Data Products @ Bhoonidhi - Microwave

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SAR-DPD/MDPG/DPA/NRSC
Being an Active Imaging RADAR, SAR is having the capabilities.

- Day and Night Imaging
- All weather Imaging with penetration through clouds, smoke, fog etc. (Supporting even during monsoon season)
Microwave Data Products at Bhoonidhi

- RISAT-1 (C-Band SAR)
- EOS-04 (C-Band SAR)
- NovaSAR (S-Band SAR)
- Sentinel-1 (C-Band SAR)
- SCATSAT (Ku Band Scatterometer)
RISAT-1

- Radar Imaging Satellite (RISAT-1), India’s first microwave satellite having state-of-the-art technology having SAR system configuration:
  - Multimode SAR (Stripmap, ScanSAR, Spotlight) – FRS-1, FRS-2, MRS, CRS & HRS
  - Orbit: Sun Synchronous Polar Orbit (SSPO) of 536 km Altitude
  - Frequency: C-band (5.35 GHz)
  - Polarization: Single, Dual, Hybrid and Quad
  - Active phased array antenna Technology (electronic Beam Steering)
  - Left and Right Looking
  - Incident Angle Independent Swath (107 - 659 km)

- RISAT-1 was launched in April 2012 and operational up to September 2016 with a mission life of 4 ½ years.
- It has served many applications including Agriculture, Forestry, Flood mapping, damage assessment, Oil spill studies etc.
RISAT-1 Data selection – Bhoonidhi

Date range
- 01 January 2016
- 01 February 2016

Product
- Standard

Satellite-Sensor
- Resolution: Low (25m - 100m) Resolution
- Source: Microwave
- Priced
  - RISAT-1_SAR(MRS)
EOS-04 MISSION

EOS-04 is Follow on Mission of RISAT-1

- Launched on 14-February 2022 by PSLV C-52 Launch Vehicle.
- Frequency: C-band (5.4 GHz).
- Imaging Modes: Stripmap, ScanSAR and Sliding-Spotlight (FRS-1, FRS-2, MRS, CRS and HRS)
- Polarizations: Single, Dual, Compact (CP) & Full (FP)
- Swath Coverage: 10 Km to 223 Km
- Spatial Resolutions: 1m to 50m
- Data availability: 23rd March 2022 onwards
OPERATION MODES OF EOS-04 SAR

- FRS1/FRS2 MODE
- HRS MODE
- CRS MODE
- MRS MODE

524.87 km

107 km

550 km
EOS-04 Data Products

Levels of Data Products

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level-0</td>
<td>Raw Signal Product (Generic Binary)</td>
</tr>
<tr>
<td>Level-1</td>
<td>Slant Range Geo-Tagged Product Ground Range Products (CEOS/GeoTiff)</td>
</tr>
<tr>
<td>Level-2</td>
<td>Enhanced Terrain corrected Geo Referenced Product (GeoTiff)</td>
</tr>
</tbody>
</table>

Value Added Products

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level-1C</td>
<td>Geo-tagged Polarimetric products</td>
</tr>
<tr>
<td>Level-3A</td>
<td>Geo-referenced Polarimetric products</td>
</tr>
</tbody>
</table>

Mosaic

- India Mosaic (for systematic coverage) Large Area Mosaic
- Projection: UTM (Level-2)
- Datum: WGS84 (Level-2)
- Resampling: CC (Level-2)

Product Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geo-location Accuracy (RMSE)</td>
<td>&lt;50 m</td>
</tr>
<tr>
<td>Radiometric Resolution (SLC)</td>
<td>3.1 dB</td>
</tr>
<tr>
<td>PSLR</td>
<td>-17 dB</td>
</tr>
<tr>
<td>Relative Radiometric Accuracy</td>
<td>1 dB</td>
</tr>
<tr>
<td>Absolute Radiometric Accuracy</td>
<td>± 1 dB</td>
</tr>
</tbody>
</table>

MOSAIC Data Products

- Source: MRS Systematic coverage Data.
- Gamma0 image for HH/HV Polarizations
- Geographic Projection
- 1 deg x 1 deg Tiles
EOS-04 Data Selection – Bhoonidhi

Date range:
- 01 September 2022 to 21 October 2022

Product:
- Standard

Satellite-Sensor:
- Resolution: High (1m - 5m) Resolution
- Source: Microwave
  - Priced
  - EOS-04, SAR(FRS1)
  - EOS-04, SAR(FRS2)
EOS-04 Data Selection – Bhoonidhi

Select Search ID (SID)
- E04_SAR_FR1_F_H
- E04_SAR_FR1_F_M
- E04_SAR_FR1_F_R
- E04_SAR_FR1_F_S

Processing Level
- K_Single Look Complex Slant

Enhancement
- 0_Raw
- N_Multi Look Ground range
- E_Enhanced Georef

Cost
- No of scenes: 1
- Priority Charges: 0.00
- Discounts: 0.00

Add Product Specifications
NovaSAR S- Band SAR

- NovaSAR is a joint technology demonstration initiative of SSTL (Surrey Satellite Technology Ltd.), UK, and Airbus DS funded by the UK Government via UK Space Agency.
- NovaSAR was launched on-board PSLV-C42 of ISRO on 16th September 2018.
- NovaSAR has two payloads
  - Synthetic Aperture Radar (SAR)
  - Automatic Identification System (AIS).
- SAR is the primary payload operating in S-band frequency band of 3.1 to 3.3 GHz.
  - It provides medium resolution SAR data ranging from 6m-45 m resolutions in Stripmap, ScanSAR and Maritime modes.
  - Polarization: Single, dual and Tri pol

