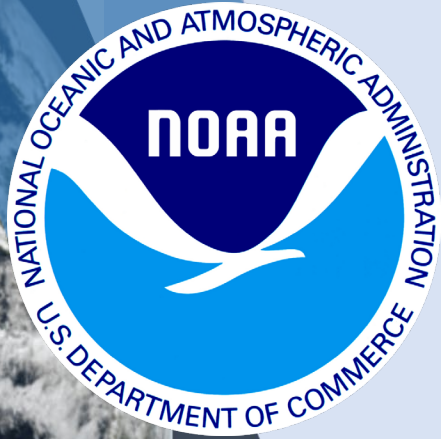




Introduction to Synthetic Aperture Radar (SAR) (and SAR Data)

Christopher R. Jackson

Satellite 201 Summer Lecture Series
10 July 2016

NOAA Coastwatch Satellite Courses

coastwatch.info@noaa.gov

The CoastWatch Synthetic Aperture Radar Instructional Series



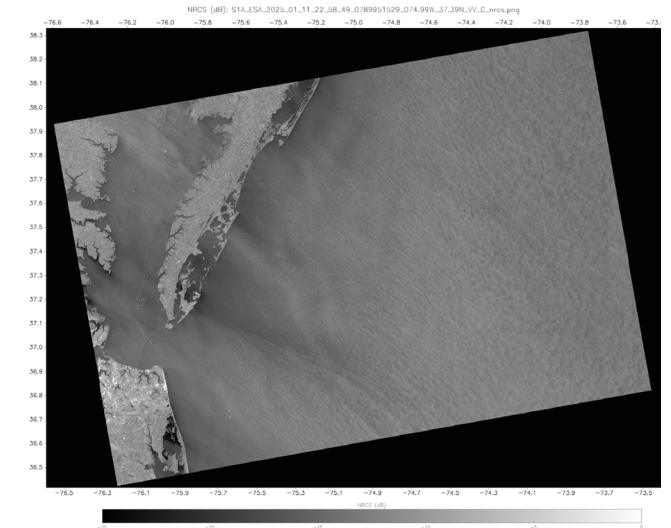
Synthetic Aperture Radar (SAR) Overview

This presentation provides a comprehensive introduction to Synthetic Aperture Radar (SAR), explaining how SAR works, what oceanic, atmospheric, and coastal features it can detect, the advantages and limitations of radar measurements, and where to access and work with SAR data products available through NOAA CoastWatch and partner archives.

Synthetic Aperture Radar (SAR) Imagery

This lecture explores how Synthetic Aperture Radar (SAR) imagery reveals oceanographic and atmospheric features by capturing variations in radar backscatter from the ocean surface. Using Sentinel-1 and other satellite examples, it demonstrates how winds, currents, waves, sea ice, storms, and surface slicks can be identified and interpreted in SAR data.

[https://coastwatch-training.github.io/lectures/#cg-synthetic-aperture-radar-\(sar\)-overview](https://coastwatch-training.github.io/lectures/#cg-synthetic-aperture-radar-(sar)-overview)

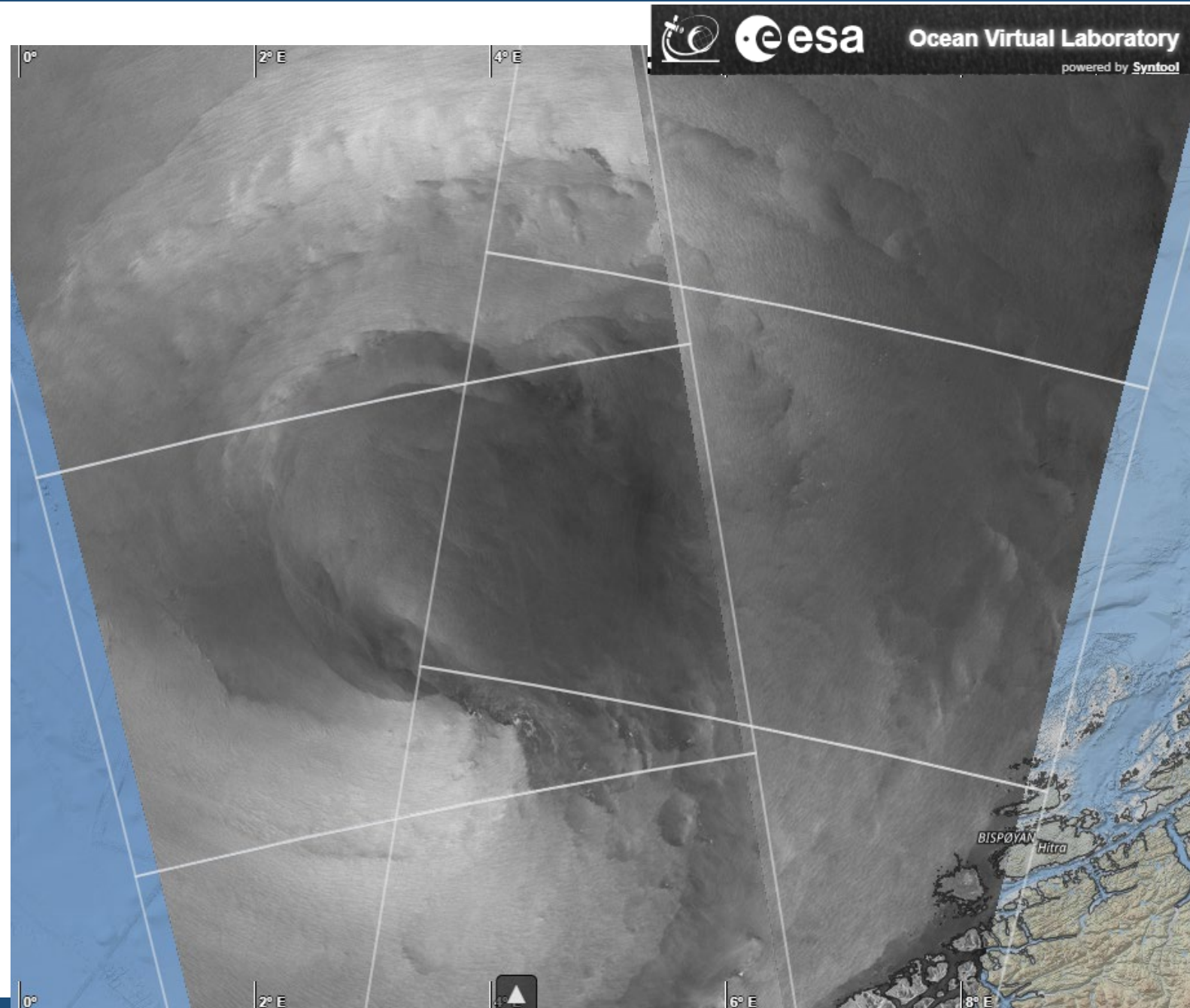


**Sentinel-1D C-Band
VV NRCS
Norwegian Sea
06 July 2026**

**Descending Pass (NE-SW)
06:02 UTC
Ascending Pass (SE-NW)
17:20 UTC**

Features include
Wind Streaks
Convective Cells
Swell Waves (Zoom)

<https://ovl.oceandatalab.com/>



Topic Overview

- The Pros and Cons of Using SAR Imagery
- What is a Synthetic Aperture Radar (SAR)
- SAR Characteristics
 - Backscatter, Frequency, Polarization
- Satellite SAR Missions
 - Collection Patterns, Beam Modes
- SAR Data Processing Levels, Files and Archives
- SAR Collection Examples

Focus on National System (ESA, CSA, NASA) with an emphasis on ocean/atmospheric roughness and sea ice



The Pros and Cons of SAR measurements

SAR Advantages

- Data collection is independent of lighting and cloud conditions
- Wide area coverage (100–450 km swath)
- High resolution coverage (30-100 m)
- Fine resolution is available (1m-3m)
- Many different products can be derived

SAR Disadvantages

- Experience is required to interpret the data
- Specialized software to read and calibrate
- Scheduled data acquisitions limit global coverage

Traditional barriers

- Cost - free access is now available
- Difficulty in reading and interpreted data
- Irregular temporal revisit times

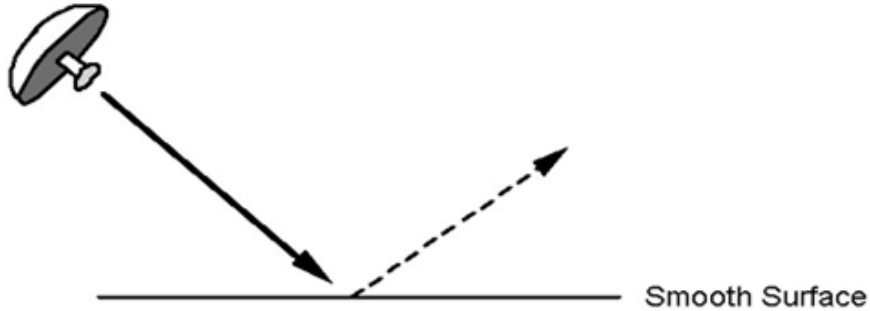


Overview of Synthetic Aperture Radar

- SAR is an active sensor that transmits a radar pulse to the earth's surface and records the energy reflected back to the sensor (backscatter).
- The returned signals are coherently combined over a time interval to produce a 2D image of the normalized radar cross section
- The distance the radar sensor travels in this time interval is the synthetic aperture length.
- The synthetic aperture is much larger than the “real” antenna aperture allowing fine resolution in the azimuth (flight track) direction
 - Azimuth resolution is proportional to the wavelength (λ) over radar aperture (L), i.e. λ/L
 - Range resolution is determined by the bandwidth of the radar pulse
- Radars use microwaves (λ = few millimeters - 1 meter), which penetrate through clouds and rain



RADAR measures the portion of the transmitter radar energy that is backscattered to the antenna



Smooth surfaces scatter most of the radar energy away from the radar, so less signal is backscattered to the SAR antenna.

These SAR images appear black.



Rough surfaces backscatter more the radar energy back to the SAR antenna.

These SAR images appear brighter

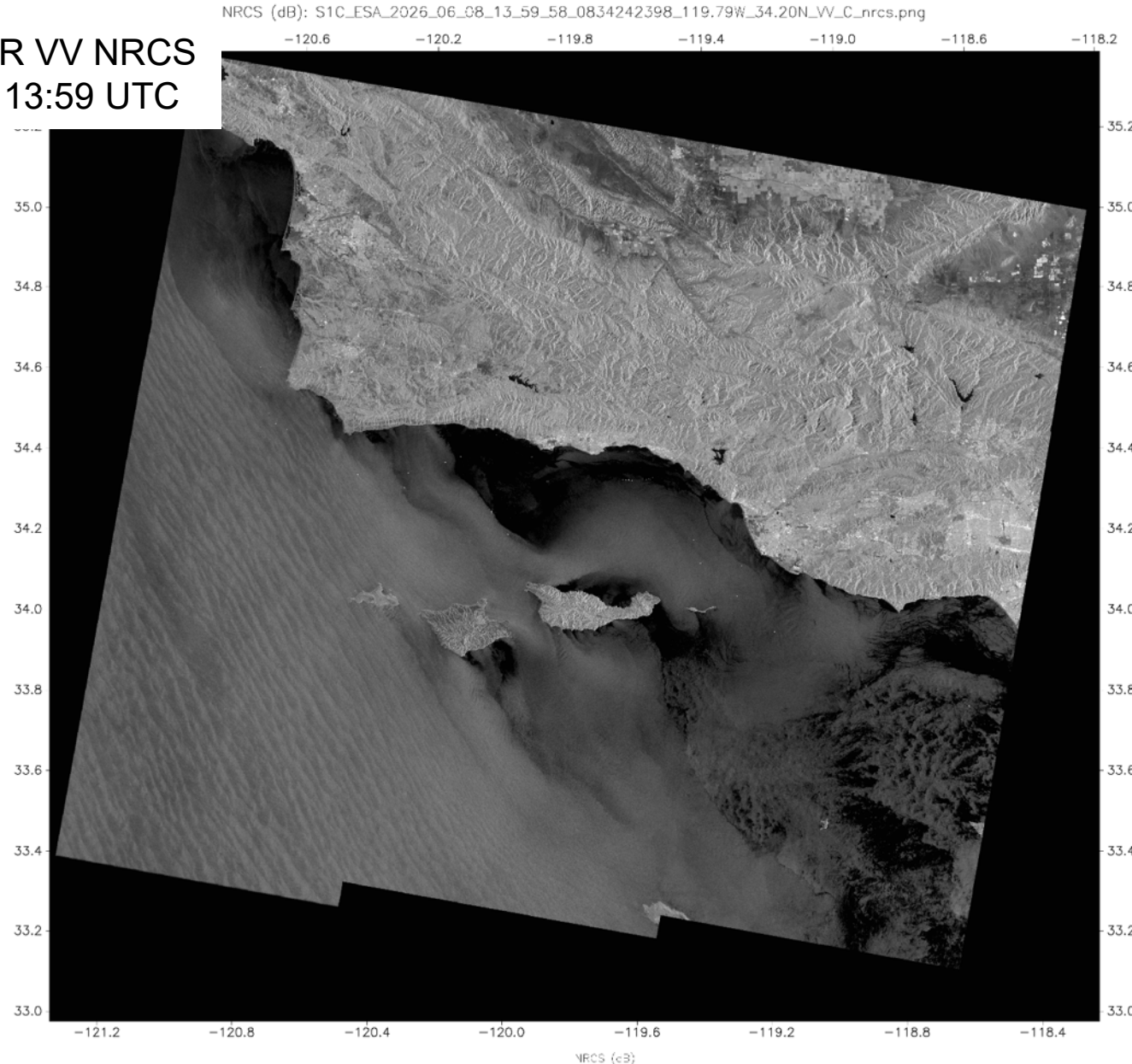
Normalized Radar Cross Section (NRCS) is the measure of radar backscatter

Images from <https://appliedsciences.nasa.gov/join-mission/training/english/arset-introduction-synthetic-aperture-radar>



Normalized Radar Cross Section (NRCS)

Sentinel-1 SAR VV NRCS
8 June 2026 13:59 UTC



- Normalized Radar Cross Section (NRCS) is the measure of backscattered radar energy.
- SAR is sensitive to roughness at the centimeter scale (close to the sensor wavelength)
- Smooth surfaces scatter the radar energy away from the satellite (and appear dark)
- Rough surfaces produce more backscatter (i.e. more radar energy returned to the satellite and appear bright)



What can be detected by SAR?

OCEANIC

Surface Waves

- Significant Wave Height
- Wave Spectra

Surfactants (Biogenic Slicks, Oil Seeps)

Sea Ice

Internal Waves

Currents and Fronts

Eddies

Upwelling

Underwater Topography

ATMOSPHERIC

Surface Wind

Convection Cells / Rolls

Storm Systems

Vortex Streets

Gravity Waves

Rain Cells / Thunderstorms

ANTHROPOGENIC

Hard Targets (Ships/Oil Platforms)

Ship Wakes

Pollution (Oil Spills)

COASTAL / LAND

Flooding and Inundation

Shorelines

Land Use

Land Deformation (interferometry)

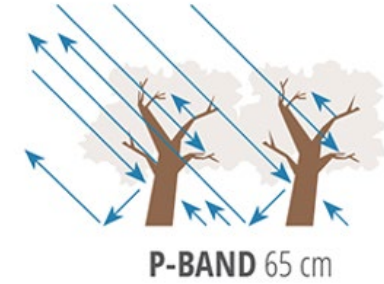
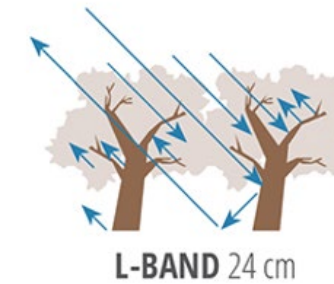
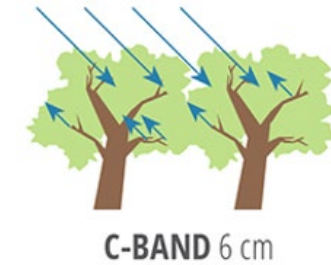
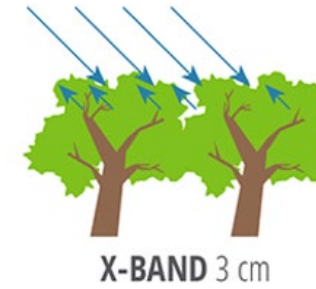
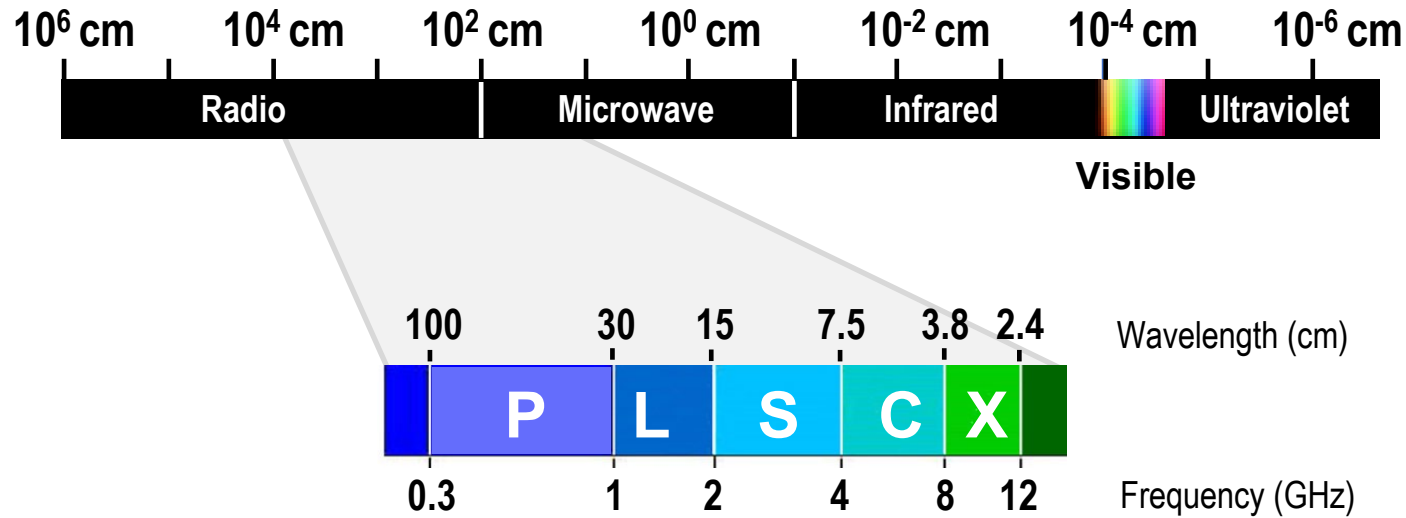
Burn Scar Identification

