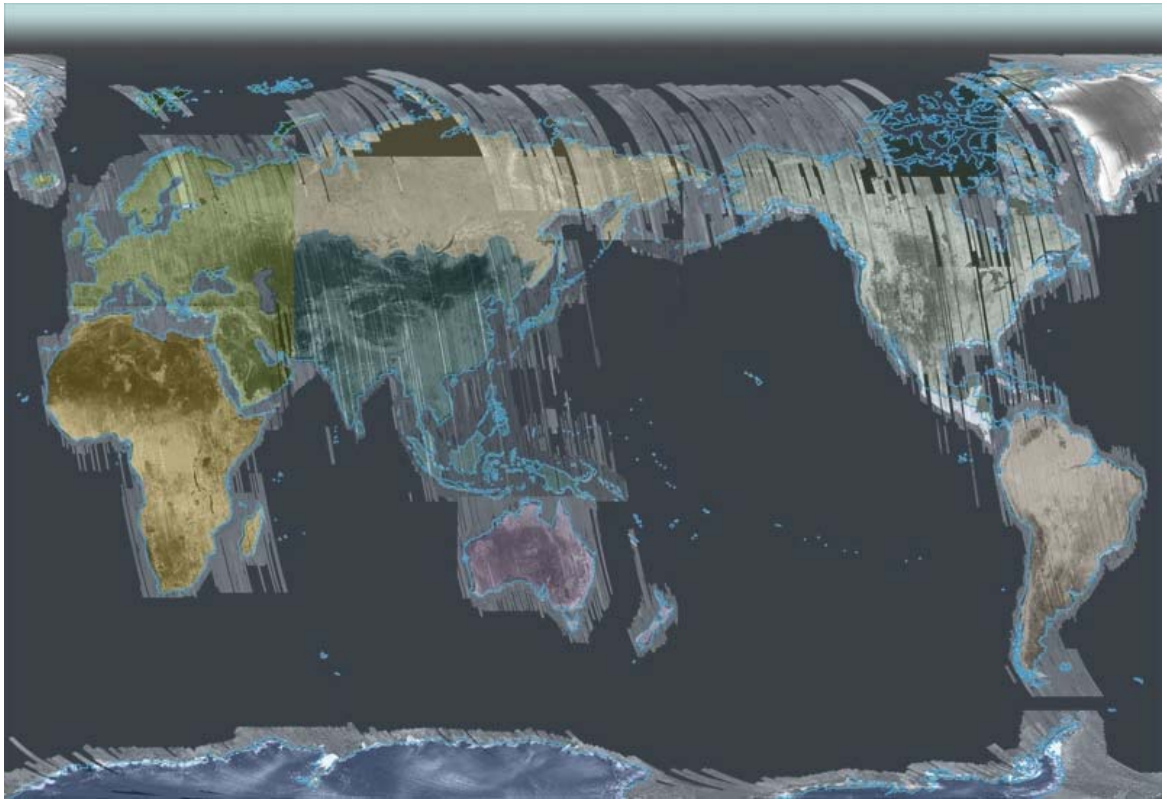
The PALSAR Systematic Observation Strategy

Ake Rosenqvist & Masanobu Shimada

JAXA EORC



The Systematic Observation Strategy (Basic Observation Scenario – BOS) for ALOS PALSAR

- Fine resolution satellite archived traditionally fragmented and heterogeneous
- ALOS the first fine resolution satellite mission to implement a fixed systematic data acquisition plan
- Implemented as a top-level **foreground mission** with a priority second only to that of special observation requests and emergency observations (e.g. earthquakes, natural disasters) and sensor calibration/validation.
- Designed to serve all ALOS user categories
- Aims to accommodate systematic global-scale, fine-resolution, monitoring of the environment through spatially and temporally consistent acquisitions over all land areas on the Earth on a repetitive basis.

Objectives of the ALOS Observation Strategy

- Aimed to support the ALOS PALSAR science objectives, and serve all user categories
- Improve initial poor simulation results due to request conflicts between the many ALOS user groups:
  - JAXA internal requests (K&C science programme, Cal/Val, InSAR, ...)
  - METI/ERSDAC (geology, resource exploration)
  - Japanese Gov't Agencies (M-Environment, M-Forestry & Agriculture, Coast Guard, Geographical Survey Inst. ...)
  - ALOS PI programme
- Creation of a systematic archive of L-band SAR data, in which a consistent time series of data can be found for any arbitrary point, or region, on the Earth.

The Systematic Observation Strategy - Factors considered*

Spatio-temporal consistency over regional scales

- Semi-continental wall-to-wall coverage
- Acquisitions within a short time window (46-day cycle)

"Adequate" temporal repetition;

- Plan individually adapted to forest and wetlands monitoring

Accurate timing;

- Regional seasonality a major driver

Consistent sensor configuration;

- Limitation of the PALSAR operational modes
  - Creation of consistent archves
  - Minimising request conflicts

Long-term continuity

- Repetition to EOL the target, continuation with ALOS-2

*__Systematic Data Acquisitions - A Pre-requisite for Meaningful Biophysical Parameter Retrieval?__
Communications, IEEE Transactions on Geoscience and Remote Sensing, Vol. 41:7, 2003.

Approach to minimise programming conflicts

Step 1: Reducing the number of operational modes to a small number of ”default observation modes” (132 => 6)

Step 2: Designating each 46-day cycle to a specific default mode.

Step 3: Separating conflicting requests into ascending and descending operations.

Ascending passes:

- Dedicated to global-scale, dual-season monitoring
- Fine-res, HH+HV @ 34.3° (Forest & Land Cover)
- Fine-res, HH @ 34.3° (Solid Earth, Forest & Land Cover)
- Quad-pol @ 21.5° & 23.2° (Pol-InSAR R/D)

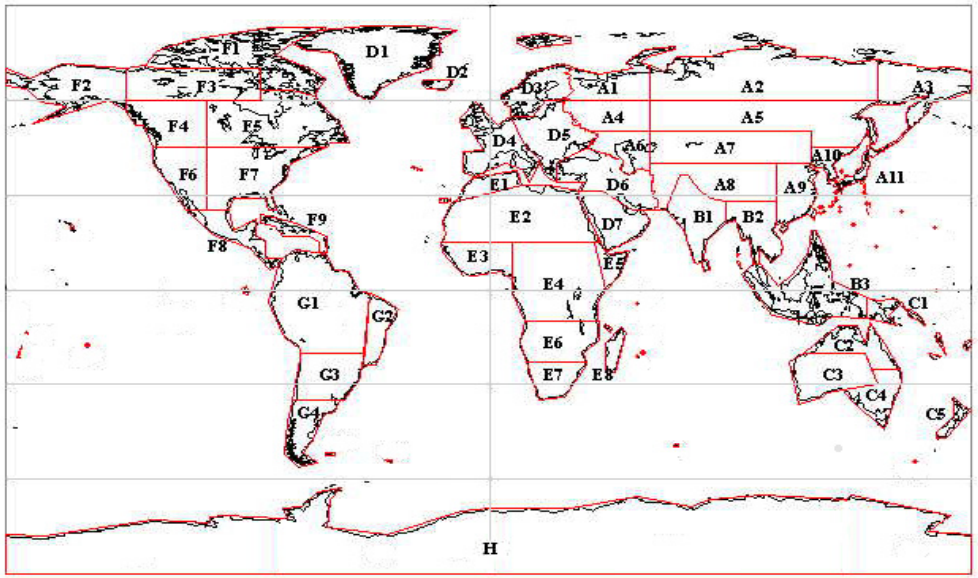
Descending passes:

- Dedicated to regional-scale, every-cycle repeat monitoring
- ScanSAR HH 5-beam (Wetlands & Rapid-deforestation)

”Best trade-off” sensor modes based on scientific requirements, identified in collaboration with a science advosory group.

