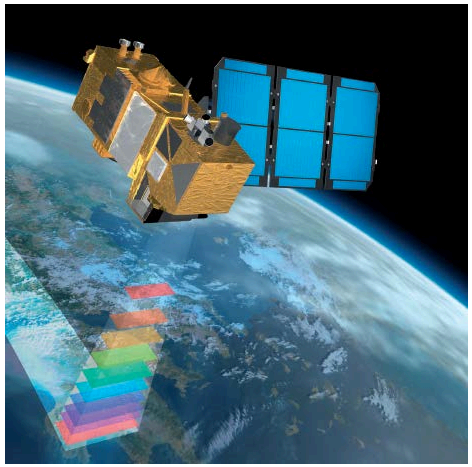
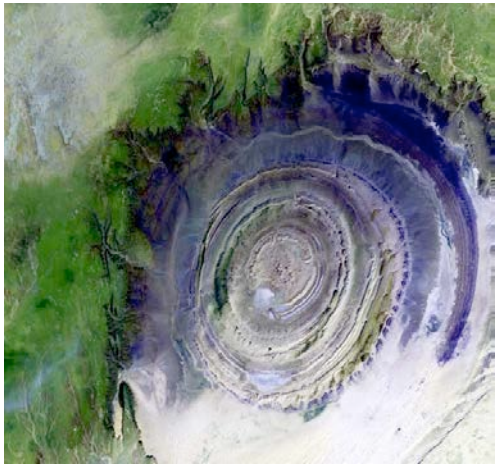
Sentinel-2 Mission:
Observation scenario, products and mission status





Bianca Hoersch, Sentinel-2 Mission Manager,

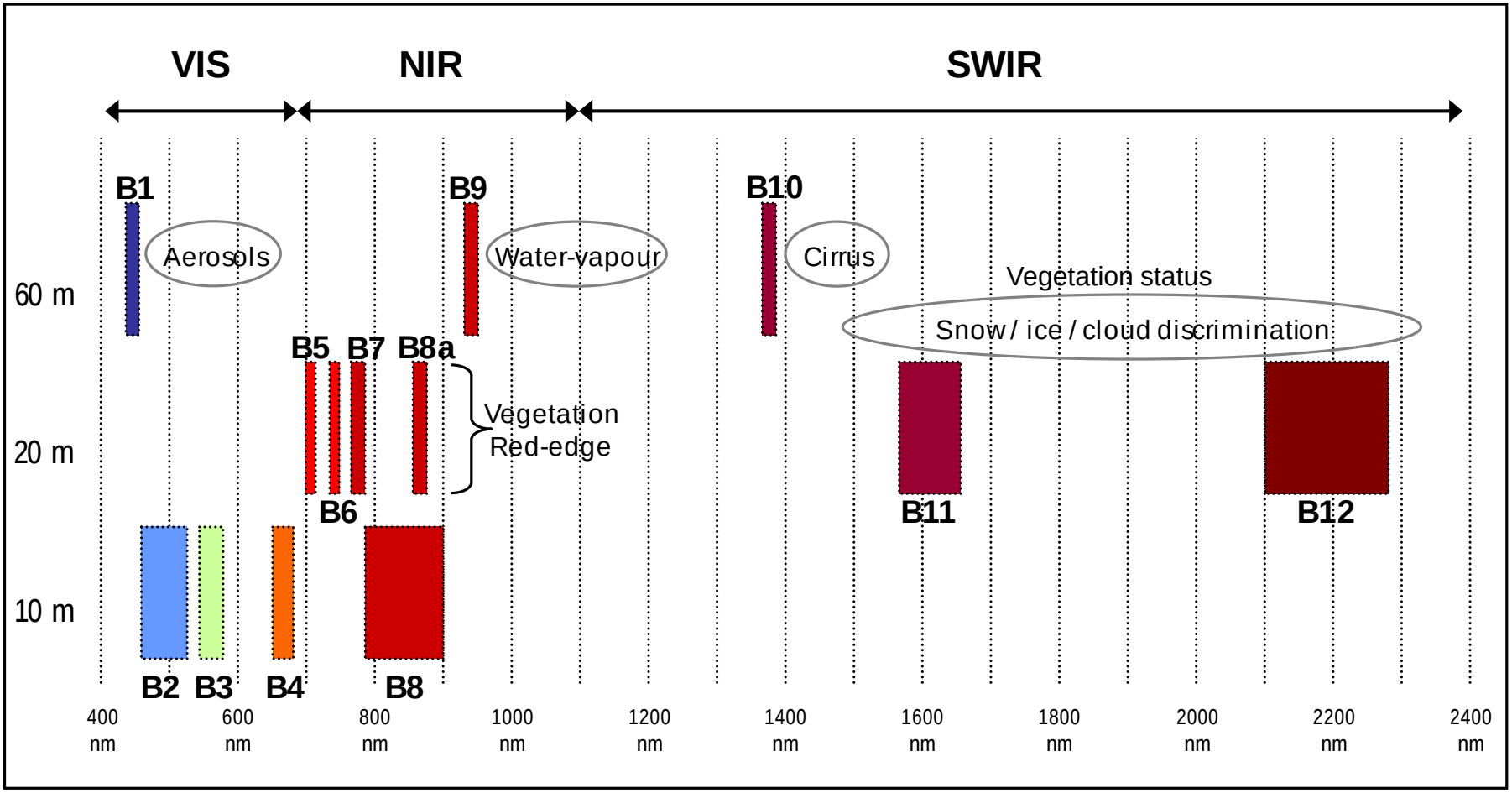
on behalf of the S2 team

Sentinel-2 Superspectral imaging mission

Mission profile

- **Two** Spacecraft operating in twin configuration
- Sun-synchronous orbit at **786 km**, **LTDN** 10:30 AM
- Multispectral instrument with **13** spectral bands (**VIS, NIR & SWIR**), at **10**, **20** and **60 m** spatial resolution
- **290 km** swath width
- **5 days** repeat cycle at Equator (cloud free) with 2 satellites
- **7 years** design life time, consumables for 12 years

13 Spectral bands



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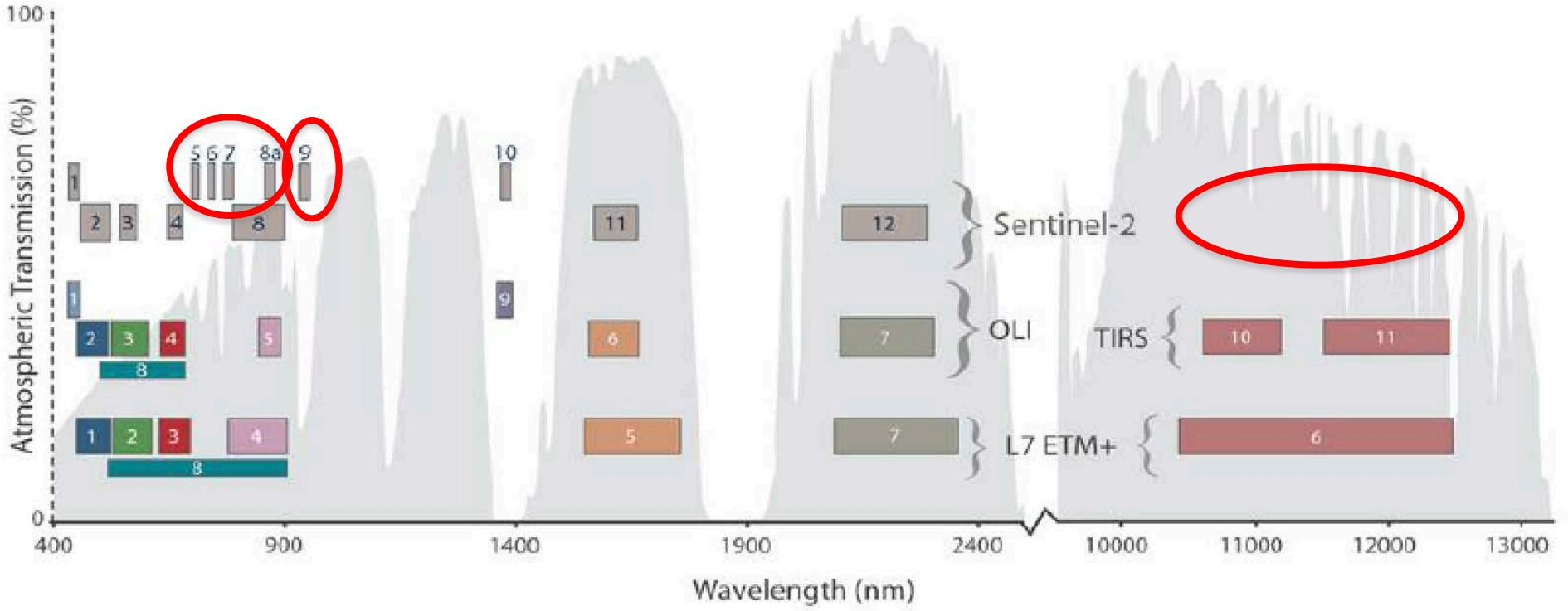
Comparison Sentinel-2 / Landsat-8 spectral bands



