



**ESA-MOST Dragon Cooperation**

中国科技部-欧洲空间局“龙计划”合作

# 2017 DRAGON 4 SYMPOSIUM

2017年“龙计划”四期学术研讨会

26-30 June 2017 | Copenhagen, Denmark

2017年6月26-30日, 丹麦 哥本哈根



# VALIDATION OF SATELLITE PRODUCTS OVER NORTHERN CHINA BY GROUND-BASED MAX-DOAS AND FTIR SPECTROSCOPY

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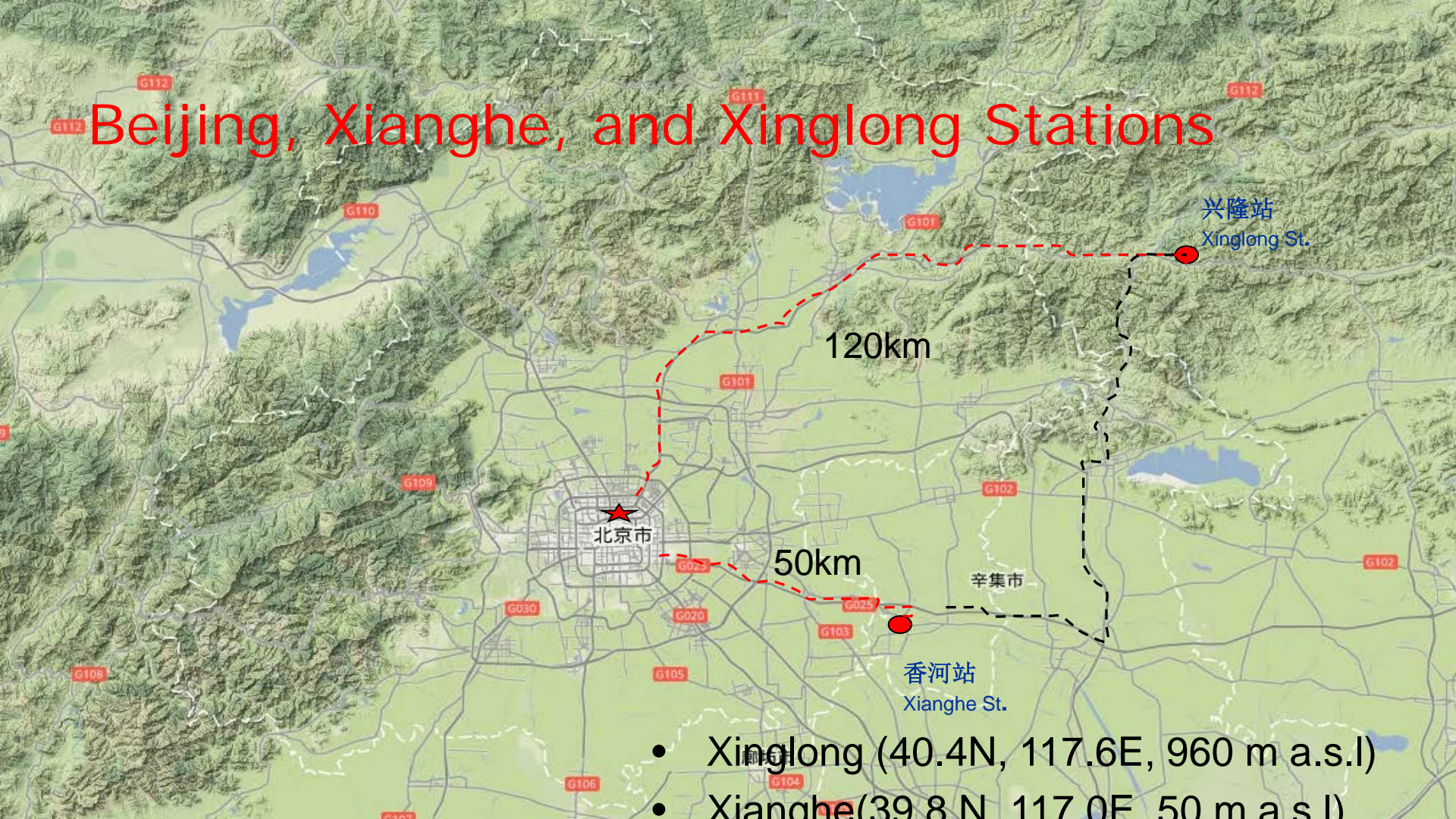
3, Belgium Institute for Space Aeronomy, Brussels, Belgium

## Contents

- Site Introduction on Xianghe and Xinglong Stations equipped with FTIRs
- NO<sub>2</sub> and SO<sub>2</sub> measured by the ground-based Max-DOAS in Xianghe Station and the Validation for Satellite Products
- XCO<sub>2</sub> and XCH<sub>4</sub> measured by the ground-based FTIR spectroscopy and the Validation for Satellite Products
- Summary



# Beijing, Xianghe, and Xinglong Stations



- Xinglong (40.4N, 117.6E, 960 m a.s.l.)
- Xianghe (39.8 N, 117.0E, 50 m a.s.l.)



# Xinglong Atmospheric Background Observational Station (XLABOS)

(40.4N, 117.6E, 960 m a.s.l.)



**XINGLONG ATMOSPHERIC  
BACKGROUND OBSERVATIONAL  
STATION (XLABOS)**  
**大气本底观测网兴隆站**

Xinglong (40.4N, 117.6E, 960 m a.s.l)





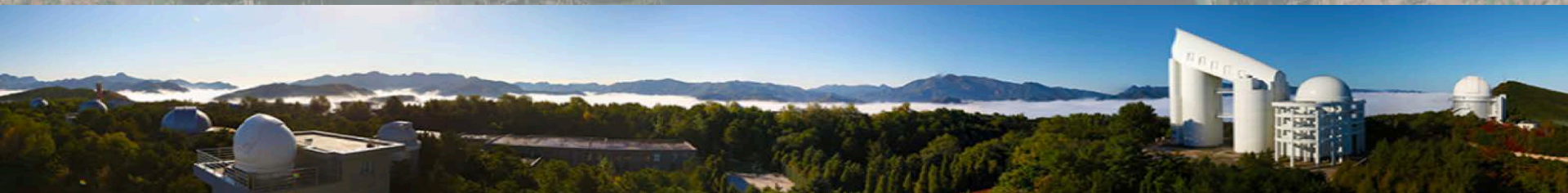


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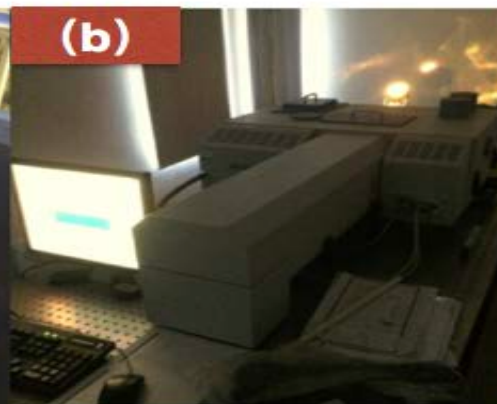
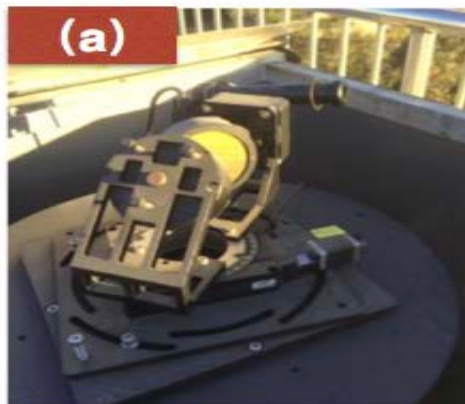
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Starting time : Sep 2014

