AGENDA

1. Welcome and introduction from the WInSAR Executive Committee: Kristy Tiampo
2. Report on WInSAR activities at UNAVCO: Scott Baker and Chris Crosby

3. Update from NASA: Gerald Bawden
4. Update from ESA: Jerome Benveniste

5. Update on NISAR and ISCE: Paul Rosen
6. Update on GMTSAR: David Sandwell

7. Update from JAXA: Shin-ichi Sobue
8. Update on UAVSAR: Yunling Lou

9. Update from ASF: Nettie Labelle-Hamer
10. Update from GEO Supersites: Michael Poland or Freysteinn Sigmundsson

Who we are and what we do

WInSAR is a group of InSAR users and researchers that coordinate InSAR activities in North America. Our mission is to:

- advocate for opening access to SAR data
- plan and sponsor training courses for the community
- distribute and maintain software, search tools and data products
- advise on policies and best practices
- maintain an archive of SAR data for North America

The Executive Committee:

Kristy Tiampo (Chair), Estelle Chaussard (Vice Chair), Eric Hetland, David Bekaert (Secretary, William Barnhard, Gareth Funning (ex-officio)

winsar.unavco.org

Training courses, 2019

InSAR Data Interpretation and Analysis for Nonspecialists

- 1 day short course at SAGE/GAGE Workshop (October)
- Targeted at 'end users', how to use processed InSAR data for your research

InSAR Processing and Theory with GMTSAR

- Multi-day short course at Scripps, July 24-26

InSAR Theory and Processing (ISCE)

- Multi-day short course at UNAVCO, August 12-16

ARIA Standard Products, ARIA Tools, & Time Series InSAR

- One day short course at JPL, August

Future courses

- Several versions of InSAR for Nonspecialists and/or ARIA Tools and Time Series Processing – EGU, SAGE/GAGE, GSA, others…
- Investigating expansion of multi-day short courses to other locations

Your feedback, please!

Thoughts or comments?

Use the notepads on the tables to give your thoughts on:

- Additional trainings that WInSAR can sponsor
- Services or unmet needs that WInSAR could fulfil
- The format of this meeting
- Anything else…

Please feel free to email me personally, as well (kristy.tiampo@colorado.edu)

GAGE National Science Foundation's Geodetic Facility for the Advancement of Geoscience

UNAVCO

WInSAR Operations Update

Christopher Crosby & Scott Baker

AGU WInSAR Business Meeting - December 11, 2019

GAGE National Science Foundation's Geodetic Facility for the Advancement of Geoscience

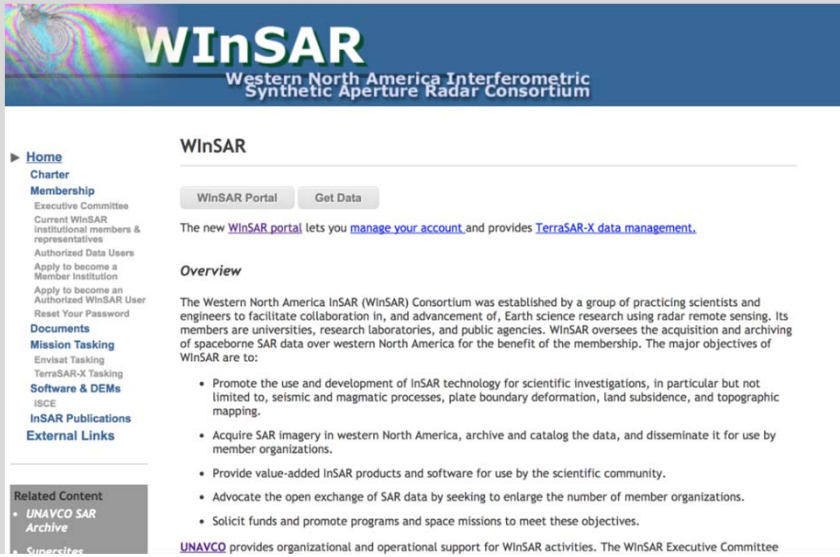
UNAVCO

WInSAR operated by UNAVCO under GAGE (Geodetic Facility for the Advancement of Geoscience (GAGE)) Cooperative Agreement. *Oct. 2018 – Sept. 2023*

WInSAR funded ~1 FTE in GAGE, supported by NSF & NASA

Activities

- Project management and Executive Committee support
- Archive operations & maintenance
- Tasking, data ordering, data ingest
- Website/portal and user community support
- ISCE software access management
- Community short course support



THE WINSAR COMMUNITY

303 WInSAR Institutional Members (9 new member institutions in 2019) =**1672 Registered Users**

Open sourcing of ISCE has resulted in decline in Adjunct (non-US) membership applications

Data:

102,997 = 136+ TB of data available for download

1,967 ALOS-2 wide swath scenes = 105+ TB

~2% of the scenes represent ~78% of the volume

InSAR Product Archive

Developed in 2014-2015 during SSARA project.

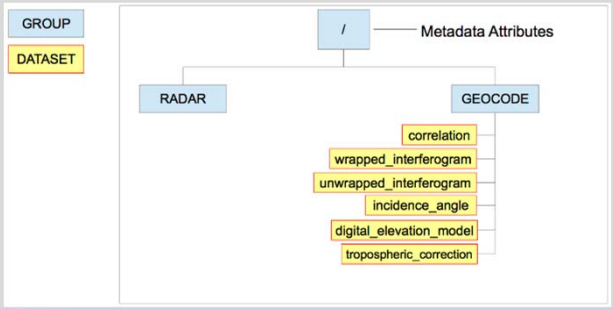
Community-contributed InSAR archive for interferograms, time series, and other derived data products: https://winsar.unavco.org/portal/insar

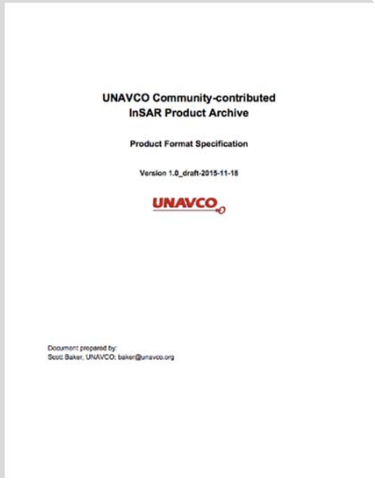
HDF5 format is used for the data products. Example converters for ROI_PAC, ISCE, and GMTSAR provided on SSARA GitHub repository

REST interface for uploading interferograms: https://winsar.unavco.org/portal/insar/api/

Datasets receive DOI =
use archive for FAIR data compliance when submitting publications.

HDF5-EOS Format





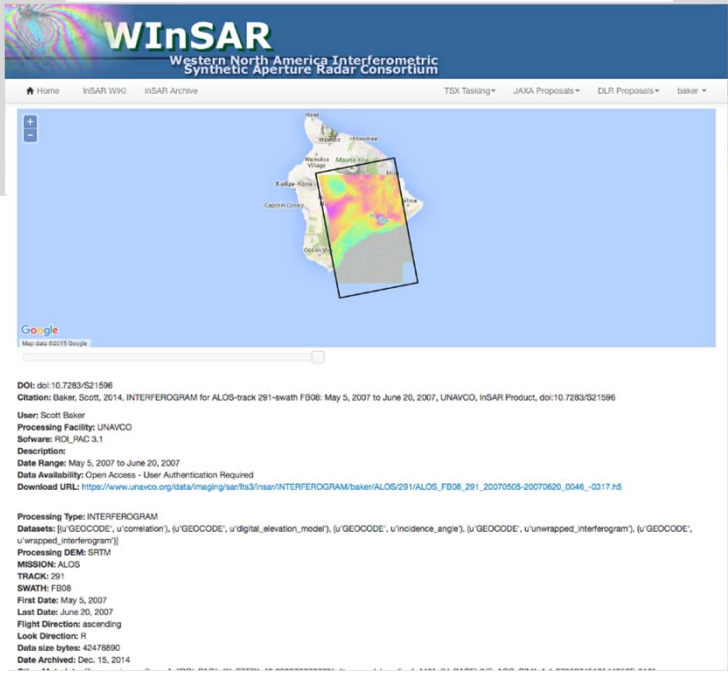
UNAVCO Community-contributed InSAR Product Archive

Product Format Specification

Version 1.0_draft-2015-11-18

UNAVCO

Document prepared by:
Scott Baker, UNAVCO; baker@unavco.org



DOI: doi:10.7283/S21596
Citation: Baker, Scott, 2014, INTERFEROGRAM for ALOS-track 291-swath FB08: May 5, 2007 to June 20, 2007, UNAVCO, InSAR Product, doi:10.7283/S21596

User: Scott Baker
Processing Facility: UNAVCO
Sofware: ROI_PAC 3.1
Description:
Date Range: May 5, 2007 to June 20, 2007
Data Availability: Open Access - User Authentication Required
Download URL: https://www.unavco.org/data/imaging/sar/lts3/insar/INTERFEROGRAM/baker/ALOS/291/ALOS_FB08_291_20070505-20070620_0046_-0317.h5

Processing Type: INTERFEROGRAM
Datasets: [(u'GEOCODE', u'correlation'), (u'GEOCODE', u'digital_elevation_model'), (u'GEOCODE', u'incidence_angle'), (u'GEOCODE', u'unwrapped_interferogram'), (u'GEOCODE', u'wrapped_interferogram')]
Processing DEM: SRTM
MISSION: ALOS
TRACK: 291
SWATH: FB08
First Date: May 5, 2007
Last Date: June 20, 2007
Flight Direction: ascending
Look Direction: R
Data size bytes: 42478890
Date Archived: Dec. 15, 2014

GAGE National Science Foundation's Geodetic Facility for the Advancement of Geoscience

UNAVCO

GeoSCIFramework: Scalable Real-time Streaming Analytics and Machine Learning for Geoscience and Hazards Research

Real-time streaming analytics on continuous integrated data streams from thousands continental and oceanic high-rate sensors, when combined with **satellite radar time series**, give a coherent high-resolution global-scale view of the motions of the earth.

Collaborators: UNAVCO/GAGE (Meertens, Lead), Rutgers University (Ocean Observatories Initiative - OOI), University of Colorado, University of Oregon, IRIS/SAGE, University of Texas Arlington (TACC/XSEDE)

Integrated data access: The framework leverages and provides seamless access to considerable NSF investments in EarthScope (GAGE and SAGE) and OOI in situ sensor networks, internationally-operated space radar systems, and NSF XSEDE computational and data storage resources.

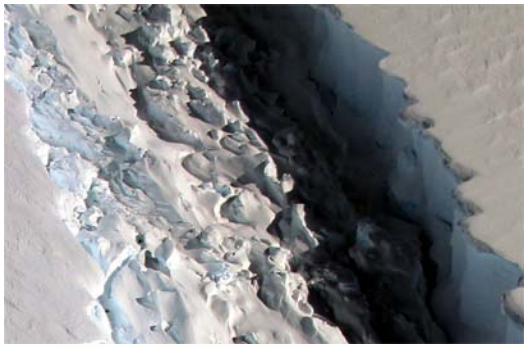
Algorithm development: An interactive environment allows users to test, modify, and implement their ideas as they integrate the large variety and volume data into new algorithms and products.

4-yr project started 1 Jan 2019

G13C-0574

SCIENCE






NASA Brief to WInSAR

Gerald Bawden

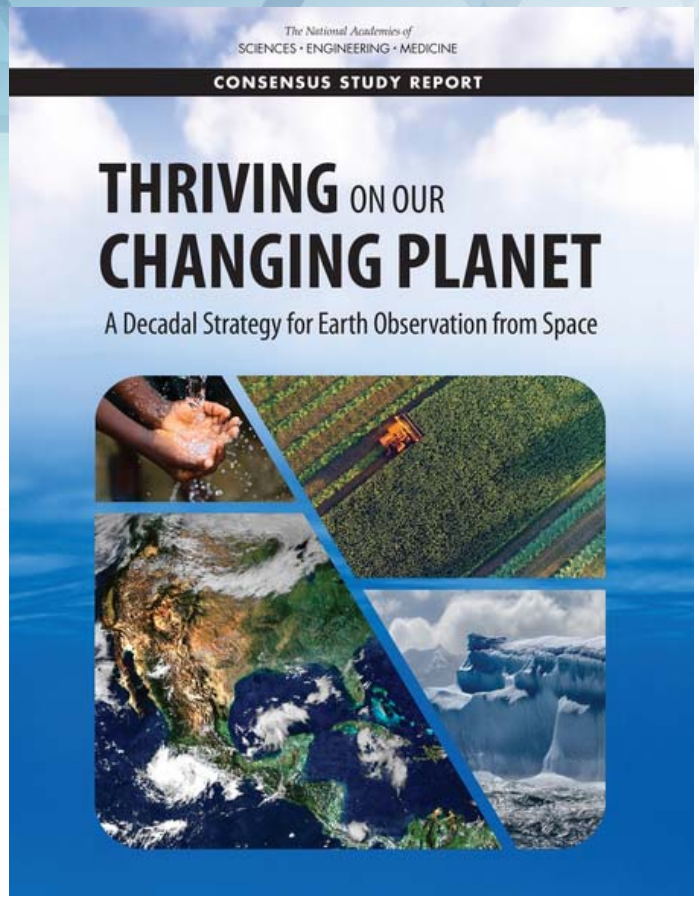
Earth Science Division, NASA HQ

December 11, 2019

Changes at NASA HQ

- Mike Freilich retired in February – *advertisement on the street*
- Sandra Cauffman is the Earth Science Division Acting Director
- Paula Bontempi is the Earth Science Division Acting Deputy Director
- Gerald Bawden (me) is the Program Scientist for Geodetic Imaging – replacing the retired Craig Dobson
  - NISAR, UAVSAR Family (P-, L-, Ka-band) airborne system, ASF, Surface Deformation and Change DO Study, International SAR,….
- Thorsten Markus is the Program Scientist for Cryosphere – replacing Tom Wagner

2017 DECADAL SURVEY

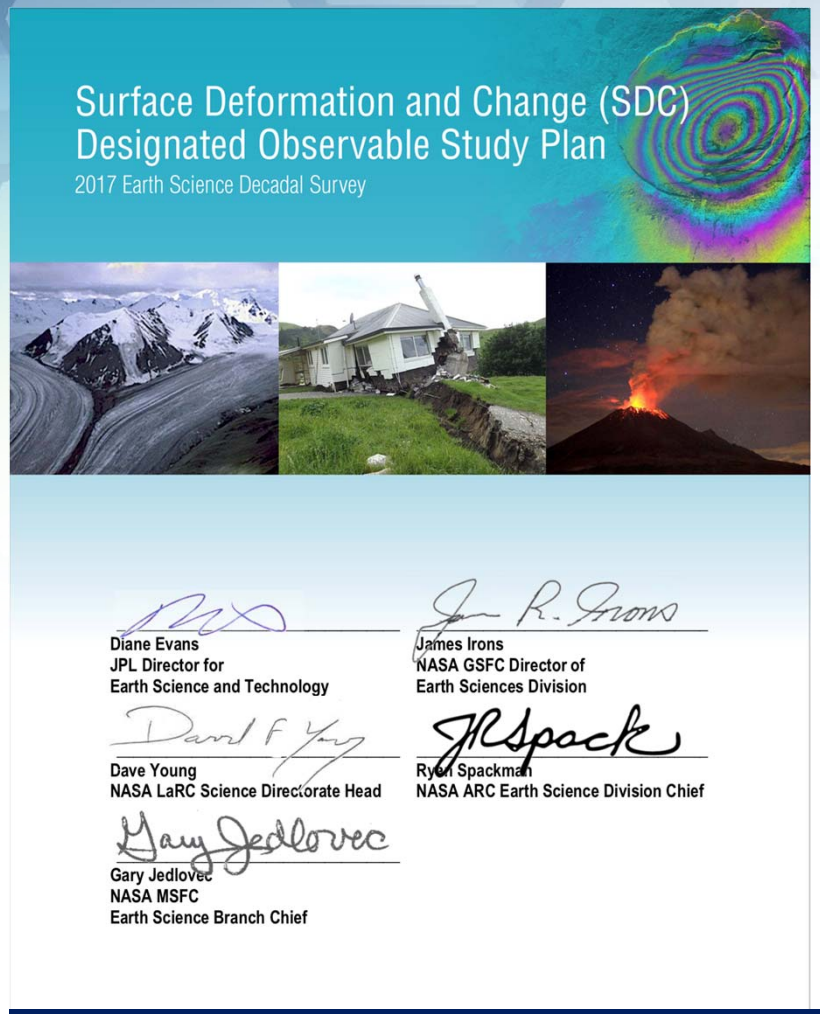


2017 Decadal Survey Snapshot

- Supports the ESD (and international) *Program of Record*
- Explicitly encourages *international partnerships*
- Calls for "cost-capping" essentially all missions
- Endorses *existing balances* in ESD portfolio
- Identifies 5 "**Designated Observables**"
- Introduces a new competed "**Explorer**" flight line with $350M cost constraint
- Calls for "**Incubator Program**" to mature specific technologies for important – but presently immature – measurements (preparation for next Decadal)

https://www.nap.edu/catalog/24938/thriving-on-our-changing-planet-a-decadal-strategy-for-earth

Surface Deformation and Change Architecture Study Objectives

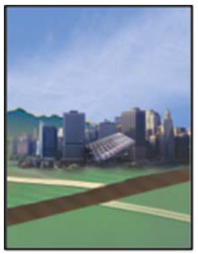


https://science.nasa.gov/earth-science/decadal-sdc

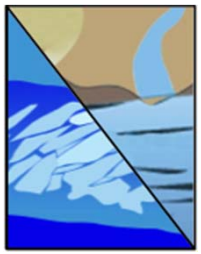
- **Determine cost-effective SAR-based architecture to implement the Decadal Survey's Surface Deformation and Change Observable – *SAR phase***
- **Evaluate other Science and Applications that SAR can enable in the trade space – *SAR backscatter***
- **Engage emerging best and new practices in industry to maximize engagement and exploitation of commercial sector capabilities and interests, including smallsat constellations**
- **Explore international partnerships to leverage capability and reduce cost.**


Solid Earth


Ecosystems


Geohazards


Hydrology


Cryosphere

2019 NISAR Science Team + NISAR Project Team members - Cal/Val

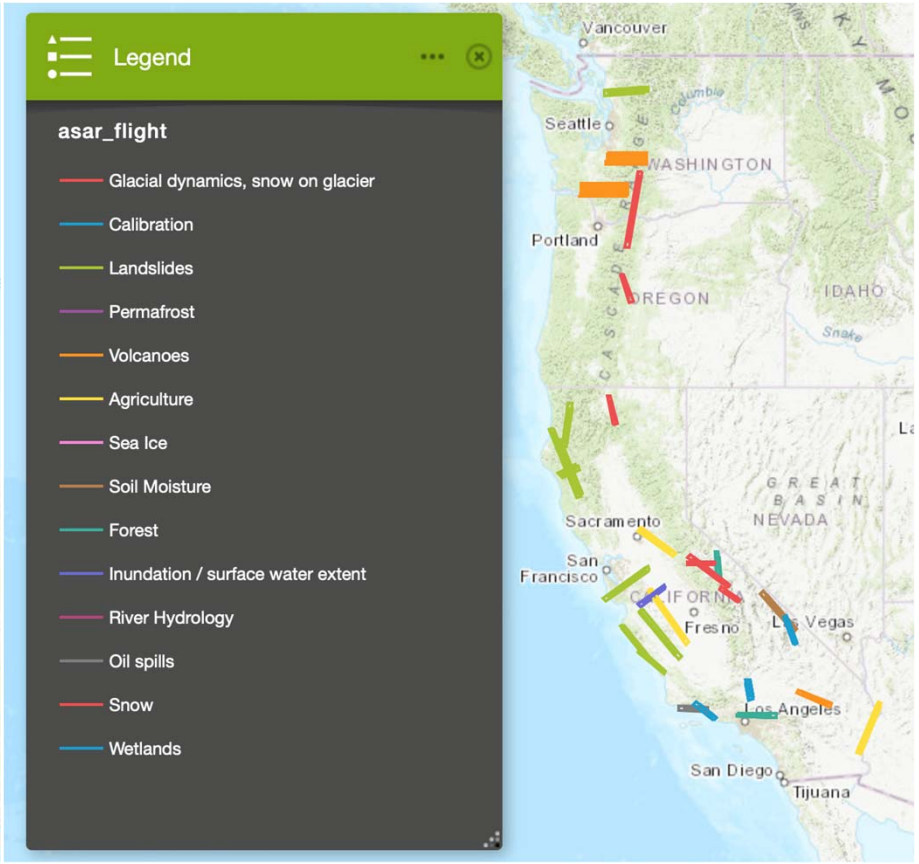
ISRO Airborne Campaign – Phase 1

Dec 4 – 16, 2019

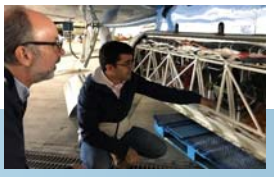
Background

The US lacks a duel L- & S- (24, 9 cm wavelengths) Synthetic Aperture Radar (SAR) imaging capability that can be used to develop and refine algorithms in advance of the NISAR Mission (Anticipated launch date January 2022). ***There is no L+S band radar dataset in the United States.***

The science topics range from Cryosphere (glaciers, sea ice, freeze/thaw), Hydrology (soil moisture, snow, lakes/rivers), Earth Surface and Interior (lava flow geology, landslides, volcanic processes), and Terrestrial Ecology (biomass, agriculture, forest), Applications (oil spills), permafrost, and Calibration/validation.

