→ FRINGE 2015 WORKSHOP

Advances in the Science and Applications of SAR Interferometry and Sentinel-1 InSAR Workshop

Sentinel-1 Ground Segment Operations

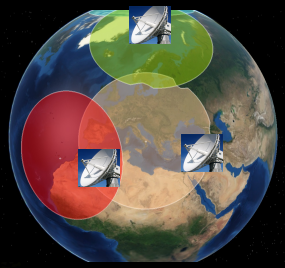
B. Rosich, P. Grimont, E. Monjoux, G. Sabella, F. Lo Zito, G.P. Izzo, M. Sansone, G. Palumbo, N. Houghton. E. Doyle, M. Cao, V. Spaventa, N. Miranda, F. Femenias, J. Martin, G. Vingione, R. Sciarra, S. Tarchini, G. Buscemi, F. Nisi, B. Angelucci, T. Carbone, O. Barois, A. Cavallini, D. Moretti & All PDGS Industry Operations Teams

23–27 March 2015 | ESA–ESRIN | Frascati (Rome), Italy

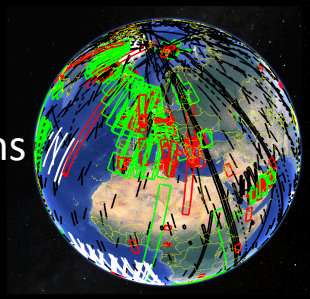
European Space Agency

Presentation outlook

Ground Segment operational qualification status & plans



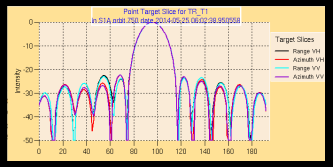
Observation scenario operations status & plans



Production scenario operations status & plans

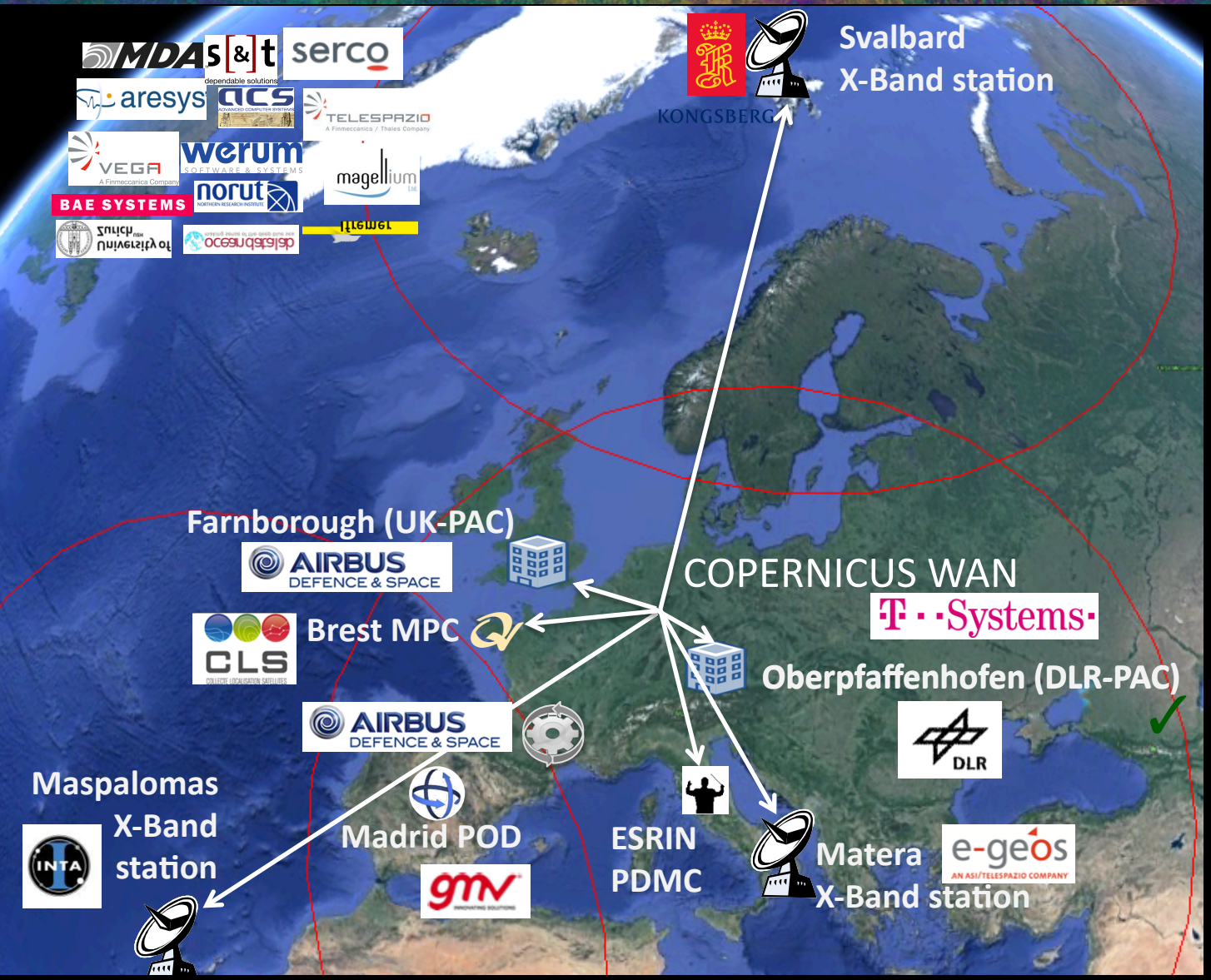
Precise orbit determination operations status and plans

Product qualification operations status & plans



Data access operations status & plans

Sentinel-1 Ground Segment Configuration



Ground Segment Configuration completed since Jan.2015

GS centres and operational services available

Including the Flight Operations Segment (FOS) at ESA-ESOC for the satellite TT&C

Payload Data management Centre (PDMC) | Mission Performance Centre (MC) | Archive and Offline Processing Centre (PAC) | X-Band Stations | Precise Orbit Determination Service

Observation scenario: operations status & Plans

The Sentinel-1 data acquisition is performed according to a systematic & pre-defined instrument observation plan (Long Term Plan, LTP) built according to the identified user needs.

During the operational qualification phase, the observation scenario is being gradually increased, in overall sensing time/coverage/modes/timeliness.

An overview of the observation scenario evolution is available on Sentinel on-line https://sentinel.esa.int/web/sentinel/missions/sentinel-1/**observation-scenario**

Observation scenario: operations status & Plans
Nominal & Emergency planning loop

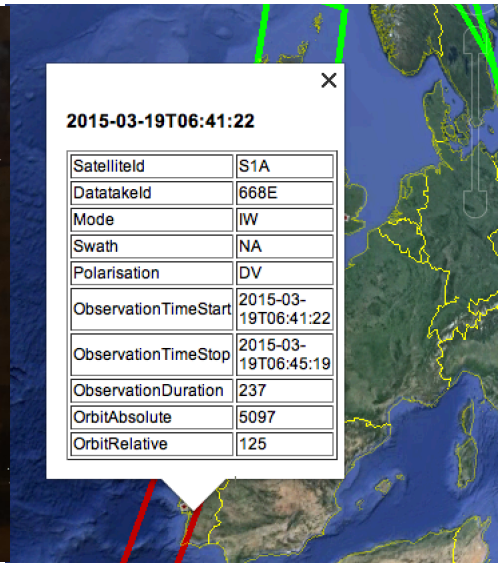
The detailed acquisition plan is available on Sentinel on-line
https://sentinel.esa.int/web/sentinel/missions/sentinel-1/observation-scenario/**acquisition-segments**

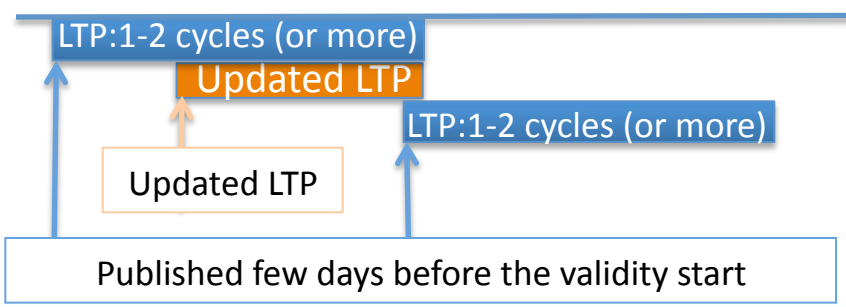
Acquisition Segments

The KML files available on this page provide detailed informatio

KML files available:

- 18 March 2015 - 05 April 2015
- 06 March 2015 - 04 April 2015





S1 operations support emergency activations whenever feasible, modifying the current planning if necessary. A new LTP is published which supersedes the previous one.

