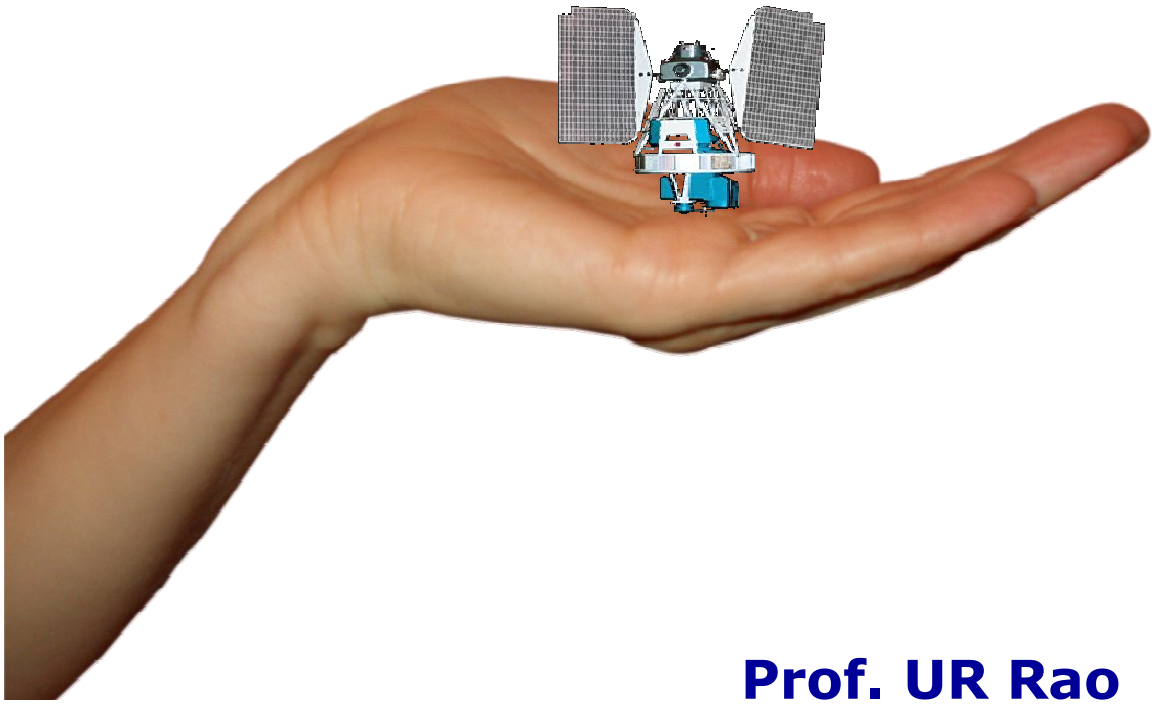
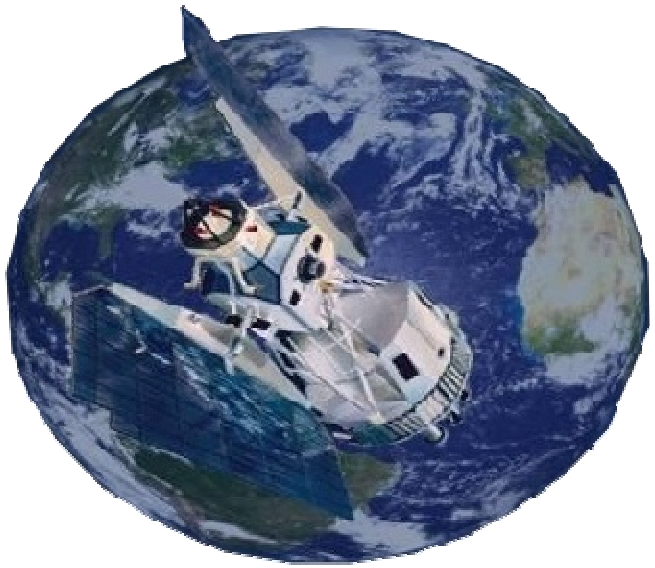
Role of Landsat in Revolutionizing the Management of Natural Resources



