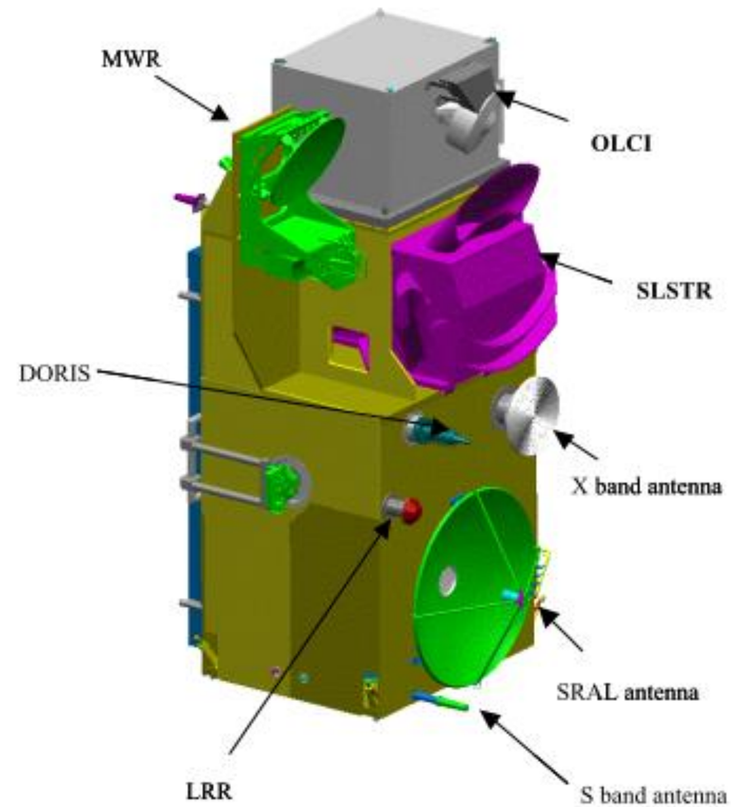

OLCI-A and OLCI-B cross-calibration using the tandem-flight period

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Disclaimer

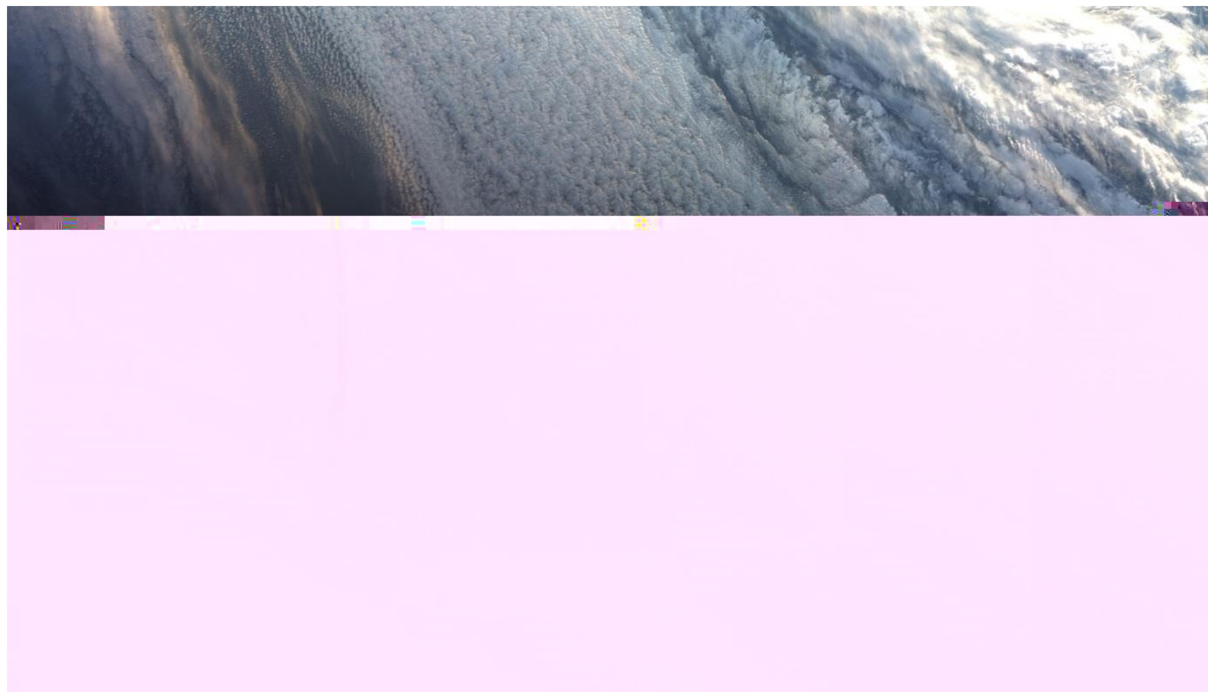
The work performed in the frame of this contract is carried out with funding by the European Union. The views expressed herein can in no way be taken to reflect the official opinion of either the European Union or the European Space Agency.

Overview

- Sentinel-3 mission and OLCI
- Tandem and Drift Phases
- Comparison methodology
  - Geometric co-registration and reprojection
  - OLCI A/B spectral characteristics and data homogenization
- Results

Sentinel-3 mission and OLCI

- **Sentinel-3:** measures sea surface topography, sea and land surface temperature, and **ocean and land surface colour** with high accuracy and reliability to support ocean forecasting systems, environmental monitoring and climate monitoring
- **S3A**: Feb 16th 2016
- **S3B**: Apr 25th 2018
- Revisit < 2 days
- **C** and **D** in preparation