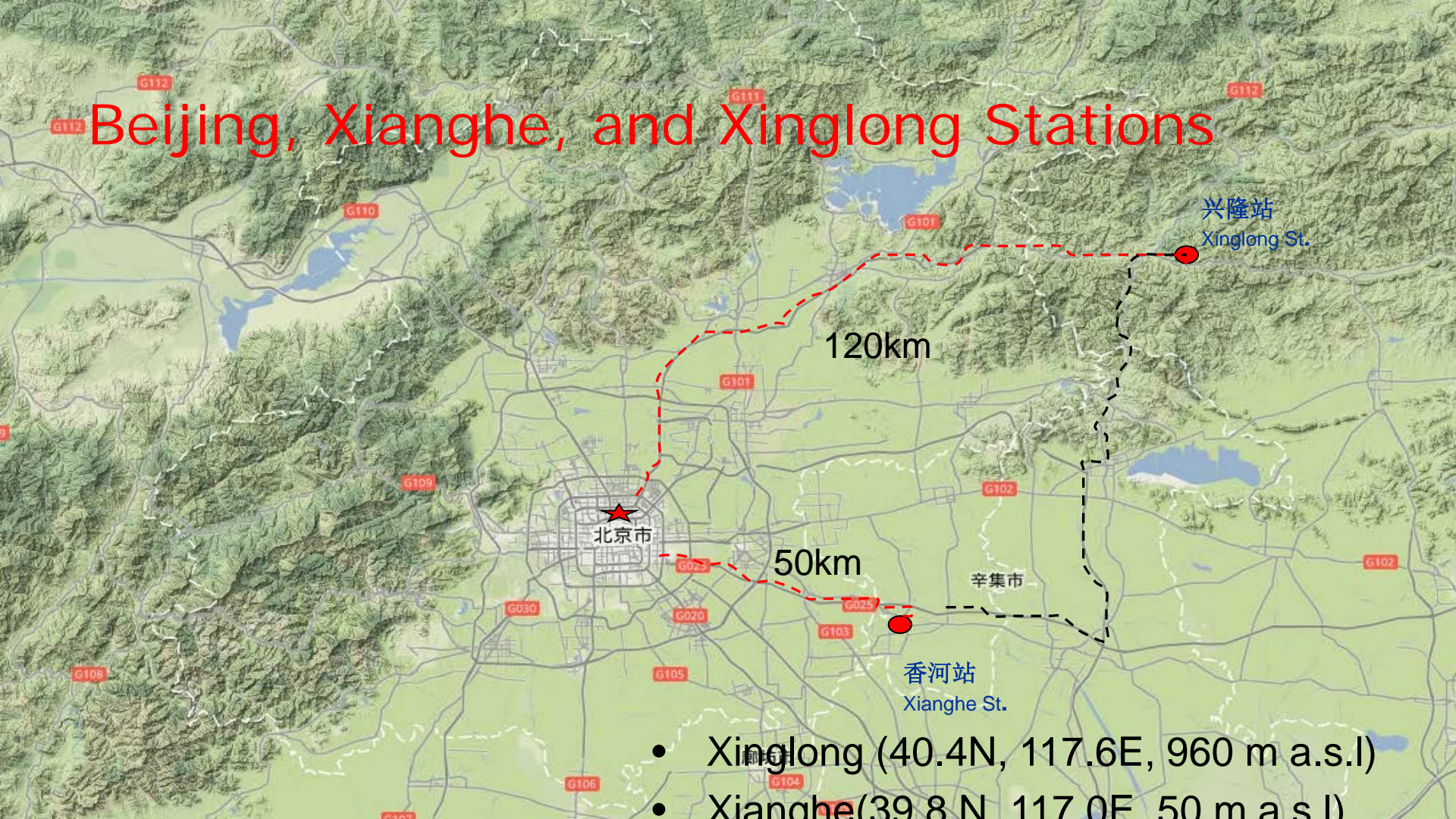
Detector: InGaAs with CaF<sub>2</sub> beamsplitter



(a) Solar tracker (homemade) (b) IFS 125M with InGaAs detector (c) Auto weather station



# Beijing, Xianghe, and Xinglong Stations



- Xinglong (40.4N, 117.6E, 960 m a.s.l.)
- Xianghe (39.8 N, 117.0E, 50 m a.s.l.)





esa

# VHF/MST radar



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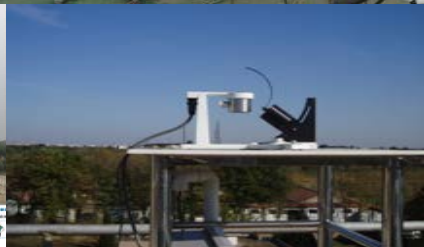




# Xianghe Aerosol-Cloud-Radiation Measurement Platform (2004—Present)



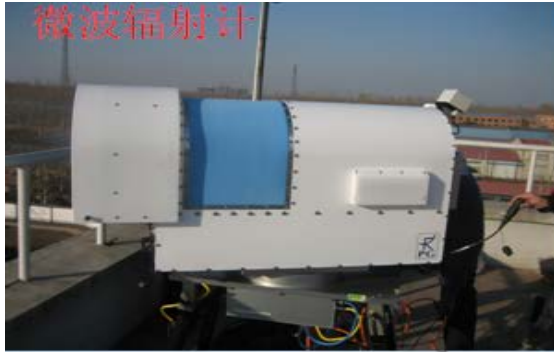
CE-318 photometer, TSI, MFRSR, global, direct, diffuse radiation, LW





## Facility (Cont.)

Lidar, Microwave Radiometer, SMPS+APS, All Sky Imager



# Instrument Containers in XIANGHE station during the intensive field campaign



**Instrument  
containers**





- Observational base for middle atmosphere, one of national longitude chain monitor network
- Regional climate and environment integrated observatory
- **Validation site for satellite remote sensing**
- Test base for high technologies in atmospheric detection and demonstration base for atmospheric observation