Observation scenario: operations status & Plans
Burst synchronisation

Operations Status

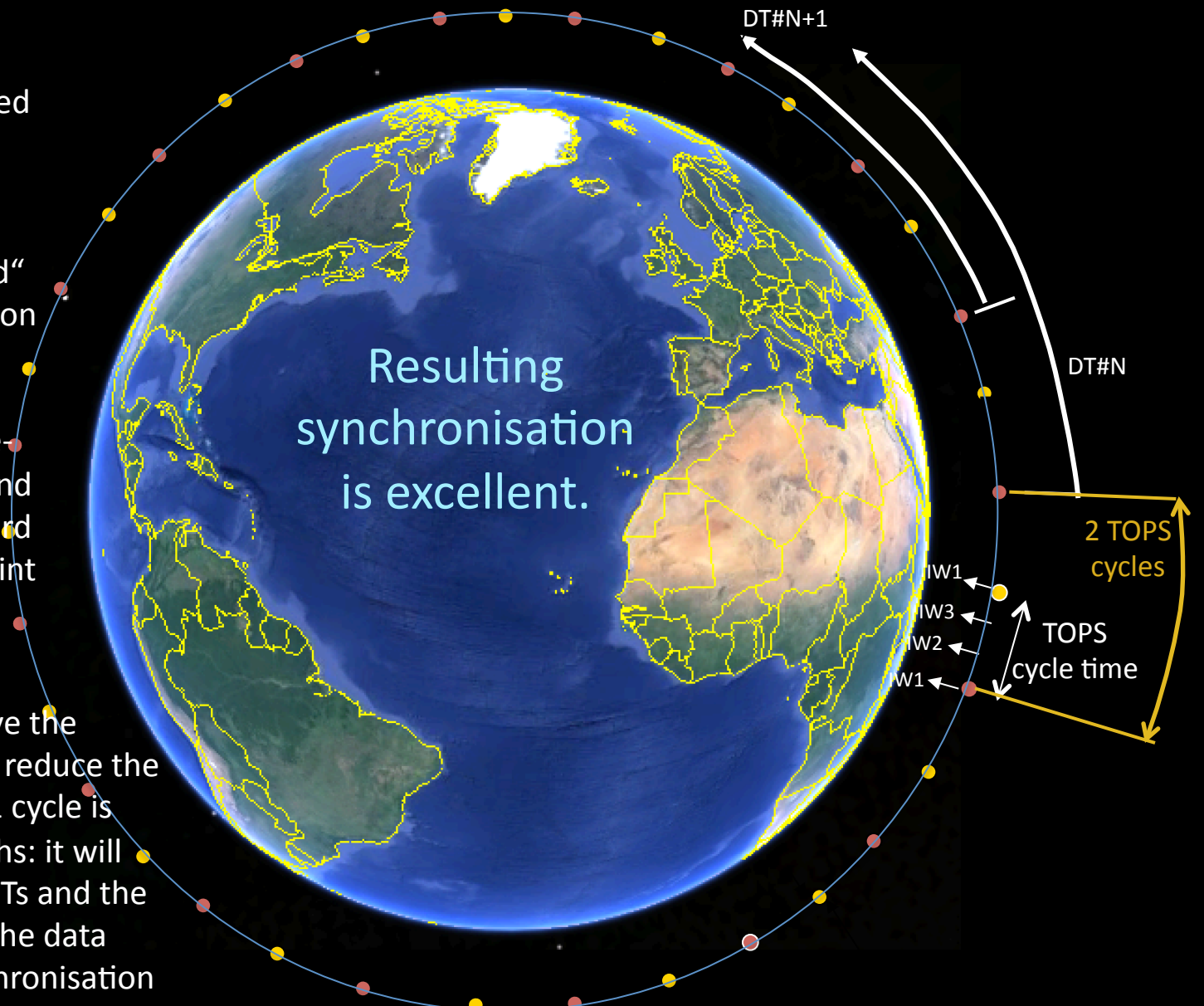
TOPS burst-synchronisation is ensured by the mission planning process.

Data take start is “shifted“ to match a synchronisation tie-point along the orbit

Current separation of tie-points is 2 TOPS cycles and planning is moved forward to match the next tie-point

Operations Plans

An enhancement to move the planning backwards and reduce the tie-points frequency to 1 cycle is planned in the next moths: it will impact the start of the DTs and the location of slices inside the data take. No impact on synchronisation



Production scenario: operations status & Plans

The Sentinel-1 Operations concept is based on a systematic production scenario:

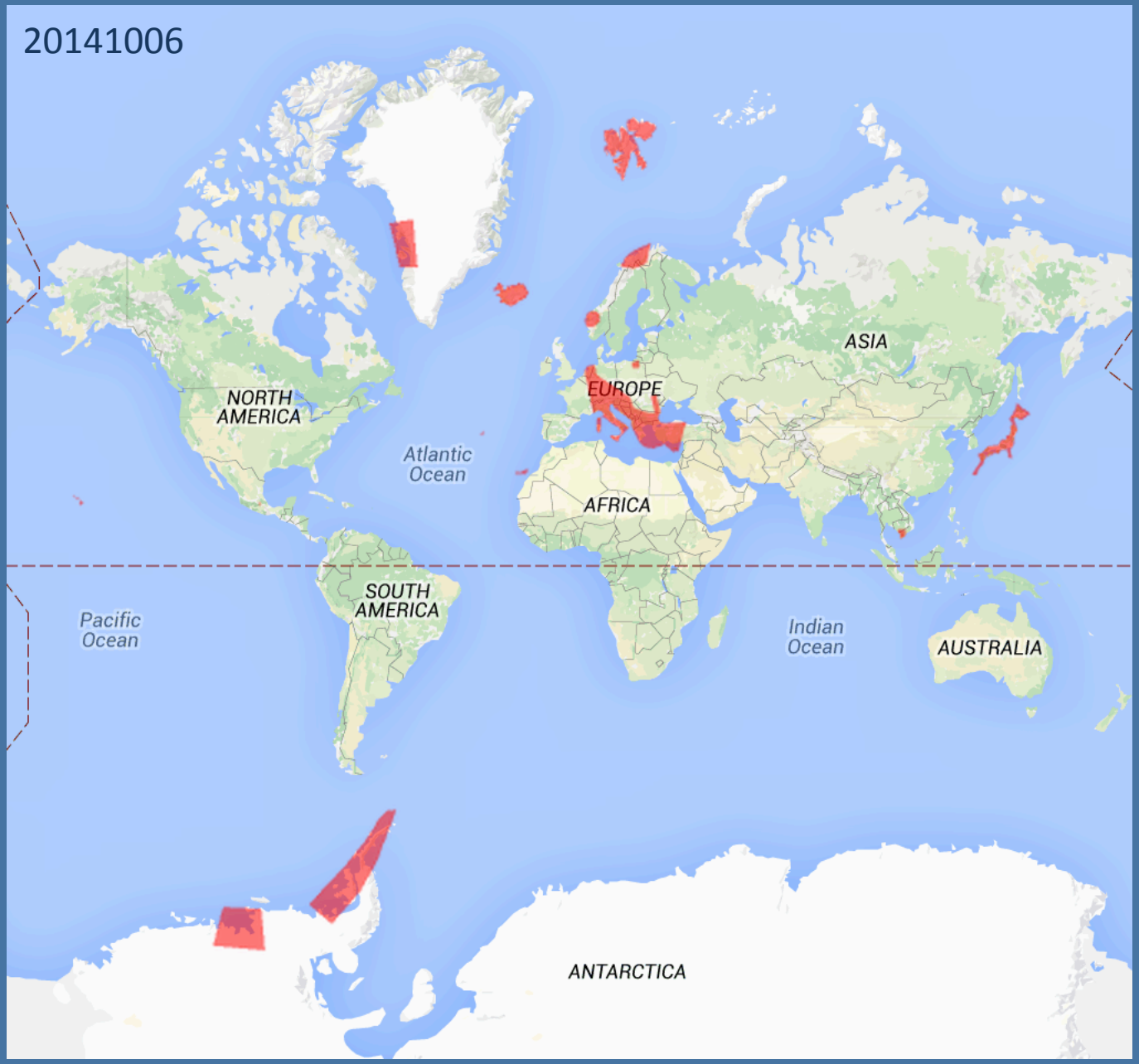
All acquired Sentinel-1 data is processed according to a **data processing scenario**, defining the set of operational user products to be systematically generated over a set of identified geographical areas in one of the possible timeliness in a fully data driven mode.