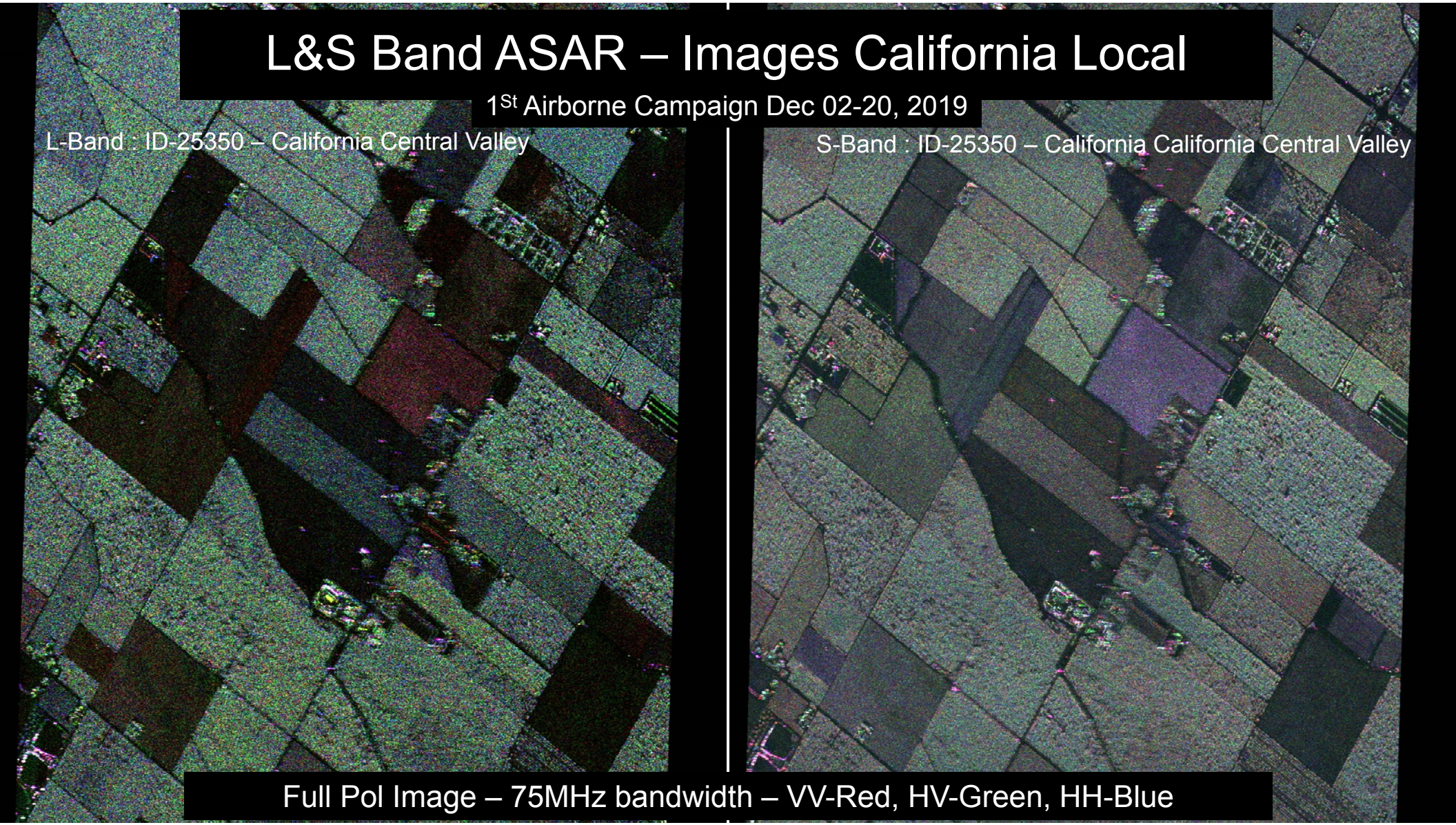


https://nasa.maps.arcgis.com/apps/webappviewer/index.html?id=d4897ae8815e453da1f7c72cee382c12



L&S Band ASAR – Images California Local

1St Airborne Campaign Dec 02-20, 2019



Full Pol Image – 75MHz bandwidth – VV-Red, HV-Green, HH-Blue

sentinel-1

→ RADAR VISION FOR COPERNICUS

esa

opernicus

Sentinel-1 Mission Status

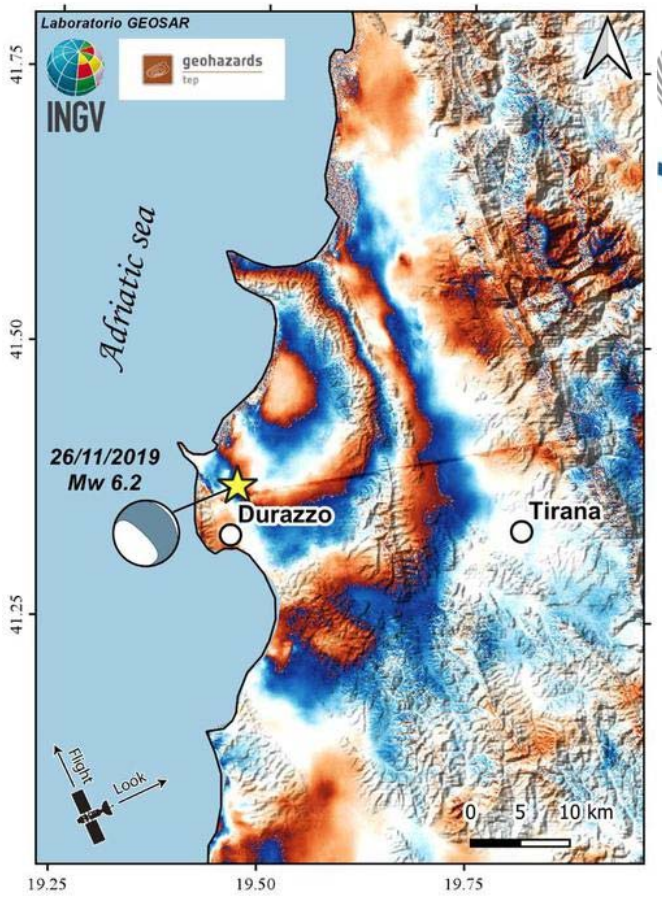
Prepared by:
Pierre Potin, Sentinel-1 Mission Manager, ESA

Presented by Jérôme Benveniste, ESA

WInSAR meeting – AGU
11 December 2019
San Francisco, USA

Sentinel-1 mission status

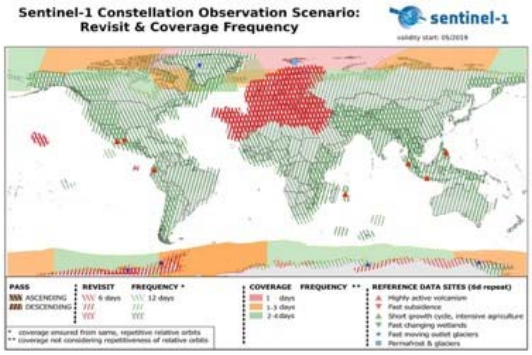
- Sentinel-1A and Sentinel-1B overall mission operations → **nominal**
- **Routine provision** of Sentinel-1 data **to operational services**
- Strong Sentinel-1 **contribution to emergency activations**, in particular from the Copernicus Emergency Management Service and from the International Charter Space and Major Disasters, for flood monitoring in particular
- **Both satellites are in good health,** no significant degradation observed
- Sentinel-1 is operated close to its **full mission capacity** (i.e. difficulty to accommodate additional observations)

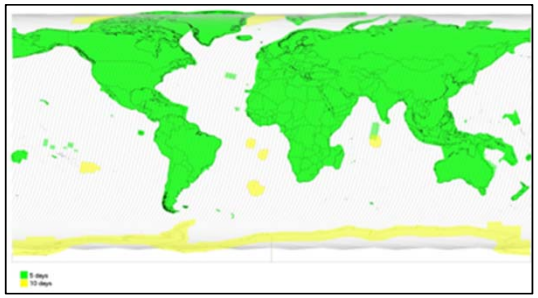


M6.2 Albania earthquake, 26 Nov 2019 – Sentinel-1 interferogram

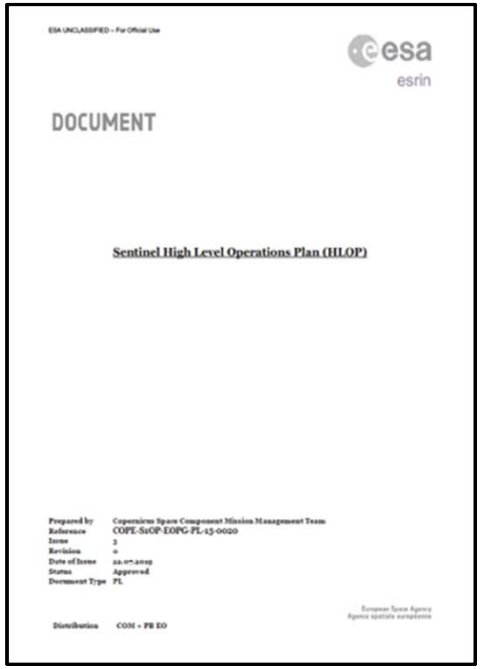
Uplift of about 10 cm near Durrës

Sentinel High Level Operations Plan (HLOP)





- A new Sentinel HLOP revision loop was launched in January 2019 with Copernicus Participating States and Copernicus Services
- The **Sentinel HLOP revision 3.0** (dated 22nd July 2019) reflects the completion of the **full operational capacity** (i.e. constellation of the Sentinel-1, -2, -3 A and B units as well as Sentinel-5P)
- The **HLOP** was unanimously **approved at the September 2019 PB-EO meeting**
- The HLOP document was previously **reviewed and accepted by the European Commission**



Sentinel HLOP version 3.0 available at:

https://sentinels.copernicus.eu/web/sentinel/news/-/article/new-version-of-the-copernicus-sentinel-hlop-available

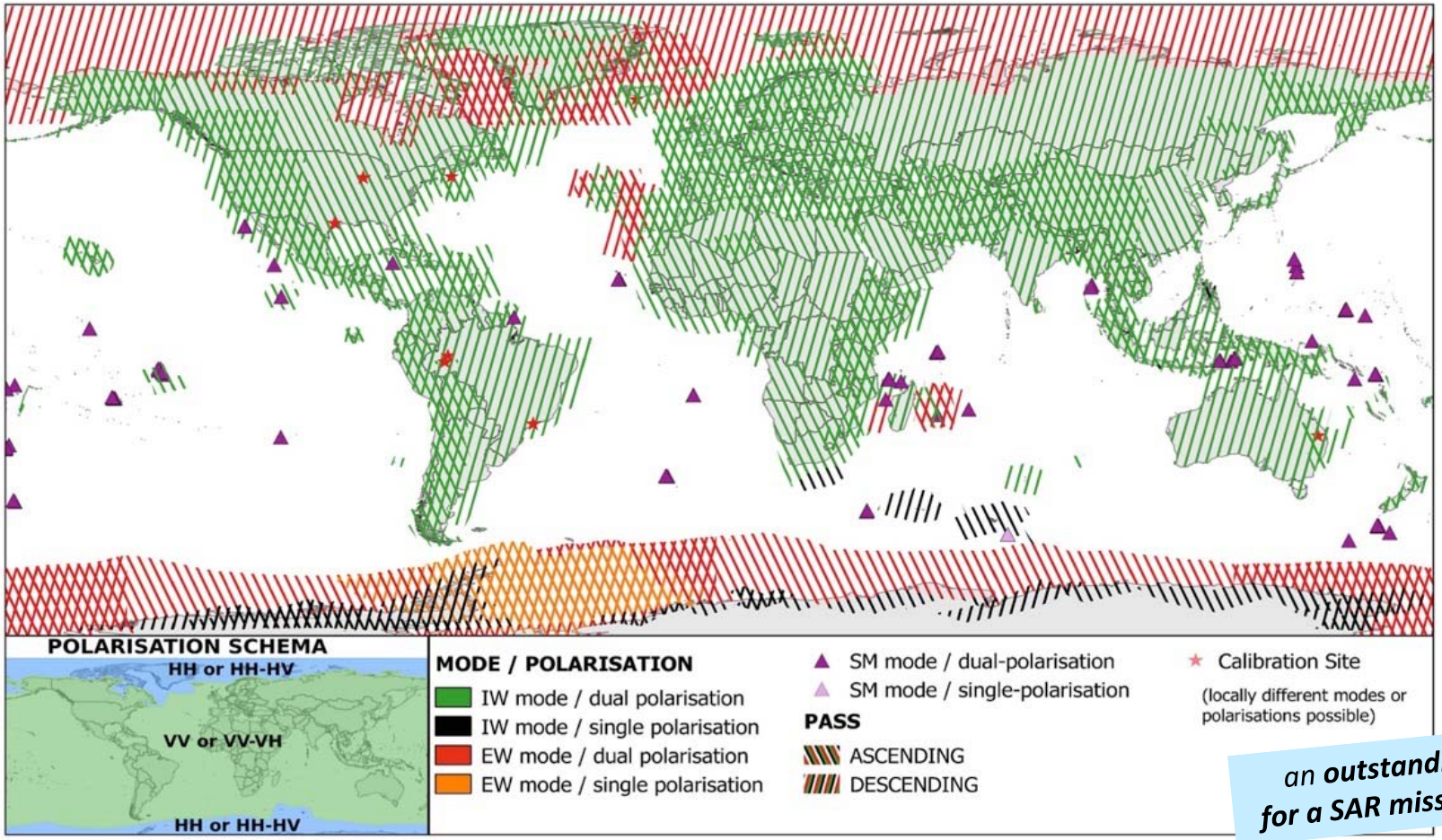
https://sentinels.copernicus.eu/documents/247904/685154/Sentinel_High_Level_Operations_Plan

Sentinel-1 Constellation Observation Scenario: Mode - Polarisation - Observation Geometry

sentinel-1

validity start: 05/2019

esa



Updated Baseline Map , starting May 2019

This map is related to SAR High Rate modes only. Wave mode operated by default over open oceans (not shown)

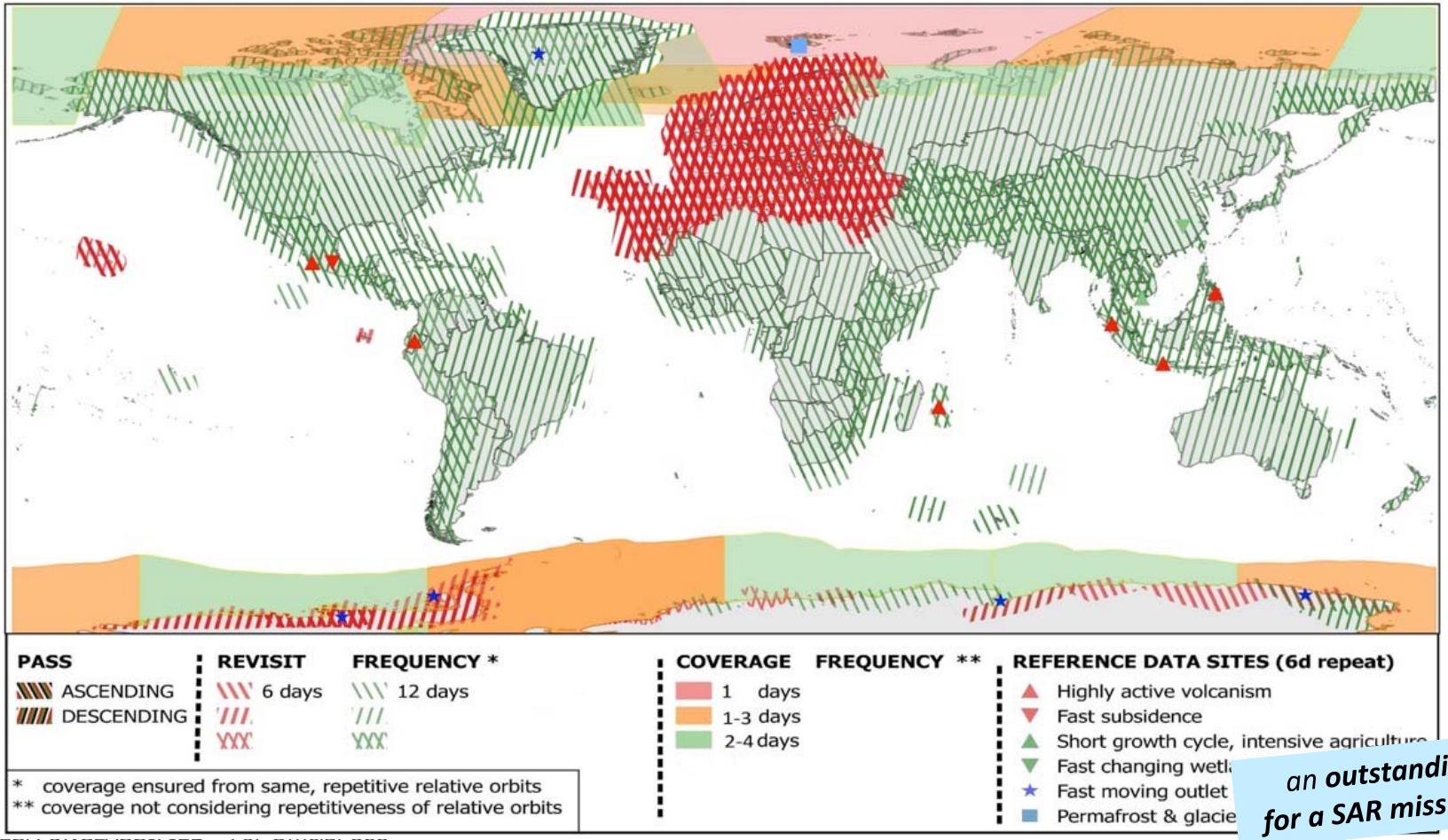
*an **outstanding coverage achievement** **for a SAR mission,** predictable and reliable!*

Sentinel-1 Constellation Observation Scenario: Revisit & Coverage Frequency

sentinel-1

validity start: 05/2019

esa



Updated Baseline Map , starting May 2019

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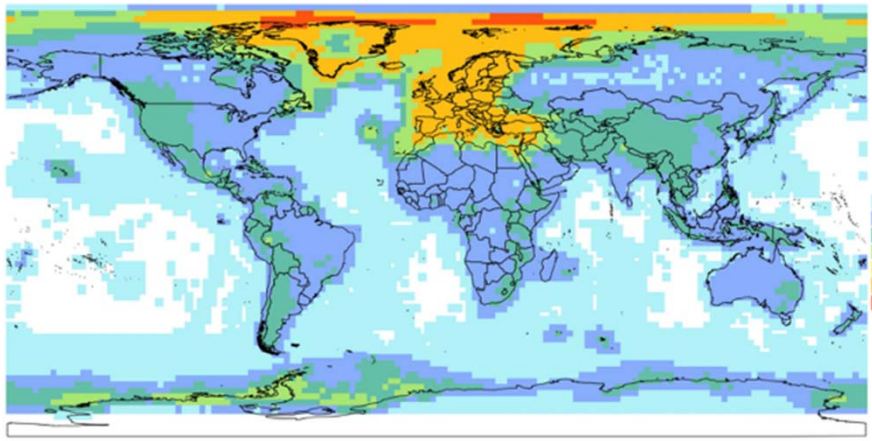
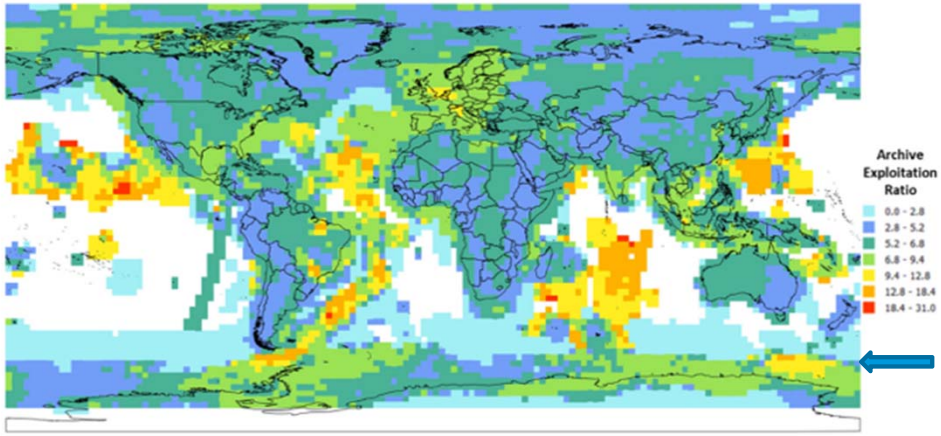
*an **outstanding coverage achievement** **for a SAR mission,** predictable and reliable!*