Roof



**The BIRA solar tracker  
will be installed in June!**

Indoor



**Installed  
in  
July 2016  
with  
3 detectors  
InGaAs  
InSb  
MCT**



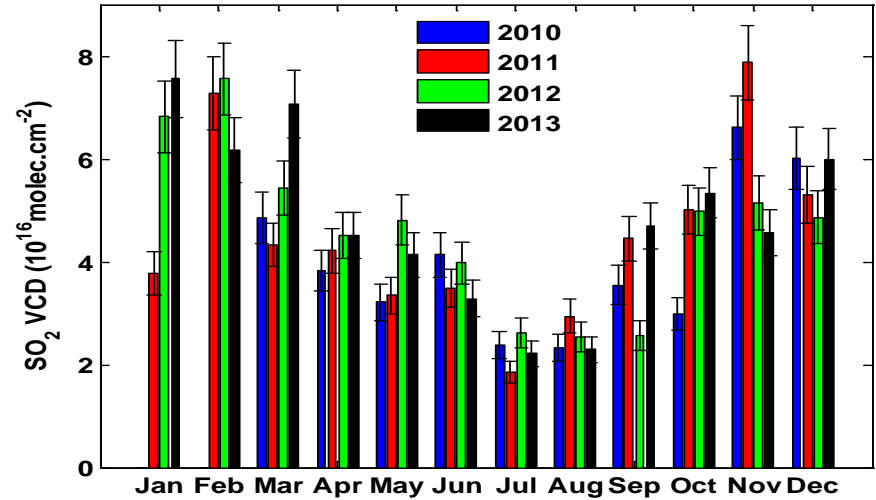
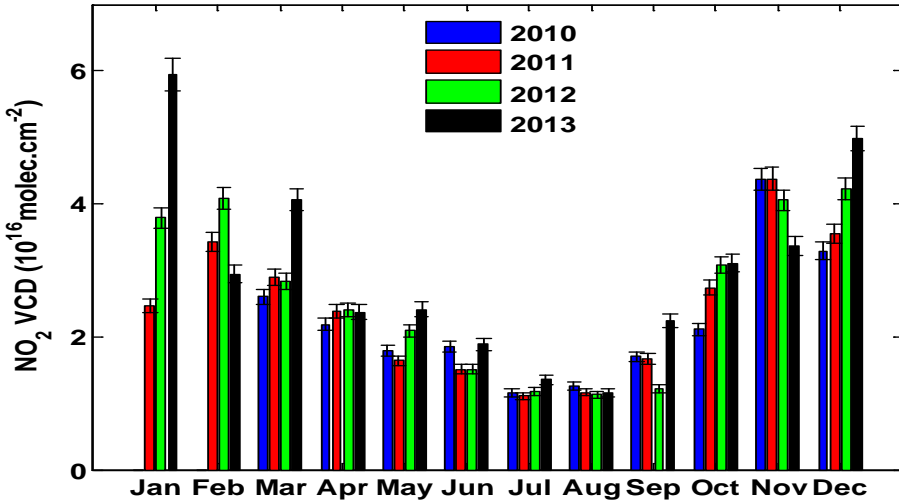
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Parameter	Data source	Fitting interval (nm)		
		338-370 (O <sub>4</sub> )	305-317.5 (SO <sub>2</sub> )	425-490 (NO <sub>2</sub> )
NO <sub>2</sub>	( <a href="#">Vandaele et al., 1998</a> ) 220K, 294K	x	x(only 294K)	x
SO <sub>2</sub>	( <a href="#">Vandaele et al., 1994</a> ) 294K		x	
O <sub>3</sub>	( <a href="#">Bogumil et al., 2000</a> )223K 243K	x(only 223K)	x	x(only 223K)
O <sub>4</sub>	( <a href="#">Hermans et al., 2003</a> )296K	x		x
BrO	( <a href="#">Fleischmann et al., 2004</a> )223K	x		
H <sub>2</sub> CO	( <a href="#">Meller and Moortgat, 2000</a> )293K	x		
Ring	( <a href="#">Chance and Spurr, 1997a</a> )	x	x	x
H <sub>2</sub> O	( <a href="#">Rothman et al., 2003</a> )298K			x





**Data pairs:**

**For MAX-DOAS data: within  $\pm 1$ h of satellite overpass**

**For Satellite data :  $\leq 100$ km、 $CF \leq 0.3$**

Satellite data from:

NO<sub>2</sub> KNMI

TEMIS(<http://www.temis.nl>)

SO<sub>2</sub> BIRA-IASB

SACS(<http://sacs.aeronomie.be>)

