Indian Remote sensing Programmes and its Geospatial Data for Development.



Nagaraja Ravoori National Remote Sensing centre Indian Space Research Organisation INDIA



India Geosatial Forum 2013 22-24 January, 2013 Hyderabad



# **Recent Emphasis on Thematic Series**



# Indian EO data acquisition



## • Over India

 Acquired by NRSC from Ground Station at Shadnagar,

Global

- Acquired through onboard SSR
- Acquired through
   SVALBARD/TROMSO (Norway)
- Acquired through International Ground Stations





# Past Indian EO Sensors & Data acquisition



- IRS 1A (1988-1996) Shadnagar only
- IRS 1B (1991-1998) Shadnagar only
- IRS 1C (1996-2004) Shadnagar, SSR, IGS (39)
- IRS 1D (1997-2007) Shadnagar, SSR, IGS (39)
- IRS P4Oceansat 1 (1998-2010) Shadnagar, SSR, IGS (10)





IRS-P4 – IGS

India	South Korea	Germany	Malaysia
Australia	USA(5)		

# Current Indian EO Sensors – Data Acquisition



- IRS P5/Carto 1 : Shadnagar , OBSSR & IGS (7)
- Resourcesat 1: Shadnagar, OBSSR & IGS (9)
- Cartosat 2: Shadnagar , OBSSR & IGS (3 mobile)
- Oceansat-2: Shadnagar, OBSSR & IGS (3)
- Resourcesat -2: Shadnagar , OBSSR



# Indian EO : International Ground Stations



COUNTRY	<b>RESOURCESAT-1</b>	CARTOSAT-1
Abudabi	2006-2008	NA
		2005-
German	2004-continuing	continuing
		2007-
Myanmar	2004-continuing	continuing
Moscow	2004-2010	2006-2007
Magadhana	2008-2010	2007-2009
Irkutsk	2006-2009	2008-2009
		2007-
China	2005-continuing	continuing
Norman (US)	2003-continuing	NA
Fairbanks ( US)	2004-continuing	NA
Australia-1	2008-continuing	NA
Australia-2	2008-continuing	NA
Kazkistan	2005-2010	NA
Kazgeocosmos	2007-2008	NA
Cuiba	2009-continuing	NA
		2009-
EV-HAWAI (US)	NA	continuing





## IRS-P6 Global Acquisitions-Status 30-09-2008



data acquired over India for LISS-1V MX

 $\bigcirc$ 

#### International Outreach- Resellers RESOURCESAT-1 & CARTOSAT-1



#### **Earth Observation Satellites – Land missions**

																		RESC			
	L-1&2	L-2 Mee	1.2 MCC	L-4	L-5 Mee	1 5 TM	SPOT -			ERS-									RISAT		
1070	1070	1979	L-3 1033	WSS	W33			IKS-IA		1/2			IKS-FS		113-20	IKO-PC		4 3AT-2			
1980	1980	1980	1980									•Archi	val poli	cy impl	emente	d for I	RS-1A/1	LB &	-		
1981		1981	1981	1981								LANDS	SAT till	1997.							
1982		1982	1982	1982								4 Cov	erage's	per yea	r archi	ved					4
1983			1983	1983																	
1984				1984								After	1997 al	l the da	ta sets	are arc	hived				
1985				1985	1985	1985															
1986				1986	1986	1986						• Med	ia cost	t has co	me dov	wn					RISAT 1
1987				1987	1987	1987															
1988				1988	1988	1988	1988	1988				• Histo	orical da	ita aro i	nyalual	hlo					Microwave C-band
1989				1989	1989	1989	1989	1989				- mste			IIvalua	bie					
1990				1990	1990	1990	1990	1990				. Dutau		• • • • • •							
1991					1991	1991	1991	1991	1991			• Prior	to 198	s only i		ks data	availa	bie			
1992						1992			1992	1992										- 10 A	Decourse et 0
1993						1993			1993	1993	1993	3									Resourcesat 2
1994						1994			1994	1994	1994	1									LISS 3 (23m)
1995						1995			1995	1995	1995	1995									LISS 4 (5.8m)
1996						1996			1996		1996	1996	1996							ý	AWiFS (55m)
1997						1997			1997			1997	1997	1997							, , , , , , , , , , , , , , , , , , ,
1998						1998			1998			1998	1998	1998							
1999						1999			1999			1999	1999	1999							
2000						2000			2000	2000		2000	2000	2000							
2001						2001			2001	2001		2001	2001	2001							4
2002										2002		2002	2002	2002							CAPTOSAT-2
2003										2003		2003	2003	2003	2003						CARTOSAT-2
2004										2004		2004		2004	2004						PAN 1m
2005												2005		2005	2005	200					
2006												2006		2006	2006	2006				-	
2007												2007		2007	2007	2007	2007		-	- 🥂	5
2008															2008	2008	2008	5	-	_	
2009															2009	2009	2009		-	-	
2010															2010	2010	2010		4		
2011															2011	201	201	201			
2012						<u> </u>		<u> </u>			<u> </u>	<u> </u>	<u> </u>		2012	2012	1 2012	<mark>4</mark> 201	4 2012	4	Cartosat 1
																				<u> </u>	PAN-2.5M, F/A
			SPOT																		•
																					۵