...there are many other applications



Frequency Effects

<https://www.earthdata.nasa.gov/learn/backgrounders/what-is-sar>

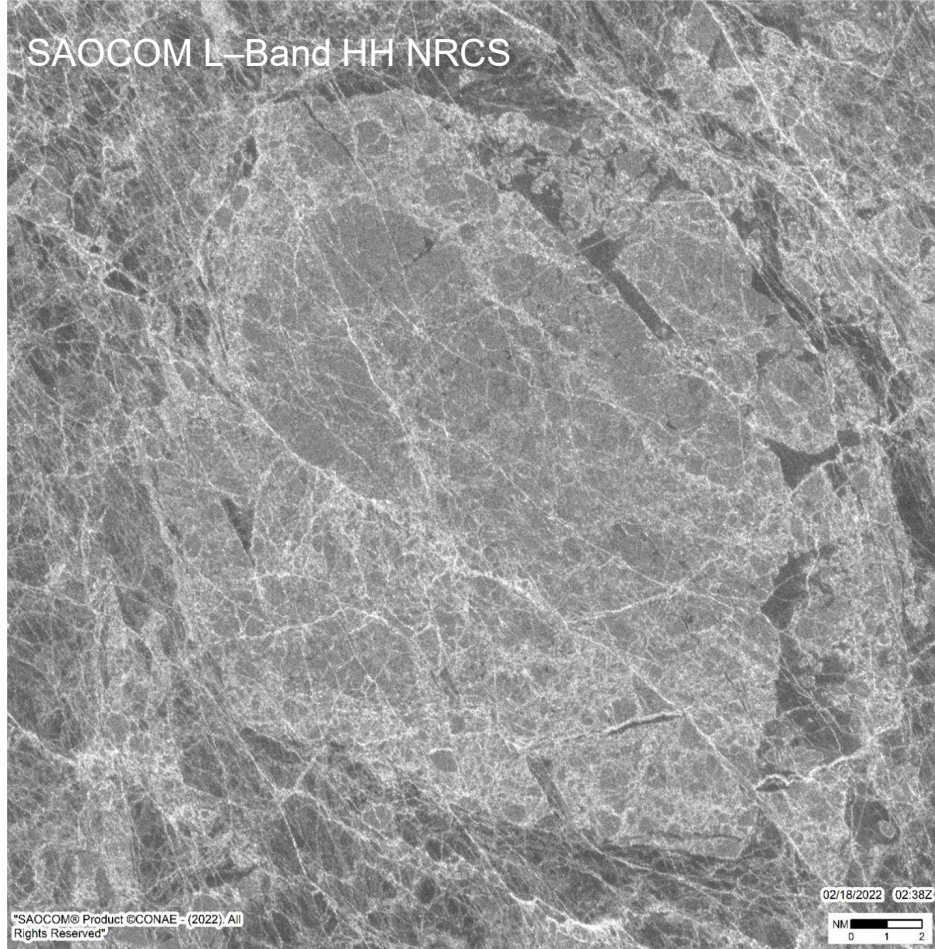


Band	Frequency (GHz)	Wavelength (cm)
X	8-12	2.4-3.8
C	4-8	3.8-7.5
S	2-4	7.5-15
L	1-2	15-30
P	0.3-1	30-100

- Radar backscatter is tied to roughness (and dielectric constant).
- Best scatterers are at the same scale as the radar wavelength.
- Physical properties of the target will interact differently to different frequencies and polarizations

Comparing L-Band and C-Band: 17-18 February 2022

SAOCOM L-Band HH NRCS

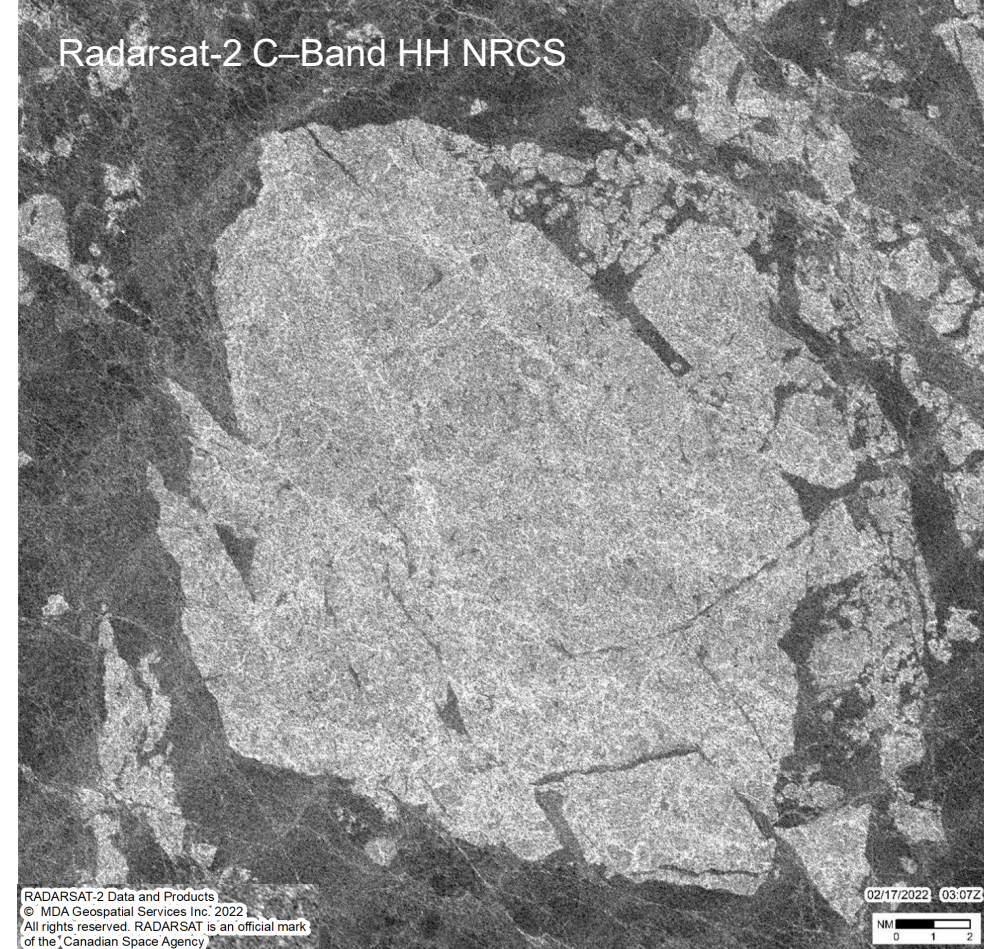


$\lambda = 24 \text{ cm}$



L-Band's longer wavelength and deeper penetration allows for the identification of internal features beyond the capabilities of C-Band. This includes internal floe boundaries, weaknesses, fractures, and roughness

Radarsat-2 C-Band HH NRCS

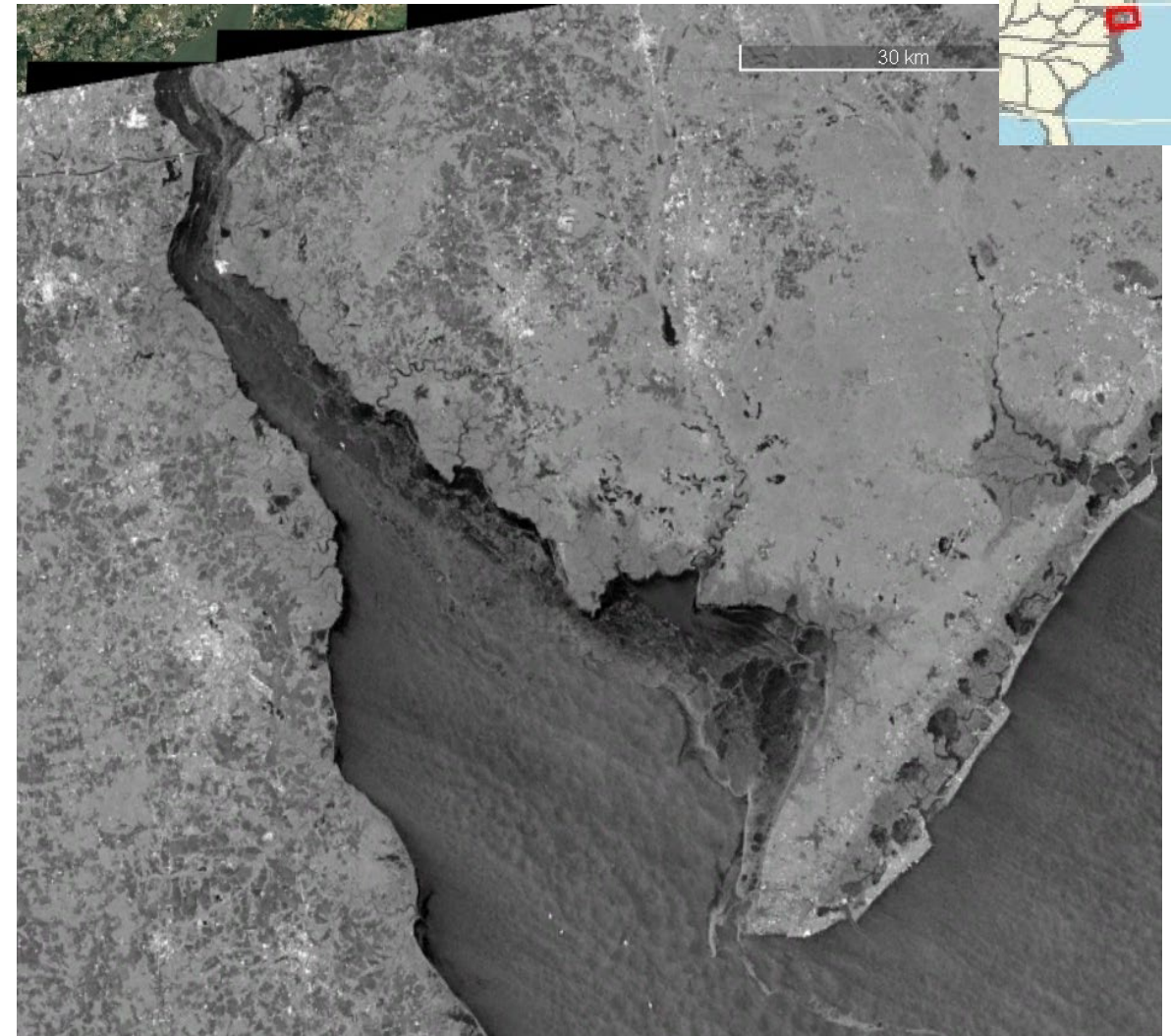


$\lambda = 5 \text{ cm}$

Comparing X-Band and C -Band: 30 January 2026



$\lambda = 3 \text{ cm}$ Icyte (X-Band) VV NRCS
30 January 2026 03:13 UTC

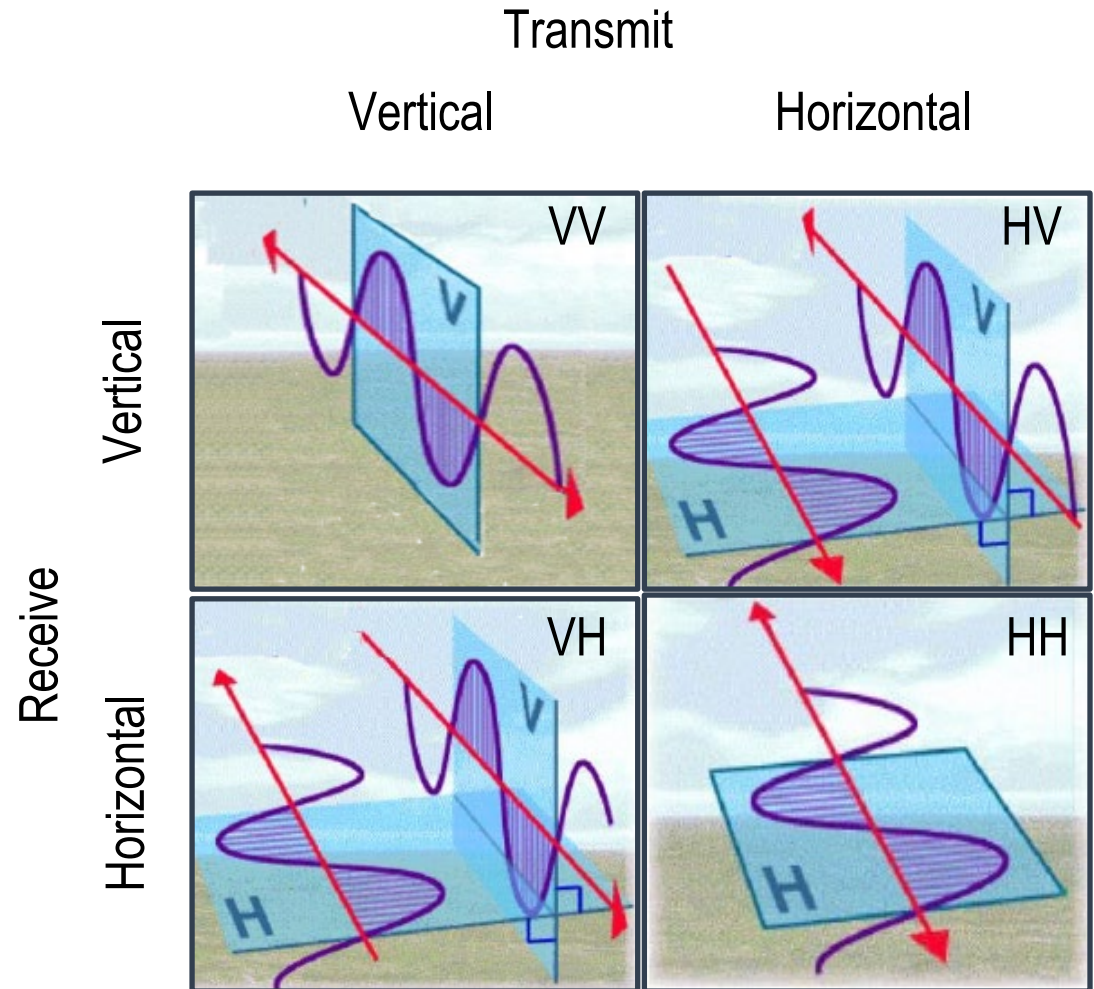


Sentinel-1A (C-Band) VV NRCS
30 January 2026 22:59 UTC $\lambda = 5 \text{ cm}$



Polarization

- Polarization refers to the orientation of the plane in which the transmitted electromagnetic wave oscillates.
- How target surfaces interact with or change the polarization of the transmitted beam can help determine physical properties of the target surfaces.
- SAR systems can collect with different polarization combinations
 - Single Polarization (HH or VV)
 - Dual Polarization (HH/HV, VV/VH, HH/VV)
 - Quad Polarization (HH/HV/VV/VH)
- Compact-Polarization is a new mode where the system transmits circular polarization and receives in linear polarization (H and V)



