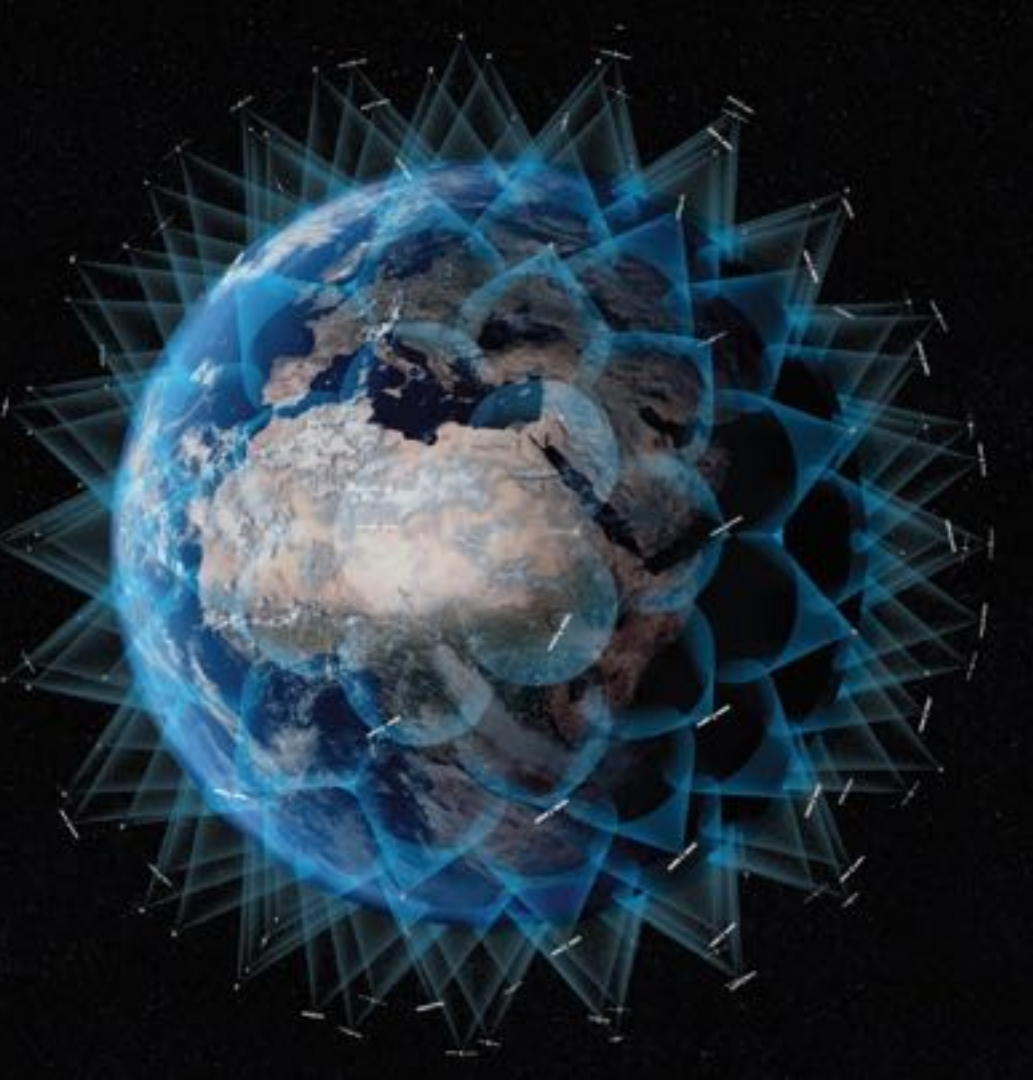


Harmonisation of data across different missions with CalibrEO and iCOR

Hyperspectral Workshop 2022

**Sindy Sterckx, Stefan Adriaensen, Iskander
Benhadj, Joris Blommaert, Liesbeth De
Keukelaere, Jan Dries, Stefan Livens, Else
Swinnen, Tom Van Roey**



