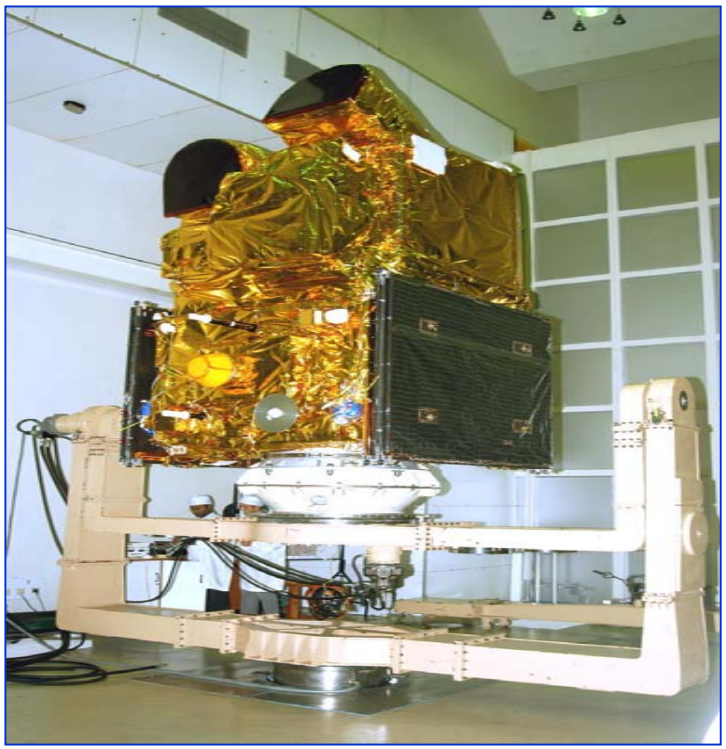
Indian Remote Sensing Satellite Programme



ANTRIX

MISSIONS TILL NOW....

INDIAN IMAGING SYSTEMS

1995/1997

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

1994

IRS-P2

LISS-2

1996

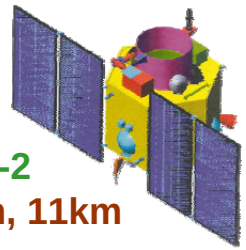
IRS-P3

WiFS, MOS X-Ray

1988/91

IRS-1A & 1B

LISS-1&2 (72/36M)



CARTOSAT-2

PAN – 1.0 m, 11km

2006

IRS-P5(Cartosat-1)

PAN-2.5M, 30 km, F/A

2005

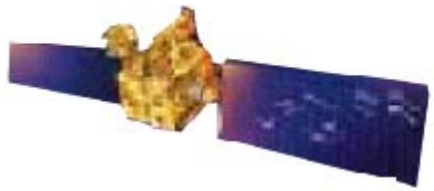
1999

INSAT-2E

CCD (1 KM)

1982

RS-D1 SMART SENSOR



IRS-P4 (OCEANSAT-1)

OCM, MSMR

1999

IRS-P6(Resourcesat-1)

LISS III - 23M ; 140 Km; 4Xs

LISS IV - 5.8M ; 3Xs

AWiFS - 60M; 740 Km

2003

1979/81

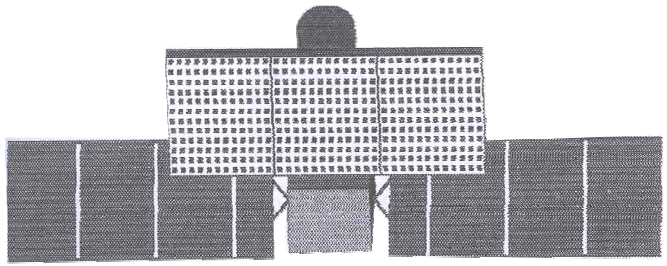
BHASKARA VIDICON, SAMIR

TES

STEP & STARE CONCEPT

2001

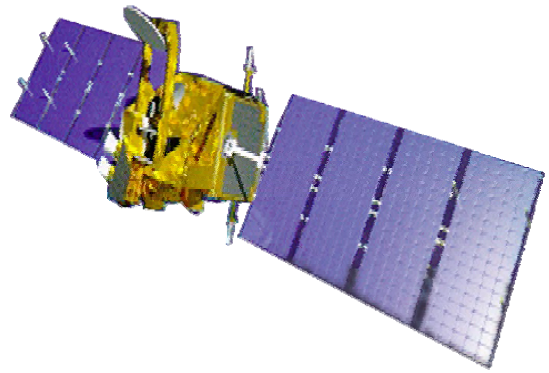
FUTURE ...



RISAT

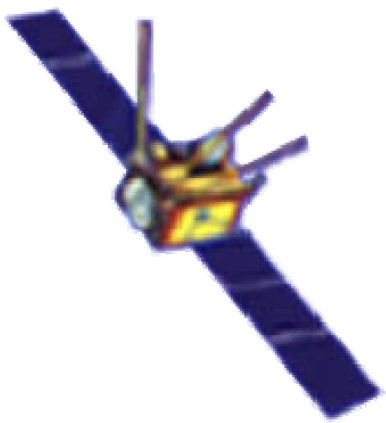
C-band SAR; 3-50 m

Multi-Pol; Multi mode



MEGHA-TROPIQUES

SAPHIR, SCARAB & MADRAS

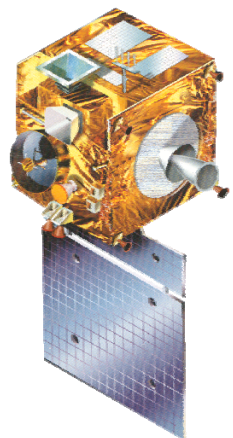


OCEANSAT-II

SCAT, OCM

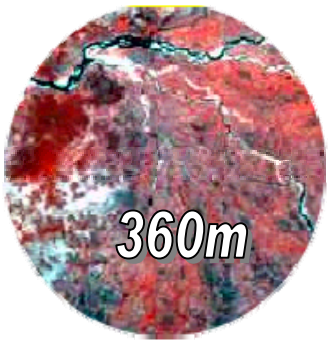
METSAT

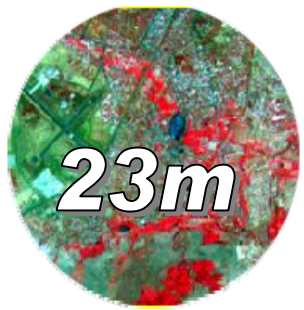
Imager and Sounder

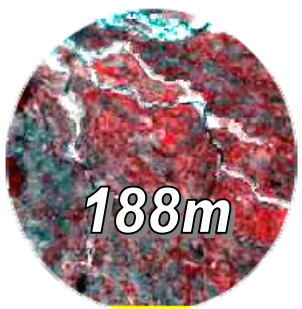


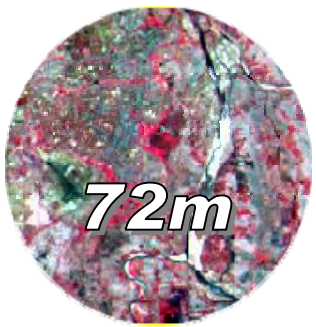
INDIAN IMAGING CAPABILITY

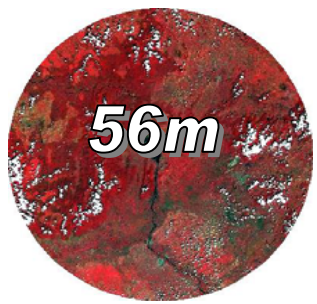
- 1 Km to 5.8 m spatial Resolution
- 24 Days to every 30 mts. Repetitivity
- 1 Million scale to Cadastral Level