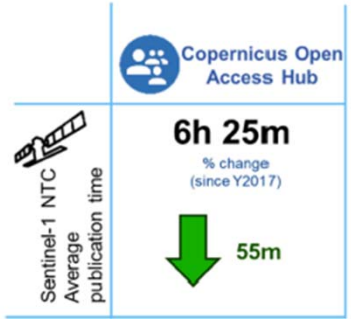
Sentinel Data Access 2018 Report
Examples of Sentinel-1 data product / user statistics



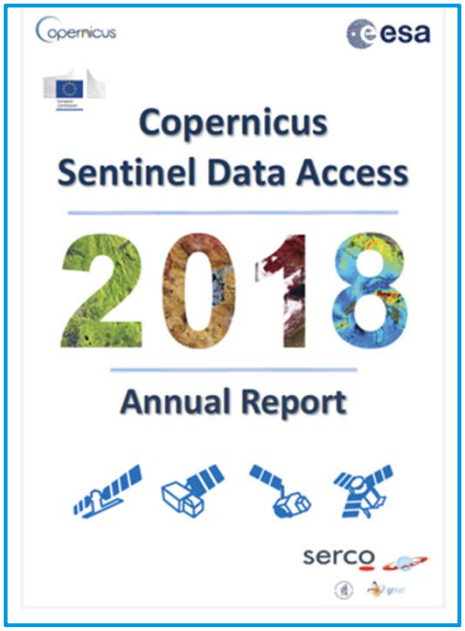
Heatmap of Sentinel-1 products (excluding OCN) published since the start of operations



Heatmap showing the archive exploitation ratio for Sentinel-1 L0 and L1 NTC products (excluding WV mode) during Y2018



Average publication timeliness on the Open Access Hub during Y2018



https://scihub.copernicus.eu/reportsandstats/

Sentinel-1 mission evolution

Ongoing / planned:

- Further **optimisation of observation scenario**
- Mitigation of C-band **SAR interferences** between Sentinel-1 and Radarsat Constellation Mission
- Further improvement of **Radial Surface Velocity** component (Level 2 OCN product)
- Analysis (and later implementation) of **S1C unit phasing with S1A / S1B**

Subject to decisions:

- Possibly, generation of **S-1 Analysis Ready Data** (**ARD) product (Radiometrically Terrain Corrected – RTC**, making use of the new **Copernicus DEM**), starting with demo product.
  => Strong request from user community

- **Operational tropical cyclone monitoring** over oceans with on-demand Sentinel-1 tasking (so far performed on best effort, decision to be made on service side)
- **Wave Mode** enhanced to **Dual Polarisation** (would be a major change, formal request needed)

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There is a good probability to have Sentinel-1C joining S1A and S1B in the timeframe 2022-2023.
Nothing yet confirmed, but working with the Copernicus Services on best S1C phasing with S1A and S1B…

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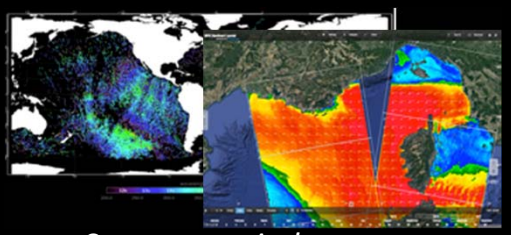
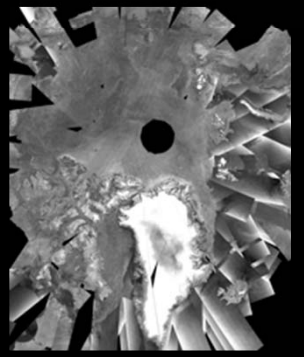
Sentinel-1 applications

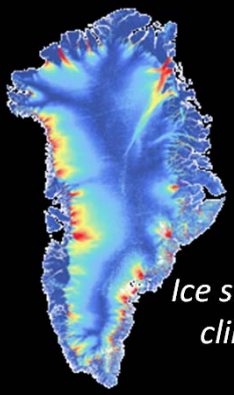
Maritime surveillance: oil spill monitoring, ship detection, illegal fisheries, etc.



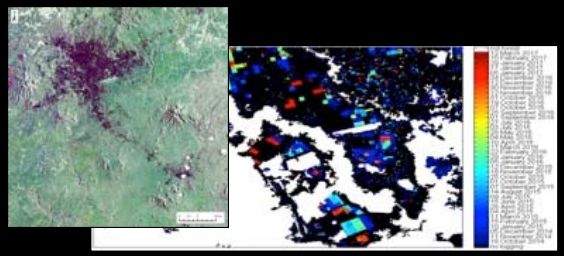
Sea state: wind, wave

Sea ice and iceberg monitoring

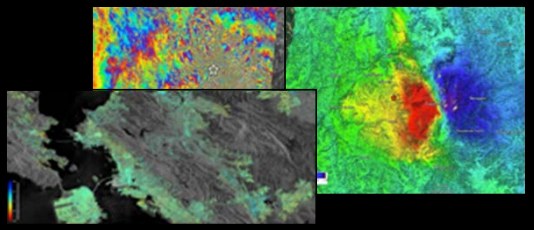




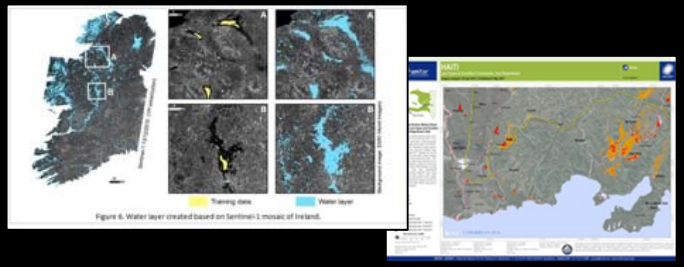
Ice sheets, glaciers, climate change



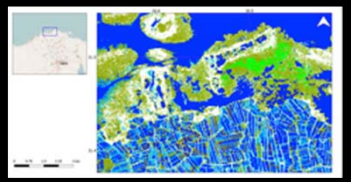
Land use, agriculture, forestry, urban planning



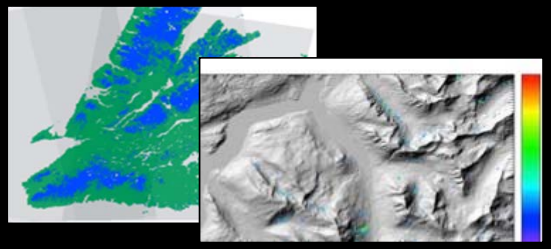
Ground deformation: subsidence, landslides, earthquakes, volcanoes, infrastructure monitoring



Emergency management



Soil moisture, wetland



Snow, permafrost, avalanches,…

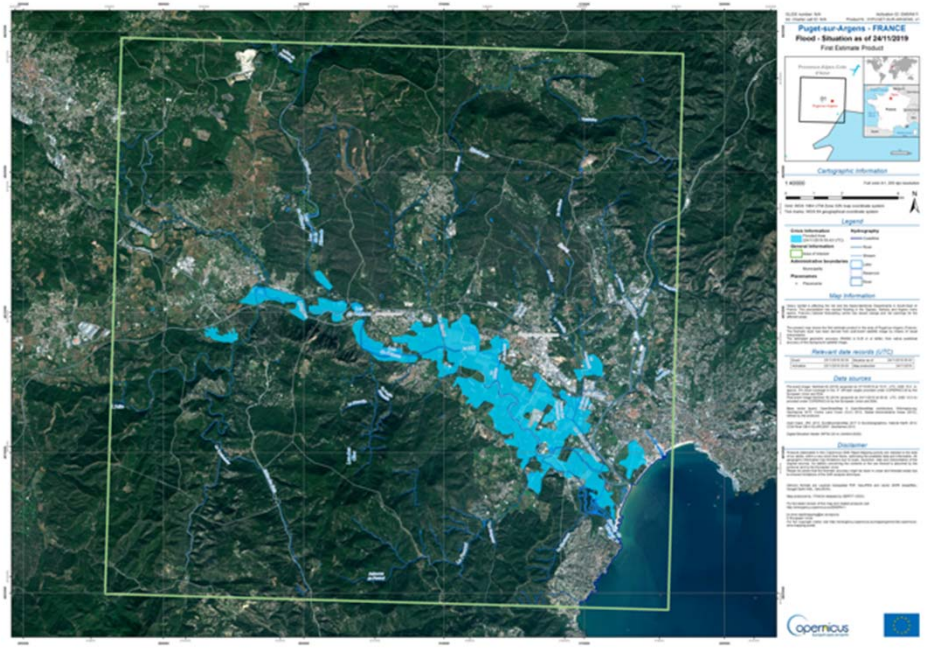
Thank you for your attention !

Copernicus Programme: copernicus.eu

Sentinel Online: sentinels.copernicus.eu

CSC Data Access: spacedata.copernicus.eu

ESA Sentinel app: available for iOS and Android



Flood map of Puget-sur Argens, France

based on Sentinel-1 image acquired on 24 November 2019

Activation EMSR0411 from the Copernicus Emergency Management Service

Dec. 11, 2018

WINSAR MEETING
FALL AGU 2019

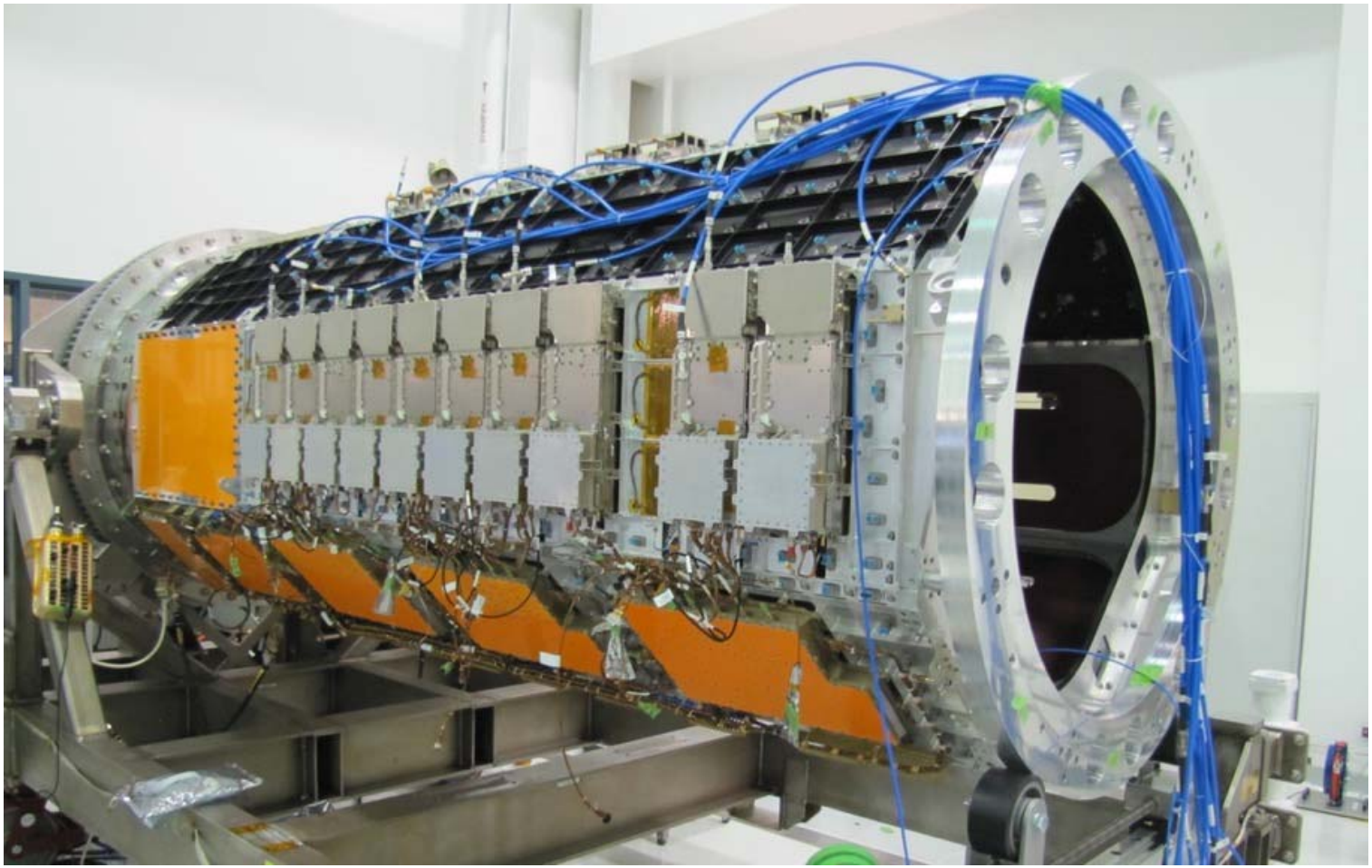
NISAR Mission and ISCE Update

Paul A. Rosen
Project Scientist, Jet Propulsion Laboratory, California Institute of Technology
http://nisar.jpl.nasa.gov

NISAR Current Status

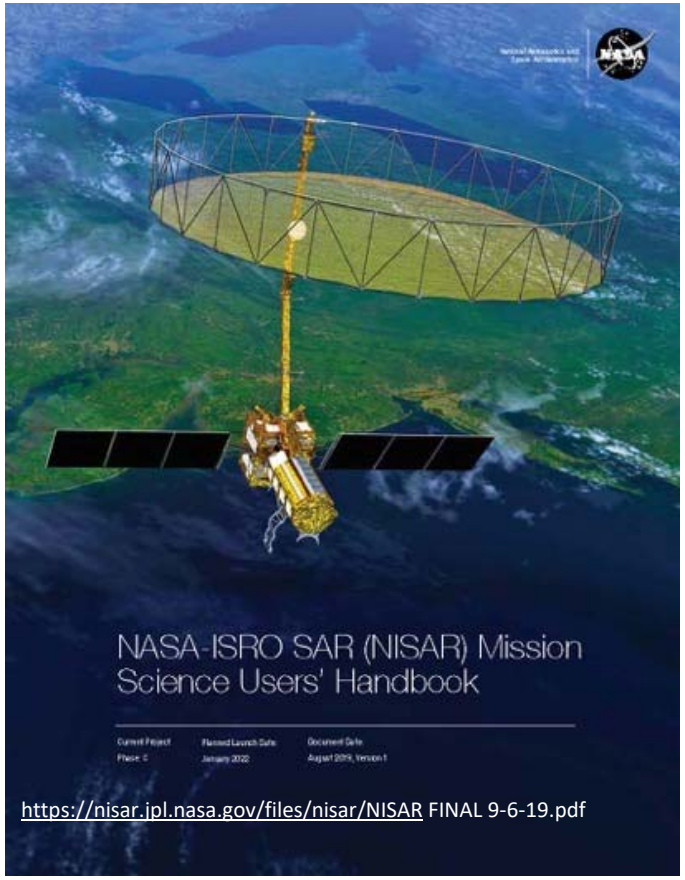
- Launch Readiness Date has slipped to May 2022
- Flight Systems are in process of Integration and Test
- Successful Mission Systems Critical Design Review in September 2019
- Revised observation plan for larger available downlink (35 Tb/day)
  - Cover North America at 40 MHz HH/HV + 5 MHz VV/VH
  - Extend North American coasts, reinstate some quad pol, other small changes
  - Reduce data culling in select high latitude locations
  - Increased radar sampling rate to improve image quality
- Science Team Activities
  - Entering Cal/Val Development Phase
  - Successful UAVSAR campaign to acquire time-series data at 6 AM and 6 PM over growing season in Southeast US.
    - Sample data products with NISAR formats and noise characteristics are being generated for community use

First Phase of Integration and Test – The Radar Instrument Structure



12-m Reflector is Assembled and Under Test

Science Users' Handbook Revised



https://nisar.jpl.nasa.gov/files/nisar/NISAR FINAL 9-6-19.pdf

Describes:

- Science and Applications
- Mission Science Requirements
- Mission Design and CONOPS
- Flight System Characteristics
- Radar and Measurement Principles
- Data Products
- Revisions include errata corrections and some updates

Other major documents:

- Cal/Val Plan
- Utilization Plan
- Application Workshop Reports
- 21 science and applications white papers

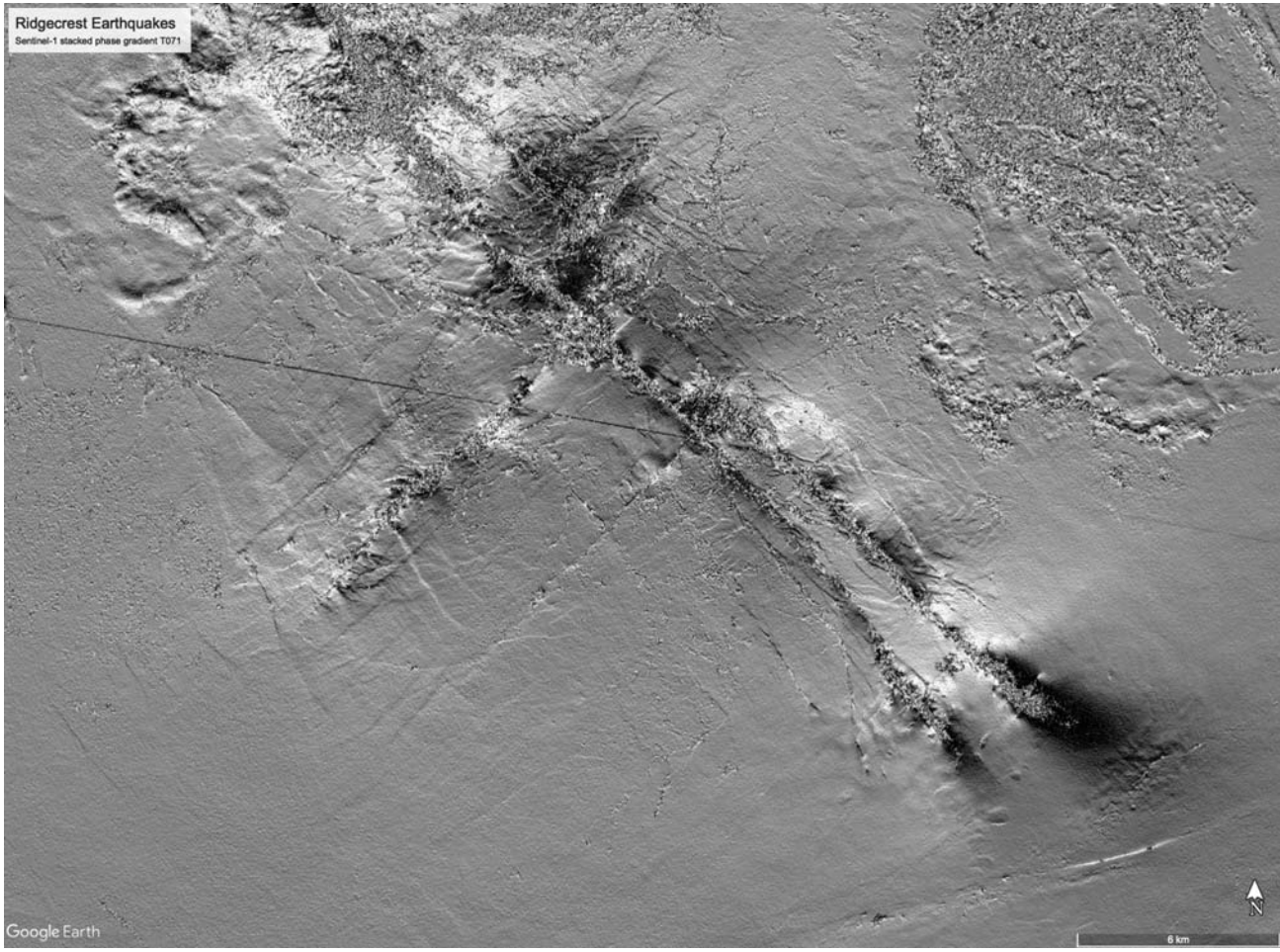
InSAR Scientific Computing Environment (ISCE)

