Committee on Earth Observation Satellites

ISRO Data Cube Initiatives for Regional CB

By

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Agenda Item #39

Working Group on

Capacity Building & Data Democracy

Indian Institute of Remote Sensing

Indian Space Research Organisation

Dehradun, India

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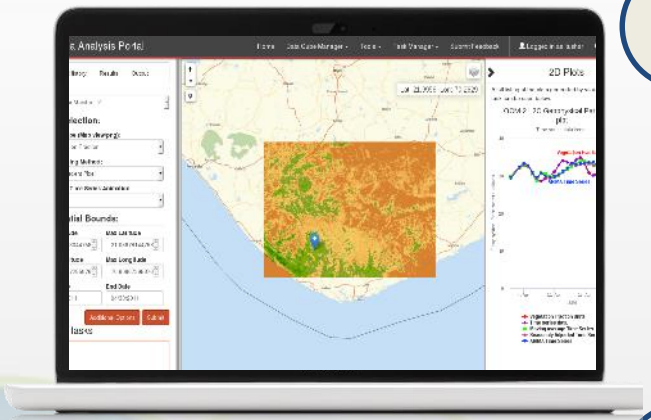


- Why EO Datacube?
- Vision for ISRO Datacube
- Design and Development
- Architecture
- Prototype Development
- Program Linkages

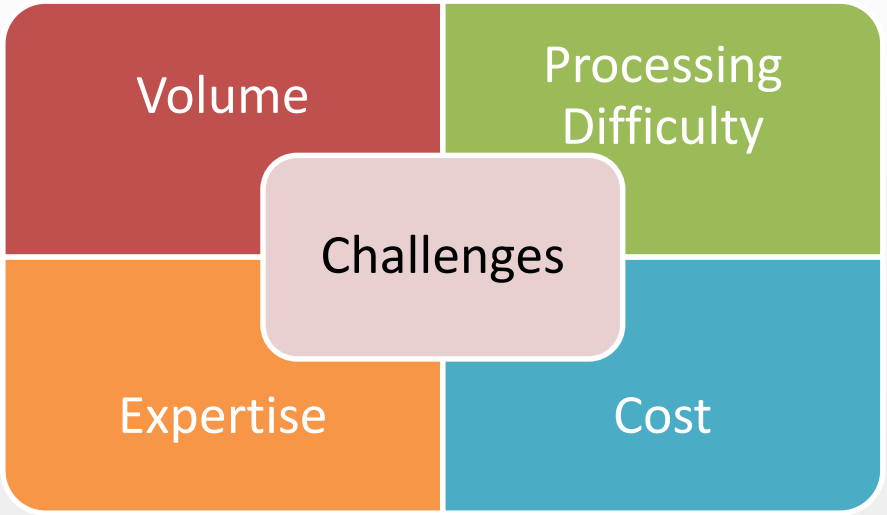
Why EO Datacube?

EO data can be considered as Big data that have volume, velocity and pseudo-variety which makes it complicated to analyze and visualize.

Expertise, Infrastructure, or Network bandwidth requires to efficiently and effectively access, process, and utilize EO data.

Data Processing

Both Pre & Post-processing EO data introduces challenges when trying to integrate or analyze.



Challenges associated with serving Big EO data.

Why EO Datacube?

- Another challenge is working with data from multiple Missions
- Data processing servers keep processed count data, TOA and SR data from multiple missions archived at different locations.

The archive not accessible to application scientists due to many constraints -

- Lack of unified storage location
- Security (directly exposing the archive library is not feasible)
- Difficult to categorize products for private use and for public access kept at same location.

Inefficient use of resources leading to under-utilization of data

Vision for ISRO Datacube

E-governance (Unified Framework for all applications …)

- Application of EO data for in crop monitoring, urban and rural infrastructure planning, disaster management, weather forecasting, forest preservation, pollution awareness etc.

Public Consumption of data for societal benefits

- Data services easily available and accessible to users
- Reduce burden of data-handling and post-processing at user end.

Growth of R&D on EO data applications

- Datacube to serve as powerful tool for data interoperability for EO Missions, in tandem with advances in collaboration among ISRO and other agencies on Analysis Ready Data (ARD)

Decentralizing by Regional Capacity Building

- To provide software toolset for deploying local, regional or national time-series of multiple spatially aligned datasets as per user needs (based on region, time period, layers, grid projection)

Design and Development

Technology development

Data storage, middleware, APIs and UIs in web and mobile applications.

