Lessons, challenges & *innovations*: Indian Case studies EO data research to use

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Scaling-up Innovations for Solution Enablement
(Commercialisation of Research and Innovations)
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Preamble

- Geospatial technology
  - As facilitator, integration of diverse source of data, provider of actionable products

- Importance of research & innovation
  - Series of small innovations

- Content & Context
  - Original aim was to develop EO based ‘national operational applications’
  - Geospatial technologies integrated due to need and for ensuring most current technologies are brought to use

Indian Case Studies

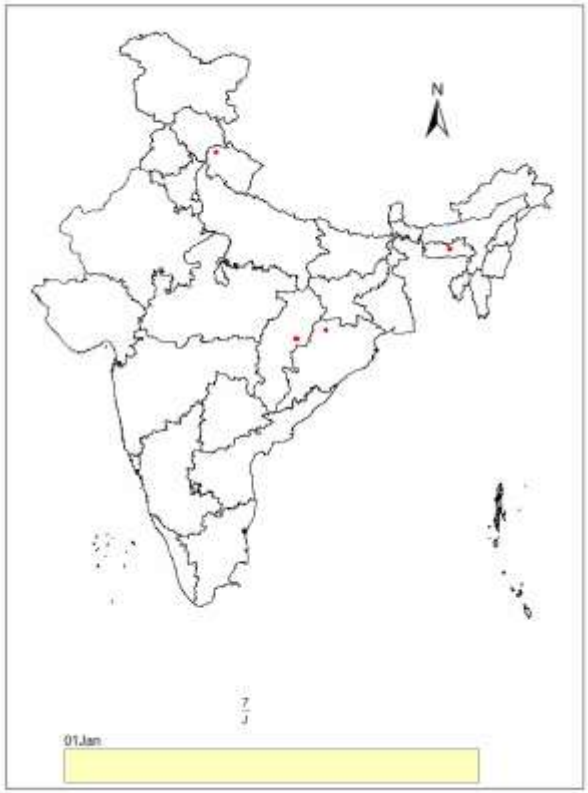
- Crop Forecasting
- Forest Fire Alerts
- Deforestation –
  - A century scale analysis to annual automated hotspots
- Carbon Pools : Forest Biomass & Soil OC/IC
- Web-GIS Platform for Governance, citizens
- Terrain – work in progress

Crop Forecasting : Pre-harvest

- Crop statistics for 66 crops from village to nation
  - **EO has to meet accuracy, timeliness & cost challenges**
- Generic Approach known, but has challenges
  - **EO Data-Pattern Recognition-Inventory-Yield-Production Forecast**
    - Challenges : Cloud Free Data, Optimal Acquisition, In-season ground truth, timely analysis
  - **Research : Sampling scheme, Multi-date Crop Discrimination, SAR for rice**
  - **Took nearly 30 years of continuous research, operational forecast, user engagement & capacity building for acceptance**
    - Ministry of Agriculture established Mahalanobis National Crop Forecasting Center in New Delhi in 2012
    - Innovations continue for operational use agency (Field Data through mobile apps, Bhuvan web-GIS, pre-processed data sets, GIS layers for stratification, crop cutting capture by mobiles

Forest Fire Alert System

- Indian forests fire prone, > 90% man made fires
- EO Data – Active Fire Algorithm – Forest Map overlay – Use ?
  - Time is key driver limiting its use
- Historical evolution
  - DMSP night lights – MODIS – Soumi NPP
- Upscaling and usage realised by
  - NRT processing after data acquisition
  - Automation of fire detection, forest overlay and transfor of location to webGIS
  - Automated SMS to user
  - Overall process completion 20-25 minutes