<table>
<thead>
<tr>
<th>Frequency band</th>
<th>S-Band 3.1 - 3.3 GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antenna</td>
<td>Micro strip Phased Array Antenna 3m x 1m</td>
</tr>
<tr>
<td>Lifetime</td>
<td>7 years</td>
</tr>
<tr>
<td>Altitude</td>
<td>580km</td>
</tr>
<tr>
<td>Polarization</td>
<td>Single, dual, tri</td>
</tr>
</tbody>
</table>

NOVASAR Strip map (6m) Date: 13Apr2021
# NovaSAR Scene Based Data products

<table>
<thead>
<tr>
<th>Product Type (Scene-framed)</th>
<th>Imaging Mode</th>
<th>Polarizations</th>
<th>Product Content (Scenes)</th>
</tr>
</thead>
</table>
| Level-1 –SLC (Single look complex) [Geotagged] | Stripmap | Single | • imagery files - for each pol  
• Quick-Look images  
• Metadata. |
| Level-1 –GRD (Ground Range detected) [Geotagged, WGS -84 Datum] | Stripmap –GRD  
GRD- Ground range detected  
SCD-ScanSAR detected  
ScanSAR/Maritime –SCD | Single/Dual/Tripol | • imagery files - for each pol  
• Quick-Look images  
• Metadata. |
| Level-2 - Bundled [Georeferenced UTM Projection WGS-84 Datum] | Stripmap/ScanSAR | Single/Dual/Tripol | • Geo-referenced Imagery files  
• Geo-referenced Sigma Naught files  
• Geo-Referenced Surface Water Layer files for each polarization,  
• IncidenceAngle file, metadata. |

Data availability: From 1st Oct 2019 onwards
### NOVASAR Data Selection - Bhoonidhi

#### Product Details for NVS_SAR_C_F_GRD

<table>
<thead>
<tr>
<th>Product Type</th>
<th>ST_Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processing Level</td>
<td>N_Multi Look Ground range</td>
</tr>
<tr>
<td>Enhancement</td>
<td>N_Multi Look Ground range</td>
</tr>
<tr>
<td>Projection</td>
<td>0_No Projection</td>
</tr>
<tr>
<td>Resampling</td>
<td>0_No Resampling</td>
</tr>
<tr>
<td>Format</td>
<td>T_GeoTIFF</td>
</tr>
</tbody>
</table>

#### Cost

<table>
<thead>
<tr>
<th>Cost type</th>
<th>scene (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of scenes</td>
<td>4</td>
</tr>
<tr>
<td>Priority Charges</td>
<td>0.00</td>
</tr>
<tr>
<td>Discounts</td>
<td>0.00</td>
</tr>
</tbody>
</table>

#### Pricing

<table>
<thead>
<tr>
<th>Indian</th>
</tr>
</thead>
</table>

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**Bhoonidhi Workshop#1**
Sentinel-1

- Sentinel-1 is satellite constellation of European Space Agency with Sentinel-1A & Sentinel-1B
- Frequency: C-Band (5.405 GHz)
- Bhoonidhi is hosting the products of Sentinel-1 with below specifications.
  - Imaging Mode: Interferometric wide swath Mode (IW mode)
  - Repetivity: 12 days
  - Polarization: VV+VH
  - Level of Product: Level-1 Ground Range
  - Swath: 250 km
  - Data availability: From 1\textsuperscript{st} Oct 2019 onwards
Sentinel-1 Data Selection – Bhoonidhi

Search Criteria
- Date range: 01 June 2022 to 21 October 2022
- Product: Standard
- Satellite-Sensor: Medium (5m - 25m) Resolution
- Source: Microwave
- Filter: Open_Data
- Selected: Sentinel-1A_SAR_IW_GRD

Submit
SCATSAT-1

- ScatSat-1 is a follow on mission of Oceansat-2.
- Payload: Scatterometer in Ku Band (13.515 GHz).
- Wind vector cell size (25 km x 25 km).
- Swath width HH: 1400km, VV: 1840km.

- Products:
  - Level-2B Wind vector products.
  - Level-3 Global Sigma0 products (HH Pol/VV Pol)
  - Level-3 Global Wind vector products.

Applications: Weather forecasting, Cyclone detection & Tracking.

Data availability at Bhoonidhi: From 01/01/2020 to 31/12/2021.
<table>
<thead>
<tr>
<th>Level of Product</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level-1 Single look complex product</td>
<td>For Interferometry &amp; Polarimetric Applications</td>
</tr>
<tr>
<td>Level-1 Ground range product</td>
<td>All thematic Applications</td>
</tr>
<tr>
<td>Level-2 Georeferenced terrain corrected product</td>
<td>All thematic Applications</td>
</tr>
<tr>
<td>Level-1C covariance product</td>
<td>For performing user-selected polarimetric decompositions</td>
</tr>
<tr>
<td>Level-3A polarimetric decomposed product</td>
<td>For target classification</td>
</tr>
<tr>
<td>Mosaic data product</td>
<td>For time series analysis.</td>
</tr>
</tbody>
</table>
Thank You