Indian Remote Sensing Satellite Programme
**Indian Imaging Systems**

1979/81
- IRS-1A & 1B
- LISS-1&2 (72/36M)

1982
- RS-D1 SMART SENSOR

1988/91
- IRS-P2
- LISS-2

1994
- IRS-P3
- WiFS, MOS X-Ray

1995/1997
- IRS-1C/1D LISS-3 (23/70M, STEERABLE PAN (5.8 M); WiFS (188M))

2001
- IRS-P4 (OCEANSAT-1)
- OCM, MSMR

2003
- IRS-P6 (Resourcesat-1)
- LISS III - 23M ; 140 Km; 4Xs
- LISS IV - 5.8M ; 3Xs
- AWiFS - 60M; 740 Km

2005
- IRS-P5 (Cartosat-1)
- PAN-2.5M, 30 km, F/A

2006
- CARTOSAT-2
- PAN – 1.0 m, 11km

1999
- INSAT-2E
- CCD (1 KM)

2003
- TES
- STEP & STARE CONCEPT
FUTURE ...
INDIAN IMAGING CAPABILITY

- 1 Km to 5.8 m spatial Resolution
- 24 Days to every 30 mts. Repetitivity
- 1 Million scale to Cadastral Level
RESOURCESAT-1 MISSION IMPROVEMENTS

• Continuity of remote sensing data availability
• Improvement in Resolution
  - Radiometric
  - Spatial and
  - Temporal

• Simultaneous data acquisition at different spatial resolutions (and swath)

• Availability of MIR (1.55 - 1.70µm) data
  - At the same resolution as of LISS-III and AWiFS bands

• Data requirements optimized due to high revisit and large swath

• LISS IV MONO and Stereo coverage.

• 10 bit data acquisition from AWiFS

• SOLID STATE RECORDER OF 120 G BITS CAPACITY FOR PAYLOAD DATA RECORDING.
## RESOURCESAT-1 PAYLOADS

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Type</th>
<th>Bands</th>
<th>GSD</th>
<th>Revisit</th>
<th>Swath</th>
</tr>
</thead>
<tbody>
<tr>
<td>LISS-3</td>
<td>XS</td>
<td>G,R, NIR (7 bits) SWIR (10 bits)</td>
<td>23.5m</td>
<td>24 Days</td>
<td>140 KM</td>
</tr>
<tr>
<td>LISS-4</td>
<td>XS</td>
<td>G,R,NIR (7 out of 10 bits) G/R/ NIR (7 out of 10 bits)</td>
<td>5.8m</td>
<td>5 Days</td>
<td>23.9 KM</td>
</tr>
<tr>
<td></td>
<td>PAN</td>
<td>(MONO)</td>
<td>5.8m</td>
<td>5 Days</td>
<td>70.3 KM</td>
</tr>
<tr>
<td>AWIFS</td>
<td>XS</td>
<td>G,R,NIR, SWIR (10 bits)</td>
<td>55-70m</td>
<td>5 Days</td>
<td>2 x 370 KM</td>
</tr>
</tbody>
</table>
Part Of Australia viewed by Resourcesat-1, LISS-III
Part of Kuwait – Viewed by Resourcesat-1, LISS-1V, Multi Spectral
Part Of Atlanta viewed by Resourcesat-1, AWIFS
2005

FIRST DEDICATED ALONG TRACK STEREOMISSION

IRS- P5 (CARTOSAT-1)
IRS P5 PAYLOADS

HIGH RESOLUTION STEREO IMAGING WITH 2 IDENTICAL CAMERAS,
FORE @ +26° & AFT @ -5° wrt NADIR

MAJOR SPECIFICATIONS

• IGFOV (m) : 2.5
• SWATH (Km) : 30 (FORE) 27 (AFT)
• SPECTRAL
  • BANDS (μm) : 0.5 – 0.85
• QUANTIZATION (BITS) : 10
• SNR : ≥ 256(450)
• SWR (%) : ≥ 20 (40)
• WEIGHT (Kg) : 235
• POWER (WATTS) : < 110
• DATA RATE : 336Mbps
• SIZE (mm) : 1100 x 800 x 1700
<table>
<thead>
<tr>
<th></th>
<th>SPOT-5</th>
<th>ALOS</th>
<th>IRS-P5</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUND RESOLUTION (m)</td>
<td>10</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>SWATH (km)</td>
<td>120</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>B/H</td>
<td>1</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td>STEREO SET</td>
<td>PAIR +20/-20</td>
<td>TRIPLET +26/0/-26</td>
<td>PAIR +26/-5</td>
</tr>
<tr>
<td>QUANTISATION</td>
<td>256</td>
<td>256</td>
<td>1024</td>
</tr>
<tr>
<td>SNR</td>
<td>120</td>
<td>&gt;70</td>
<td>&gt;400</td>
</tr>
<tr>
<td>COMPRESSION</td>
<td>2.8:1</td>
<td>4.5:1 OR 9:1</td>
<td>3.3:1</td>
</tr>
<tr>
<td>MTF</td>
<td>25</td>
<td>10</td>
<td>25</td>
</tr>
</tbody>
</table>
VALUE ADDED SERVICES - STRENGTHS

Manpower
Expert team of devoted professionals having long years of experience.

Remote Sensing Applications
Image Processing & GIS Development
Geology & Mineral Exploration
Agriculture, Soils & Agronomy
Water Resources Management
Watershed evaluation /Development
Forestry & Environment
Infrastructure Development
Urban/ Town Planning & Socio-economics
Civil Engineering, Topographical Surveys
Geotechnical investigations
Information Technology
Software Development

Domain Expertise
India

Crop Acreage and Production Estimation
Crop Acreage and Production Estimation
sponsored by Department of Agriculture & Cooperation since 1988

- Aims at district-level pre-harvest production forecasts using single-date RS data for area estimation.
- Spectral indices, historical data & weather inputs for yield forecasts.
- Aims to meet specified accuracy goals (90/90 accuracy) & transfer the technology to users.

