Indian Space Programme
&
Country Report to 5th GEOSS-AP

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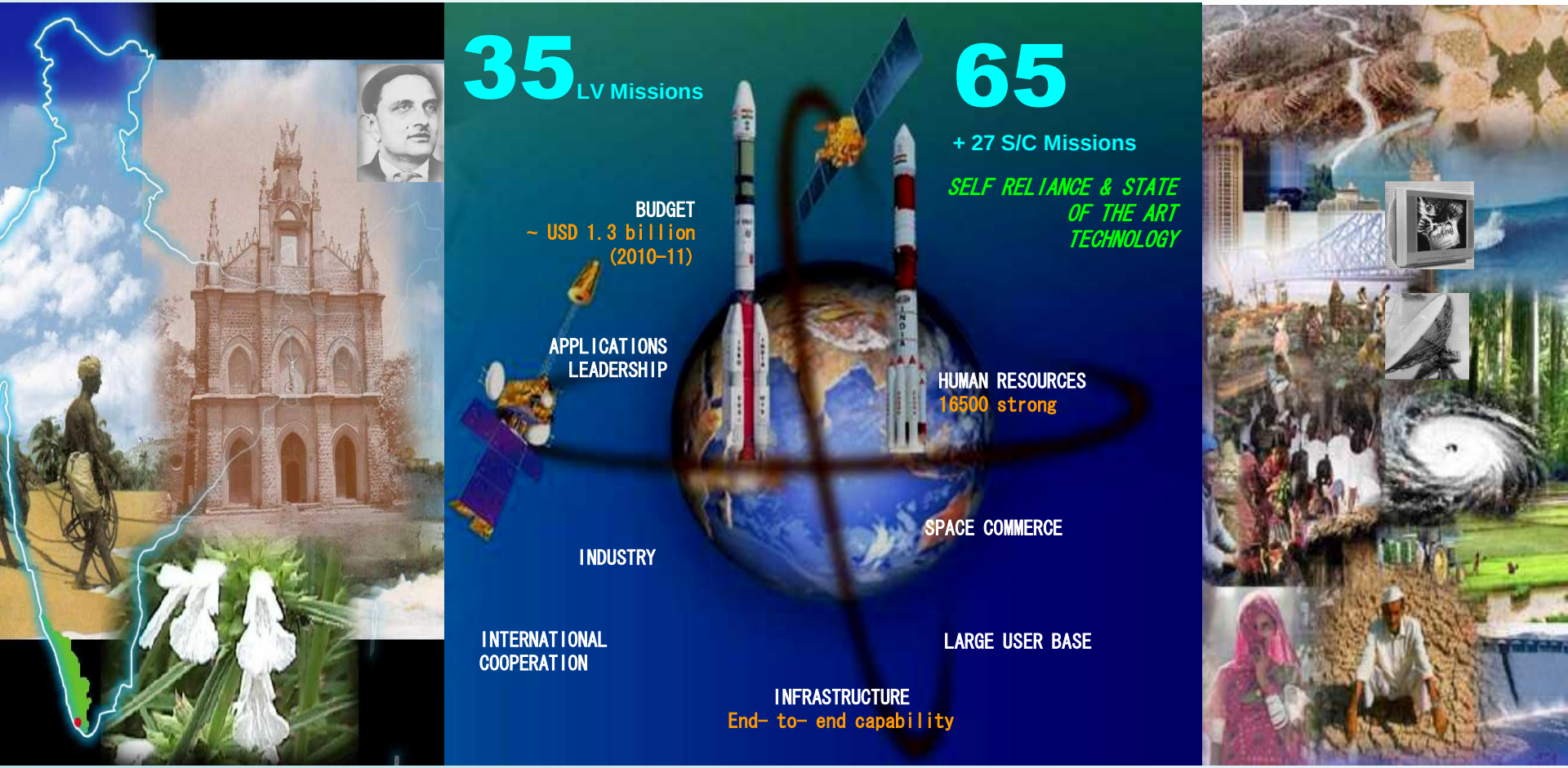
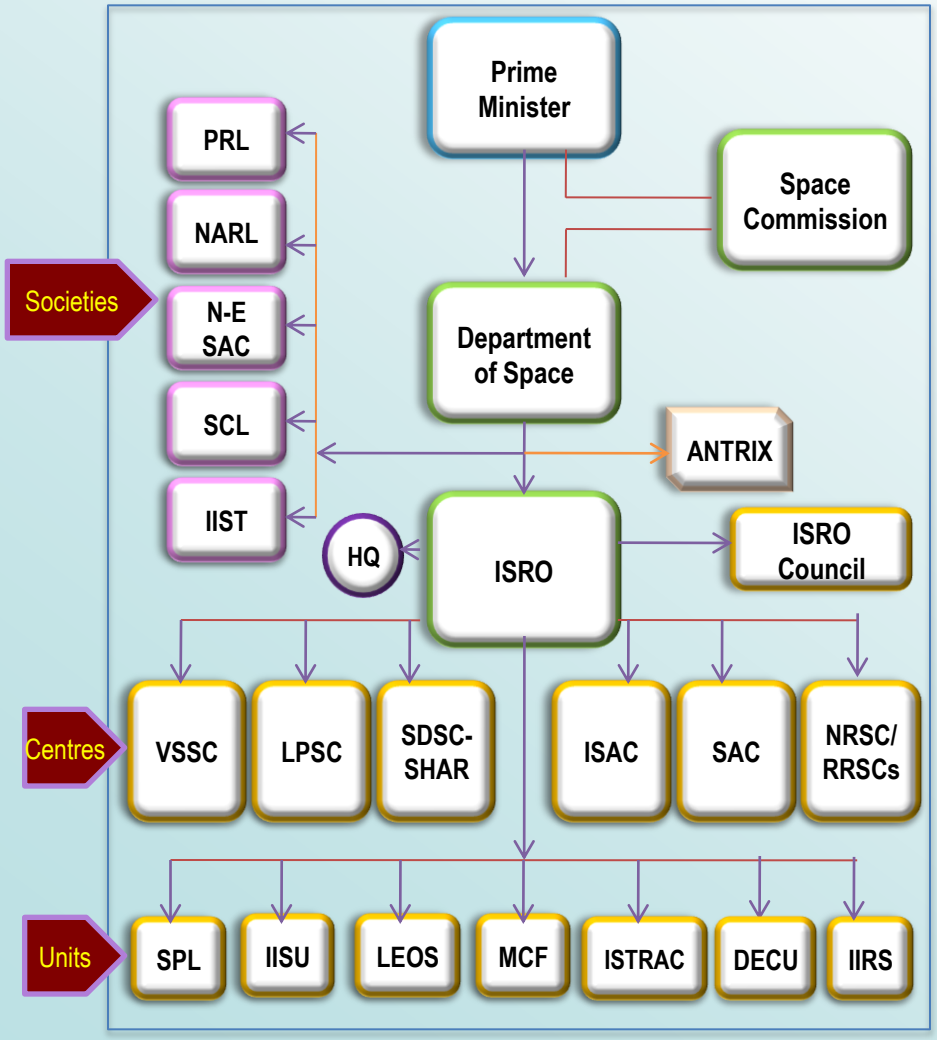
5th GEOSS Asia-Pacific, April 2-4, 2012, Tokyo, Japan