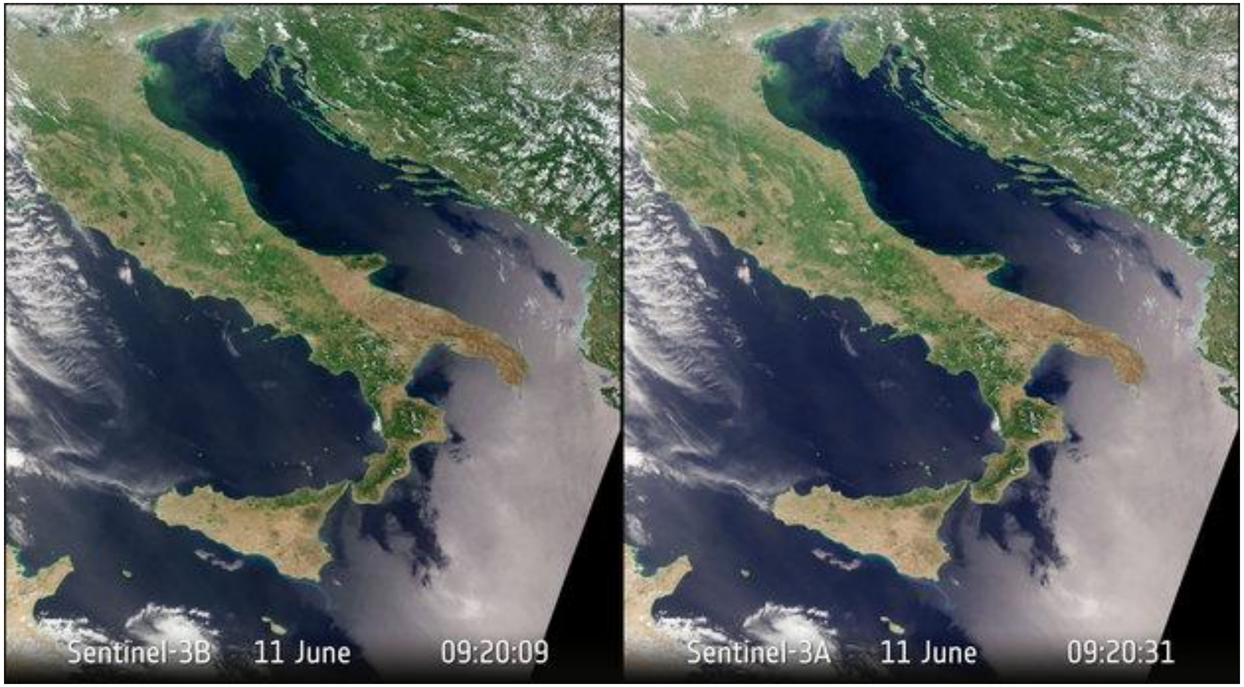
Antarctica - Sentinel-3B's very first sight
https://www.eumetsat.int/website/home/News/DAT_3912999.html

- **OLCI**: Ocean and Land Colour Instrument
- **VNIR**: 21 bands (400-1020 nm)
- GSD: 300 m at nadir (FR)
- Swath width: 1270 km
- 5 cameras, tilted to avoid glint

S3A/S3B tandem/drift phases

- **S3A/S3B tandem**: S3B put on **same ground track** as S3A, **30s ahead**
- **Tandem** period: early June to mid-October 2018
- Preceded and followed by **drift** periods, from and to nominal S3-B orbits (A & B interleaved ground tracks)

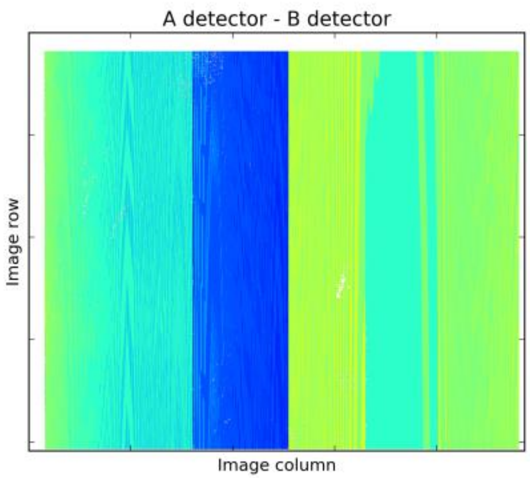
→ **ideal framework for sensor inter-comparison and inter-calibration**



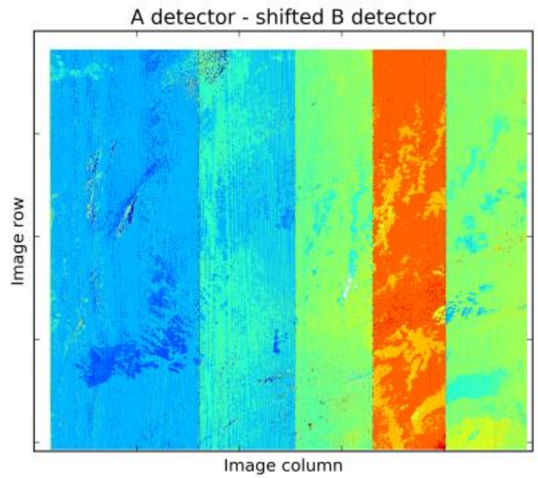
https://earth.esa.int/web/sentinel/missions/sentinel-3/news/-/article/sentinel-3-flies-tandem

Geometrical coregistration and reprojection on L3 grid

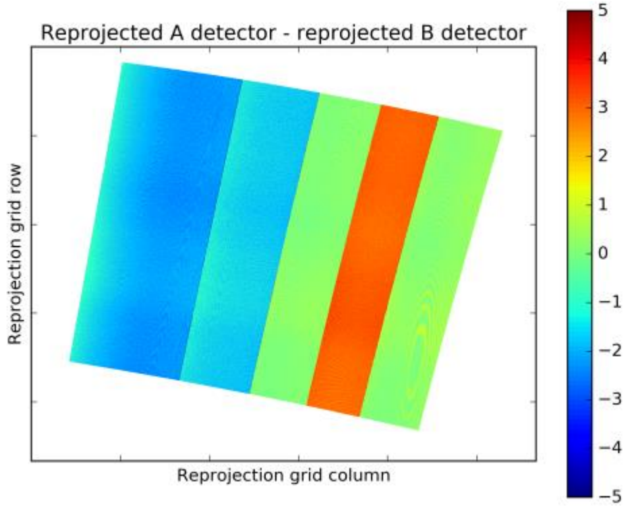
- Detectors footprints cannot match perfectly (raw differences in detector indices on the left)
- Perform an image coregistration based on image 2D-shifts and radiometry best match (regression) per pixel (differences in detector indices in the middle)
- Geometrical calibration performed at L1B used for reprojection on L3 grid, differences in reprojected products (right image) show same patterns per camera