Data processing and Re-formatting

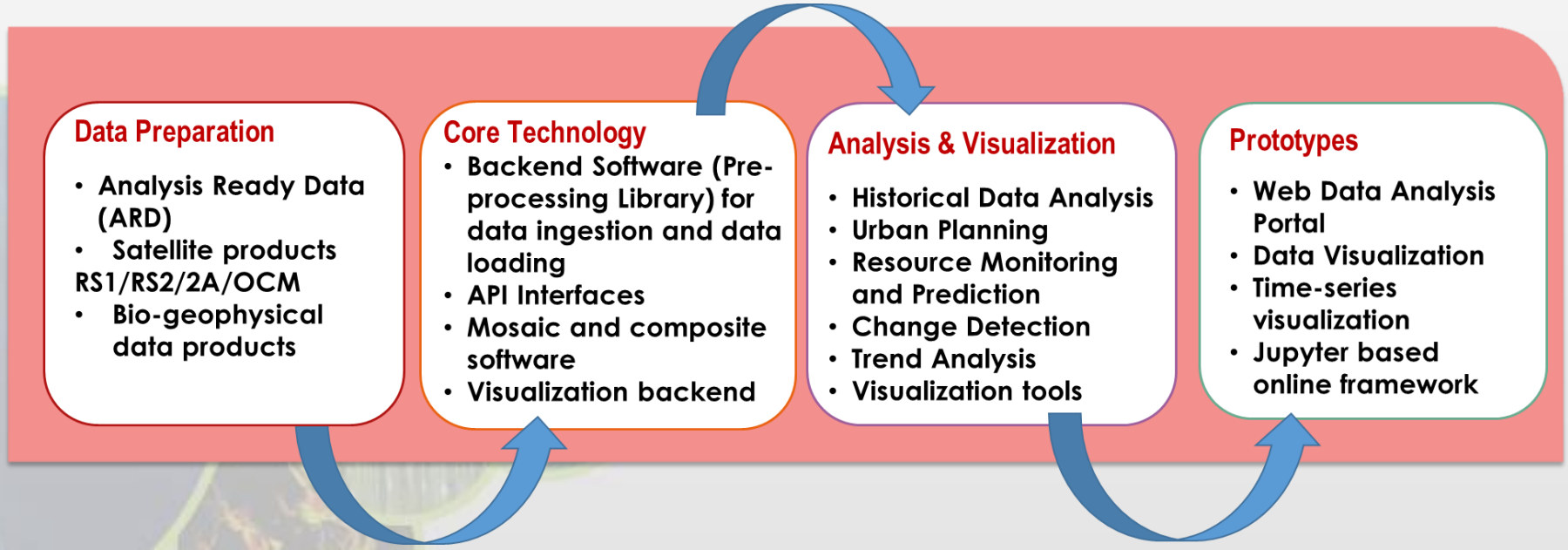
Standardization in Pre-processing, database definition, ARD generation, formatting, tiling, post-processing etc.