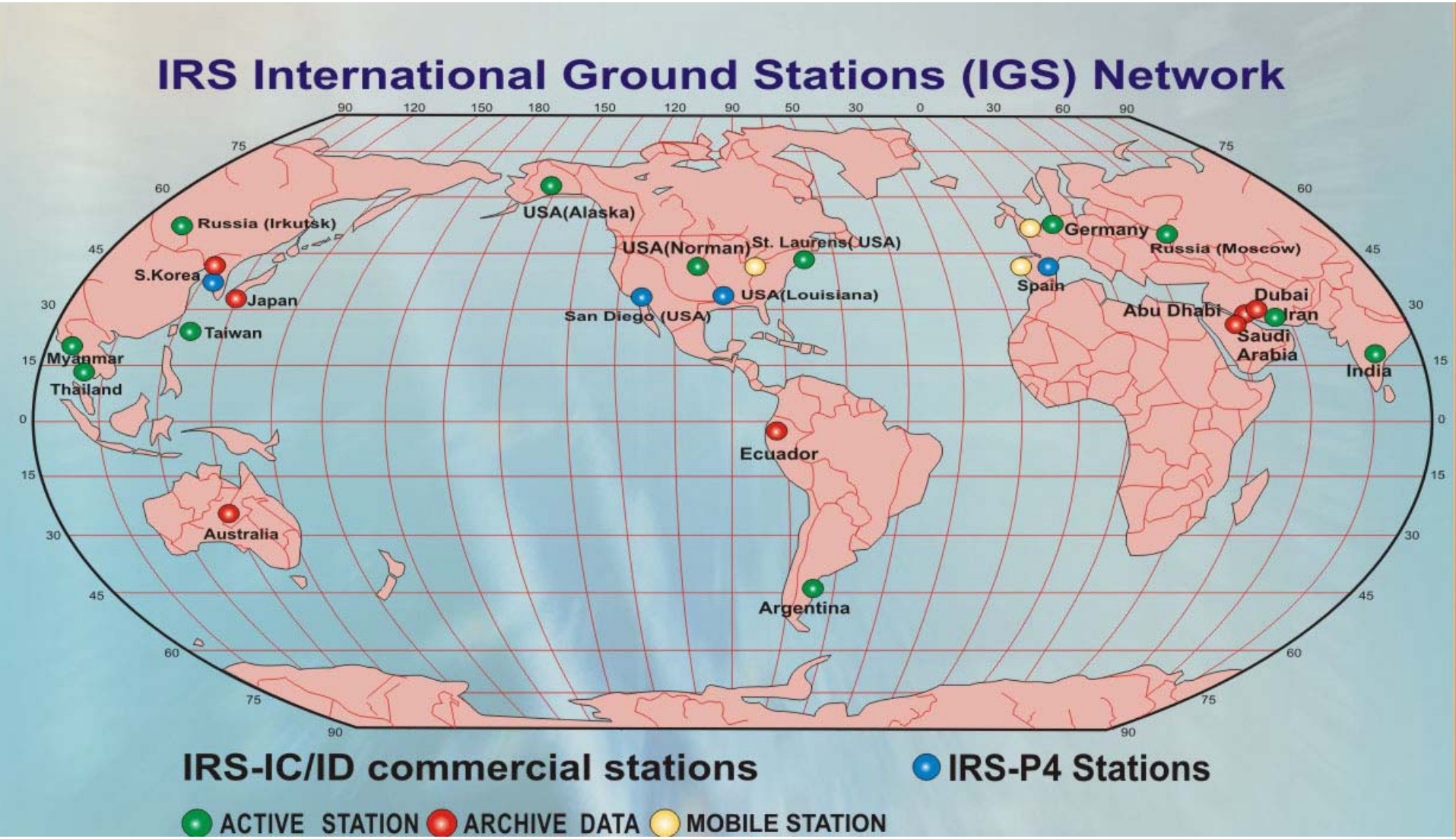




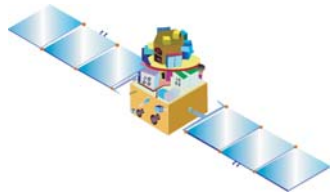







IRS International Ground Stations (IGS) Network
Russia (Irkutsk)
S.Korea
Japan
Taiwan
Myanmar
Thailand
Australia
USA(Alaska)
USA(Norman)
St. Laurens(USA)
USA(Louisiana)
San Diego (USA)
Ecuador
Argentina
Germany
Russia (Moscow)
Spain
Dubai
Abu Dhabi
Iran
Saudi Arabia
India
IRS-IC/ID commercial stations
IRS-P4 Stations
ACTIVE STATION
ARCHIVE DATA
MOBILE STATION

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

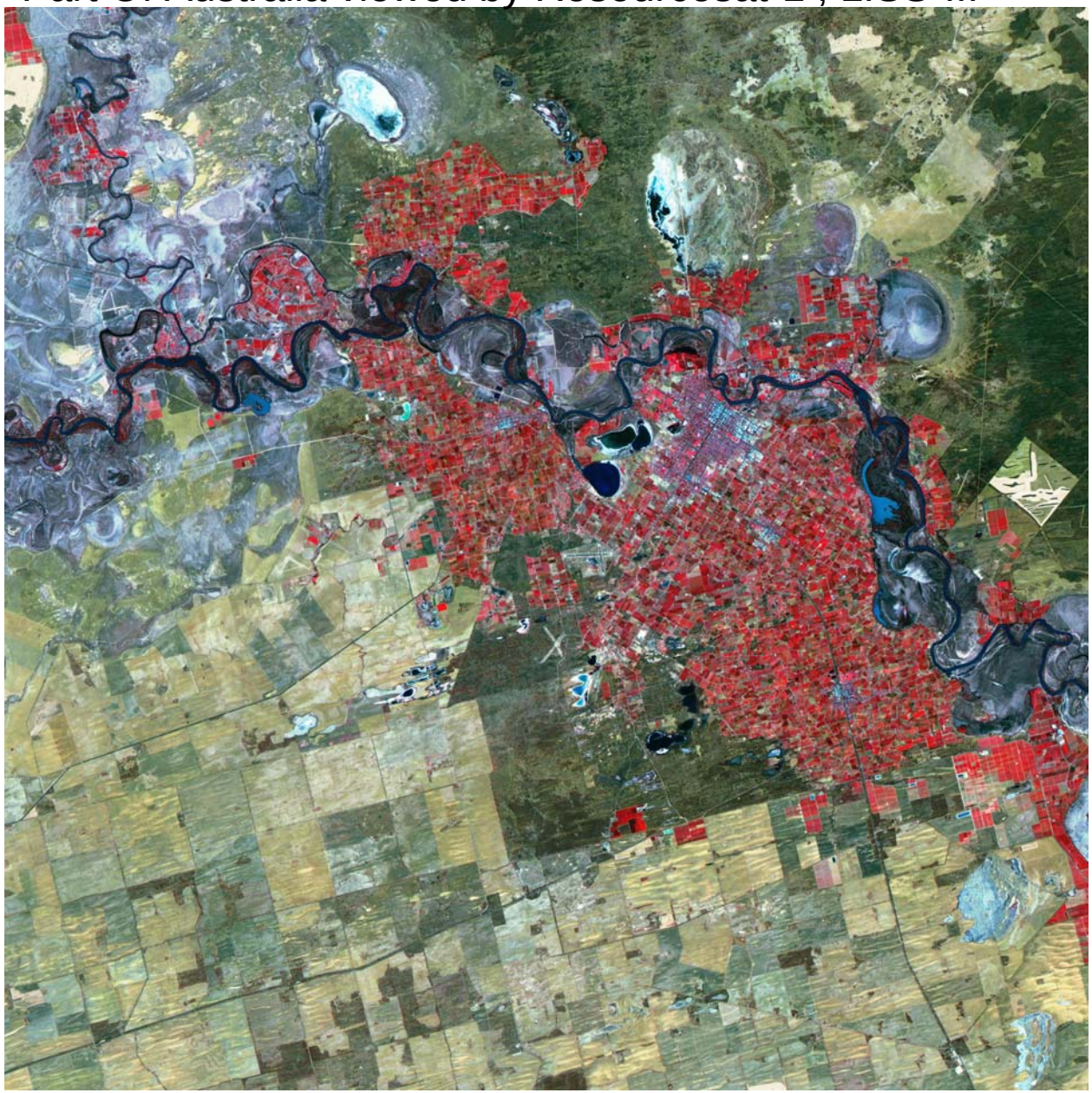
- SOLID STATE RECORDER OF 120 G BITS CAPACITY FOR PAYLOAD DATA RECORDING.

