Status of Sentinel-1 and acquisition plans for GFOI

Frank Martin Seifert, Pierre Potin, Johannes Roeder,
ESA – Earth Observation Programme
5th Space Data Coordination, ESRIN, Frascati, 24 February 2014

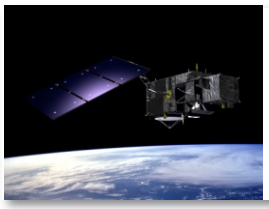
GMES Sentinel Missions

Sentinel 1 – SAR imaging
All weather, day/night applications, interferometry

3 April 2014 (A), 2015+ (B)

Sentinel 2 – Multispectral imaging
Land applications: urban, forest, agriculture,..
Continuity of Landsat, SPOT

Spring 2015 (A), 2016 (B)

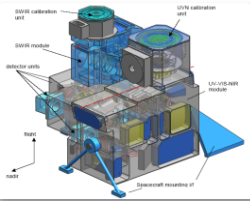


Sentinel 3 – Ocean and global land monitoring
Wide-swath ocean colour, vegetation, sea/land surface temperature, altimetry

2015 (A), 2016 (B)

Sentinel 4 – Geostationary atmospheric
Atmospheric composition monitoring, trans-boundary pollution

2018

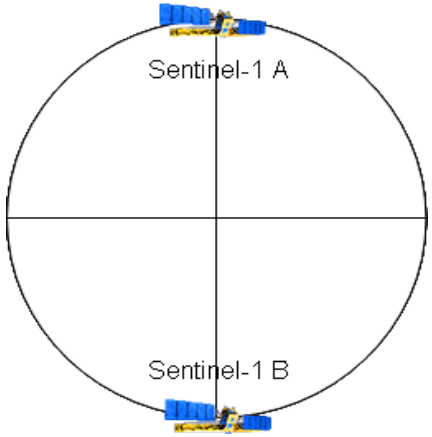


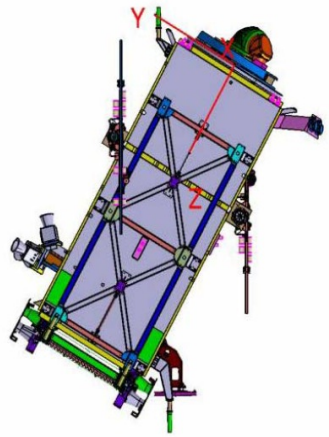
Sentinel 5 and Precursor – Low-orbit atmospheric
Atmospheric composition monitoring

2015 (5P), 2019

Sentinel-1 Mission Facts

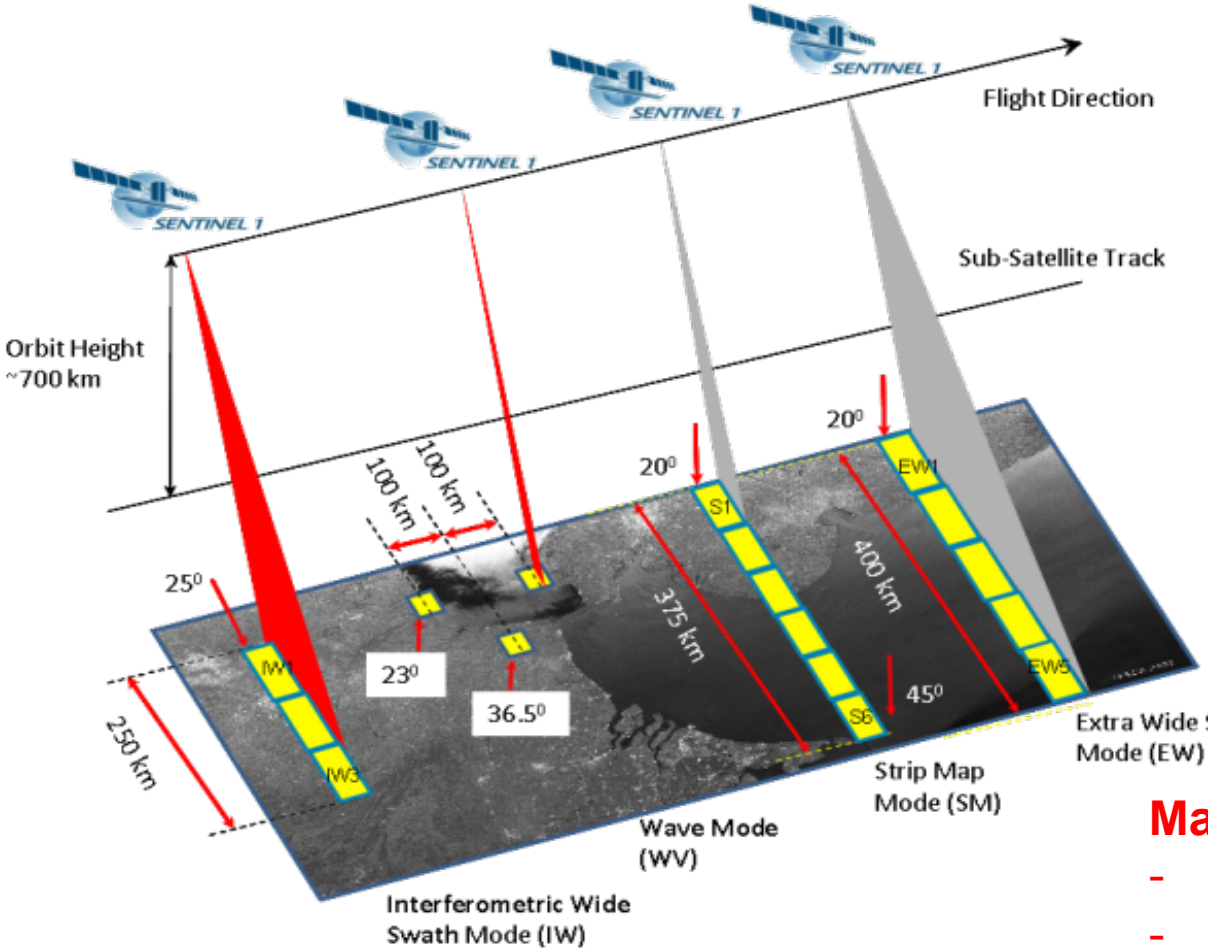
- Constellation of two satellites (A & B units)
- C-Band Synthetic Aperture Radar Payload (at 5.405 GHz)
- 7 years design life time with consumables for 12 years
- Near-Polar sun-synchronous (dawn-dusk) orbit at 698 km
- 12 days repeat cycle (1 satellite), 6 days for the constellation
- Both Sentinel-1 satellites in the same orbital plane (180 deg phased in orbit)
- Optical Communication Payload (OCP) for data transfer via laser link with the GEO European Data Relay Satellite (EDRS)
- Launch of Sentinel-1A scheduled for **3 April 2014** (Sentinel-1B ready for launch by end 2015)





