Royal Netherlands
Meteorological Institute
Ministry of Infrastructure and the Environment

In-flight performance of the Ozone Monitoring Instrument

AURA STM
August 31, 2016

Erik Schenkeveld (KNMI)
Glen Jaross (NASA)
Sergey Marchenko (SSAI)
David Haffner (SSAI)
KNMI Team

Outline

12 years of OMI in-flight calibration data

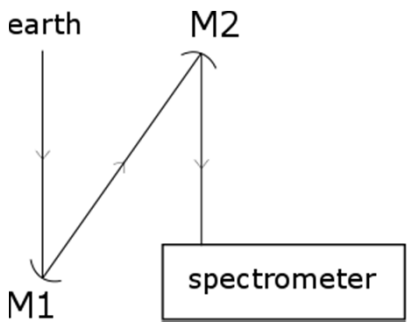
- Calibration concept of OMI
- Basic instrument performance
- Long term calibration
- Conclusions

Outline

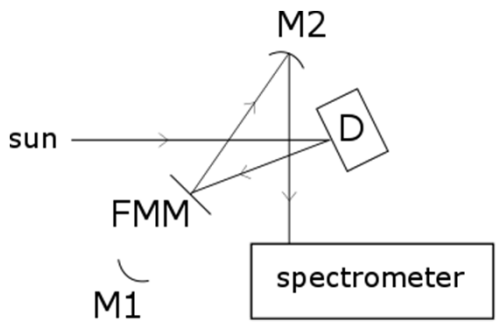
Long-term instrument performance:

- Detector degradation
- Solar diffuser degradation
- Radiance channel degradation
- Spectral calibration
- Row anomaly

