HYDROSAR – WEATHER-RELATED HAZARD INFORMATION FROM SAR

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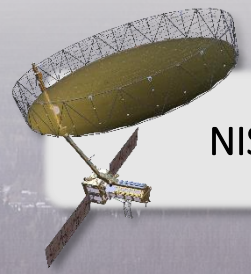
Lecture 2: An Introduction to the OpenSARLab and HyP3 Tools Used by HydroSAR

Integrating with 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

From Sensor Data to Science Products

HydroSAR SAR Tools Ecosystem

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

Operational Processing Platform

ASF HyP3

Increasing addition of Level-3 products

Algorithm Development Platform

The OpenSARLab

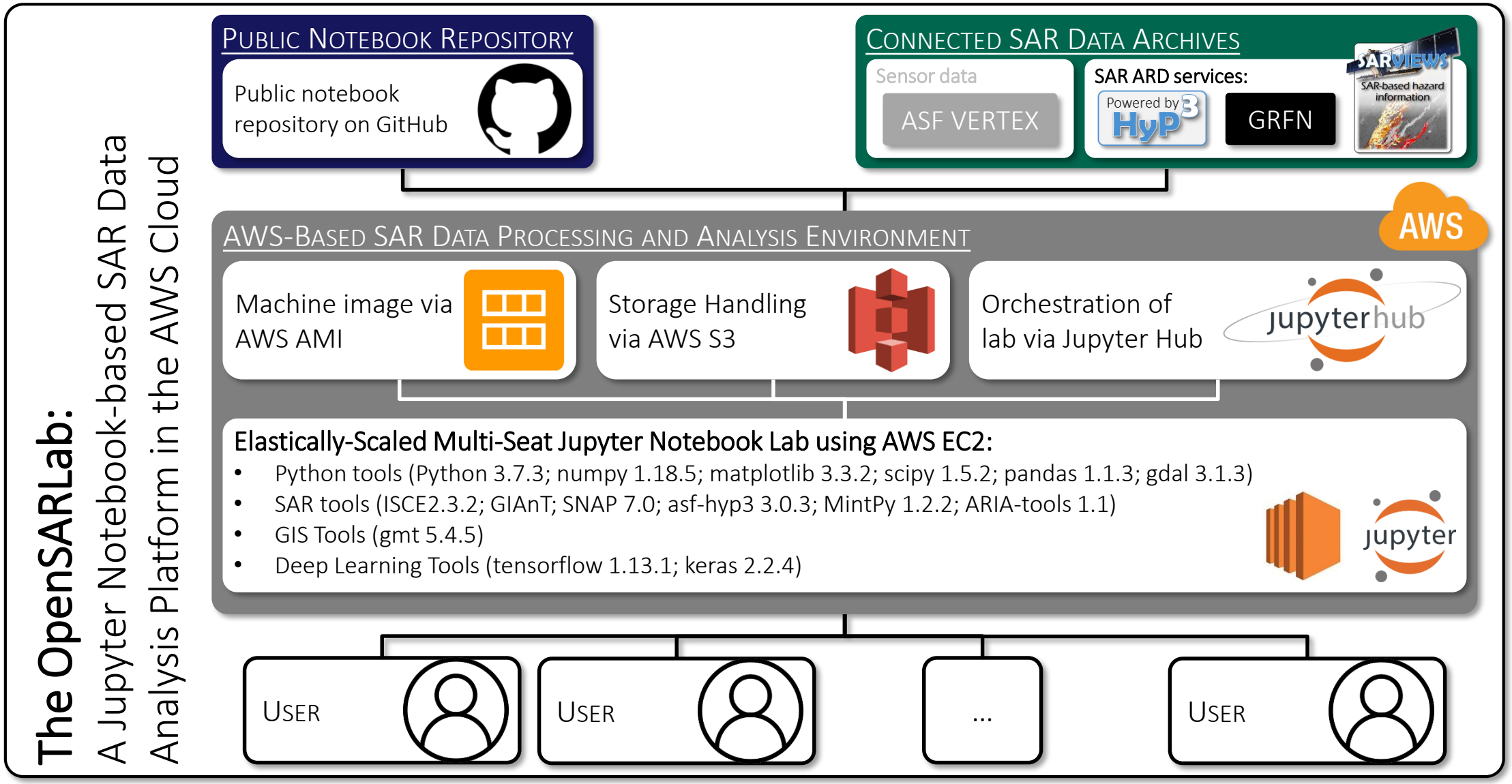
ALGORITHM DEVELOPMENT PLATFORM:
THE OPENSARLAB

Please Log Into the OpenSARLab Now!

- https://opensarlab.asf.alaska.edu/

Generation of Level-3 Science Data in the OpenSARLab Environment

Web Address: opensarlab.asf.alaska.edu

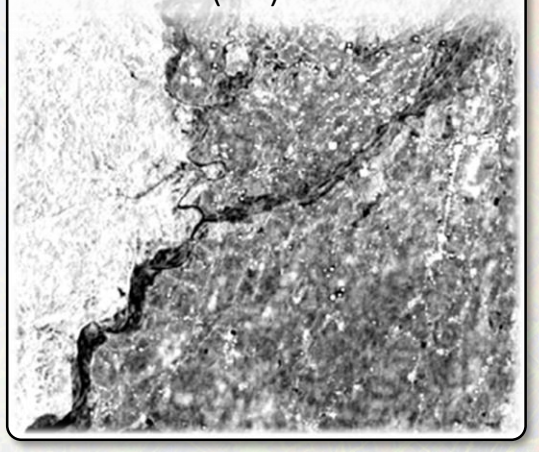


The OpenSARLab

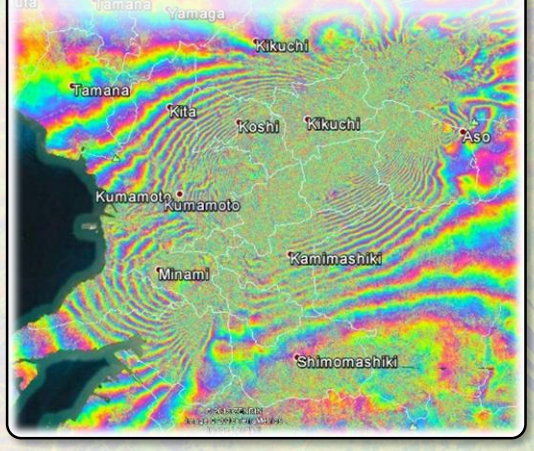
Selection of Currently Available SAR Data Processing and Analysis Apps

