12th International Workshop on Greenhouse Gas Measurements from Space

The Pre-Launch Status of TanSat Mission

Yi Liu

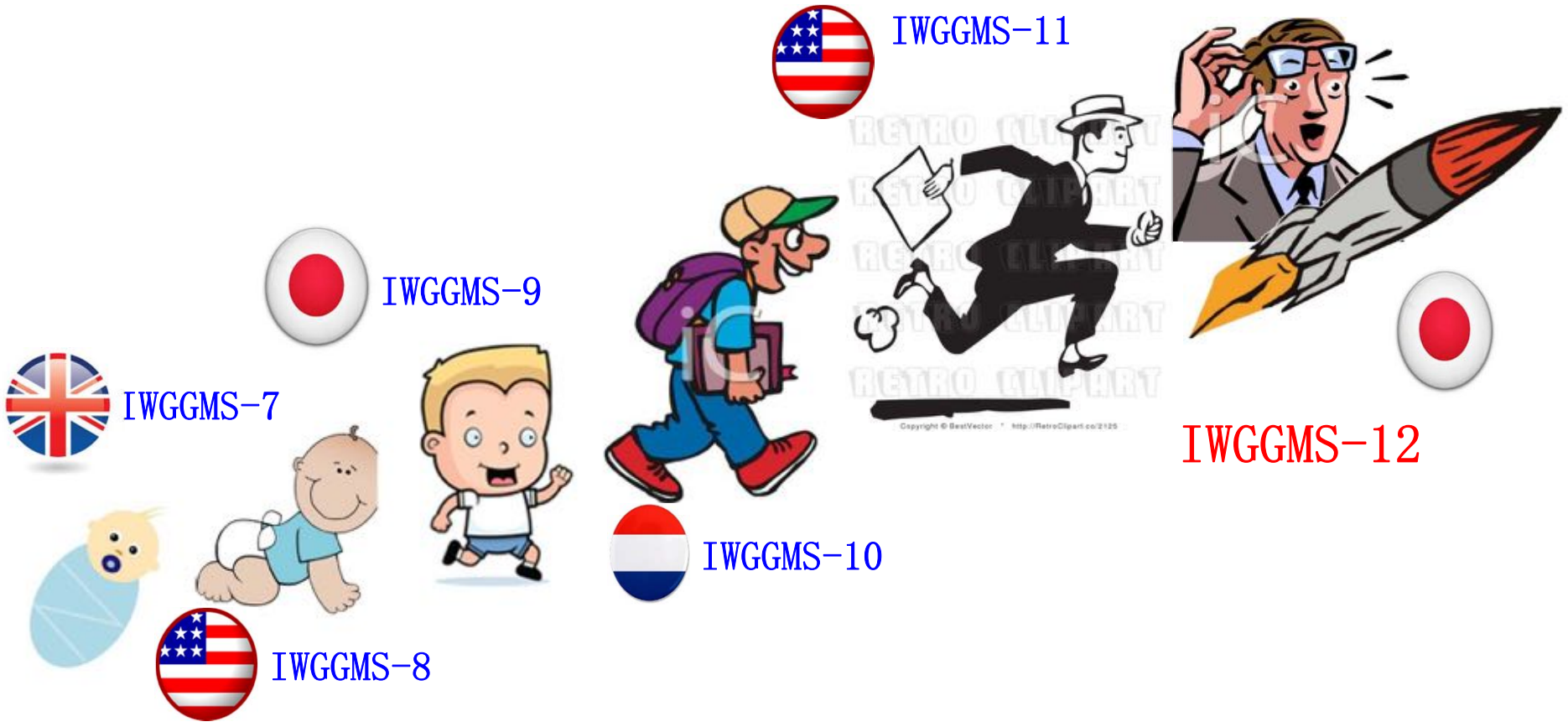
TanSat Science Team

Institute of Atmospheric Physics, Chinese Academy of Sciences

9 June 2016

Kyoto University， Japan

Our journey of IWGGMS-7 to -12



Outline

1. TanSat Mission
2. Satellite platform & Payload--Current Status
3. Retrieval algorithm-XCO2 and CO2 Flux inversion
4. Ground based validation
5. Schedule and Plan

The TanSat Mission

(1) National High Technology Research & Development Programs by Ministry of Science and Technology of China (MOST)

Term-1 (2011-2017)

Term-2 (2013-2015)

(2) Strategic Priority Research Program -Climate Change: Carbon Budget and Relevant Issue by Chinese Academy of Sciences (CAS) – (2011-2015)

(3) Strategic Priority Research Program – Space Science: Scientific Research Satellite (CAS) (2015-2016)

--- Organization of TanSat Mission

--- Funding Launch

Term-1(2011-2017)

Measurement Goals

XCO2

1~4 ppmv

Monthly

500 x 500 km^2

Term-2(2013-2015)

Measurement Goals

CO2 Flux

Relative flux error

20%

Monthly

500 x 500 km^2

Team of The TanSat Project

Team Leader	Mission
Zengshan Yin **Shanghai Engineering Center for Microsatellites**	**Team leader and Satellite platform**
Yuquan Zheng **Changchun Institute of Optics, Fine Mechanics and Physics**	**Carbon Dioxide Spectrometer**
Changxiang Yan **Changchun Institute of Optics, Fine Mechanics and Physics**	**Cloud and Aerosol Polarization Imager (CAPI)**
Zhongdong Yang **National Satellite Meteorological Center, CMA**	**Data receiver, Calibration and Operational Process**
Yi Liu **Institute of Atmospheric Physics, CAS**	**Science requirement， CO2 Retrieval Algorithm, Validation and Application**
Xiangjun Tian **Institute of Atmospheric Physics, CAS**	**CO2 Flux inversion**
Chengcai Li **Beking University**	**Aerosol and cloud Retrieval Algorithm for CAPI**

Satellite Platform - Observation Mode

Name	Characters
Orbit type	sun-synchronous
Altitude	700 km
Inclination	98°
Local time	13:30
Weight	500Kg

Nadir mode- Observation over land
- Push broom
- Principle plane track

Sun-glint mode- Observation over ocean
- Sun glint track
- Principle plane track

Target mode- Validation
- Surface target track
- Multi angles for one target

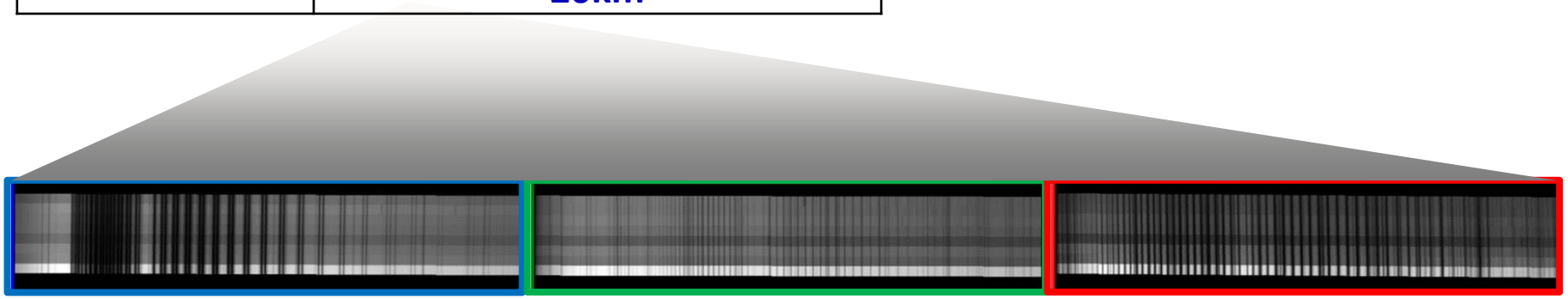
TanSat Instrument

Carbon Dioxide Sensor (CDS)

	O_2-A	CO_2 Weak	CO_2 Strong
Spectral Range(nm)	758-778	1594-1624	2042-2082
Spectral Resolution(nm)	0.038-0.047	0.120-0.142	0.160-0.182
SNR	360	250	180
Spatial Resolution	2kmx2km		
Swath	20km		