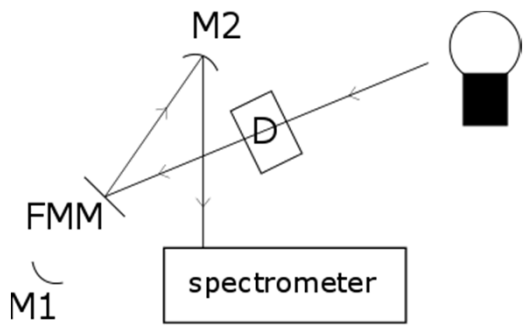
Calibration concept of OMI



Radiance



Irradiance



Calibration

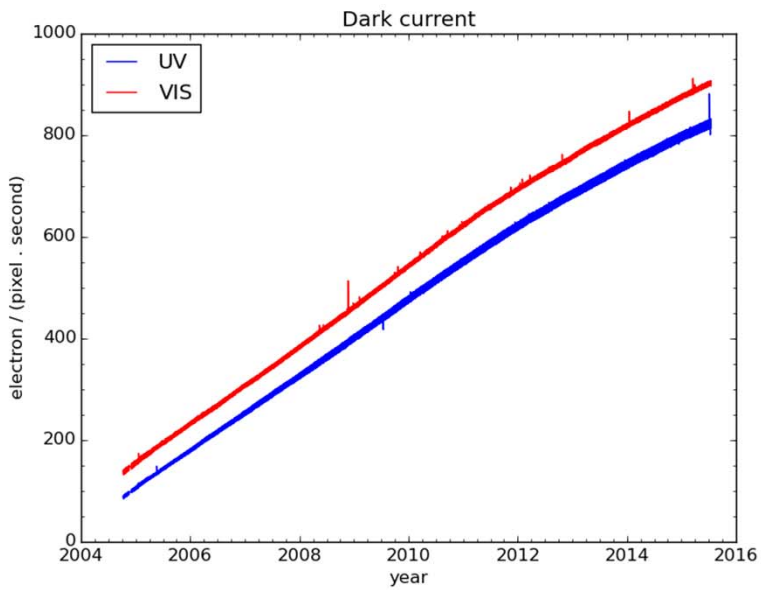
Basic instrument performance

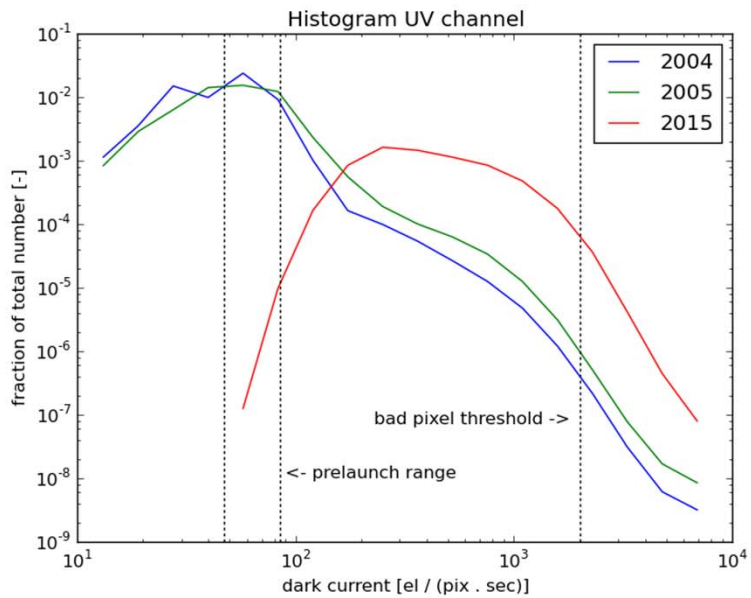
- Detector degradation is the most important degradation of OMI
- The CCD detectors of OMI are sensitive to cosmic hits
- To protect against cosmic hits, 10 kg of aluminum shielding was added to the instrument shortly before launch
- Cosmic hits cause 3 effects:

1) Short duration peaks in signal
2) Change in dark current
3) Increase in Random Telegraph Signal (RTS)

