

GFOI-SDCG-9 / SENTINEL-1A

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25/02/2016

Issue/Revision: .

Reference:

Status:

ESA UNCLASSIFIED - For Official Use

1. Sentinel-1 observation scenario
2. Review of GFOI recommendations for Sentinel-1A
3. Sentinel-1A country spotlights
4. Sentinel-1 observation scenario evolution

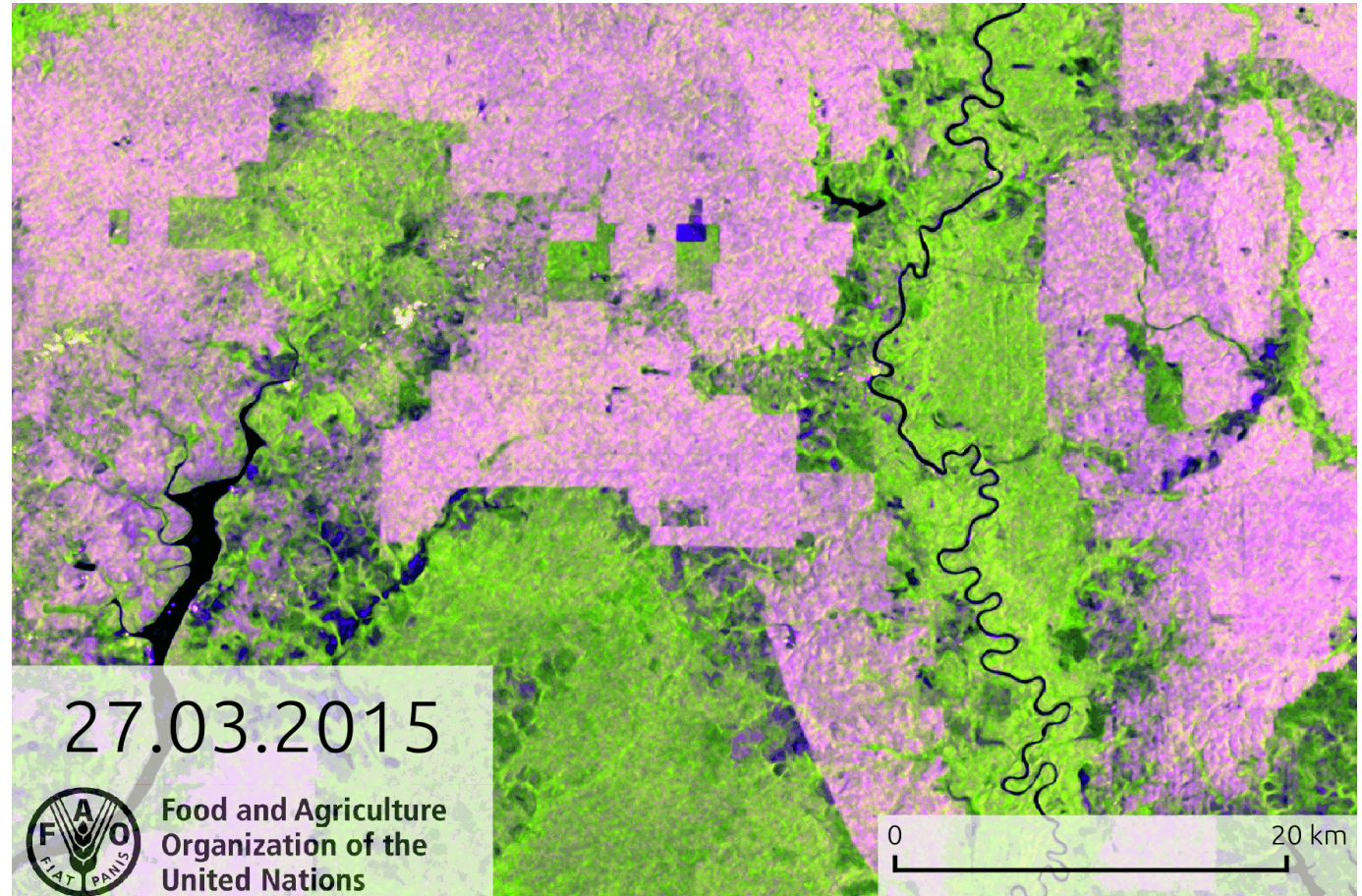
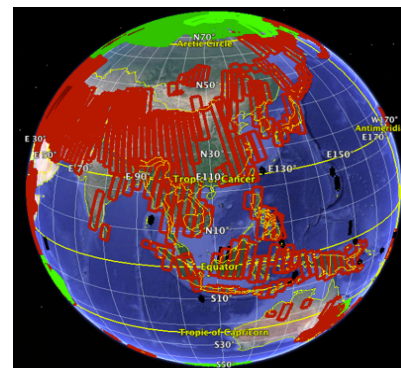
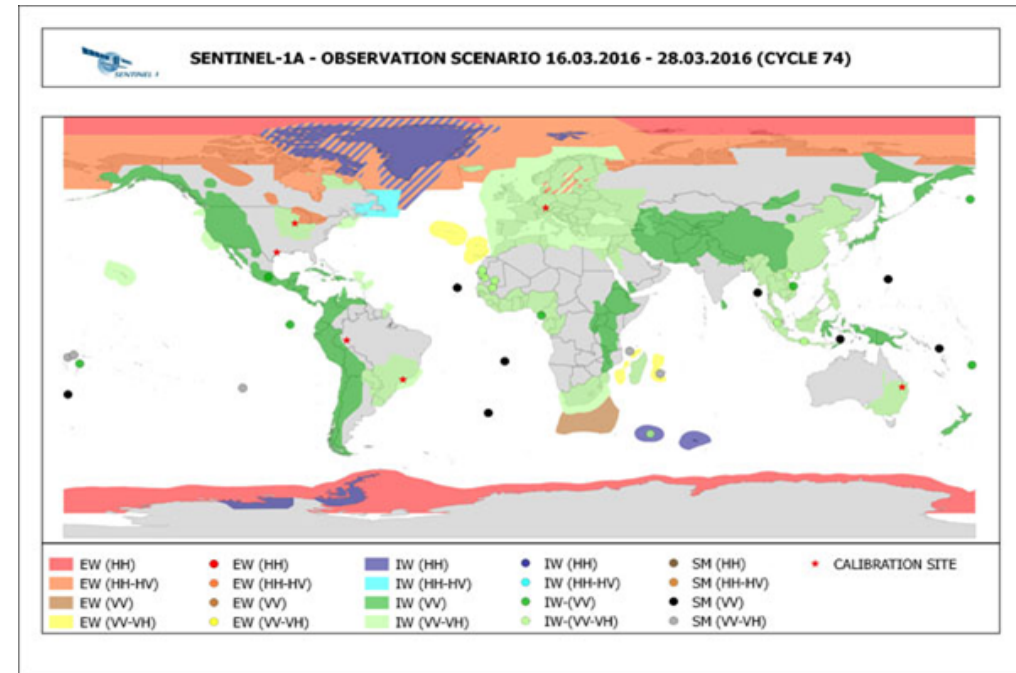