EO revolution

Steep rise in number of EO (small) satellites

➔ By combining EO data: improved coverage, faster revisit

Increased need for consistency across missions

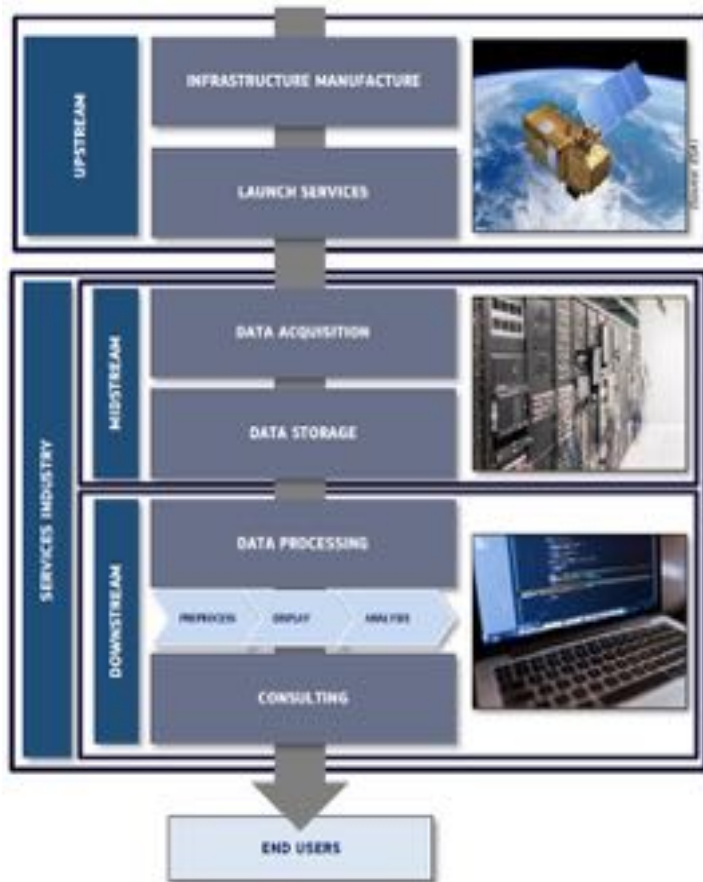
- Sen2Like, HLS : L8/S2 harmonization

However, calibration differences due to :

- Diversity in calibration approaches & reference used
- Calibration constraints small missions



Consistency at Level-1



Data Quality through

- Calibration
- Validation

Missions:

- PROBA-V
- Hyperscout-1
- Sentinel-3
- Sentinel-2
- APEX
- FLEX
- CHIME



Agriculture



Landuse & Biodiversity



Climate



Water & Coast



Infrastructure



Security



vito


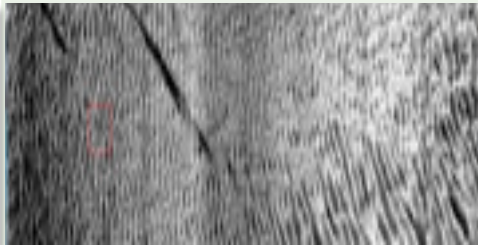
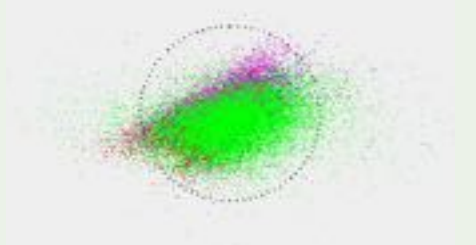

remote sensing

CALIBREO



CalibrEO – what it brings

CalibrEO - vicarious calibration

Geometry	Radiometry	Geometry	Radiometry
			
<ul style="list-style-type: none"><input type="checkbox"/> Accuracy (rel + abs)<input type="checkbox"/> Multitemporal<input type="checkbox"/> MTF<input type="checkbox"/> Expert evaluation (anomalies, artefacts,...)	<ul style="list-style-type: none"><input type="checkbox"/> Accuracy (rel + abs)<input type="checkbox"/> Multitemporal<input type="checkbox"/> SNR<input type="checkbox"/> Satellites cross consistency<input type="checkbox"/> Expert evaluation (anomalies, artefacts,...)	<ul style="list-style-type: none"><input type="checkbox"/> Refined Line of Sight<input type="checkbox"/> Refined attitude data<input type="checkbox"/> Ground Control Points	<ul style="list-style-type: none"><input type="checkbox"/> Equalization parameters<input type="checkbox"/> Absolute calibration coefficients<input type="checkbox"/> Linearity check<input type="checkbox"/> Spectral smile



