EGU General Assembly 2020

TM12

What will it take to get YOU to use SAR? A Conversation about Capacity Building in the Field of SAR Remote Sensing

Convener: Tyler Erickson

Co-conveners: Andrea Nicolau, David Saah

Join the chat Thu, 07 May, 19:00–20:00

Tyler

Andrea

David

Meeting Link: https://meetingorganizer.copernicus.org/EGU2020/session/38257

Full Presentations (with videos): https://drive.google.com/drive/folders/16WsHA48RX0NrzAOW7l2KFm0h_D1tOCCB

Session details:

While Synthetic Aperture Radar (SAR) remote sensing with its weather independence and day-and-night capabilities has long been identified as a useful data set for many science disciplines, it is only due to a number of recent developments that SAR has also become an attractive resource for practitioners and decision-makers in areas such as disaster management, agricultural monitoring, water resource management, and ecosystem sustainability.

New sensors such as Sentinel-1 and the upcoming NASA-ISRO SAR mission (NISAR) are or will provide free and open access to global SAR data with frequent revisit rates. New software and processing algorithms are providing value-added products that come fully geocoded and in easy to read data formats. All of these changes have led to increased demand for SAR data and to a vast diversification of the SAR user community. They have also resulted in a pressing need for a more diverse library of training resources, webinars, and curricula. This is particularly true for the applications and decision-making communities, whose information needs are not well met by currently available training materials.

Building on these identified needs, this town hall follows up on the recent AGU TownHall (https://www.agu.org/Fall-Meeting/Events/Data-TH43K) and seeks to solicit open discussion on key topics:

- Is more capacity needed in processing raw SAR data vs. starting with “Analysis Ready Data” products?
- Is there really a difference between SNAP vs. GAMMA processing?
- What type of computing infrastructure is necessary? (Local development vs. HPC vs. Cloud)
- Is the current set of available learning resources sufficient, and if not what changes are needed?
- What is preventing the remote sensing community from using SAR for operational applications? What are more pressing limitations, data or processing capabilities?

A diverse panel of experts representing four important components of capacity building (1 research; 2 - infrastructure; 3 - end user applications; 4 - curriculum development) will guide a town hall conversation about topics/needs raised by audience participants. The goal of this town hall is to identify the next steps necessary for the increased applied use of SAR. Input collected from this town hall will inform future capacity-building efforts in this important and rapidly growing earth observation field.

Panel of Experts

Franz Meyer
Chief Scientist, Alaska Satellite Facility
Professor, University of Alaska Fairbanks

David Small
Senior Research Scientist, University of Zurich

Iain H Woodhouse
University of Edinburgh, Carbomap
Earth Blox

Josef Kellndorfer
Founder, Earth Big Data, LLC
NISAR Science Team

Erika Podest
Scientist
Jet Propulsion Laboratory-NASA

Christiane Schmullius
SAR-EDU/EO College / Professor,
Friedrich Schiller Universitat Jena

Robert Eckardt
SAR-EDU/EO College / Professor,
Friedrich Schiller Universitat Jena

SAR ARD DEVELOPMENT AND SAR CAPACITY BUILDING

ACTIVITIES AT THE UNIVERSITY OF ALASKA FAIRBANKS & THE ALASKA SATELLITE FACILITY

Contributors:

Franz J Meyer[1)], K. Hogenson[1)], E. Lundell[1)], A. Lewandowski[1)], A. Flores[3)], E. Anderson[3)], E Cherrington[3)], P.A. Rosen[2)], S. Owen[2)], D.B. McAlpin[1)], S. Zwieback[1)], R. Griffin[3)], G. Galindo[4)], T. Torres[5)], Aracely Lima[6)]

[1)]Geophysical Institute, Alaska Satellite Facility, University of Alaska Fairbanks, Fairbanks
[2)]Jet Propulsion Laboratory, Pasadena, CA
[3)]University of Alabama, Huntsville, AL, USA
[4)]IDEAM, Bogotá, Colombia; [5)]Universidad Central del Ecuador; [6)]IIGE, Ecuador

May 2020 – EGU

The NASA Alaska Satellite Facility (ASF) DAAC

- **ASF is NASA Distributed Active Archive Center (DAAC) for SAR Data**
  - Established in 1991 as the prime U.S. downlink and processing center for SAR data
  - Operates 3 antennas for command uplink and data downlink of NASA and non-NASA remote sensing satellite systems
- **Currently, ASF is housing about 8.5PB of SAR data in its archives, most of which in the Amazon Web Service Cloud → all data available on spinning disks for immediate download**

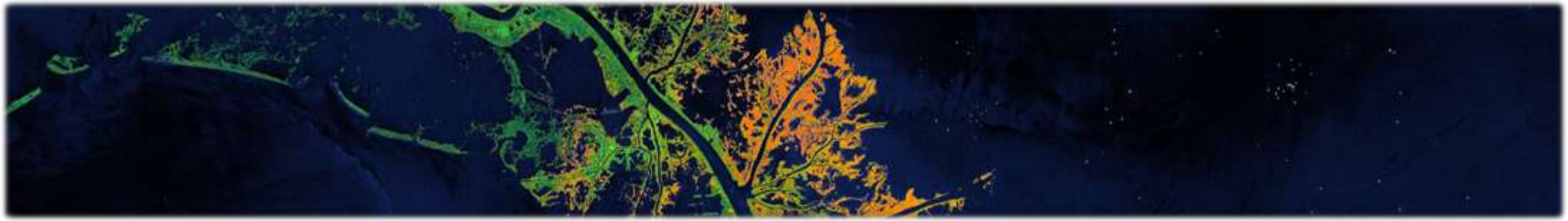
SCAN ME

41 years of SAR data (since '78)
https://search.asf.alaska.edu

NISAR DAAC (all L0 – L2 data)

Host of
global Sentinel-1 archive

Visit ASF @ www.asf.alaska.edu



ARD Products & Cloud-Based Data Analysis Environments

From Sensor Data to Science Products

SAR Tools Ecosystem in Support of the SAR Science Community

Level-1 Data

Uncalibrated SAR Sensor data in sensor geometry

Level-2 Data

Geocoded versions of Level-1 data

Level-3 Data

derived science data provided in geocoded space and physical units

Level-1 to Level-2 Processing

ASF HyP3

SARVIEWS SAR-based hazard information

Level-2 to Level-3 Processing

The OpenSARLab

LEVEL-2 DATA PROCESSING:
THE HYP3 SERVICE

ASF's Level-2 Data Processing Platforms: The ASF HyP3 Platform

- **HyP3 [Hybrid Pluggable Processing Pipeline]**: Cloud-based processing system for prototyping of value-added Sentinel products

- **Features:**
  - **Fully cloud-based processing and archiving**
  - Elastic scaling of compute resources
  - Easy integration of new algorithms
  - Create AOI-based subscription via API or map interface
  - Automatic production of value-added products from SAR for every incoming image
  - Distribution via pull or push
  - Email notification service

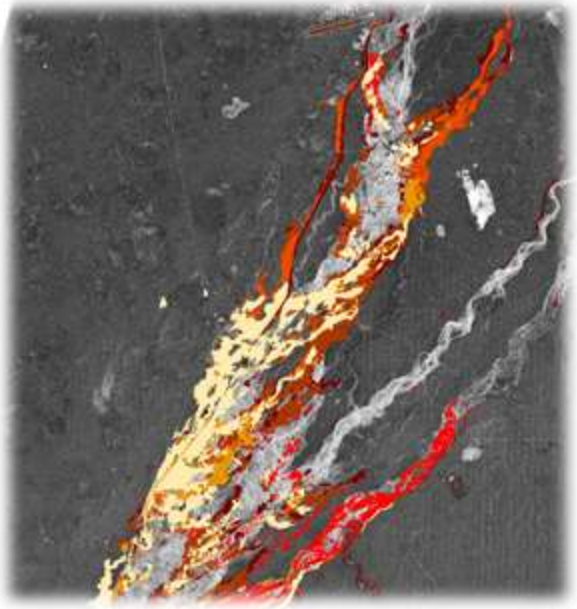
The Cloud-based Hyp3 Data Processing Engine
(http://hyp3.asf.alaska.edu/)

The ASF HyP3 Platform

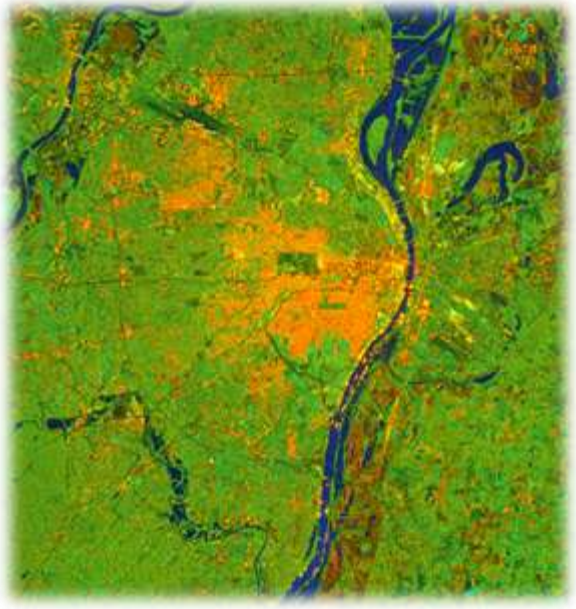
Embedded Application Ready Data (ARD) Product Algorithms

RTC Image Time Series

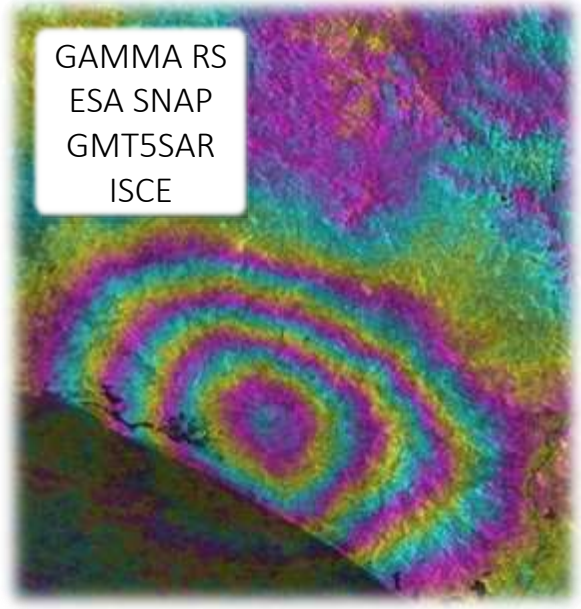
Change Detection Maps



RGB Color Composites



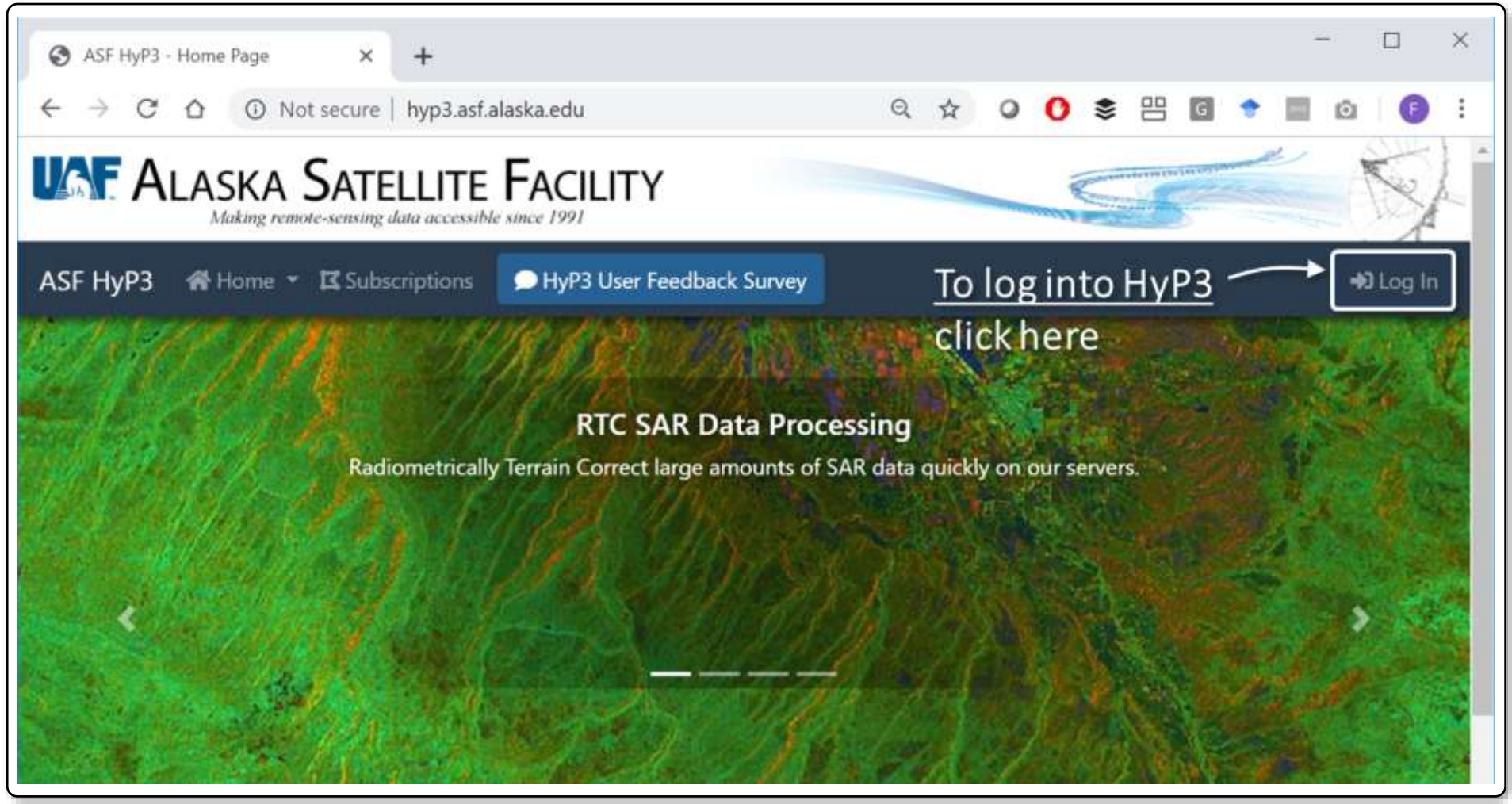
InSAR Products



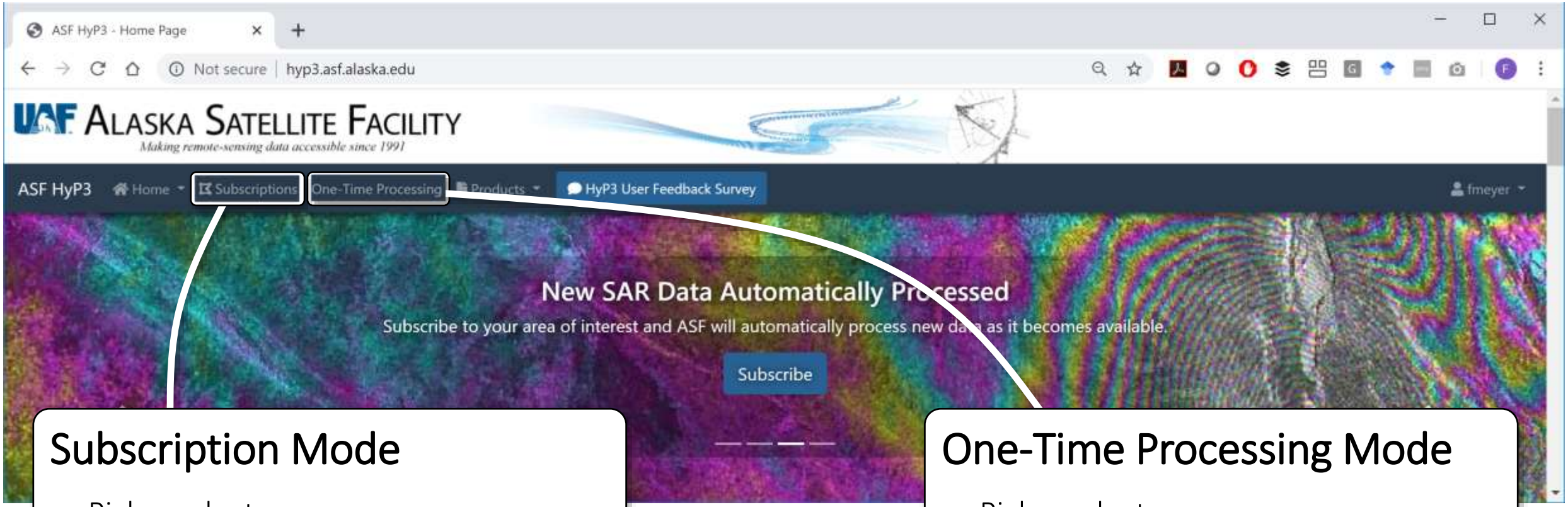
Creating an Account and Logging into HyP3

- **HyP3 uses NASA Earthdata Login**
  - First-time sign-in to HyP3 will create data base entry
  - Send email to uso@asf.alaska.edu with request for access

Access HyP3:
http://hyp3.asf.alaska.edu/



HyP3: Subscription & One-Time Processing Modes



Subscription Mode

- Pick product
- Define Area of Interest
- Pick start and end date of subscription