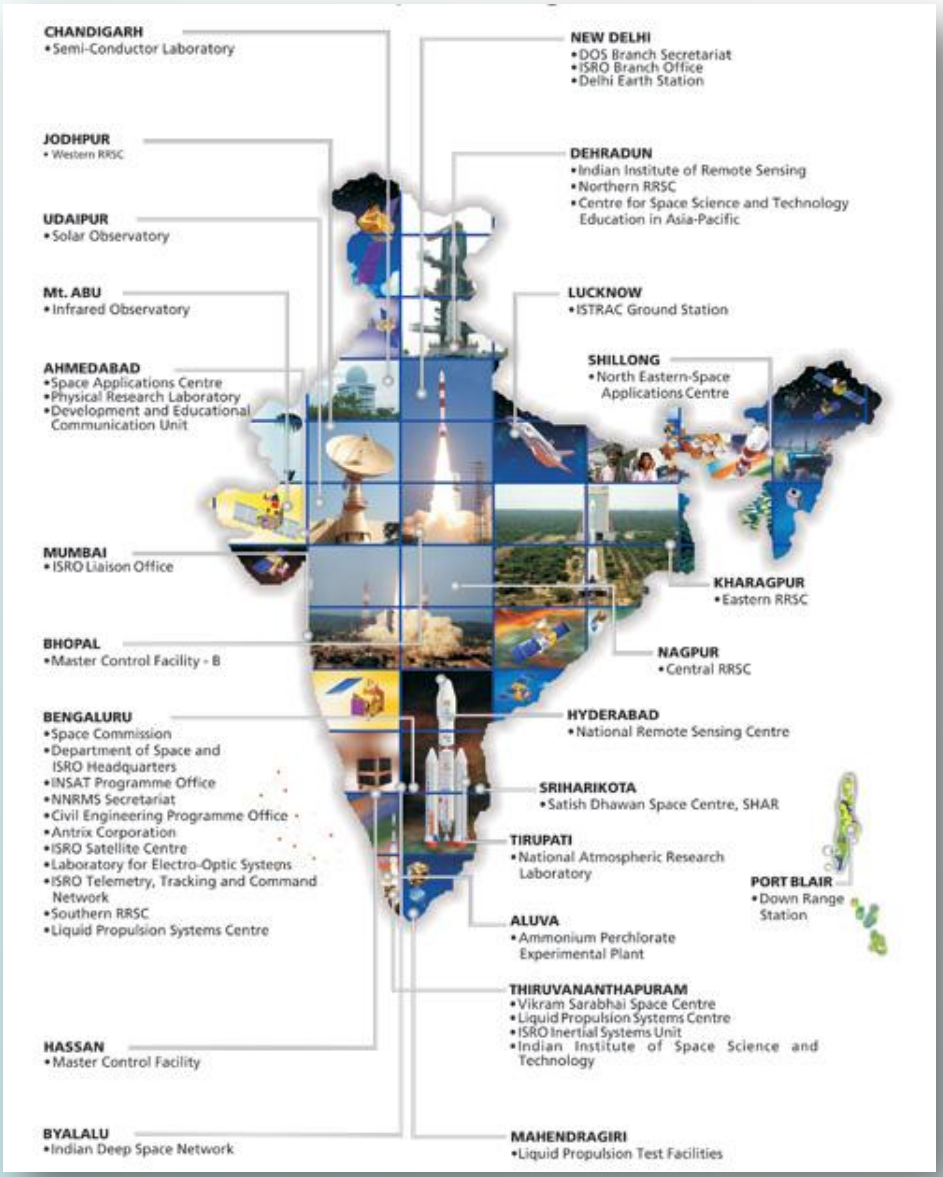
Indian Space Programme as of now…



- Self reliance in space transportation, spacecraft operations
- Leadership in Applications

