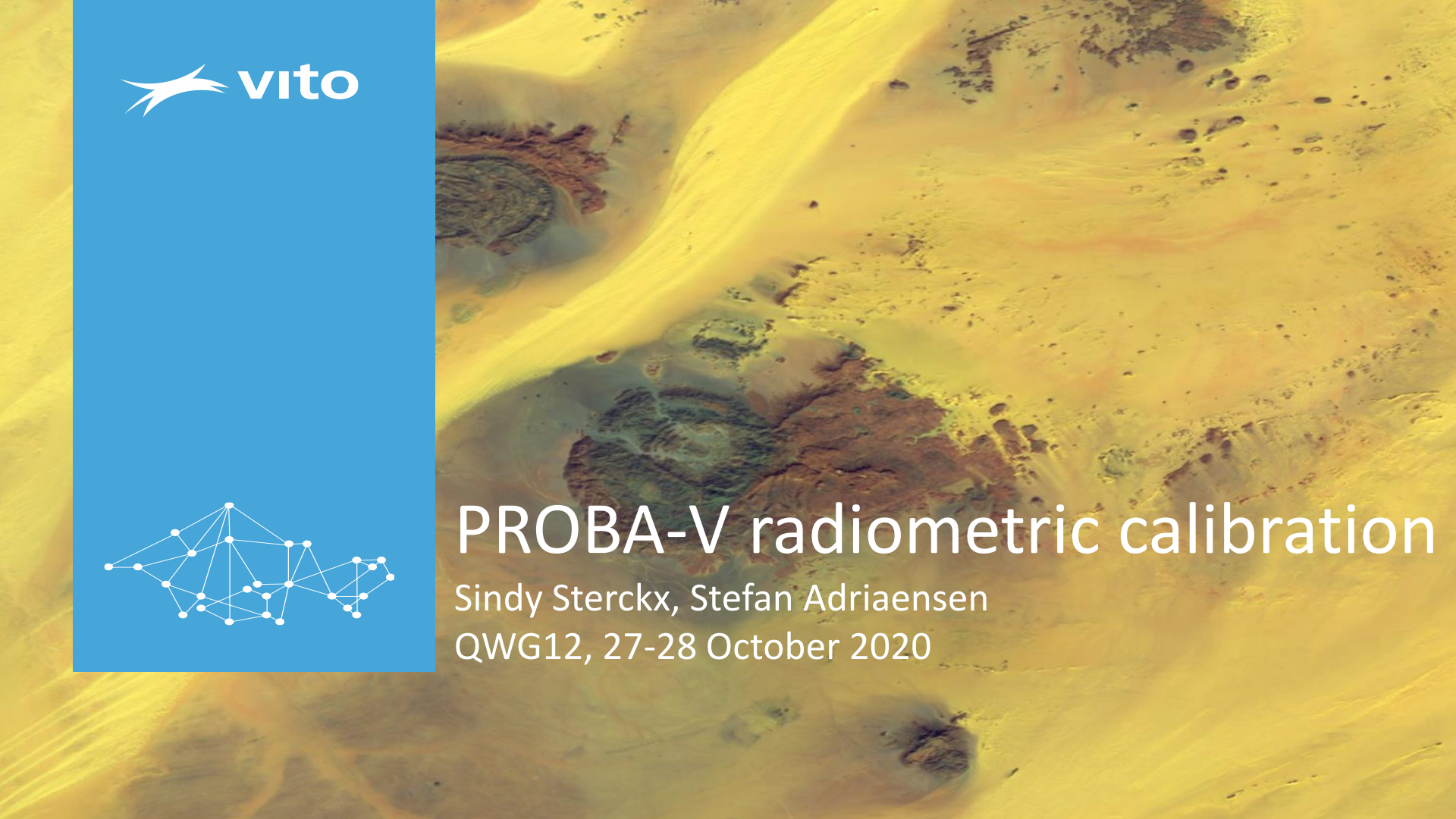


PROBA-V radiometric calibration

Sindy Sterckx, Stefan Adriaensen

QWG12, 27-28 October 2020

CONTENT

- Investigation LEFT BLUE issue
  - The issue
  - Differences in LEFT-CENTER overlapping region
  - OSCAR Libya-4 VZA dependencies
  - DCC interband results vs Pixel/VZA
  - Polarisation sensitivity
  - C1 : Degradation model applied since May 2017
- Trend model

THE ISSUE

- Analyses from Rayference (presented at QWG 11)

Suggested corrections to be applied

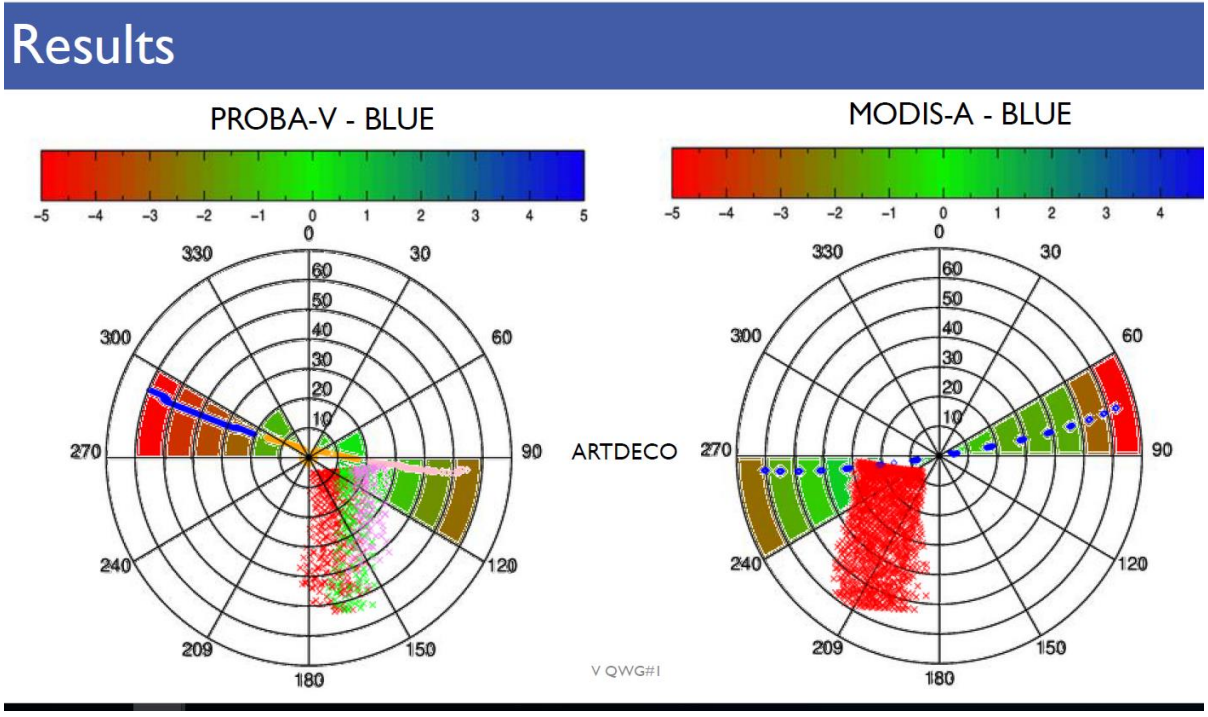
PROBA-V				
ALL	1.024	1.005	0.997	1.004
LEFT	1.040	1.005	0.997	1.001
CENTRAL	1.011	1.012	1.001	1.003
RIGHT	1.010	0.999	0.993	1.014
	BLUE	RED	NIR	SWIR

+/- 3% difference

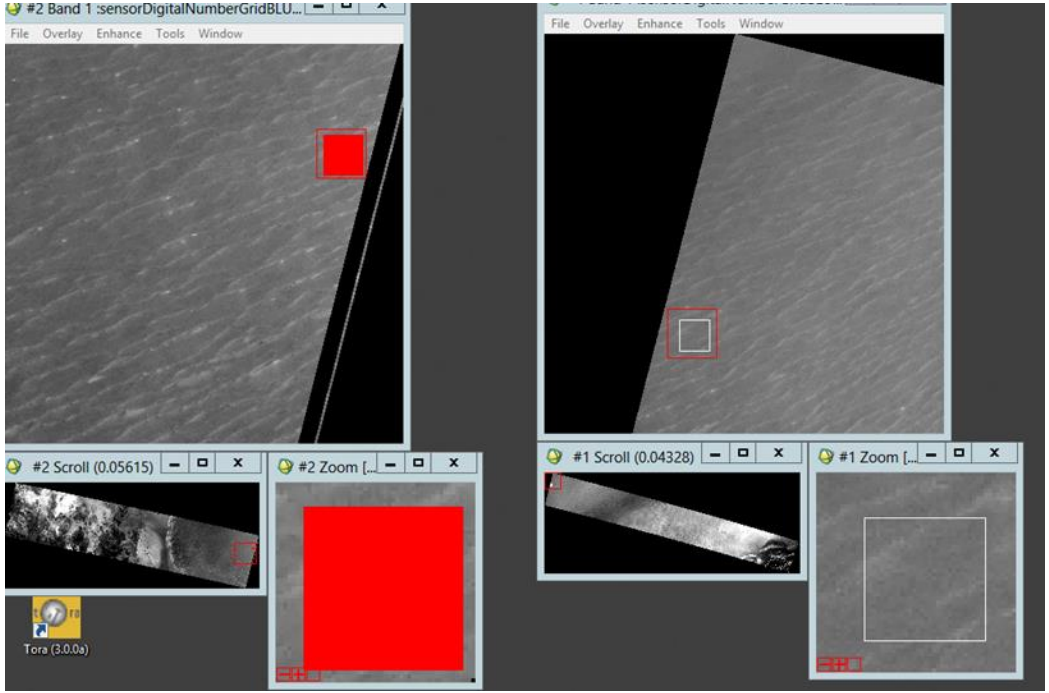
For PROBA-V, it is suggested to apply a correction per camera

THE ISSUE (CON'T)

- Analyses from Rayference (presented at QWG 11)



