

Accessing SAR Data

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Objectives

By the end of this exercise, you will:

- be familiar with different types of SAR imagery
- know where and how to access them
- be familiar with the SNAP Toolbox



Outline

- Part 1: Different Sources of SAR Data
- Part 2: Where to Access SAR Data
- Part 3: Accessing Sentinel-1 SAR Data
- Part 4: Accessing the SNAP Toolbox





Different Sources of SAR Data

Coverage

■ freely accessible
■ freely accessible & reliably repeated acquisition plan

The Legacy:

 1978

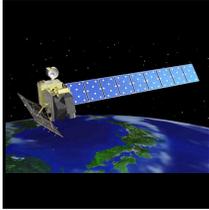
 SeaSAT

 1991-2011

 ERS 1/2

 2002-2012

 ENVISAT

● 2002-2012

 ALOS-1

 1995-2013

 Radarsat-1

The New:

 2007

 TanDEM-X

 2007

 Radarsat-2

 2007

 COSMO-SkyMed

● 2014

 ALOS-2

 2014

 Sentinel-1

The Future:

 2018

 SAOCOM

 2018

 PAZ SAR

 2018

 RCM

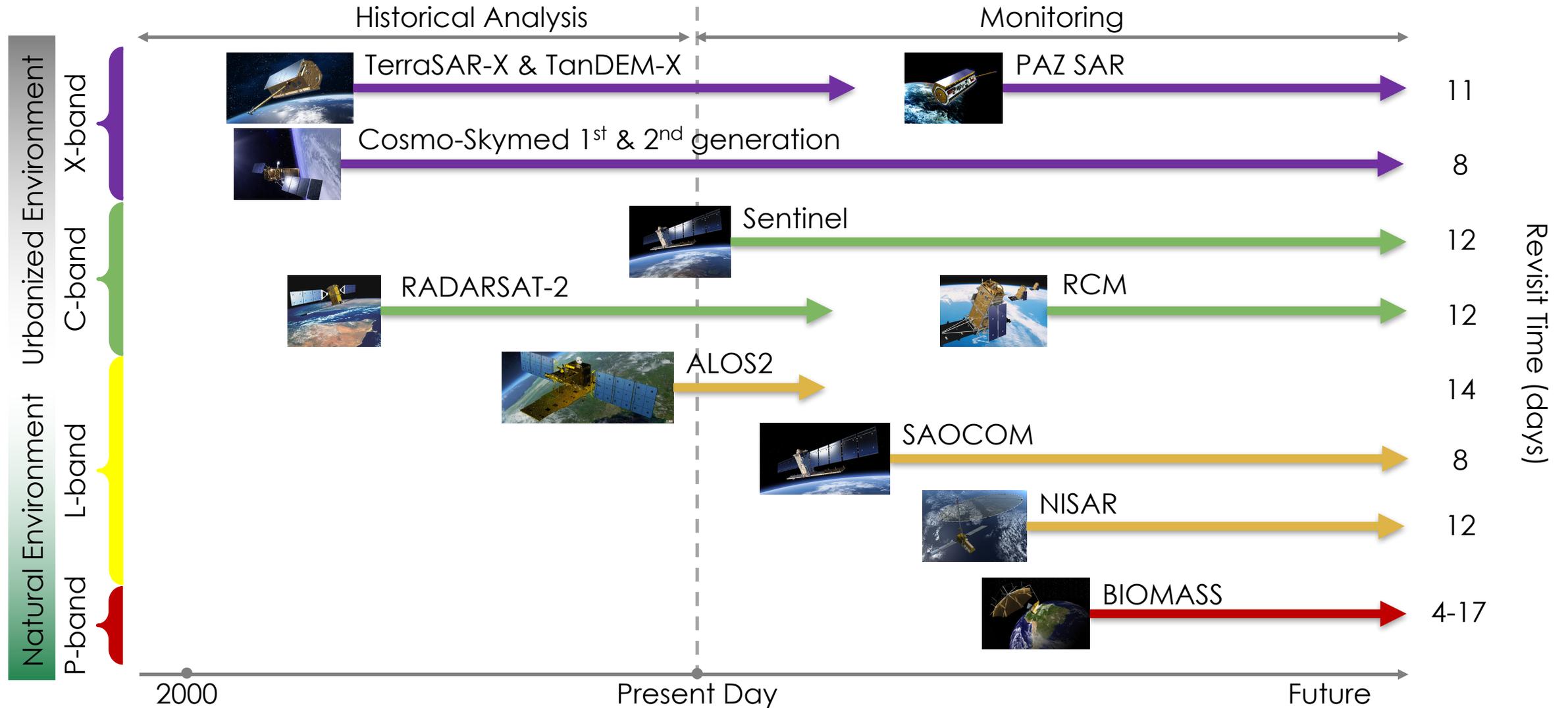
 2021

 NISAR

 2021

 Biomass

Instrument Frequency



Courtesy: A. Ferretti, TRE (modified by Franz Meyer)

NASA's Applied Remote Sensing Training Program

Resolution vs. Spatial Coverage

Medium (10 m-class) Resolution Large-Coverage Systems

- Sensors
 - Current ALOS-2; Sentinel-1; RADARSAT-2
 - Future: SAOCOM; NISAR; RCM; BIOMASS
- Suitable for applications such as:
 - Monitoring medium to large scale surface deformation
 - subsidence, slopes
 - Assessing impacts of hazards
 - flooding, earthquakes
 - General mapping change detection

Most of the medium-res data are free or low cost (not ALOS-2 and R-2)



Resolution vs. Spatial Coverage