Operational User Products: Production scenario strategy			
Processing scenario	**Instrument mode**	**Product Type**	**Timeliness**
Systematic Global	**SM** **IW** **EW**	**L0 & L1-GRDH** **L0 & L1-GRDH** **L0 & L1-GRDM**	**Fast-24h**
	WV	L2 OCN	Fast-24 -> NRT
Systematic Regional	**SM,IW,EW**	**L0** **L1 GRD** **L1 SLC** L2 OCN	**NRT, Fast24h**

Global: Applies to all acquired data

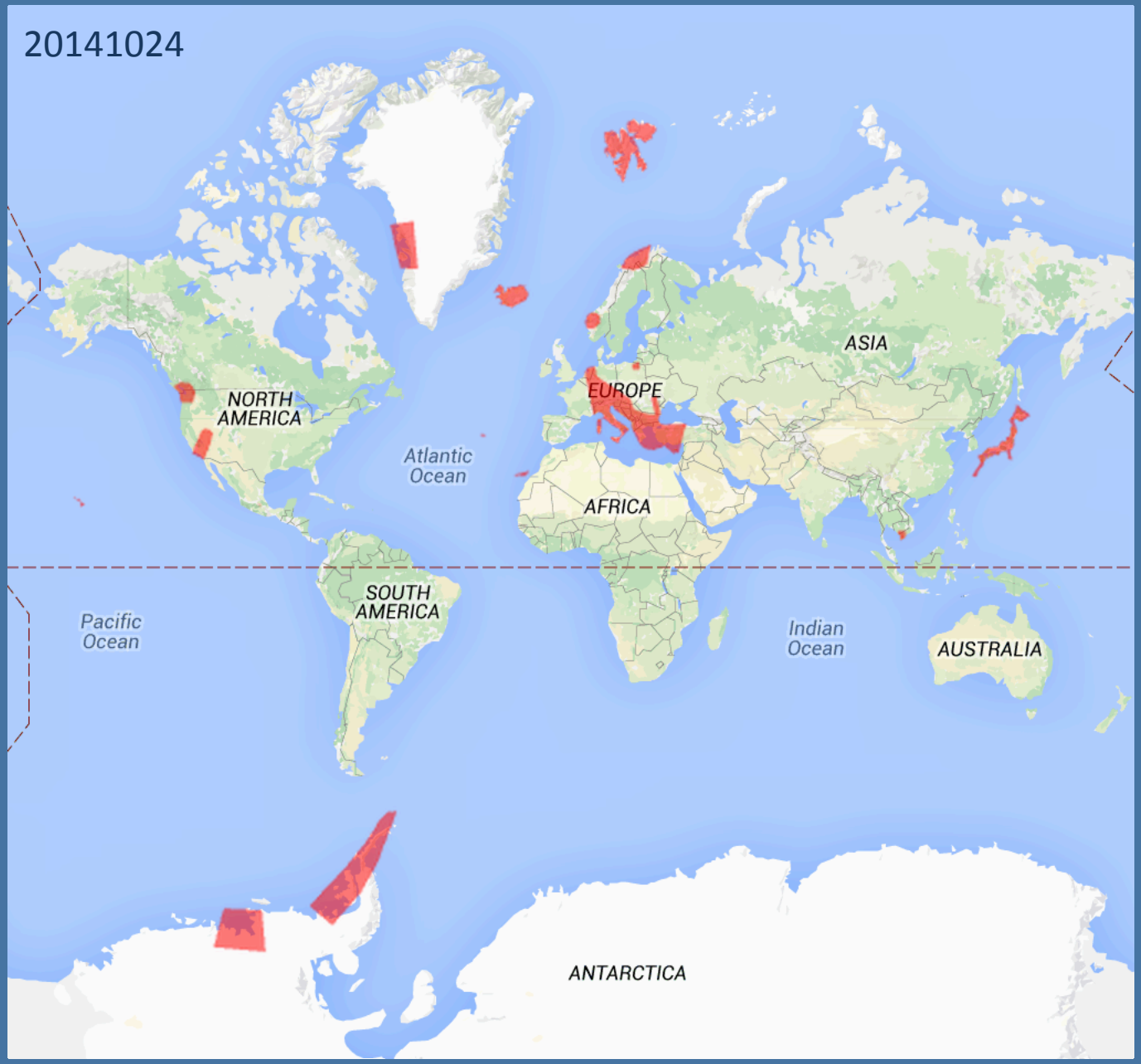
Regional: Applies to data acquired over well defined geographical areas, including areas required in NRT (cf. HLOP)

Sentinel-1 Level-1 IW L1-SLC systematic processing and dissemination areas
Operational Scenario since 2015-10-06



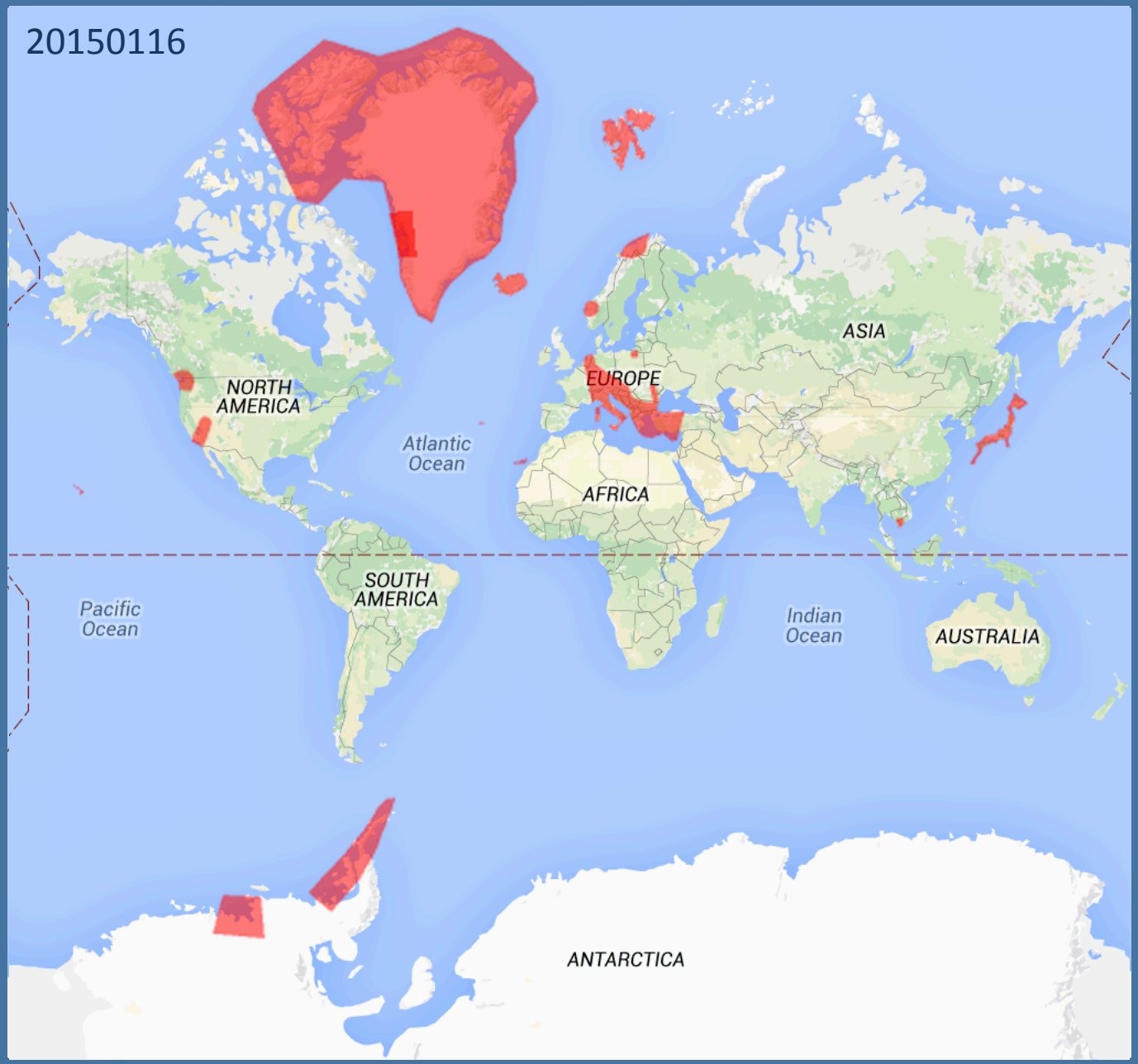
Babiak Poland
Mexico City
Nordes Norway
Norwegian Glaciers
Pine Island
Antarctic Peninsula
Upernavik Glacier
Svalbard
Azores
Canaries
Chad (spot)
Hawaii
Iceland
Japan
Mekong Delta (spot)
South Europe (partial)

Sentinel-1 Level-1 IW L1-SLC systematic processing and dissemination areas
Operational Scenario since 2015-10-24



Babiak Poland
Mexico City
Nordes Norway
Norwegian Glaciers
Pine Island
Antarctic Peninsula
Upernavik Glacier
Svalbard
Azores
Canaries
Chad (spot)
Hawaii
Iceland
Japan
Mekong Delta (spot)
South Europe (partial)
Las Angeles
Vancouver/Seattle

Sentinel-1 Level-1 IW L1-SLC systematic processing and dissemination areas
Operational Scenario since 2015-01-16



