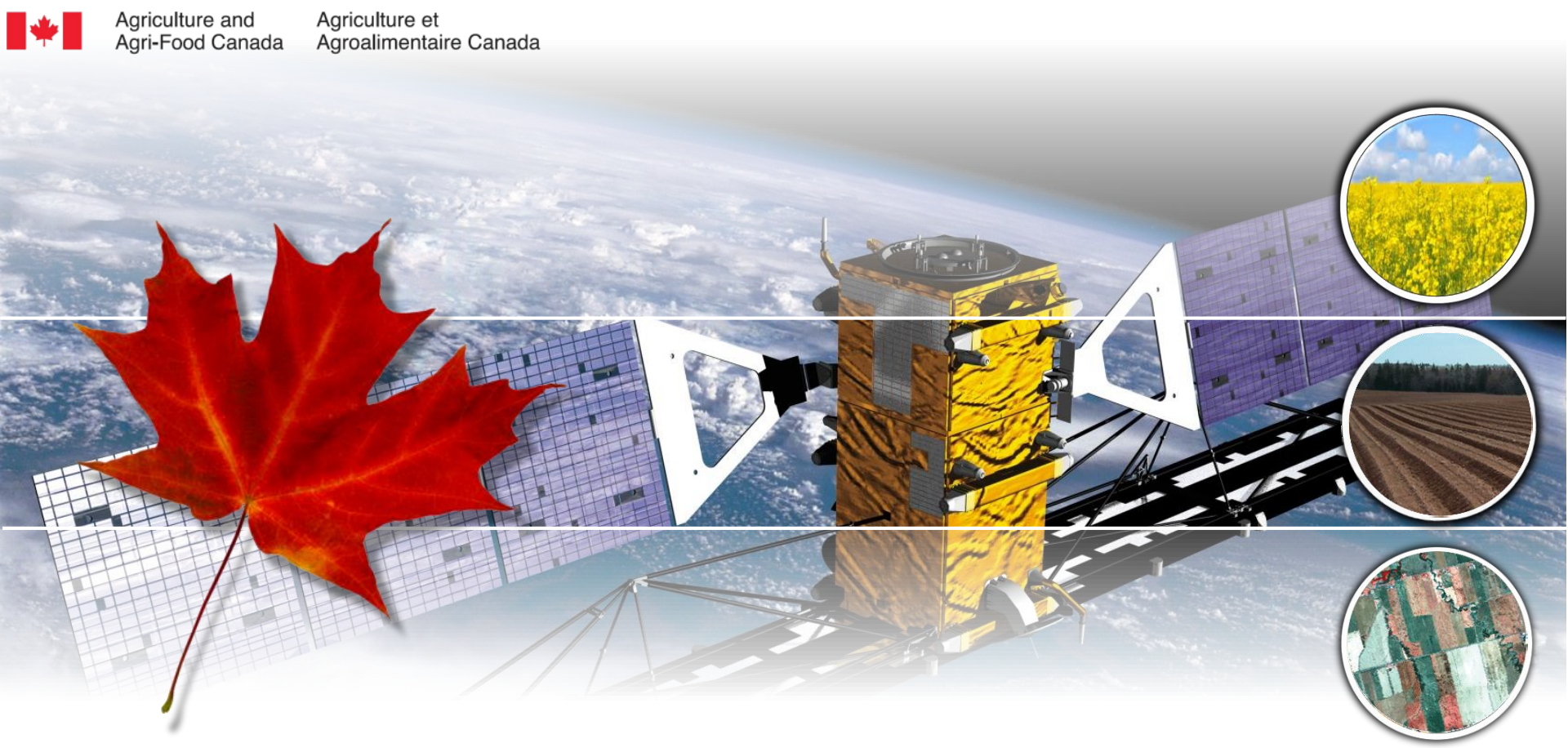
Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada



Lab 1:
Where's the Data

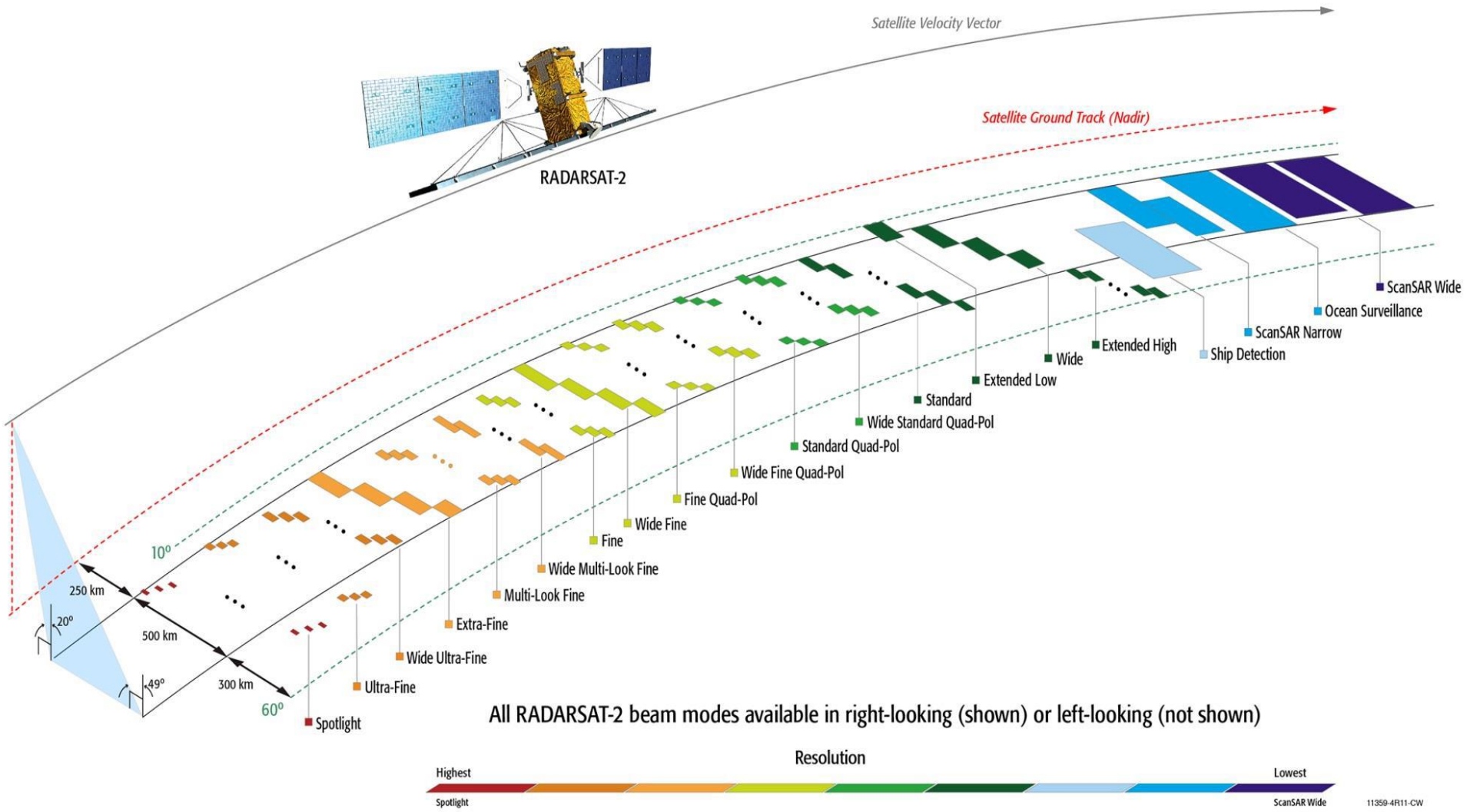
Carleton UNIVERSITY
Canada's Capital University