High (1 m-class) Limited-Coverage Resolution Systems

- Sensors
 - Current: TerraSAR-X; TanDEM-X; COSMO-SkyMed constellation
 - Future: PAZ SAR; COSMO-SkyMed 2nd Gen
- Suitable for applications such as:
 - Mapping and analysis of urban environments
 - building, bridges
 - Detecting localized hazards
 - sinkholes, small landslides
 - Tracking things that change quickly (since most high-res systems have a higher repeat frequency)

High-res data is typically more expensive





Where to Access SAR Data

Accessing Sentinel-1 SAR Data

- Both links provide free SAR data, however you have to register first
- The Alaska Satellite Facility Vertex Search Engine:
 - contains SAR datasets from different satellites)
 - <https://vertex.daac.asf.alaska.edu/>

The screenshot shows the Alaska Satellite Facility Vertex Search Engine interface. The page header includes "EARTHDATA", "Data Discovery", "DAACs", "Community", and "Science Disciplines". The main header is "UAF ALASKA SATELLITE FACILITY" with the tagline "Vertex is the Alaska Satellite Facility's data portal for remotely sensed imagery of the Earth." The navigation bar includes "Vertex", "Interactive Tours", "Help", "ASF Home", "Earthdata Login", "Download Queue 1", and "Contact".

The left sidebar contains filters for "Geospatial", "Granule", and "Missions". Under "Geospatial", there are sections for "Geographic Region", "Date", and "Dataset". The "Dataset" section is expanded, showing a list of datasets with checkboxes and their corresponding time ranges:

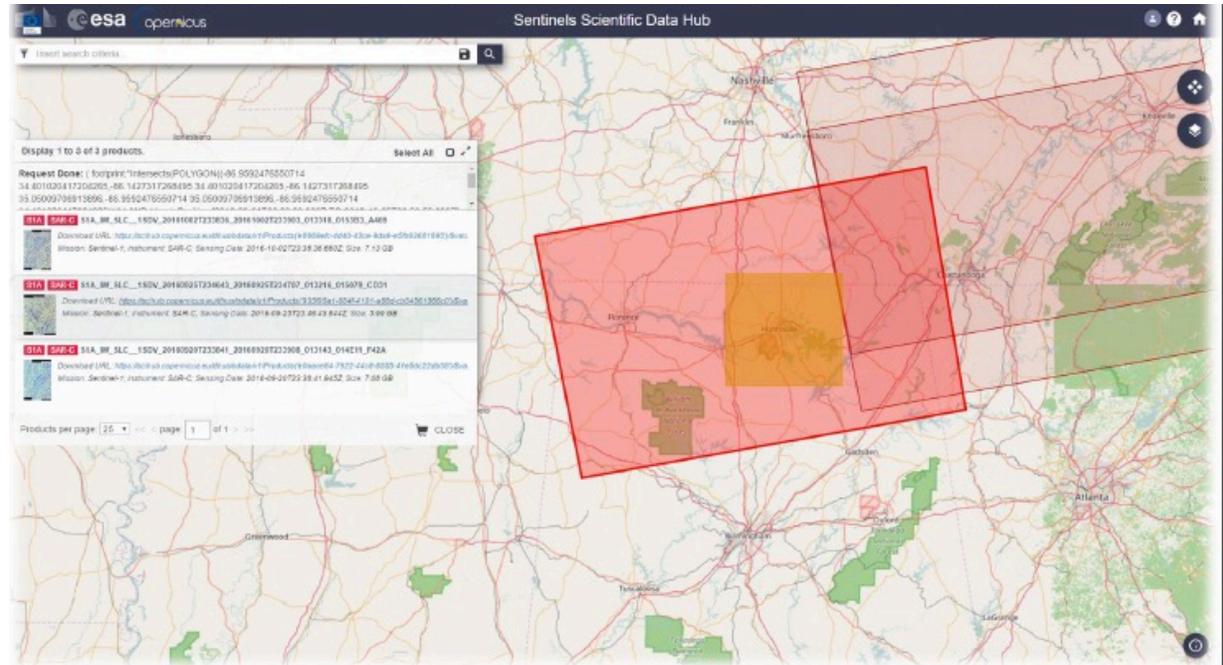
Dataset	Info
<input checked="" type="checkbox"/> Sentinel-1B	2016-now
<input checked="" type="checkbox"/> Sentinel-1A	2014-now
<input type="checkbox"/> SMAP	2015-now
<input type="checkbox"/> UAVSAR	2008-now
<input type="checkbox"/> ALOS PALSAR	2006-2011
<input type="checkbox"/> RADARSAT-1	1995-2008
<input type="checkbox"/> ERS-2	1995-2011
<input type="checkbox"/> JERS-1	1992-1998
<input type="checkbox"/> ERS-1	1991-1997
<input type="checkbox"/> AIRSAR	1990-2004
<input type="checkbox"/> SEASAT	1978-1978

Below the dataset list is a "Path & Frame (optional)" section and a "Search" button. The main content area features a world map with a "World Map" and "South Polar" view selector. A legend indicates the "Number of Frames" with color-coded categories: 1 (blue), 2-5 (green), 6-15 (yellow), 16-20 (orange), and 21+ (red). A "Please use the map and/or the search parameters on the left to select your search criteria." message is displayed on the right. The footer includes the NASA logo, copyright information for 2017, and contact details for the Alaska Satellite Facility.



Accessing Sentinel-1 SAR Data

- The European Space Agency (ESA) Copernicus Open Access Hub
 - contains SAR data from the Sentinel-1 satellite
 - <https://scihub.copernicus.eu/>





Accessing Sentinel-1 SAR Data

Sentinel-1 Background

Sentinel-1A	
Agency	European Space Agency (ESA)
Instrument	C-Band SAR (5.4 GHz)
Incidence Angle	Side-Looking, 15-45° off-nadir
Polarization	(VV and VH) or (HH and HV)
Sensor Height at Equator	693 km
Orbit	Sun Synchronous (dusk/dawn)
Revisit Time (Orbit Repeat Cycle)	12 days
Resolution	5 m x 20 m
Swath Width	250 km (IWS mode)
Mean Local Time	6:00 a.m. Descending
Launch	3 April 2014
Planned Lifetime	7 years