Superimposed detector images difference



Detector images difference after coregistration from regression of radiometry

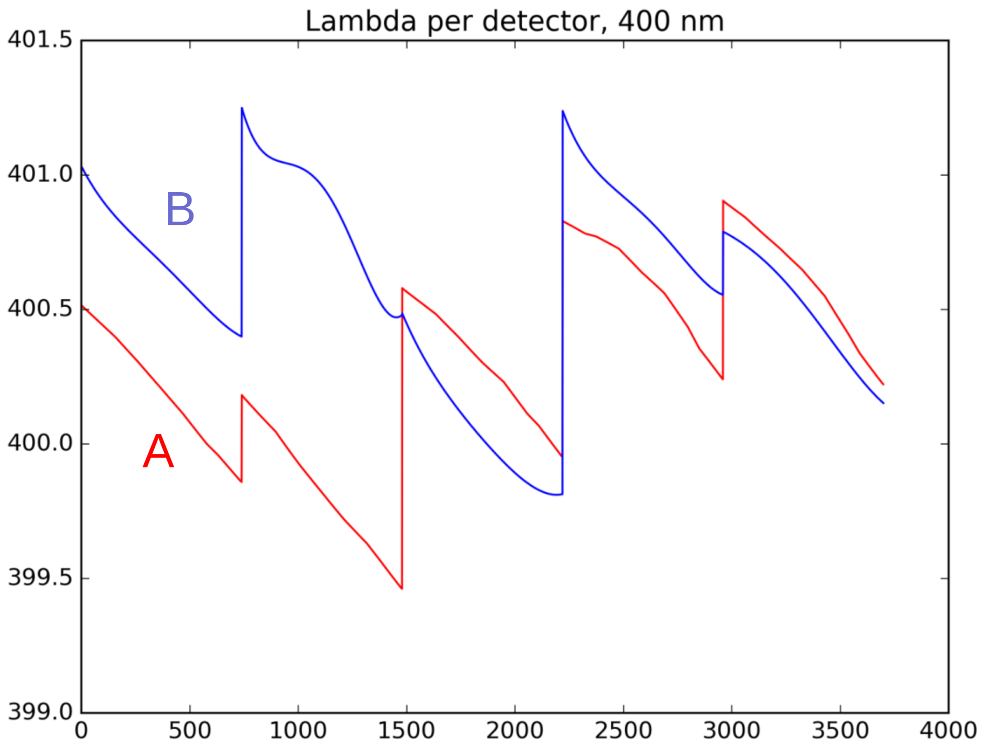


Detector images difference after reprojection on same L3 grid

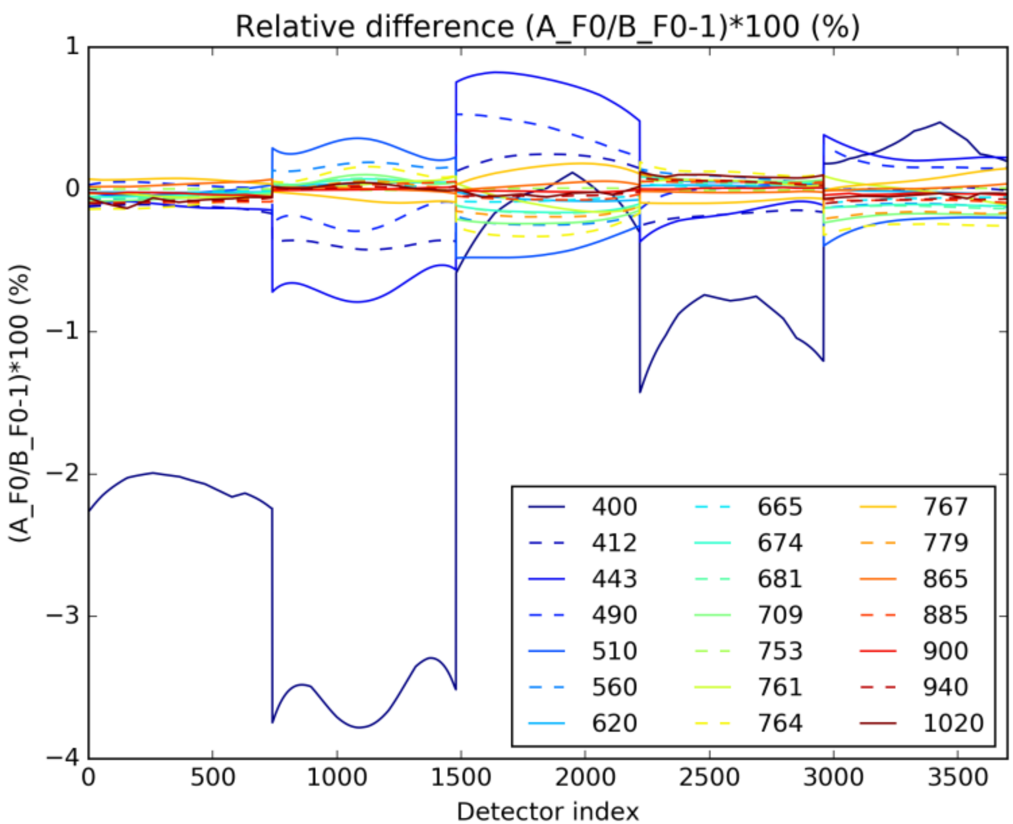
→ reprojection used preferably to image coregistration technique for each image

OLCI A / B spectral characterization and data homogenization

- Spectral characterization shows **up to 1 nm difference** between OLCI-A and OLCI-B



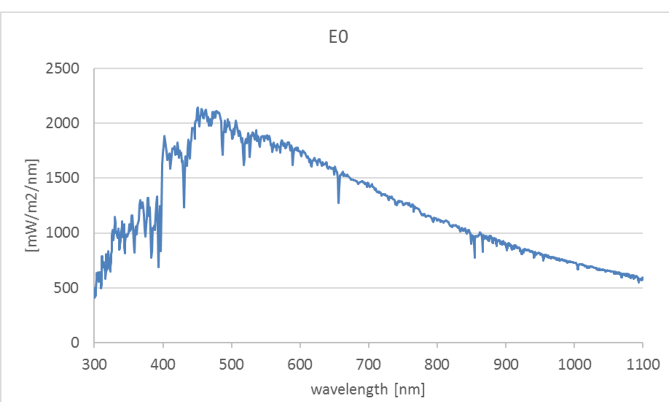
OLCI A / B spectral characterization and data homogenization