Natural Resources Canada | Ressources naturelles Canada

CSA ASC

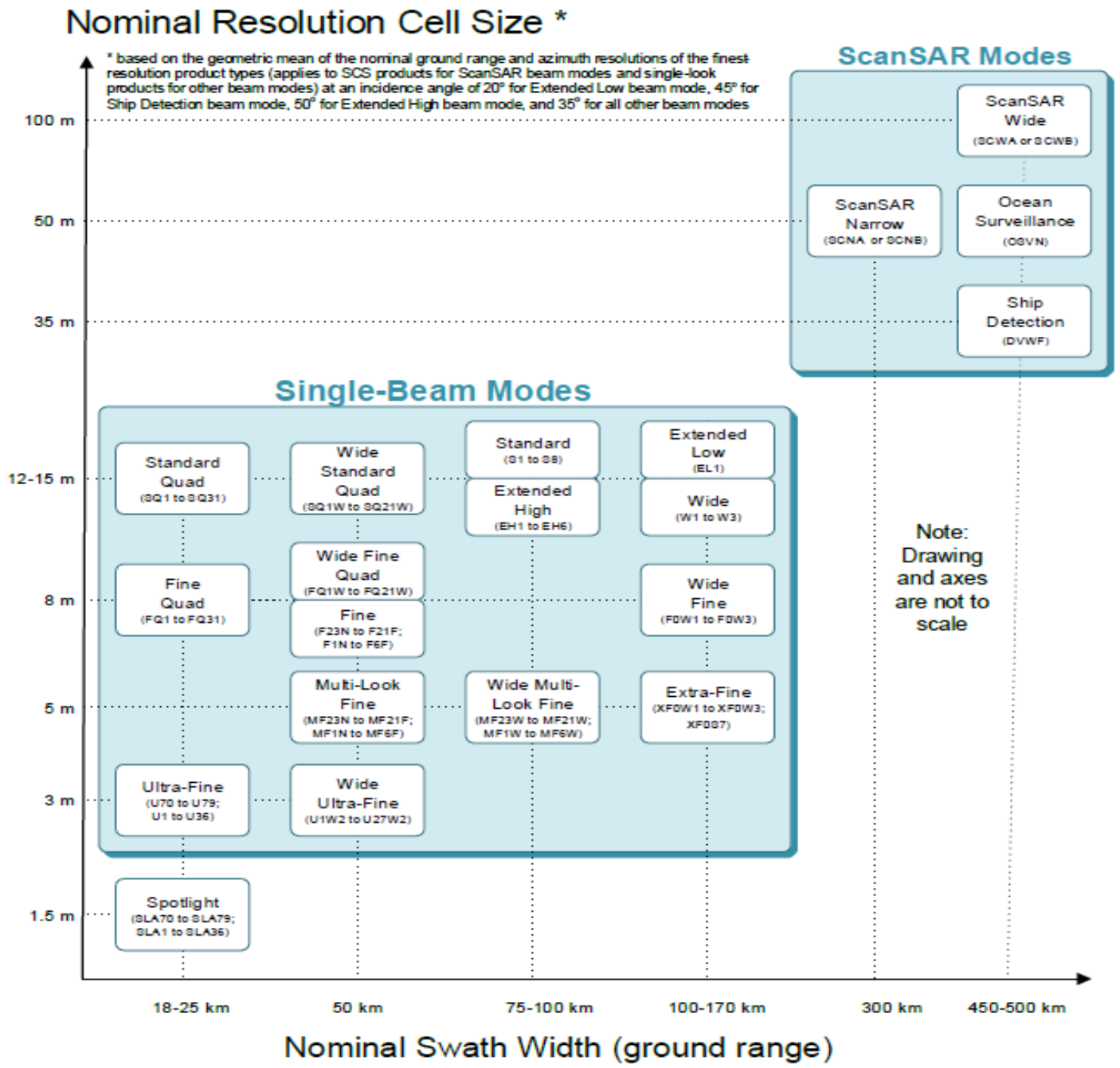
Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

RADARSAT-2



RADARSAT-2 SAR Beam Modes – Revisit time: 24 days

Image source: https://mdacorporation.com/docs/default-source/product-spec-sheets/geospatial-services/rsat_newbeammodes.jpg?sfvrsn=4



RADARSAT-2 beam modes and beam positions in terms of their nominal swath width and achievable product resolution

Image Source: https://mdacorporation.com/docs/default-source/technical-documents/geospatial-services/52-1238_rs2_product_description.pdf?sfvrsn=10

RADARSAT-2 Image Products

Slant Range SLC Product (Single Look Complex)

- Each image pixel is represented by a **complex** (real *I* and imaginary *Q*) magnitude value.
- No interpolation into ground range coordinates is performed during processing for SLC image products, and so the range coordinate is given in radar **slant range** rather than ground range.
- The processing for all SLC products covers a **single look** in range and azimuth directions.
- Intended for applications that require the full bandwidth and phase information, e.g. for SAR **interferometry and polarimetry**.

RADARSAT-2 Image Products

Ground Range Products (1)

- The range resolution is measured in ground range coordinates, i.e. along an assumed Earth's surface that follows the shape of the ellipsoid at a local elevation height.
- These products are useful, if geocoding or orthorectification is to be applied by the customer, or in case geocoding is not required.

SGX - SAR Georeferenced eXtra: have very fine resolution that ensures that all image information is preserved and makes the imagery suitable for post-processing.

SGF - SAR Georeferenced Fine: generated with pixel dimensions larger than those of the corresponding SGX products, therefore appropriate for applications where the reduction in product volume is important, and where the full precision is not needed.

The numerical value of each pixel in the digital image represents the intensity of the SAR image averaged over the sampling interval.

RADARSAT-2 Image Products

Ground Range Products (2)

SCN - ScanSAR Narrow beam: refers to SGF product produced from the ScanSAR Narrow Beam Mode generated using two looks in range and two looks in azimuth.

SCW - ScanSAR Wide beam: refers to SGF product produced from the ScanSAR Wide Beam Mode generated using four looks in range and two looks in azimuth.

SCF (ScanSAR Fine) and **SCS (ScanSAR Sampled)**: are similar to SCN or SCW products with the additional processing options of noise subtraction.

RADARSAT-2 Image Products

Geocorrected Products:

SSG - SAR Systematic Geocorrected: generated by geocorrection of single beam products. The geocorrection process for SSG products does not include the use of ground control points (GCP). Geocorrection can include either orthorectification using a Digital Elevation Model (DEM) or can be based on a fixed elevation above a reference ellipsoid, which is specified by the user.

SPG - SAR Precision Geocorrected: bears the same relationship to the input image data as the SSG product, except that it is geocorrected using precise ground control points.

RADARSAT-2 Data Access

- Natural Resources Canada Earth Observation Data Management System (EODMS).
- RADARSAT-2 data is available through EODMS for Government of Canada users only.
- EODMS will be used for RCM data ordering. Other users need to register.