Observation matrix plan concept

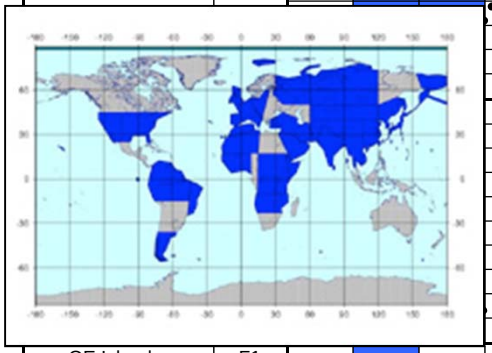
Geographical observation units



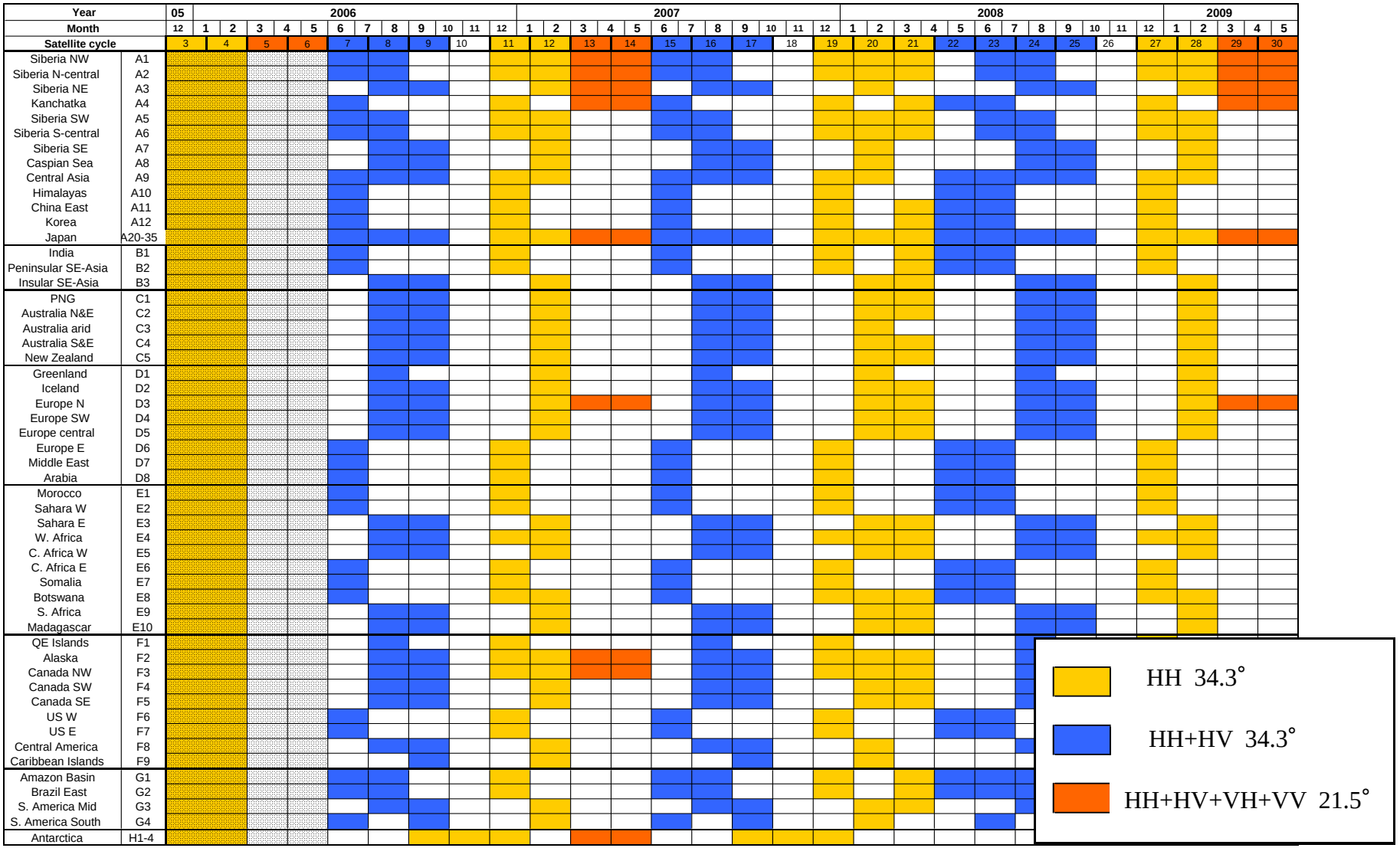
Fixed observation modes (ascending passes)

- HH 34.3°
- HH+HV 34.3°
- HH+HV+VH+VV 21.5°

Year		2006							2007							
Month		6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
Satellite cycle		7		8	9	10		11	12		13	14		15		16
Siberia NW	A1															
Siberia N-central	A2															
Siberia NE	A3															
Kanchatka	A4															
Siberia SW	A5															
Siberia S-central	A6															
Siberia SE	A7															
Caspian Sea	A8															
Central Asia	A9															
Himalayas	A10															
China East	A11															
Korea	A12															
Japan	A20-35															
India	B1															
Peninsular SE-Asia	B2															
Insular SE-Asia	B3															
PNG	C1															
Australia N&E	C2															
Australia arid	C3															
Australia S&E	C4															
New Zealand	C5															
Greenland	D1															
Iceland	D2															
Europe N	D3															
Europe SW	D4															
QE Islands	F1															
Alaska	F2															