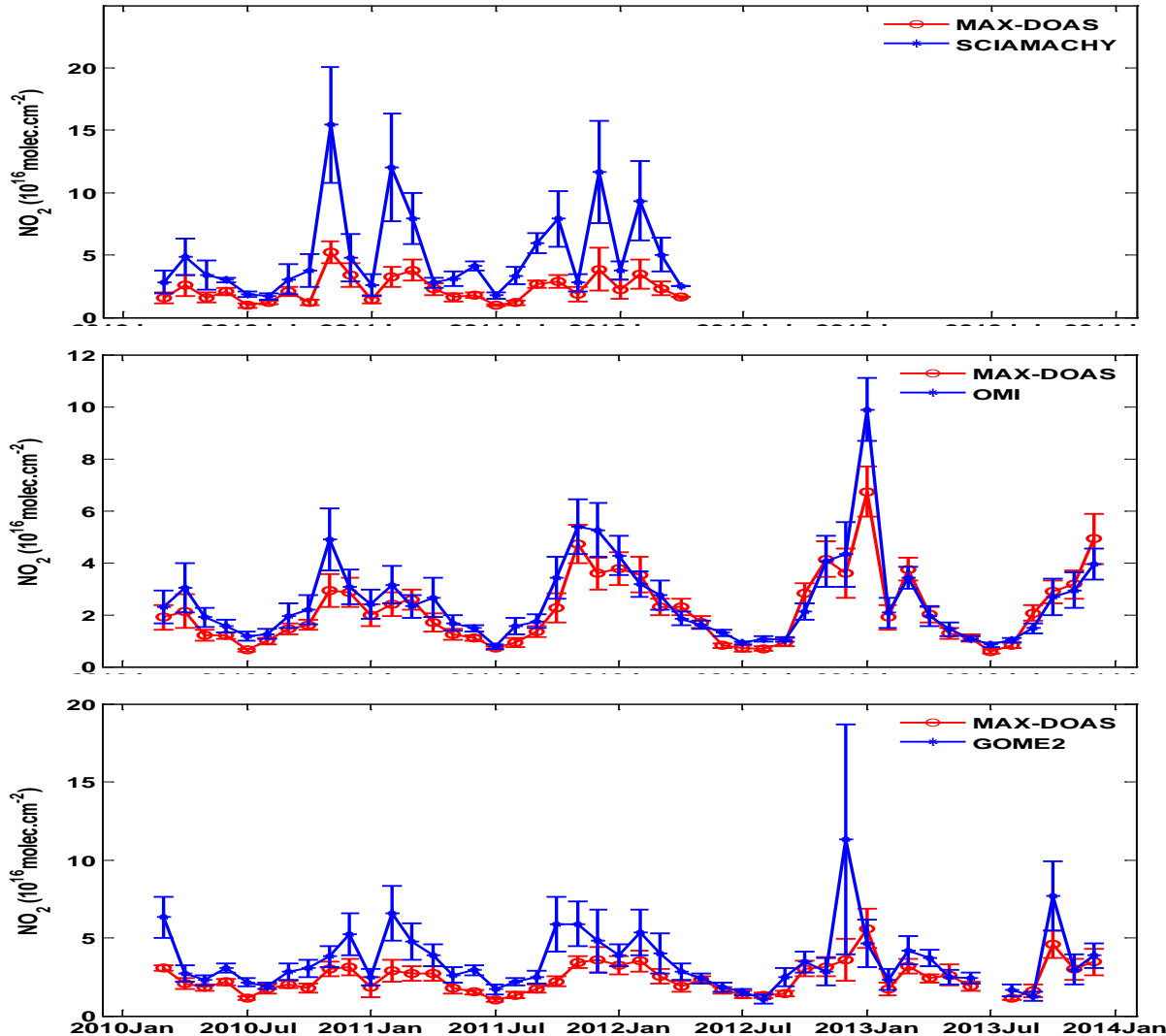


# Month mean $\text{NO}_2$ VCD of satellite and MAX-DOAS

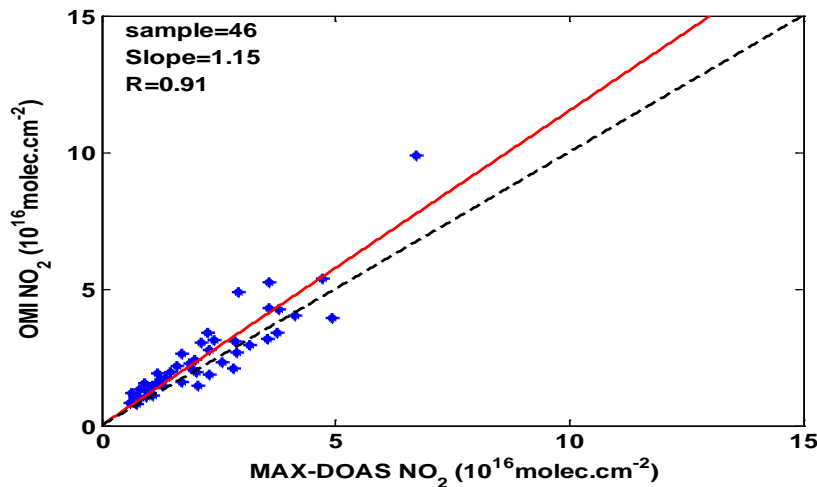
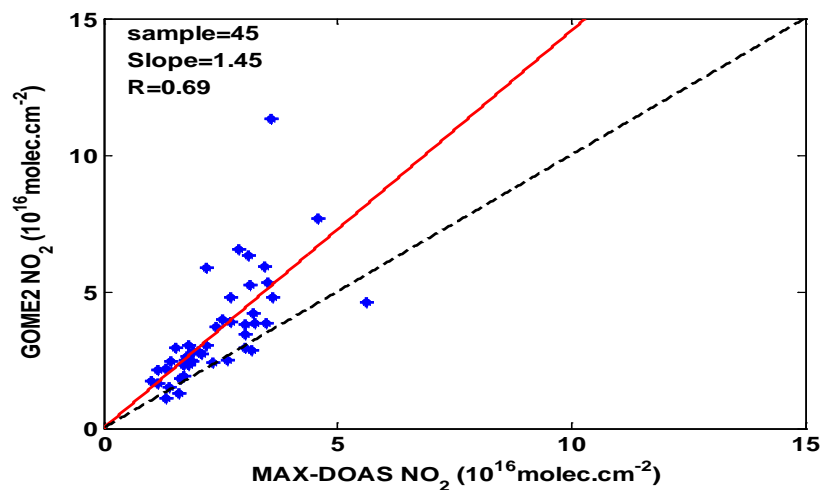
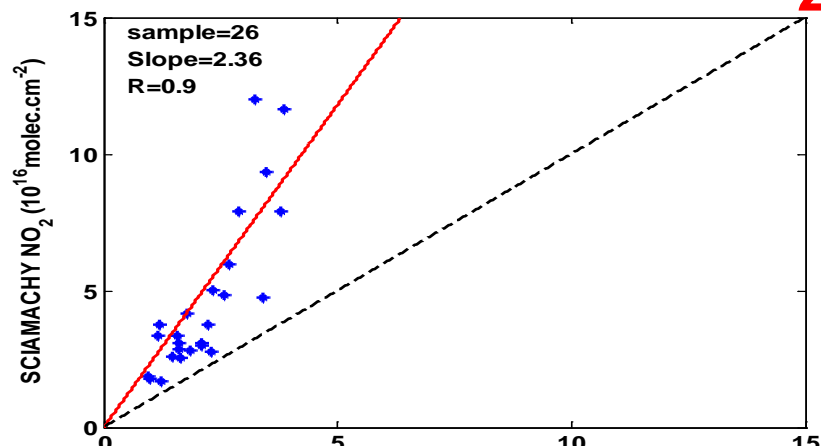
For  $\text{NO}_2$  of KNMI,  
OMI : high quality,  
SCIAMACHY: over  
estimate  
GOME2: over estimate  
slightly

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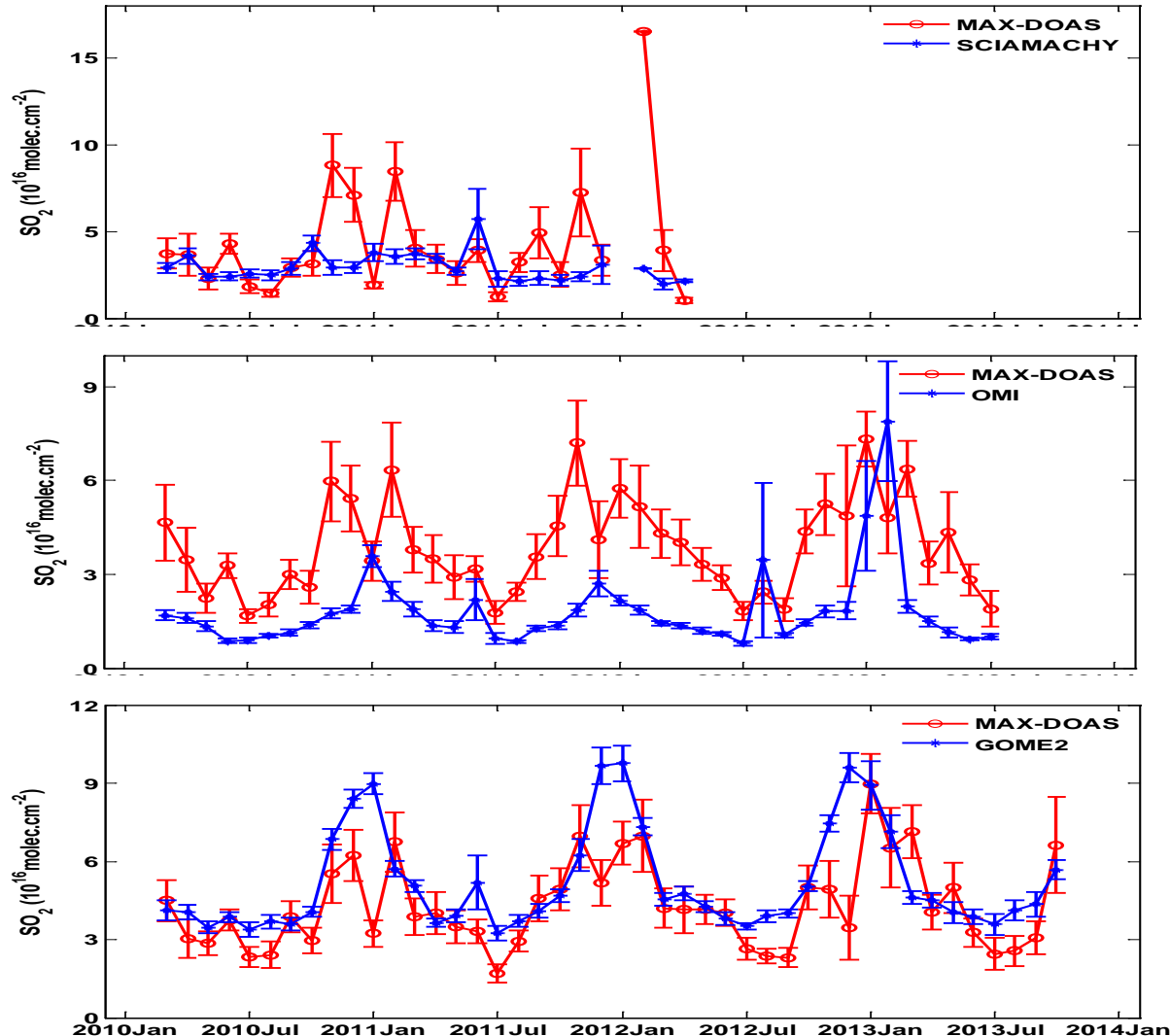