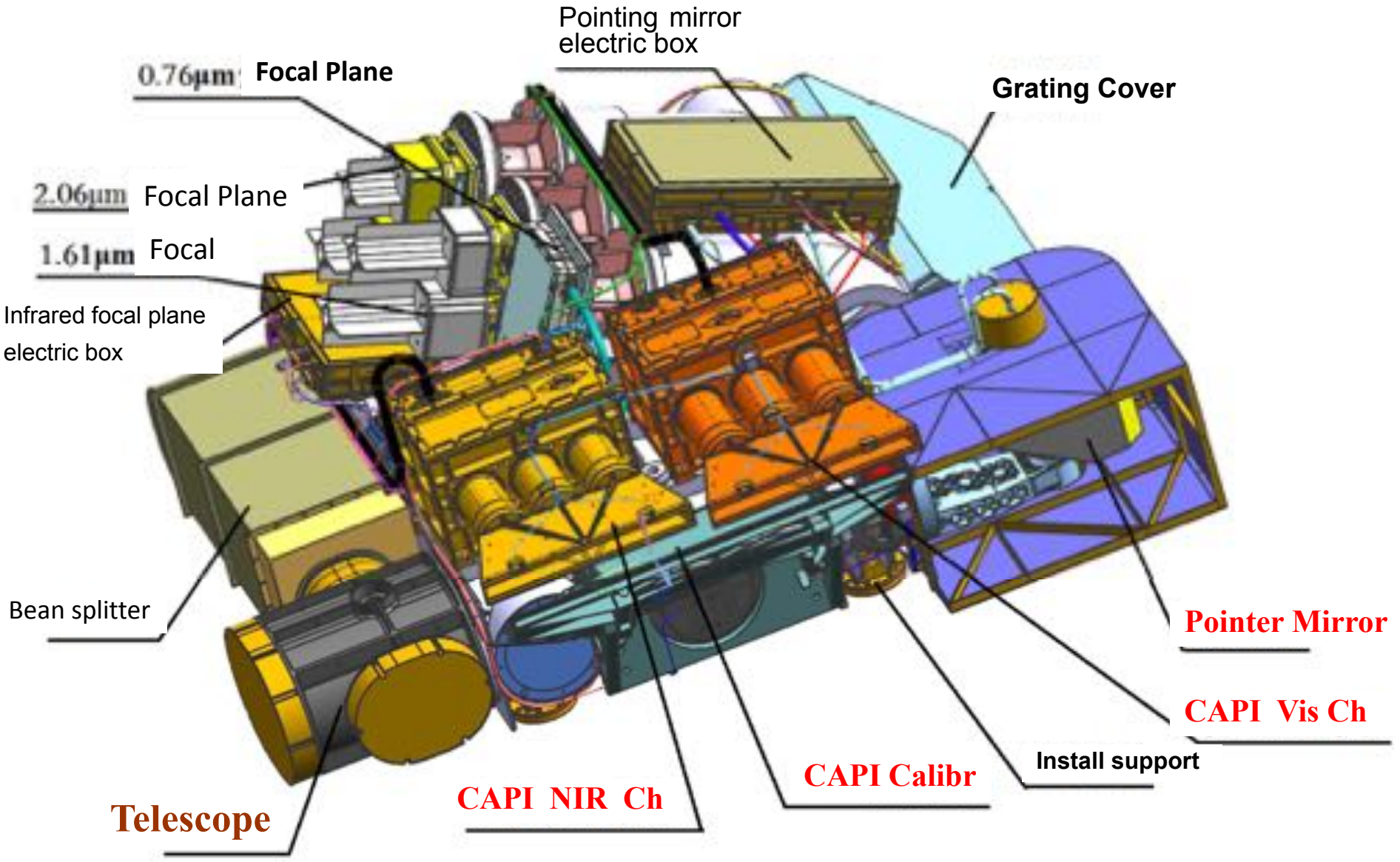
Cloud and Aerosol Polarization Imager (CAPI)

Ultraviolet: 0.38μm
- Visible: 0.67μm
- Near infrared: 0.87, 1.375, 1.64μm
- **Polarization: 0.67 & 1.64 μm**



0.765μm O_2 A-Band **CO_2 1.61μm Band** **CO_2 2.06 μm Band**

CDS and CAPI


Pointing mirror
electric box
0.76μm Focal Plane
Grating Cover
2.06μm Focal Plane
1.61μm Focal
Infrared focal plane
electric box
Bean splitter
Pointer Mirror
CAPI Vis Ch
Install support
CAPI Calibr
CAPI NIR Ch
Telescope

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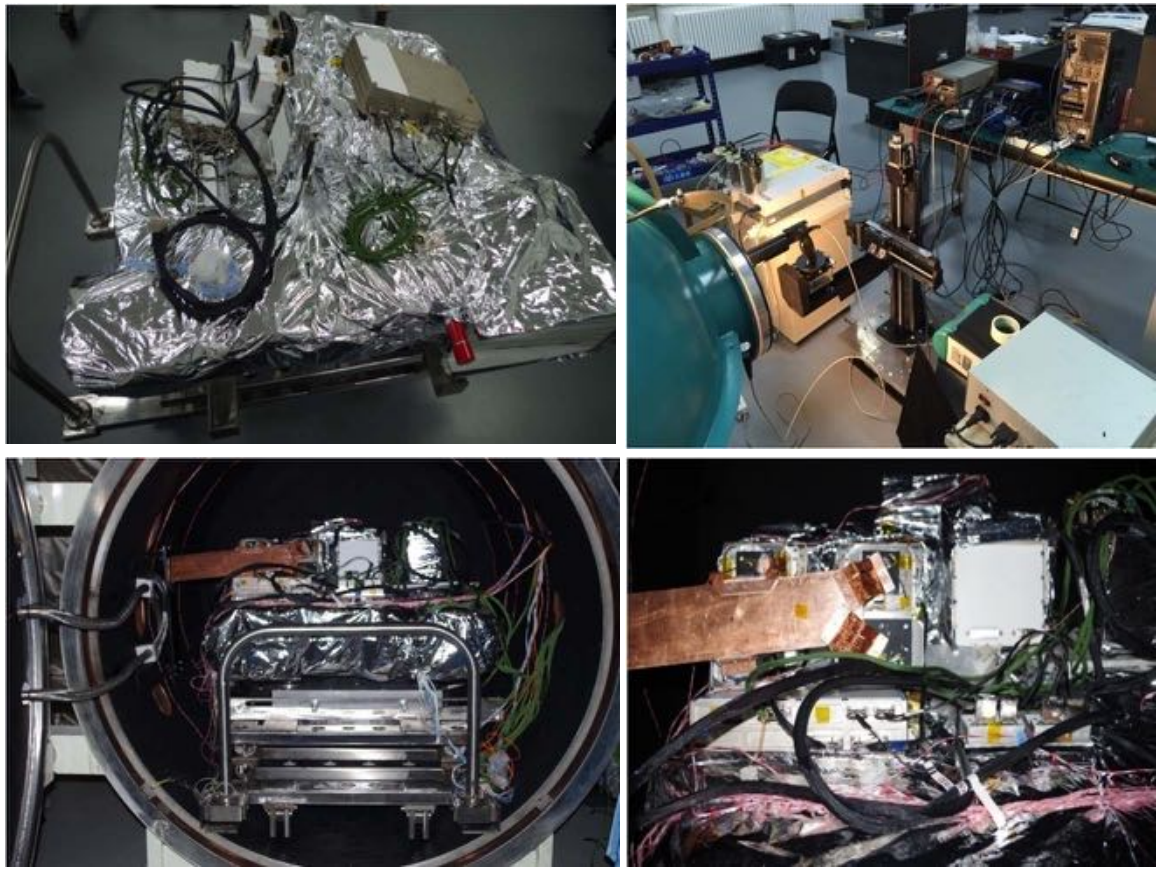
Preflight calibration in laboratory

Preflight calibration

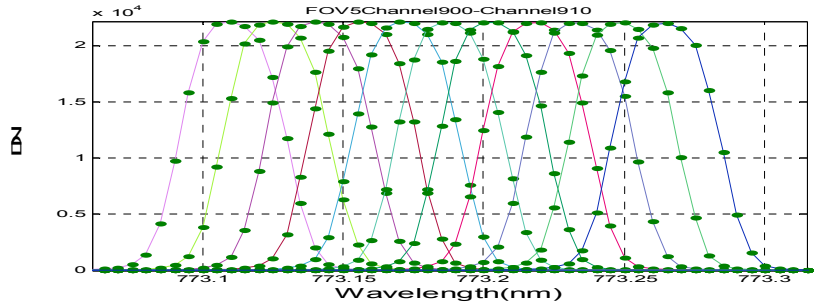
2015-2016

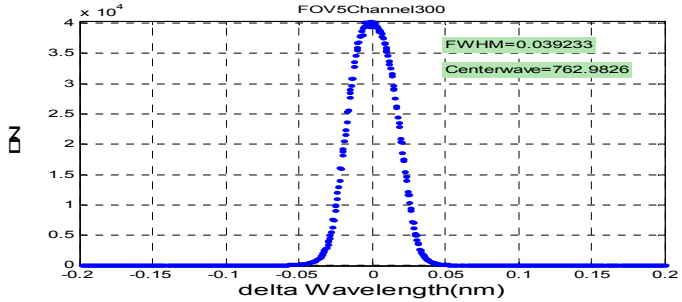
- **Radiometric Cal.**
- **Spectral Cal.**
- **Polarization Cal.**
- **Geometric Cal.**
- **SNR**