User Engagement

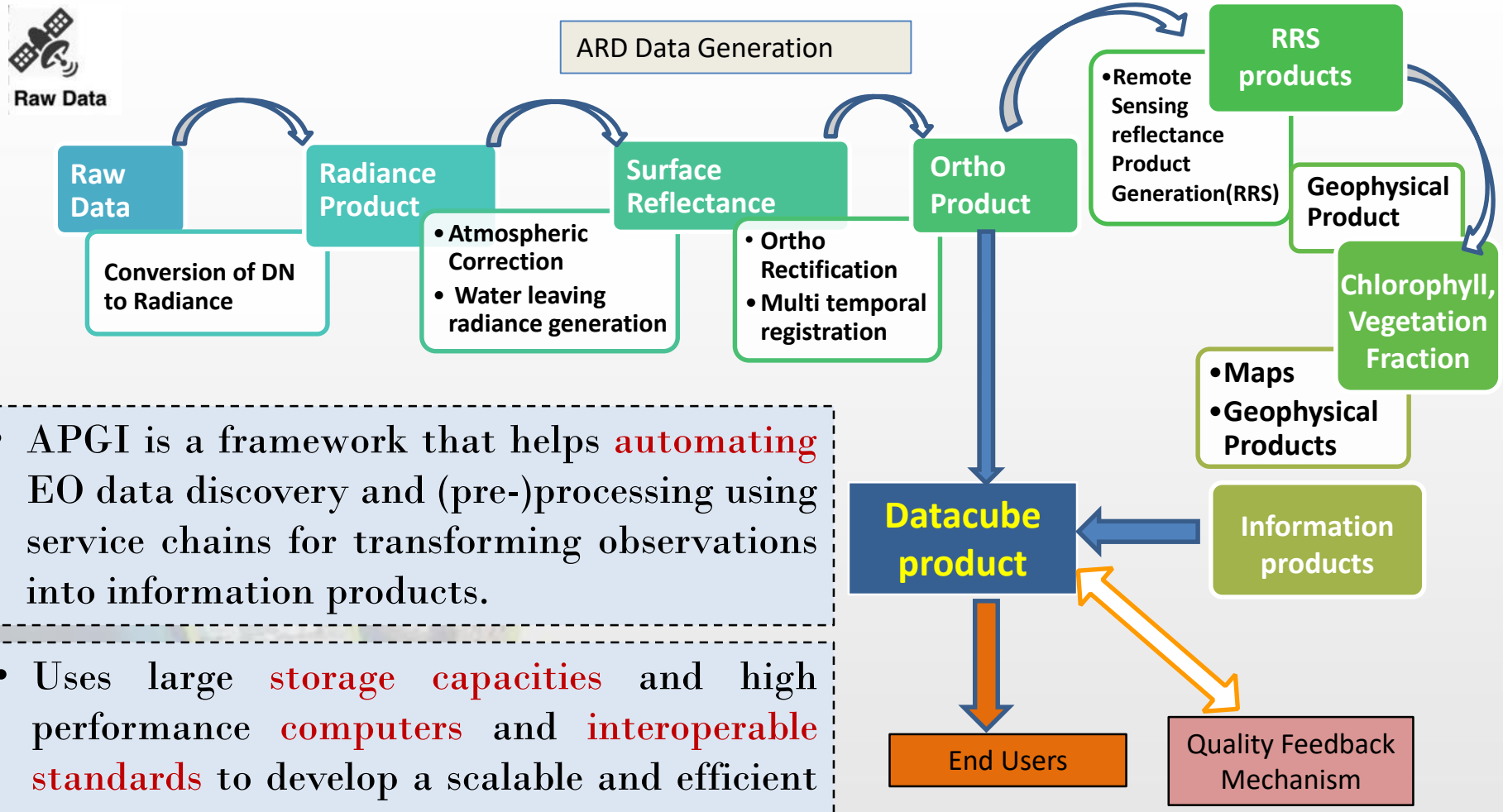
- Common understanding of the issues in different phases and mitigation plan.
- Focus on the user experience and feedback.

Prototype Deployment

Emphasis on deployment of Data Cubes to ISRO users as beta site and populate more ARDs into the framework.



Automated Data processing Pipeline



- APGI is a framework that helps automating EO data discovery and (pre-)processing using service chains for transforming observations into information products.

- Uses large storage capacities and high performance computers and interoperable standards to develop a scalable and efficient analysis system.

Infrastructure Development

1. Independent components based Software Architecture
2. Multiple technology assimilation
3. Ingesting high volume, variety and velocity raster and corresponding metadata
4. Integration of multiple on-line and standalone applications for data analysis.
5. Data Visualization components (web-based)
6. Data Analytics components (Jupyter Hub based)

Architecture

Satellite Data Databases @ SAC

Data transfer

* ***Satellite data stores could be co-located with data cube infrastructure***

30+ TB data and growing !!!!

ISRO Data Cube Infrastructure

DataCube "Ingester"

Python/C++ Pre-processing Library

Populating Metadata Database

Organizing Files

Postgres Database

Database Indexes

NAS Storage Server

XML/YAML/JSON Metadata

Polls DB Data Layers

Pulls Pixel Layers or Pixel Time-Series Stacks

API Module (Python)

Serves pixels to Application via OGC complaint WMS/WFS/WCS

Server

Numpy,Xarray & Geopandas for Multi-Temporal Datasets *(Latitude/Longitude/Time)*

Geoserver for Static Raster/Vector layers

Present Data Stack

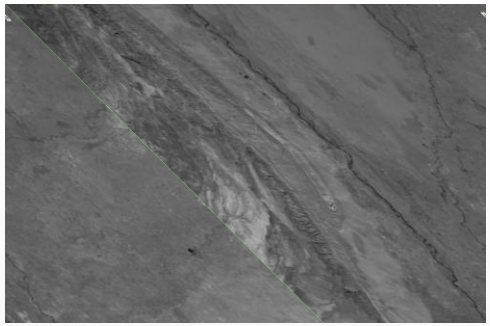
OCM-2 -> RS-1/2/2A (AWiFS -> LISS-3 -> LISS-4) -> CARTO-2S