Sentinel-1 SAR Imaging Modes

4 mutually exclusive SAR modes with different resolution and coverage



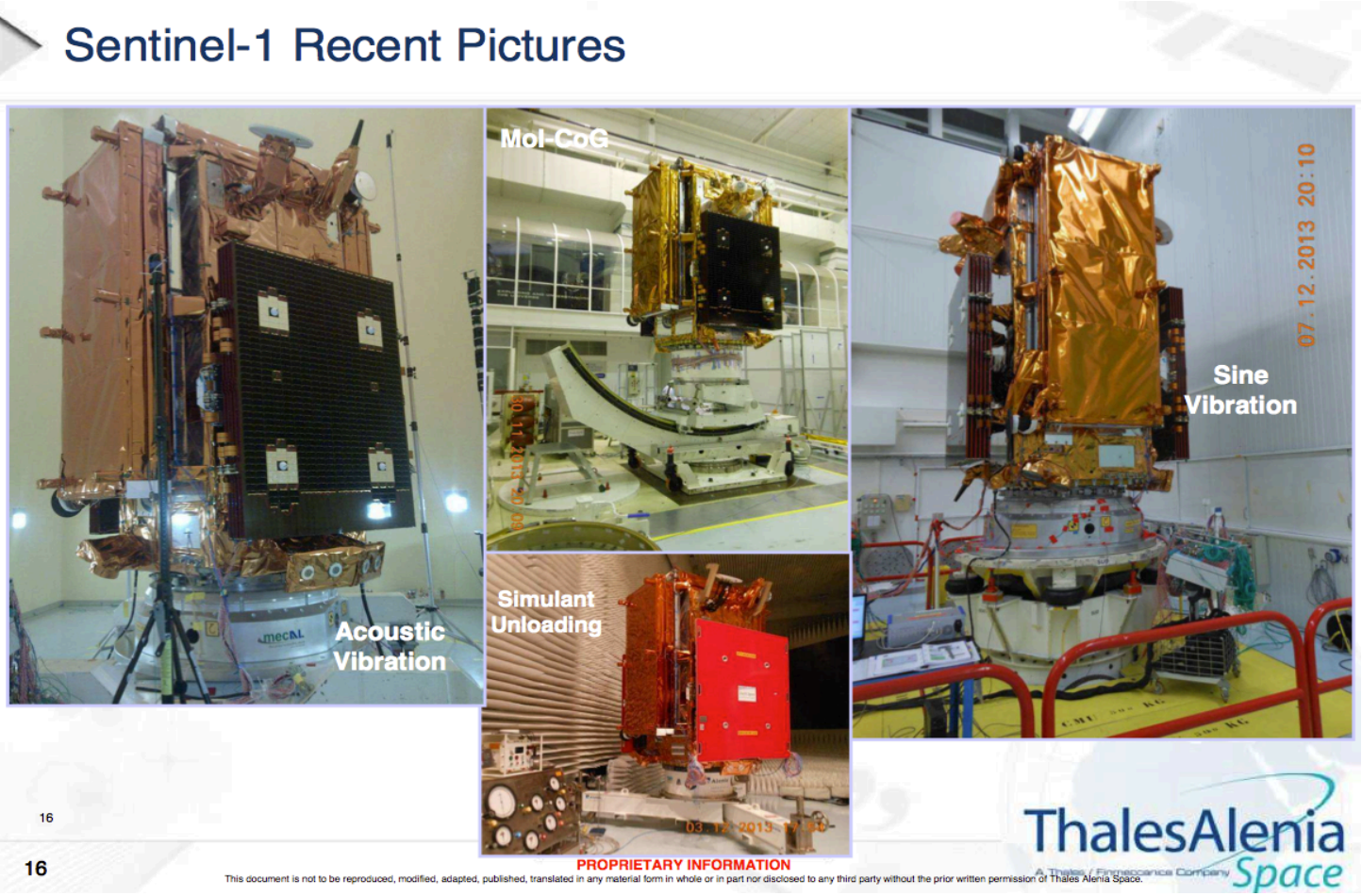
- Polarisation schemes for IW, EW & SM:
  - ✓ single polarisation: HH or VV
  - ✓ dual polarisation: HH+HV or VV+VH
- Wave mode: HH or VV
- SAR duty cycle per orbit:
  - ✓ up to 25 min in any of the imaging modes
  - ✓ up to 74 min in Wave mode