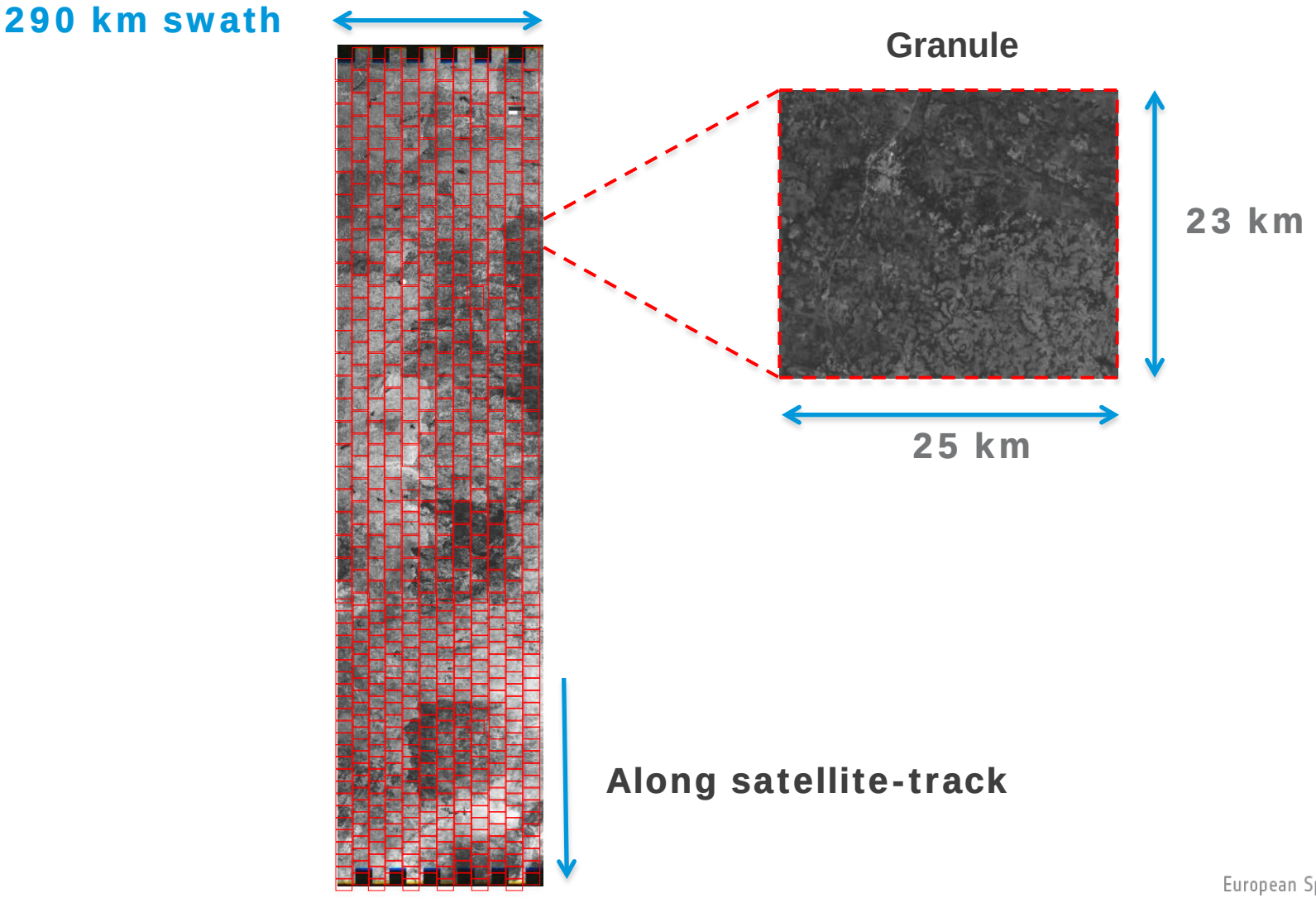
Source: http://landsat.usgs.gov/L8_band_combos.php

Pre-flight cross-calibration took place, post-flight campaigns planned

Level-1B / Definition

1. **Top-of-atmosphere (TOA) radiances in sensor geometry**
2. **Image radiometry key features**
    a. Radiometric corrections include: dark signal, pixel response non-uniformity, defective pixels interpolation and restoration (deconvolution + denoising).
    b. Radiances coded in 12 bits.
3. **Image geometry key features**
    a. Coarse registration between bands and between staggered detectors (no resampling).
    b. Includes a refined geometrical viewing model calculated using a GRI (Global Reference Image).

Level-1B: Product Example



Level-1C / Definition

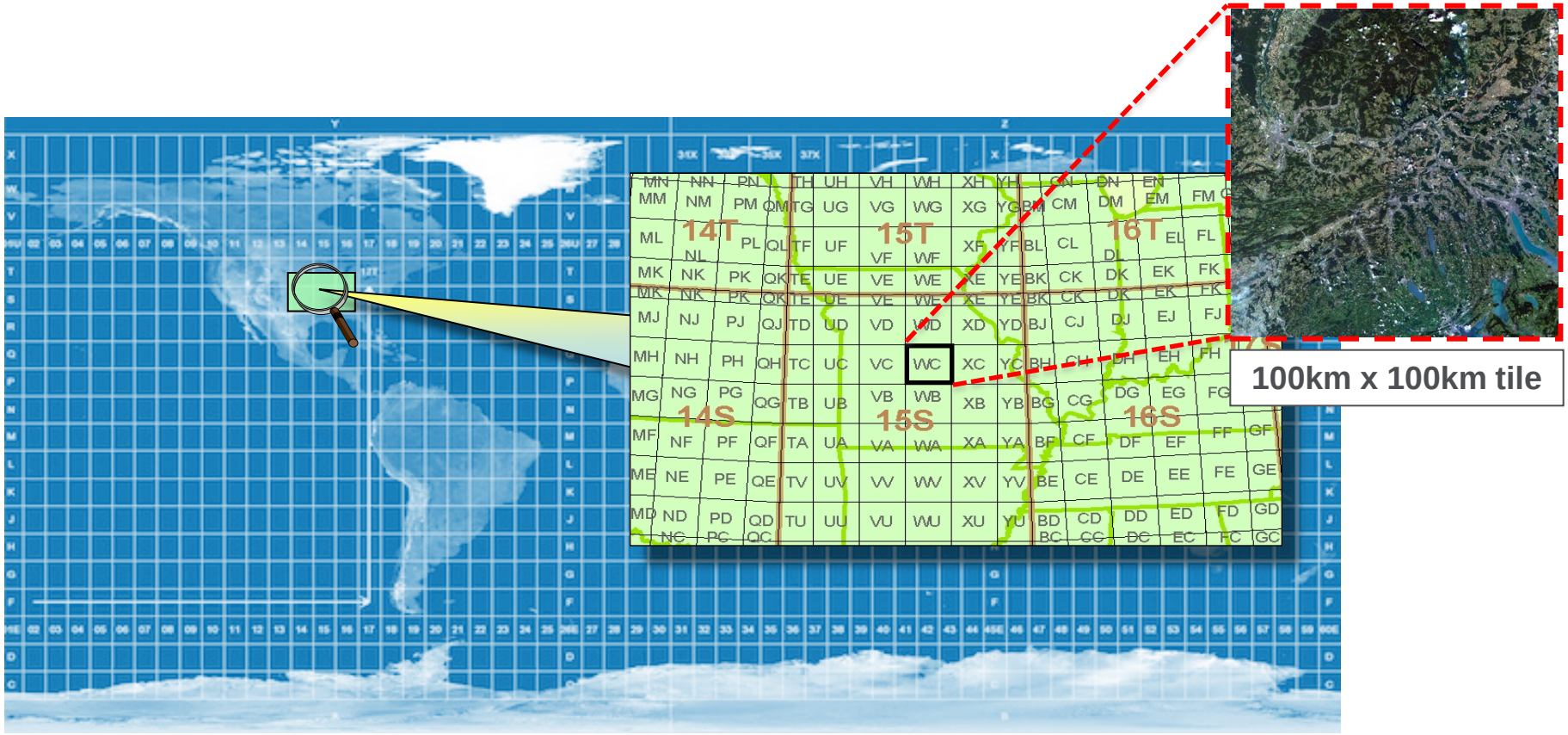
- Top-of-atmosphere (TOA) reflectances in cartographic geometry
  - ✓ Projection UTM / WGS84.

- Image radiometry key features:
  - ✓ Reflectances coded in 12 bits.
  - ✓ Product includes all necessary parameters required to convert the provided reflectances into radiances.

- Image geometry key features:
  - ✓ Orthorectification uses an 90m-resolution DEM (PlanetDEM).
  - ✓ Sub-pixel multi-temporal registration between images.

Level-1C / Tiling

- Cartographic Reference System: UTM (with 6ºx8º grid zones).
- Each grid zone is split into ~100x100km² UTM “Tiles”.



Level-1C / Data Quality Targets

Radiometric Data Quality	
Absolute radiometric uncertainty	3 % (goal) , 5 % (threshold)
Inter-band relative radiometric uncertainty	3%
Linearity knowledge accuracy	1%
Modulation Transfer Function (MTF)	0.15 to 0.3 (for 10m bands) <0.45 (for 20 & 60m bands)
Geometric Data Quality	
Absolute geolocation uncertainty	20m 2σ (threshold) 12.5m 2σ (goal) with GCPs
Multi-temporal registration	0.3 pixel 2σ (goal) with GCPs
Multi-spectral registration (for any couple of spectral bands)	0.3 pixel 3σ

Level-2A / Definition

1. **Bottom-of-atmosphere (BOA) reflectances in cartographic geometry (UTM/WGS84).**
2. **Products additionally include:**
    a. Scene Classification Map
    b. Water Vapour Map
    c. Aerosols Optical Thickness Map
3. **Algorithm includes:**
    a. Cloud and cloud shadow detection.
    b. Cirrus detection and correction.
    c. Slope effect correction.
    d. BRDF effect correction.

