



# MEASUREMENT OF GREENHOUSE GASES WITH FTIR AT XIANGHE STATION

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# Outline

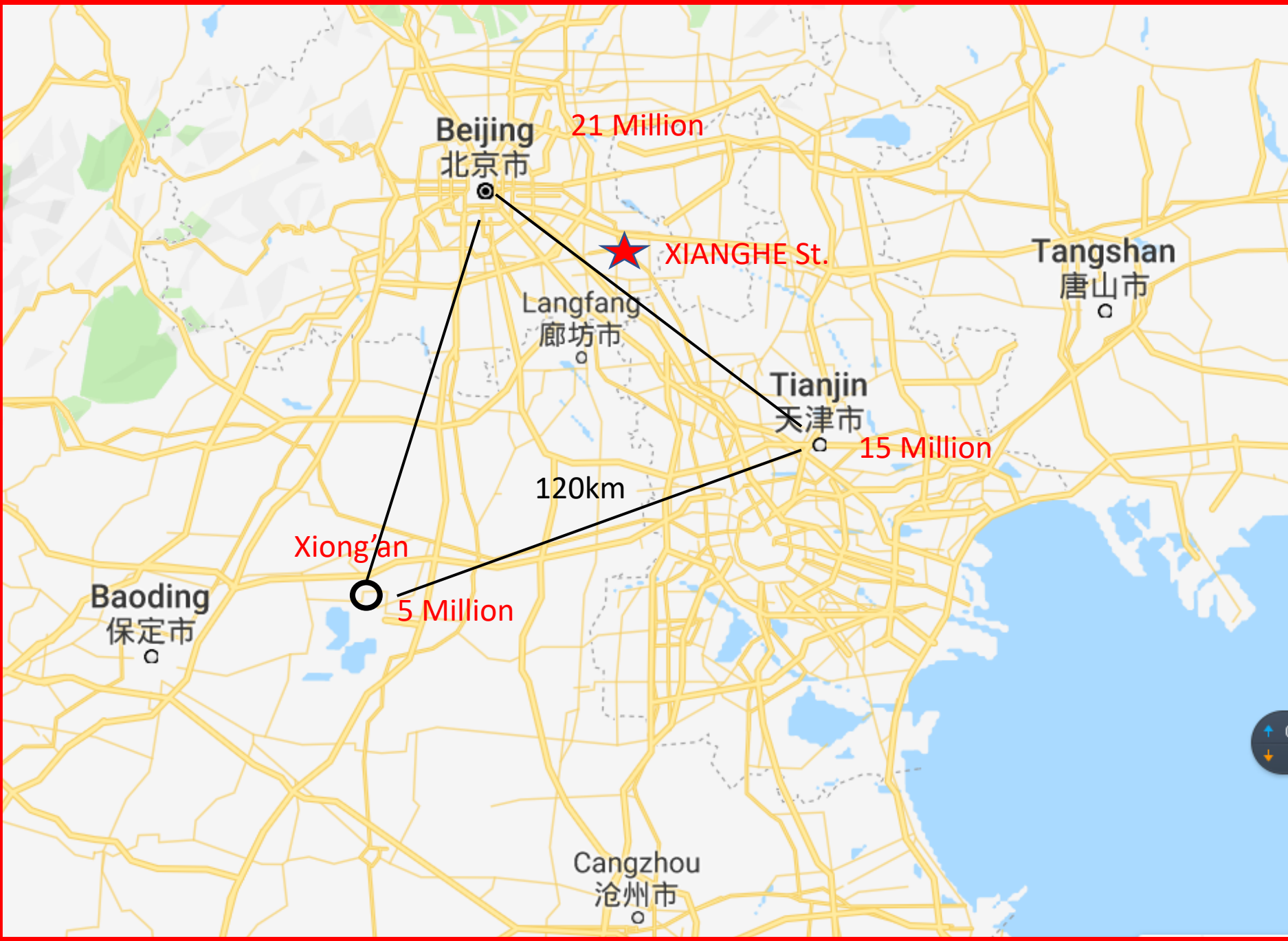
- Introduction to Xianghe Station
- Current situation of Xianghe FTS
- Validation for satellite products
- Future work

# FTIR Sites in China





China Great Bay Area, Shenzhen with 10M people



Beijing  
北京市

21 Million

★ XIANGHE St.