→ Go

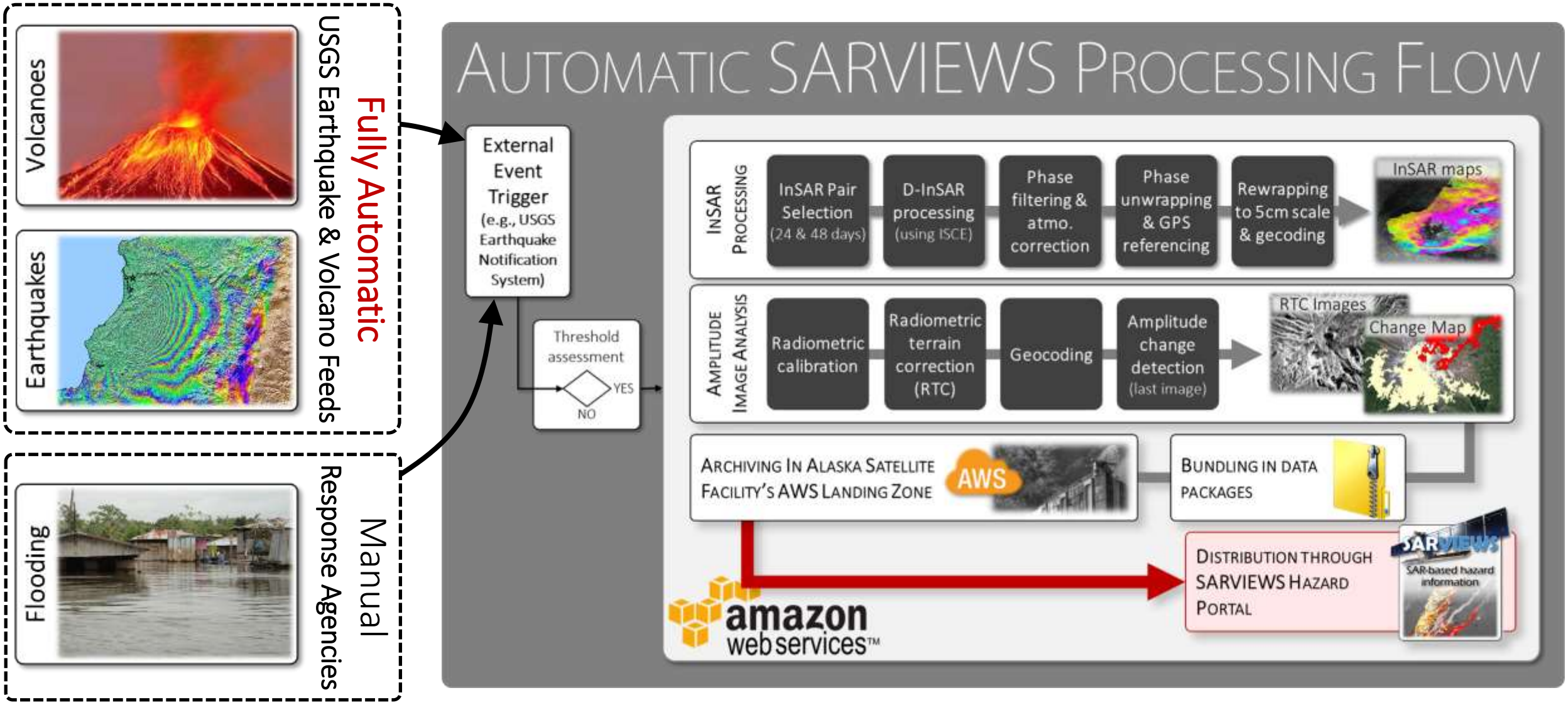
One-Time Processing Mode

- Pick product
- Specify list of granule names

→ Go

ASF's Level-2 Data Processing Platforms: The SARVIEWS Service

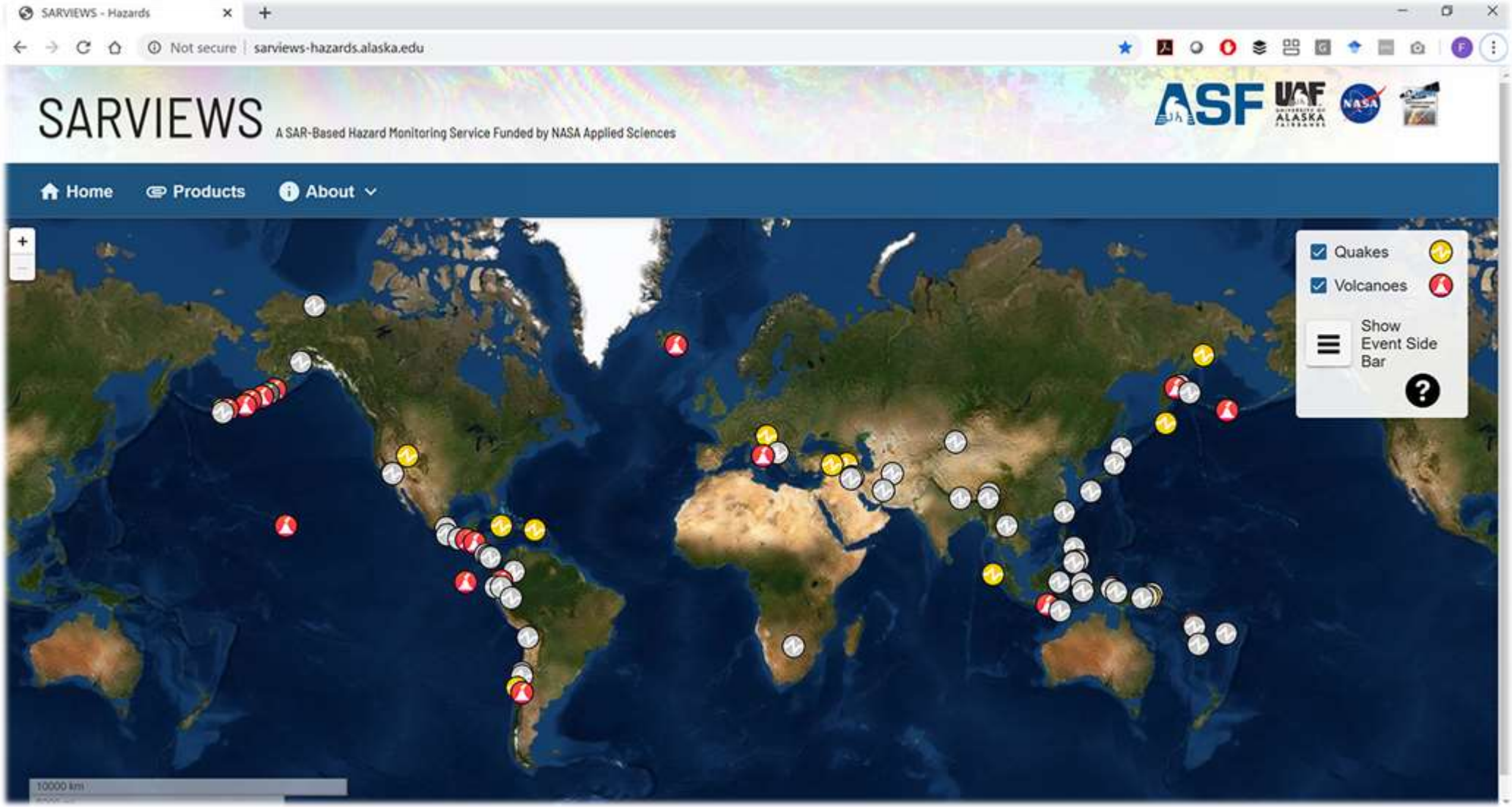
Automating ARD Generation for Hazard Events



The SARVIEWS Hazard Portal

Funded by: Applied Sciences Program

VISIT US @ HTTP://SARVIEWS-HAZARDS.ALASKA.EDU/

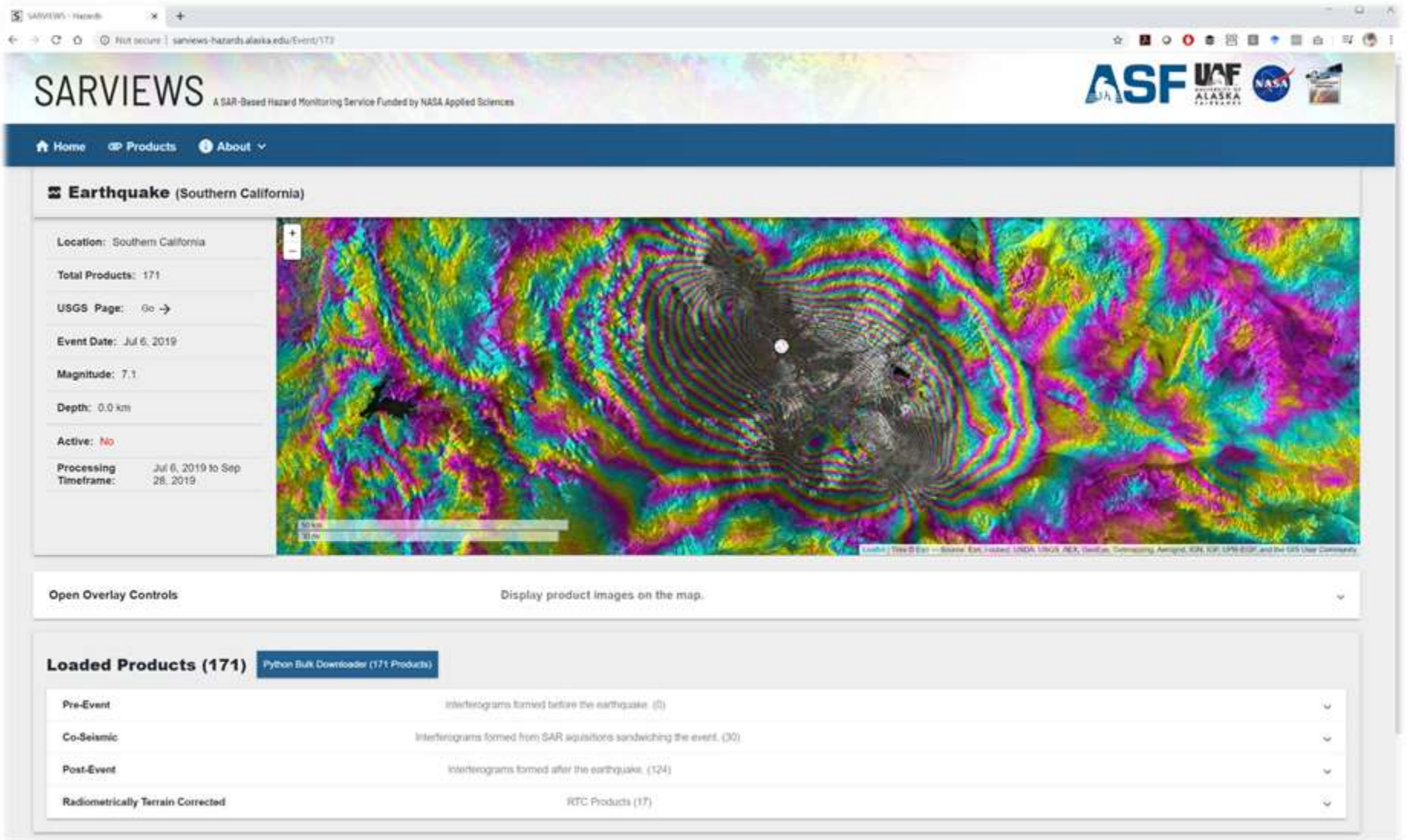


The SARVIEWS Hazard Portal

Funded by: Applied Sciences Program

Separate pages per Monitored event:

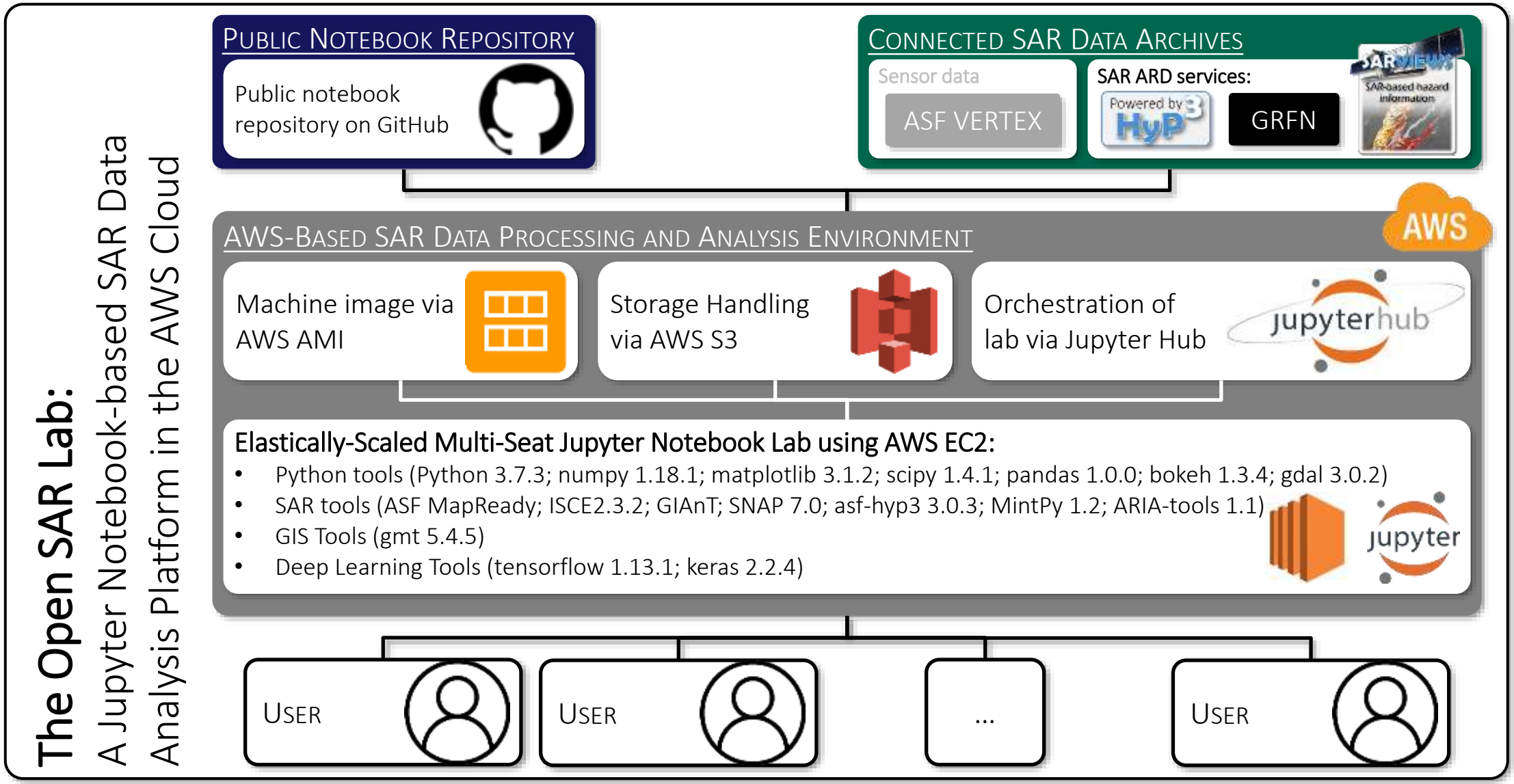
- View data
- Overlay products on map
- Individual download
- Bulk download



LEVEL-3 DATA PROCESSING:
THE OpenSARLab

Generation of Level-3 Science Data in the ASF OpenSARLab Environment

Web Address: opensarlab.asf.alaska.edu

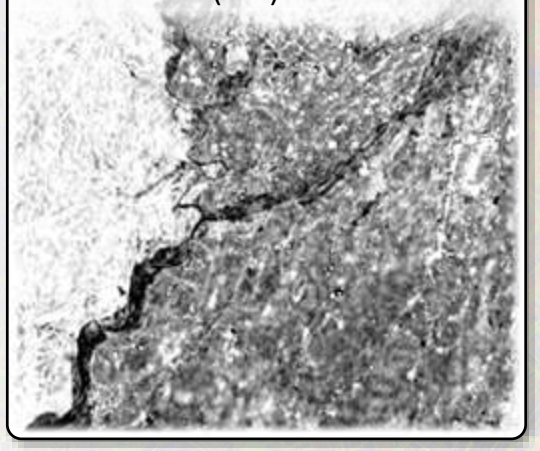


The ASF OpenSARLab

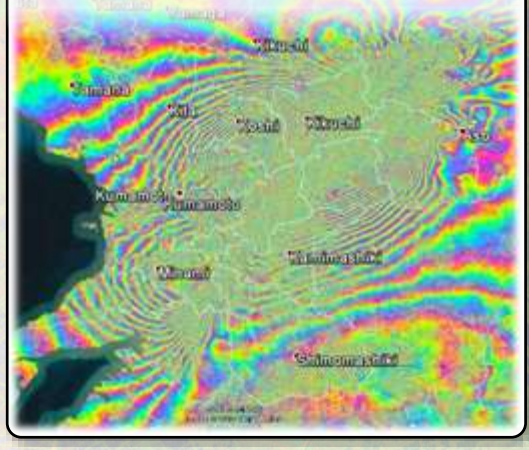
Currently Available SAR Data Processing and Analysis Apps

