25 Years of Indian Remote Sensing Satellite (IRS) Series

Vinay K Dadhwal
Director
National Remote Sensing Centre (NRSC), ISRO
Hyderabad, INDIA

50th Session of Scientific & Technical Subcommittee of COPUOS, 11-22 Feb., 2013, Vienna
The Beginning

- 1962: Indian National Committee on Space Research (INCOSPAR), at PRL, Ahmedabad
- 1963: First Sounding Rocket launch from Thumba (Nov 21, 1963)
- 1967: Experimental Satellite Communication Earth Station (ESCES) established at Ahmedabad
- 1969: Indian Space Research Organisation (ISRO) established (15 August)
## Pre IRS-1A Satellites

- ARYABHATTA, first Indian satellite launched in April 1975
- Ten satellites before IRS-1A (7 for EO; 2 Met)
- 5 Procured & 5 SLV / ASLV launch

<table>
<thead>
<tr>
<th>Date</th>
<th>Satellite</th>
<th>Instrument</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr 19, 1975</td>
<td>ARYABHATTA</td>
<td></td>
<td>First Satellite</td>
</tr>
<tr>
<td>Jun 07, 1979</td>
<td>BHASKARA – 1</td>
<td>TV (1km 2 band), SAMIR (Repeat)</td>
<td>First EO Satellite (Repeat)</td>
</tr>
<tr>
<td>Nov 20, 1981</td>
<td>BHASKARA – 2</td>
<td></td>
<td>For SLV Exptl Flight</td>
</tr>
<tr>
<td>Aug 10, 1979</td>
<td>ROHINI</td>
<td></td>
<td>For SLV Dev. Flight</td>
</tr>
<tr>
<td>Jul 18, 1980</td>
<td>RS - 1</td>
<td></td>
<td>For ASLV Dev. Flight</td>
</tr>
<tr>
<td>May 31, 1981</td>
<td>RS – D1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apr 11, 1983</td>
<td>RS – D2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar 24, 1987</td>
<td>SROSS - 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apr 10, 1981</td>
<td>INSAT-1A</td>
<td>VHRR (2.75/11 km VIS/TIR) (Repeat)</td>
<td>Geostationary</td>
</tr>
<tr>
<td>Aug 30, 1983</td>
<td>INSAT-1B</td>
<td></td>
<td>Meteorological</td>
</tr>
</tbody>
</table>

**SAMIR**: 3 band MW Radiometer  
**SROSS**: Stretched Rohini Series Satellite
Indian Remote Sensing Satellite (IRS) – 1A

- First Operational EO Application satellite, built in India, launch USSR
- Carried 4-band multispectral camera (3 nos), 72m & 36m resolution

Satellite Launch: March 17, 1988
Baikanur Cosmodrome Kazakhstan
Since IRS-1A

- Established of operational EO activities for
  - EO data acquisition, processing & archival
  - Applications & institutionalization
  - Public services in resource & disaster management
  - PSLV Launch Program to support EO missions
  - International partnership, cooperation & global data sets
### Early IRS Multispectral Sensors

- **1st Generation**: IRS-1A, IRS-1B
- **2nd Generation**: 3 tier image (WiFS/AWiFS), SWIR band; IRS-1C/1D, Resourcesat-1/2

<table>
<thead>
<tr>
<th>Mission</th>
<th>IRS-1A</th>
<th>IRS-1B</th>
<th>IRS-1C</th>
<th>IRS-1D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>975 kg</td>
<td>975 kg</td>
<td>1250 kg</td>
<td>1250 kg</td>
</tr>
<tr>
<td>Onboard power@</td>
<td>600 Watts</td>
<td></td>
<td>809 Watts/(9.6 sqm)</td>
<td></td>
</tr>
<tr>
<td>Payloads, (Solid State Push Broom Camera)</td>
<td>LISS-1 (72.5 m)</td>
<td>LISS-2A , 2B (36.25 m)</td>
<td>WiFS (189 m)</td>
<td>LISS-3 (23.6m) &amp; PAN (&lt;6m)</td>
</tr>
<tr>
<td>Onboard TapeRecorder</td>
<td>-</td>
<td>-</td>
<td>62 Gb</td>
<td>62 Gb</td>
</tr>
<tr>
<td>Launch Vehicle/ Site</td>
<td>Vostok, Baikanur, Kazakhstan</td>
<td>Molniya, Baikanur, Kazakhstan</td>
<td>PSLV C1, SHAR, India</td>
<td></td>
</tr>
<tr>
<td>Orbit # (ht km)</td>
<td>904 km</td>
<td>904 km</td>
<td>817 km</td>
<td>740 x 817 km</td>
</tr>
<tr>
<td>Inclination</td>
<td>99.08°</td>
<td>99.08°</td>
<td>98.69°</td>
<td>98.69°</td>
</tr>
<tr>
<td>Repetivity/ (Orbits)</td>
<td>22 days / (307 orbits)</td>
<td></td>
<td></td>
<td>24 days</td>
</tr>
</tbody>
</table>
### ISRO EO SATELLITES