CLIENT

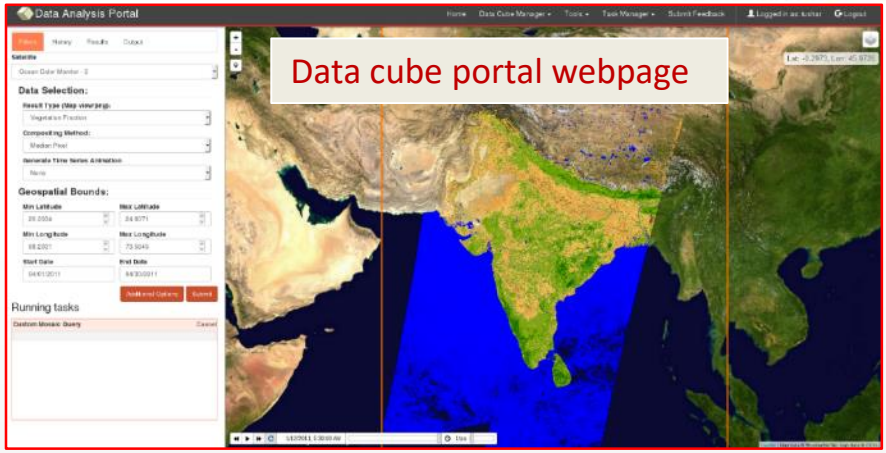
Application Infrastructure (Python/Jupyter, over web browser)

Application/User Interface

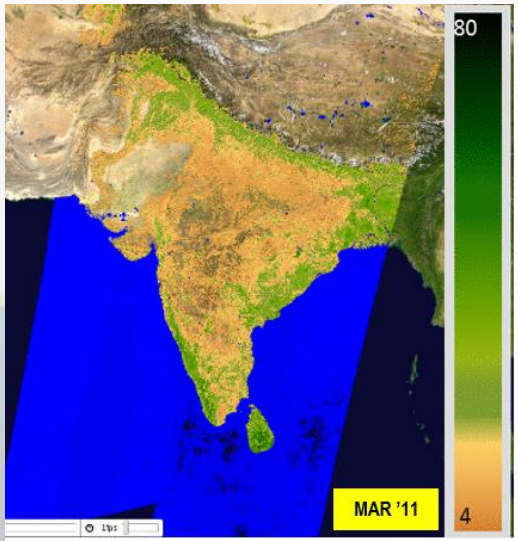
Prototype Development



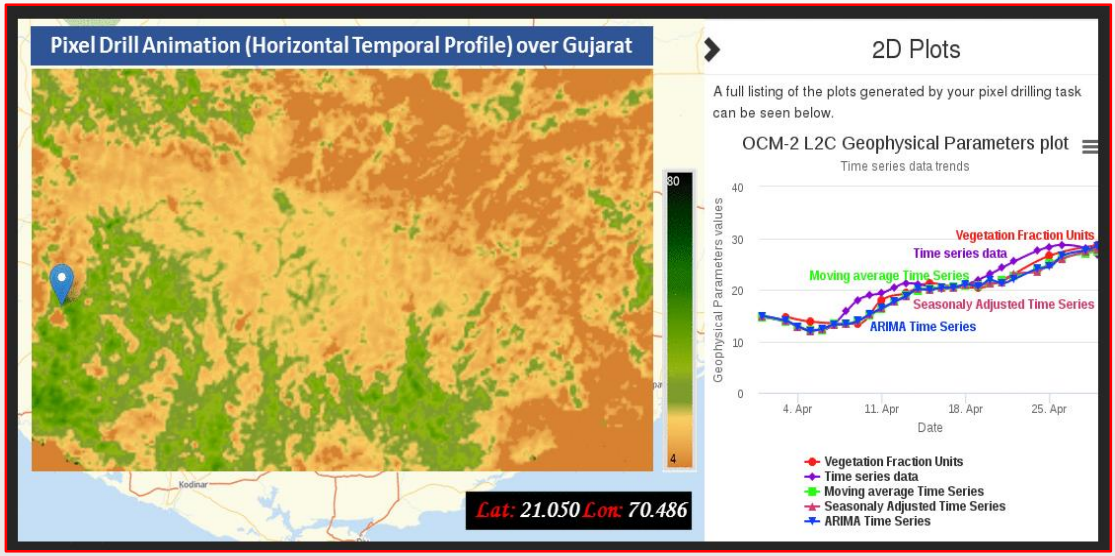
A small part of West India animated with multi-temporal band-8 of OCM-2