SAR Image Processing and Geocoding

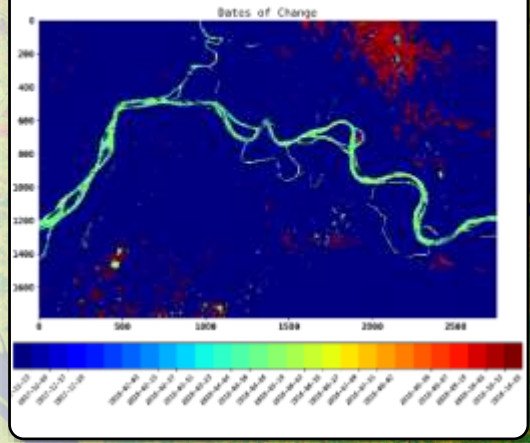
SAR Amplitude Time Series (TS) Analysis



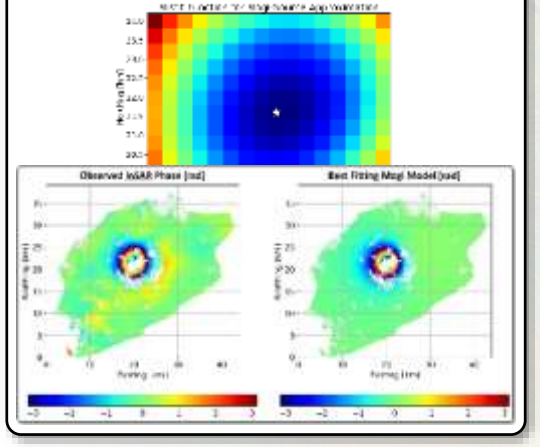
InSAR Processing



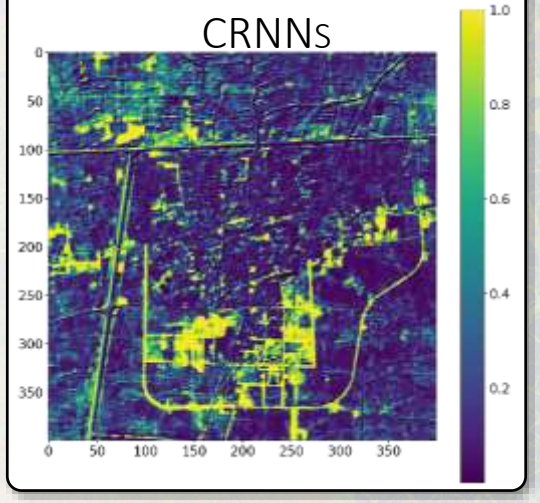
SAR Amplitude TS Change Detection



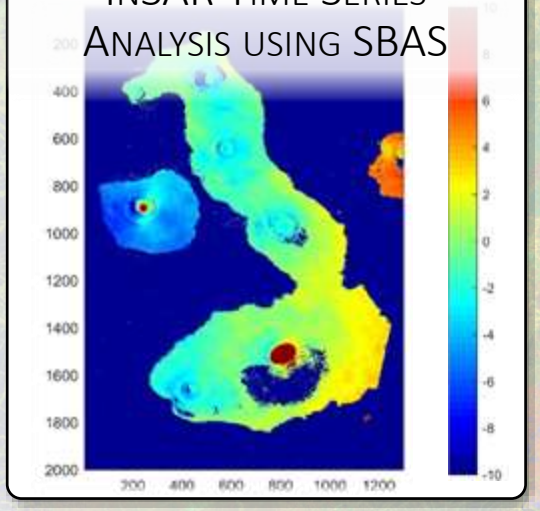
Volcano Source Modeling using InSAR



Change Detection using CRNNs

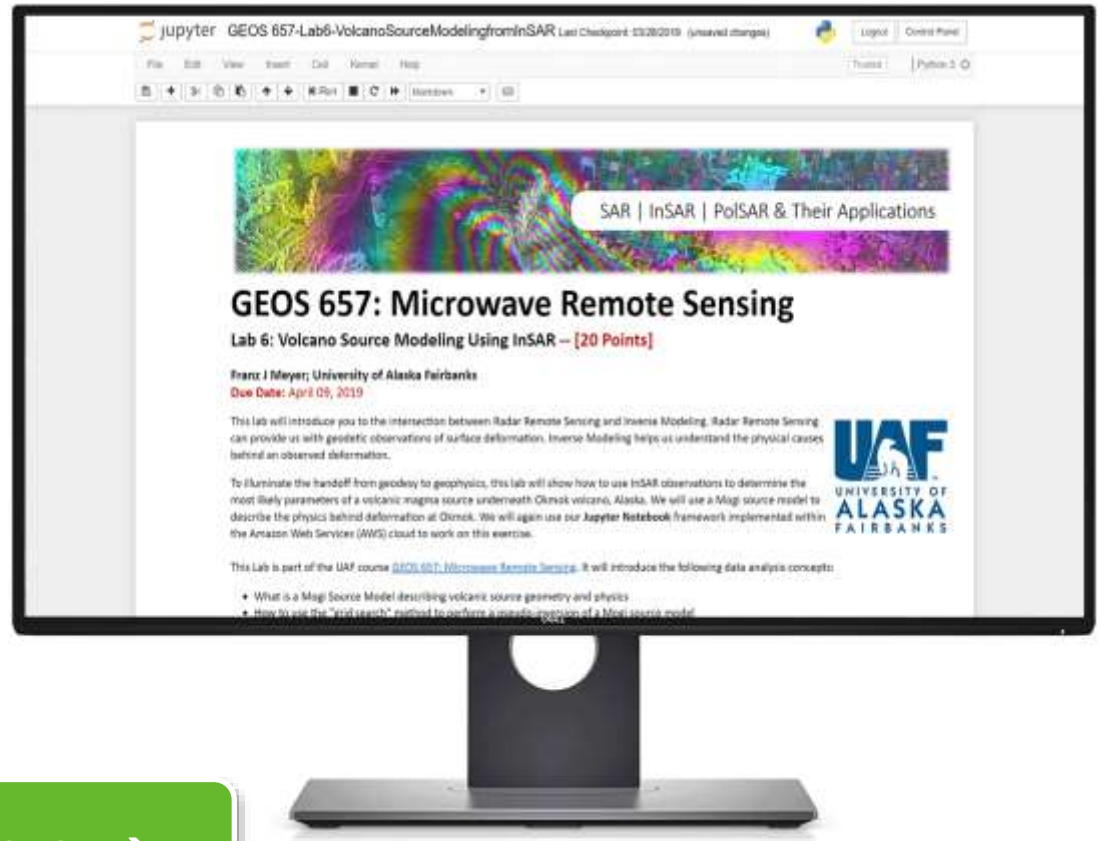


InSAR Time Series Analysis using SBAS



Benefits of the Notebook-based Processing Environments

- **Jupyter Notebook benefits:**
  - Mix code with instructions and explanations → enable self-guided learning
  - Mix synthetic data for demonstration with real data for use in science and applications
  - Collaborate on algorithm development and easily expand existing code
  - Vanilla entry to python programming
  - **Fully reproducible science and processing results**
  - Option of locating Notebook server right next to the data – e.g., do heavy processing in the cloud → only download what you need



Growing availability pre-configured and broadly installed notebook hubs → most notebooks should run out of the box on these hubs

Working Within the Open SAR Lab

Features within the Notebook Lab

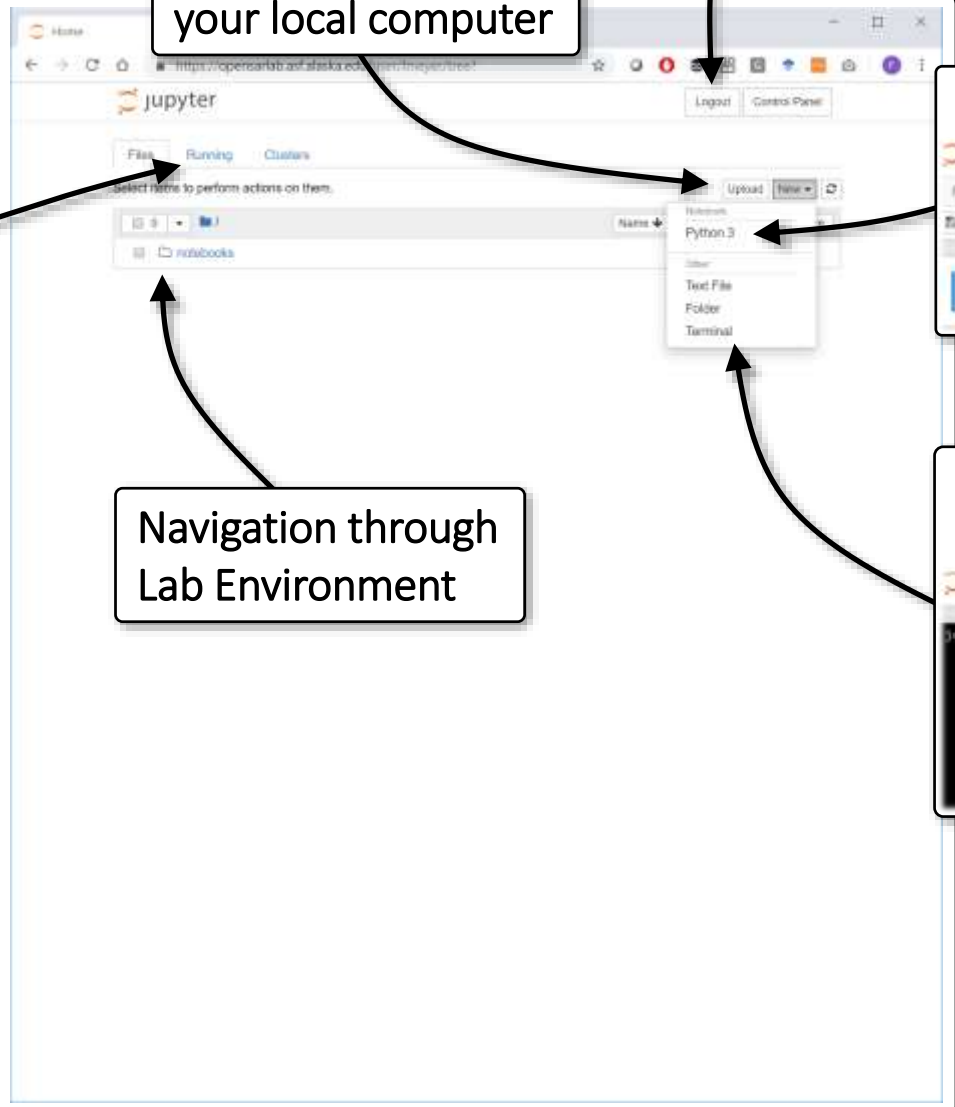
- **Home screen features:**

Logout

Upload files from your local computer

Check on your Running Processes – Shut down Notebooks you don't

The Open SAR Lab: Home Screen



Navigation through Lab Environment

Create new Jupyter Notebook

Open a Terminal for Command-Line work

Open SAR Lab Sneak Peek:
opensarlab.asf.alaska.edu

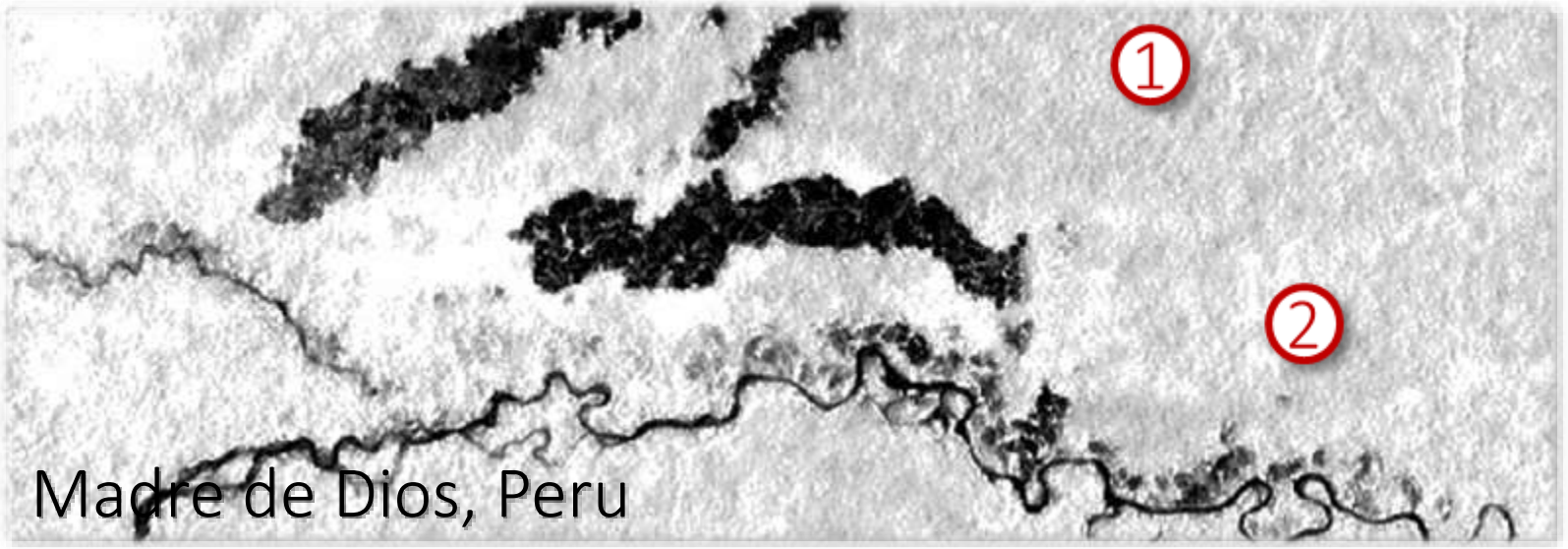
Monitoring Deforestation in Peru Using

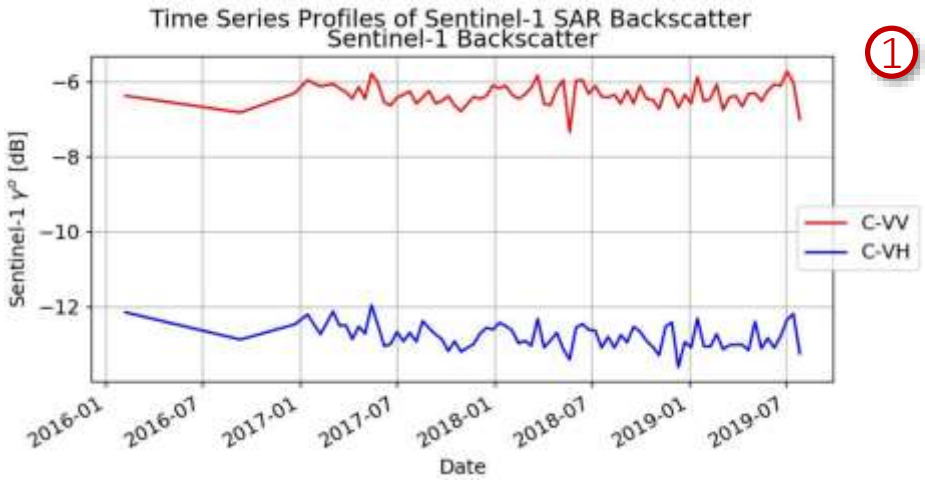
OpenSARLab and HyP3: https://opensarlab.asf.alaska.edu/

- Explore Environmental Signatures in Deep SAR data stacks

Powered by: jupyter AWS

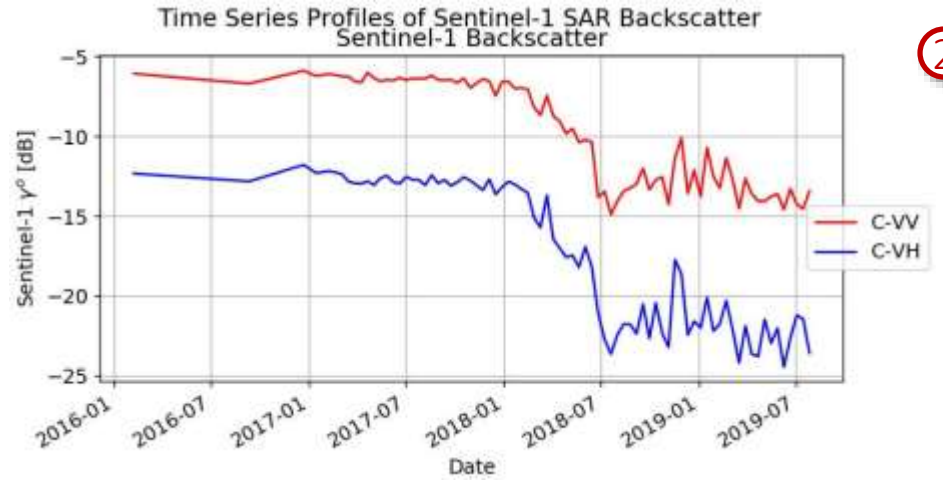
Example: Madre de Dios, Peru





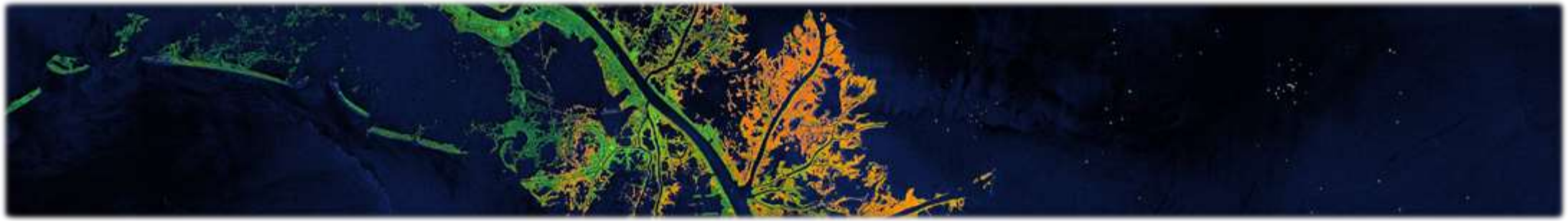
1 Stable Forest:

Radar brightness highly stable → indicative of stability of sensing system



2 Degraded Forest:

Radar brightness indicative of environmental change



SUMMARY OF OUTREACH & TRAINING ACTIVITIES

Graduate-level Class on Microwave Remote Sensing Available Online

- **All Materials for UAF class GEOS657 “Microwave Remote Sensing” available online**
  - For free material and information about the class visit radar.community.uaf.edu
  - Feel free to peruse through the class syllabus and the other content of the class webpage and provide feedback / suggestions / comments to fjmeyer@alaska.edu

The SAR-CBC Project – Developing Training Resources for New SAR Users

Development of New Capacity Building Curricula Focused on Applications and Decision-Making

Topic #1: Training needs assessment in collaboration with in-region partners

Topic #2: Development of curricula & training materials

Topic #3: Web and Data Processing Tools

Supported AmeriGEO Social Benefit Areas (SBAs)

The Core SAR-CBC Team and Project Partners

Project Team

UAF, ASF	**UAF:** SAR expertise & experience in SAR training **ASF:** Access to global SAR data archive & cloud processing
JPL, NISAR	SAR & SAR training; integration with NISAR; expertise in SAR applications relevant to this project
UAH, SERVIR	Extensive capacity building experience; in-region expertise; multi-lingual; expertise in success and outcome metrics

In-Region Partners

Ecuador:	Centr. Univ. of Ecuador (UCE) Inst. de Invest. Geologico Y Energ. (IIGE)
El Salvador:	Ministry of Environment and Natural Resources (MARN)
Colombia:	Institute of Hydrology, Meteorology, and Environmental Studies (IDEAM)