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SENTINEL-1 OBSERVATION SCENARIO



- The Sentinel High Level Operations Plan (HLOP) is part of the Copernicus Space Component (CSC) **system technical baseline** defined in the EU – ESA Copernicus Agreement
- The HLOP **provides the top level operations plan** of all Sentinel missions, including space and ground segment activities
- The HLOP includes in specific Annexes the high level description of the Sentinel observation scenarios
- **Regular updates of the Sentinel HLOP** are foreseen based on a specific revision process defined in the document itself

The HLOP describes a priority scheme, which is based on the Copernicus Regulation, the GSC Programme Declaration, and the EU-ESA Copernicus Agreement

→ It is used for managing the potential conflicting user needs for accessing Sentinel missions' resources

The following priorities, in descending order, are defined:

1 - Copernicus service use

Copernicus service providers, responding to the Copernicus governance, consisting of all “Copernicus services” approved by the European Commission

2 - National utilisation by Participating States in accordance with the Copernicus Regulation and the **GMES Space Component Programme Declaration** and by the following **EU institutions**: European Parliament, European Council, Council of European Union, European Commission, European External Action Service (EEAS)

3 - Other use

Cooperation agreements between EU and **international partners** and **initiatives (e.g. GFOI), scientific use, other use**

Sentinel-1 observation scenario

Main components & thematic domains

Agriculture

European coverage

Forestry

Calibration/validation



Maritime surveillance

Zonal mapping



Emergency


Tectonic active areas and volcanoes / landslides and subsidence

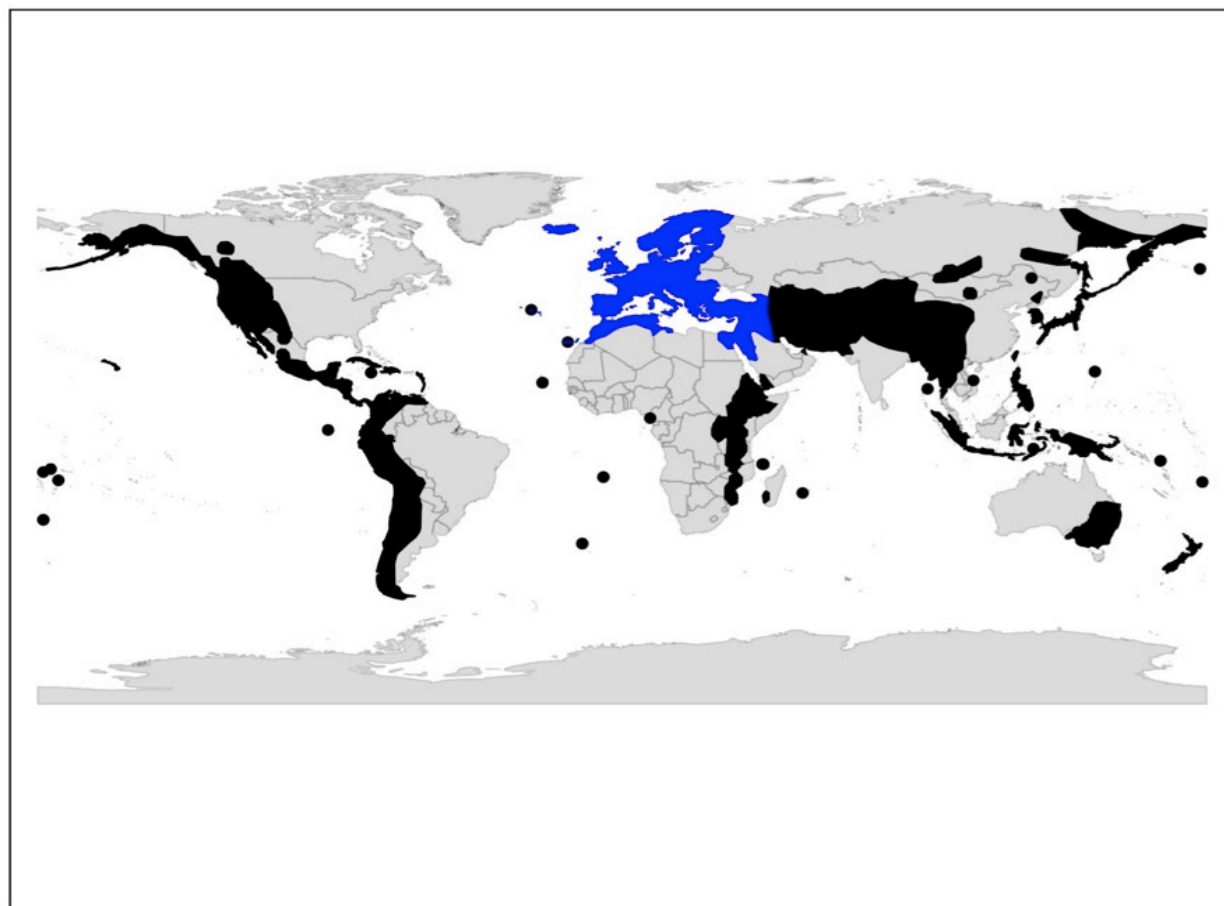
Security

Sea state

Sea-ice, icebergs, lake-ice

Ice sheets, glaciers, permafrost and snow

 **SENTINEL-1A - Tectonic active areas and volcanoes / subsidence and landslides**



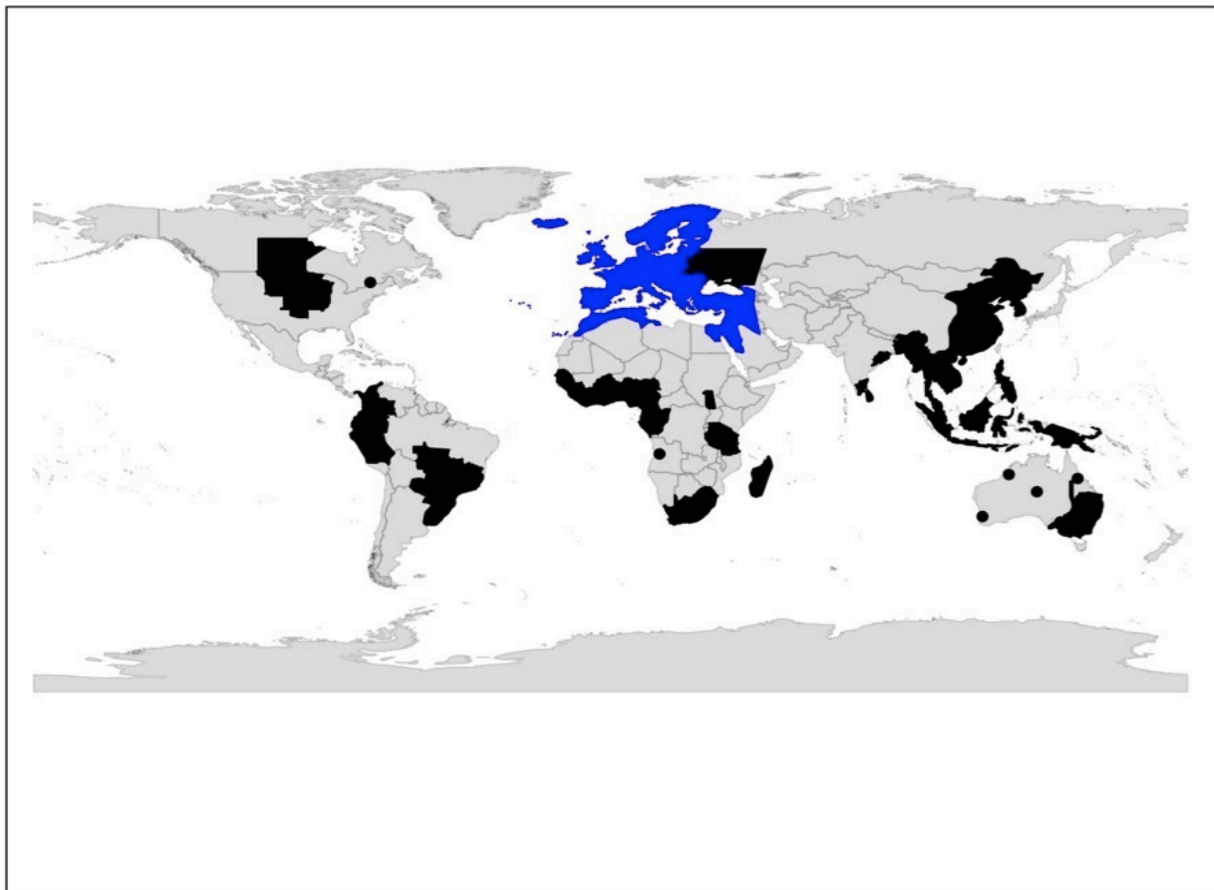
- **BLUE:** Acquisitions in IW mode, VV +VH polarisation, every 12 days ascending and descending
- **BLACK:** Acquisitions in IW mode, VV polarisation, every 24 days ascending and descending, alternating asc and desc passes every 12 days (i.e. repeat on the same track every 24 days)
- **Stripmap mode (SM)** acquisitions over selected small volcanic islands
- Increased sampling density over supersites outside Europe
- About one third of global landmass covered regularly under this frame