Spectral characterization shows up to 1 nm difference between OLCI-A and OLCI-B

It can appear small but:

- differences in TOA radiance can come **up to 4%** at 400 nm firstly due to **solar irradiance**

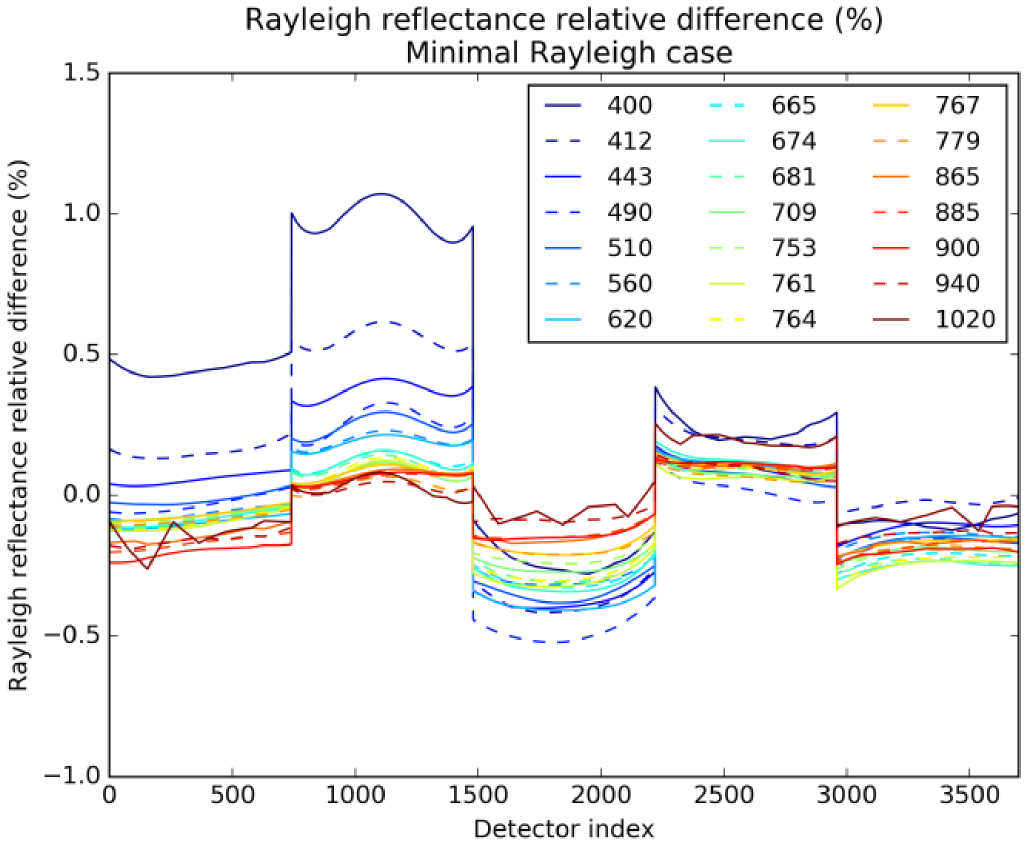


OLCI A / B spectral characterization and data homogenization

Spectral characterization shows up to 1 nm difference between OLCI-A and OLCI-B

It can appear small but:

- differences in TOA radiance can come up to 4% at 400 nm firstly due to solar irradiance
- Secondly due to **Rayleigh scattering** strong dependency with wavelength (@400nm, 1nm≈1%)



OLCI A / B spectral characterization and data homogenization

- Spectral characterization shows up to 1 nm difference between OLCI-A and OLCI-B

→ **homogenization** of OLCI-A and OLCI-B must be performed prior any comparison = “measurand adjustment”

- It can appear small but differences in TOA radiance can come up to 4% at 400 nm firstly due to solar irradiance

→ corresponds to OLCI “**smile-correction**” performed in first L2 processing steps