Babiak Poland
Mexico City
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Antarctic Peninsula
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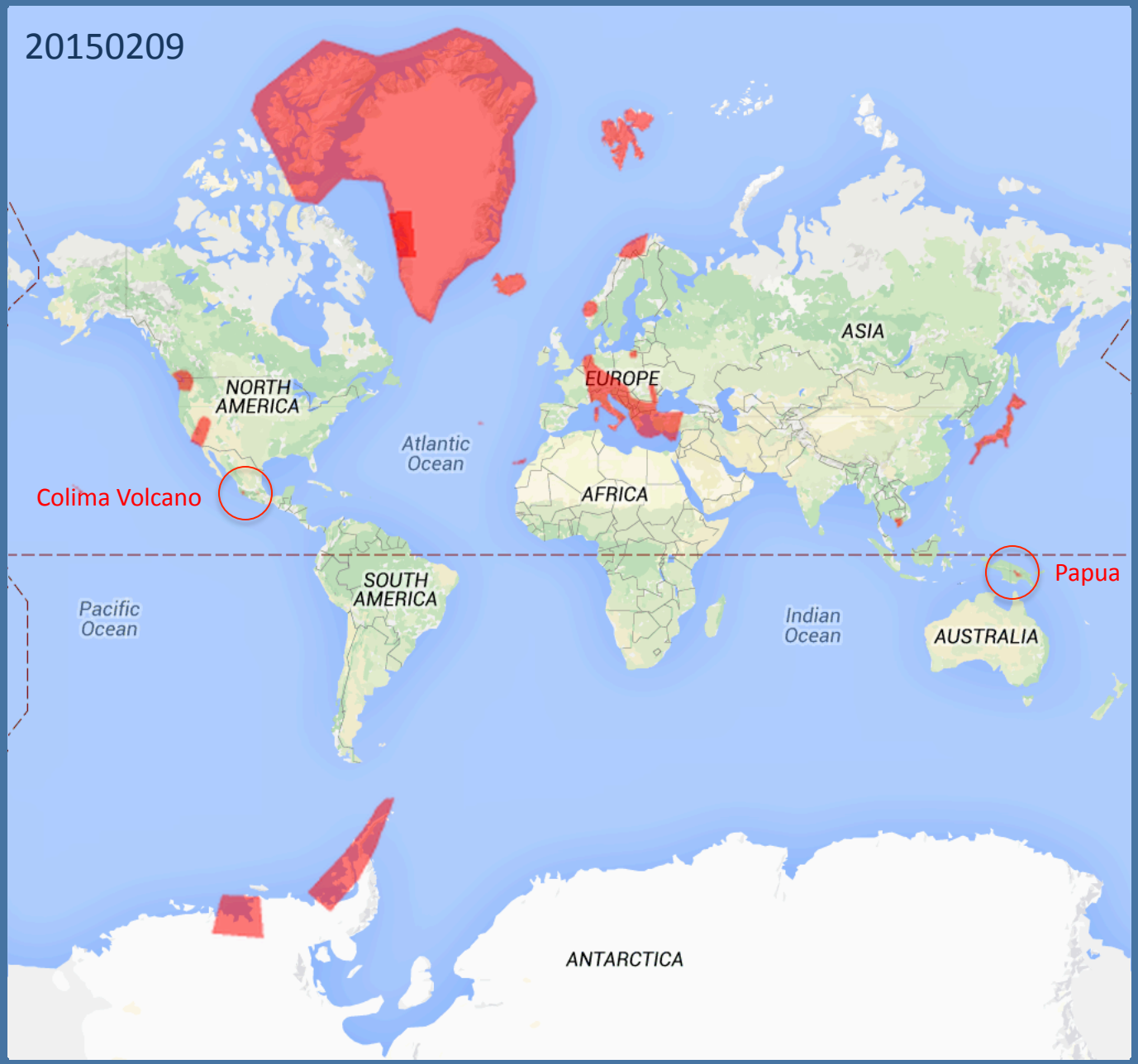
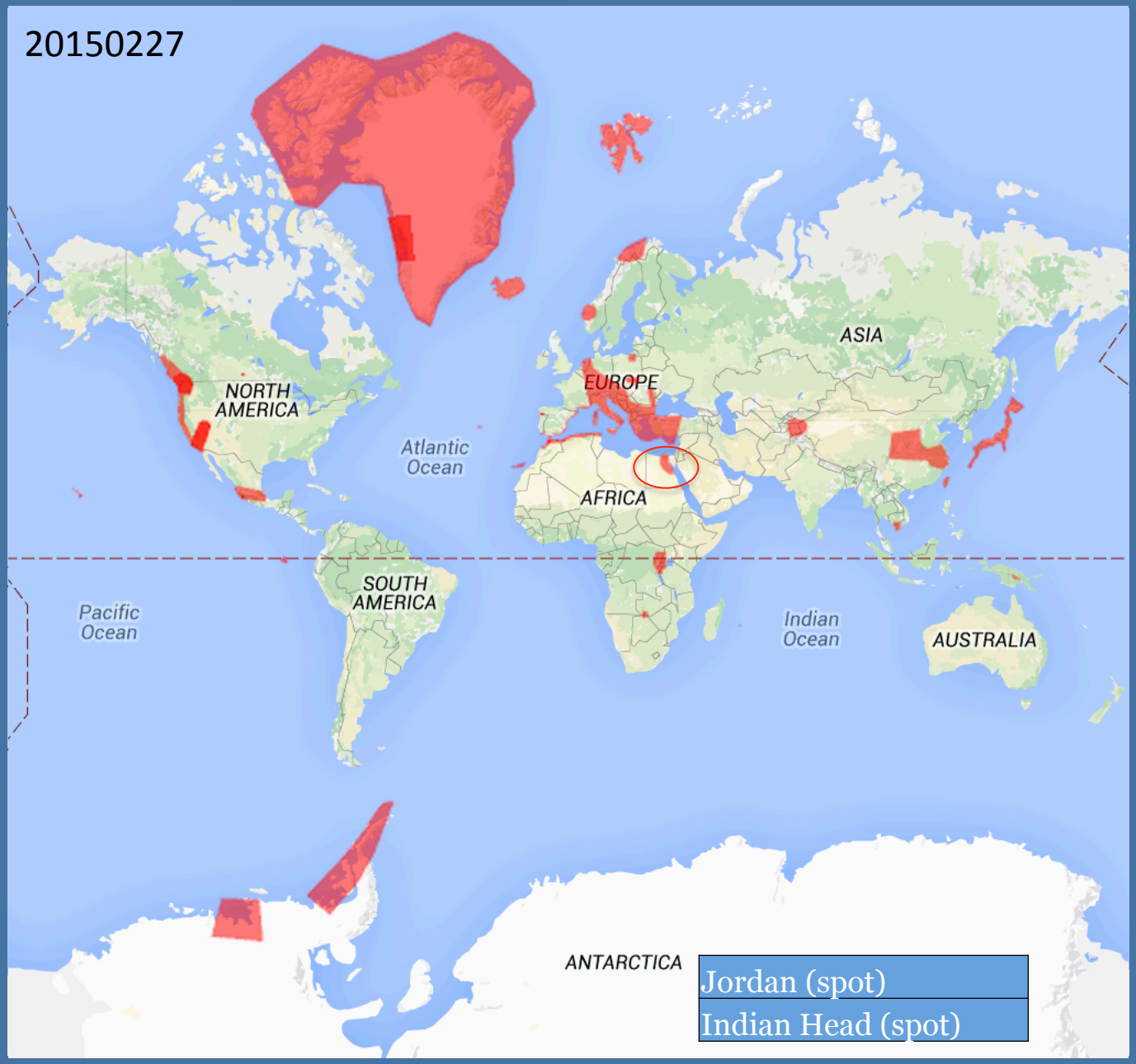
Svalbard
Azores
Canaries
Chad (spot)
Hawaii
Iceland
Japan
Mekong Delta (spot)
South Europe (partial)
Las Angeles
Vancouver/Seattle
Greenland

Sentinel-1 Level-1 IW L1-SLC systematic processing and dissemination areas
Operational Scenario since 2015-02-09