**GEO / MET**
- **INSAT-1A**
- **INSAT-1B**
- **INSAT-1C**
- **INSAT-1D**
- **INSAT-2A**
- **INSAT-2B**
- **INSAT-2C**
- **INSAT-2D**
- **INSAT-2E**
- **KALPANA-1**
- **INSAT-3A**

**ISRO: 1975-2012**
- **101 Missions**
- **(68 Sat/ 33 Launch)**

**Meteorological Satellites:**
- Arayballa
- BSO, ROHINI, 1976
- BSK2, RS-D1 1988
- RS-D2

**Oceanographic Application Satellites:**
- IRS-1A
- IRS-1B
- IRS-1C
- IRS-1D
- IRS-1E
- IRS-P2
- IRS-P3
- IRS-1F

**Cartographic Satellites:**
- P4 OCEANSAT1
- TES
- P5 CARTOSAT-2
- P5 CARTOSAT-2A
- P5 CARTOSAT-2B
- P5 RESOURCESAT-1
- P6 RESOURCESAT-1
- P6 RESOURCESAT-2
- P7 RESOURCESAT-2

**Meghatropiques:**
- INS-1

**SARAL:**
- INSAT-3D

---

**ISRO EO SATELLITES**

<table>
<thead>
<tr>
<th>Year</th>
<th>Satellite</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>Arayballa</td>
</tr>
<tr>
<td>1976</td>
<td>BSO, ROHINI</td>
</tr>
<tr>
<td>1979</td>
<td>BSK1, RS-D1</td>
</tr>
<tr>
<td>1981</td>
<td>BSK2, RS-D1</td>
</tr>
<tr>
<td>1982</td>
<td>RS-D2</td>
</tr>
<tr>
<td>1988</td>
<td>IRS-1A</td>
</tr>
<tr>
<td>1989</td>
<td>IRS-1B</td>
</tr>
<tr>
<td>1991</td>
<td>IRS-1C</td>
</tr>
<tr>
<td>1992</td>
<td>IRS-1D</td>
</tr>
<tr>
<td>1993</td>
<td>IRS-1E</td>
</tr>
<tr>
<td>1994</td>
<td>IRS-P2</td>
</tr>
<tr>
<td>1995</td>
<td>IRS-P3</td>
</tr>
<tr>
<td>1996</td>
<td>IRS-1F</td>
</tr>
<tr>
<td>1997</td>
<td>P4 OCEANSAT1</td>
</tr>
<tr>
<td>2000</td>
<td>TES</td>
</tr>
<tr>
<td>2001</td>
<td>P5 CARTOSAT-1</td>
</tr>
<tr>
<td>2003</td>
<td>P5 RESOURCESAT-1</td>
</tr>
<tr>
<td>2004</td>
<td>P6 RESOURCESAT-1</td>
</tr>
<tr>
<td>2005</td>
<td>P6 RESOURCESAT-2</td>
</tr>
<tr>
<td>2006</td>
<td>P7 RESOURCESAT-2</td>
</tr>
<tr>
<td>2008</td>
<td>P7 RESOURCESAT-2</td>
</tr>
<tr>
<td>2010</td>
<td>P7 RESOURCESAT-2</td>
</tr>
<tr>
<td>2011</td>
<td>P7 RESOURCESAT-2</td>
</tr>
<tr>
<td>2012</td>
<td>P7 RESOURCESAT-2</td>
</tr>
<tr>
<td>2013</td>
<td>P7 RESOURCESAT-2</td>
</tr>
</tbody>
</table>
Cartographic Application Satellites

- PAN Camera (5.8m) onboard IRS-1C/1D (1995/1997) was forerunner to Cartographic series