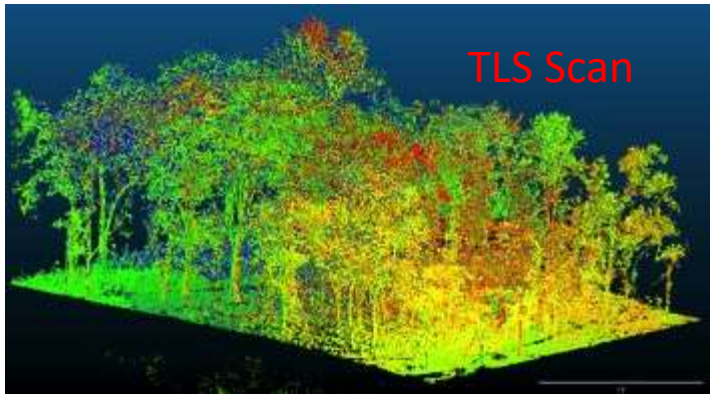


Monitoring Forest Cover

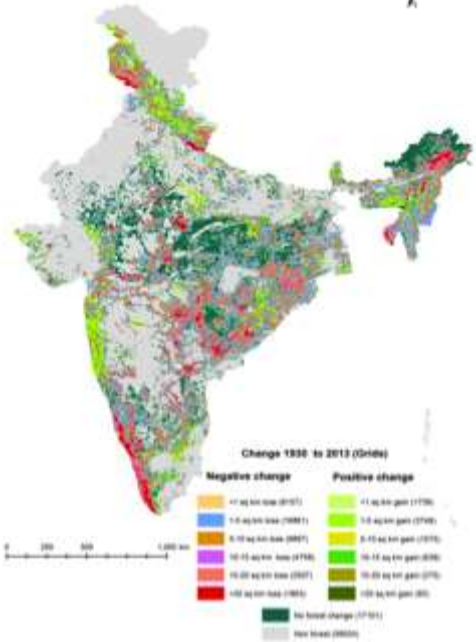
- Forest Departments have maintained forest statistics
  - Legal definition of land utilization used (has own pitfalls)
- Forest Mapping by NRSA in 1980s showed lower tree cover
  - Forest Survey of India, established and assigned task of biennial forest cover mapping
- Operational use of RS, but

Satellite Remote Sensing in Forestry and Environment

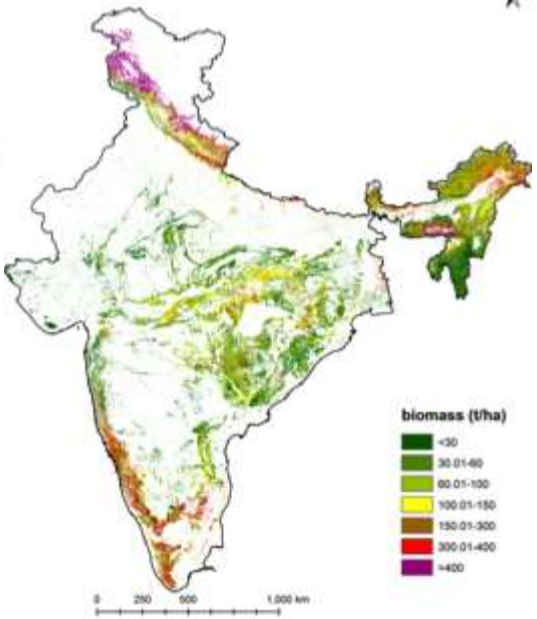
- Automated annual forest cover loss using IRS AWiFS data
- RS based spatial analysis for studying historical change
- Forest fire reporting: MODIS and NPP-Soumi.
- Multi-resolution satellite data have been used for biomass estimation
- In preparation for future missions, aerial and terrestrial LiDAR are being used to study three dimensional forest structure