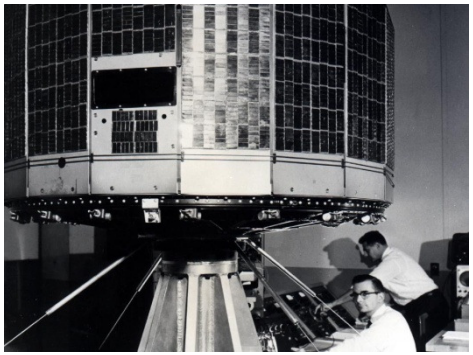


Prof. UR Rao
Former Chairman, ISRO, India

40 Years of Landsat, June 6, 2012

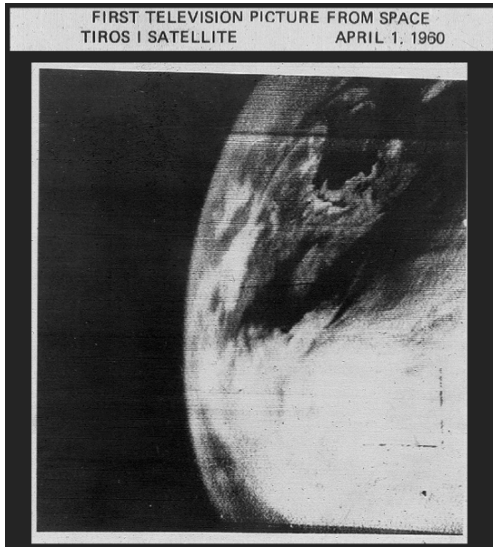
Evolution of Remote Sensing Satellites

TIROS



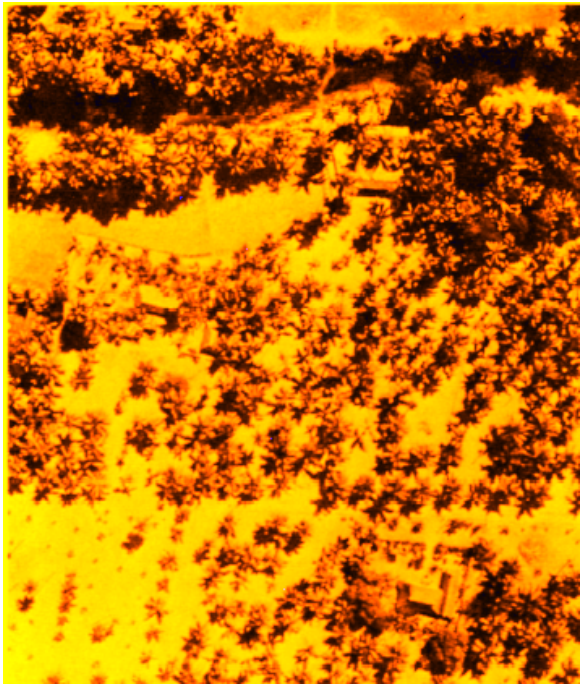
First successful weather satellite (Television Infrared Observation Satellites)

Launched by NASA on April 1, 1960



Source: NASA

Aerial Survey



Aerial view of Grove Area (Coconut Root Wilt Disease Study)

Source: ISRO

Landsat Series of Satellites

Landsat-1: 1972-78

Landsat-2: 1975-82

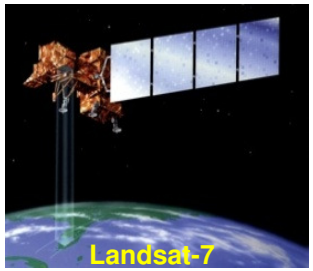
Landsat-3: 1978-83

RBV & MSS

Landsat-4: 1982-93

Landsat-5: 1984-2011

MSS & TM



Landsat-7:

1999 Till date

ETM+

Source: NASA

Evolution of Remote Sensing Satellites

Source: CEOS

1972-1981

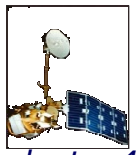
Landsat-1, 2, 3 – USA
Nimbus-6 – USA
TIROS-M – USA
Lageos-1 – Italy
Meteosat-1 – Europe

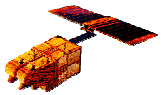
....

....

~12

1982-1991


Landsat -4,5


SPOT – 1/2


FY – 1A


IRS – 1A / 1B

Landsat-4,5 – USA
NOAA-1 – USA
DMSP-7 – USA
GOES – USA
IRS-1A – INDIA
GMS -3 – JAPAN
SPOT – FRANCE
FY-1A – CHINA
ERS -1 – EUROPE
METEOR-2N21 – RUSSIA

....

....

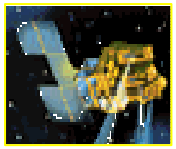
~50

1992-2001


Landsat-7


IKONOS


IRS – 1C


SPOT-5

LANDSAT-7 – USA
QUIKSAT – USA
JASON – USA & FRANCE
IRS-1C, 1D – INDIA
FY-2A – CHINA
CBERS1 – CHINA & BRAZIL
SPOT-5 – FRANCE
STELLA – FRANCE
JERS-1 – JAPAN
OCEAN1 – RUSSIA
RADARSAT-1 – CANADA
ADEOS – JAPAN
SICH-1 – UKRAINE
SAC-A – ARGENTINA

.....

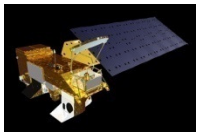
.....

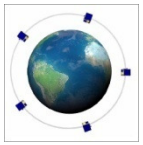
~90

2002-2011


RISAT-1


ENVISAT


AQUA


RAPIDEYE

AQUA – USA
RISAT-1 – INDIA
HY-1A – CHINA
FEDSAT – AUSTRALIA
ENVISAT – EUROPE
BILSAT – TURKEY
NIGERIASAT – NIGERIA
ALOS – JAPAN
CALIPSO – FRANCE
TOPSAT – UK
COSMOSKYMED – ITALY
THEOS – THAILAND
RAPIDEYE – GERMANY
GOSAT – JAPAN
TANDEMX – GERMANY

....

....