Basic instrument performance

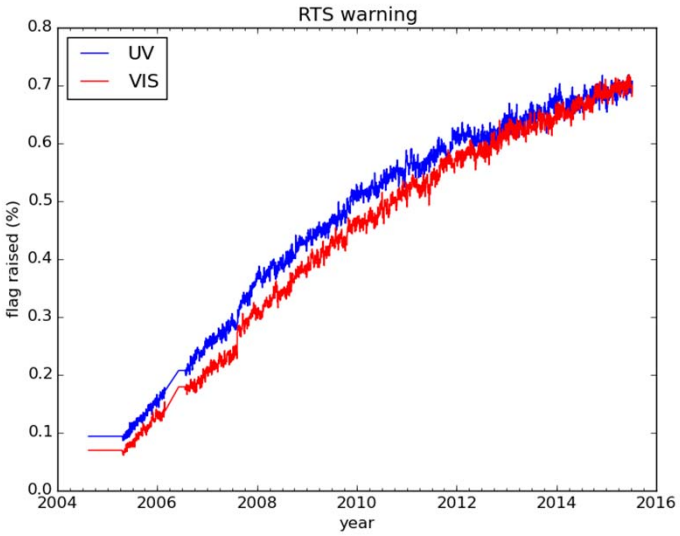
Increase in dark current



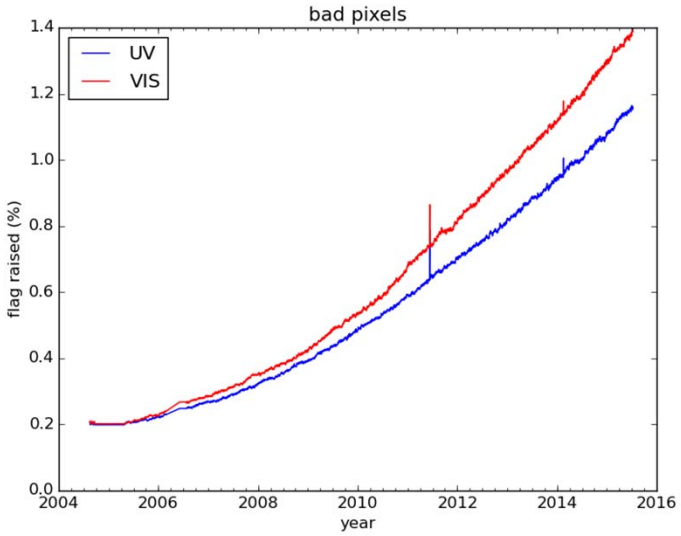


Basic instrument performance

Increase in RTS flagging



Increase in bad pixel flagging



These results are for unbinned pixels

Binned pixels have a percentage that is about 8 times larger

Basic instrument performance

Remedies:

Short duration peaks in signal

Transient outlier correction in L1B processor

Change in dark current

Full-automatic analysis of background measurements at eclipse side of orbit, and creation of daily time-dependent OPF

Increase in Random Telegraph Signal flagging

RTS flagging map in daily time-dependent OPF

Increase in Bad Pixel flagging

Bad pixel flagging map in daily time-dependent OPF

Basic instrument performance

Row anomaly

A number of rows give less signal as expected

Problem exists since June 2007

Four different effects:

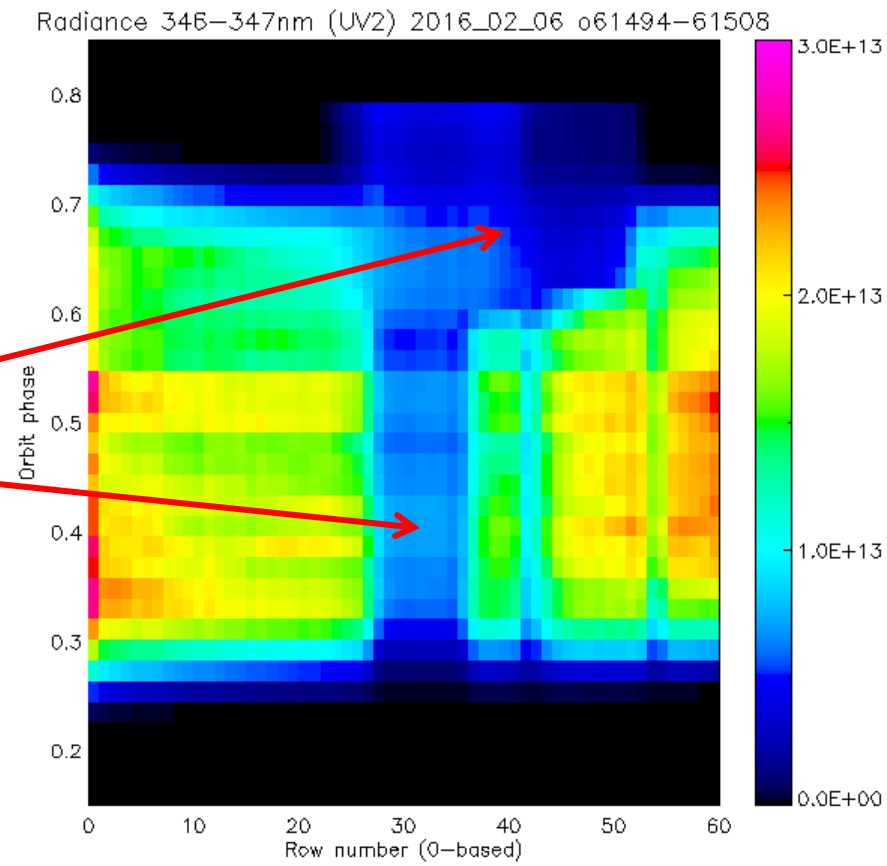
- Blockage effect
- Solar light contamination
- Wavelength shift
- Earth radiance from outside nominal field of view

Possible cause: a piece of Multi-Layer Insulation that is blocking the radiance port