Sentinel-1 observation scenario

Agriculture, Forestry and Soil Moisture

priority areas

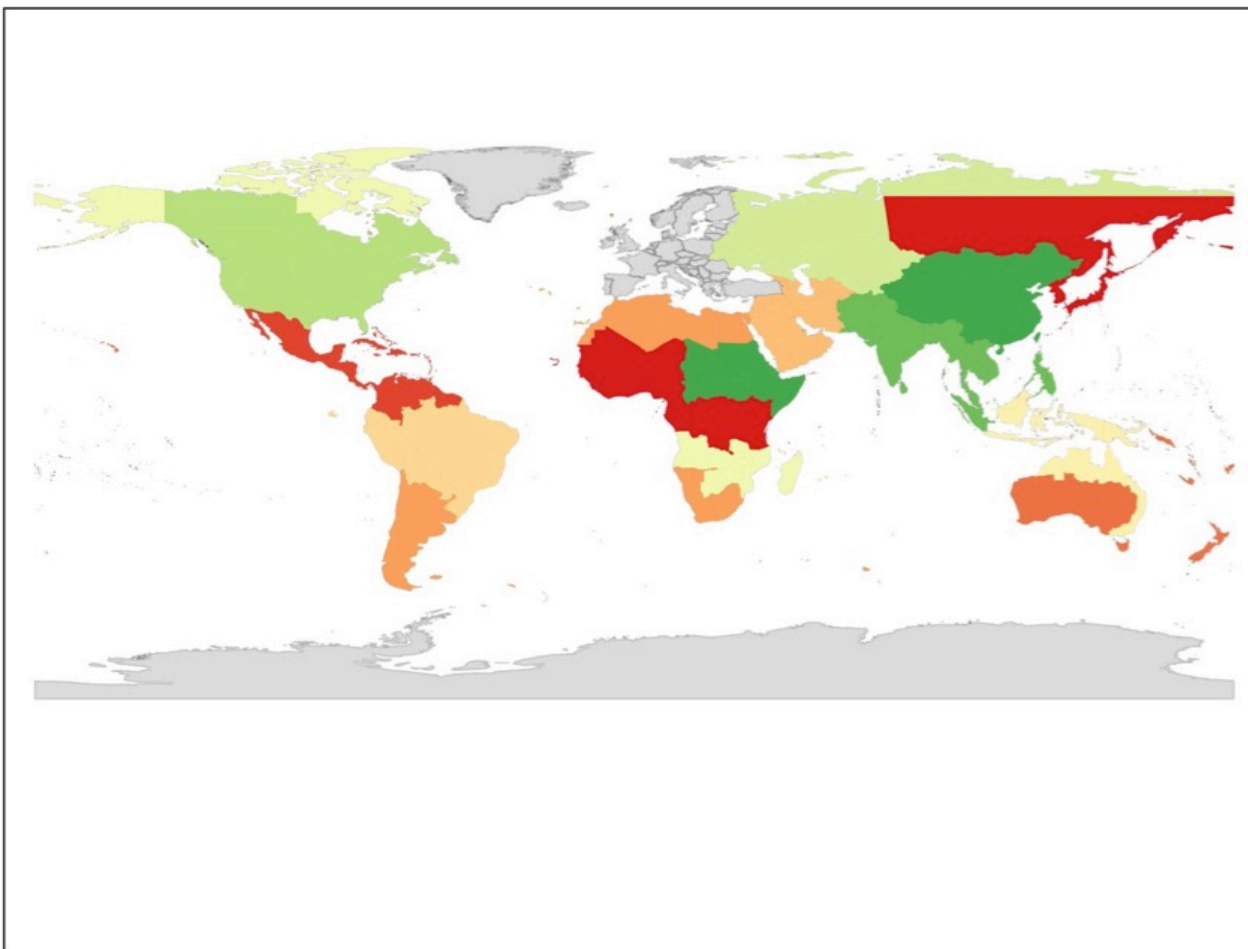
 **SENTINEL-1A - Agriculture / Forestry**



- **BLUE:** Acquisitions in IW mode, VV+VH polarisation, every 12 days ascending and descending
- **BLACK:** Acquisitions in IW mode, VV+VH polarisation, every 12 days in one pass
 - Repeat over parts of SE-Asia IW VV+VH currently every 24 days, plus complementary acquisitions in IW VV
 - North Andes and Tanzania covered with lower frequency (dedicated campaigns for forestry monitoring)
- **Agriculture focus:** mainly based on requirements from
 - wet rice crop monitoring (e.g. GEOGLAM)
 - soil moisture retrieval
- **Forestry focus:** mainly based on requirements from
 - GFOI
 - regions with high risk for illegal logging
 - Mostly cloudy tropical rainforests



SENTINEL-1A - Zonal mapping



- IW mode, VV+VH polarisation, one pass
- Acquisitions following a zonal approach, prime acquisition windows prevailing regional dry season conditions
- Continuous acquisition zones (e.g. Tectonic active areas) become upgraded to dual polarisation whenever they fall into a regional zonal acquisition window
- Revisit per zone **several times a year**
- Main driver: emergency reference mapping, low frequency global applications (e.g. forest mapping, land use, urban area mapping...)

Sentinel-1 Available GRD Products (Density Map - IW mode only)



SENTINEL-1A - GLOBAL PRODUCT OFFER AT SCIHUB (IW mode / all polarisations / GRDH product)
(S1 products acquired in other modes than IW [esp. EW] are not shown in this graphic)