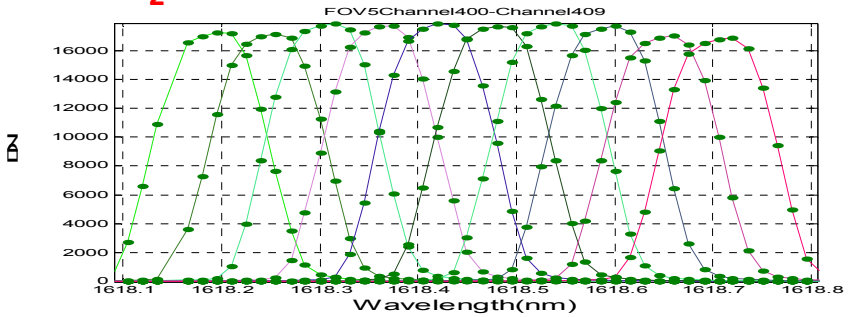
ILS calibration results

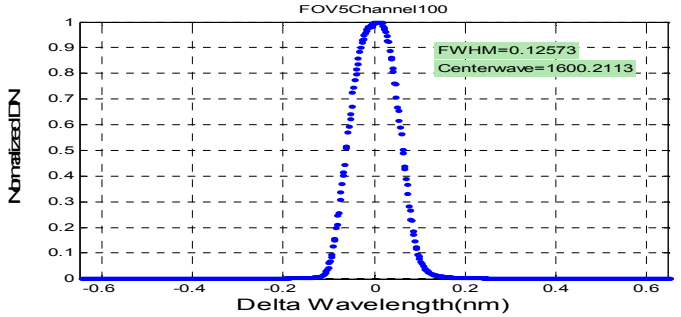
O_2 A



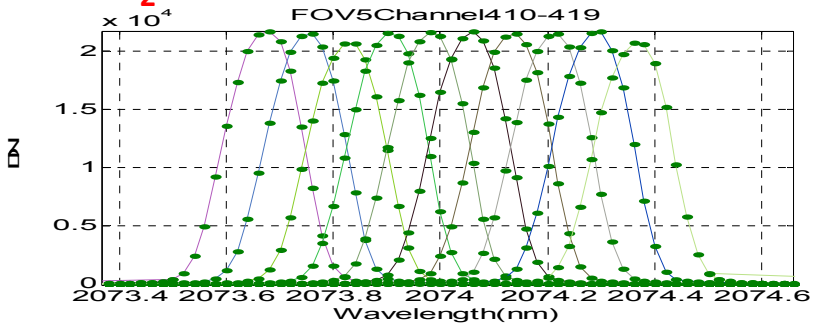


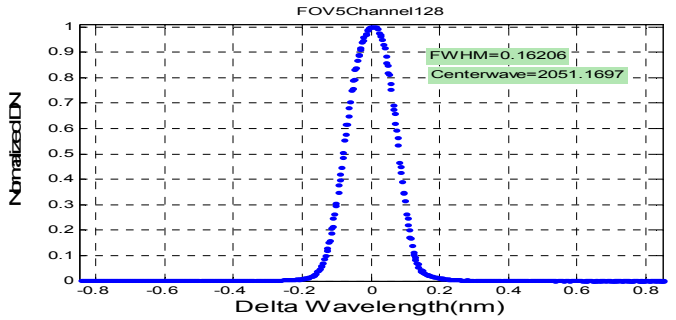
CO_2 W



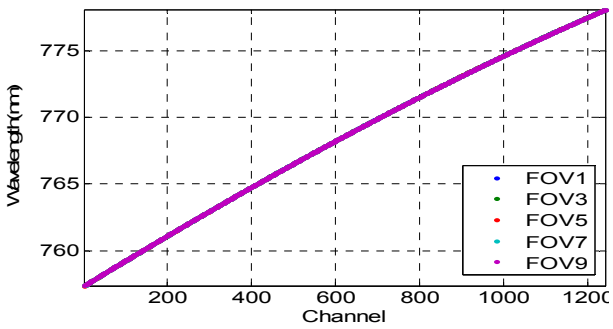


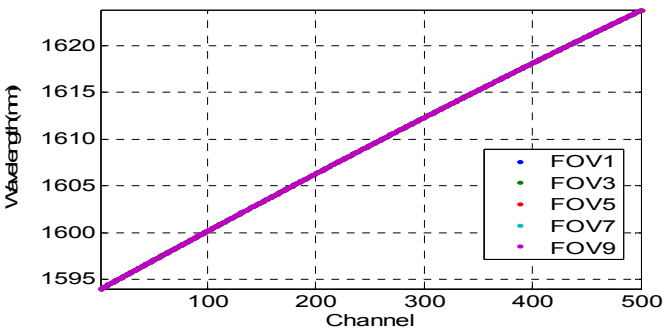
CO_2 S

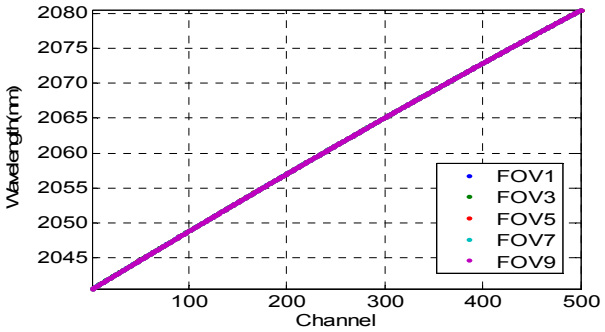


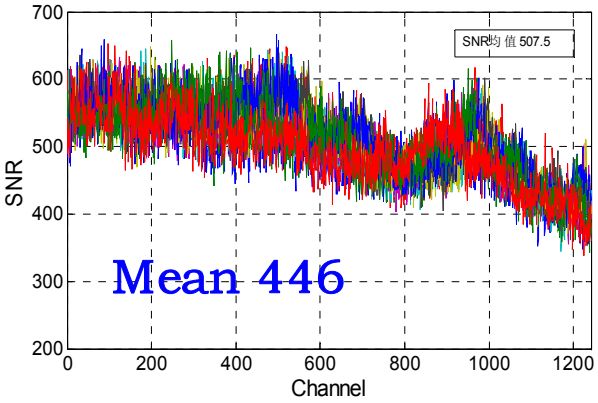


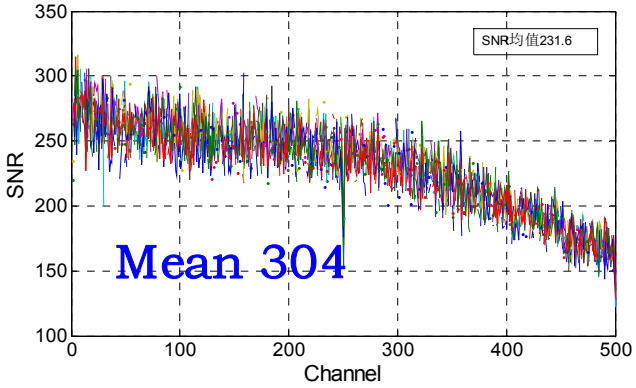
Wavelength grid and SNR

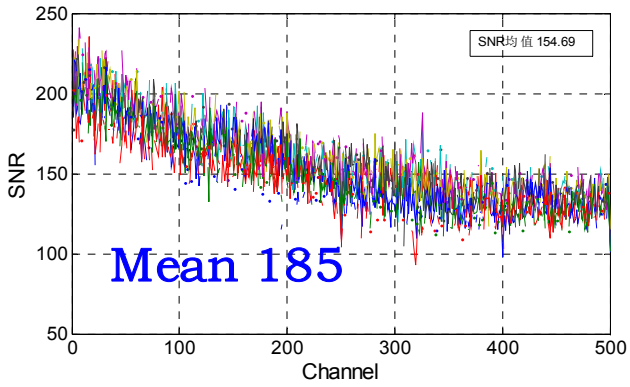












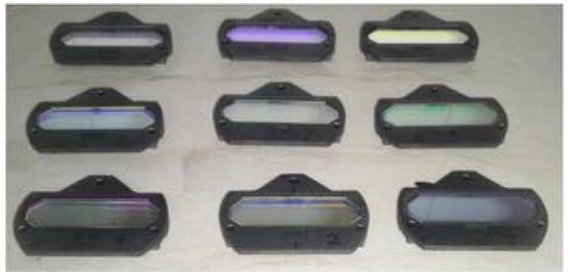
O_2 A band

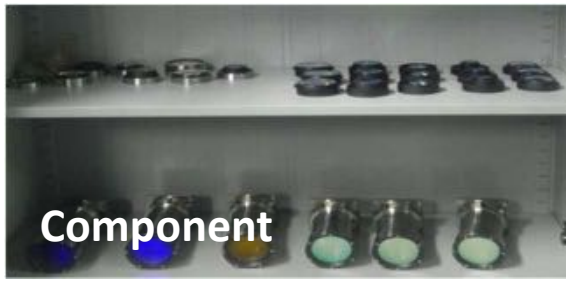
CO_2 weak band

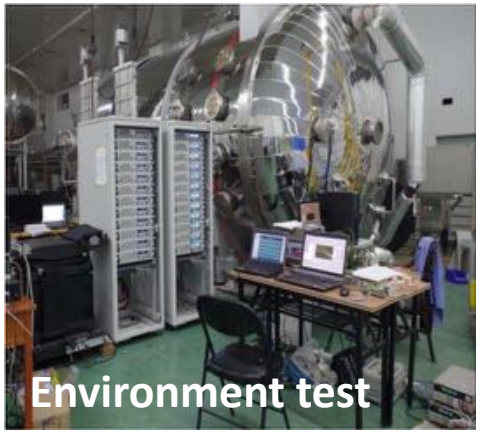