S2 Products Summary

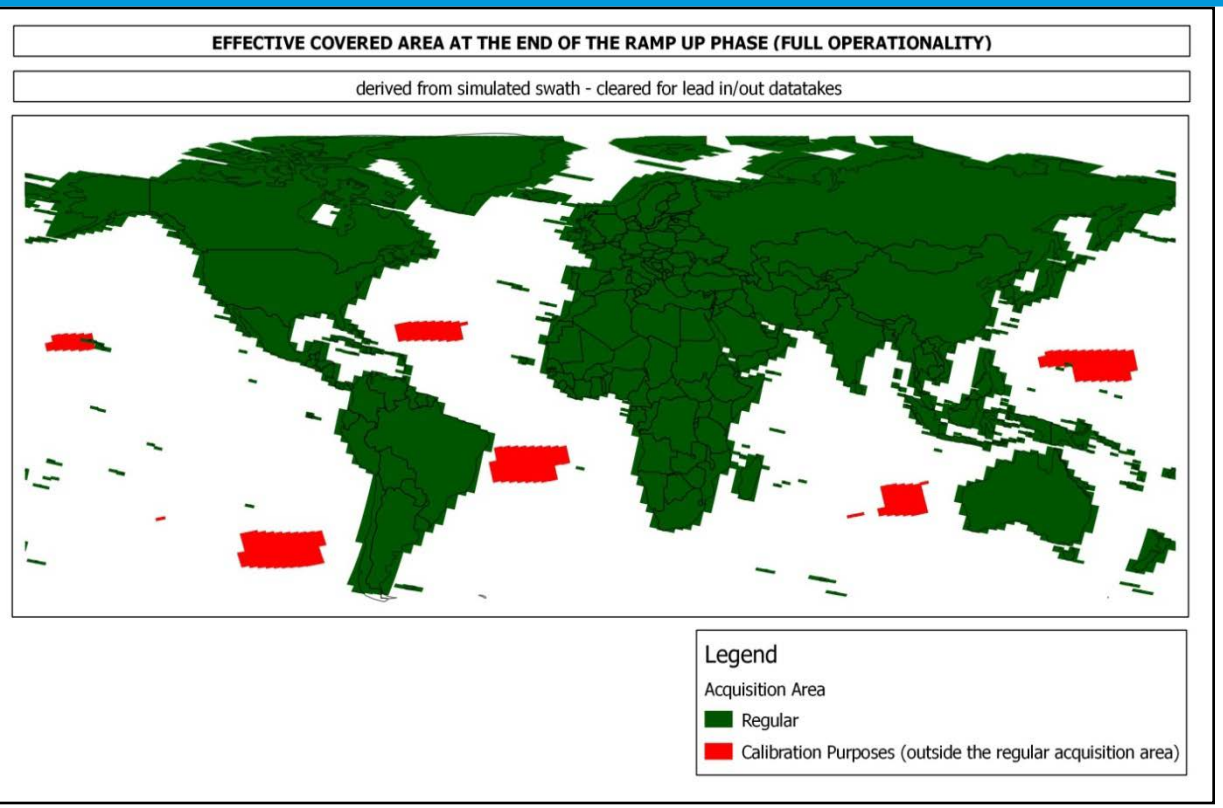
Name	High-level Description	Production	Preservation Strategy	Volume
Level-1B	Top-of-atmosphere radiances in sensor geometry	Systematic	Long-term	~27 MB (each 25x23km^2)
Level-1C	Top-of-atmosphere reflectances in cartographic geometry (UTM/WGS84)	Systematic	Long-term	~500 MB (each 100x100km^2)
Level-2A	Bottom-of-atmosphere reflectances in cartographic geometry	On user side (using Sentinel-2 Toolbox)	-	~600 MB (each 100x100km^2)

To be available via the same mechanisms as Sentinel-1, see previous talk of P. Potin et al.

This product is initially offered as part of the Sentinel-2 toolbox:
https://earth.esa.int/web/sentinel-tbx/sentinel-2-toolbox

The possibility of a systematic global production of L2A is currently being explored

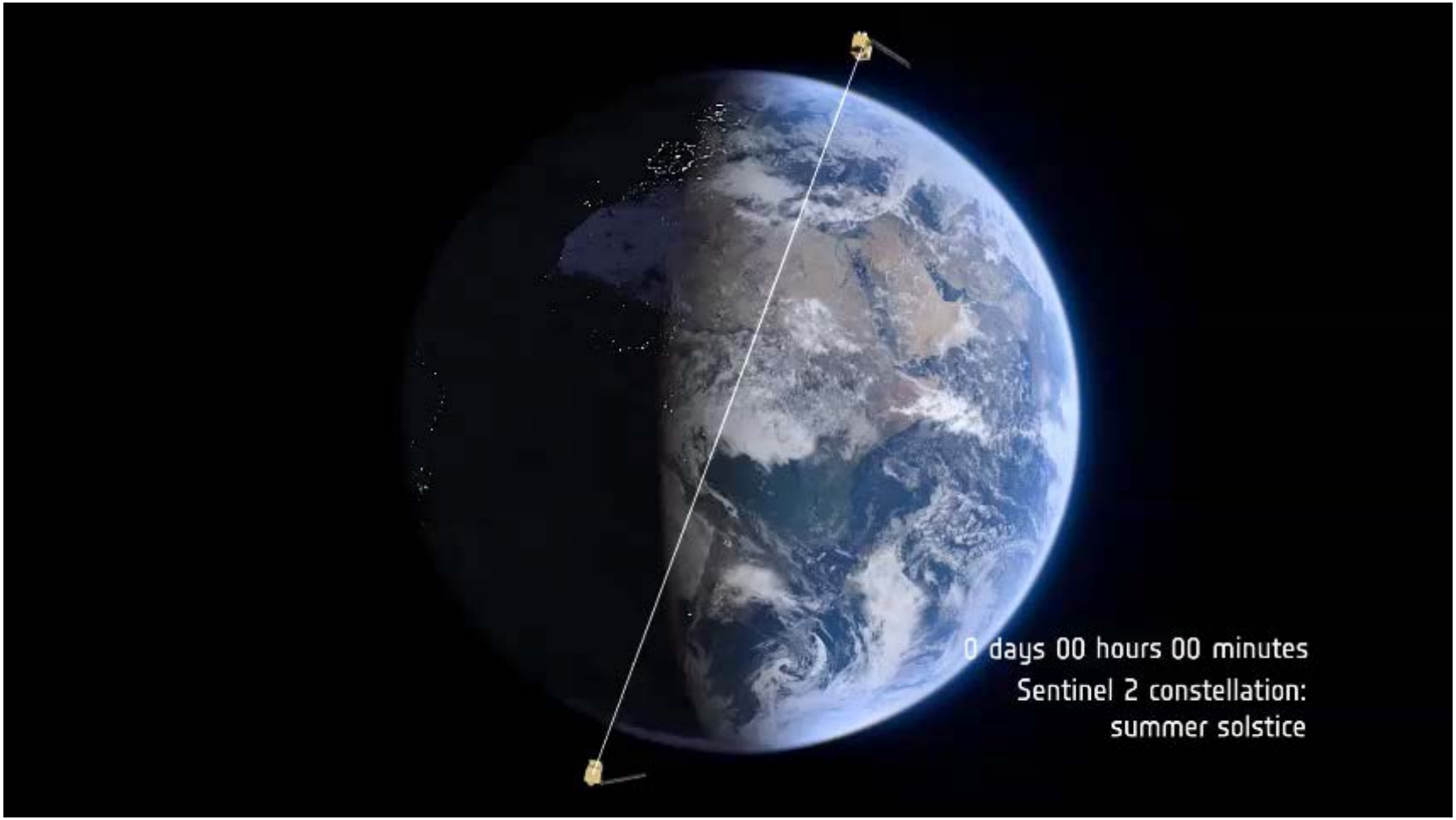
S2 nominal observation plan



Baseline in full operations is systematic acquisition of:

- ✓ All land surfaces (-56° and +84° latitude);
- ✓ Major (greater than 100 km² size) and EU islands;
- ✓ Coastal (20km off the coast)
- ✓ inland waters, Mediterranean Sea and all closed seas;
- ✓ Cal/Val sites: see next slides