- ISCE 2.3 is officially open source and on github
  - ISCE 2.X will continue to be maintained while ISCE 3.0 matures
- ISCE 3.0 is also officially open source and on github
  - NISAR-funded upgrade of ISCE
  - Faster, configuration managed, planned to be even more modular
  - Many modules now functional, but lack the framework
  - Not really ready for prime-time: INTERFACES WILL CHANGE
- Second Jupyter notebook-based ISCE/GIAnT training at UNAVCO Aug 2019
  - Anticipate third UNAVCO training in Aug 2020

NISAR Mission Animation – it's 6 minutes…

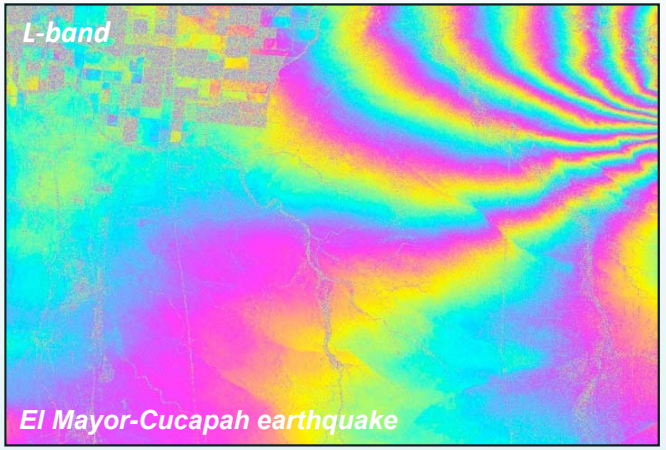
GMTSAR Progress https://github.com/gmtsar/gmtsar

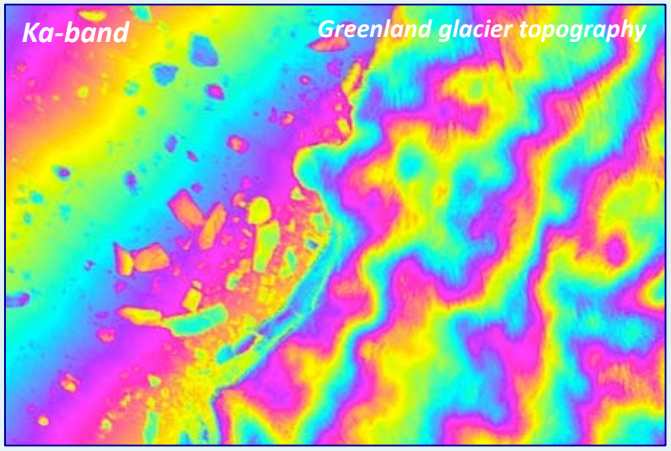
- Developers: Xiaohua (Eric) Xu, David Sandwell, Paul Wessel, Leonardo Uieda, Xiaopeng Tong, Robert Mellors, Meng (Matt) Wei, Scott Baker, and Anders Hogrelius
- Funding:
  - 3 years of funding from NSF Cyberinfrastructure
- Software distribution:
  - github; homebrew; macports
- New features:
  - S1 time series processing
  - Split spectrum ionosphere
  - Solid Earth tide correction (GACOS)
  - Integer ambiguity resolution
- Planned Features:
  - Ocean loading tide correction
  - Parallel sbas and xcorr
  - Automated testing
- UNAVCO short course:
  - SIO August, 2019
- Usage: 24,000 DEM downloads since March 2013



JAXA

UAVSAR Update



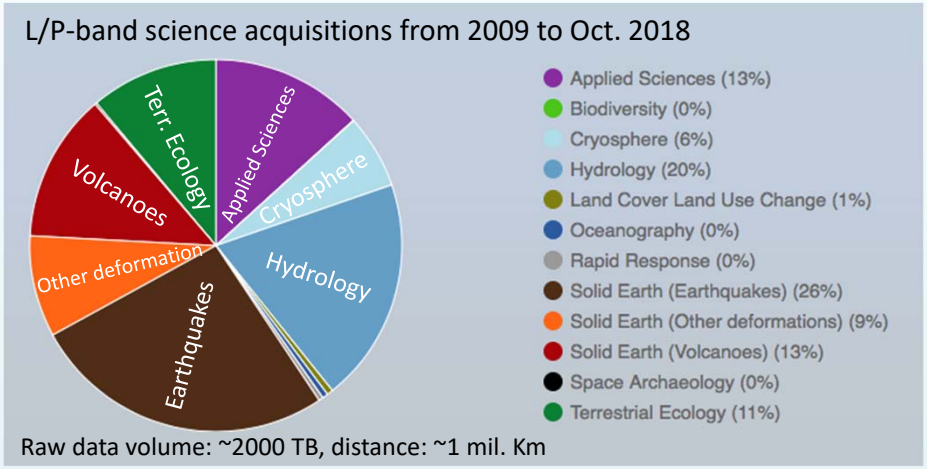


UAVSAR Project Manager: Yunling Lou

WINSAR Meeting, December 10, 2019

UAVSAR's Current Performance

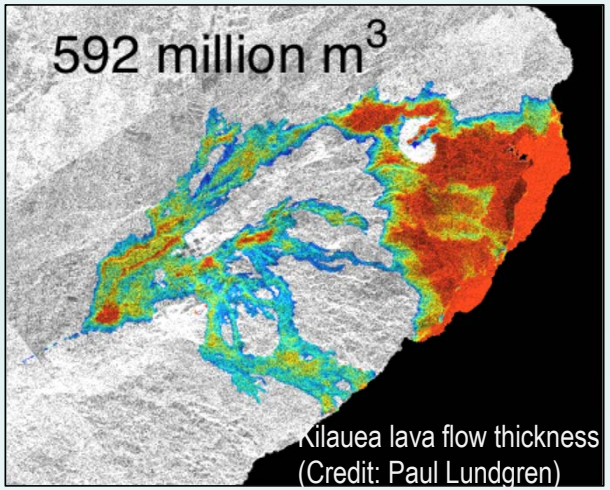
- Meeting science metrics: supporting ~500 flight hours of R&A requests per year, with increasing demand
- Three radar bands:
  - L-band polarimetric repeat-pass InSAR
  - P-band (AirMOSS) pol. repeat-pass InSAR
  - Ka-band (GLISTIN-A) single-pass InSAR
- Accommodation: pod-based radar mounted to bottom of G-III (AFRC and JSC)
- FY20: hosting ISRO L/S-ASAR in the UAVSAR pod to collect data in multiple disciplines in the US to support NISAR mission preparation



Non-pressurized pod with air inlets for cooling the radar electronics

Advantages of UAVSAR for Earth Surface Monitoring

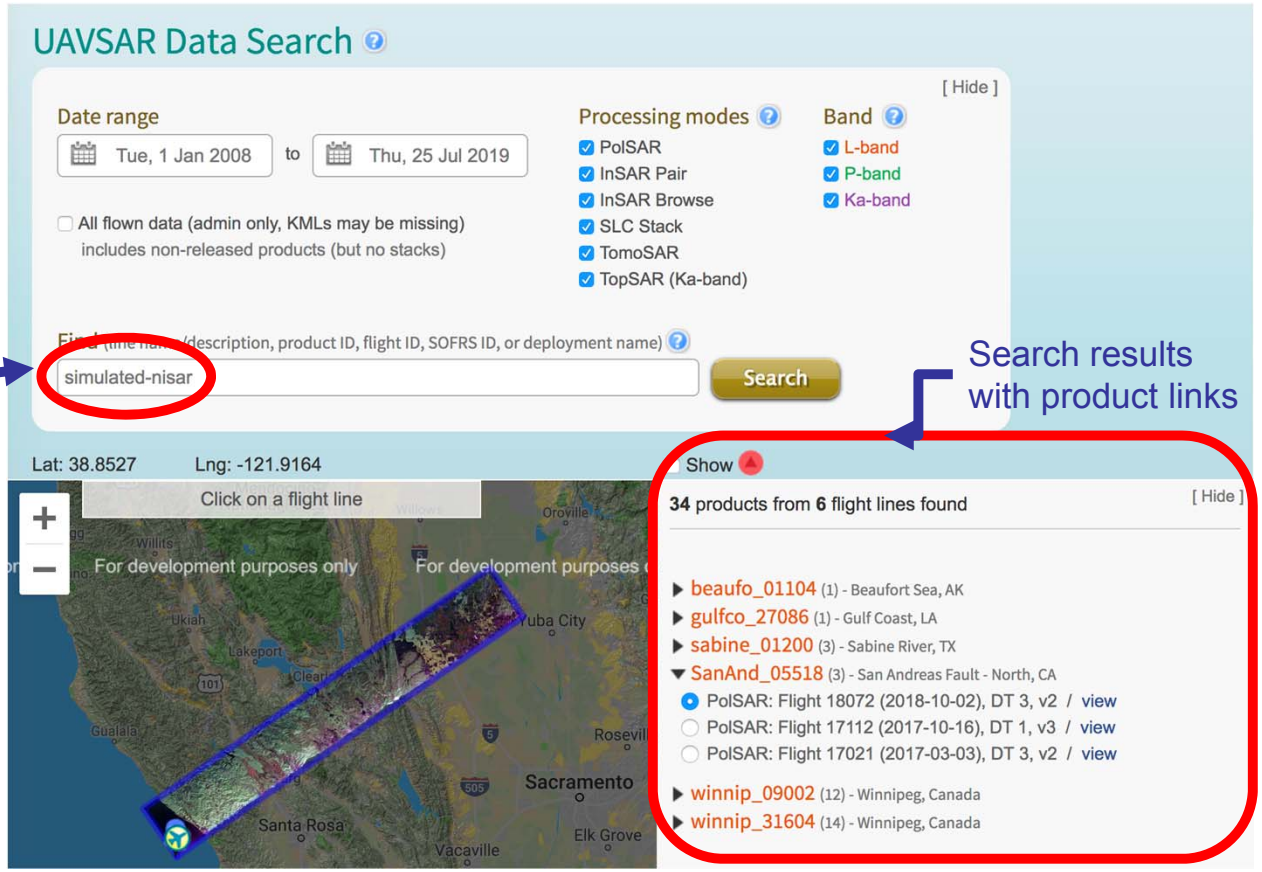
- Flexible viewing geometry, enabling the optimization of sensitivity to fault motion (e.g. San Andreas fault monitoring)
- High spatial resolution and sensitivity, enabling the observation of small localized motion such as landslides and small surface ruptures (e.g. El Mayor-Cucapah and Napa earthquakes)
- Flexible observation time, allowing us to dwell over a site for hours or conduct daily observations over rapidly evolving events (e.g. rapid response)
- P-band radar's longer wavelength has the potential to observe deep seated landslides and subsurface ground motion
- Ka-band single-pass InSAR is able to observe surface height changes on the order of tens of centimeters
  – e.g. Lava flow from 2018 Kilauea eruption



Simulated NISAR Products

- Add additive noise to convert the UAVSAR NEσ_0 to NISAR ranges
- Sub-band UAVSAR 80 MHz SLC data in range to 20, 40 or 5 MHz sub-bands

Search keyword for simulated NISAR products

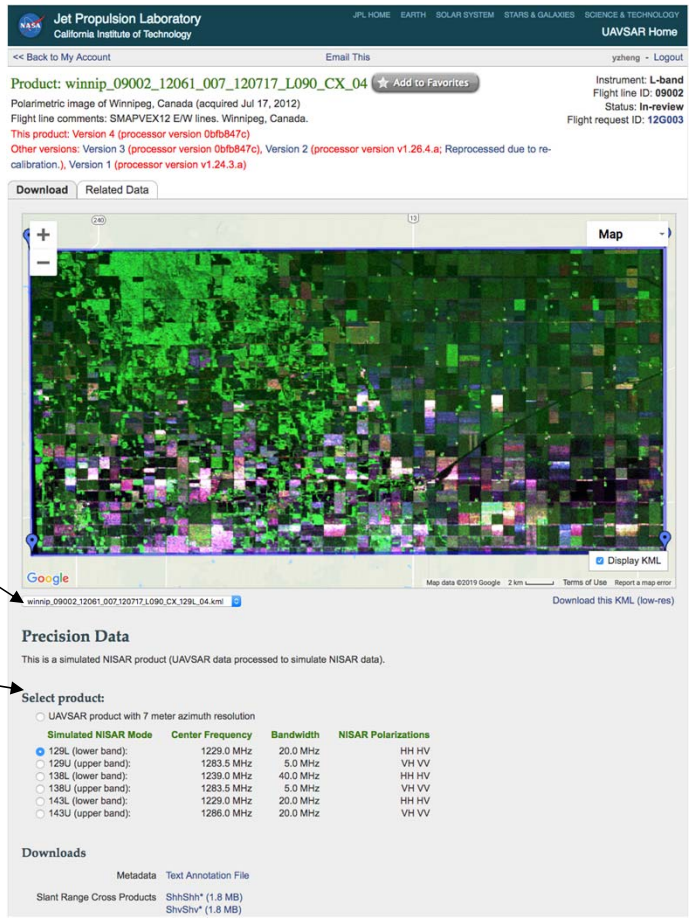


Search results with product links

Simulated NISAR Sample Products

- Products are compatible with ISCE
- Users can preview different modes of data in kml,
- Users can choose which mode of data to download

Simulated NISAR Product Page



wget commands on bottom of the page

UAVSAR Next Gen

Objectives

- Ensure robustness of current capabilities
- Modernize UAVSAR capabilities so that it could be a testbed to push the envelope of future technologies that will enable decadal surveys to make new measurements

Options

- Simultaneous multi-frequency capability
- Single-pass L-band InSAR
- Along-track interferometry
- Bistatic mode
- Operate on G-V
- Camera
- What else?


Alaska Satellite Facility 2019
Nettie La Belle-Hamer
ASF Director
GI Deputy Director

Headline News

- Alaska Governor cut the budget radically, but backed off when Recall Campaign proved initially successful
- Current cuts are still harsh, with more to come
- Planned three additional years of cutting if this Governor remains in office
- State government trying to decide if that is even legal…

UA Under Discussion

- A lot of unknowns, but we do know that the Geophysical Institute is and will remain the largest research institution in the State of Alaska
- The UA President and the Board of Regents have vowed to protect Research
  - Will honor all grants and contracts
  - Stated they plan to increase research funding
- **Proceeding with the business at hand and working to protect the Institute and insulate ASF**

NASA’s NISAR, to be launched in 2022, has an estimated data flow into ASF during mission of **one petabyte every 10 days**

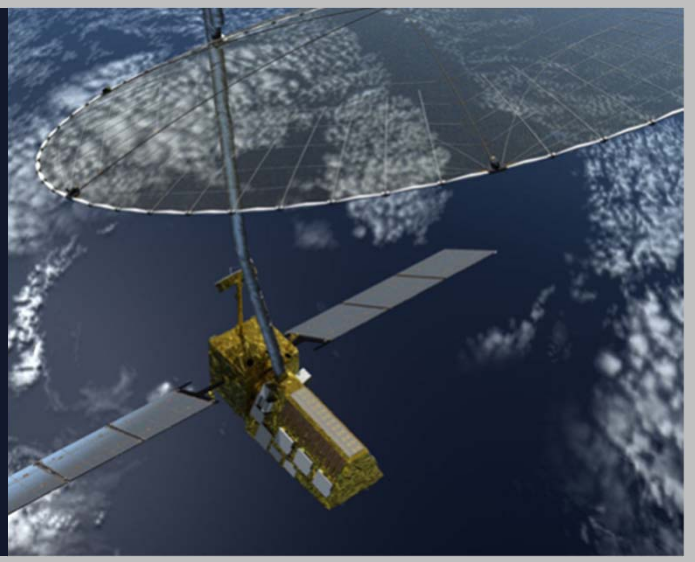
~150 petabytes over three years

80 TBs/day
generation

400 TBs/day
reprocessing

300 GB
Granules

150 PBs @ 50 Gbps
processing speed for months



Current ASF DAAC Activities Related to NISAR

- Getting Ready for NISAR (GRFN)
  - GRFN Successfully demonstrated in AWS, from the SDS to the ASF DAAC, processing and delivery at 5X the rate for NISAR
- Supporting global user community and global data sets
- ASF currently archives over 8 PB of SAR data
- Ingests over 2 PB of new Sentinel-1 data per year
- Data are available for immediate download at no cost to the user from ASF Data Search (https://search.asf.alaska.edu) and the ASF Search API
- Distributes 500-1,000 TB of data to over 5,000 distinct users each month
- Fully integrated into the Amazon Web Services (AWS) cloud for ingest, archive, and distribution

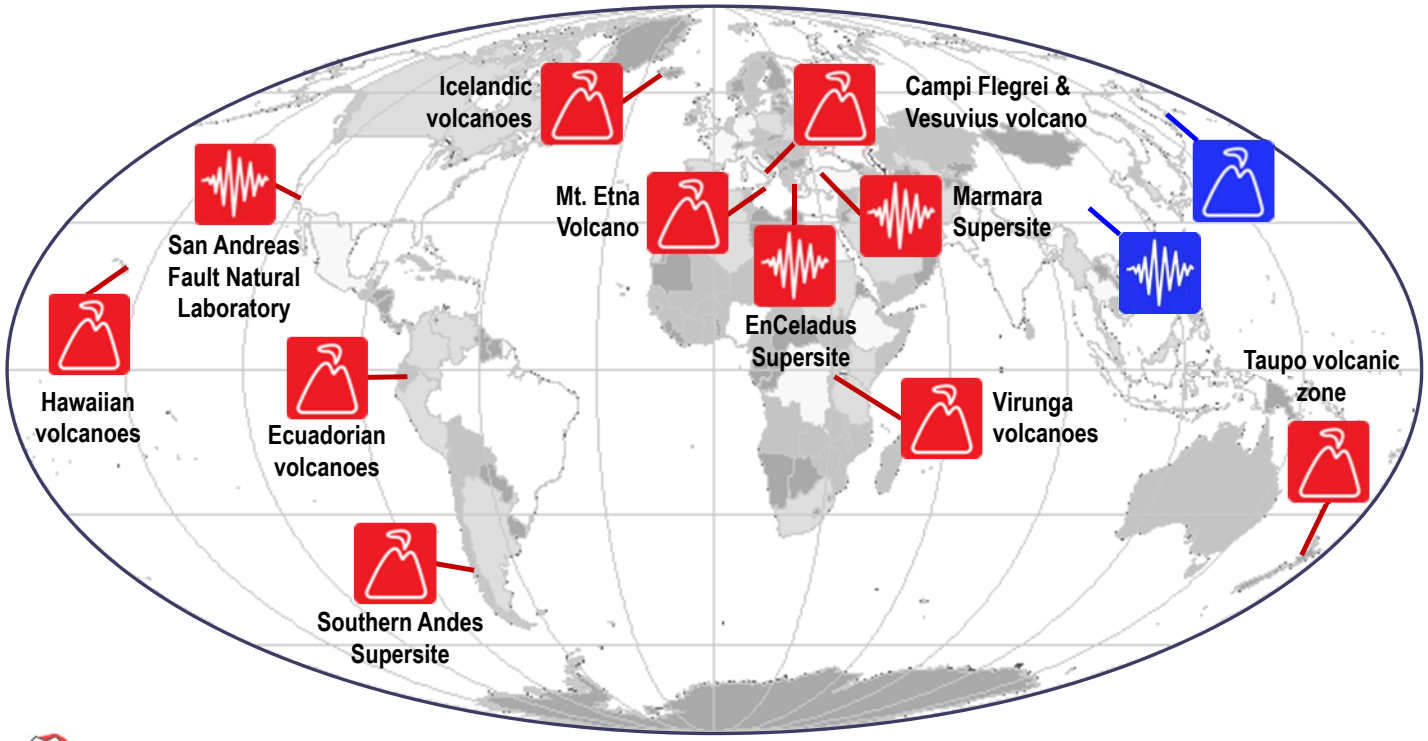
Things that are coming…

- ALOS-1 mirror site at ASF DAAC for PALSAR and AVNIR
  - Global
  - All reprocessed data set
  - Hosted in the cloud
- ASF UWG proposed to ESDIS for the Sentinel-1 RTC and GRFN spin off
- Capacity building through DAAC and other funding for SAR dat usage

Updates from the GEO Geohazard Supersites initiative

Michael Poland and Freysteinn Sigmundsson

The Supersite network in 2019



GSNL

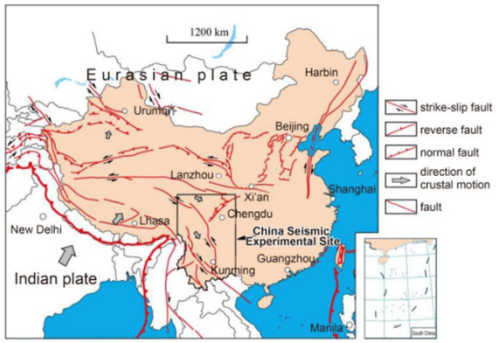
geo-gsnl.org

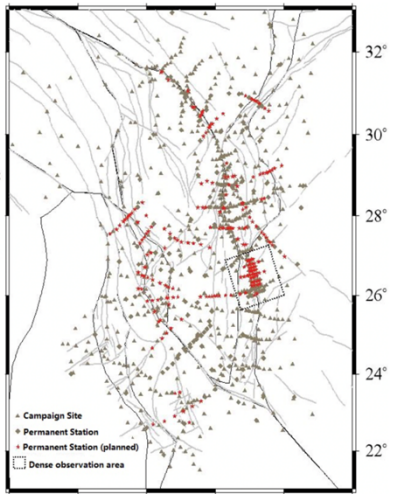
News

1. Two new Supersite proposals from China and Russia
2. 2019 training for Virunga and Ecuador Supersite scientists thanks to USGS VDAP and INGV: field geochemistry, InSAR data processing and source modeling
3. Provision to Supersite scientists of Virtual Machines with software for SAR/optical data processing and modeling (only for developing countries).
4. 3000+ CSK data available through the ESA-GEP.