Landsat MSS (82m) TM (30 m)





Multi Spectral (20m) Pan (10 m)



IRS-1A & 1B LISS-1&2 (72/36m)



IRS-1C/1D LISS-3 (23/70m) PAN (5.8m); WiFS (188m)



IRS-P3 WiFS, MOS X-Ray



#### Earth Observation Satellites – Ocean & atmospheric missions



Data Volume – Land Missions (in Tera Bytes)



OCM

#### Global coverage

## **Oceansat-2**





#### **Ku Band Scatterometer**





## **Remote Sensing Data Policy 2011**

As per RSDP 2011 :

All data resolutions up to 1 m shall be distributed on a nondiscriminatory basis and on "as requested basis".

All data better than 1m resolution will be supplied after excluding sensitive areas as below.

All Government Ministries/ Departments/ PSU / Autonomous bodies/ Govt. Educational Institutions can obtain the data without any further clearance with safe custody certificate.

Private sector Users recommended by at least one Government agency can obtain the data without any further clearance.

Other Private, Foreign and other users can obtain the data after further clearance from an inter-agency High Resolution Image Clearance Committee (HRC).







![](_page_16_Picture_0.jpeg)

![](_page_17_Picture_0.jpeg)

![](_page_18_Picture_0.jpeg)

![](_page_19_Picture_0.jpeg)

![](_page_20_Picture_0.jpeg)

![](_page_21_Picture_0.jpeg)

![](_page_22_Picture_0.jpeg)

![](_page_23_Picture_0.jpeg)

![](_page_24_Picture_0.jpeg)

![](_page_25_Picture_0.jpeg)

![](_page_26_Picture_0.jpeg)

![](_page_27_Picture_0.jpeg)

![](_page_28_Picture_0.jpeg)

![](_page_29_Picture_0.jpeg)

![](_page_30_Picture_0.jpeg)

![](_page_31_Picture_0.jpeg)

![](_page_32_Figure_0.jpeg)

#### **Thrust Areas :**

- National Mapping Missions;
- Disaster Management Information Support ;
  - Climate Change Studies
- Research & development in upcoming technologies
- Information services through integrated NR Mapping & GIS

## **Major National Mission Programmes**

![](_page_33_Figure_1.jpeg)

# Towards Enhancing Agricultural Productivity

#### In-season forecast...

![](_page_34_Picture_2.jpeg)

CAPE/ FASAL: Area Statistics (MoA)

#### Effective Input/ Output Management

![](_page_34_Picture_5.jpeg)

Fertiliser Req. Assessment (IFFCO)

#### Horticultural Inventory

![](_page_34_Figure_8.jpeg)

Banana; Maize; Tobacco; Chillies; cotton; Paddy National Horticulture Mission (MoA)

#### Crop intensification/ extensification

![](_page_34_Picture_11.jpeg)

Salinity Mapping for reclamation (CWC)

# Towards Improving Water Use Efficiency

Performance evaluation of irrigation commands for improving WUE (MoWR)

![](_page_35_Picture_2.jpeg)

#### Tank Inventory for increasing Irrigation potential (GoKar)

![](_page_35_Picture_4.jpeg)

