Sentinel 2 Geometric Image Quality

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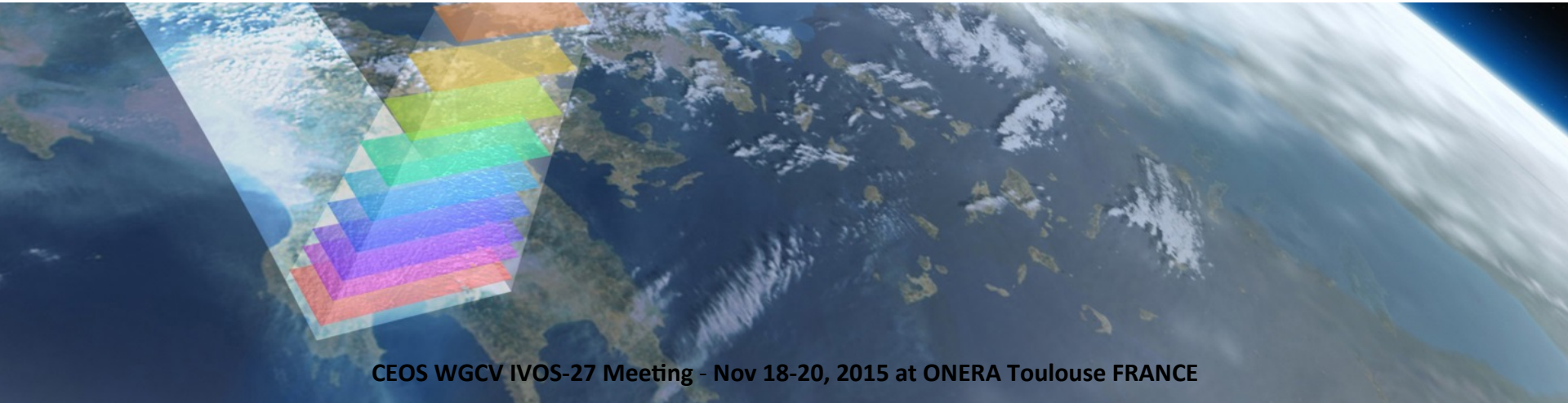
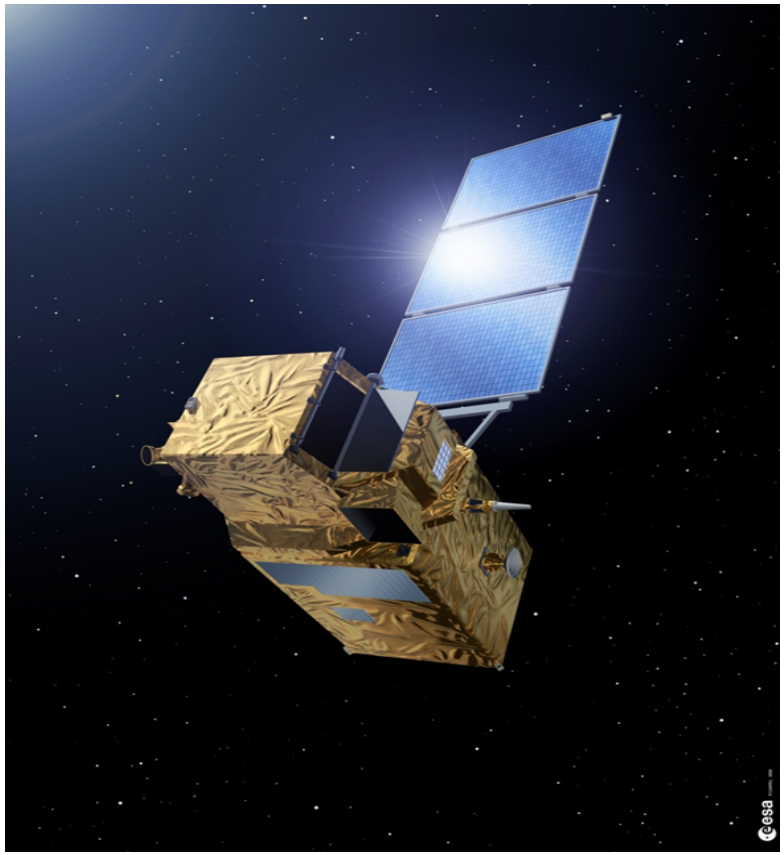