Collaborators

SAR EDU remote sensing education initiative

UNAVCO

NASA ARSET Applied Remote Sensing Training

Current SAR-CBC Project Status

Topic #1: End-User Needs Assessment: Complete

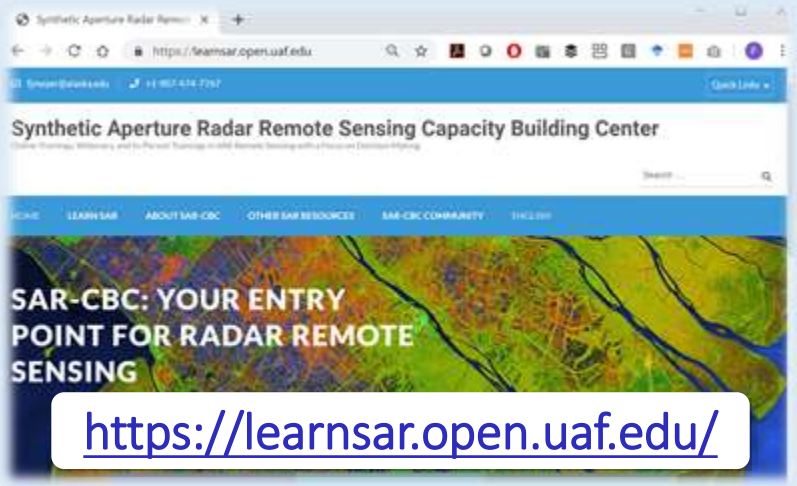
- Iterated needs-assessment questionnaire with partners
- **07/18:** Needs-assessment telecon w/ IIGE & UCE, Ecuador
- **09/18:** Needs-assessment telecon with IDEAM, Colombia
- **11/18:** Needs-assessment telecon with MARN, El Salvador
- **2019**: Repeated telecons with partners ahead of trainings

Topic #2: Curriculum Development: In Progress

- Overall SAR-CBC Curriculum developed and aligned with ARSET training levels
- Relevant Level-0 and Level-1 trainings identified & integrated
- **Two out of four** training Syllabi & related materials completed
- Material for two trainings translated to Spanish

Topic #3: Web and Data Analysis Tools: In Progress

- Cloud-based Jupyter Notebook lab completed
- Website developed & published; content in development



Recent SAR-CBC Training Activities

In-Person Trainings

Aug 2019: SAR Course on "Ecosystems Applications of SAR", Bogota, Colombia

Jan 2020: SAR Course on "SAR in Hazard Monitoring" -- Quito, Ecuador

Webinars & Other Trainings

Jul 2019: Webinar "Q&A Session on SAR"

- With NASA ARSET
- Spanish & English
- 200 participants
- All Q&A data curated (ask if interested)

YouTube Available on YouTube

Aug 2019: Support of SAR Training during AmeriGEOSS Week in Peru

Oct 2019: Webinar "Introduction to SAR"

- To partner organizations in Ecuador
- Approx. 40 attendees
- In Preparation for in-person training

SAR-CBC Status and Lessons Learned

- **UAF/ASF is developing tools and to support new and established users with the processing of large SAR data volumes**
  - HyP3: http://hyp3.asf.alaska.edu/
  - SARVIEWS: http://sarviews-hazards.alaska.edu/
  - OpenSARLab: opensarlab.asf.alaska.edu

SCAN ME!

VISIT ASF HYP3

VISIT SARVIEWS

VISIT THE OPENSARLAB

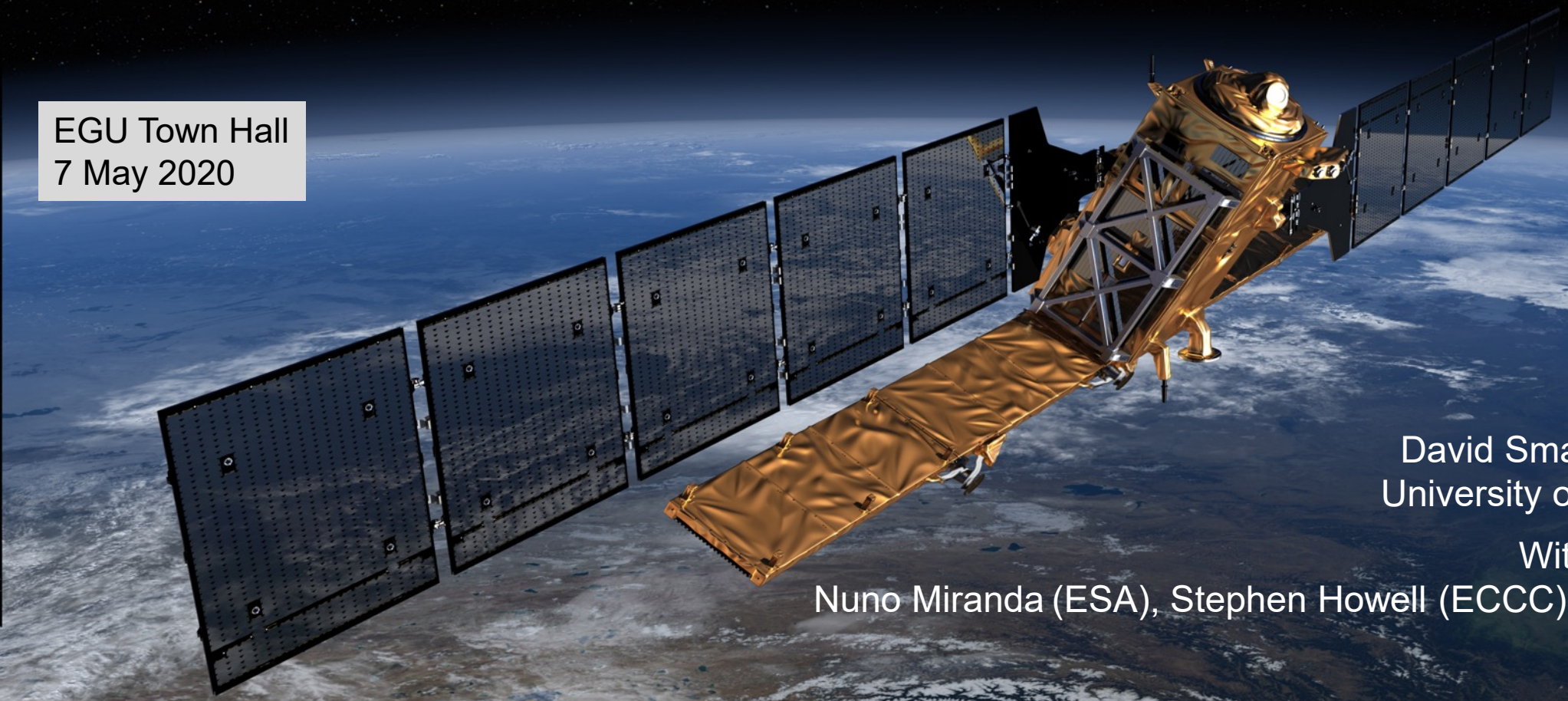
- **SAR-CBC: A SAR Capacity Building Center for the use of SAR in Decision Making**
  - Materials | Webinars | Cloud-based tools → training applications communities in the use of SAR
  - Material development and extensive training activities are ongoing → **all materials free and open**
  - Full support of both English and Spanish-Speaking communities

Follow us

Questions?

Towards Analysis Ready Data for Wide-area Radar Satellite Backscatter Analysis

EGU Town Hall
7 May 2020



David Small, Christoph Rohner
University of Zurich, Switzerland

With contributions from:
Nuno Miranda (ESA), Stephen Howell (ECCC), Yves Crevier (CSA)

(adapted from a presentation given to CEOS SAR Cal/Val at ESRIN (Frascati, Italy) in Nov. 2019)

Radar terrain corrections

- Geometric Terrain Correction (**GTC**)
- Radiometric Terrain Correction (**RTC**)
- Wide area backscatter *composites* from Local Resolution Weighting (**LRW**)
- LRW backscatter *composite* time series are ***Analysis Ready Data*** **(ARD)**
  - *2D image time-series:*
    - *Applicable over wide area*
    - *Lowers barrier to entry for analysis*

- **CEOS CARD4L** Analysis Ready Data for Land Processes
  - Define standards for ARD backscatter products
    - RTC (L1): Terrain-flattening – Normalised Radar Backscatter (NRB)
    - LRW (L3): Wide-area **Analysis Ready Data**

Terrain-flattened Gamma Nought

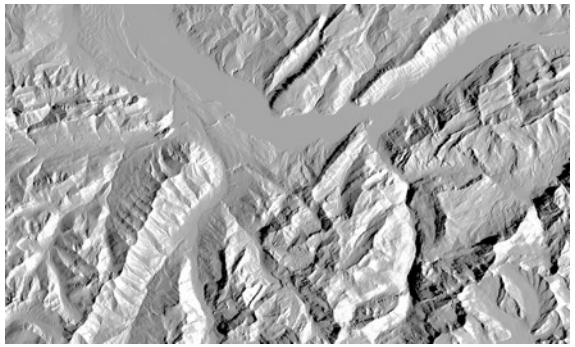
Dept. of Geography / Remote Sensing Laboratories

Interlaken, Switzerland
Sentinel-1A IW GRDH VH-pol.
May 26, 2015

Terrain-flattening: Small D. *Flattening Gamma: Radiometric Terrain Correction for SAR Imagery*, IEEE Trans. on Geoscience & Remote Sensing, 49(8), Aug. 2011, pp. 3081-3093.

Normalise β^0: divide by simulated image

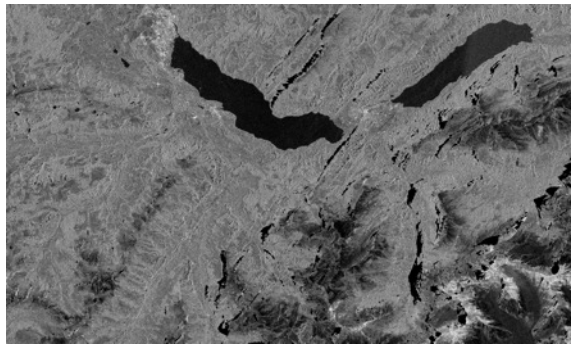
β^0 GTC



A_γ / A_β

-26dB -1dB

γ_T^0 =



RTC

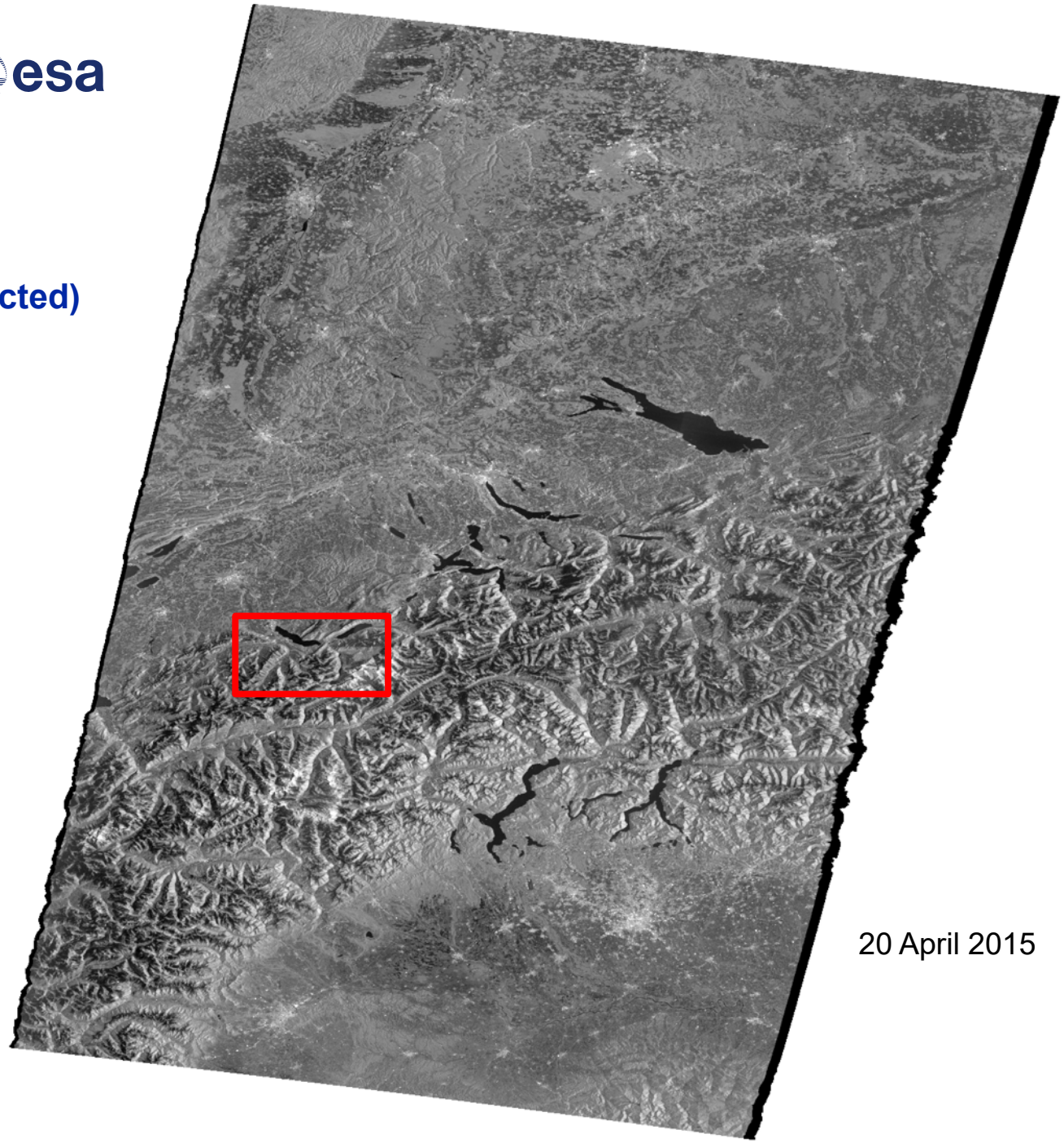
$$\gamma_T^0 = \beta^0 \cdot \frac{A_\beta}{A_\gamma}$$

Sentinel-1A: GTC

(Geometrically Terrain Corrected)

γ_E^0

-26dB -1dB



Generated automatically from 3 IW GRDH products using SRTM3

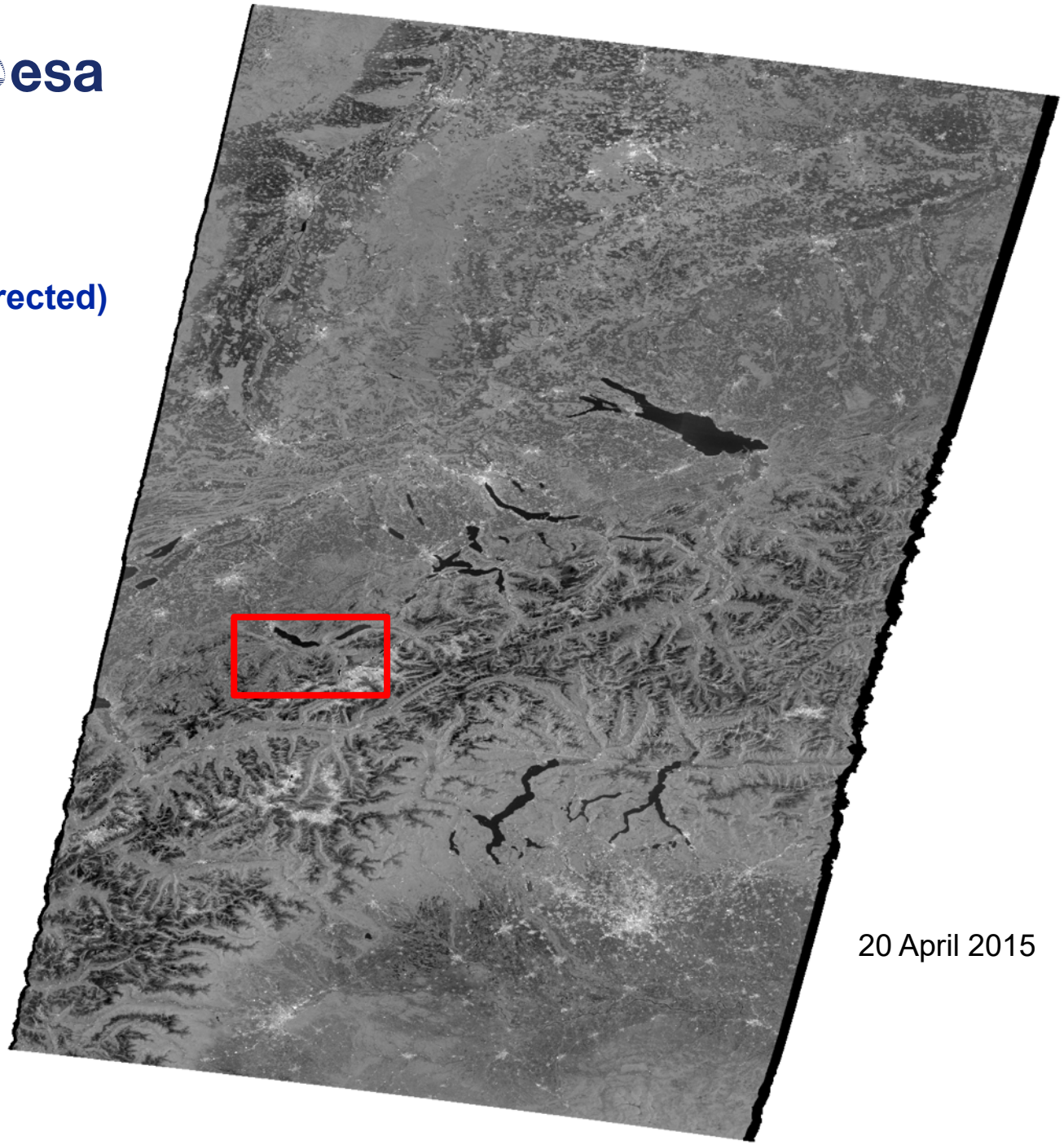
20 April 2015

Copernicus Sentinel data (2015)