Langfang  
廊坊市

Tangshan  
唐山市

Tianjin  
天津市

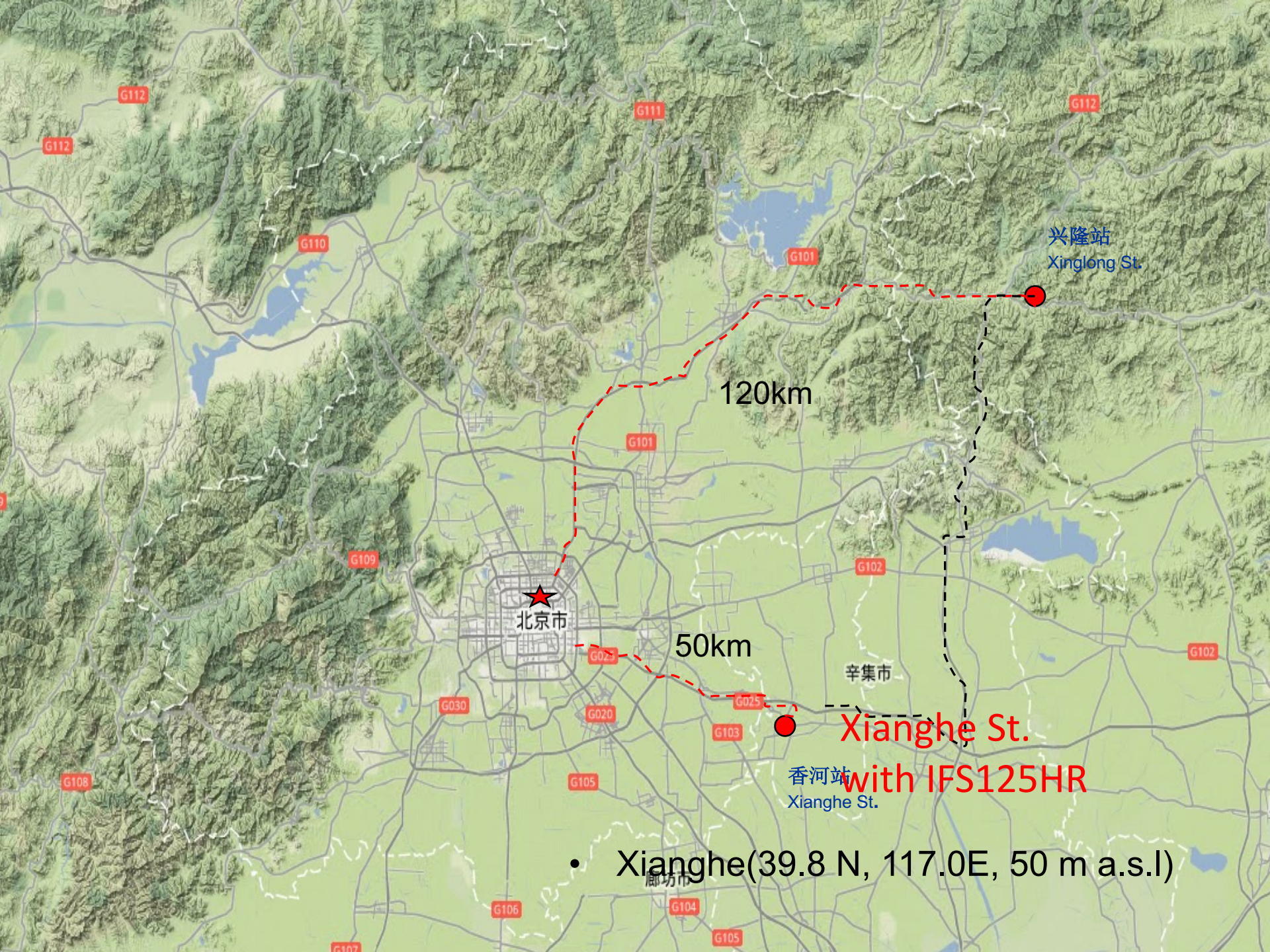
15 Million

120km

Xiang'an  
5 Million

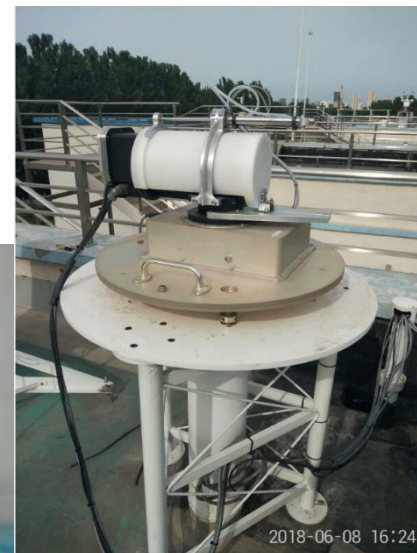
Baoding  
保定市

Cangzhou  
沧州市



- Xianghe(39.8 N, 117.0E, 50 m a.s.l)

# Xianghe IFS125HR

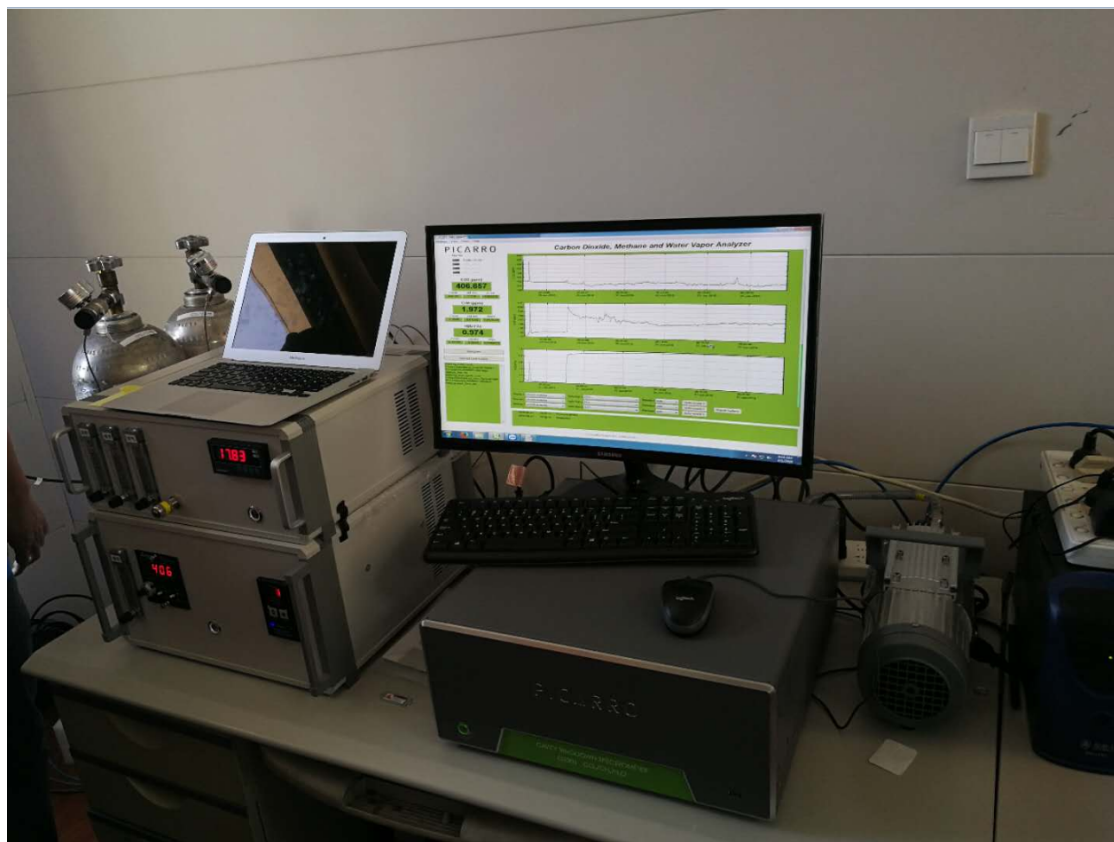


# FTIR Sites and Instruments

Site	Instrument	Spectral Res.(cm <sup>-1</sup> )	Starting time
Beijing	IFS125HR	~0.0025	2016
Xianghe	IFS125HR	0.0025	2018
Xinglong	IFS125M	0.02	2014
Hefei	IFS125HR	0.001	2014
Shenzhen	IFS125HR	~0.0025	2011

