Estimate FLEX-like level 1B radiance uncertainties by comparing data sets with different band settings from Sentinel 3 tandem mission

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Living Planet Symposium 2022
B1.04.1 FLEX validation status and plans
Wed 25th May 11:40–11:55

Motivation

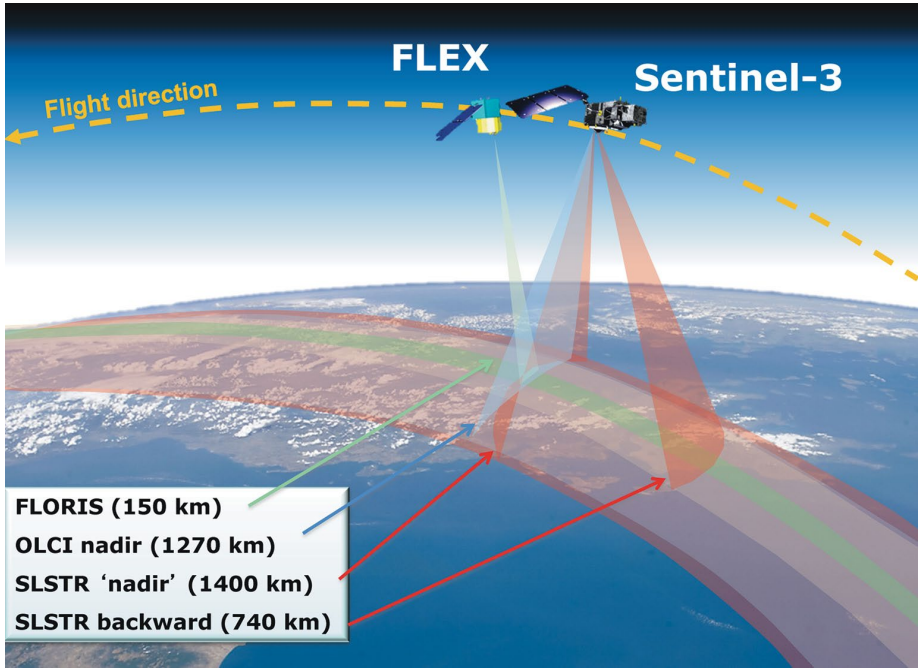


Fig. 1: Tandem mission of FLEX and Sentinel-3 with planned launch of FLEX in 2024 taken from Drusch et al. 2017

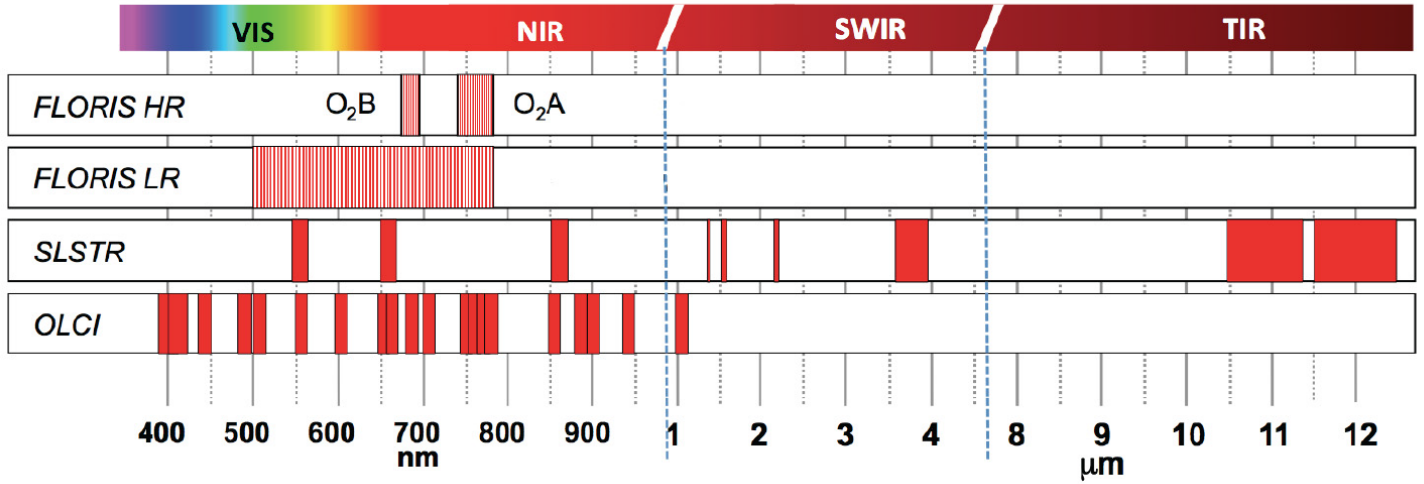


Fig. 2: Band distribution of FLEX and OLCI taken from Drusch et al. 2017

S3-Tandem mission: OLCI-FLEX configuration

- Summer 2018: Tandem mission of Sentinel-3A and -3B during S3B commissioning phase
- for 24 acquisition scenes OLCI-B was programmed to mimic FLEX
- Reprogrammed OLCI-B has 45 bands within 500-800 nm with FWHM between 1.7 nm and 3.7 nm
- Part of Atmoflex and FLEXsense project

