

# CALVAL JAXA Agency Report

16:00- September 2016

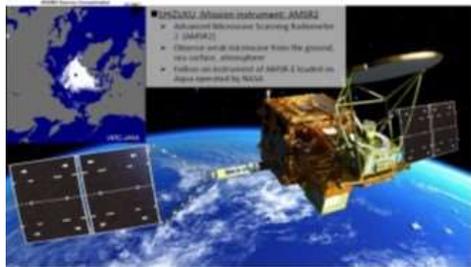
100th Anniversary Hall at Senju Campus  
Tokyo Denki Univ.



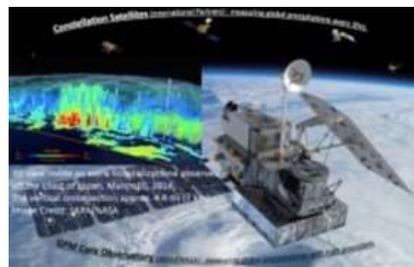
# JAXA's earth observing instruments from space



## Non-optical



AMSR2 on GCOM-W (2012-)



DPR on GPM (2014-)



SAR on ALOS-2 (2014-)



CPR on EarthCARE (near future)

CAL & VAL of ALOS-2 will be presented on Wed. 7

## Optical



GOSAT (2009-)



GCOM-C (near future)



GOSAT-2 (near future)

# Updates since the 40<sup>th</sup> meeting in Canberra



SGLI on GCOM-C : Prelaunch calibration completed

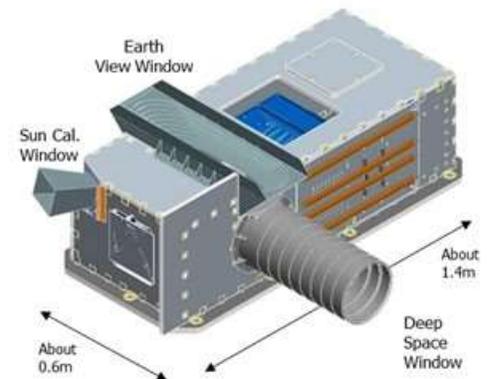
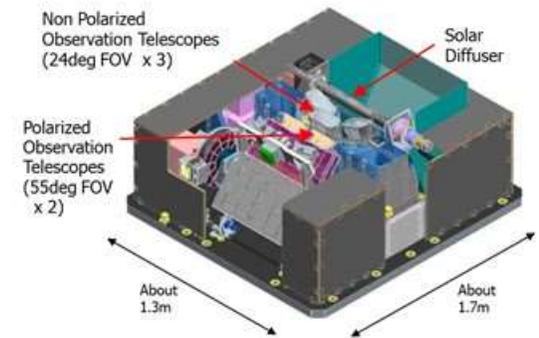
EarthCARE : Final test

To be delivered to ESA

GOSAT : 8<sup>th</sup> annual vicarious calibration and validation campaign  
CAL & VAL remaining issues (TIR, UV, bright surface)

Himawari: 9 will be launched on Nov. 1, 2016 from Tanagashima  
JAXA Himawari Monitor

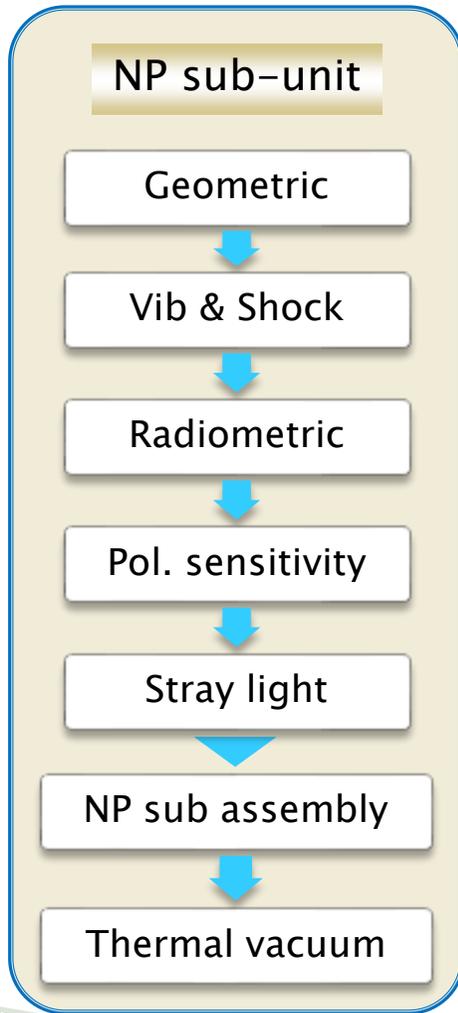
# SGLI (Second Generation Global Imager) on GCOM Status