Coverage

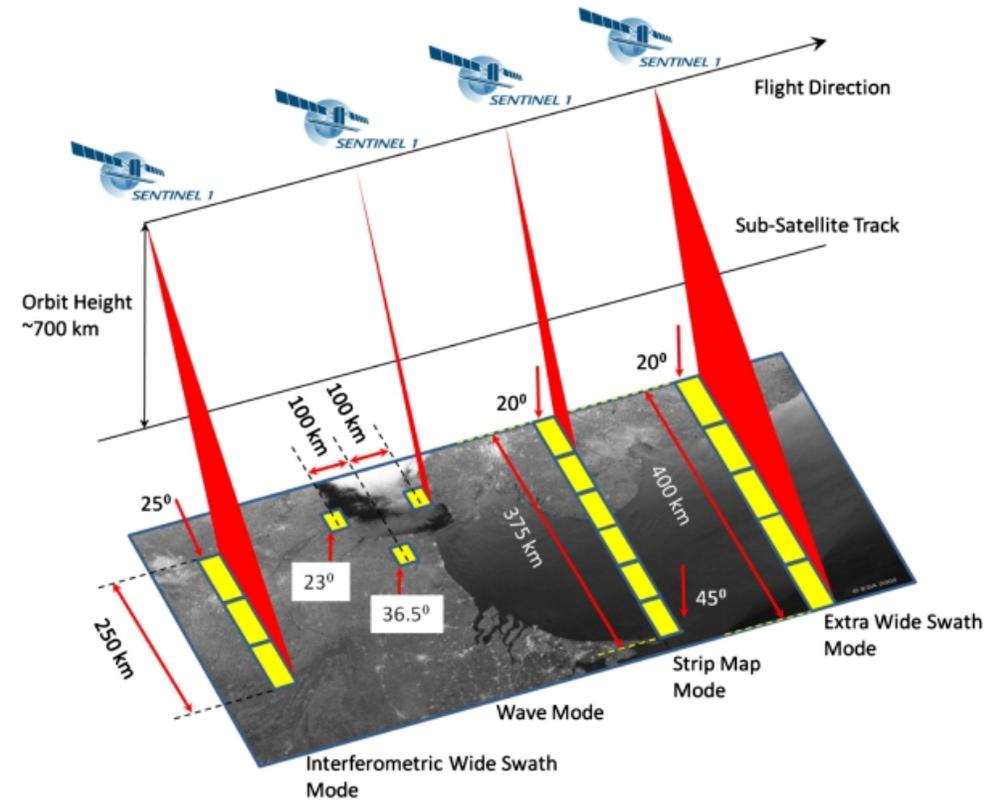
- Sentinel 1 consists of two satellites: A and B
- Each satellite has global coverage every 12 days
- Global coverage of six days over the equator when using data from both satellites