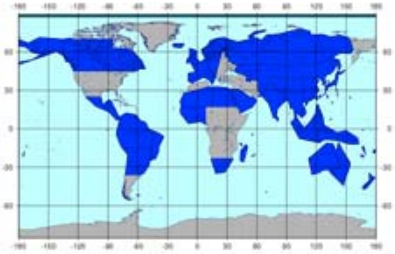
PALSAR Ascending acquisitions



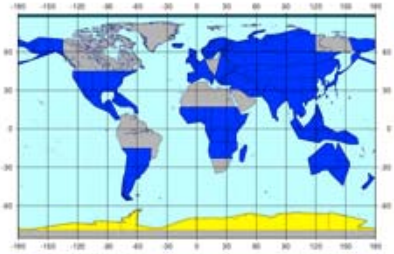
PALSAR Ascending acquisitions 2009/2010

CYCLE_27 / 27-Apr.-2009

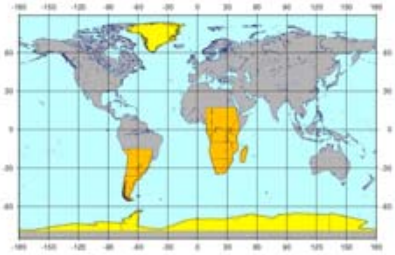
CYCLE_28 / 12-Jun.-2009



CYCLE_29 / 28-Jul.-2009



CYCLE_30 / 12-Sep.-2009



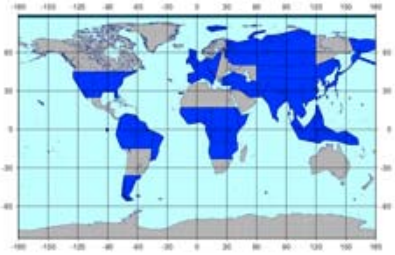
CYCLE_31 / 28-Oct.-2009

CYCLE_32 / 13-Dec.-2009

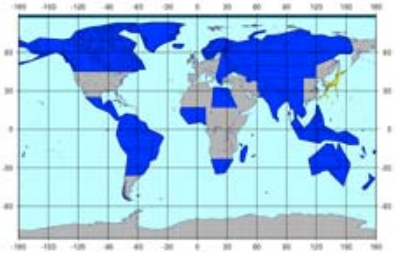
CYCLE_33 / 28-Jan.-2010

CYCLE_34 / 15-Mar.-2010

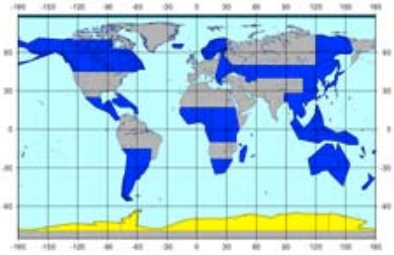
CYCLE_35 / 30-Apr.-2010



CYCLE_36 / 15-Jun.-2010



CYCLE_37 / 31-Jul.-2010

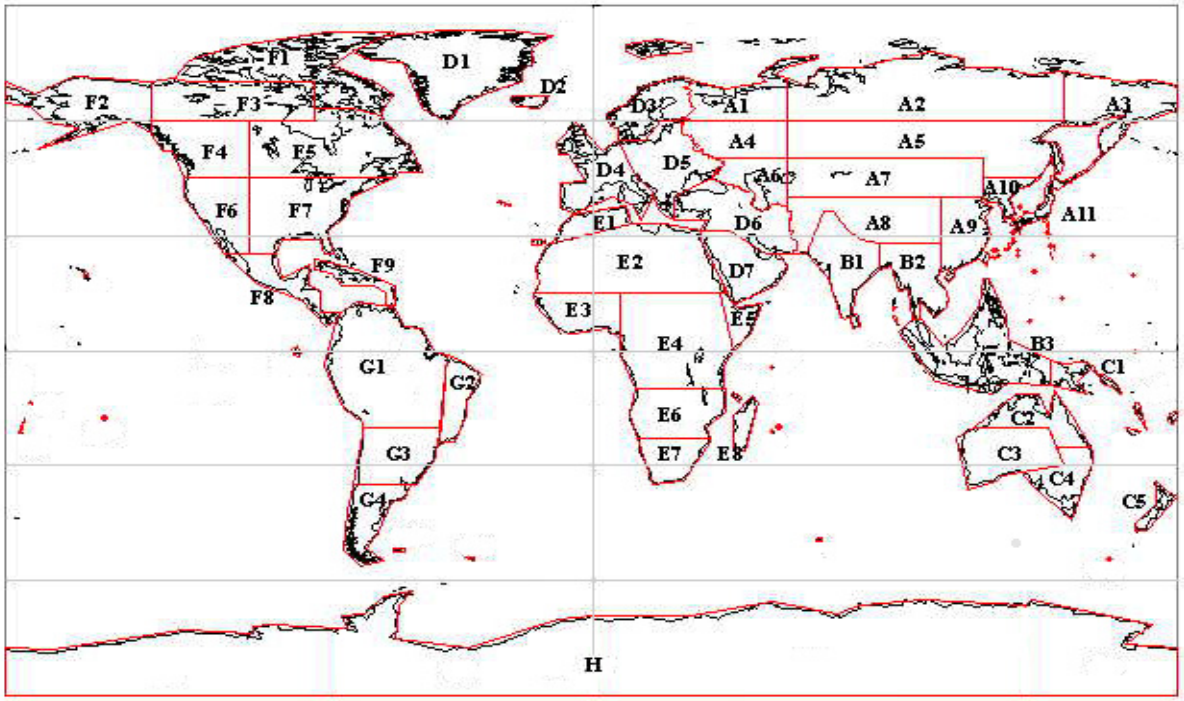


CYCLE_38 / 15-Sep.-2010

Sensor mode	Off-nadir	Polarizarion
Fine Beam	41.5°	HH
Fine Beam	34.3°	HH+HV
Fine Beam	21.5°	HH+HV+VH+VV
Fine Beam	23.1°	HH+HV+VH+VV
Fine Beam	34.3°	HH