Data cube portal webpage



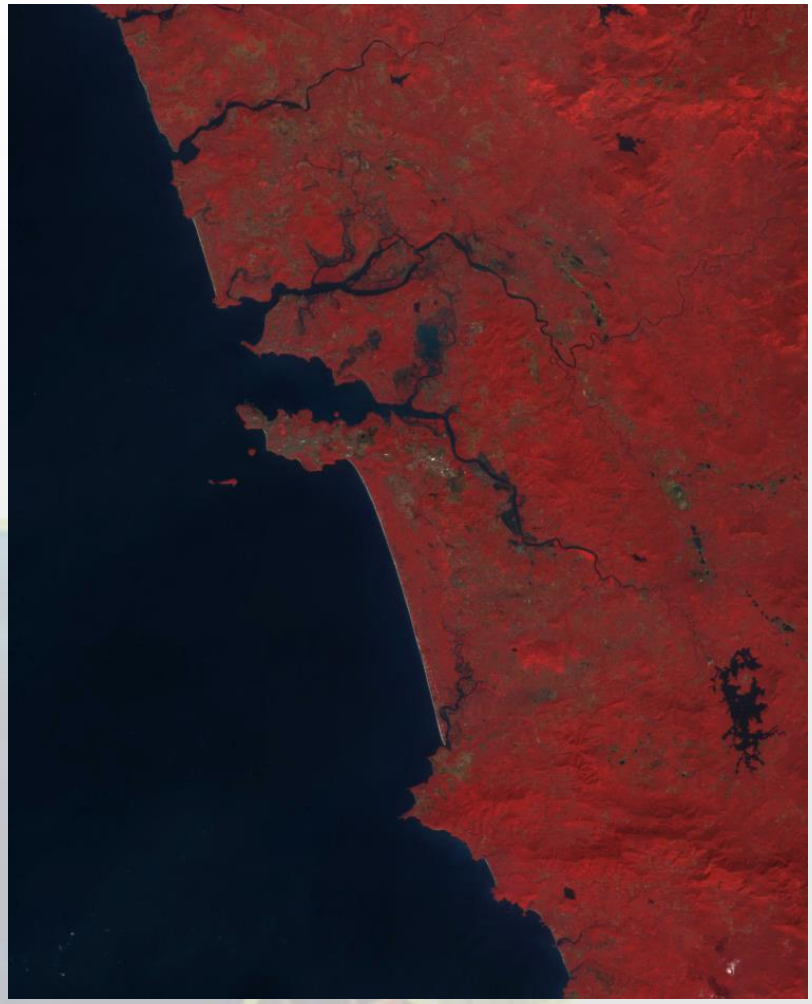
Vegetation fraction and land surface water monthly composite prod.