Main modes of operations:

- **IW over land and coastal waters**
- **EW over extended sea and sea-ice areas**
- **WV over open oceans**

SENTINEL-1 STATUS

Sentinel-1A major milestones



QAR KO (Satellite Qualification Review)
→ January 13th, 2014

QAR Conclusion
→ February 18th, 2014

Shipment to Kourou
→ February 21st, 2014

Launch Campaign Start
→ February 24th, 2014

Launch
→ March 28th, 2014

IOCR (Satellite In-Orbit Commissioning Review
→ July, 2014

SENTINEL-1 Observation Concept Overview - Mission Ramp-Up

Sentinel-1 Observation Scenario Objective

<u>In line with the Sentinel operations strategy objectives:</u>

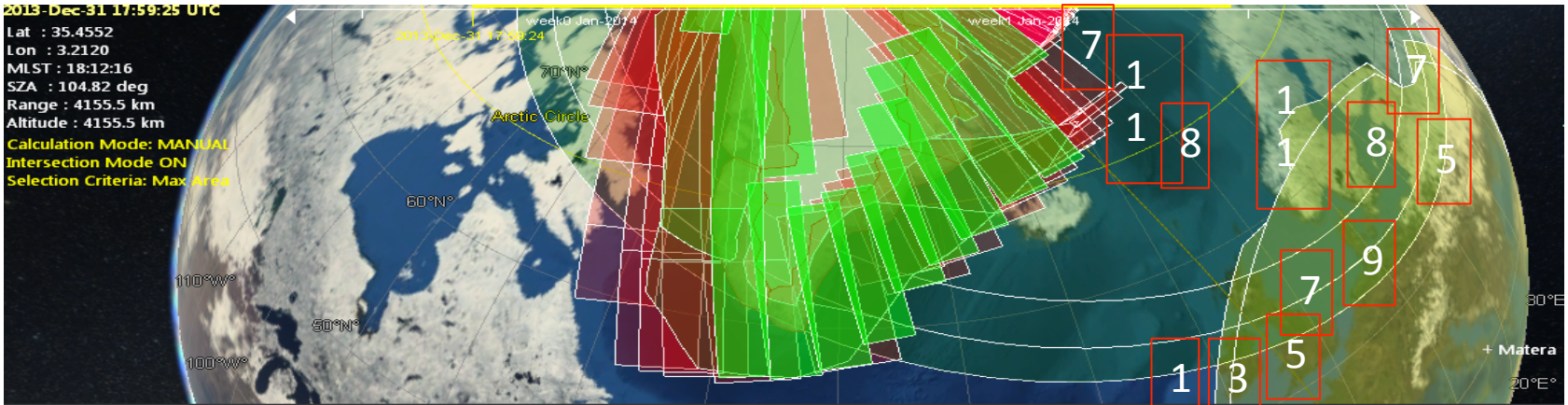
→ Implement a pre-defined and conflict-free observation plan, aiming at fulfilling, to the best extent, the observation requirements from:

- the Copernicus services
- the use by ESA / EU Member States

→ In addition, on best effort basis:

- ensure continuity of ERS/ENVISAT
- implement requirements from the science community
- contribute to international cooperation activities.