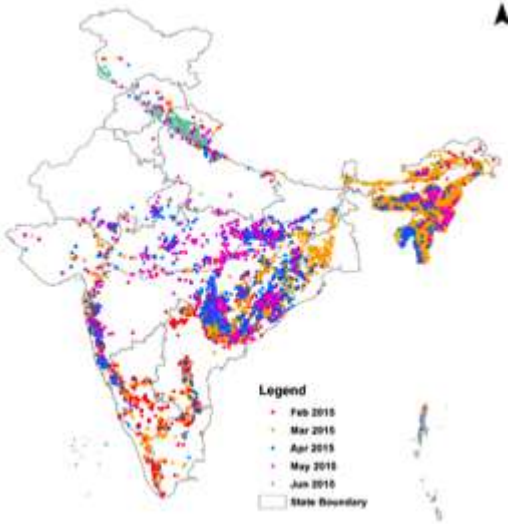
Forest Change in India 1930 - 2013



National Forest Biomass using multi-Resolution RS data

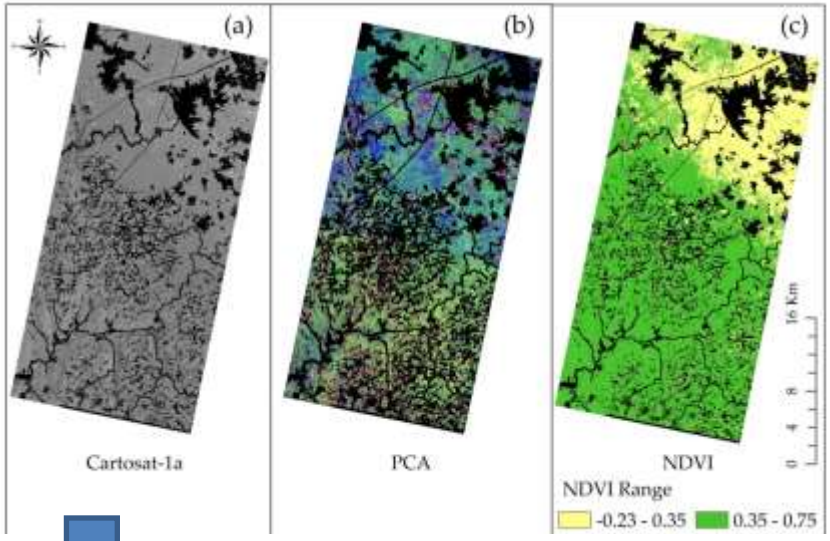


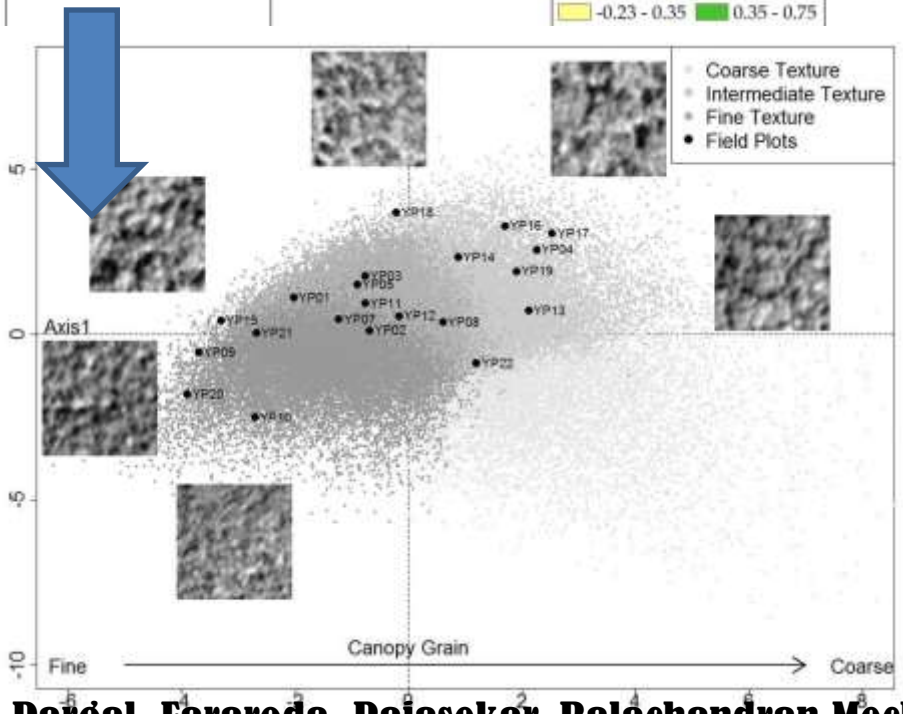
Annual Forest Fire Locations - 2015

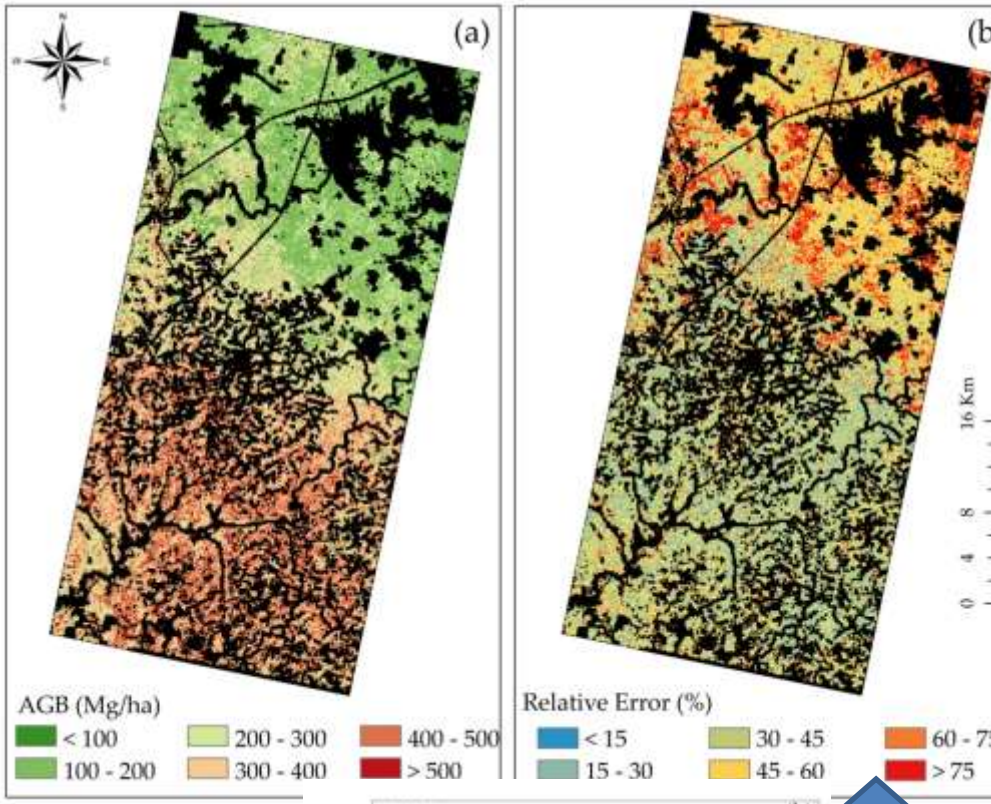


Automated annual forest loss using IRS AWiFS

FOTO Forest Biomass: Cartosat-1, Yellapur







Pargal, Fararoda, Rajasekar, Balachandran, Mechain, Barbier, Jha, Pelissier, Dadhwal, Couteron, 2016

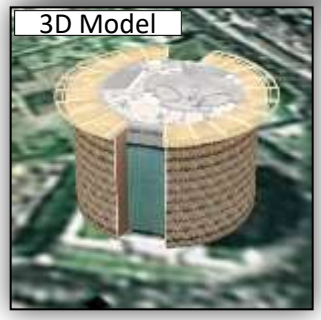
Remote Sensing, (Under Review)

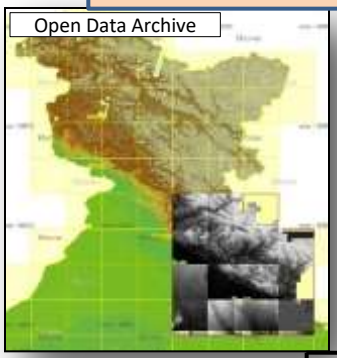
BHUVAN – Evolution of National GIS Platform

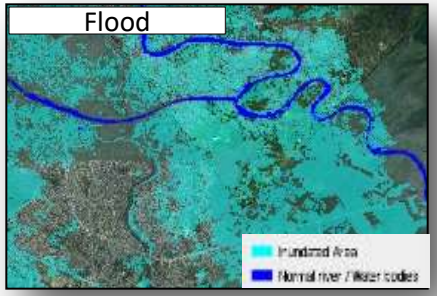
- 2009 Initiated as public web access EO data visualization
  - Challenges (i) Intercomparison, (ii) Niche, (iii) Usage, (iv) Response
- Step-wise annual updates for
  - Free /open data download
  - webGIS/ OGC compliant WMS/WMTS of all national maps by NRSC
  - Updating EO data content (resolution, location accuracy, ...)
  - Near real time disaster output sharing
  - State / thematic mashups
  - Platform for full applications
  - Geo-tagging
  - Mobile, multi-lingual
  - Platform upgrade with distributed services ...

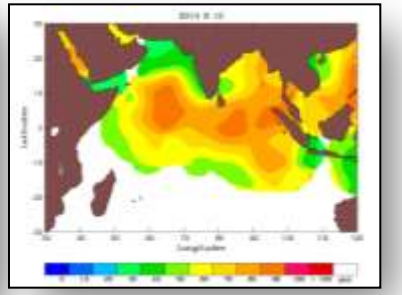
BHUVAN is rich in Content & Services >> Scaling up

- Satellite Map Terrain
- Base & Thematic Data
- Open Data Satellite Data & Products
- Bhuvan Applications
- SERVICES Disaster Weather Ocean
- Crowd Sourcing
  - Web
  - Mobile