ANALYSES : OVERLAP REGION



- Using desert scenes for which CENTER and LEFT camera overlap over the desert ROI
- Comparison of mean reflectance within overlapping ROI (not pixel-by pixel)
- 10 scenes selected in period 2015 -2018

vito remote sensing

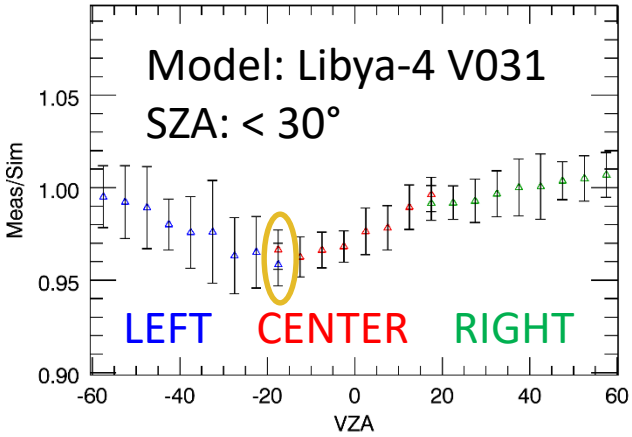
ANALYSES : OVERLAP REGION

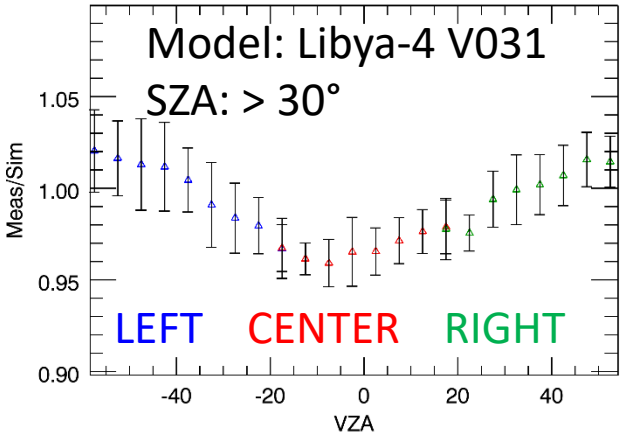
Small difference observed in overlap region

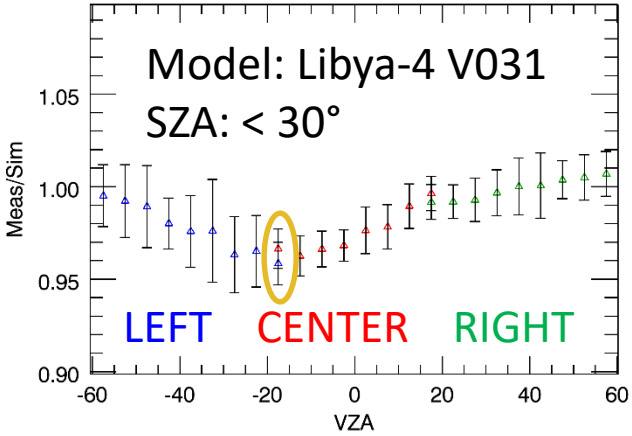
in average **LEFT BLUE TOA reflectance** values **0.7% lower than CENTER TOA reflectance**

- Using desert scenes for which CENTER and LEFT camera overlap over the desert ROI
- Comparison of mean reflectance within overlapping ROI (not pixel-by pixel)
- 10 scenes selected in period 2015 -2018

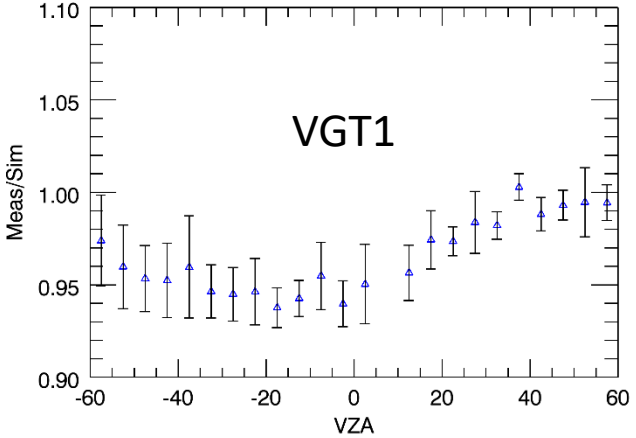
ANALYSES : OSCAR LIBYA-4 VZA DEPENDENCIES

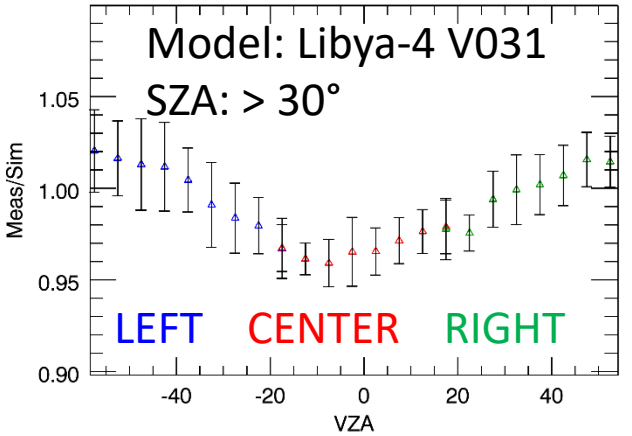

Model: Libya-4 V031
SZA: < 30°
LEFT
CENTER
RIGHT
Meas/Sim
1.05
1.00
0.95
0.90
-60
-40
-20
0
20
40
60
VZA


Model: Libya-4 V031
SZA: > 30°
LEFT
CENTER
RIGHT
Meas/Sim
1.05
1.00
0.95
0.90
-40
-20
0
20
40
VZA

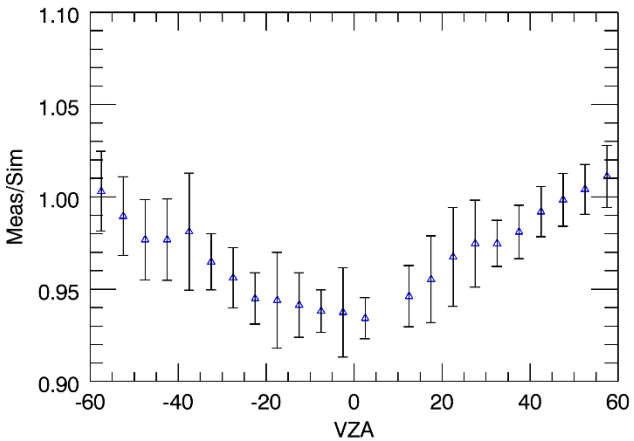


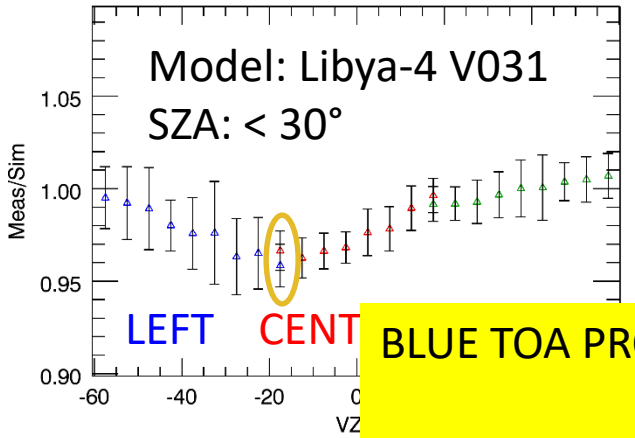
VGT1 blue max SZA SZA: < 30°

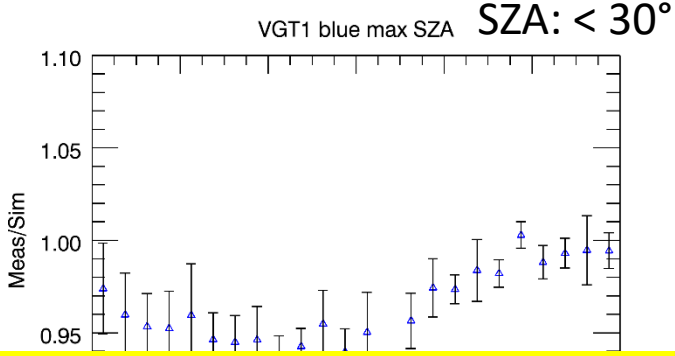




VGT1 blue min SZA SZA: > 30°

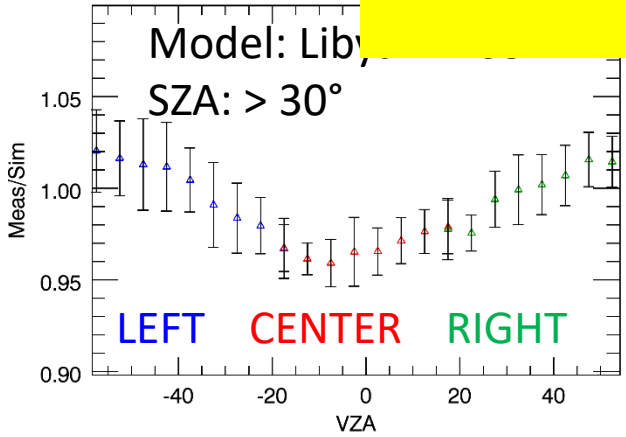


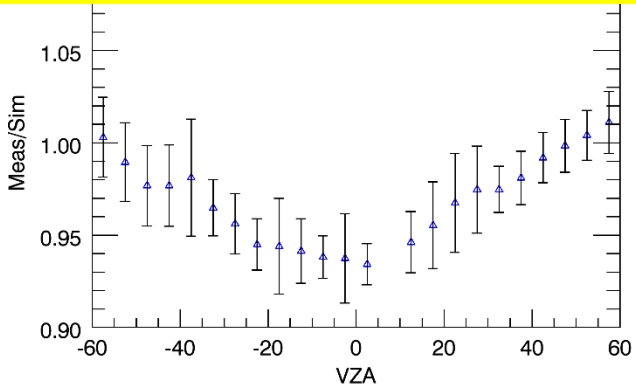


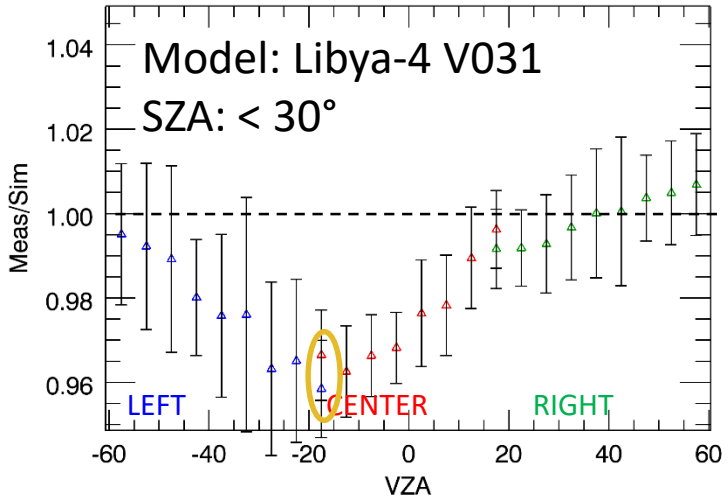


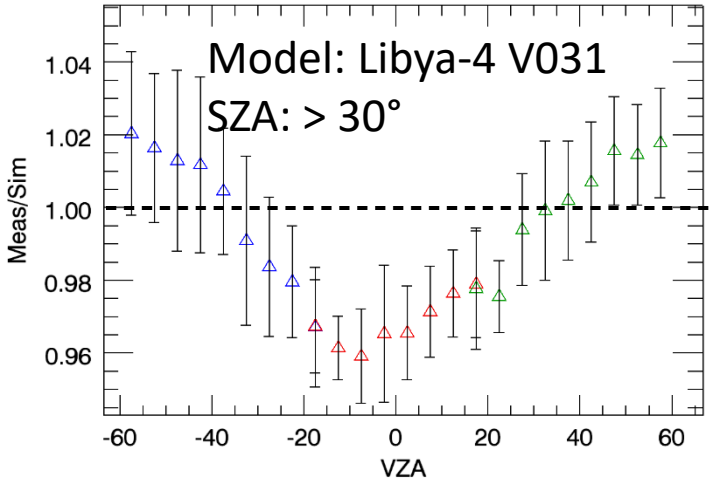
BLUE TOA PROBA-V BLUE reflectance slightly larger than VGT1

