Lunar Calibration Meeting
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GOSAT Lunar Calibration Status towards GOSAT-2

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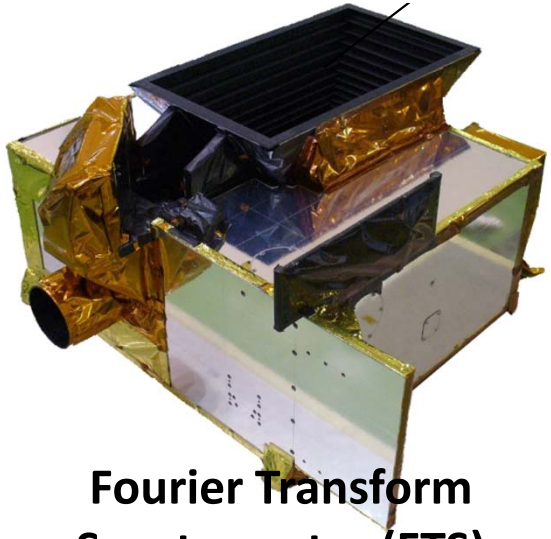
TANSO-FTS and CAI specifications

2009 ~ present in operation

GOSAT

Thermal And Near infrared Sensor for carbon Observation (TANSO)



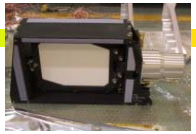
Fourier Transform Spectrometer (FTS)

Cloud and Aerosol Imager (CAI)

Fourier Transform Spectrometer (FTS)	
Mission	GHGs measurements
Band	SWIR-0.76μm, 1.6μm, 2.0μm bands with P/S polarization (O_2-A, CO_2, CH_4, H_2O band)
	TIR-5.5~14.3μm (CO_2, CH_4, O_3 band)
Spec. Res.	0.2cm^{-1}
Swath	750km ex: 5 points / every 180km
Footprint	10.5km

Cloud and Aerosol Imager (CAI)	
Mission	Cloud detection and aerosol correction within FTS IFOV
Band	0.38, 0.67, 0.87, 1.60μm band
Swath	750-1000km
Footprint	0.5 and 1.5km

GOSAT calibrations

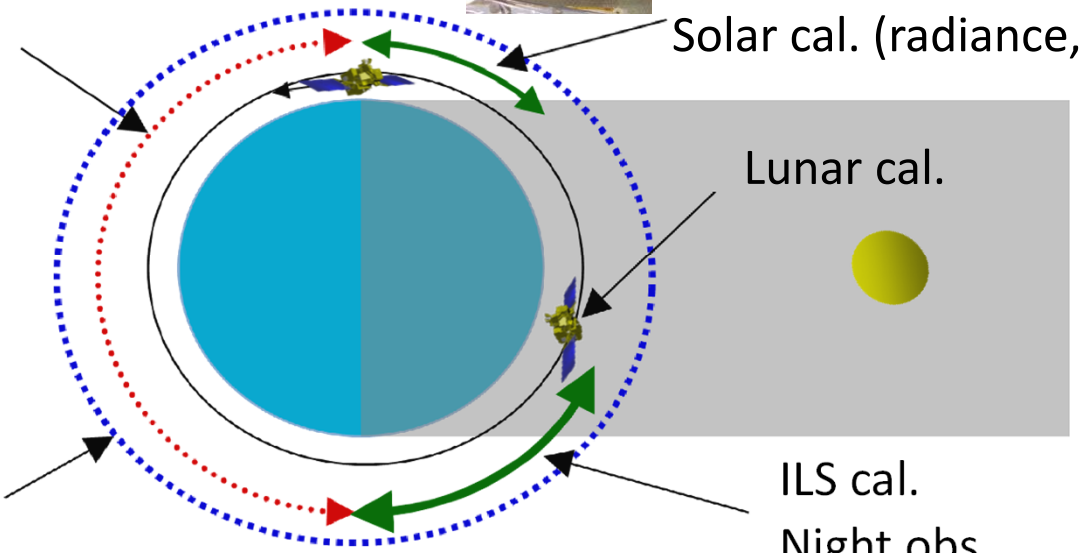


Solar diffuser plate onboard FTS

FTS-SWIR obs.

