

Applications of SAR for sustainable social & economic development in India

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20th February, 2006



Antrix Corporation Limited

- The Marketing and Commercial Arm of Indian Space Research Organisation (ISRO), reaching the Indian Space Capabilities to the Global Customers
- Commercializing the Space Spin-offs through Industry for wider reach
- Close cooperation with Industry/users for effective utilization of space technology
- Played a catalytic role in the growth of a vibrant geo-spatial information industry in India

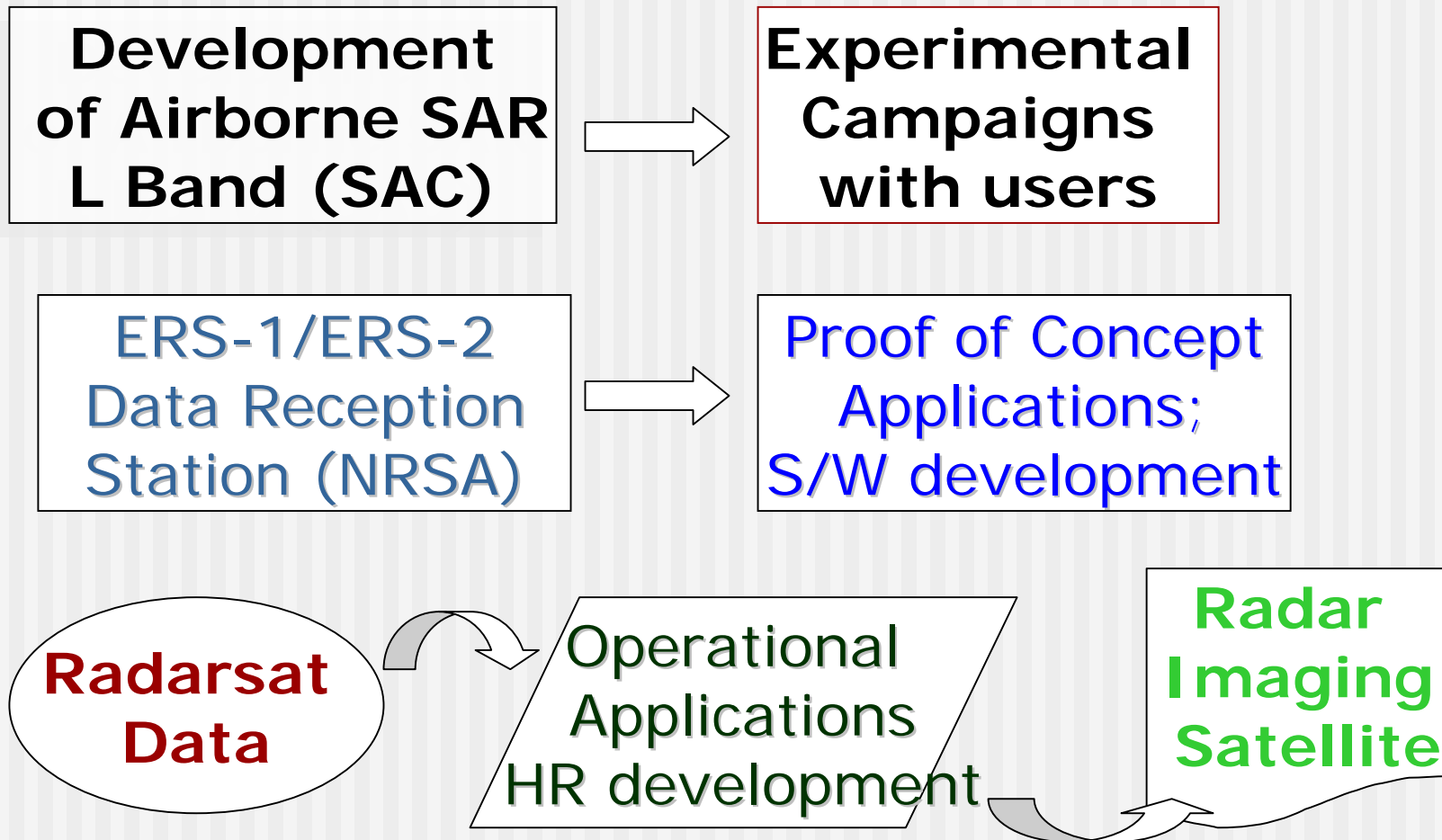
Imaging Radar – Advantages

- **All weather capable, Day - night operable, multiple operation modes with variable spatial resolution, polarizations, look angle and scene coverage**
- **Unique application potential; Mapping as well as parameter retrieval**
- **Complementary to optical remote sensing**
- **Radar response is sensitive to more than one target parameter viz., dielectric constant, surface roughness, penetration, slope etc.,**
- **Choice among diverse sensor parameters viz., frequency, polarization and look angle increase application potential**
- **Multi-date, multi-channel and polarimetric approaches for wider applications**