China seismic Supersite objectives

1. **Imaging of new earthquakes.** Request to access Cosmo-Skymed, TerraSAR-X for all earthquakes in China with M > 6
2. **Post-seismic deformation along the Longmenshan fault.** Request acquisition of 6-day repeat Sentinel 1 imagery for track 62 over the fault of the 2008 M7.8 Wenchuan, Sichuan earthquake.
3. **Interseismic deformation along the Haiyuan fault.** Propose to image the creeping section of the fault with Cosmo-Skymed and TerraSAR-X.
4. **Support research at the China Seismic Experimental Site (CSES).** Request acquisition of 6-day repeat Sentinel 1 imagery and ALOS 2 data.



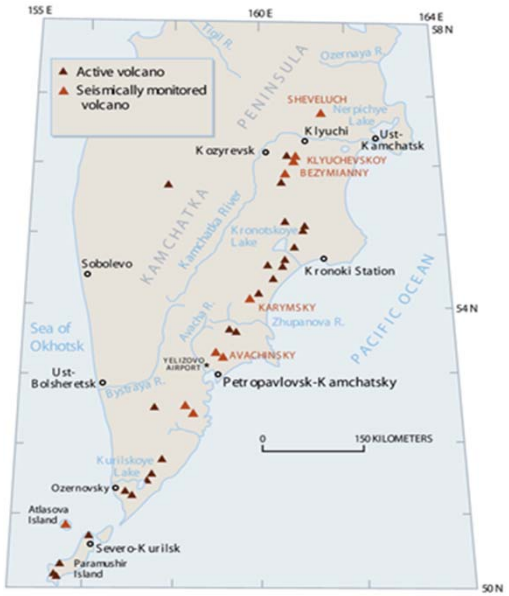


Proposed by Aerospace Information Research Institute, Chinese Academy of Sciences

The CSES site will provide multisensor imaging of a large seismic area.
Open data policy

Kamchatka/Kuriles Volcano Supersite objectives

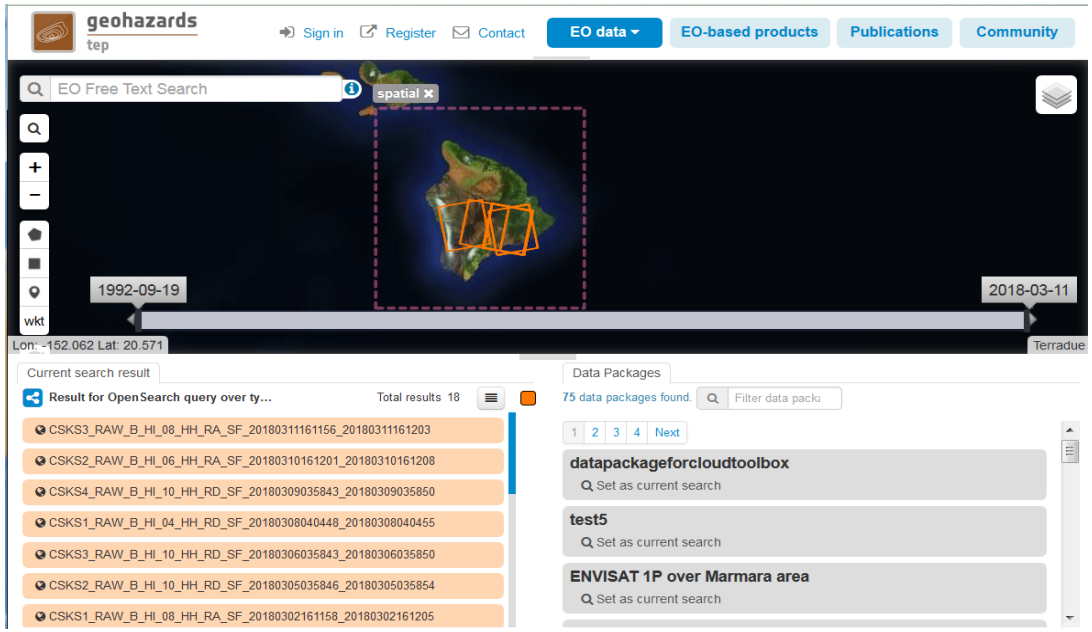
1. **Volcano hazard assessment.** HR InSAR data (CSK-TSX) and Pleiades for HR DEMS over several poorly mapped volcanoes.
2. **Volcano deformation monitoring and source modeling.** Request HR InSAR data (CSK-TSX)
3. **Track effusion/emission rates.** Request or access radar and optical satellite imagery and other aerial image products.
4. **Support local decision makers with hazard information.**



Proposed by Kamchatka Institute of Volcanology and Seismology

CSK data available through the GEP

Over 3000 images available
ESA-GEP: https://geohazards-tep.eu/
Instructions for access on website: geo-gsnl.org/open data/ satellite data



ALOS-2 OPERATION STATUS

Shinichi Sobue, Takao Fukuda,
Haruchika Kamimura, Osamu Ochiai, Akiko Noda,
and Takashi Omote

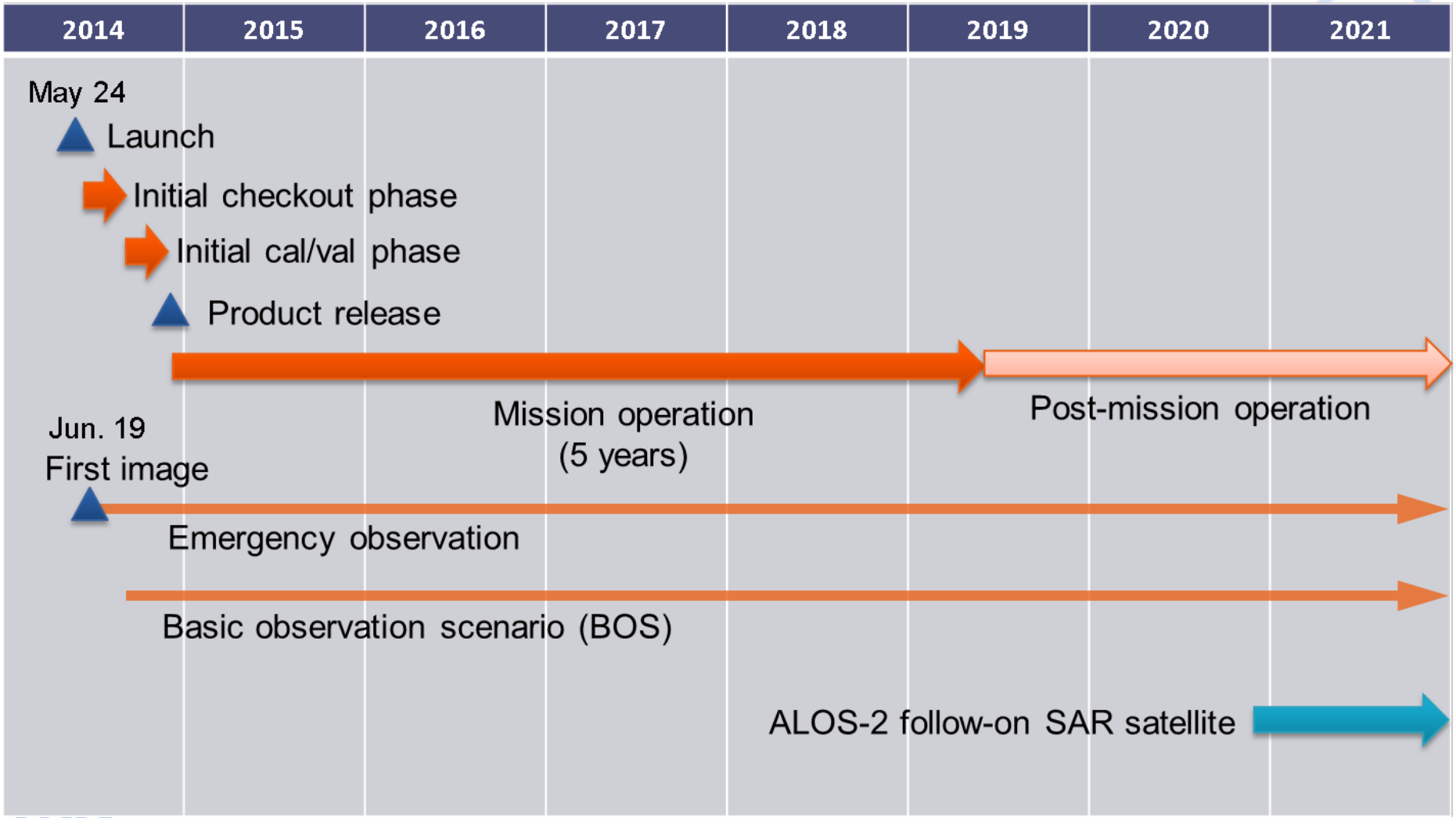
ALOS-2 Project team
Japan Aerospace Exploration Agency (JAXA)

December 11, 2019

ALOS-2

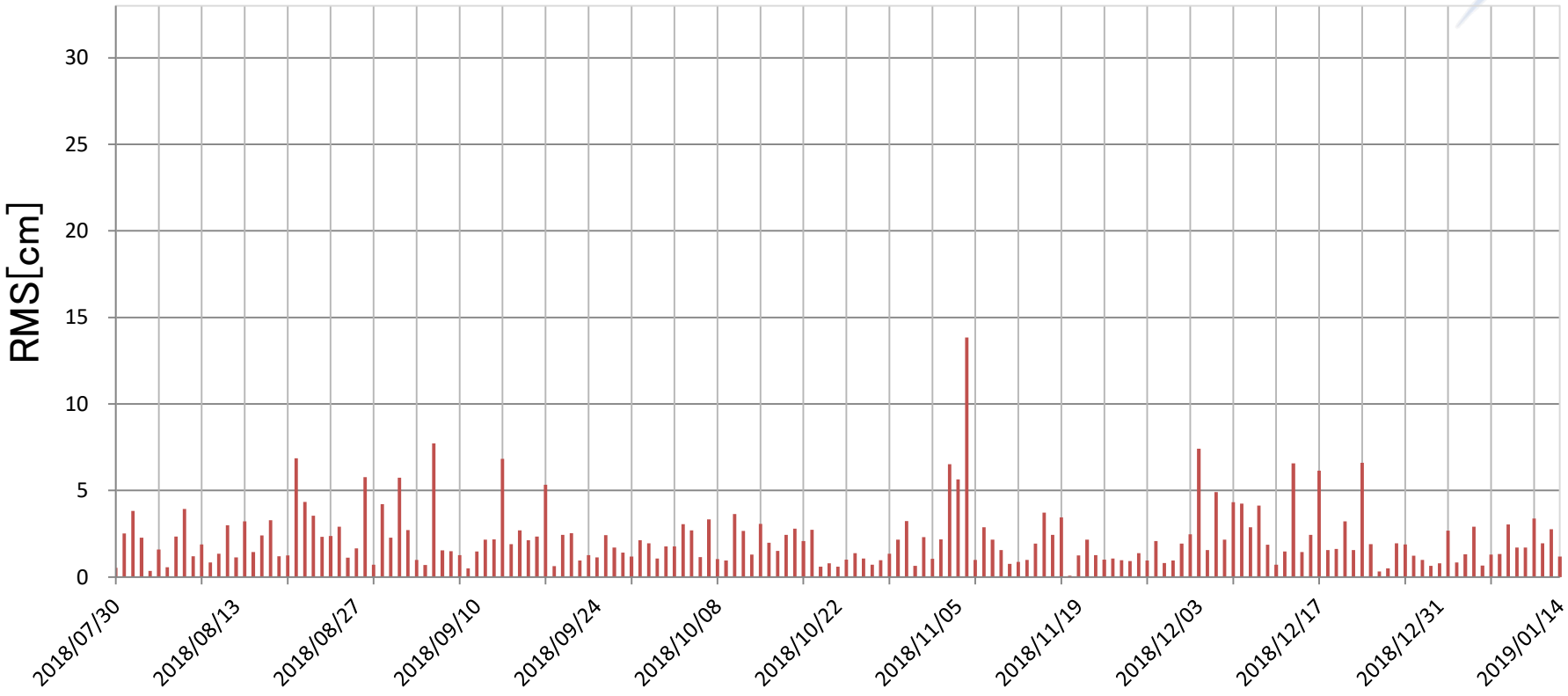
Application	Disaster, Land, Agriculture, Natural Resources, Sea Ice & Maritime Safety
L-band SAR (PALSAR-2)	Stripmap: 3 to 10m res., 50 to 70 km swath ScanSAR: 100m res., 350km/490km swath Spotlight: 1×3m res., 25km swath
Orbit	Sun-synchronous orbit Altitude: 628km Local sun time : 12:00 +/- 15min Revisit: 14days Orbit control: ≦+/-500m
Life time	5 years (target: 7 years)
Launch	May 24, 2014; H-IIA launch vehicle
Downlink	X-band: 800Mbps(16QAM) 400/200Mbps(QPSK) Ka-band: 278Mbps (Data Relay)
Experimental Instrument	Compact InfraRed Camera (CIRC) Space-based Automatic Identification System Experiment 2 (SPAISE2)

ALOS-2 schedule



Satellite operation

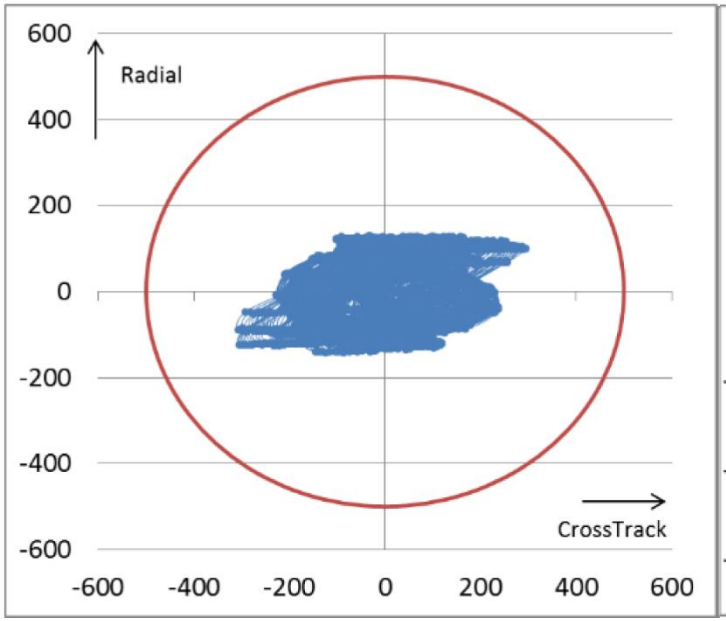
Attitude control (2018/7/30-2019/1/27)

