



FY-3F/OMS pre-launch calibration and instrument performance

OMS-Limb: Yuan Li¹, Guanyu Lin², Zhanfeng Li², Yu Huang²

OMS-Nadir: Qian Wang¹, Yongmei Wang³, Entao Shi³, Jinghua Mao³

¹National Satellite Meteorological Center, CMA

²Changchun Institute of Optics, Fine Mechanics and Physics, CAS

³Center for Space Science and Applied Research, CAS



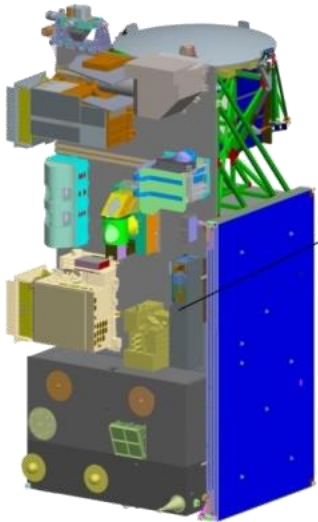
10 March 2022 GSICS UVN Spectrometer Breakout Session



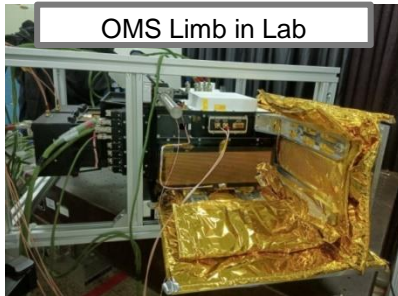
- OMS Limb pre-launch calibration and instrument performance
- OMS Nadir Specifications and observation modes
- Conclusion and next plan

Introduction to OMS limb instrument

- OMS-limb is a spectrometer to be carried on FY-3F satellite working in the band of 290-500nm. By detecting the 15-60km limb ultraviolet / visible band spectral radiation of the atmosphere in the daylight, the vertical distribution information of O3, NO2, SO2 and stratospheric aerosol profiles can be retrieved.



Location of OMS Limb on the satellite



OMS Limb in Lab

Detection gas type of OMS Limb

Variable	Explanation
BrO	UV spectrometry. BrO lines around 300 nm. Limb sounding mechanically or electronically
HCHO mole fraction	UV spectrometry. HCHO lines around 350 nm. Limb sounding mechanically or electronically
ClO	UV Spectrometry. ClO lines around 300 nm.
Atmospheric temperature	UV and VIS spectrometry.
NO2 mole fraction	UV and VIS spectrometry. Several lines in the ranges around 220 nm and 400 nm.
O3	UV and VIS spectrometry. Ozone lines in the bands around 340 nm (Huggins).
PSC occurrence	UV and VIS spectrometry.
SO2 mole fraction	UV spectrometry. SO2 lines around 350 nm.
Specific humidity	UV and VIS spectrometry. Limb sounding.
Aerosol mass mixing ratio	UV and VIS spectrometry.
Aerosol volcanic ash	UV and VIS spectrometry;

OMS limb observation mode

OMS limb observation mode

Limb atmosphere detection mode

Solar calibration (main)

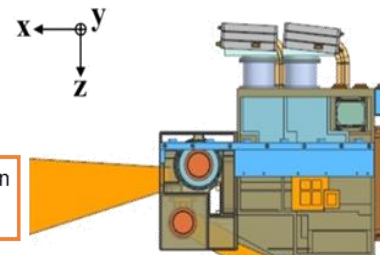
Solar calibration (standby)