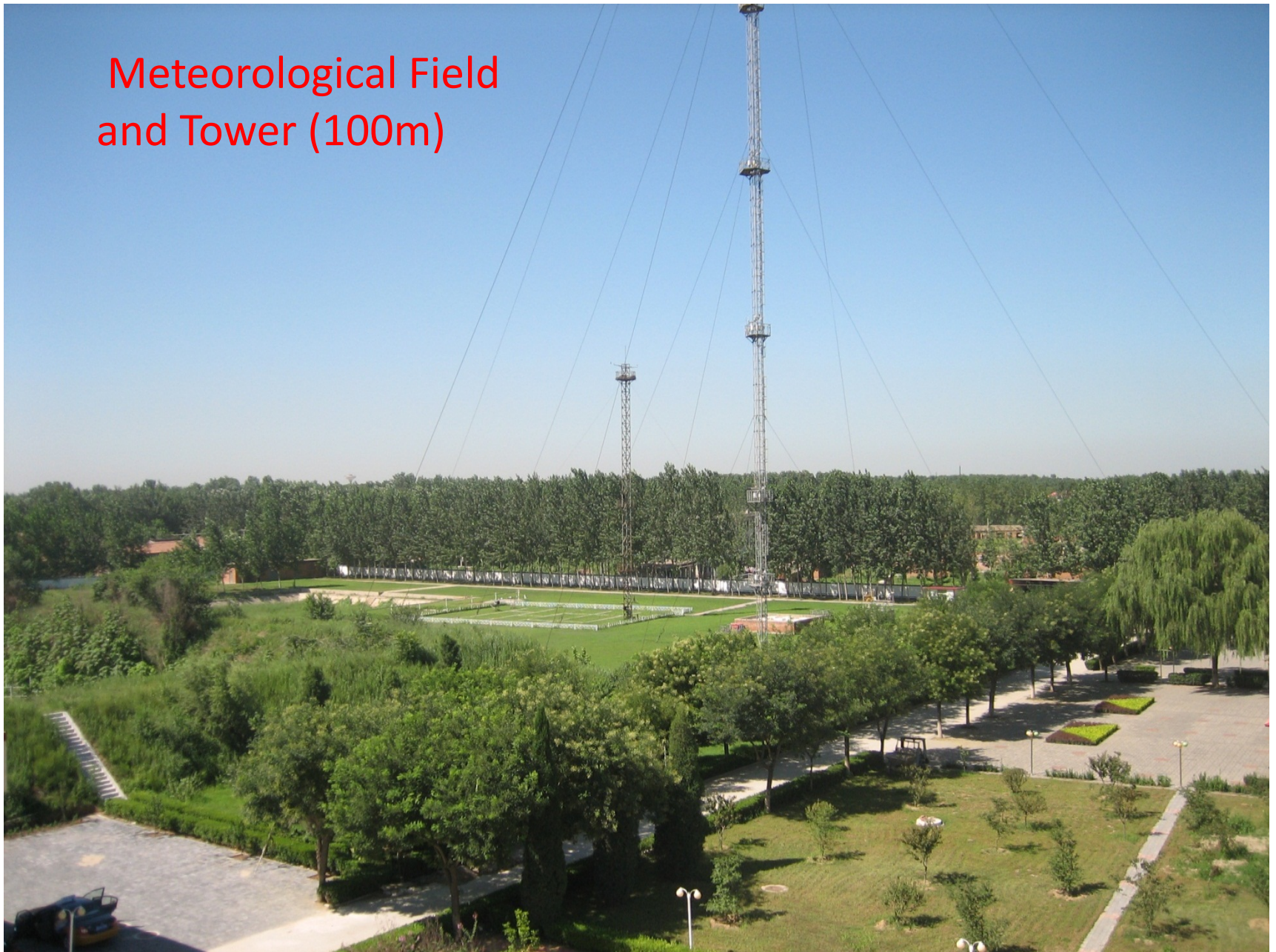


# CO<sub>2</sub>/CH<sub>4</sub>/H<sub>2</sub>O measurement by PICARRO G2301 in Xianghe Station



Specifications: Range: 0-500 ppm; Precision: 0.06 ppm

# Meteorological Field and Tower (100m)



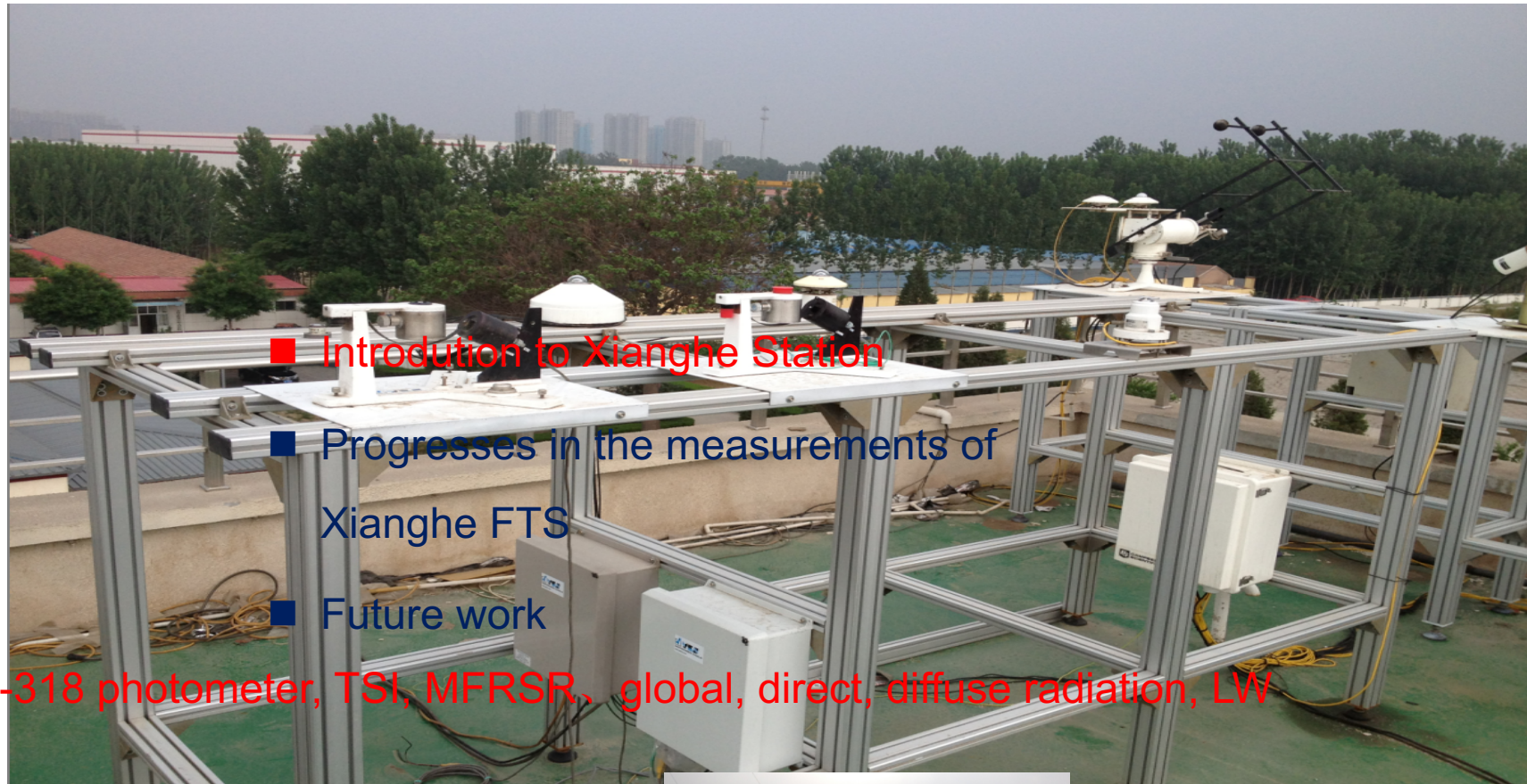
# Observational Building in Xianghe St.