nrsa

RESOURCESAT-1 PAYLOADS

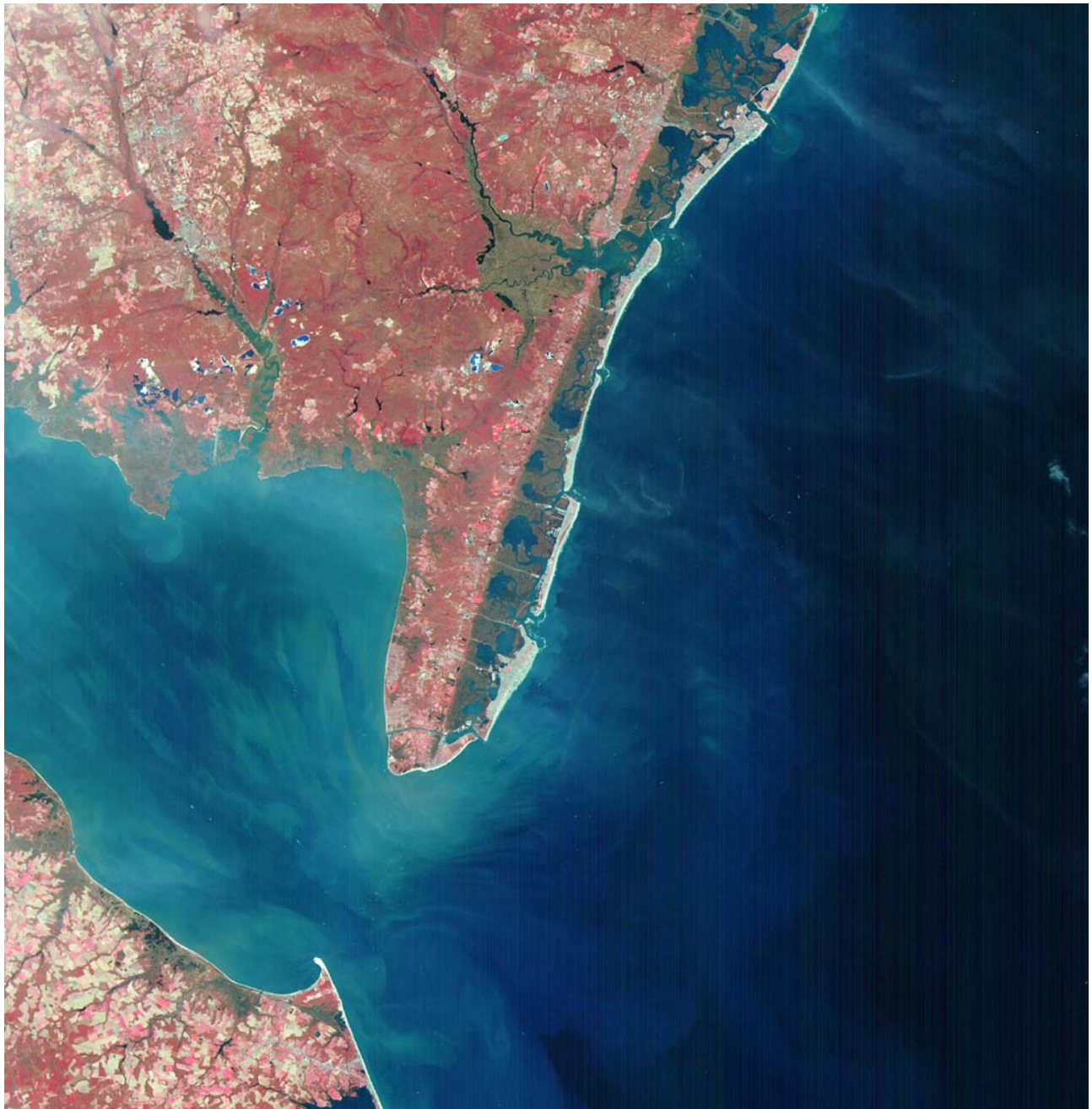
Sensor	Type	Bands	GSD	Revisit	Swath
LISS-3	XS	G,R, NIR (7 bits) SWIR (10 bits)	23.5m	24 Days	140 KM
LISS-4	XS	G,R,NIR (7 out of 10 bits)	5.8m	5 Days	23.9 KM
	PAN (MONO)	G/R/ NIR (7 out of 10 bits)	5.8m	5 Days	70.3 KM
AWIFS	XS	G,R,NIR, SWIR (10 bits)	55-70m	5 Days	2 x 370 KM