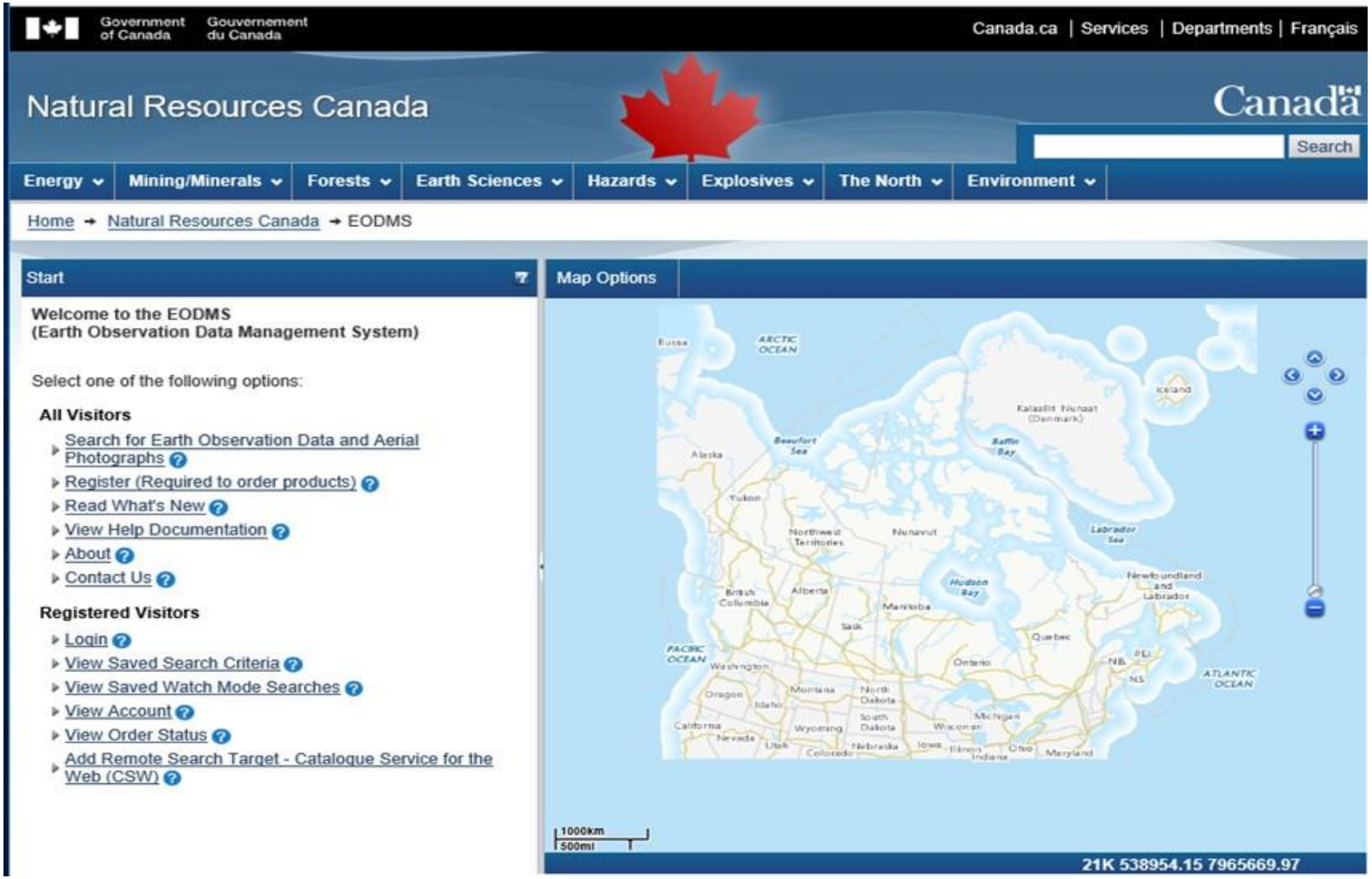
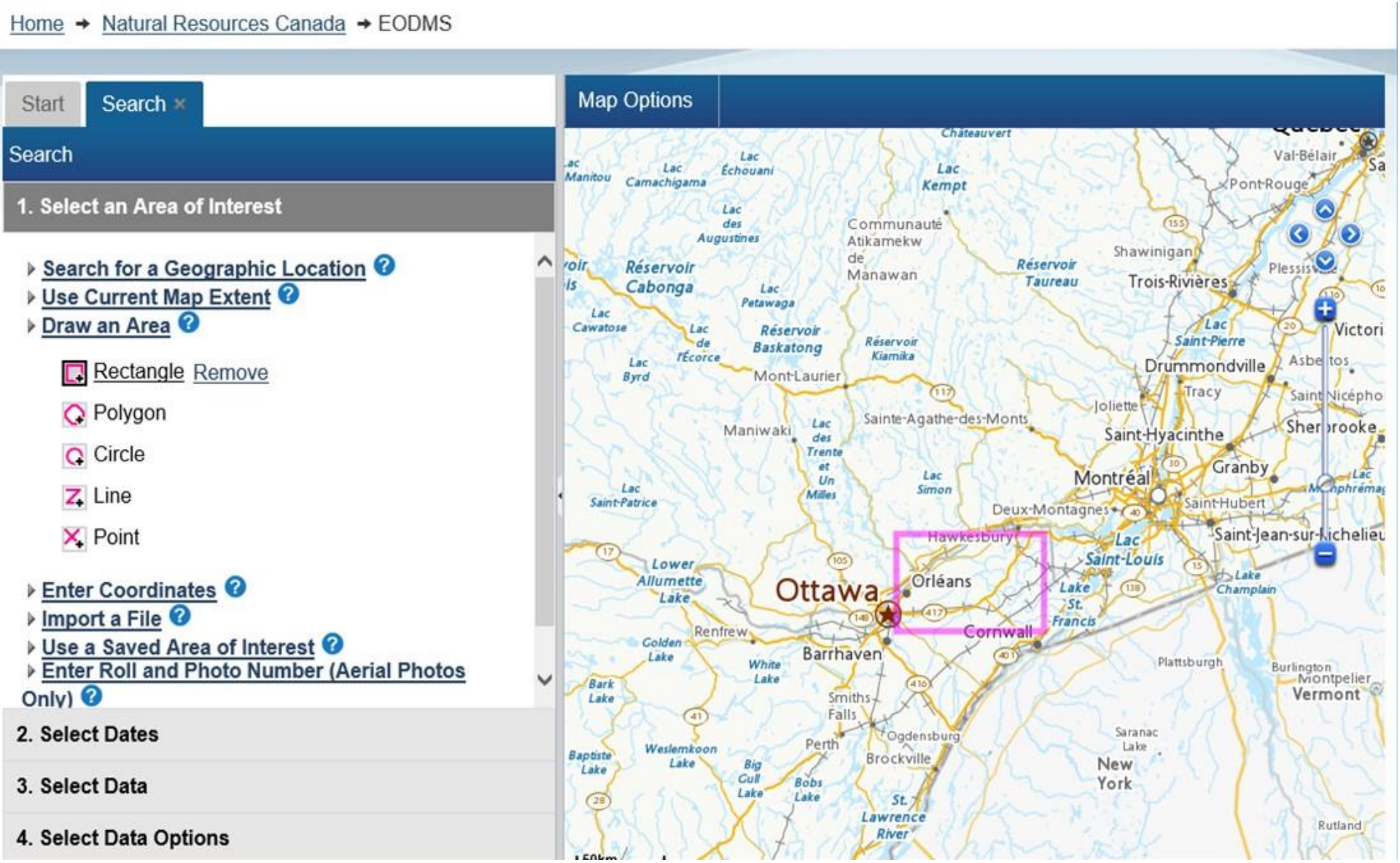
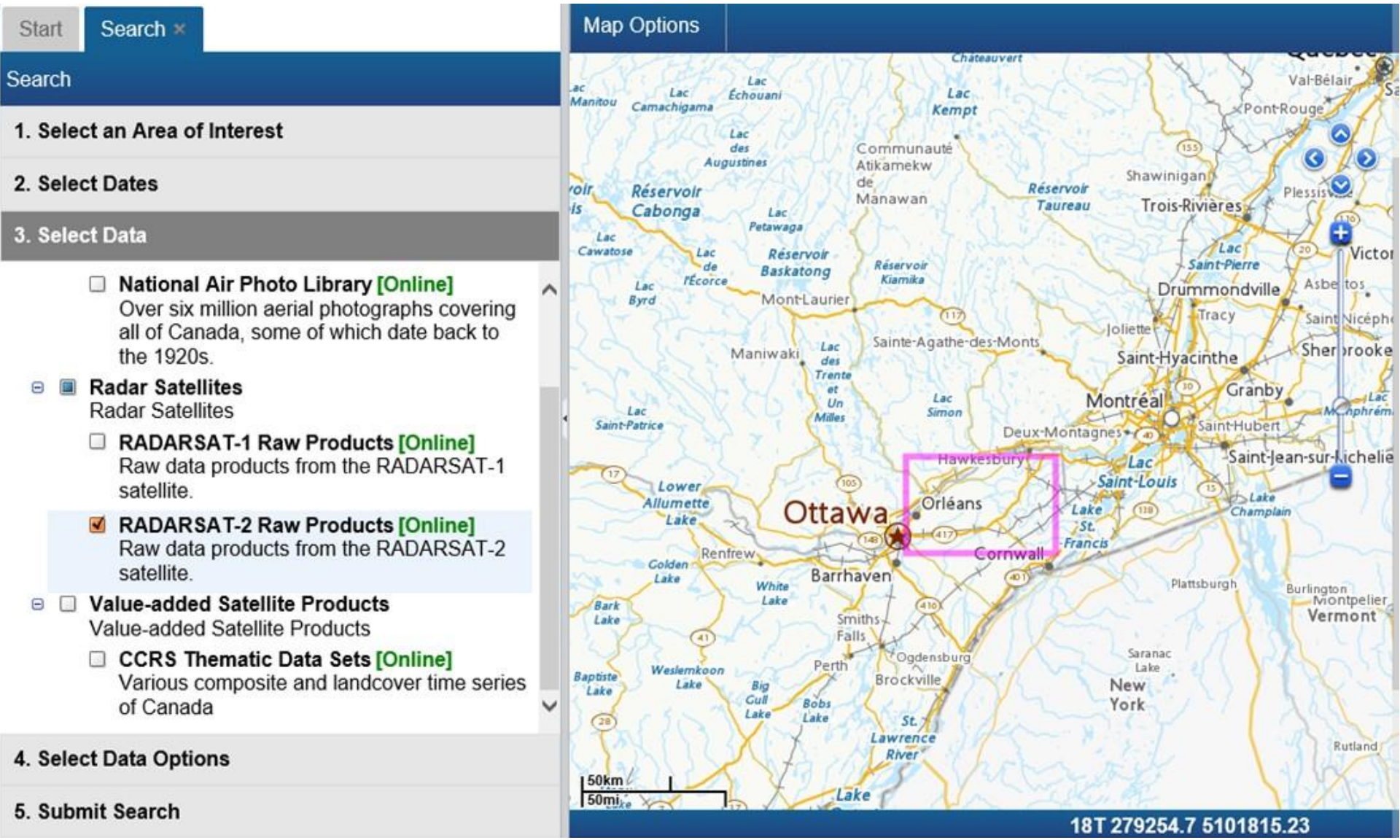