# MaxDOAS for measuring UV-VIS spectra for retrieving $O_3/NO_2/SO_2$ in Xianghe



# Xianghe BSRN and AERONET Site (2004—Present)

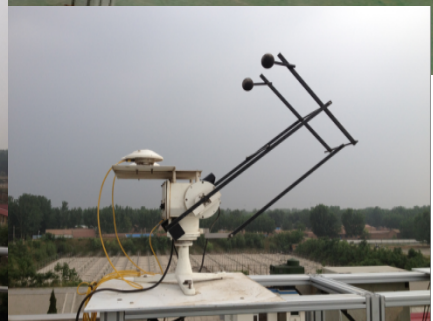


■ Introduction to Xianghe Station

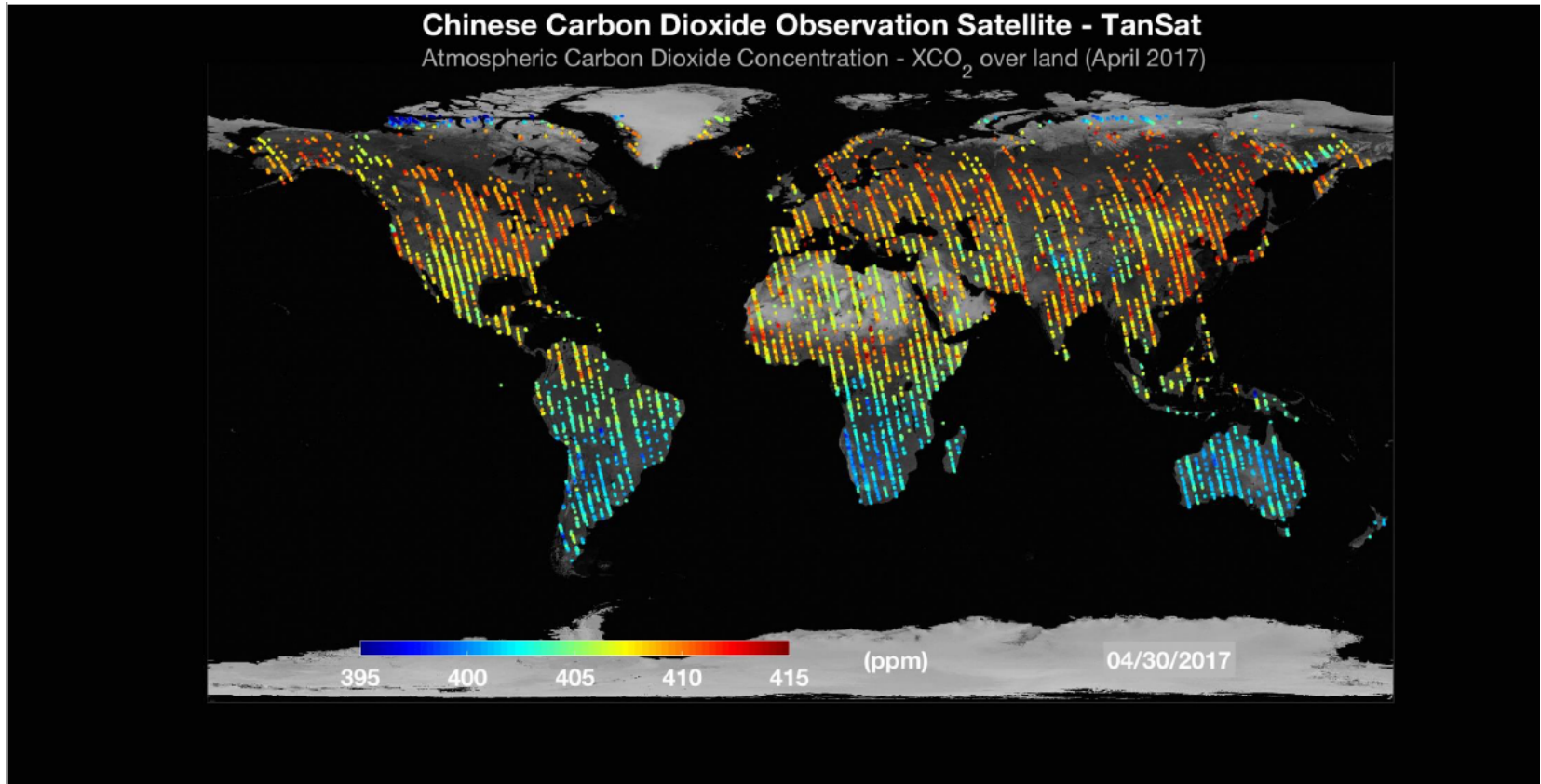
■ Progresses in the measurements of Xianghe FTS

■ Future work

CE-318 photometer, TSI, MFRSR, global, direct, diffuse radiation, LW



# XCO<sub>2</sub> Retrieval from Chinese TanSat



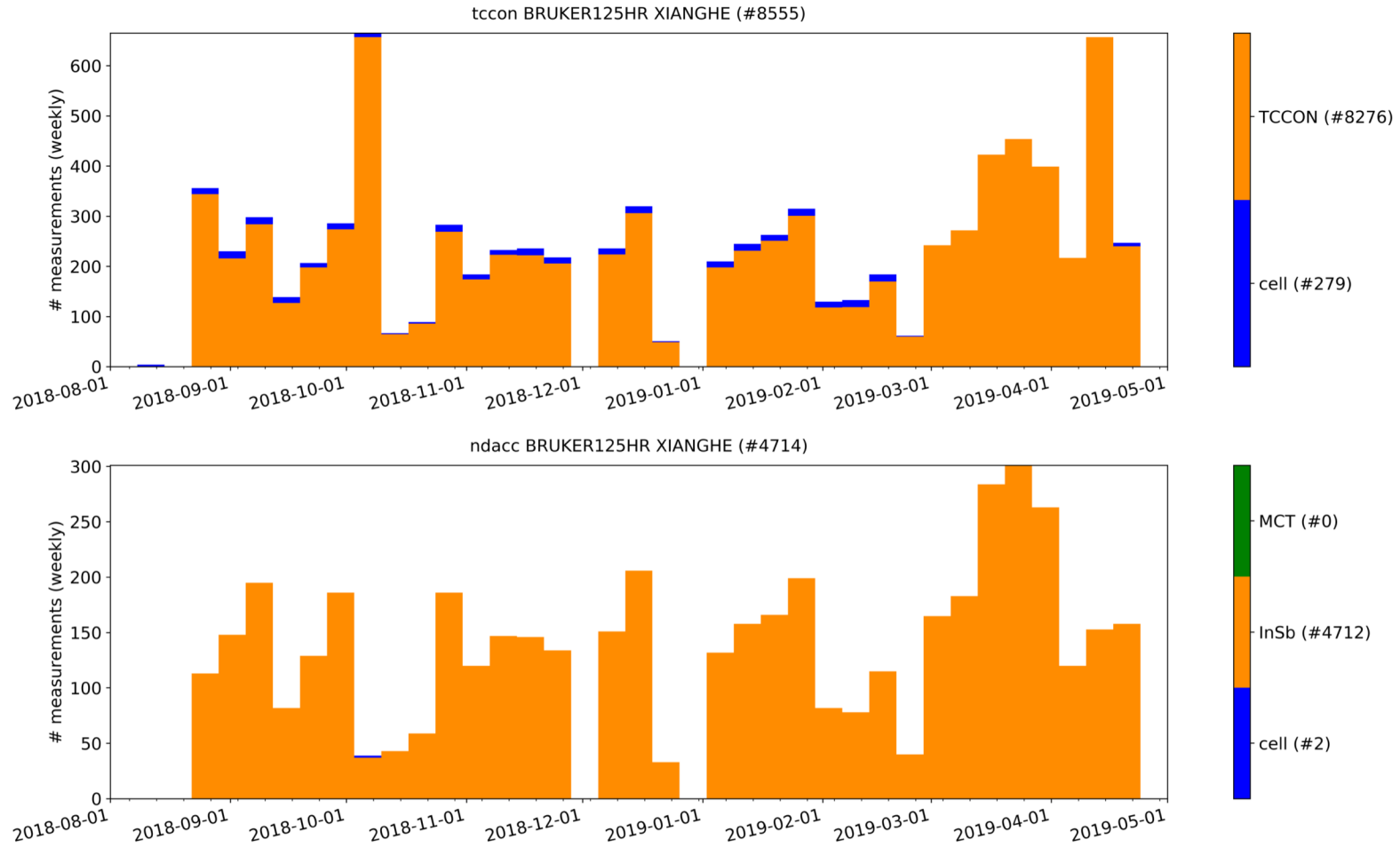
**Citation:** Yang, D. X., Y. Liu, Z. N. Cai, X. Chen, L. Yao, and D. R. Lu, 2018: First global carbon dioxide maps produced from TanSat measurements. *Adv. Atmos. Sci.*, **35**(6), 621–623, <https://doi.org/10.1007/s00376-018-7312-6>.