CEOS WGCV IVOS-27 Meeting - Nov 18-20, 2015 at ONERA Toulouse FRANCE

OUTLINE

- Sentinel-2 mission
- Geometric Model
- LOS calibrations
  - multi-spectral registration performances
- Pointing bias calibrations
  - geolocation performances
- Global Reference Image
  - multi-temporal registration performances



S2 Mission

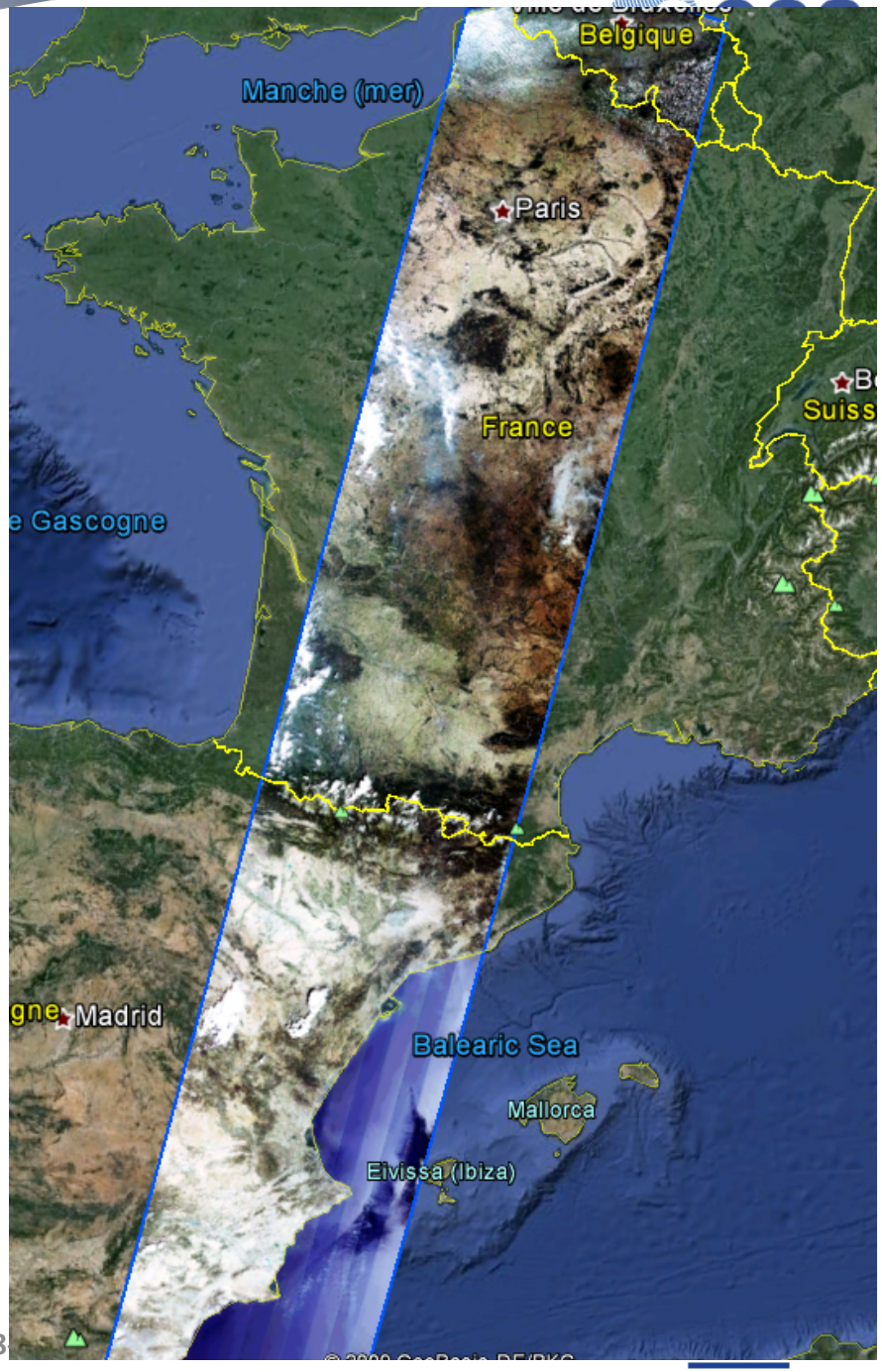
Sentinel-2

High resolution optical imaging mission for land services

- Global coverage of land surfaces (56°S to 84°N)