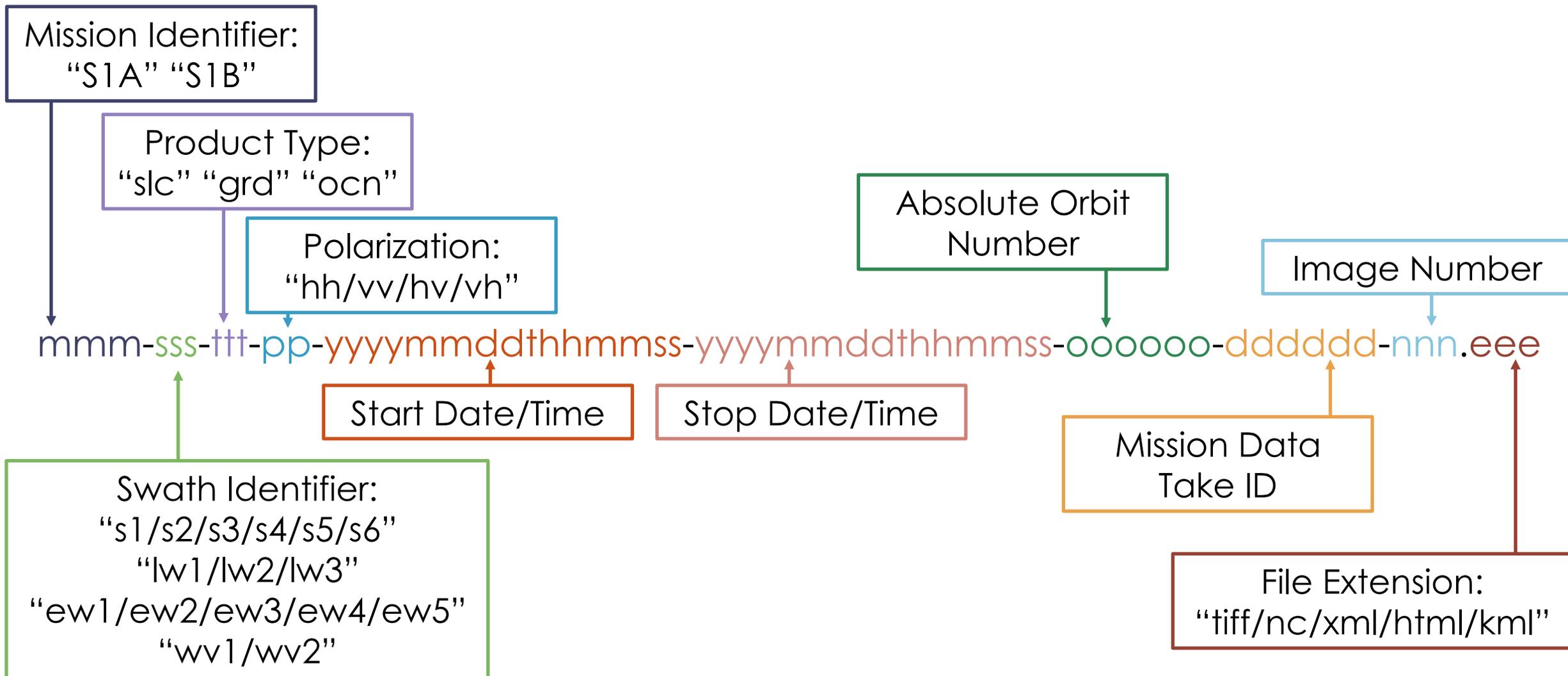
Modes of Acquisition

Different satellites may have different modes of acquisition, which means that the spatial resolution and polarization can vary. For example, Sentinel-1 has the following modes:

- Extra Wide Swath (EW): for monitoring oceans and coasts
- Strip Mode (SM): by special order only and intended for special needs
- Wave Mode (WV): routine collection for the ocean
- Interferometric Wide Swath (IW): routine collection for land



File Naming Format



File Naming Format

In the file naming system, there are three types of product types: SLC, GND, and OCN

- SLC: Single Look Complex
- GND: Ground Range Detected (select this one)
 - GRD products can be in one of three resolutions:
 - Full Resolution (FR)
 - High Resolution (HR)
 - Medium Resolution (MR)
 - OCN: Ocean products for wind, wave, and currents

The resolution is dependent upon the amount of multi-looking performed.

Level-1 GRD products are available in MR and HR for IW and EW modes, MR for WV mode and MR, HR and FR for SM mode



Accessing Sentinel Data

1. Identify your area (-60.31,-4.52,-57.81,-4.52,-57.81,-2.92,-60.31,-2.92,-60.31,-4.52) and dates of interest (Apr. 25-29, 2015)
2. Identify images of interest (Sentinel-1 A/B)
3. Click on **Search**
4. Select granule
S1A_IW_GRDH_1SDV_20150428T093856_20150428T093921_005682_0074A1_D968
5. Download the L1 Detected High-Res Dual-Pol (GRD-HD) Product

Granule Information

Data courtesy of ESA

Dataset: [Sentinel-1A](#)

Granule: [S1A_IW_GRDH_1SDV_20150428T093856_20150428T093921_005682_0074A1_D968](#)

Granule Details

- Acquisition Date: 2015-04-28
- Beam mode: IW
- Path: 10
- Frame: 603
- Ascending/Descending: Descending
- Polarization: VV+VH
- Absolute Orbit: 5682
- Frequency: C-Band

Products

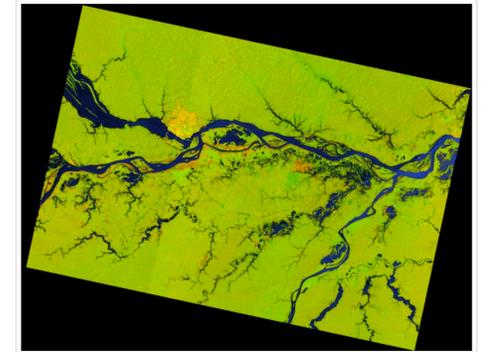
Download

[L1 Detected High-Res Dual-Pol \(GRD-HD\)](#)
(1.01 GB)

[L1 Single Look Complex \(SLC\)](#) (4.51 GB)

[L0 Raw Data \(RAW\)](#) (1.54 GB)

[XML Metadata \(RAW\)](#) (40.62 KB)