→ Need to find *a priori* the solutions on the potential conflict among users (e.g. different SAR operation modes / polarisation required over same geographical area)



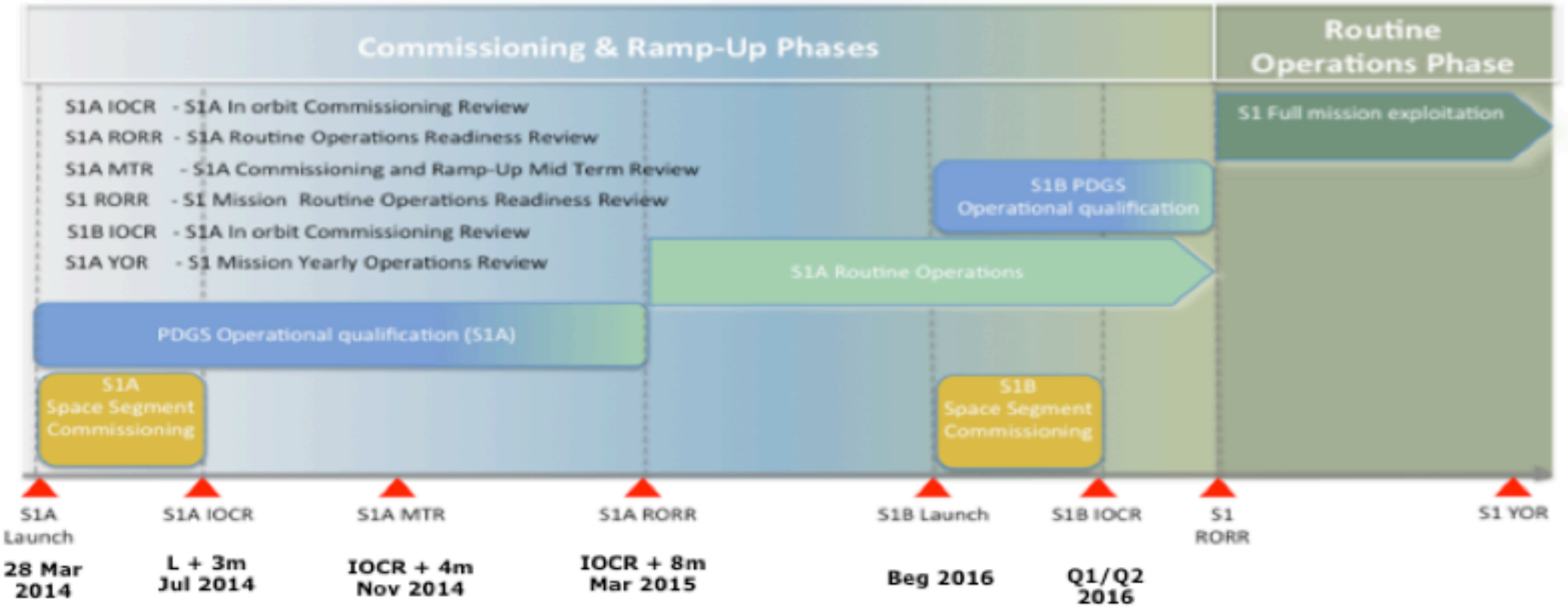
Collecting the Sentinel-1 Observation Requirements

Group	Source of Requirements
Copernicus services and Copernicus use	- Extrapolation of Copernicus Data Access Data Warehouse requirements - Direct discussions with Copernicus services and EU Agencies (e.g. EMSA)
National services and use by ESA and EU Member States	- Discussions with Member States Delegations - Reply to Collaborative Ground Segment questionnaire (in the framework of the GOCG)
Scientific use, on-going projects, continuity of ERS/ENVISAT	- Recommendations from scientists at key SAR workshops (FRINGE, SEASAR), and others ESA organised workshop (e.g. SEN4SCI, Cryosphere, Int. Forum on Geohazards, etc.) - ESA GSE Projects (e.g. Polar View, MARISS, Terrafirma, GMFS, etc.) - Glob-series projects, CCI, SEOM, etc. - Extrapolation of ERS/ENVISAT projects
International Initiatives, International cooperation	- GEO/CEOS (e.g. GFOI, GEOGLAM, Geo-hazard Supersites), IGOS, FAO, REDD+, PSTG, IICWG, GCOS, CliC, TIGER, DRAGON, etc. - Requests from international partners (e.g. US (NOAA / NASA / USGS), Australia, China, etc.)
Other use including use for commercial value-adding	EARSC, etc.