- 5 days revisit with 2 satellites under the same viewing conditions
- Swath 290km
- 13 spectral bands: VNIR & SWIR (443nm – 2190nm)
- Spatial resolution: 10m / 20m / 60m

Level products

- Level 1B: Long acquisitions used for geometric calibration
- Level 1C : ortho 100km*100km



Geometric Model

- Orbit position from GPS
- Attitude data from Gyro-Stellar Estimator
- Image datation
- Lines of sight calibration
- Earth model

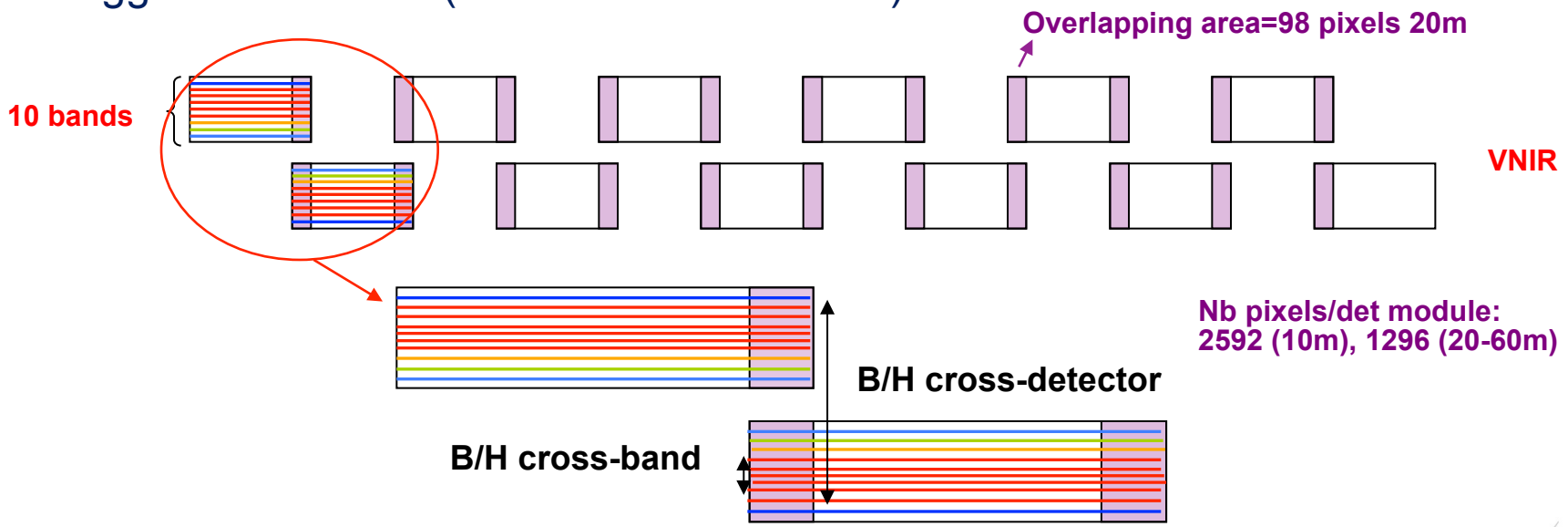
→ Relationship $(l, c, h) \Leftrightarrow (\lambda, \phi, h)$