SAR and Indian context

- 40 million hectares of arable land flood prone
- Monsoon cloud cover during major crop growth season affects data collection and thereby the capability for in-season crop forecasts
- Meteorological forecasting improvements need active sensors and greater repetitivity

STEPS IN CAPACITY BUILDING



Diverse Applications

- Use of Radarsat data, with its wider swaths (upto 500 Kms) and better repetivity, for flood impact monitoring on an operational basis
- Application of multi date images during the crop calendar for crop classification studies,
- Crop yield forecasting models using both optical and SAR data
- Large area and recurrent flood monitoring such as in Bramhaputra plains

Current Application Spectrum for SAR Data in INDIA

- **AGRICULTURE:** Operational Monitoring of Kharif (Monsoon) Rice Crop. Early detection of Drought. Monitoring of other Kharif Crops
- **FLOOD MAPPING:** Operational Mapping of Flooded areas as a part of Disaster Monitoring and Relief operation
- **SOIL MOISTURE:** Large area soil moisture mapping as input to Hydrological applications (drought and flood), Agriculture
- **FORESTRY:** Biomass estimation (also forest density and type)
- **TERRAIN ANALYSIS:** Accurate DEM generation, Land movement (for earthquake studies and land subsidence)
- **OCEANOGRAPHY:** Sea State, Waves, Oil Spills, Coastal Bathymetry
- **SNOW AND GLACIER:** Preliminary studies on snow / ice mapping
- **GEOLOGY:** Mapping of Surface and sub-surface structures, aquifers, mineralogy

Example: Improved Multi-Crop Classification using multi date SAR

Time composite image of ERS-1 SAR: Godavari Delta
October 8, November 12 and December 17, 1992

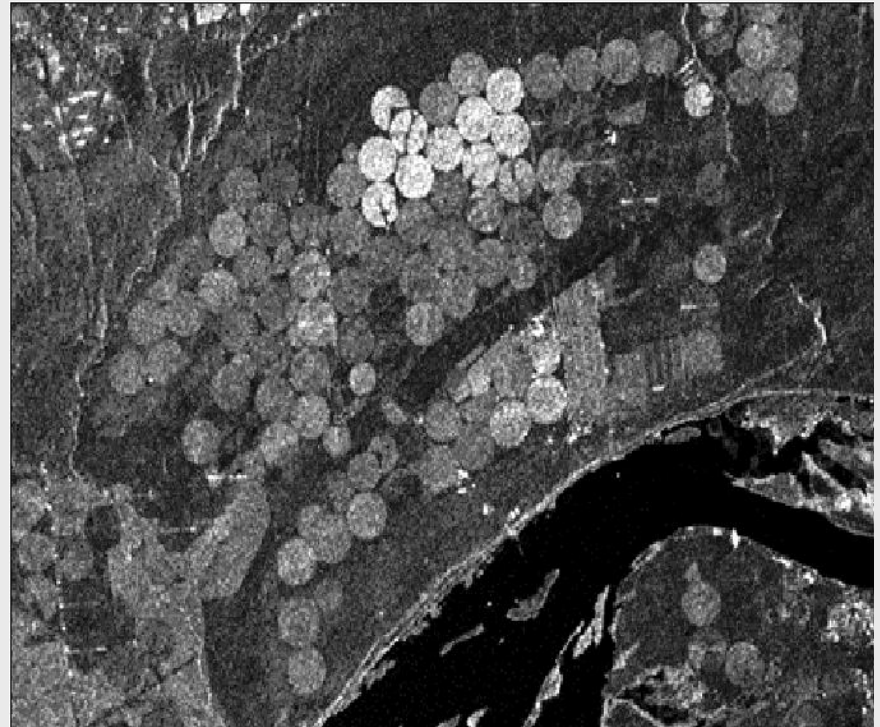
1. Early transplanted paddy
2. Late transplanted paddy
3. Harvested paddy fields
4. Permanent Fallows
5. Tapioka
6. Banana plantation
7. Mixed plantation
8. Cashew plantation
9. Coconut plantation
10. Built up area