SAR Image Processing and Geocoding

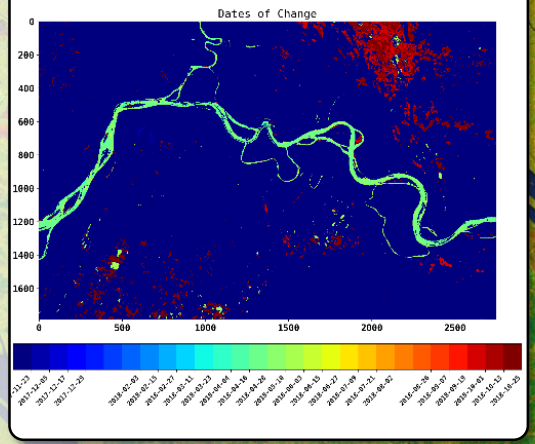
SAR Amplitude Time Series (TS) Analysis



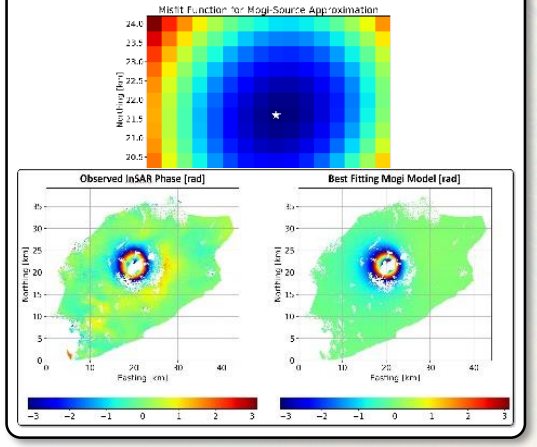
InSAR Processing



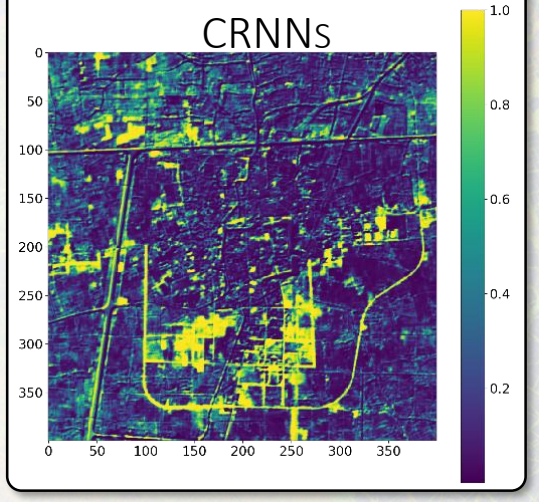
SAR Amplitude TS Change Detection



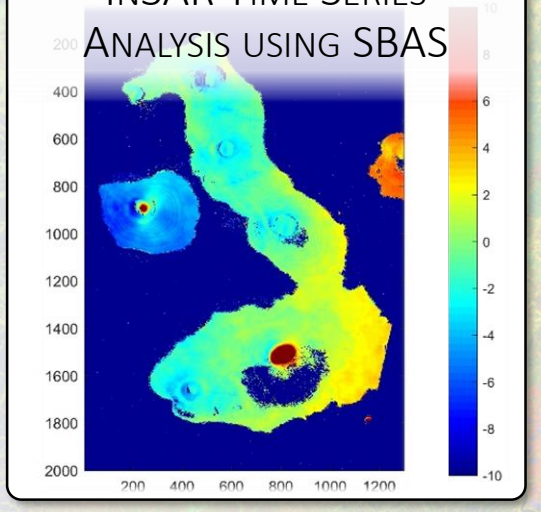
Volcano Source Modeling using InSAR



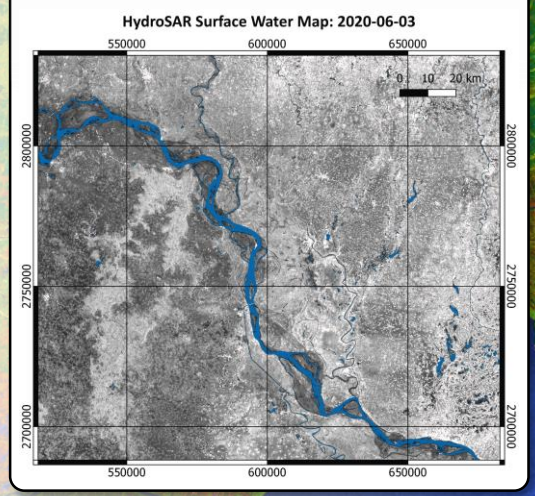
Change Detection using CRNNs



InSAR Time Series Analysis using SBAS

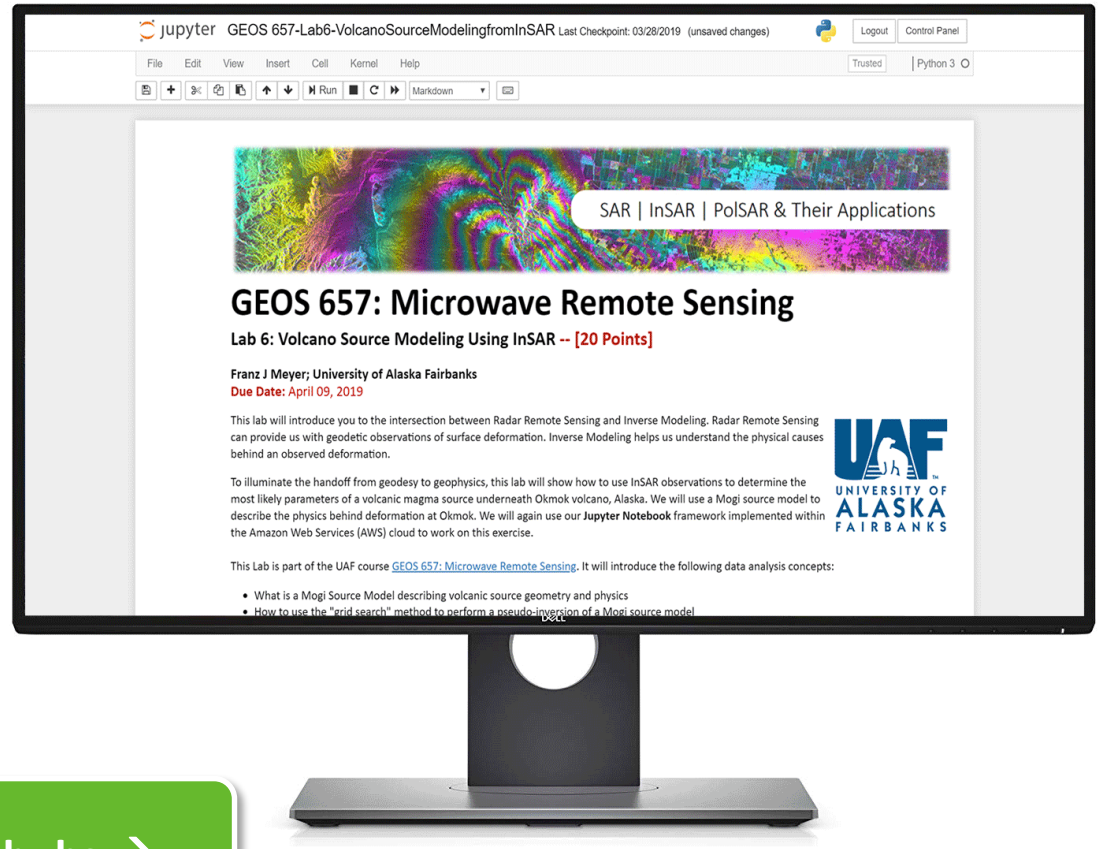


HydroSAR Workflows



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