- Secondly due to Rayleigh scattering strong dependency with wavelength

→ **depends on the target** with assumptions on the target behaviour

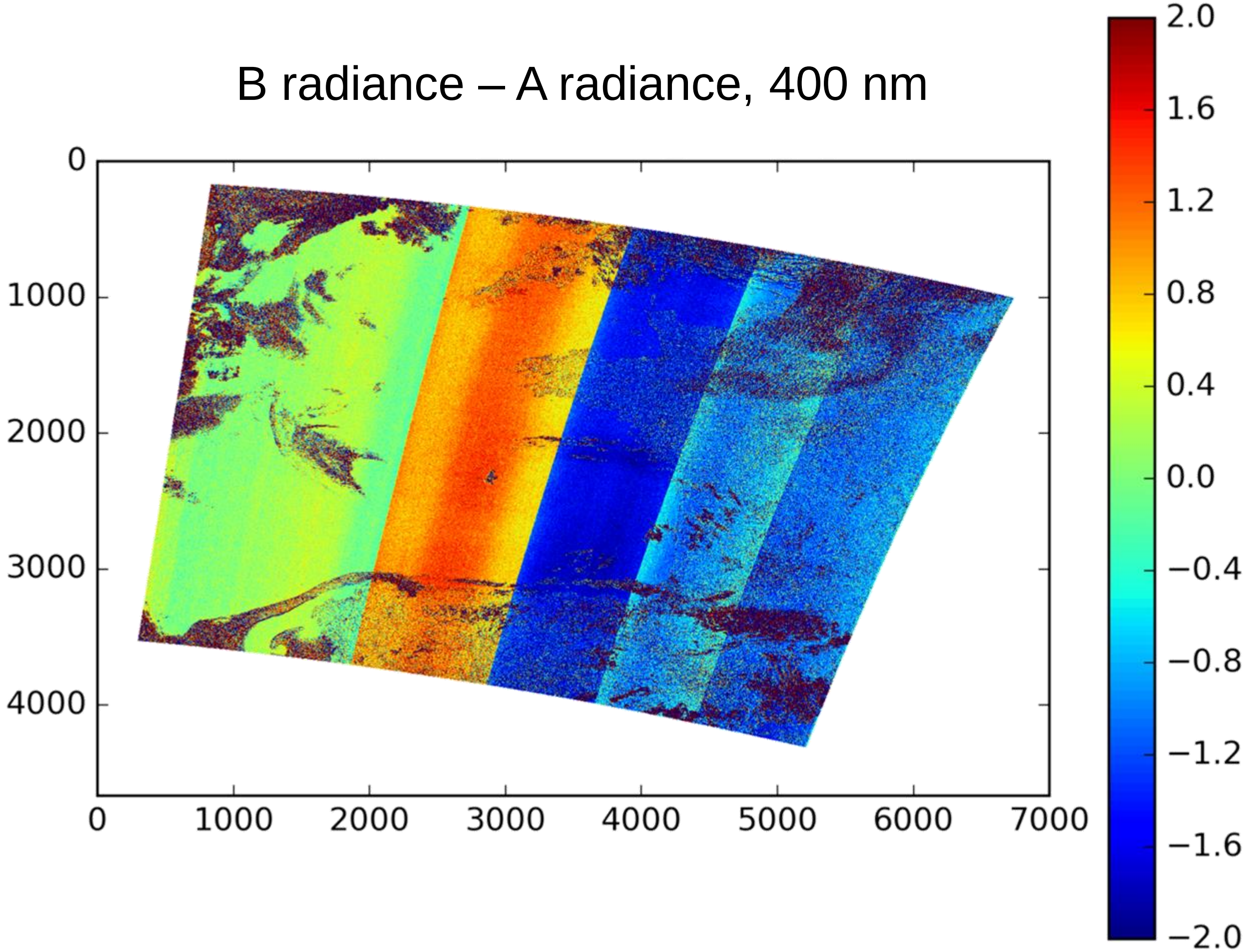
- Finally due to **BOA** dependency with wavelength

→ **OLCI L2 smile-correction** breadboarded and **used** for the **homogenization**

- Gaseous absorption differences (out of strong features) has a small effect

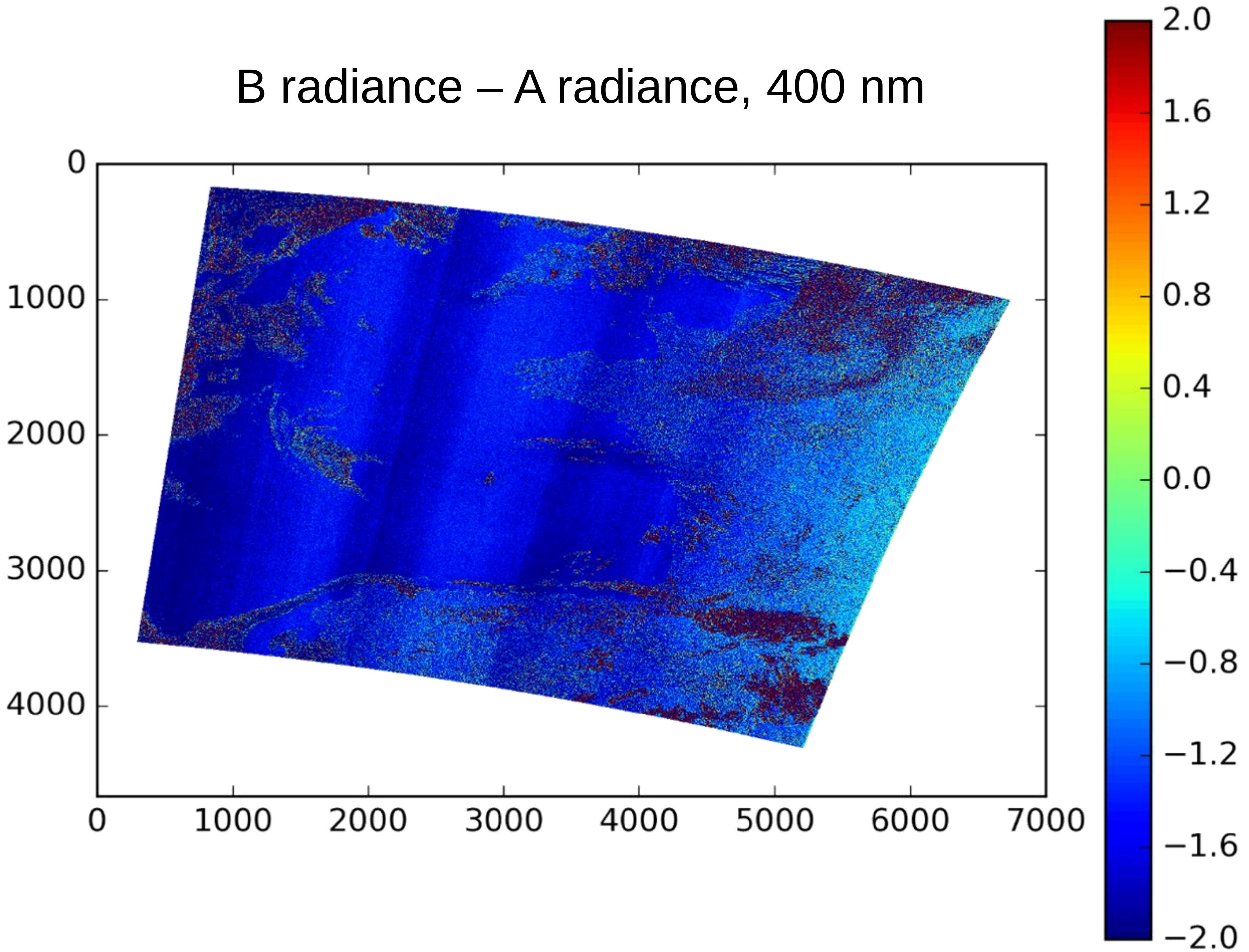
→ adjust toward **nominal** wavelength **both** for A and for B (=operational process)

Homogenization benefits example: prior (i.e. radiance comparisons at *measured* wavelengths)