Mercury lamp calibration

Tungsten lamp calibration

Bad pixel detection mode

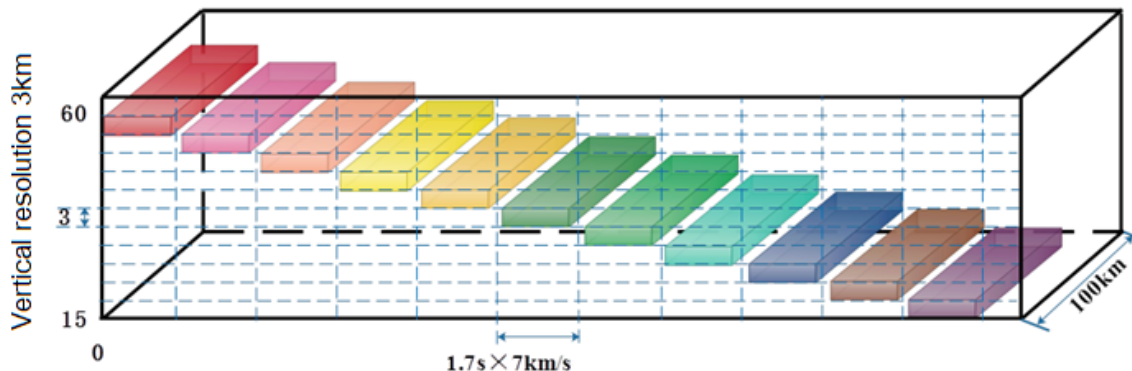
Dark current mode



Solar calibration field of view

Limb observation field of view

x Flight direction
y
z Point to the center of the earth



Flight distance of Single layer 11.7km

OMS Limb specifications and optical path design

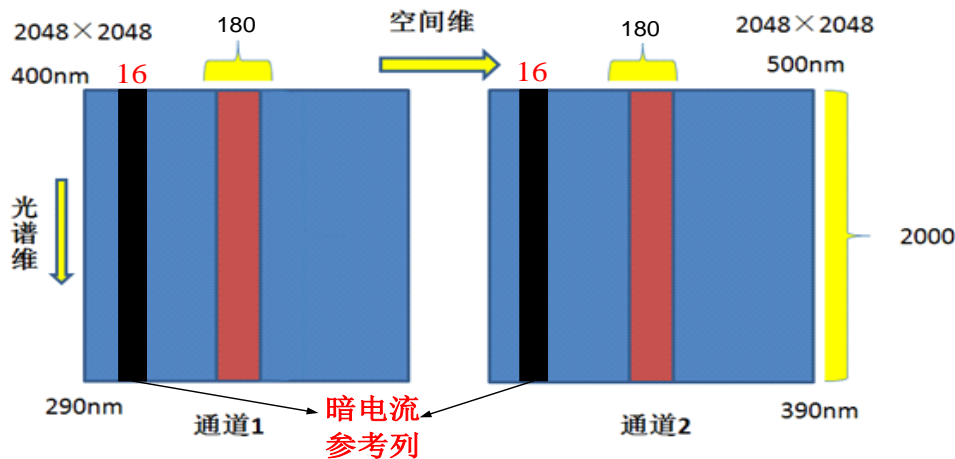


OMS Limb specifications

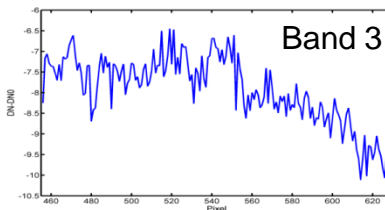
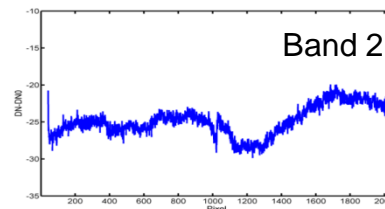
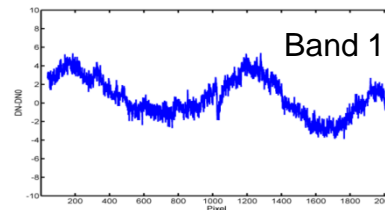
No.	Test items	Technical requirement
1	Spectral range / nm	290-500
2	Spectral resolution / nm	0.6
3	Spectral sampling interval	Continuous sampling pixel by pixel
4	Wavelength calibration accuracy / nm	0.01
5	Spatial resolution / km	3 (vertical, i.e. the height direction of the Limb of the earth)
6	Instantaneous field of view / °	2.3 (horizontal) × 0.045 (vertical)
7	Dynamic range	10 ⁵
8	Relative radiometric calibration accuracy	Better than 2%
9	Calibration accuracy of diffuse reflector	Better than 3%
10	Absolute radiometric calibration accuracy	Better than 3%
11	Signal to noise ratio	> 300@0.1mw /cm ² × sr × nm (radiance)