AIBP: Accelerated Irrigation Benefit Programme (CWC)

- Mapping irrigation infrastructure
  - Assessment of IP created
  - Percentage completion
    - Critical gap areas

![](_page_35_Picture_10.jpeg)

#### Reservoir Storage Loss Assessment (CWC)

![](_page_35_Picture_12.jpeg)

#### ...more Crop per Drop...

## **Gaps in Canal stretch**

![](_page_36_Picture_1.jpeg)

# **Minors off taking from Distributary**

## Towards Improving the Livelihoods

![](_page_37_Figure_1.jpeg)

![](_page_37_Figure_2.jpeg)

![](_page_37_Picture_3.jpeg)

# Stages to reach Grass Roots & Benefits of PFZ

![](_page_38_Figure_1.jpeg)

## Towards Building Infrastructure

#### (Physical)

#### **National Urban Info System**

![](_page_39_Picture_3.jpeg)

#### **Rural road connectivity**

![](_page_39_Picture_5.jpeg)

#### Road/ Rail pipeline alignment

![](_page_39_Picture_7.jpeg)

#### Hydropower site selection

Powerk

![](_page_39_Picture_9.jpeg)

#### Geomorphology

#### Geology

Land use / Land cover

# **Towards Building Infrastructure**

#### Social

![](_page_40_Figure_2.jpeg)

# India - WRIS WebGIS

Generation of Database & Implementation of Web Enabled Water Resources Information System In the Country

> देश में जल संसाधन आँकड़ों का जनन व वेब सामर्थ्य सूचना प्रणाली का क्रियान्वयन

![](_page_41_Picture_3.jpeg)

![](_page_42_Figure_0.jpeg)

Main Information System – 12					
١.	BASE DATA INFO SYS				
н.	SURFACE WATER INFO SYS				
ш.	GROUND WATER INFO SYS				
IV.	HYDRO – MET INFO SYS				
v.	WATER QUALITY INFO SYS				
VI.	SNOW COVER / GLACIER INFO SYS				
VII.	INLAND NAVIGATION WATERWAYS INFO				
VIII.	INTER-BASIN TRANSFER LINKS INFO SYS				
IX.	HYDROLOGICAL EXTREMES INFO SYS				
х.	LAND RESOURCES INFO SYS				
XI.	WATER TOURISM INFO SYS				
XII.	SOCIO – ECONOMIC INFO SYS				

## Main Information System – 12 Sub System – 35, Layers – 114 and Attributes - > 4500

![](_page_43_Picture_1.jpeg)

#### 1. Base Data Info Systems

1. Administrative

2. Region

4. Terrain

![](_page_43_Picture_5.jpeg)

#### 2. Surface Water Info Systems

- 5. Water Resource Division
- 9. Surface Water Body10. Water Resources Projects
- 11. Command Area

3. Infrastructure

- 7. Watershed
- 8. River

Basin

6.

shed 12. Minor Irrigation 13. Canal

![](_page_43_Picture_13.jpeg)

- 14. Aquifer / Litholog
- 15. Ground Water Level
- 16. Ground Water Potential (RGDWM)

![](_page_43_Picture_17.jpeg)

#### 4. Hydro - Met Info Systems

- 17. Meteorological 18. Climate
- Hydro Observation
   Flood Forecasting

![](_page_43_Picture_21.jpeg)

#### 5. Water Quality Info Systems

- 21. Surface Water Quality
- 22. Ground Water Quality

![](_page_43_Picture_25.jpeg)

23. Snow Cover / Glacier

![](_page_43_Picture_27.jpeg)

- 7. Inland Navigation Waterways Info Systems
  - 24. Inland Navigation Waterways

![](_page_43_Picture_30.jpeg)

8. Inter - Basin Transfer Links Info Systems

31. Wasteland

32. Soil

25. Inter - Basin Transfer Links

![](_page_43_Picture_33.jpeg)

- 9. Hydro Met Extremes
  - 26. Flood 27. Drought
  - 28. Extremes Events

![](_page_43_Picture_37.jpeg)

#### **10. Land Resources Info Systems**

29. Land Use / Land Cover30. Land Degradation

![](_page_43_Picture_40.jpeg)