Rajahmundry and its surroundings in A.P., during 1992

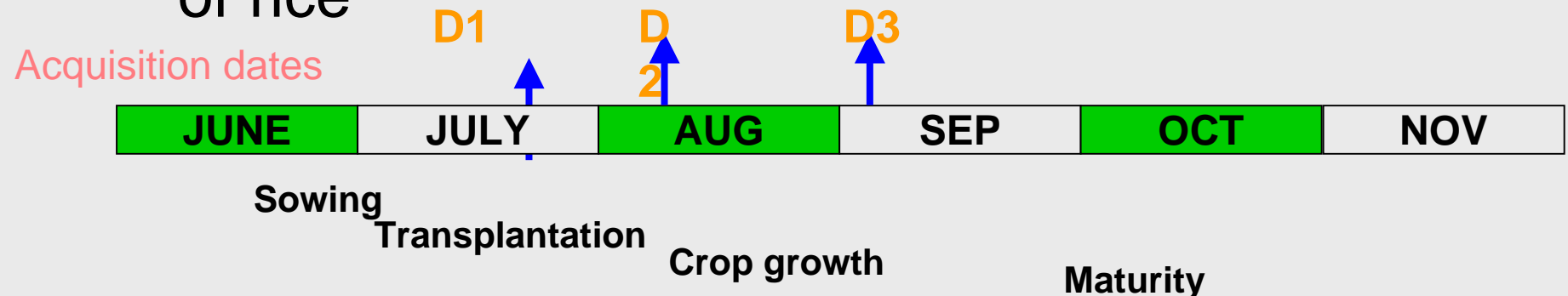
Example: Study of soil moisture conditions in soils

**Improved
sensitivity to soil
moisture, using
multidimensional
SAR data**



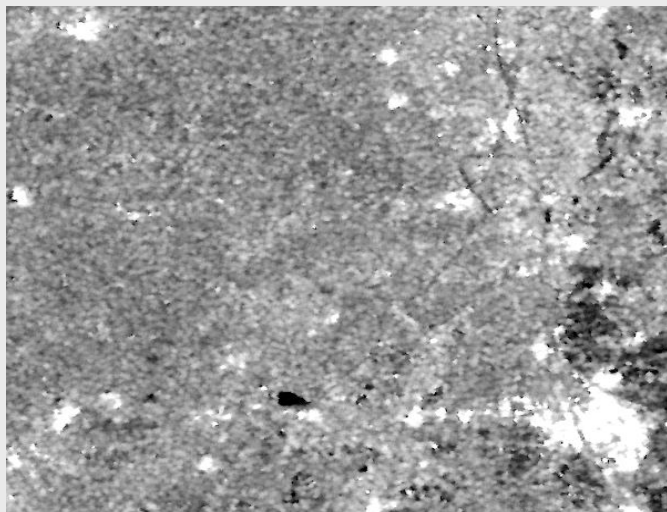
EXAMPLE: RICE ACREAGE ESTIMATION IN MONSOON SEASON

- Kharif is one of the Bi-annual Production seasons in India involving Monsoon
- RADARSAT ScanSar data is being utilized for rice acreage estimation, overcoming the limitation of non-availability of optical data during monsoon season
- Multi date SAR data of July, August & September data utilized for Acreage estimation of rice