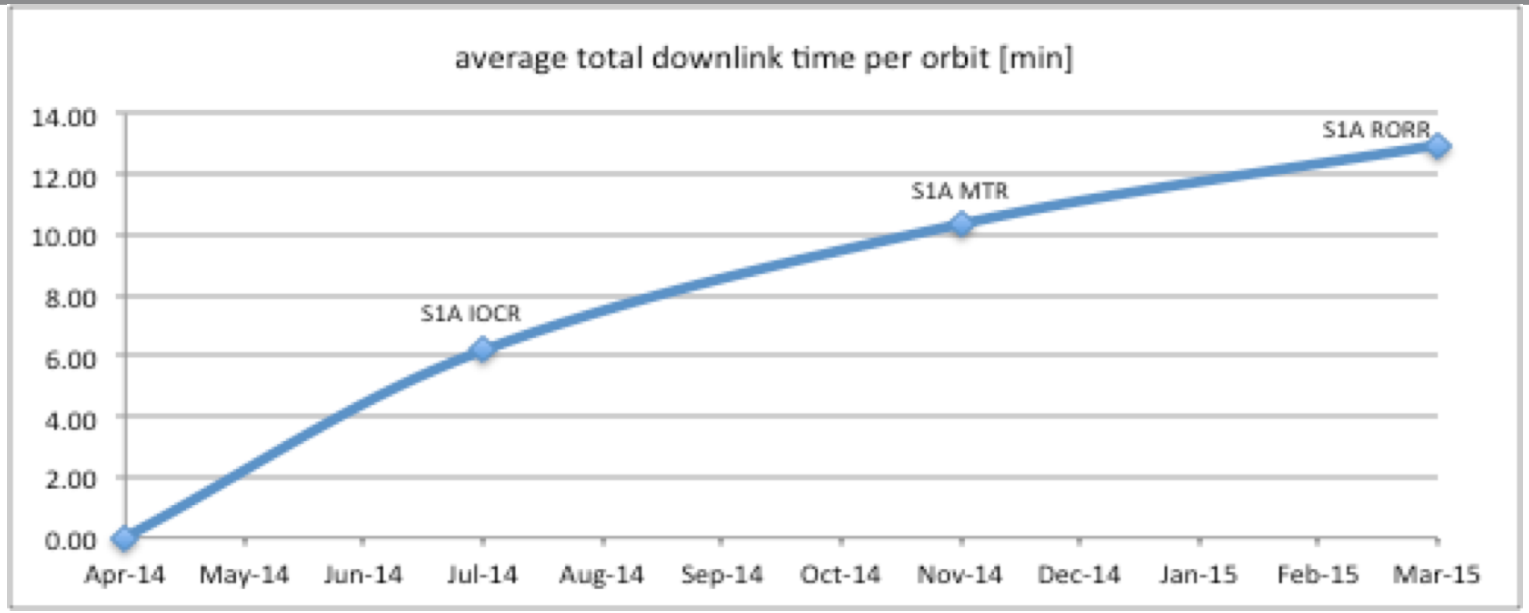
SENTINEL-1 MISSION RAMP-UP

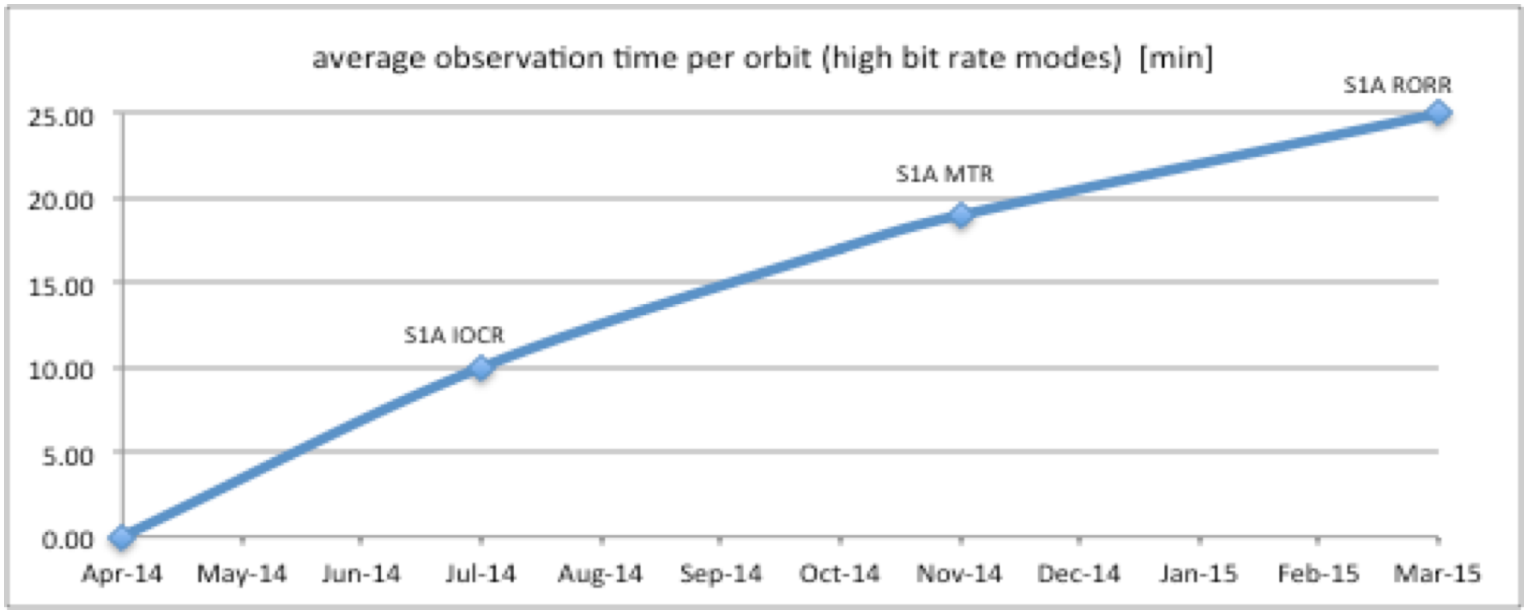
Sentinel-1 mission operations is characterized by phases:

- **A gradual ramp-up** allowing adapting the Sentinel-1 exploitation capacity to the increasing needs of the users while optimizing the available resources
- **Progressive evolution** in the availability of the overall system, the data throughput and timeliness, the committed services to users



Sentinel-1 gradual capacity increase: data download & sensing time





GFOI Request to Sentinel-1

- **Dual-pol IW mode: VV/HV**
- **Consistent and systematic acquisitions**
- **Simulate coverage 4 times a year**

- **Acquire tectonic data sets in the tropics with dual–pol, e.g. Latin America**

- **Prioritize areas with heavy cloud coverage**

- **High interest by some countries for early detection of forest disturbances – "Early Warning" – with frequent coverage need.**

GFOI Input to Sentinel-1 HLOP

Latin America:

- Southern Mexico
- **Ecuador** (new input after SDCG-4)
- **Colombia** (whole, Pacific region, Amazon region more frequent ~ monthly)
- **Peru**
- **Xingu (Brazil)** - continuation of Envisat observations as development test bed

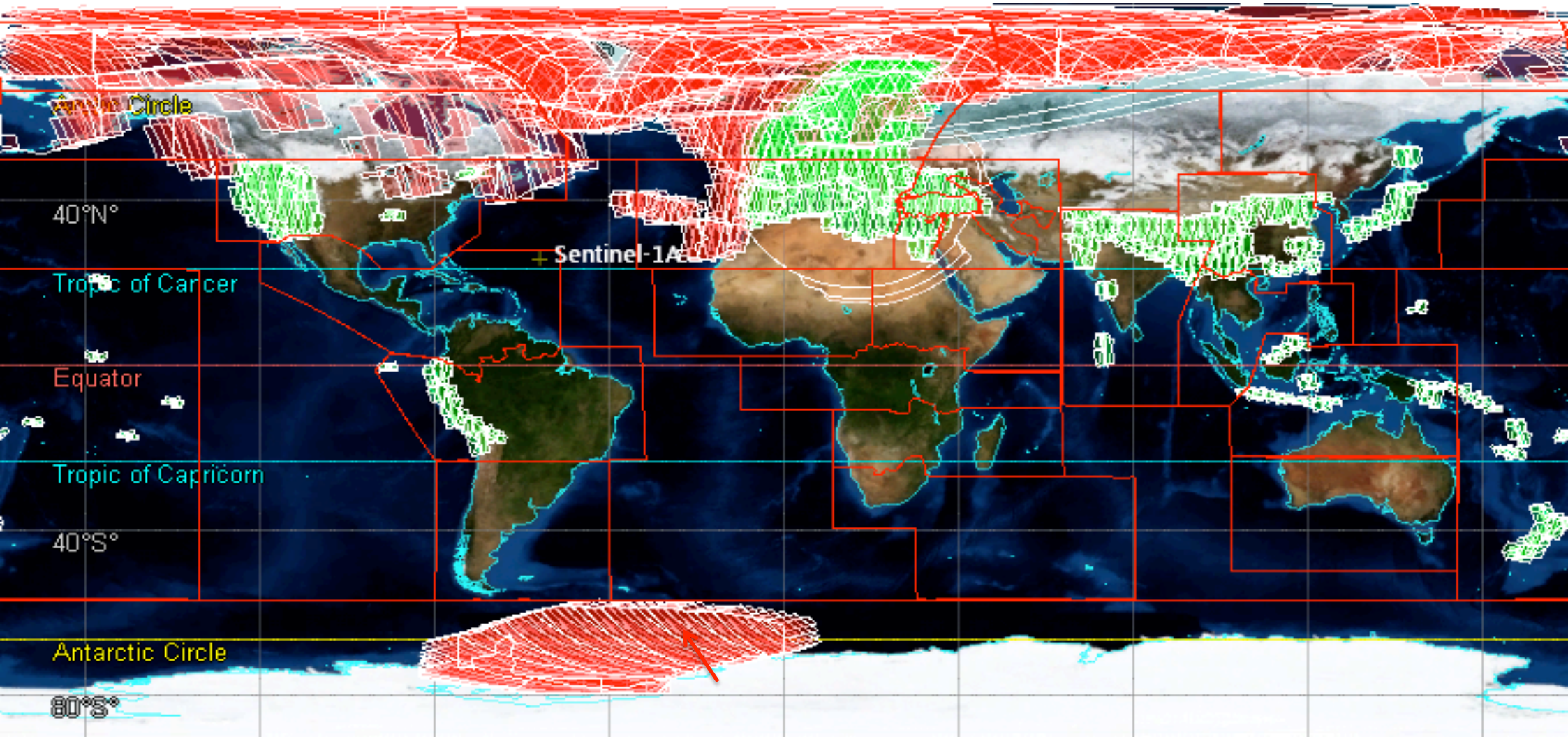
Africa:

- a larger part of **Tanzania** (whole, with preference west and / or south)
- any part in the Congo Basin (**Cameroon, DRC,** Rep of Congo, Gabon, ...)

Asia:

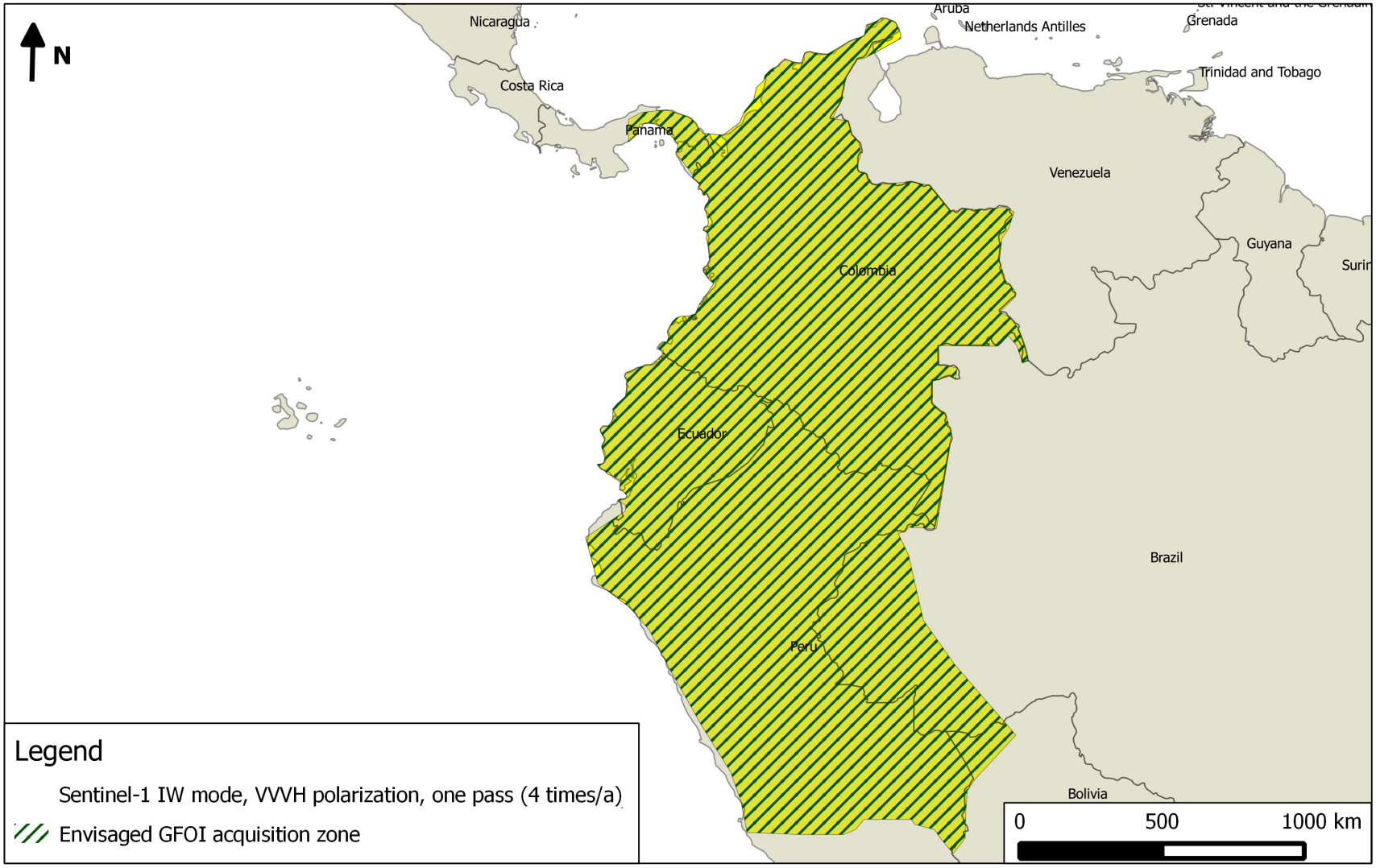
- Indonesia (**Sumatra**, best whole, but also **Western** / Eastern half of the island, otherwise/and parts of **Borneo**)
- Mekong area with **Viet Nam, Cambodia,** ...