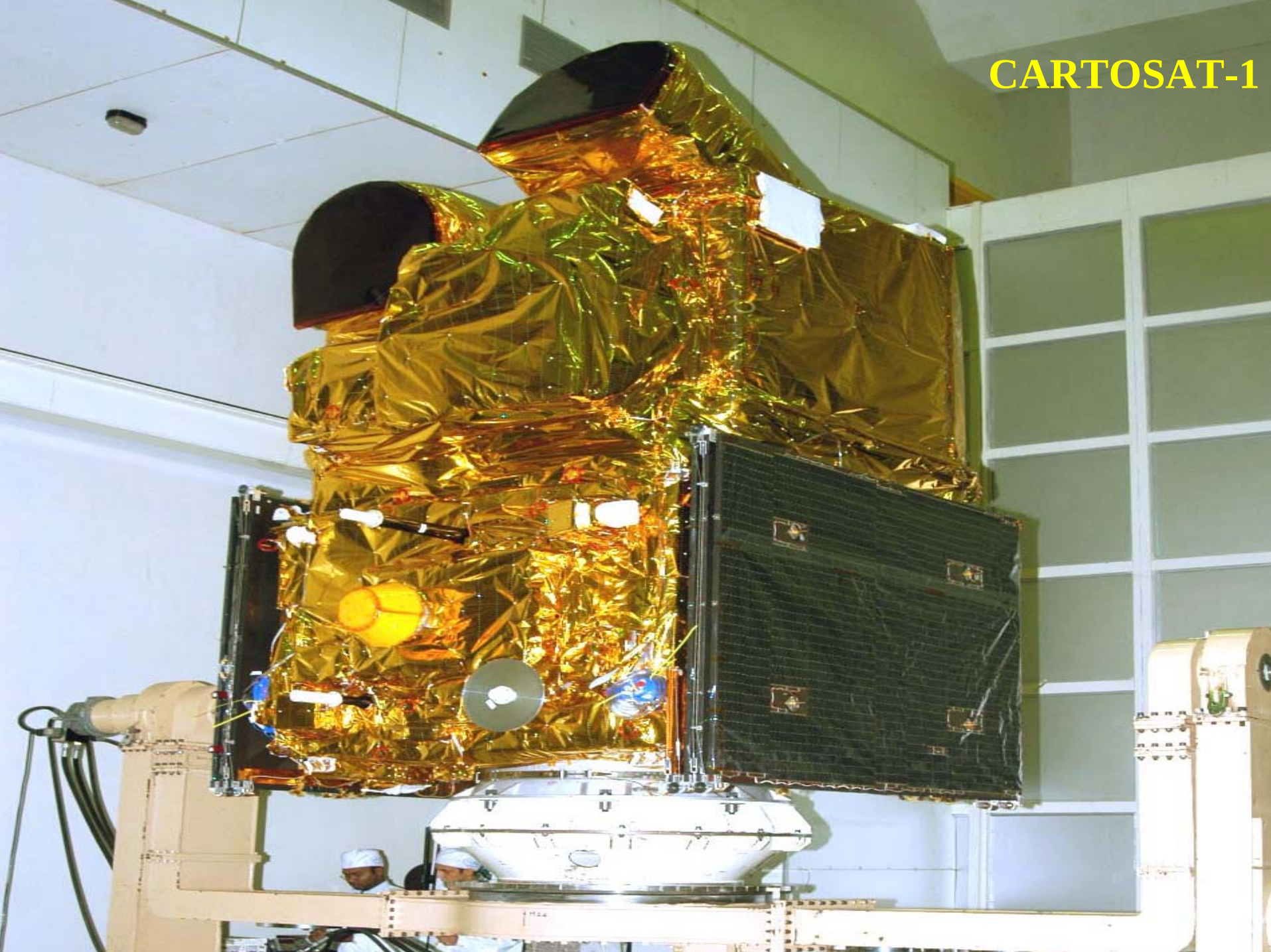
Part Of Australia viewed by Resourcesat-1 , LISS-III

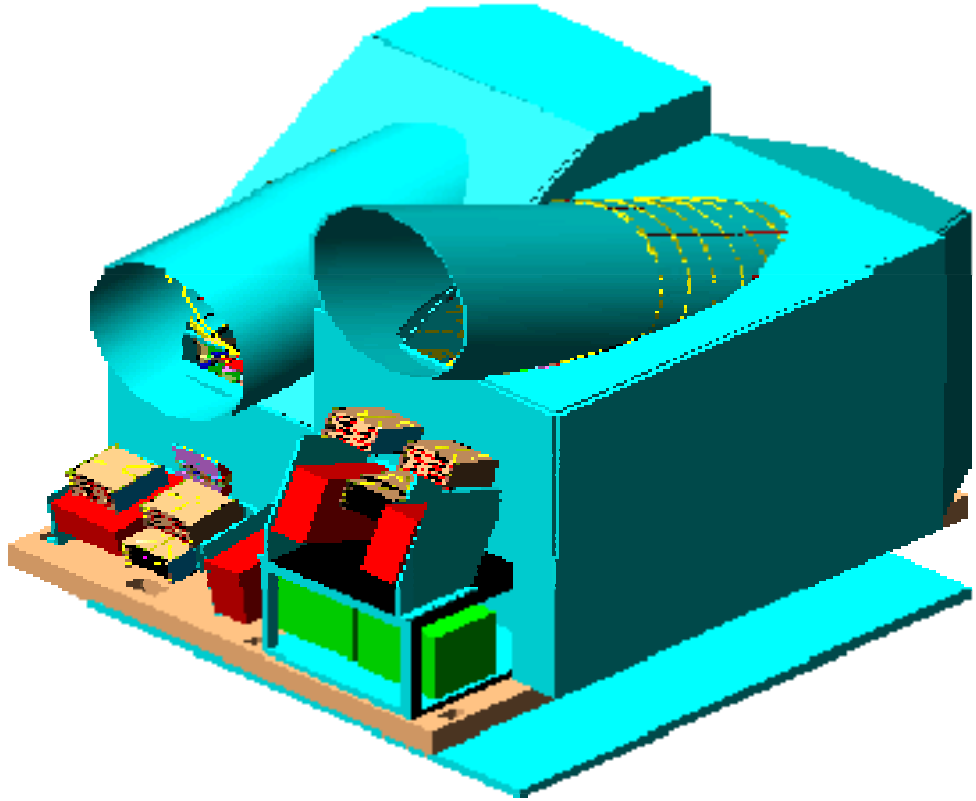


Part of Kuwait –Viewed by Resourcesat-1 , LISS-1V,Multi Spectral

Part Of Atlanta viewed by Resourcesat-1 , AWIFS




CARTOSAT-1



2005

FIRST DEDICATED ALONG TRACK STEREO MISSION

IRS- P5 (CARTOSAT-1)

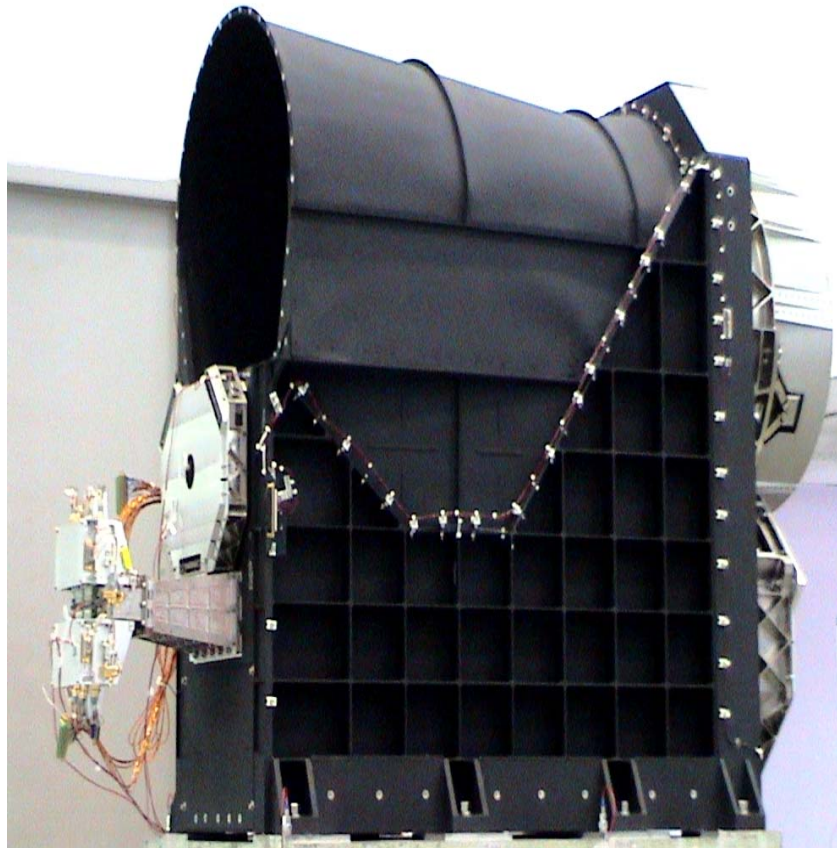
IRS P5 PAYLOADS

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 (um) : 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**