Image Source: https://www.eodms-sgdot.nrcan-rncan.gc.ca/index_en.jsp

RADARSAT-2 Data Access



RADARSAT-2 Data Access



RADARSAT-2 Data Access
MDA Portal

Image source: https://gsiportal.mdacorporation.com/gc_cp/#/map

RADARSAT Constellation Mission

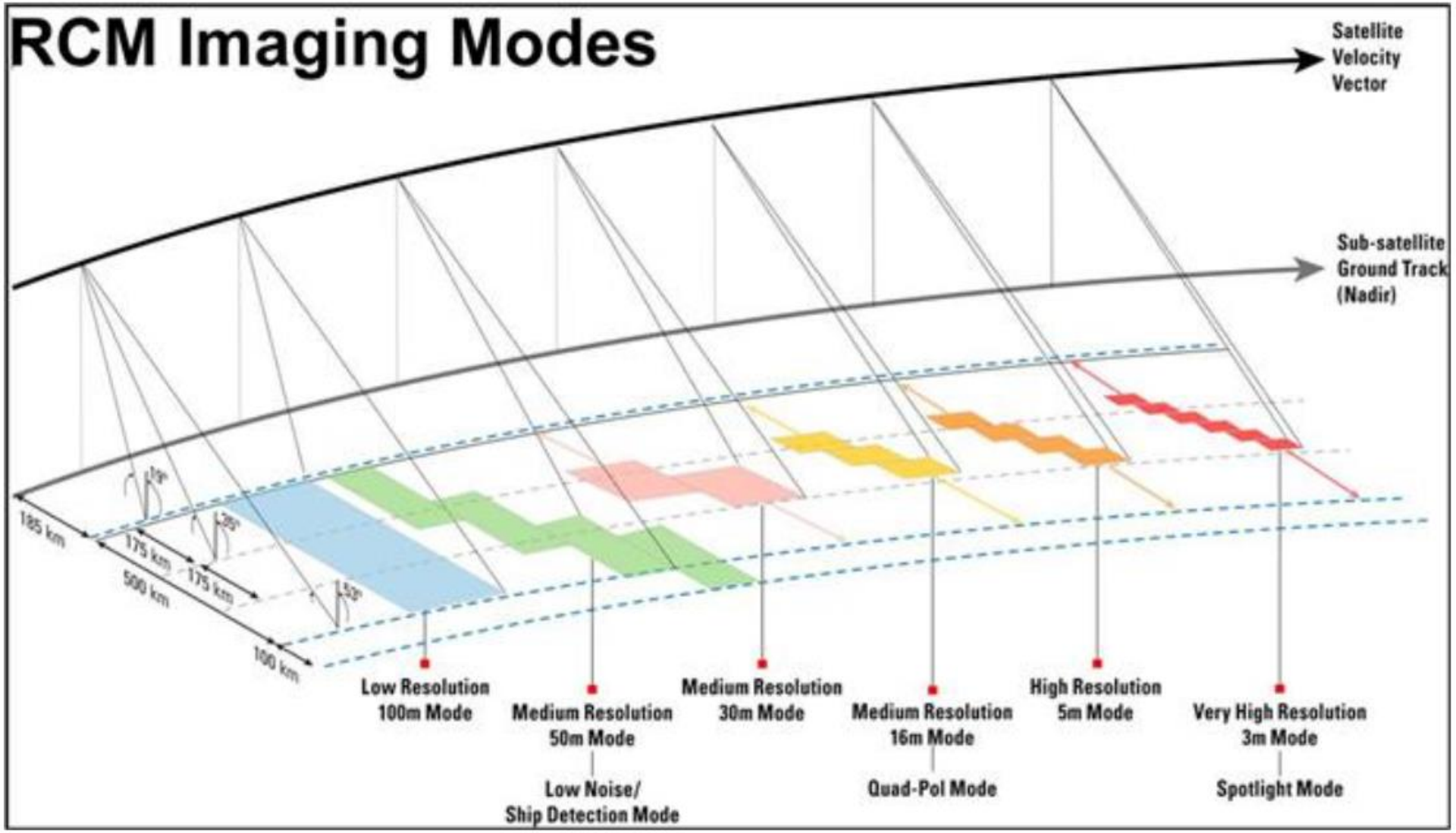
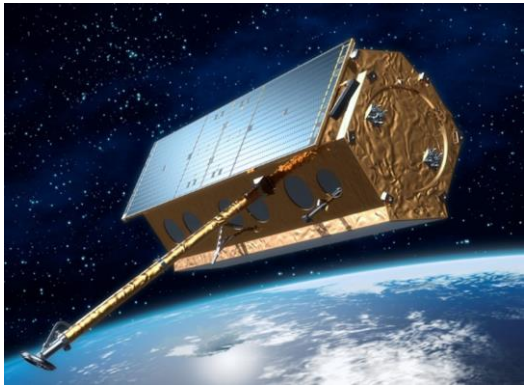
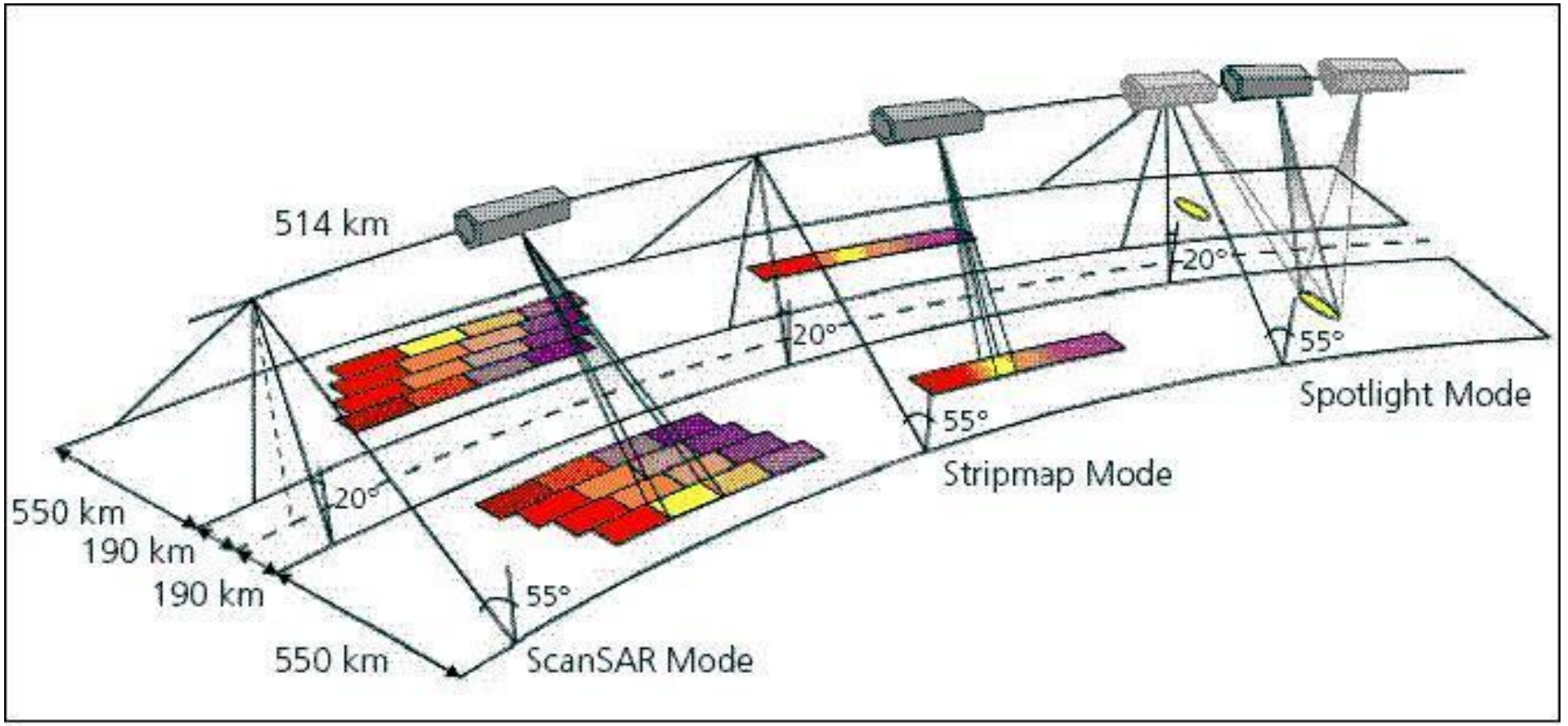