CO_2 strong band

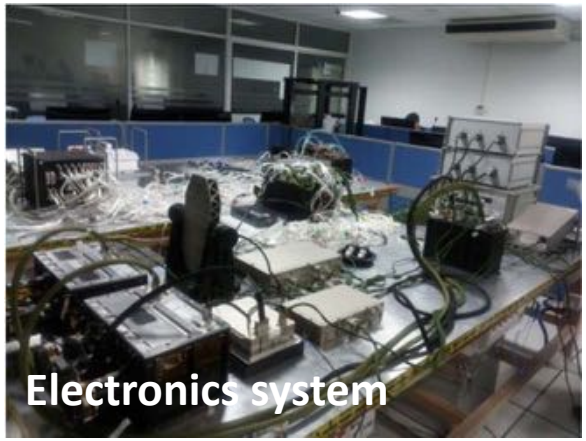
CAPI preflight test

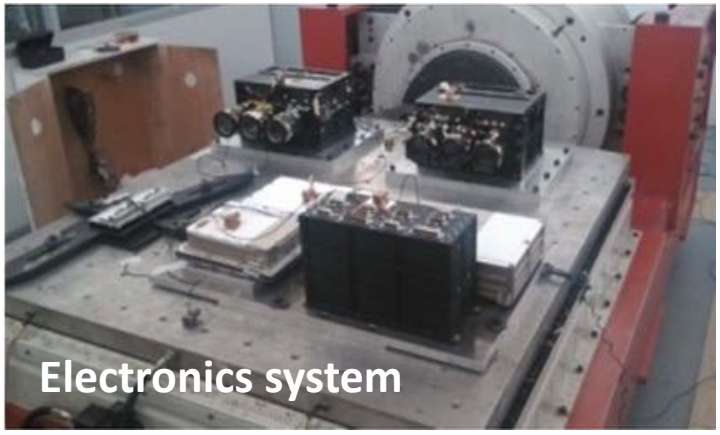

Integration of instrument



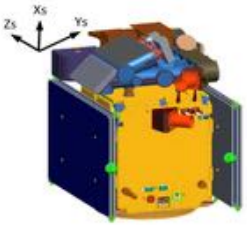

Component

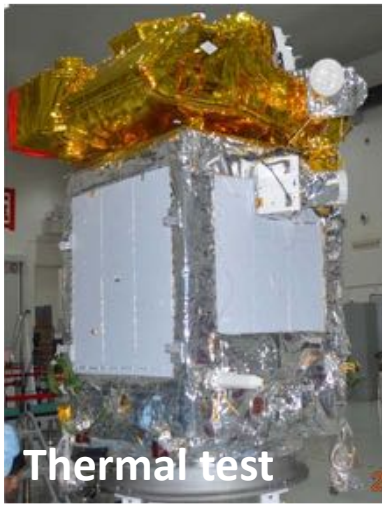

Environment test

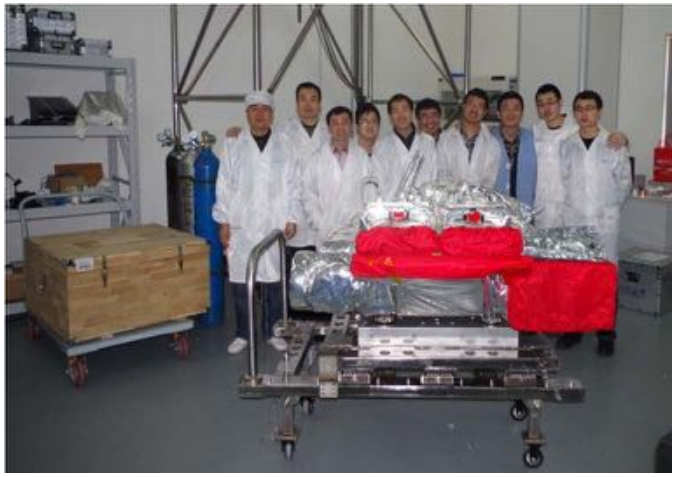

Electronics system

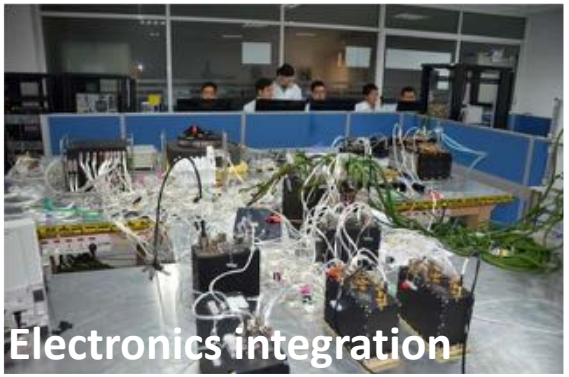

Electronics system

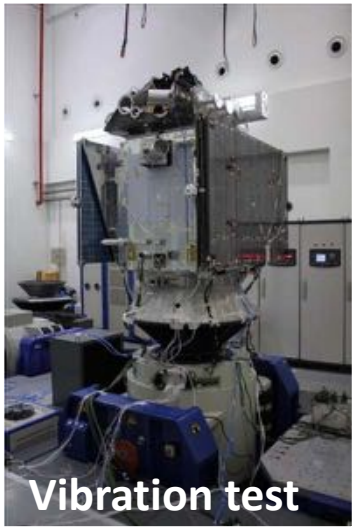
Preflight instrument integration



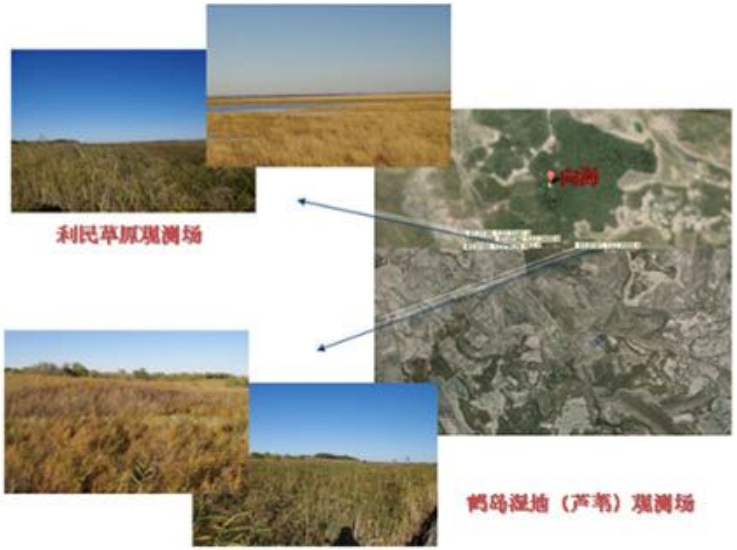

Thermal test

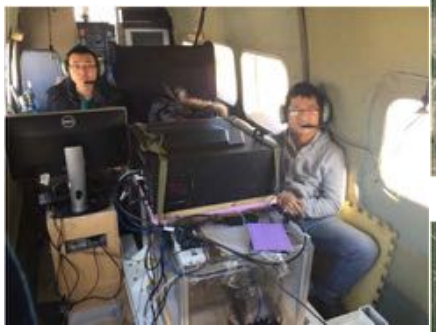


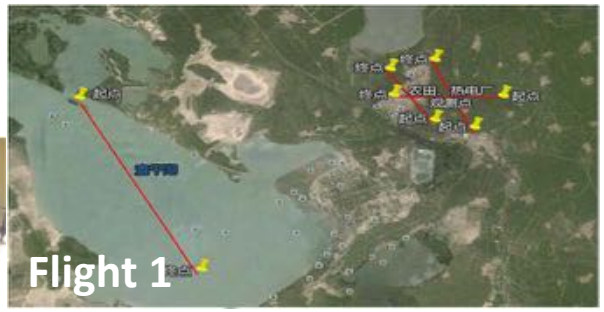

Electronics integration

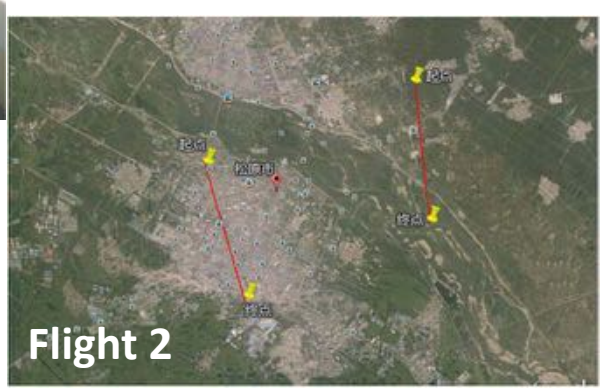