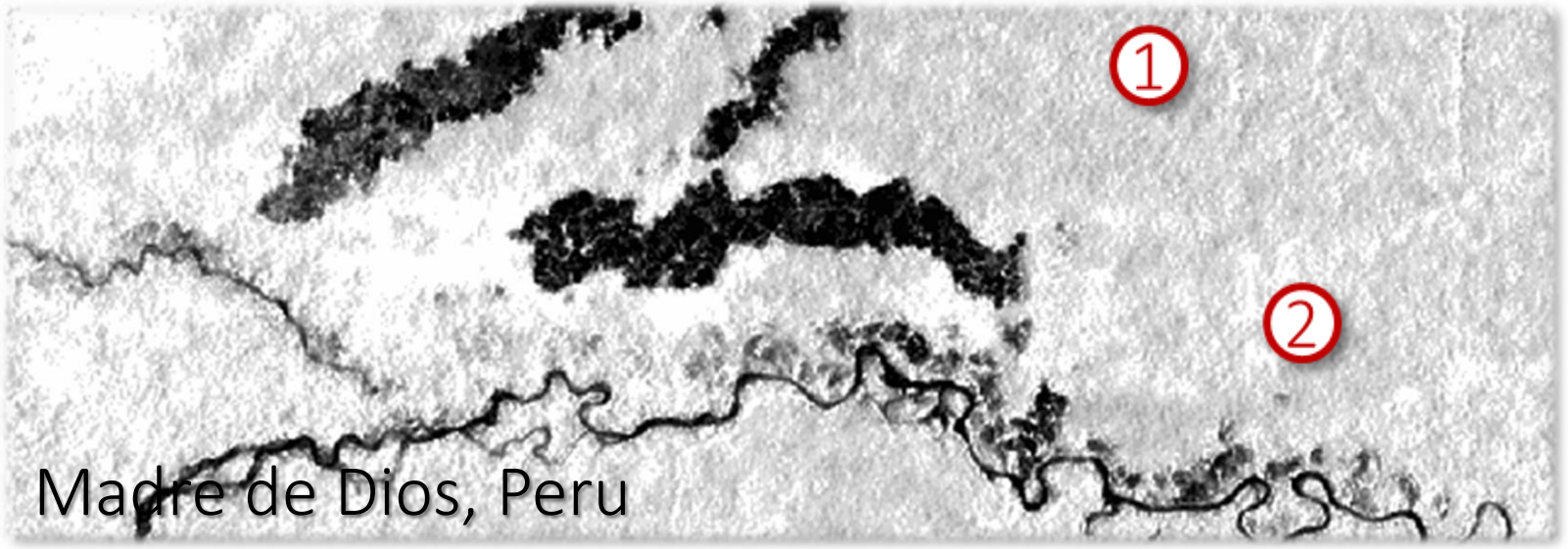
Monitoring Deforestation in Peru Using

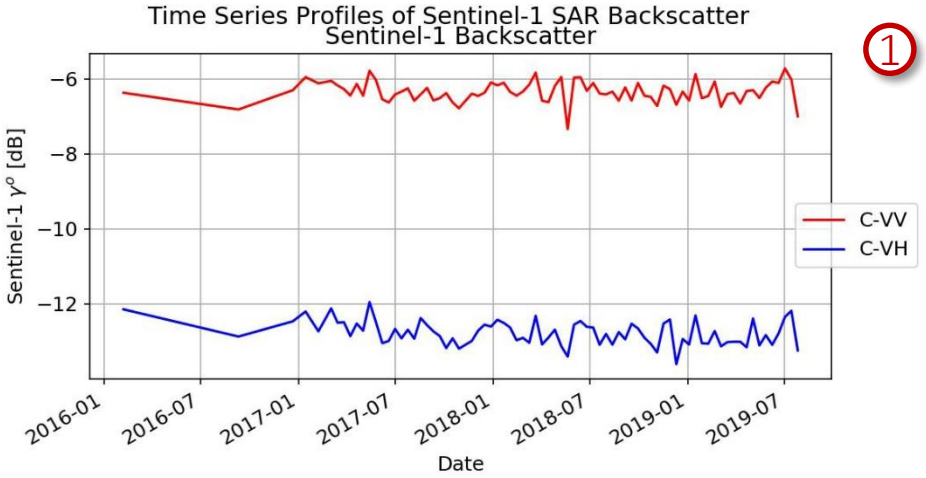
OpenSARLab and HyP3: https://opensarlab.asf.alaska.edu/

- Explore Environmental Signatures in Deep SAR data stacks

Powered by: jupyter AWS

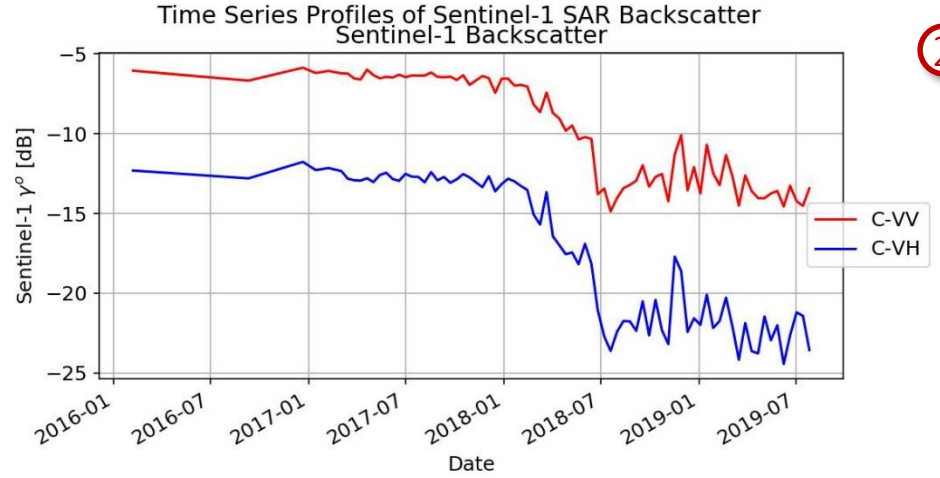
Example: Madre de Dios, Peru





① Stable Forest:

Radar brightness highly stable → indicative of stability of sensing system



② Degraded Forest:

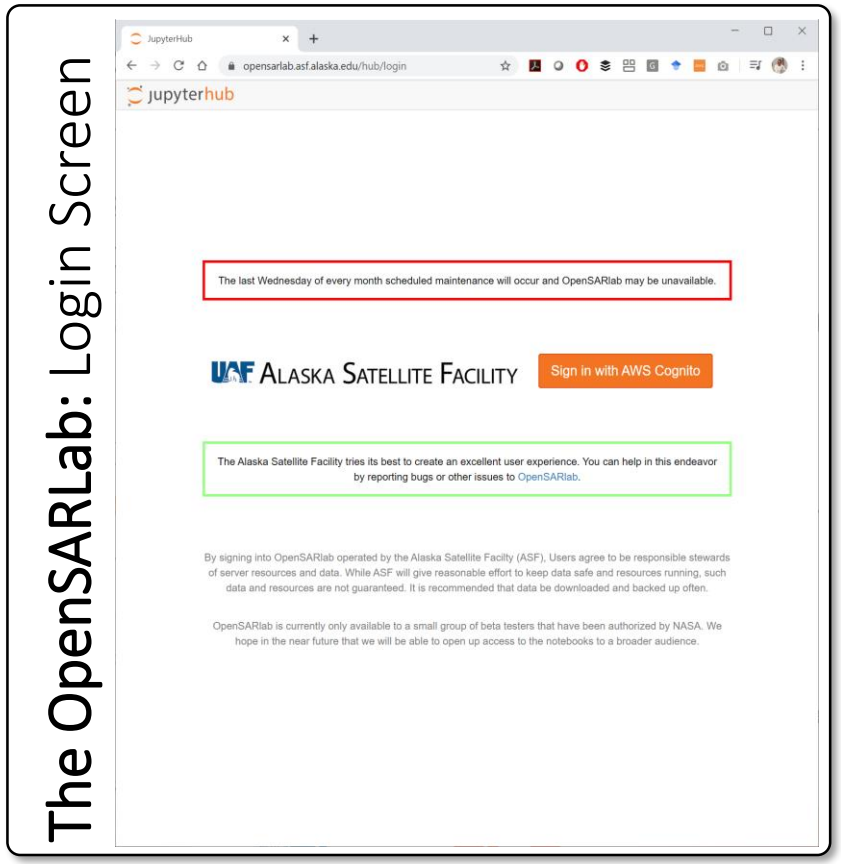
Radar brightness indicative of environmental change