- TES (2001) experimental satellites for HR images
  - Step & stare imaging

- IRS-P5/Cartosat-1 (2005) in-track stereo imaging
  - Spatial Res 2.5m, Fore & Aft cameras
  - Global Acquisition, Indian CARTODEM, many IGS
  - Input to creation of Orthoimages for 1:10,000 thematic mapping

Ocean Satellites & Sensors

- IRS-P3 (Mar 21, 1996)
  - Experimental, MOS (DLR), WiFS

- IRS-P4/Oceansat-1 (May 26, 1999)
  - Ocean Color Monitor (8#, 360m)
  - MSMR Microwave Radiometer

- Oceansat-2 (Sep 23, 2009)
  - OCM,
  - Scatterometer
  - ROSA

- FUTURE & PLANS
  - SARAL : Altimeter (Feb 2013 Launch)
  - Oceansat-3 : Improved OCM (with TIR), Scatterometer
Atmospheric & Meteorological Sensors

• Experimental Sensors
  – MICROWAVE RADIOMETER: SAMIR [BHASKAR 1, 1979; BHASKAR 2, 1981], MSMR (Oceansat-1, 1999)
  – SCATTEROMETER: OSCAT (Oceansat 2, 1999)
  – RADIO OCCULTATION: ROSA (Oceansat 2, 1999)

• Operational Meteorology Sensors Geostationary (Since 1981)
  – VHRR (2.75/11km VIS/TIR): INSAT 1A/1B/1C/1D; INSAT 2A/2B/2C
  – VHRR (2/8/8km VIS/WV/TIR): INSAT 3A, KALPANA
  – CCD (1km): INSAT 2E/3A

• Scientific Missions
  – ISRO-CNES: Megha-tropiques (2011)
  – MADRAS, SAPHIR, SCARAB

• FUTURE
  – INSAT 3D: 6 Channel Imager & 19 Channel Sounder (Launch Mid 2013)
Data Acquisition, Processing & Archive

- Integrated Multi-mission Ground Segment for EO Satellites (IMGEOS) established at Shadnagar (NRSC) in 2011
- Antartica Ground Station for EO Satellites (AGEOS) at Larsemann Hills, 2013
- Many IGS has acquired IRS Data
- Indian data archive now exceeds 1000 TB
International Partnerships & Cooperation

- Data exchange & support for disaster management
- Indian EO satellite data reception at International Ground Stations (IGS)
- International sensors on Indian EO satellites
  - MOS (Germany), ROSA (Italy), AIS (Canada)
- Piggy-back launch on PSLV
  - On 11 PSLV missions, 29 foreign satellites from 18 countries
- Joint Missions
  - ISRO CNES : Megha-tropiques, SARAL
- Global Data Sets
- Contribute to CEOS Global Virtual Constellation
Ocean Color Monitor (GAC) : Ocean & Land

OCEANSAT-2 OCM Image Mosaic  Sep 7-8, 2012

Chlorophyll-a OCM-2 Sep 7-8, 2012
Global Products

- Global data from OSCAT onboard Oceansat-2 disseminated in near real time
  - Data acquisition at SVALBARD, NRT processing at Shadnagar (India)
- OCM Global Area Coverage (GAC) for ocean (8-day) and land (monthly)
- Meghatropiques SCARAB
- SARAL data would be available from ISRO & CNES
Global Products - OSCAT

- Global data from OSCAT onboard Oceansat-2 disseminated in near real time
EO – Near Future Satellites

**SARAL**
Satellite with ARgos & ALtika - Joint ISRO-CNES Mission

- **Payloads**
  - Ka-band Altimeter (~35.5GHz)
  - Dual freq Radiometer (23.8/36.8 GHz)

- **Status**
  - PSLV Launch : 25 Feb 2013

**GISAT**

- **Multiple acquisition from Geosynchronous Orbit**
- **Payloads**
  - High resolution MX (50 m) - VNIR (HRMX-VNIR): Hyper spectral VNIR & SWIR: 320m and 192m Res.
  - TIR 1.5km (HRMX-TIR)

- **Status**
  - PSLV Launch 2016/17

**INSAT - 3D**
For improved understanding of weather systems

- **Payloads**
  - 19 channel Sounder
  - 6 Channel Imager

- **Status**
  - Launch by 2013

**Resourcesat-2A**
Land and Water Resources Applications – Continuity Mission

- **Payloads**
  - LISS IV Mx, LISS III & AWiFS

- **Status**
  - PSLV Launch : 2015/16

... Followed by Oceansat-3 & Hyperspectral, Very High Resolution imaging sensors
Thank you