Courtesy Prof. Y. Liu , Z. Cai, D.X. Yang

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# Current situation of Xianghe FTS

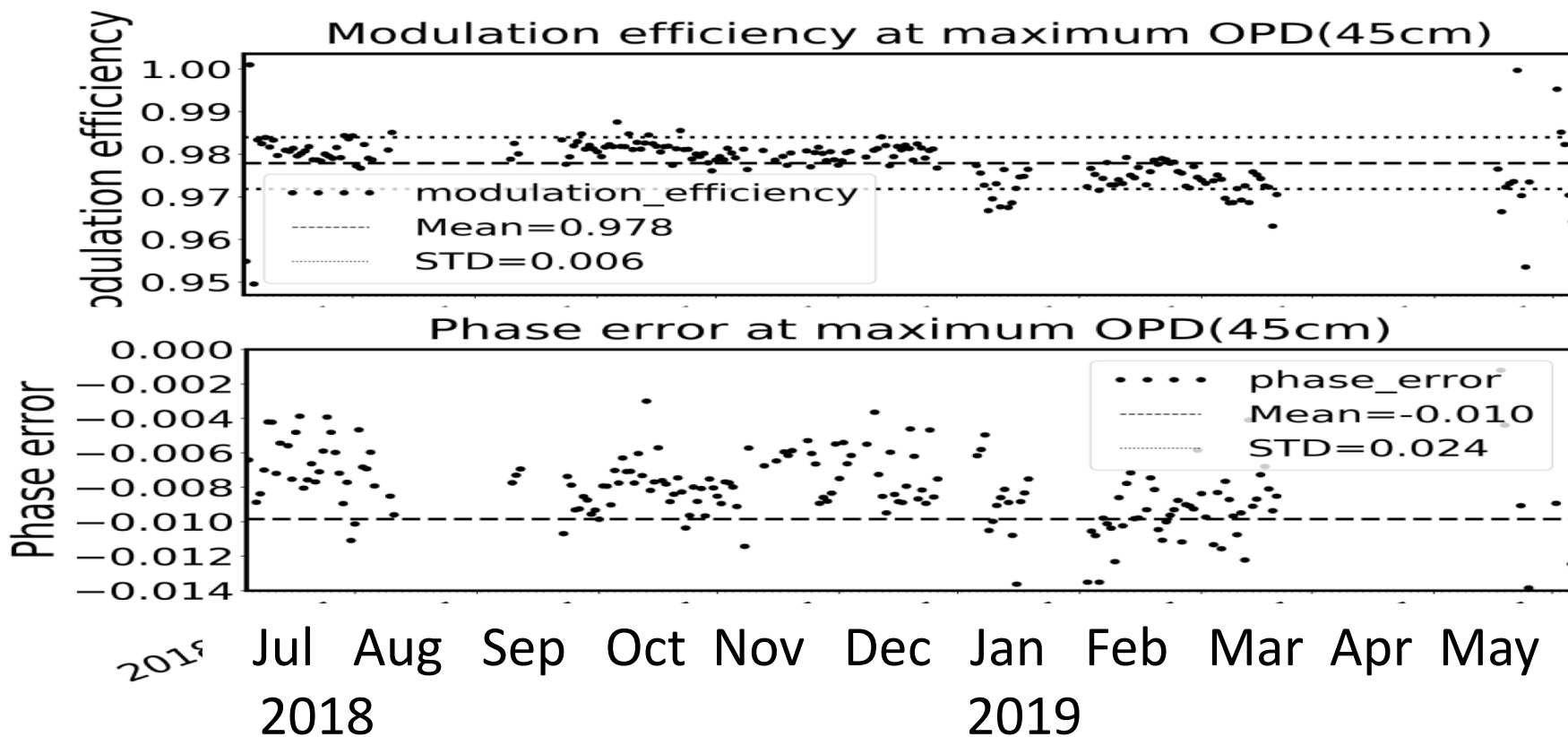


8555 Spectra of InGaAs; 4712 Spectra of InSb  
279 HCl cell (every day); 2 HBr cell  
(to April 2019)

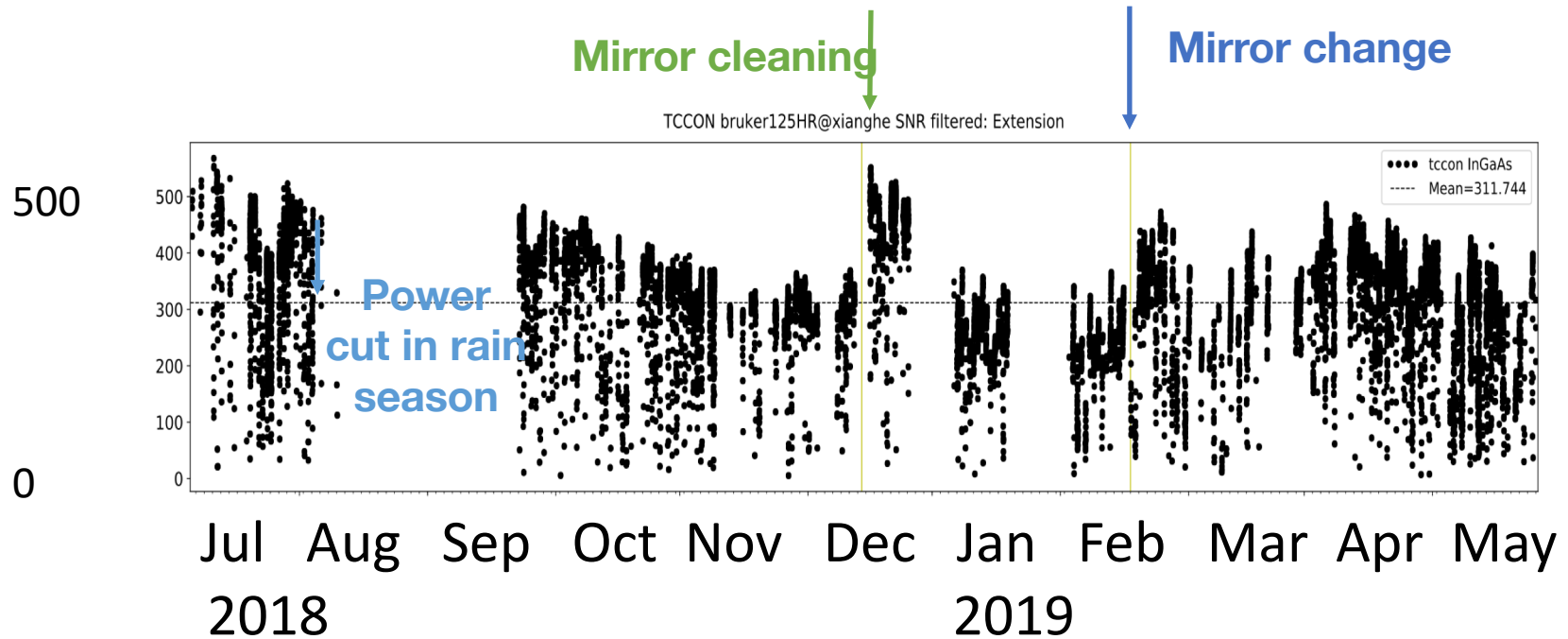


# Instrument Line Shape – HCl Cell measurements

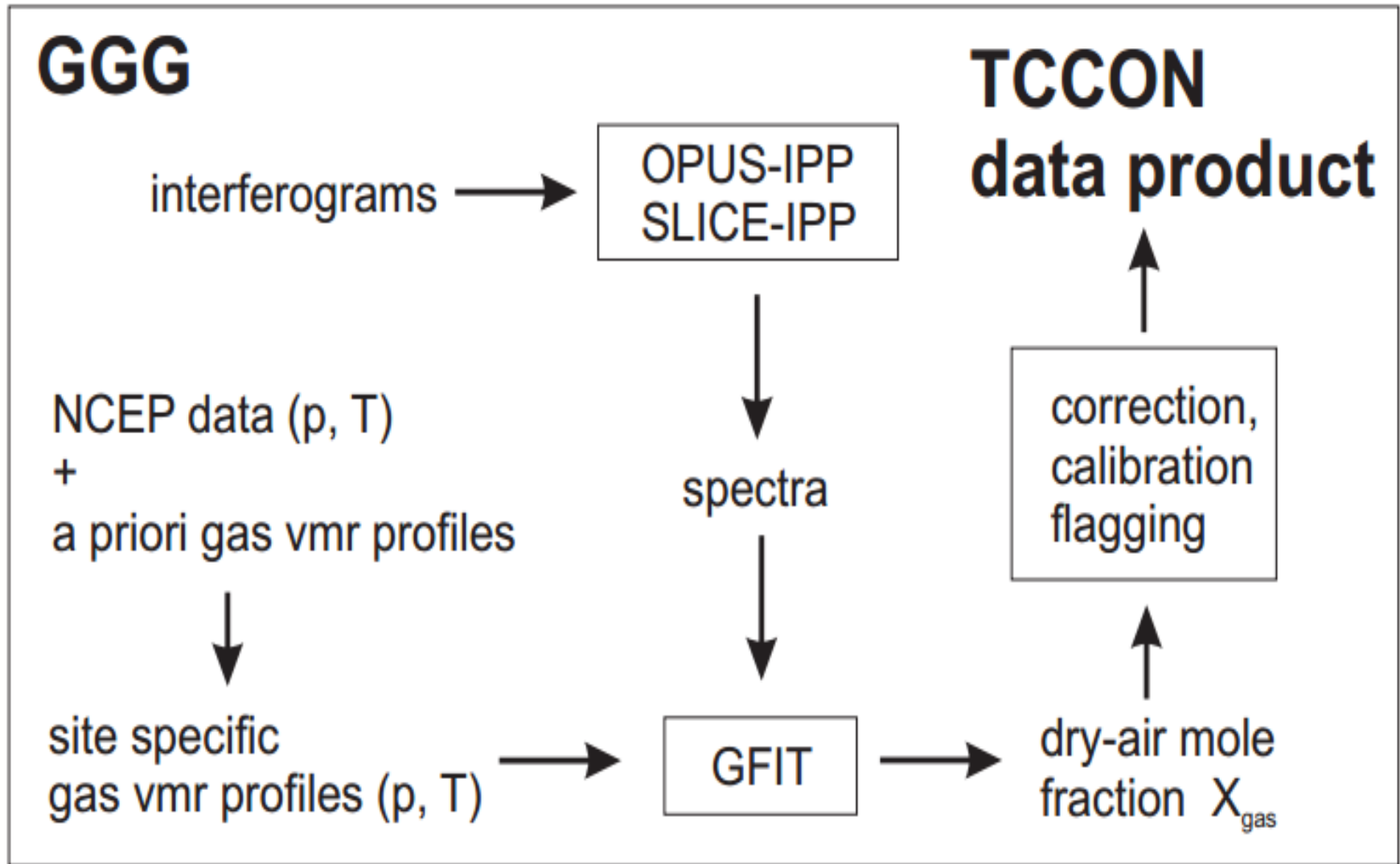
ME & PE