Full Resolution Browse Image





Accessing the SNAP Toolbox

Sentinel-1 Toolbox

An open source software developed by ESA for processing and analyzing radar images from different satellites. It includes:

- Calibration
- Speckle Noise
- Terrain Correction
- Mosaic Production
- Polarimetry
- Interferometry
- Classification



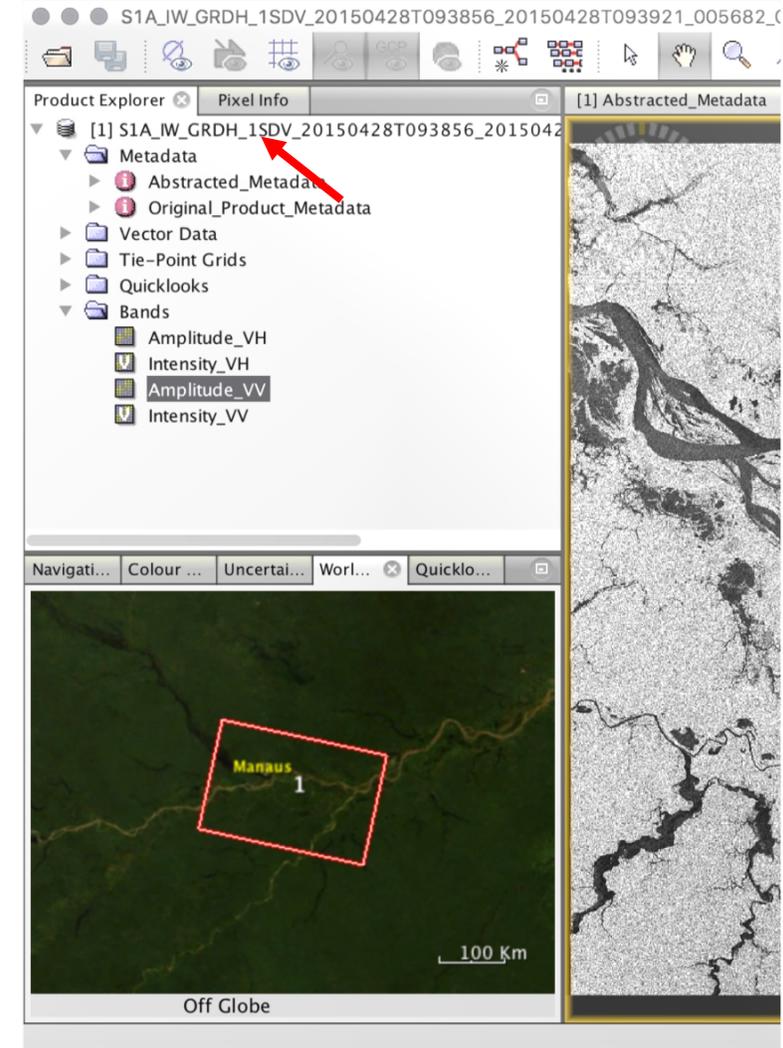
Accessing the SNAP Toolbox

1. Open the data with the Sentinel Toolbox
 - Initiate the Sentinel Toolbox by clicking on the its desktop icon
 - In the SNAP interface, go to the **File** menu and select **Open Product**
 - Select the folder that contains your Sentinel-1 data, and double click on the **.zip** file (do not extract files from the .zip file; the program will do that for you)



Accessing the SNAP Toolbox

2. The **Product Explorer** window of the Sentinel Toolbox contains your file. Highlight the filename and double click on it to view the directories within the file, which contains information relevant to the image, including:
 - **Metadata:** different parameters related to the orbit and data
 - **Tie Point Grids:** interpolation of latitude/longitude, incidence angle, etc.
 - **Bands:** within the file



Accessing the SNAP Toolbox

3. There are two bands for each polarization:
 - Amplitude
 - Intensity (amplitude squared)
4. In the lower left-hand side, you can see in Worldview the coverage of the image selected. The image is inverted because it is oriented the same way it was acquired
5. In the upper left window, select **Pixel Info** to see the value and the latitude/longitude of each pixel in the open image
6. Go back to the **Product Explorer** tab
7. Select the file name of the Sentinel-1 dataset. Afterwards, select **Open RGB Image Window** to display a color image of VV, VH, and VV/VH ratio.