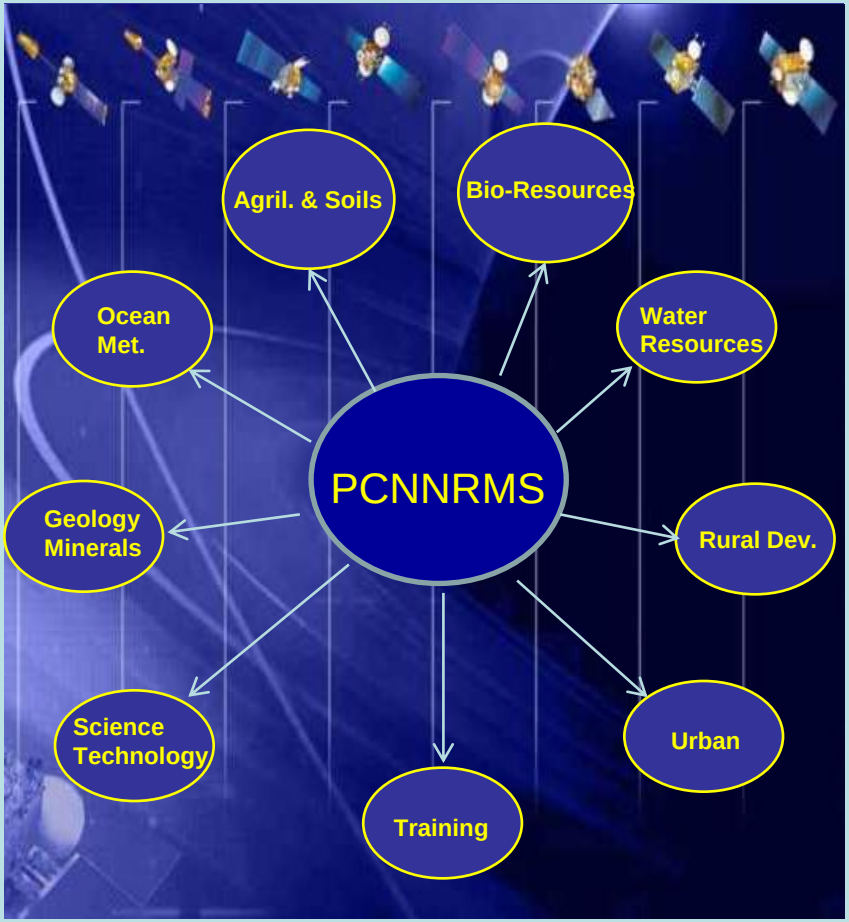
ISRO - The Organisation





National Framework for EO Applications

National Natural Resources Management System (NNRMS)



Standing Committees- 9
Represented by entire EO Community

The EO Community

National

Govt. of India, Ministries and Departments
Agriculture, Forest, Earth Science, Water...

States

State Remote Sensing Applications Centres-24
RS Cells in State Urban Planning, Water etc.

Academia

Indian Inst. of Tech., Universities, Colleges…
Research, Applications Projects, S/W Dev.

NGO's

Non-Government Org.s & Professional Societies

Commercial

Private Industry
Nationally Distributed, Address Applications Projects, S/W……

Launch Facility & Launchers

Early vehicles

Operational

Operational

New Generation

PSLV	GSLV	GSLV-MkIII
294 tonnes	414 tonnes	629 tonnes
1.3 in SSO/ 1.05 in GTO	2 in GTO	4 in GTO / 10 in LEO
Flights: 19 (1994 –2011)	Flights: 7 (2001-10)	2013