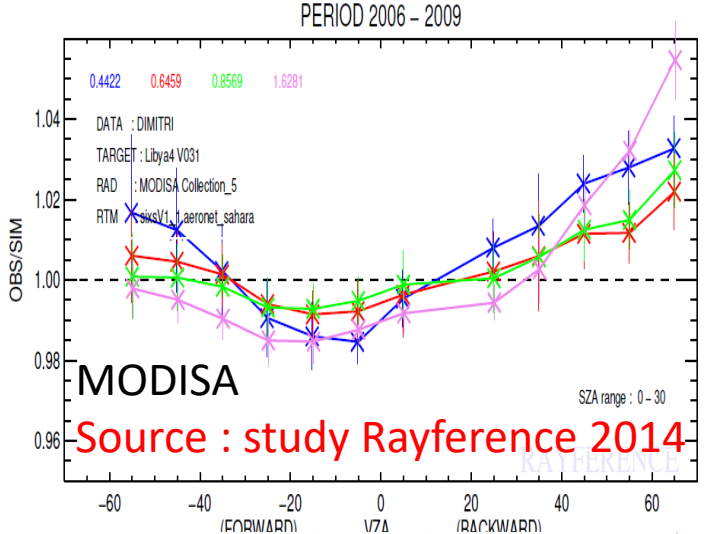
No significant larger negative difference for LEFT camera

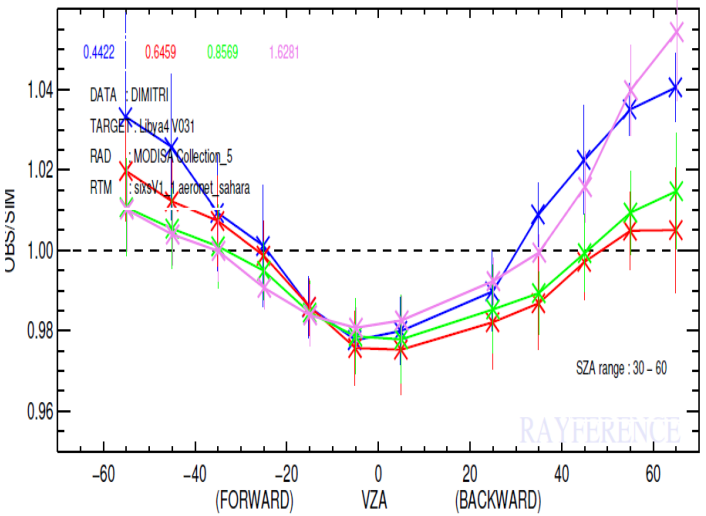


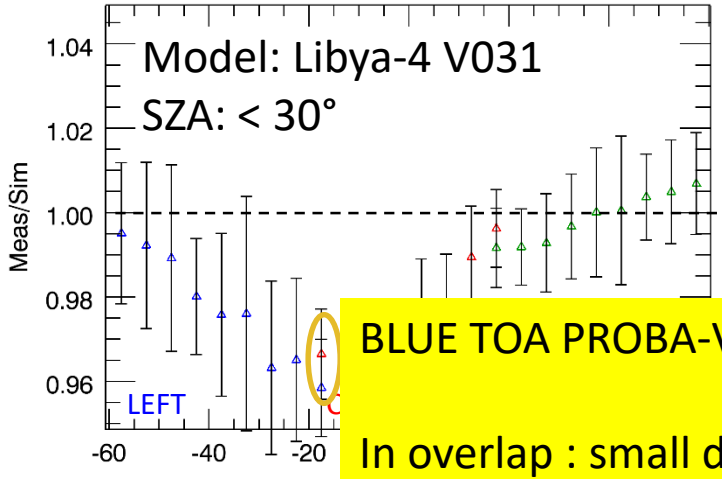


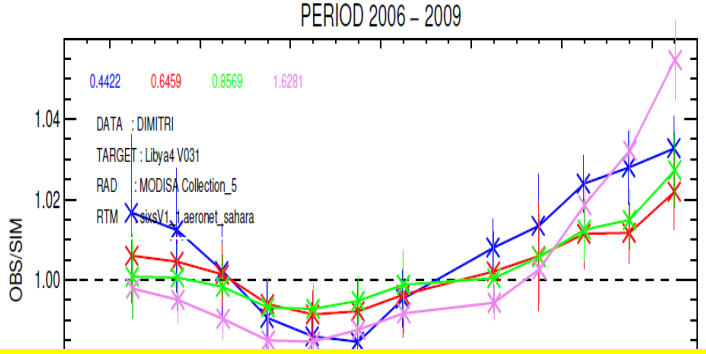

Model: Libya-4 V031
SZA: < 30°
Meas/Sim
VZA
LEFT
CENTER
RIGHT

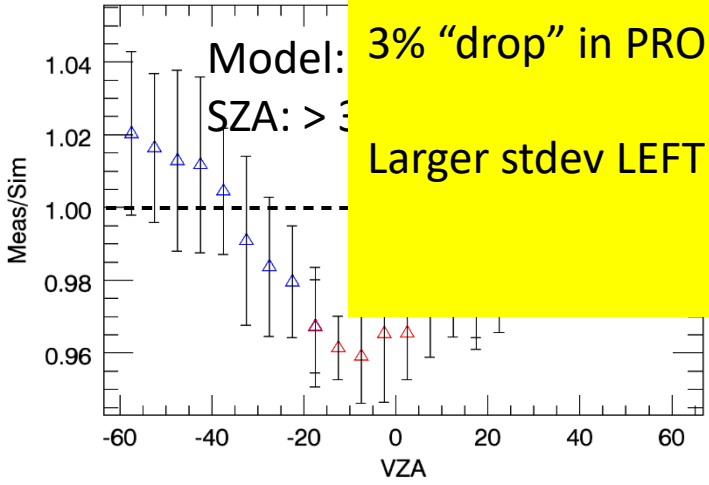

Model: Libya-4 V031
SZA: > 30°
Meas/Sim
VZA

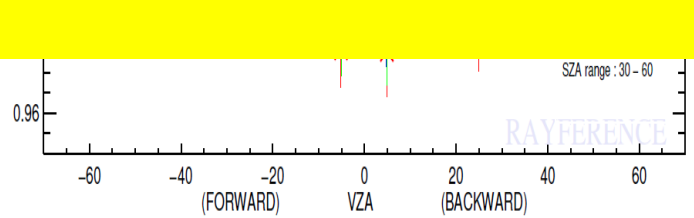

PERIOD 2006 – 2009
0.4422 0.6459 0.8569 1.6281
DATA : DIMITRI
TARGET : Libya4 V031
RAD : MODISA Collection_5
RTM : sixsV1_1_aeronet_sahara
OBS/SIM
MODISA
SZA range : 0 – 30
Source : study Rayference 2014
(FORWARD)
VZA
(BACKWARD)


0.4422 0.6459 0.8569 1.6281
DATA : DIMITRI
TARGET : Libya4 V031
RAD : MODISA Collection_5
RTM : sixsV1_1_aeronet_sahara
OBS/SIM
SZA range : 30 – 60
(FORWARD)
VZA
(BACKWARD)









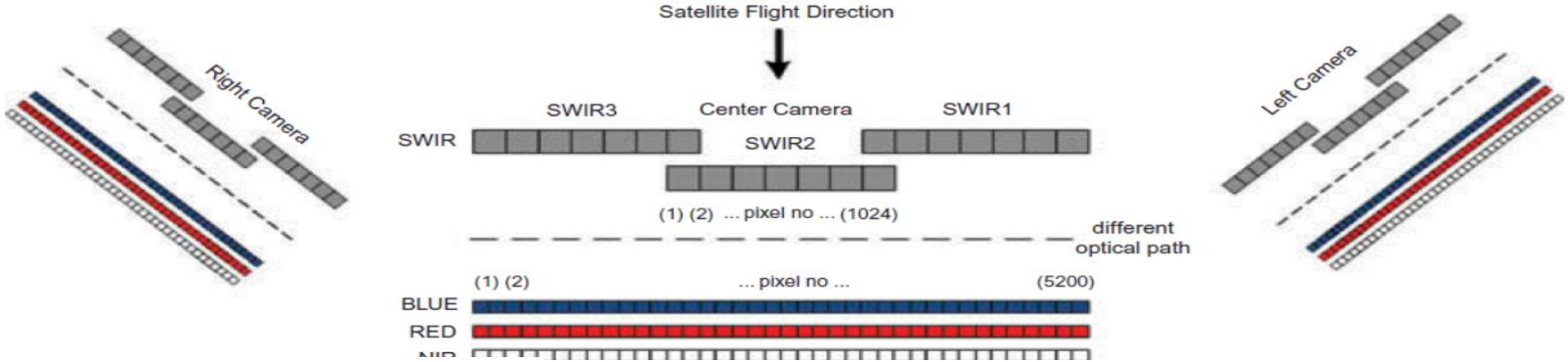
BLUE TOA PROBA-V +/- 1-2 % lower than MODIS BLUE