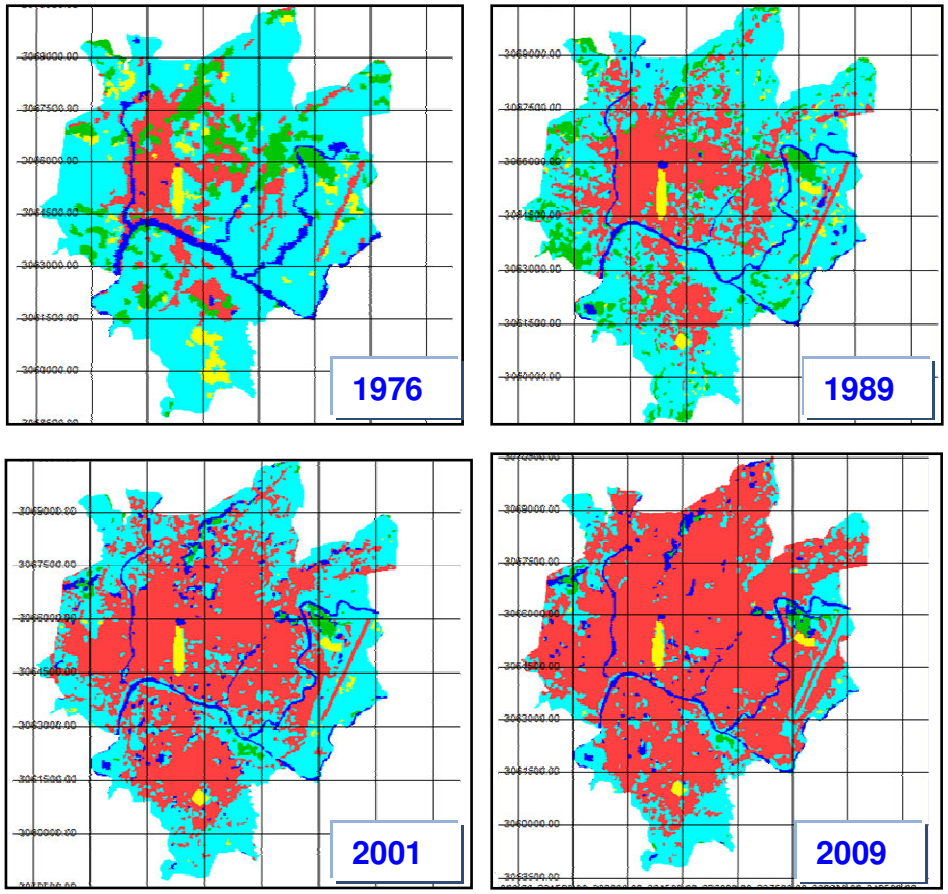
~135

Evolution of Remote Sensing Satellites

Parameter	1972-1981	1982-1991	1992-2001	2002-2011
Spatial Resolution	80m	30m -10m	10 - 5.8m	<0.4m
Spectral Coverage	VNIR	VNIR, SWIR, MIR Thermal	VNIR, SWIR, MIR Thermal, Microwave	VNIR, SWIR, MIR Thermal, Microwave
Spectral Resolution	Multi Spectral	Multi Spectral	Hyper Spectral	Hyper Spectral
Radiometric Resolution	6 bits	8 bits	12 bits	16 bits
Data rate	15 Mbps	85 Mbps	170 Mbps	800 Mbps
Data Storage	Mega Bytes	Giga Bytes	Terra Bytes	Peta Bytes

LANDUSE

Land Use Maps of Kathmandu, Nepal

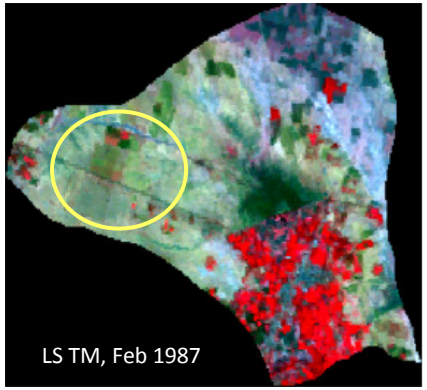


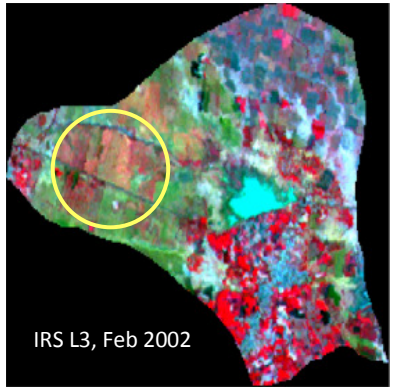
Urban/Built-up
Water Body
Forest Cover
Open Field
Cultivated Land