- **11. Water Tourism Info Systems** 
  - 33. Water Tourism

![](_page_43_Picture_43.jpeg)

- **12. Socio Economic Info Systems**
- 34. Rural 35. Urban

# **Towards Building NR Assets**

### Wasteland Mapping

 Total wastelands in the country

 64 Mha (2000)
 55 mha (2003)
 47 mha (2006)
 46 mha (2008)
 Wasteland Atlas

 Digital database
 A Targeted Rural Programme: with village & watershed boundaries overlaid

2005

2007

2009

#### **Forest Cover Mapping** (biannual)

- Forest Survey of India
  - 1987 onwards (Landsat MSS to IRS LISS III)
  - Forest cover in 2010: 67.8 Mha (20.64%)
  - 1:50,000 scale

#### **Natural Resources Census**

![](_page_44_Picture_9.jpeg)

Inventory of Natural Resources & Periodic monitoring

![](_page_44_Picture_11.jpeg)

Soil, Geomorphology, land use, land degradation, Vegetation, Water resources, Snow/Glacier

![](_page_44_Picture_13.jpeg)

- **Snow/ Glacier Mapping** 
  - Snow-melt Runoff
     Forecasting
  - Glacier inventory (2169 glaciers; 25,469 sq km)
  - Glacier Retreat Study

Input to Climate Change/ Hydrologic modeling

# Towards building Disaster Resilience

**Disaster Management Support Programme** 

![](_page_45_Picture_2.jpeg)

## Decision Support Centre (DSC) Services

#### Seasonal Monitoring

#### **Floods**

![](_page_46_Picture_3.jpeg)

- Flood Inundation Maps
- Damage Assessment
- Hazard Zonation
- Bank Erosion Studies

#### Drought

![](_page_46_Picture_9.jpeg)

- MonthlyAgril.
  - **Drought Report**
- End-of-the-Season
- Agril. Drought Report

#### Forest Fire

![](_page_46_Picture_15.jpeg)

Active Fire Detection
Damage Assessment

#### **Event Based Monitoring**

#### Earthquake

![](_page_46_Picture_19.jpeg)

Damage
 Assessment

#### Cyclone & Tsunami

![](_page_46_Picture_22.jpeg)

- Inundation MapsRecession Maps
- Damage
   Assessment

![](_page_46_Picture_25.jpeg)

Damage
 Assessment
 Hazard Zonation

Information Dissemination <u>Central</u>: MHA, CWC, Min. of Agri, GSI, IMD, MOEF <u>State</u>: Relief Commr., DM, Agri, Forest, other concerned Line Depts.

## SIS- DP

![](_page_47_Figure_1.jpeg)

![](_page_48_Picture_0.jpeg)

## Web based Spatial data delivery

Bhuvan opens the door to graphic visualization of digital geospatial India allowing individuals to experience the fully interactive terrain viewing capabilities.

#### **NRSC DATA Archives**

![](_page_49_Figure_3.jpeg)

Forest &

Soils

Geomorpholo

Wetlands

Snow Cover /Glacier

Land Degradation

Land Use /Land Cover

•AWiFS -1: 250000

• LISS III - 1 : 50000

NR Census Layer

-182 MSS L-2 MSS L-3 MSS L-4 MSS L-5 MSS L-5 TM SPOT -1 NOAA IRS-1A IRS-1B ERS-1/2 IRS-P2 IRS-1C IRS-P3 IRS-1D IRS-P4 MODIS IRS-P6 IRS-P6 IRS-P6 

#### National Data base on Natural Environment Multi-institutional initiative

Natural Resource Census-NNRMS & User projects

	Land use/Land cover : 250K	(ISRO)					
Vegetation	Land use/Land cover : 50K	(ISRO)					
v	Land Degradation	(ISRO & National Bureau of Soil Survey)					
	Snow and Glaciers	(ISRO & Ministry of Environment & Forests					
	Soil	(Soil and Landuse Survey of India & ISRO)					
	Geomorphology	(ISRO & Geological Survey of India)					
ШР	Vegetation Type	(Forest Survey of India & ISRO)					
	Wetland	(ISRO & Ministry of Environment & Forest)					
	Biodiversity *	(ISRO & Dept. of Biotechnology)					
	Ground water*	(ISRO & Min. of Rural Development)					
	Wasteland* (ISRO & Min. of Rural Development						
	Irrigation Infrastructure and water R	esources* (ISRO & Min. of water resources)					
	* Users Projects						