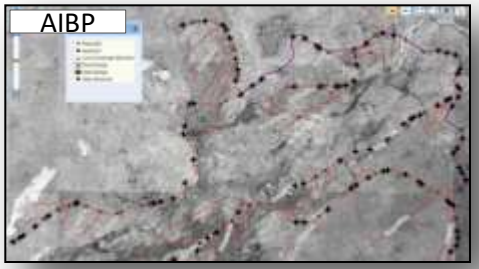


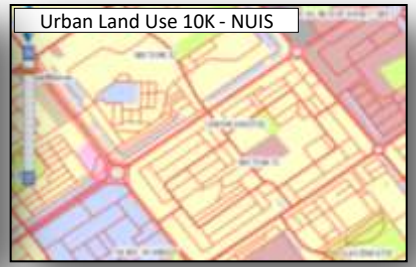




- Agriculture
- e-Governance
- Irrigation
- Tourism
- Urban
- + State Portals

- Land Use Waste Land
- Water Bodies and Floods
- Geomorphology / Lineament
- Erosion
- Salt effected water logging



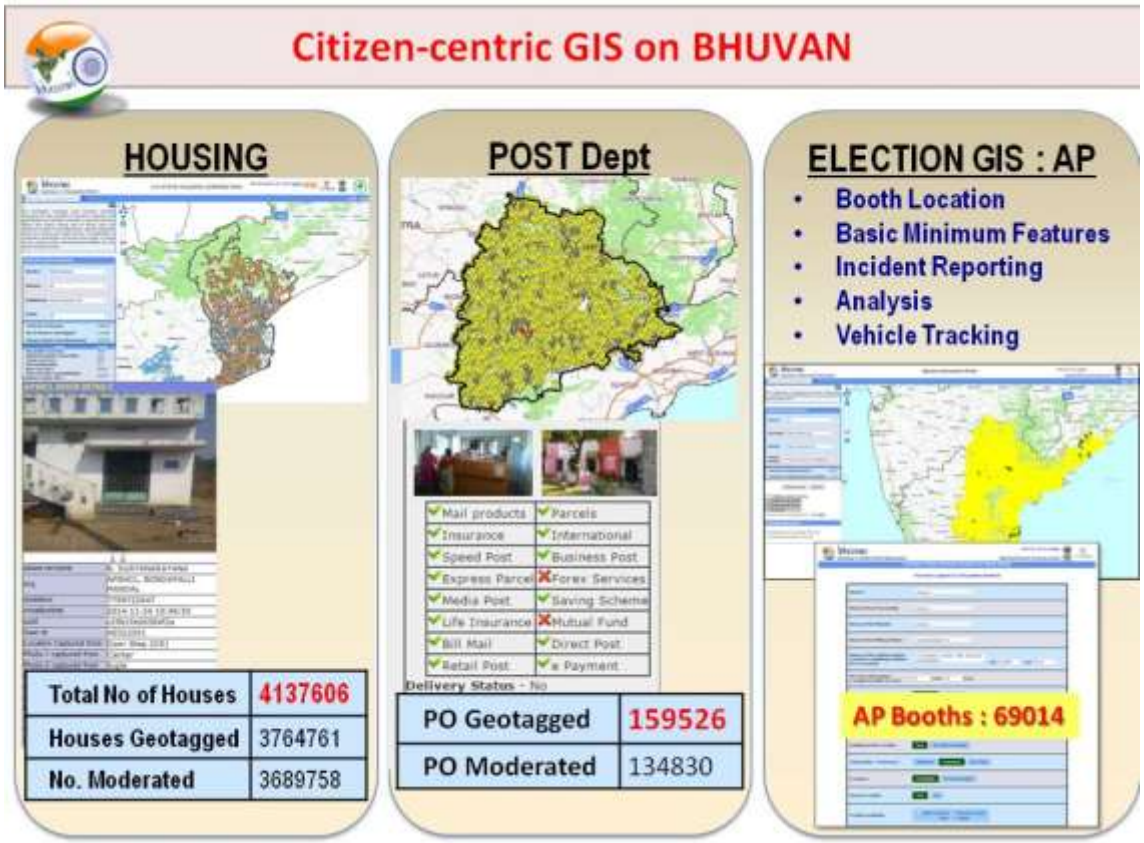


BHUVAN – *some quantification*

- EO Data Hosted on Bhuvan - 3 Trillion pixels processed
- 1m HR Data - 10.5 lakhs Sq Km
- 2.5m Cartosat + MX - 17 lakh Sq km (2014-16)
- Additional 6.5 Lakh Sq Km Project specific 2.5 m data
- Locations/ Points of Interest - 10 million
- Bhuvan Web Applications - 75+
- Mobile applications - 54
- Daily Unique Visitors : Sum in Month - 116000
- National Information System for Climate & Environment Studies
  - Geophysical Products – 58 (Available for download)
- OGC Compliant Map services - 6200+
- Base for User Geospatial Data –
  - 22 Ministries Applications and 30 State portals online