Strongest differences between cameras in TOA radiances at 400 nm…

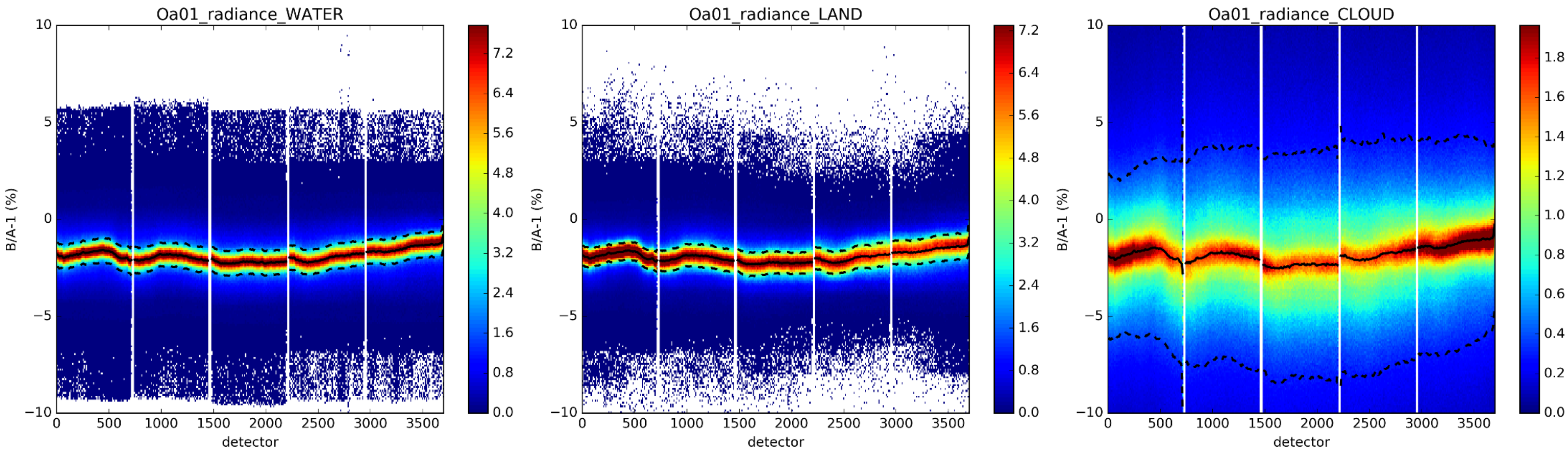
Homogenization benefits example: after (i.e. comparisons at *nominal* wavelengths)



Much more homogenous!
Remaining differences to investigate !

Comparisons, one day statistics (20180702)

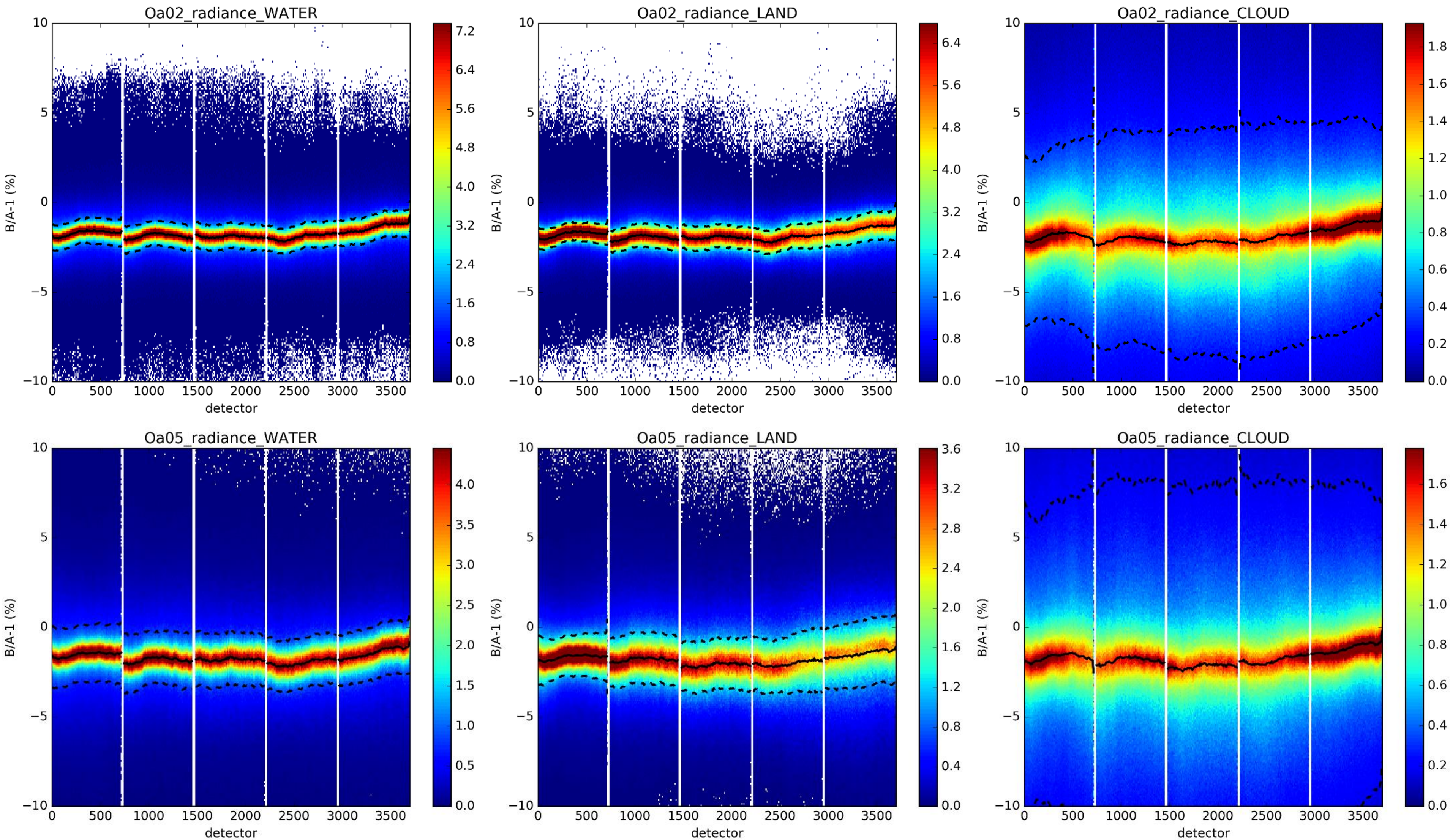
B / A -1 (%), **400** nm



- histograms per bin of detectors (i.e. across the FOV, gathering data along-track)
- differences are comparable for all targets Water/Land/Cloud
- larger dispersion over clouds due to cloud motion and parallax effects, but mean is ok (in metrological language: less precision, same accuracy)
- strong bias about 1-2% between A and B (seen at all bands, slightly decreasing with increasing wavelength)
- intra-camera effects, though small in comparison (0.5 % roughly)

