OVERVIEW OF THE RESEARCH ACTIVITIES AT THE TCCON SITE IN PARIS

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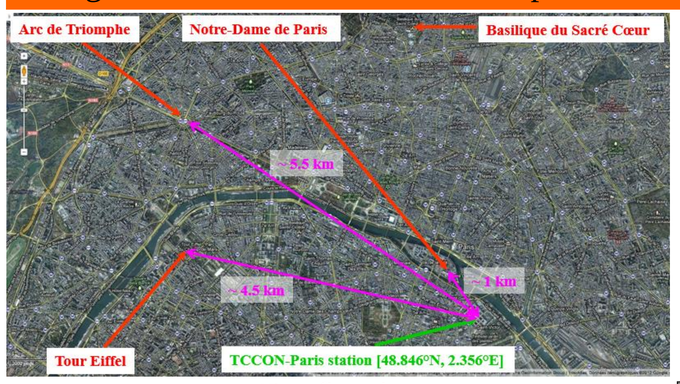
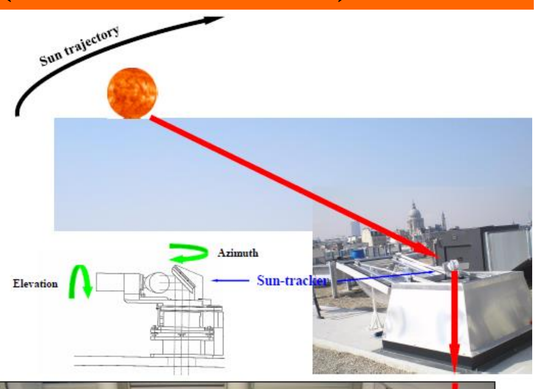
TCCON-Paris site

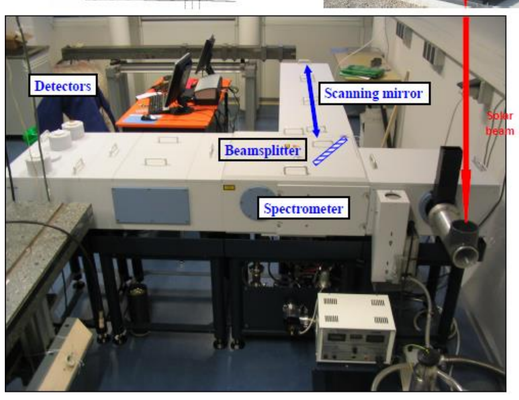
The LERMA ground-based Fourier Transform Spectrometer (FTS-Paris) is located in downtown Paris at the Jussieu campus of Sorbonne Université. The FTS-Paris instrument (Bruker IFS-125HR) is associated to a sun-tracker installed on the roof terrace of the QualAir platform to perform solar absorption observations. Since September 2014, FTS-Paris is part of TCCON. The TCCON-Paris station provides rare hot spot measurements and contributes to satellite instrument validation. NDACC configuration measurements are also performed (cf. Poster from Hao FU).





IR configuration

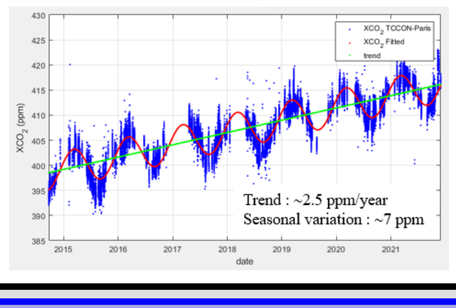
Internal source	Globar or tungsten lamp
Beamsplitter	KBr : 450 - 4800 cm^{-1} CaF_2 : 1850 - 14000 cm^{-1}
Entrance window	KBr : 450 - 25000 cm^{-1} CaF_2 : 1850 - 14000 cm^{-1}
MCT detector	D* > $2.5x10^{10}$ $cmHz^{1/2}W^{-1}$
InSb detector	D* > $1.5x10^{11}$ $cmHz^{1/2}W^{-1}$
InGaAs detector(+)	NEP < $5x10^{-12}$ $W/Hz^{1/2}$
HBr & N_2O cells	NDACC Ref. #80 & #26
HCl cell(+)	TCCON Ref. #15