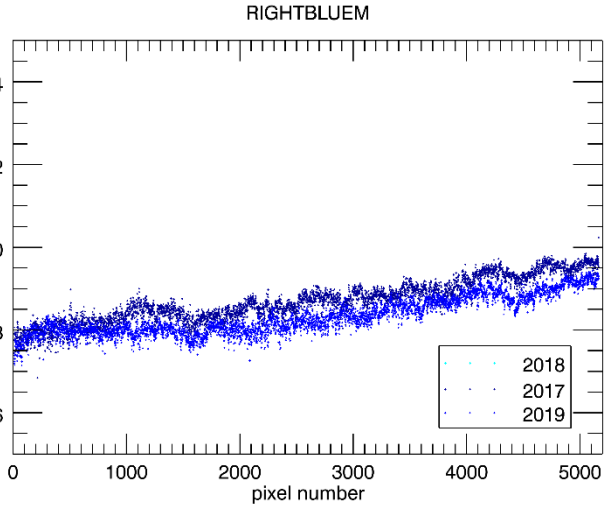
In overlap : small difference (< 1%) between LEFT and CENTER

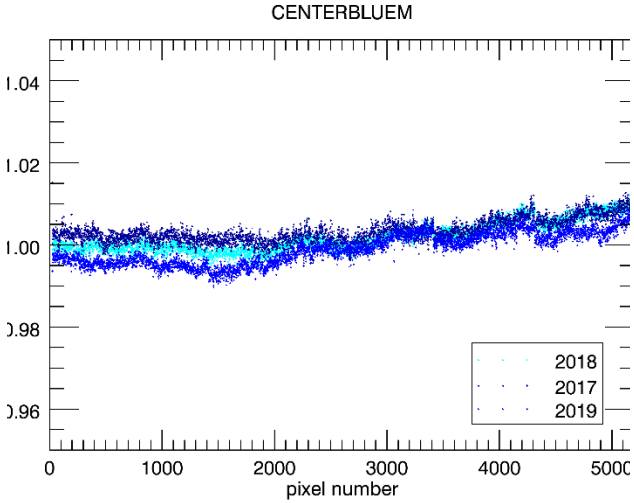
3% “drop” in PROBA-V TOA LEFT reflectance not really visible

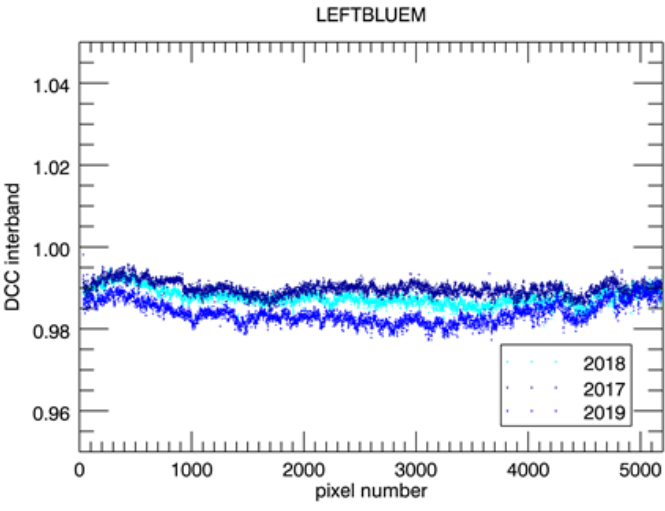
Larger stdev LEFT BLUE => larger uncertainty in results

DCC INTER-BAND VS PIXEL/VZA

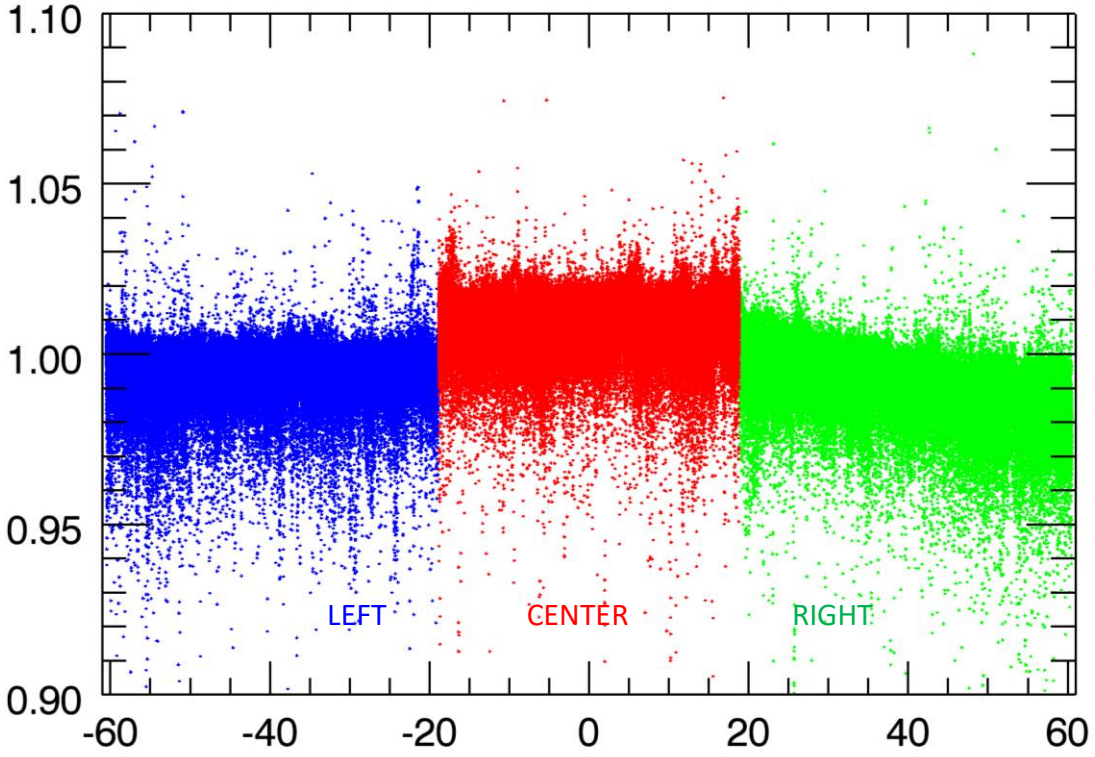








DCC INTER-BAND VS PIXEL/VZA



POLARISATION INFORMATION

Polarisation Pre-launch design values for single camera :

		blue	red	nir	swir
DoP	0 mm	1.24%	0.31%	0.05%	0.69%
DoP	12 mm	1.53%	0.37%	0.07%	0.69%
DoP	26 mm	2.74%	0.45%	0.21%	0.73%
DoP	edge	3.92%	0.35%	0.39%	0.89%

Distance towards center of camera

Center
Center+/- 923 VNIR pixels
Center +/- 2000 VNIR pixels

Polarisation Pre-launch FAR measured values single camera :

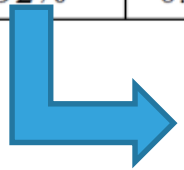
		blue	red	nir	swir
DoP	0 mm	1.08%	0.10%	0.03%	0.57%
DoP	12 mm	1.37%	0.13%	0.06%	0.58%
DoP	26 mm	2.48%	0.11%	0.18%	0.63%
DoP	edge	3.53%	0.11%	0.33%	0.82%

POLARISATION INFORMATION

Polarisation Pre-launch design values for single camera :

		blue	red	nir	swir	
DoP	0 mm	1.24%	0.31%	0.05%	0.69%	Center
DoP	12 mm	1.53%	0.37%	0.07%	0.69%	Center+/- 923 VNIR pixels
DoP	26 mm	2.74%	0.45%	0.21%	0.73%	Center +/- 2000 VNIR pixels
DoP	edge	3.92%	0.35%	0.39%	0.89%	

Distance towards center of camera

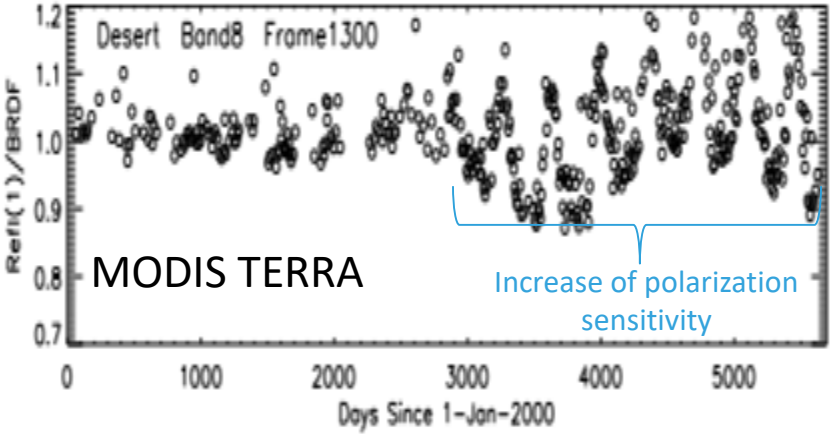


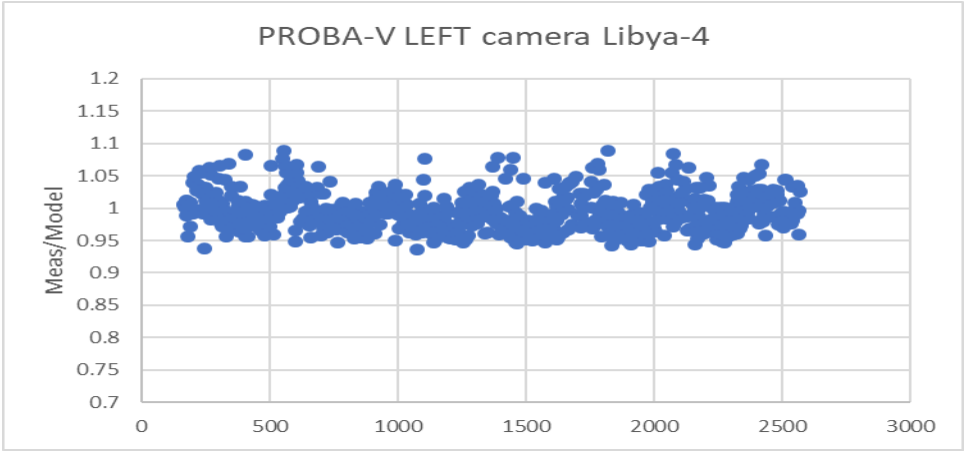
Assume 70% polarization in TOA blue

Up to 2.7 % uncertainty at the edge

QS: Increase of Polarisation sensitivity after launch ?