# Month mean $\text{SO}_2$ VCD of satellite and MAX-DOAS

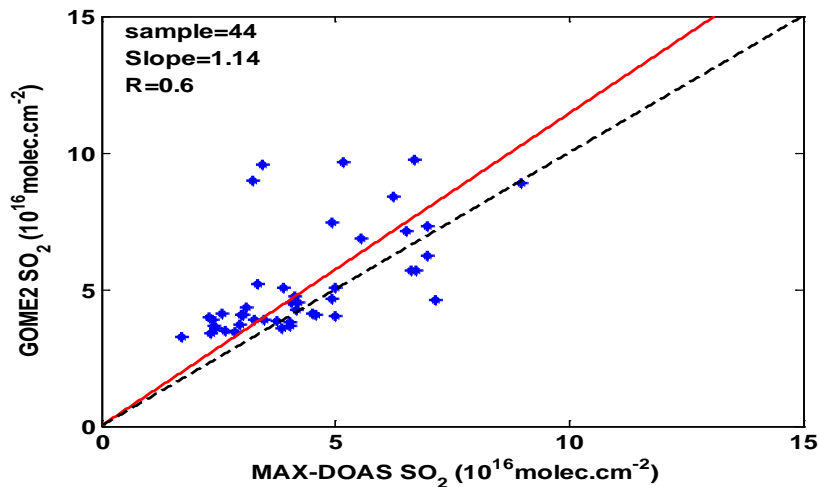
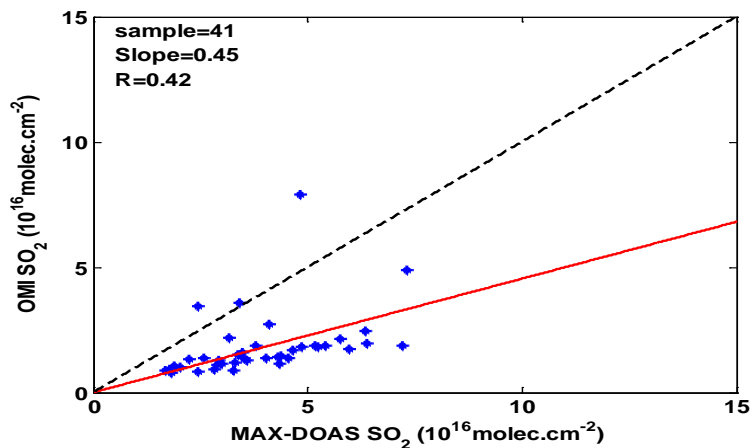
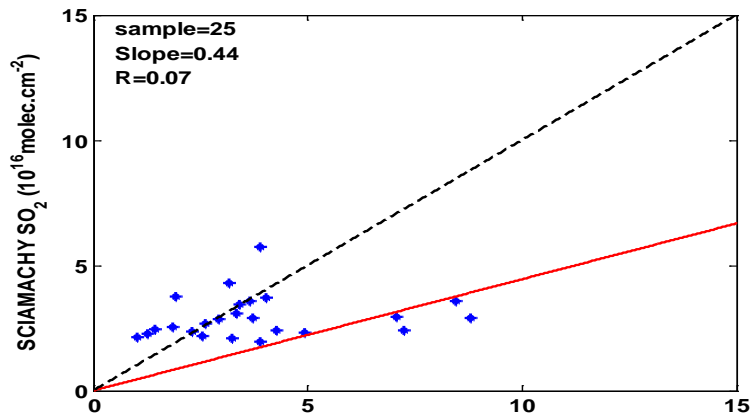
For  $\text{SO}_2$  of BIRA,  
OMI : under estimate  
SCIAMACHY: deviation  
GOME2: good quality