Band1:
290-400nm, FWHM0.6nm
Band2:
390-500nm, FWHM0.6nm
Band3 (polarization):
290-500nm, FWHM4-40nm

OMS limb pre-launch calibration: Dark current



The average value of 16 columns of pixels in the non-optical detection working area of the detector is used as the reference dark current

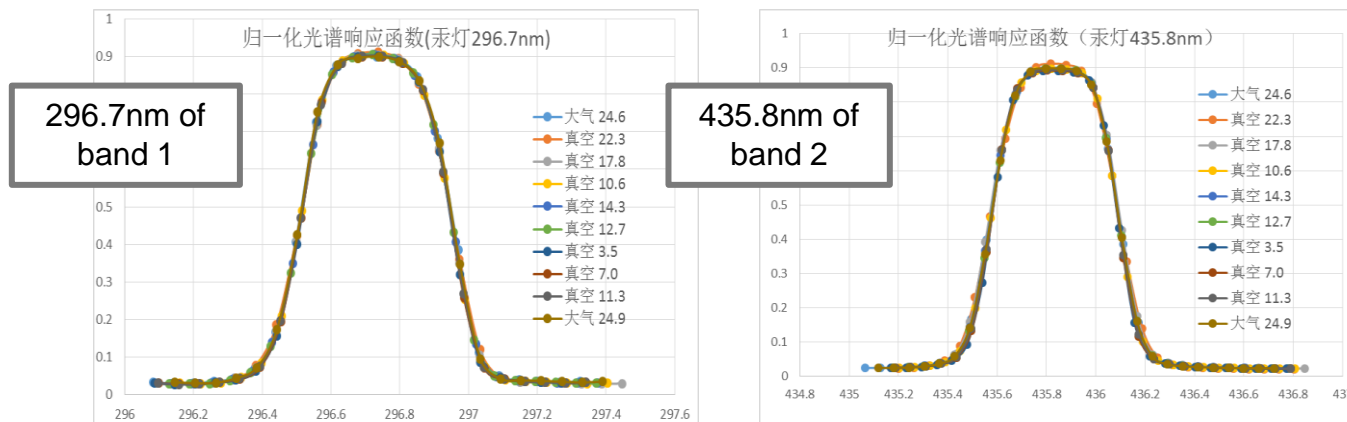


Difference model between imaging pixels DN and dark reference column pixels DN0

OMS limb pre launch calibration - spectral performance

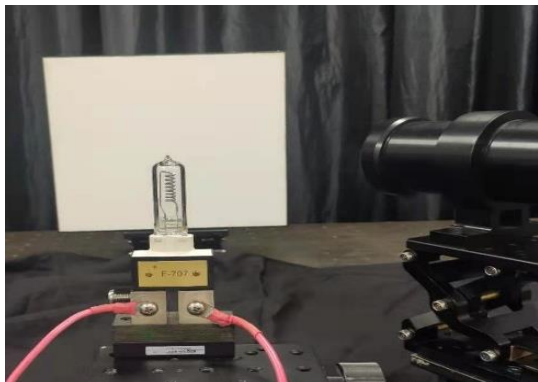
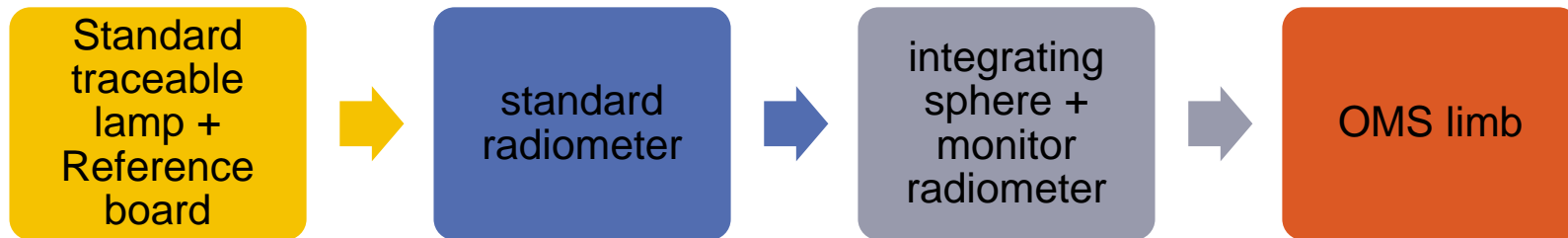