![](_page_50_Picture_0.jpeg)

Bhuvan Gateway to Indian Earth Observation Data Products & Services

# Goal×

To manifest the distinctiveness of Indian Earth Observation capabilities through online rendering of multi-resolution, multi-temporal multi-sensor IRS imagery;
> overlaying value added thematic information on 2D/3D virtual globe;
> providing satellite data and products for download;
> consume thematic datasets as OGC web services;

And online Geo-Processing

Release 1 12 Aug 2009

www.bhuvan.nrsc.gov.in

# Uniqueness

Availability of Uniform high resolution data

![](_page_51_Picture_2.jpeg)

Multi- Sensor, Temporal, Platform IRS series of satellites

**Rich Thematic Information** 

Weather Data from ISRO AWS 🚺

Ocean Services 🙀

![](_page_51_Picture_7.jpeg)

**Collaboration/Sharing/Community Participation** 

**Online Shape file Creation** 

Thematic data sets to consume as Web Services

**Terrain Profile** 

**Multi-Lingual** 

![](_page_51_Picture_13.jpeg)

Free Data Download (CartoDEM, AWiFS(2008, 2009), LISS-III (2008-09)

![](_page_52_Figure_0.jpeg)

# Data in Bhuvan (RSDP Policy) Raster Data

- IRS -P6 AWiFS 56 m (visualize + download)
- IRS P6 LISS III 23 m (visualize + download)
- IRS P6 LISS IV 5.8 m
- Cartosat 1 2.5 m (for 102 Cities)
- Cartosat -2 (Foreign Cities + 5 Indian cities) 1 m
- Oceansat 1 & 2 OCM 180m
- Cartosat-1 'Digital Elevation Model' (download))

IRS - Indian Remote Sensing Satellite AWiFS- Advanced Wide Field Sensor LISS – Linear Imaging Self Scanning Sensor OCM – Ocean Color Monitor

![](_page_53_Picture_9.jpeg)

![](_page_53_Picture_10.jpeg)

# Vector Data – Base Layers Administrative Boundaries : Image: Imag

## **Thematic Information**

![](_page_54_Picture_2.jpeg)

Groundwater prospects

![](_page_54_Picture_4.jpeg)

Watershed

![](_page_54_Picture_6.jpeg)

![](_page_54_Picture_7.jpeg)

![](_page_54_Picture_8.jpeg)

Land Use Land Cover (LULC) (visualize + consume as OGC service)

Flood data-sets (visualize + consume as OGC service)

# **Information Services on Bhuvan**

Volunteered Geographic Information

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Weather information

![](_page_55_Picture_4.jpeg)

Disaster Specific Datasets

![](_page_55_Picture_6.jpeg)

![](_page_55_Picture_7.jpeg)

![](_page_55_Picture_8.jpeg)

Ocean Services

![](_page_55_Picture_10.jpeg)

![](_page_55_Picture_11.jpeg)

# Use cases

"Platform to create, visualize, share, analyze Geospatial data products and services "

Few of the areas where exactly how Bhuvan is used are:

## As a Map Centric Application

- APNIC showcasing school information using Bhuvan (Sarva Sikshya Abhiyan)
- India Geoportal towards National Spatial Data Infrastructure
- INFFRAS Dissemination and Visualization of Forest Fire alerts through Bhuvan

## **Moving towards User Centric Applications**

- BNHS For Important Bird Area (IBA) Mapping and Birds migration
- Snajeevini Labs For Incident reporting
- Rajiv Awas Yojana(RAY) Technology demonstrated to NGO (SPARC, Mumbai) on how to use Bhuvan for delineating the Slum Boundaries and visualizing them on Bhuvan

![](_page_56_Figure_11.jpeg)

![](_page_56_Figure_12.jpeg)

![](_page_56_Picture_13.jpeg)

![](_page_56_Picture_14.jpeg)

![](_page_56_Picture_15.jpeg)

![](_page_56_Picture_16.jpeg)