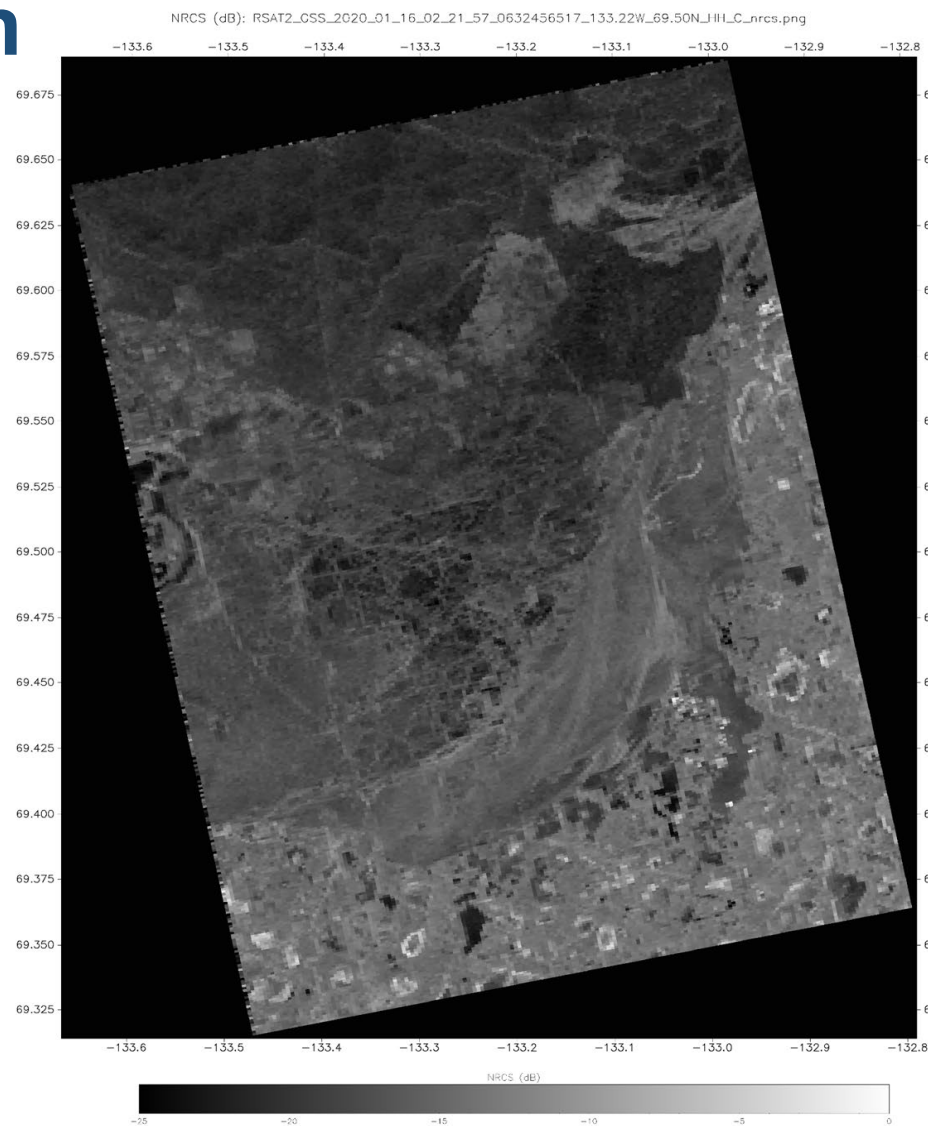
Polarization

Radarsat-2
16 January 2020
02:22 UTC

Sea Ice and
Coastal Canada

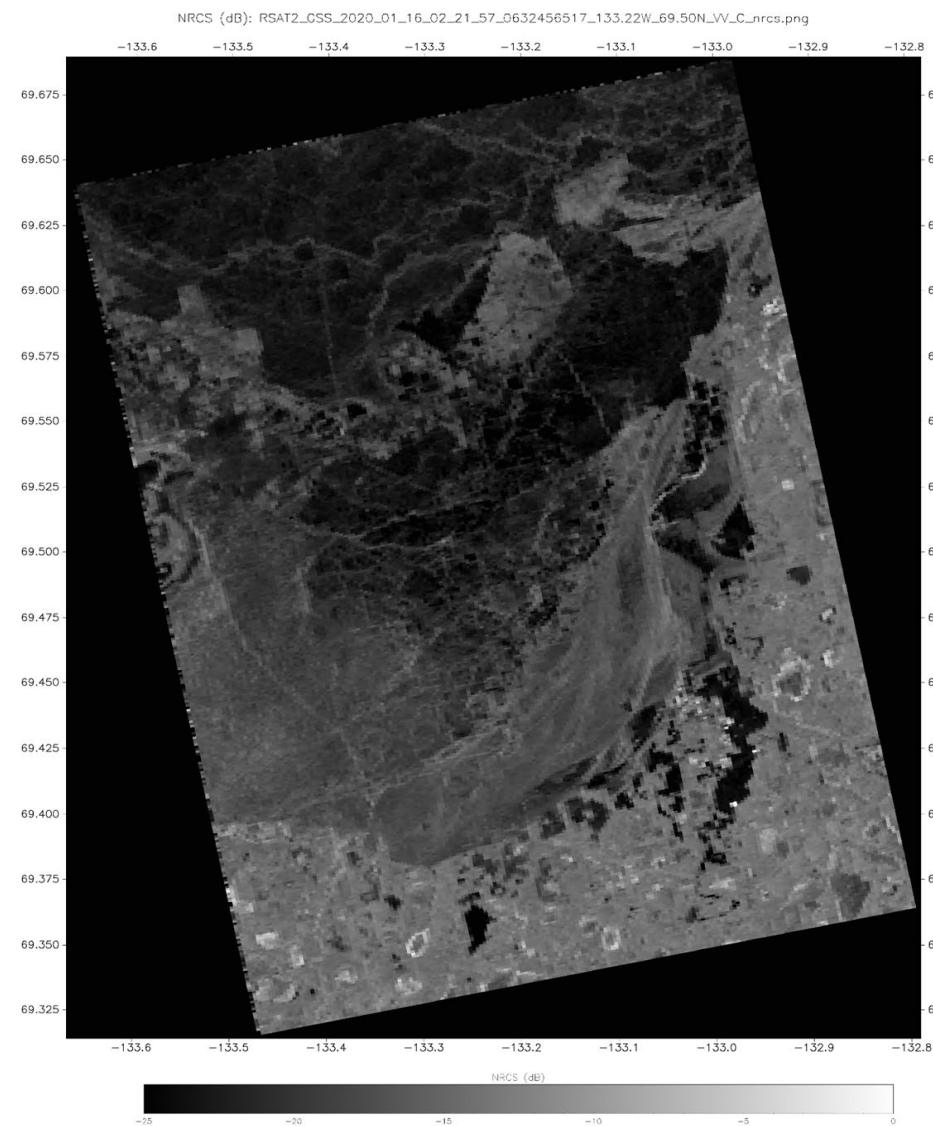


HH Polarization



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RADARSAT is an official mark of the Canadian Space Agency
Processed at NOAA/NESDIS/STAR/SOCD for National Ice Center 2022 Sep 15 03:04:42 UTC

VV Polarization



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RADARSAT is an official mark of the Canadian Space Agency
Processed at NOAA/NESDIS/STAR/SOCD for National Ice Center 2022 Sep 15 03:03:23 UTC



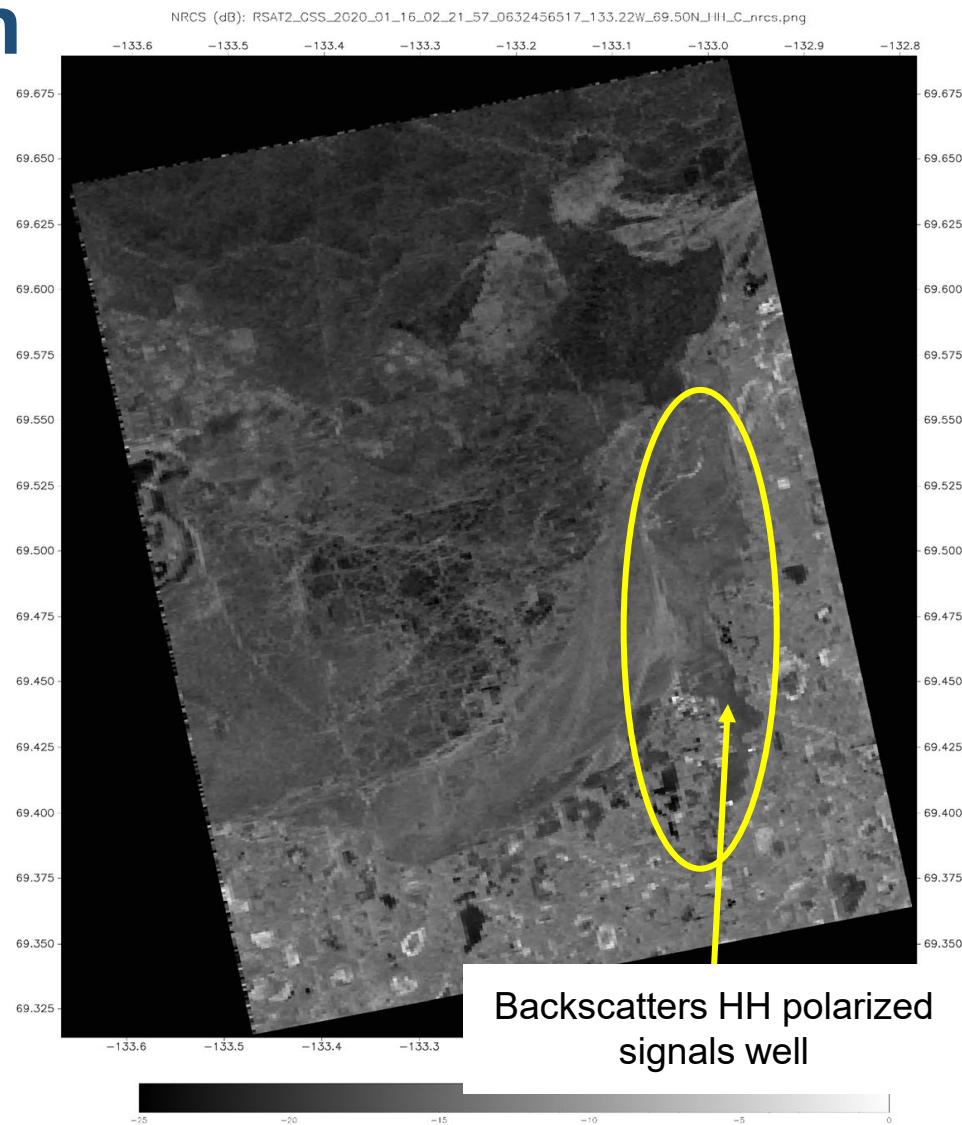
Polarization

Radarsat-2
16 January 2020
02:22 UTC

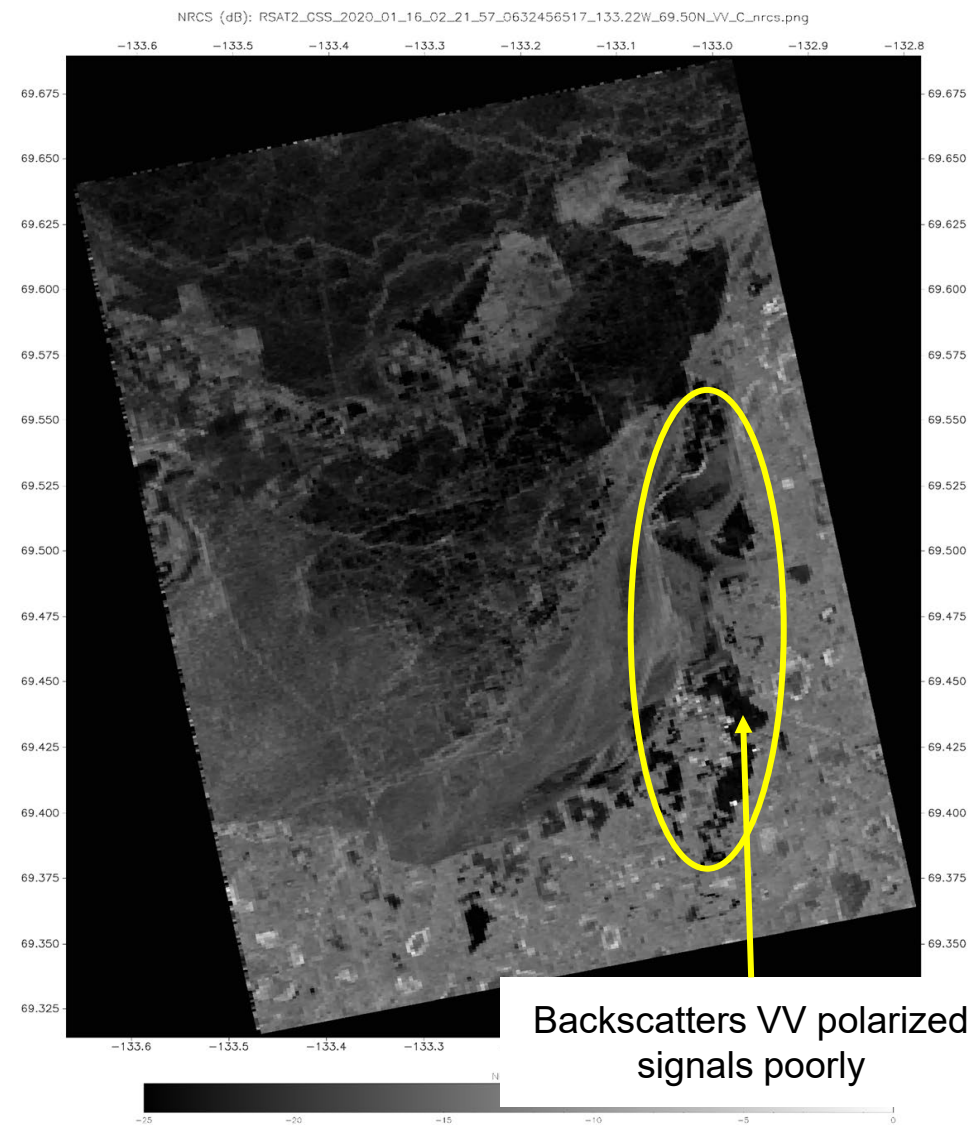
Sea Ice and
Coastal Canada



HH Polarization



VV Polarization



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Processed at NOAA/NESDIS/STAR/SOCD for National Ice Center 2022 Sep 15 03:04:42 UTC



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Processed at NOAA/NESDIS/STAR/SOCD for National Ice Center 2022 Sep 15 03:03:23 UTC



SAR Satellites

- Sentinel-1 (2014) ushered in a new era for SAR data coverage and access
- There is more SAR data available “today” than at any previous time (a significant amount is available free and in near real time)



	Sentinel-1	RCM	NISAR
Launch	2014 (A) / 2024 (C) / 2025 (D)	2019 (1,2,3)	2025
Altitude	693 km	593 km	747 km
Repeat	12 Day	12 Day	12 Day
LT Ascending Node	18:00	18:00	06:00 (Left Looking)
Center Frequency	C-Band 5.405 GHz	C-Band 5.405 GHz	L-Band 1.25 GHz S-Band 3.2 GHz
Polarization	VV,VH (HH,HV)	HH,VV,HV,VH, Compact	HH,HV (VV,VH) Quad (US/India)
Swath Width	80,240,400	30,125,350,500	240,120 (Quad)
Resolution (Wideswath)	40/80 m	30/50/100 m	3-50 m (L)



Current SAR System

L-Band

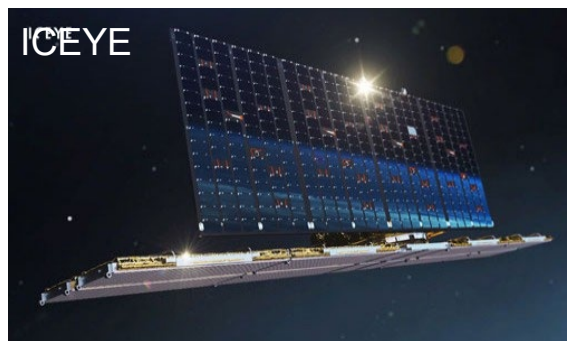
- ALOS-4
- SAOCOM
- ROSES-L (Future)

C-Band

- Radarsat-2
- Chorus (Future)

X-Band

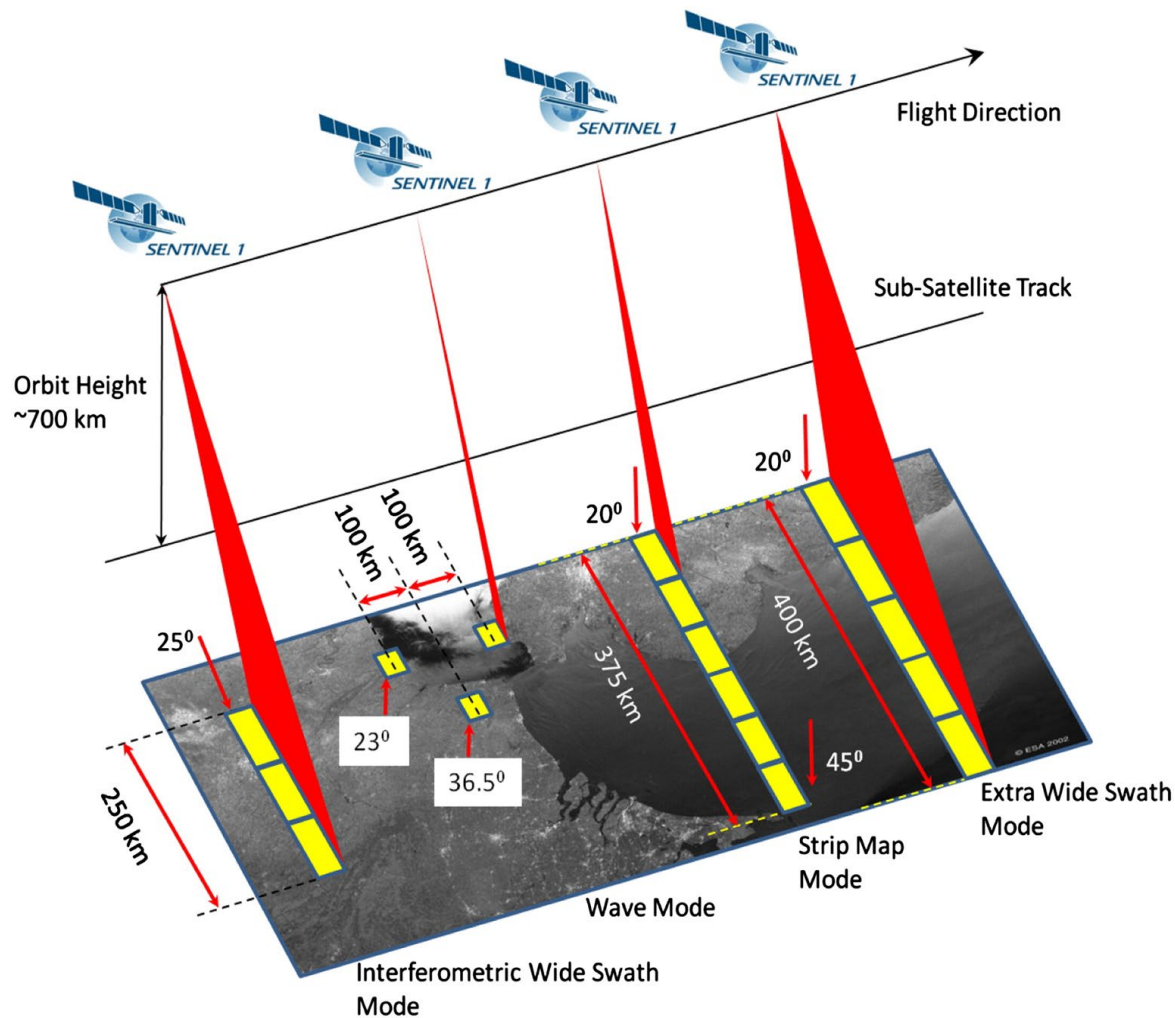
- TerraSAR-X / TanDEM-X
- COSMO-SkyMed
- Capella Space (Constellation)
- Iceye (Constellation)
- Umbra (Constellation)