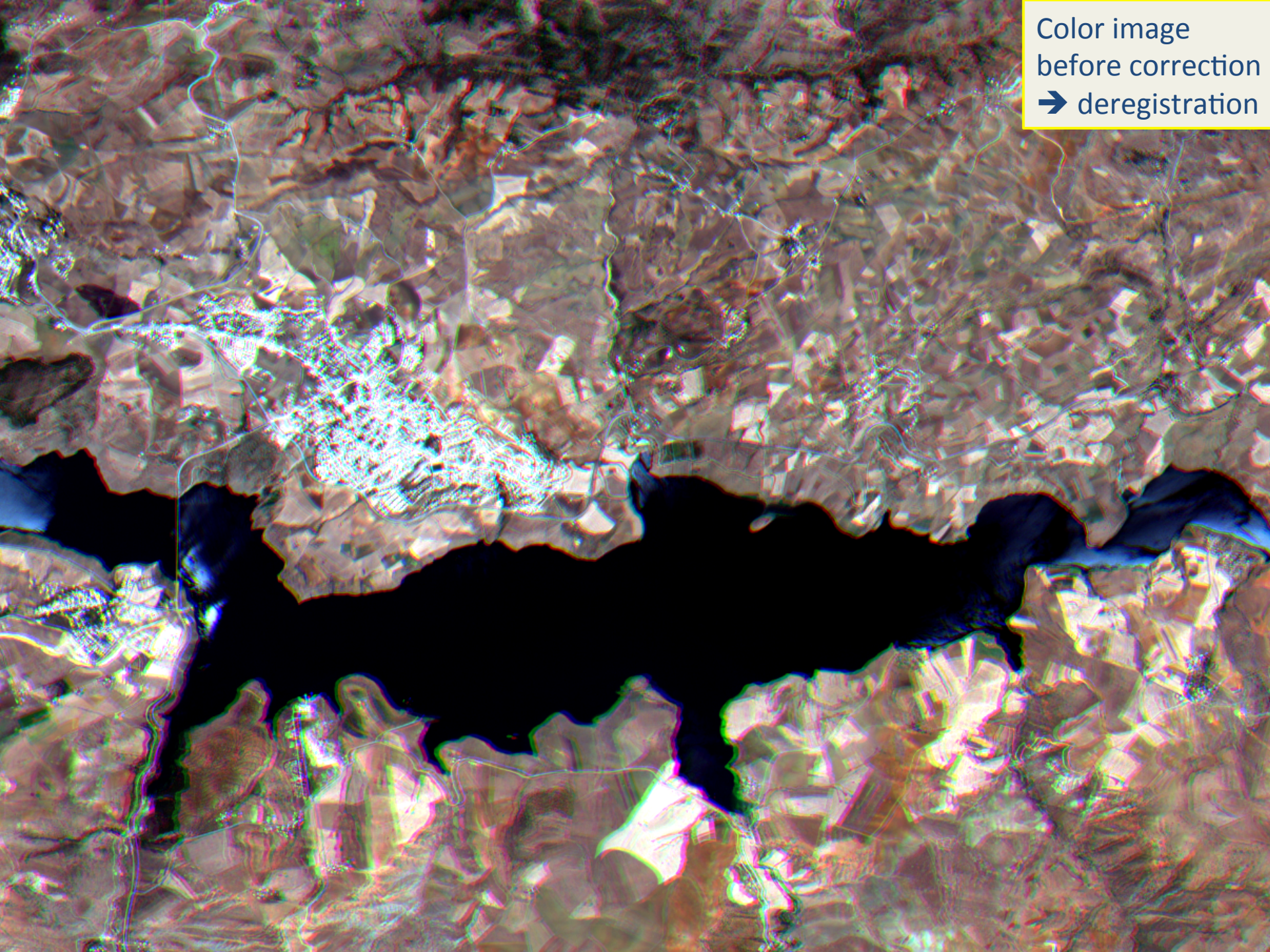
Multi-Spectral Registration

MSI focal plane

→ 13 spectral bands to calibrate