Sentinel-1A: RTC
(Radiometrically Terrain Corrected)

$$\gamma_T^0$$

-26dB -1dB



20 April 2015

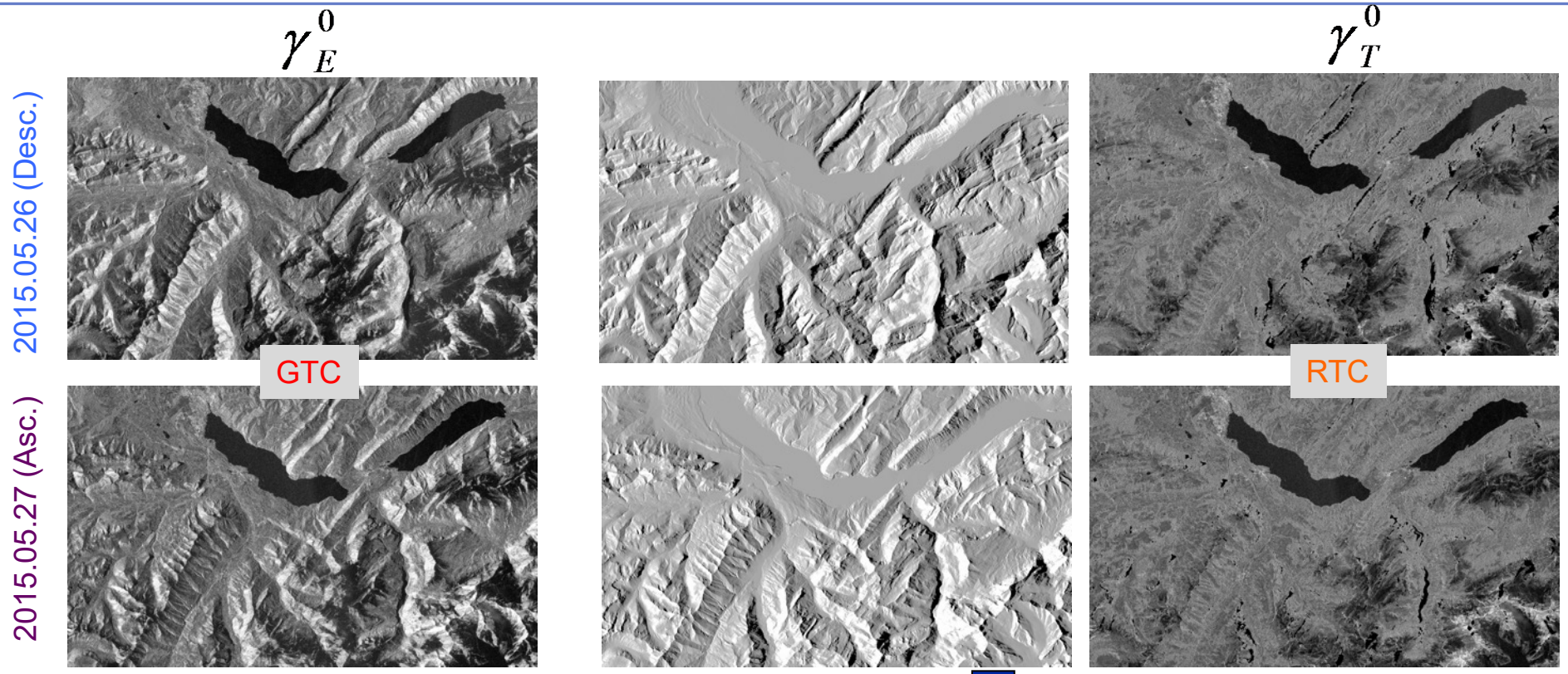
Generated automatically from 3 IW GRDH products using SRTM3

Contains modified Copernicus Sentinel data (2015)

Backscatter Composites

-26dB -1dB

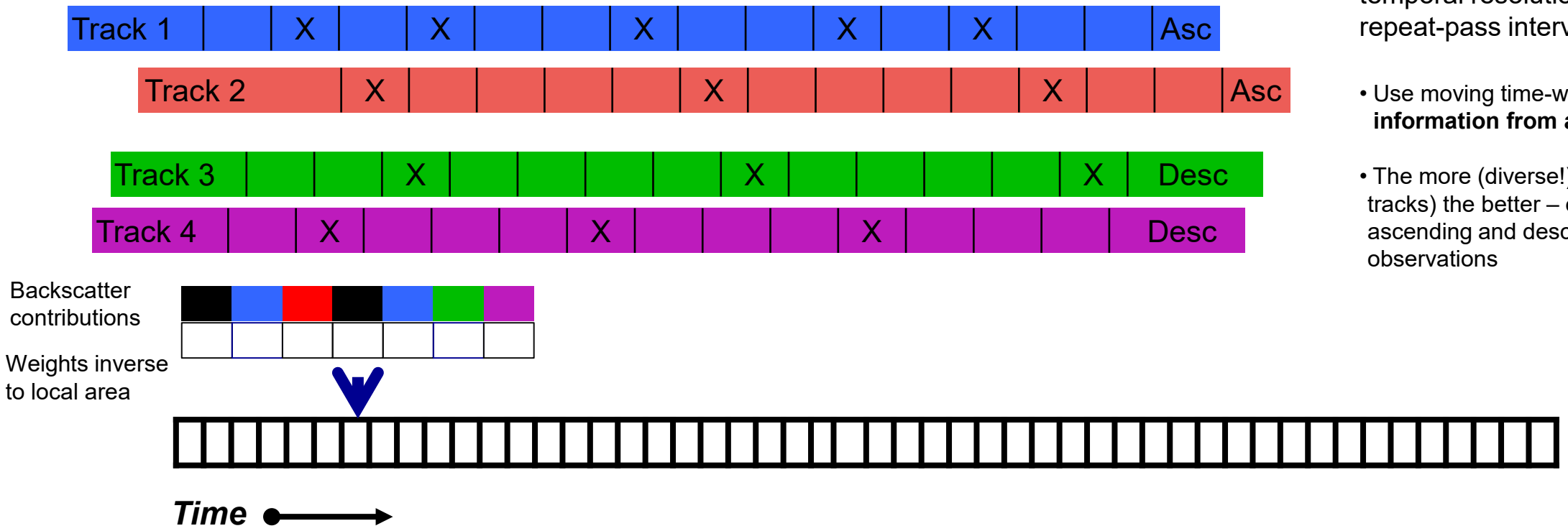
Dept. of Geography / Remote Sensing Laboratories



- Combine asc. & desc. observations to generate **composite** with improved local resolution
- Less shadow than single RTC, lower noise

Interlaken, Switzerland

Revisit Interval: Breaking the tyranny of exact repeat passes

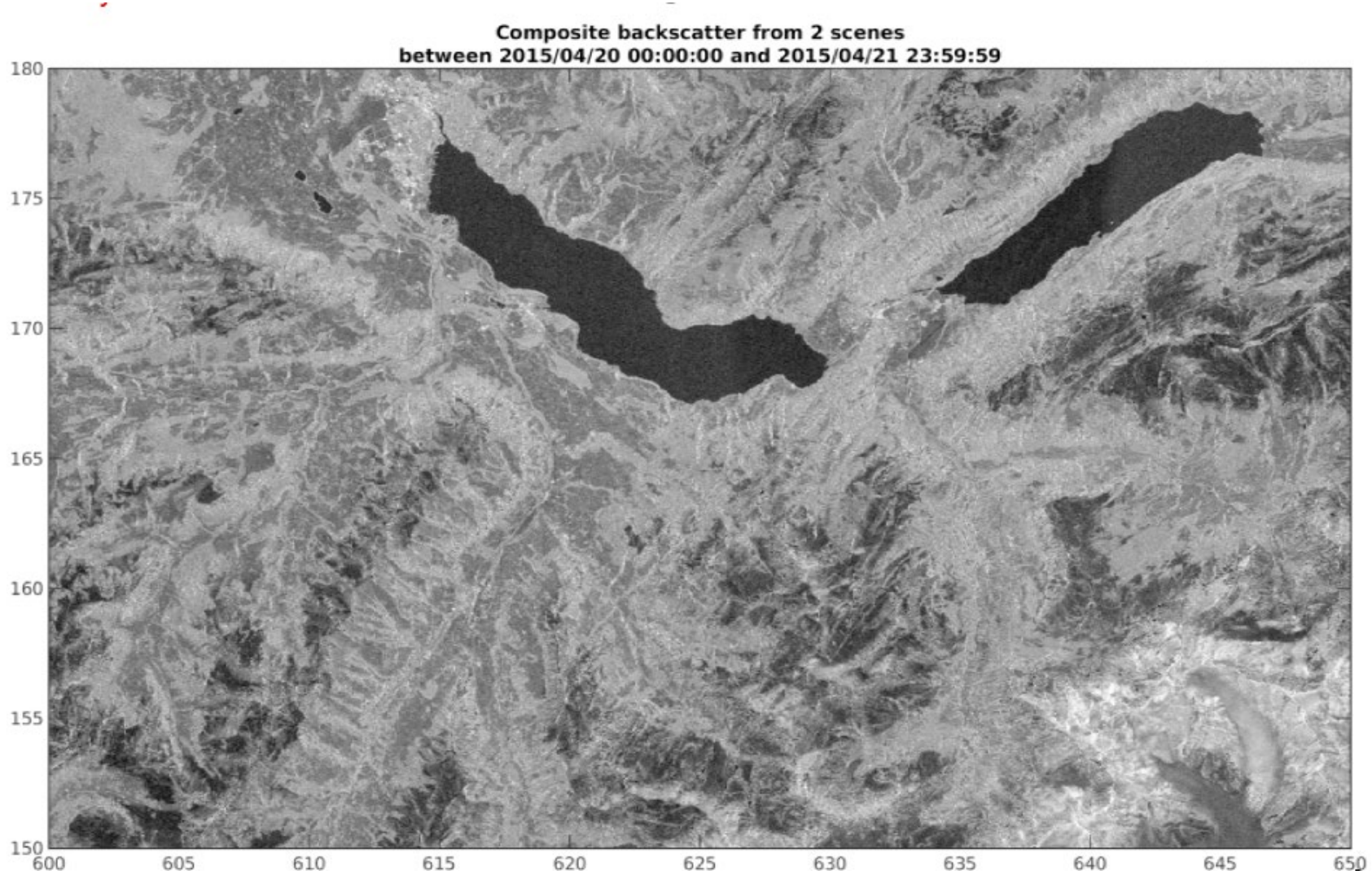


For *Regular Intervals* with temporal resolution better than repeat-pass interval

- Use moving time-window integrating **information from all tracks**
- The more (diverse!) data (and tracks) the better – esp. combine ascending and descending observations

Composites in Time Series Movie

-26dB -1dB



Contains modified Copernicus Sentinel data (2015)

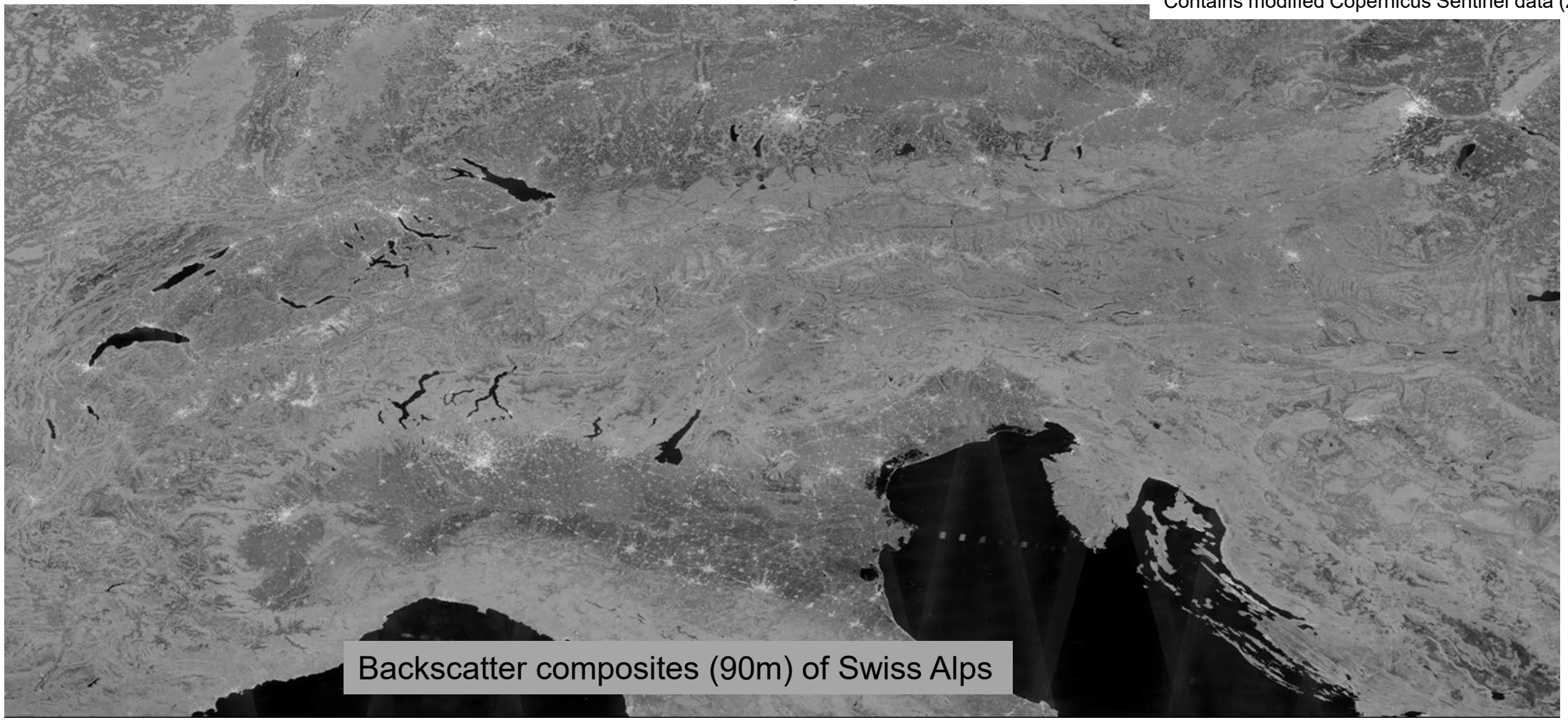
Interlaken, Switzerland

University of Zurich[UZH]

Sentinel-1 Alpine Springtime Backscatter Time-Series

Dept. of Geography / Remote Sensing Laboratories

S-1A + S-1B IW VH-pol. **Feb. - June 2019**: 12 day windows



SRTM used for geometric and radiometric corrections

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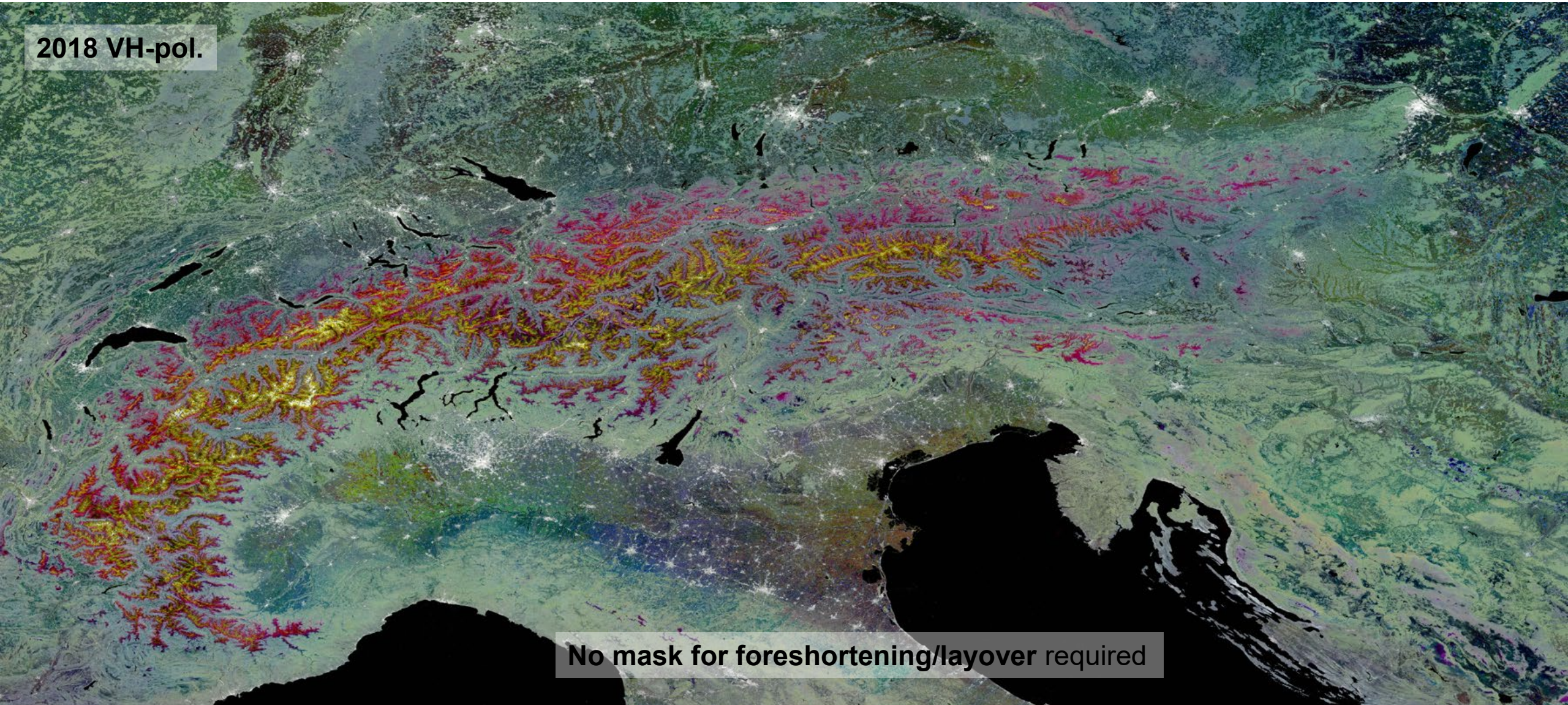
Contains modified Copernicus Sentinel data (2018)

Dept. of Geography / Remote Sensing Laboratories

Sentinel-1 IW Backscatter Composites 2018 VH: Feb 24-Mar 7, April 1-12, May 1-12; -23dB (black) to -6dB (white)