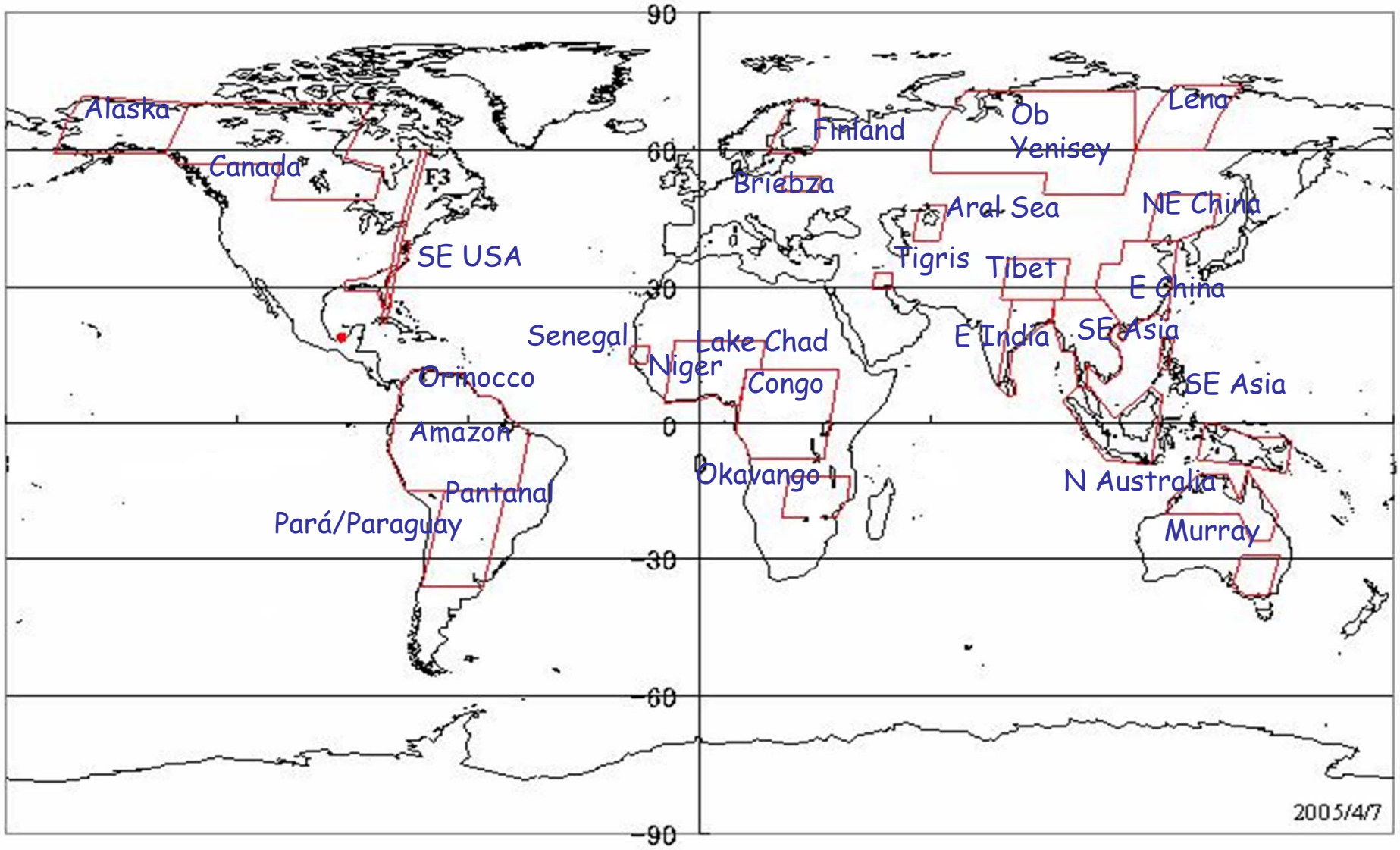
PALSAR Ascending acquisition plan

- 3-5 global PALSAR coverages annually
  - Fine-res HH+HV @ 34.3˚ (summer/dry season)
  - Fine-res HH @ 34.3˚ (winter/wet season)
  - Scansar HH (descending)
- Bi-annual global coverage in InSAR mode (boreal - annual)
- Repetition during ALOS life-time (April 2011)



To minimise seasonal bias in the PALSAR time series, each region is covered the same time (months) every year, witin a 46-day time period.

PALSAR Descending acquisition plan (ScanSAR)



PALSAR Descending

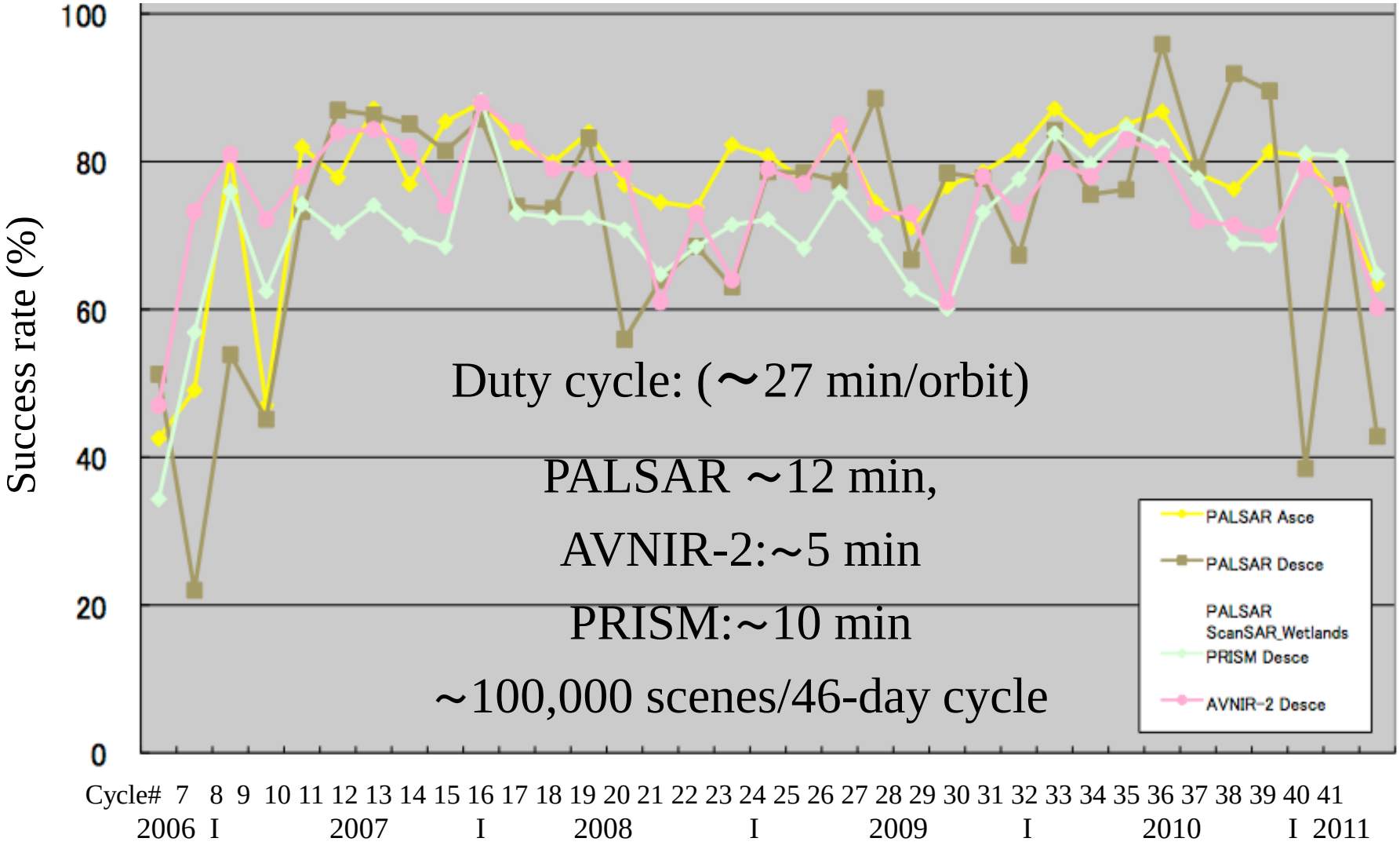
- 1 in 3 passes acquired to reduce data
- Optical sesors have priority in case of conflict
- One Global ScanSAR coverage/year
- Intensive 46-day monitoring of globally significant wetlands

Year	2005							2006												2007												2008											
Month	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12

Satellite cycle	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
West Siberia						■	■	■	■	■	■	■	■																
Lena Delta																						■	■	■	■	■	■	■	■
Volga Delta																						■	■	■	■	■	■	■	■
Amur																						■	■	■	■	■	■	■	■
East China paddy						■	■	■	■	■	■	■	■																
Tibet																						■	■	■	■	■	■	■	■
India paddy												■	■	■	■	■	■	■	■										
Mainland SE-Asia				■	■	■	■	■	■	■	■	■	■																
Insular SE-Asia				■	■	■	■	■	■	■	■																		
Luzon				■	■	■	■	■	■	■	■																		
New Guinea				■	■	■	■	■	■	■	■																		
North Australia				■	■	■	■	■	■	■	■																		
Murray-Darling																						■	■	■	■	■	■	■	■
Finland				■	■	■	■	■	■	■	■																		
Pripet-Biebrza						■	■	■	■	■	■	■	■																
Tigris marshes																						■	■	■	■	■	■	■	■
Niber Basin																						■	■	■	■	■	■	■	■
Congo Basin									■	■	■	■	■	■	■	■	■												
Okavango-Mozambique											■	■	■	■	■	■	■	■											
Senegal wetlands																						■	■	■	■	■	■	■	■
ASF mask						■	■	■	■	■	■	■	■																
BOREAS SSA														■	■	■	■	■	■	■	■								
Quebec-Everglades													■	■	■	■	■	■	■	■									
SE USA																						■	■	■	■	■	■	■	■
Mexico																						■	■	■	■	■	■	■	■
Amazon Basin	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					■	■	■	■		
Pantanal	■	■	■	■	■	■	■	■	■	■																			