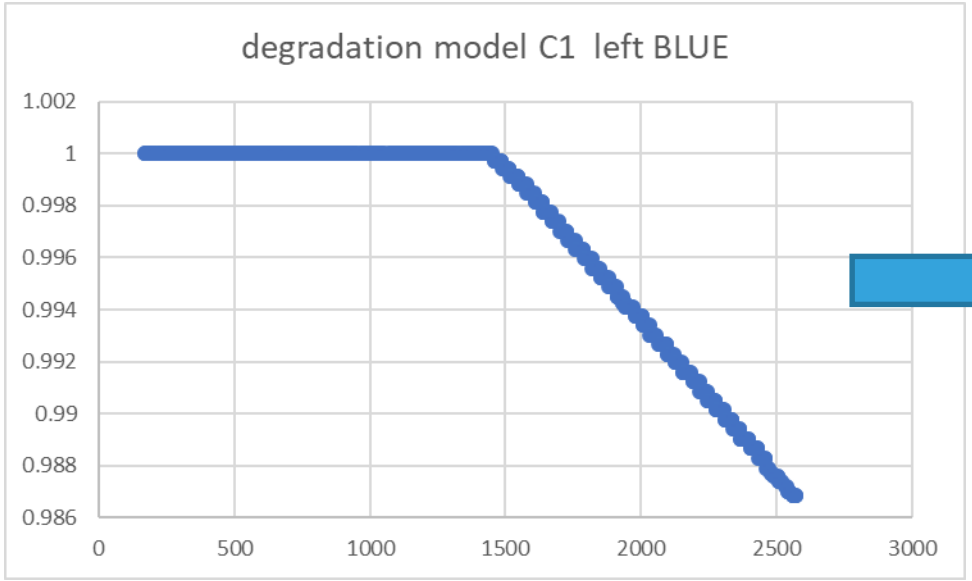
MODIS-TERRA ISSUE POLARISATION





A. Wu, X. Geng, A. Wald, A. Angal, and X. Xiong, "Assessment of Terra MODIS On-Orbit Polarization Sensitivity using Pseudo-invariant Desert Sites," IEEE Trans. Geosci. Remote Sens., vol. 55, no. 7, pp. 4168–4176, Jul. 2017.

COLLECTION 1 : DEGRADATION MODEL SINCE MAY 2017



Underestimation of PROBA-V vs MODIS BLUE TOA reflectance partly due to degradation of BLUE response which is not fully corrected for in C1

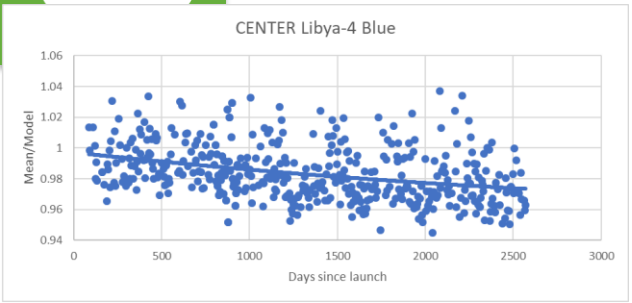
PRELIMINARY CONCLUSIONS LEFT BLUE ISSUE

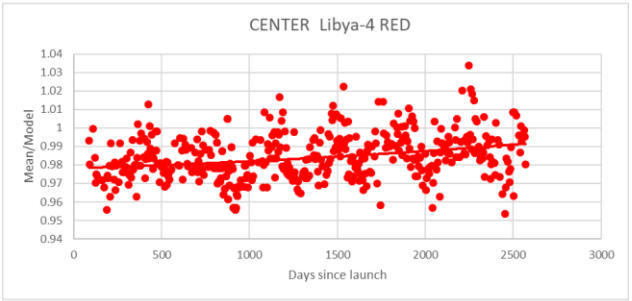
- BUE TOA reflectance about 1~2 % lower than MODIS AQUA band 9 TOA reflectance (C5)
  - Partly due to absolute bias
  - Partly due to degradation of BLUE response not fully corrected for in C1
- Inter-camera biases LEFT-CENTER BLUE :
  - In overlap region ~0.7 %
  - Polarisation sensitivity might explain some of larger uncertainties near edge
- In C2 :
  - Degradation model from start
    - Reprocessing scenes – re-evaluation biases
  - Correction for overall bias : ~1% (TBC)
  - 0.7- 1% (TBC) extra correction to LEFT-BLUE to correct for inter-camera bias

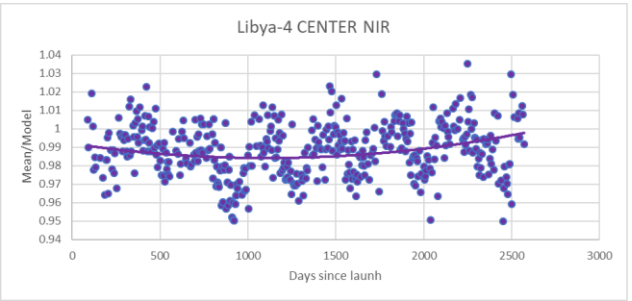
CONTENT

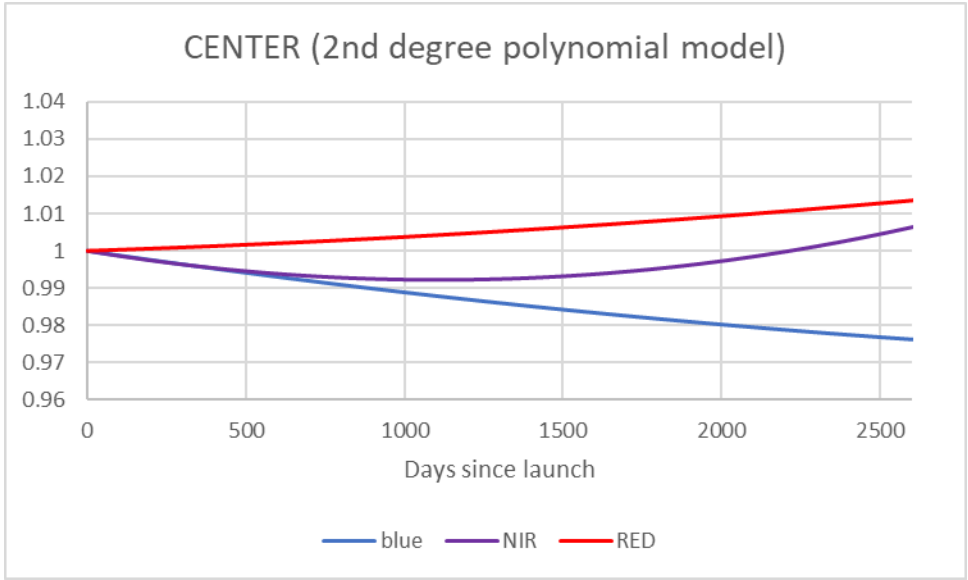
- Investigation LEFT BLUE issue
  - The issue
  - Differences in LEFT-CENTER overlapping region
  - OSCAR Libya-4 VZA dependencies
  - DCC interband results vs Pixel/VZA
  - Polarisation sensitivity
  - C1 : Degradation model applied since May 2017
- Trend model