Basic instrument performance

Row anomaly
in UV2 channel

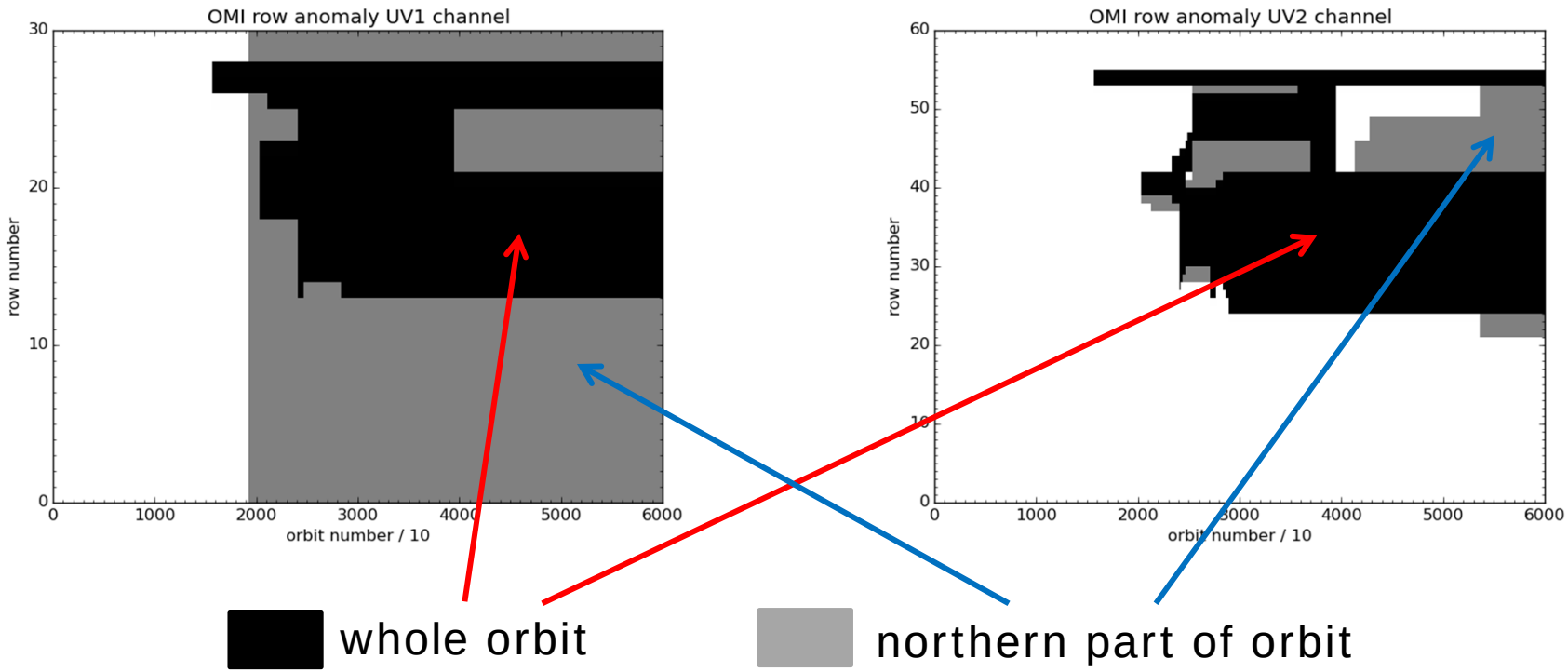
Blocked rows



Basic instrument performance

Row anomaly:

Affected rows over time in UV1 and UV2 channel



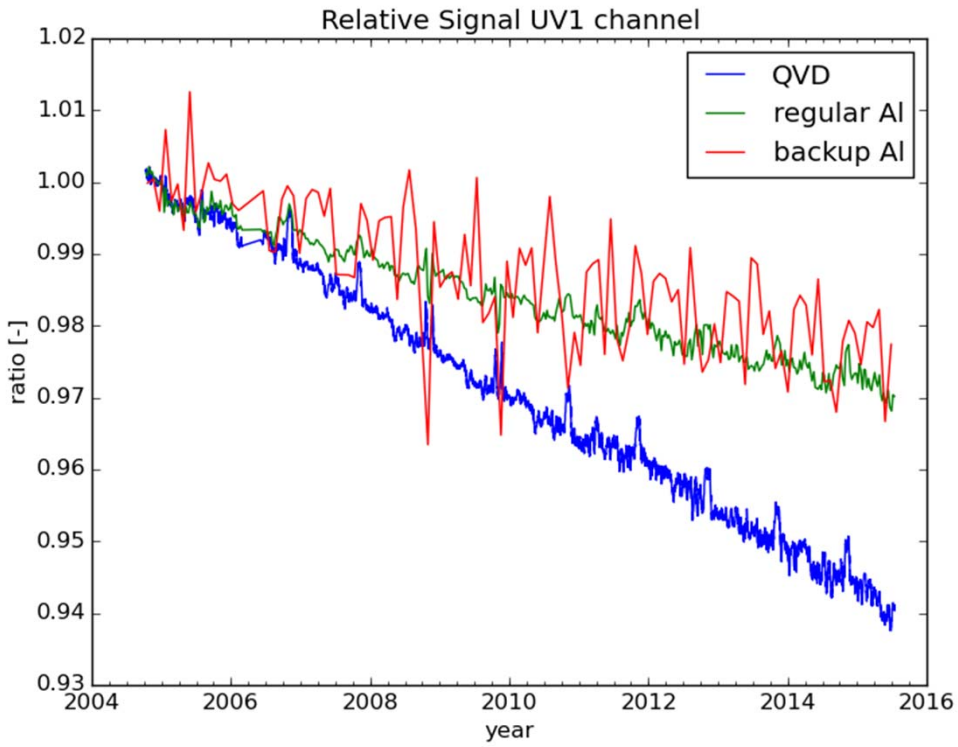
Basic instrument performance

Row anomaly:

No corrections are performed in L1B processor, only a flagging scheme is available