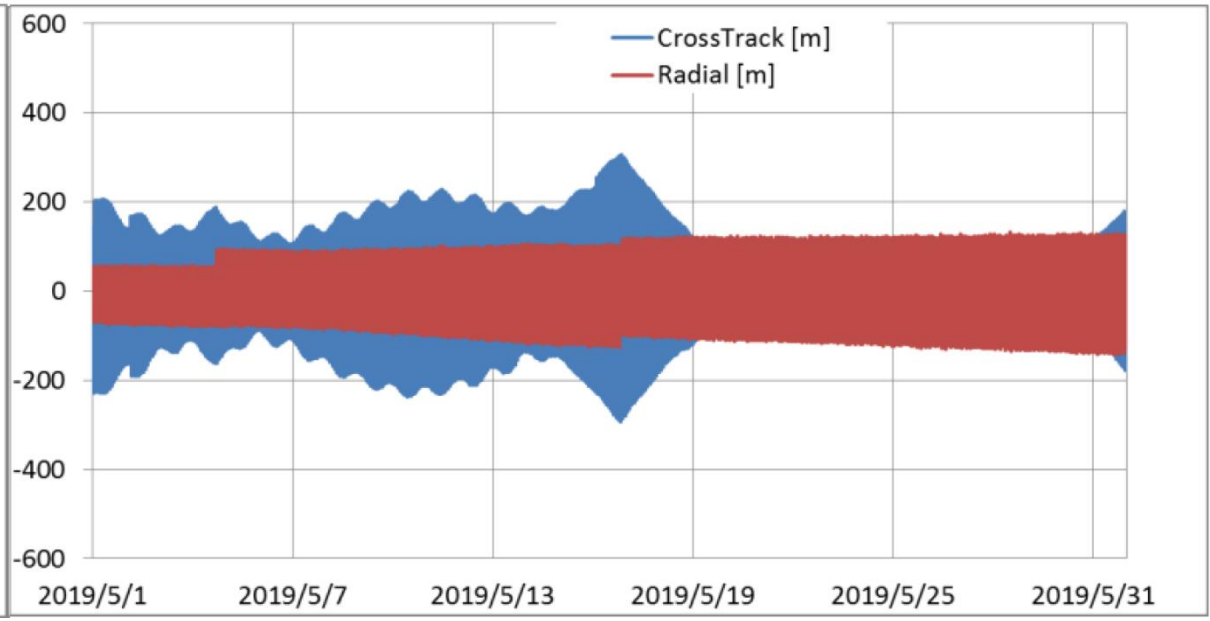


※精度評価方法:
・2つの軌道決定期間について重複箇所の距離の差でRMS評価を実施

Satellite operation

2019/5/1-5/31

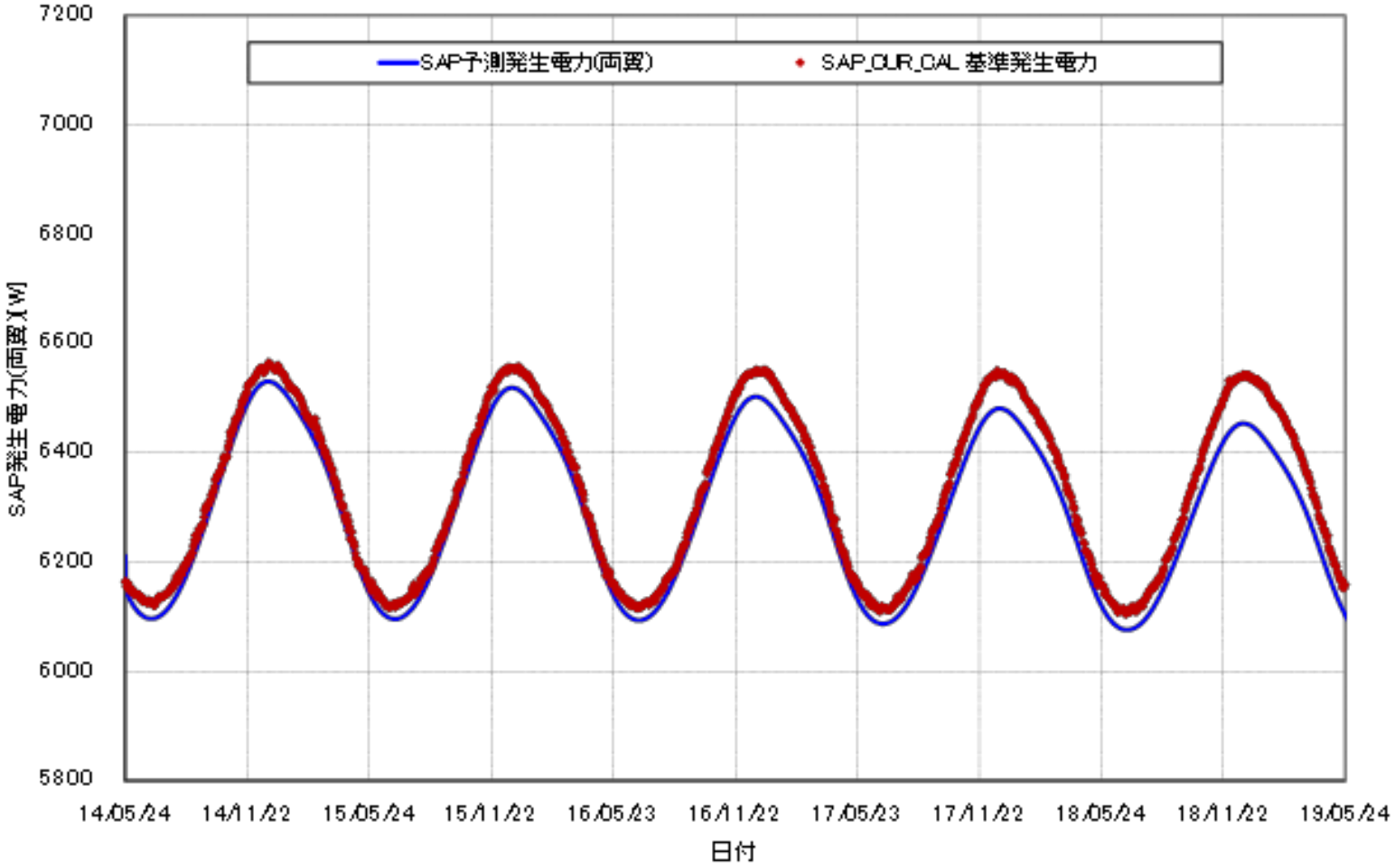




Period	保持確率[%]
2019/5/1-5/31	100

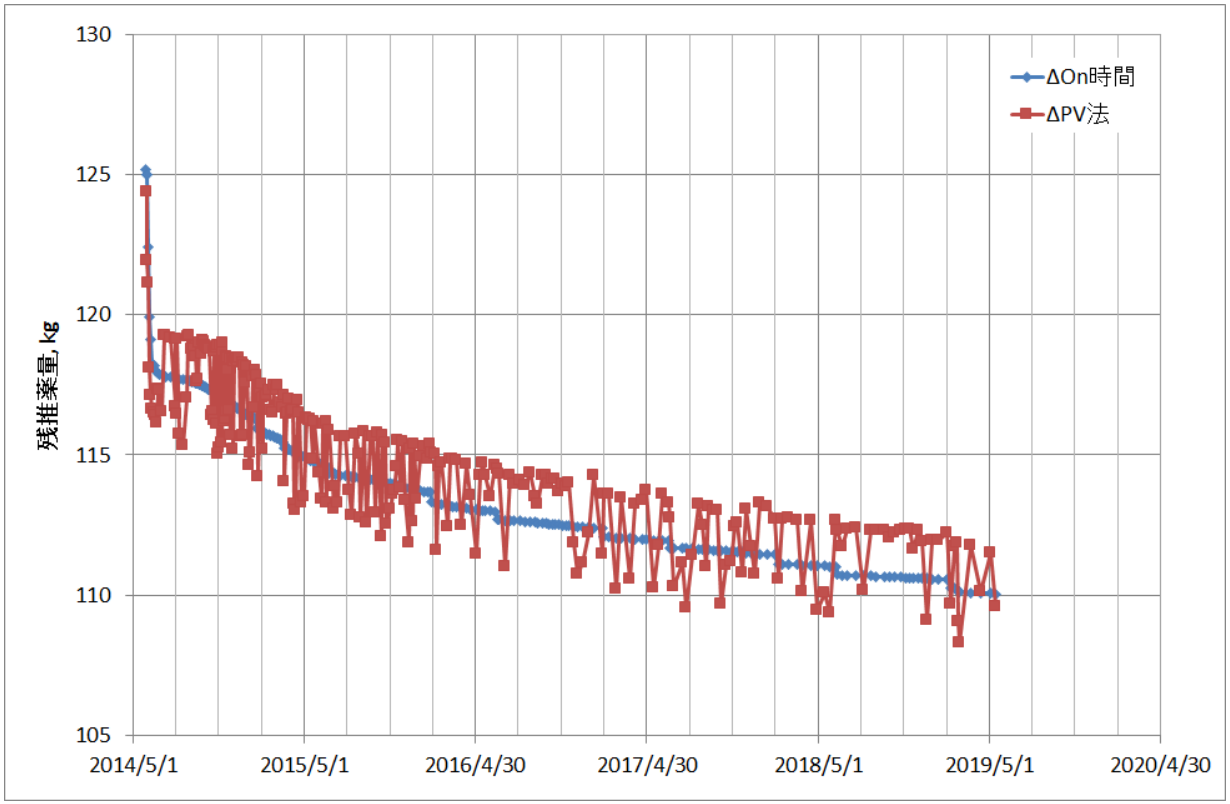
Satellite operation – Power

✓ SAP発生電力はほぼ劣化傾向なく推移している。



Satellite operation – Fuel

- ✓ 消費推薬量は約16kg、残推薬量は約110kg。
- ✓ 残推薬量のうち、無効推薬やデオービット用推薬を除いた有効推薬量では、今後8年程度は軌道保持が可能。

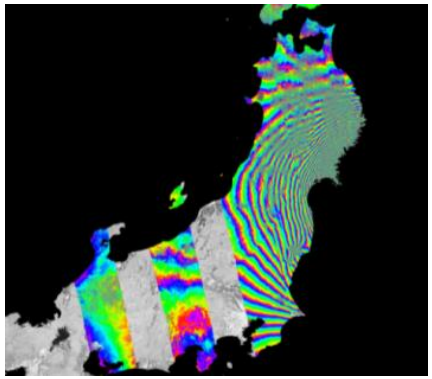


ΔOn時間法：スラスタを流れる推薬質量流量とスラスタの⊿On時間から算出
ΔPV法：圧力センサ出力値/タンク温度を用いて算出

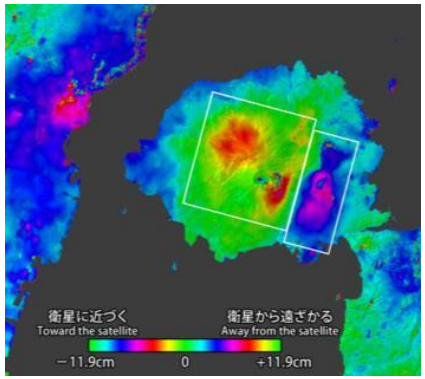
ALOS-2 Mission Objectives

Disaster monitoring

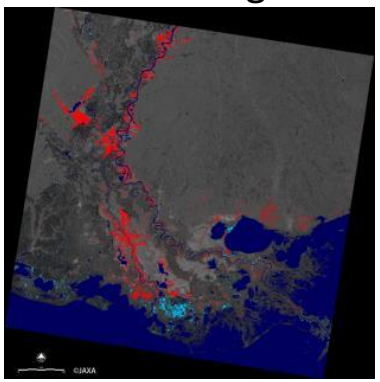
Earthquake



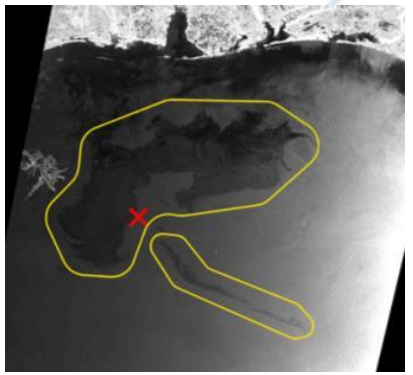
Volcano



Flooding

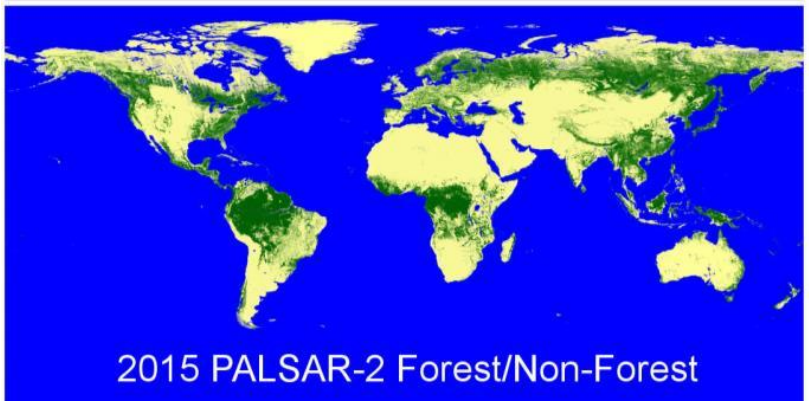


Ocean

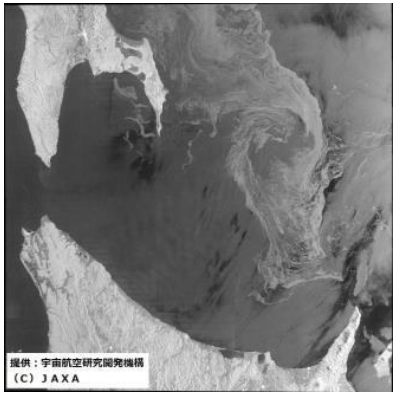


Environment and land management

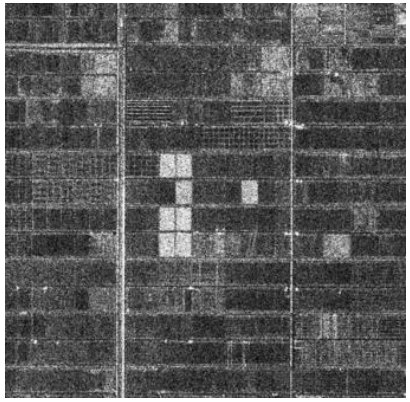
Forest and wetland



Ice



Agriculture & natural resources



Basic Observation Scenario (BOS) world

1-3 years

■1年目

回帰	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
年	2014年											2015年														
回帰開始日	08/04	08/18	09/01	09/15	09/29	10/13	10/27	11/10	11/24	12/08	12/22	01/05	01/19	02/02	02/16	03/02	03/16	03/30	04/13	04/27	05/11	05/25	06/08	06/22	07/06	07/20
ディセンディング	地殻湿地・伐採	南域 Super Site	地殻湿地・伐採	南域 Super Site	N 65以上 490km	地殻湿地・伐採	全球3m (1/3)		地殻湿地・伐採	全球3m (1/3)		地殻湿地・伐採		N 65以上 490km	地殻湿地・伐採	地殻・森林 (14-day InSAR)		地殻湿地・伐採	地殻・森林 (14-day InSAR)		地殻湿地・伐採	地殻・森林 (14-day InSAR)		地殻湿地・伐採	N 65以上 490km	地殻湿地・伐採
	W2 (2)R	F2(6)L	W2 (2)R	F2(6)L	V2(2)R	W2 (2)R	U2 (6)R	U2 (7)R	W2 (2)R	U2 (8)R	U2 (9)R	W2 (2)R		V2(2)R	W2 (2)R	F2 (5)R	F2 (5)R	W2 (2)R	F2 (6)R	F2 (6)R	W2 (2)R	F2 (7)R	F2 (7)R	W2 (2)R	V2(2)R	W2 (2)R
アセンディング	地殻	極域	World 1-1(10m)					World 2-1(10m)			極域	北極域	World 1-2(10m)			GR Super Site	GR Super Site	ポラリメトリ観測6m (1/5)					World 2-2(10m)		
	W2 (2)R	W2(2)R / W2(2)L	F2 (7)R	F2 (5)R	F2 (6)R			F2 (7)R	F2 (5)R	F2 (6)R	W2(2)R / W2(2)L	W2(2)R	F2 (7)R	F2 (5)R	F2 (6)R	F2(6)R	F2(6)R	FP (6)R	FP (5)R	FP (4)R	FP (3)R	FP (7)R		F2 (7)R	F2 (5)R	F2 (6)R

■2年目

回帰	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
年	2015年											2016年														
回帰開始日	08/03	08/17	08/31	09/14	09/28	10/12	10/26	11/09	11/23	12/07	12/21	01/04	01/18	02/01	02/15	02/29	03/14	03/28	04/11	04/25	05/09	05/23	06/06	06/20	07/04	07/18
ディセンディング	南域 Super Site	南域 Super Site	地殻湿地・伐採	南域 Super Site	N 65以上 490km	地殻湿地・伐採	全球3m (2/3)		地殻湿地・伐採	全球3m (2/3)		地殻湿地・伐採		N 65以上 490km	地殻湿地・伐採	地殻・森林		地殻湿地・伐採	地殻・森林		地殻湿地・伐採	地殻・森林	地殻・森林	地殻湿地・伐採	N 65以上 490km	地殻湿地・伐採
	F2(6)L	F2(6)L	W2 (2)R	F2(6)L	V2(2)R	W2 (2)R	U2 (6)R	U2 (7)R	W2 (2)R	U2 (8)R	U2 (9)R	W2 (2)R		V2(2)R	W2 (2)R	F2 (5)R	F2 (6)R	W2 (2)R	F2 (7)R	F2 (5)R	W2 (2)R	F2 (6)R	F2 (7)R	W2 (2)R	V2(2)R	W2 (2)R
アセンディング	北極域	極域	World 1-1(10m)					World 2-1(10m)			極域	南極域	World 1-2(10m)			GR Super Site	GR Super Site	ポラリメトリ観測6m (2/5)					World 2-2(10m)		
	W2(2)R	W2(2)R / W2(2)L	F2 (7)R	F2 (5)R	F2 (6)R			F2 (7)R	F2 (5)R	F2 (6)R	W2(2)R / W2(2)L	W2(2)L	F2 (7)R	F2 (5)R	F2 (6)R	F2(6)R	F2(6)R	FP (6)R	FP (5)R	FP (4)R	FP (3)R	FP (7)R		F2 (7)R	F2 (5)R	F2 (6)R

■3年目

回帰	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
年	2016年											2017年														
回帰開始日	08/01	08/15	08/29	09/12	09/26	10/10	10/24	11/07	11/21	12/05	12/19	01/02	01/16	01/30	02/13	02/27	03/13	03/27	04/10	04/24	05/08	05/22	06/05	06/19	07/03	07/17
ディセンディング	南域 Super Site	南域 Super Site	地殻湿地・伐採	南域 Super Site		地殻湿地・伐採	全球3m (3/3)		地殻湿地・伐採	全球3m (3/3)		地殻湿地・伐採			地殻湿地・伐採	地殻・森林		地殻湿地・伐採	地殻・森林		地殻湿地・伐採	地殻・森林		地殻湿地・伐採		地殻湿地・伐採
	F2(6)L	F2(6)L	W2 (2)R	F2(6)L		W2 (2)R	U2 (6)R	U2 (7)R	W2 (2)R	U2 (8)R	U2 (9)R	W2 (2)R			W2 (2)R	F2 (5)R	F2 (6)R	W2 (2)R	F2 (7)R	F2 (5)R	W2 (2)R	F2 (6)R	F2 (7)R	W2 (2)R		W2 (2)R
アセンディング	北極域/地殻	極域	World 1-1(10m)					World 2-1(10m)			極域	南極域	World 1-2(10m)			GR Super Site	GR Super Site	ポラリメトリ観測6m (3/5)					World 2-2(10m)		
	W2 (2)R	W2(2)R / W2(2)L	F2 (7)R	F2 (5)R	F2 (6)R			F2 (7)R	F2 (5)R	F2 (6)R	W2(2)R / W2(2)L	W2(2)L	F2 (7)R	F2 (5)R	F2 (6)R	F2(6)R	F2(6)R	FP (6)R	FP (5)R	FP (4)R	FP (3)R	FP (7)R		F2 (7)R	F2 (5)R	F2 (6)R

白字 広域観測[350km]モード ビーム区分：W2、観測方向：右、ビーム番号：No.2
黒字 広域観測[350km]モード ビーム区分：W2、観測方向：左、ビーム番号：No.2
白字 高分解能[3m]モード、ビーム区分：U2、観測方向：右、ビーム番号：No.6-9
黒字 高分解能[3m]モード、ビーム区分：U2、観測方向：左、ビーム番号：No.6-9
白字 高分解能[3m]モード、ビーム区分：U3、観測方向：右、ビーム番号：No.10-14
黒字 高分解能[3m]モード、ビーム区分：U3、観測方向：左、ビーム番号：No.10-14

白字 フルポラリメトリ[6m]モード、ビーム番号：No.3-7

Basic Observation Scenario (BOS) world

4-6 years

■4年目

回帰	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
年	2017											2018														
回帰開始日	07/31	08/14	08/28	09/11	09/25	10/09	10/23	11/06	11/20	12/04	12/18	01/01	01/15	01/29	02/12	02/26	03/12	03/26	04/09	04/23	05/07	05/21	06/04	06/18	07/02	07/16
ディセンディング	南極域 Super Site	地殻 南極域 Super Site	湿地 伐採	南極域 Super Site	地殻 南極域 Super Site	湿地 伐採	10m Super Site		湿地 伐採	10m Super Site	地殻	湿地伐採 1&2	地殻 1	湿地伐採2 地殻 2	湿地 伐採 1	地殻 1	湿地伐採2 地殻 2	湿地 伐採 1	地殻 1	湿地伐採2 地殻 2	湿地 伐採 1	地殻 1	湿地伐採2 地殻 2	湿地 伐採 1	湿地 伐採 2	湿地 伐採 1
		W2(2)R	W2 (2)R		W2(2)R	W2 (2)R	F2(7)R	F2(5)R	W2 (2)R	F2(6)R	W2(2)R	W2 (2)R	W2 (2)R	W2(2)R	W2 (2)R	F2 (7)R	W2(2)R	W2 (2)R	F2 (5)R	W2(2)R	W2 (2)R	F2 (6)R	W2(2)R	W2 (2)R	W2 (2)R	W2 (2)R
	F2(6)L	F2(6)L		F2(6)L	F2(6)L									W2(2)R			F2(7)R			F2(5)R			F2(6)R			
アセンディング	北極域/地殻	極域	World 1-1(10m)				World 2-1(10m)			極域	南極域	World A(10m)			グリーンランド Super Site	World B(10m)				World C(10m)			南極域	World D(10m)	
	W2 (2)R	W2(2)R	F2 (7)R	F2 (5)R	F2 (6)R		F2 (7)R	F2 (5)R	F2 (6)R	W2(2)R	W2(2)L	F2 (7)R	F2 (5)R	F2 (6)R	F2(6)R	F2 (6)R	F2 (7)R	F2 (5)R		F2 (7)R	F2 (5)R	F2 (6)R	W2(2)L	F2 (7)R	F2 (5)R	F2 (6)R
		W2(2)L								W2(2)L																