Image source: http://www.asc-csa.gc.ca/eng/satellites/radarsat/technical-features/characteristics.asp

TerraSAR-X/TanDEM-X





Overview of the TerraSAR-X scanning modes - Revisit time: 11 days

Image Source: https://earth.esa.int/web/eoportal/satellite-missions/t/terrasar-x

Imaging Mode	Standard Scene Size[a] [km]	Maximum Acquisition Length [km]	Slant Range Resolution[b] [m]	Azimuth Resolution[b] [m][c]	Polarisation	Full Performance Range [°]
Staring SpotLight (ST)	4 x 3.7[d]	3.7	0.6	0.24	Single (VV or HH)	20° to 45°
HighRes SpotLight 300 MHz (HS300)	10 x 5[c]	5	0.6	1.1	Single (VV or HH)	20° to 55°
HighRes SpotLight (HS)	10 x 5	5	1.2 1.2	1.1 2.2	Single (VV or HH) Dual (HH & VV)	20° to 55°
SpotLight (SL)	10 x 10	10	1.2 1.2	1.7 3.4	Single (VV or HH) Dual (HH & VV)	20° to 55°
StripMap (SM)	30 x 50 single pol 15 x 50 dual pol	1,650	1.2 1.2	3.3 6.6	Single (VV or HH) Dual (HH & VV, HH & HV, or VV and VH)	20° to 45°
ScanSAR (SC)	100 x 150	1,650	1.2 (at 150 MHz)	18.5	Single (VV or HH)	20° to 45°
Wide ScanSAR (WS)	270 x 200[c]	1,500	Depending on range bandwidth 1.7 - 3.3	40	Single (VV, HH, HV or VH)	15.6° to 49°

TerraSAR-X imaging modes

Image Source: https://mdacorporation.com/docs/default-source/product-spec-sheets/geospatial-services/image_product_guide.pdf?sfvrsn=4

TerraSAR-X Image Products

SSC - Single Look Slant Range Complex: data are represented as complex numbers containing amplitude and phase information. It is compatible with the SLC product available from RADARSAT-2.

MGD - Multi Look Ground Range Detected: multi look product with reduced speckle and approximately square resolution cells. For the slant to ground range projection the WGS84 ellipsoid and an average, constant terrain height value are used.

GEC - Geocoded Ellipsoid Corrected: multi looked, resampled and projected product. The image is represented in map geometry with ellipsoidal corrections only, thus no terrain correction is performed.

EEC - Enhanced Ellipsoid Corrected: multi looked, resampled and projected product. However, image distortions caused by varying terrain height are corrected using an external Digital Elevation Model (DEM). It features the highest level of geometric correction available and is thus quickly interpretable and combinable with other sources of information.

TerraSAR-X/TanDEM-X Data Access

- EOWEB® GeoPortal (EGP) is used to check the data archive and program future acquisitions.
- The data are not free. However users may be able to submit proposals to DLR to access a limited number of images for research

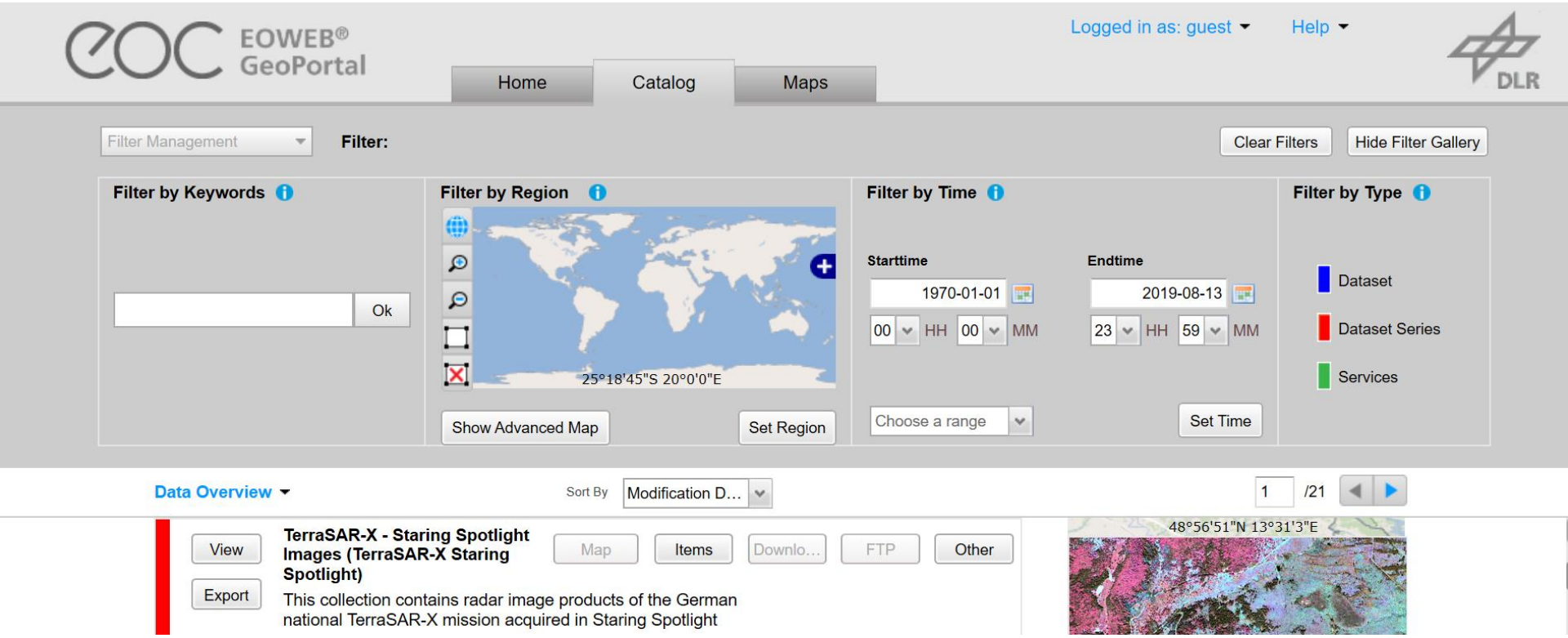
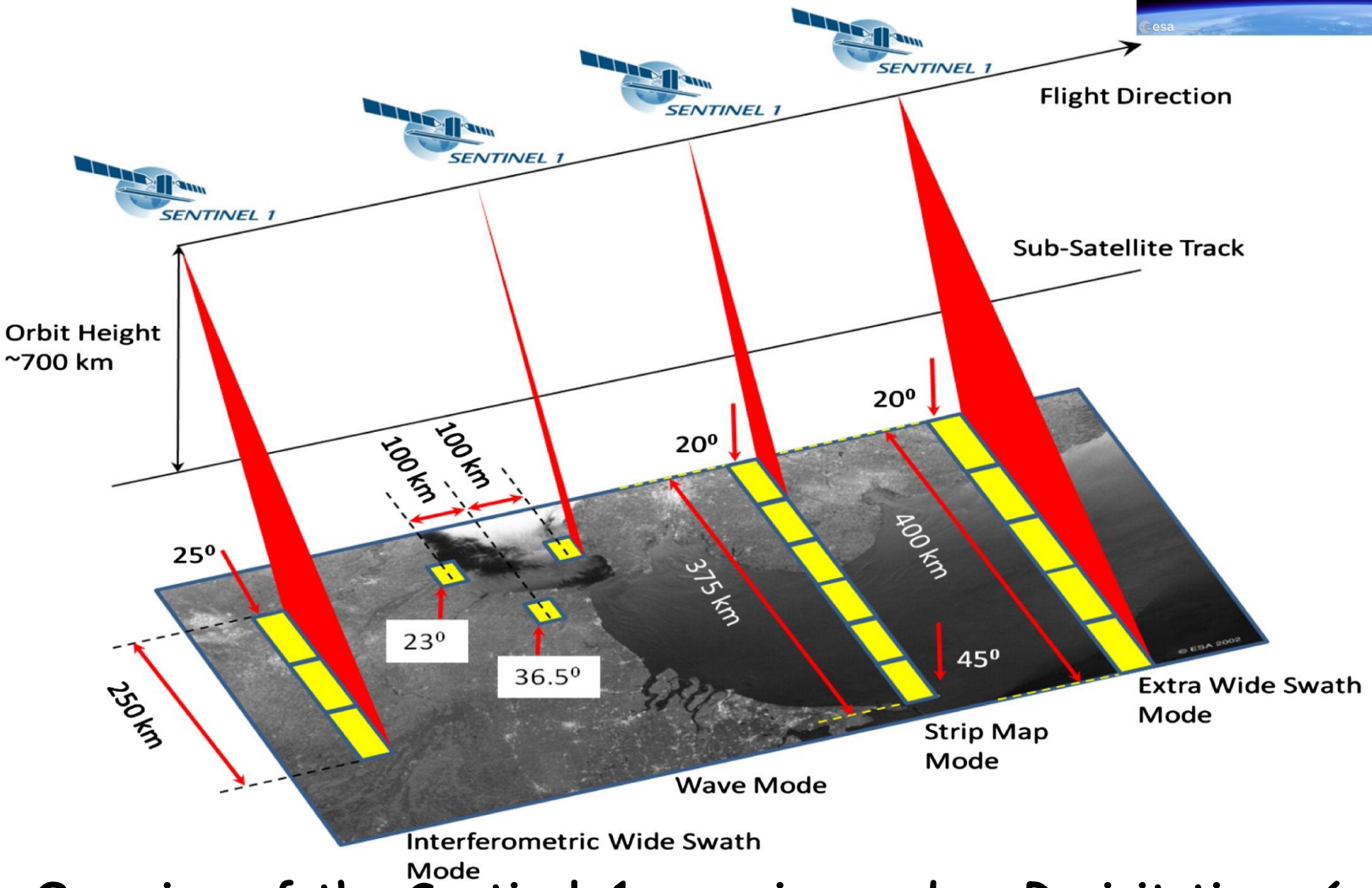