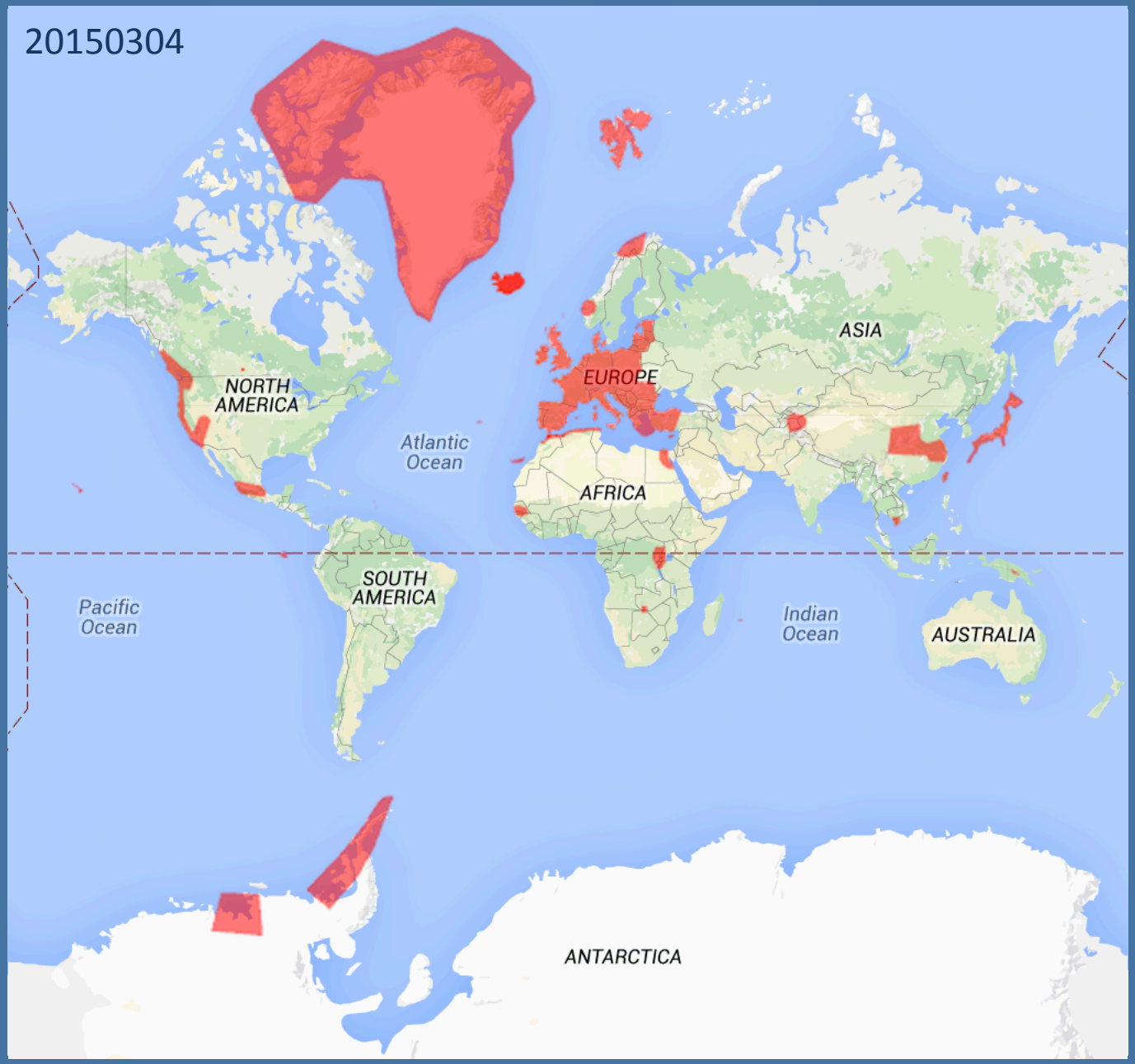
Babiak Poland
Mexico City
Nordes Norway
Norwegian Glaciers
Pine Island
Antarctic Peninsula
Upernavik Glacier
Svalbard
Azores
Canaries
Chad (spot)
Hawaii
Iceland
Japan
Mekong Delta (spot)
South Europe (partial)
Las Angeles
Vancouver/Seattle
Greenland
Papua (spot)
Colima Volcano

Sentinel-1 Level-1 IW L1-SLC systematic processing and dissemination areas
Operational Scenario since 2015-02-27



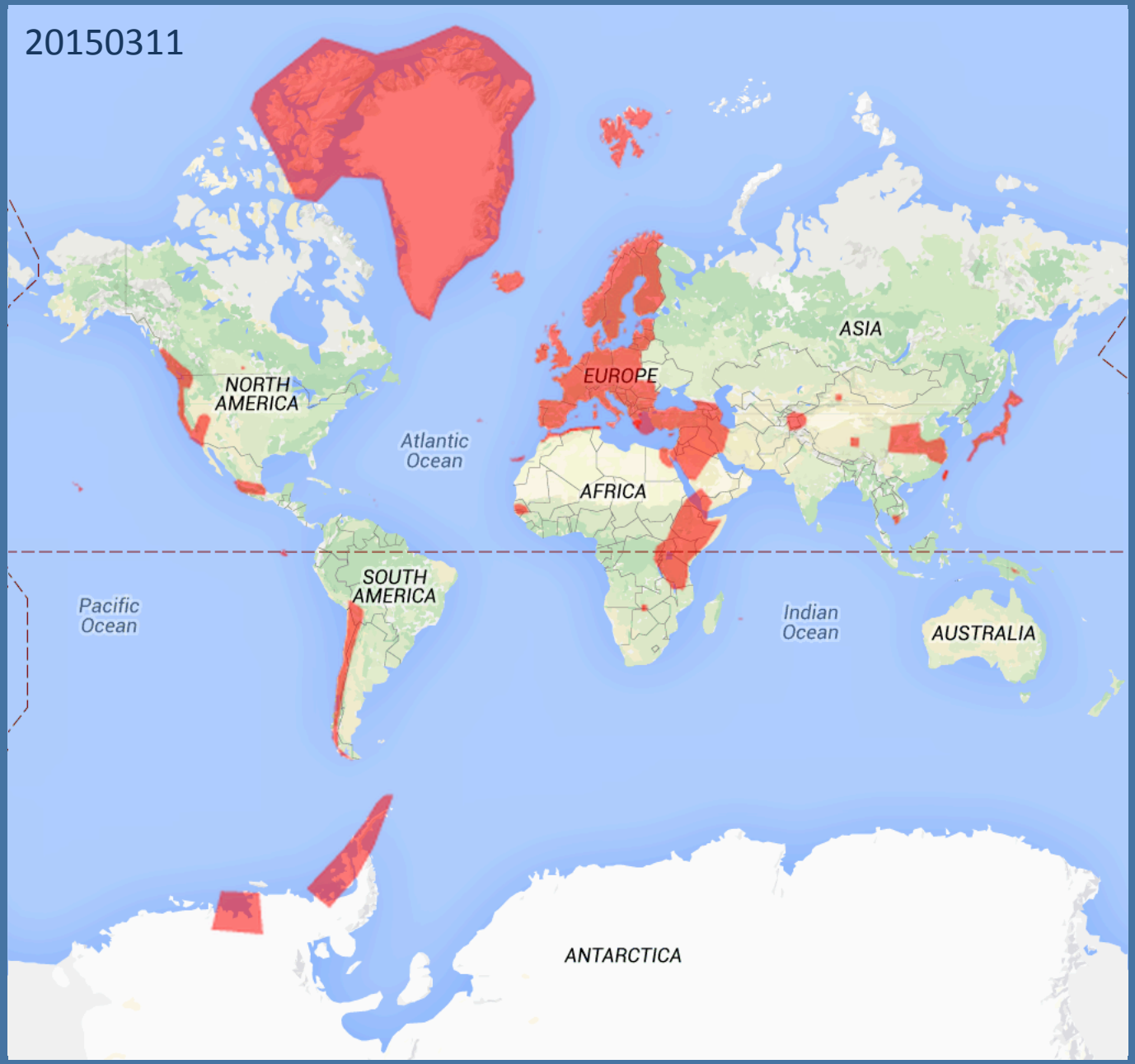
- Nordes Norway
- Norwegian Glaciers
- Pine Island
- Antarctic Peninsula
- Upernavik Glacier
- Svalbard
- Azores
- Canaries
- Chad (spot)
- Hawaii
- Iceland
- Japan
- Mekong Delta (spot)
- Greenland
- Papua (spot)
- US west coast
- La Reunion
- Galapagos
- Taiwan
- Upper Nile
- Central Mexico
- North Africa Coast
- Congo Volcanoes
- Caprivi Namibia
- Carpathians
- East China & Pamir
- Europe Capital Cities

Sentinel-1 Level-1 IW L1-SLC systematic processing and dissemination areas
Operational Scenario since 2015-03-04