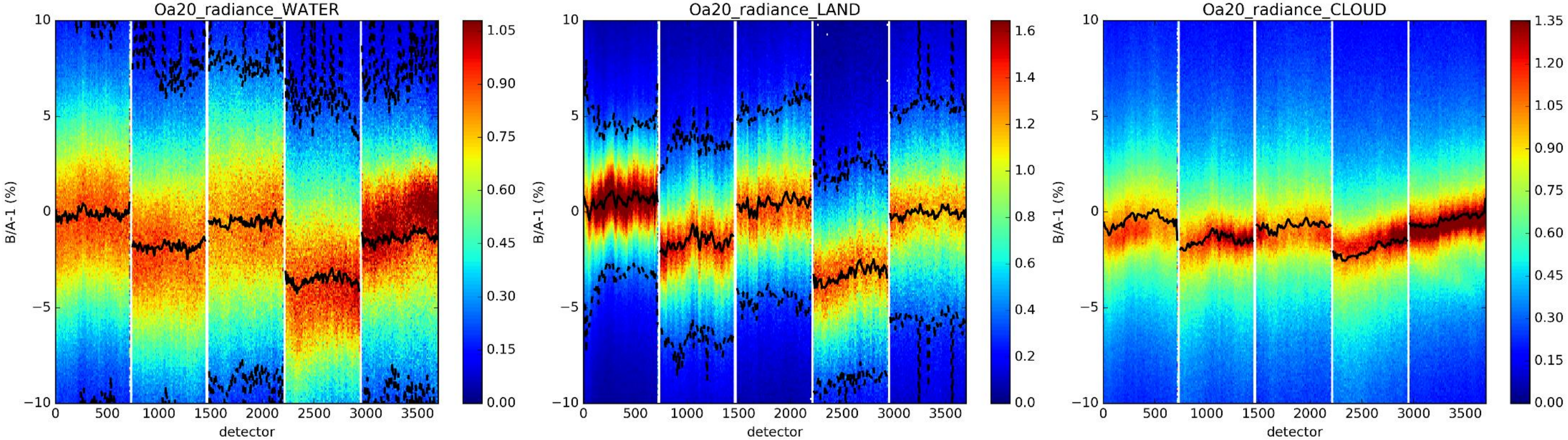
Comparisons, one day statistics (20180702)

B / A -1 (%), **412** nm and **510** nm



Comparisons, one day statistics (20180702)

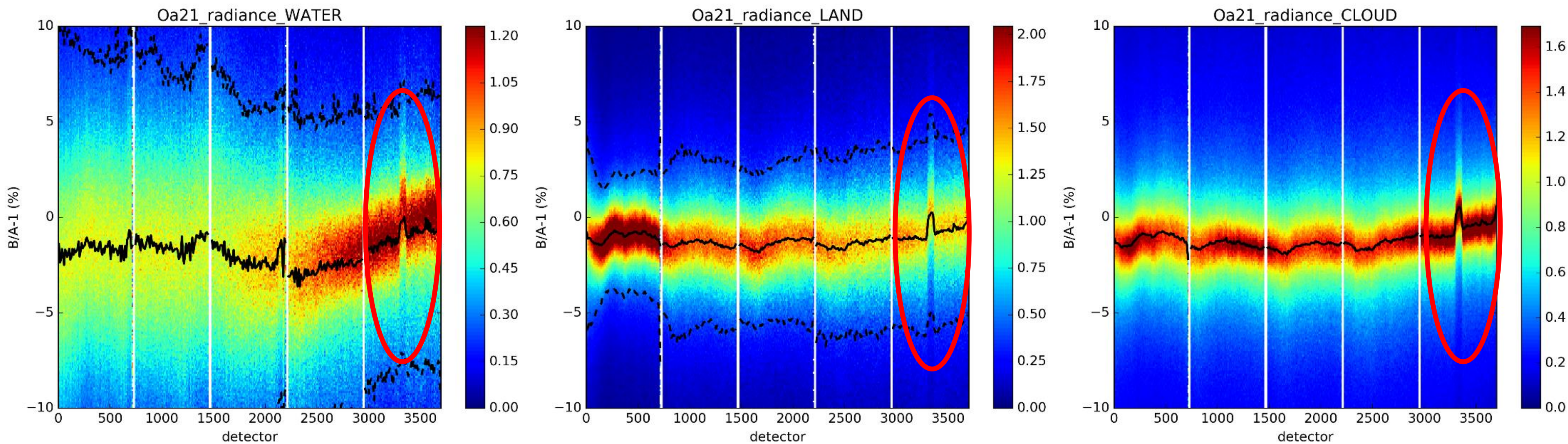
B / A -1 (%), **940** nm



- effect of strong gas absorption features not handled in the methodology
  → H_2O here, O_2 at dedicated bands… (even stronger)
- clouds: higher altitude, less H_2O, less impact
- needs a fine handling/modeling of absorption (not done here)

Comparisons, one day statistics (20180702)