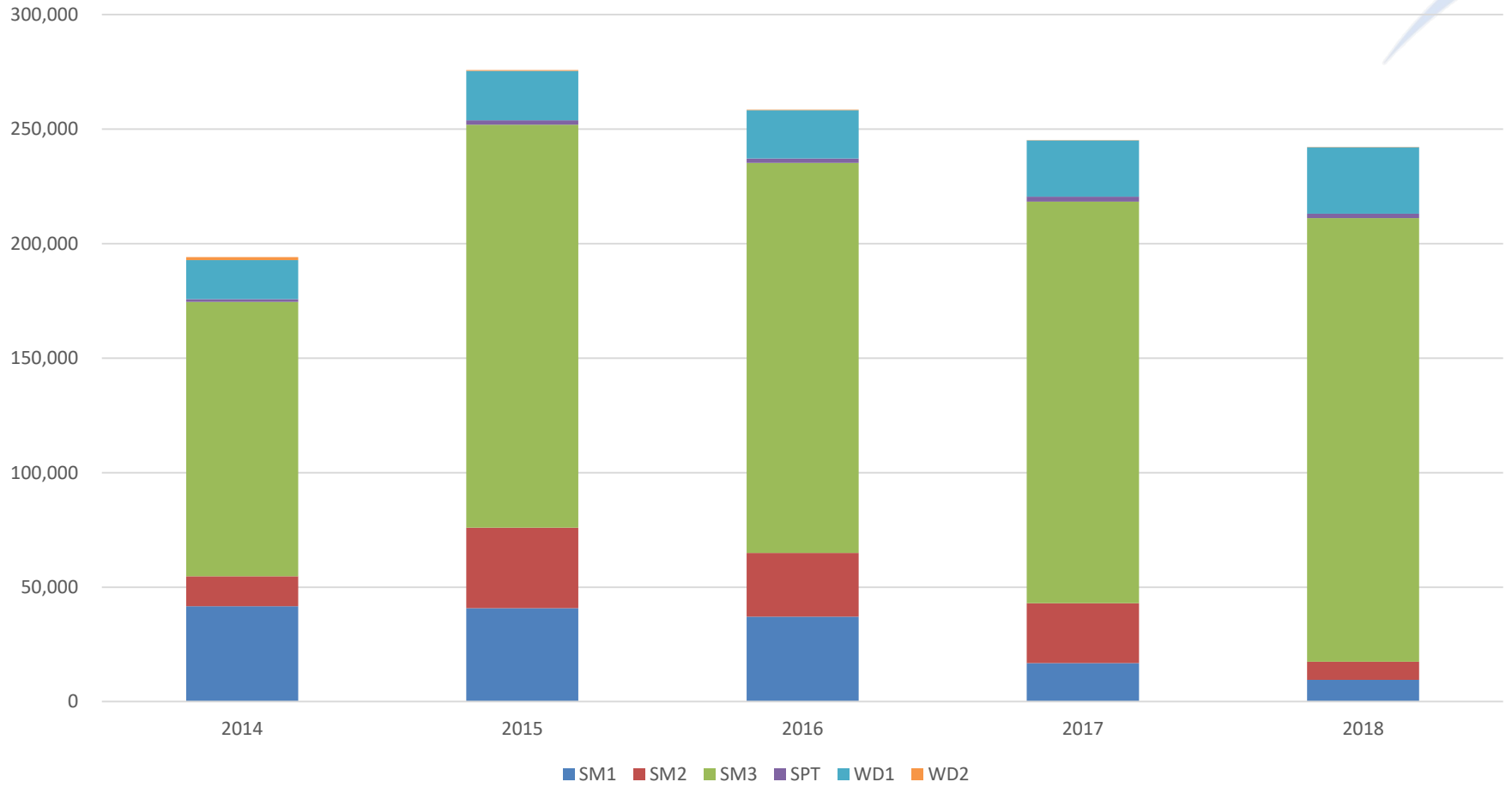
■5年目

回帰	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131
年	2018											2019														
回帰開始日	07/30	08/13	08/27	09/10	09/24	10/08	10/22	11/05	11/19	12/03	12/17	12/31	01/14	01/28	02/11	02/25	03/11	03/25	04/08	04/22	05/06	05/20	06/03	06/17	07/01	07/15
ディセンディング	南極域 Super Site	湿地伐採 2 南極域 SuperSite	湿地 伐採 1	地殻 1 南極域 Super Site	湿地伐採2 地殻 2 南極域Super	湿地 伐採 1	地殻 1 10m Super Site	湿地伐採2 地殻 2	湿地 伐採 1 10m Super	地殻 1 10m Super Site	湿地伐採2 地殻 2	湿地 伐採 1	地殻 1	湿地伐採2 地殻 2	湿地 伐採 1	地殻 1	湿地伐採2 地殻 2	湿地 伐採 1	地殻 1	湿地伐採2 地殻 2	湿地 伐採 1	地殻 1	湿地伐採2 地殻 2	湿地 伐採 1	湿地 伐採 2	湿地 伐採 1
		W2(2)R	W2 (2)R	W2(2)R	W2(2)R	W2 (2)R	W2(2)R	W2(2)R	W2(2)R	W2(2)R	W2(2)R	W2 (2)R	W2 (2)R	W2(2)R	W2 (2)R	F2 (7)R	W2(2)R	W2 (2)R	F2 (5)R	W2(2)R	W2 (2)R	F2 (6)R	W2(2)R	W2 (2)R	W2 (2)R	W2 (2)R
	F2(6)L	F2(6)L		F2(6)L	F2(6)L		F2(7)R	W2(2)R	F2(5)R	F2(6)R	W2(2)R			W2(2)R			F2(7)R			F2(5)R			F2(6)R			
アセンディング	World E(10m)			北極域/地殻	北極域	World F(10m)					World A(10m)			極域	グリーンランド Super Site 南極域	World B(10m)				World C(10m)				World D(10m)	
	F2 (7)R	F2 (5)R	F2 (6)R	W2 (2)R	W2(2)R	F2 (7)R	F2 (5)R	F2 (6)R			F2 (7)R	F2 (5)R	F2 (6)R	W2(2)R	F2(6)R	F2 (6)R	F2 (7)R	F2 (5)R		F2 (7)R	F2 (5)R	F2 (6)R		F2 (7)R	F2 (5)R	F2 (6)R
														W2(2)L	W2(2)L											

■6年目

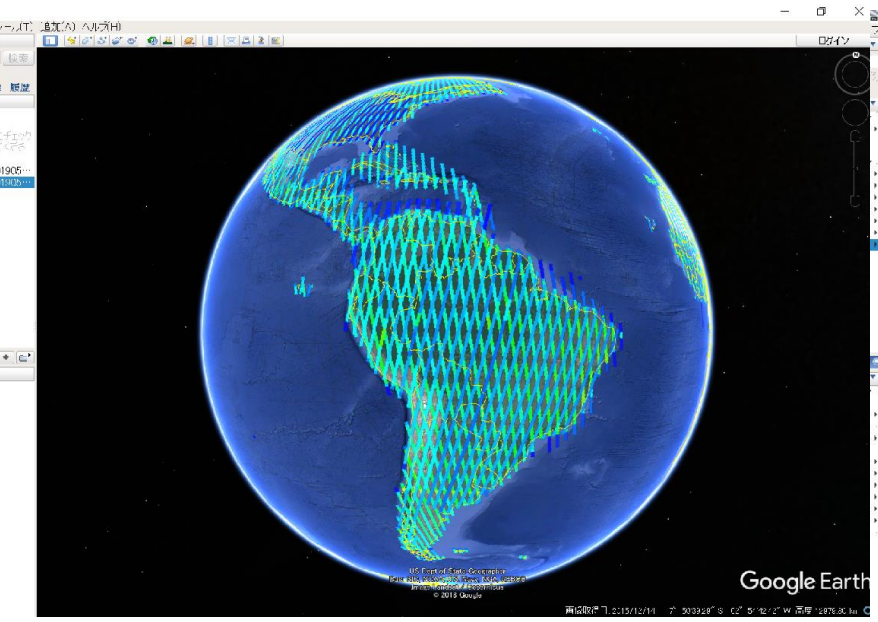
回帰	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157
年	2019年												2020年													
回帰開始日	07/29	08/12	08/26	09/09	09/23	10/07	10/21	11/04	11/18	12/02	12/16	12/30	01/13	01/27	02/10	02/24	03/09	03/23	04/06	04/20	05/04	05/18	06/01	06/15	06/29	07/13
ディセンディング	南極域 Super Site	湿地伐採 2 南極域 SuperSite	湿地 伐採 1	地殻 1 南極域 Super Site	湿地伐採2 地殻 2 南極域Super	湿地 伐採 1	地殻 1 10m Super Site	湿地伐採2 地殻 2	湿地 伐採 1 10m Super	地殻 1 10m Super Site	湿地伐採2 地殻 2	湿地 伐採 1	地殻 1	湿地伐採2 地殻 2	湿地 伐採 1	地殻 1	湿地伐採2 地殻 2	湿地 伐採 1	地殻 1	湿地伐採2 地殻 2	湿地 伐採 1	地殻 1	湿地伐採2 地殻 2	湿地 伐採 1	湿地 伐採 2	湿地 伐採 1
		W2(2)R	W2 (2)R	W2(2)R	W2(2)R	W2 (2)R	W2(2)R	W2(2)R	W2(2)R	W2(2)R	W2(2)R	W2 (2)R	W2 (2)R	W2(2)R	W2 (2)R	F2 (7)R	W2(2)R	W2 (2)R	F2 (5)R	W2(2)R	W2 (2)R	F2 (6)R	W2(2)R	W2 (2)R	W2 (2)R	W2 (2)R
	F2(6)L	F2(6)L		F2(6)L	F2(6)L		F2(7)R	W2(2)R	F2(5)R	F2(6)R	W2(2)R			W2(2)R			F2(7)R			F2(5)R			F2(6)R			
アセンディング	World E(10m)			北極域/地殻	極域	World F(10m)					World A(10m)			極域	グリーンランド Super Site 南極域	World B(10m)				World C(10m)				World D(10m)	
	F2 (7)R	F2 (5)R	F2 (6)R	W2 (2)R	W2(2)R	F2 (7)R	F2 (5)R	F2 (6)R			F2 (7)R	F2 (5)R	F2 (6)R	W2(2)R	F2(6)R	F2 (6)R	F2 (7)R	F2 (5)R		F2 (7)R	F2 (5)R	F2 (6)R		F2 (7)R	F2 (5)R	F2 (6)R
					W2(2)L									W2(2)L	W2(2)L											

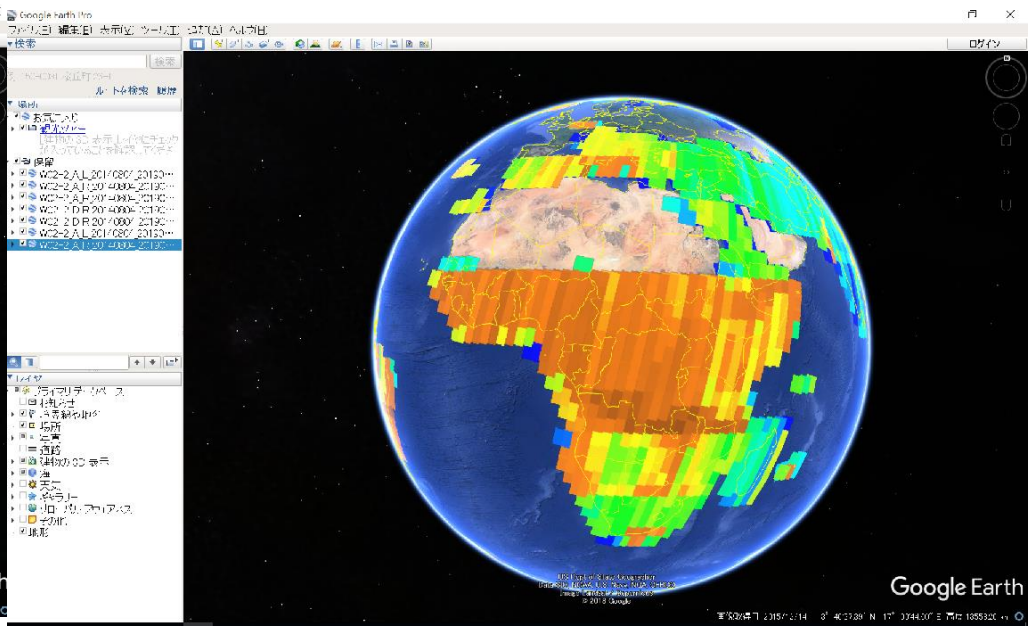
Observation results – 5 years operation



Observation results – 5 years operation

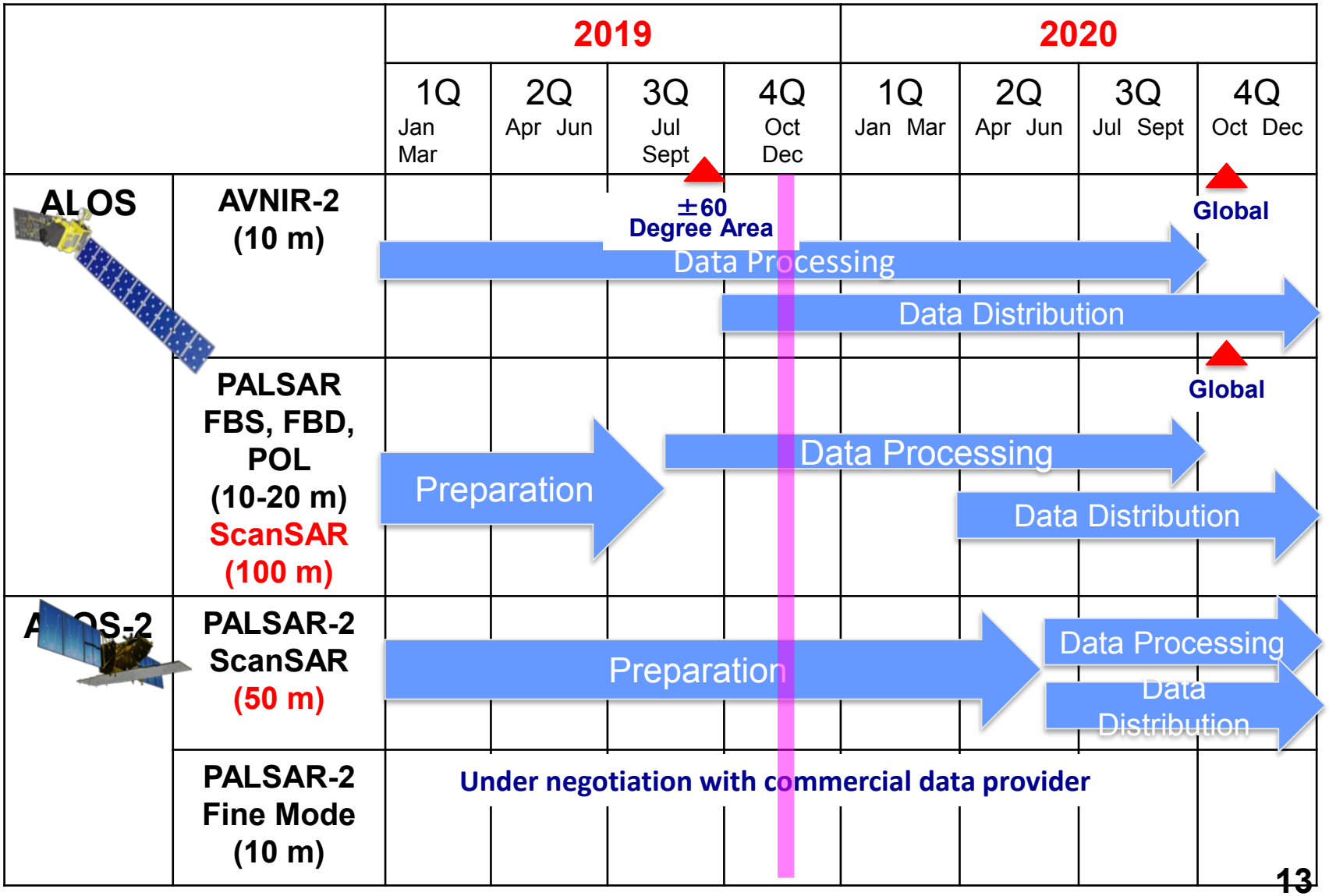
https://www.eorc.jaxa.jp/ALOS-2/obs/jpal2_obs_result.htm





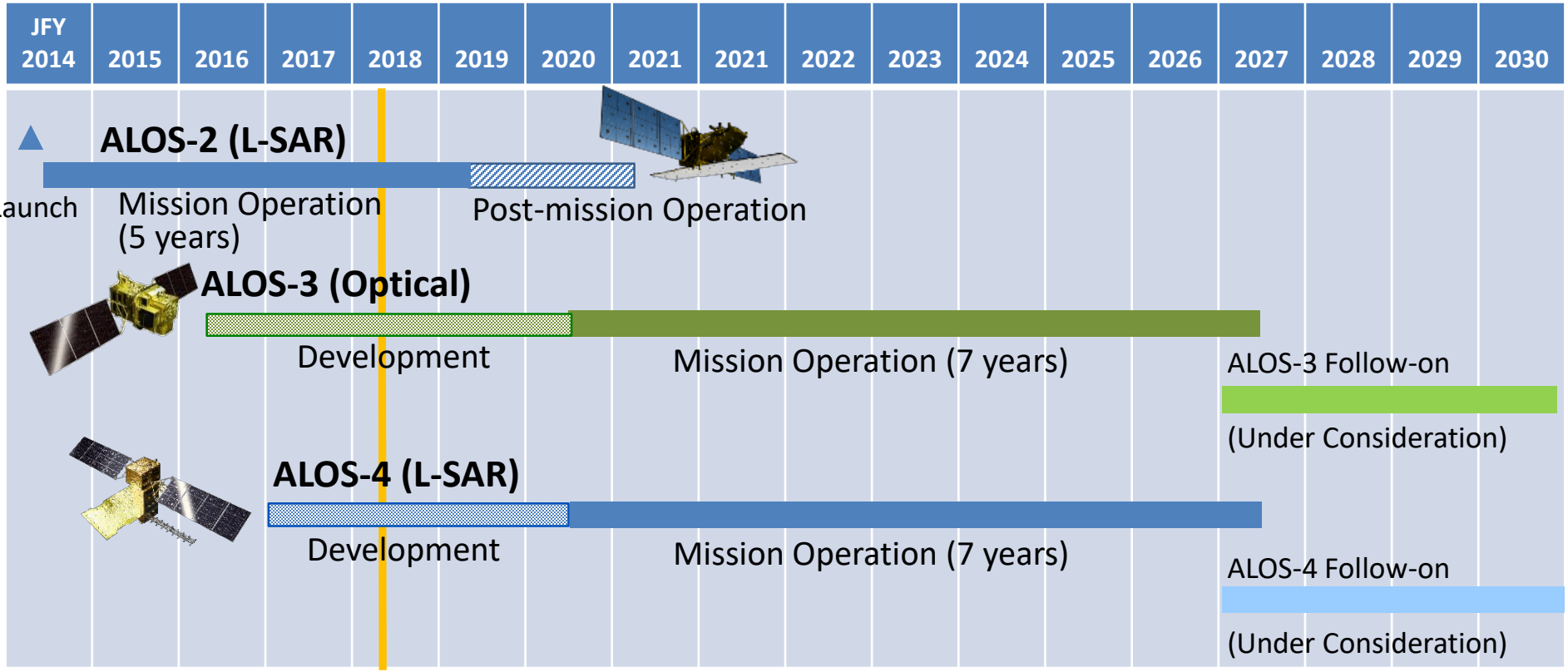
Schedule of ALOS/ALOS-2 Data Processing and Open Free Access

As of December 2019

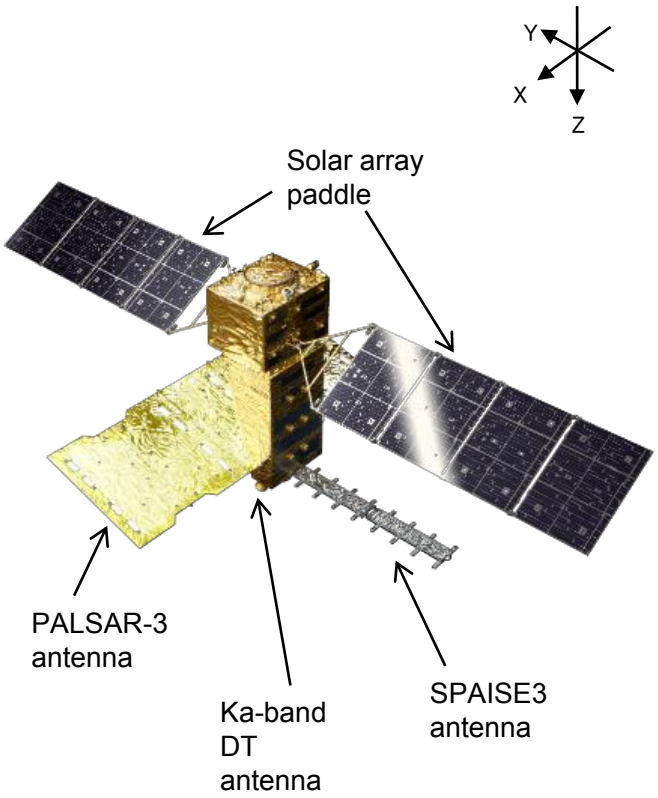


Continuous Observations by ALOS Series

- ✓Assurance of safety and security of citizens, *i.e.* disasters monitoring and management, land deformation monitoring, national developing management, foods and natural resources, environmental issues in global etc.
- ✓Enhancement of commercial use of Earth observation data, *i.e.* National Spatial Data infrastructure (NSDI) and new applications.