- In the heat balance test on May 10-20, 2021, the monitoring test of ozone Limb spectral performance with vacuum / atmosphere and temperature was completed by using the internal mercury lamp of the instrument.

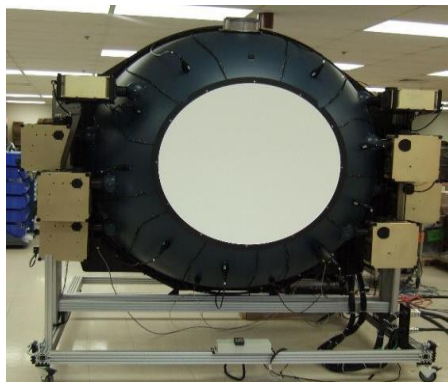


The bandpass of the instrument in the characteristic spectral line under vacuum and atmosphere, and the temperature range of 4 ~ 25 °C under vacuum.

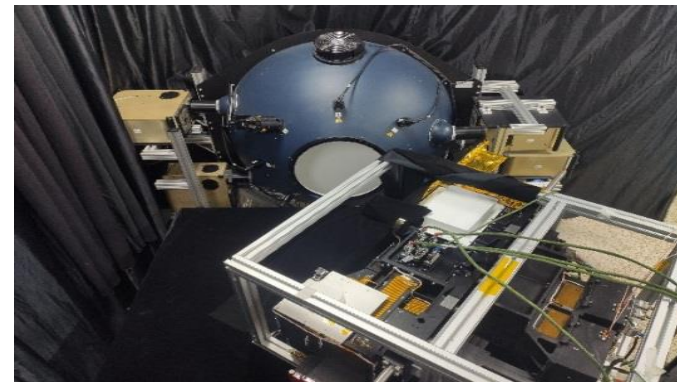
OMS limb pre launch calibration - Radiometric Calibration



Standard traceable lamp from NIST



Integrating sphere



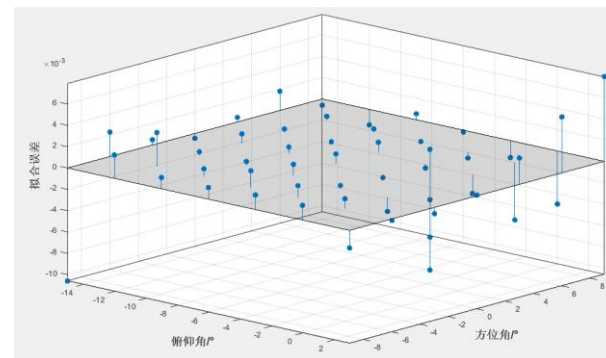
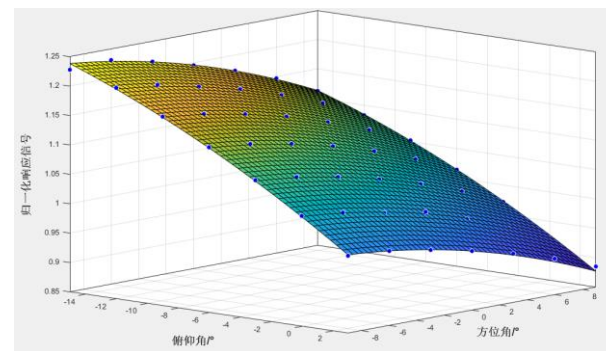
Radiation calibration of OMS limb

OMS limb pre launch calibration BRDF of Reference board

- The two-dimensional turntable is used to drive the instrument to rotate, and the response of the diffuse board of the instrument at different angles is obtained.