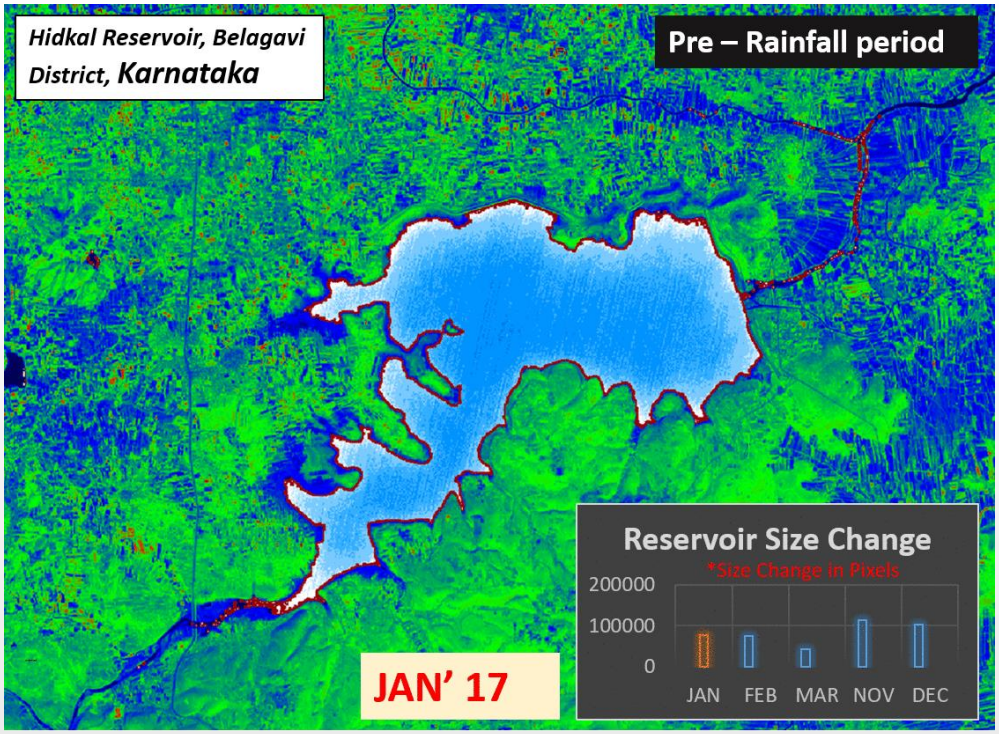
Horizontal time-series profile featuring pixel drilling operation over multi-temporal VF product stack.1