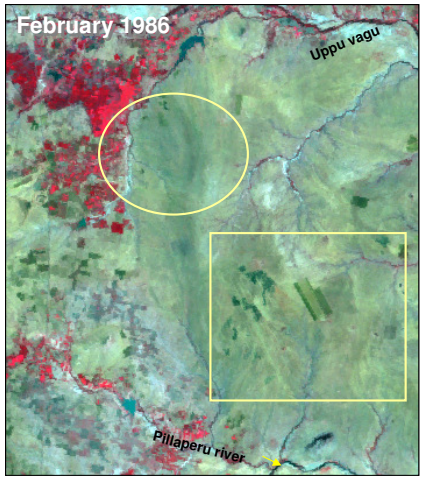
Source: www.geospatialnet.com

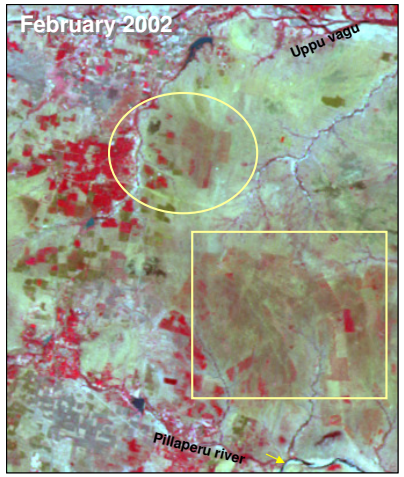
WASTELAND

Wasteland Study, India









Total Wasteland (2008-09) : 467021 Sq. Km

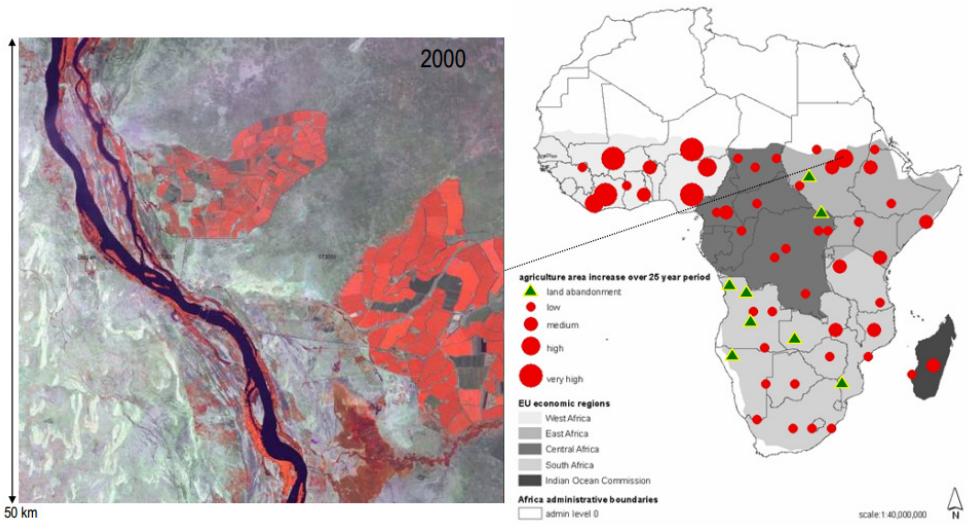
Source: ISRO

AGRICULTURE

White Nile Irrigation Scheme

White Nile Irrigation Scheme – pre expansion 1975
And after construction 2000 (images Landsat)
Land use change Eva, H.D., et al

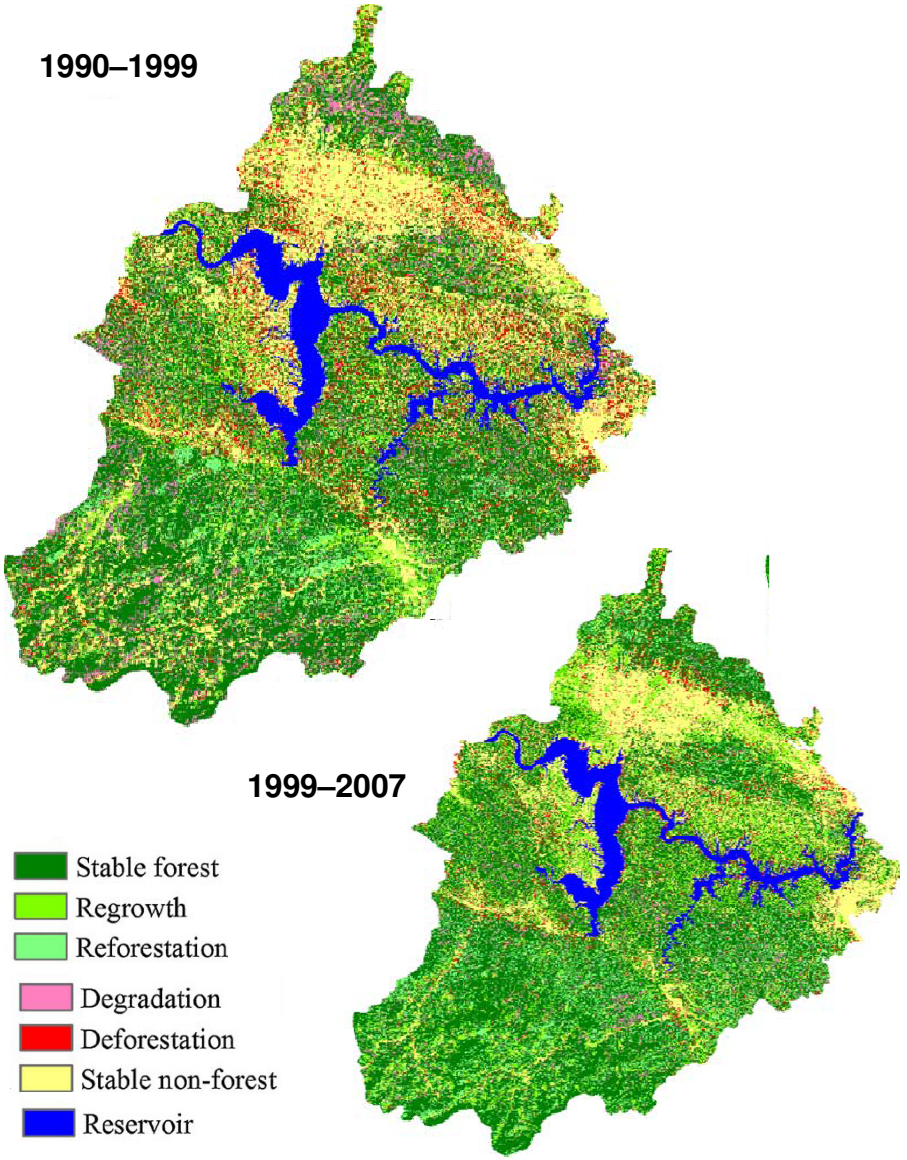
50,000 km² of natural vegetation converted to agriculture every year since the 1970s