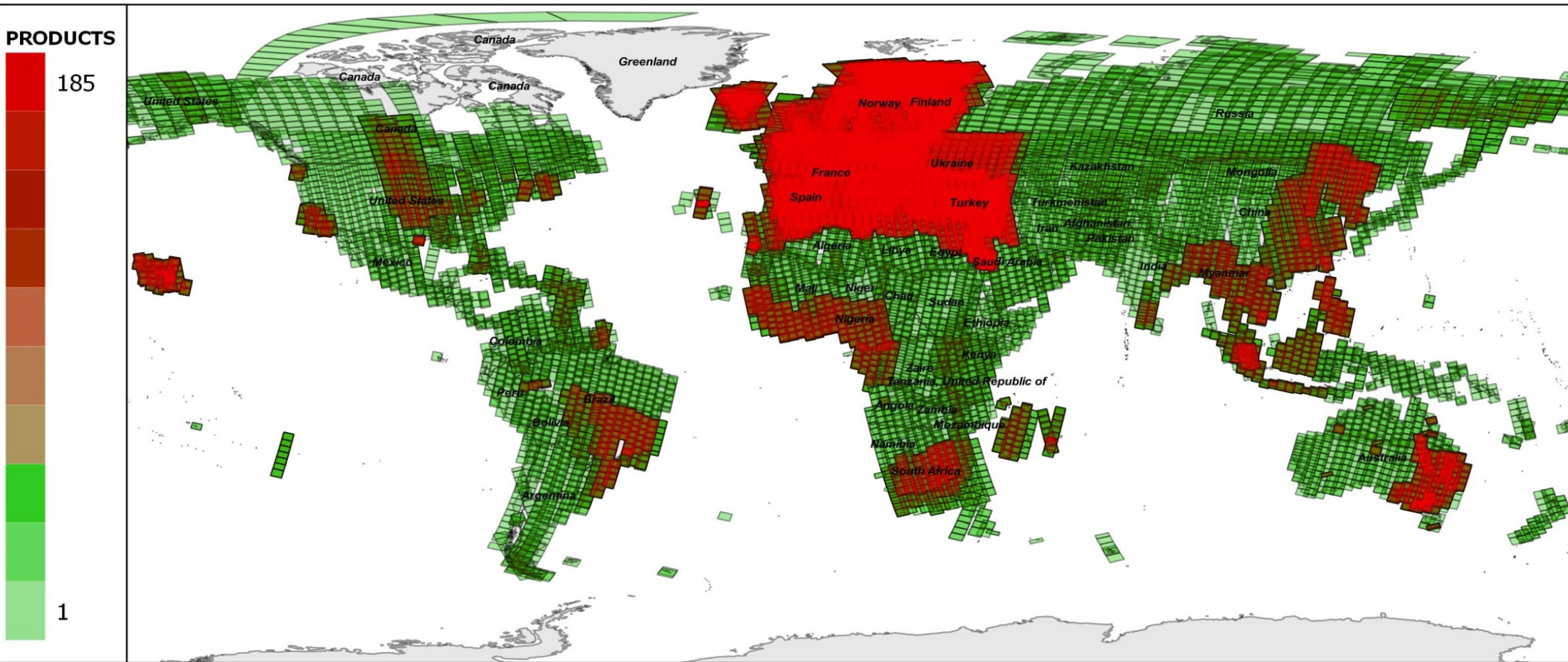


REFERENCE PERIOD: 03.10.2014 - 18.02.2016 | TOTAL OF UNIQUE PRODUCTS: > 121 000

Sentinel-1 Available GRD Products (Density Map - IW mode only)



SENTINEL-1A - GLOBAL PRODUCT OFFER AT SCIHUB (IW mode / DV polarisation / GRDH product)
 (S1 products acquired in other modes than IW [esp. EW] are not shown in this graphic)



REFERENCE PERIOD: 03.10.2014 - 18.02.2016 | TOTAL OF UNIQUE PRODUCTS: > 60 500

REVIEW OF GFOI RECOMMENDATIONS FOR SENTINEL-1A

Review of GFOI recommendations for S1A (pre-launch) ; meeting at ESA working group level with GFOI representatives 24.12.2013:

- Besides general mission recommendations for C-band SAR and forestry applications, regional prioritised focus areas have been outlined by GFOI representatives on three continents

➤ Recommendations:

- At least two coverage during the ramp up phase
- At least four coverage per year during early operations
- Coverage in IW mode, VV-VH polarisation from the same passes/tracks

South America:

- Colombia
- Ecuador
- Peru



(during ramp up refined to NE of Loreto province (PE) + Central Colombia)

(during ramp up Roraima + Tapajos sites [BR] added)

Africa:

- Tanzania

Asia:

- Vietnam

➤ Dedicated forestry reference data site

- Sumatra (Riau province)
- Local continuous high-frequency sampling in IW-DV from t_0 onwards

➤ **“S1A observation goal”: 4 coverage / year**

GFOI recommendations for Sentinel-1A (early operations 2015)

	Month	SE-Asia	Completeness	Coverage achieved	E-Africa	Completeness	Coverages achieved	S-America				Completeness	Coverage achieved		
		(Vietnam)	% of country surface covered by GRD/RAW available at SCIHUB	IW-DV	(Tanzania)	% of country surface covered by GRD/RAW available at SCIHUB	IW-DV	GFOI: (NE-Loreto [PE] /Central Colombia: <u>Zonal mapping</u> : Wall-to-wall	Colombia	Ecuador	Peru	% of country surface covered by GRD/RAW available at SCIHUB	IW-DV		
S1A operations ramp up phase	Oct-14			3+			2								
	Nov-14														
	Dec-14				1st zonal mapping (A)	100			1st GFOI coverage	Central Colombia	-	NE-Loreto	100		
	Jan-15														
	Feb-15	24d repeat	99.9												
	Mar-15	24d repeat	98.25												
	Apr-15	24d repeat	71.9			1st GFOI-Coverage(A)		84.8							
	May-15	24d repeat	99.09							1st zonal mapping	99.98	67.44	90	85.81	
	Jun-15	24d repeat	73.64												
S1A operational phase	Jul-15	24d repeat	99.8	5+			2								
	Aug-15	24d repeat	96.87												
	Sep-15	24d repeat	98.51			2nd GFOI-Coverage(A)		100		2nd GFOI coverage	Central Colombia	-	NE-Loreto	100	
	Oct-15	24d repeat	84.22												
	Nov-15	24d repeat	0.9991												
	Dec-15	24d repeat	99.98			2nd zonal mapping (D)		100		2nd zonal mapping	-	-	-	81.16 (ongoing)	
	Jan-16	24d repeat	99.98									99.98	-		
	Feb-16	24d repeat	95.58									-	78.5 (ongoing)		
	Mar-16									3rd GFOI coverage					