Working Within the OpenSARLab

Account Creation & Login

1. **In your web browser, navigate to:** https://opensarlab.asf.alaska.edu

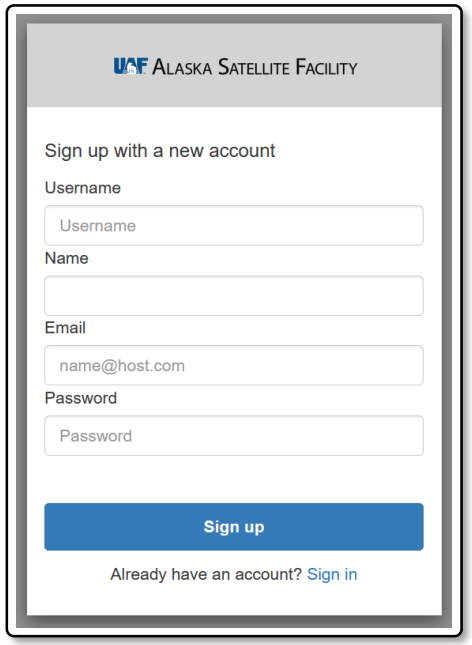
2. **Click on** "Sign in with AWS Cognito"



3. **First time user**: Click on "Sign up"

4. **Fill in the signup form** and submit → **wait for approval** from UAF Team

5. Once approved, **go back to login screen and sign in** to the environment



Working Within the OpenSARLab

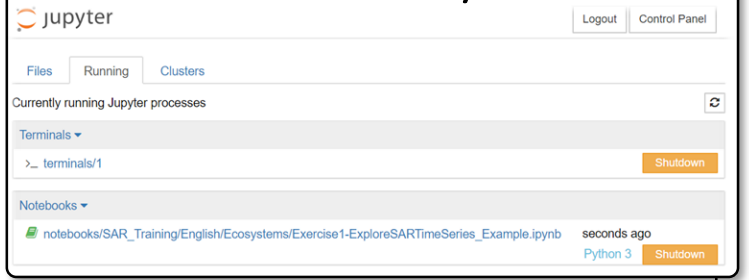
Features within the Notebook Lab

- **Home screen features:**

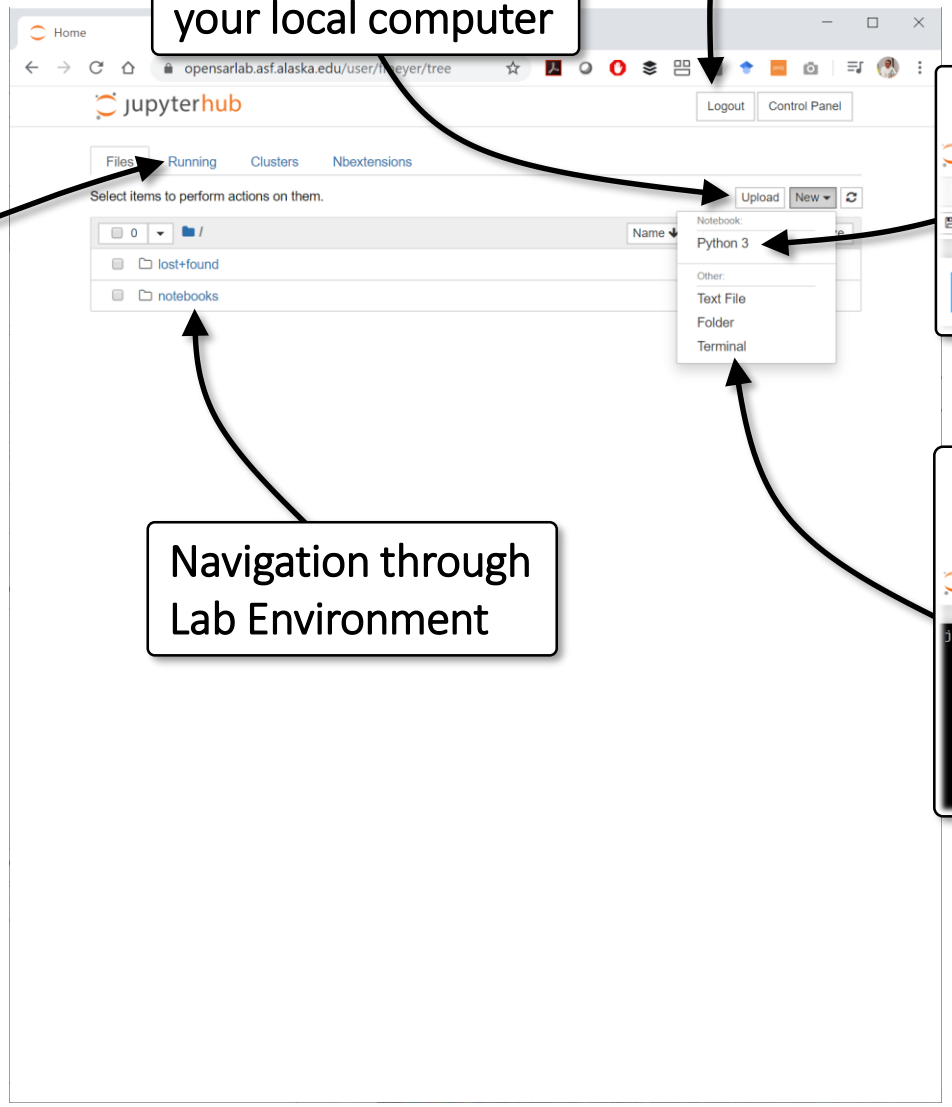
Logout

Upload files from your local computer

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

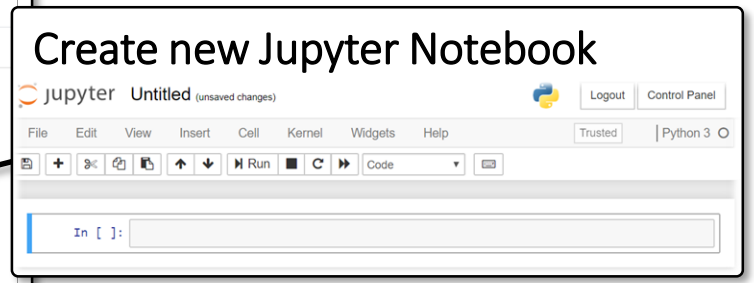


The Open SAR Lab: Home Screen