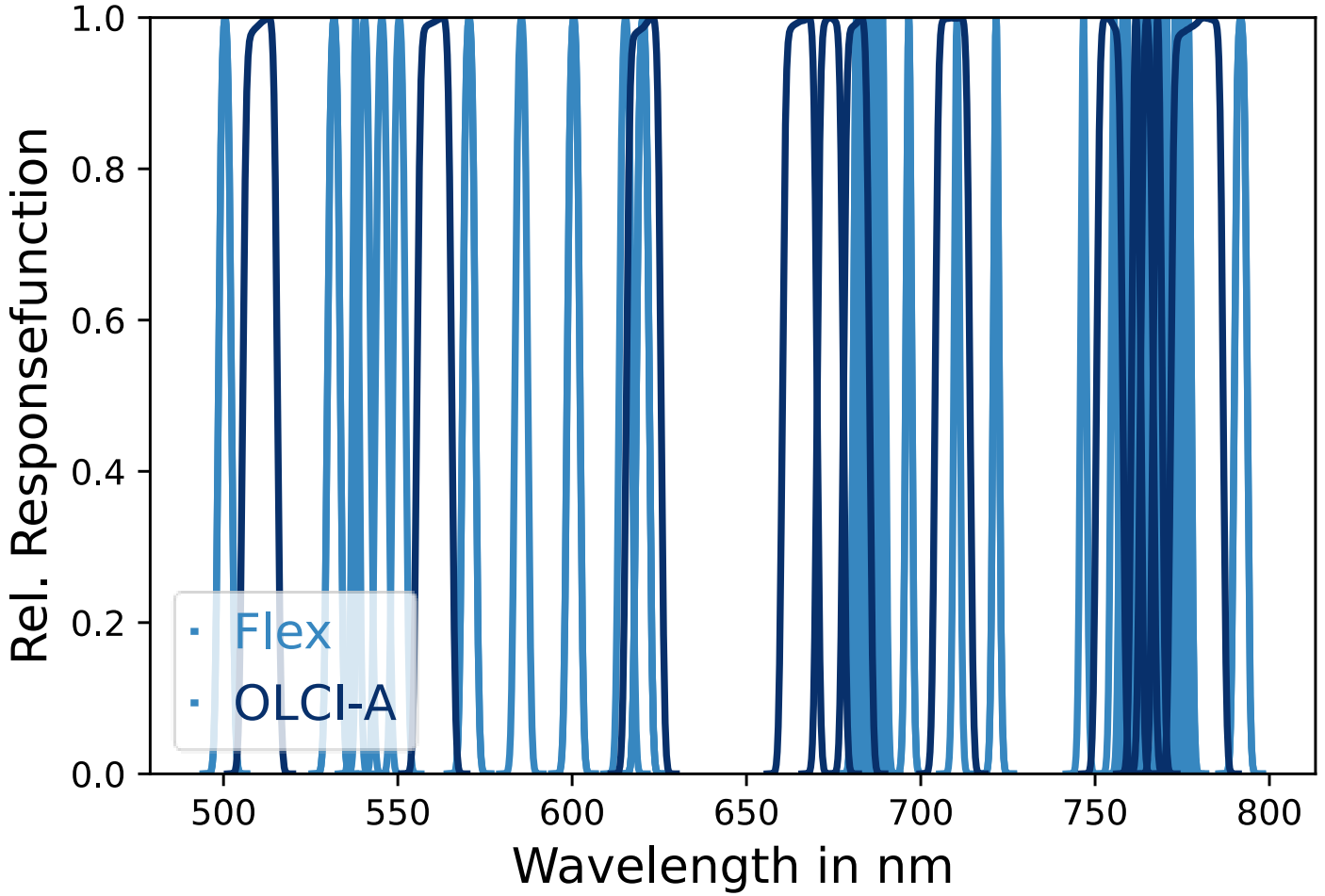
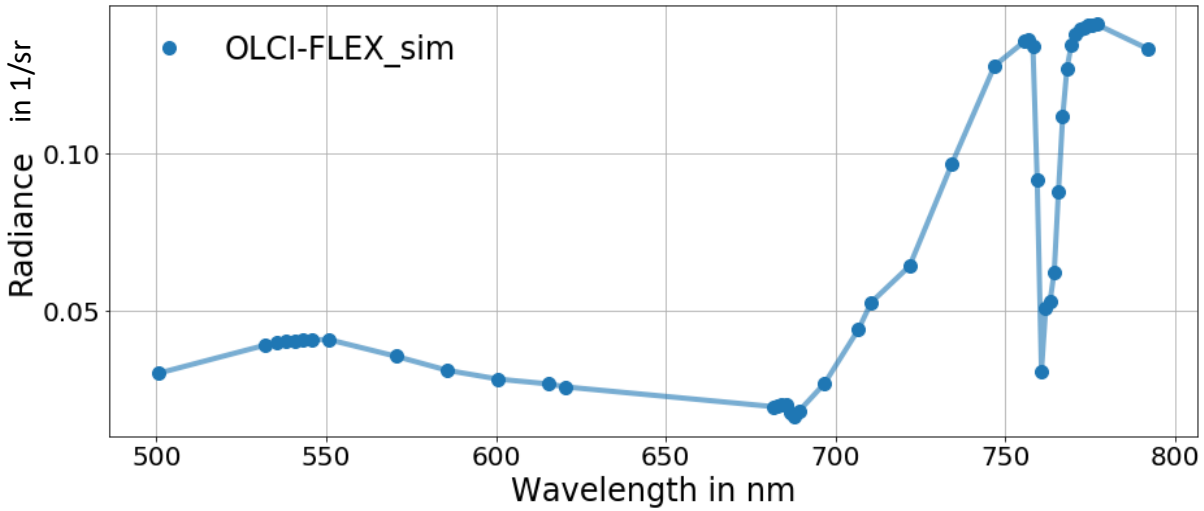
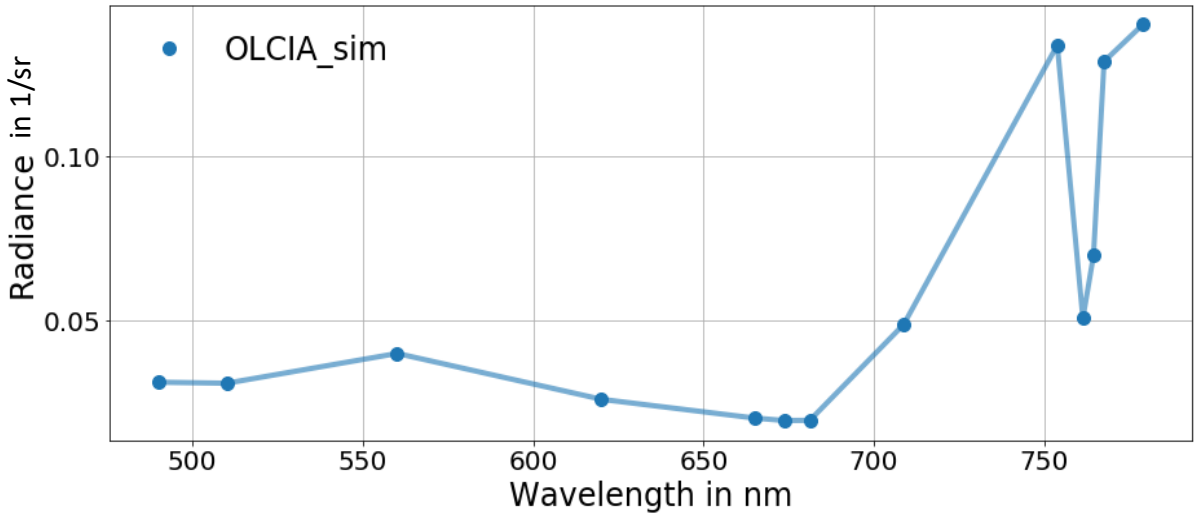


Fig. 3: Relative response function of OLCI-FLEX (light blue) and OLCI-A (dark blue) showing the band distribution and the FWHM