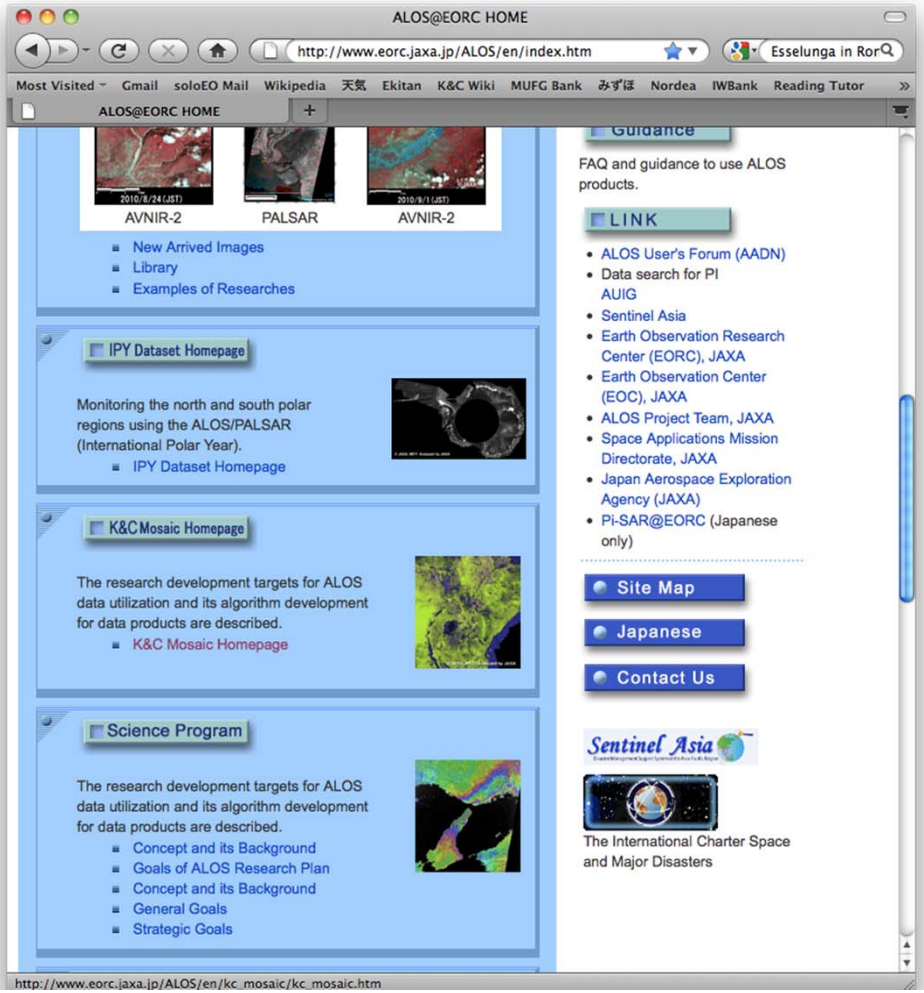
ALOS BOS in operation

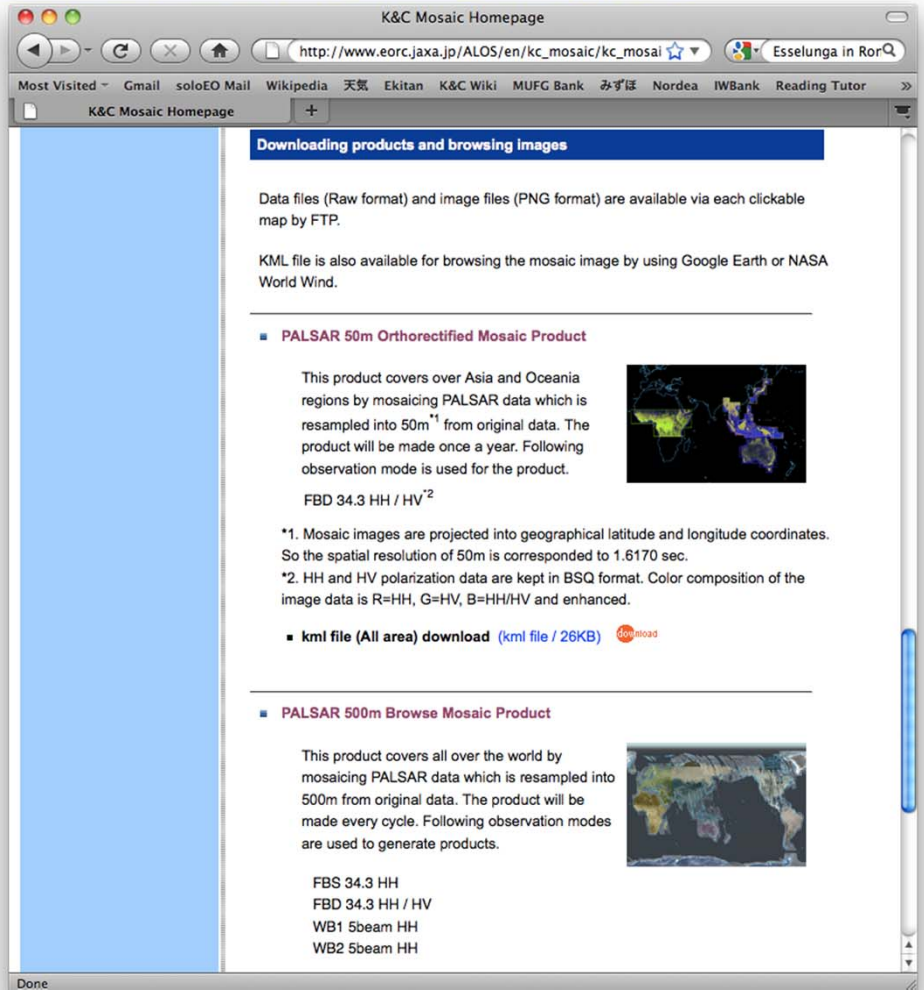
Acquisition success rate:
Strip map (Asc) :~80%, ScanSAR (Desc) :~72%