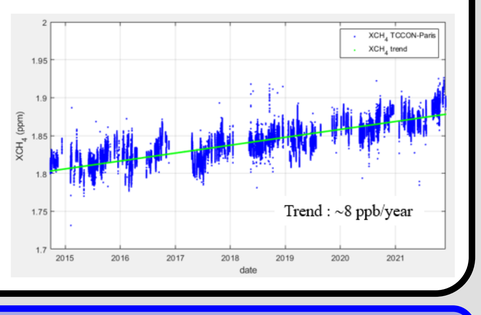


FTS-Paris with its sun-tracker, cf. Té *et al.*, RSI, 2010

(+) Equipment supported by LEFE/INSU

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

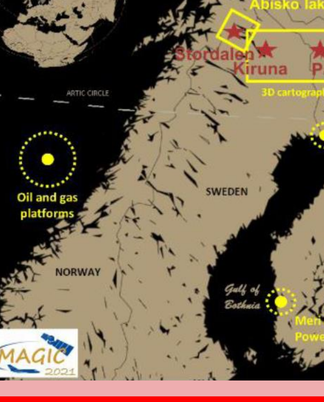




Instrumental Update

Meteorological sensors

- Loss of the pressure sensor #1 by Vaisala during the calibration process. We received a new one which needs to be cross-compared with the sensor #2 (actually on site)
- Humidity and Temperature sensor (Vaisala HMP155)


Pressure sensor #2

Pyranometer

- Installation of a pyranometer for the study of the solar radiance in order to automate the FTS-Paris measurement [2022]

Sun-tracker protection dome

- Failure of the automatic opening system of the sun-tracker dome in 2022
- Different solutions are currently under investigation

EM27/SUN measurement @TCCON-Paris

- Regular COCCON measurement at the Paris TCCON site by the EM27/SUN #118 of LERMA [since 2022]

2021 MAGIC field measurement campaign @Kiruna

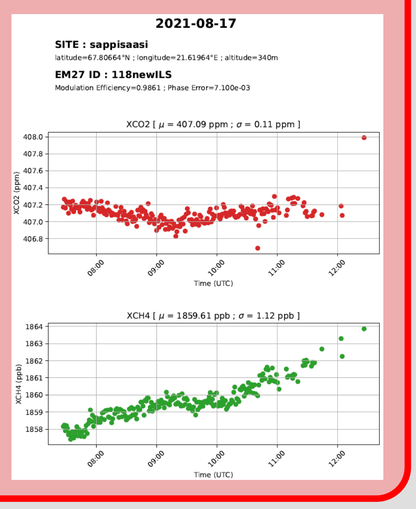
⇨ MAGIC satellite validation & scientific project (Monitoring of Atmospheric composition and Greenhouse gases through multi-Instruments Campaigns)

⇨ The 2021 campaign took place during two weeks (from August 14th to 27th) in the north of Scandinavia (Sweden and Finland), Kiruna and surroundings.

⇨ Gathering about 80 international scientists of 7 countries, the campaign aims to study and better understand the natural and anthropogenic sources and sinks of the carbon (CH_4 and CO_2) in boreal regions

⇨ Three EM27/SUN and one CHRIS instruments were deployed on the field overflown by three scientific aircrafts and several Aircore balloons

⇨ https://magic.aeris-data.fr/magic2021/



Research activities @TCCON-Paris

EM27/SUN activities

⇨ LERMA EM27/SUN operated according to the COCCON requirements on the field campaigns and at the TCCON-Paris site for regular measurements

⇨ COCCON data analysis using PROFFAST software developed by the KIT

⇨ Regular intercomparison campaigns between the French COCCON consortium EM27/SUNs and TCCON-Paris (CNES, GSMA, LERMA, LMD, LOA, LSCE)

⇨ Implementation of a new ILS (Instrument Line Shape) measurement bench at LERMA to characterize and monitor the ILS evolution of all above EM27/SUNs in order to check their stability, cf. Frey *et al.*, AMT, 2015