General Idea: **Transfer function**

Instrument 1 ⟷ Instrument 2





Find state of atmosphere and surface that explains measurement of instrument 1

→

Transfer atmosphere and surface parameter to settings of instrument 2

→

Forward simulate measurement of instrument 2

Difference of OLCI-FLEX and OLCI-A

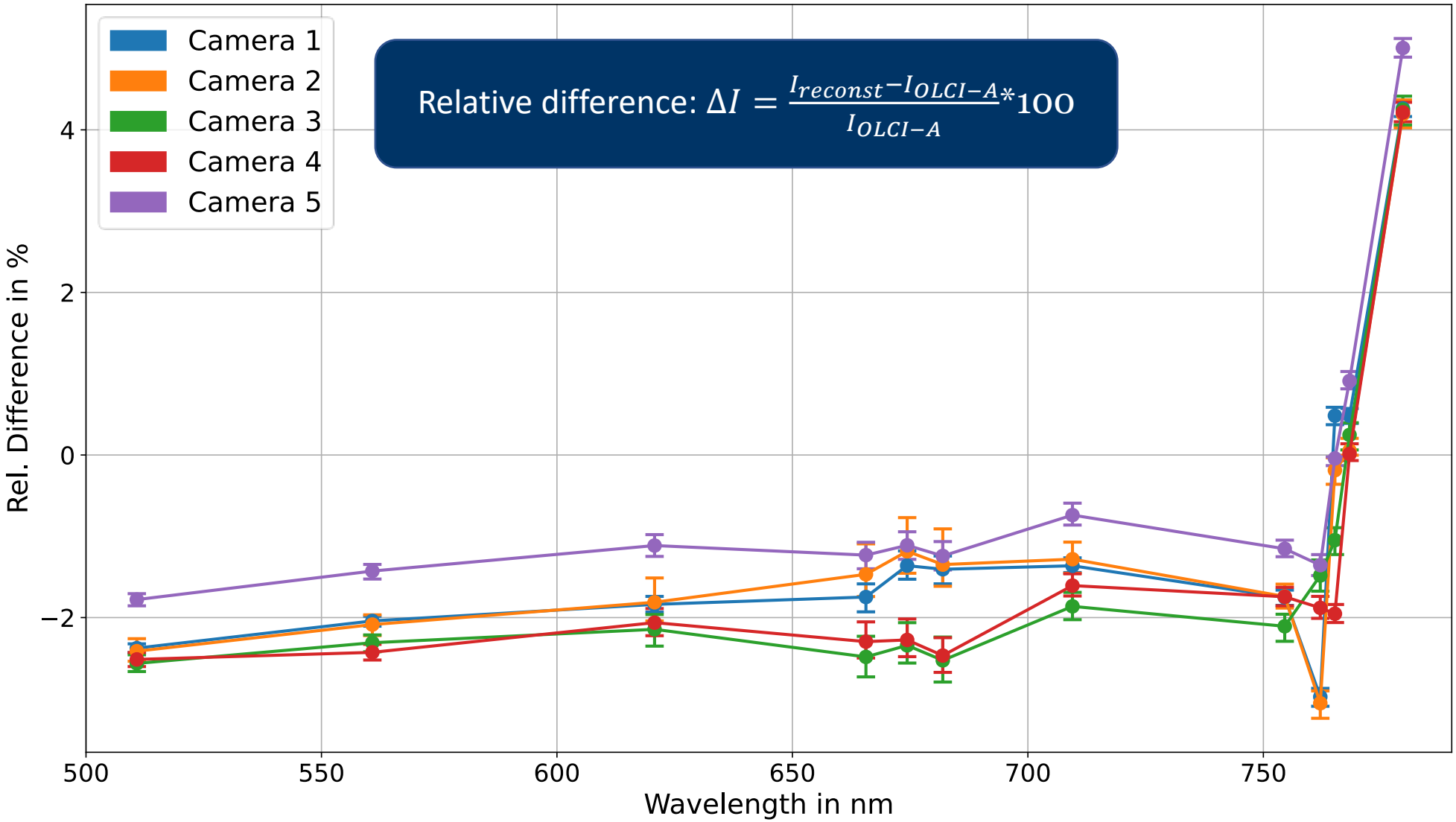


Fig. 3: Median rel. difference for each camera of one acquisition scene (02/07/2018). Data set for each camera about 200 000 pixel.

Difference of OLCI-FLEX and OLCI-A

OLCI-FLEX about 2 % darker than OLCI-A
→ absolute calibration

OLCI-FLEX about 5 % brighter
→ e.g. processing of OLCI-FLEX L0-L1

Oxygen absorption band: band characterization important

Lack of information in vegetated surface reflectance
→ additional information (PCR) for FLEX won't be necessary