Geometric Calibration Heritage

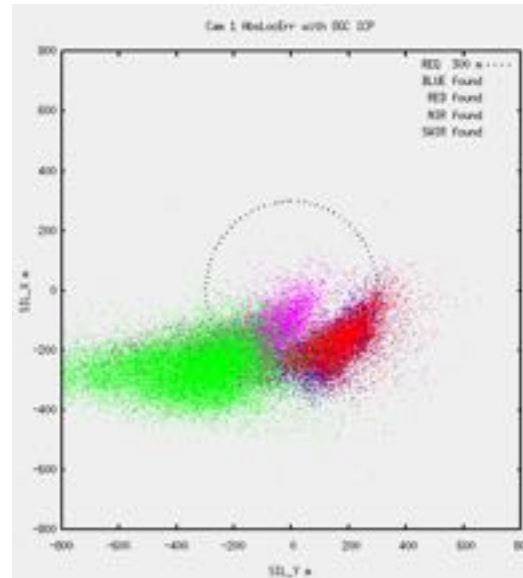
- Usage of GCPs and a geometric model
- Template matching technique
- Bundle adjustment technique



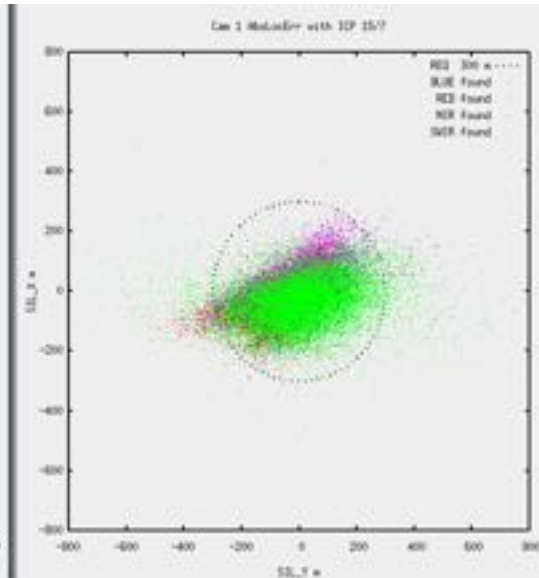
On-ground
ICP

1st in-
flight ICP

Along track (m)



Across track (m)