Navigation through Lab Environment

Create new Jupyter Notebook



Open a Terminal for Command-Line work

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

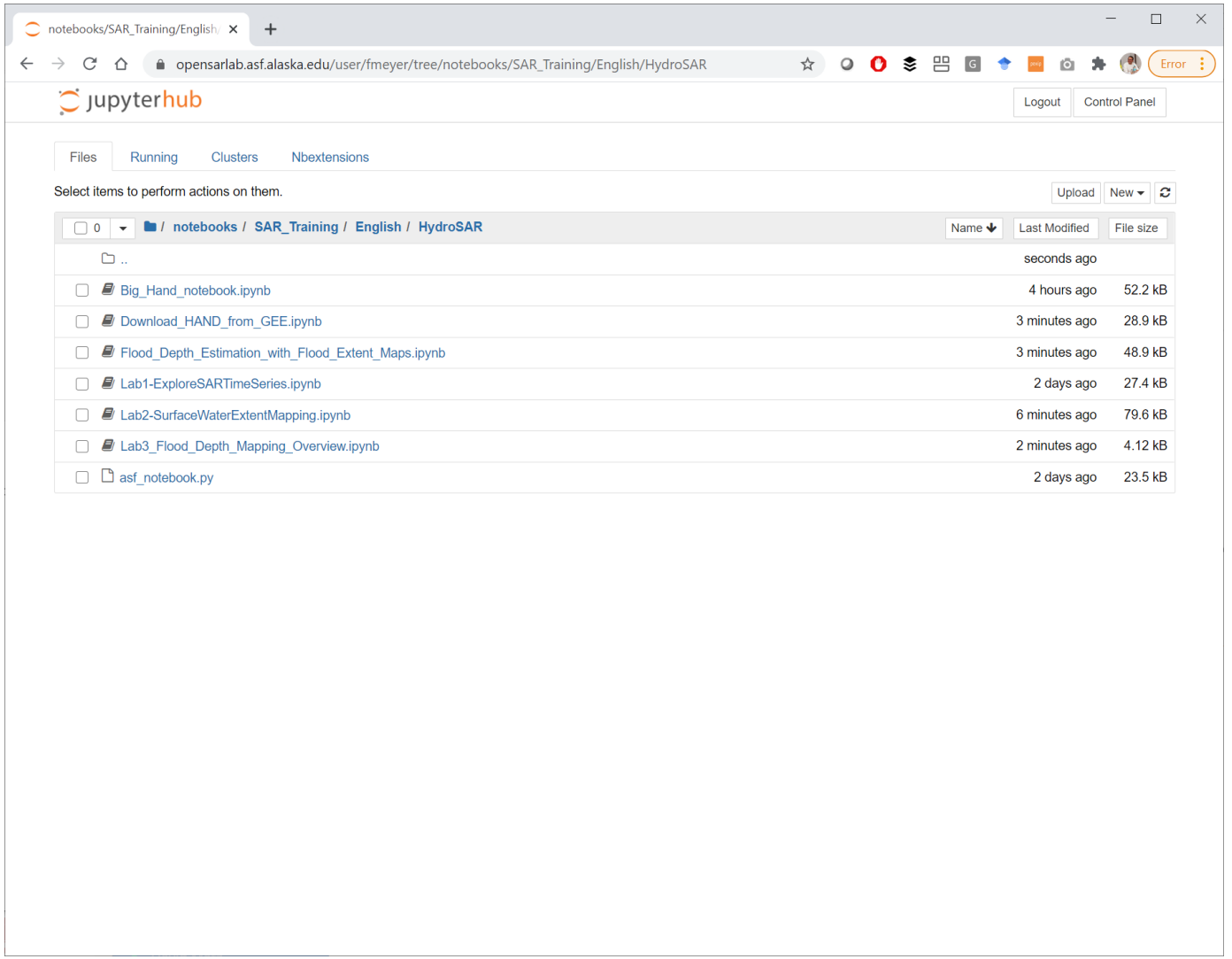
Working Within the OpenSARLab

Navigate to the Notebooks Relevant for this Training

- **To find the Jupyter notebooks relevant for this training, navigate to:**

notebooks/
↳ SAR_Training/
↳ English/
↳ HydroSAR/

The Open SAR Lab: Notebooks for Training



OPERATIONAL PROCESSING PLATFORM:

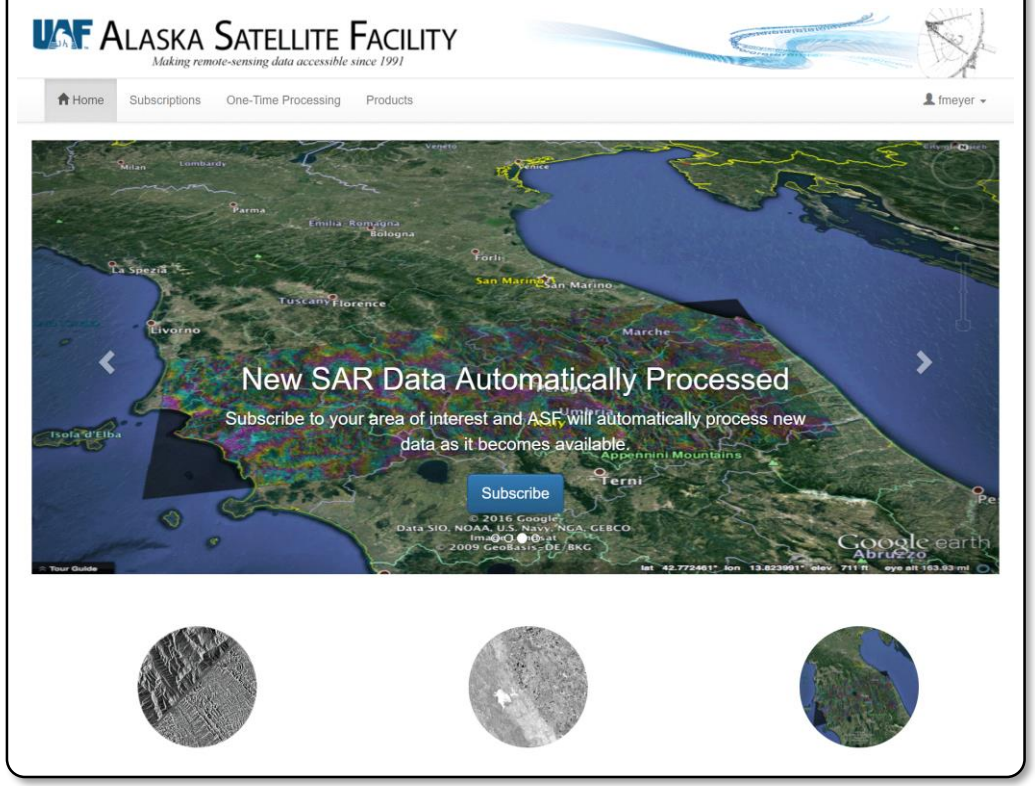
THE HYP3 SERVICE

ASF's Operational Processing Platform HyP3

- **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

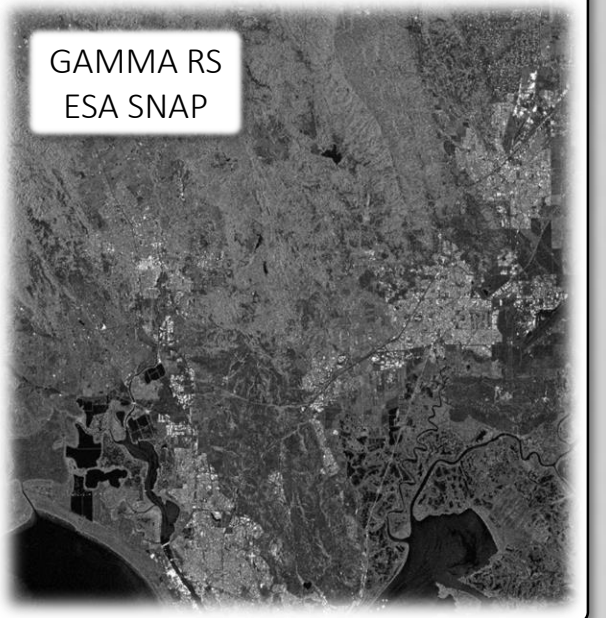
The Cloud-based Hyp3 Data Processing Engine
(http://hyp3.asf.alaska.edu/)