Image Source: https://eoweb.dlr.de/guestegp/main#mainWindowtabCatalog

Sentinel-1A / 1B



Overview of the Sentinel-1 scanning modes- Revisit time: 6 days

Image Source: https://sentinel.esa.int/web/sentinel/missions/sentinel-1/instrument-payload

Sentinel-1 Image Modes and Products

Acq. Mode	Product Type	Resolution Class	Resolution Rng x Azi [m]	Pixel Spacing Rng x Azi [m]	Num Looks Rng x Azi
SM	SLC		1.7x4.3 to 3.6x4.9	1.5x3.6 to 3.1x4.1	1x1
	GRD	FR	9x9	3.5x3.5	2x2
		HR	23x23	10x10	6x6
		MR	84x84	40x40	22x22
IW	SLC		2.7x22 to 3.5x22	2.3x14.1	1x1
	GRD	HR	20x22	10x10	5x1
		MR	88x87	40x40	22x5
EW	SLC		7.9x43 to 15x43	5.9x19.9	1x1
	GRD	HR	50x50	25x25	3x1
		MR	93x87	40x40	6x2
WV	SLC		2.0x4.8 3.1x4.8	1.7x4.1 2.7x4.1	1x1
	GRD	MR	52x51	25x25	13x13

Image Source: https://earth.esa.int/web/sentinel/technical-guides/sentinel-1-sar/products-algorithms/level-1-algorithms/products)

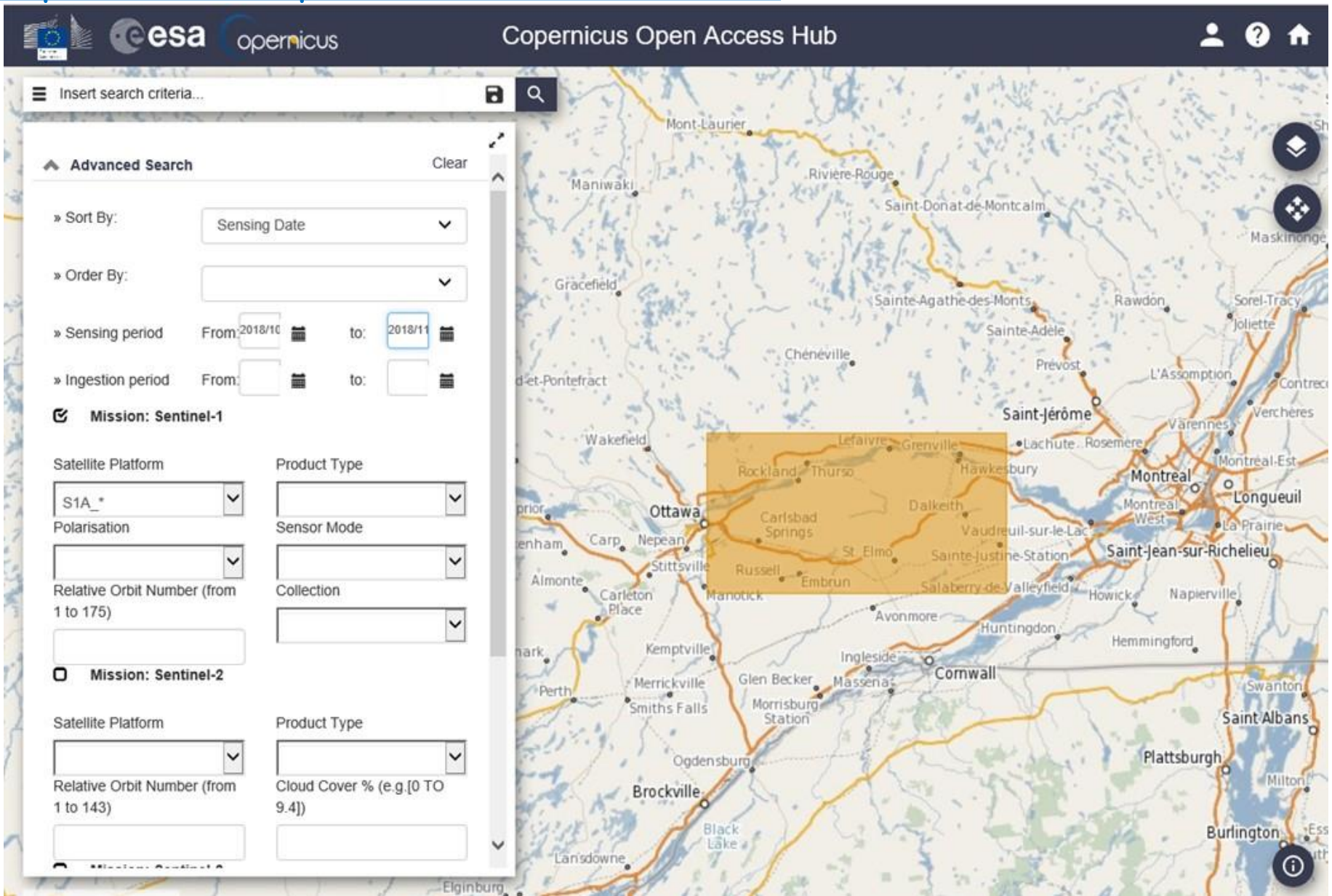
Sentinel-1 imaging modes

Product types

- **SLC - Single Look Complex**: Slant range Single Look Complex product
- **GRD - Ground Range Detected**: Ground range multi-looked that can be in one of three resolutions: Full Resolution (FR), High Resolution (HR), and Medium Resolution (MR)