B / A -1 (%), 1020 nm



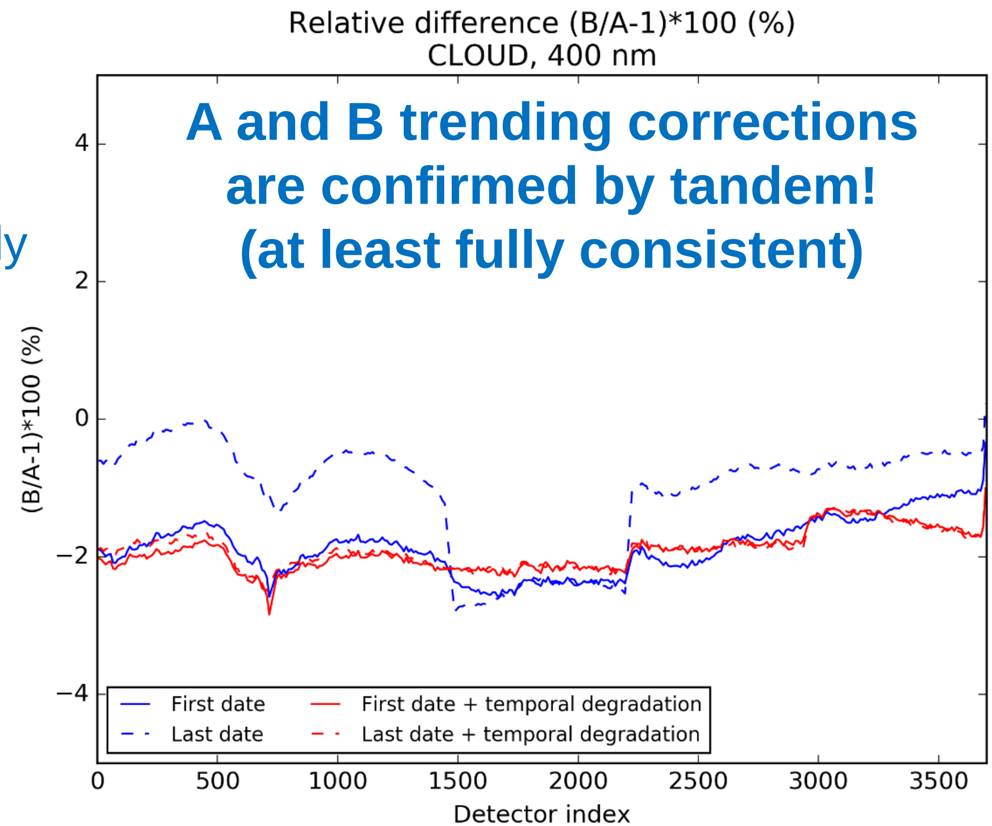
- at 1020 nm low signal over water → less precision
- specific feature detected at 1020 nm, camera 5, answers the “camera 5 anomalous pixels” open question:
  “does anomalous response detected in OLCI-A calibration data come from sensor or diffuser ?”
  → answer is **sensor** as seen as the tandem ratio “bump”

Comparisons: can tandem ratios see instruments evolution ?

- OLCI-A routinely corrected for long-term drift
- OLCI-B was not during tandem, using fixed calibration coefficients. Drift model now available, have been applied *a posteriori*

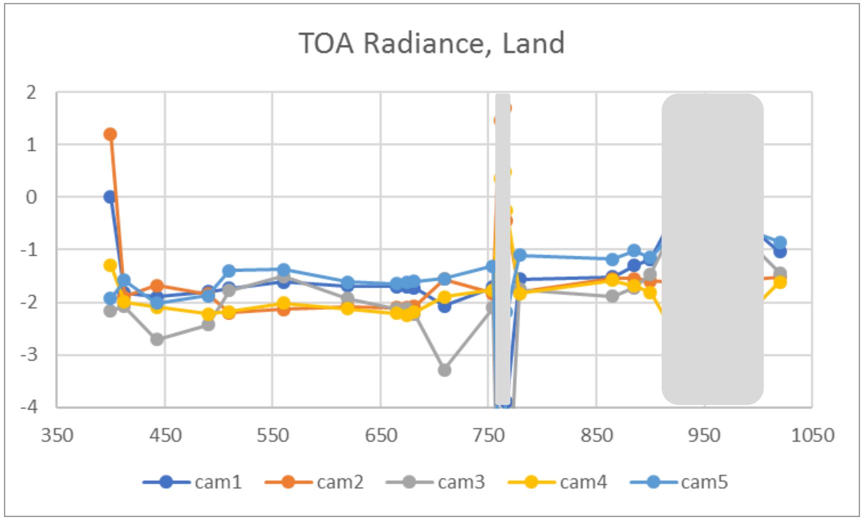
Trend corrected for A only
Trend corrected for both

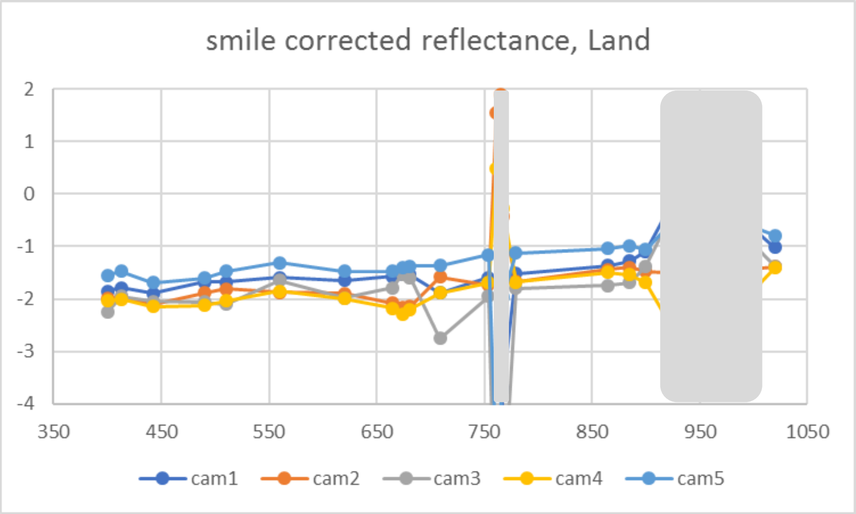
Tandem start
Tandem stop



As a kind of conclusion

B / A -1 (%), camera averages vs. λ





- **Must take care of what we intercompare**

- **Not everything is perfect there (e.g. T_{gas}) but ratios start to look like a meaningful inter-calibration, in particular if assuming it is diffuser related**

THANKS FOR YOUR ATTENTION