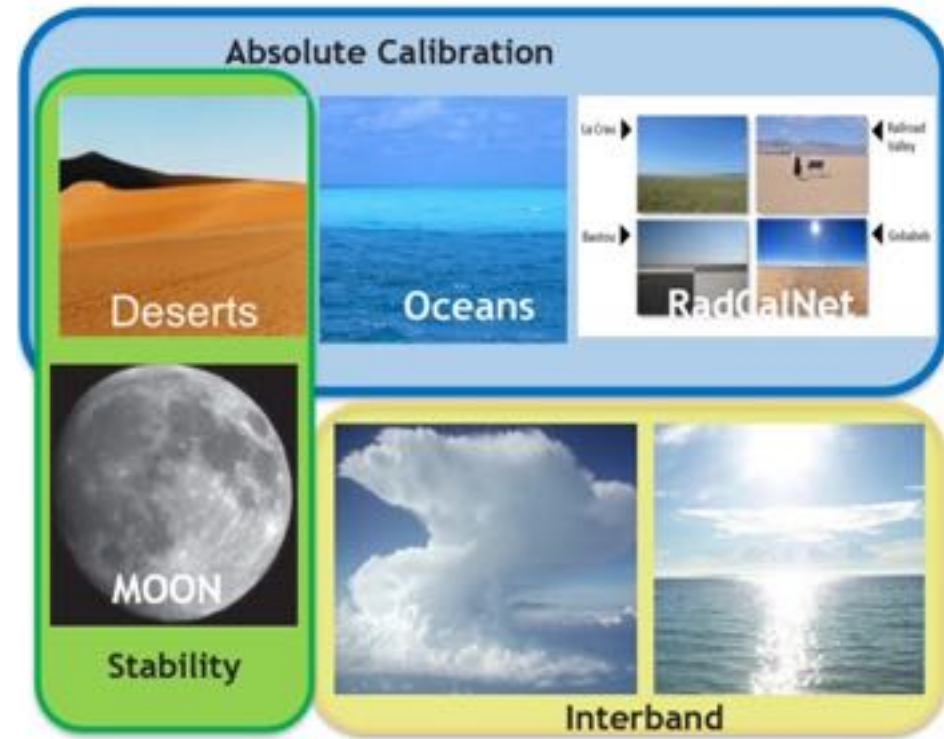


Across track (m)



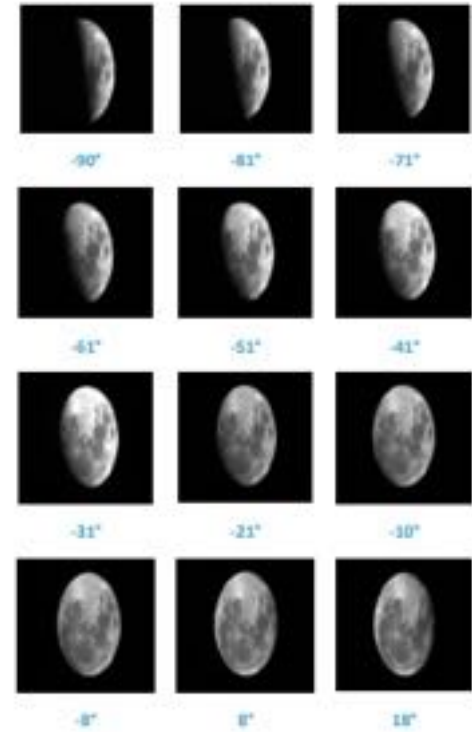
Vicarious radiometric calibration heritage

OSCAR* (Optical Sensor Calibration with simulated Radiances)

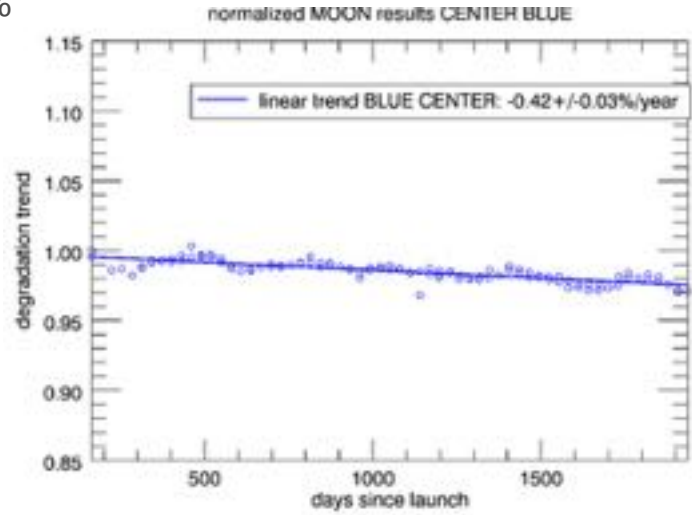
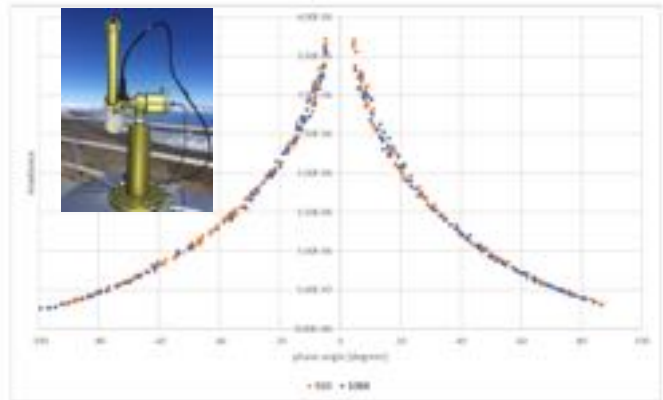