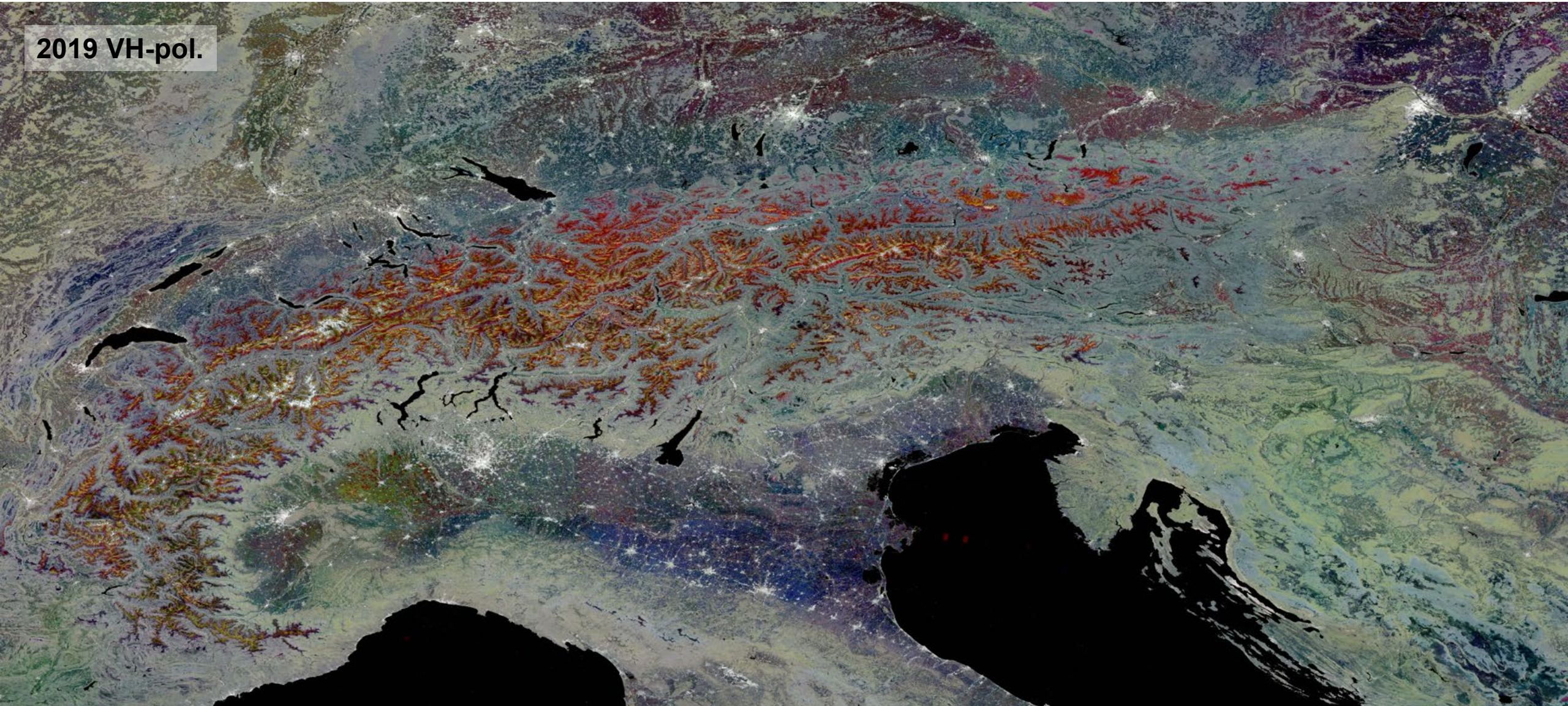
University of Zurich[UZH]

esa

Contains modified Copernicus Sentinel data (2019)

Dept. of Geography / Remote Sensing Laboratories

Sentinel-1 IW Backscatter Composites 2019 **VH**: Feb 6-17, April 1-12, May 1-12; -23dB (black) to -6dB (white)



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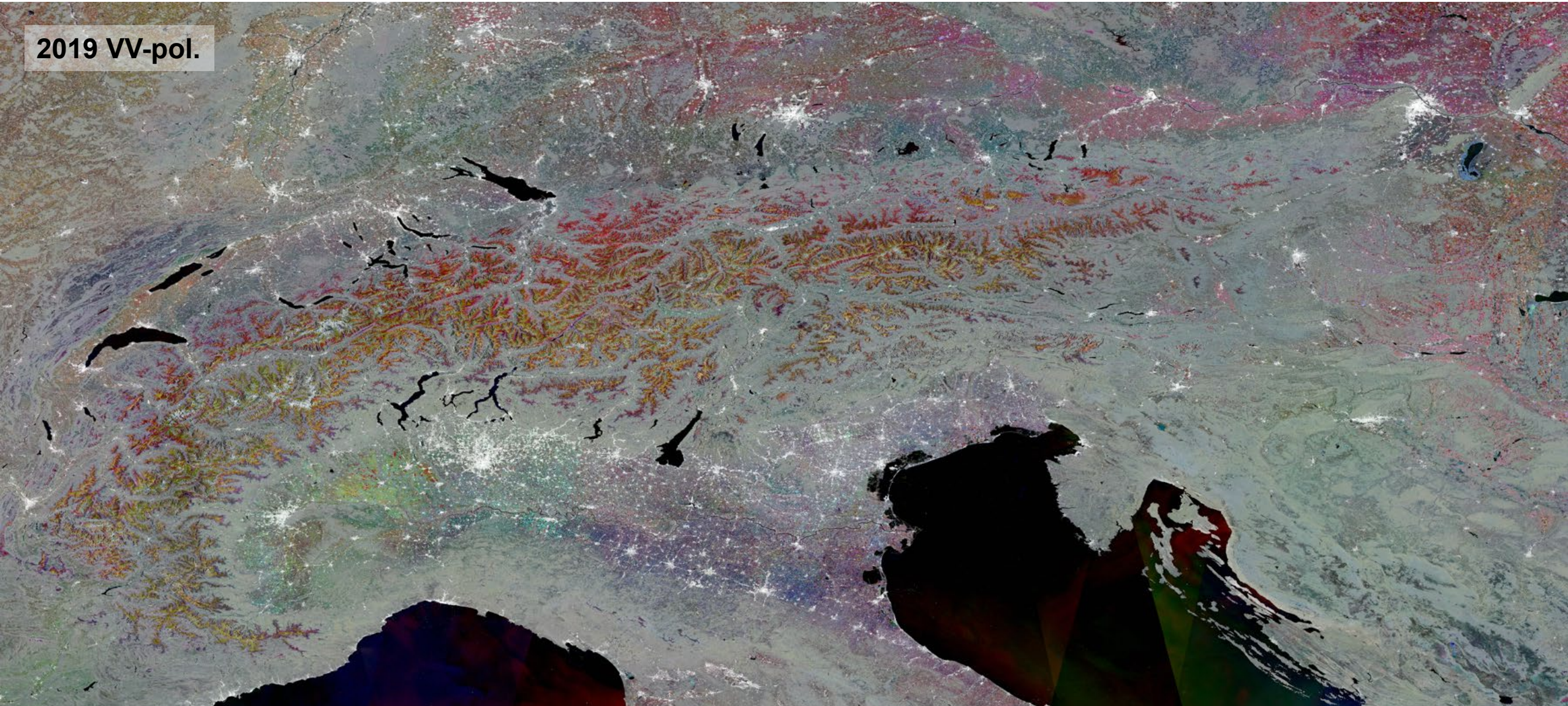
esa

Contains modified Copernicus Sentinel data (2019)

Dept. of Geography / Remote Sensing Laboratories

Sentinel-1 IW Backscatter Composites 2019 **VV**: Feb 6-17, April 1-12, May 1-12



Radar products in map geometry

Correction(s) Applied	GTC	RTC	LRW (ARD)
Geometry (position)	✔	✔	✔
Radiometry (contributing area)		✔	✔
Spatial Resolution homogeneity			✔
Seamless wide-area coverage			✔
Time series from multi-sensor inputs			✔
Temporal resolution can be < repeat			✔

Univer
Zurich

Dep

Ellesmere Island Backscatter Composites

S-1A+S-1B EW+IW HV

1 day delta

2 day window

N.B. CDEM

Apr. – Aug. 2017

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Ellesmere Island Backscatter Composites

S-1A+S-1B EW+IW HV

+RS2 SCWA

1 day delta
1 day window

N.B. CDEM

Apr. – Aug. 2017

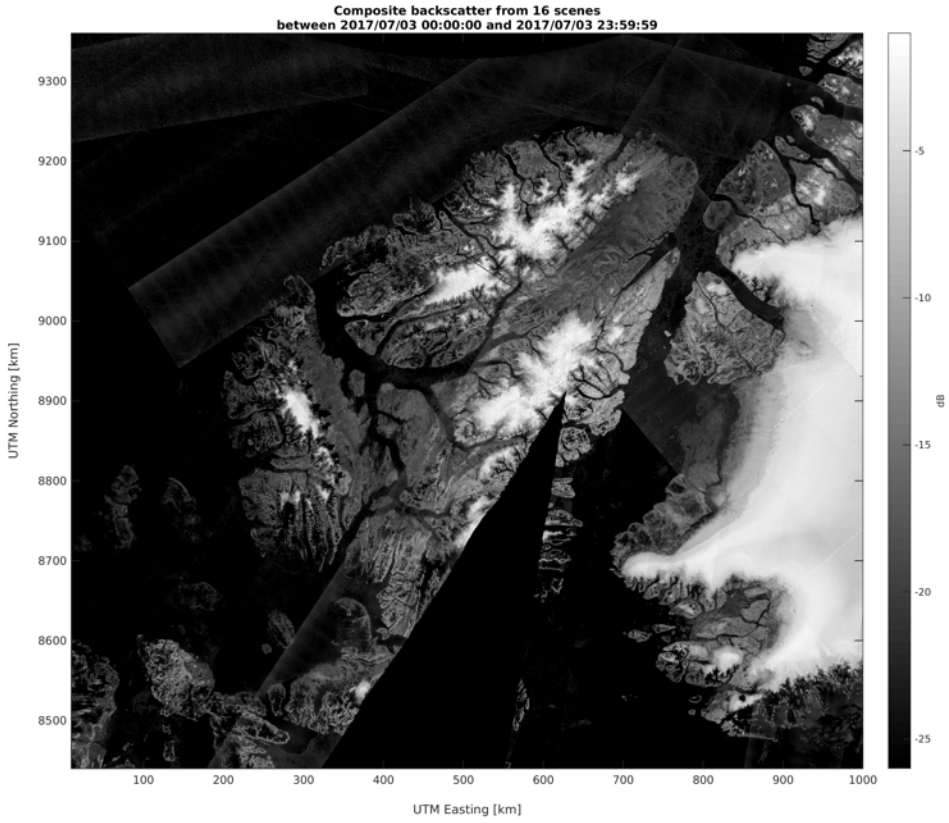
- **Comparisons with Passive Microwave & ASCAT: Sea ice melt onset detection** (Howell, Small, et al., Rem. Sens. Env., 2019.

esa

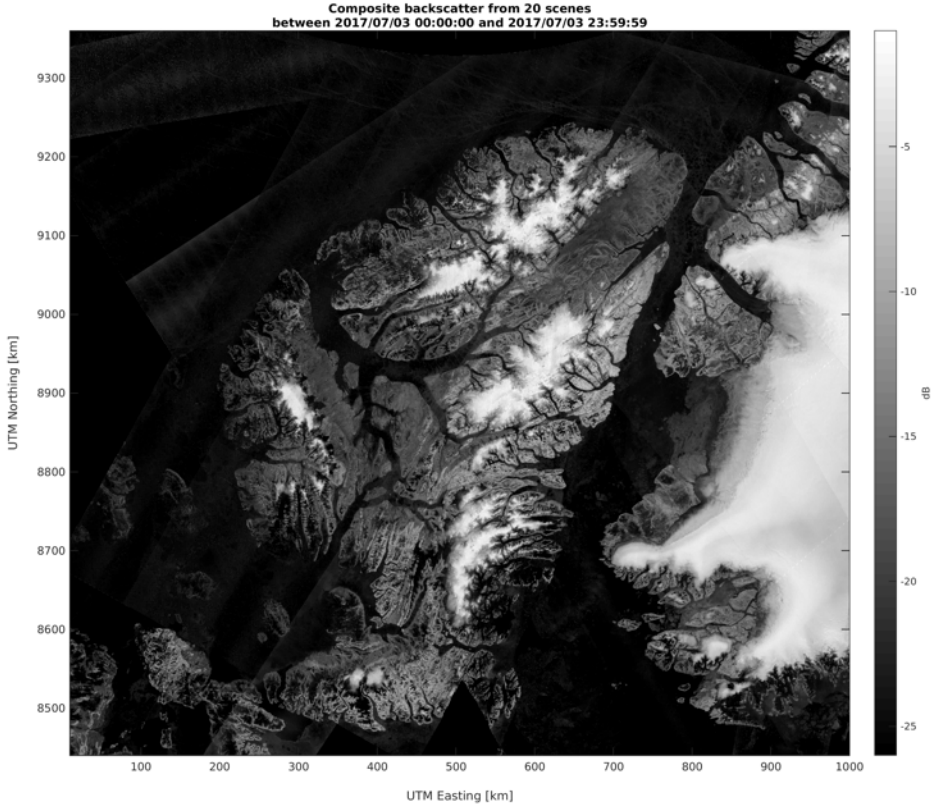
CSA ASC

Ellesmere Island Backscatter HV-pol. Composites – July 3, 2017

S-1A+S-1B



S-1A+S-1B+ RS2



Contains modified Copernicus Sentinel data (2017)

Conclusions

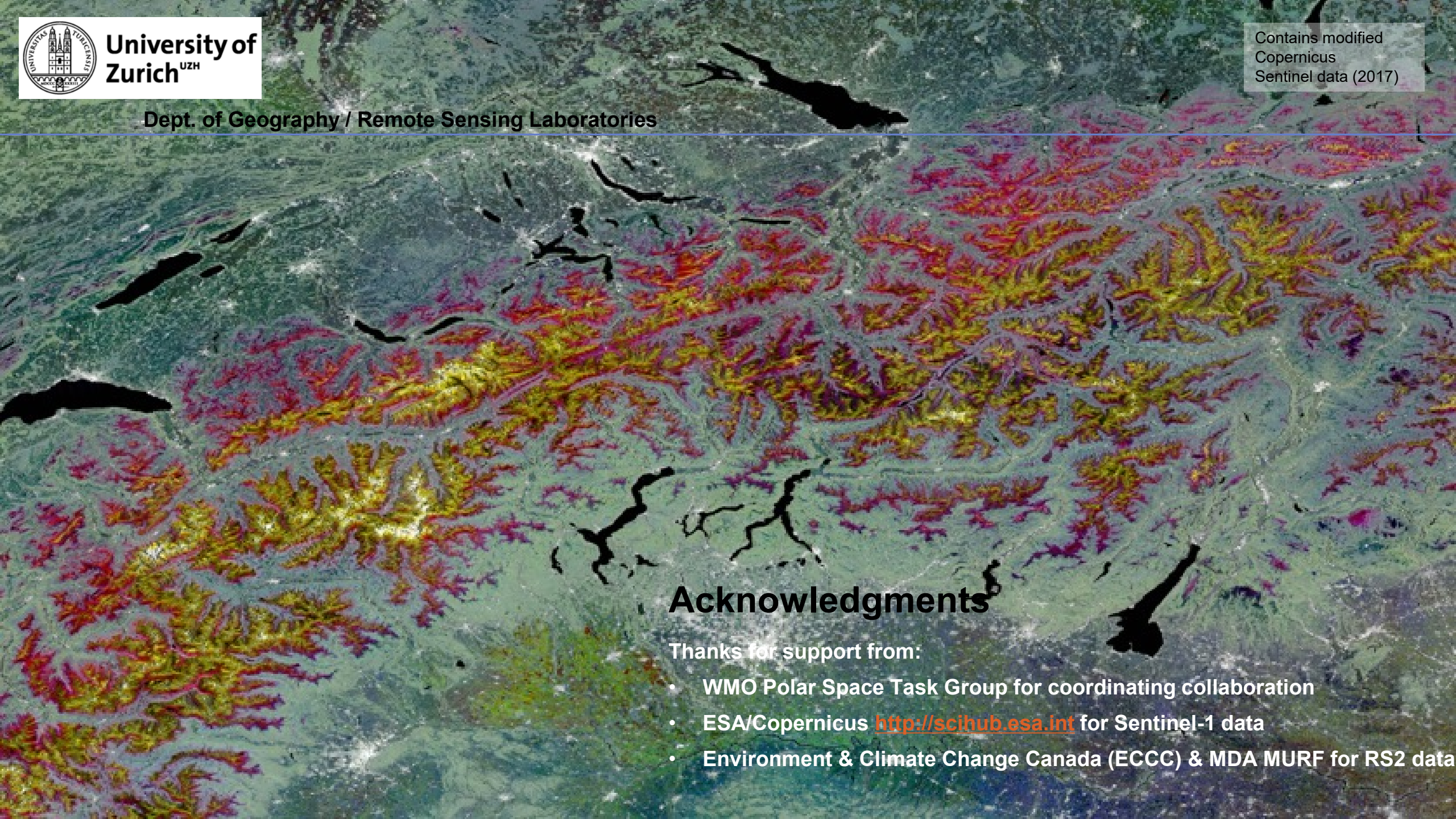
Composite backscatter from **multi-sensor** constellations

- Relies on high standard of level 1 geometric and radiometric calibration
- Best given acquisitions with consistent backscatter regime (e.g. 30° < θ < 40° S-1 IW / RS2 SCNB); ascending + descending
- Share the coverage load, *improve temporal resolution*, ***lower costs***!

Multi-Sensor Backscatter composites ***Analysis Ready***

- Wider coverage, less noise and higher mean resolution than single-scene RTC products
- Selected References:
  - Small D., **Flattening Gamma: Radiometric Terrain Correction for SAR Imagery**, TGRS, 2011.
  - Small D. et al., **Wide-area Analysis Ready Radar Backscatter Composites**, In Review, 2019.
  - Jäger D., **Wide-area wet snow mapping of the Alps based on Sentinel-1 multi-track radar backscatter composites**, M.Sc. Thesis, UZH, 2016.
  - Rüetschi M., M. Schaepman, D. Small, **Using Multitemporal Sentinel-1 C-band Backscatter to Monitor Phenology and Classify Deciduous and Coniferous Forests in Northern Switzerland,** Remote Sens., 10(55), 2018.
  - Rüetschi M., D. Small, L. Waser, **Rapid Detection of Windthrows Using Sentinel-1 C-Band SAR Data,** Remote Sens., 11(2), 2019.
  - Howell S. et al., **Estimating melt onset over Arctic sea ice from time series multi-sensor Sentinel-1 and RADARSAT-2 backscatter**, RSE, 2019.