Use of BHUVAN in g/e-Governance

- Geotagging of resources/ activities *(leading to visualization [transparency], ciitizen use and planning)*
  - Post Offices and postal Services
  - Polling Booths (Andhra – Basic Minimum Facilities)
  - Housing for poor [
  - Health Facilities
  - Village Assets (Amenities)



Information Systems for Governance

- Examples
  - Railway Assets Information System (Min Railways)
  - Toll Information System (NHAI)
  - Postal Information System (Min Post & Telecom)
  - Financial Information System (Min Finance)
  - Airport Management System (Min Tourism/ AAI)
  - Health Information System (Min Health & Ayush)
  - School Information System (MHRD)
  - …

Bhuvan-GAIL: Gas Pipe Line Surveillance

Background

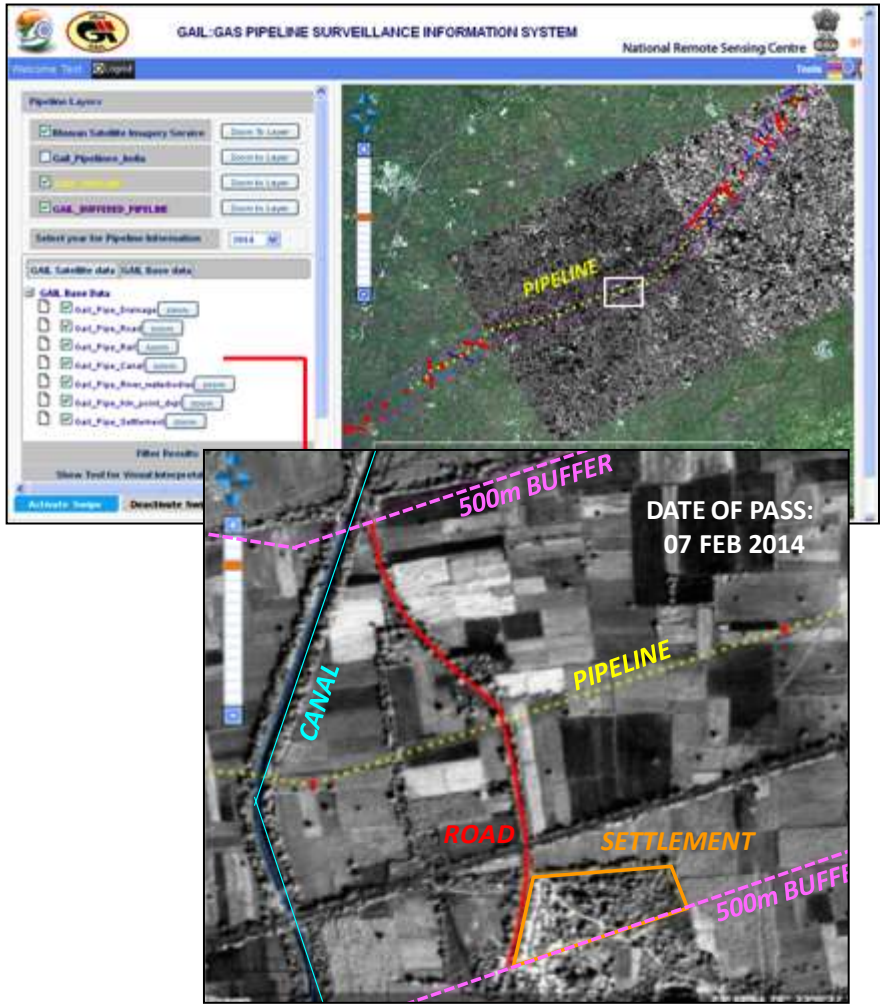
- GAIL India Ltd. Maintains 15,000 Km Pipe line infrastructure for Gas Transportatin.
- Regular Surveillance of Pipeline is mandatory over pipeline Right of Usage (ROU).