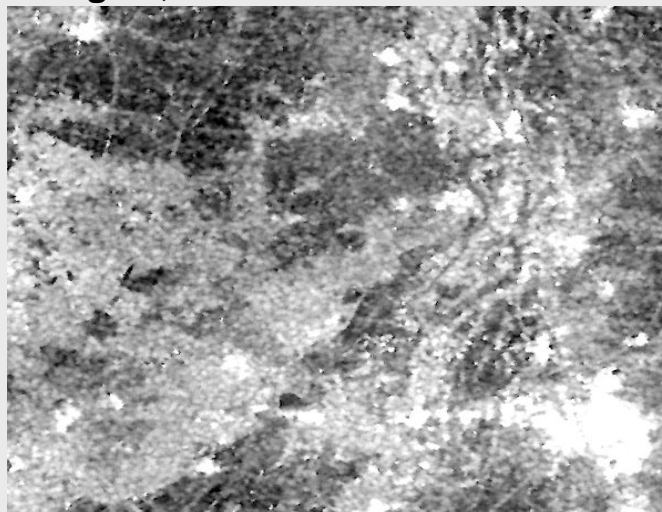


RICE CROP AT DIFFERENT PLANTING DATES IN PARTS OF ANDHRA PRADESH

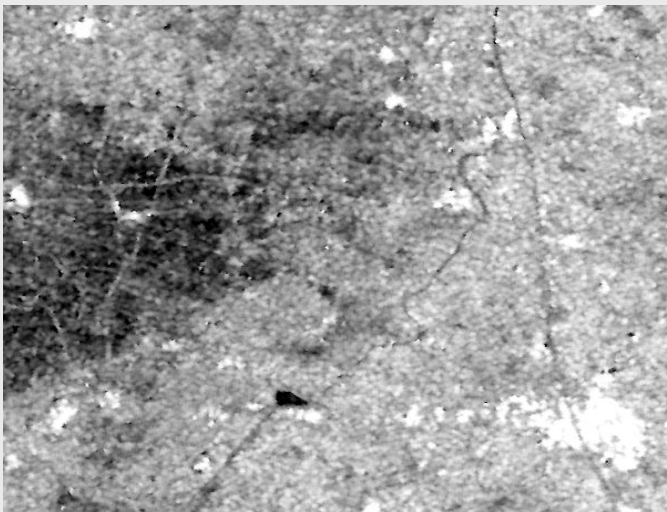
Jul 27, 2005