SENTINEL-1A

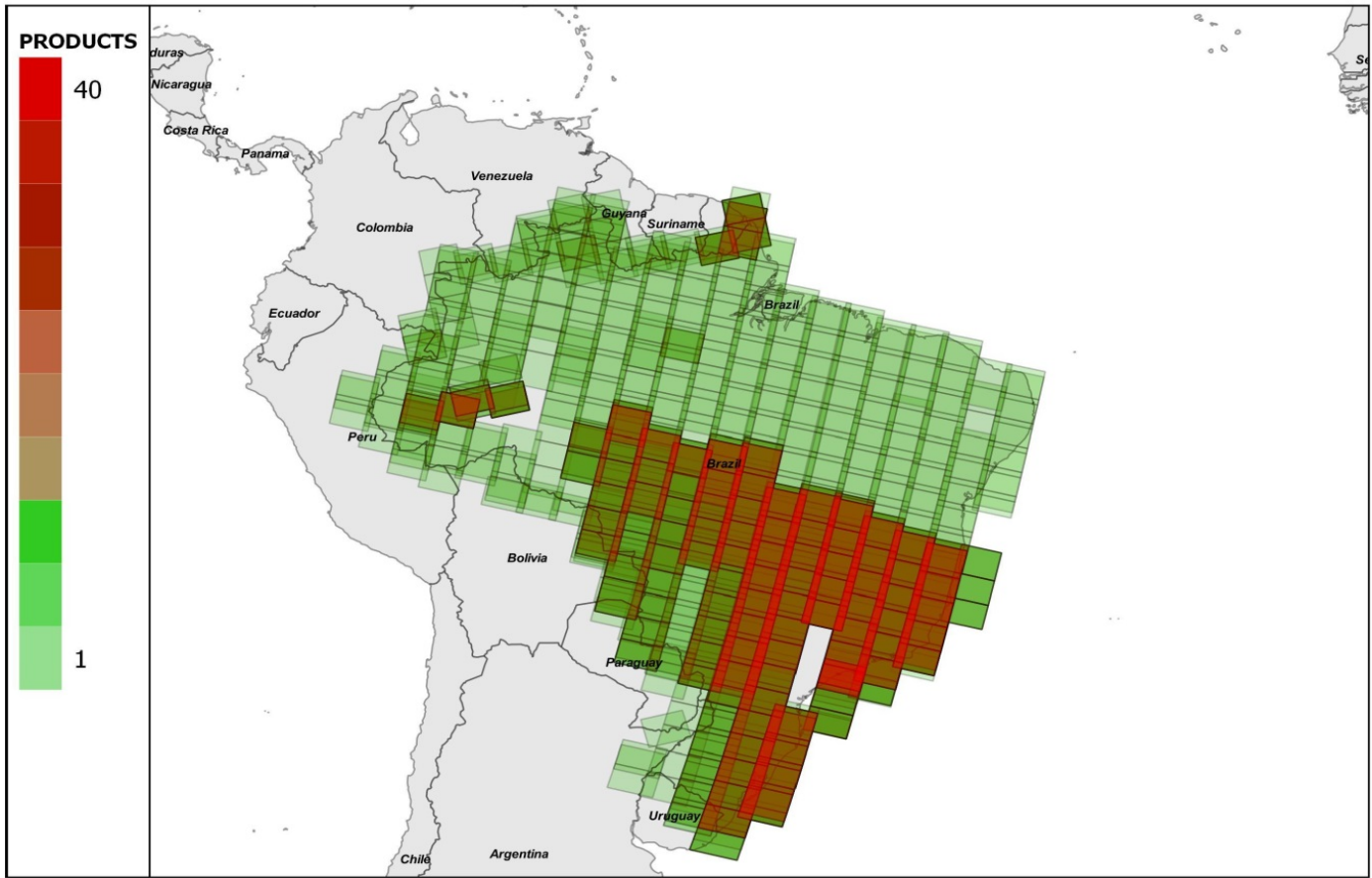
COUNTRY SPOTLIGHTS

	Month	ASIA - Indonesia	
		% of country surface covered by GRD/RAW available at SCIHUB	
S1A operations ramp up phase	Oct-14	18.1	Riau,Sumatra
	Nov-14	24.5	Riau,Sumatra / parts of Java
	Dec-14	25.3	Riau,Sumatra / parts of Java
	Jan-15	18.6	Riau,Sumatra / parts of Java
	Feb-15	28.6	Riau,Sumatra / parts of Java
	Mar-15	73.4	1st zonal mapping
	Apr-15	55.5	Sumatra/Java/Borneo
	May-15	83.8	Sumatra/Java/Borneo + 1st zonal Mapping New Guinea
	Jun-15	46.37	Sumatra/Java/Borneo
S1A operational phase	Jul-15	54.2	Sumatra/Java/Borneo
	Aug-15	40	Sumatra/Java/Borneo
	Sep-15	53.6	Sumatra/Java/Borneo
	Oct-15	41.06	Sumatra/Java/Borneo
	Nov-15	48.12	Sumatra/Java/Borneo
	Dec-15	93.55	2nd zonal mapping
	Jan-16	60.4	Sumatra/Java/Borneo
	Feb-16	51.8	Sumatra/Java/Borneo

Indonesia:

- Gradual increase of IW-DV acquisitions; actually > 50 % of the country covered (24d repeat; prevailing pass DSC)
- In addition: Two countrywide coverages completed
- Additional routine acquisitions in IW-SV (tectonic monitoring)