Objectives

- Develop Geospatial solution
- Near real-time Bhuvan Application for surveillance .

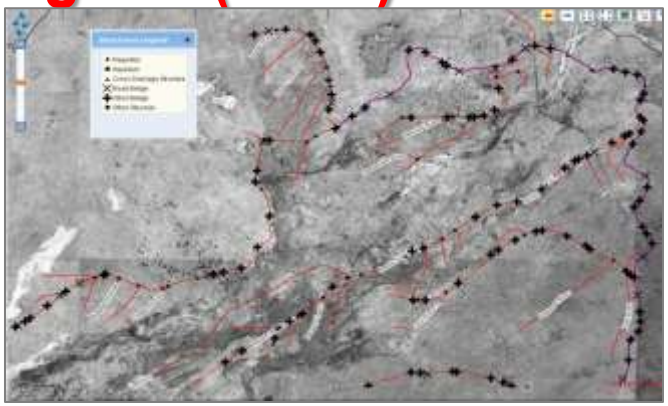
Challenges

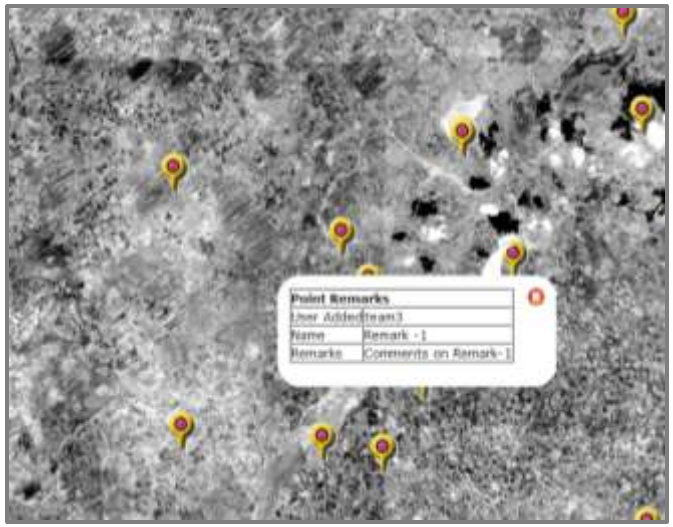
- Multi Satellite data coverage.
- Complimentary information
- Automatic in change analysis.
- Pilot implementation in progress

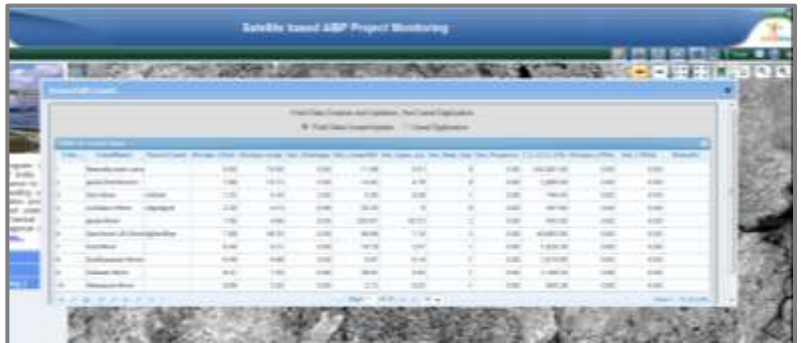


BHUVAN WebGIS Services - EO monitoring of Accelerated Irrigation Benefit Program (AIBP)

- Bhuvan – AIBP Portal: Facilitates Visualization of Irrigation projects
- Datasets Available for Visualization:
- Monitoring the Canal progress on Bhuvan
- Salient Features:
- Canal Digitization: Facilitates digitization of Canal Networks with Calculation of total Canal Length, No. of gaps, Gaps Segments Length through help of Cartosat data.
- Add Content option for Remark Notification
- 3 levels of Access Control
- Data Editing facility for Field Data.