Historical: SEASAT, ERS-1&2, Radarsat-1, ENVISAT, JERS-1 ALOS-1/2

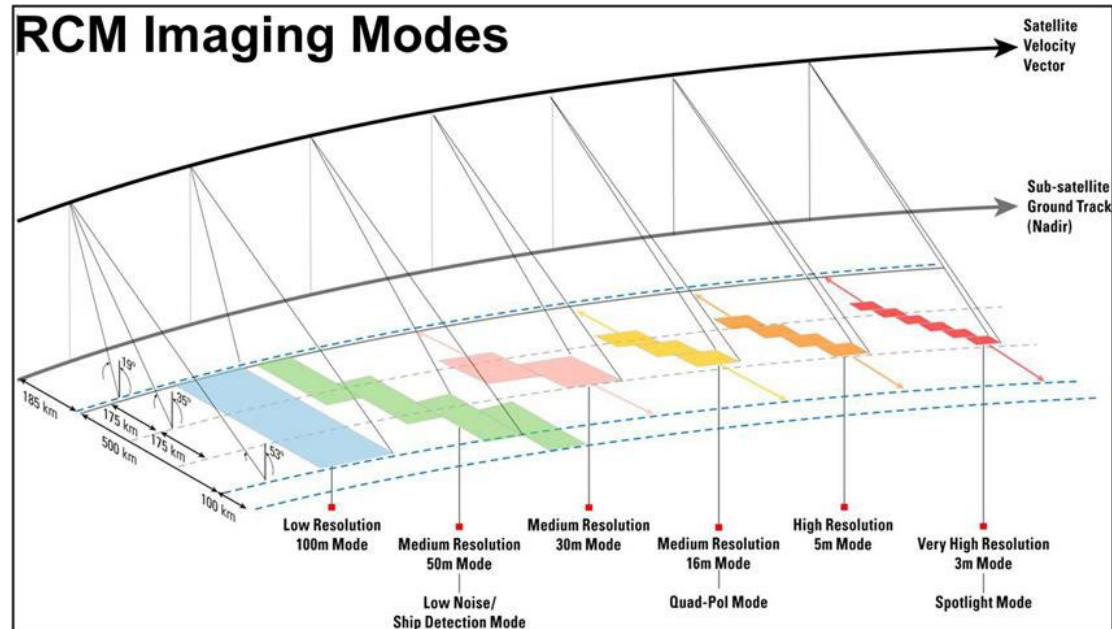
List is not comprehensive

SAR Overview



- The latest generation of SAR have very sophisticated capabilities offering a wide variety of data collection modes
- For a SAR on a polar-orbiting satellite, this imagery can have fine spatial resolution of <3 to >100 meters over a swath that can be as wide as 500 kilometers
 - Tradeoffs between coverage area and resolution
- SAR data are collected over a small portion of each orbit (typically 25%)
 - Collections are programmed in advance
- Sentinel-1 changed the SAR paradigm implementing a regular (and repeating) data collection pattern
 - Temporal Image Stacks
 - <https://sentinels.copernicus.eu/copernicus/sentinel-1/acquisition-plans>

SAR Overview



- Low Resolution (100 m) 5 Options
- Medium Resolution (50 m) 11 Options
- Medium Resolution (30 m) 4 Options
- Low Noise 4 Options
- Ship Detection 1 Mode
- Medium Resolution (16 m) 16 Options
- High Resolution (5 m) 23 Options
- Very High Resolution (3 m) 42 Options
- Spotlight 29 Options
- Quad Pol 21 Options

Options include combinations of polarization and beam positions

<https://www.asc-csa.gc.ca/eng/satellites/radarsat/technical-features/characteristics.asp>

NISAR Mode Options

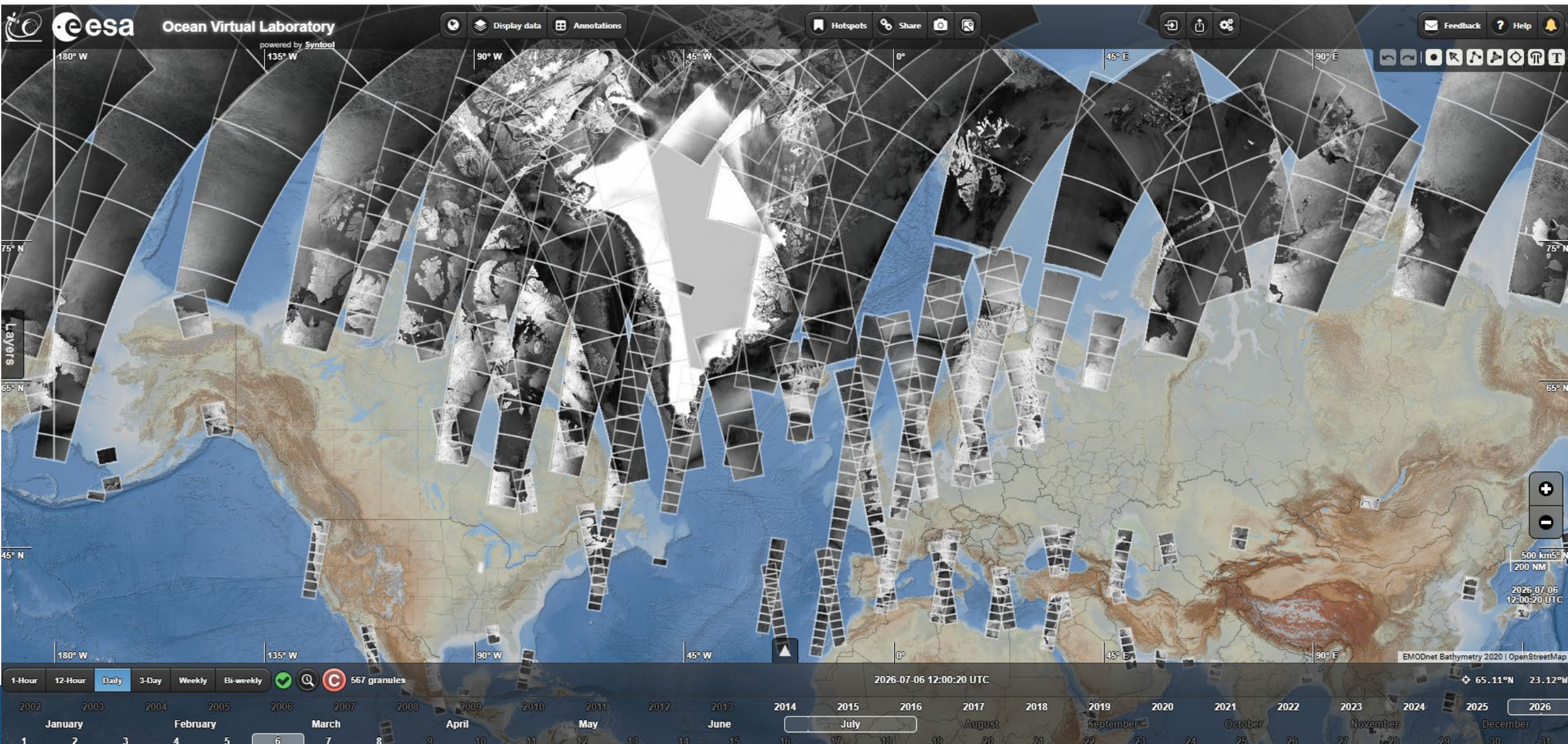
<https://nisar-docs.asf.alaska.edu/observation-plan/>

Mode Number	Mnemonic	Primary Science Target
001	L: ENG: NO: 77M+---: FS: B4: F04	Noise only collection H+V, 4-bit BFPQ
068	S: DB-: DH: 37W+---: B4: D03	New mode
076	S: DB-: SH: 37W+---: B4: D03	ISRO land ice
130	L: SCI: QP: 20M+05N: FS: B4: F28	US agriculture / India agriculture low res
148	L: SCI: DH: 20M+05N: FS: B4: D01	Background land
150	L: SCI: SH: 77M+---: HS: B4: D02	Land ice
151	L: SCI: SH: 40M+05N: FS: B4: D02	Land ice low res
152	L: SCI: SH: 20M+05N: FS: B4: D01	Low data rate study mode single-pol
153	L: SCI: SV: 05W+---: FS: B4: D01	Sea ice dynamics
154	L: SCI: QD: 05W+---: FS: B4: D01	Open ocean
156	L: SCI: DH: 40M+05N: FS: B4: D02	L-only background land
161	L: SCI: DV: 05W+---: FS: B4: D01	ISRO ice / Sea ice
190	L: PST: CP: 77M+---: FS: B4: F04	4-bit post-take
191	L: PRE: NO: 77M+---: FS: B4: F04	4-bit pre-take
196	L: SCI: DV: 20M+05N: FS: B4: F04	Sea ice types
201	L: SCI: QP: 20M+05N: FS: B4: F05	India agriculture / Himalayas / Image cal/val
212	L: SCI: DH: 20M+05N: FS: B4: D01	Systematic coverage & deformation
214	L: SCI: SV: 05W+---: FS: B4: D01	Ocean
215	L: SCI: DV: 20M+05N: FS: B4: D01	Sea ice types / Coastal sea
217	L: SCI: DH: 40M+05N: FS: B4: D02	High-res deformation (urban / landslide)
231	L: SCI: QD: 05W+---: FS: B4: D01	Beaufort Sea
233	L: SCI: QD: 05W+---: FS: B4: D01	Beaufort Sea / Antarctica stations
234	L: SCI: DH: 20M+05N: FS: B4: D01	ISRO background
237	L: SCI: QP: 20M+05N: FS: B4: F05	ISRO cal/val
238	L: SCI: DH: 40M+05N: FS: B4: D02	ISRO background land and global science cal/val targets
242	L: SCI: DH: 40M+05N: FS: B4: D02	Urban areas and ES sites
246	L: SCI: SH: 77M+---: HS: B4: D02	Land ice - Greenland
247	L: SCI: SH: 40M+05N: FS: B4: D02	Land ice - Antarctica
248	L: SCI: DH: 40M+05N: FS: B4: D02	ISRO Bohai Bay and NASA urban area
254	L: PST: CP: 77M+---: FS: B4: F04	4-bit joint post-take
255	L: PRE: NO: 77M+---: FS: B4: F04	4-bit joint pre-take



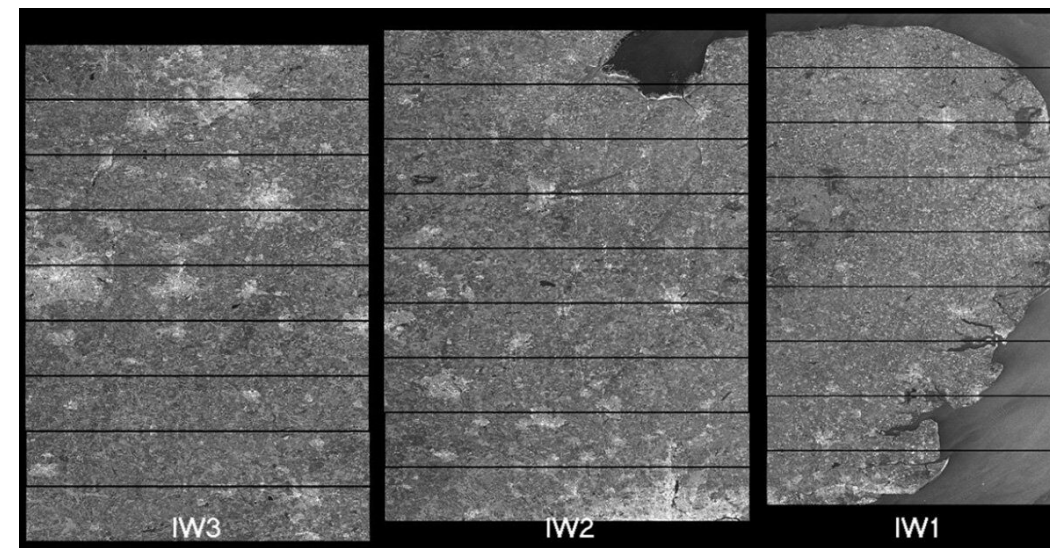
Sentinel-1 SAR Collections 06 July 2026

<https://ovl.oceandatalab.com>

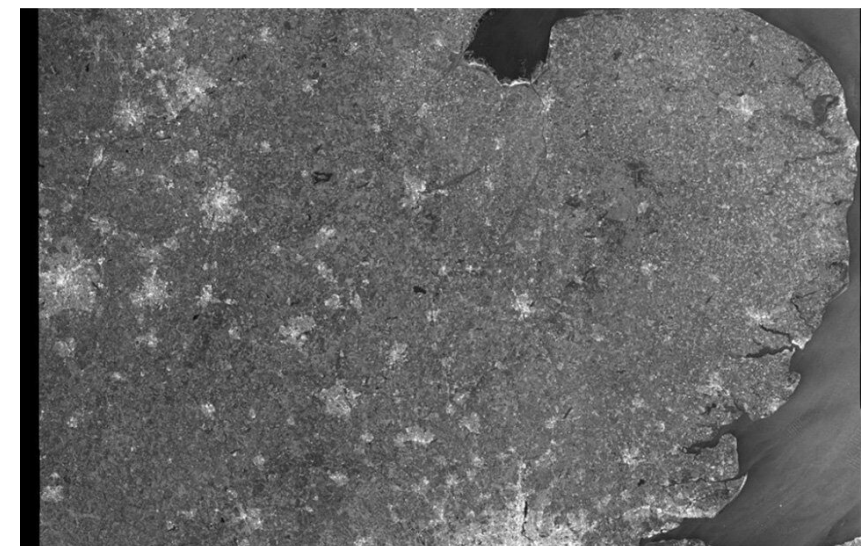


Sentinel-1 SAR Image Processing Levels

- **Level-0:** Compressed and unfocused raw data. Level-0 products are the basis from which all other high-level products are produced, with a typical size of 1GB (in IW mode).
- **Level-1 Single Look Complex:** Focused data, geo-referenced using orbit and attitude data from the satellite and provided in slant-range geometry. These products have a typical size of 8GB (in IW mode dual-polarization) and 4 GB (in IW mode single polarization). Highest Resolution – Speckle Noise
- **Level-1 Ground Range Detected:** focused data that has been detected, multi-looked and projected to ground range using an Earth ellipsoid model. Typical product size is 1GB (in IW mode).
- **Level-2:** Systematically distributed ocean products for wind, wave and currents applications.
- Spatial resolution is often confused with pixel size, which is the spacing of the pixels in the azimuth and ground range direction after processing the data.



SLC



GRD

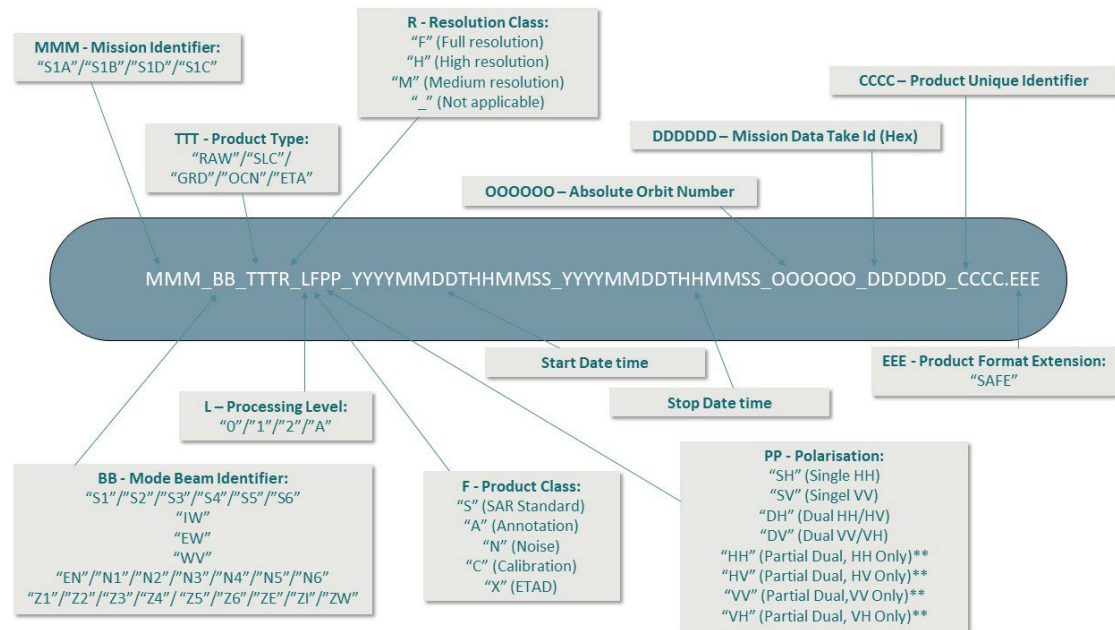
https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-1/Data_products