	SPOT-5	ALOS	IRS-P5
GROUND RESOLUTION(m)	10	2.5	2.5
SWATH (km)	120	30	30
B/H	1	1	0.6
STEREO SET	PAIR +20/-20	TRIPLET +26/0/-26	PAIR +26/-5
QUANTISATION	256	256	1024
SNR	120	>70	>400
COMPRESSION	2.8:1	4.5:1 OR 9:1	3.3:1
MTF	25	10	25

CARTOSAT-1
EGYPT

P6 LISS MX- P:YONGYANG(NORTH KOREA)

VALUE ADDED SERVICES - STRENGTHS

Manpower

Expert team of devoted professionals having long years of experience.

Domain Expertise

- 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

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

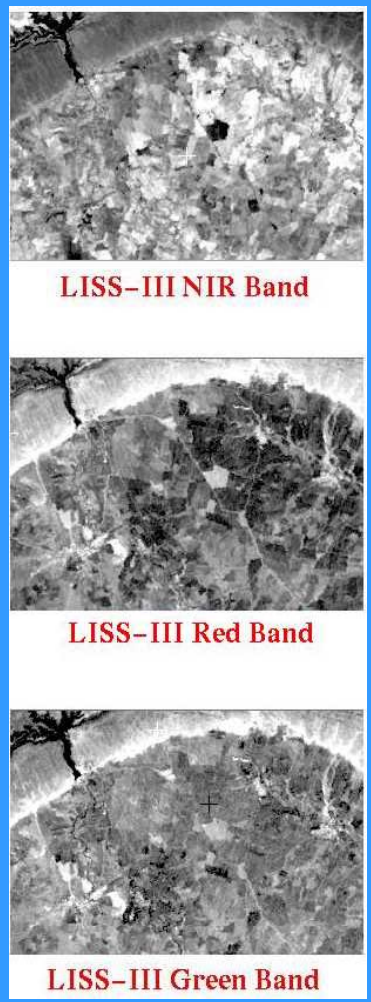
wheat, rice, mustard, groundnut, cotton, rabi sorghum & sugarcane **in major growing areas in 15 states**

(AP, Assam, Bihar, Gujarat, Haryana, HP, Karnataka, Orissa, Maharashtra, MP, Punjab, Rajasthan, Tamil Nadu, UP & W. Bengal)

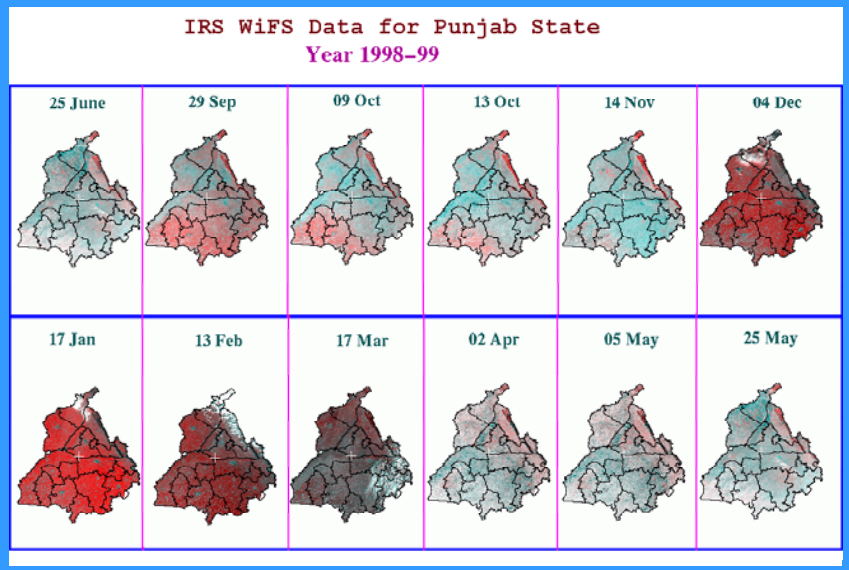
Remote sensing data for crop assessment and monitoring