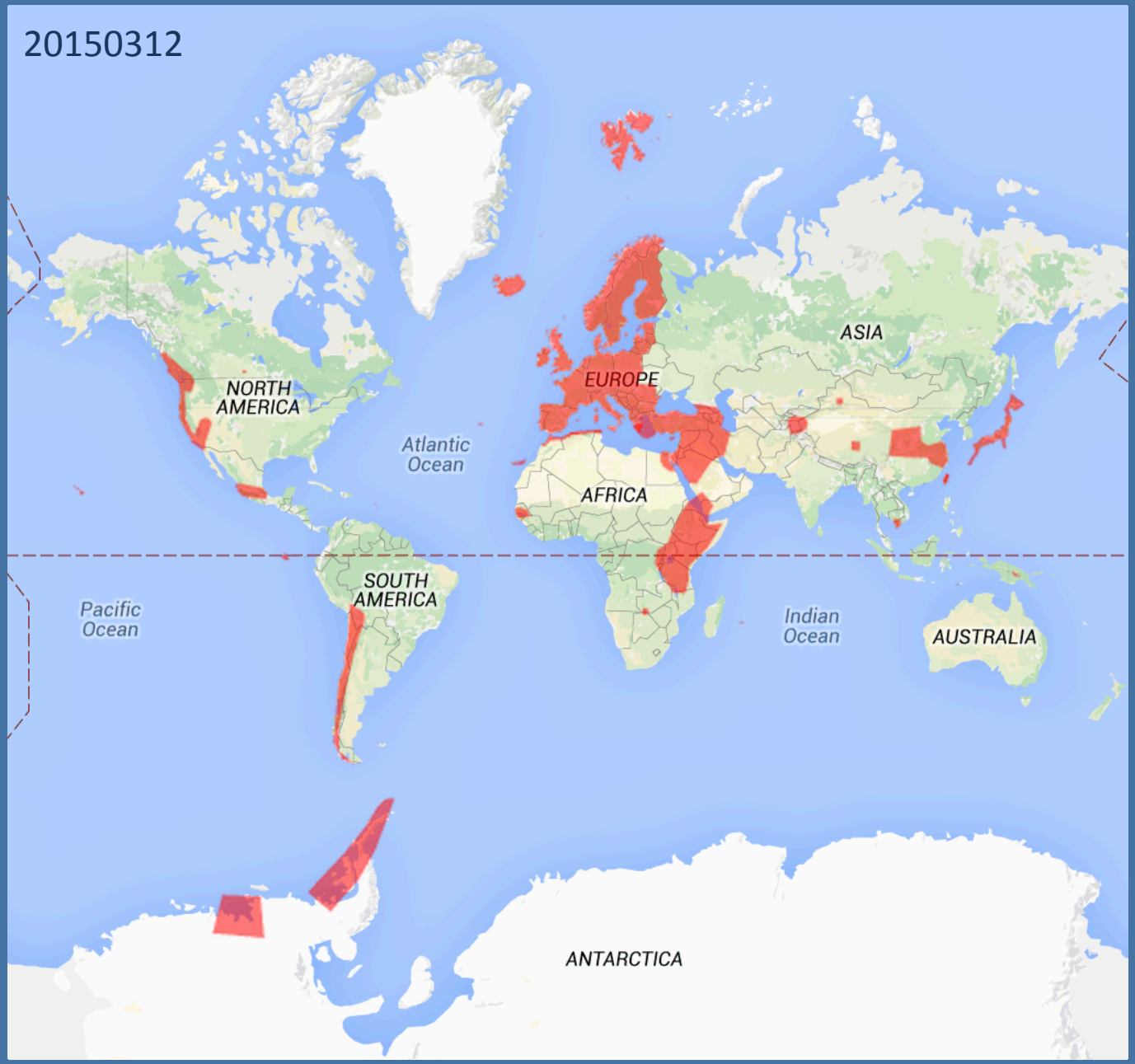
Europe large & UK
The Gambia

Sentinel-1 Level-1 IW L1-SLC systematic processing and dissemination areas
Operational Scenario since 2015-03-11



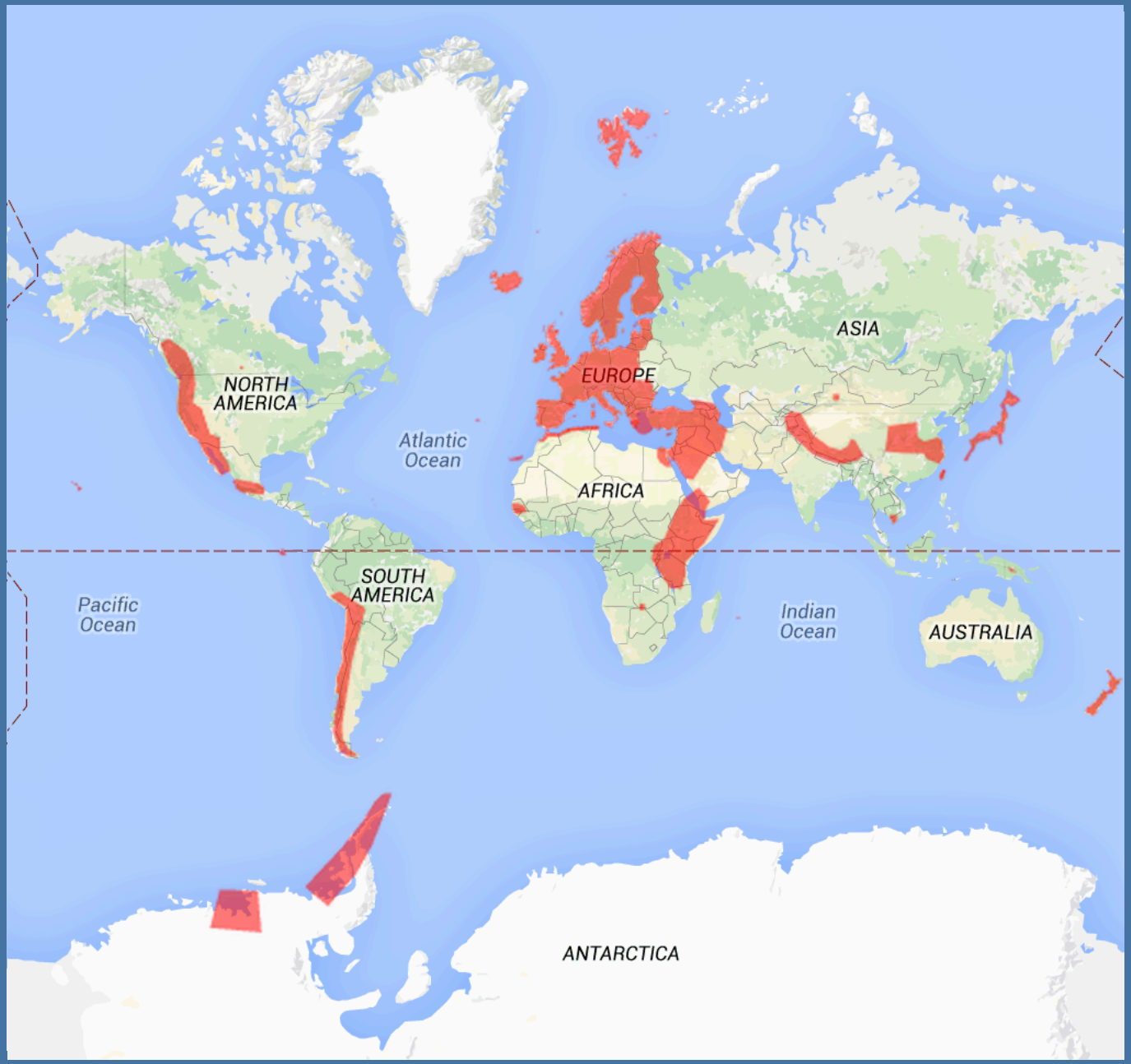
Europe Full
African Rift
Middle East (part.)
The Andes(Chile-Uyuni)
Chinese Gas storage (spot)
Tibet Railway (spot)

Sentinel-1 Level-1 IW L1-SLC systematic processing and dissemination areas
Operational Scenario since 2015-03-12



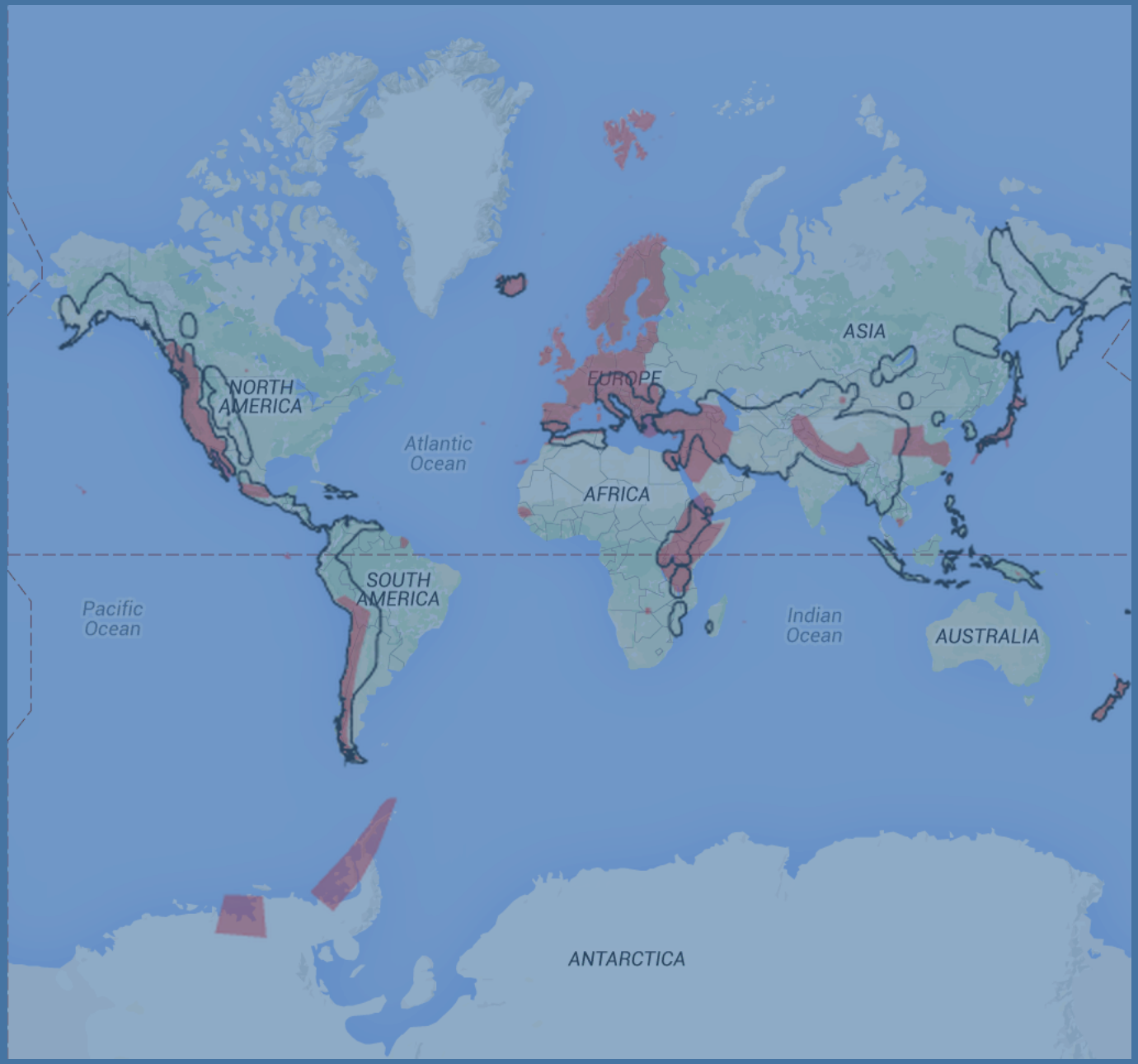
Greenland (END)