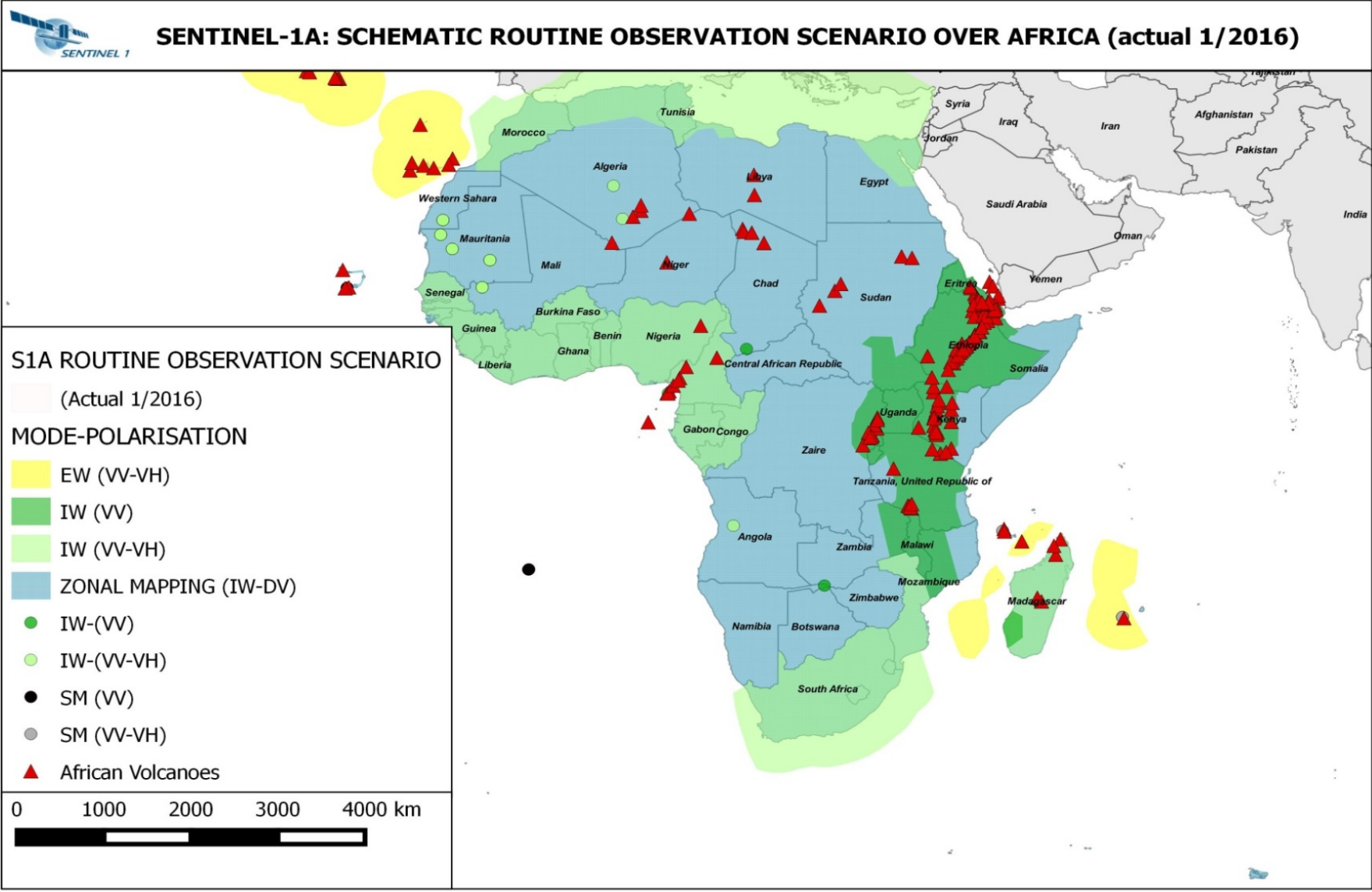
 **SENTINEL-1A - GLOBAL PRODUCT OFFER AT SCIHUB (IW mode / DV polarisation / GRDH product)**