India's current Space Assets

Communication Satellites

Currently 10 operational satellites; 168 Transponders

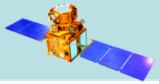
Indian Imaging Capability

Geo stationary



INSAT-2E	KALPANA-1	INSAT-3A
VHRR, CCD	VHRR	VHRR,CCD
1999	2002	2003

Sun Synchronous

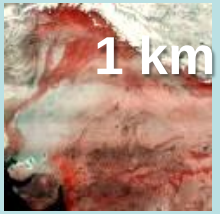




TES	RESOURCESAT-1/2	CARTOSAT-1
PAN	LISS 3; LISS 4; AWiFS	PAN, F/A
2001	2003/11	2005

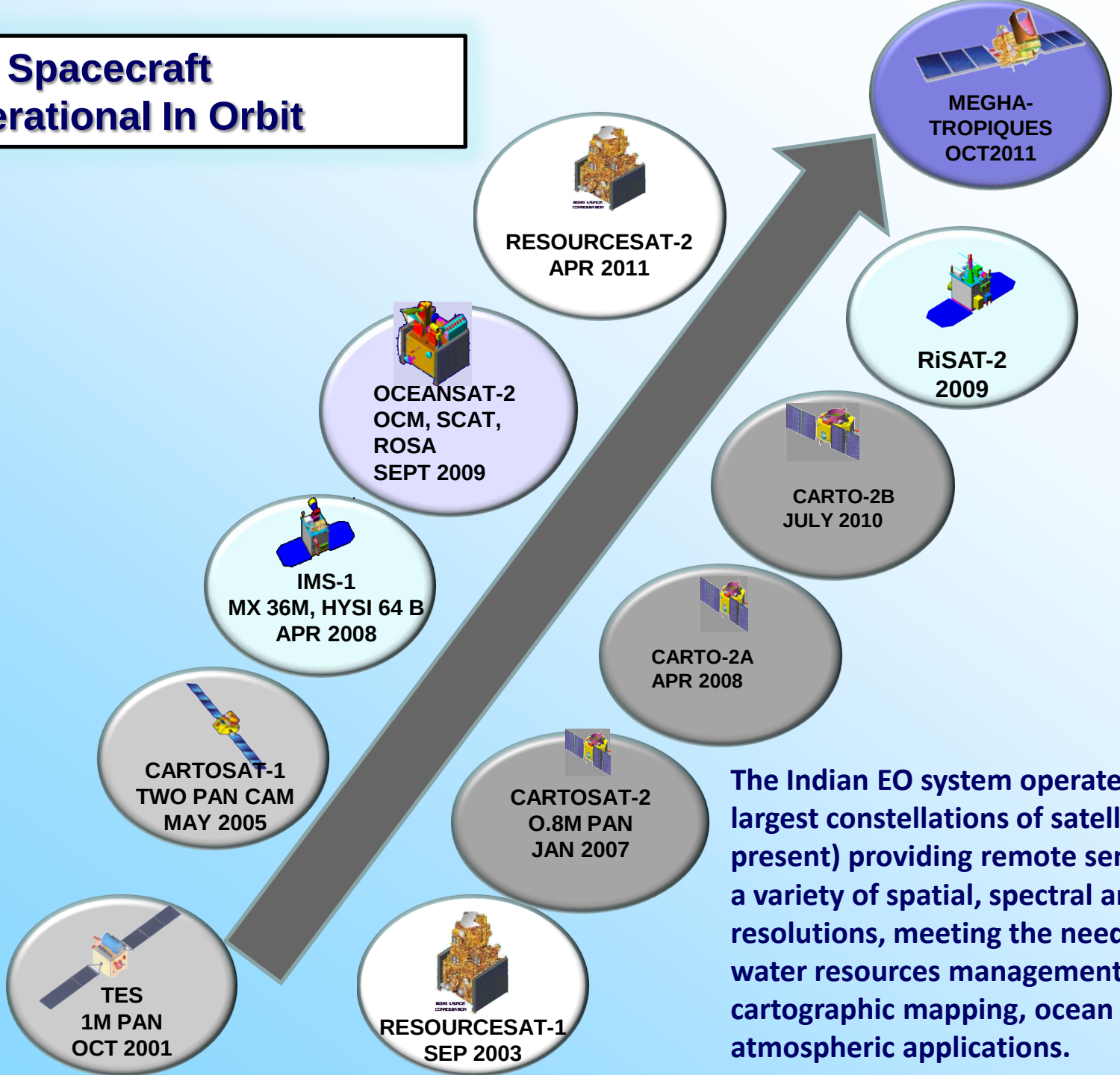




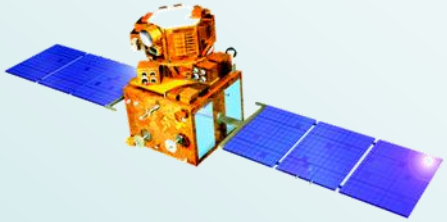
CARTOSAT-2/2A/2B, PAN	IMS - 1 HYSi, MX	RISAT-2 X-SAR	Oceansat-2 OCM, SCAT, ROSA	Megha-Tropiques MADRAS, SAPHIRE, SCARAB ROSA
2007/ 08/ 10	2008	2009	2009	2011



IRS Spacecraft Operational In Orbit



The Indian EO system operates one of the largest constellations of satellites (11 at present) providing remote sensing data in a variety of spatial, spectral and temporal resolutions, meeting the needs of land and water resources management, cartographic mapping, ocean and atmospheric applications.



Resourcesat-2

Launch: 20 April 2011

- **3 Cameras (AWiFS, LISS 3, LISS 4)**
- **Repetitivity: 5 days (AWiFS) to 24 days (LISS 3) & Revisit : 5 days (LISS 4)**
- **Spatial resolution of 5.8 m (LISS 4) – 56 m (AWiFS)**
- **Swath of 70 km (LISS 4) to 740 km (AWiFS)**

Data products

- Improved radiometric quality
- Ortho-Rectification using CartoDEM
- Improved Geo-location accuracy
- Automatic LISS-4 MX Registration

Registered LISS-4 FMX

SSR : 200 Gb for 12 min. recording of each payload of LISS-4 or LISS-3 + AWIFS
Capability : Steerable with ± 26 deg. across track
Payload can be operated in every orbit for a duration of 16 min.