Sentinel-1 Level-1 IW L1-SLC systematic processing and dissemination areas
Operational Scenario since 2015-03-19 00:00UTC



Pine Island
Antarctic Peninsula
Upernavik Glacier
Svalbard
Azores
Canaries
Chad (spot)
Hawaii
Iceland
Japan
Mekong Delta (spot)
Papua (spot)
La Reunion
Galapagos
Taiwan
Upper Nile
Central Mexico
North Africa Coast
East China & Pamir
Chinese Gas storage (spot)
African Rift
Middle East (part.)
Europe Full
The Andes (extended)
Himalaya-Tajikistan
New Zealand
US west coast (extended)

Sentinel-1 Level-1 IW L1-SLC systematic processing and dissemination areas
Operational Scenario since 2015-03-19 00:00UTC



Pine Island
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Papua (spot)
La Reunion
Galapagos
Taiwan
Upper Nile
Central Mexico
North Africa Coast
East China & Pamir
Chinese Gas storage (spot)
African Rift
Middle East (part.)
Europe Full
The Andes (extended)
Himalaya-Tajikistan
New Zealand
US west coast (extended)

Production scenario: Operations Plans

Current systematic SLC availability:

- ALL Europe
- Almost ALL Current & Previous Supersites & Event Supersites
- Large percentage of the CEOS Volcano & Seismic Pilot areas
- Specific Project spot sites

Future Plans

Gradually completion of CEOS Volcano & Seismic Pilot areas coverage

Additional specific project spot sites

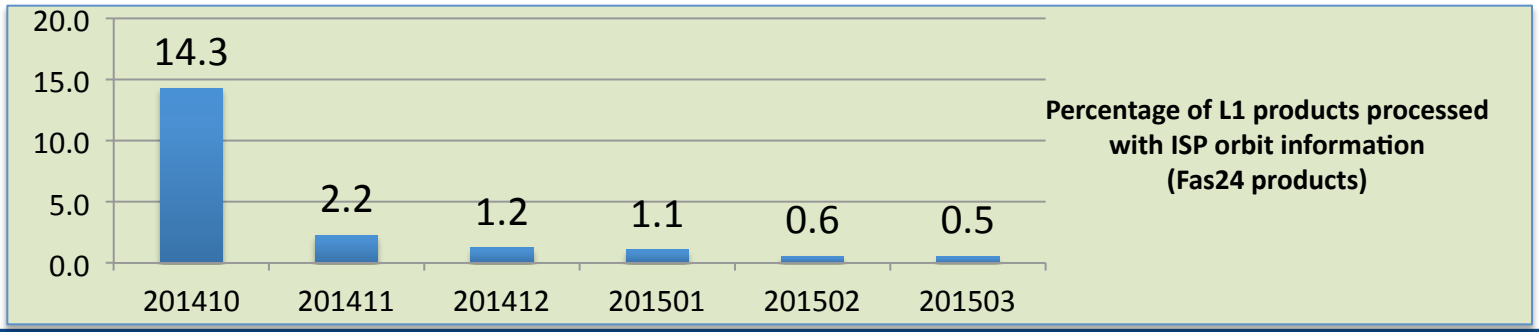
Further evolution to all acquired data over land

Production scenario: operations status & Plans
Use of orbit information in the Sentinel-1 Production scenario

- On-board processed GNSS data are embedded in the SAR ISPs.
- Sentinel-1 satellite GNSS data is downlinked typically every orbit for on-ground processing.

- Acquired GNSS data is routinely processed by the Precise Orbit Determination (POD) service, providing:
  - Restituted orbit files (**AUX_RESORB**) within 3 h from GNSS downlink : **accuracy < 10 cm rms**
  - Precise orbit files (**AUX_POEORB**) within 21 days from GNSS downlink: **accuracy < 5 cm rms**

Production scenario strategy: Use of Orbit information			
Instrument mode	**Processing scenario**	**Timeliness**	**Orbital information**
L0	All	All	**Predicted Orbit**
L1 GRD/SLC	Systematic Global & Regional	NRT	**ISP SVs**
		Fast24	**POD Restituted (99%) & ISP SVs (1%)** (AUX_RESORB)
	Reprocessed > 21 days	-	**POD Precise** (AUX_POEORB)

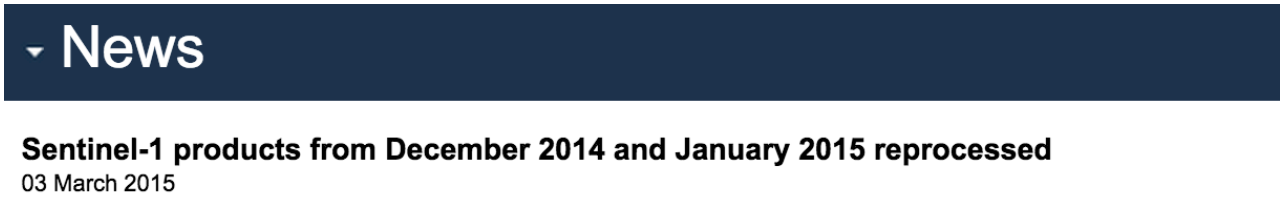


Production scenario: operations status
Issue with the relative orbit number annotation

- A number of Sentinel-1 L0 and L1 products acquired between **9th December 2014 and 21st January 2015** with incorrect relative orbit number reported in the product manifest have been made available on line as part of the nominal data dissemination flow.

- These products are affected by an incorrect annotation of relative orbit and cycle number
- The correct relative orbit number can be derived from the annotated absolute orbit number: Relative Orbit Number = MOD(Orbit Number – 73, 175) + 1

- Further information available on Sentinel on-line news:

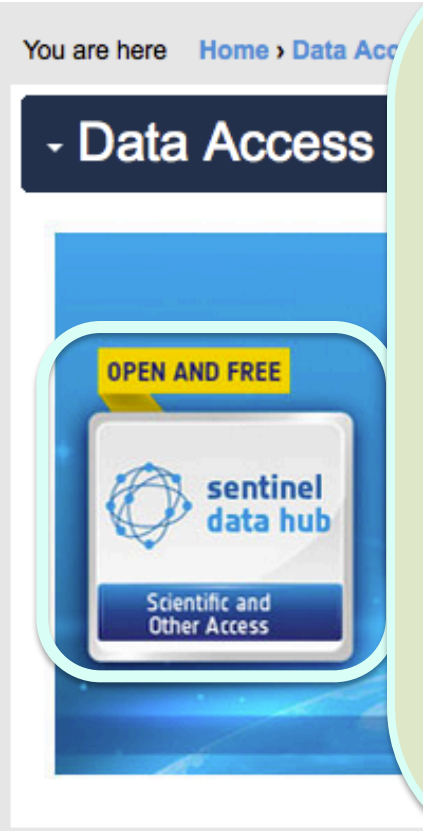


and on quality disclaimer#4:
https://131.176.235.71/disclaimer/4/

- The affected products have been removed from the on-line data access point on 5th Feb. 15
- A correct version of these products has been re-processed and gradually published after this date.