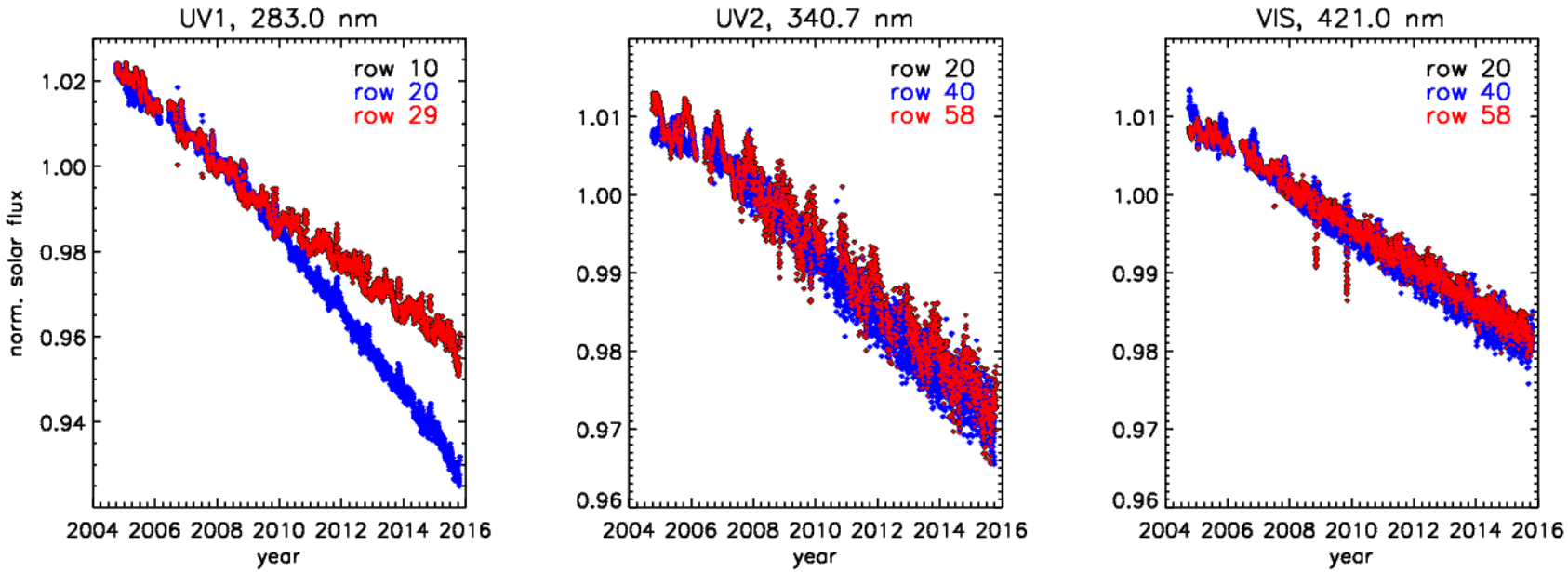
Long term calibration

Solar calibration measurements for UV1 channel, showing degradation results for all diffusers



Long term calibration

Solar calibration measurements for QVD diffuser for all channels



Long term calibration

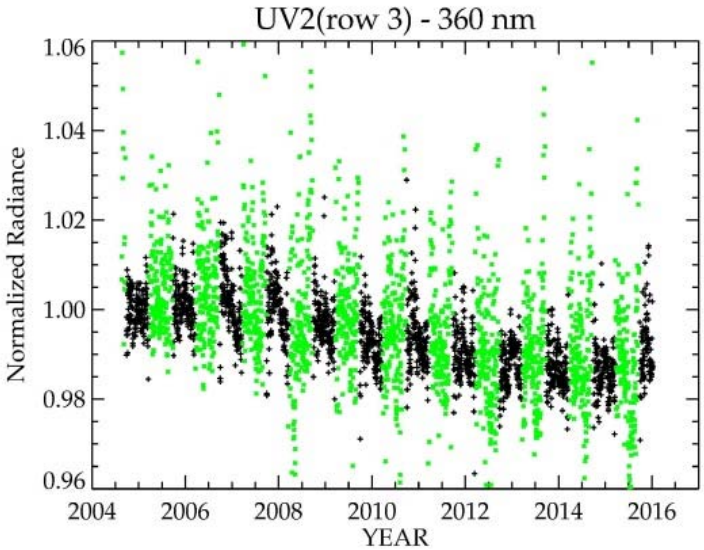
Irradiance degradation result for the three channels in the timeframe 2005 - 2016

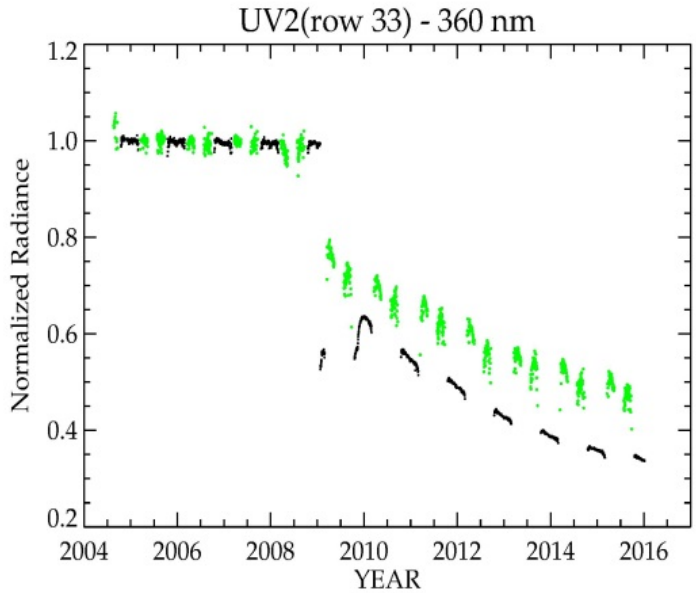
	UV1	UV2	VIS
QVD	6 %	4 %	3 %
Regular Al	3 %	2 %	2 %
Backup Al	2 %	1 %	1 %