⇨ Use of LINEFIT developed by the KIT to characterize the ILS of each EM27/SUN within the French consortium, cf. Table

ILS measurement at LERMA based on the setup proposed by the KIT

EM27 \ Modulation	From LERMA	From KIT
CNES (SN92)	0.9843 ± 0.004	0.9838
LERMA (SN118)	0.9851 ± 0.002	0.9847
REIMS (SN130)	0.9843 ± 0.0004	0.9839
LSCE (SN138)	0.9891 ± 0.0004	0.9883

OCO-2 target mode study

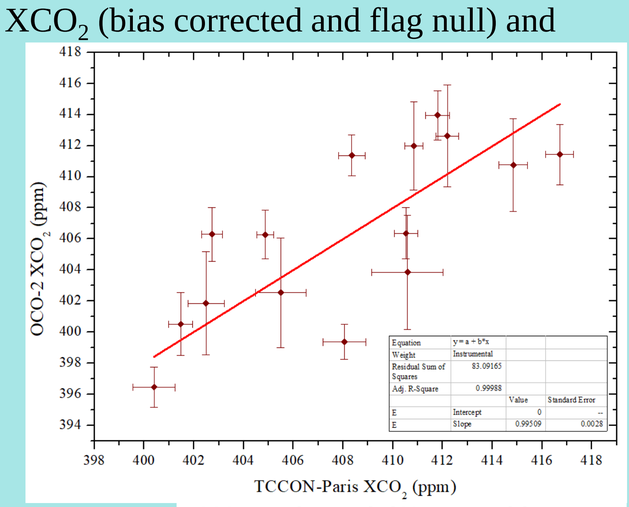
⇨ TCCON-Paris is selected for the validation of the OCO-2 target mode since July 2015. The site is regularly targeted, but only few overpasses occur at favorable meteorological conditions

⇨ Cross-comparison between OCO-2 XCO_2 (bias corrected and flag null) and TCCON-Paris XCO_2 :

- slope of 0.99509 very close to 1
- R^2 = 0.99988
- Still, there are few points falling significantly off the line

⇨ Case by case study for these significant difference points with a better characterization of the atmospheric status is under way:

- cloud & aerosols coverage
- filter of the OCO-2 data to be averaged



TCCON error bars = std of 30 min around the overpass
OCO-2 error bars = std of all flag 0 measurements

Participation in Paris area observation network (OCAPI)

⇨ Air pollution / quality survey, Foret *et al.*, final revision in Atmos. Environ.

GGG2020

⇨ Reanalysis of the TCCON-Paris data using GGG2020 [09/2014 - 06/2021] :

- Successful QA/QC control
- Paris data delivered to Caltech every 3 months
- Paris data released to the public every 6 months

Contribution to space missions

⇨ Validation of satellite instruments:

- OCO-2, cf. Dogniaux *et al.*, AMT 2021
- TROPOMI, cf. Sha *et al.*, AMT 2021
- IASI-MetOp, cf. Vandenbussche *et al.*, Remote Sensing, 2022
- GOSAT & GOSAT-2, cf. Taylor *et al.*, ESSD, 2022 and Noël *et al.*, AMT, 2022

⇨ TCCON-Paris regularly used as target for OCO-2 & OCO-3

⇨ Preparation of new satellite missions: MicroCarb, MERLIN, IASI-NG, …

TCCON & COCCON & NDACC-IRWG networks global study

⇨ NO_2 study under lead of Vigouroux

⇨ C_2H_6 study under lead of Sun, cf. Sun *et al.*, ACP, 2021

⇨ OCS study under lead of Hannigan, Hannigan *et al.*, JGR Atmospheres, 2022

⇨ NDACC N_2O cell exercise under lead of Hase

⇨ EM27/SUN ILS study under lead of Alberti, Alberti *et al.*, AMT, 2022

Funding sponsors

⇨ Sorbonne Université, CNRS-INSU, CNES, Région Ile de France, IPSL, …

⇨ Funding provided by CNES for TCCON-Paris instrument maintenance under the project ICOS-AtmoSat (2020-2024) coordinated by M. Ramonet (LSCE)