OMS limb diffuse board angle characteristic calibration test



Fitting results and errors of angular characteristics of main diffuser of Band 1

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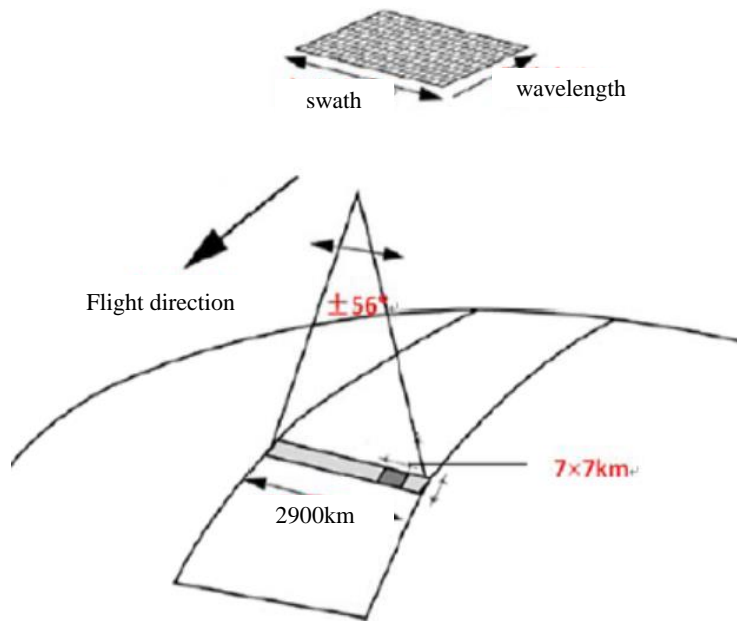
Scientific Objective

OMS-nadir is a payload on FengYun-3F in low Earth orbit that provides daily global information on concentrations of trace gases and aerosols. The selected wavelength range for OMS-nadir allows observation of atmospheric constituents, including the total column of O₃, NO₂, SO₂, and O₃ profile.

Instrument overview

- ✓ Hyper-spectral imagers make images in 2 spectral bands
- ✓ No scanning mirrors cross track
- ✓ Scanning in flight direction (Push broom)
- ✓ Wide cross flight IFOV
- ✓ Narrow along flight IFOV
- ✓ 2D detectors (CCD)
- ✓ 2D grating spectrometer

The OMS-nadir instrument



OMS-nadir Instrument Specifications

Band coverage	UV1: 250-300nm UV2:300-320nm VIS: 320-500nm
Swath Width	2900km
Total field of view	112°
Nadir ground pixel size (along track × across track)	UV1: 21 km × 28 km UV2: 7 km × 7 km VIS: 7 km × 7 km
Spectral resolution	UV1: 1 nm UV2: 0.5 nm VIS: 0.5 - 0.6 nm
Polarization sensitivity	Depolarized using a scrambler
Global coverage	1 day
Local time	Descending node of 10:00 a.m.

Schematic diagram of OMS-nadir flying over the Earth.

Scientific observation modes at the day side of the orbit

- ✓ Collecting the sunlight reflected by the Earth.
- ✓ Collecting the dark current from shielded pixels at the edge of the detector.

Calibration observation modes at the night side of the orbit

Sun measurements with two QVD diffusers

- ✓ One of the diffusers is for Sun calibration observation, acquiring the data to perform in-orbit spectral and radiometric calibration.
- ✓ The other is to monitor optical degradation.

White light source (WLS) measurements with a diffuser

- ✓ Measuring changes in the CCD performance, in particular the pixel-to-pixel response non-uniformity.
- ✓ Monitoring radiometric throughput.

Led measurements

- ✓ Monitoring the CCD pixel behavior and linearity of the detector and electronics.

- Pre-launch calibration of engineering model of FY-3F/OMS was finished.
- Pre-launch calibration of flight model of FY-3F/OMS will be carried out in May, 2022.
- FY-3F is scheduled to launch at the end of 2022;
- In-orbit and inter calibration algorithms are under developing.



Thank You

Thank you for the attention!

Email: liyuan@cma.gov.cn