Source: NASA

FORESTRY

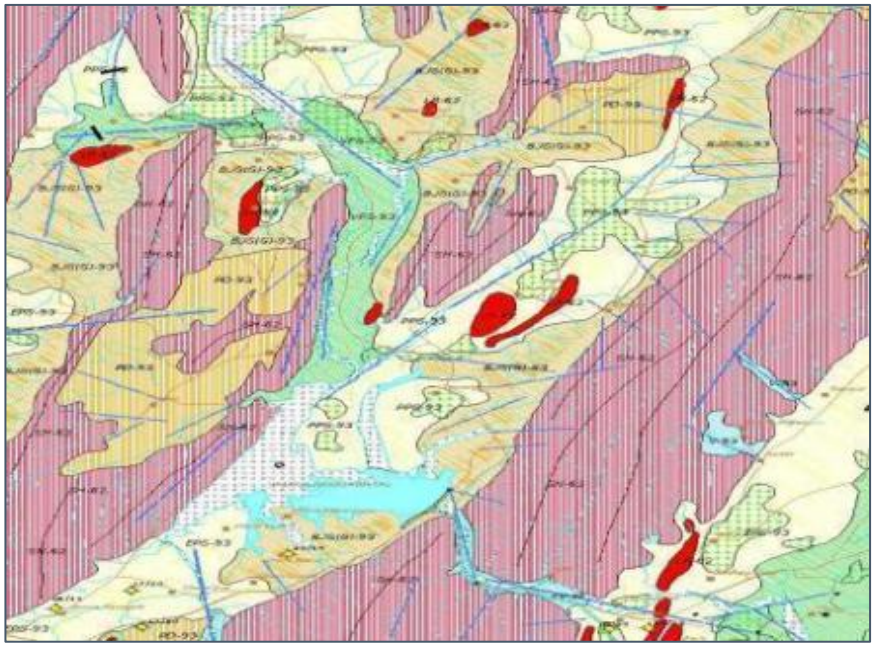
Forest change categories in Danjiangkou, China