Vibration test

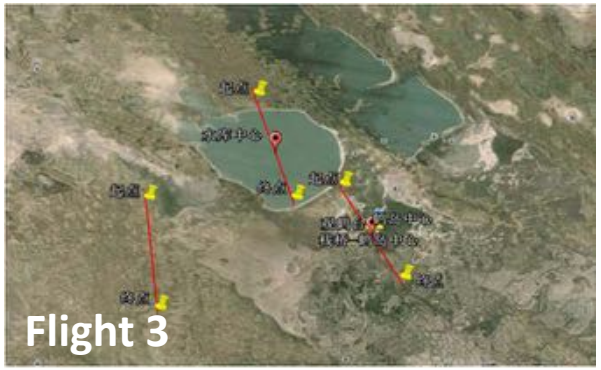
Aircraft experiment





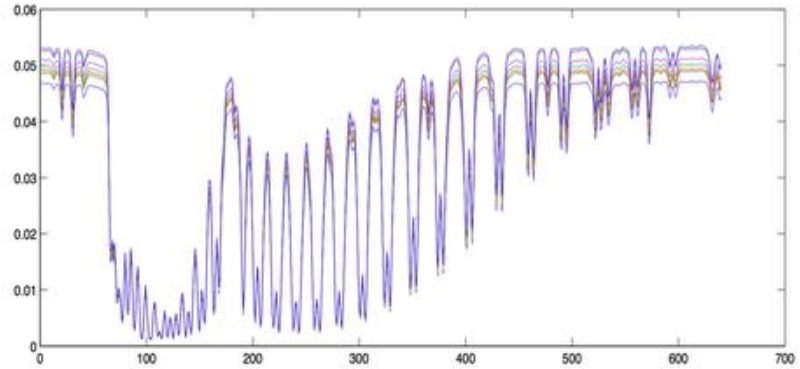


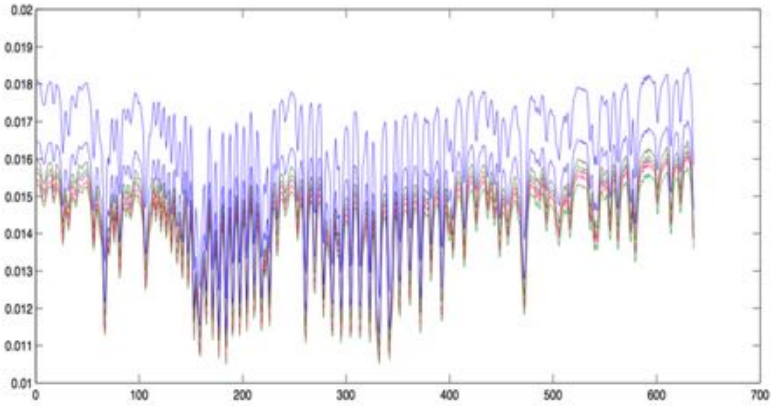




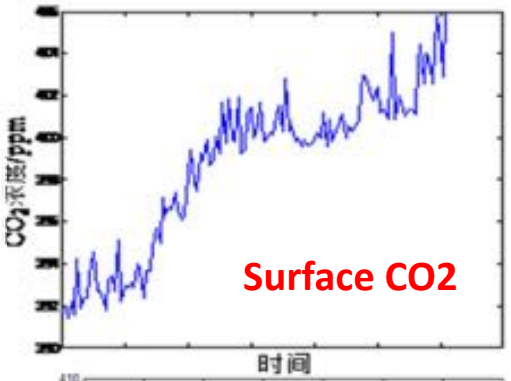
Airborne experiment of CDS (Dr. Yue)

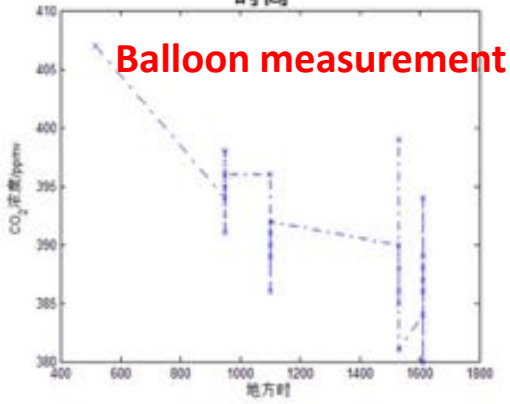
CDS measurement

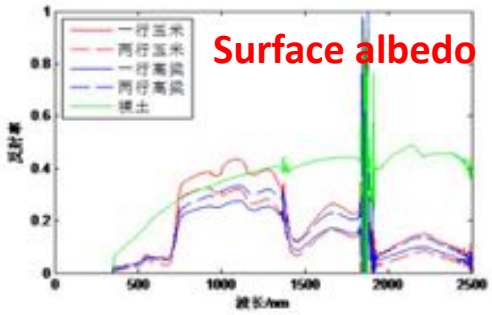


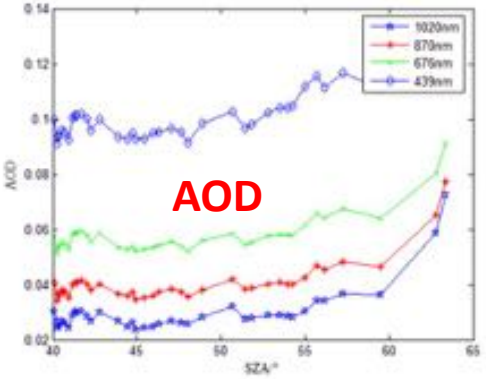


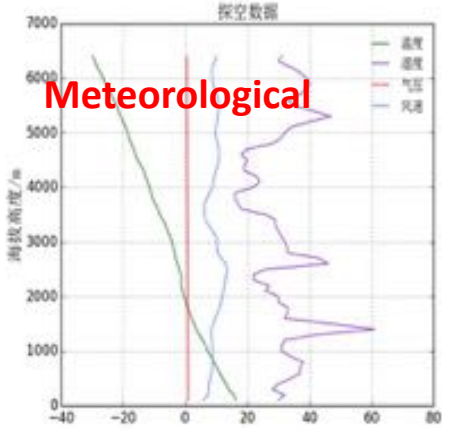
Collaboration measurement











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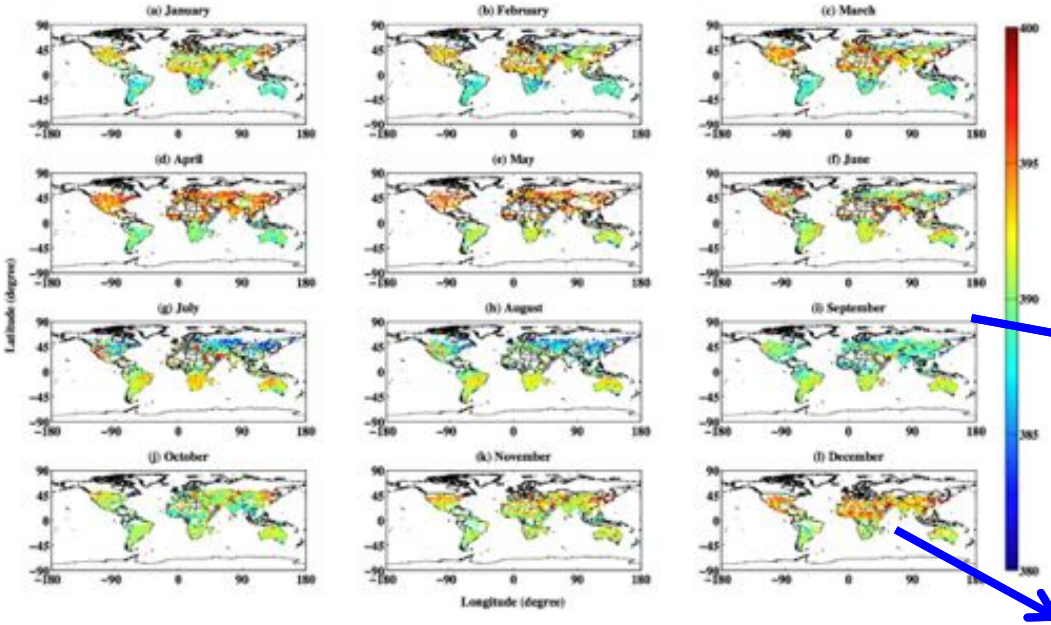
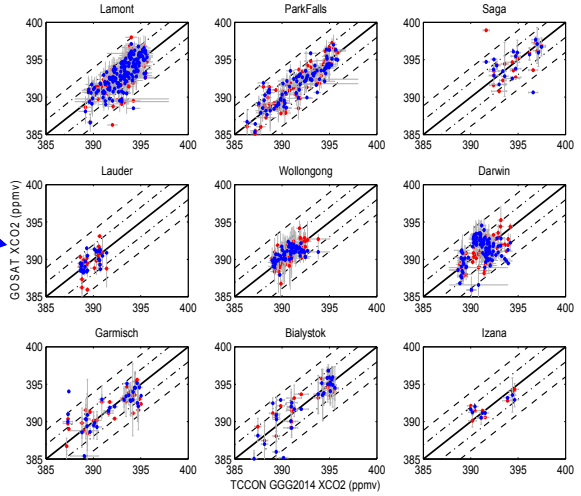
TanSat Retrieval algorithm (D.X. Yang)