Slum Mapping Bhuvan Cell, NRSC

#### Andhra Pradesh – Forest Department

- Community Forest Management
  - 1. Visualization and querying
  - 2. Online Editing
  - 3. Spatial Query (Dynamic)
  - 4. Analysis and Report
  - 5. User data Upload(Shape File)

#### "Van Samrakshan Samiti ; Species Information"

![](_page_57_Picture_9.jpeg)

![](_page_57_Picture_10.jpeg)

#### Karnataka – Forest Department

- Forest Monitoring System
  - 1. Geospatial query
  - 2. Monitoring of Assets
  - 3. Online shape file creation
  - 4. Change Analysis
  - 5. Forest Fire alert

"Beat boundary; Asset layers; VFC; Green India Mission; Elephant Corridor; Forest Types"

Bhuvan Cell, NRSC

Rajasthan – Rajasthan Road Development Agency

- PRADHAN MANTRI GRAM SADAK YOJANA
- Value addition and updation of GIS database

![](_page_58_Picture_4.jpeg)

"OGC Web Services towards interoperability "

- Jharkhand Space Application center
  - Towards Point of Interest and linking with Management Information System

"School data; Health data – District Hospital to Community Health Centre"

- Punjab Punjab Remote Sensing Centre / Tourism Department
  - Point of Interest Data having 46 classes towards tourism Tourist Places, Hotels, ATMs, Banks, Restaurants, Railway Station, Airport etc
  - Ground Photographs and Land use
    - 1. Facility Search
    - 2. Proximity Analysis
    - 3. Routing

![](_page_58_Picture_15.jpeg)

- Water Resources AIBP
  - 1. User added cartosat-1 data (private) on Bhuvan
  - 2. Drawing / chainage on Bhuvan
  - 3. Stored graphic in client for reference
  - 4. Download as shape file and chainage value as txt file

![](_page_59_Picture_6.jpeg)

- 1. Citizen
  - I. Viewing and querying as a layer group
  - II. Reporting
- 2. Planner
  - I. Editing
  - II. Versioning
- 3. Administrator
  - I. Monitoring

![](_page_59_Picture_15.jpeg)

![](_page_59_Picture_16.jpeg)

- CRRI-CSIR, Ministry of Road Transport and Highways
  - 1. National Highways data base
  - 2. Tracing of Road and features
- Ministry of Railways
  - 1. Data Submission through Bhuvan for Indian Railways

# **Upcoming Features**

- 1. Bhuvan Maps
- 2. Location Based Services
- 3. Integration of Geomorphology, LDD, Forest Fire Regime, LHZ, WSA etc

![](_page_60_Figure_10.jpeg)

![](_page_60_Picture_11.jpeg)

For Indian Railways

#### Decentralized Planning Space Based Information Support for SIS-DP Satellite Image Thematic Cadastral Maps Data "Empowering Panchayats for Prosperity" Assests Climate Mapping Data SIS-DP Gram Panchayat Socio-Panchayat Samiti economic Data Zilla Parishad

Bhuvan

**Geo - Panchayats** 

Activity

**Planning &** 

Monitoring

#### Economic Benefits

#### Rs. Millions

	Program	Nature of Benefit	Estimate from Case Studies	Potential Benefit to the country in the Long-run
1.	National Drinking Water Technology Mission	Cost saving due to increase in success rate	2,560 (5 States)	5,000 – 8,000
2.	Urban Area Perspective / Development / Zonal / Amenities Plan for Cities / Towns	Cost saving in mapping	50.4 (6 Cities)	16,000 – 20,000
3.	Forest Working Plan	Cost saving in mapping	2,000 (200 Divisions)	11,860
4.	Potential Fishing Zone Advisories	Cost saving due to avoidance of trips in non-PFZ advisories	5,450	16,350
5.	Wasteland Mapping: Solid Land Reclamation	<b>Productivity</b> gain	990 (UP)	24,690
6.	Integrated Mission for Sustainable Development: Horticultural Development in Land With and Without Shrub	Gross income	Rs.0.20 to 0.40 (per hectare)	13,000 – 26,000
7.	Bio-prospecting for Medicinal Herbs	Value of Indian life saving drugs		800

![](_page_63_Picture_0.jpeg)