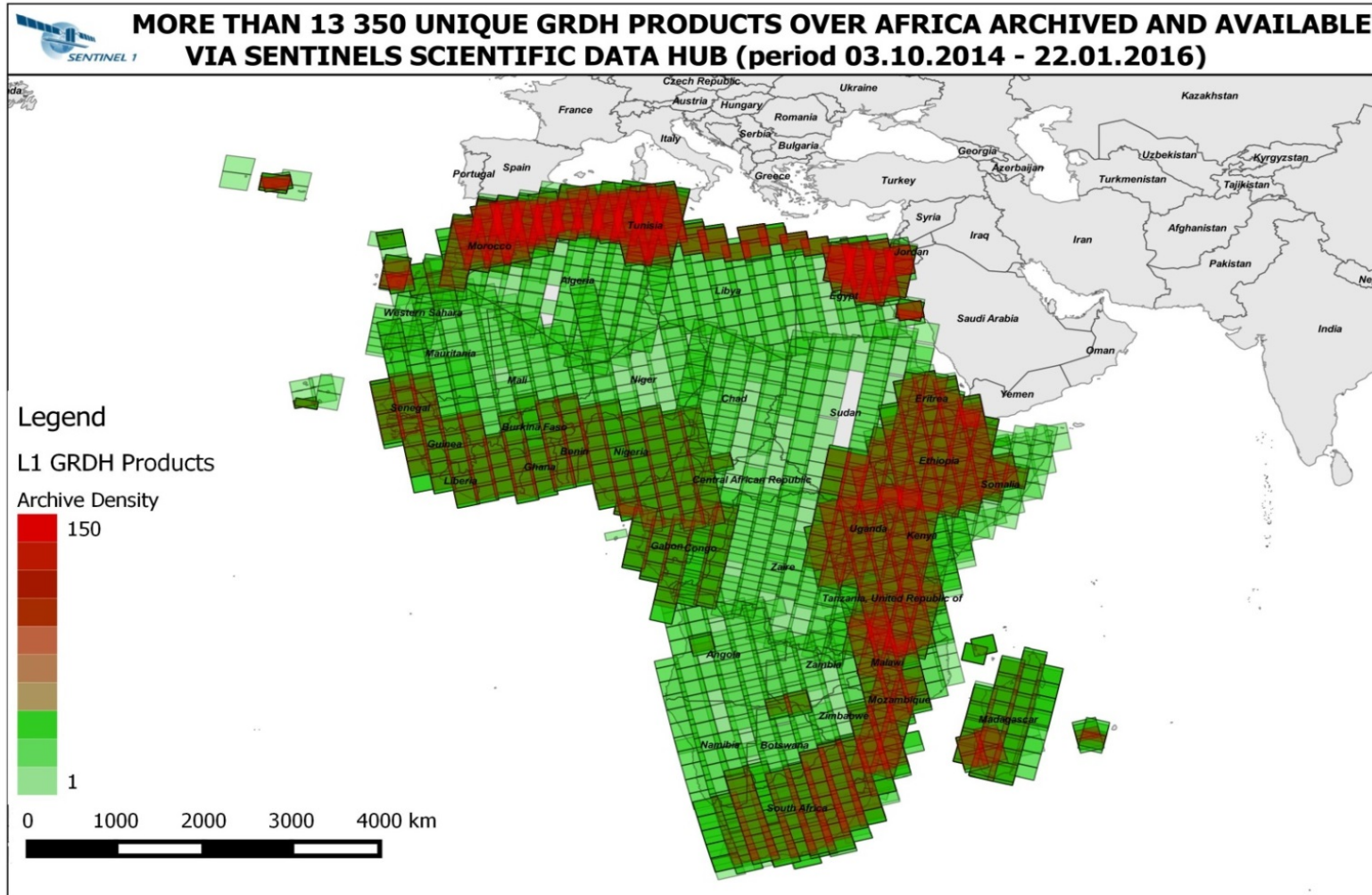
REFERENCE PERIOD: 03.10.2014 - 19.02.2016 | TOTAL OF UNIQUE PRODUCTS: > 2100

Brazil:

- Southern Brazil: Routine IW-DV acquisitions over soil moisture/agriculture priority area (12-24d repeat; prevailing pass DSC)
- In addition: Two countrywide IW-DV coverages (5/2015 and 1/2016)
- Additional routine acquisitions for sensor validation purposes in various modes (Amazonas)
- GFOI test - beds (Roraima + Tapajos)
- Agreed support for dedicated IBAMA & INPE activities



➤ ~ 65 % of the acquisitions over Africa performed in dual polarisation (VV-VH); main part of routine acquisitions over the East African rift valley (~ 35 %) performed in single polarisation (VV).



Kenya:

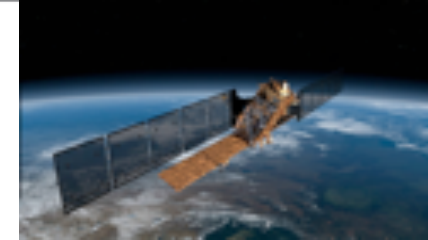
- Four coverage in IW-DV performed in 2015 (ASC);
- ~ 30 coverage (IW-SV) over W-Kenya (resulting from tectonics & volcano monitoring)

Cameroon:

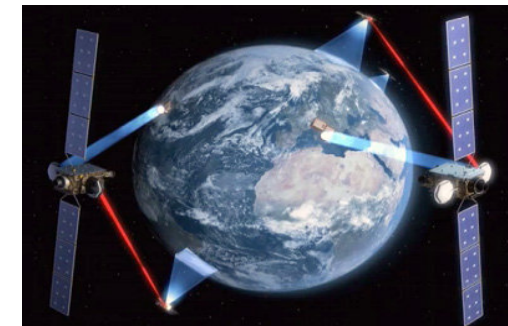
- ~20 coverage in IW-DV in 2015; (>20 coverage foreseen per year in 2016);
- routine IW-DV observations



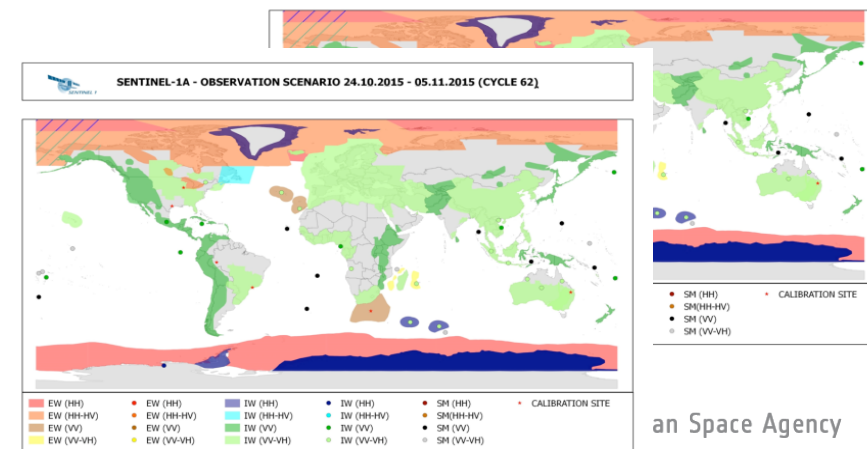
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SENTINEL-1 OBSERVATION SCENARIO EVOLUTIONS



SENTINEL-1A - OBSERVATION SCENARIO 24.10.2015 - 05.11.2015 (CYCLE 62)



- Increase of download capacity:
 - Use of EDRS (European Data Relay System)
 - Use of 4th X-band core station (Inuvik)
- Use of Sentinel-1B, gradually allowing to reach the Full Operations Capacity (FOC) with the constellation
- Evolution of the observation requirements
 - from the Copernicus services (incl. the evolution of the service “perimeter”)
 - National requirements from Copernicus Participating States
 - Other requirements (science, commercial, etc.)
- System constraints, e.g. SAR duty cycle, X-band downlink duration, On-Board Data Management (decoupling sensing from downlink), Mission Planning System further optimisations, etc.
- At a later stage, contribution of (and interoperability with) the Radarsat

➔ The use of Sentinel-1B similarly to Sentinel-1A will basically allow to increase the observations frequency by a factor 2 globally.

In addition, specific strategies will be implemented to increase the global land mapping frequency.

➔ A.o. with elevated relevance for forestry applications:

- Stepwise increase of IW-DV revisit over tropical forest belt foreseen
- Improved coverage of boreal forest zones (also in terms of observation season for dedicated regions)