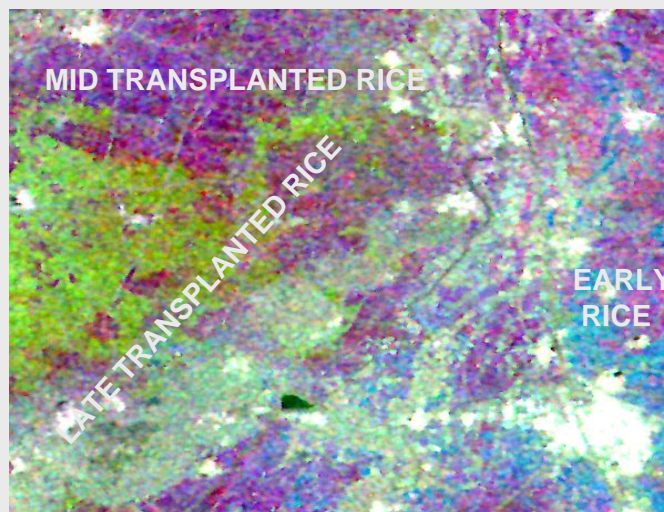
Aug 20, 2005



Sep13, 2005

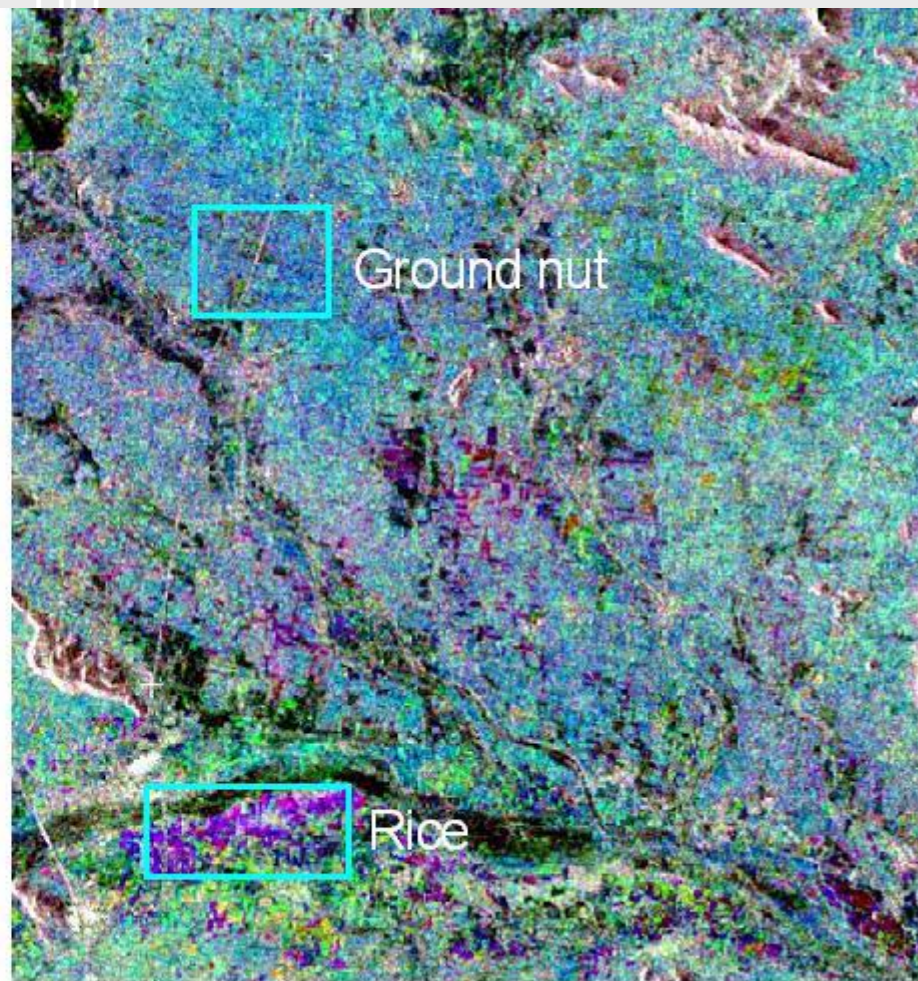
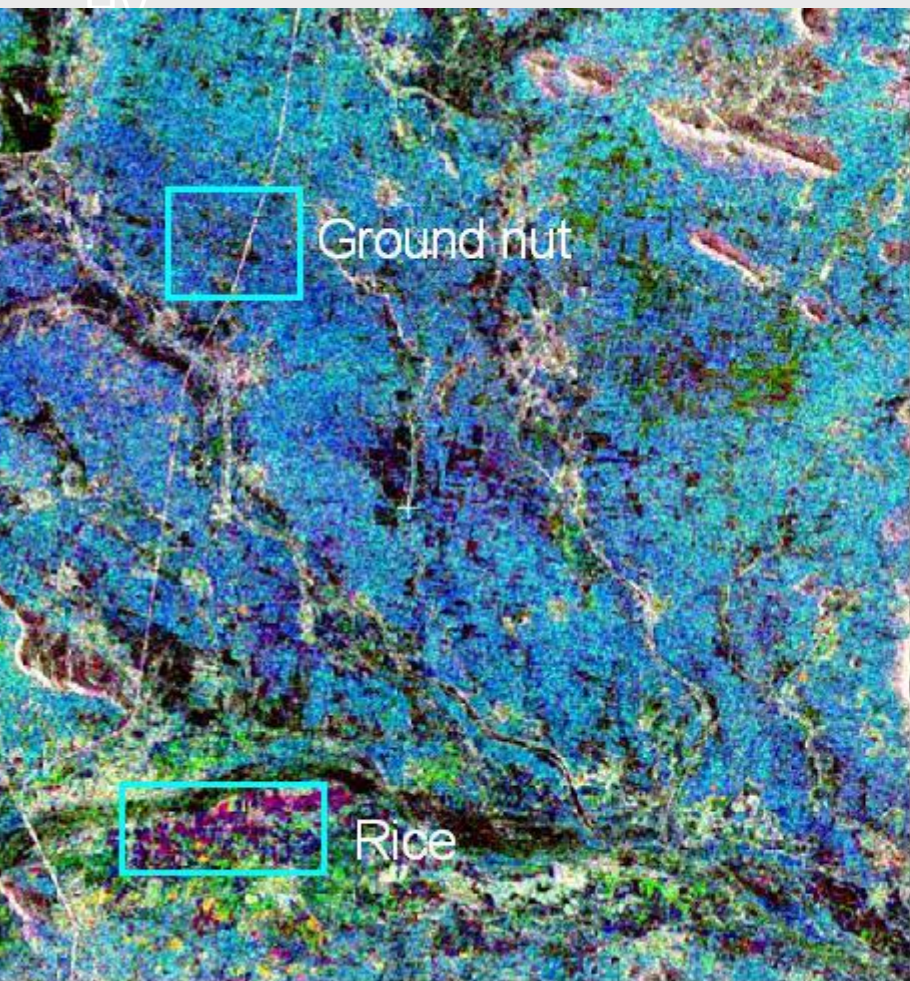