Sentinel-1 Product

S1A_IW_GRDH_1SDV_20260608T163200_20260608T163229_064880_082CFD_2DC7.SAFE

Naming Convention



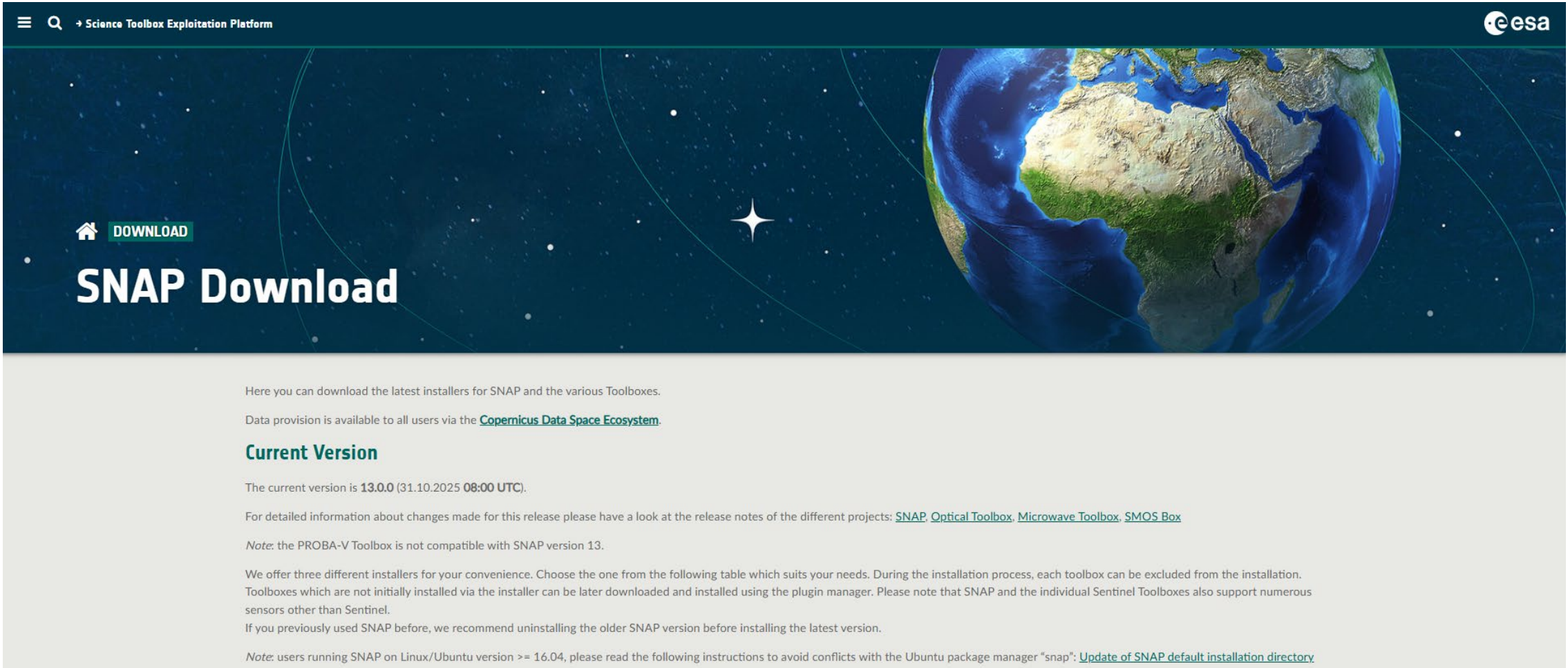
Directory Structure



- Sentinel-1 (and RCM) Level-1 native files are a zip file with contain the image (tif) and metadata (xml).
- Calibration constants and sensor noise correction are needed to transform the Digital Number (DN) in the tif files to NRCS



SNAP Toolbox for SAR data



The screenshot shows the SNAP Download page. The header includes a menu icon, a search icon, and the text "Science Toolbox Exploitation Platform" on the left, and the ESA logo on the right. The main banner features a satellite view of Earth with the text "SNAP Download" and a "DOWNLOAD" button. Below the banner, the text reads: "Here you can download the latest installers for SNAP and the various Toolboxes. Data provision is available to all users via the [Copernicus Data Space Ecosystem](#)." The "Current Version" section states: "The current version is **13.0.0** (31.10.2025 08:00 UTC). For detailed information about changes made for this release please have a look at the release notes of the different projects: [SNAP](#), [Optical Toolbox](#), [Microwave Toolbox](#), [SMOS Box](#)." A note mentions: "Note: the PROBA-V Toolbox is not compatible with SNAP version 13." Another note states: "We offer three different installers for your convenience. Choose the one from the following table which suits your needs. During the installation process, each toolbox can be excluded from the installation. Toolboxes which are not initially installed via the installer can be later downloaded and installed using the plugin manager. Please note that SNAP and the individual Sentinel Toolboxes also support numerous sensors other than Sentinel. If you previously used SNAP before, we recommend uninstalling the older SNAP version before installing the latest version." A final note says: "Note: users running SNAP on Linux/Ubuntu version >= 16.04, please read the following instructions to avoid conflicts with the Ubuntu package manager 'snap': [Update of SNAP default installation directory](#)".

<https://step.esa.int/main/download/snap-download/>

- SNAP will read the native format of most SAR system
- Users can calibrate and manipulate the data (sub-set or composite)
- SNAP-Python interface `esa_snappy`

RCM Product

RCM1_OK4256220_PK4256221_1_SC50MA_20260709_092700_HH_HV_GRD

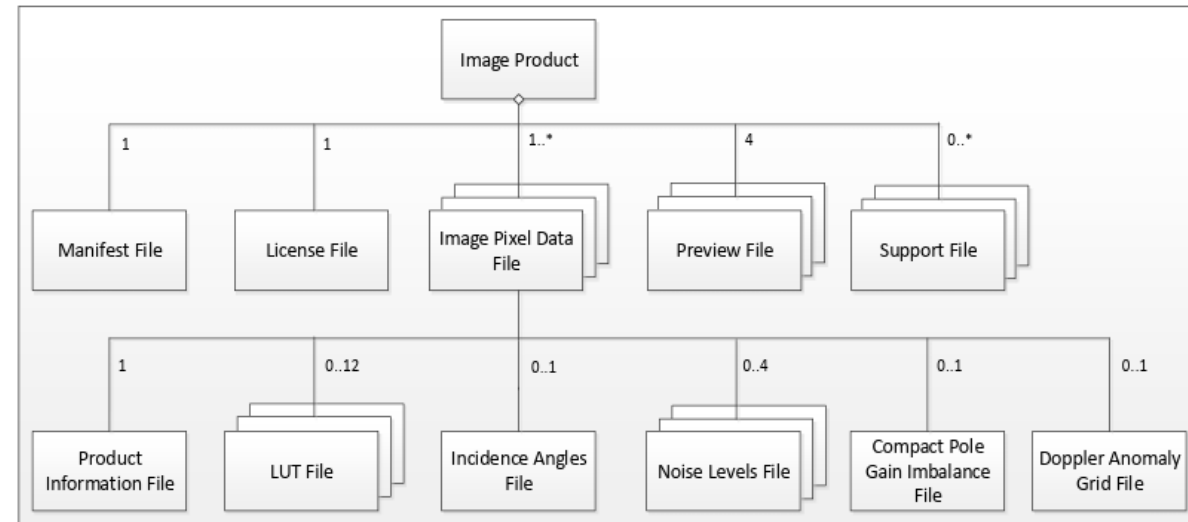
The standard folder naming format is:

RCM<SatelliteId>_OK<OrderId>_PK<ProductId>_<BeamModeMnemonic>_<Date>_<Time>_<Polarizations>_<ProductType>

Name Component Breakdown

- RCM**: Mission prefix.
- <SatelliteId>**: The specific satellite (1, 2, or 3).
- OK<OrderId>**: The unique order ID from the client.
- PK<ProductId>**: The product ID within the Product Information File (PIF).
- <BeamModeMnemonic>**: The imaging mode (e.g., SC50 for ScanSAR, SQ for Spotlight).
- <Date>**: Acquisition date.
- <Time>**: Acquisition time.
- <Polarizations>**: Polarization used (e.g., HH, VV, HH-HV).
- <ProductType>**: The processing level (e.g., SLC, GRD).

https://ftp.maps.canada.ca/pub/csa_asc/Space-technology_Technologie-spatiale/radarsat_constellation_mission_plan/RCM-SP-52-9092_Product_Spec_1-15_Public.pdf



<https://www.asc-csa.gc.ca/eng/satellites/radarsat/technical-features/characteristics.asp>

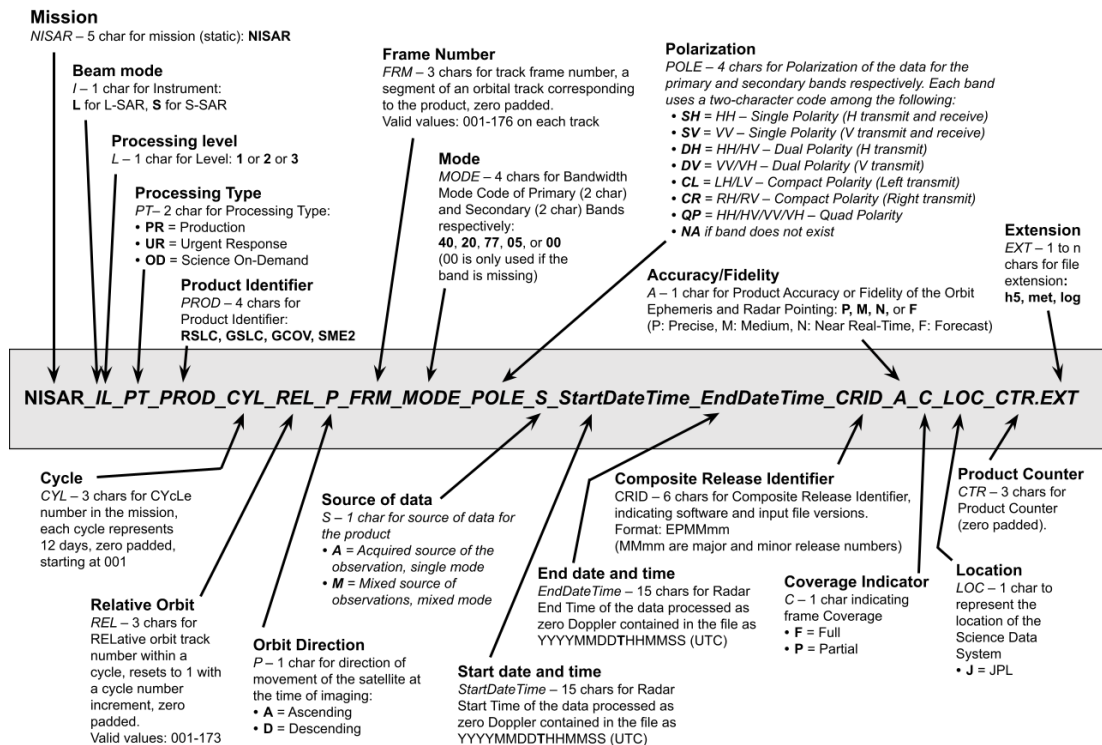
https://ftp.maps.canada.ca/pub/csa_asc/Space-technology_Technologie-spatiale/radarsat_constellation_mission_plan/RCM-SP-53-0419_Image_Product_Format_Definition_2-8_Public.pdf



NISAR Products

NISAR_L2_PR_GCOV_006_151_A_012_4005_DHDH_A_20251202T155058_20251202T155131_X05009_N_F_J_001

<https://nisar-docs.asf.alaska.edu/>



- NISAR Products are distributed in HDF5 format
- Noise and Calibration Coefficients are pre-applied by NASA. The files contain NRCS (gamma)
- Regular distribution of NISAR ongoing collection is expected to begin in July 2026

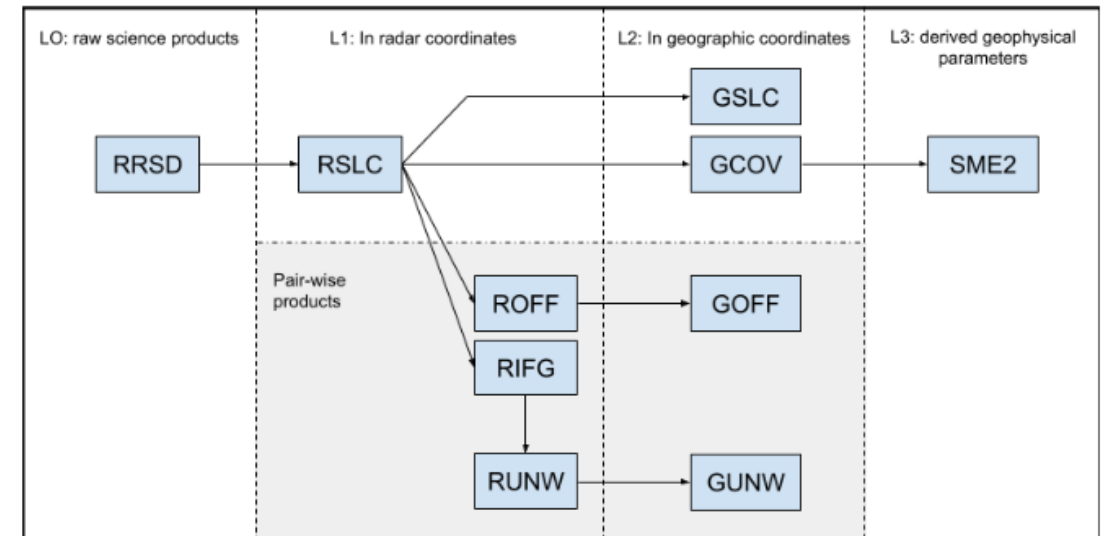


Figure 1: NISAR Data Product Levels based on product specification documentation



SAR Data Repositories

NOAA CoastWatch

- https://coastwatch.noaa.gov/cw_html/cwViewer.html
- Sentinel-1 SAR imagery (since 2018) around the U.S. and the Arctic
- NetCDF format (NRCS) and can be previewed with PNG images

NASA Earth Data (Alaska Satellite Facility DAAC)

- <https://search.asf.alaska.edu/#/>
- NISAR, Sentinel-1 (SEASAT, SIR-C, Limited: ALOS PALSAR, ALOS-2, Radarsat-1, ERS-1,2)
- Native system files (formats vary) Sentinel-1 coverage begins in 2014, NISAR in 2026

Copernicus Space Data Ecosystem

- <https://browser.dataspace.copernicus.eu/>
- Sentinel-1 (Native SAFE – tif/xml) Sentinel-1 coverage begins in 2014

CSA Earth Observation Data Management System

- <https://www.eodms-sgdot.nrcan-rncan.gc.ca/index-en.html>
- Radarsat Constellation Mission (Native SAFE – tif/xml). RCM coverage begins in 2019

ESA EOData Gateway

- <https://earth.esa.int/eogateway/search?category=data>
- Envisat, ERS-1, ERS-2 (Native N1 Format), Radarsat-1



What can be detected by SAR?

OCEANIC

Surface Waves

- Significant Wave Height
- Wave Spectra

Surfactants (Biogenic Slicks, Oil Seeps)

Sea Ice

Internal Waves

Currents and Fronts

Eddies

Upwelling

Underwater Topography

ATMOSPHERIC

Surface Wind

Convection Cells / Rolls

Storm Systems

Vortex Streets

Gravity Waves

Rain Cells / Thunderstorms

ANTHROPOGENIC

Hard Targets (Ships/Oil Platforms)

Ship Wakes

Pollution (Oil Spills)

COASTAL / LAND

Flooding and Inundation

Shorelines

Land Use

Land Deformation (interferometry)

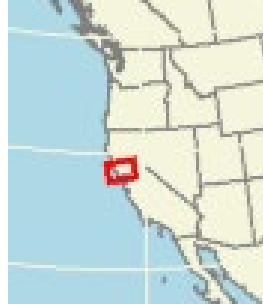
Burn Scar Identification

...there are many other applications

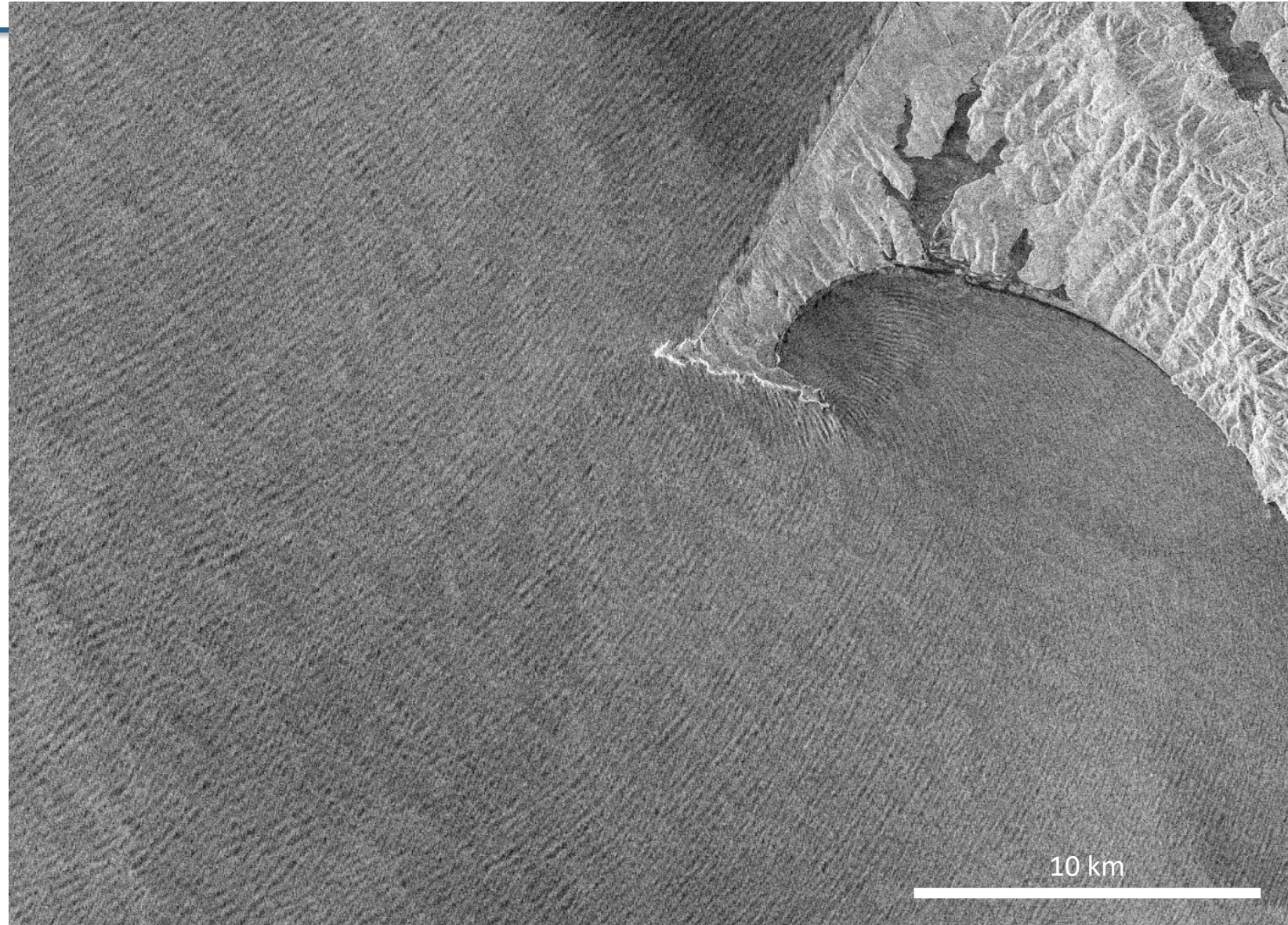
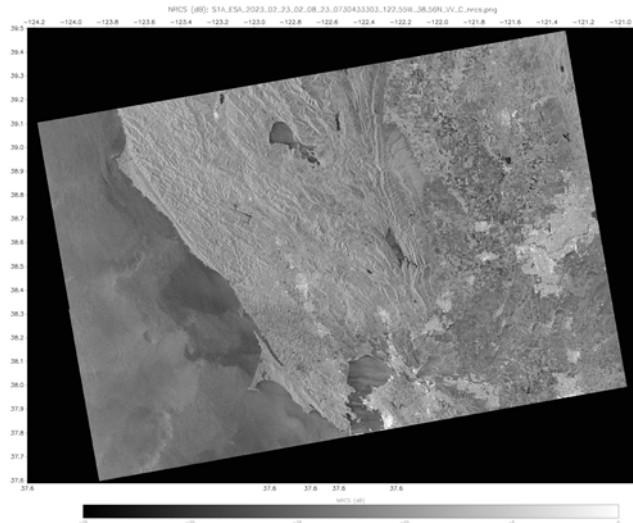