→ Spectral bands acquired at a different time

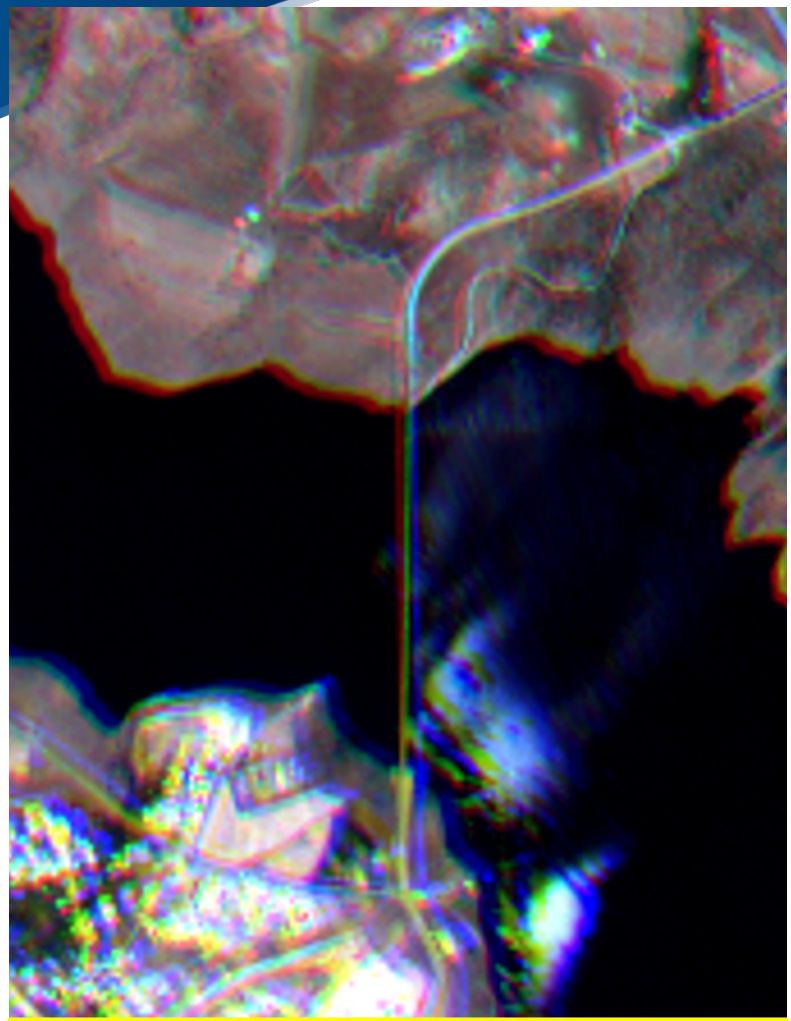
12 staggered detectors (for both VNIR & SWIR)