Lunar calibration: LIME model



- LIME model target accuracy : 2%



<https://calvalportal.ceos.org/lime>

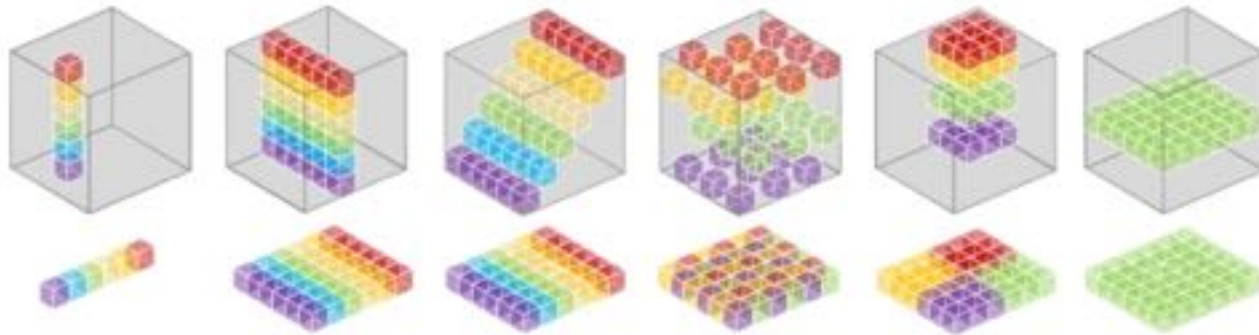


PROBA-V lunar acquisitions



Hyperspectral missions

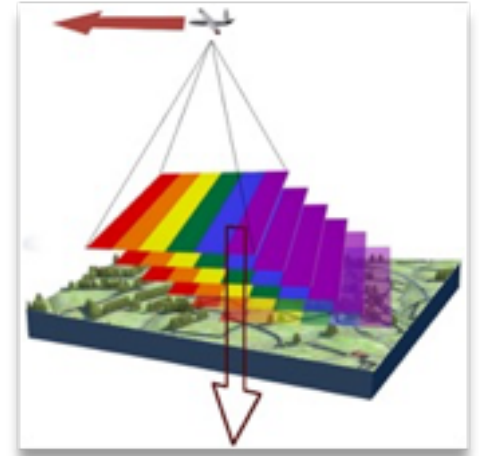
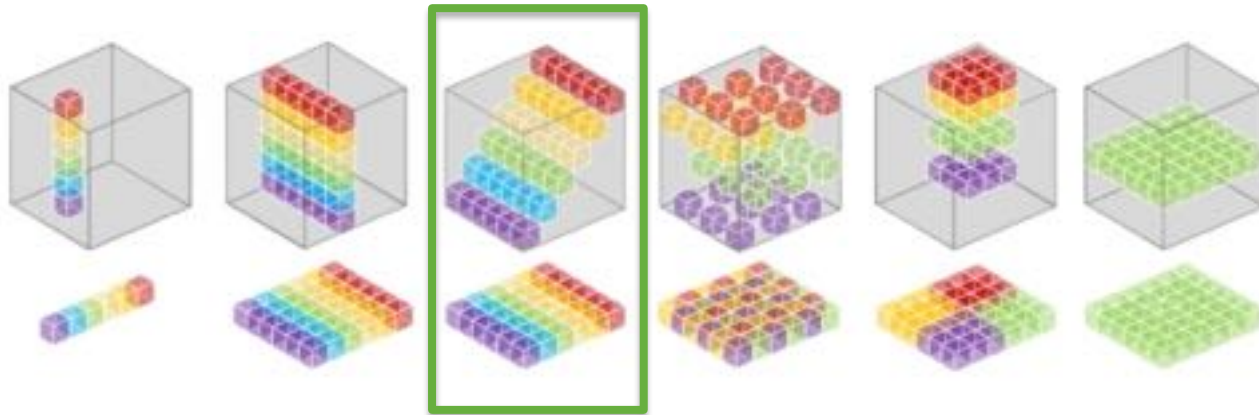
Many different techniques that provide multi- or hyperspectral imaging