CAI obs.

Solar cal. (radiance, Fraunhofer)



Lunar cal.

FTS onboard-camera

CAI

FTS-TIR obs.

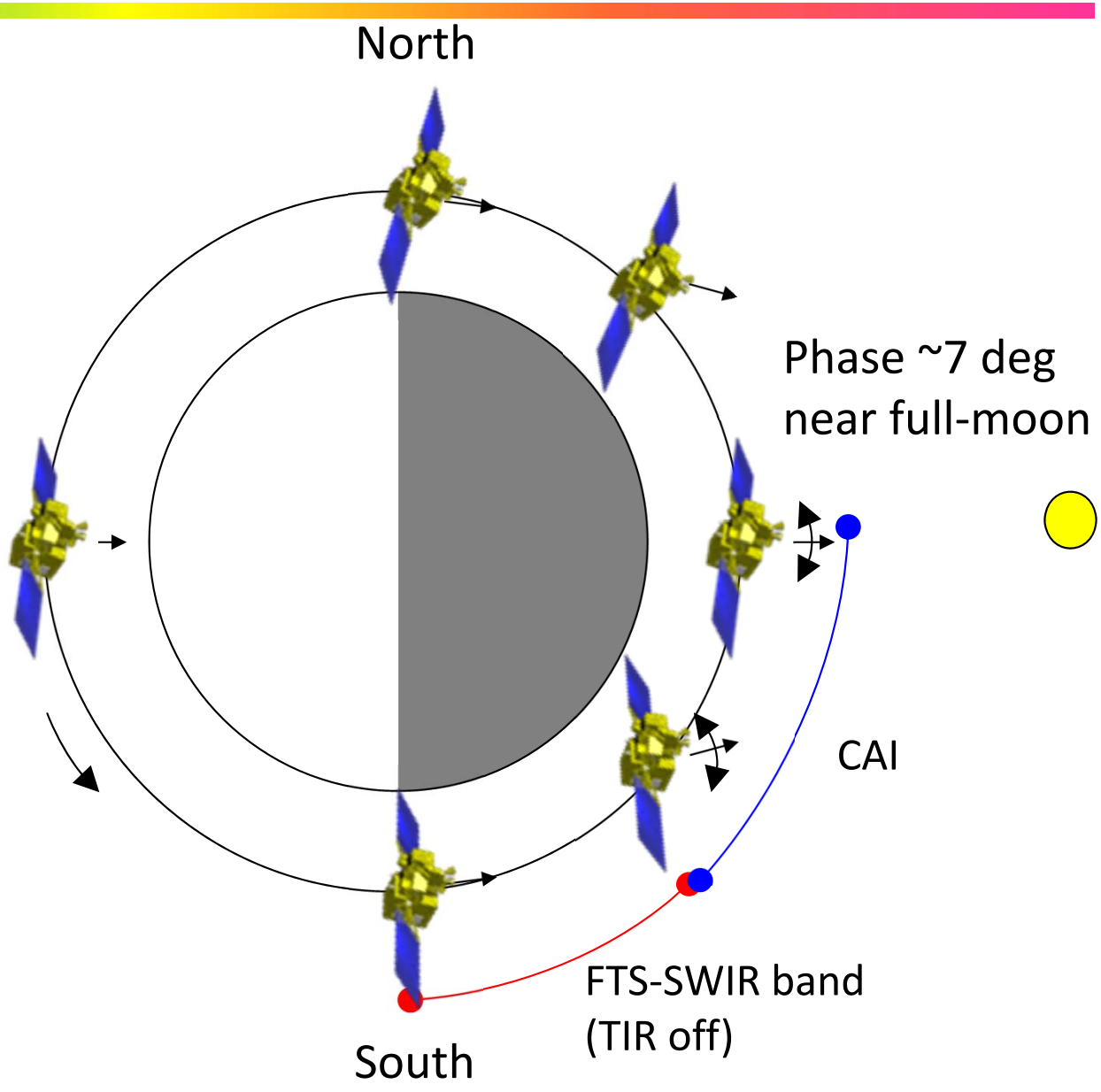
ILS cal.

Night obs.