TREND MODEL

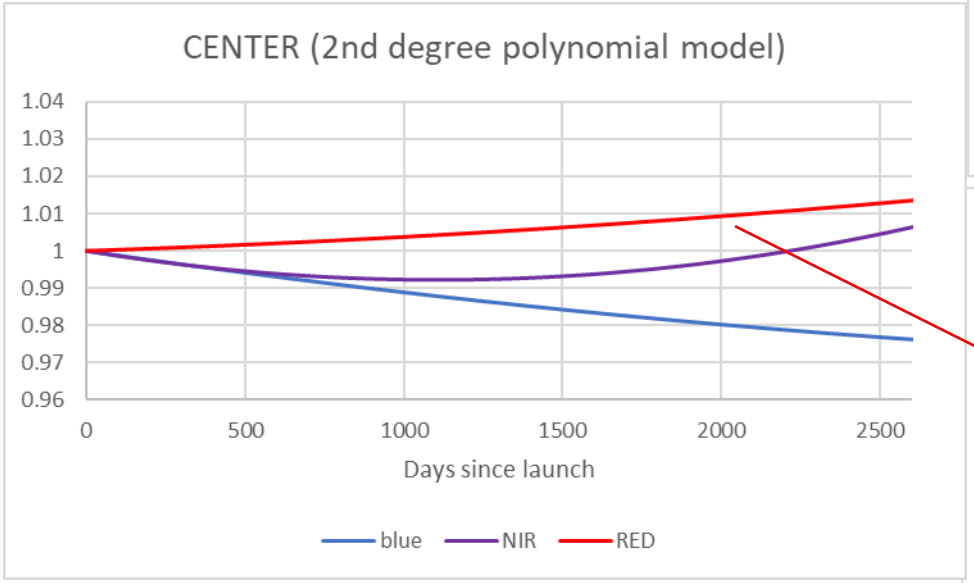

CENTER Libya-4 Blue
Mean/Model
Days since launch

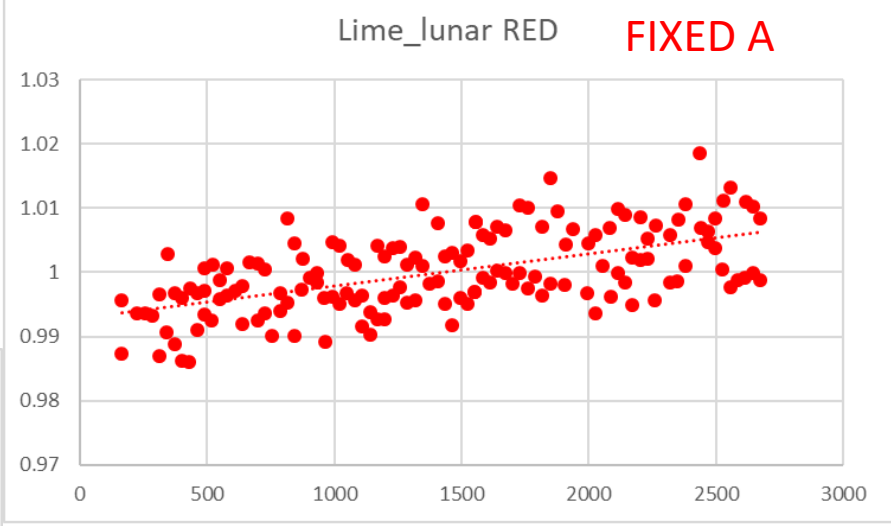

CENTER Libya-4 RED
Mean/Model
Days since launch

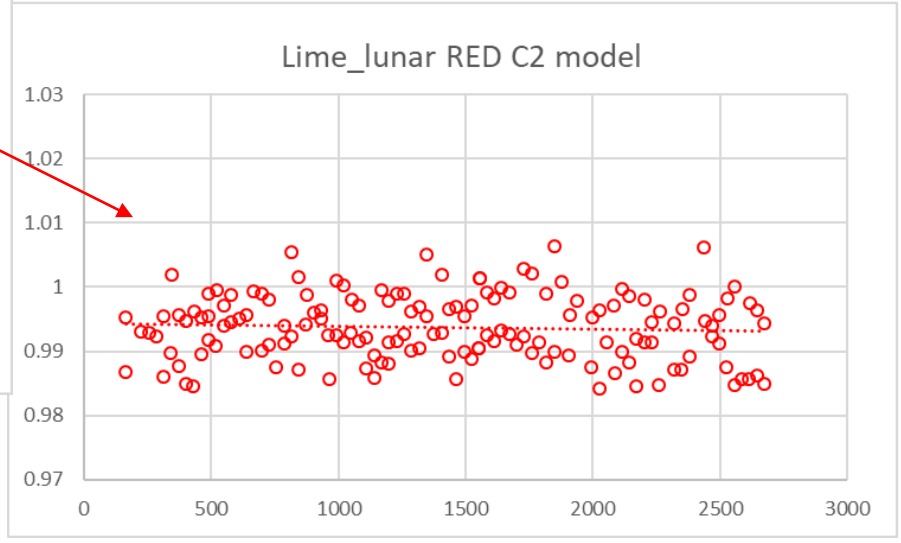

Libya-4 CENTER NIR
Mean/Model
Days since launh


CENTER (2nd degree polynomial model)
Days since launch
blue
NIR
RED

LUNAR LIME







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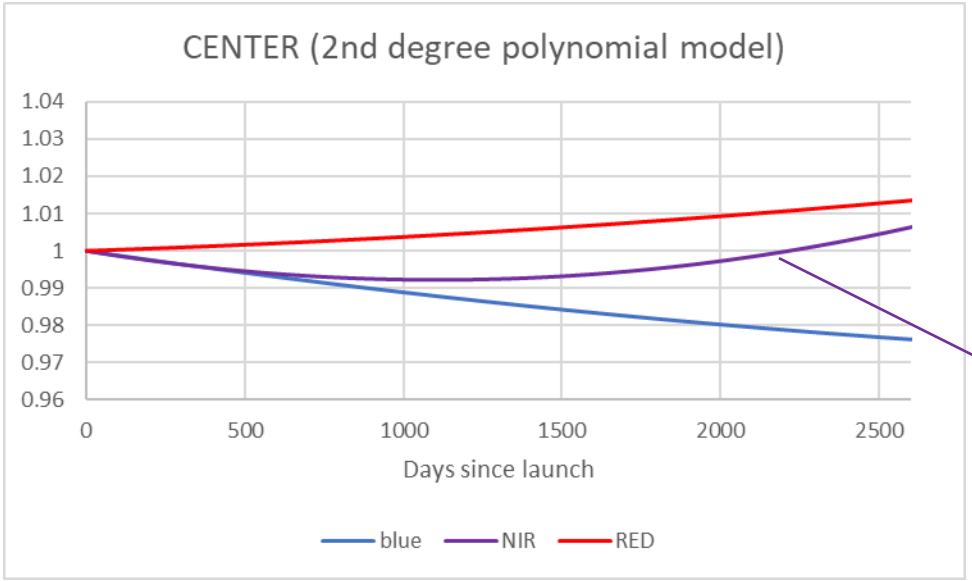
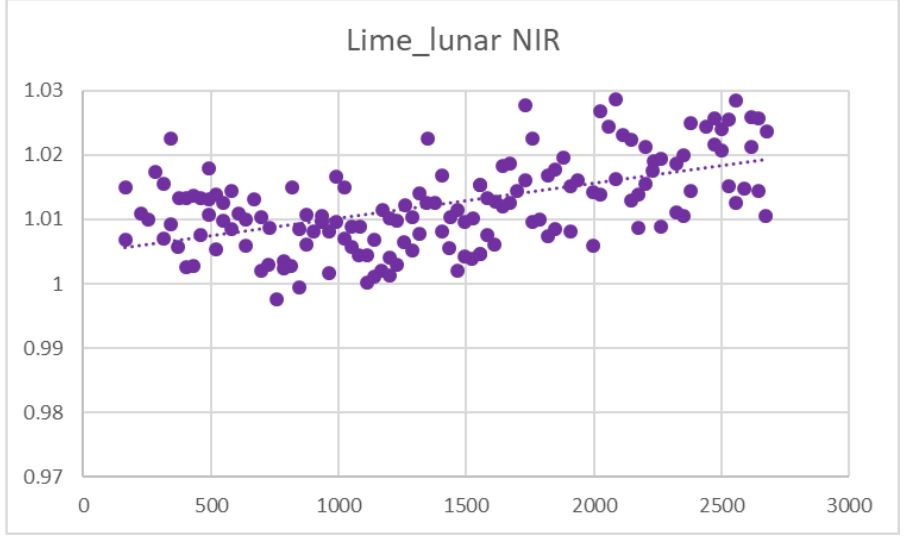
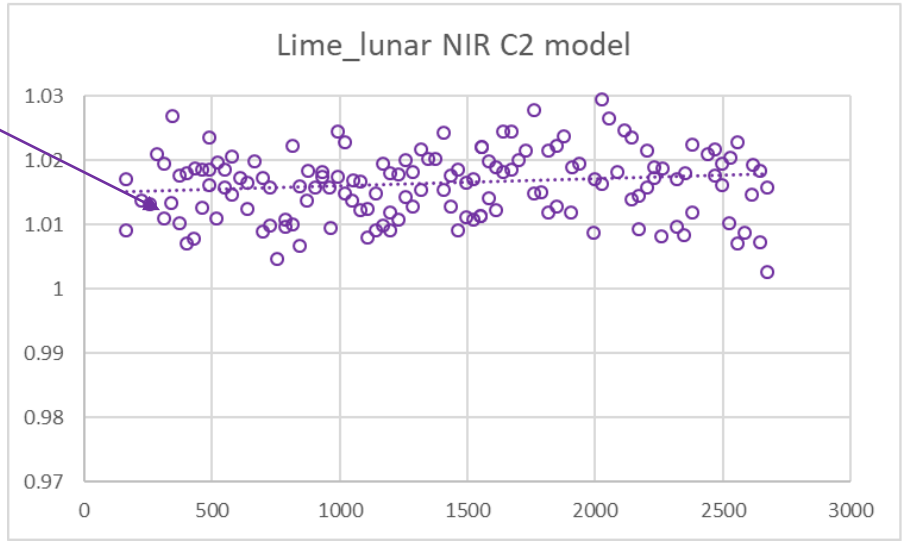
LUNAR LIME