Acquisition results available online at

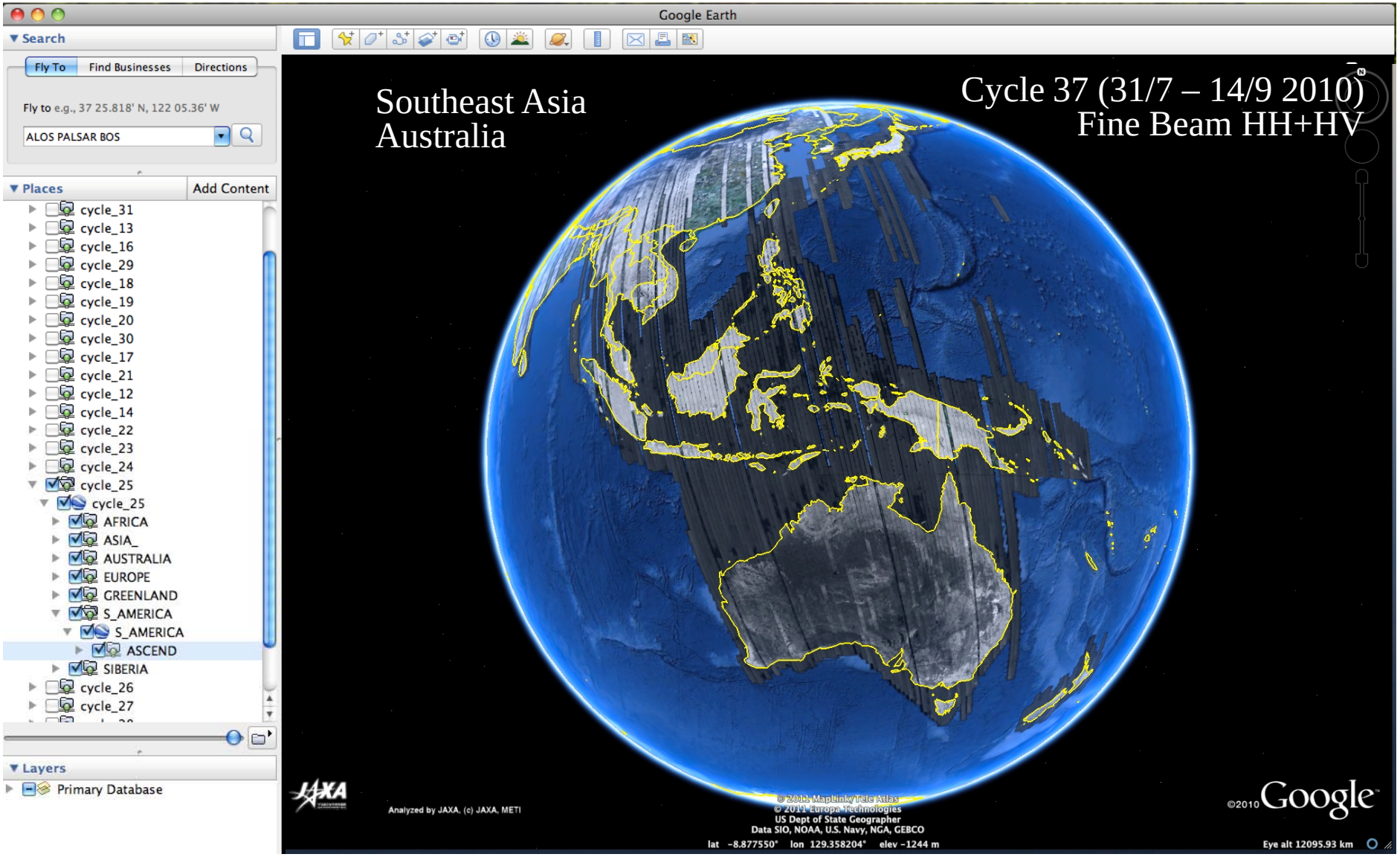
http://www.eorc.jaxa.jp/ALOS/en/kc_mosaic/kc_mosaic.htm





EORC, JAXA

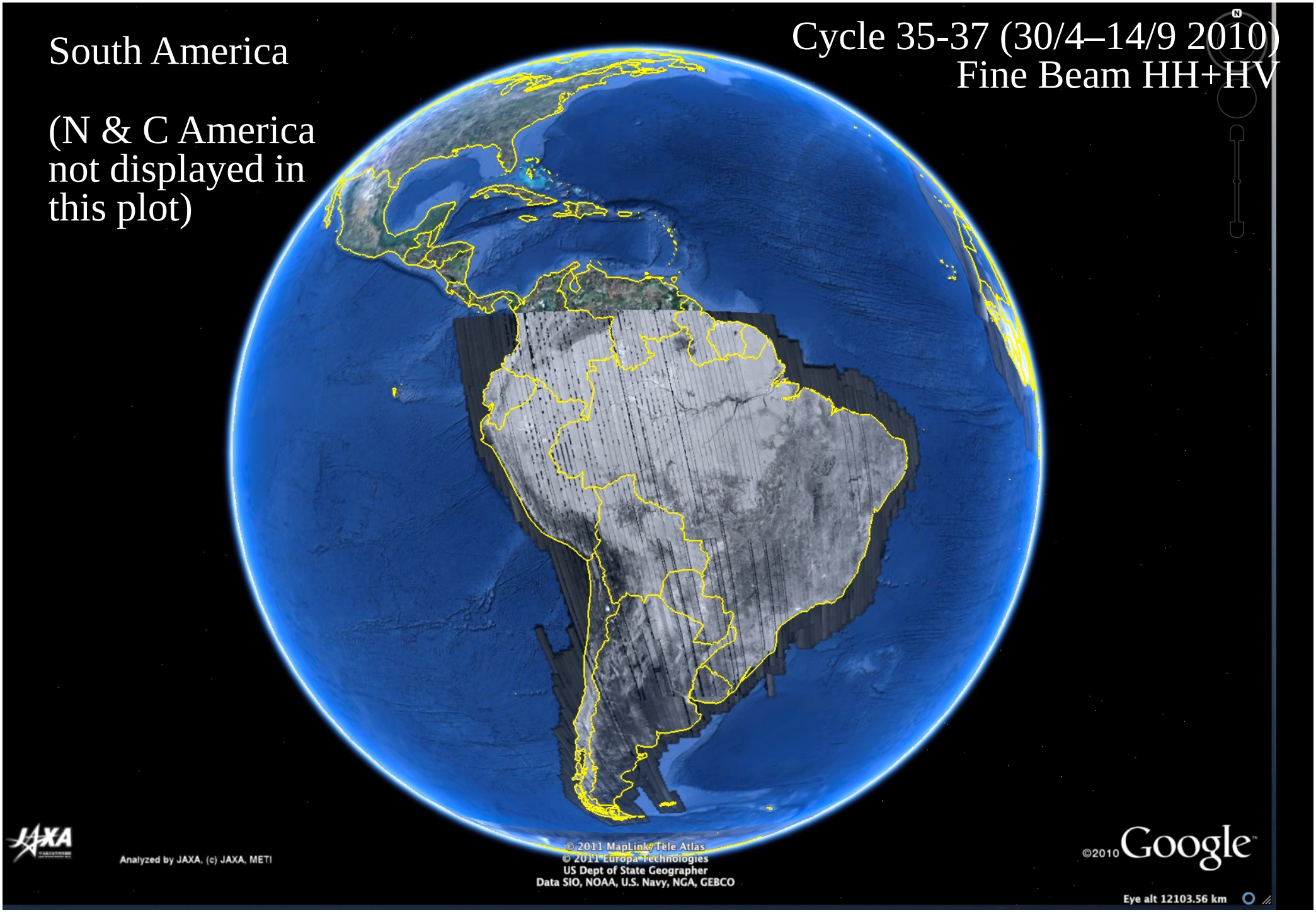
500 m browse mosaics showing acquisition results for each 46-day cycle available as KML files.