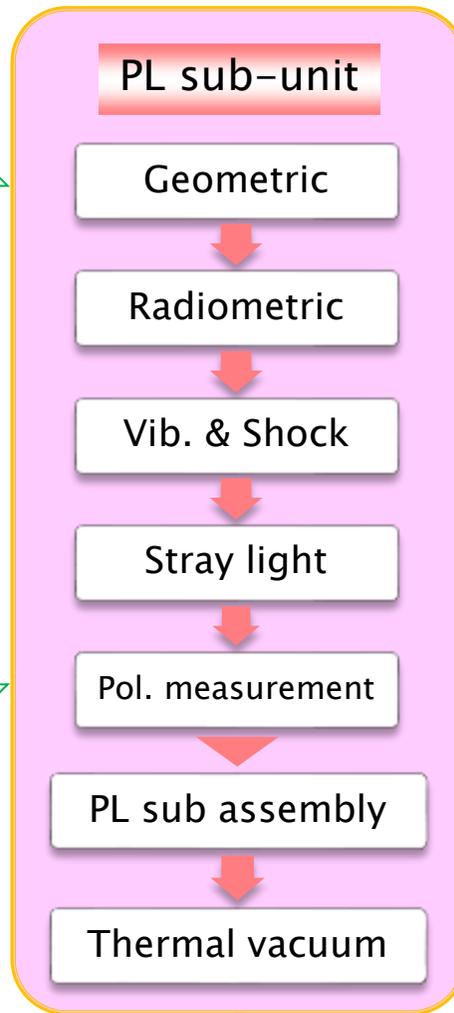
Sensor Unit	Features
SGLI VNR	Non Polarized Observation ( 11ch ), IFOV 250m, Swath 1150km Polarized Observation ( 2ch ), IFOV 1km, Swath 1150km
SGLI IRS	Shortwave Infrared ( SWI 4ch ), IFOV 250m/1km, Swath 1400km Thermal Infrared ( TIR:2ch ), IFOV 500m, Swath 1400km