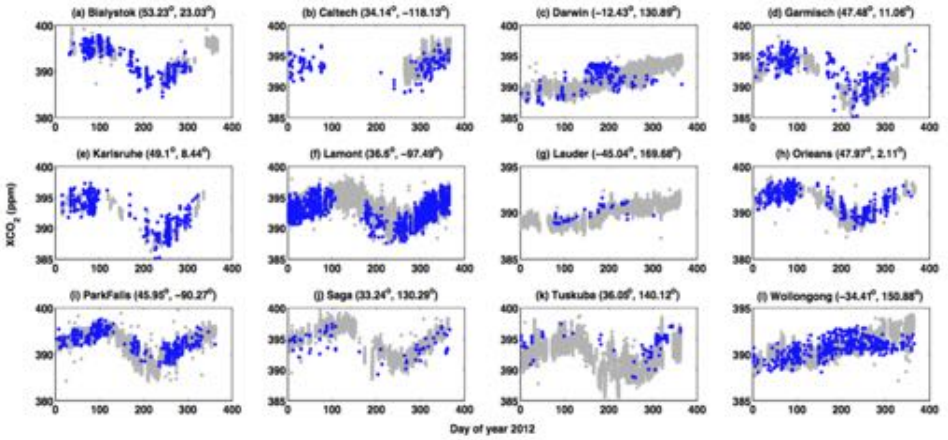


Validation

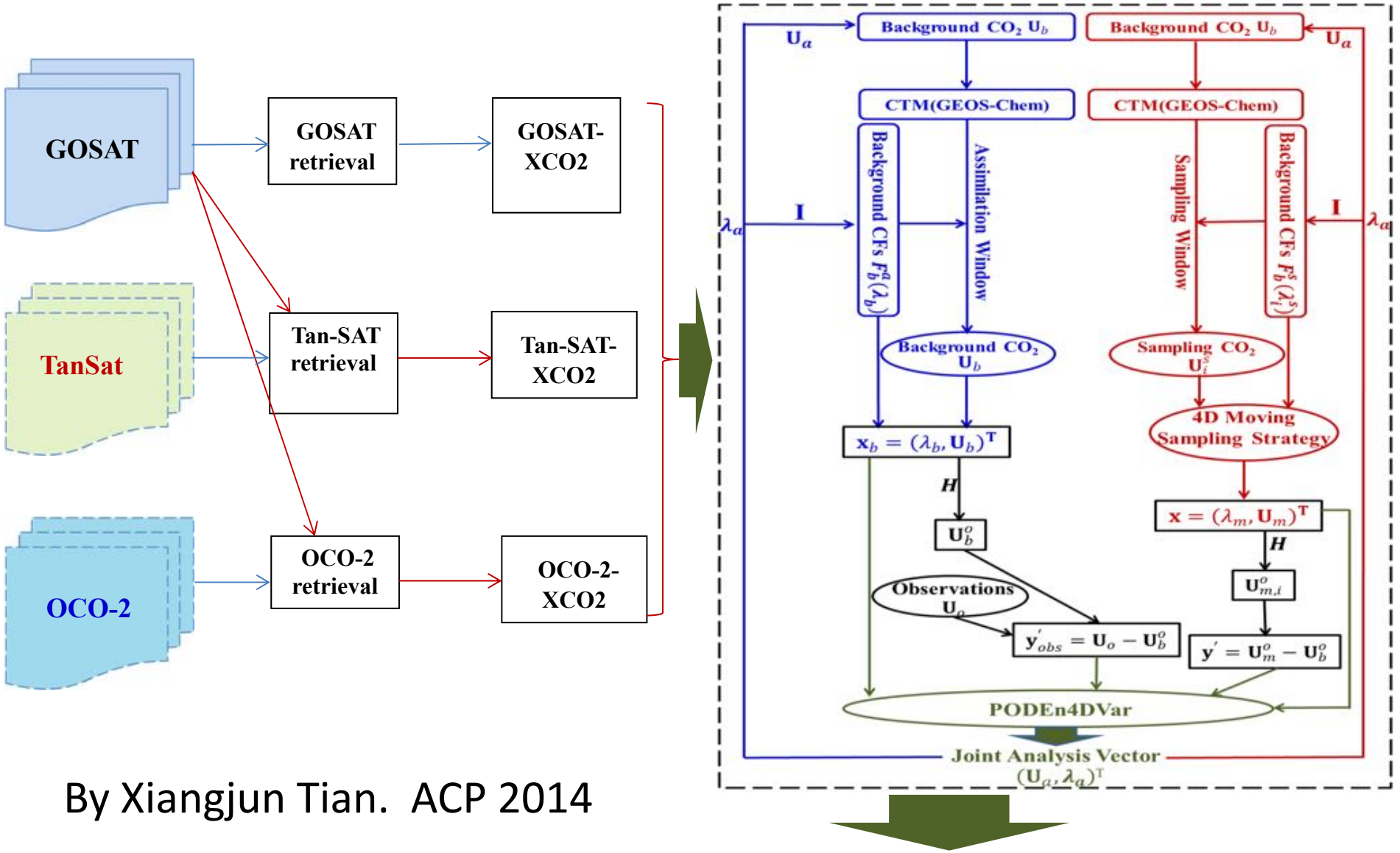
Variation



TCCON site	Latitude (°)	Longitude (°)	IAPCAS-GOSAT	
			Bias (ppmv)	RMSE (ppmv)
Lamont, USA	36.60	−97.49	−0.58	1.41
Park Falls, USA	45.95	−90.27	0.29	1.29
Saga, Japan	33.24	130.29	1.13	2.08
Lauder, New Zealand	−45.04	169.68	−0.11	0.90
Wollongong, Australia	−34.41	150.88	−0.77	0.95
Darwin, Australia	−12.43	130.89	0.62	1.99
Garmisch, Germany	47.48	11.06	2.02	1.89
Bialystok, Poland	53.23	23.03	0.01	1.50
Izana, Tenerife	28.30	−16.50	−1.22	1.31
Mean	–	–	0.15	1.48



CO_2 Flux—inversion model---→ Tan-Tracker



By Xiangjun Tian. ACP 2014

Simultaneously Estimate Surface CO_2 fluxes and 3-D Atmospheric CO_2 Concentrations