South America

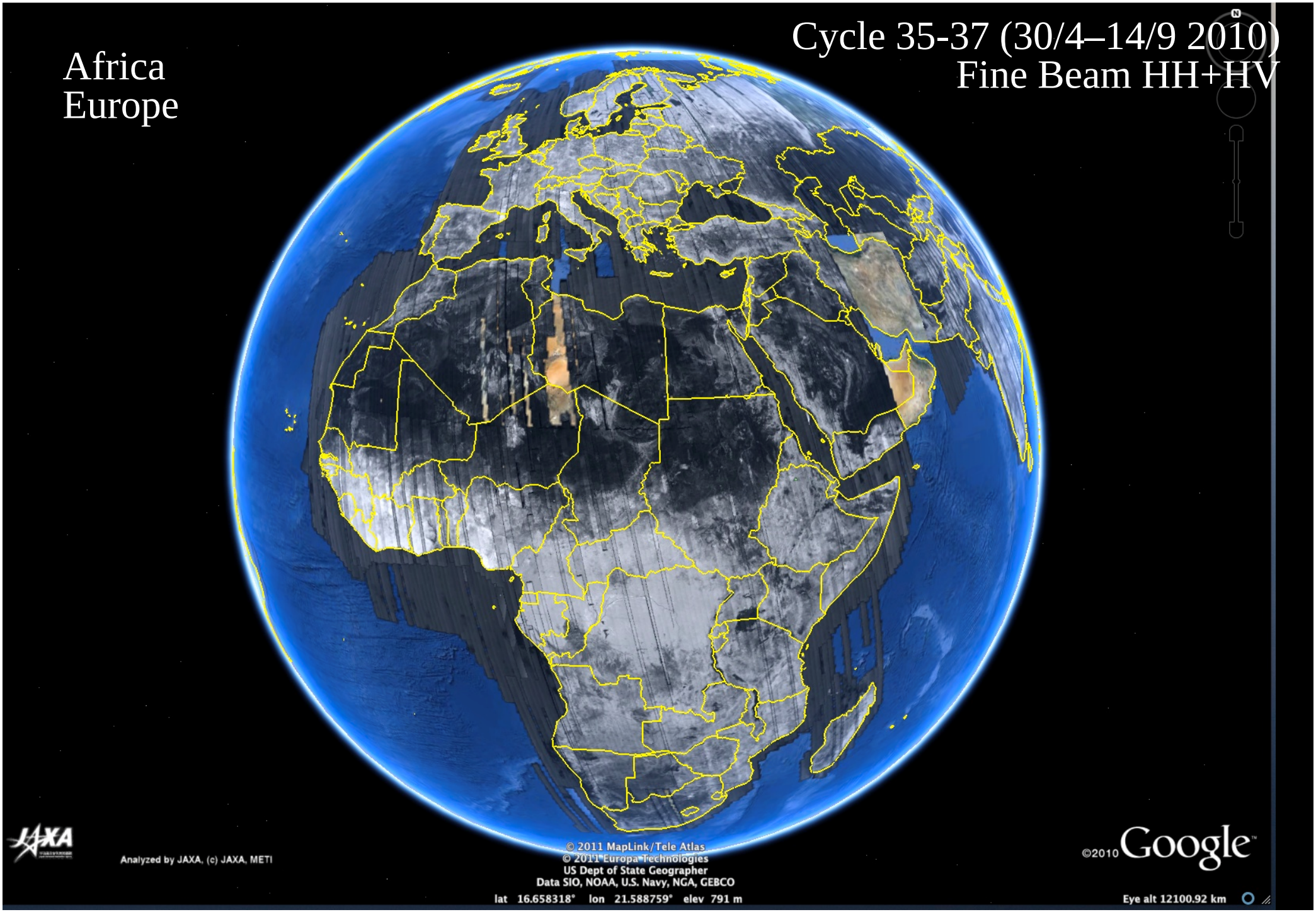
(N & C America not displayed in this plot)

Cycle 35-37 (30/4–14/9 2010)
Fine Beam HH+HV



Africa
Europe

Cycle 35-37 (30/4–14/9 2010)
Fine Beam HH+HV



PALSAR pass definition

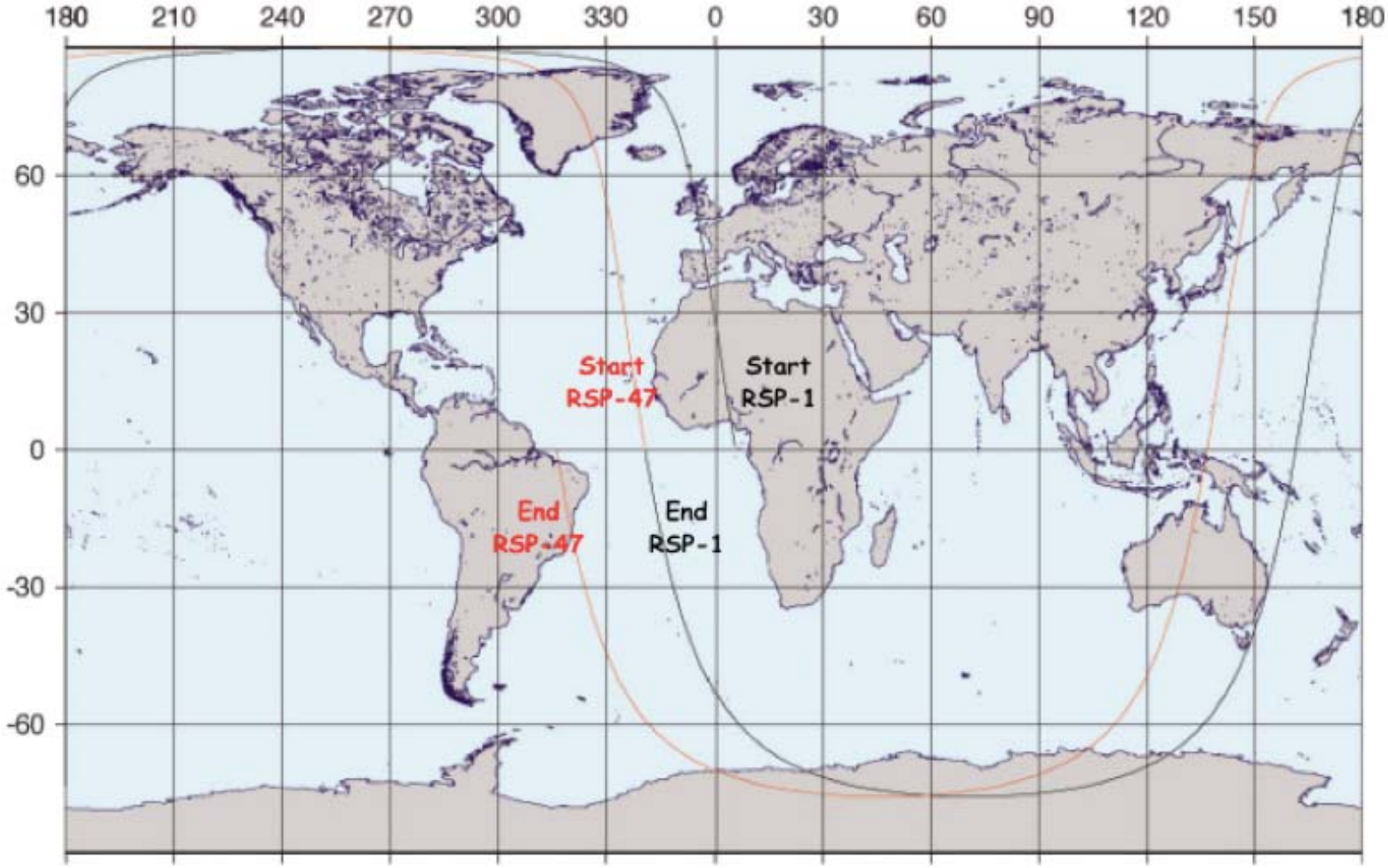


Figure 1.4.1 RSP pass definition concept. RSP pass numbers begin and end at ascending crossing of the Equator.