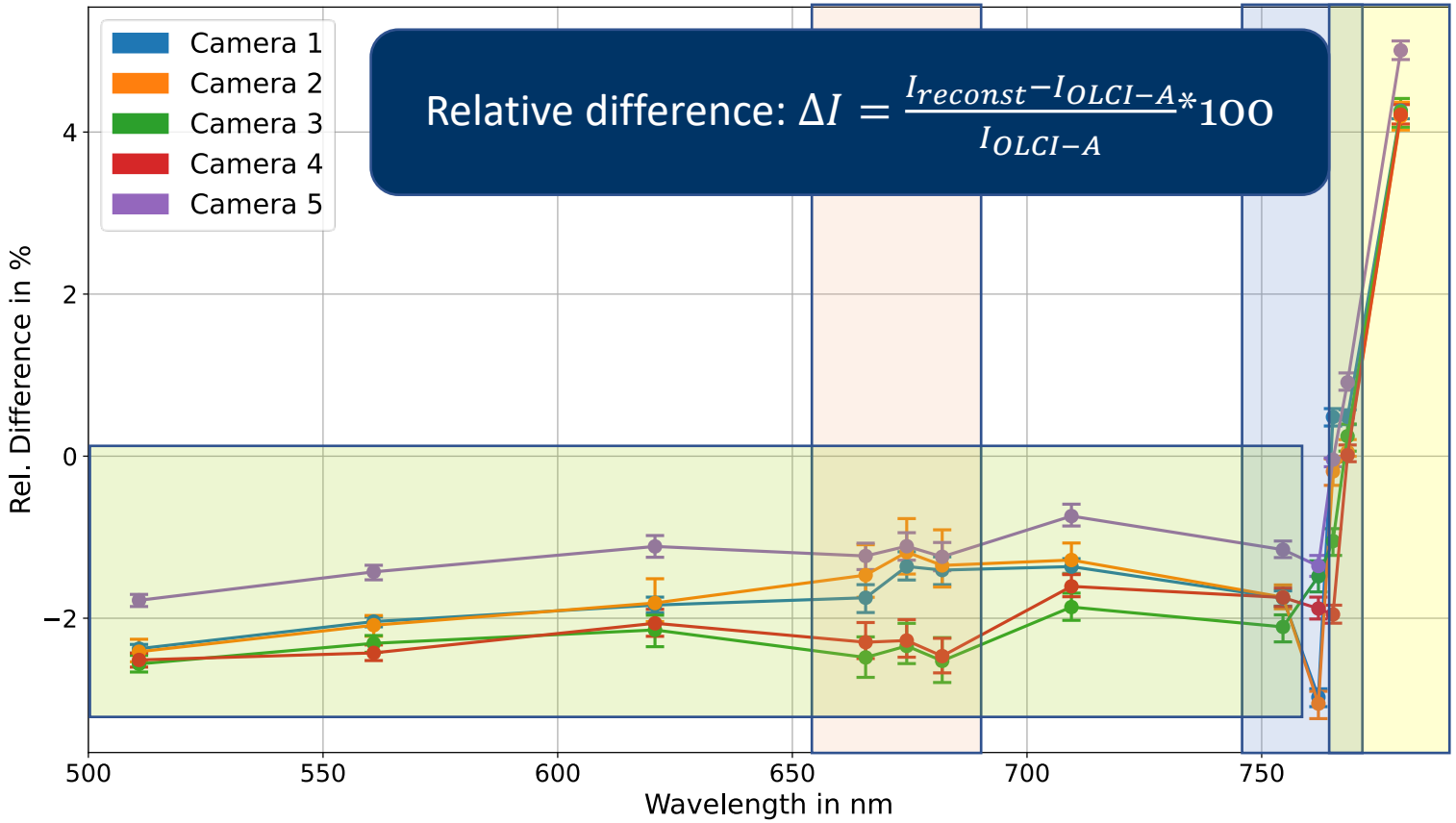
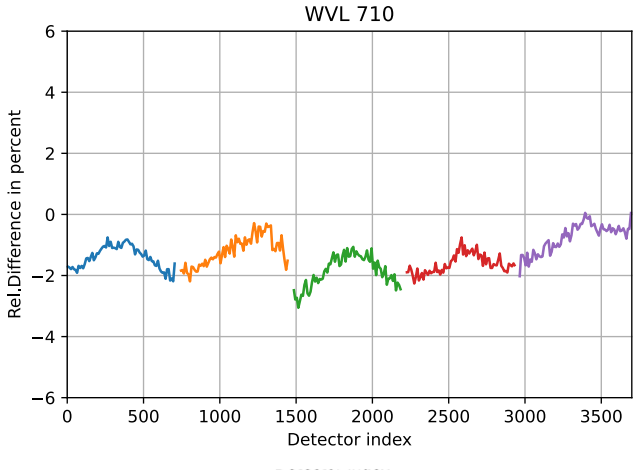
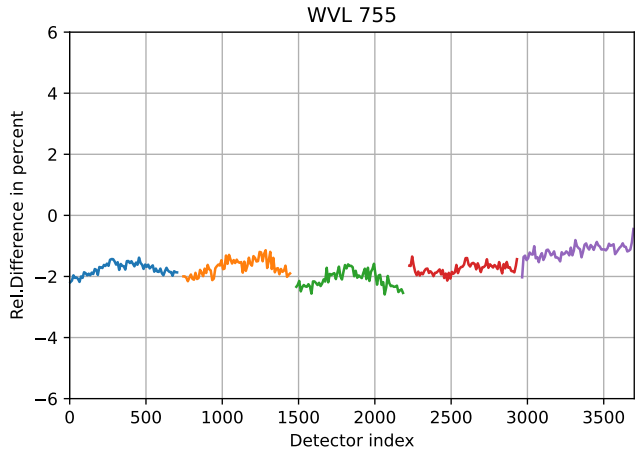
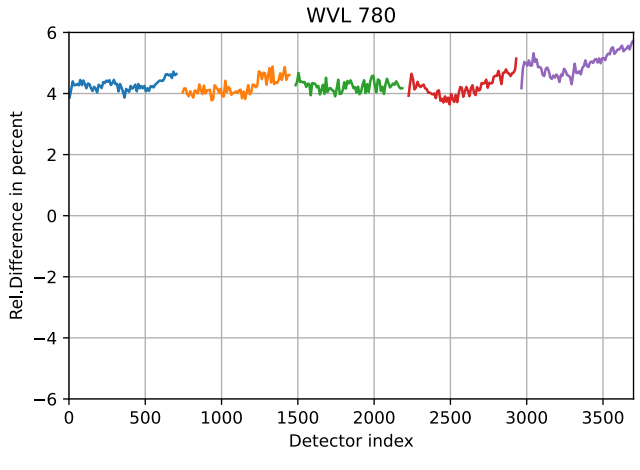


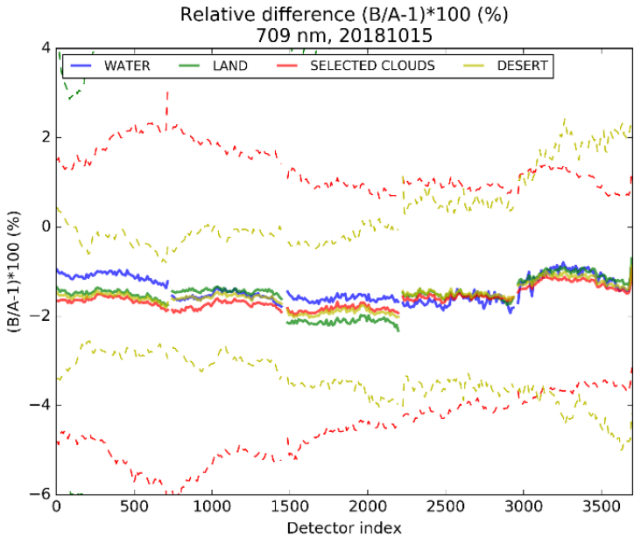
Fig. 3: Median rel. difference for each camera of one acquisition scene (02/07/2018). Data set for each camera about 200 000 pixel.

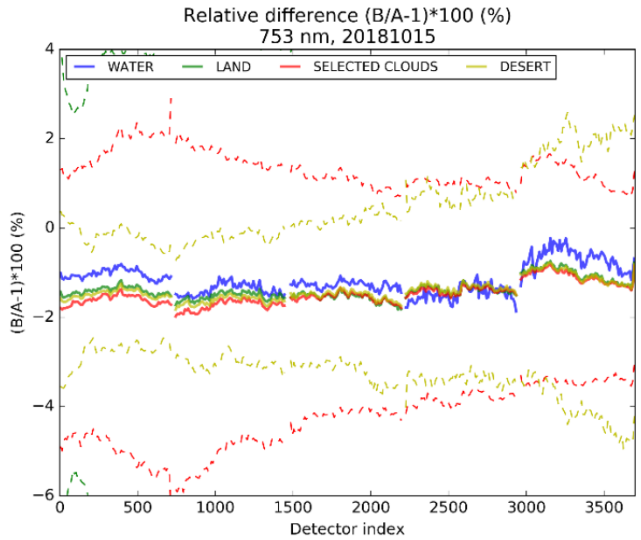
Difference over detector index

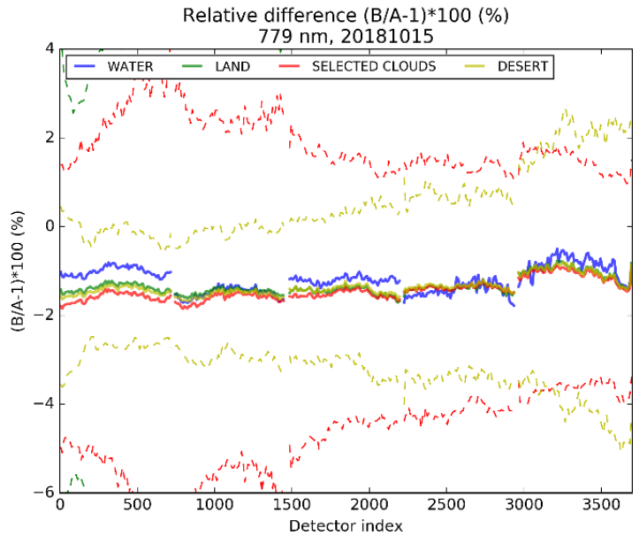












Lower figures from *Lamquin, N., Clerc, S., Bourg, L., & Donlon, C. (2020). OLCI A/B tandem phase analysis, part 1: Level 1 homogenisation and harmonisation. Remote Sensing, 12(11), 1804*