Megha-Tropiques - A Joint ISRO-CNES Mission

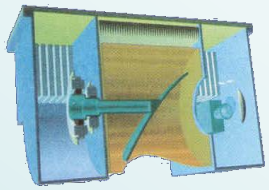
Launch: 12 Oct 2011

For studying water cycle and energy exchanges to better understand the life cycles of the tropical convective system

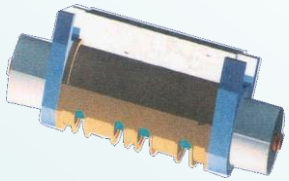
Low inclination (20º) for frequent simultaneous observations of tropics

- **Water vapour**
- **Clouds**
- **Cloud condensed water**
- **Precipitation**
- **Evaporation**

SAPHIR



SCARAB



MADRAS

ROSA

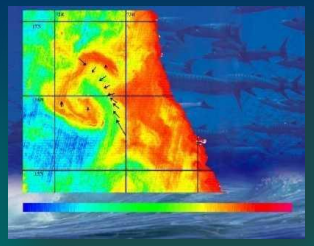
Contributing to Global Precipitation Mission (GPM)

Payload	Type	Characteristic	Data Type
MADRAS	Microwave imager	Five Frequency, 9-channel Microwave imager 18, 23, 36, 89 and 157 Ghz All in V and H Polarisations except for 23 GHz (V only)	Surface wind speed, total water vapour, cloud liquid water, rainfall, cloud ice
SAPHIR	Sounder	Six-channel millimetre wave Humidity sounder at 183 Ghz (Water vapour Resonance Frequency)	Vertical humidity profiling at 6 altitudes with good horizontal resolution
SCARAB	Scanner	Four-channel Earth radiation budget instrument 0.5-0.7 µm, 0.2-4 µm, 10.5-12.5 µm, 0.2-200 µm, with a spatial resolution of 40 km	Long-wave radiation fluxes
ROSA	Sounder	Radio Occultation System to obtain vertical profiles of humidity, temperature, Aerosol contents, etc., GPS receivers at L1 and L2 channels	Vertical profiles of humidity, temperature, and aerosol contents with good vertical resolution

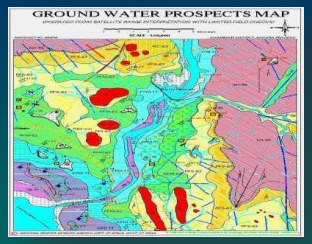
Applications for Societal Outreach

Agriculture

Fisheries

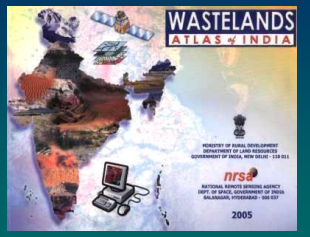


Drinking Water

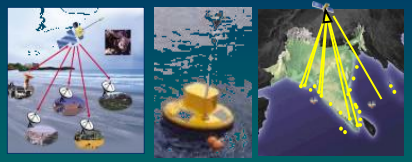


Watershed Development

Wasteland mapping

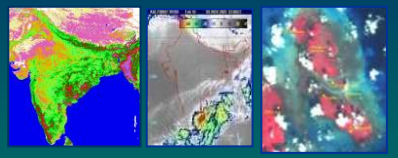


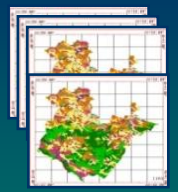
Disaster Management Support (DMS) System



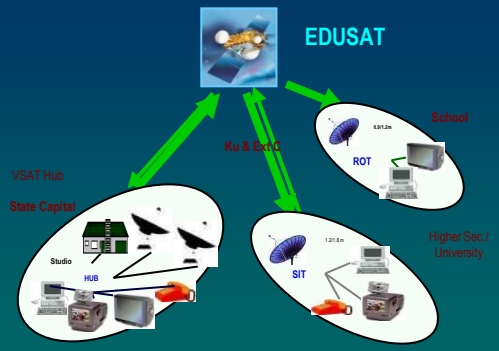
Networking, Early Warning
[CWDS, IOTWS, INFFRAS, ..]