Three Date Composite FCC



Groundnut crop studies using three date ENVISAT SAR data

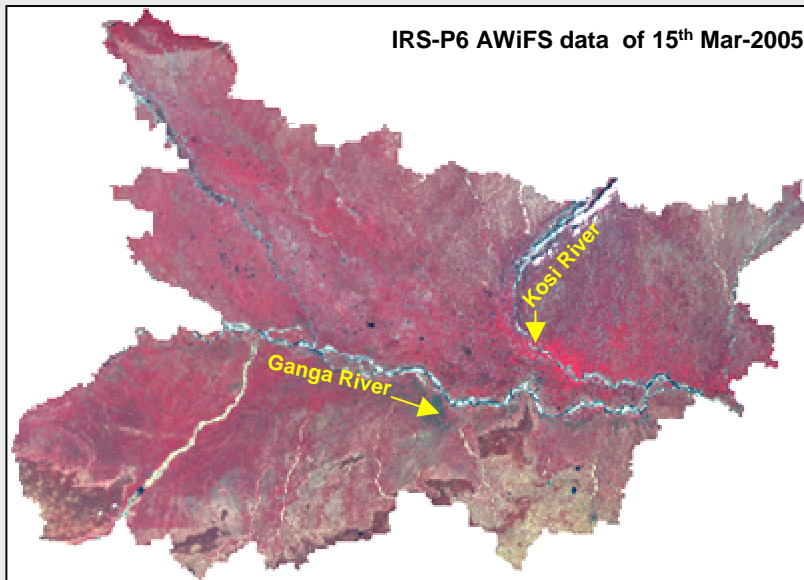
11-Jul, 15-Aug, 19-Sep, 2005



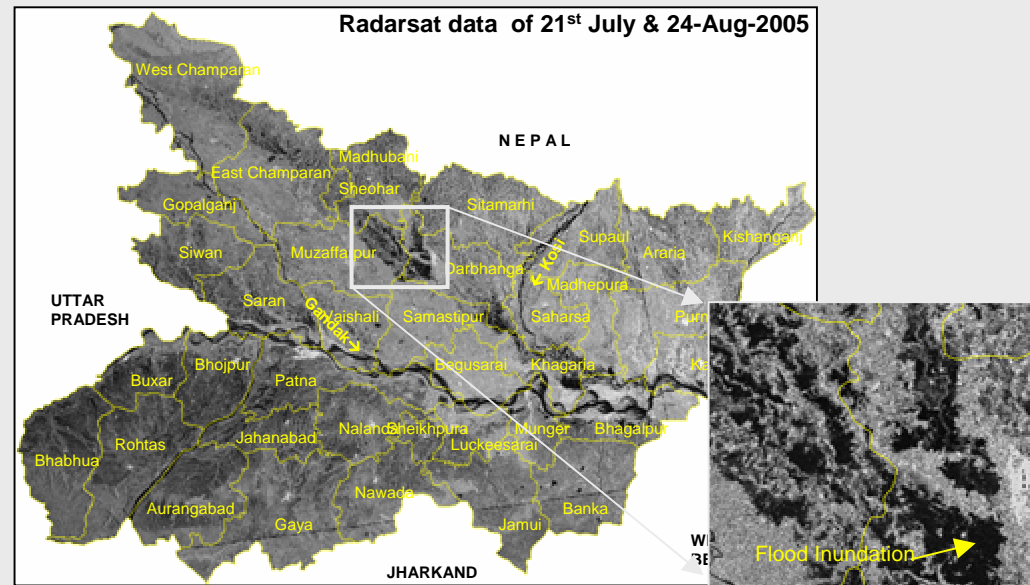
SAR DATA in Flood Relief

- Comparison of pre-flood and during flood satellite images providing flood inundation details
- Flood situation is monitored using multi-temporal satellite data,
- NRSA is providing flood maps in near real time to Ministry of Home Affairs and respective States for relief