Summary

Main outcome:

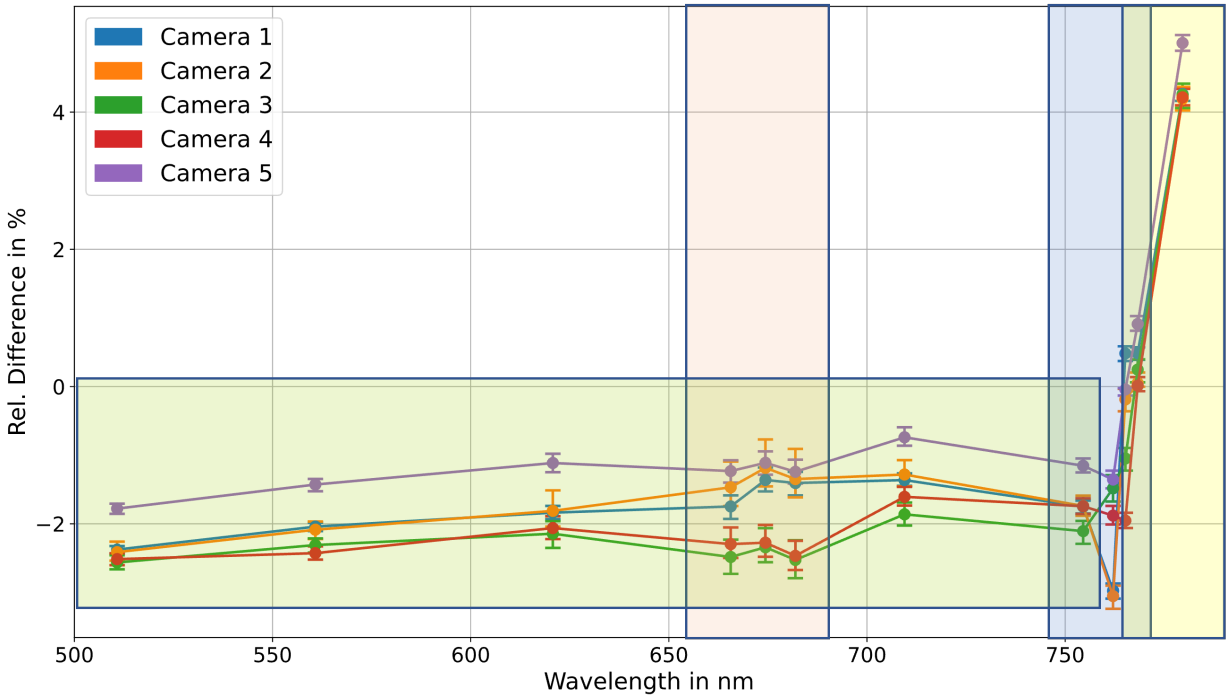
- Transfer function is sensitive to calibration and other errors

→ measurement errors found for Sentinel 3 tandem mission in FLEX mode

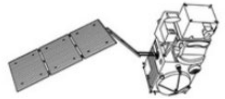
→ method validated

Lessons learned:

- surface reflectance must be well characterized
- O2 band characterization

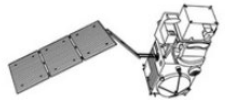


Further application of transfer function



- Comparison: Satellite-based vs. Ground-based

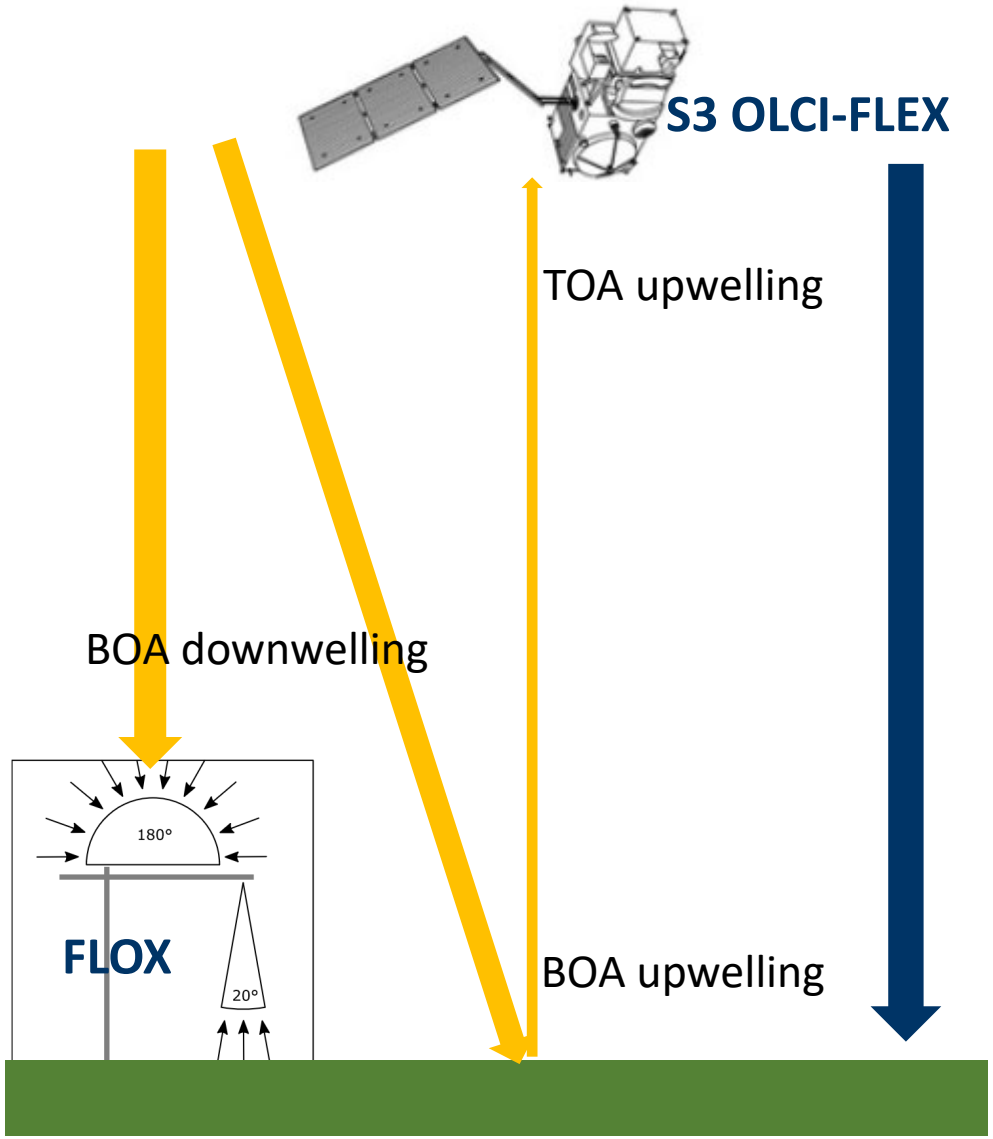
  → OLCI-FLEX vs. FLOX



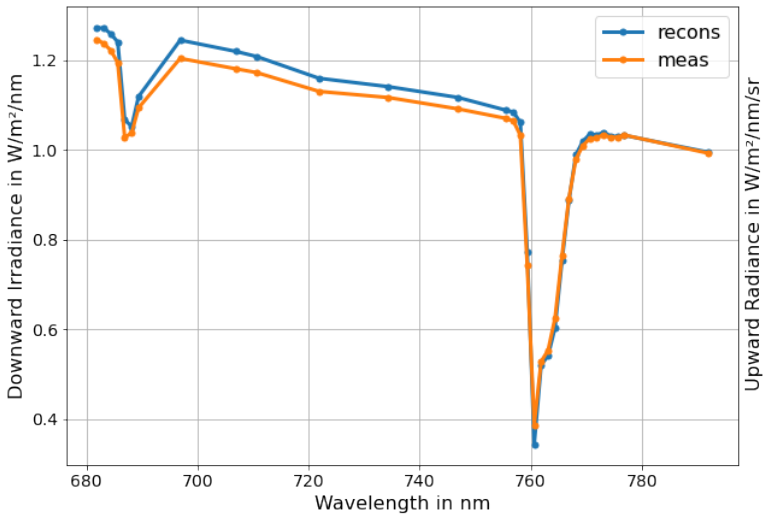
- Comparison Satellite-based vs. Aeroplane vs. Ground-based

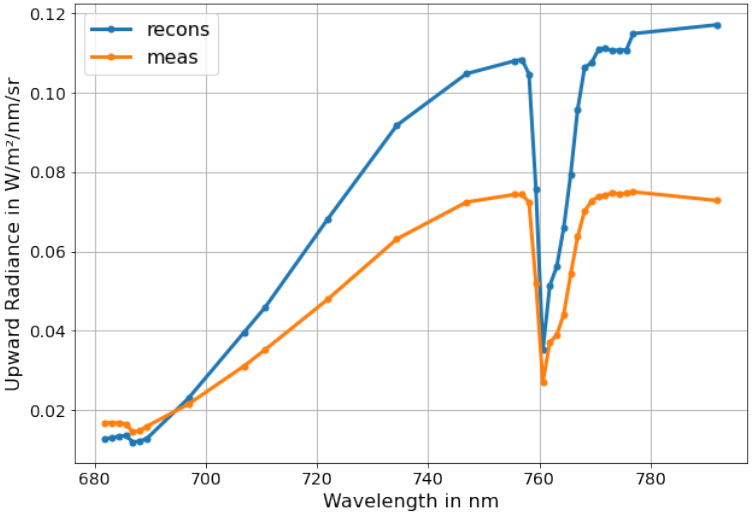
  → OLCI-FLEX vs. Hyplant vs. FLOX

Further application of transfer function for comparison of Satellite vs ground based

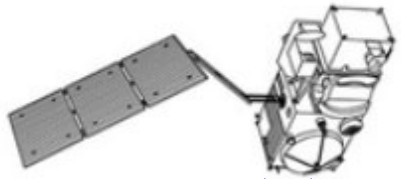


- Comparison of ground-based and satellite based instruments:
  - information from TOA measurement are used to forward simulate BOA downwelling and upwelling radiance
- Application to FLOX showed only downwelling radiance can be used for comparison due to strong dependence on surface reflectance

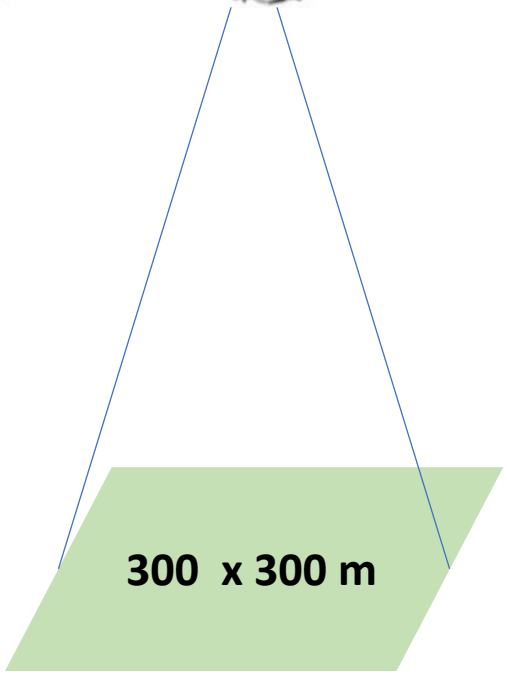


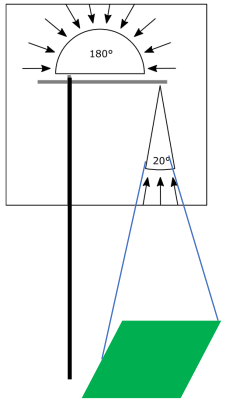


Different instruments have different size of observation area
→ measurement of surface reflectance is measured over those areas
→ with inhomogeneity surface reflectance differs
With Hyplant difference can be quantified by comparing single pixels with average over 100x100 pixel