Ocean – Swell Waves

Sentinel-1 SAR VV Co-Pol NRCS
23 February 2023 02:08 UTC



- Swell waves (wavelength ~400 m – 1km) are produced by storms and consistent wind forcing
- The swell can be seen refracting around Point Reyes (California)

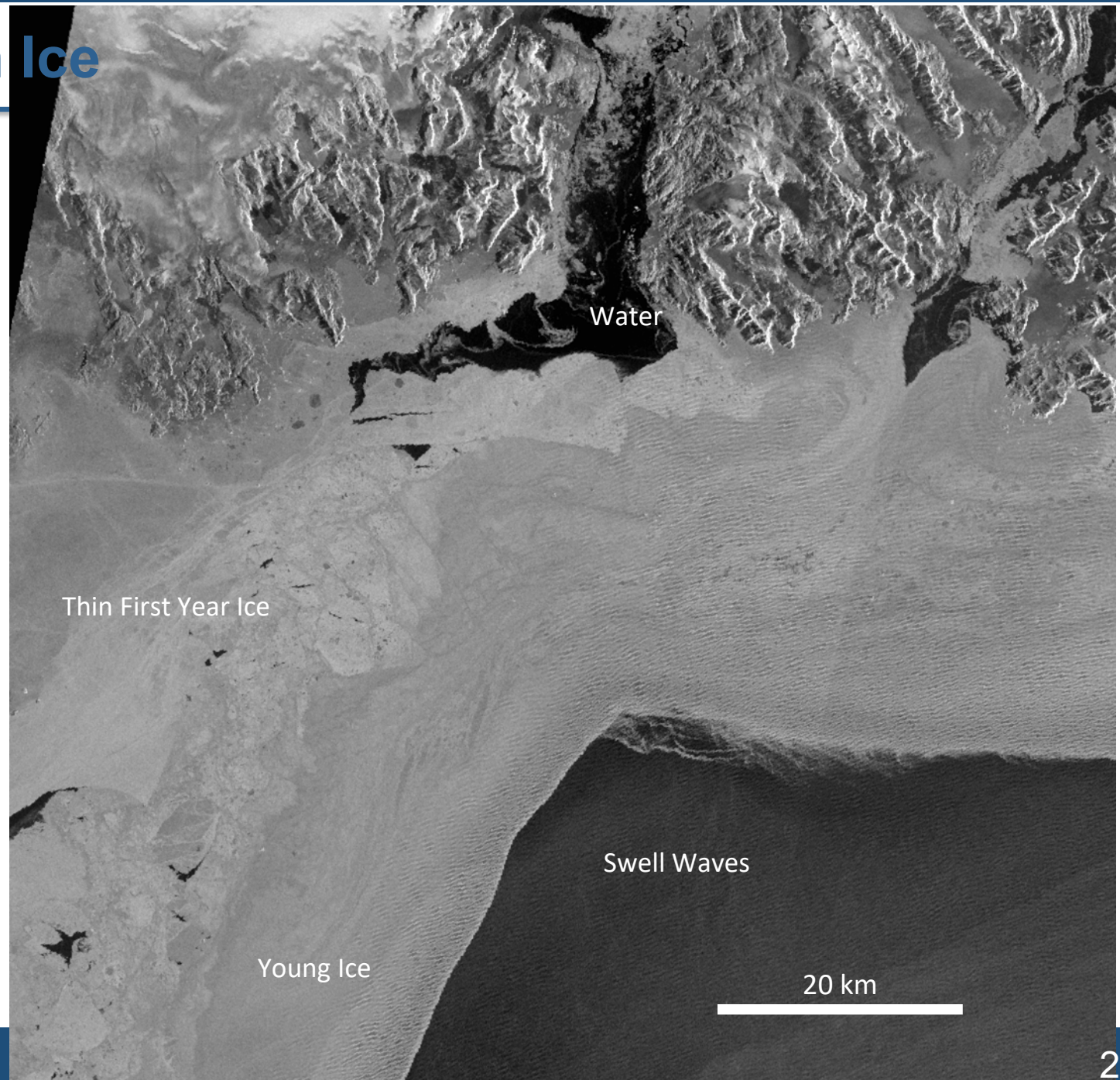
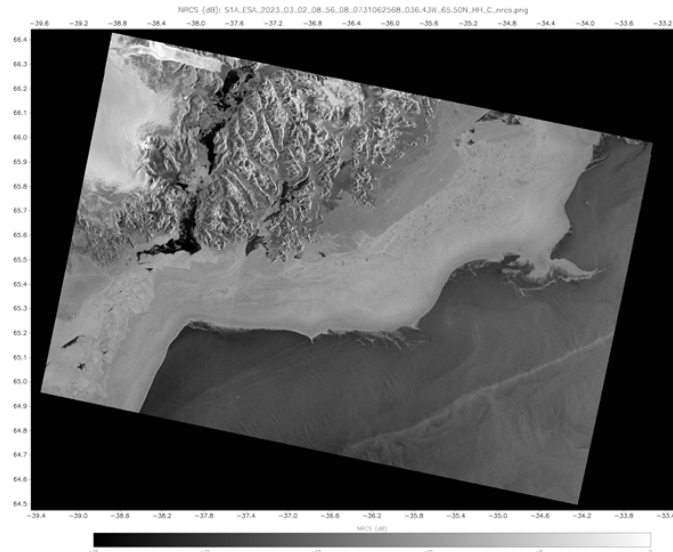


Marginal Ice Zone - Waves in Ice

Sentinel-1 SAR HH Co-Pol NRCS
02 April 2023 22:50 UTC

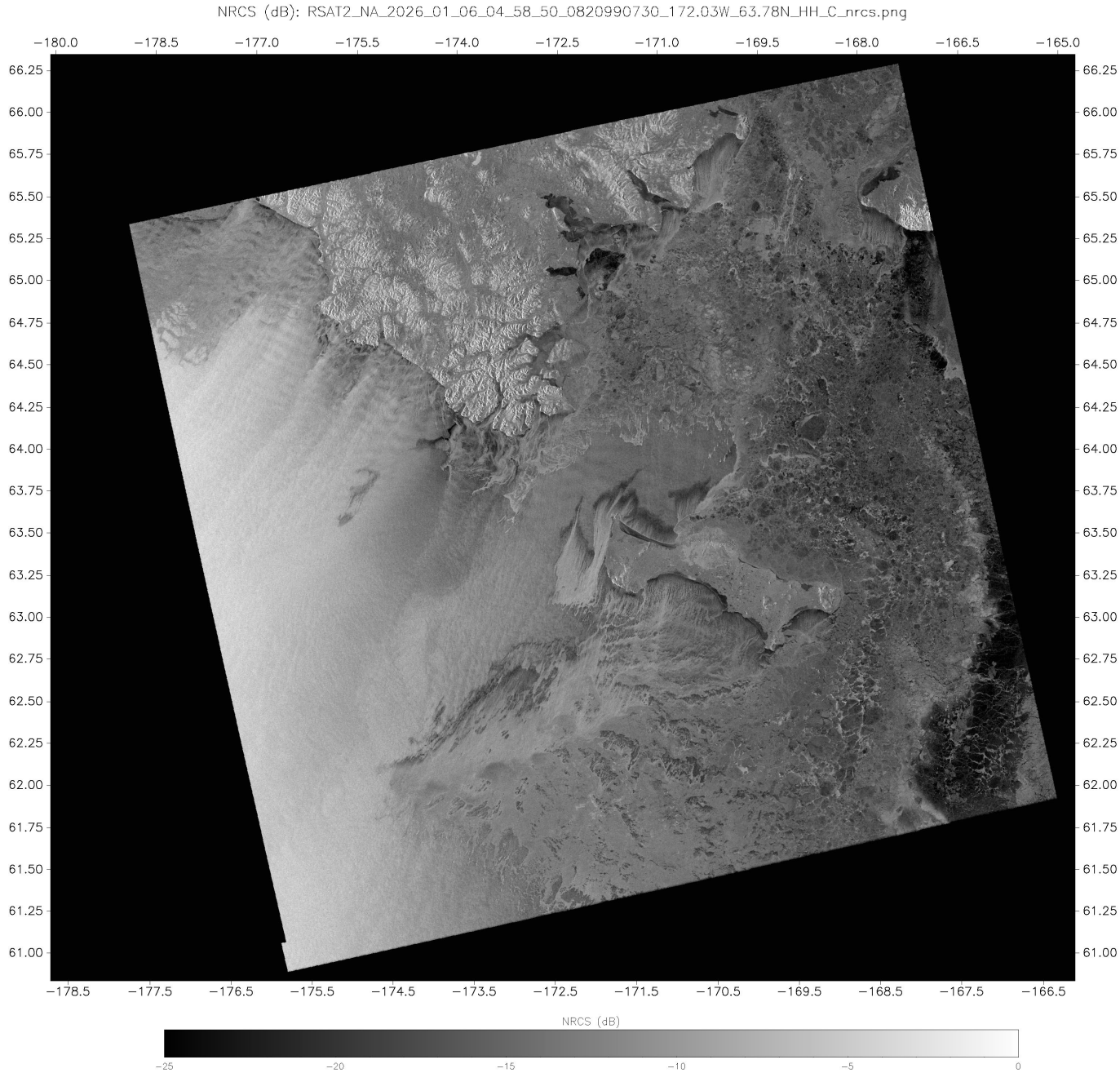


Marginal Ice Zone: The region of an ice cover which is affected by waves and swell penetrating into the ice from the open ocean.



Sea Ice

Radarsat-2 SAR HH Co-Pol NRCS
06 January 2026 04:58 UTC



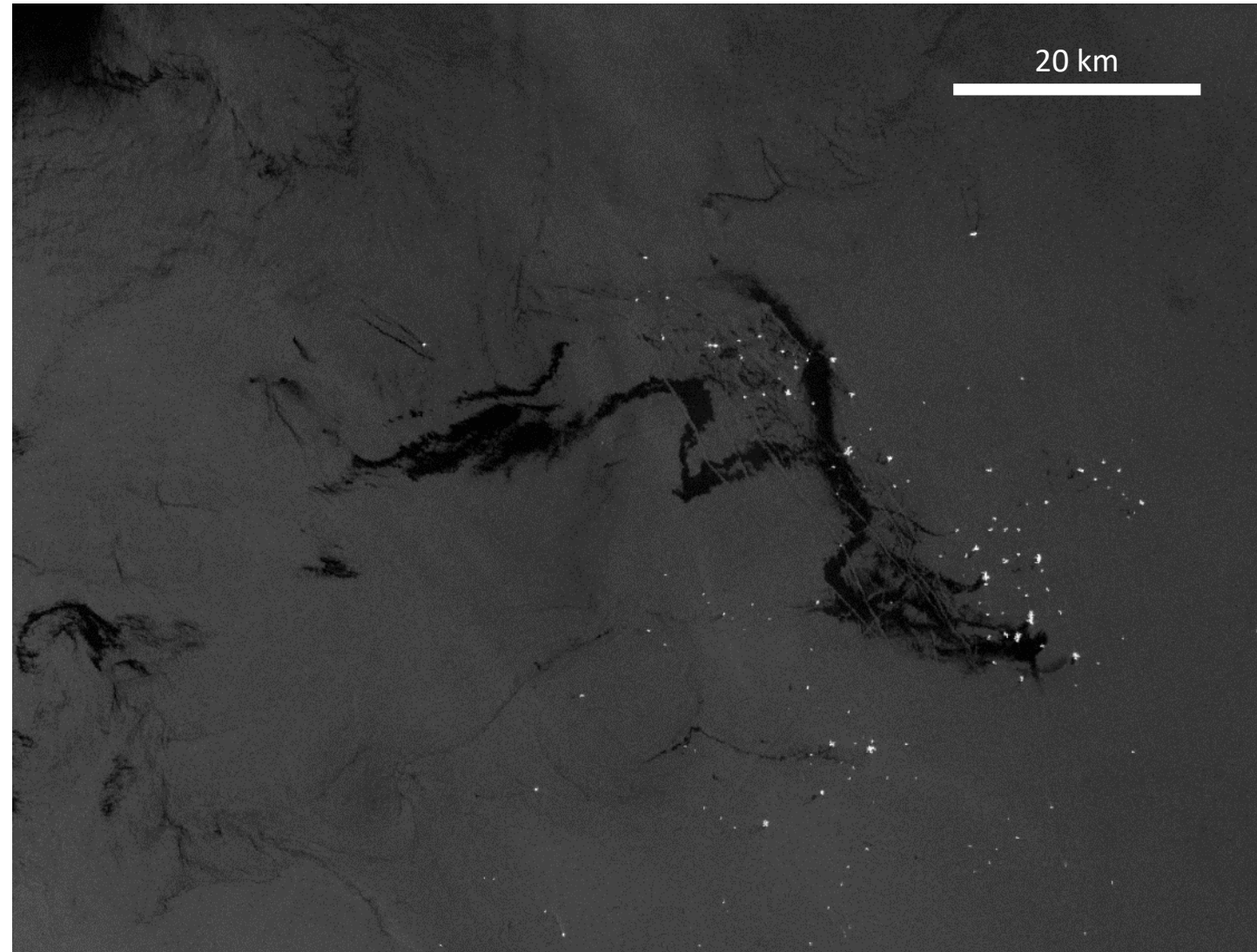
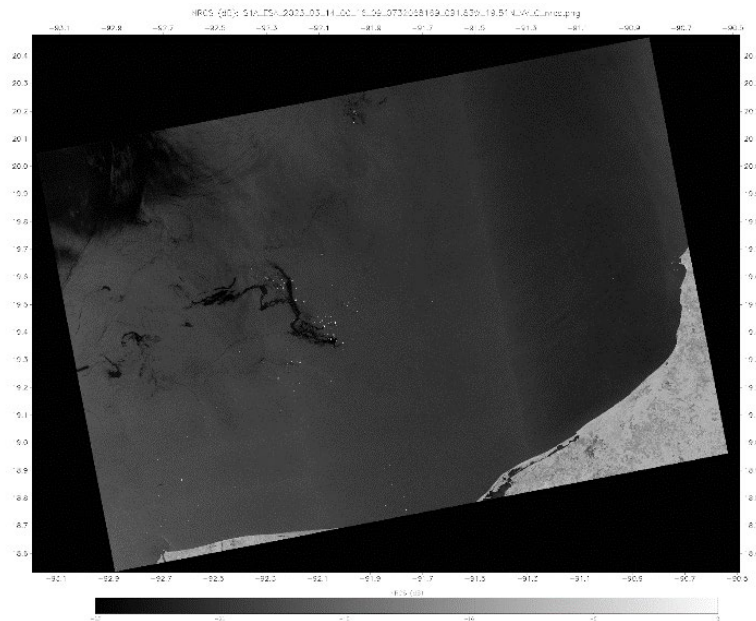
RADARSAT-2 Data and Products Copyright MDA Geospatial Services Inc. 2025 - All Rights Reserved
RADARSAT is an official mark of the Canadian Space Agency
Processed at NOAA/NESDIS/STAR/SOCD for National Ice Center 2026 Jan 06 06:02:26 UTC

Ocean – Surfactants

Sentinel-1 SAR VV Co-Pol NRCS
14 March 2023 00:16 UTC



Ships and Oil Platforms (high backscatter)
Oil spill and surfactants (low backscatter)