- **Realising the full potential of SAR satellites is achievable with multi-agency coordination**



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Contains modified Copernicus Sentinel data (2017)

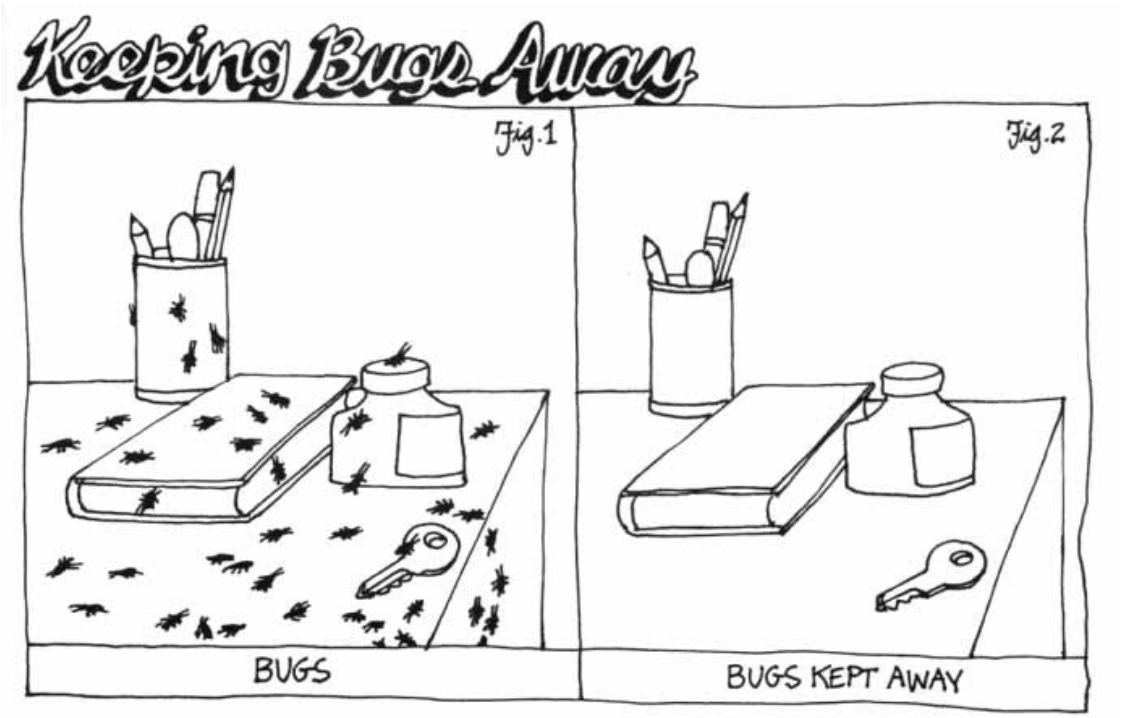
Acknowledgments

Thanks for support from:

- WMO Polar Space Task Group for coordinating collaboration
- ESA/Copernicus http://scihub.esa.int for Sentinel-1 data
- Environment & Climate Change Canada (ECCC) & MDA MURF for RS2 data

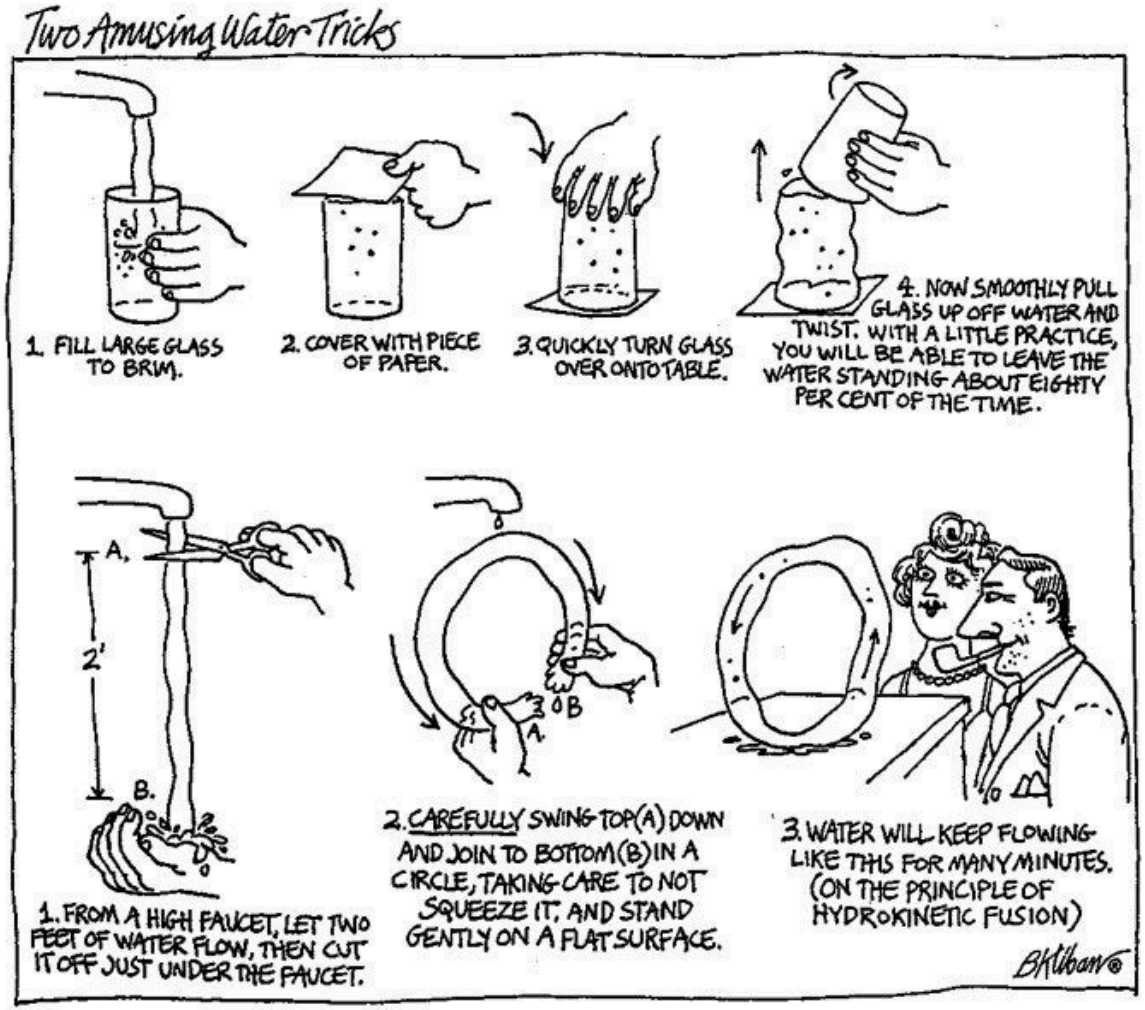

Prof Iain H Woodhouse
@fortiain
University of Edinburgh

Users want SAR to be like this…



B. Kliban, Never Eat Anything Bigger Than Your Head

But to beginners, SAR usually looks like this…



@fortiain

B. Kliban, *Advanced Cartooning and Other Drawings* (New York, 1993), p. 25.

How do we help the transition?

- **More/better training:** e.g. EO College SAR MOOC “Echoes in Space”
- **More Analysis Ready Data (ARD):** e.g. Earth Engine, EO Browser
- **More tools for accessing ARD:** e.g. EO Browser (www.sentinel-hub.com), Earth Blox (coming soon, www.blox.earth)

National Aeronautics and Space Administration

NASA ARSET: SAR Capacity Building

Erika Podest, Jet Propulsion Laboratory, California Institute of Technology
Ana Prados, Brock Blevins, Selwyn Hudson-Odoi, Amita Mehta, Sean McCartney

EGU 2020

May 7, 2020

What is preventing the remote sensing community from using SAR for operational applications? What are more pressing limitations, data or processing capabilities?

Some of the limitations are:

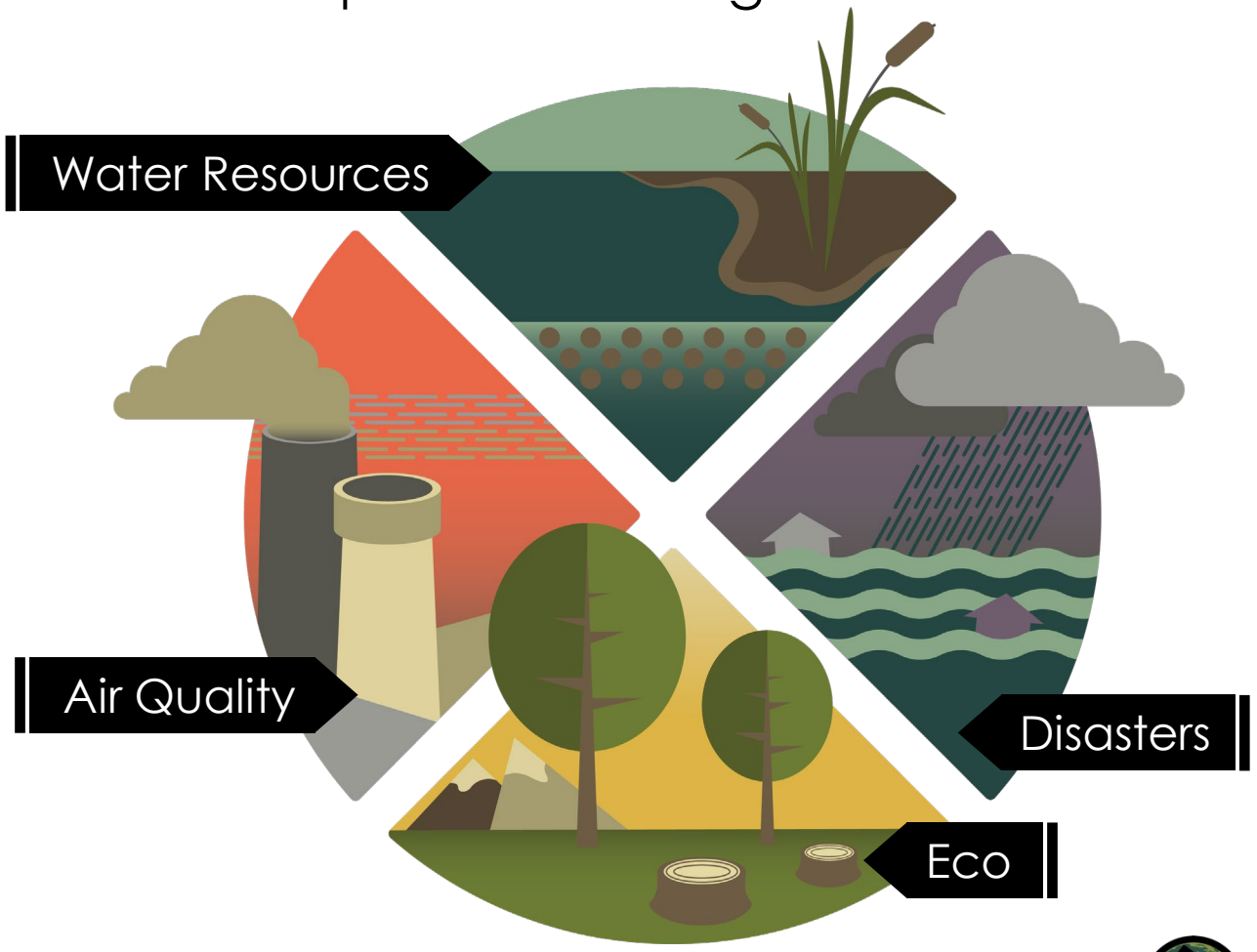
- People are intimidated by the data
- There are not enough online demonstrations on how to do specific analysis with SAR
- SAR processing on personal computers is slow - need for a cloud computing capability that is easy to use - GUI driven

NASA's Applied Remote Sensing Training Program (ARSET)

http://arset.gsfc.nasa.gov/

- Empowering the global community through remote sensing training
- Part of NASA's Applied Sciences Capacity Building Program
- Seeks to increase the use of Earth science in decision-making through training for:
  - policy makers
  - environmental managers
  - other professionals in the public and private sector

Topics for Trainings Include:



ARSET Training Formats

Online

– Offered through the internet
– 2-5 weeks long
– 1-2 hours a week
– Available at all levels
– Live & recorded
– Free
– Materials available in English & Spanish

In-Person

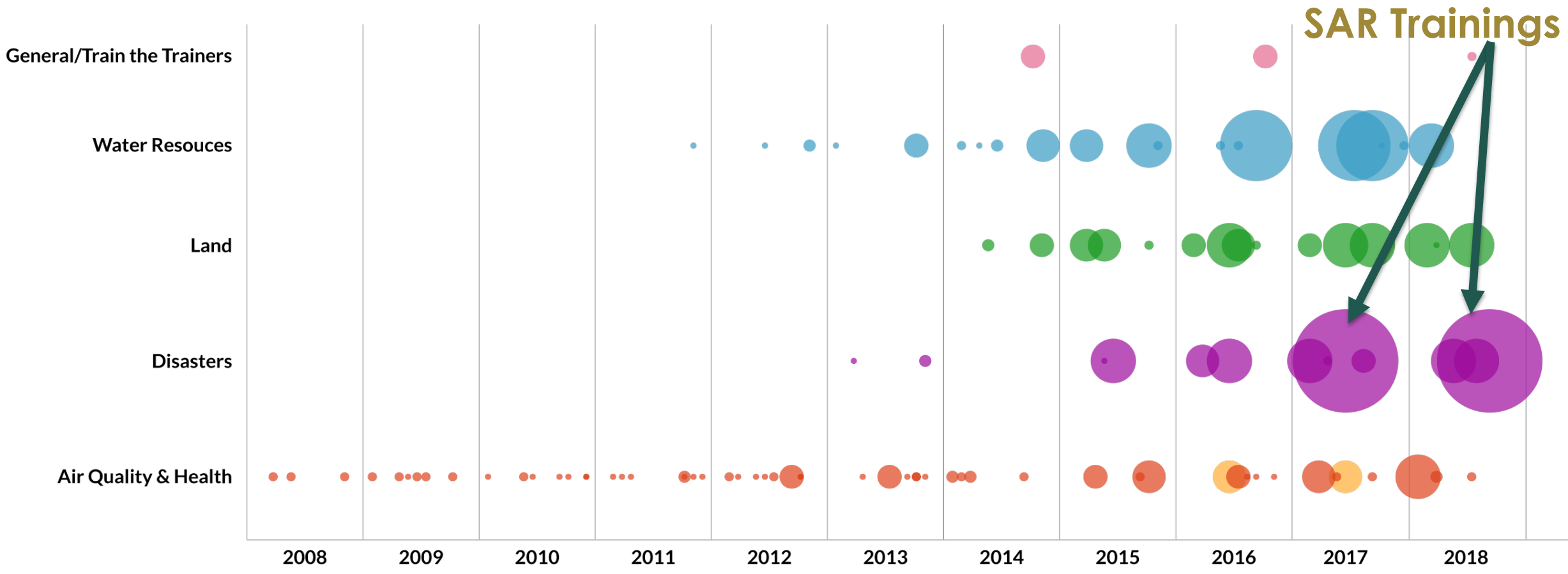
– Hosted with a partner
– Typically in a computer lab
– 2-7 days long
– Focus on locally-relevant case studies
– Certain topics can be presented in Spanish

Train the Trainer

– Online or in-person
– Designed for individuals and organizations looking to develop their own applied remote sensing trainings

ARSET Trainings

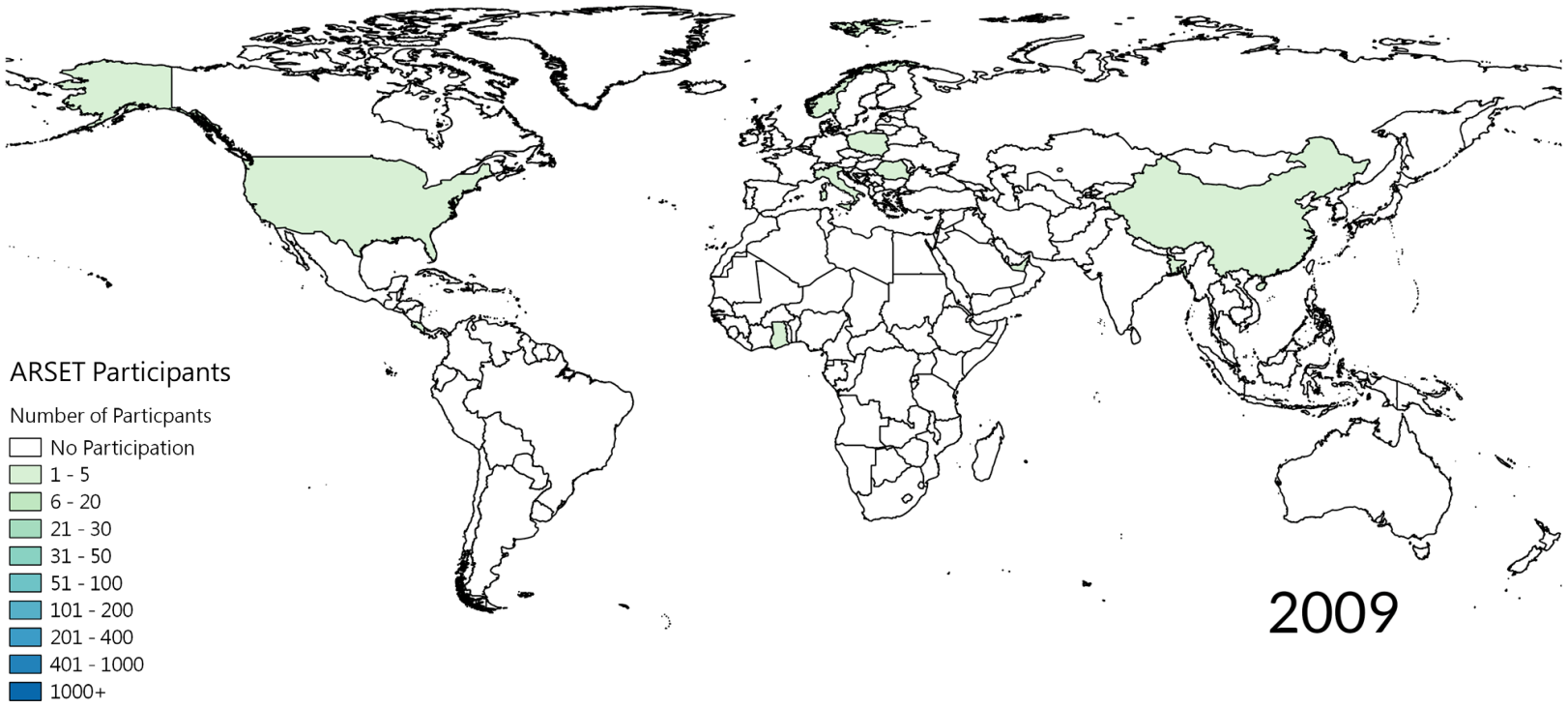
110+ trainings 18,000+ participants 160 countries 4,000+ organizations