Hyperspectral missions

Many different techniques that provide multi- or hyperspectral imaging



Through scanning motion: full spectral information



Experience built up for hyperspectral missions

Radiometric and geometric calibration for *Hyperscout*[®] -1 (launched in 2018; Cosine)



HyperScout Geometric calibration

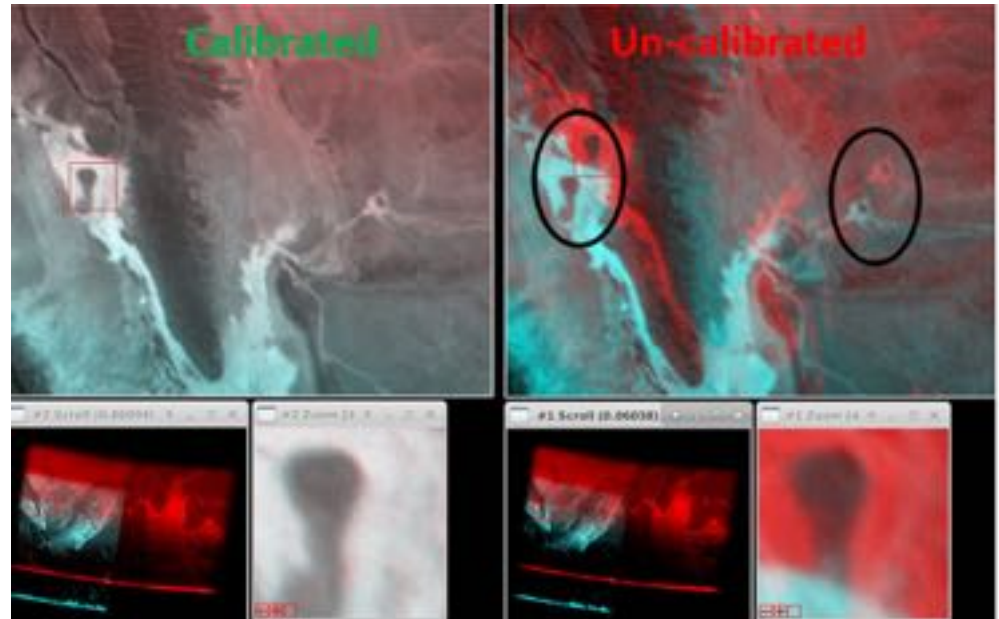
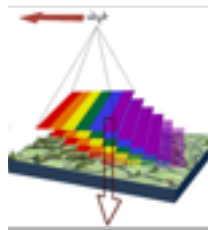
Projected DN frame

False color

R: frame1 (first frame)

G: frame15 (last frame)

B: frame15

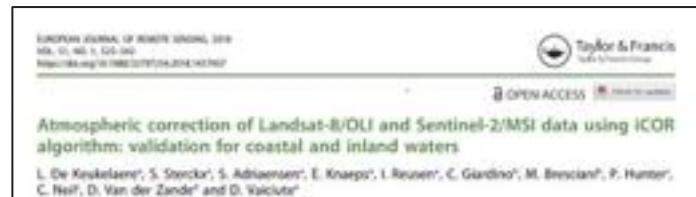
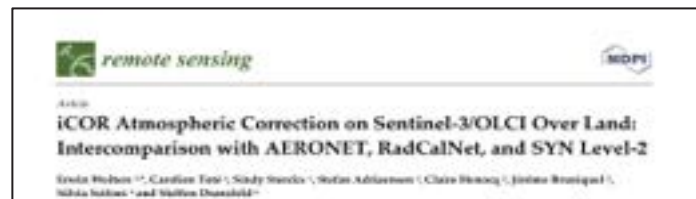
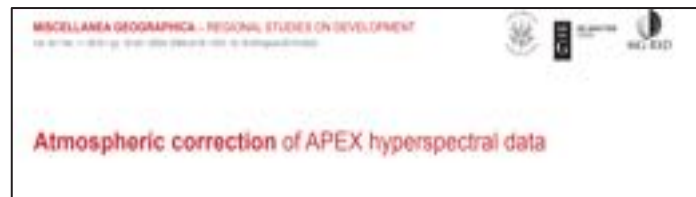