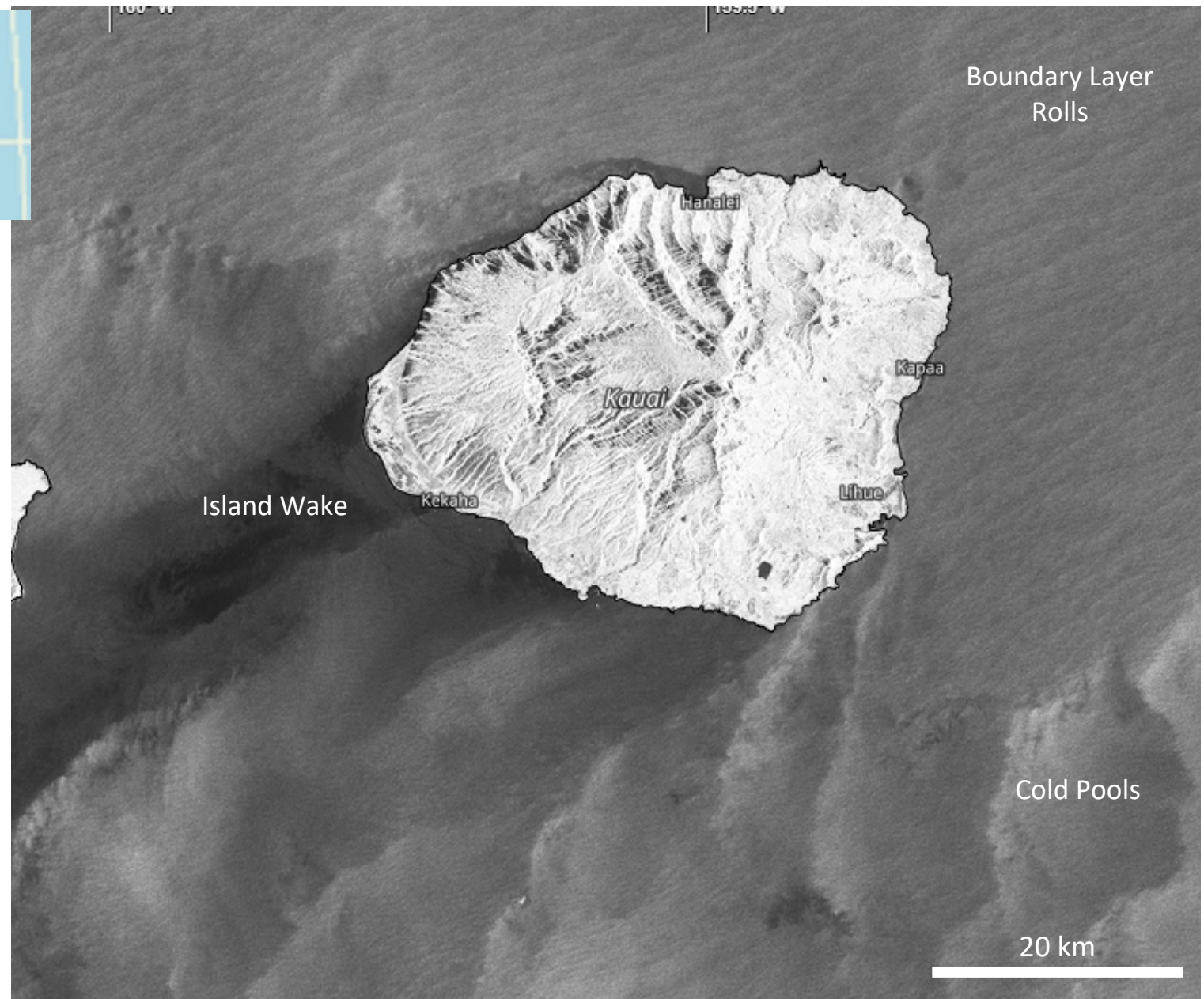
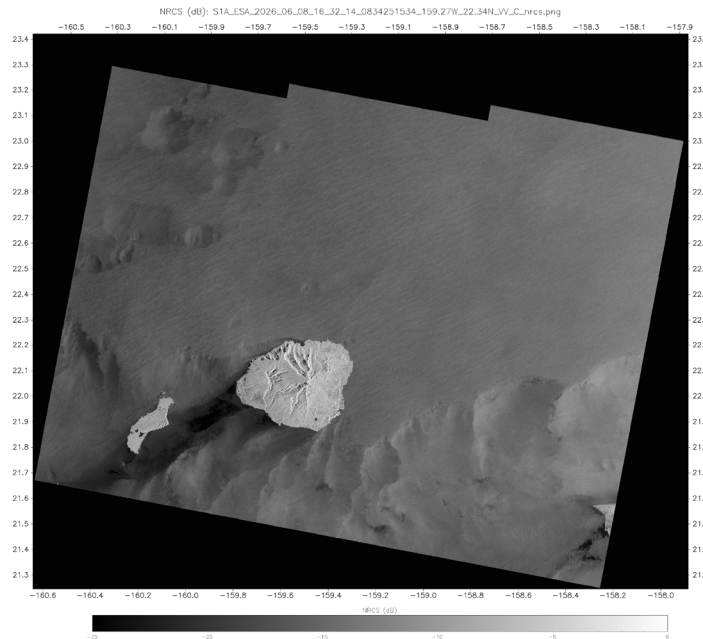


Atmosphere

Sentinel-1 SAR VV Co-Pol NRCS
08 June 2026 16:32 UTC

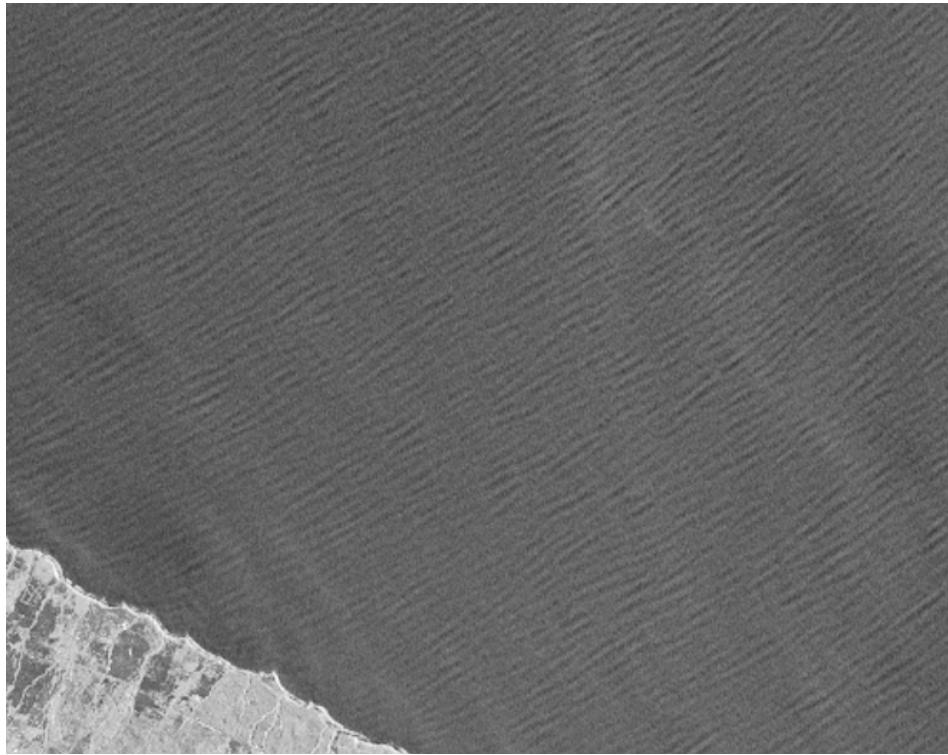


Signatures of atmospheric boundary layer rolls, cold pools and an island wake around Hawaii