Long term calibration

Radiance channel degradation

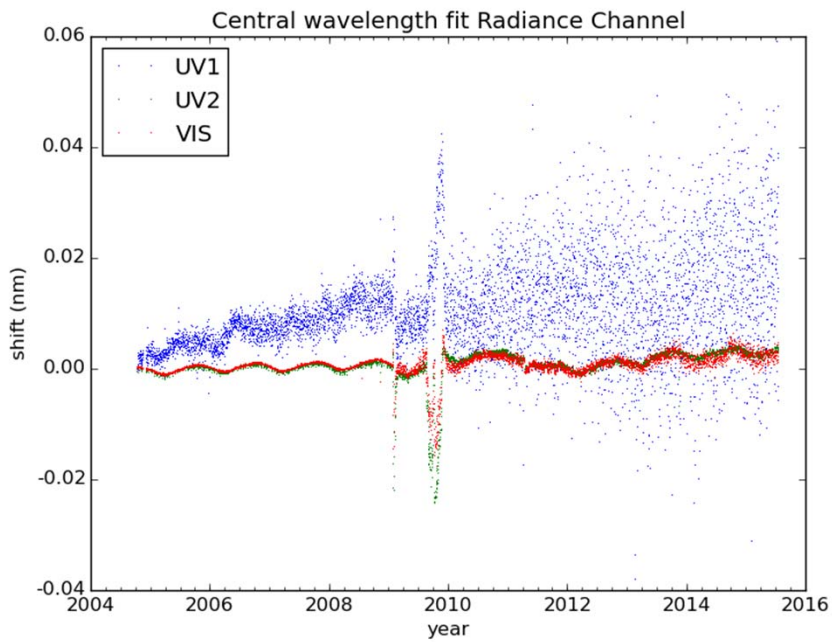
Degradation results from Ice Sheet data from Greenland and Antarctica