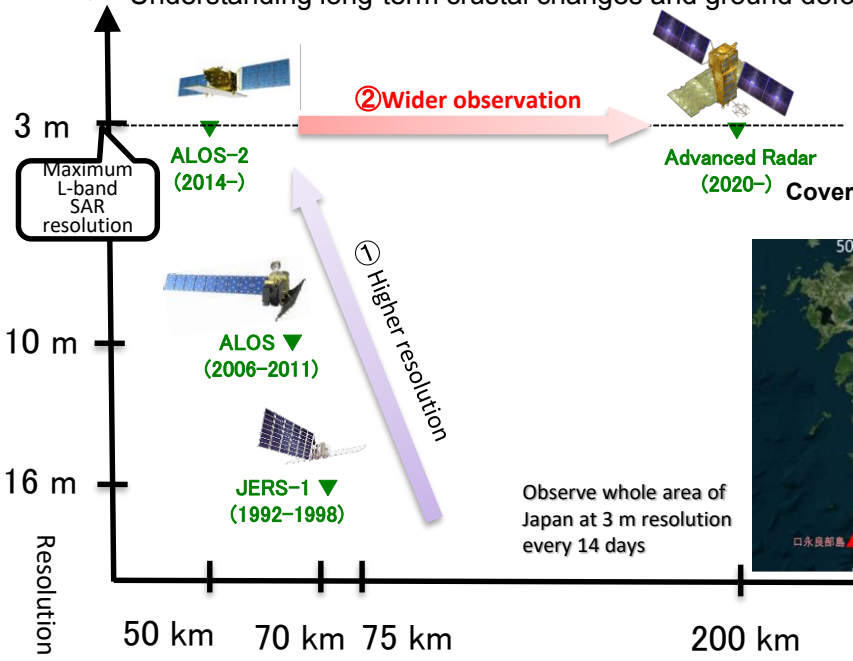
ALOS-4 Overview



Launch	**JFY 2020 by H-3 launch vehicle**
Orbit	Sun-synchronous sub-recurrent orbit Altitude: 628 km Inclination angle: 97.9 degree Local sun time at descending: 12:00 ± 15 min. Revisit time: **14 day** (15-3/14 rev/day) (Same orbit as ALOS-2)
Lifetime	**7 years**
Satellite Mass	Approx. 3 tons
Downlink	3.6 Gbps/1.8 Gbps (**Ka-band**)
Mission Instruments	- **PALSAR-3** (Phased Array type L-band Synthetic Aperture Radar-3) - **SPAISE3** (SPace based AIS Experiment 3)
Prime contractor	Mitsubishi Electric Corporation

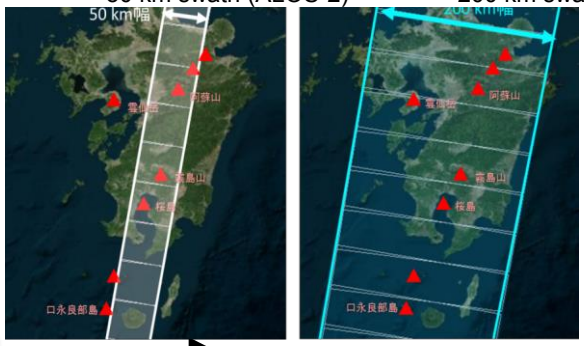
Future Application Realized by ALOS-4

- ✓ **More frequent observation**
  - ✓ Detection of early indication of crustal changes and ground deformation (volcanos, land subsidence and land slide)
  - ✓ Infrastructure Displacement Monitoring for avoiding missed abnormal changes and more effective civil engineering infrastructure management)
- ✓ **Mutual interference with ALOS-2**
  - ✓ Understanding long-term crustal changes and ground deformation



Coverage of active volcanoes in Kyushu island, Japan

50 km swath (ALOS-2) 200 km swath



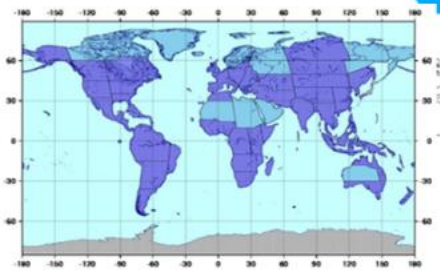
Conclusions

- SAR data is used for multiple applications contributing to societal benefits.
- For operational use, following requirements need to be considered:
  - ✓ Providing data for a user within 5 hours from recipient of an emergency observation request, in the event of a disaster
  - ✓ Accumulating long-term data for monitoring changes
- ALOS-4 succeeds ALOS-2 characteristics for continuity of ALOS-2 applications having wider swath width and high temporal observation (every 2 weeks) with big data analysis.
- ALOS-2 extended operation (post nominal operation)
  - Duty cycle change 50% -> 30% (maximum observation time per a orbit 50min -> 30min) from this October

Observation result in 2018/1-2019/1 SM3

観測データ取得実績(カバー率)

全球:高分解能10m　取得状況(F2-5～7)右観測/昇交(北行)軌道
【 2018/1/1～2019/1/27 】



基本観測 観測エリア
(1年に2～4回観測)

全観測予定シーン数	58,752
観測シーン数	58,326
未観測シーン数	426
カバー率	99.27%

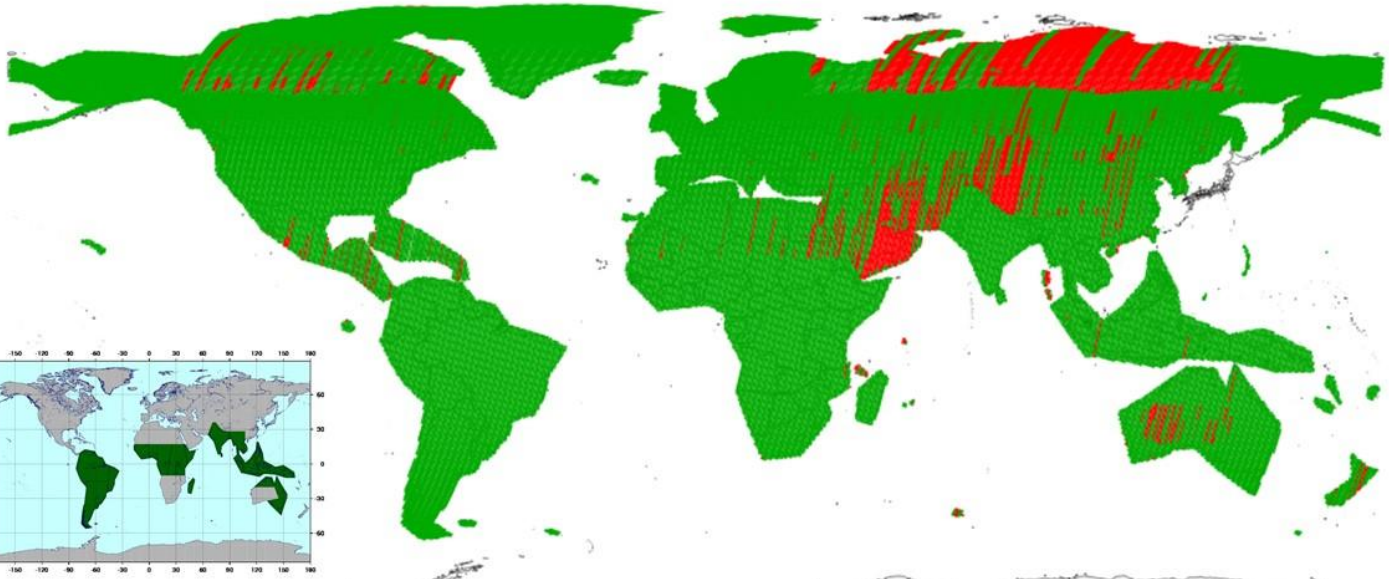
•全球観測:1年目、2年目、2017年度は取得済
(2017年以降、衛星の運用年度単位から西暦の年単位で取得率を報告することに変更。)

Observation result in 2014/8-2019/6 SM1

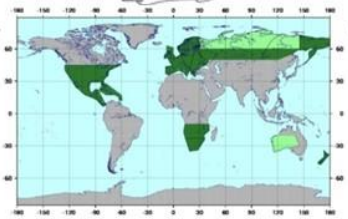
観測データ取得実績(カバー率)

全球:高分解能3m　取得状況(U2-6～9)右観測/降交(南行)軌道

【 2014/8/2～2019/6/2 】



1年目観測エリア



2年目観測エリア　3年目観測エリア

全観測予定シーン数	77,835
観測シーン数	68,388
未観測シーン数	9,447
カバー率	87.86%

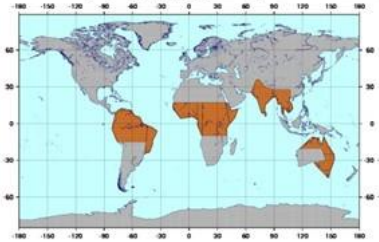
Observation result in 2014/8-2019/6 SM2

観測データ取得実績(カバー率)

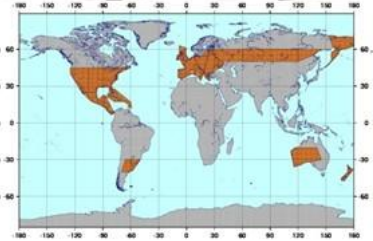
全球:高分解能6m　取得状況(FP6-3～7)右観測/昇交(北行)軌道

【 2014/8/2～2019/6/2 】

1年目観測エリア



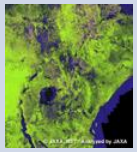
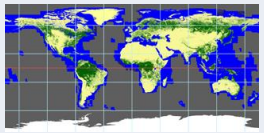
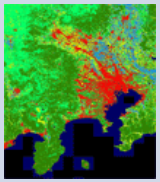
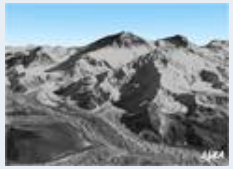
2年目観測エリア



3年目観測エリア

全観測予定シーン数	97,256
観測シーン数	73,051
未観測シーン数	24,205
カバー率	75.11%

JAXA's Open & Free ALOS/ALOS-2 Products

	Products and URL
	**K&C Mosaic Homepage** 1) PALSAR 50m Orthorectified Mosaic Product. 2) PALSAR 500m Browse Mosaic Product. http://www.eorc.jaxa.jp/ALOS/en/kc_mosaic/kc_mosaic.htm
	**Global PALSAR-2/PALSAR/JERS-1 Mosaic and Forest/Non-Forest map** Global 25m-resolution mosaic using ALOS-2 PALSAR-2, ALOS PALSAR, and JERS-1 SAR images and global forest/non-forest map. http://www.eorc.jaxa.jp/ALOS/en/palsar_fnf/fnf_index.htm
	**High Resolution Land-Use and Land-Cover Map** The High Resolution Land-Use and Land-Cover Map generated using mainly AVNIR-2 in Japan. http://www.eorc.jaxa.jp/ALOS/lulc/lulc_jindex.htm
	**ALOS Global Digital Surface Model "ALOS World 3D - 30m"** Global digital surface model (DSM) dataset with a horizontal resolution of approx. 30-meter mesh (1 arcsec) . http://www.eorc.jaxa.jp/ALOS/en/aw3d/index_e.htm
	**ALOS Ortho Rectified Image Product (ALOS-ORI)** ALOS/AVNIR-2 ORI products with approx.10-meter mesh in horizontal resolution. The dataset of the Japanese islands is released. http://www.eorc.jaxa.jp/ALOS/en/alos-ori/index.html
	**JJ-FAST: JICA-JAXA Forest Early Warning System in the Tropics** Web-based system using JAXA's ALOS-2 to monitor tropical forests in 77 countries every 1.5 months and release deforestation data. http://www.eorc.jaxa.jp/jjfast/

Open data - Mosaic and FNF

ALOS Home > about PALSAR-2/PALSAR Global Forest / Non-forest Map > Global PALSAR-2/PALSAR/JERS-1 Mosaic and Forest / Non-forest Map

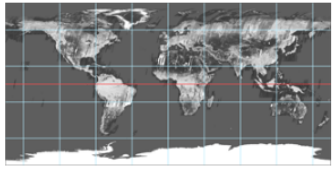
Global PALSAR-2/PALSAR/JERS-1 Mosaic and Forest / Non-forest Map

* These map uses Javascript. Please enable JavaScript on your browser.

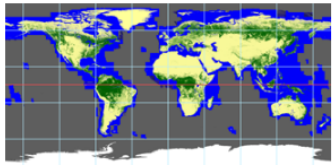
25m resolution product

Global

- JERS-1 SAR Mosaic:
  - >> 1996

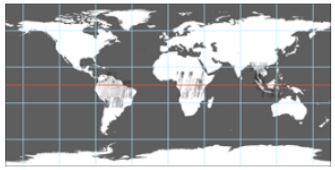


- PALSAR/PALSAR-2 mosaic and forest/non-forest (FNF) map:
  - >> 2007 >> 2008 >> 2009 >> 2010 >> 2015
  - >> 2016 >> 2017

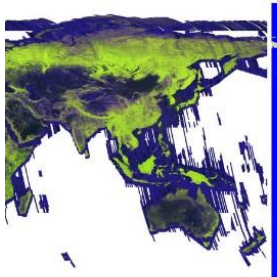


Tropical region (Amazon, Africa, and SE-Asia)

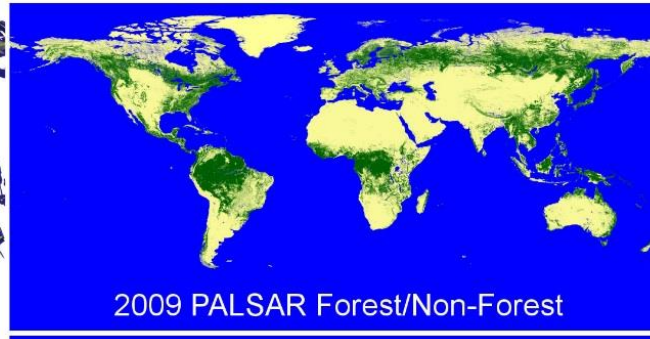
- JERS-1 SAR Mosaic:
  - >> 1993 >> 1994 >> 1995 >> 1996 >> 1997
  - >> 1998



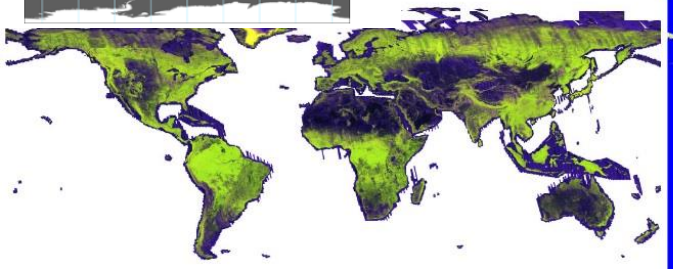
https://www.eorc.jaxa.jp/ALOS/en/palsar_fnf/data/index.htm



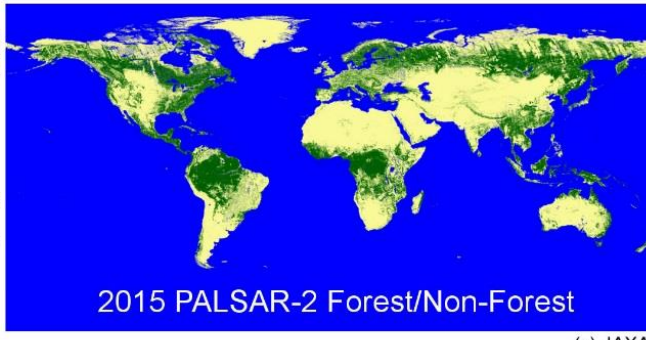
n Mosaic



2009 PALSAR Forest/Non-Forest

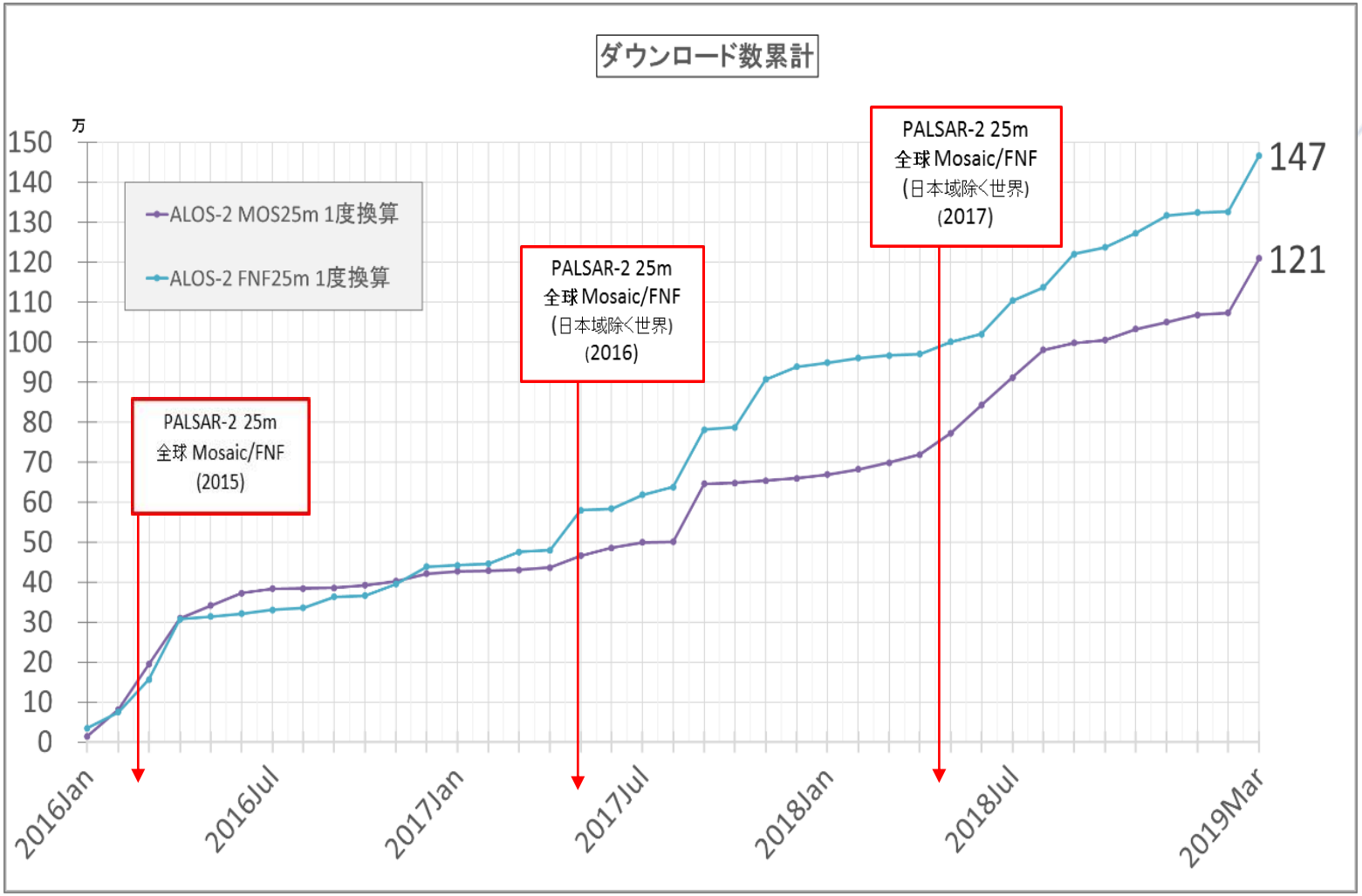


2015 PALSAR-2 25m Mosaic



2015 PALSAR-2 Forest/Non-Forest

Mosaic data distribution



- 緯度経度１度四方を1タイル(単位)として，オンラインダウンロード可能(全球陸域をカバーするためには約22,000タイル必要)
- 約147万タイルがダウンロードされている(2019年3月時点)