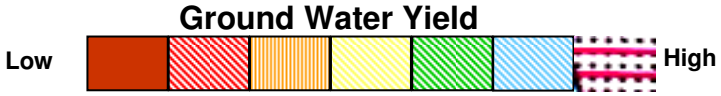


Source: Shi et. al. 2011

WATER RESOURCES

Groundwater Exploration & Recharge - India

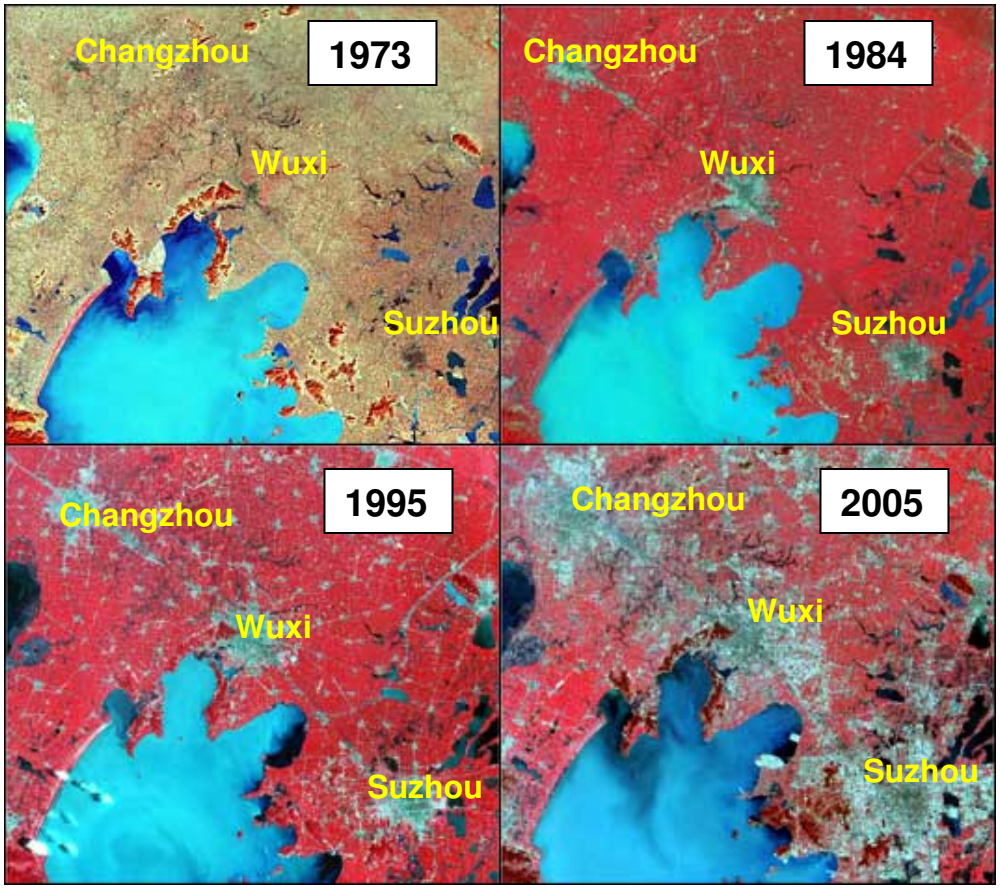




Source: ISRO

URBAN

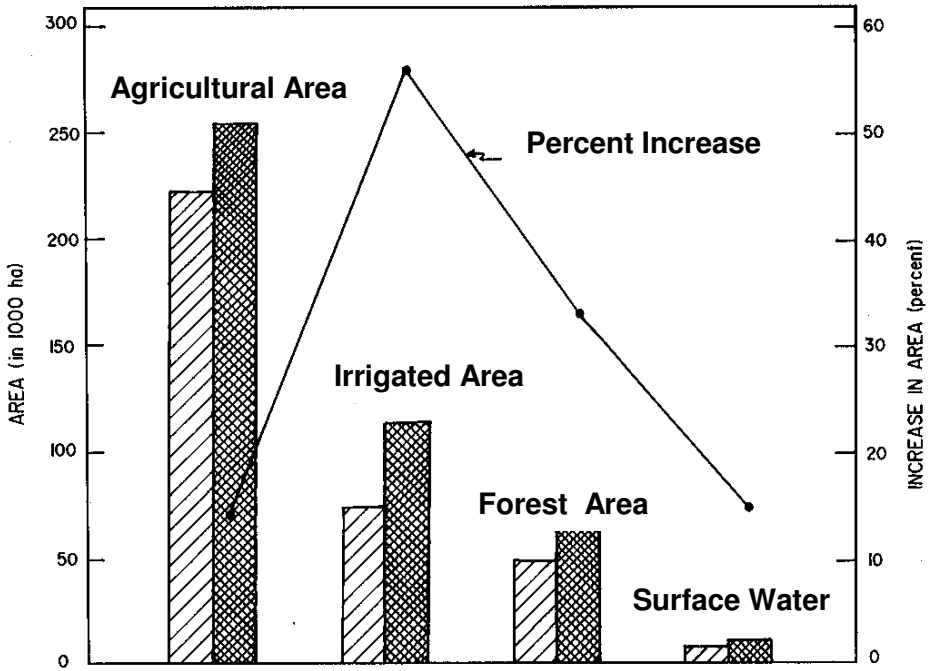
30 years of rapid urban expansion in China's Shanghai region.



Source: http://www.earthobservations.org (GEO)

SUSTAINABLE IMPROVEMENT

Improvement of Carrying Capacity in Developing Countries

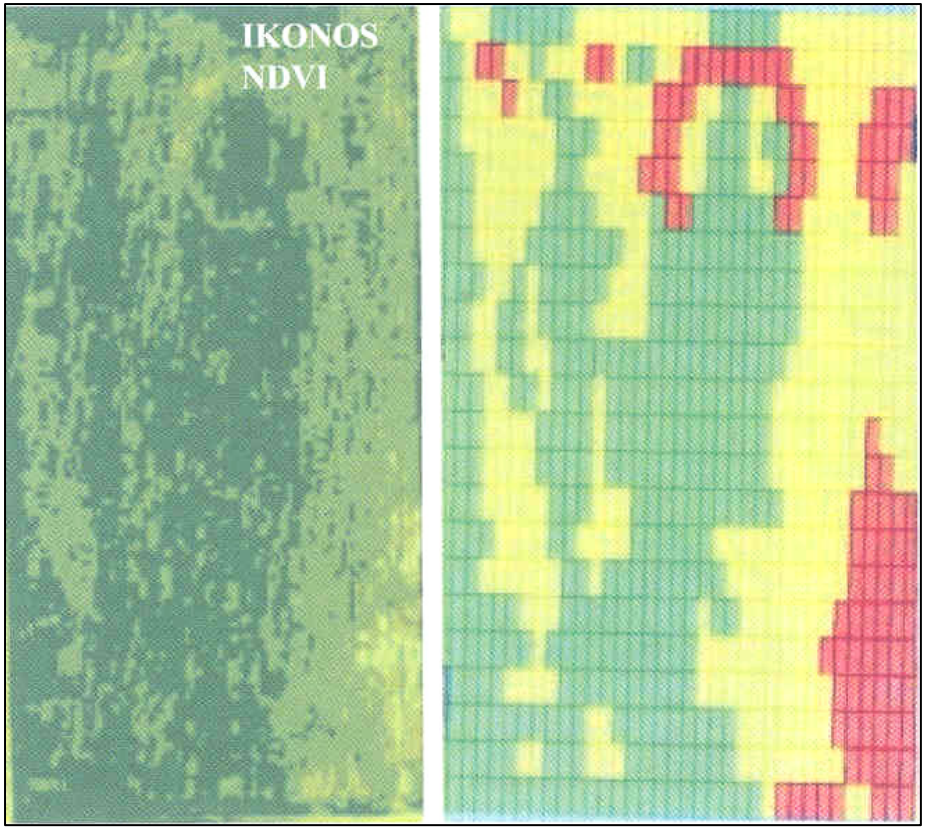


Increase in Land and Water Resources in 20 Watersheds as a result of Integrated Mission for Sustainable Development (IMSD) Strategy Implementation 1988-1996