NDEM, Hazard Zonation,
Risk Assessment, …



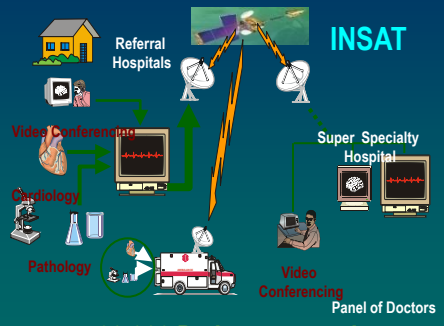


Tele-Education



> 55,000 Virtual Class Rooms

Tele-Medicine

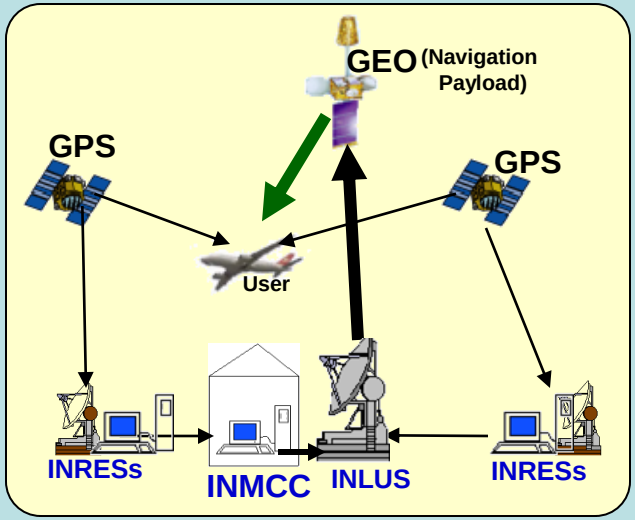


~ 500,000 Patients treated

Village Resources Centre

Satellite Navigation

GAGAN: GPS & Geo-Augmented Navigation

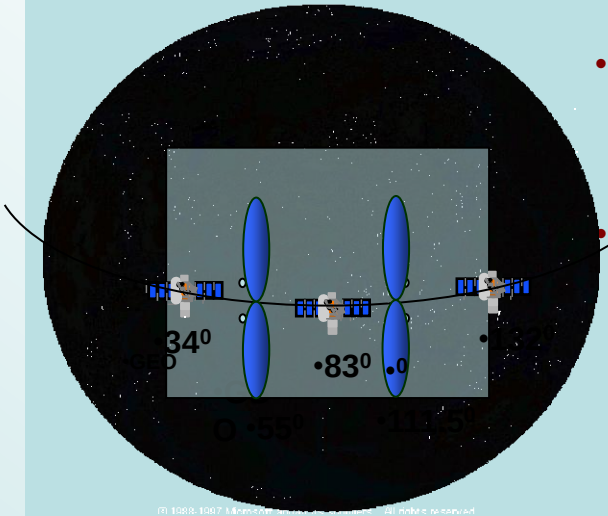


GAGAN Coverage

Gagan Uplinking Facility

Improved Positioning Accuracies (from 30m to 6m)

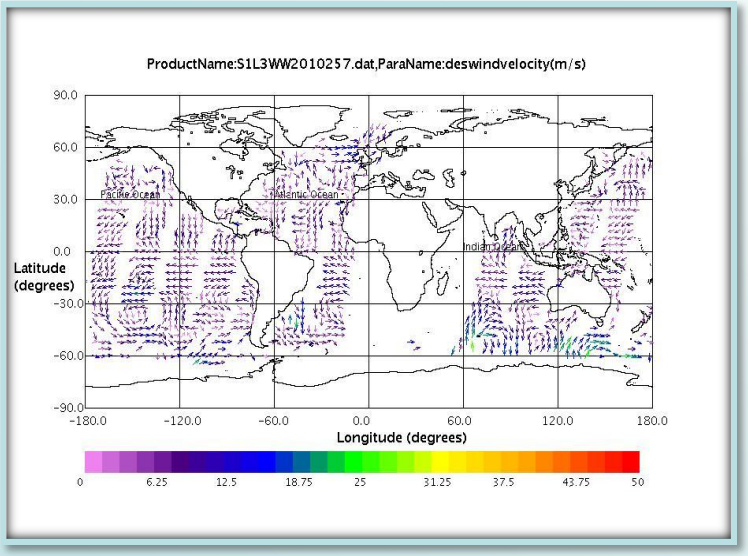
IRNSS: Indian Regional Navigation Satellite System (2012-14)



- Constellation of 7 satellites in GSO/ GEO
- Reliable Position, Navigation & Timing services over India & its neighbourhood

- GAGAN: Technology Demonstrator Ground segment completed; One payload is already in GSAT-8
- IRNSS: Configuration of the Spacecraft & Ground segment finalized; Development of onboard subsystems, navigation software & user receivers in progress

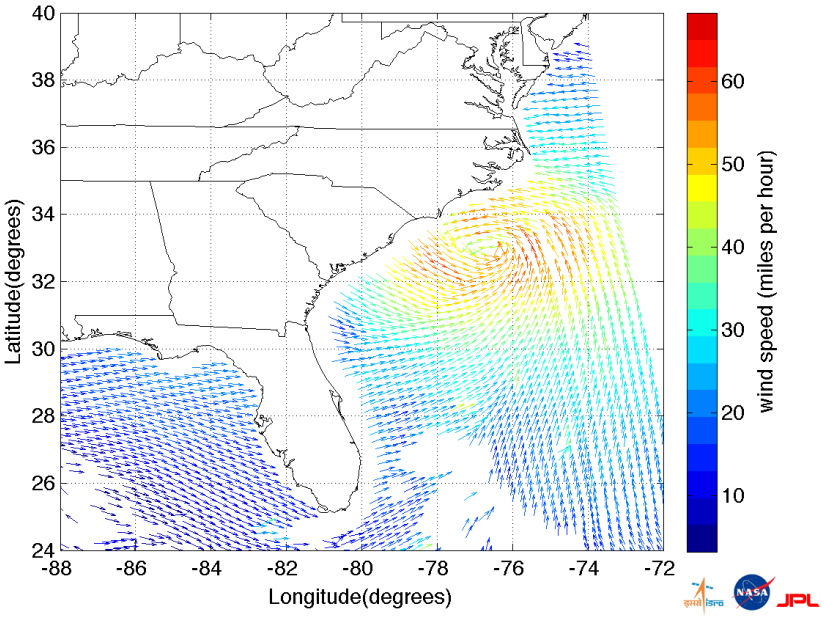
OCEANSAT 2 OCM and Scatterometer Global Wind vector products