# Signal to Noise Ratio



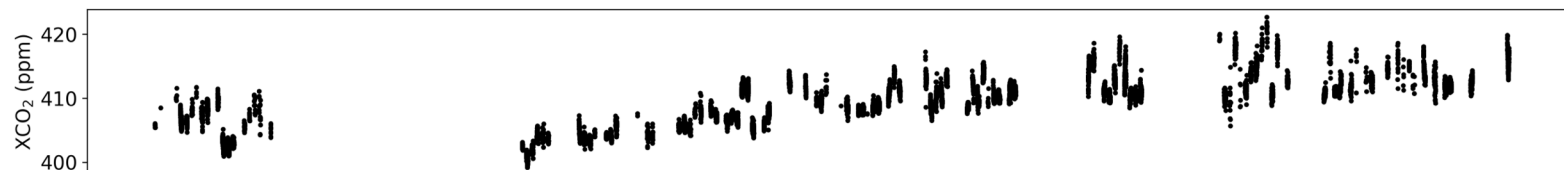
# Retrieval procedures



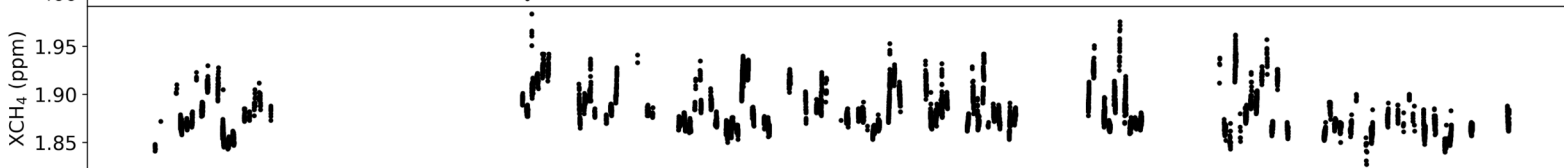
# TCCON species (using GGG2014)

9 species were retrieved: XCO<sub>2</sub>, XCH<sub>4</sub>, XCO, XN<sub>2</sub>O, XHF, XHDO

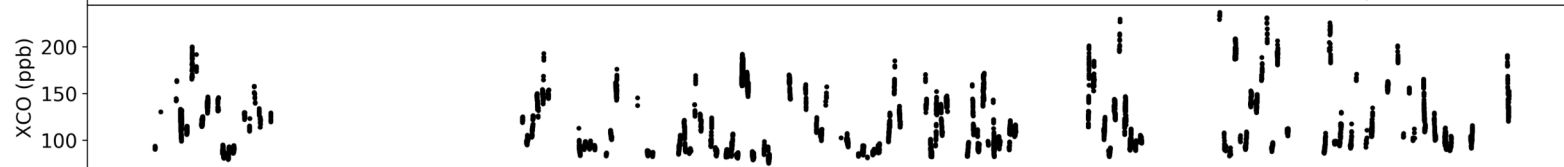
**XCO<sub>2</sub>**  
400-420



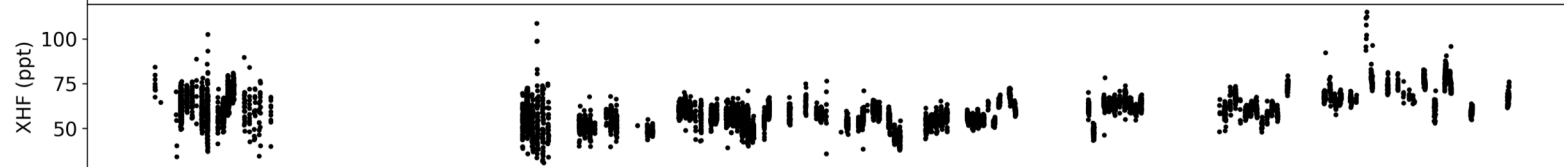
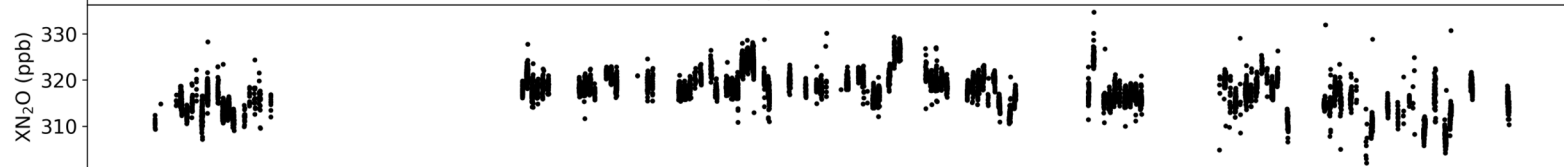
**XCH<sub>4</sub>**  
1.85-1.95