# VNR Proto Flight Test Flow

*completed*

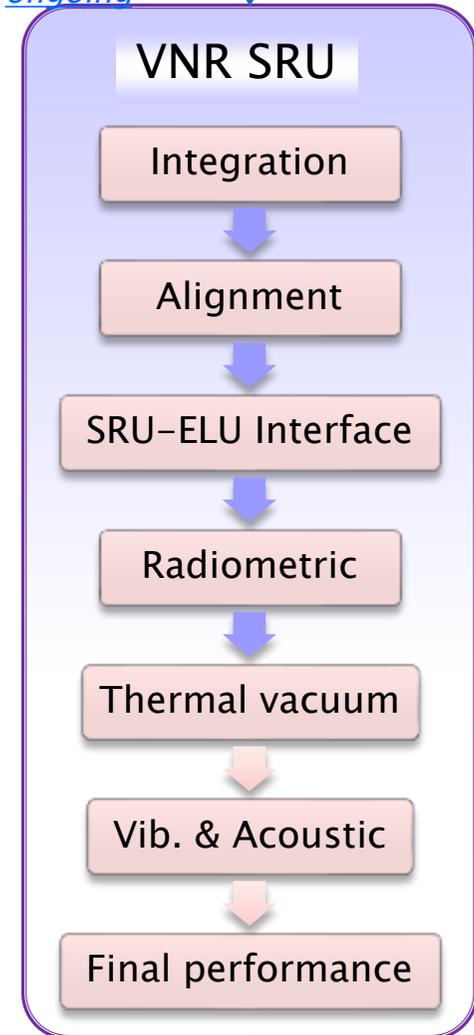


*completed*



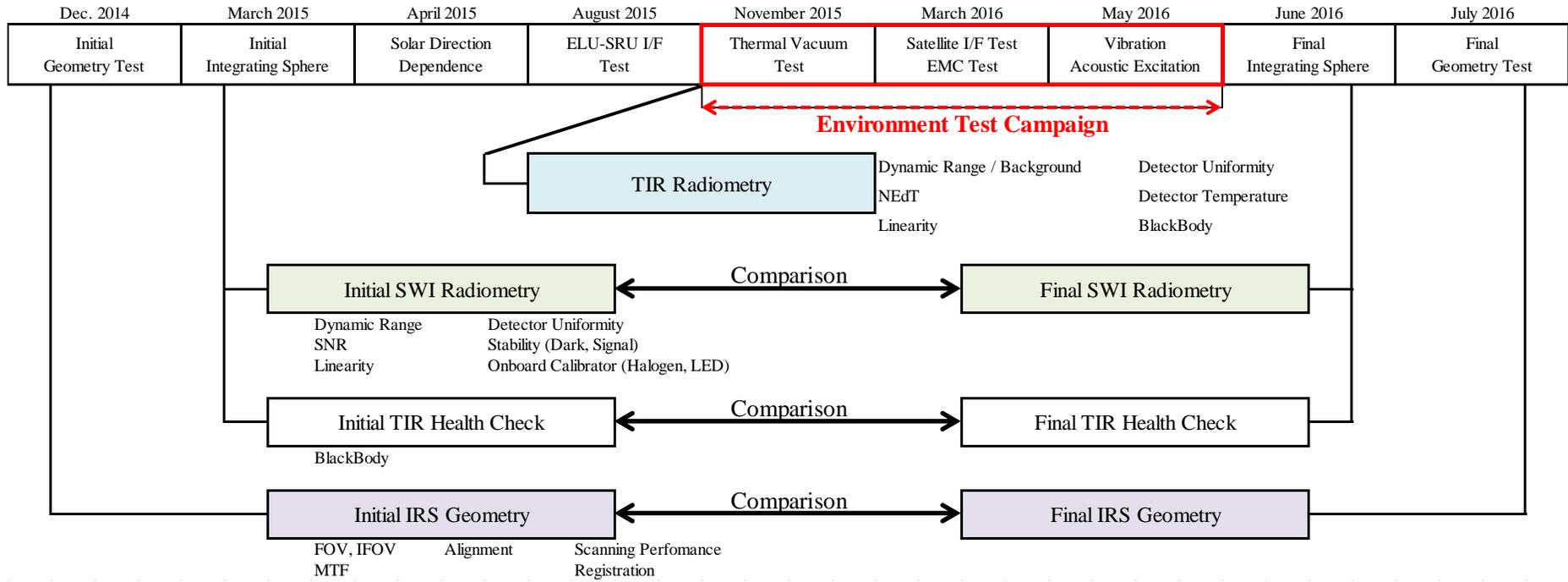
NP/PL sensor Phase

*ongoing*



NP: non-polarized  
PL: Polarized

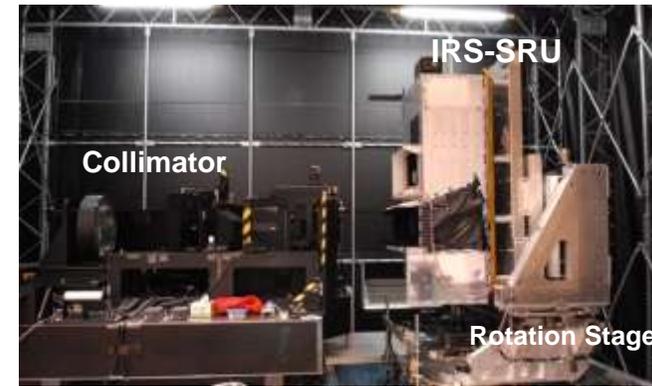
# Verification Flow of IRS-SRU PFT



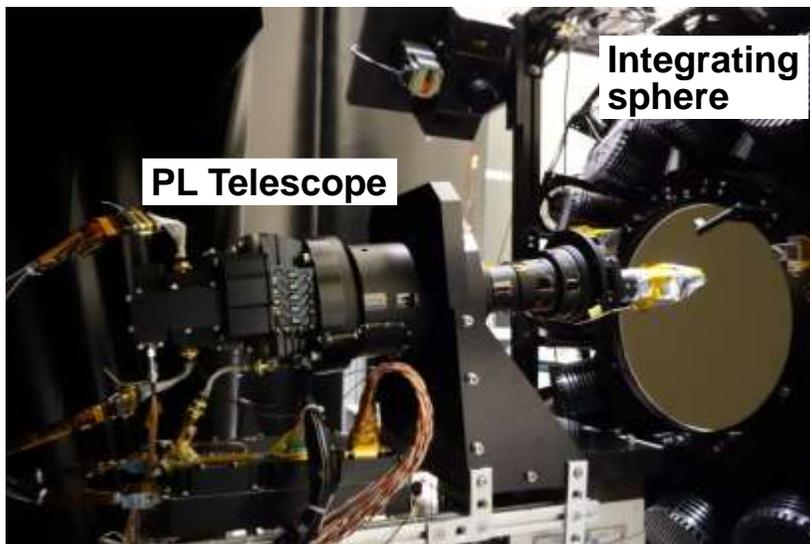