S2 nominal observation plan



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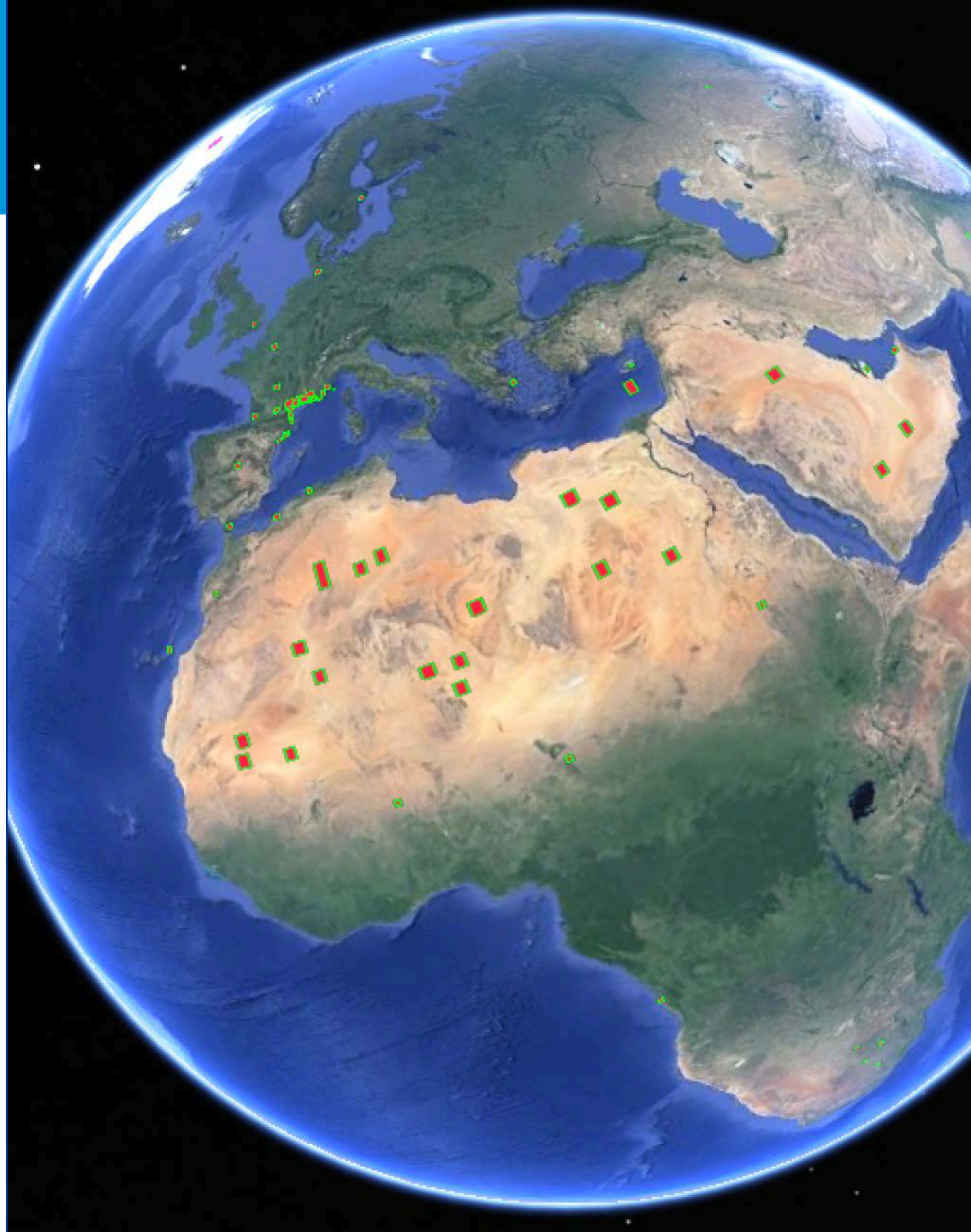
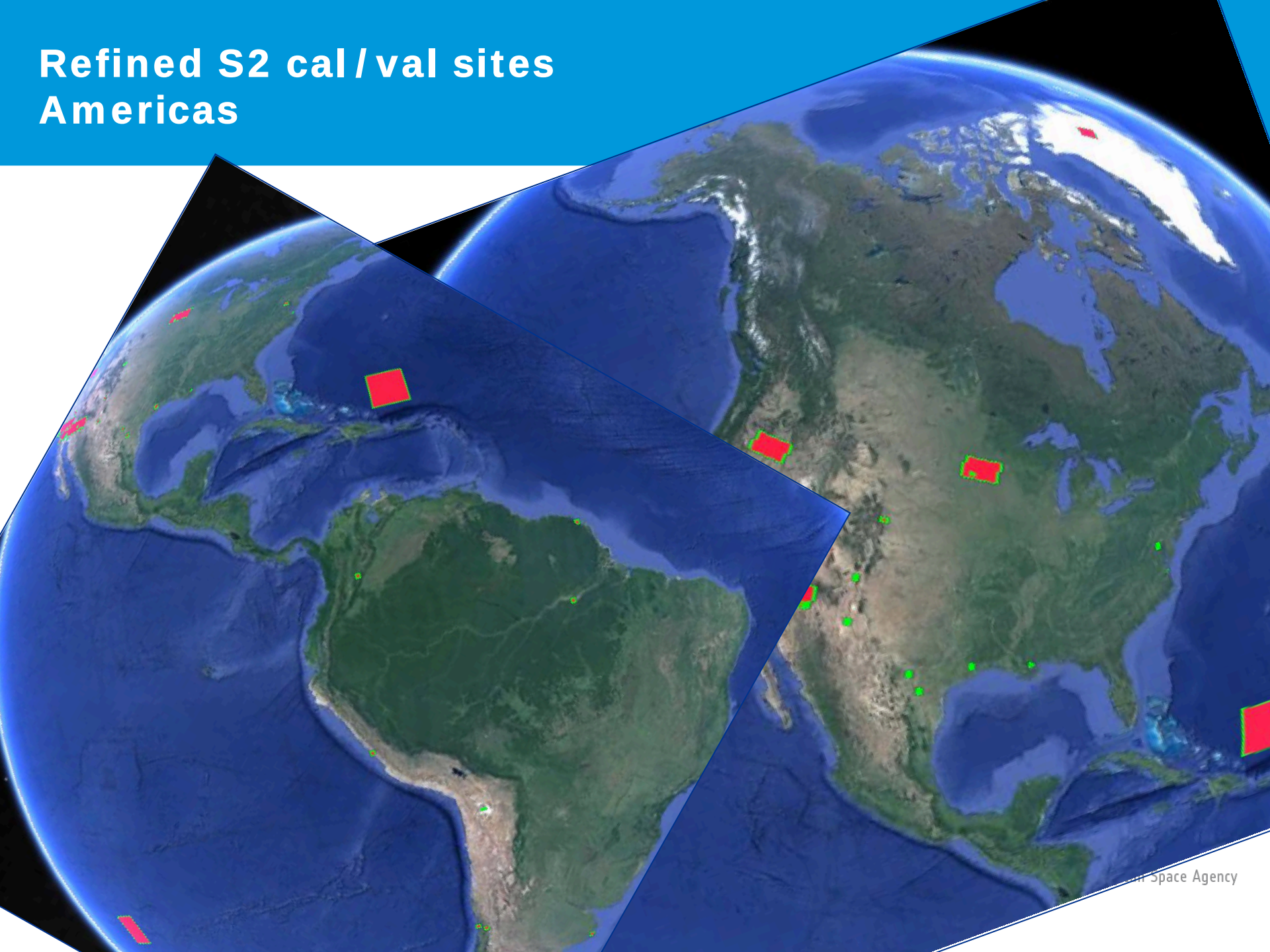
Refined S2 cal/val sites Europe

Refined S2 cal/val sites Europe-Africa

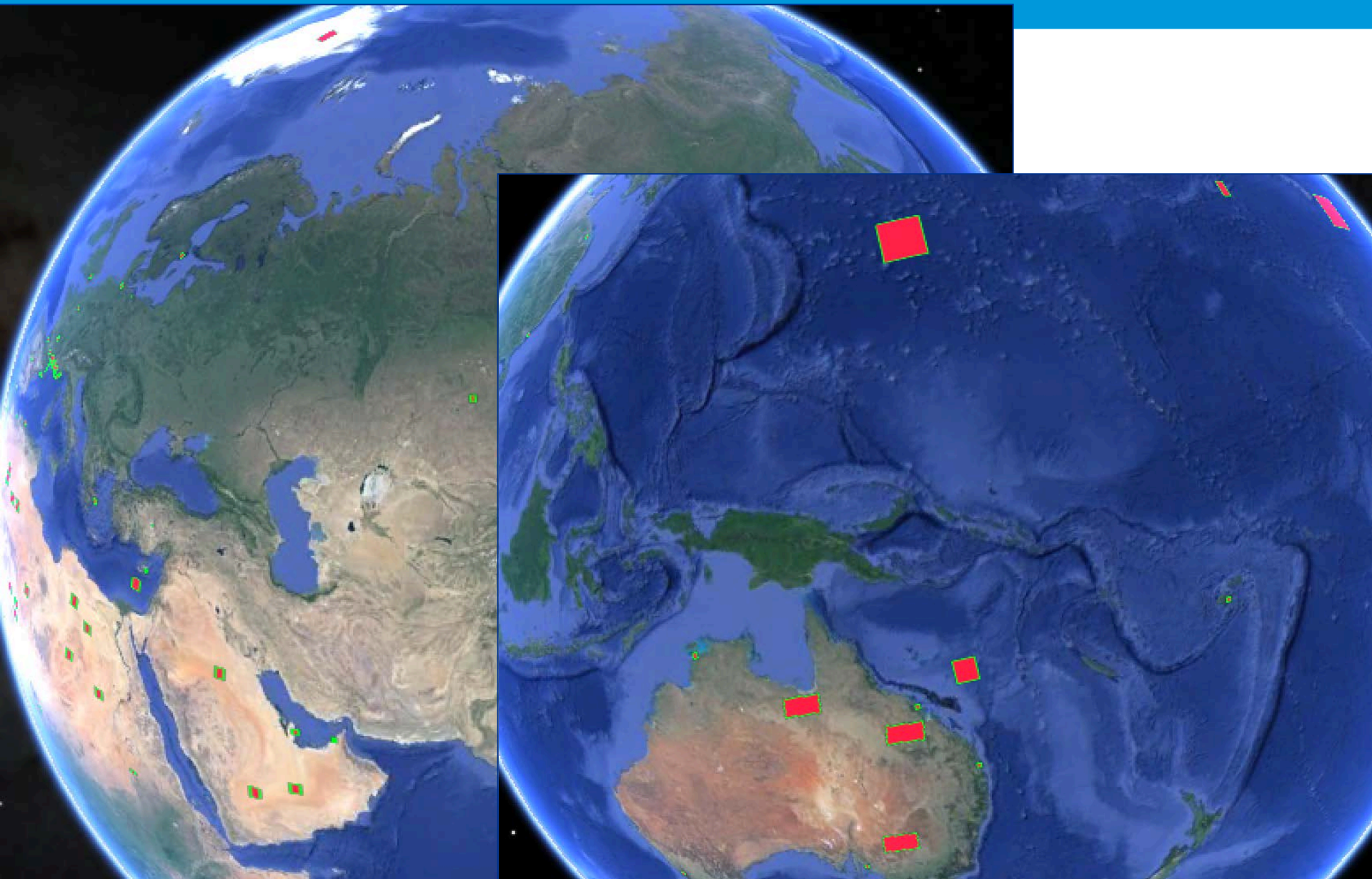


Refined S2 cal/val sites Americas



European Space Agency

Refined S2 cal / val sites Asia / Australia



Sentinel-2 ramp-up – under definition

Like for Sentinel-1, a gradual ramp-up is being defined for Sentinel-2, increasing/improving gradually the observations plan and performance level in a stepwise approach

-Gradual increase of acquisition capacity from a reduced observation/processing scenario to full systematic observation