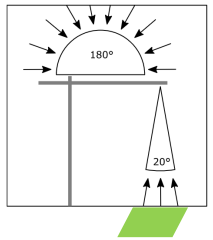


S3 OLCI-FLEX





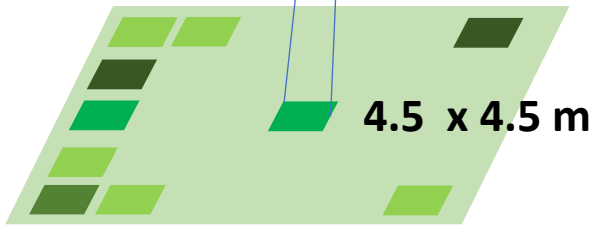
FLOX



30 x 30 m

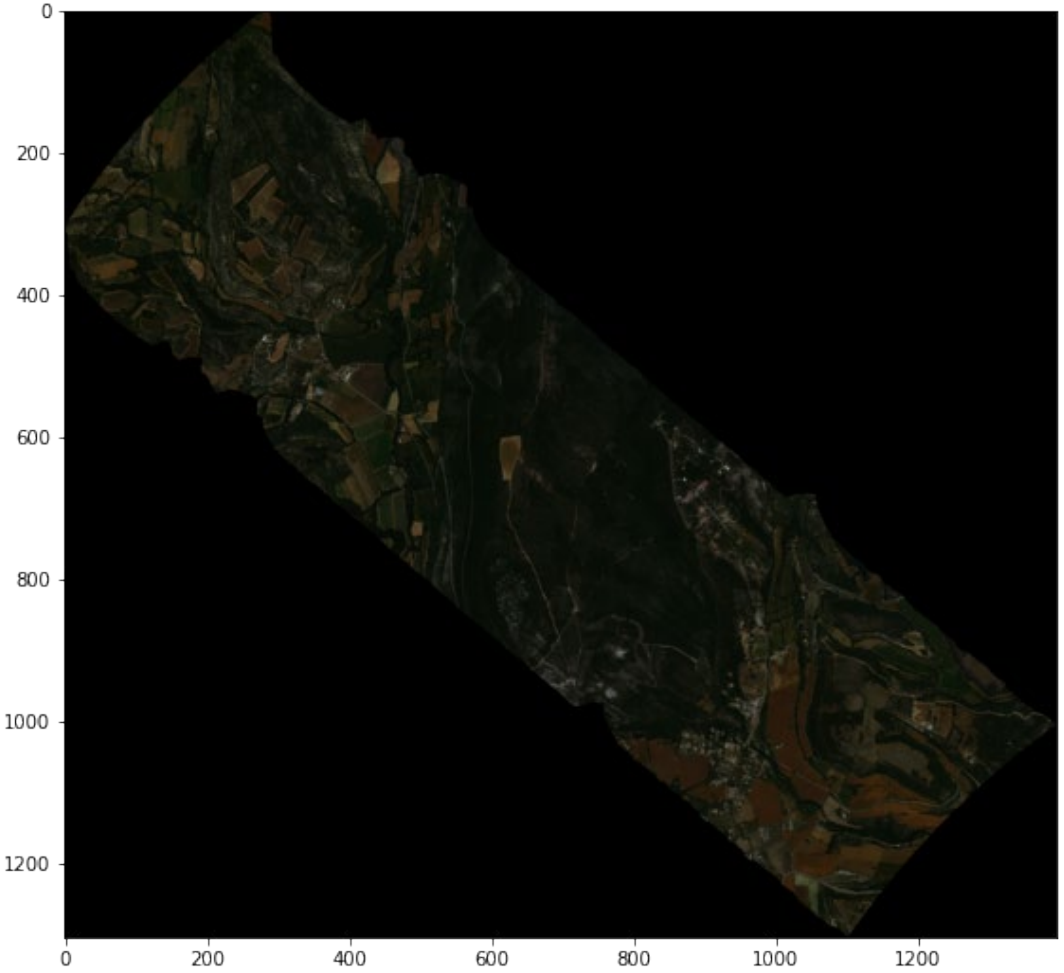
1 x 1 m

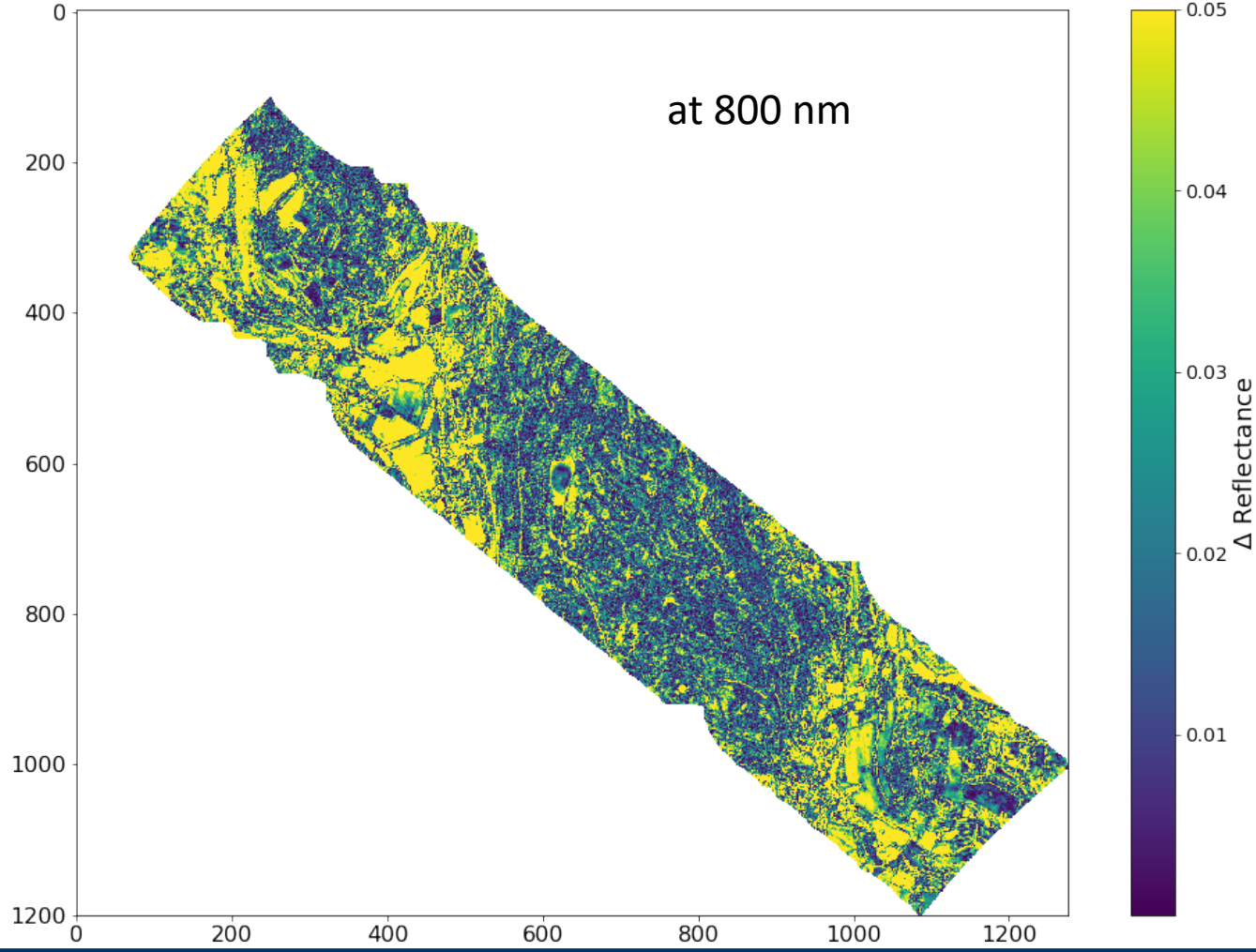
Hyplant



450x 450 m

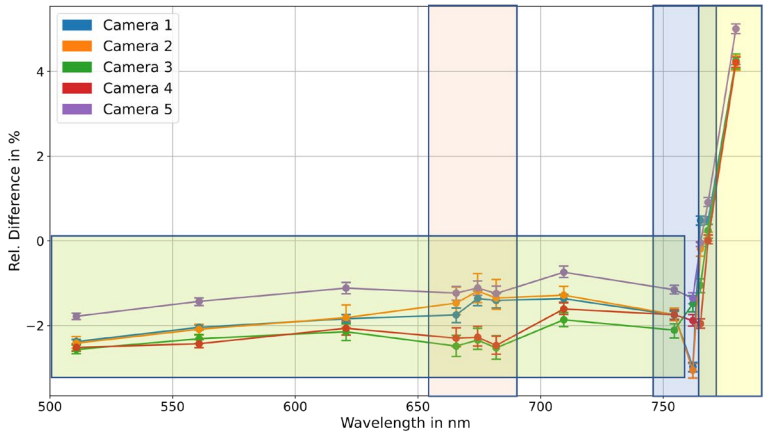
South France (Observatoire de Haute-Provance) on 10/07/2018:
Δ Reflectance= Reflectance 450x450 –Reflectance 4.5x4.5