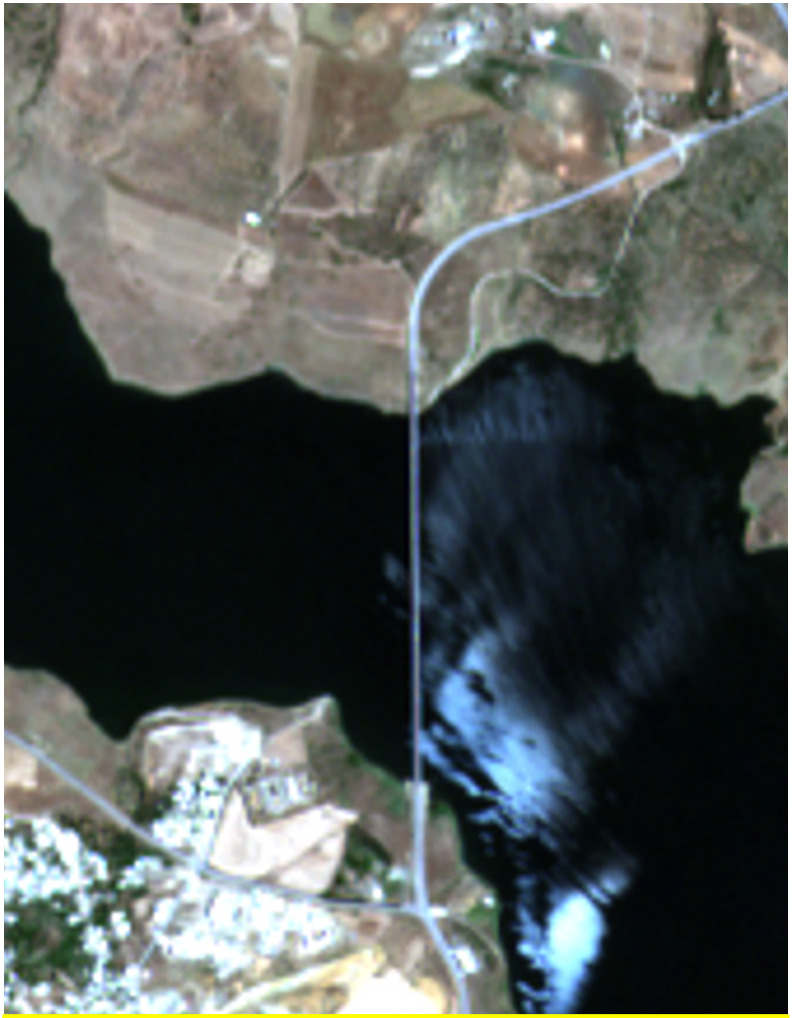

Color image
before correction
➔ deregistration


Color image
after correction

Zoom



Color image before LOS calibrations
➔ Deregistration



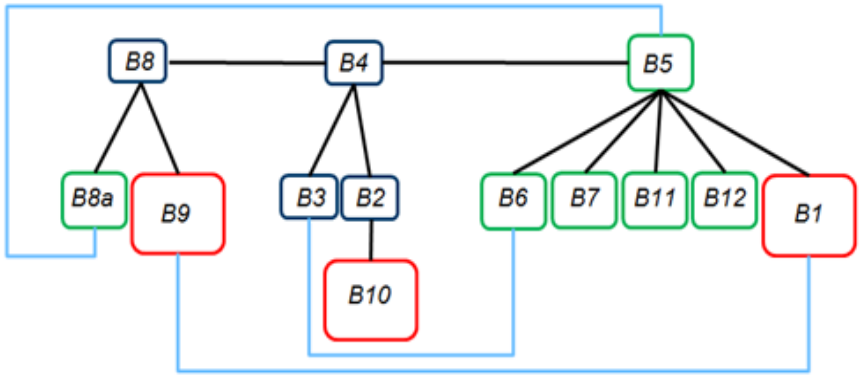
Color image after LOS calibration
➔ Good registration

Multi-Spectral Registration

Objective : Calibration of the Lines Of Sight to perform good multi-spectral registration performances < 0,3 pixels at 3σ (S2 SRD specification)

Method : inter-band correlation ; external reference correlation

Calibration and verification tree :

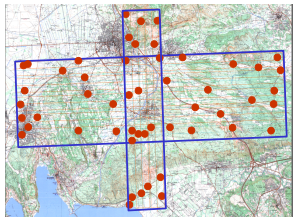


	function		
	Across track	Along track	total
MAX	0.13	0.20	0.30
MAX w/o B10	0.11	0.16	0.21

Good Co-registration performances

Geolocation

Objective : Calibration of the viewing frames to perform a good geolocation performance.