	FTS				CAI			
	B1P/S 0.76um	B2P/S 1.6um	B3P/S 2um	B4 5.5-14.3um	B1 0.38um	B2 0.67um	B3 0.87um	B4 1.6um
Radiance	Vicarious calibration (1/year) Solar calibration（backside: 1/month） Lunar calibration (2/year)			Vicarious calibration (1/year) Cross comparison (AIRS)	Vicarious calibration（1/year） Lunar calibration (2/year) Dark (Night observation: 1/month)			
Spectral features	Fraunhofer line (spectral shift) ILS calibration (B2P/S: 1/month)			-	-			
Geometry	FTS onboard-camera image is validated by using AVNIR-2.				Validated by using GSHHS			

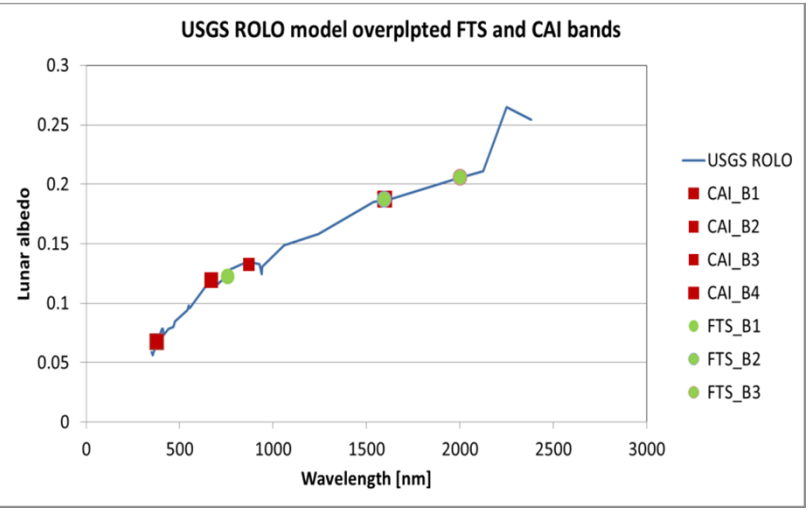
Lunar calibration for GOSAT

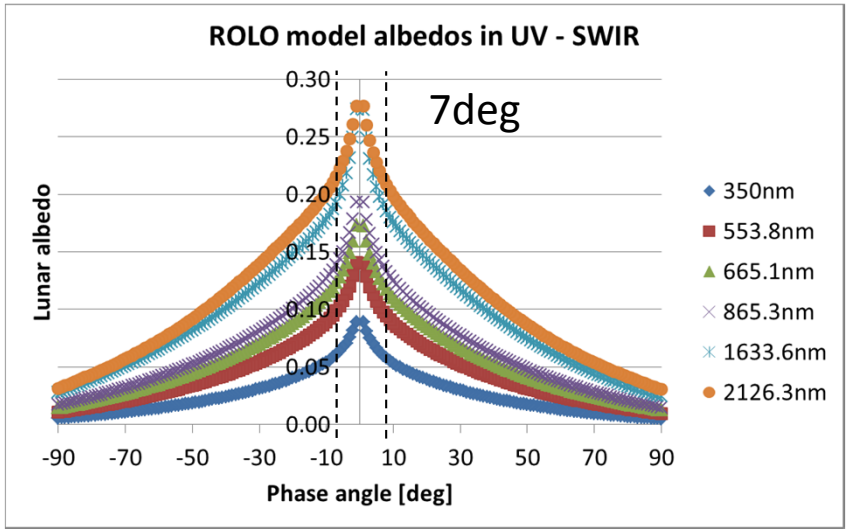
- Radiometric onboard calibration for FTS SWIR and CAI
- For FTS, gazing the moon by the satellite pointing with half IFOV
- For CAI, scanning the moon by the satellite pitch motion
- Once a year (also with backup, i.e. total twice)
- Bright and stable target with observation phase angle of 7 degrees near full-moon