Example Program Linkages

Prototype Deployment for Gujarat, Goa and neighboring Regions

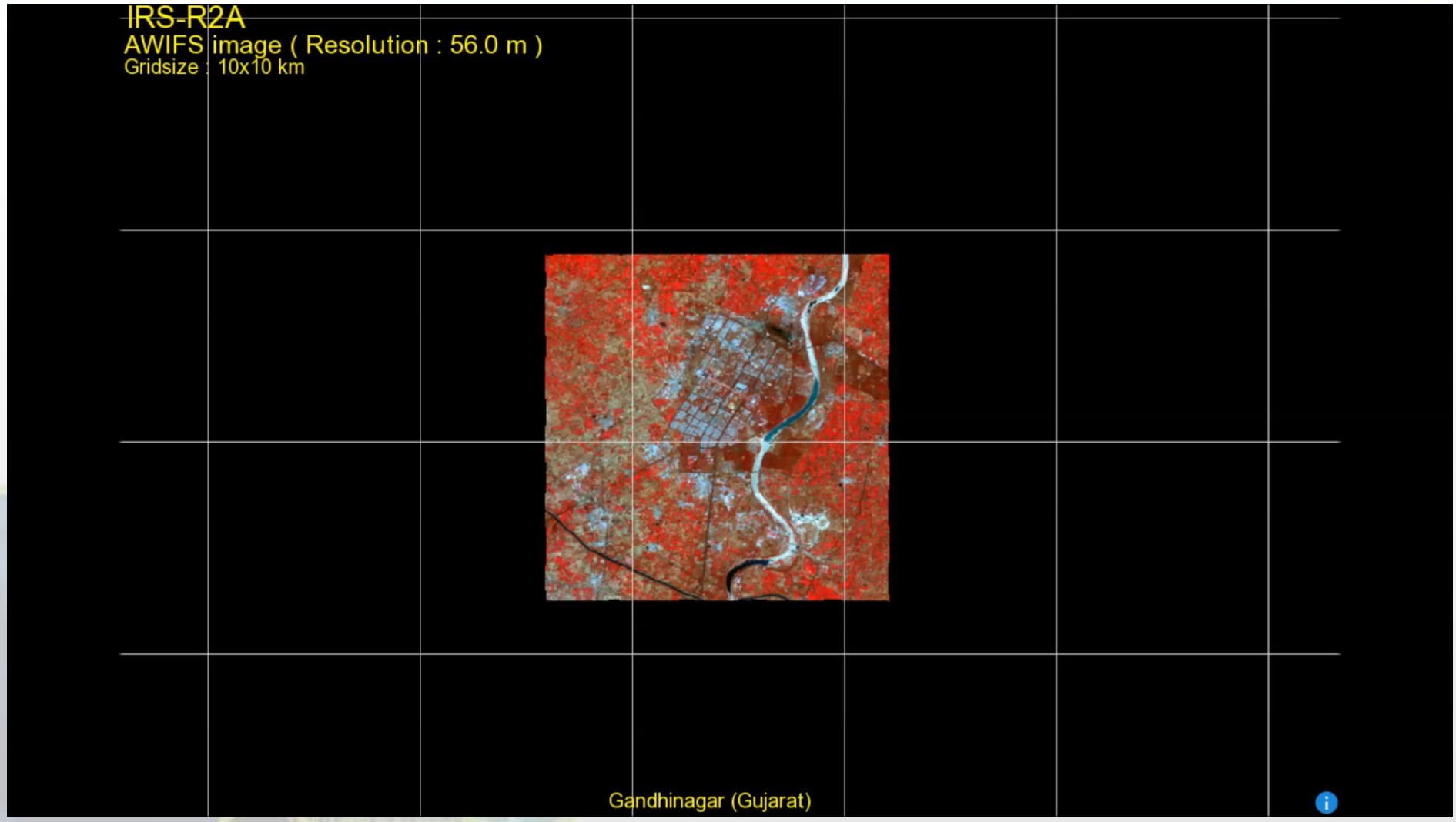


GOA



Pre and post rainfall RS2A LISS-3 BAND-5 data featuring change in reservoir levels in Karnataka. Reference reservoir boundary shown in red color.

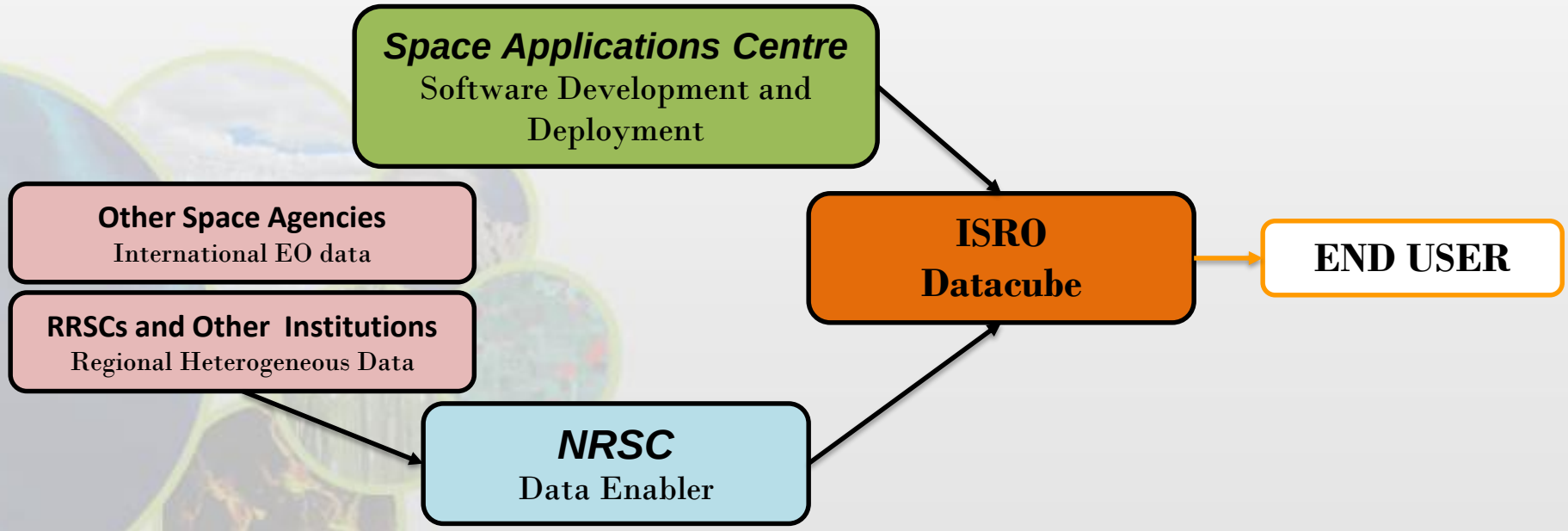
Visualization of Multi-resolution Image



Implementation partners

Role of Agencies

- SAC and NRSC will spearhead the ISRO datacube initiative - SAC in software design, development and optimization role - NRSC as data enabler, data assimilation and finally Platform and Data as service Distributer.
- All ISRO and State centers to facilitate EO data enrichment by enabling collection and dissemination of field survey and ground truth data.
- Foster the ingestion of International EO data in tandem with ISROs EO data with collaborations from Other Space Agencies.



Thank you!