Pre-Flood



During Flood

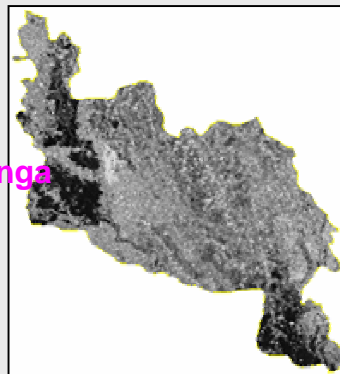
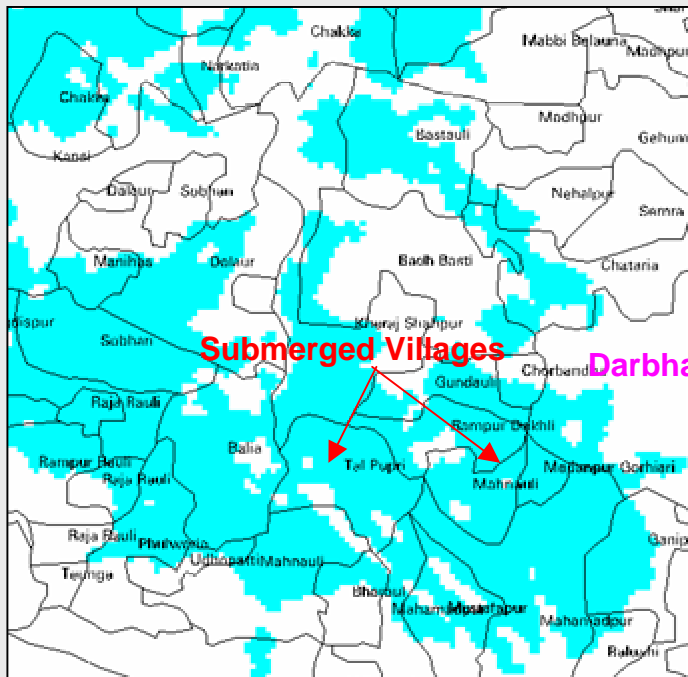


Flood Map

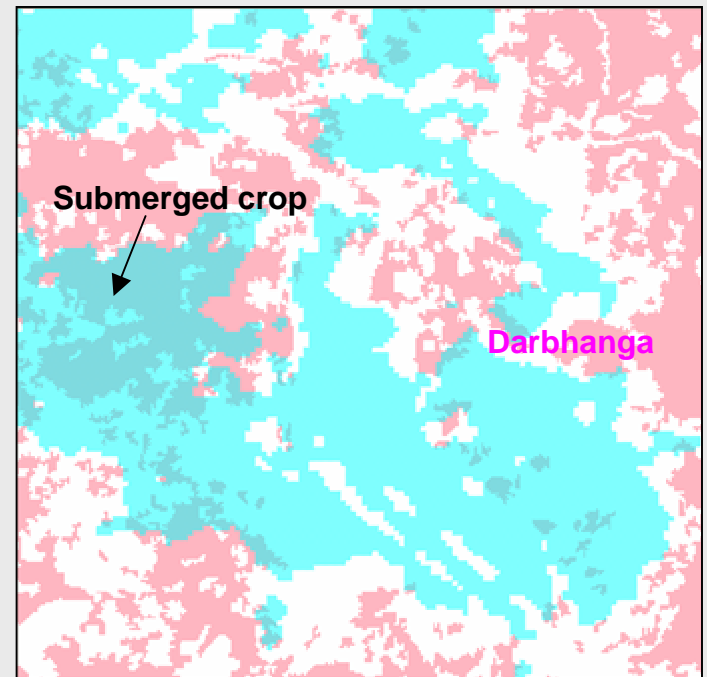
EXAMPLE: Flood Damage Assessment

- Generation of Damage Assessment statistics
- By integrating the flood inundation layer with the database layers such as village boundaries, crop etc. damage can be assessed.