Target moon exploration with lunar albedo model

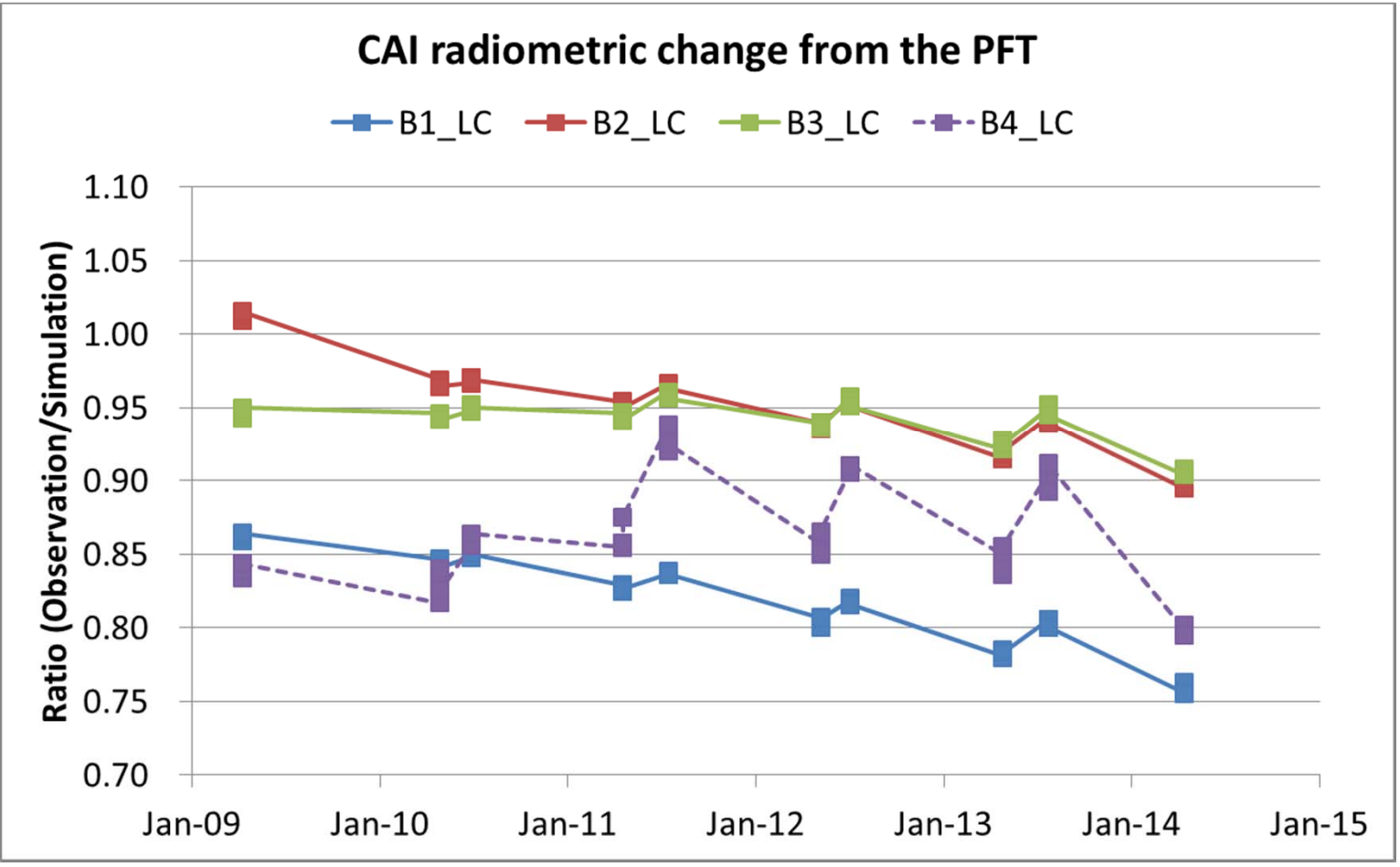
- In the first 2 years, the nearest full moon.
- In the last 4 years, phase angle of 7 deg for avoiding steep albedo change and decreasing the calibration uncertainty.
- The USGS ROLO model [Kieffer and Stone, 2005] is used in this study.