PALSAR pass order

Ascending passes

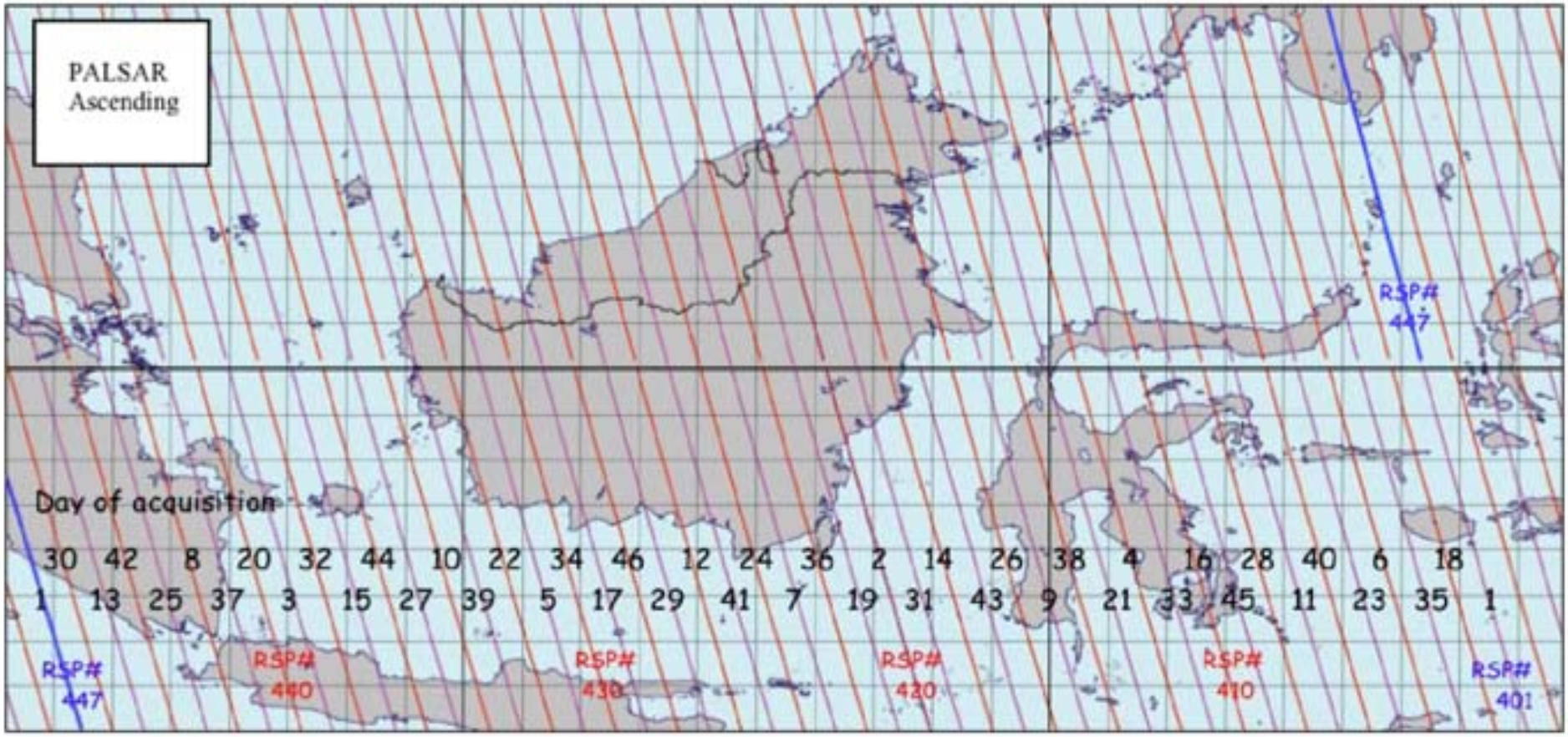


Figure 1.4.2 RSP pass map [ascending passes]. Numbers in black indicate the relative day of acquisition during a given 46-day repeat cycle (Note: path numbers depend on off-nadir angle and are here are given for illustration only).

PALSAR pass order

Descending passes

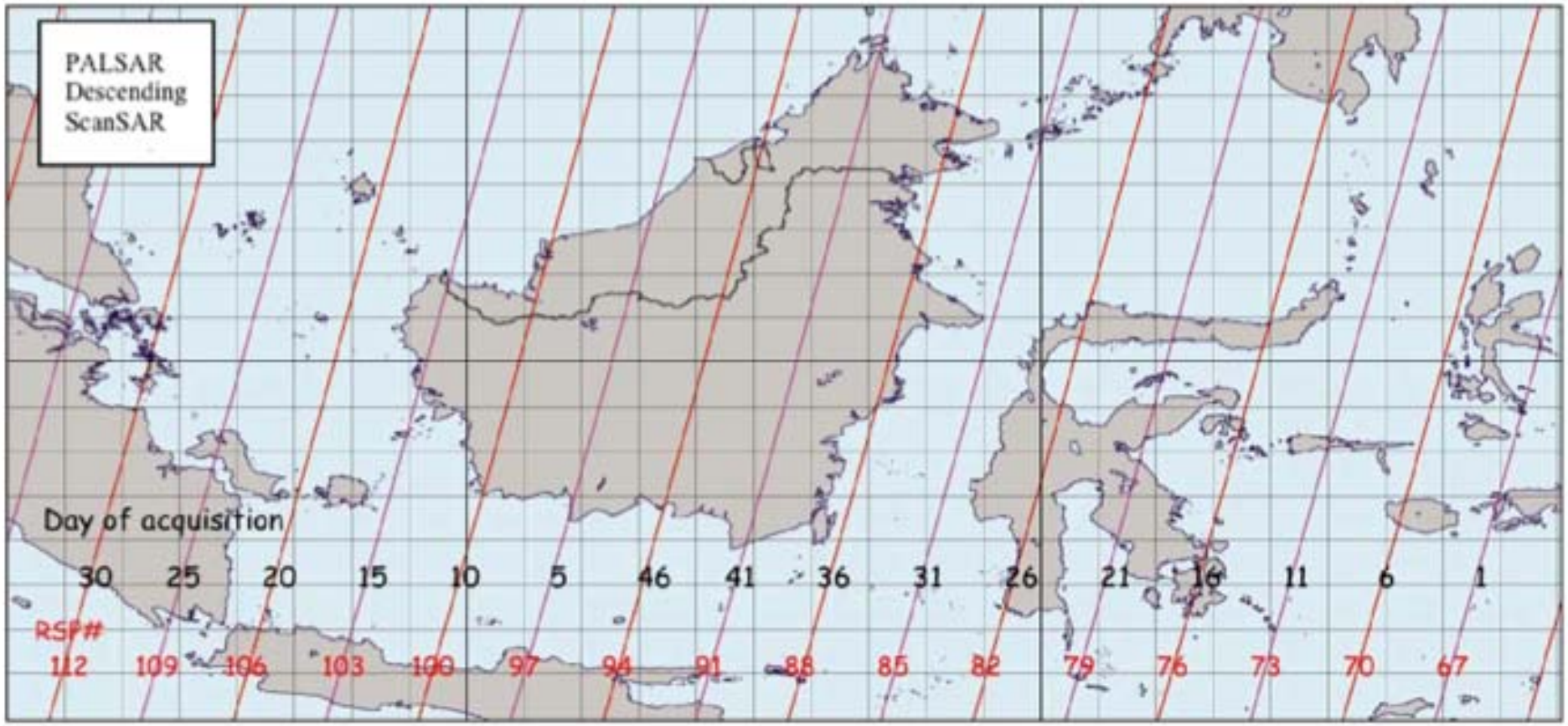


Figure 1.4.3 RSP pass map [descending; ScanSAR]. During standard operations in ScanSAR mode, data volumes are reduced by 2/3 by decreasing acquisitions to 1 out of every 3 ScanSAR passes.