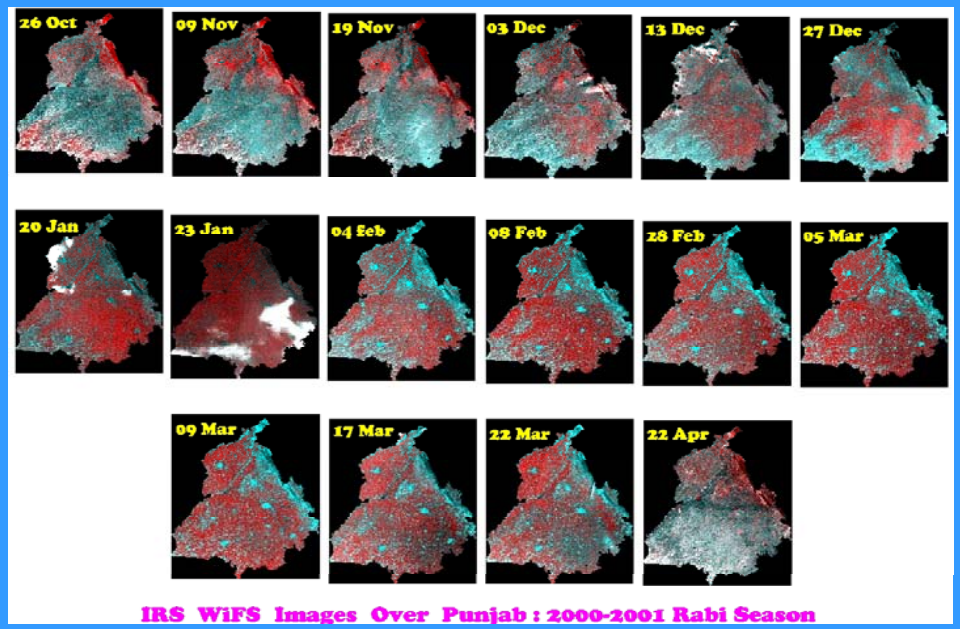
SPATIAL

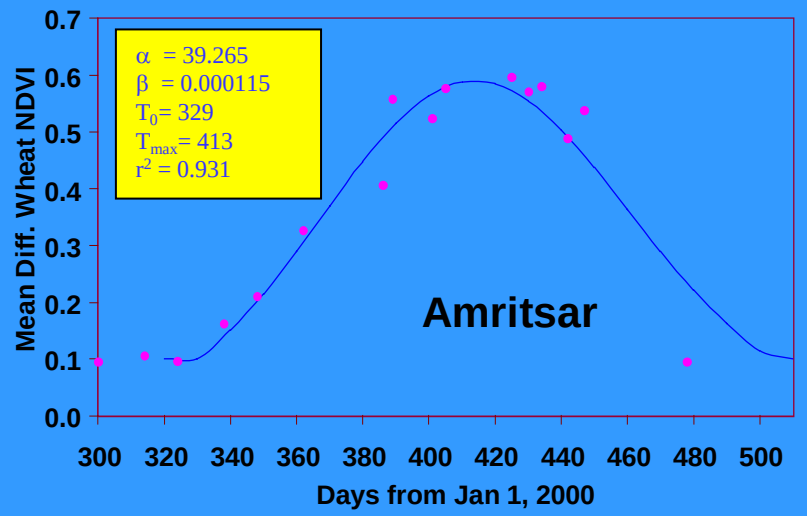
SPECTRAL

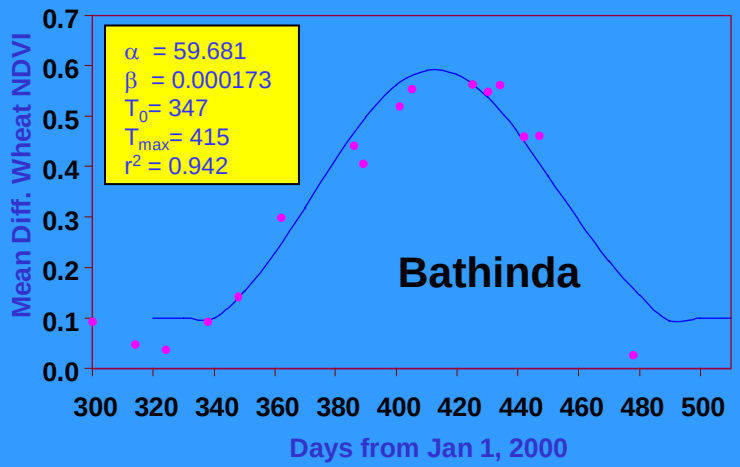


TEMPORAL

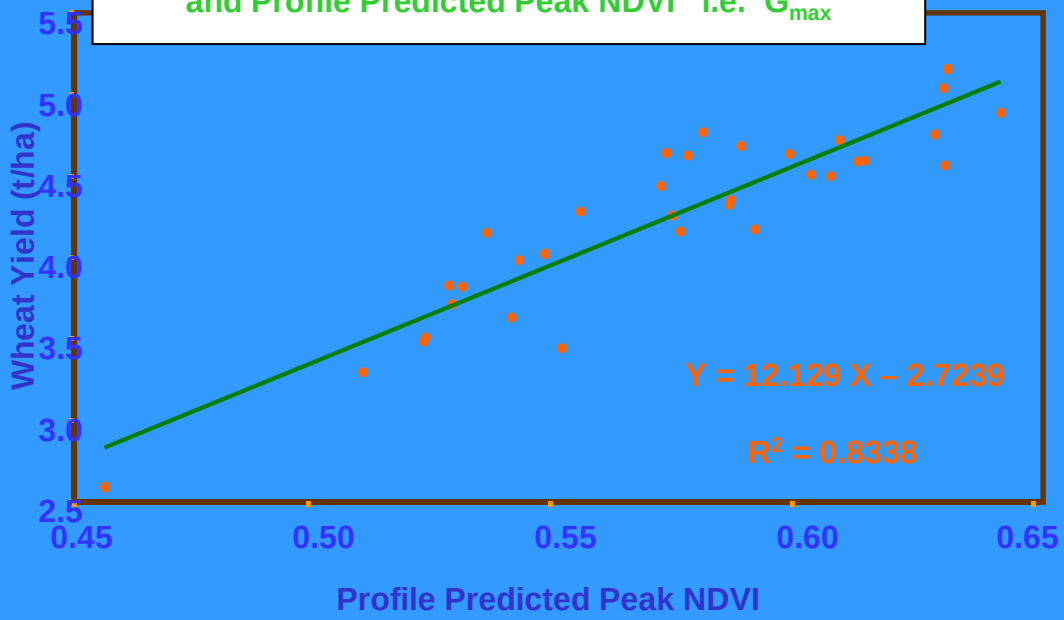








A Linear Relationship Between District WheatYield and Profile Predicted Peak NDVI i.e. G_{max}



$$G(t) = G_o * (t/T_o)\,\alpha * \exp\,[-\beta\,(t^2-T_o^2)]$$

SUGGESTED SCHEDULE FOR FORECASTING

Crop	States	Acreage	Production
K-rice	Pun, JK, NE	Jul. mid	Sep. mid
	Har, UP, S-State	Jul. mid	Sep. end
	Asm, Bih,MP, WB..	Jul. end	Oct. end
	All India	Jul. end	Oct. mid
Wheat	Guj, Mah, MP, Raj	Dec. end	Feb. end
	Other States	Jan. end	Mar. end
	All India	Jan. end	Mar. end

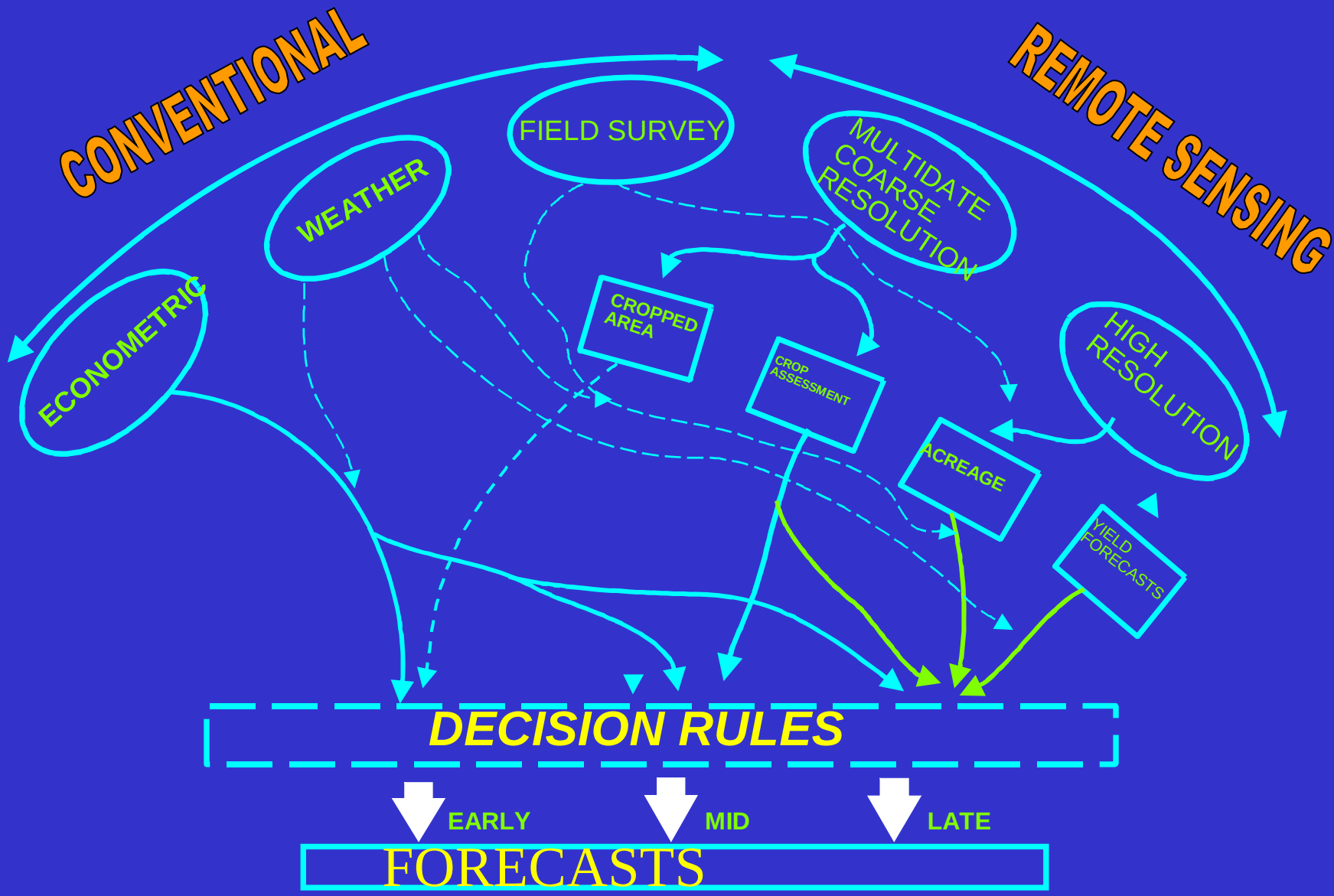
Forecasting Agricultural out put using Space, Agro-meteorology and Land based observations