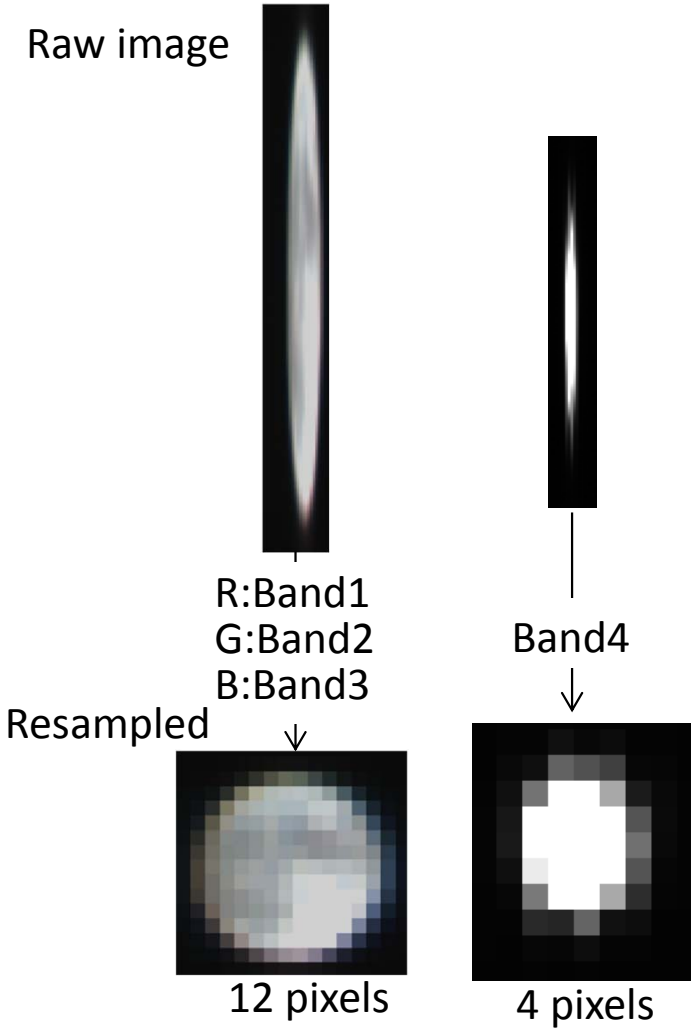




Date	Phase angle
11-Mar-09	3.43 deg
9-Apr-09	4.84 deg
28-Apr-10	4.66 deg
26-Jun-10	2.02 deg
18-Apr-11	7.53 deg
15-Jul-11	7.52 deg
6-May-12	7.53 deg
4-Jul-12	7.33 deg
26-Apr-13	7.17 deg
23-Jul-13	7.51 deg