Source: UR Rao, 1999 – Space Forum

PRECISION FARMING

St. Thomas Area, North Dakota

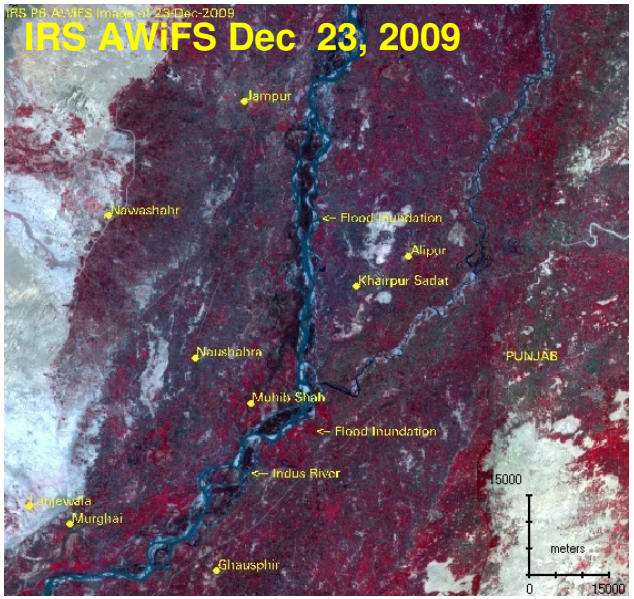


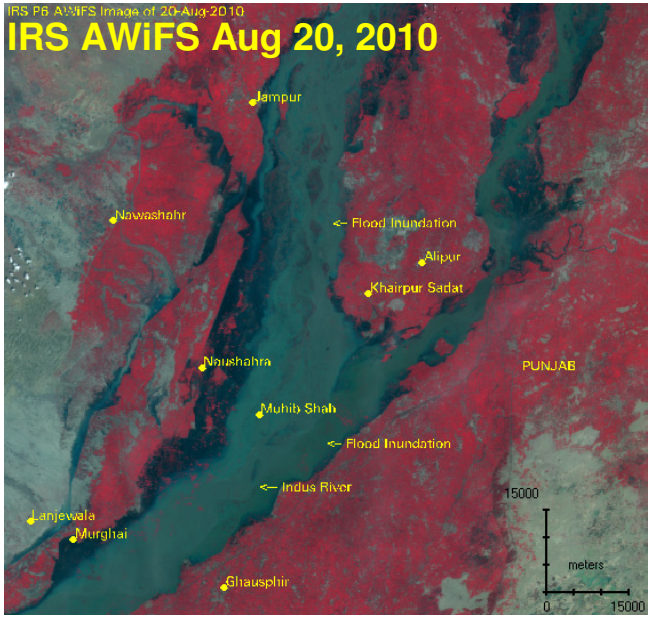
Red = 210 kg/ ha N
Yellow = 180 kg/ ha N
Green = 130 kg/ ha N

Source: Christopher Small, 2003 – www.sciencedirect.com

DISASTER MANAGEMENT

Pakistan – Floods – August 2010

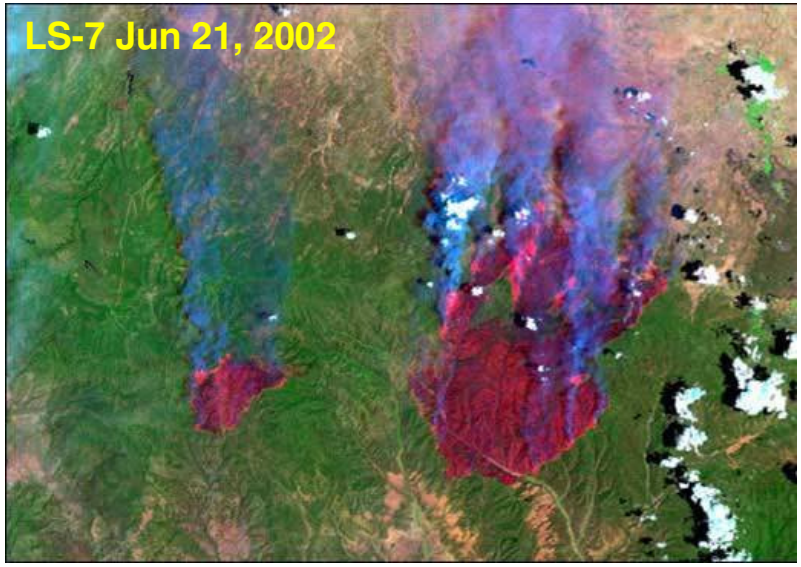


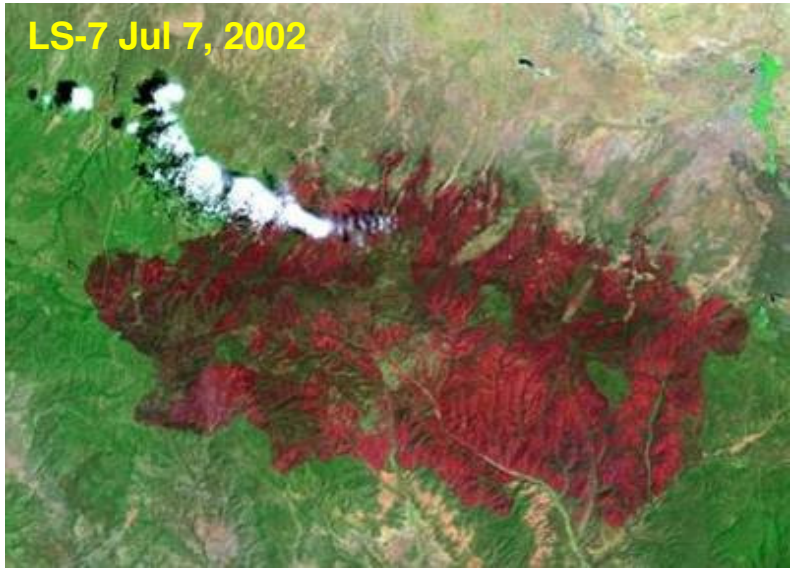


Source: ISRO

Affected about 14 million people

Rodeo - Chediski Forest Fire, Arizona





Source: USGS Landsat Project

468,000 acres destroyed

DATA SHARING MECHANISMS

LANDSAT

- Highest year of distribution - US Fiscal Year 2001 - ~ 25,000 scenes were delivered.
- Policy Change by USGS – 2008

- Result: More than 2.0 million images since 2008
- Global Data Archives – 40 Years of Ortho rectified Data

Now Many Other Countries too….