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

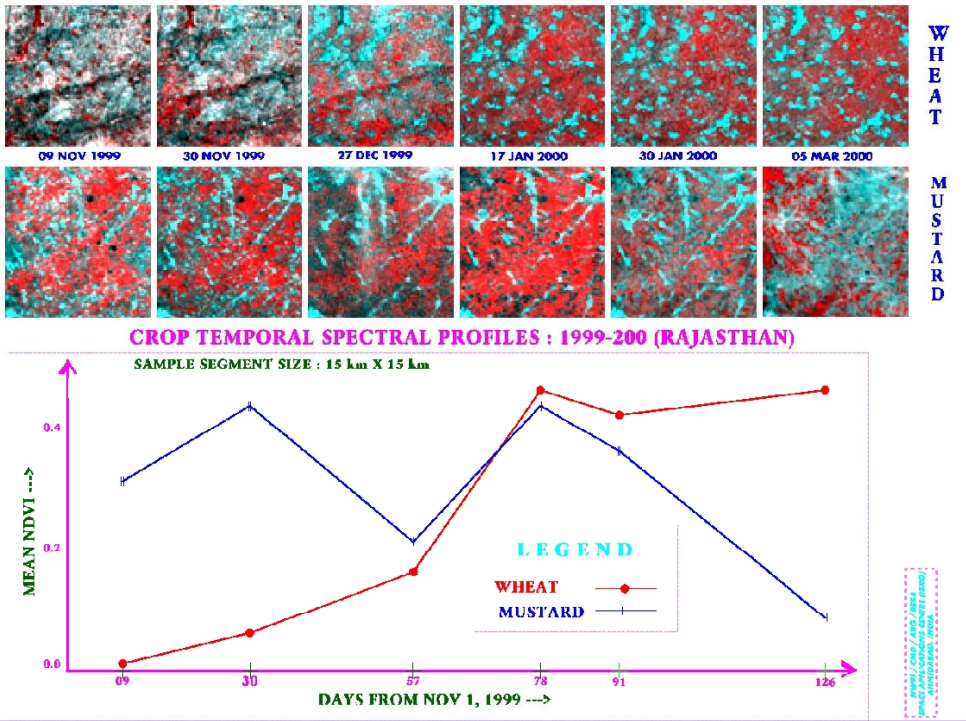
OVERALL APPROACH IN 'FASAL'



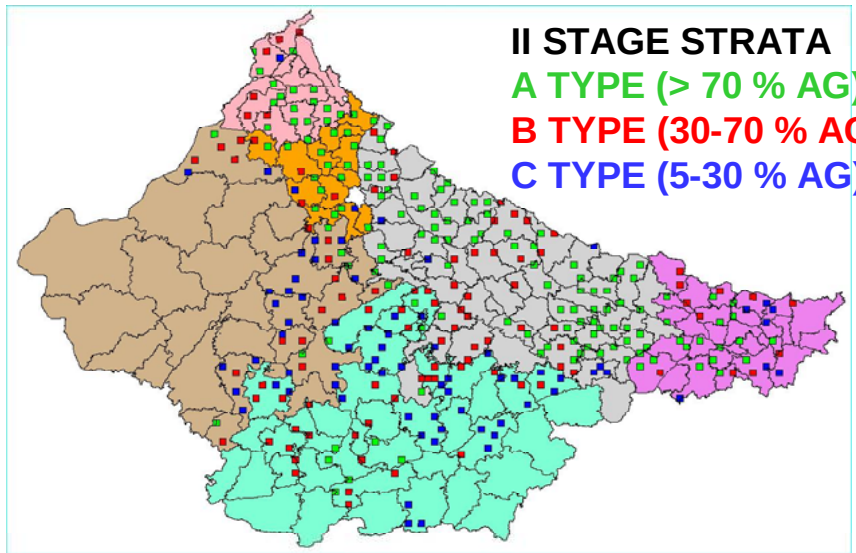
National Wheat Production Forecasting

- 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

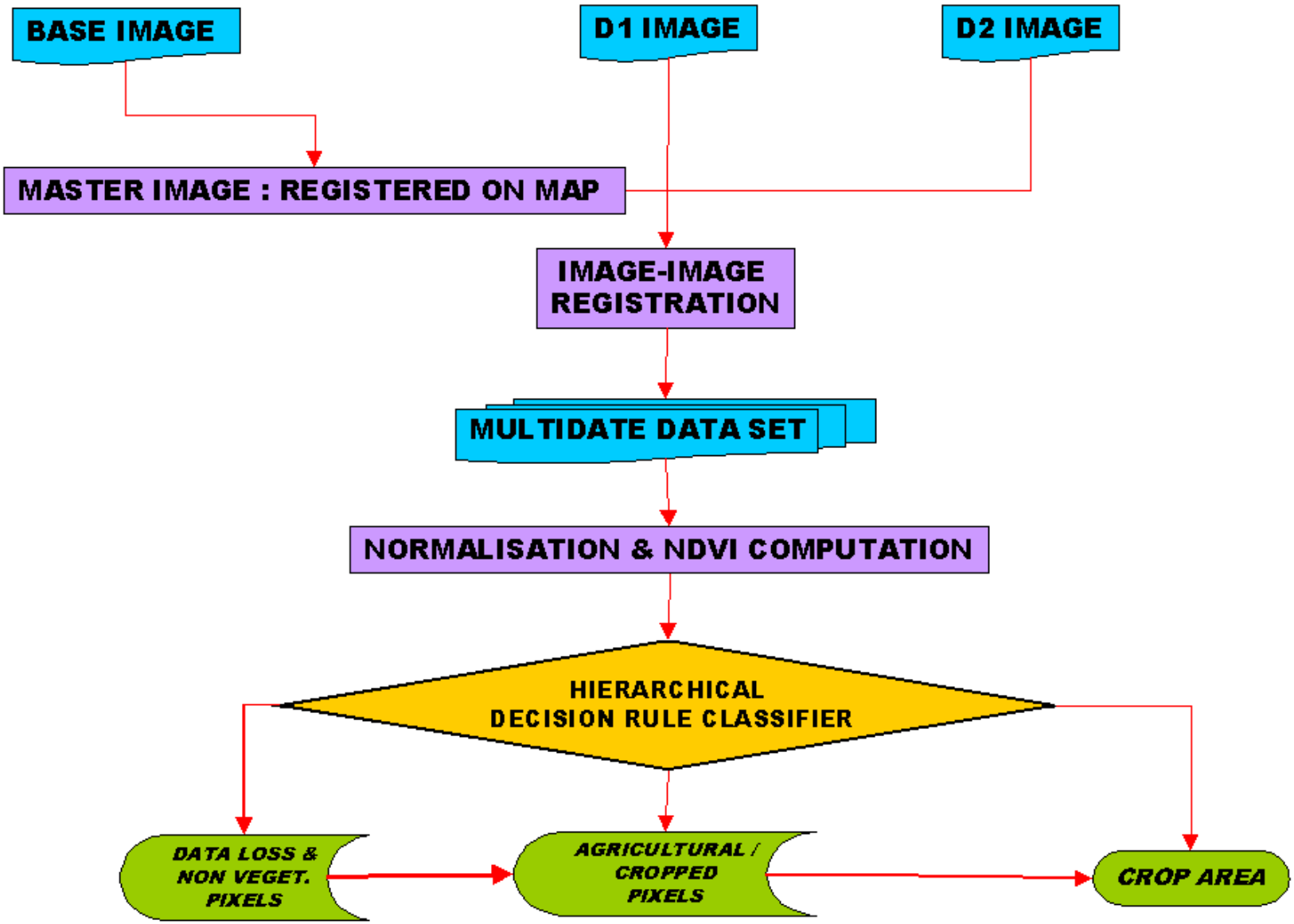
Multi-date hierachical decision rules classification with startified sampling approach using 10x10 km segments and 10 % sampling