## SWI Radiometry

## TIR Radiometry

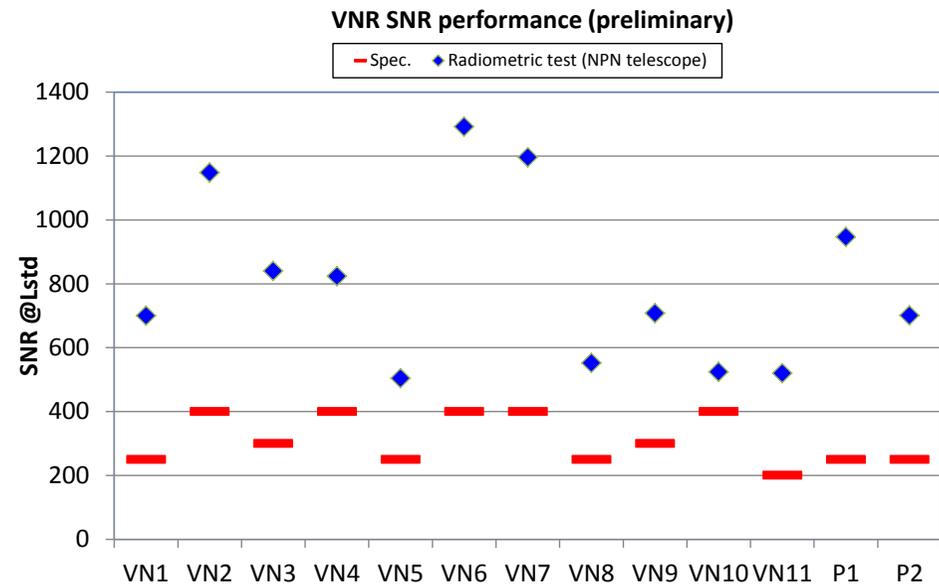
## IRS Geometry



- Radiometric tests of VNR telescopes were completed.
  - Using the 1mφ BaSO<sub>4</sub> integrating sphere
  - Characterize radiometric performances:
    - ✓ SNR, dynamic range, linearity, PRNU, gain stability, etc.
- SRU-level radiometric tests will be carried out.