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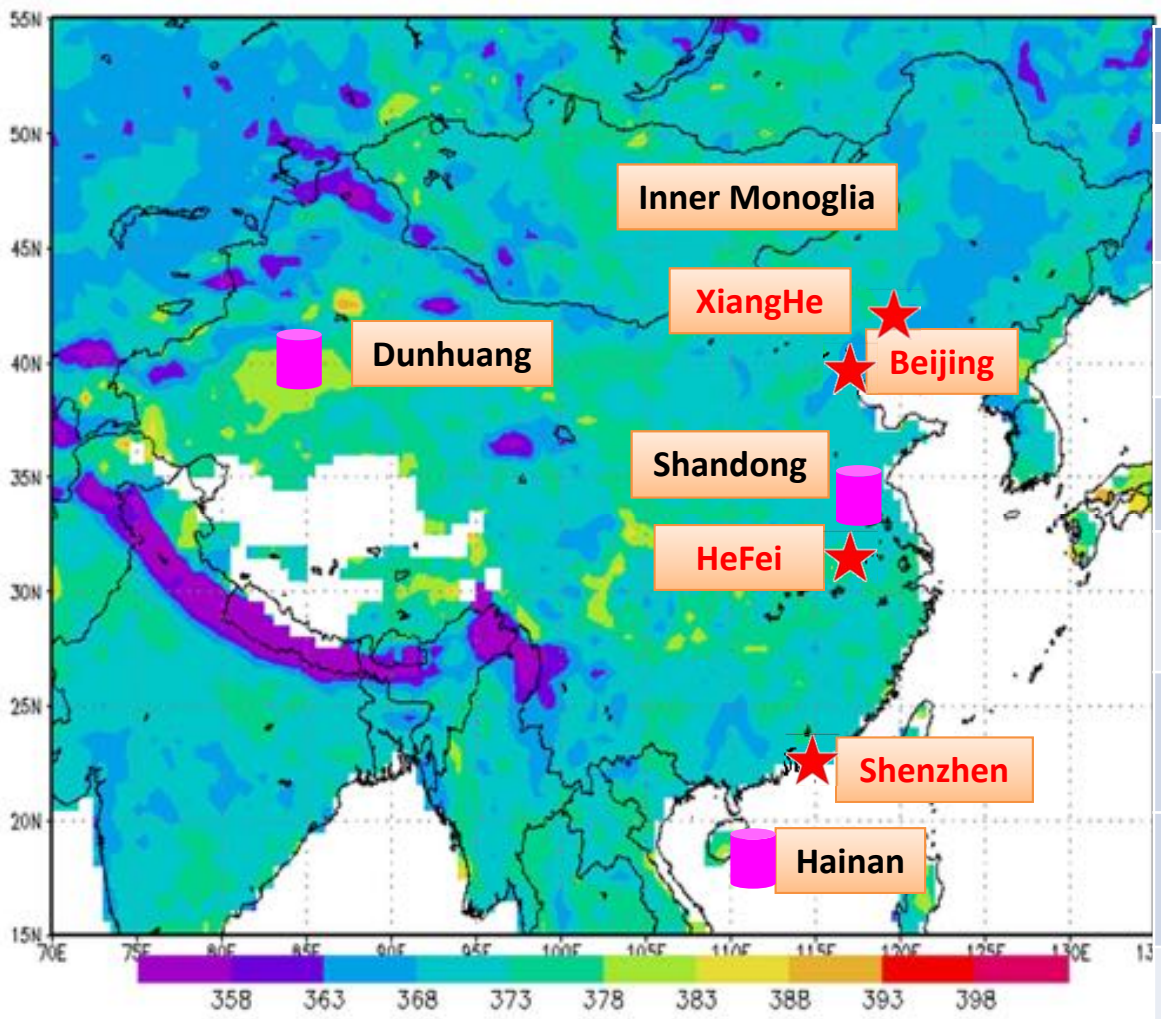
Ground based measurement network

TanSat

Ground-based Measurement Sites in China



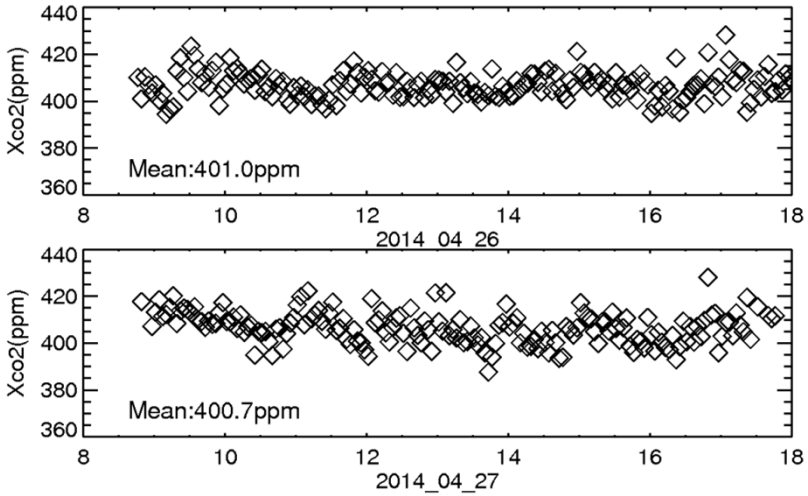
Calibration, Validation & priori data

Ground sites

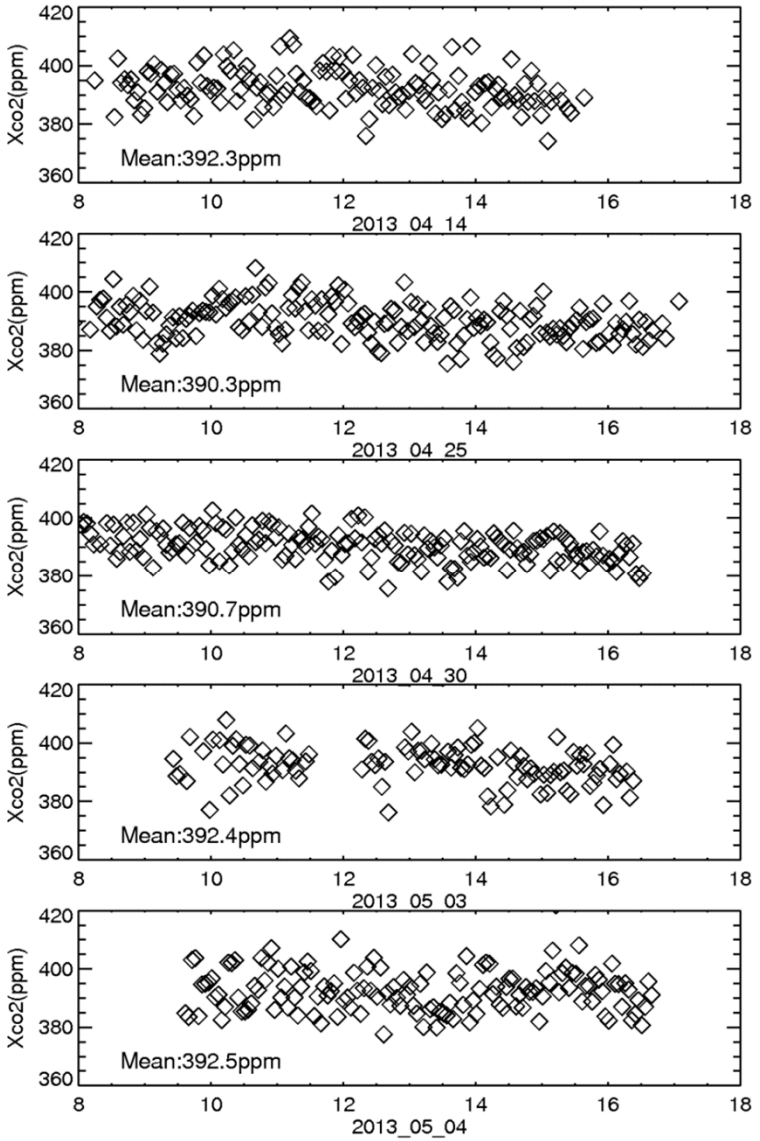
Site	Instrument
Beijing	IFS125/HR CMA
XiangHe	IFS125/HR IAP/CAS
HeFei	IFS 125/HR AIOFM/CAS
Shenzhen	IFS125/HR
Xinglong	IFS 125/M IAP/CAS
Dunhuang	Optical Spectrum Analyzer(OSA)
Shandong	OSA
Hainan Island	OSA

Surface CO2 validation Stations

XCO2 retrieved from Optical Spectrum Analyzer (OSA)