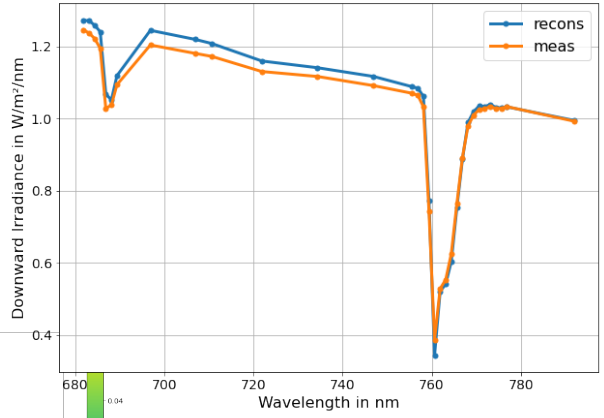


Summary and outlook

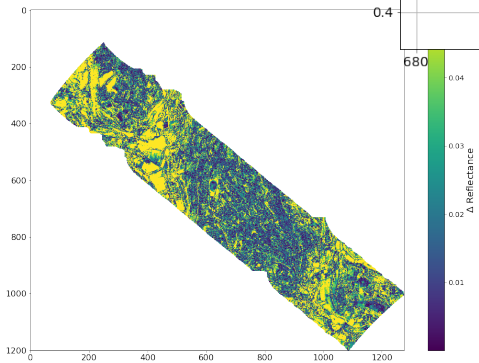
- Transfer function is sensitive to calibration and other errors



- FLOX downwelling BOA radiance validates atmospheric correction



- aeroplane data (Hyplant) can be used to study inhomogeneity/representativity of surface reflectance



Thank you for your attention.
If you have any questions, please do not hesitate to contact me.
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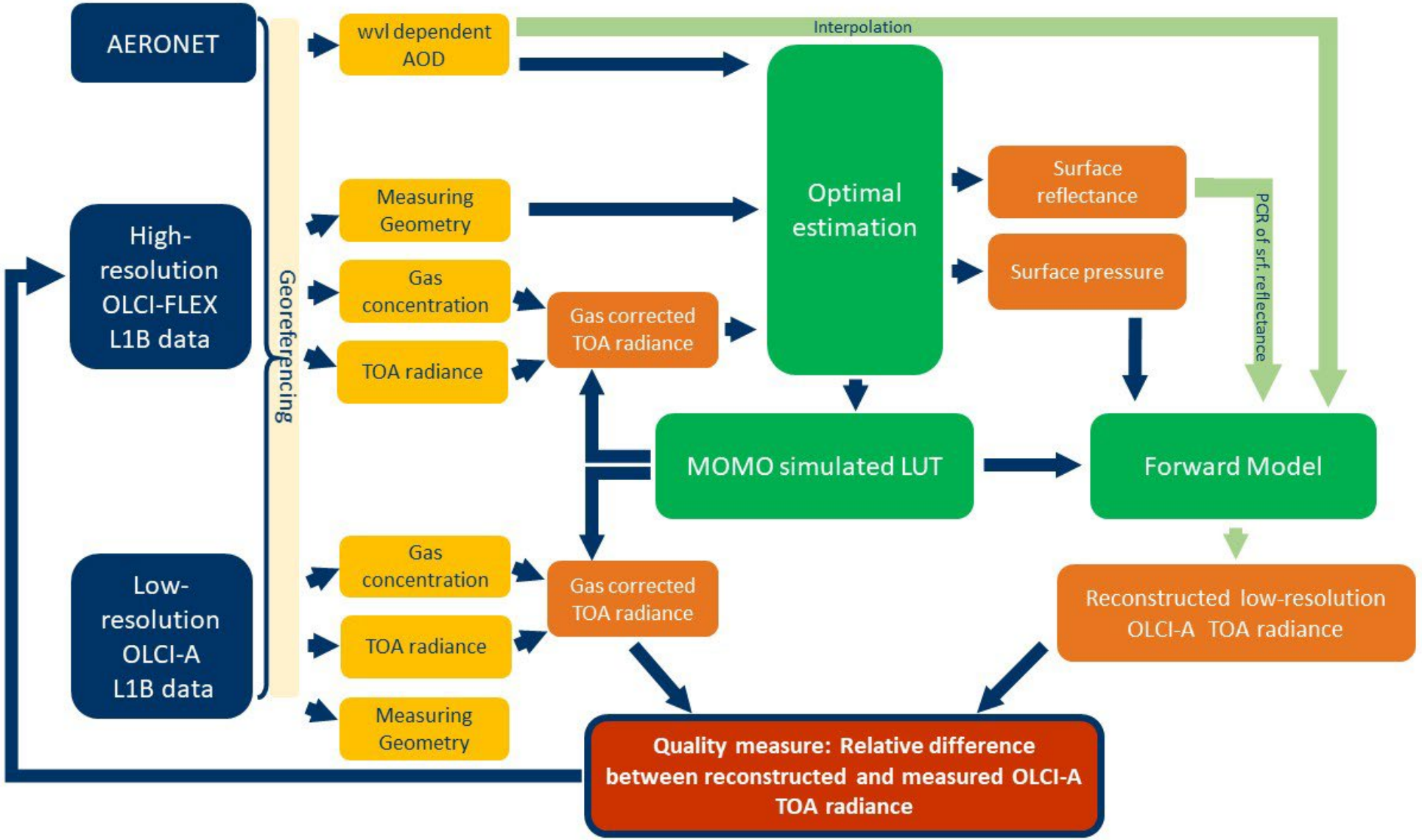
References:

Drusch *et al. 2017*, 'The FLuorescence EXplorer Mission Concept—ESA's Earth Explorer 8', *IEEE Trans. Geosci. Remote Sensing*, vol. 55, no. 3, pp. 1273–1284, Mar. 2017, doi: 10.1109/TGRS.2016.2621820.

Lamquin, N., Clerc, S., Bourg, L., & Donlon, C. (2020). OLCI A/B tandem phase analysis, part 1: Level 1 homogenisation and harmonisation. Remote Sensing, 12(11), 1804

Transfer function for OLCI-FLEX