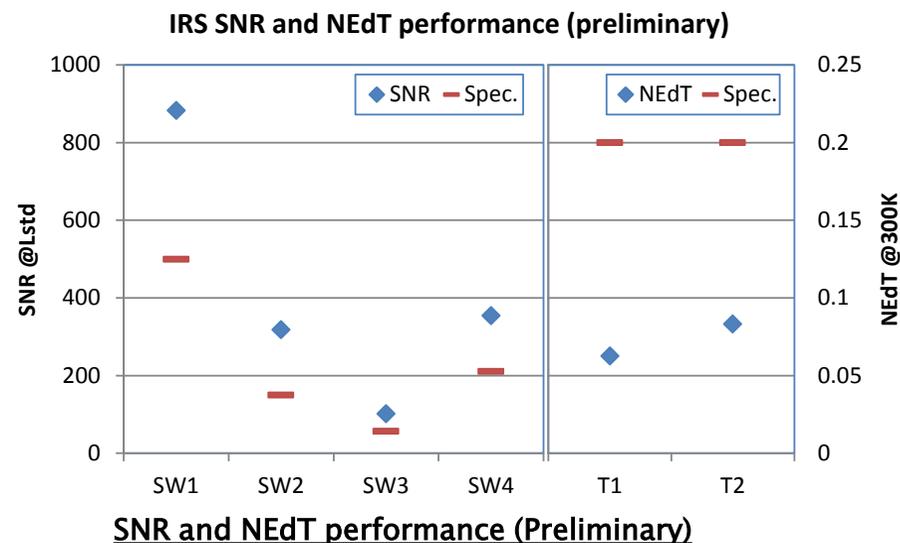
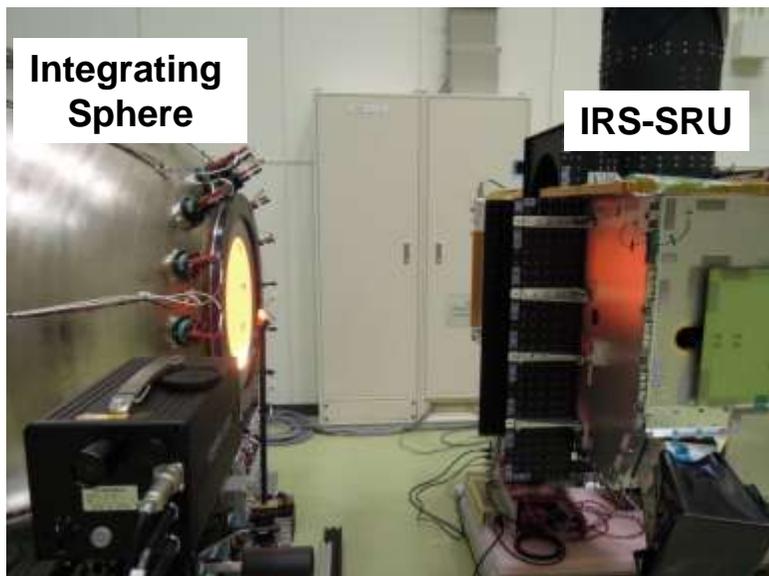
Radiometric test configuration

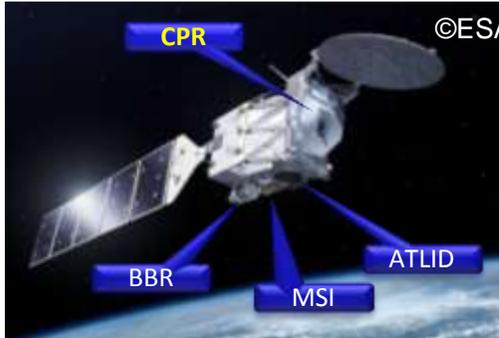


SNR performance of VNR (Preliminary)

# IRS SRU radiometric test

- Initial Radiometric test of SWIR bands was completed.
  - Using the gold-coated integrating sphere
    - ✓ Achieve flat reflectivity in SWIR region
    - ✓ Reduce water vapor effect in the test room (esp. SW2 band)
  - Characterize radiometric performances;
    - ✓ SNR, dynamic range, linearity, PRNU, gain stability, etc.
- Radiometric characterization of TIR bands
  - Will be performed in the T/V test using high emissivity blackbody.