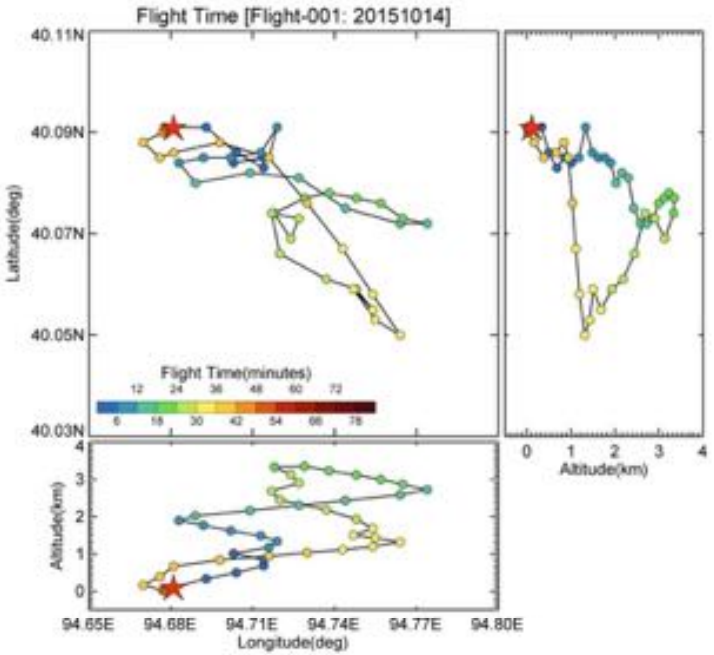


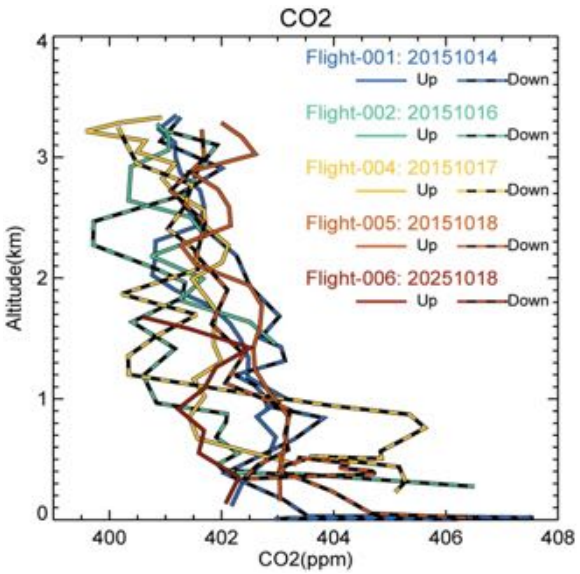
XCO2 from OSA measurement in Dunhuang

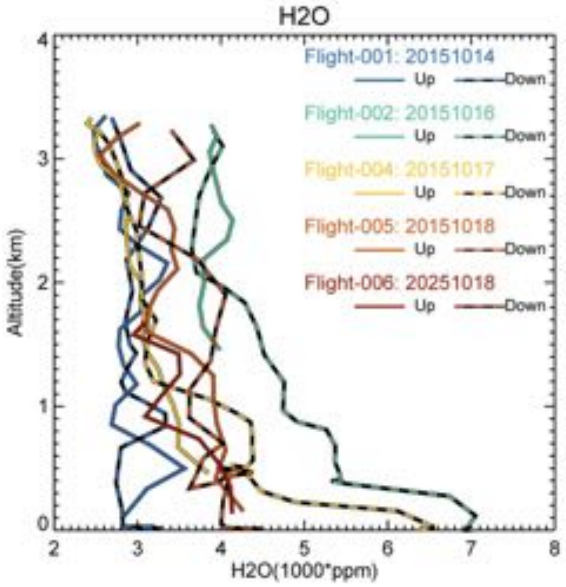


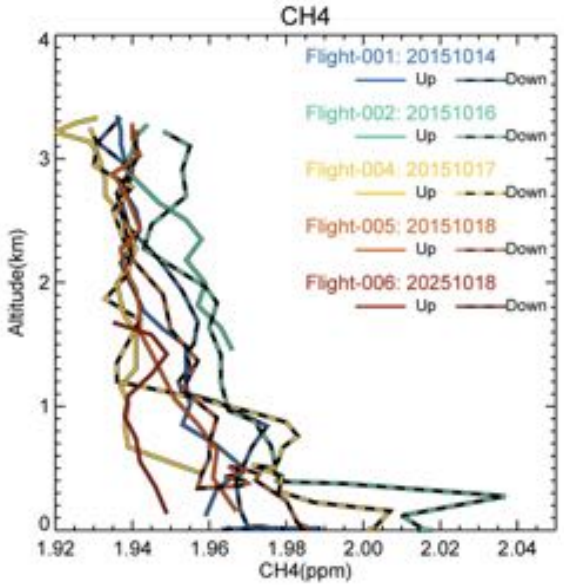
XCO2 from OSA measurement in Shandong

Aircraft measurement of CO2 profile in Dunhuang







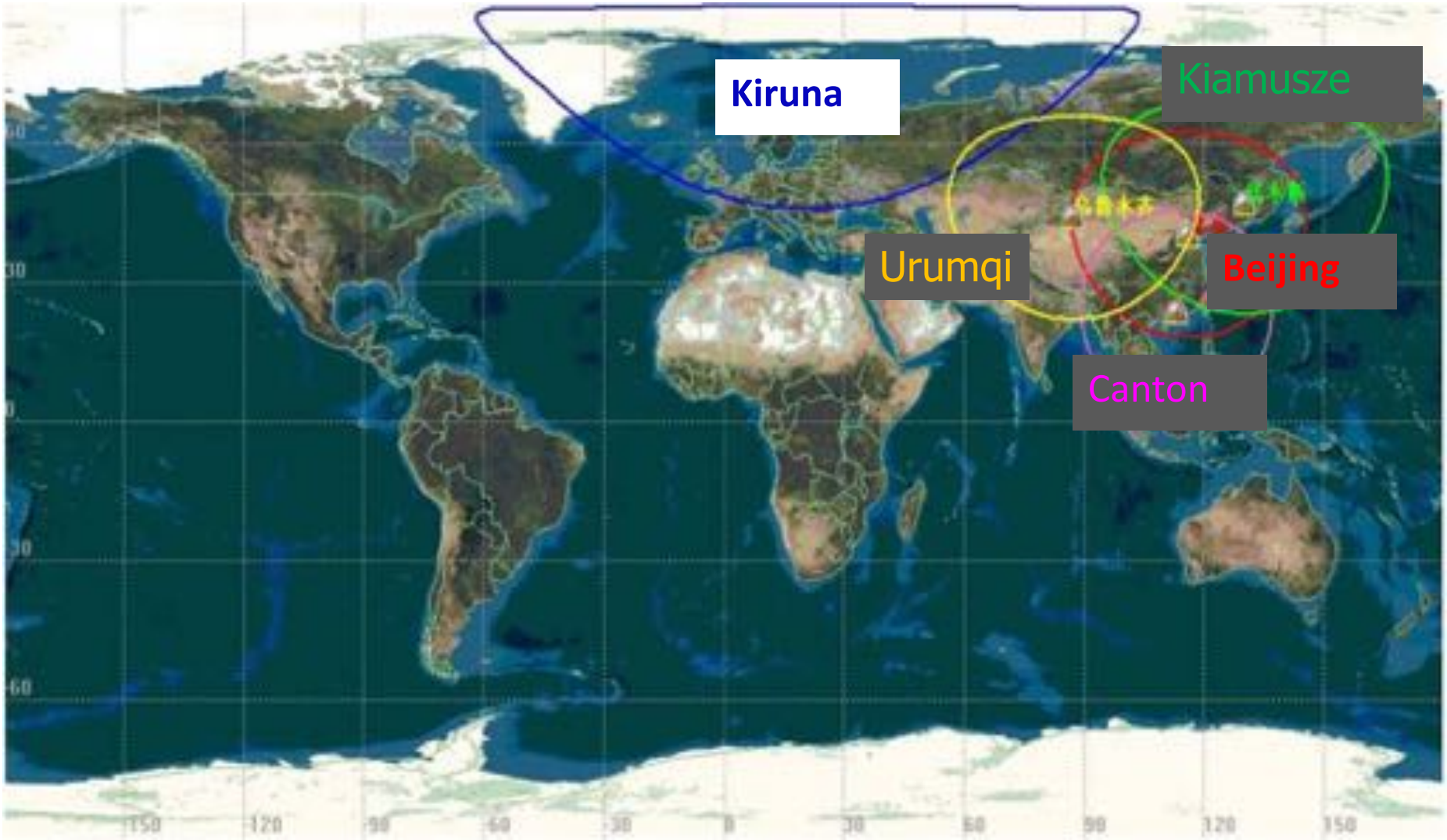


Ground satellite receiving stations —FY Meteorological Satellite system

Five receiving stations:

1. Beijing in China 2. Canton in China 3. Urumqi in China 4. Kiamusze in China

5. Kiruna in Sweden



Outline

1. TanSat Mission
2. Satellite platform & Payload--Current Status
3. Retrieval algorithm
4. Ground based validation
5. Schedule and Plan

2016
Satellite integration test
Preflight algorithm
Launch

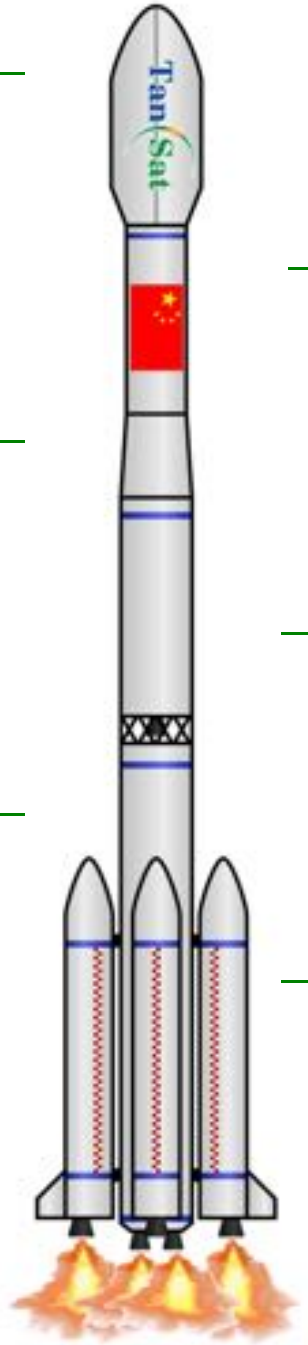
2015
CO_2 Spectrometers
Satellite Readiness Review

2014
Electromechanical Integration
Critical Design Review

2013
Preliminary Design Review

2012
Observation simulation

2011
kick off
Science Requirement Review




Thank You!
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CAS
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