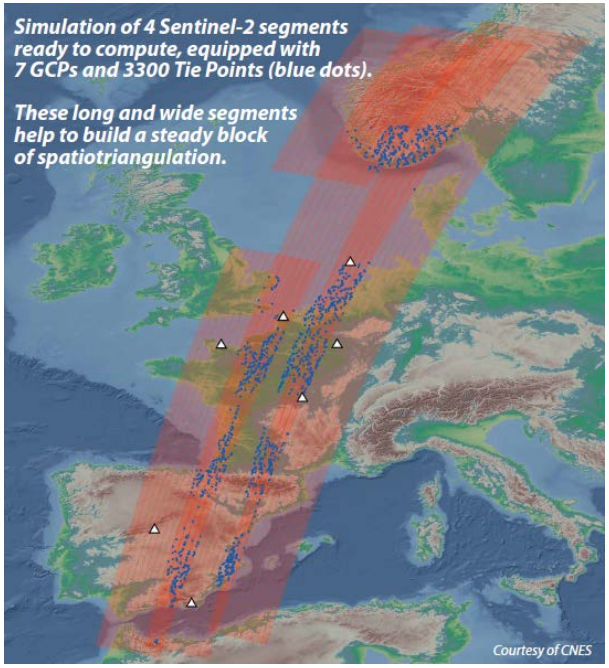
-Ensuring coverage of global Cal/Val needs

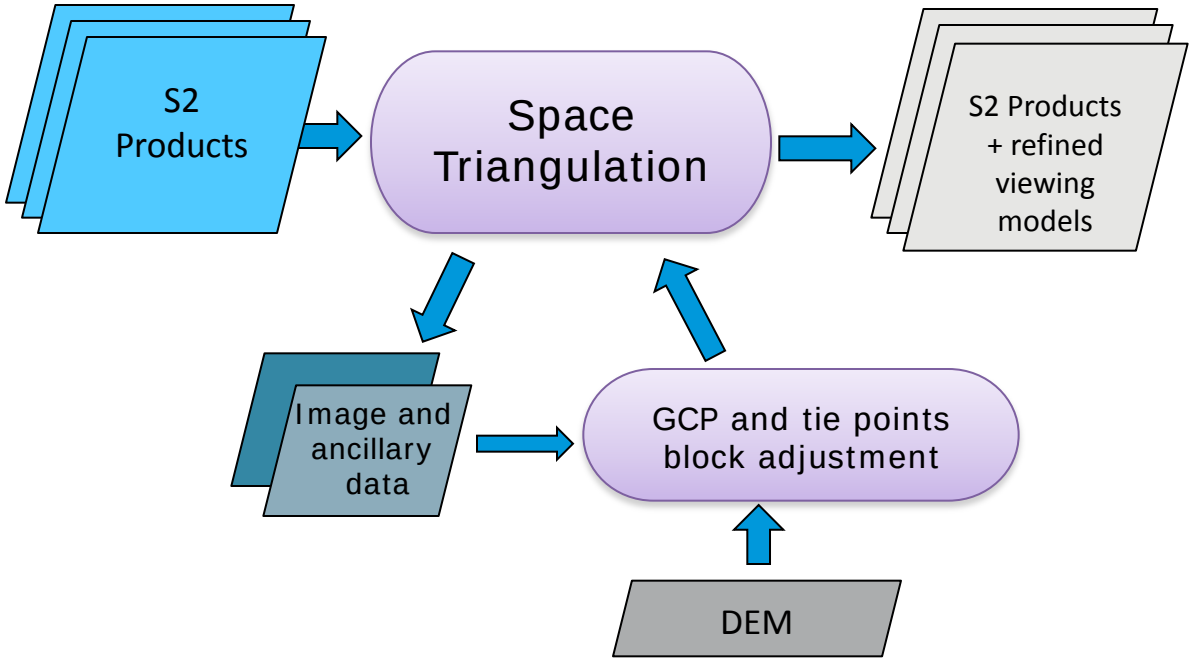
-Ensuring as early as possible COPERNICUS dataset needs

-Ensuring maximum coverage/orbit length for generation of a global reference image (GRI), which is required to produce high accuracy L1C products…this may take up to ±9 months to produce

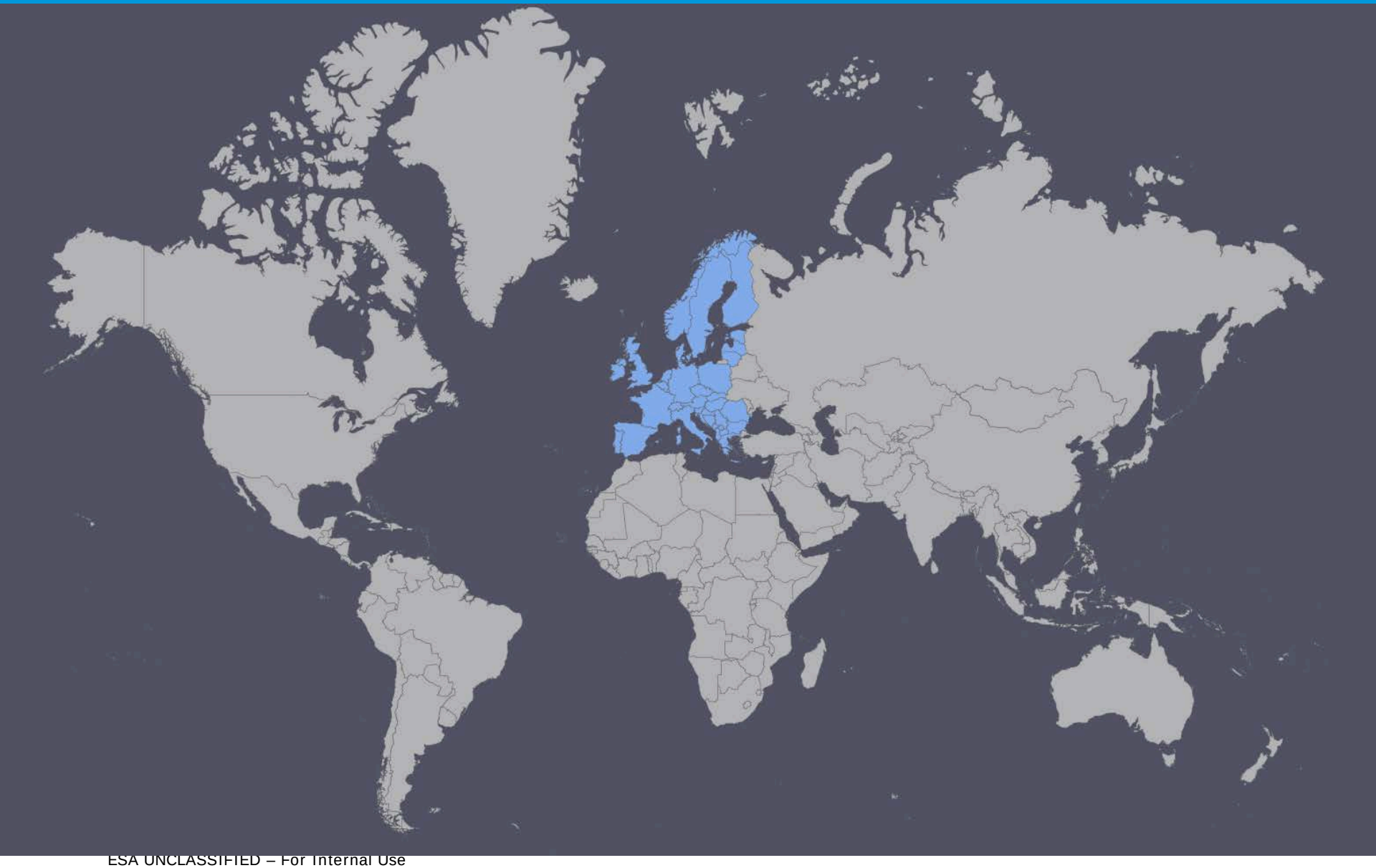
Global Reference Image (GRI) Generation

- Objective: To obtain a full repeat cycle dataset of well-localized mono-spectral Level-1B images (band 4, red) which will be used as reference images in the processing chain.
- Methodology: Massive spatio-triangulation on multi-continental blocks (starting with Europe-Asia-Africa block).
- GRI planned around Launch + 9 months.