SAMPLE SEGMENT LOCATION : NWPF



Area Estimation: Procedure



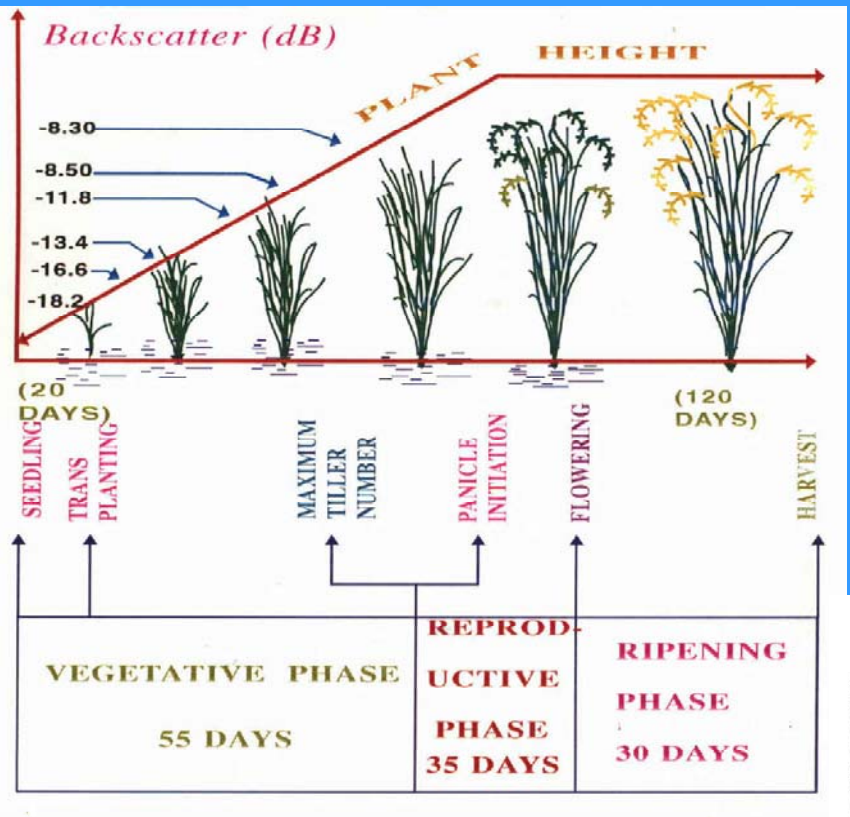
Results – At a Glances

Wheat Production (M t)			
YEAR	NWPF	DES	RD (%)
1997-98	67.27	66.35	1.40
1998-99	72.88	70.79	2.95
1999-00	70.20	75.57	-7.10
2000-01	68.37	68.46	-0.13
2001-02	73.57	71.80	2.46
2002-03	70.71	65.10	8.62
2003-04	71.95	72.10	-0.20
2004-05	72.93	72.00	1.29

NWPF – National Wheat Production Forecast

DES – Estimates by Department of Economic and Statistics

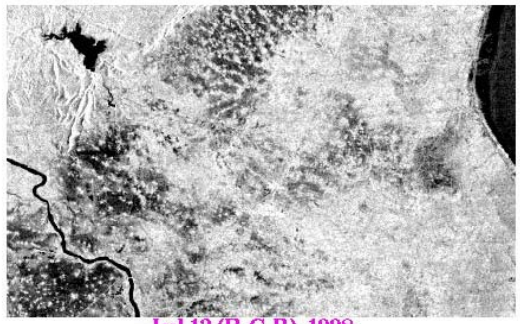
RD – Relative Deviations



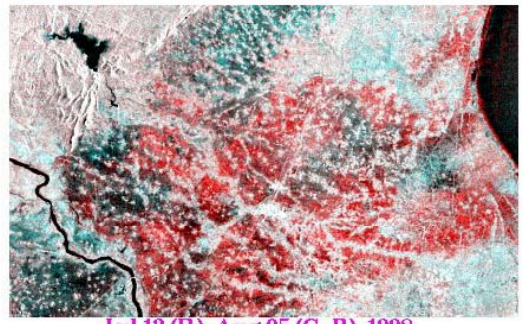
Backscattering Changes with Crop Age

Orissa State – Progress of Rice Crop

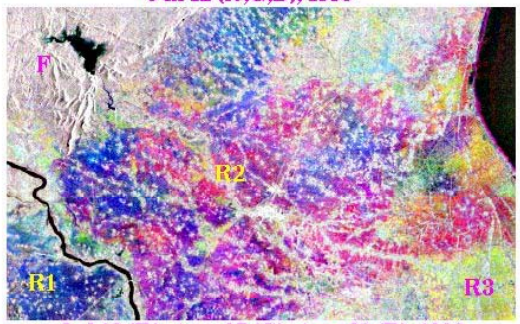
Four-date RADARSAT ScanSAR Data (SCN B, C Band/5.3GHz/HH Pol/Inc Ang 30d-46d)



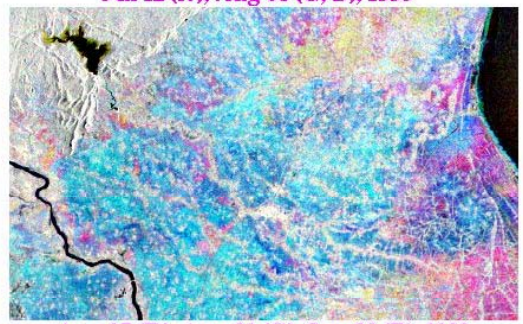
Jul 12 (R,G,B), 1998



Jul 12 (R), Aug 05 (G, B), 1998



Jul 12 (R), Aug 05 (G), Aug 29 (B), 1998



Aug 05 (R), Aug 29 (G), Sep 22 (B), 1998