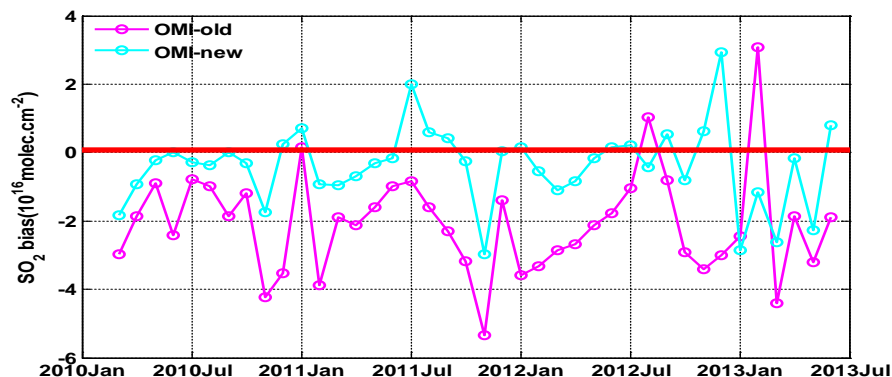
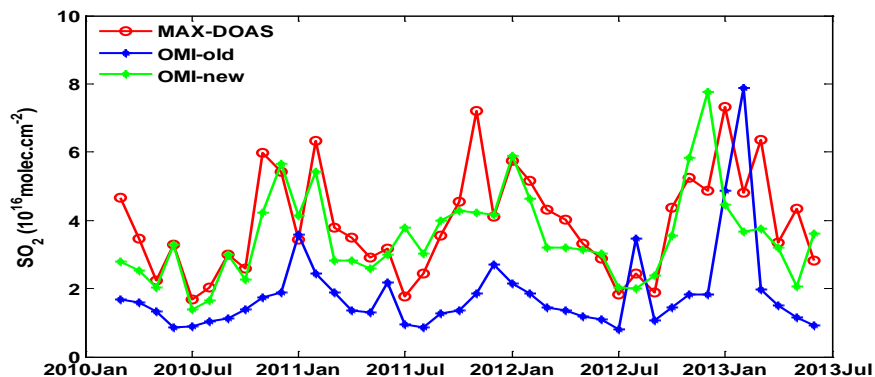
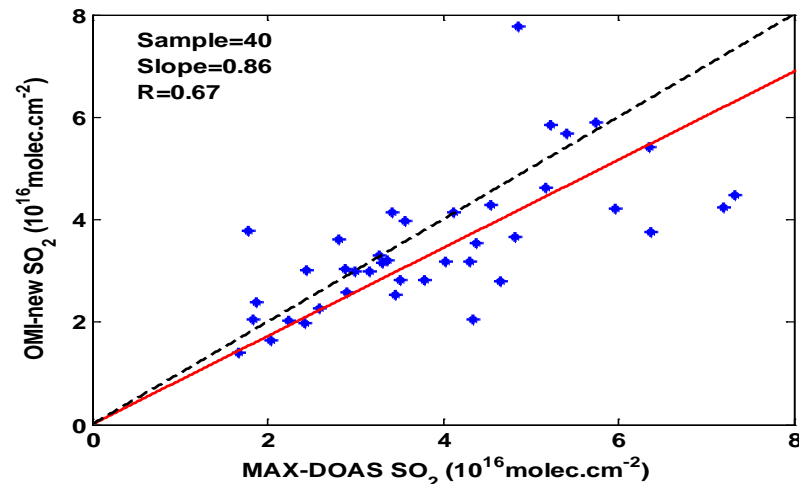
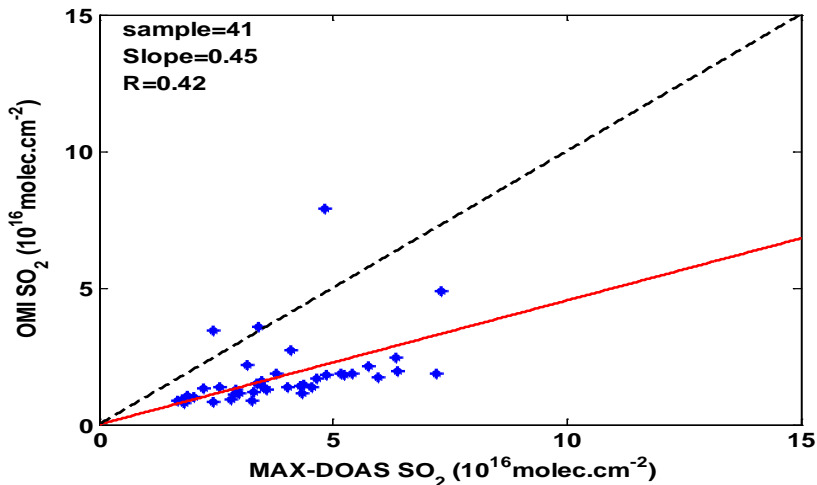
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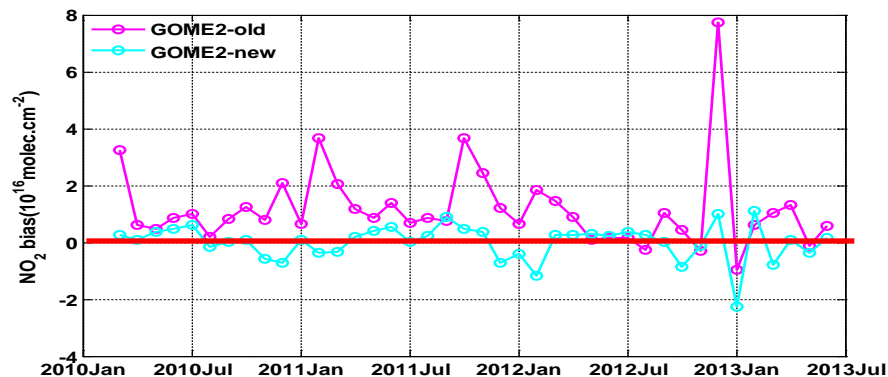
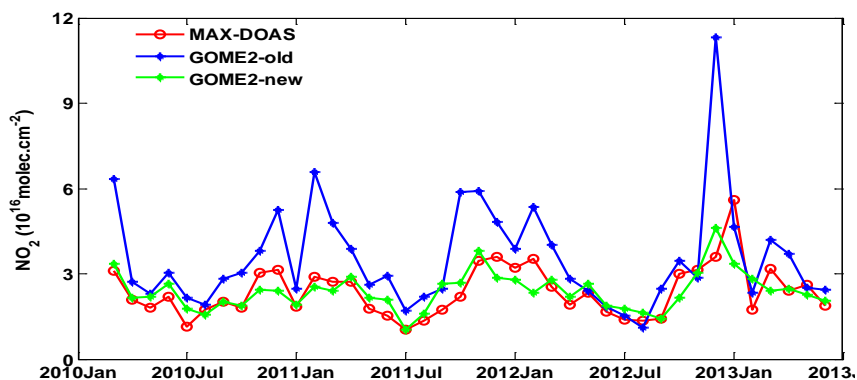
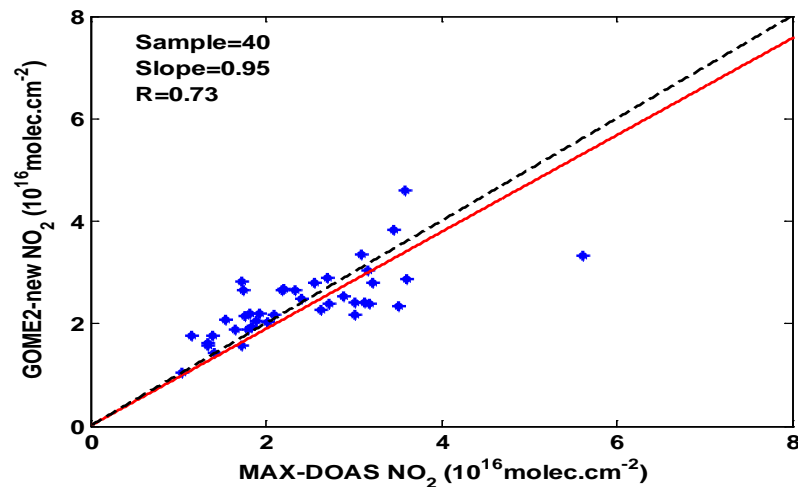
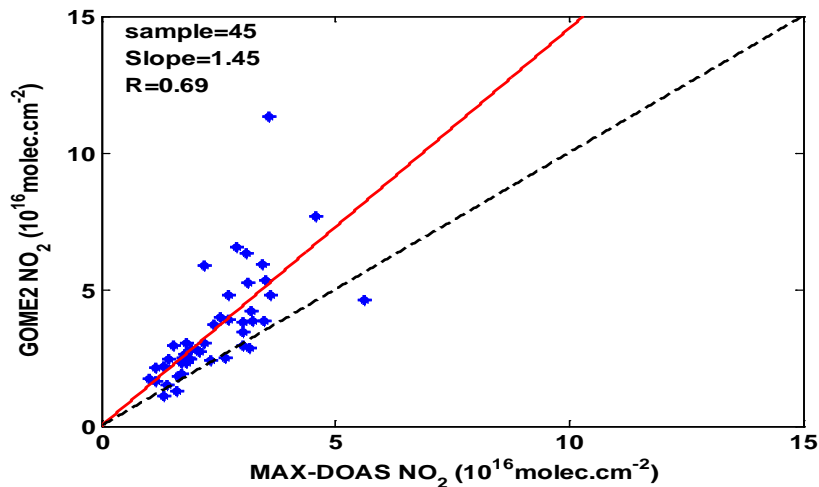












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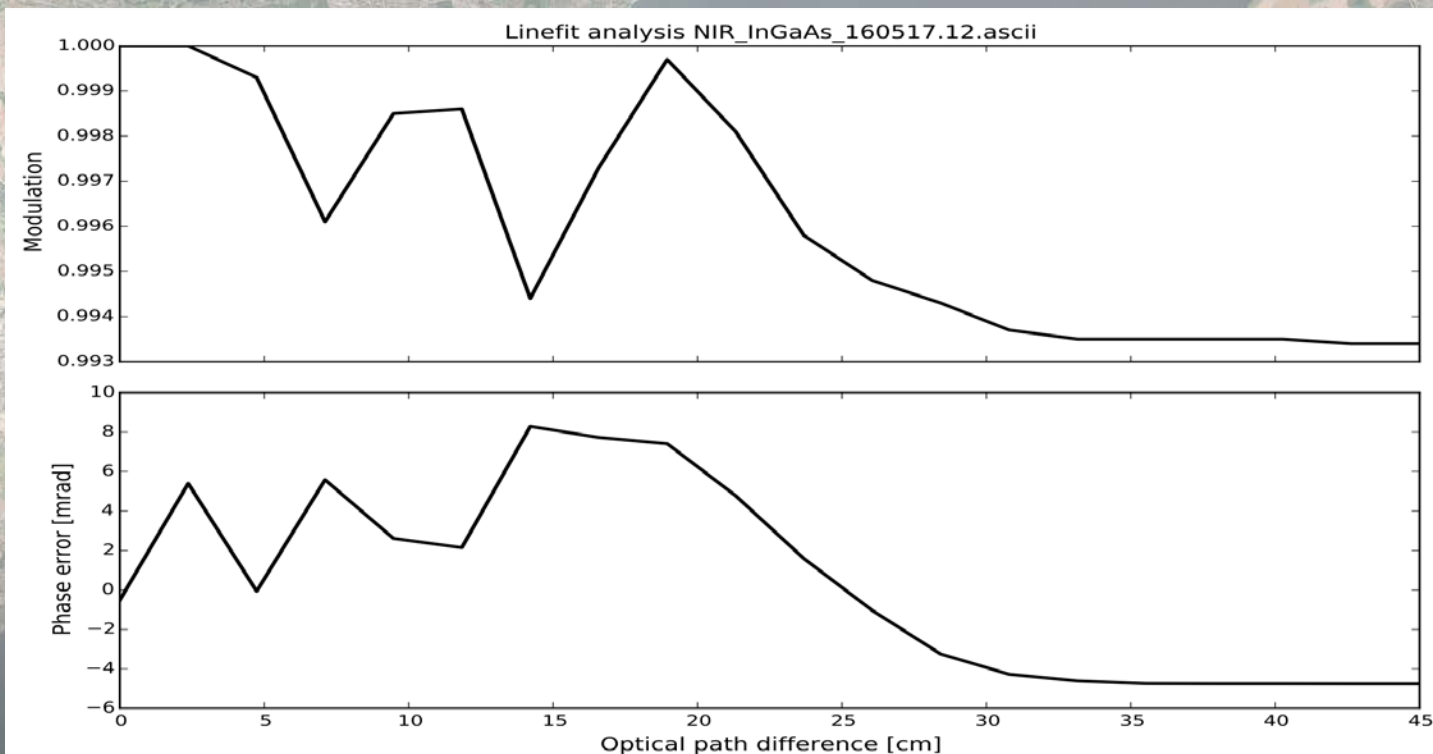