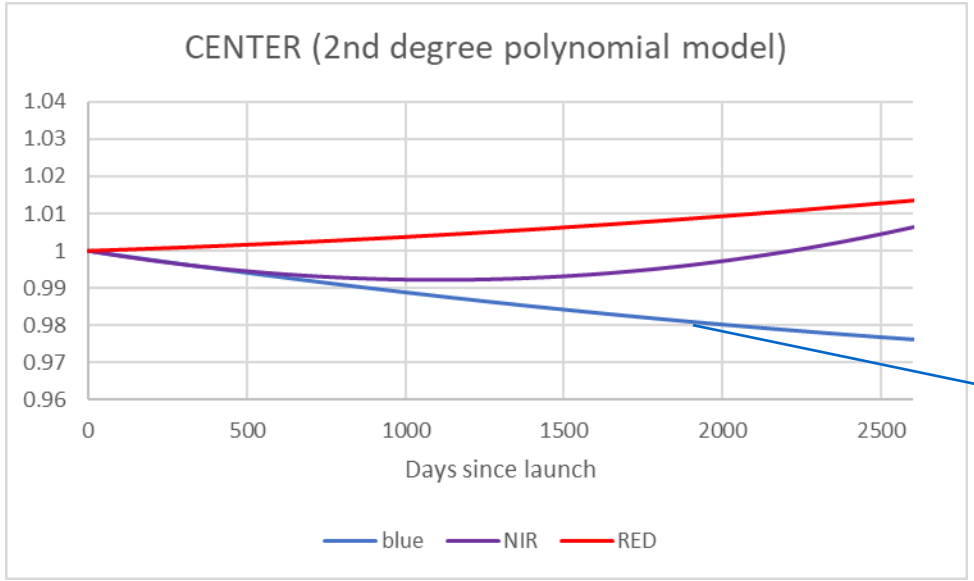


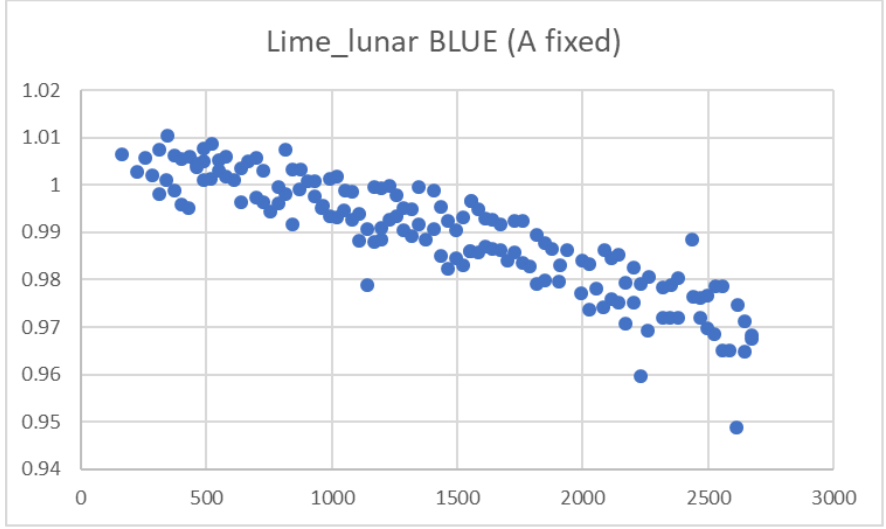


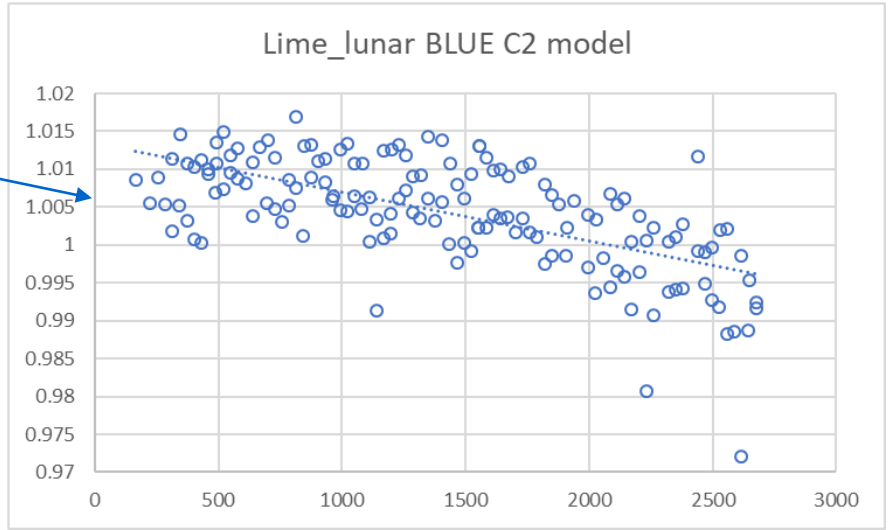


vito
remote sensing

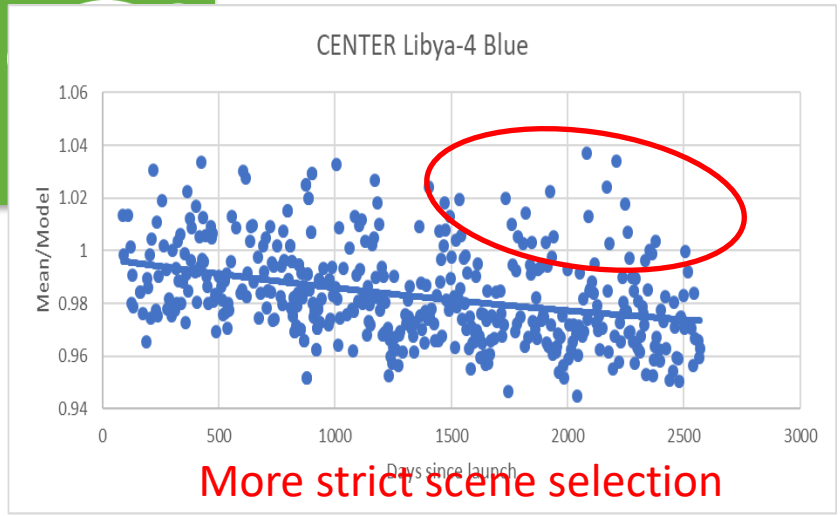
LUNAR LIME



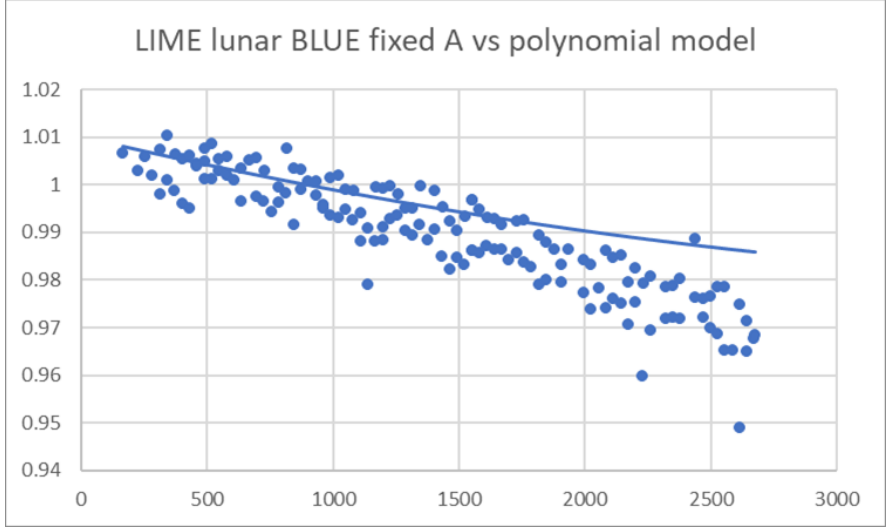


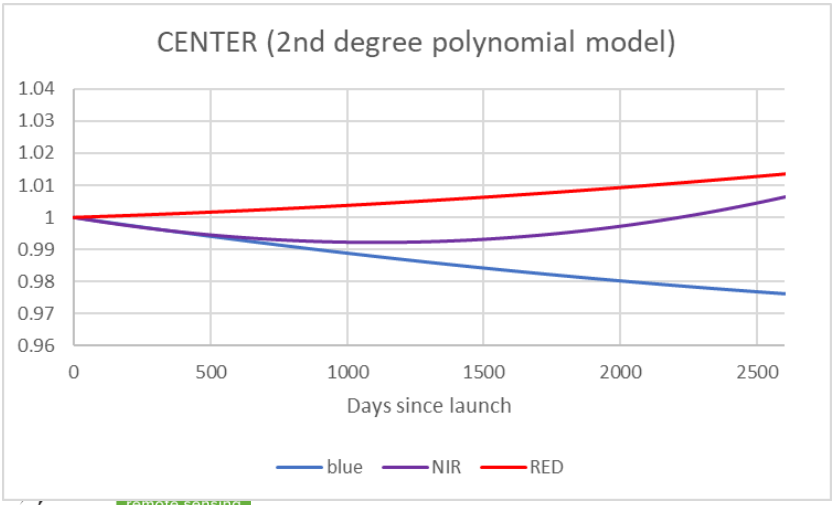


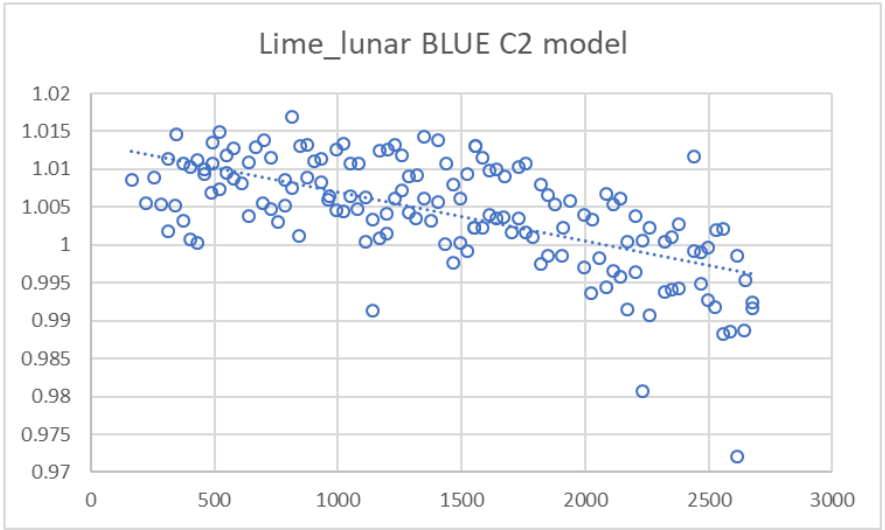
vito
remote sensing



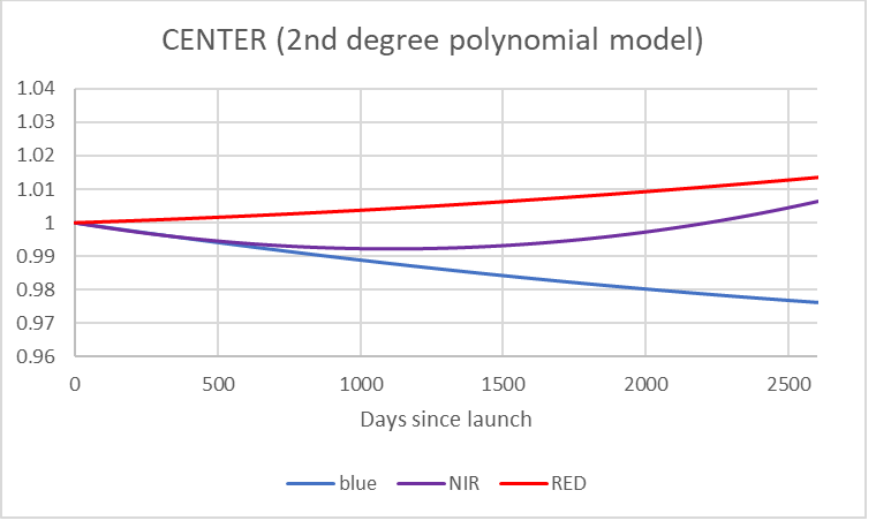
More strict scene selection

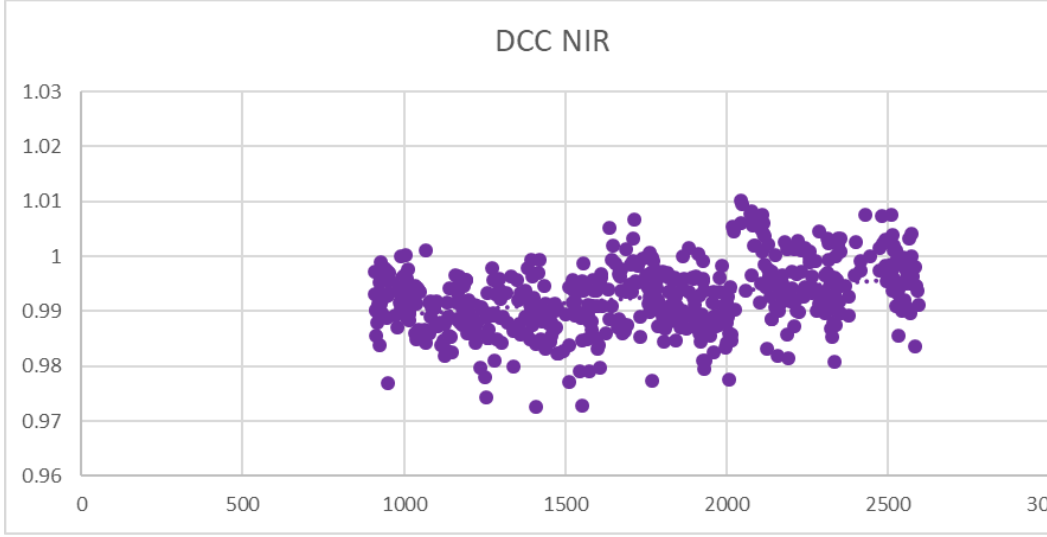


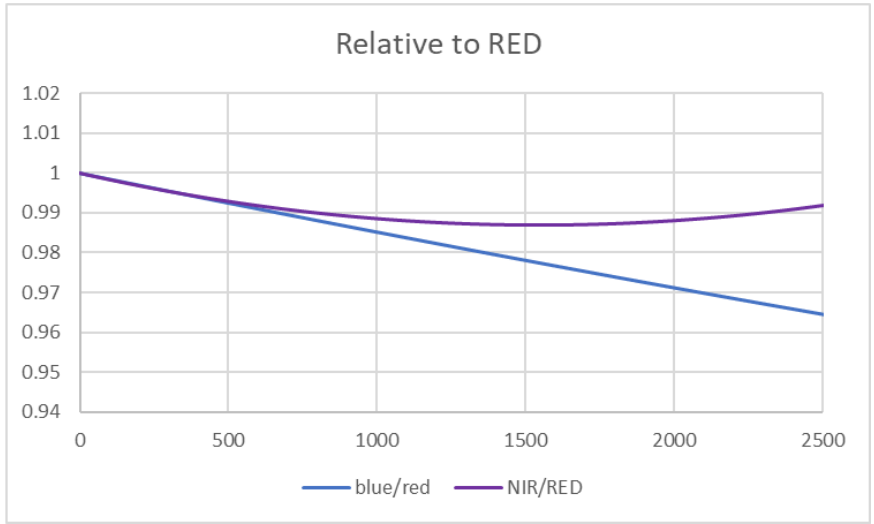


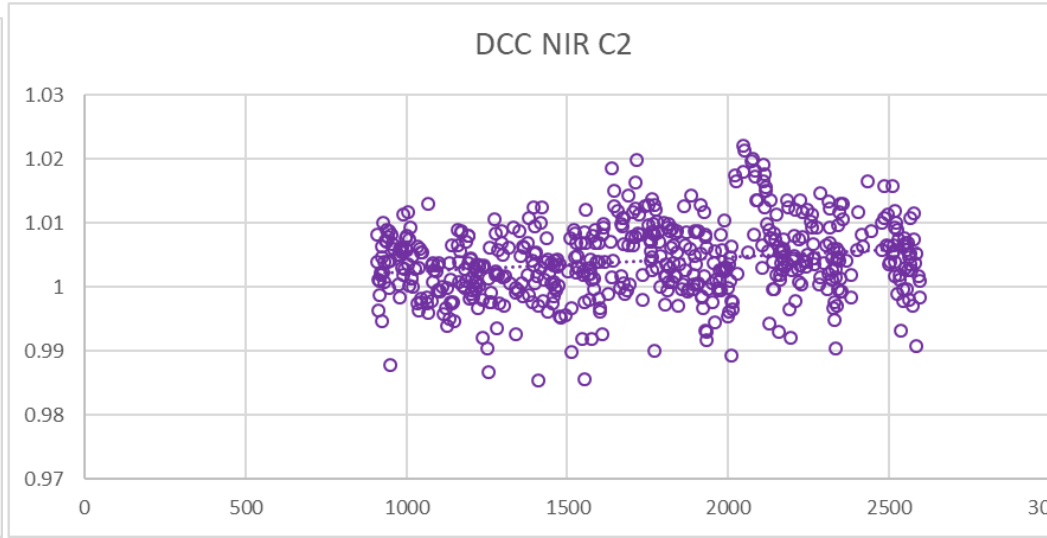


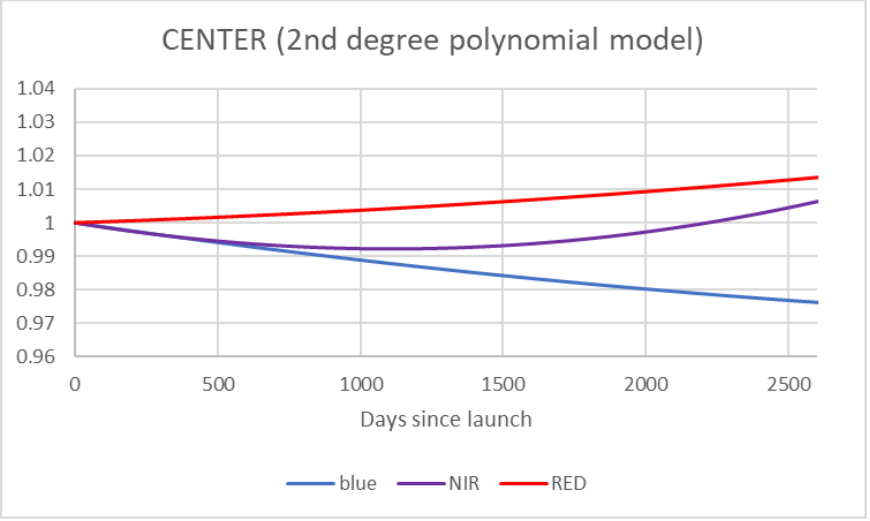
remote sensing

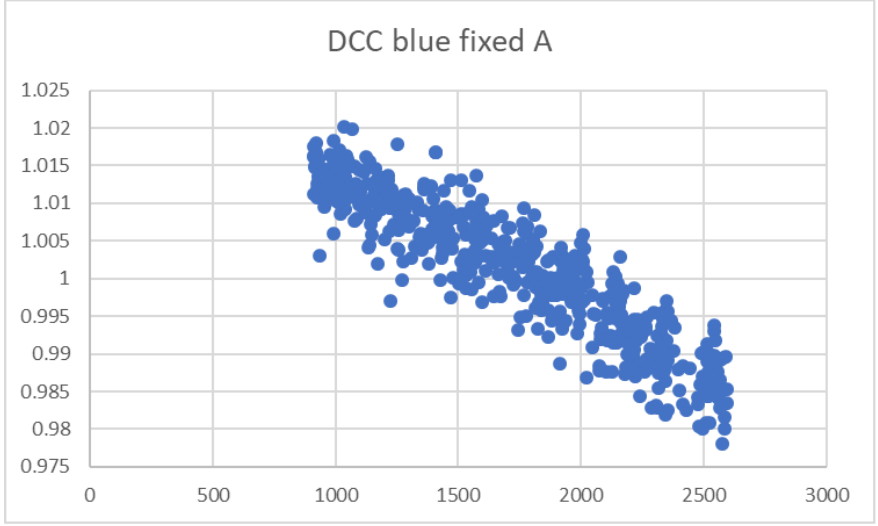

CENTER (2nd degree polynomial model)
1.04
1.03
1.02
1.01
1
0.99
0.98
0.97
0.96
0
500
1000
1500
2000
2500
Days since launch
blue
NIR
RED

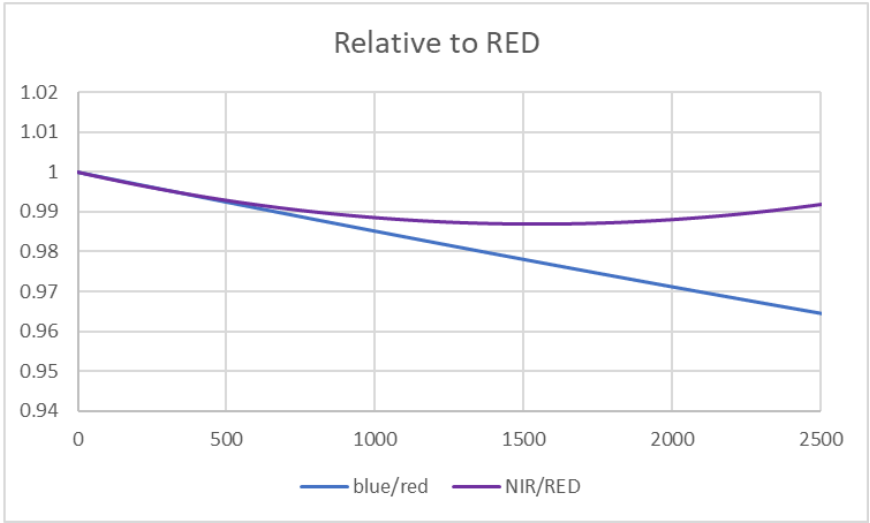

DCC NIR
1.03
1.02
1.01
1
0.99
0.98
0.97
0.96
0
500
1000
1500
2000
2500

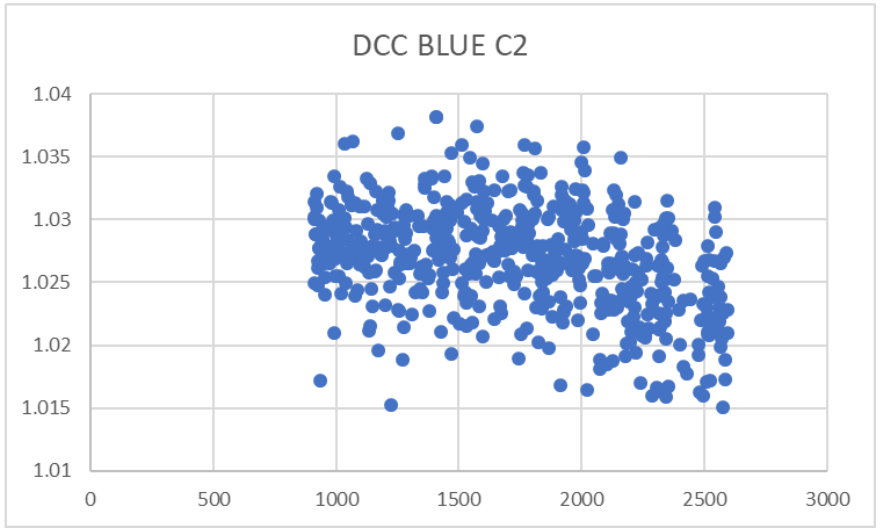

Relative to RED
1.02
1.01
1
0.99
0.98
0.97
0.96
0.95
0.94
0
500
1000
1500
2000
2500