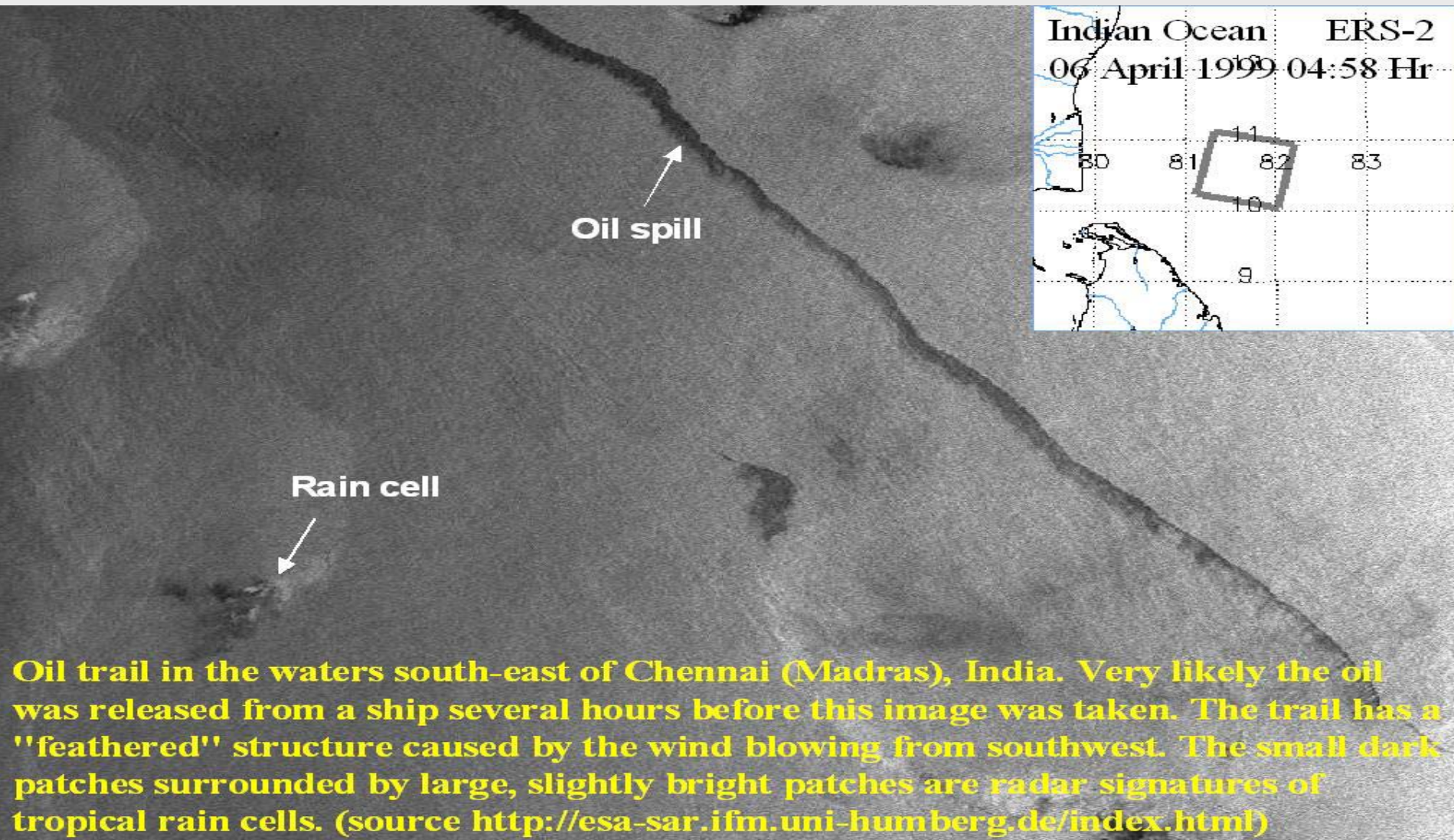
Villages Affected



Submerged Crop



EXAMPLE: Study of Spillage from Ships/boats in the Indian Ocean using ENVISAT data



The Road Ahead



- Launch of India's RISAT- by 2007/08
- RISAT- Capabilities:
 - Multi-mode SAR payload
 - Operating frequencies in C band
 - Resolution from 3 to 50 meters in different modes
 - 10-240 Km swath in different modes
- Potential for enhanced applications using multiple sources of SAR data

Concluding remarks

- **RISAT will add to global capacity for satellite based C-band SAR data, its temporal capability and its utilisation for a variety of applications**
- **In addition**, availability of multi-polarisation L- and X-band SAR from missions like TERRASAR X & L will enhance the existing capabilities further .
- **SAR provides both complementarity and supplementarity to optical RS data**
- **With large-scale availability of SAR data and lowering of its cost, use of SAR can become cost effective and timely**

Thank you