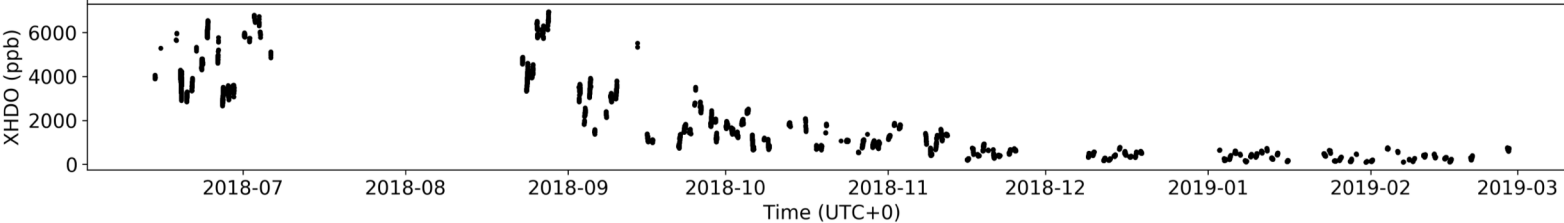
**XCO**



**XN<sub>2</sub>O**



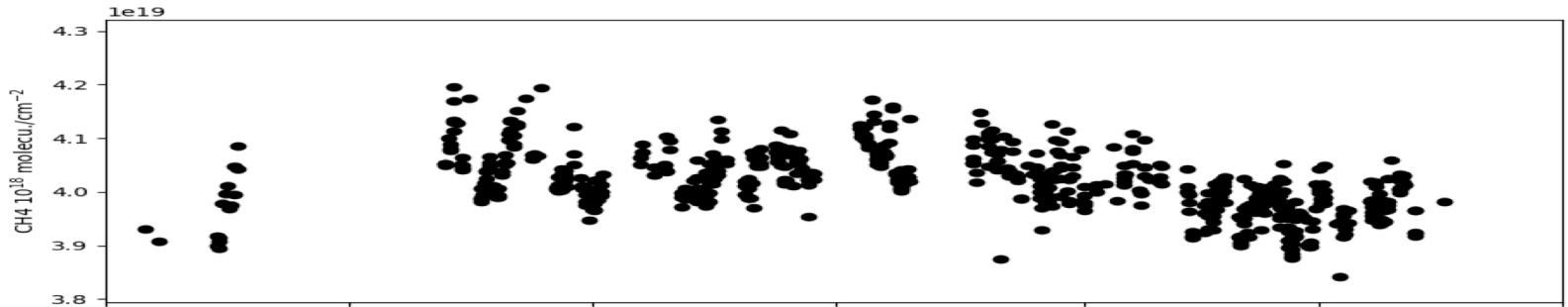
**XHDO**



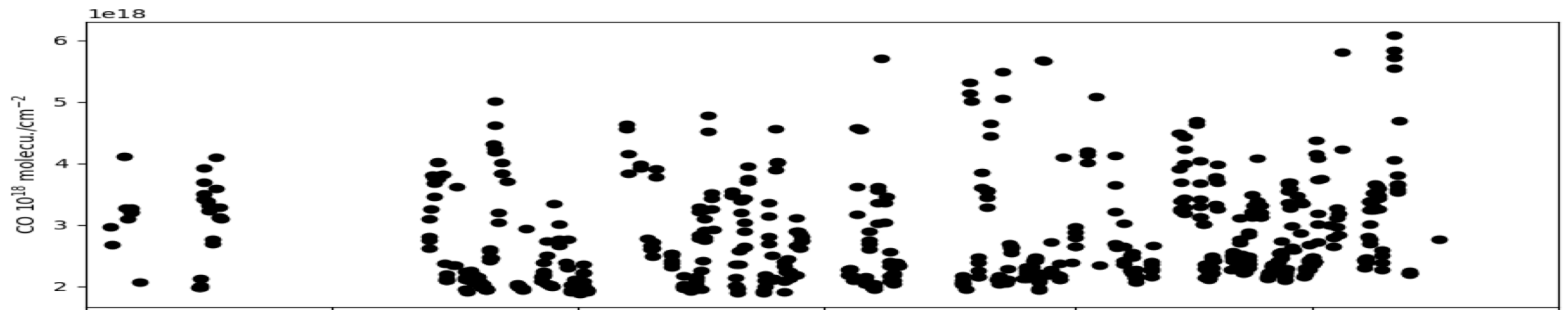
# NDACC species (using SFIT4)

9 species were retrieved: C<sub>2</sub>H<sub>2</sub>, C<sub>2</sub>H<sub>6</sub>, CO, CH<sub>4</sub>, HCL, HCN, HF, HCHO, N<sub>2</sub>O, CH<sub>4</sub>, CO and N<sub>2</sub>O.