blue/red
NIR/RED


DCC NIR C2
1.03
1.02
1.01
1
0.99
0.98
0.97
0
500
1000
1500
2000
2500


CENTER (2nd degree polynomial model)
1.04
1.03
1.02
1.01
1
0.99
0.98
0.97
0.96
0
500
1000
1500
2000
2500
Days since launch
blue
NIR
RED


DCC blue fixed A
1.025
1.02
1.015
1.01
1.005
1
0.995
0.99
0.985
0.98
0.975
0
500
1000
1500
2000
2500
3000


Relative to RED
1.02
1.01
1
0.99
0.98
0.97
0.96
0.95
0.94
0
500
1000
1500
2000
2500
blue/red
NIR/RED


DCC BLUE C2
1.04
1.035
1.03
1.025
1.02
1.015
1.01
0
500
1000
1500
2000
2500
3000

PRELIMINARY CONCLUSIONS TREND MODEL

- FOR CENTER CAMERA
  - Lunar LIME results for validation degradation model
    - RED & NIR trends in Lunar Lime results corrected for by degradation model
    - BLUE trends in Lunar Lime results corrected for until +/- day 1500by degradation model
    - BLUE trends in Lunar Lime results undercorrected for > day 1500
      Similar observations in DCC BLUE interband results

=> ACTION : more strict selection of scenes for degradation trending BLUE

THANKS FOR YOUR ATTENTION