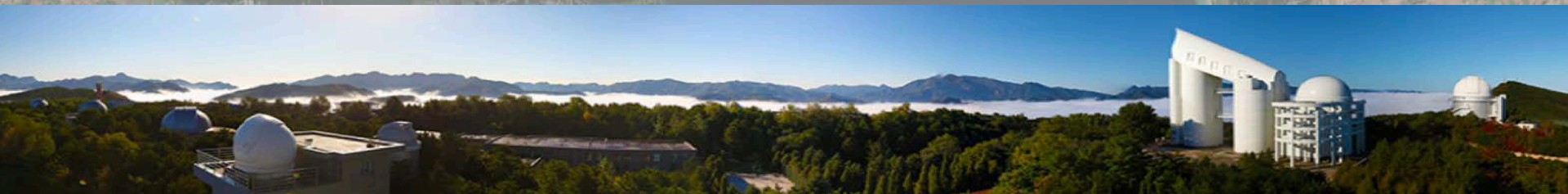
Indoor

**IFS125HR Installed in July 2016 with 3 detectors: InGaAs, InSb, and MCT**  
***And IFS125M installed in Xinglong in 2014 with InGaAs detector***

HCI cell (#55) on 2017-05-16  
LINEFIT 14.5 vacuum

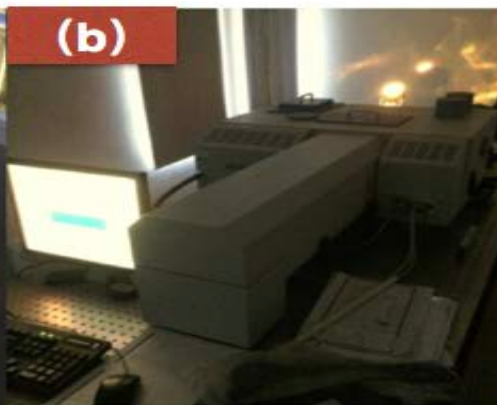
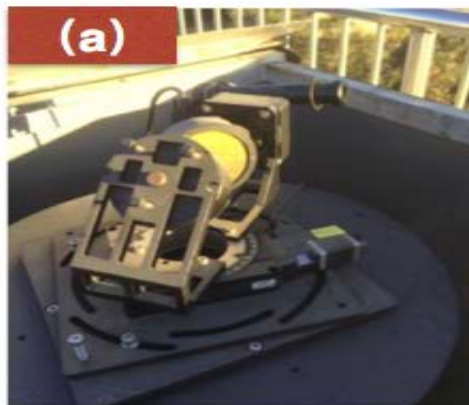