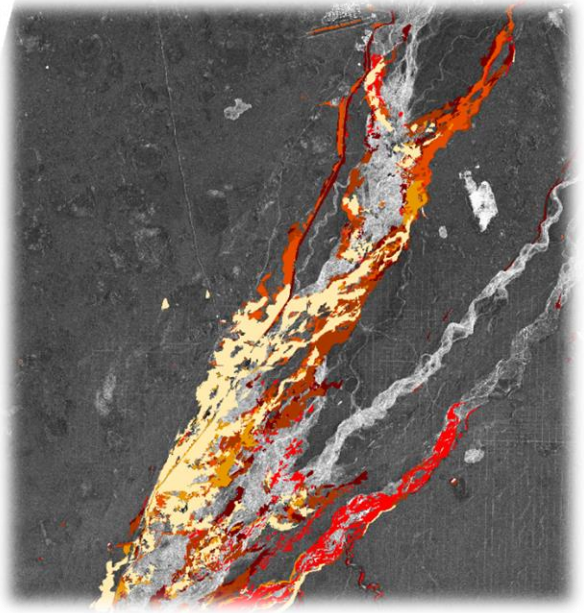
The ASF HyP3 Platform

Embedded Application Ready Data (ARD) Product Algorithms

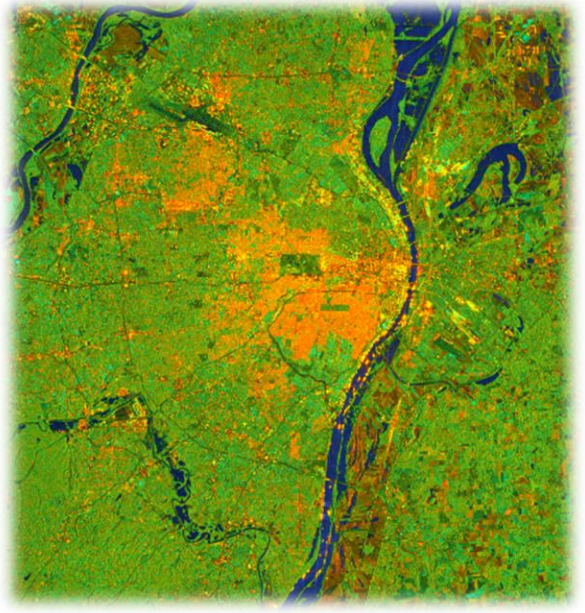
RTC Image Time Series



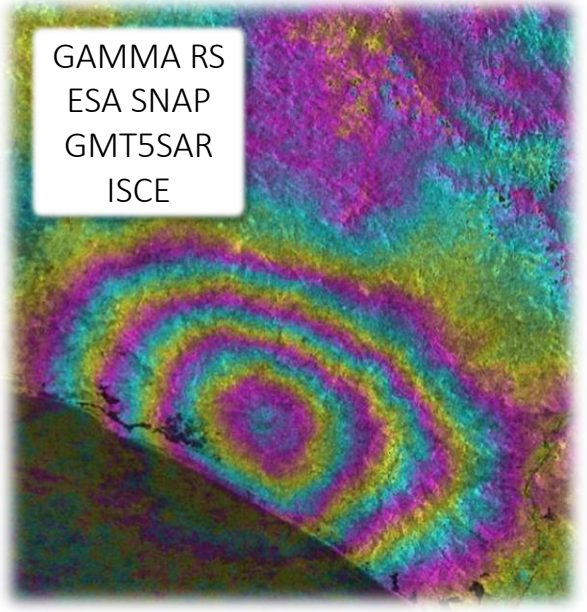
Change Detection Maps



RGB Color Composites



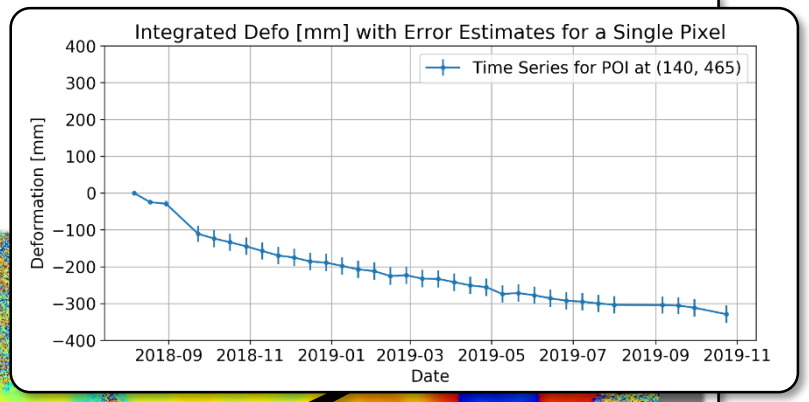
InSAR Products

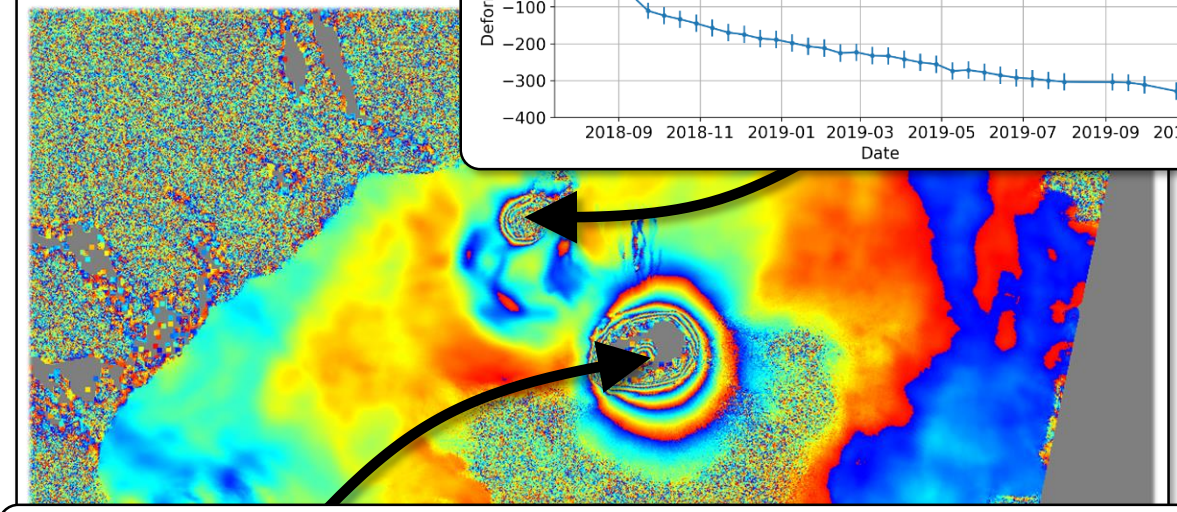


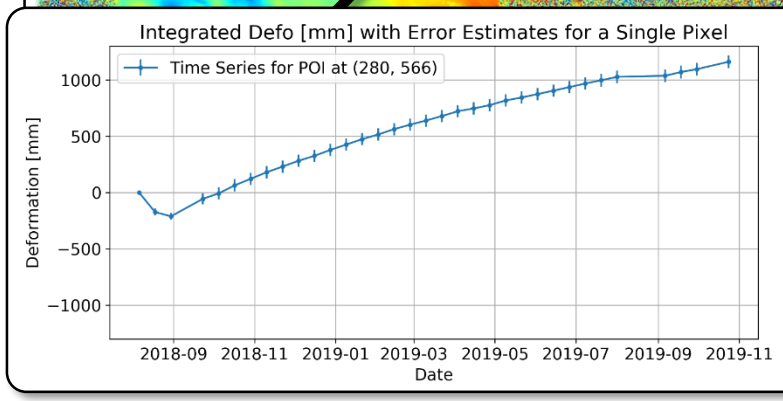
HyP3 ARD Examples

InSAR Data:

Sierra Negra,
Galapagos Islands



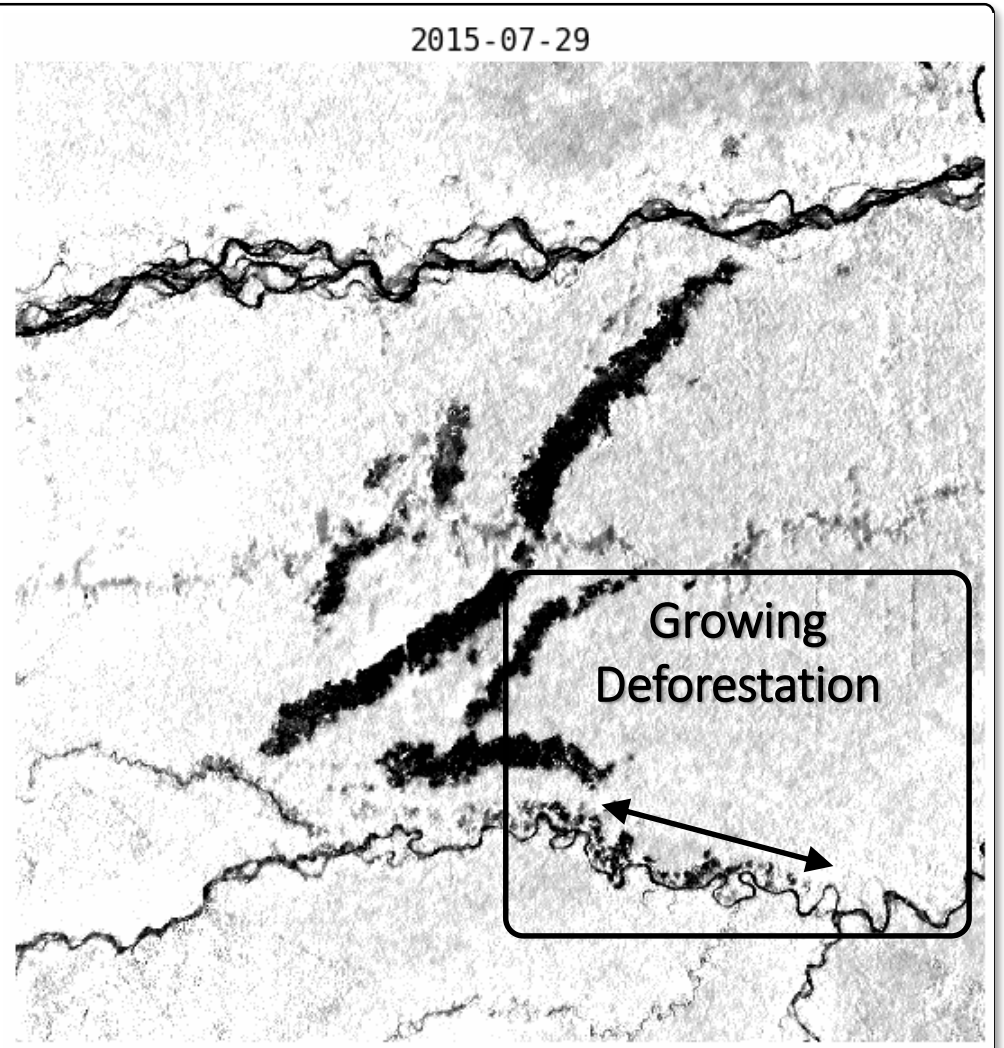




Level 3 time-series data created in the **#OpenSARLab**

RTC Image Time Series:

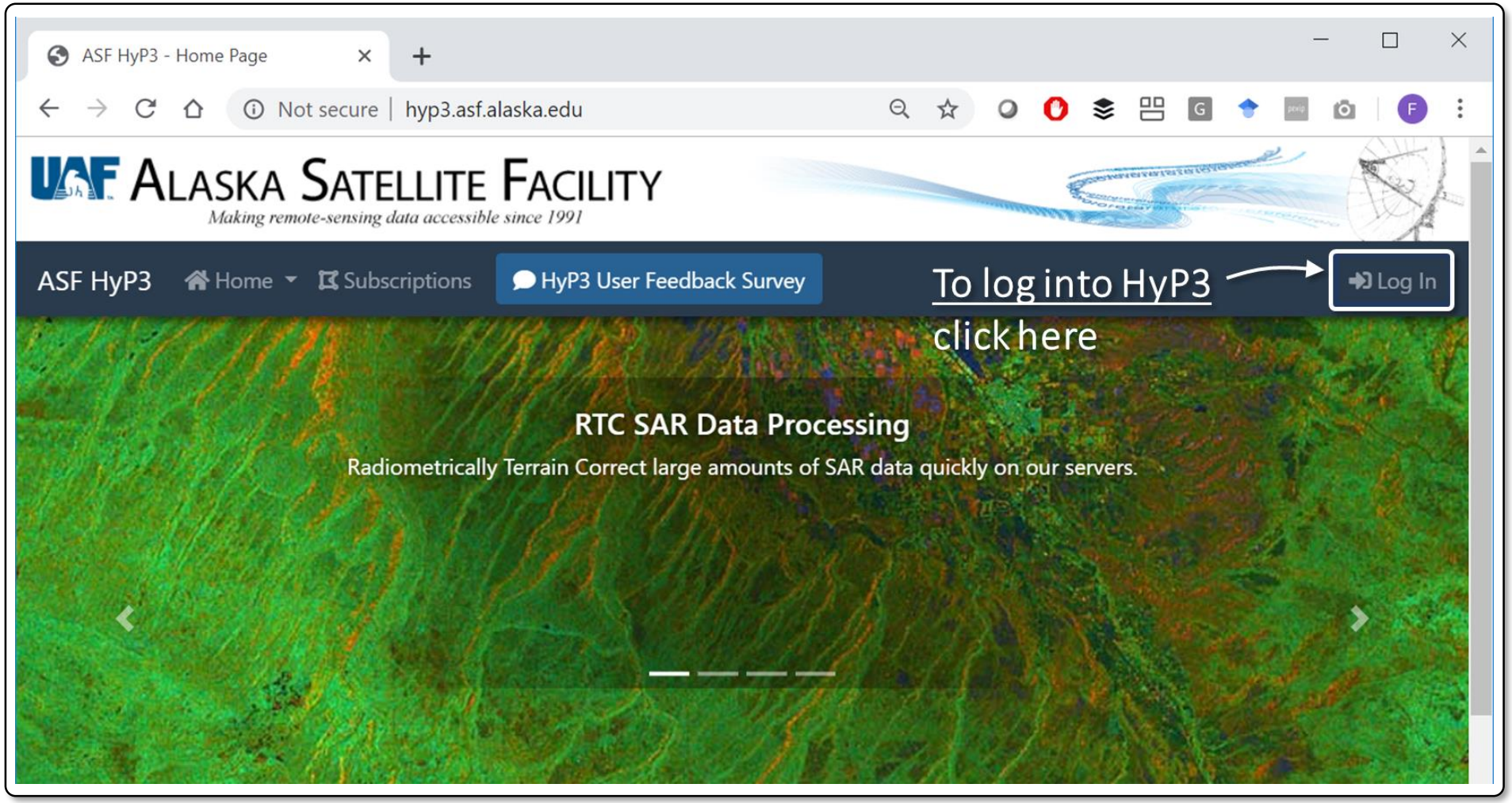
Deforestation, Marde de Dios, Peru



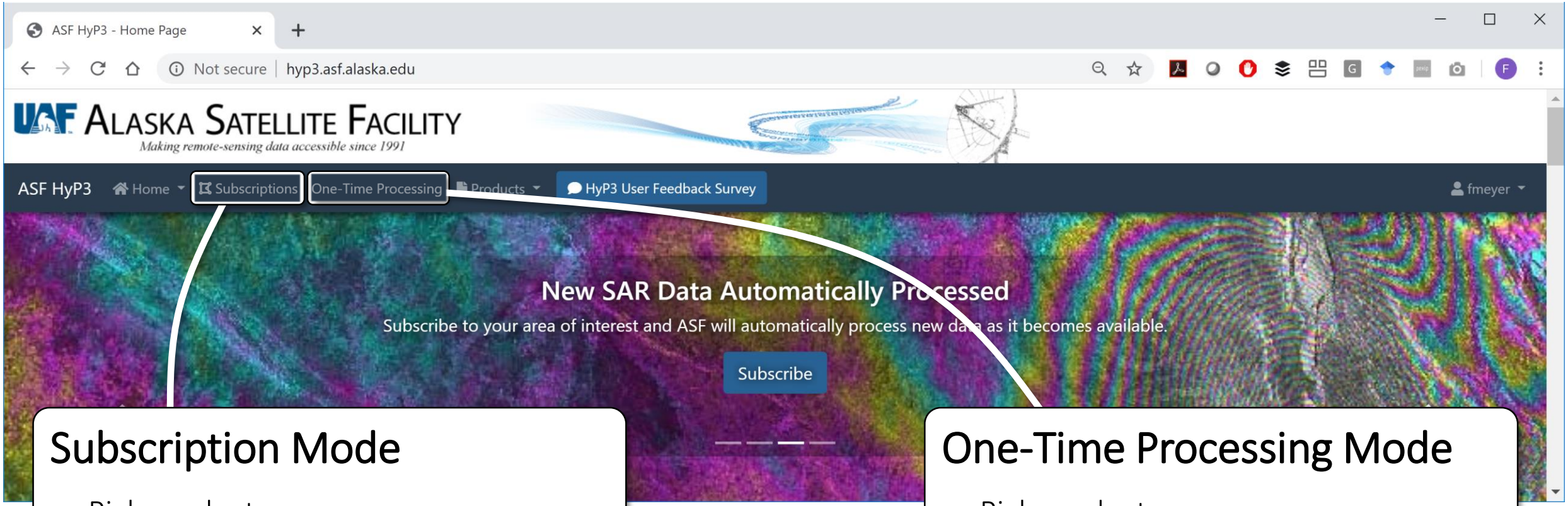
Creating an Account and Logging into HyP3