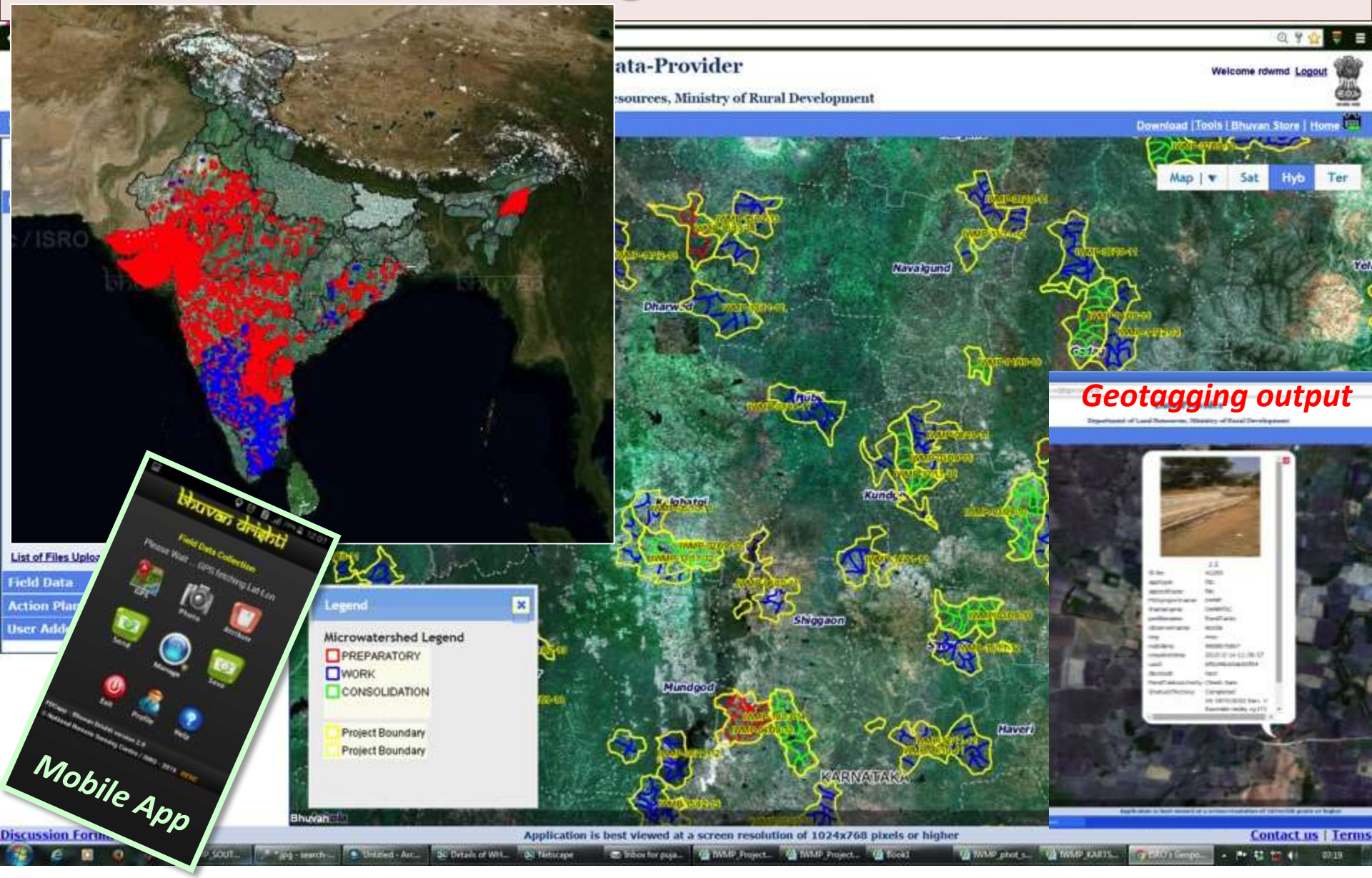




Geospatial Technology enabled Governance

- Use at all levels of Governance & most of departments
  - Panchayat, Blocks, Municipalities, Districts/Basins, States, National
- Use in planning, project implementation & monitoring, citizen access & transparency, policy & compliance
  - Urban – Housing for all, Smart Cities
  - Culture – Protected Monuments, Management Zones
  - Posts – Locations, services, postman beat
  - Petroleum – Pipeline monitoring for right of usage
  - Panchayati Raj - decentralised planning, panchayat assests
  - Land Resources – IWMP,
  - Drinking Water, Sewerage – Rural supply grids, disposal sites
  - CWC – Monitoring AIBP
  - Railways – Assets, Ticketing geo-fencing, Unmanned Crossings,..
  - ….

National Level Watershed Monitoring (IWMP)
Satellite images & Mobile tools



Future Directions

- Research for Operating in free/open mid-resolution EO data era
  - Landsat, OLI, Sentinel + ...
- Historical time series web-access/ API for server end processing
- Mobile devices with special sensors for field data colection