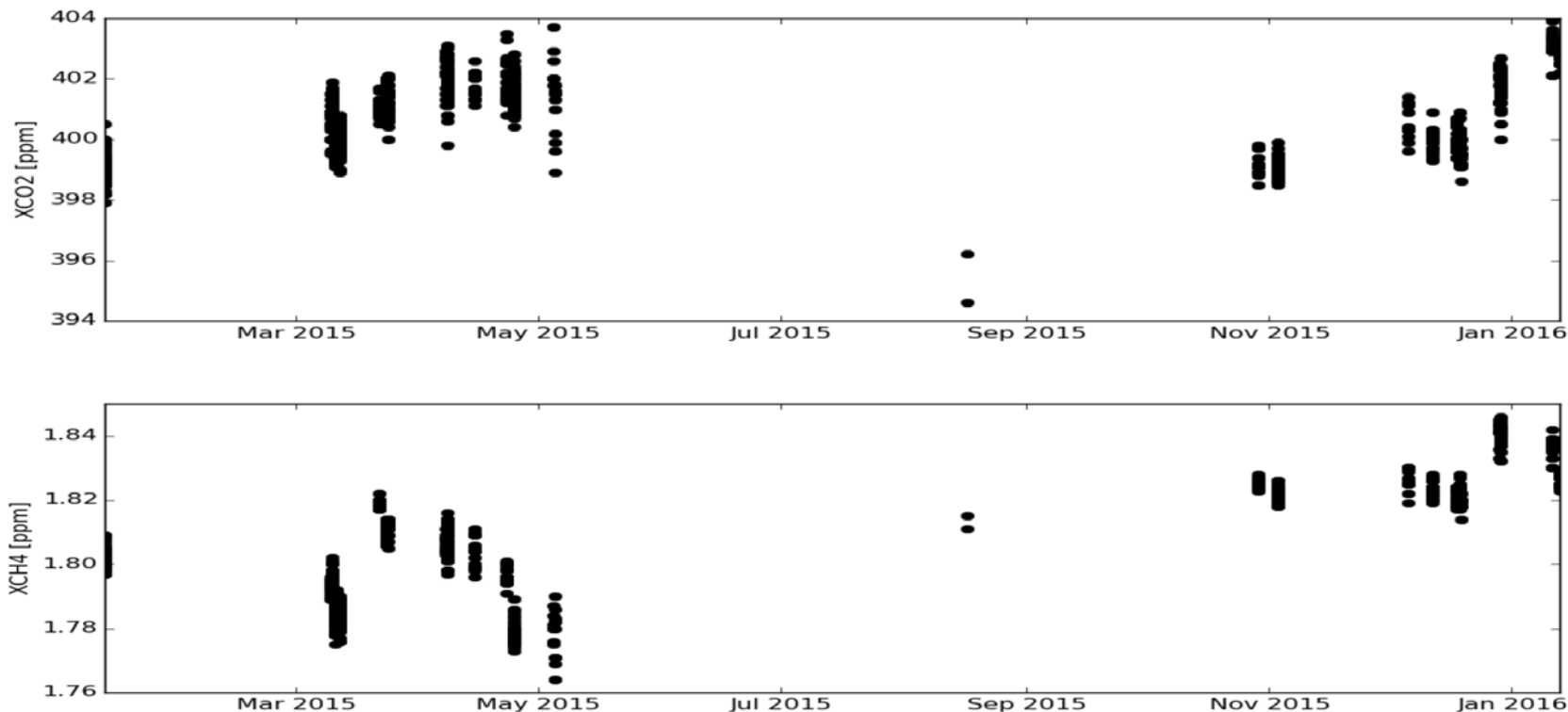


Starting time : Sep 2014

Detector: InGaAs with CaF<sub>2</sub> beamsplitter

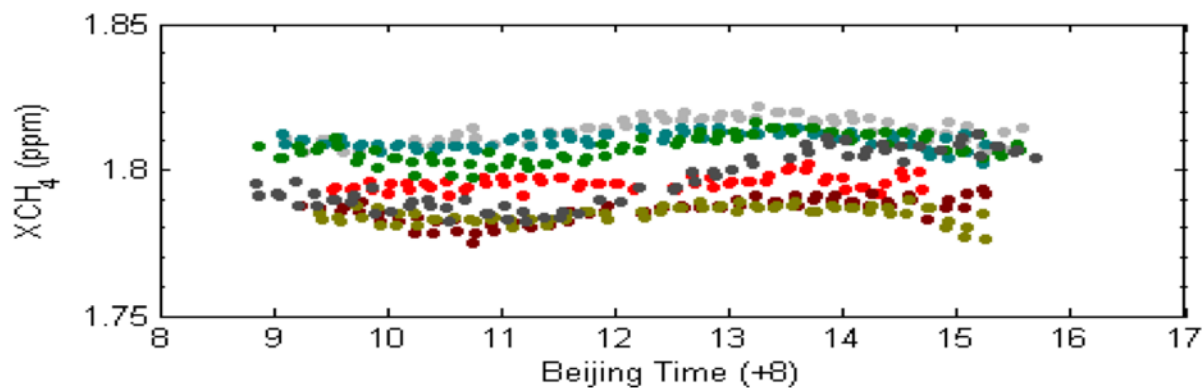
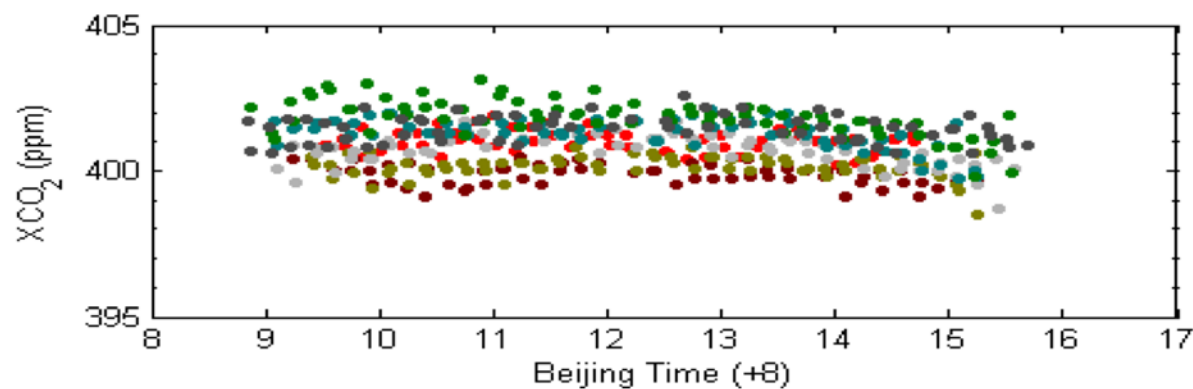
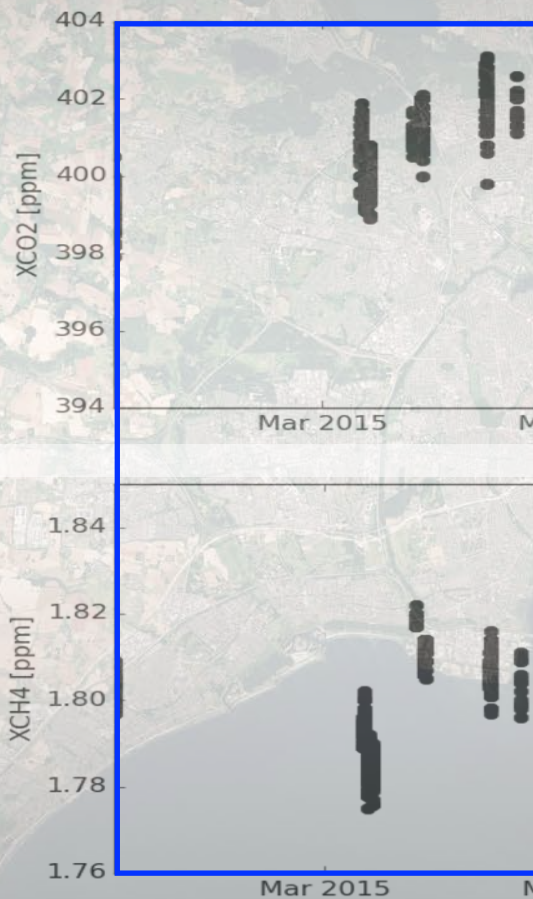


(a) Solar tracker (homemade) (b) IFS 125M with InGaAs detector (c) Auto weather station



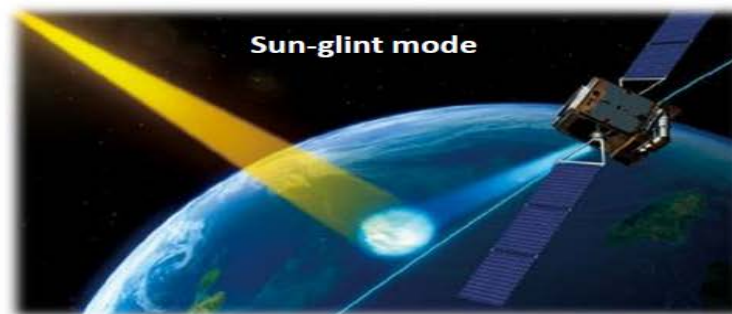
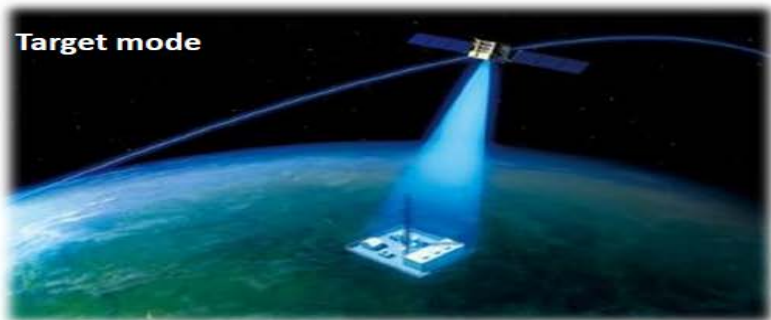
Retrieval Algorithm : GGG2014; Period : 2015.01-2016.01; Error of XCO<sub>2</sub> <0.6 ppm; Error of XCH<sub>4</sub><3 ppb





Parameter	Specification
Orbit	Sun synchronous
Orbit Altitude	700 km
Orbit inclination	98°
Over Local Time	13:30+/-30
Payload WT	500 kg

## TANSAT



## SUMMARY

- (1) The Xianghe and Xonglong sites with IFS125M and IFS125HR instruments will be suitable for the validation of satellite products of XCO<sub>2</sub> and XCH<sub>4</sub>. (GOSAT, TANSAT, OCO-2)
- (2) The MAX-DOAS in Xianghe station has been in operation for over 10 years, providing the dataset for the validation of satellite products such as OMI, GOME-2, Schimarchy, and the analysis of change trends of NO<sub>2</sub> and SO<sub>2</sub>. Some discrepancies are founded, much improvements can be made with appropriate corrections.



***Thanks for your attention!***