Sentinel-1 Data Access

https://scihub.copernicus.eu/dhus/#/home



Alaska Satellite Facility Data Portal

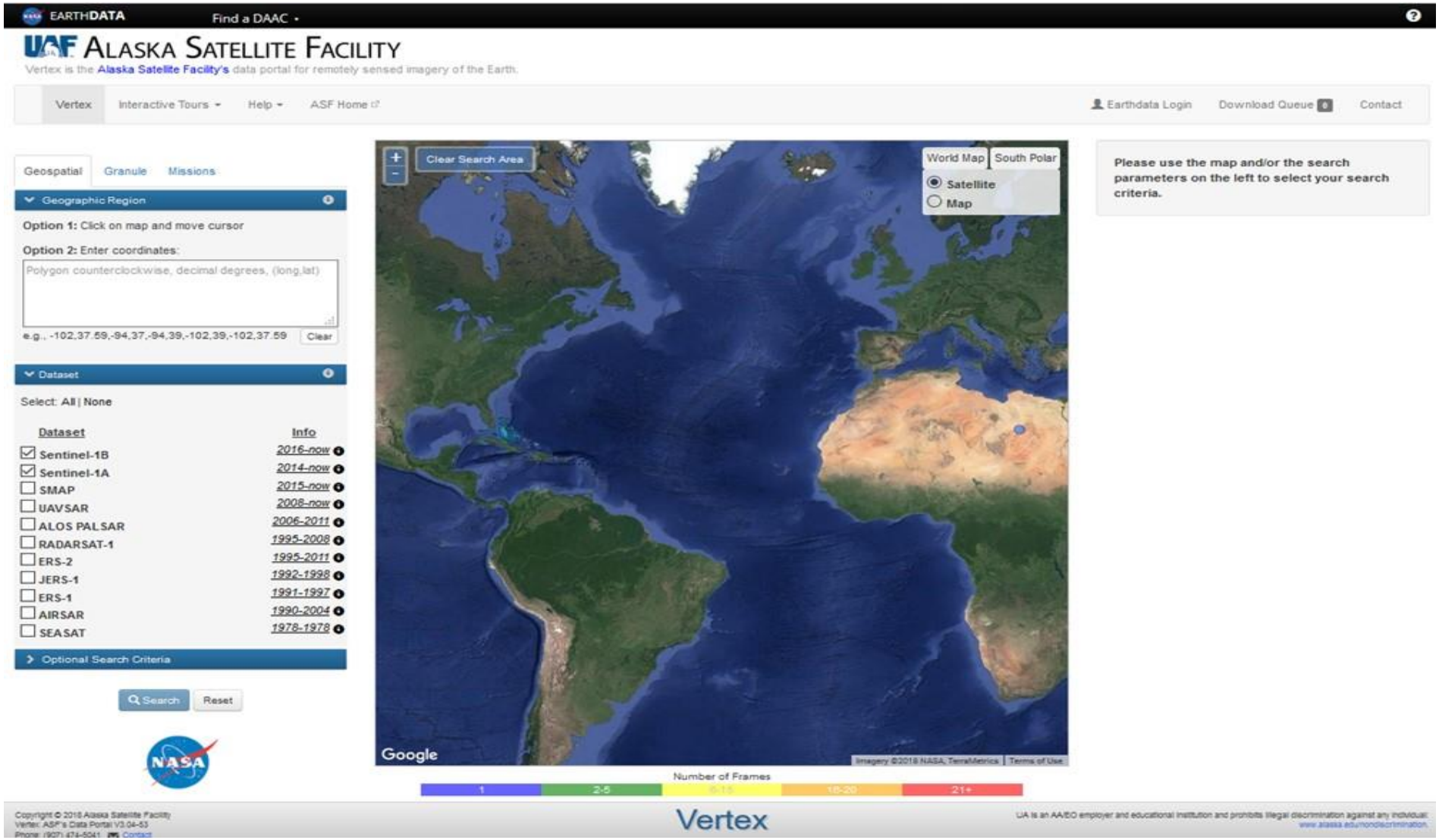
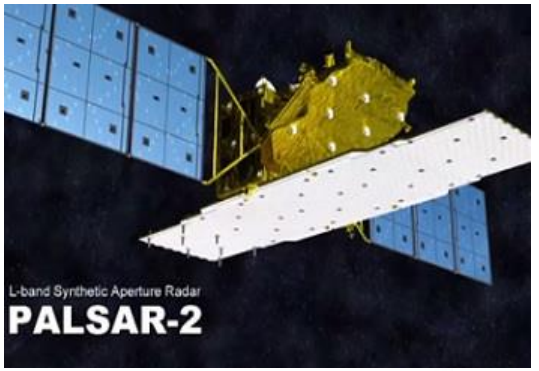
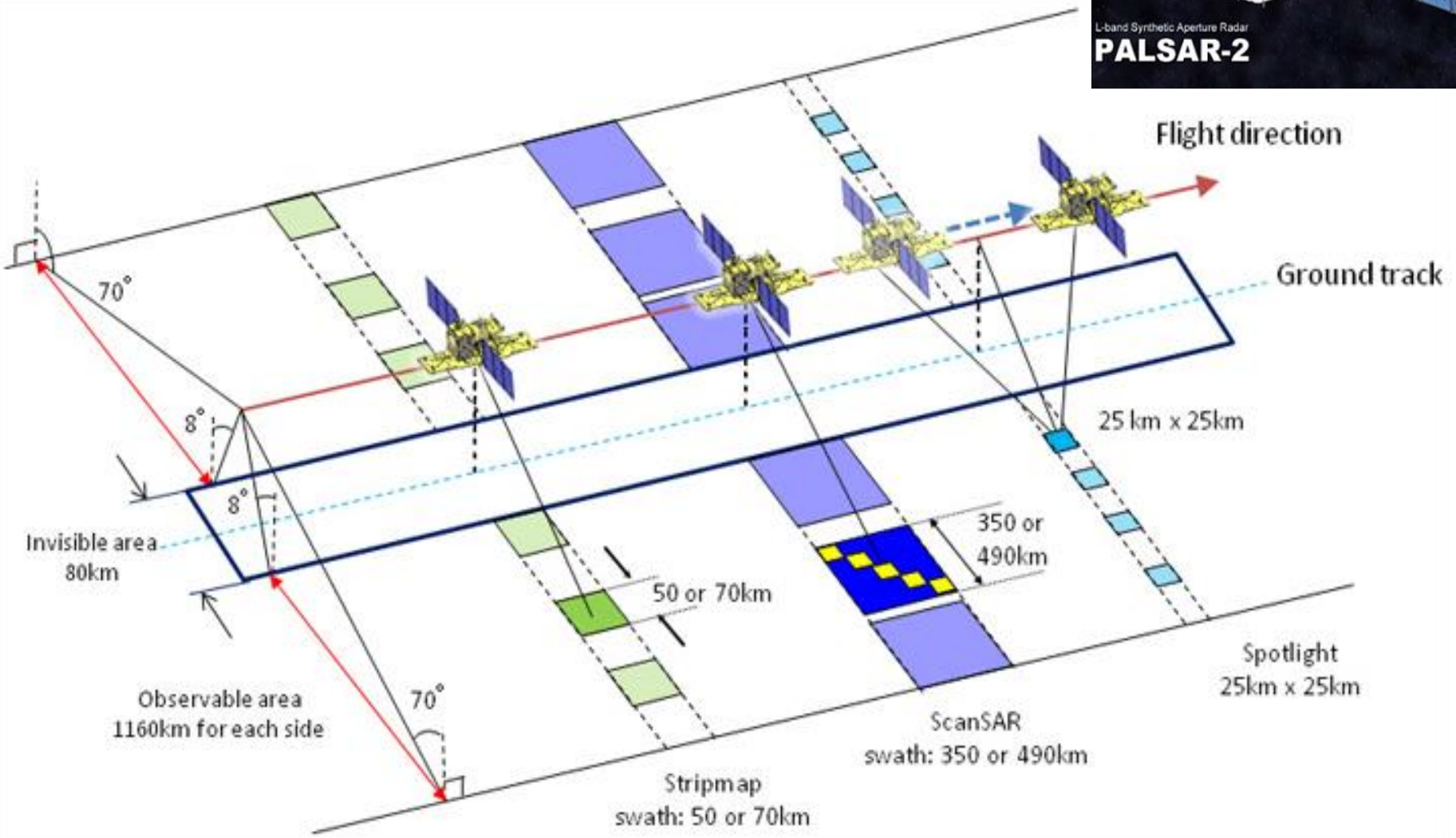