* size of bubble corresponds to number of attendees

ARSET Trainings

ARSET Global Participants (2009, 2012-2017)



110+ trainings

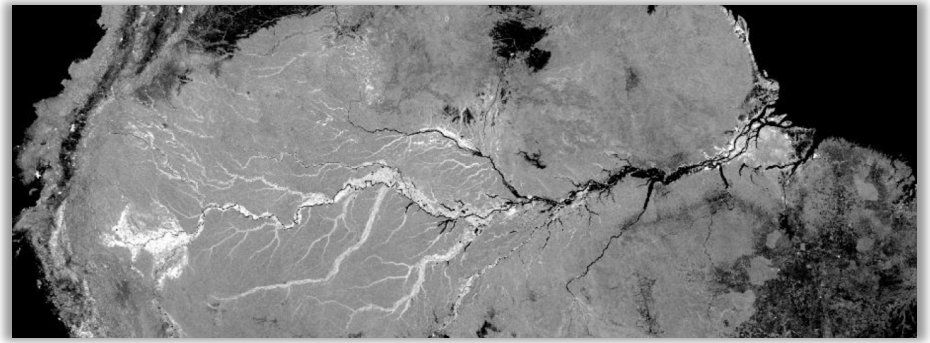
18,000+ participants

160 countries

4,000+ organizations

Online SAR Training: Introduction to SAR - 2017

Introduction to Synthetic Aperture Radar; Introducción al Radar de Apertura Sintética



- Session 1: Basics of SAR (Podest)
- Session 2: SAR Processing and Data Analysis (Podest)
- Session 3: Introduction to Polarimetric SAR (Pinto)
- Session 4: Introduction to SAR Interferometry (Fielding)

Four, one-hour sessions in English and Spanish

June - July 2017

The objective was to provide an introduction to SAR to a non-technical audience focusing on:

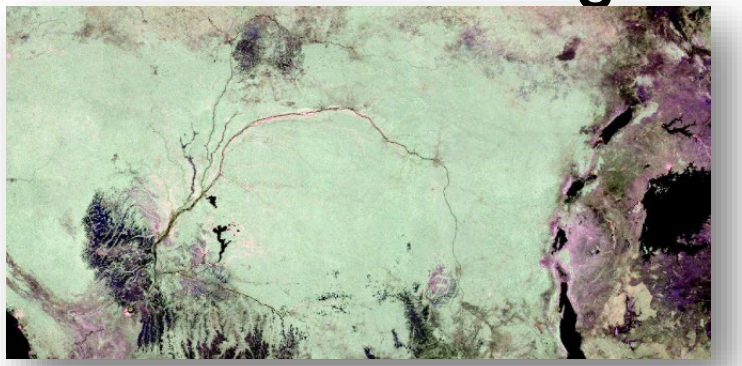
- explaining concepts and understanding the information content in SAR images.
- providing demos on how to interpret SAR images, process SAR data, and perform basic analysis.

Intro to SAR Statistics:

- 984 participants
- 599 organizations
- 75 countries
- 26 U.S. States
- Over 21,000 YouTube views

Online SAR Training: Advanced SAR - 2018

Radar Remote Sensing for Land, Water, & Disaster Applications



- Session 1: SAR for Land Cover Mapping (Podest - JPL)
- Session 2: SAR for Flood Mapping (Podest - JPL)
- Session 3: SAR for Mapping Crop Growth (McNairn- Agriculture and Agri-Food Canada)
- Session 4: INSAR for Earthquake Deformation (Fielding-JPL)

Four, one-hour sessions in English and Spanish

July - August 2018

Prerequisite: Introduction to SAR

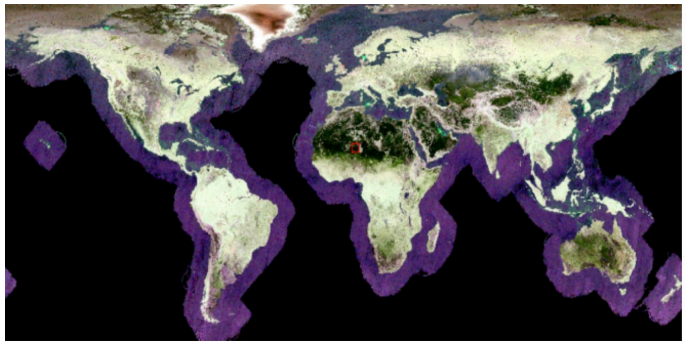
- The objective was to provide an advanced SAR training focused on specific topics:
- Half of each session covered theory. Understanding image characteristics specific to the session's application.
- The other half covered a demo using SNAP and either Sentinel-1 or PALSAR data.

Advanced SAR Statistics:

- 1047 participants
- Spanish Session: 743
- English Session: 304

Online SAR Training: Advanced SAR - 2019

SAR for Landcover Applications and SAR for Disasters and Hydrological Applications



- Session 1: Monitoring Flood Extent with GEE (Podest - JPL)
- Session 2: Exploiting SAR to Monitor Agriculture (McNairn - Agriculture and Agri-Food Canada)

5, two-hour sessions in English and Spanish

July – Aug 2019 and Dec 3-5, 2019

- Session 1: Monitoring Flood Extent with GEE (Podest-JPL)
- Session 2: InSAR for Landslide Observations (Fielding-JPL)
- Session 3: Generating a Digital Elevation Model (Grunfeld - CONAE)

Advanced SAR Statistics:

- 2516 participants total
- 963 participants in the Spanish session
- Over 1300 unique organizations/agencies
- Over 115 countries
- Over 37 U.S. States

Lessons Learned from Online Trainings

Positives:

- Certificate of completion
- Define learning objectives
- Summary slide in the middle and at the end along with questions
- Course evaluation
- Open source data and software
- Accessibility to recordings and presentations
- YouTube channel
- Spanish and English-greater outreach

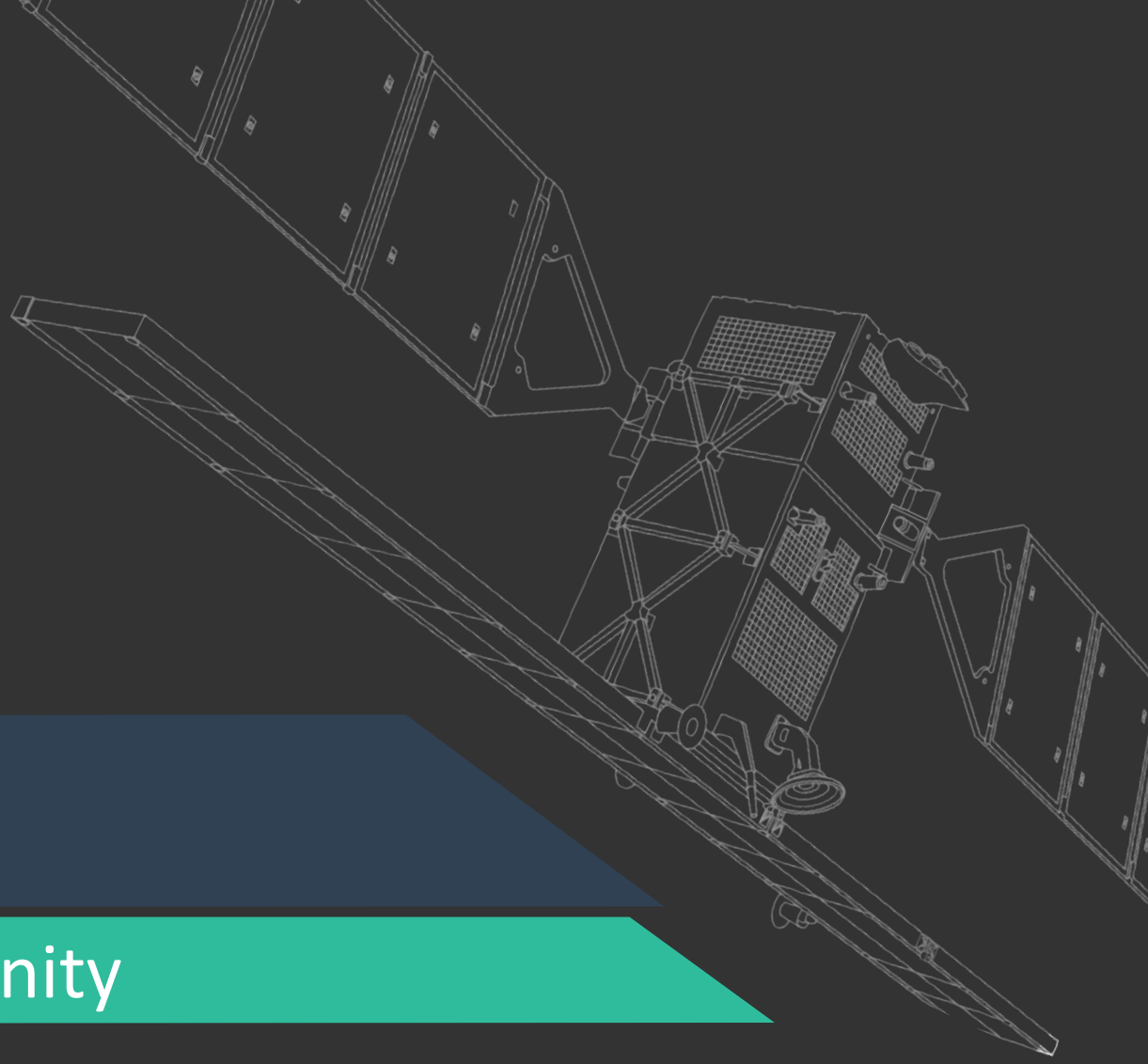
Lessons Learned:

- Participants with slow connections had audio problems. State minimum connection speed.
- Demos are very helpful
- Homework is encouraged
- Subset demo images
- Post instructional demo guide and images
- Pre-record sessions especially the demo's
- Stand alone power point presentations
- Use Google Earth Engine
- Show how to ingest final product into QGIS
- Q/A session and showing how to do things on the fly

Specific Areas of Interest

- Large interest in INSAR (landslides, volcanoes, earthquakes)
- Landcover mapping (deforestation, biomass estimation)
- Flooding
- Data fusion (SAR and Optical)
- SAR derived products available
- Processing on the cloud

http://arset.gsfc.nasa.gov/



EO College

Learning platform for the EO Community

Robert Eckardt
Friedrich-Schiller University Jena
Department for Earth Observation
Jena, Germany

- Zero Hunger (2022)
- Land Applications (2021) [CB-31]
- Basics Optical (???)
- Basics Hyperspectral (2021) [CB-38]
- Winter, Water, Warming (2020)
- Advanced Radar (2020) [CB-28]
- Basics Radar (2017)

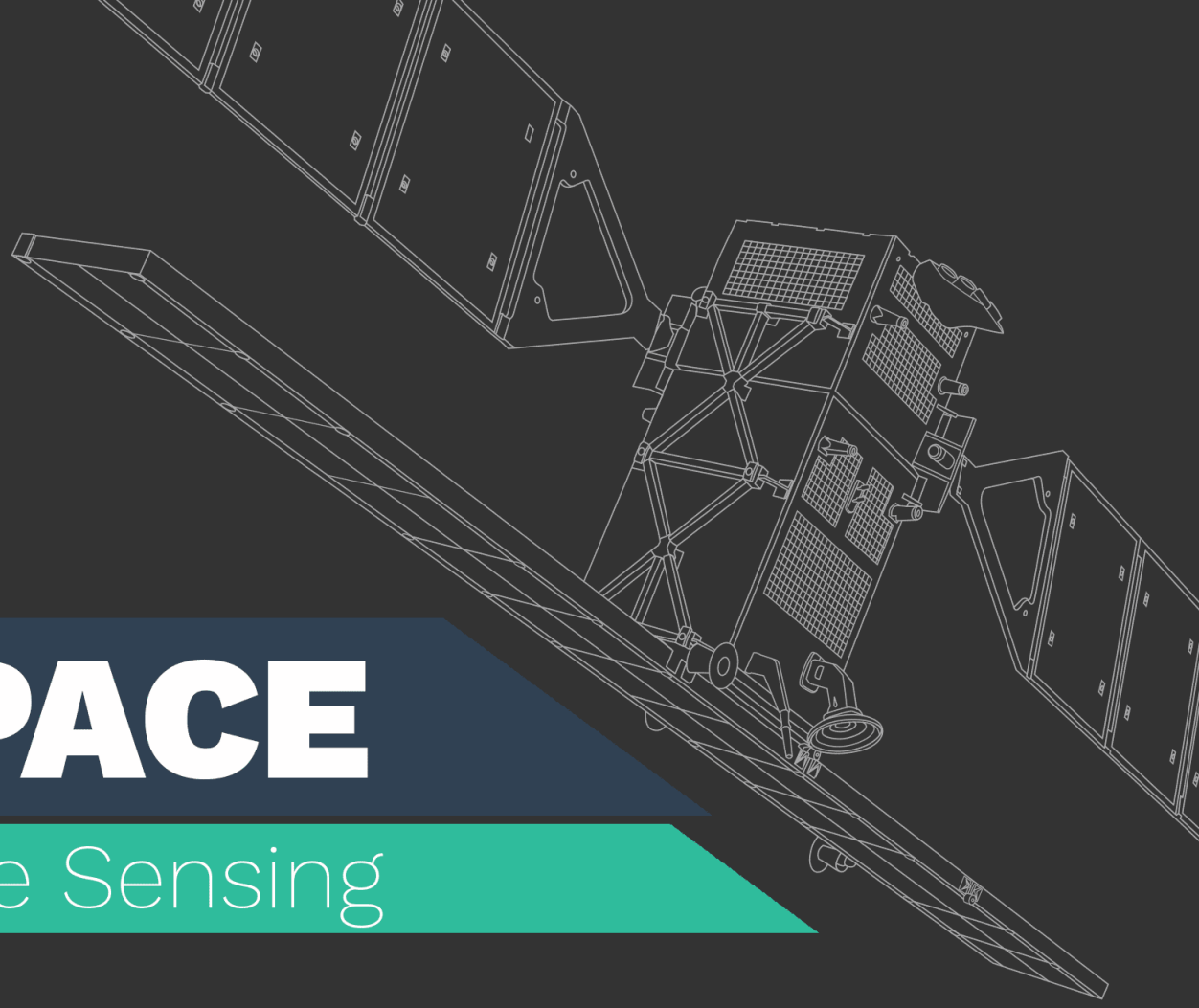
eo college

eo-college.org

September 2017

>14.000 registered users

> 1.500.000 pageviews



ECHOES IN SPACE

Introduction to Radar Remote Sensing

FREE OF CHARGE

OPEN TO ANYBODY

SELF-PACED LEARNING

5 LESSONS

CERTIFICATE FOR COMPLETION

eo-college.org/courses/echoes-in-space

- **Challenges:**
  - Sustainability and quality of materials
  - Discoverability of materials
  - Reusability of materials
  - Engaging learners
  - Bridging the digital divide
  - Efficient use of resources

- **Potential Solutions:**
  - Metadata Standards
  - Blended Learning
  - Mobile Learning
  - Cloud processing interface
  - Adaptive learning
  - The role of AI

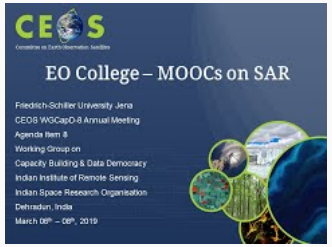
Talk: EO College - Future Vision

https://www.youtube.com/watch?v=ZNo8qzdVFyA

Talk: EO College – State of the art and future developments (WGCapD-9)

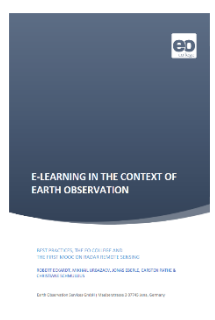
https://www.youtube.com/watch?v=8V7Dyhl-v7A

Talk: EO College – MOOCs on SAR



https://www.youtube.com/watch?v=i6k5T2ZRVmU

Report: eLearning in the context of Earth Observation



http://bit.ly/eLearning_in_EO

SAR Handbook: Comprehensive Methodologies for Forest Monitoring and Biomass Estimation

- **Freely-available** eBook, interactive pdfs, and training modules; result of a 2-year joint collaboration between **NASA SERVIR** & **SilvaCarbon**
- **Applied content, hands-on trainings** to get started using SAR for **forest monitoring, biomass estimation,** mangrove extent, time series analysis
- Authored by **world-renowned SAR experts** from the NISAR Science Team, US Forest Service, academia
- Reviewed and tested by the SERVIR Global network
- **Downloadable open-source scripts** and sample datasets for a variety of forestry applications; useful for **beginners to experts**

Selected pages from Ch. 6: Radar Remote Sensing of Mangrove Forests (by Dr. Marc Simard, Sr. Scientist & mangrove specialist, NASA Jet Propulsion Laboratory)

Download the SAR Handbook here: https://bit.ly/2UHZtaw
SAR Handbook training modules and more: https://bit.ly/2GeKvAN
For more information, visit the SERVIR website: SERVIRglobal.net
Contact: Africa Flores-Anderson (africa.flores@nasa.gov)

SERVIR SilvaCarbon NASA USAID FROM THE AMERICAN PEOPLE UAF Alaska Satellite Facility EARTH BIG DATA Where Solutions Begin. University of Massachusetts Amherst THE UNIVERSITY OF ALABAMA IN HUNTSVILLE CILSS RCMRD ICIMOD adpc