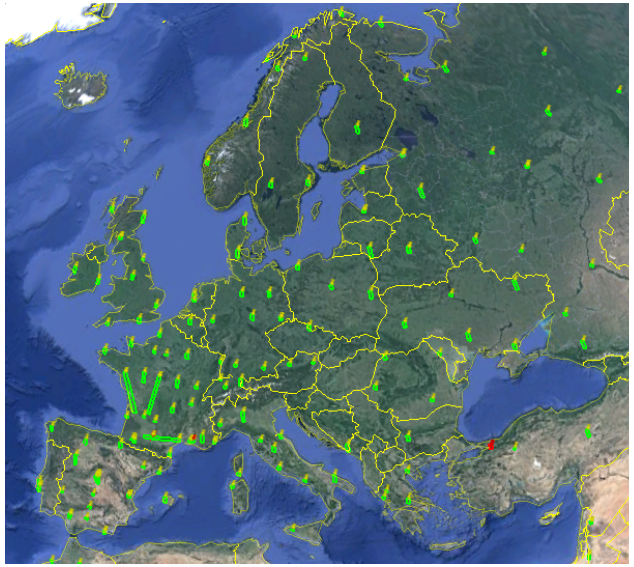


Requirements:

→ < 20,0m without refining over Ground Control Points at 2σ

→ < 12,5m after refining over reference Ground Control Points at 2σ

Geolocation was estimated with respect to a set of 500 Pleiades images having a geolocation accuracy of 5m



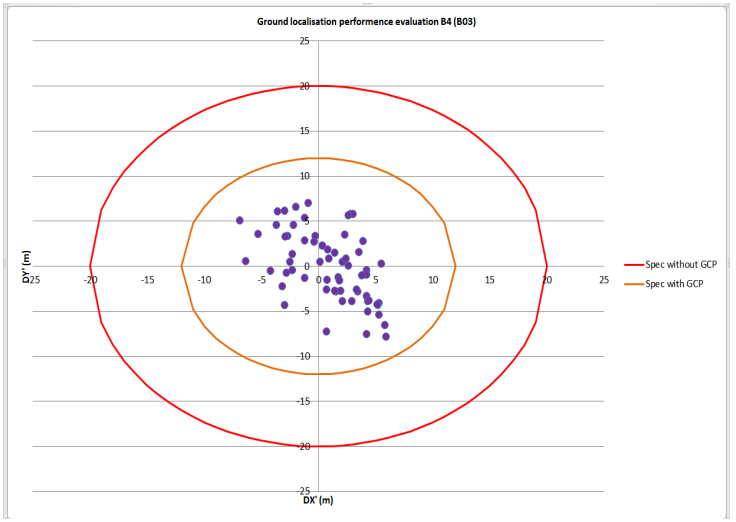
Geolocation

Geolocation performance : Distance between a common feature identified within reference images and S2 images

- **After launch (without any calibration): ~2,5 km**
- **03/07/15 (following Star Trackers re-alignment on board) : ~700 m**

Ground calibration : MSI LOS – to - Spacecraft alignment (Roll, pitch and yaw pointing angles)

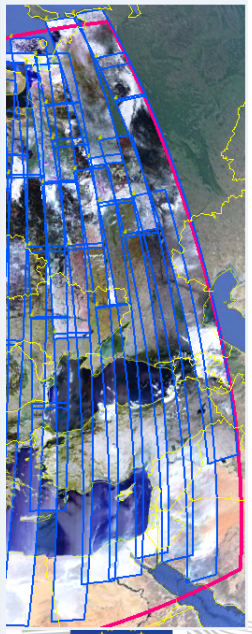
- **1st parameters (July) : 34m @ 2σ**
- **2nd parametrization (September): 11m @ 2σ**
- **3rd parametrization (October) 10m @ 2σ**



- Map
  co-lo
- Used
  regis
  proc
- Real

Goal ➡
require
multi-t
registra
(same

rmediate
ope GRI
ctober)



Global Reference Image
Multi-temporal registration performances

Intermediate Europe GRI : 19 L1B

Correction of the geometric model of each S2 acquisition, realized by IGN and validated by CNES