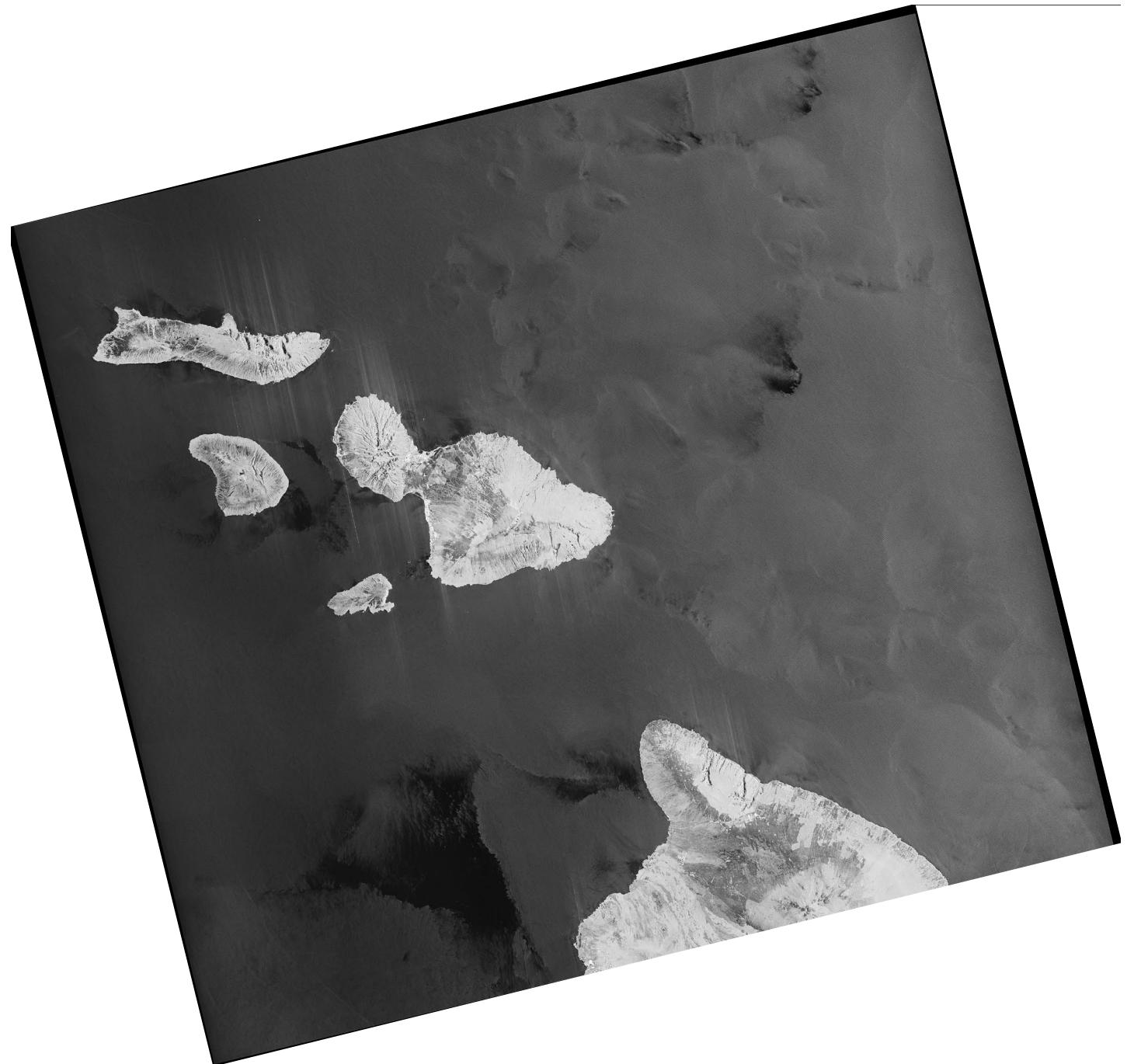


NISAR L-Band Image

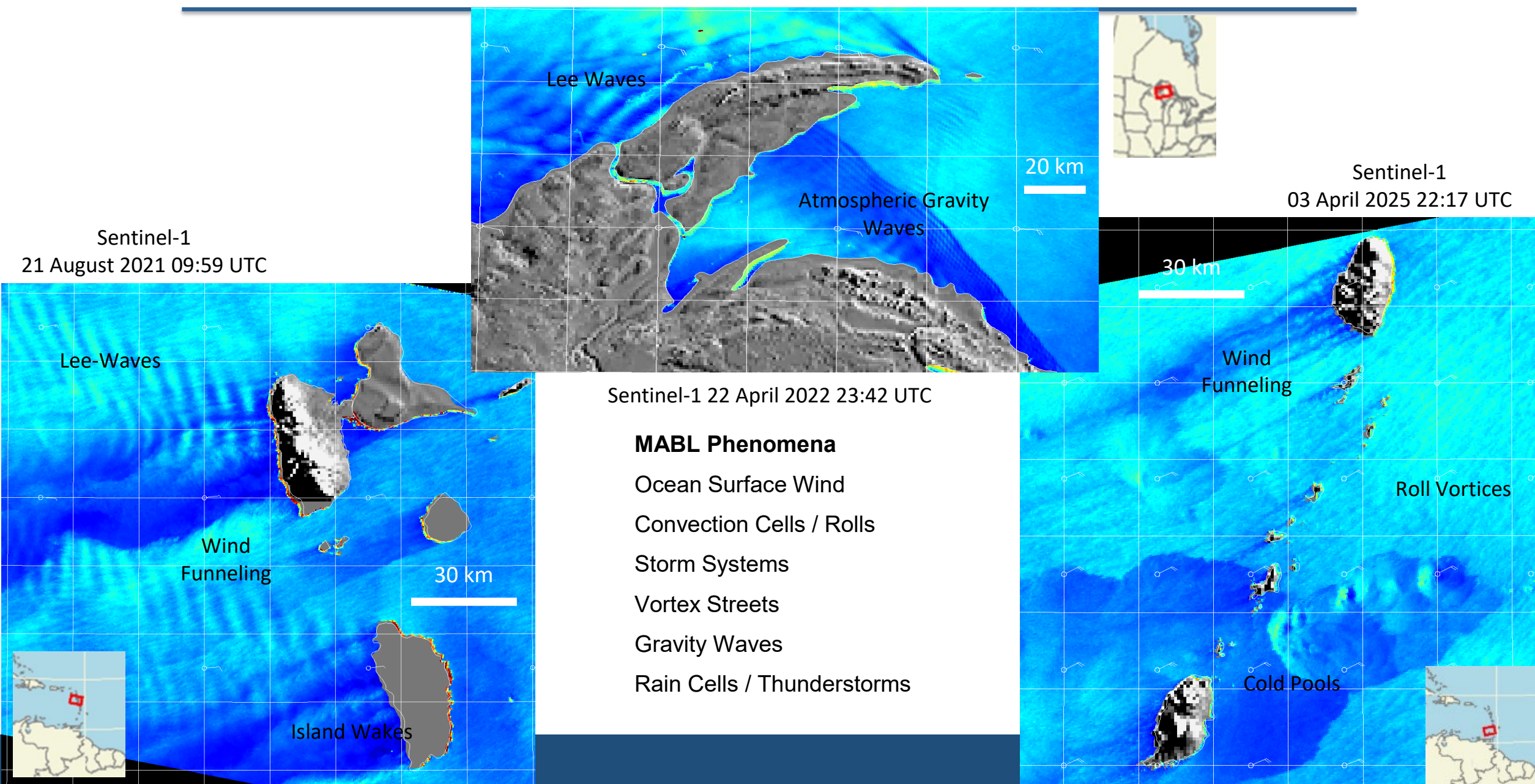
L-Band HH NRCS
02 Dec 2025 15:58 UTC



NISAR_L2_PR_GCOV_006_151_A_012_4005_DHDH
_A_20251202T155058_20251202T155131_X05009_
N_F_J_001



SAR Wind Features at the Marine Atmospheric Boundary Layer

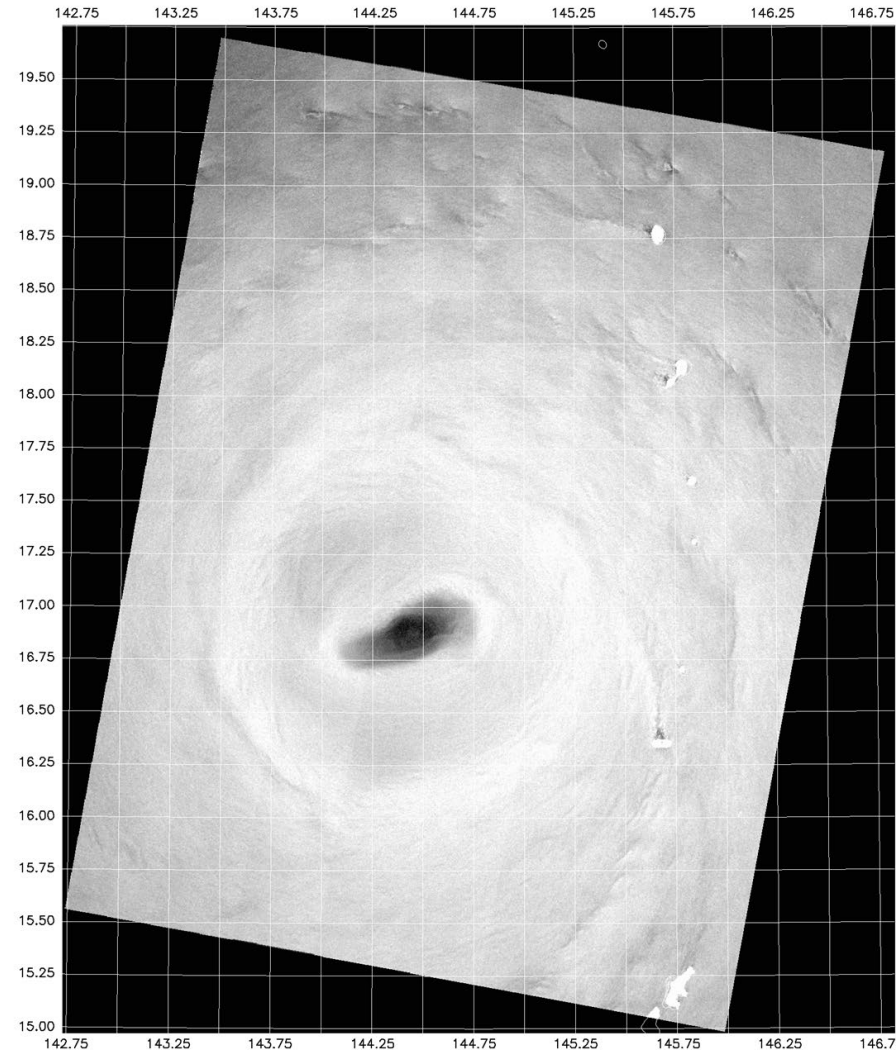


SAR for Tropical Cyclones – Sinlaku 15 April 2026 20:11

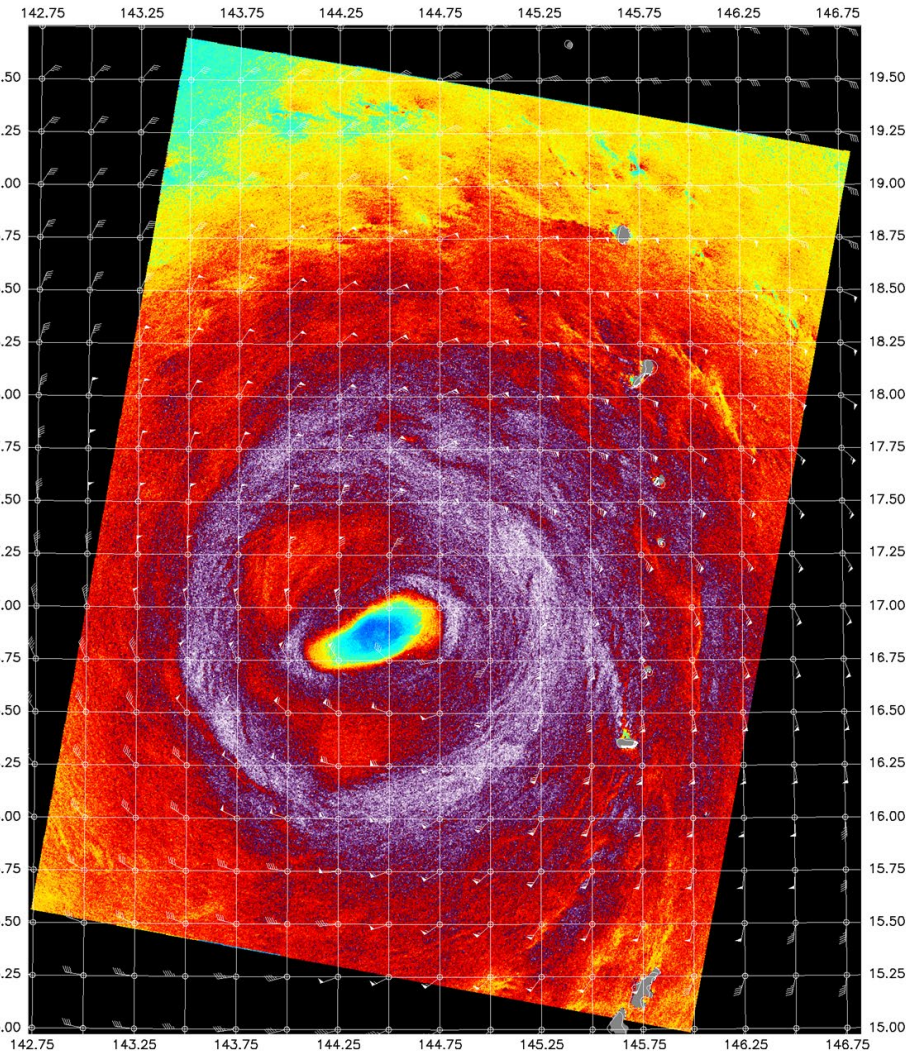


RCM-3
Acquisition Date: 20:11:16 UTC
WP042026 / SINLAKU
Longitude: 144.435
Latitude: 16.870
Incidence Angle (Deg): 46.897
NE VMax (kts): 92.75
SE VMax (kts): 91.93
SW VMax (kts): 91.82
NW VMax (kts): 88.35
RMax (nmi): 47.00 - 57.00

RCS: RCM3_SHUB_2026_04_15_20_11_16_0829599076_144.75E_17.37N_VH_C-12_MERGED01_wind_levi



SAR Wind: RCM3_SHUB_2026_04_15_20_11_16_0829599076_144.75E_17.37N_VH_C-12_MERGED01_wind_level2.nc





The 2024 Atlantic Hurricane Season in SAR Winds (RCM Collections)

Milton,
Helene,
Rafael

Ernesto

Kirk & Leslie

Web Resources

STAR Tropical

https://coastwatch.noaa.gov/SAR/sar_winds_tropical.html

And subscribe to our tropical SAR notification mailing list!

STAR S1 Winds

https://coastwatch.noaa.gov/SAR/sar_winds_s1.html

STAR Radarsat-2/RCM Winds

https://coastwatch.noaa.gov/SAR/sar_winds_rcm.html

NOAA Polarwatch

<https://coastwatch.noaa.gov/cwn/about/coastwatch-nodes/polarwatch.html>

SAR Marine Users Manual

<https://sarusersmanual.com/>

High Resolution Wind Monitoring With Wide-Swath SAR: A User's Guide (June 2005)

<https://www.star.nesdis.noaa.gov/socd/mecb/sar/publications.php>

NASA NISAR

<https://nisar-docs.asf.alaska.edu/>

NASA Intro to SAR

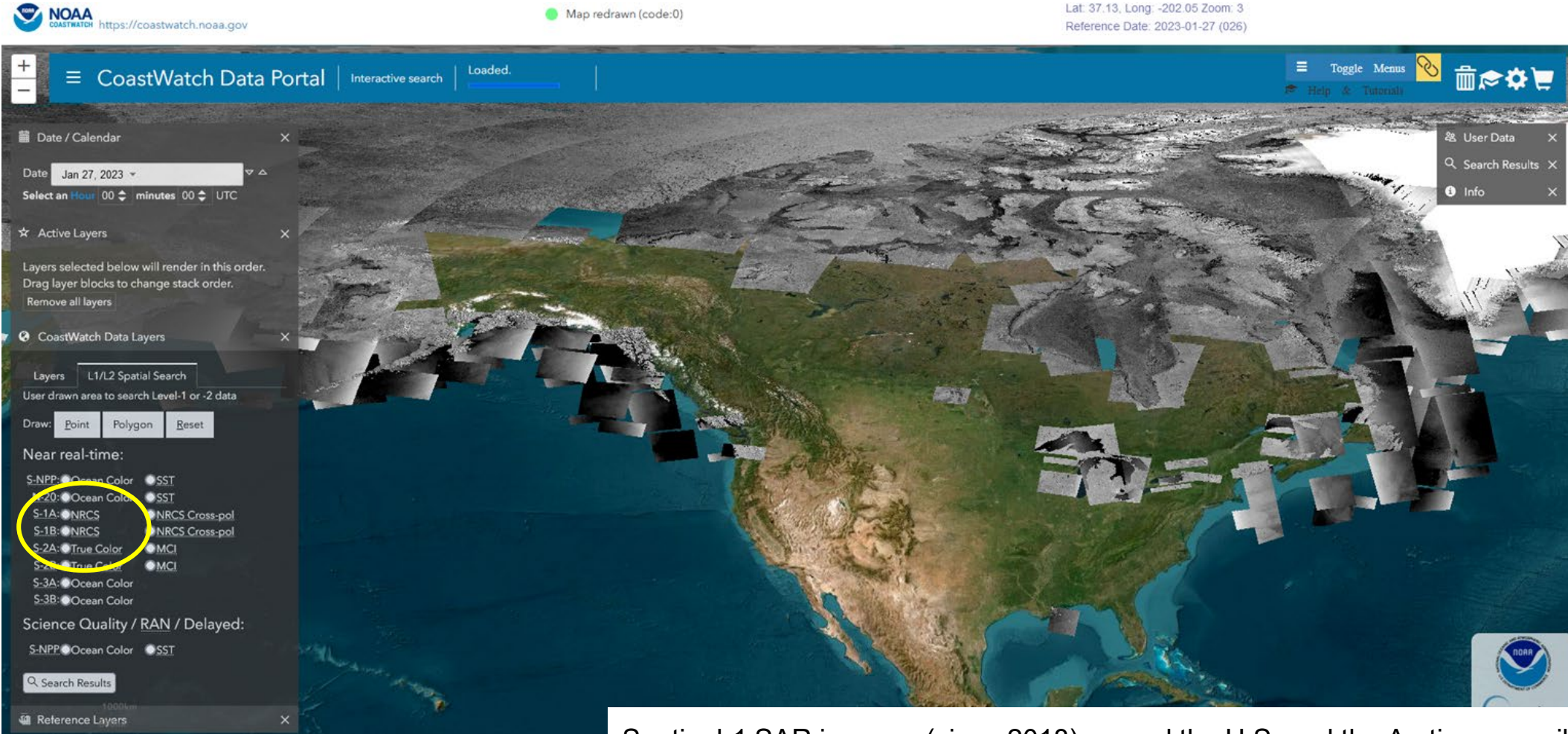
<https://www.earthdata.nasa.gov/learn/trainings/introduction-synthetic-aperture-radar-sar-its-applications>

Thank you!





SAR Data at CoastWatch



Sentinel-1 SAR imagery (since 2018) around the U.S. and the Arctic are available at CW
The data are in NetCDF format and can be previewed with PNG images

https://coastwatch.noaa.gov/cw_html/cwViewer.html



SAR Data at Alaska Satellite Facility

The screenshot displays the Alaska Satellite Facility (ASF) Data Search Vertex interface. The top navigation bar includes the NASA logo, 'EARTHDATA', and 'Other DAACs'. The search bar contains 'Geographic Search', 'Sentinel-1', 'Area of Interest - WKT', 'Start Date: 1/27/2023', 'End Date: 1/27/2023', and 'Filters: 1,000 of 595 Files'. The map view shows a satellite image of the North Atlantic and surrounding landmasses, with numerous blue rectangular outlines indicating SAR data swaths. The bottom left corner displays '595 Scenes (595 of 595 Files)' and a thumbnail of a SAR image with the filename 'S1A_IW_GRDH_1SDV_20230128T04441... 491F' and timestamp 'January 28 2023 04:44:10Z'.

- The Alaska Satellite Facility Data Archive host data from a variety of SAR sensors (Sentinel-1, ALOS-1, ERS).
- The data are available in a variety of formats
- Specialized software is needed to read the native data formats
- Requires registration with NASA (free) to download the imagery.

<https://search.asf.alaska.edu/#/>



Sentinel-1 Data at Copernicus Data Space Ecosystem

The screenshot displays the Copernicus Data Space Ecosystem interface. On the left, a search results panel shows four Sentinel-1 SAR data entries. Each entry includes a thumbnail, a file ID, mission details, instrument, size, and sensing time. The first entry is '4930_008455_010BB9_2E95.SAFE' with a size of 1683MB and sensing time '2026-07-08T17:49:05.723905Z'. The second entry is 'S1C_IW_GRDH_1SDV_20260708T174840_20260708T174905_008455_010BB9_8A74.SAFE' with a size of 1682MB and sensing time '2026-07-08T17:48:40.723825Z'. The third entry is 'S1C_IW_GRDH_1SDV_20260708T174815_20260708T174840_008455_010BB9_6669.SAFE' with a size of 1681MB and sensing time '2026-07-08T17:48:15.723784Z'. The fourth entry is 'S1C_IW_GRDH_1SDV_20260708T174750_20260708T174815_008455_010BB9_F90E.SAFE' with a size of 1681MB and sensing time '2026-07-08T17:47:50.723708Z'. A 'Load more' button is at the bottom of the list. The top of the interface features the Copernicus logo, language selection (EN), a login button, and a search bar. The main area on the right shows a map of Europe with several blue rectangular swaths indicating Sentinel-1 satellite swaths. The map includes a search bar at the top right with the text 'Go to Place', a scale bar at the bottom right showing '1000 km', and a coordinate display 'Lat: 69.17, Lng: -25.86'. The bottom of the interface features logos for the European Union, Copernicus, and ESA, along with 'About' and 'Support' links.

<https://browser.dataspace.copernicus.eu/>
<https://dataspace.copernicus.eu/data-collections/copernicus-sentinel-missions/sentinel-1>

Showing 200 results of 19511

Select all Add to workspace

4930_008455_010BB9_2E95.SAFE
Mission: SENTINEL-1 Instrument: SAR Size: 1683MB
Sensing time: 2026-07-08T17:49:05.723905Z
Visualise VV&VH IW

S1C_IW_GRDH_1SDV_20260708T174840_20260708T174905_008455_010BB9_8A74.SAFE
Mission: SENTINEL-1 Instrument: SAR Size: 1682MB
Sensing time: 2026-07-08T17:48:40.723825Z
Visualise VV&VH IW

S1C_IW_GRDH_1SDV_20260708T174815_20260708T174840_008455_010BB9_6669.SAFE
Mission: SENTINEL-1 Instrument: SAR Size: 1681MB
Sensing time: 2026-07-08T17:48:15.723784Z
Visualise VV&VH IW

S1C_IW_GRDH_1SDV_20260708T174750_20260708T174815_008455_010BB9_F90E.SAFE
Mission: SENTINEL-1 Instrument: SAR Size: 1681MB
Sensing time: 2026-07-08T17:47:50.723708Z
Visualise VV&VH IW

Load more

Leaflet | © OpenStreetMap contributors - Disclaimer

- Sentinel-1 imagery are available at the Copernicus Space Data Ecosystem
- The data are available in the S1 native format (xml/geotiff)
- Requires registration to download the imagery.



RCM Data at CSA - Earth Observation Data Management System

<https://www.eodms-sgdot.nrcan-rncan.gc.ca/index-en.html>

Canada

Fullscreen off

Start

Map Options

Earth Observation Data Management System

Data

Search ?

[RADARSAT Analysis Ready Data \(CEOS\)](#)

[Sentinel Near Real-time Canada Mirror EU](#)

[Floods and river ice break-up](#)

Account

[Register \(Required to Download\)](#)

[Login](#)

New

[eodms-cli](#) (New! Fast Downloads w/ eodms-py.)

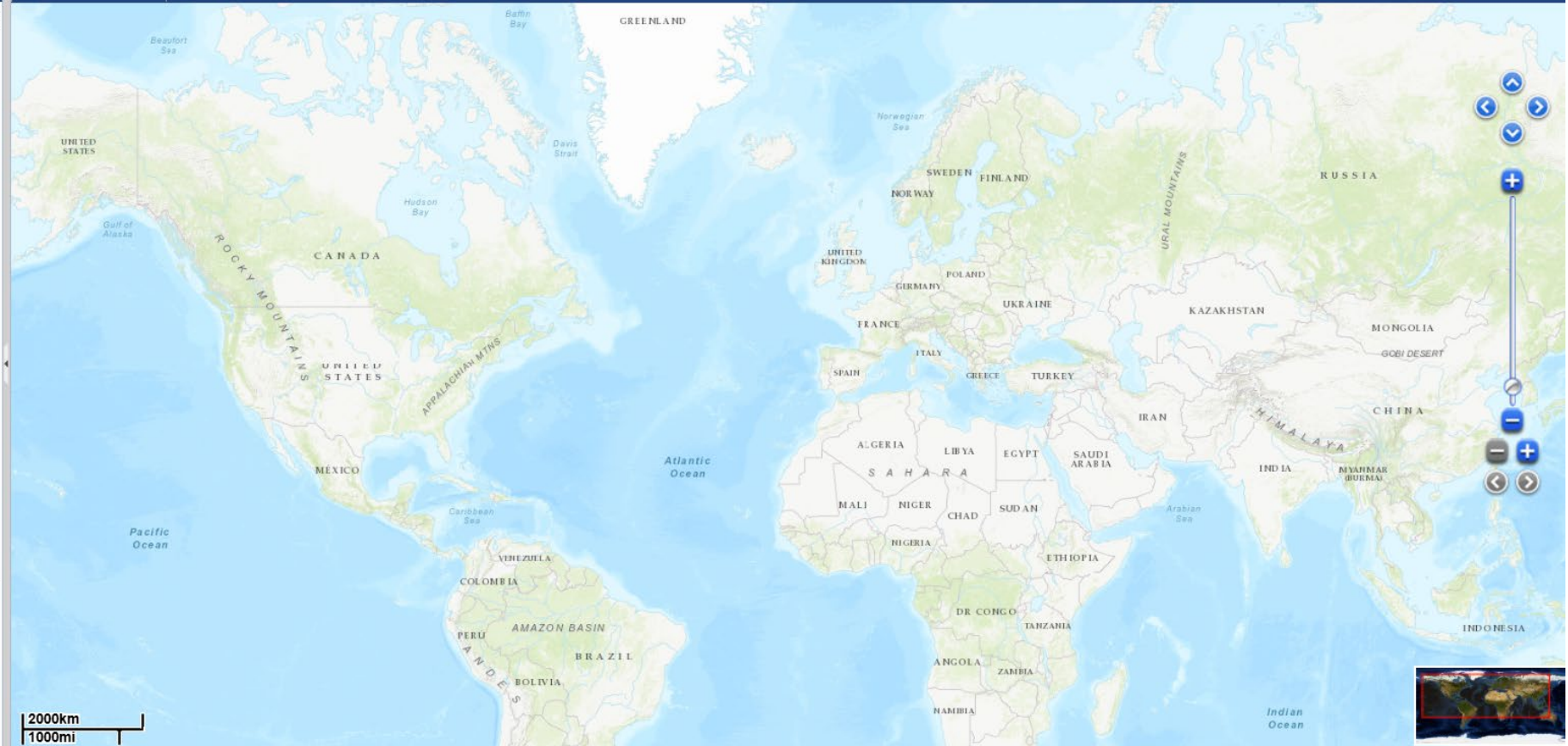
[RADARSAT Notebooks](#) (New! Jupyter Notebooks)

More

[FAQ \(w/ Screenshots\)](#)

[Wiki](#)

[Commercial Imagery for GC and Indigenous](#)



- The data are available in the RCM native format (xml/geotiff)
- Requires registration to download the imagery.