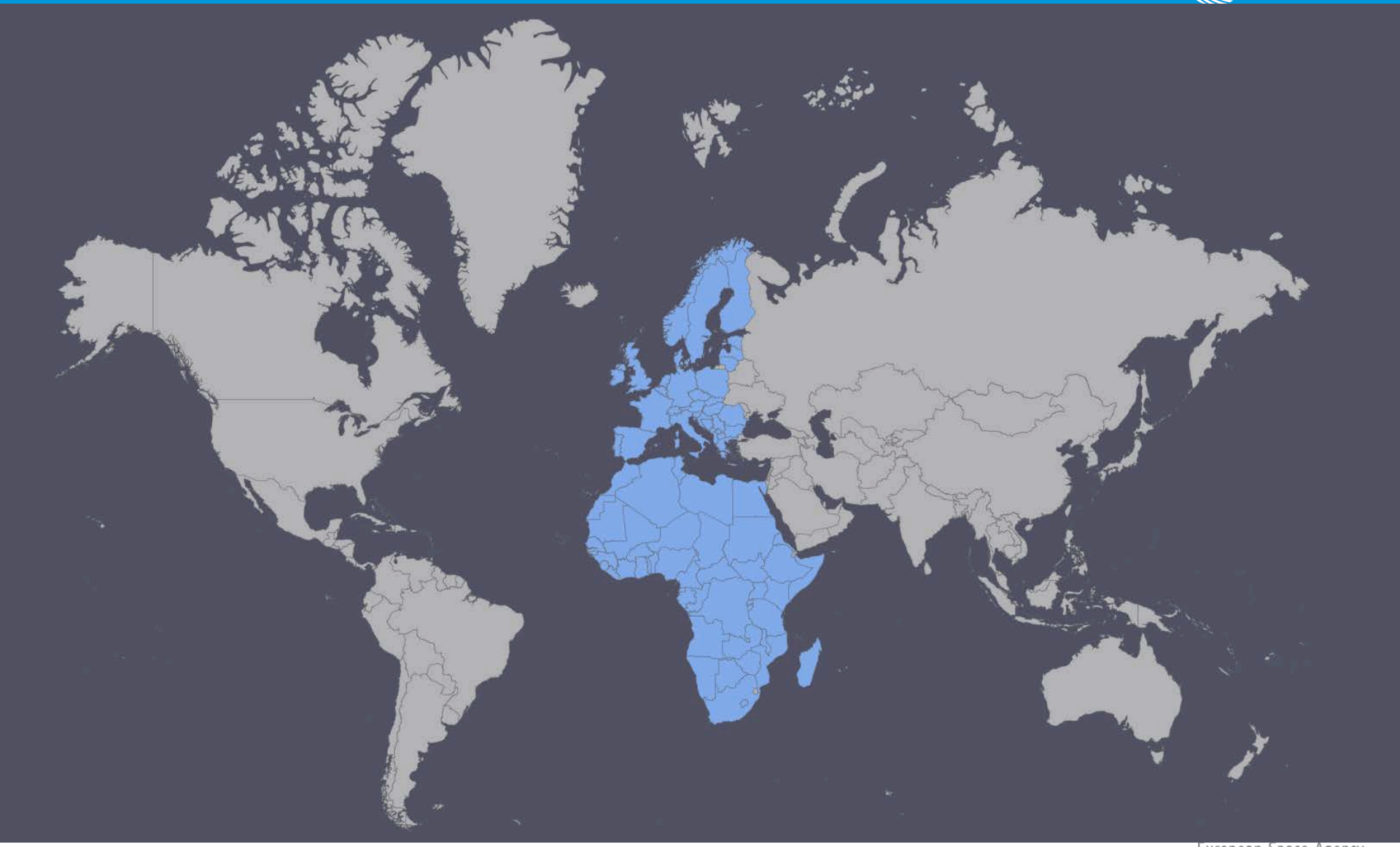




GRI Block-1



GRI Block-2



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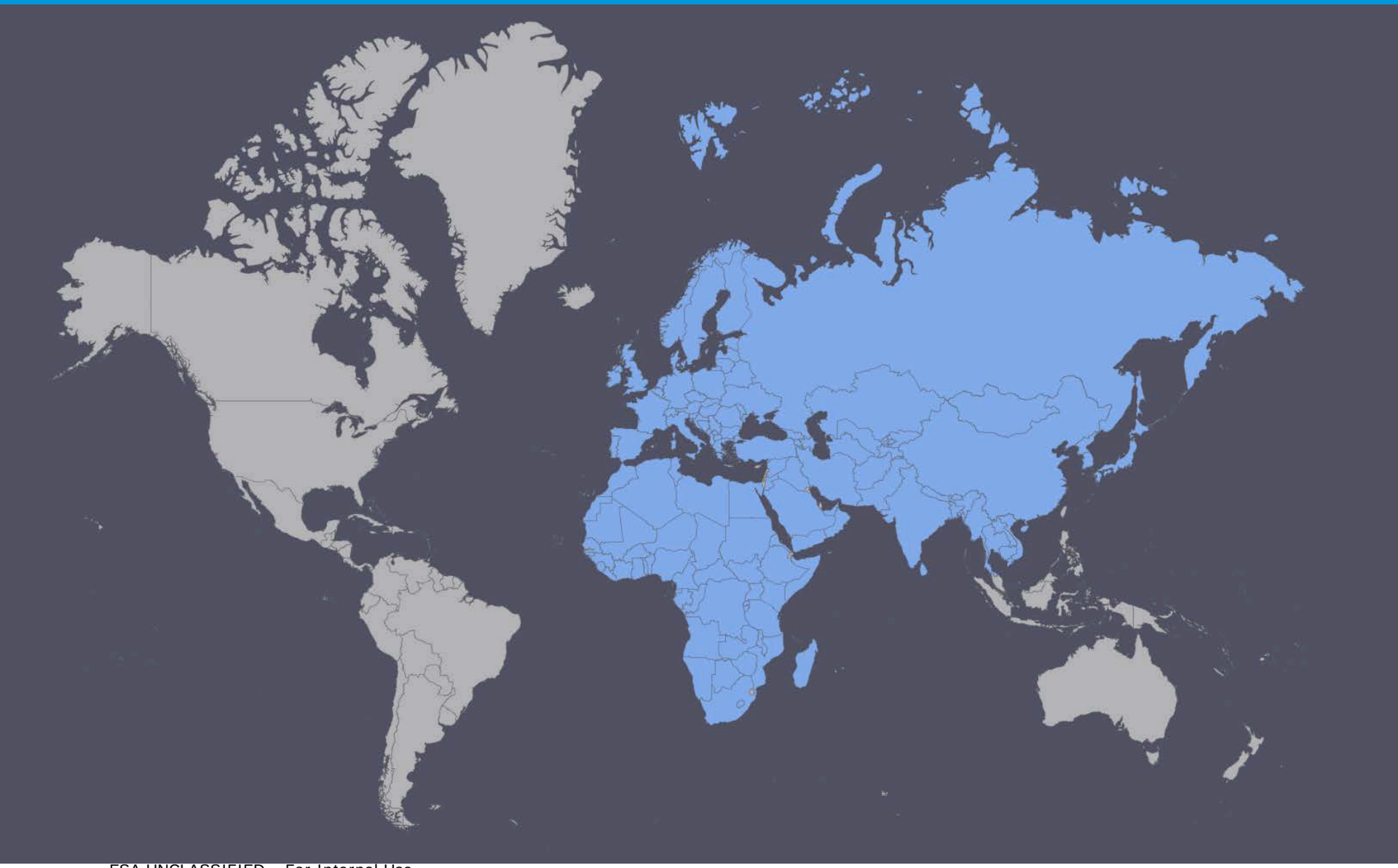
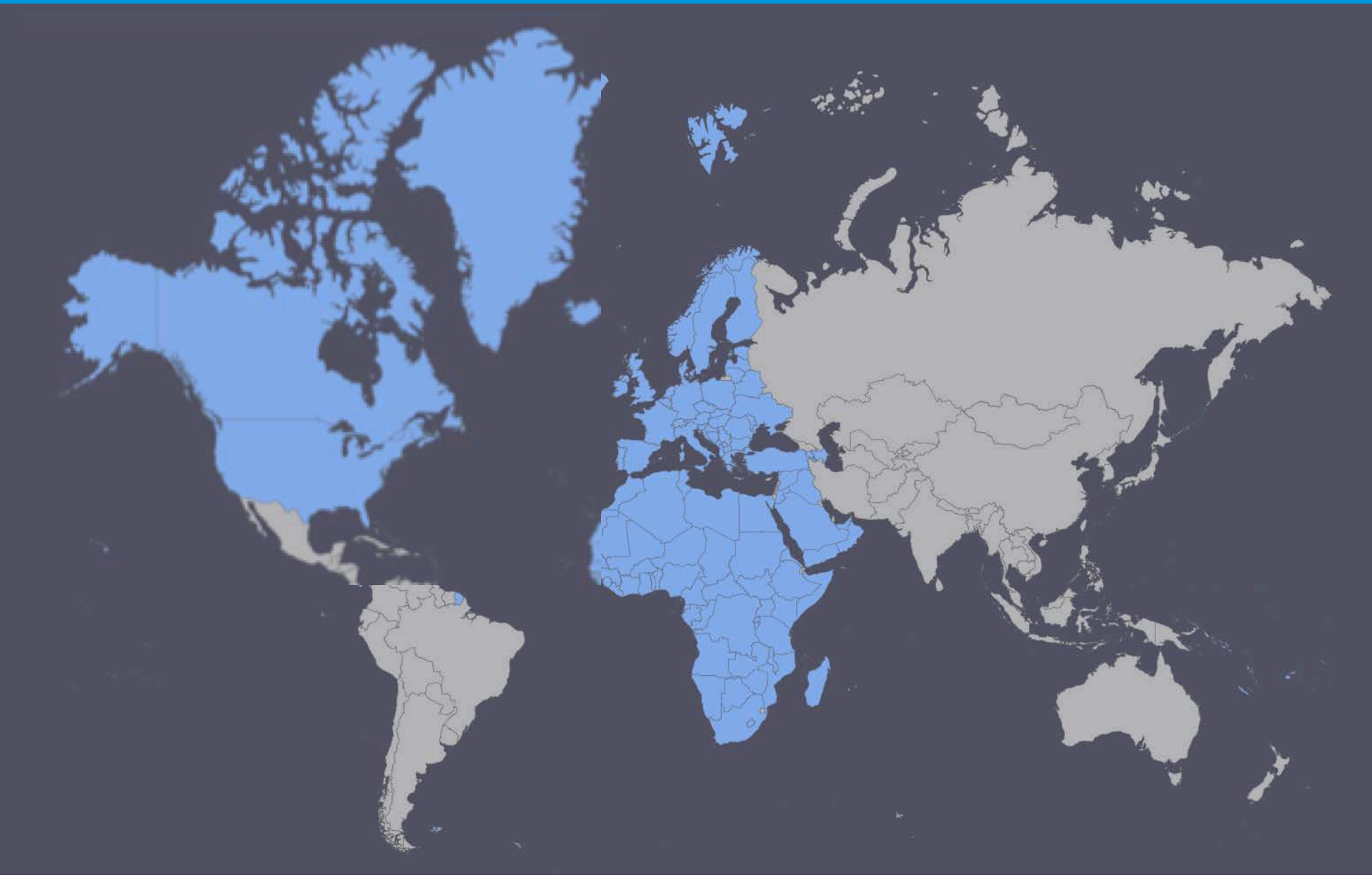
GRI Block-3