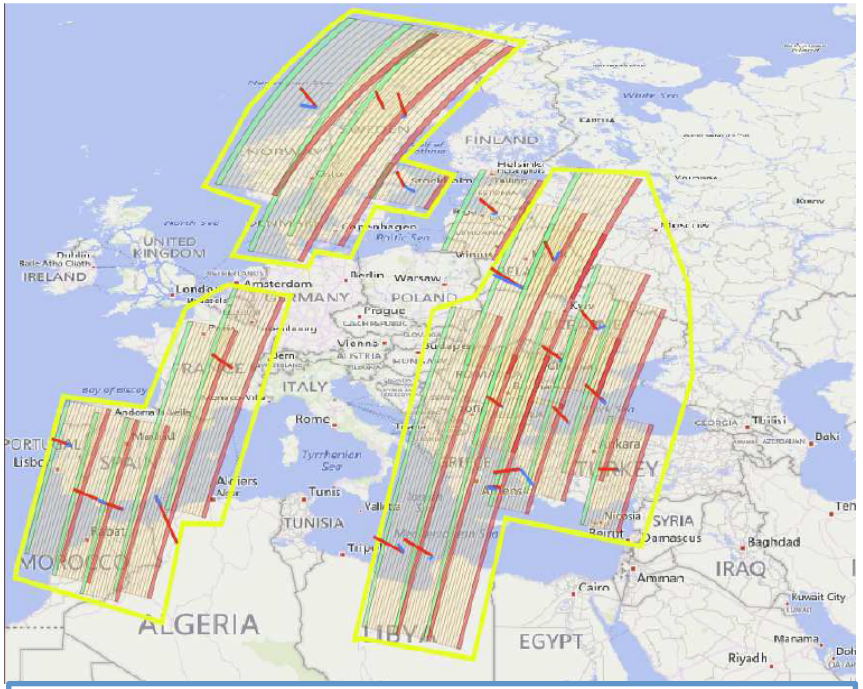
- **Before correction**

=> 95% of pixels were below **13,5m** / reference

- **After correction**

=> 95% of pixels were below **8,5m** / reference

➔ Expected to be improved with new calibration



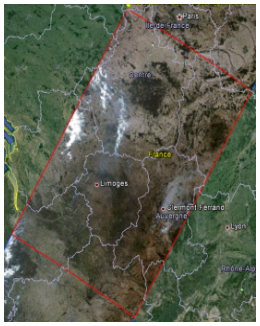
Intermediate Europe GRI (October)
IGN Espace courtesy

Final GRI over Europe

- Acquisitions ongoing (95% of coverage: 65L1B)
- Delivery **end of 2015**

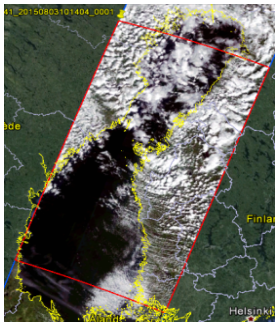
Global Reference Image
Multi-temporal registration performances

Objective : Multi-temporal registration performances **< 0,3 pixels@2σ**


Clear, cloud-free images


Water images


Desert


Very cloudy images


Cloudy images

Method

Test of registration on 9 products

Tuning of correlation and registration parameters => Robust parameters determined for registration

Achieved registration

	Mean distance	95% of pixels
Before registration to GRI	< 1,27pixels	
After registration to GRI (Clear + water + cloudy + desert cases)	< 0,16 pixels	< 0,36 pixels

➔ Excellent registration results
➔ Robust to difficult cases

Remark: For Very cloudy images => Difficult to estimate because of the low number of valid correlation points
=> mean distance to the reference 0,35 pixels.

Conclusion

Very good performances 4 months after launch :

- Multispectral registration <0,3pixels
- Geolocation around 10m (without any ground control point)
- Multitemporal registration <0,3pixels with the intermediate GRI

All these performances will be confirmed at the end of December taking into account :

- Temporal stability
- The new GRI covering the whole Europe

Thank You for Your Attention !