Consistency at Level-2

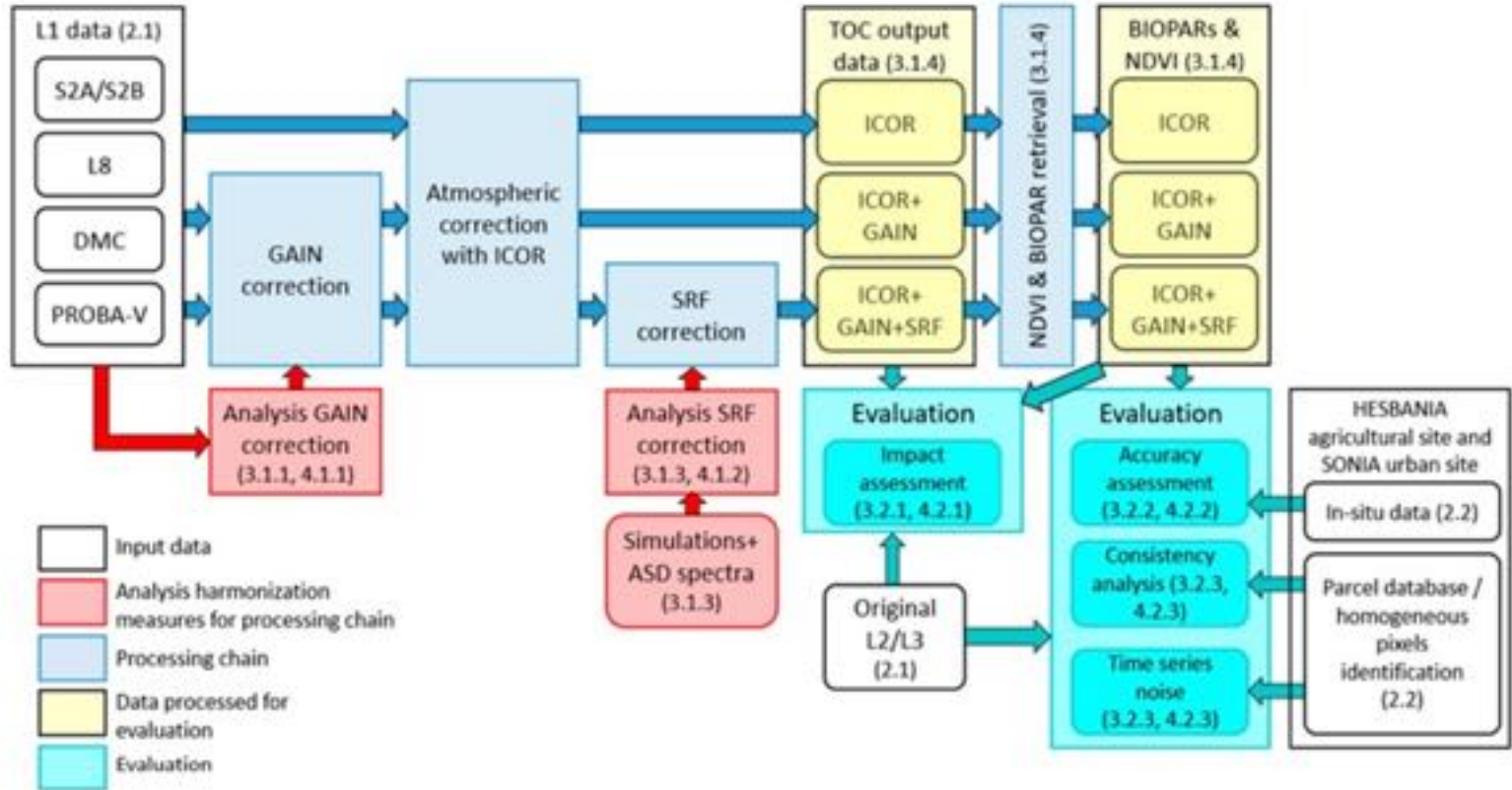


- ❑ Part of ACIX I&II, Aqua&Land
- ❑ iCOR - heritage: APEX A/C workflow
- ❑ Retrieves both land surface reflectance and water-leaving reflectance
- ❑ Includes SIMEC adjacency correction for water
- ❑ iCOR publicly available for S2, L8, S3