CAPE covers 7 major crops:
- wheat, rice, mustard, groundnut, cotton, rabi sorghum & sugarcane

in major growing areas in 15 states
- (AP, Assam, Bihar, Gujarat, Haryana, HP, Karnataka, Orissa, Maharashtra, MP, Punjab, Rajasthan, Tamil Nadu, UP & W. Bengal)
Remote sensing data for crop assessment and monitoring

- **Spatial**
  - LISS-III NIR Band
  - LISS-III Red Band
  - LISS-III Green Band

- **Spectral**

- **Temporal**
  - IRS WIFS Data for Punjab State
    - Year 1998–99
    - Dates: 25 June, 29 Sep, 09 Oct, 13 Oct, 14 Nov, 09 Dec, 17 Jan, 13 Feb, 17 Mar, 02 Apr, 05 May, 25 May
A Linear Relationship Between District Wheat Yield and Profile Predicted Peak NDVI i.e. $G_{\text{max}}$

\[ Y = 12.129X - 2.7239 \]

$R^2 = 0.8338$

$G(t) = G_0 \cdot \left( \frac{t}{T_0} \right) \cdot \alpha \cdot \exp\left[ -\beta \left( \frac{t}{T_0} - 2 \right) \right]$
<table>
<thead>
<tr>
<th>Crop</th>
<th>States</th>
<th>Acreage</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-rice</td>
<td>Pun, JK, NE</td>
<td>Jul. mid</td>
<td>Sep. mid</td>
</tr>
<tr>
<td></td>
<td>Har, UP, S-State</td>
<td>Jul. mid</td>
<td>Sep. end</td>
</tr>
<tr>
<td></td>
<td>Asm, Bih, MP, WB..</td>
<td>Jul. end</td>
<td>Oct. end</td>
</tr>
<tr>
<td></td>
<td>All India</td>
<td>Jul. end</td>
<td>Oct. mid</td>
</tr>
<tr>
<td>Wheat</td>
<td>Guj, Mah, MP, Raj</td>
<td>Dec. end</td>
<td>Feb. end</td>
</tr>
<tr>
<td></td>
<td>Other States</td>
<td>Jan. end</td>
<td>Mar. end</td>
</tr>
<tr>
<td></td>
<td>All India</td>
<td>Jan. end</td>
<td>Mar. end</td>
</tr>
</tbody>
</table>
Forecasting **Agricultural output** using **Space, Agro-meteorology and Land based observations**

**Objective:** Multiple In-season (from planting to maturity) assessment and forecast of crops

**Proposed Crops:**
- Wheat
- Rice- Kharif, Rabi, Summer
- Cotton
- Sorghum- Kharif, Rabi
- Sugarcane
- Rapeseed/mustard
- Groundnut
- Jute
- Maize
- Pearl millet
- Ragi
- Summer-Mung/Urd
National Wheat Production Forecasting

• Multiple pre-harvest forecast using multi-date AWiFS as primary RS source and weather-yield models
• National-scale forecast with state-level disaggregation
• Spatio-temporal analysis of within and across season crop growth differences

Multi-date hierarchical decision rules classification with stratified sampling approach using 10x10 km segments and 10% sampling

SAMPLE SEGMENT LOCATION : NWPF

CROP TEMPORAL SPECTRAL PROFILES : 1999-2000 (RAJASTHAN)

LEGEND
- WHEAT
- MUSTARD

II STAGE STRATA
- A TYPE (> 70 % AG)
- B TYPE (30-70 % AG)
- C TYPE (5-30 % AG)
Area Estimation: Procedure

BASE IMAGE

D1 IMAGE

D2 IMAGE

MASTER IMAGE: REGISTERED ON MAP

IMAGE-IMAGE REGISTRATION

MULTIDATE DATA SET

NORMALISATION & NDVI COMPUTATION

HIERARCHICAL DECISION RULE CLASSIFIER

DATA LOSS & NON VEGET. PIXELS

AGRICULTURAL / CROPPED PIXELS

CROP AREA
<table>
<thead>
<tr>
<th>YEAR</th>
<th>NWPF</th>
<th>DES</th>
<th>RD (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997-98</td>
<td>67.27</td>
<td>66.35</td>
<td>1.40</td>
</tr>
<tr>
<td>1998-99</td>
<td>72.88</td>
<td>70.79</td>
<td>2.95</td>
</tr>
<tr>
<td>1999-00</td>
<td>70.20</td>
<td>75.57</td>
<td>-7.10</td>
</tr>
<tr>
<td>2000-01</td>
<td>68.37</td>
<td>68.46</td>
<td>-0.13</td>
</tr>
<tr>
<td>2001-02</td>
<td>73.57</td>
<td>71.80</td>
<td>2.46</td>
</tr>
<tr>
<td>2002-03</td>
<td>70.71</td>
<td>65.10</td>
<td>8.62</td>
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<tr>
<td>2003-04</td>
<td>71.95</td>
<td>72.10</td>
<td>-0.20</td>
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<tr>
<td>2004-05</td>
<td>72.93</td>
<td>72.00</td>
<td>1.29</td>
</tr>
</tbody>
</table>

NWPF – National Wheat Production Forecast  
DES – Estimates by Department of Economic and Statistics  
RD – Relative Deviations
Backscattering Changes with Crop Age

Orissa State - Progress of Rice Crop
Four-date RADARSAT ScanSAR Data (SCN B, C Band/5.3GHz/HH Pol/Inc Ang 30d–46d)