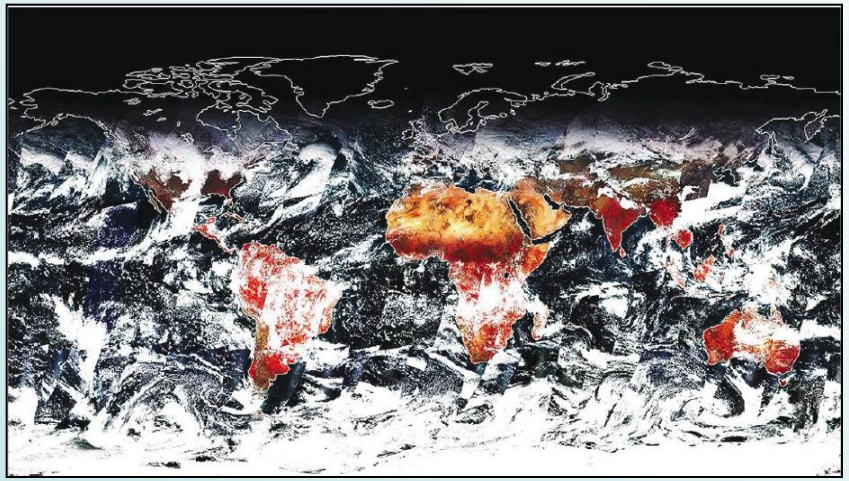


Global SCAT data acquisition, processing & dissemination: within 150 min using SVALBARD data link

Data made available from NRSC WeB and EUMETCAST

Hurricane "Irene"





OCM data - GAC

Capacity building

CSSTE-AP

Indian Institute of Remote Sensing, Dehra Dun

Space Applications Centre, Ahmedabad

Physical Research Laboratory, Ahmedabad

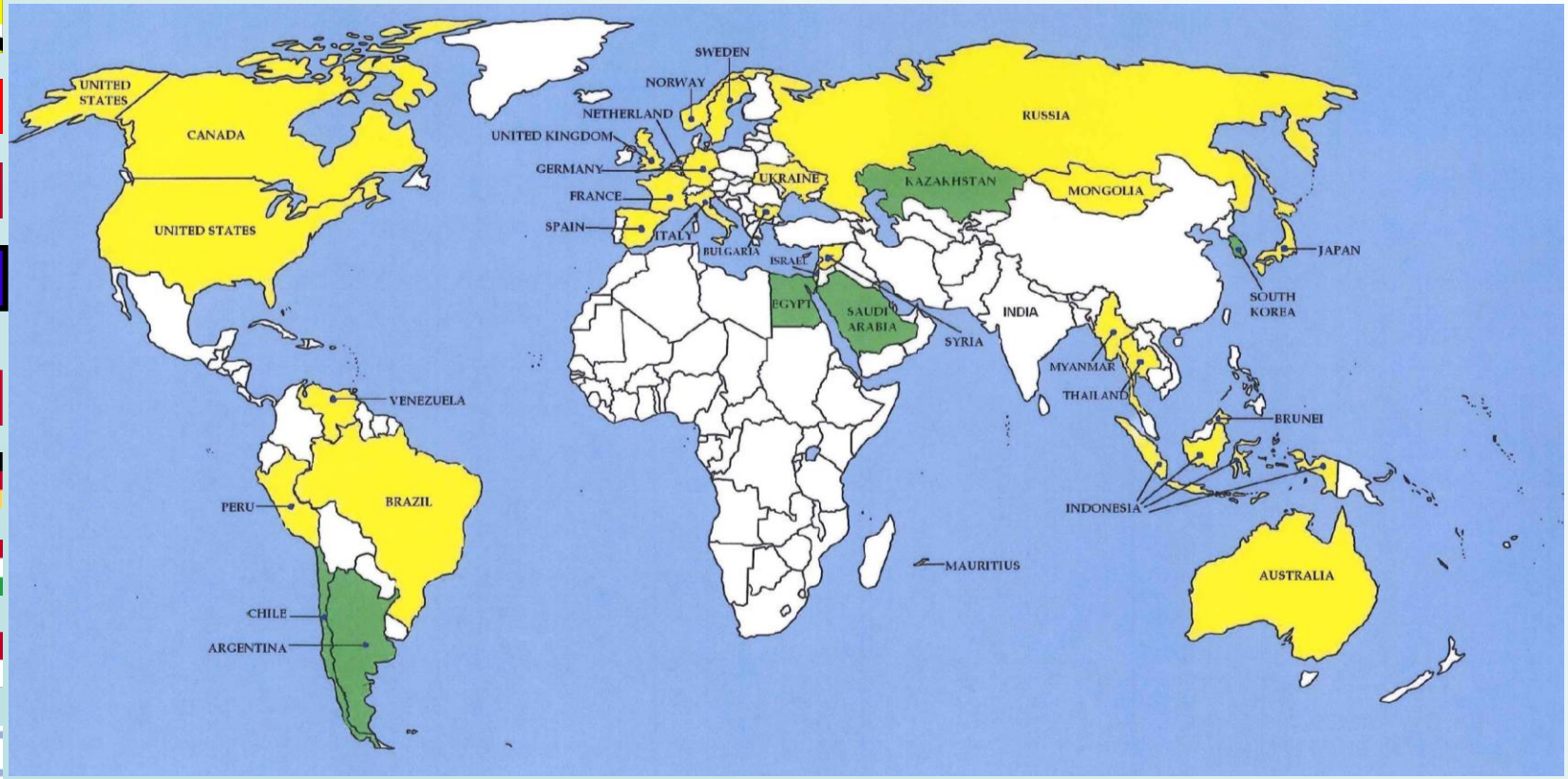
- United Nations Centre for Space Science & Technology Education in Asia & the Pacific (CSSTE-AP) established in India for benefitting Asia Pacific Countries in Space Technology
- Offers 10 Months Post Graduate Courses in:
  - Remote Sensing & GIS
  - Satellite Communications
  - Satellite Meteorology
  - Space Science
- 994 participants from 31 Countries in this region
- 28 participants from 17 Countries outside this region