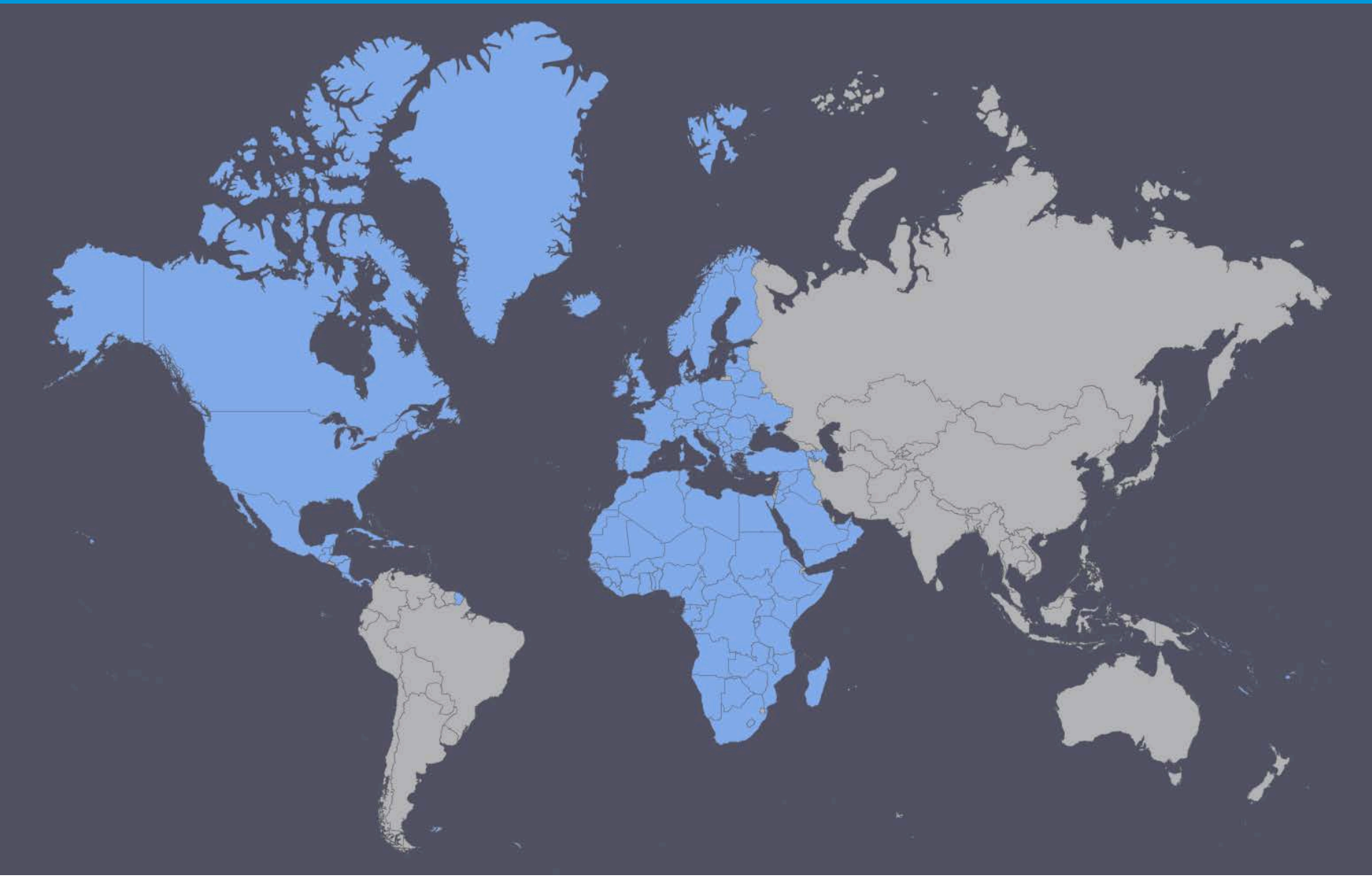


GRI Superblock 1

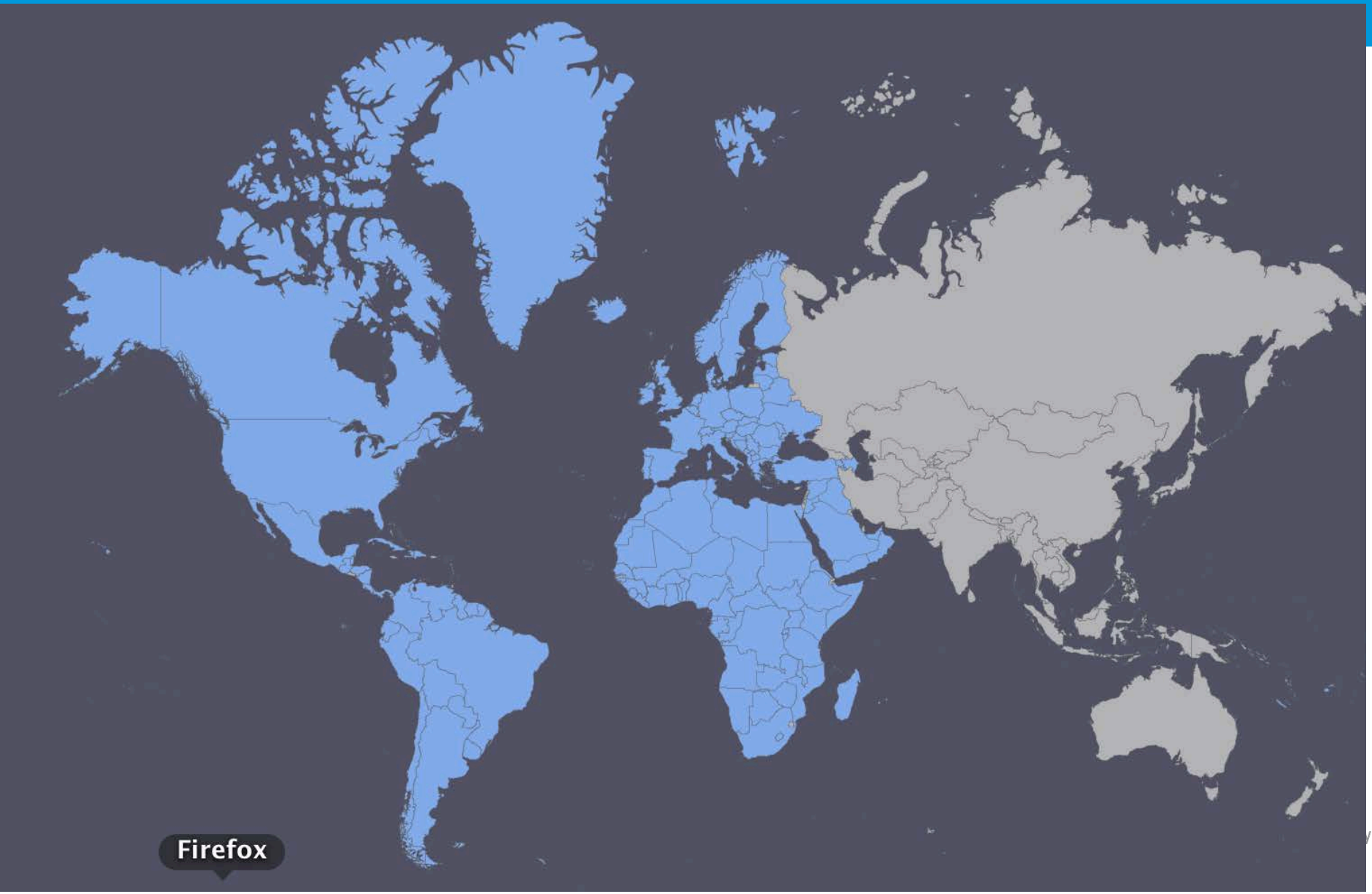
Possible switch to Americas (North)



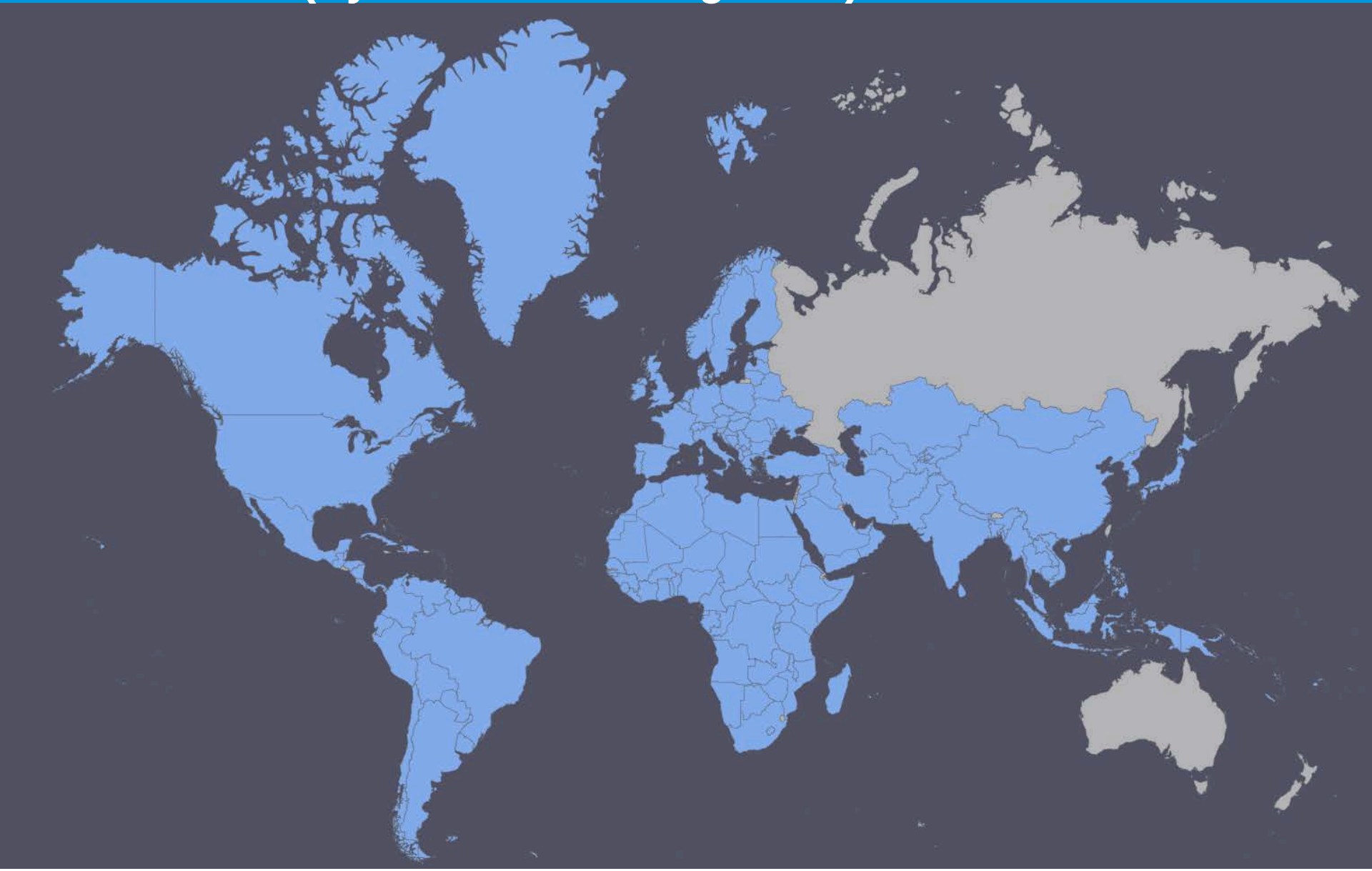
Possible switch to Americas (North, Central)



