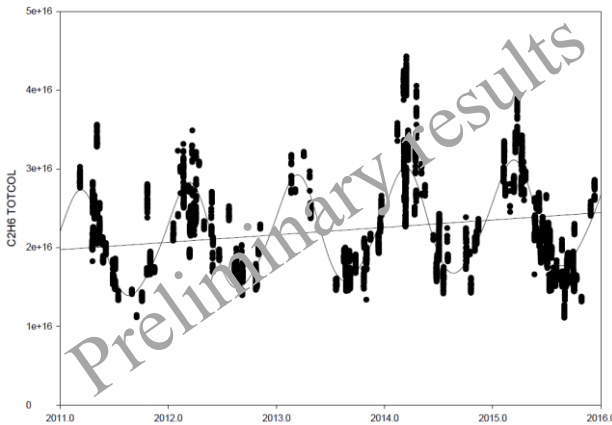
- ⇒ TCCON network
- ⇒ NDACC network
- ⇒ International Labs
- ⇒ National Labs



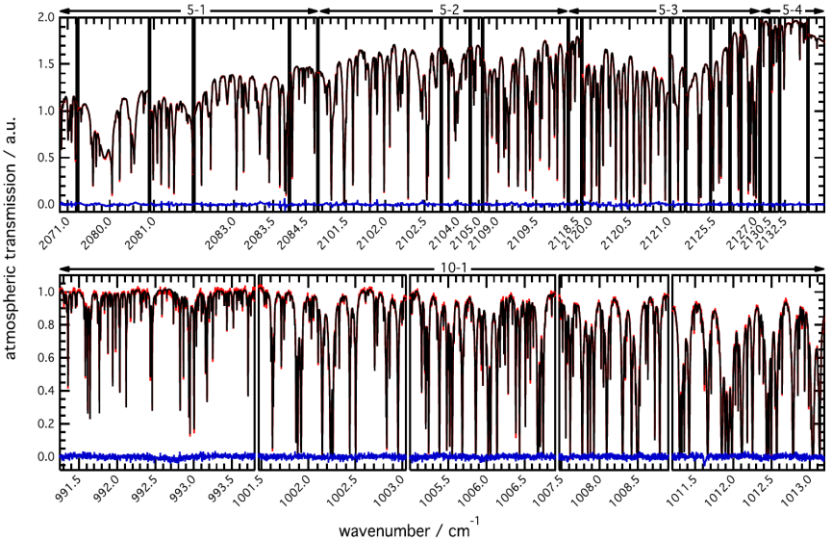
(Té *et al.*, ASA-HITRAN 2012)



(Figure from Krysztofiak *et al.*, Atmosphere-Ocean 2014)



Atmosphere as a spectroscopy lab: ozone



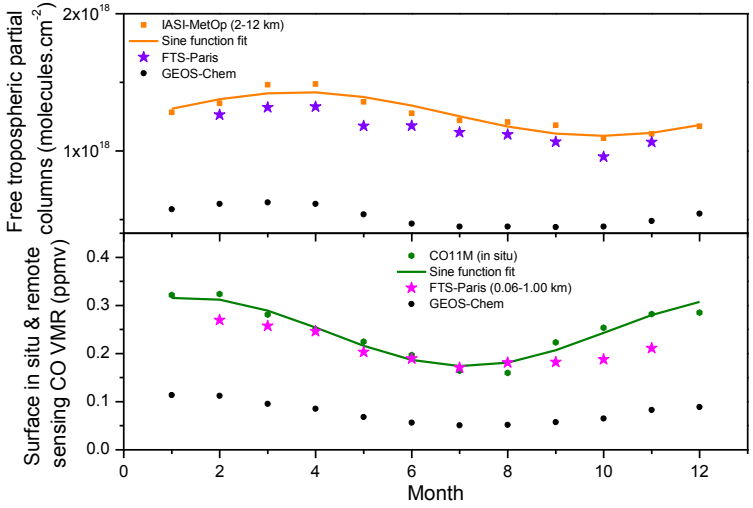
⇒ Good agreement @10 µm between databases
~0.6% (GEISA2011 vs HITRAN2012)
~0.3% (S&MPO2015 vs HITRAN2012)

⇒ Self consistency @5 & 10 µm
S&MPO2015 (best) VS HITRAN2012 (worse)

⇒ Disagreement @5 µm between databases
up to ~4%

(Figure from Janssen *et al.*, JMS 2016)

First evidence of time lag of CO seasonal variation between surface and free troposphere



⇒ Consistency between FTS-Paris, IASI & GEOS-Chem in the free troposphere

⇒ Consistency between FTS-Paris, CO11M & GEOS-Chem in the surface

⇨ Time-lag of about 2 months between surface and column CO

(Figure from Té *et al.*, ACP 2016)

Té e

Perspectives

Summary and Perspectives

➔ **Regular NDACC & TCCON measurements**

➔ **Molecular spectroscopy study** (GSMA, MONARIS, LERMA …)
⇒ **Spectroscopic parameter consistency (SMO_3 project)**

➔ **Atmospheric species study : C_2H_6, OCS, CO/C_2H_6, H_2CO, …**
(international collaborations)

➔ **Satellite instrument validation**
⇒ **On-going OCO-2 target mode & Contributions to MicroCARB mission**
⇒ **Validation of future space missions** (MERLIN, GOSAT-2 …)

➔ **TCCON site inter-comparison using an EM27/ sun**
⇒ **Preparatory campaign @Paris & Trainou in spring 2017**

EM27/sun in spring 2017

@Jussieu

@Trainou

➔ **EM27/sun lent by KIT**

➔ **Multi-instrumentations campaign @Trainou**

- ⇒ **TCCON & EM27/sun**
- ⇒ **Picarro (in situ)**
- ⇒ **Balloon - AirCore**
- ⇒ **Aircraft**

➔ **Four labs collaborations**

- ⇒ **KIT-IMK**
- ⇒ **LERMA**
- ⇒ **LMD**
- ⇒ **LSCE**

➔ **Thanks to CNES support**

Summary and Perspectives

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⇒ **Preparatory campaign @Paris & Trainou in spring 2017**
(TCCON & EM27/sun, aircraft & balloon, in situ tower measurements, …)
⇒ **Next campaign @Paris, Karlsruhe & Trainou in spring 2018**
⇒ **WMO standard transfer to the Paris site**

➔ **Towards a NDACC site in the center of Paris**
⇒ **Improve coverage of atmospheric species**
⇒ **Monitoring of O_3 and NH_3 @10 µm**
(collaboration with LATMOS, LERMA-LATMOS thesis ?)
⇒ **Validation of future IASI-NG space mission**

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l'Observatoire de Paris — LERMA

Laboratoire d'Études du Rayonnement et de la Matière en Astrophysique et Atmosphères

Thank you for your attention

Institut Pierre Simon Laplace — Sciences de l'environnement

cnes CENTRE NATIONAL D'ÉTUDES SPATIALES

l'Observatoire de Paris

Station QualAir Jussieu

2017 Annual Joint NDACC-IRWG & TCCON meeting hosted by the LERMA at the TCCON-Paris station

https://irwg-tccon-2017.sciencesconf.org/