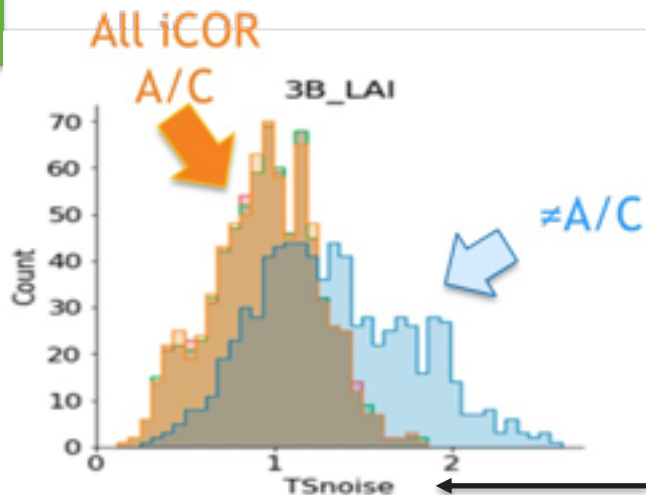


Harmonisation of multi-mission timeseries: the Belharmony approach





Harmonisation of multi-mission timeseries: the Belharmony approach



- original
- ICOR
- ICOR+gain
- ICOR+gain+SRF



TSnoise : timeseries noise of the time series resulting from combining the data from the different sensors, before and after the harmonization measures



Article

**Harmonization of Multi-Mission High-Resolution Time Series:
Application to BELAIR**

Els Swinnen ^{1,*}, Sindy Sterckx ^{1,2}, Charlotte Wirian ², Boud Verbeiren ^{2,3} and Dieter Wens ¹



TAILORED SERVICES TO MEET YOUR REQUIREMENTS

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ENTRY-LEVEL QUALITY VERIFICATION



VERIFICATION OF GEOMETRIC
AND RADIOMETRIC ACCURACY

RADIOMETRY

- Absolute radiometric accuracy check
- Evaluation of SNR
- Expert evaluation (anomalies, artefacts,...)

GEOMETRY

- Absolute geolocation check
- Band to Band co-registration check
- MTF analysis
- Expert evaluation (anomalies, artefacts,...)

EXPRESS DATA CALIBRATION



ACHIEVE INDUSTRY-STANDARD
ACCURACY IN A SHORT TIME

RADIOMETRY

- Absolute radiometric calibration
- Evaluation of SNR
- Dark current calibration
- Inter-band verification
- Interpixel verification
- Spectral verification

GEOMETRY

- Absolute geolocation correction
- Refinement of satellite Line of sight
- RPC model bias correction
- Band to Band co-registration

PREMIUM DATA CALIBRATION



ACHIEVE AND MAINTAIN
OPTIMAL ACCURACY OVER
A MISSION LIFETIME

RADIOMETRY

- Absolute radiometric calibration
- Evaluation of SNR
- Dark current calibration
- Inter-band calibration
- Interpixel calibration
- Spectral calibration
- Multi-temporal stability monitoring
- Cross-calibration of the constellation

GEOMETRY

- Absolute geolocation correction
- Refinement of satellite Line of sight
- RPC model bias correction
- Band to Band co-registration
- Correction of satellite attitude data

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We can also provide a complete end to end processing Earth Observation data pipeline (Level0, 1A, 1B and 1C) including a customised premium calibration.

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EXPRESS DATA CALIBRATION



ACHIEVE INDUSTRY-STANDARD ACCURACY IN A SHORT TIME


RADIOMETRY

- Inter-camera calibration
- Interpixel verification
- Spectral verification

GEOMETRY

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- Refinement of satellite Line of sight
- RPC model bias correction
- Band to Band co-registration

PREMIUM DATA CALIBRATION



ACHIEVE AND MAINTAIN OPTIMAL ACCURACY OVER A MISSION LIFETIME

RADIOMETRY

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- Cross-calibration of the constellation

GEOMETRY

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Thank you for your attention

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