**CPR: Cloud Profiling Radar**



**ATLID: Atmospheric Lidar**



**MSI: Multi-Spectral Imager**



**BBR: Broad-Band Radiometer**

CPR Engineering Model



@ Tsukuba Space Center

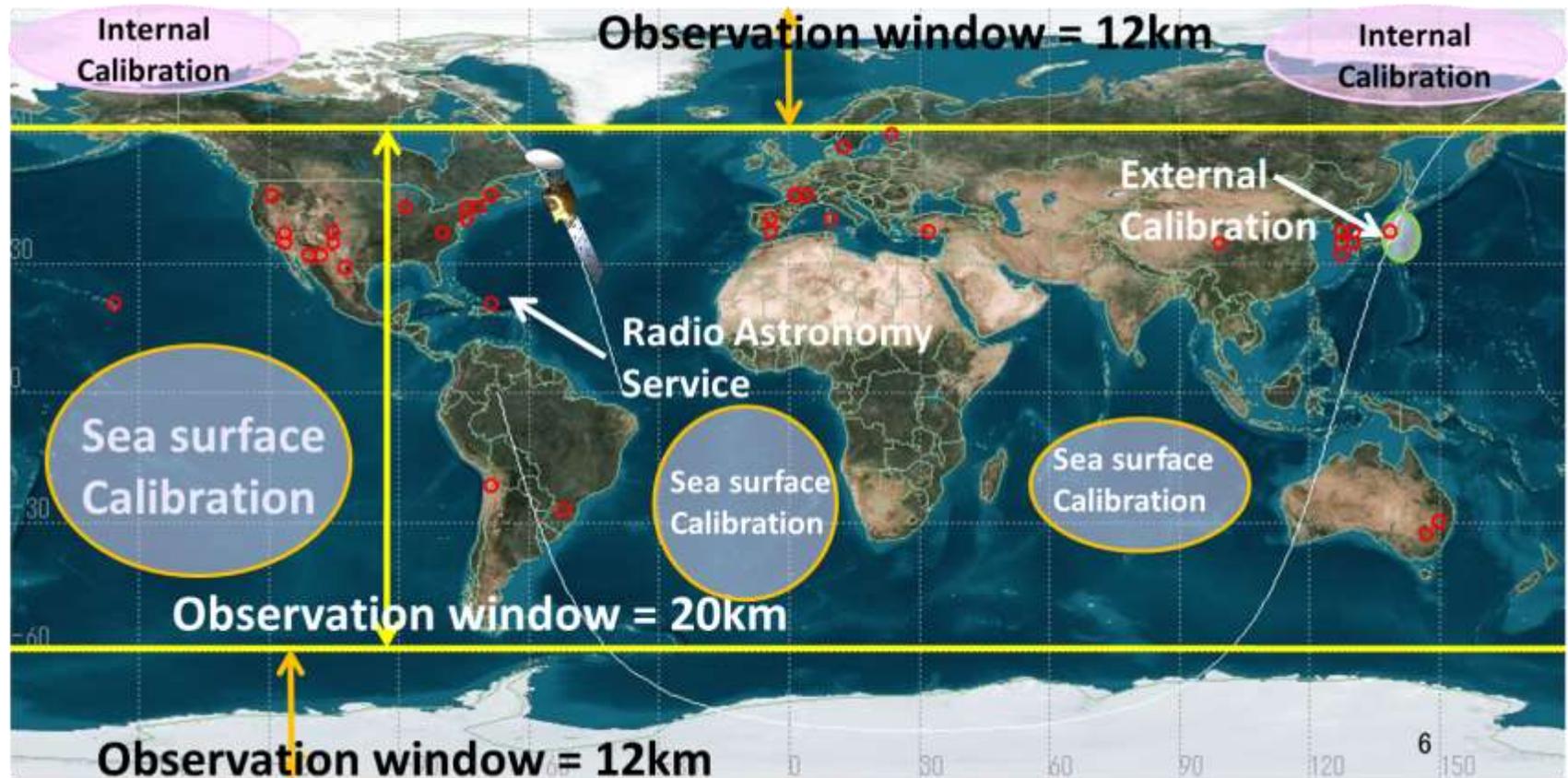
- CPR measures the upward and downward flow velocity
- 2.5m-diameter main reflector with ultra-fine geometrical tolerance and W-band 1.5 kW transmitter and receiver, center frequency 94.050 GHz
- CPR measures reflectivity and Doppler velocity: 20 km, 16 km, 12 km.