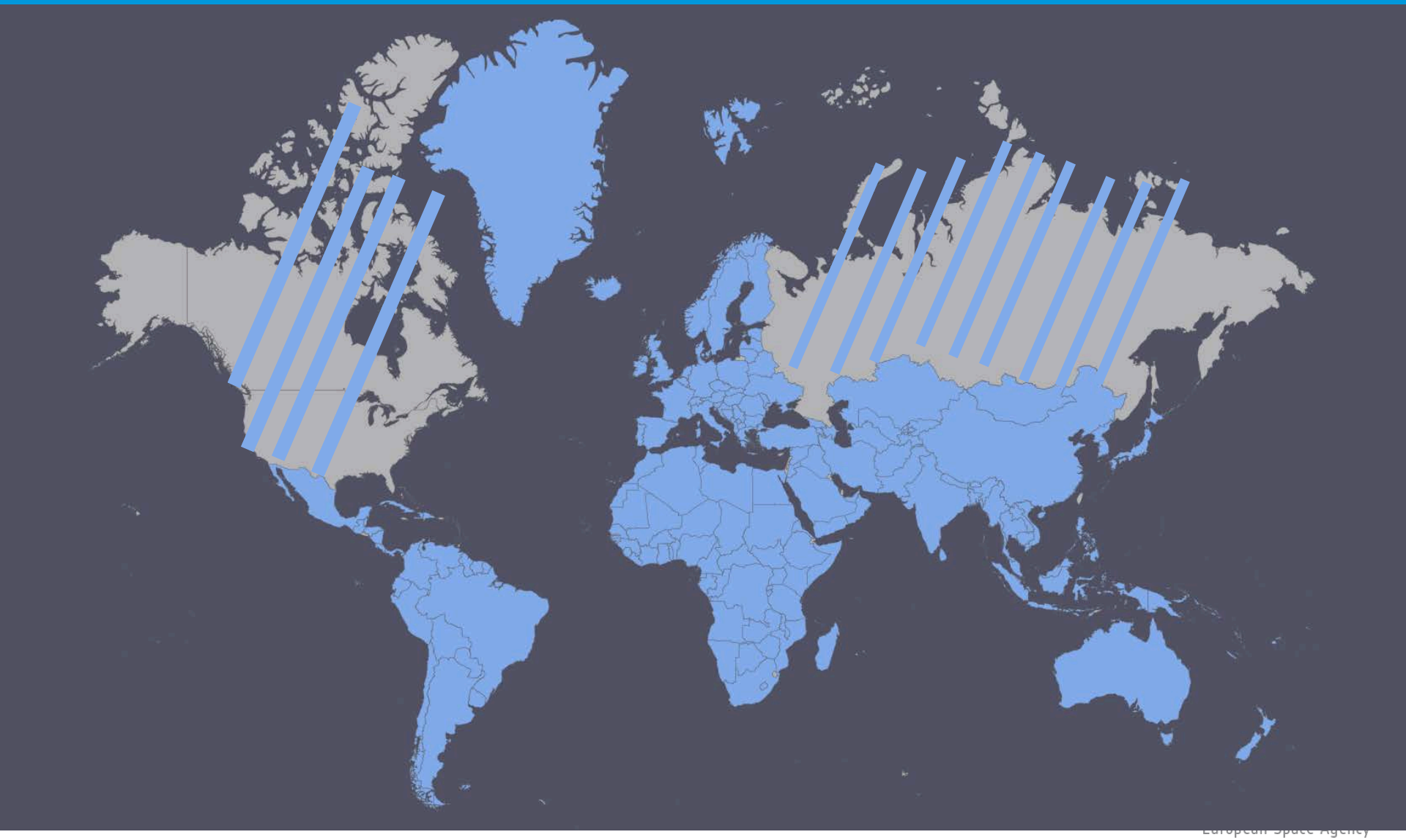
Europe with Superblock 2 (North, Central, South America)



Potential intermediate or alternating scenarios (systematic non-global)



Potential intermediate or alternating scenarios (non-systematic)



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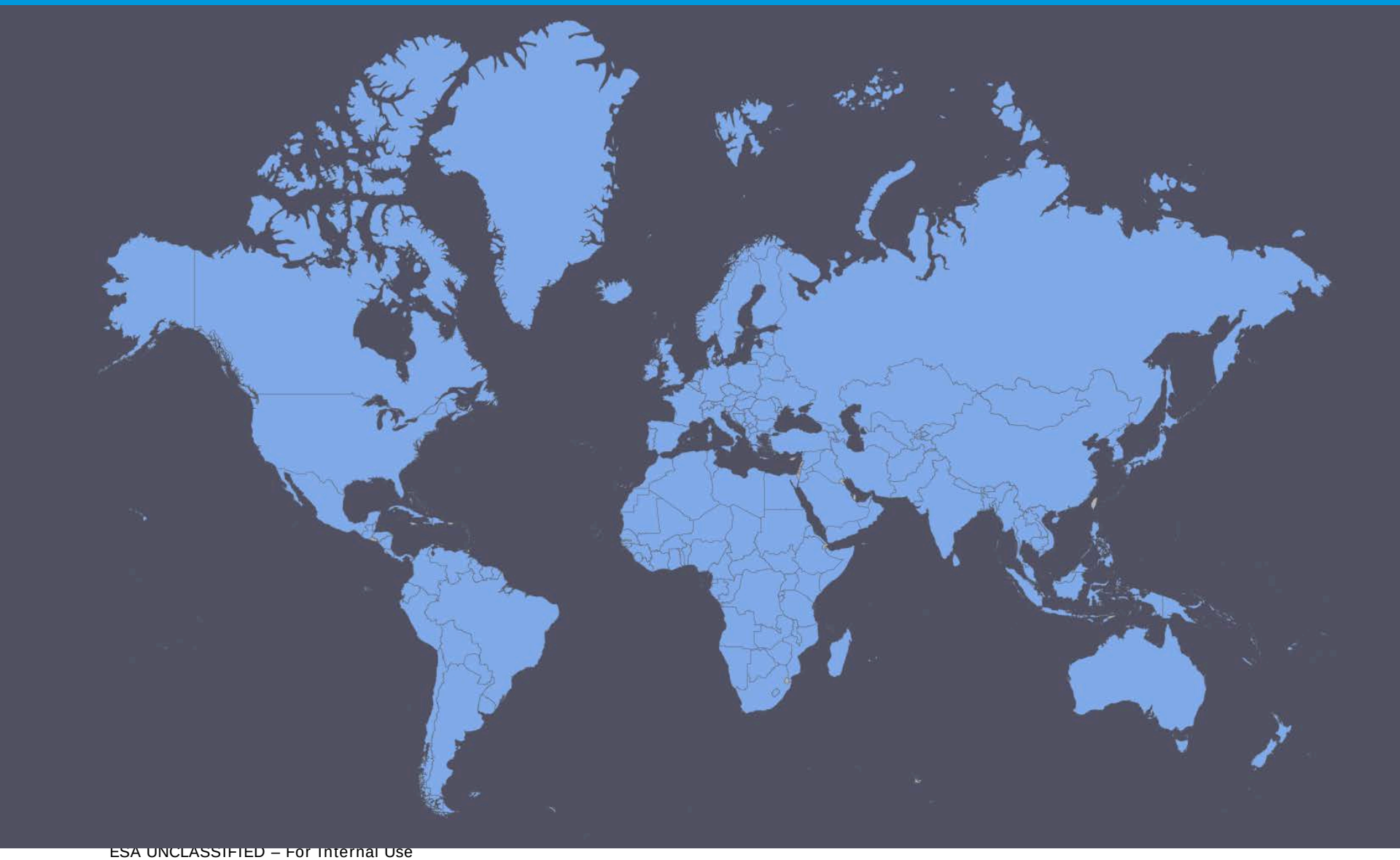
FINAL



Uniqueness of Sentinel-2

1. Systematic acquisition of all land surfaces and coastal waters.
2. High revisit frequency (5 days periodicity, same viewing direction).
3. Large swath (290*km*).
4. High spatial resolution (10*m* / 20*m* / 60*m*).
5. Large number of spectral bands (13 in VNIR-SWIR domain).
6. Level 1B and Level 1C data will be available just like S1, free and open:

Space Agency

Close to launch

Current assumed launch date:

12 June 2015 for S2A, launch readiness for S2B in June 2016

Thank you

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