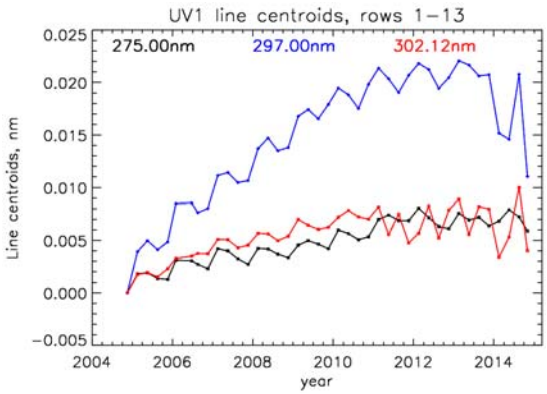
Long term calibration

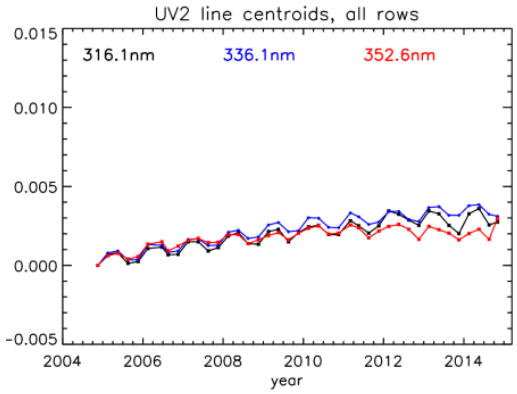
Spectral Calibration Radiance channel

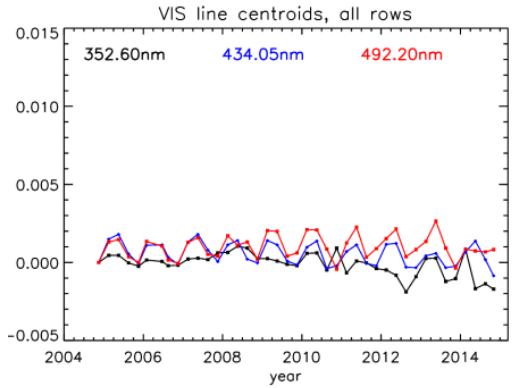


Long term calibration

Spectral Calibration Irradiance channel

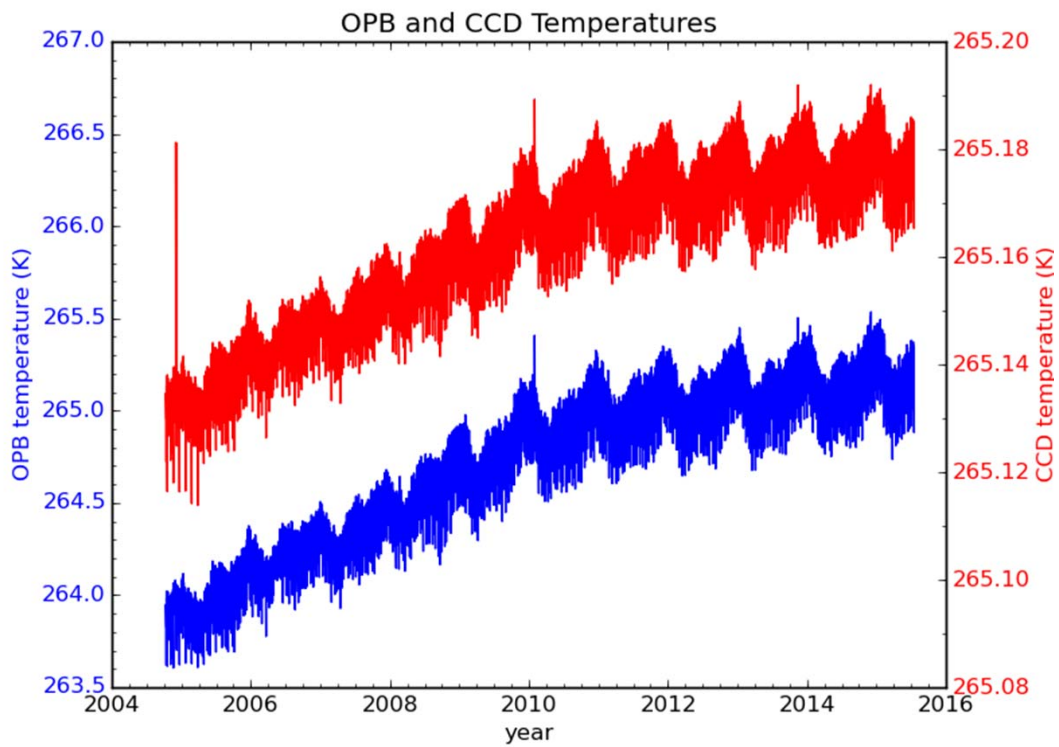






Long term calibration

Optical Bench and CCD temperatures



Conclusions

Summary of conclusions

Dark current	7 x increase
RTS flagging	increase to 0.7 %
Dead pixel flagging	increase to 1.4 %
Irradiance decrease	~6 % QVD diffuser; 3% regular Al; 2% backup Al
Radiance decrease	~2.5% UV1; ~1.5% UV2; ~1% VIS
Wavelength shifts	~0.015 nm in UV1; ≤0.005 nm in UV2 and VIS
Row Anomaly	UV2 and VIS: >~30 % (southern hemisphere) and up to ~70 % (part of the northern hemisphere) UV1: >~30 % (southern hemisphere) and all rows (part of the northern hemisphere)

Conclusions

- Degradation of the instrument goes slowly, and better than expected
- Row anomaly is the largest problem for OMI
- The instrument can deliver useful science data for the coming 5 to 8 years, which is comparable to the expected lifetime of the Aura spacecraft