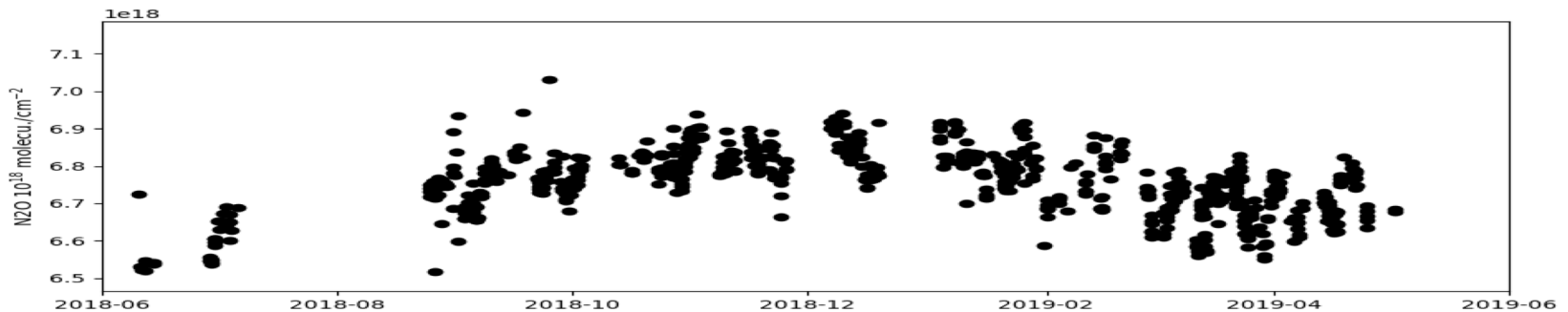
XCH<sub>4</sub>



XCO



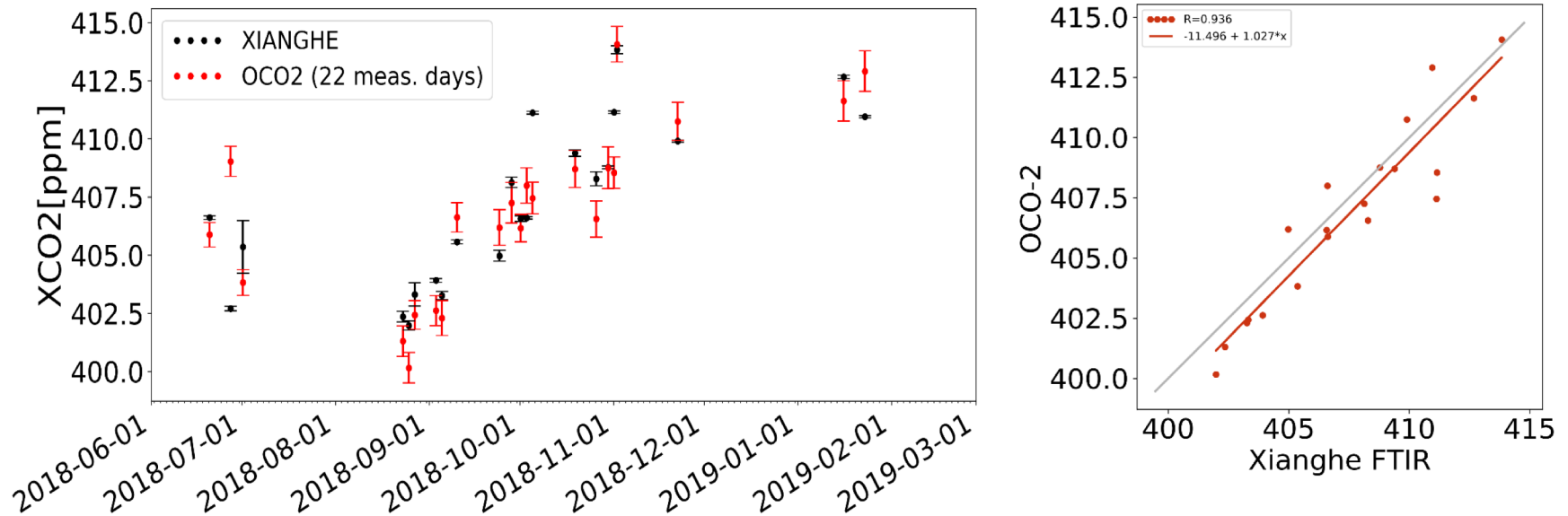
XN<sub>2</sub>O



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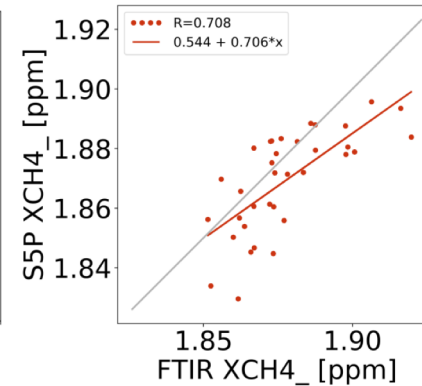
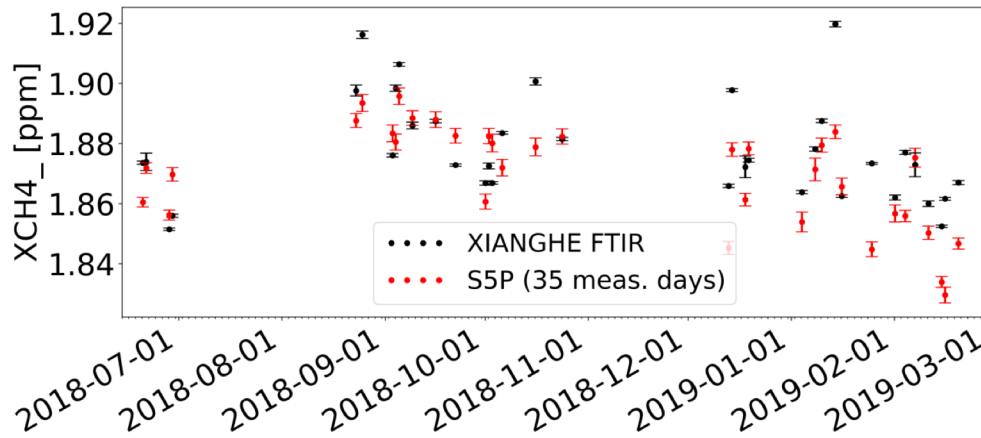
# Preliminary results in the comparison with OCO-2 products.



**FTIR@XH vs. OCO-2** 【longitude  $\pm 5^\circ$  , latitude  $\pm 2.5^\circ$  ,  $\Delta t = \pm 2h$ 】 :  
days=22, Bias = -0.683ppm, Std = 1.357ppm, R = 0.936

# ✓ Satellite validation for TROPOMI XCH<sub>4</sub> and CO

$$\text{Bias} = (\text{TROPOMI} - \text{FTIR}) / \text{FTIR}$$

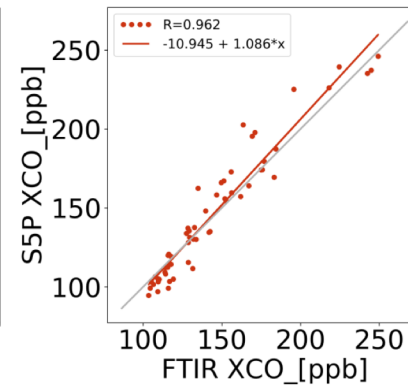
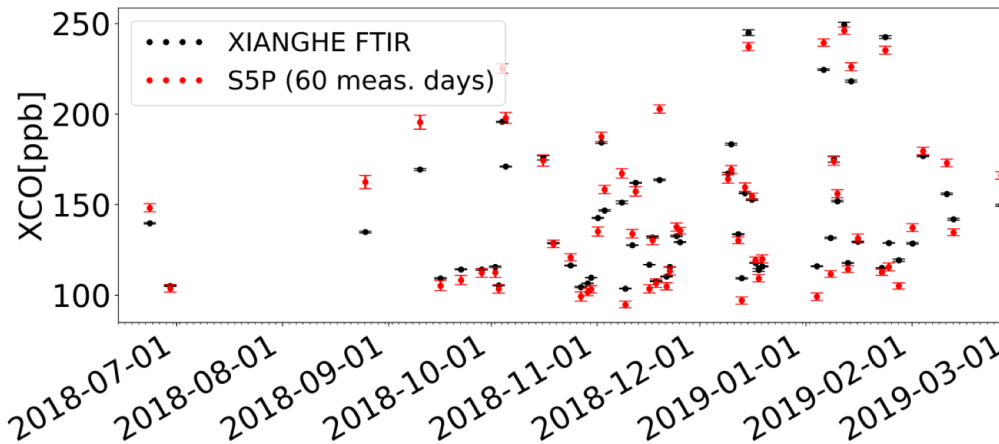


**XCH<sub>4</sub>**  
 100km,1hr  
 days=35  
 Bias = -0.441%  
 Std = 0.689%  
 R = 0.708

Fig. 1 (a) Time series of daily mean XCH<sub>4</sub> from FTIR and TROPOMI

(b) Correlation

S5P CH<sub>4</sub> Validation Target: Bias below 1.5% and precision below 1%



**XCO**  
 50km,30min  
 days=60  
 Bias = 0.363%  
 Std = 7.954%  
 R = 0.962

Fig. 2 (a) Time series of daily mean XCO from FTIR and TROPOMI

(b) Correlation

S5P CO Validation Target: Bias below 15% and precision below 10%



# Future work

- More measurements following the operational standards
- Carefully check the quality of the recorded spectra
- More validation for satellite products



*Thanks for your attention!*