CAI lunar calibration result

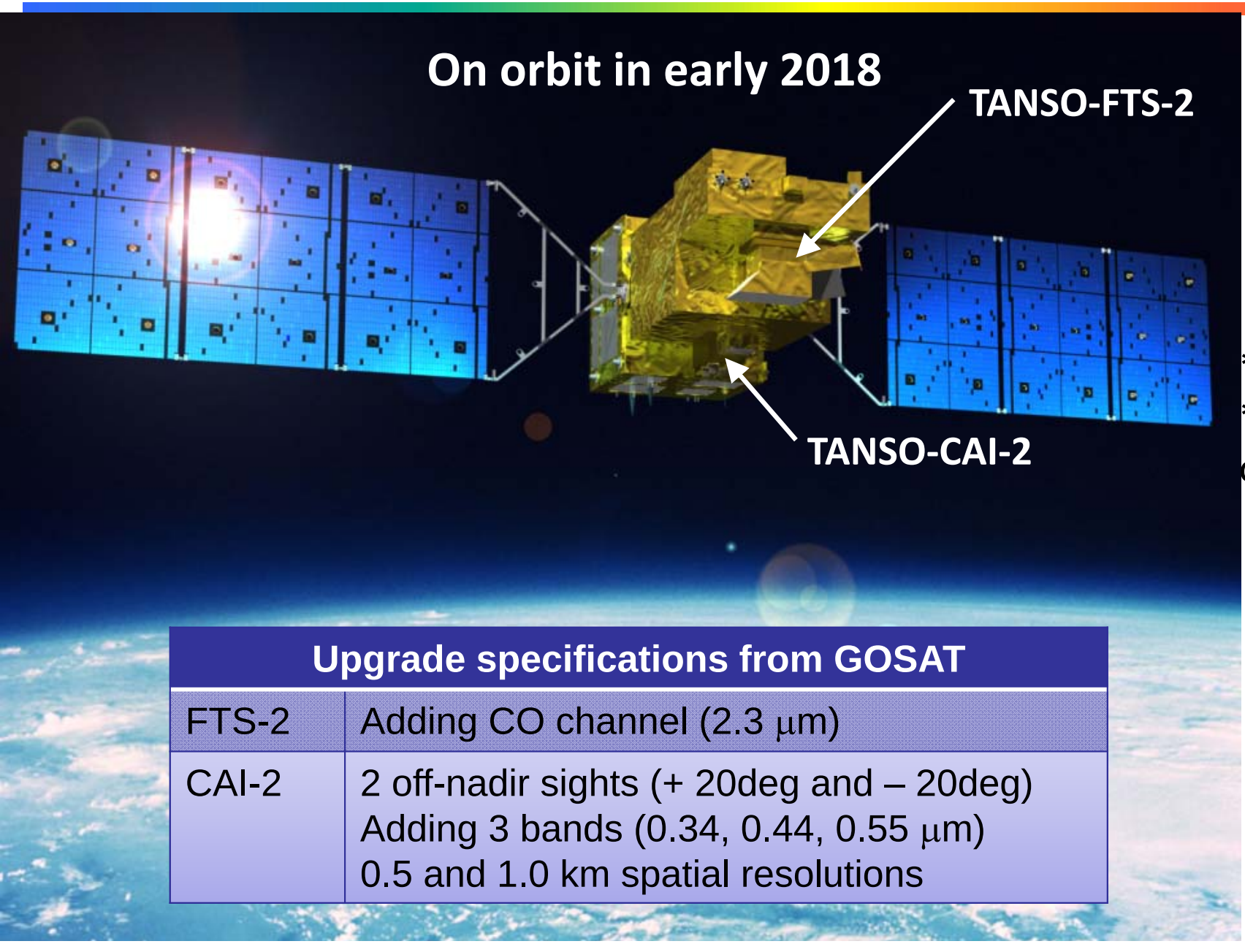




- Band4 IFOV is broader than the identical. It might not be well-evaluated.
- Band1-3 radiometric trends are evaluated well.

CAI lunar observation on 28 April 2010. Images are oversampled in along-track direction.

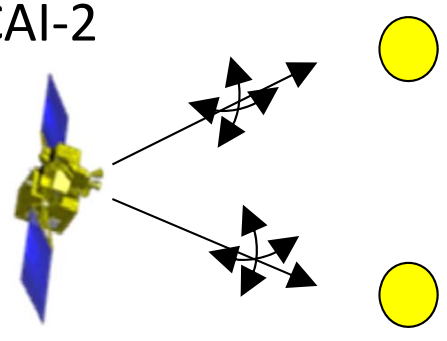
GOSAT-2 lunar calibration plan



Upgrade specifications from GOSAT	
FTS-2	Adding CO channel (2.3 μm)
CAI-2	2 off-nadir sights (+ 20deg and – 20deg) Adding 3 bands (0.34, 0.44, 0.55 μm) 0.5 and 1.0 km spatial resolutions

GOSAT-2 lunar cal

CAI-2



*AT scan for radiometry
*CT scan for PRNU correction (upgrade)

FTS-2

*SWIR for radiometry
*TIR signal output (upgrade)

Summary

- GOSAT has operated lunar calibration around April and July every year since 2009 for radiometric calibration.
- GOSAT targets the moon with observation phase angle around 7 deg.

- CAI observes the moon with a linear array sensor of 0.38-1.6 microns by pitch (along-track) scan operation.
- FTS observes the moon with a half size of the IFOV of 0.78-2.0 microns in high resolution. (not shown here)

- GOSAT-2 will be upgraded in FTS-2 by adding 2.3micron channel, while CAI-2 by extending to 0.34 micron.
- CAI-2 will also examine the photo response non-uniformity (PRNU) by yaw (cross-track) scan operation.