An updated version of all these products is available on line since 3 March 2015

Data access operations Status & plans



Open & Free on-line data access to S1 operational user products to "scientific/other-use users"

1st Step On-line data access to S1 systematic product flow through a "rolling-archive" approach

2nd Step On-line data access to S1 products after the roll-out period

Data access operations Status & plans

Rolling-archive data access

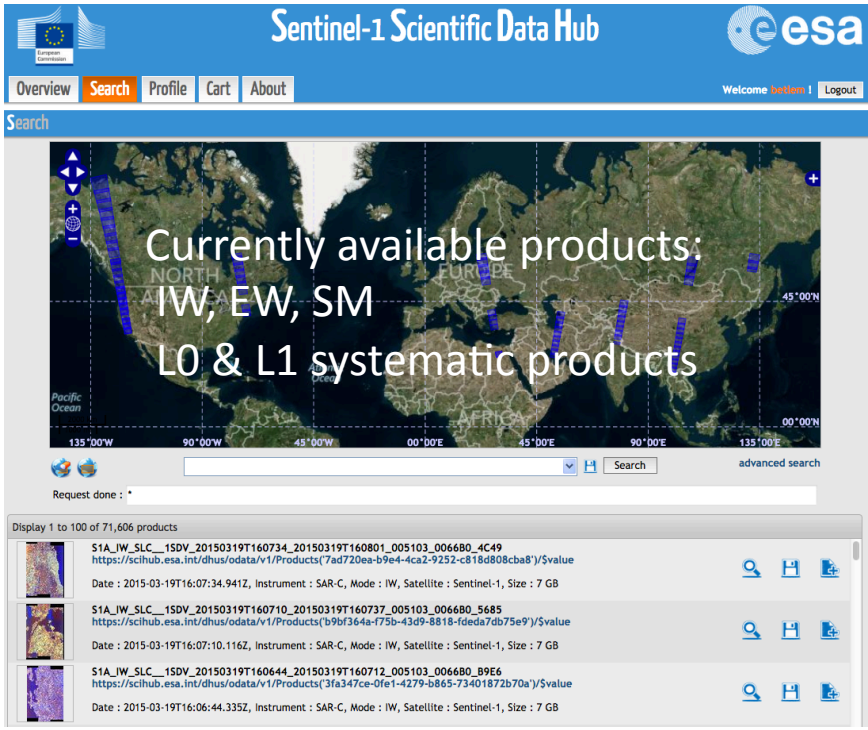
1st Step On-line data access to S1 systematic product flow through a "rolling-archive" approach

Initial Plan

- On-line user access through self-registration
- Two months rolling period.

Current Status

- Open access available to all users through https://scihub.esa.int.
- S1 systematically generated user products available for download (typically within less than 24h)
- Automated download scripting published
- Restriction on concurrent downloads
- **Roll-out not activated: all data still available on line**



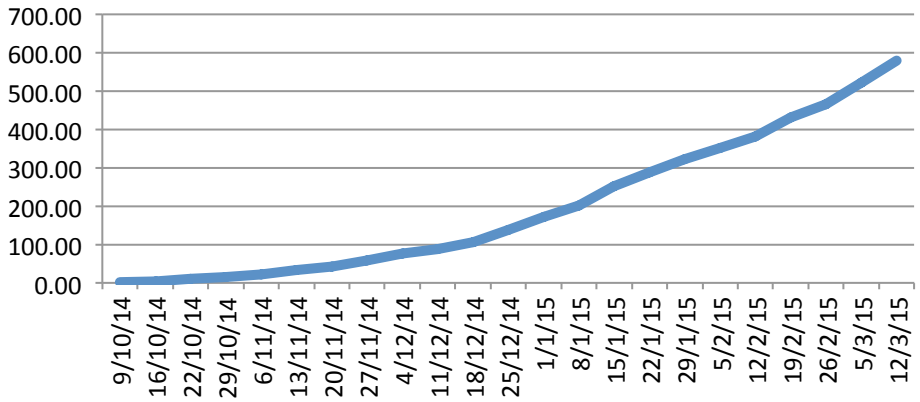
Operations Plans

- **L2 products available by Q3 2015**
- **Data rolling will be activated in October 2015 (i.e. no data will be rolled out before October 2015)**

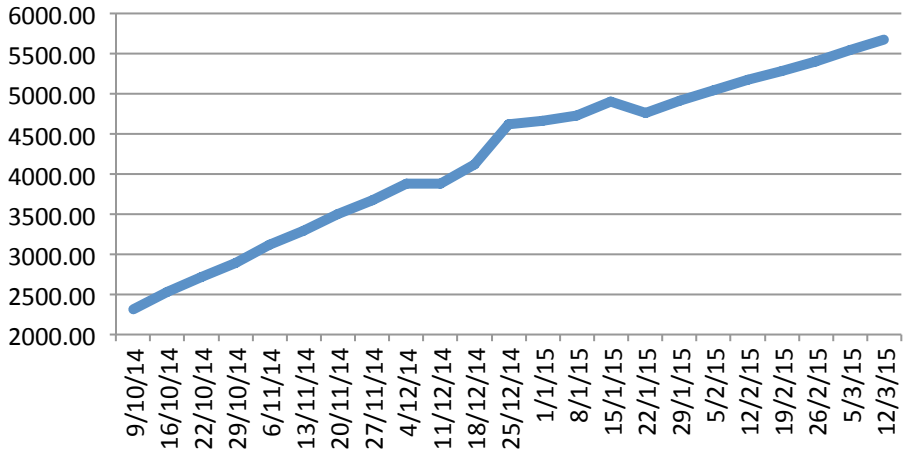
Data access operations Status & plans

Rolling-archive data access Statistics

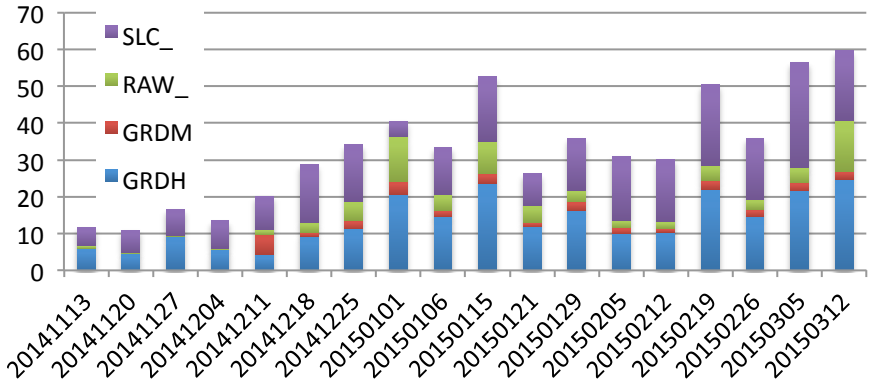
Total volume of Downloaded products by the users



Total number of registered users



Volume of products downloaded per week [TB]



About 600 TB downloaded since 3-10-14

More than 5000 users registered

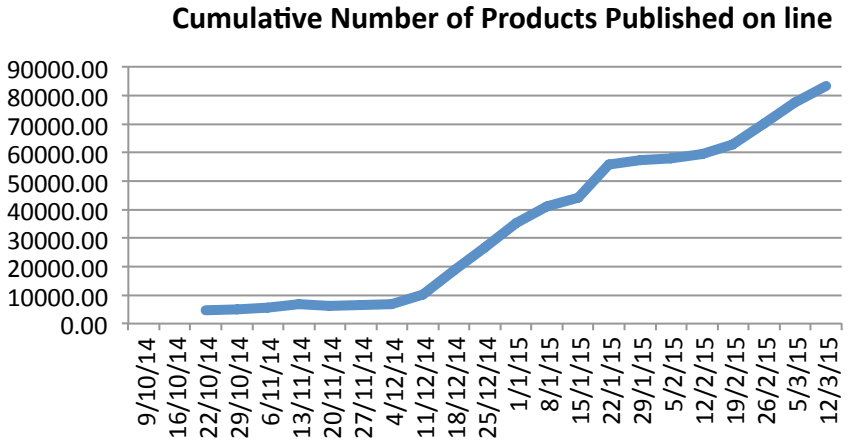
More than 60,000 products available on line

Data access operations Status & plans
Archive data access

2nd Step On-line data access to S1 products after the roll-out period

Current Status

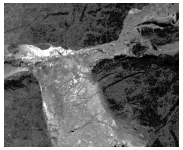
- All S1 published products since the start of the data access are available on line (incl. reprocessed products for rel. orbit number issue)



Operations Plans

- **Gradual archive access planned from June 2015 (i.e. before activation of the on-line archive rolling)**

Ground Segment Operations: Status & Plans
News & user support



First X-Band Acquisition(Matera): L+2d
First SAR instrument data take (WV mode): L+3d
First operational S1 L0&L1 products: L+3d

Start of regular GS commissioning operations (planning, acquisition, production, archiving and CP team data access): L+6d

Start of S1 sample user products on-line access to "any" user: 9-05

Opening of data access to expert users: 14-08

First INSAR pairs and first TOPS INSAR results: 21-08

Start of S1 systematic production with POD precise orbits regularly generated by the POD service: 14-06

Orbit achievement: 7-08

Start of L1 NRT-3h production 28-08

Opening of S1 regular data access 3-10

POD orbits available for user download

Enhanced on-line data access performances 8-12

All PDGS centres integrated in regular operations 23-1-15

KML planning and SLC areas published 3-15

Rel.Orbit number products reprocessed on line 3-15

L1 product format change 19-3-15

Operations News on https://sentinel.esa.int/

User support: eosupport@copernicus.esa.int

S1A Commissioning Phase

Sentinel-1A Operational qualification (S1A)

S1A Routine Operations

3-4-14 S1AL

23-3-15 Fringe

Conclusions

S1 systematically generated L0 & L1 GRD & L1 SLC products are available for on-line download since 3rd October 2014.

S1 products will be kept on line until October 2015 (1st year of mission operations)
Gradual access to S1 archive planned by June 2015.

Regular operations news on https://sentinel.esa.int/

S1 operations are nominally performing since S1A Launch: observation, production, product qualification and data access being gradually enhanced to maximize the mission exploitation

S1 operations paradigm with systematic processing of all data and open & free data access to all users is a major challenge but… it is being made possible!

S1A operations qualification being completed… S1B operations arriving soon.