## Status

CPR will be delivered to ESA this fiscal year.

Proto Flight Test is ongoing: vibration test etc.

- Geometric calibration (antenna beam pointing)
- Radiometric calibration (sensitivity)
- Doppler velocity calibration



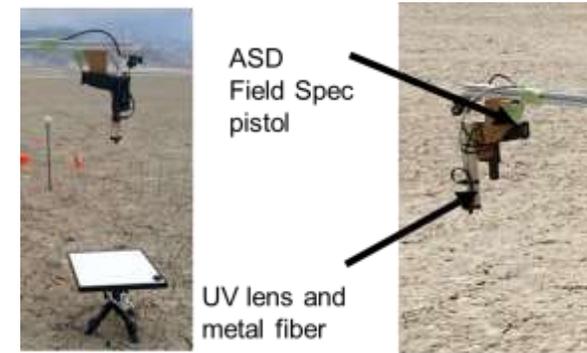
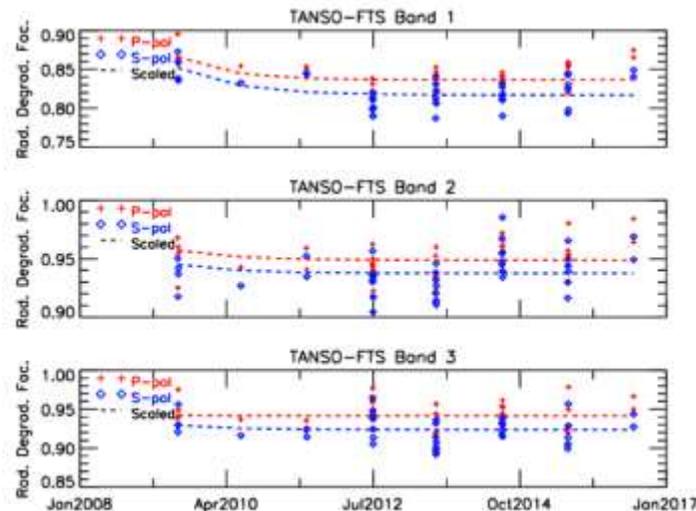


# GOSAT (2009-) and GOSAT-2

Newly introduced items in CAL & VAL 2016 campaign



- (1) VAISALA new system
- (2) EM27 mid IR for carbon monoxide CO (for GOSAT-2) with stainless steel mirrors and cryo-cooler
- (3) USB4000 UV spectrometer (300-350nm reflectance) for GOSAT-2
- (4) Prede Ultra sonic Anemometer (wind direction and speed) for validation
- (5) NASA Ames AJAX airplane for validation and TIR radiometric validation



TANSO-FTS radiance degradation factor since 2009



# GOSAT (2009-) and GOSAT-2



TANSO-FTS TIR radiometric validation and new level 1b product release

## Nonlinear correction updates

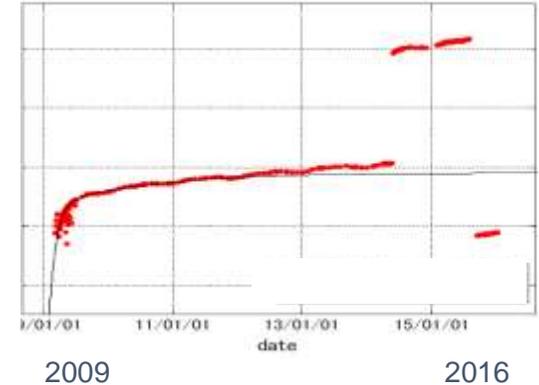
$$V_{NLcorrected} = V_{Pamp} + a_{nlc} V_{Pamp}^2$$

$$a_{nlc} = 0.6056 > 0.7057$$

$$V_{Pamp} = - \left( \frac{(V_{DC} - V_{DCoffset}(time))}{g_{DC}} \right) - \frac{V_{AC}}{g_{AC}}$$