- **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

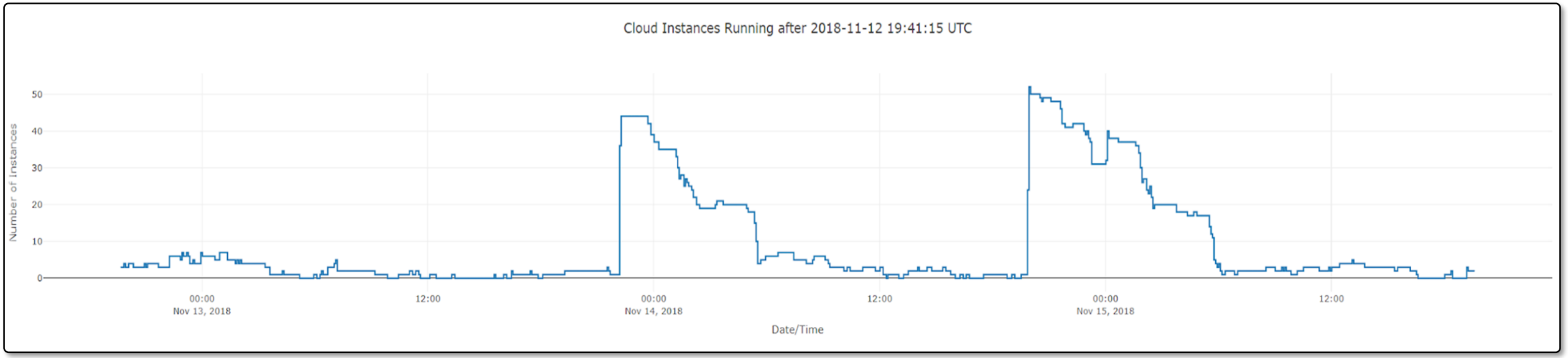
→ Go

One-Time Processing Mode

- Pick product
- Specify list of granule names

→ Go

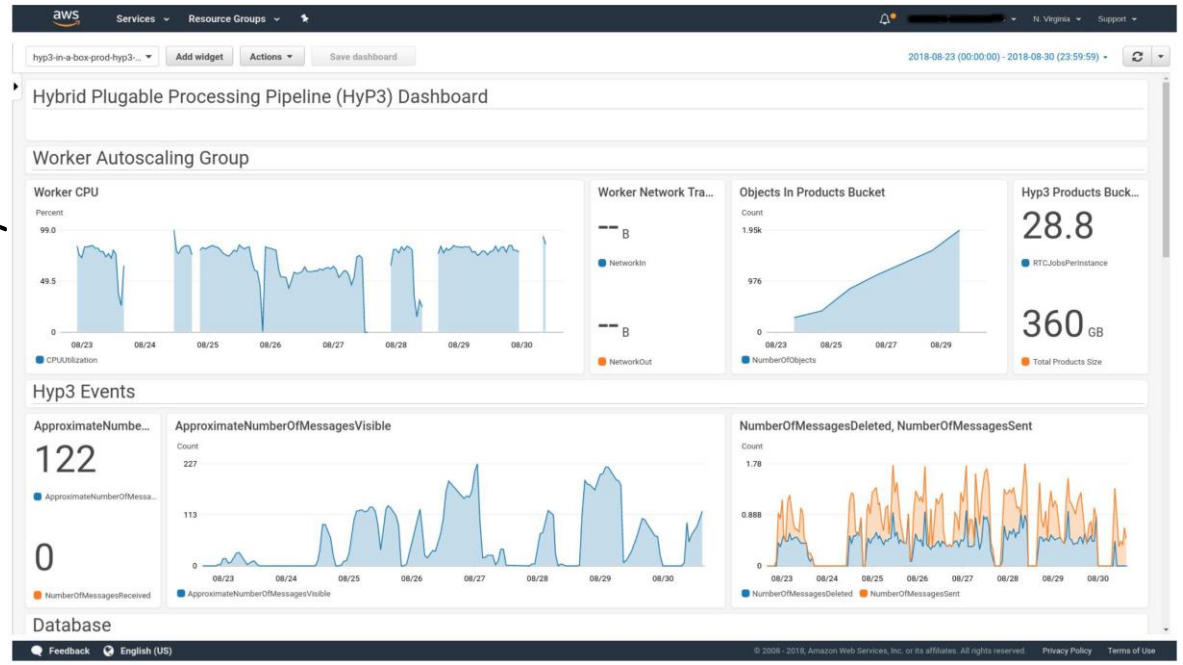
Example of HyP3 Autoscaling Capabilities



The HyP3 In a Box Idea

- **HyP3 In a Box** project will turn HyP3 into distributable Amazon Cloud template
  - Allowing other users to host their own HyP3 system
  - Full control over resource management and costs
  - For example, if user has purchased a license for proprietary processing software, or develops their own processing software, this can be integrated internally into their own HyP3 In a Box system.

Real Time Analytics



Customizable Spending

Customize both size and number of worker servers to fit your processing needs and cost requirements

Increase Throughput: number of running workers.

Increase Speed: Power and size of each worker.

Workflow for Mapping Flood Extent and Depth for your own Area Of Interest Using HyP3 and the OpenSARLab

How to do Flood Extent and Depth Mapping on your own Data?

- Find a good Area of Interest and Evaluate SAR Coverage using the ASF Data Search Client https://search.asf.alaska.edu/
  - You could decide to chose all available data or restrict yourself to specific orbit directions and orbit tracks (path ID)
- Order Level-2 RTC (Radiometric Terrain Corrected) Data through our operational processing service HyP3 https://hyp3.asf.alaska.edu/
  - Follow the instructions in the class to create your HyP3 processing subscription
- Once your RTC data is ready, log into the OpenSARLab (https://opensarlab.asf.alaska.edu/) and run the following Jupyter Notebooks in the order given:
  - **Retrieve data from your HyP3 Account**: LoadHyP3Data-FullFrame.ipynb
  - **Derive HAND Data over your area of interest**: Big_Hand_notebook.ipynb
  - **Extract Surface Water Extent for each Acquisition Date**: HYDRO30Workflow-v1.ipynb
  - **Calculate Flood Depth Information**: Flood_Depth_Estimation_with_Flood_Extent_Maps_v0_1_8.ipynb (or later versions as updates come in)
- The Notebooks are located on the OpenSARLab in folder *notebooks / SAR_Training / English / HydroSAR / ProcessOwnData*

QUESTIONS?

UP NEXT: YOUR FIRST OPENSARLAB EXERCISE