Image Source: https://vertex.daac.asf.alaska.edu/

ALOS-2 / PALSAR-2





Overview of the PALSAR-2 scanning modes - Revisit time: 14 days

Image Source: https://www.eorc.jaxa.jp/ALOS-2/en/about/palsar2.htm

Observation Mode	Spotlight	ScanSAR			Stripmap *			Full (Quad.) Polarimetry *	
		[28MHz]	[14MHz]	[490km]	[3m]	[6m]	[10m]	[6m]	[10m]
Obs. Mode ID (code)	SBS	WWS/WWD	WBS/WBD	VBS/VBD	UBS/UBD	HBS/HSD	FBS/FBD	HBQ	FBQ
Width (East-West) (Length of Range Direction)	25km	350.5km	350.5km	489.5km	55km (max)	55km (max)	70km (max)	40-50km	30km
Length (North-South) (Length of Azimuth Direction)	25km	355km	355km	355km	70km	70km	70km	70km	70km
Time Duration of Azimuth Direction	N/A	52 sec	52 sec	52 sec	10 sec	10 sec	10 sec	10 sec	10 sec
Range Resolution*1	3.0m	47.5m(5look)	95.1m(5look)	44.2m(2look)	3.0m	6.0m	9.1m	5.1m	8.7m
Azimuth Resolution*1	1.0m	77.7m(3look)	77.7m(3look)	56.7m(1.5look)	3.0m	4.3m	5.3m	4.3m	5.3m
Pixel Spacing Levels 1.5/3.1	0.625m	25m			2.5m	3.125m	6.25m (2look)	3.125m	6.25m (2look)
Pixel Spacing Level 2.1	0.625m/1.25m/2.5m	25m/50m/100m			2.5m/5.0m /10.0m	3.125m/6.25m /12.5m	6.25m /12.5m	3.125m/6.25m /12.5m	6.25m /12.5m
Polarization	Single (HH, HV, VH, or VV)	Single (HH, HV, VH, or VV) Dual (HH+HV or VH+VV)			Single (HH, HV, VH, or VV) Dual (HH+HV or VH+VV)			Full (Quad.) Polarimetry (HH+HV+VH+VV)	

PALSAR-2 imaging modes – Revisit time: 14 days

Image Source: http://en.alos-pasco.com/alos-2/palsar-2/

PALSAR-2 Image Products

Level	Definition
Level 1.1	This is complex number data on the slant range following compression of the range and azimuth. As one-look data, it includes phase information and will be the basis for later processing. In wide-area mode, image files are created for each scan.
Level 1.5	This is multi-look data on the slant range from map projection amplitude data, with range and azimuth compressed.
Level 2.1	Geometrically corrected (orthorectified) data using the digital elevation data from Level 1.1.
Level 3.1	Image quality-corrected (noise removed, dynamic range compressed) data from Level 1.5.

Slant range products

(Similar to SLC)

Ground range detected product

Image Source: http://en.alos-pasco.com/alos-2/palsar-2/

PALSAR-2 Data Access

The Earth Observation Data Utilization Promotion Platform

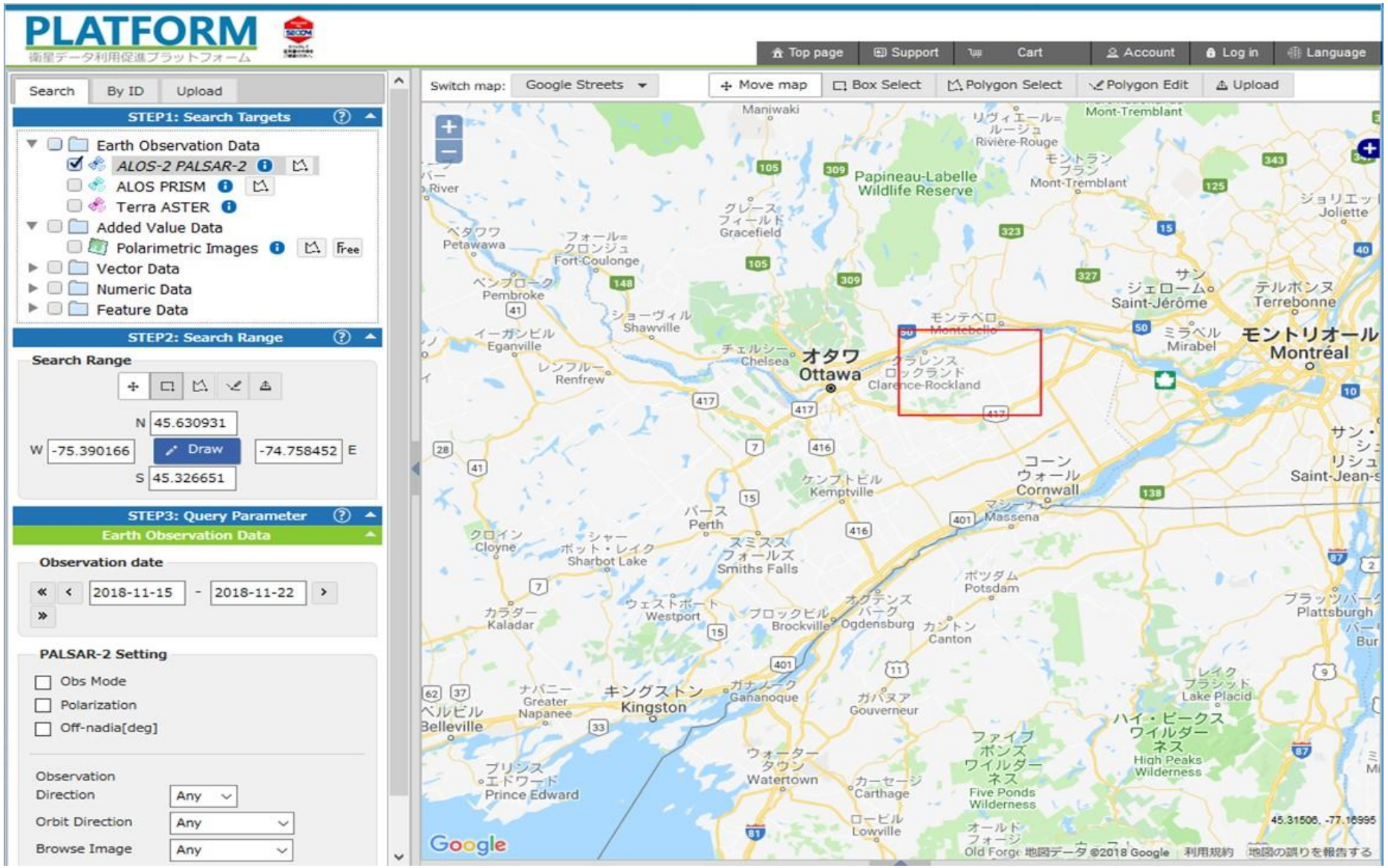


Image Source: https://satpf.jp/spf/?sb=search&sensor=ALOS-2_PALSAR-2&item=sb1_sar_palser2