Indicative observations plan for cycles 1 and 2 after IOCR_Acquisitions over 1 repeat cycle

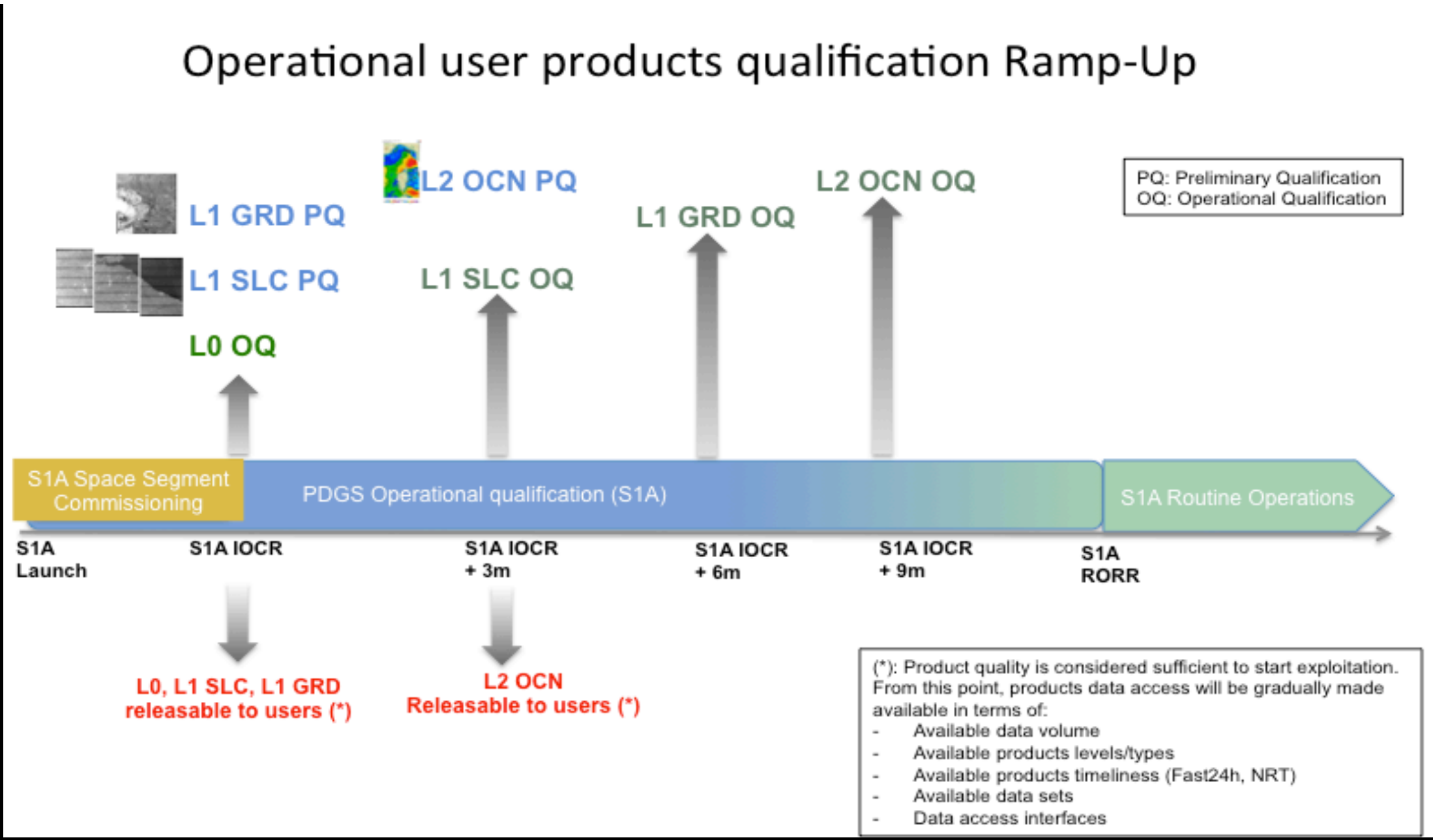


Sentinel-1 Acquisitions related to GFOI during ramp-up phase in South America

Sentinel-1 GFOI related acquisition zone in South America during the ramp up phase



Gradual provision of qualified products



Summary

- **Launch of Sentinel-1A: 3 April 2014**
- **3 months commissioning phase (➔ 10% duty cycle)**
- **9 months ramp-up phase (➔ 25% duty cycle)**

- **Priority for Copernicus and National services (ESA and EU)**
- **Inclusion for early acquisitions of GFOI requests in Latin America and South East Asia during ramp-up phase**
- **More difficult for Africa**

- **Gradual provision of Sentinel-1 products to users after commissioning phase**