Indian Institute of Space Science & Technology

- Setup in September 14, 2007 under DOS, GOI
- The first professional Space University in India - the third in the World
- Offers programmes in Space Science and Space Technology in Aerospace Engineering, Avionics and Physical Sciences

International Cooperation

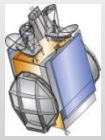
- Policy coordination
- Joint Missions
  - Megha Tropiques
  - SARAL
- Payloads
  - Chandrayaan 2
  - ROSA in Oceansat-2
  - UV detector in Astrosat
- Capacity Building
- Emergency Management
  - Intl. Charter
  - Sentinel-Asia
  - Search & Rescue



Cooperative arrangements are in place with 34 Countries/ Organisations

ANTRIX Corporation

Reaching Indian Space Excellence to the Global Markets……



W2M HYLAS

Two satellite contracts from Europe - In alliance with EADS Astrium

Contracts for 2 PSLV Launches;
9 MICRO/ NANO Satellites

IRS Data marketed thru' 20 Foreign Stations

- Remote Sensing Satellites, Data and Services
- Communications Satellites & Services
- Satellite Components
- Launch Services
- Ground Systems and Other Services
- Mission Support
- Consultancy & Training

Customer Profile

HUGHES SPACE COMMUNICATIONS, MATRA MARCONI SPACE, CNES, DLR, BRASILIAN INDUSTRY etc., SPACE IMAGING, MDA, ALENIA, RESTEC, EUTELSAT, AVANTI…

Intn'l Launches

KITSAT (Korea), TUBSAT & BIRD (Germany), PROBA (Belgium), LAPAN-TUBSAT (Indonesia), PEHUENSAT (Argentina), AGILE (Italy), Polaris (Israel), NLS-4, NLS-5, RUBIN-8

Transponders Leased

126 from INSAT

+ 80 from Foreign Satellites

ISRO's contribution to CEOS Virtual Constellations

1. Land Surface Imaging (LSI) – Resourcesat-2
2. Ocean Colour Radiometry (OCR) – Oceansat-2 OCM
3. Ocean Surface Vector Wind (OSVW) - Oceansat-2 Scatterometer
4. Precipitation (PC) – Megha-Tropiques
5. Ocean Surface Topography (OST) – SARAL
6. Atmospheric Composition (ACC)
7. Sea Surface Temperature (SST-VC) - (*under discussion*)

Major contributions of India/ISRO to GEO activities

Support to GEO

- Participation in GEOSS Societal Benefit Areas (SBAs)
- Support to GEOSS Data Sharing Principles and co-chairing the Data Sharing Task Force (DSTF)
- Supporting the GEO Task on Forest Carbon Tracking (FCT)
- Hosting the Secretariat for Global Agricultural Monitoring (GEO Task AG-01);
- Co-chairing the User Interface Committee (UIC)

Support to CEOS

- ISRO is CEOS Chair 2012 and will be hosting the 26th CEOS Plenary in India
- ISRO Chaired the CEOS Working Group on Education and Training (1st WGEdu) and defined its strategy
- Support to space based virtual constellation
- Co-chairing the LSI study team and development of WGISS portal on LSI
- Support to CEOS data handbook

Participation in GEOSS-AP

- Hosting a GEOSS-AP in 2011-12 was planned
- Organising 5th GEOSS-AP(On request for transfer) was taken up
- All ground work including Official clearances, Programme outline, Identification of a New Working Group on “Agriculture and Food Security”, Identification of WG Co-Chairs, Venue selection, Website etc. was done.
- Only Letter of Agreement had remained, now the Draft agreeable to GEO and Govt. of India is also ready.

Readiness for 6th GEOSS-AP

All preparatory work done and available for use is offered

Theme: ? (To be discussed)

- Let us Plan Rio+ 20+20 Scenario
- EO to Plan Rio+20+20
- Suggestions from the House Invited

THANK YOU