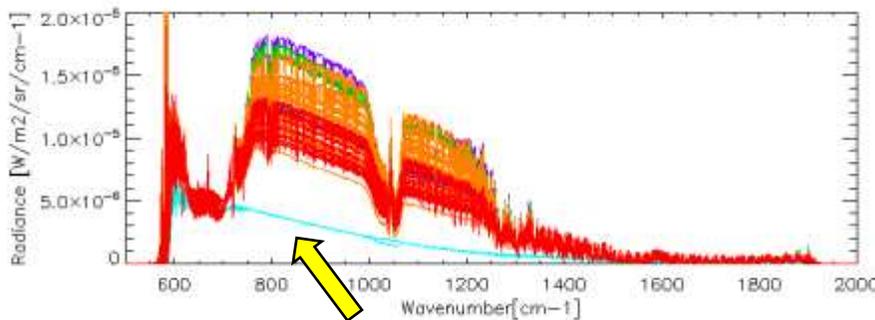
$$V_{DCoffset}(time)$$

Spectral bias were removed by applying new DC electrical circuit model (time dependent) and new coefficient to non-linearity correction.



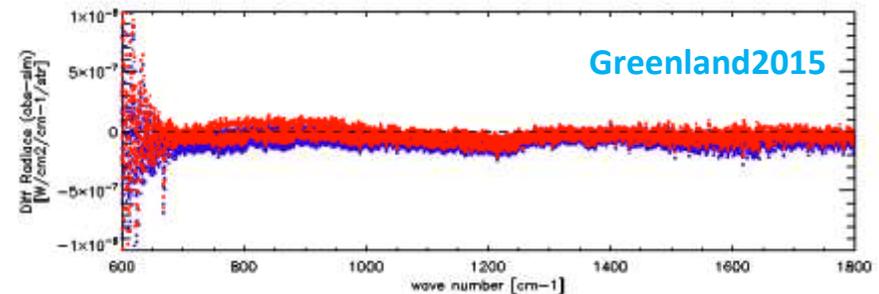
Radiometric validation after non-linearity correction needs cold target in addition to deep space view.

GOSAT TANSO-FTS L1B spectra over various calibrations sites



Greenland

Greenland Mar. 23, 2015 Double Difference SSEC S-HIS FTS onboard ER-2 vs GOSAT (blue: V161 red: new version)



$$DoubleDifference = (\tilde{R}_{OBS}^{GOSAT} - \tilde{R}_{CALC}^{GOSAT}) - (\tilde{R}_{OBS}^{SHIS} - \tilde{R}_{CALC}^{SHIS})$$



# GOSAT (2009-) and GOSAT-2 Remaining CAL & VAL Issues



*new*

## (1) Polarization correction in thermal IR.

- TANSO-FTS covers wide range from 0.76 to 16 micron.
- The mirror protection coating is optimized for NIR and SWIR.
- Geometry (polarization relation) of nadir observation and side looking calibration are different
- Larger polarization sensitivity creates systematic error
- PCA (principal component analysis) is ongoing

## (2) UV (300-400nm) reference at the field site

- Surface reflectance measurement needs frequent radiometric calibration using the reference
- Spectralon is easily contaminated in UV.

## (3) Portable FTS for validation over bright surface

- Most of the validation site for column CO<sub>2</sub>, CH<sub>4</sub> and CO are currently located near city or forest.
- Multiple scattering between aerosol and bright surface is one of the largest error source



The Greenhouse Gases Observing Satellite (GOSAT) is designed to measure the concentration of major greenhouse gases from space. GOSAT Project is a part of JEPIC (Japan Earth Observation Project) provided by the Japan Aerospace Exploration Agency (JAXA), the National Institute for Environmental Studies (NIES) and the Ministry of the Environment (MOE).



*Status update, L1 algorithm, Calibration, Photo, moves*  
<http://www.eorc.jaxa.jp/GOSAT/index.html>





# JAXA Himawari Monitor Updated on August 31, 2016



<http://www.eorc.jaxa.jp/ptree/index.html>

Operation and weather forecast: Japan Meteorological Agency  
Advanced data analysis (aerosol): JAXA Earth Observation Research Center