CBERS

1,20,000 images per year

nrsc

80,000 images per year

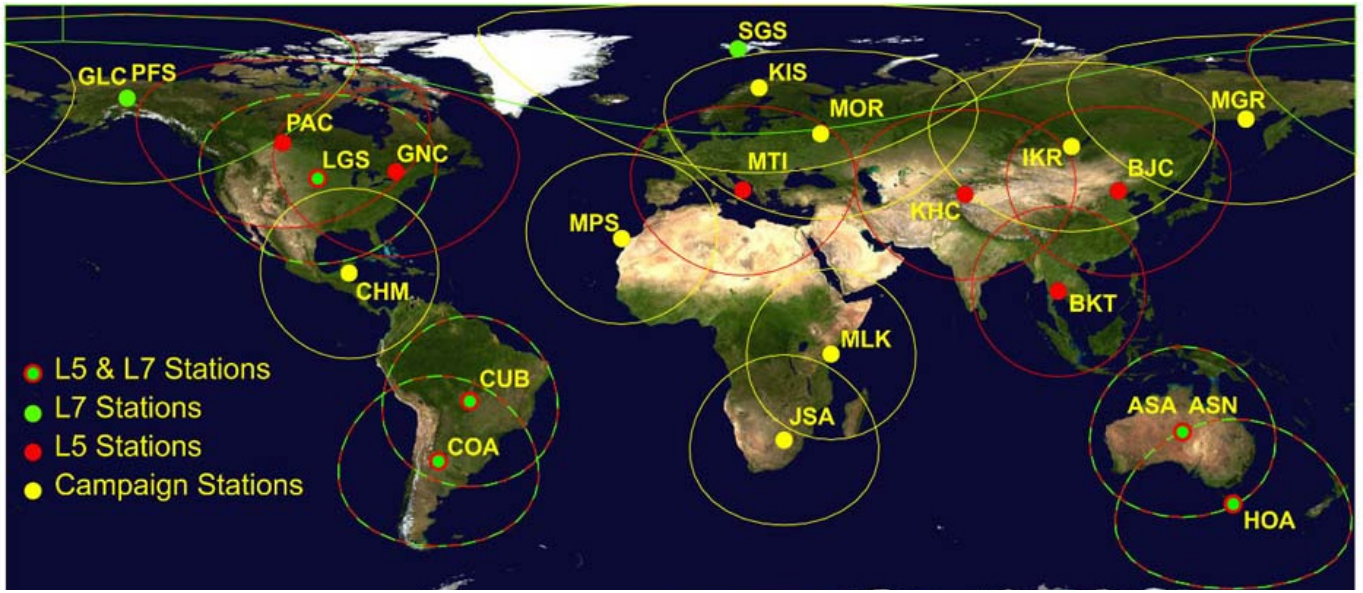
DISASTER MANAGEMENT SUPPORT

International Charter Space & Major Disasters

Sentinel Asia

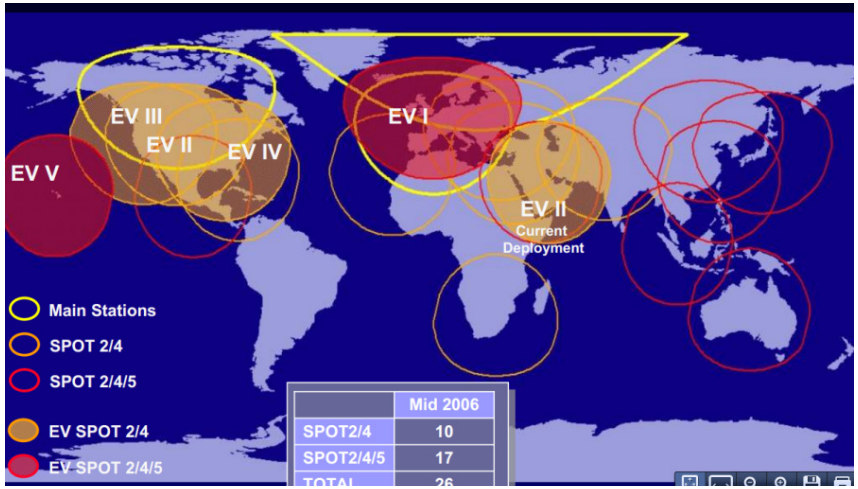
GROUND STATIONS TO FACILITATE DEVELOPING COUNTRIES

Landsat Ground Stations



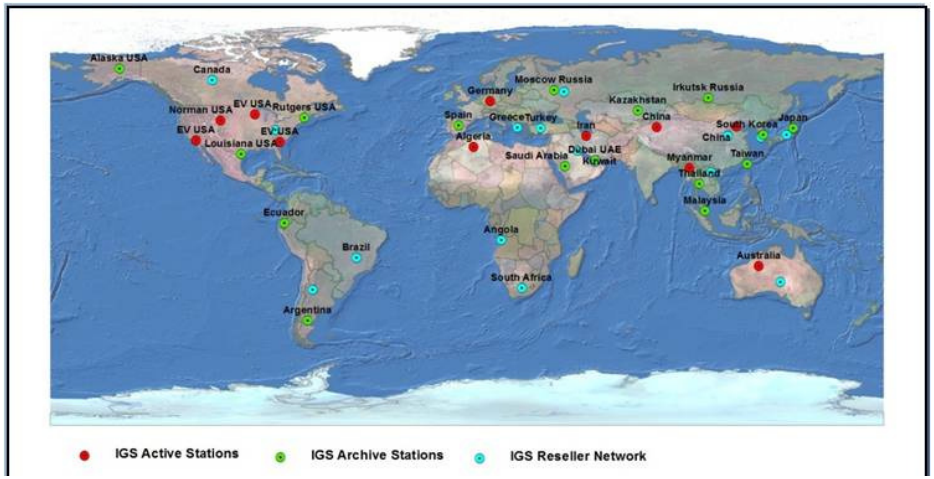
Total Number of Stations : 19

SPOT Ground Stations



Total Number of Stations : 20

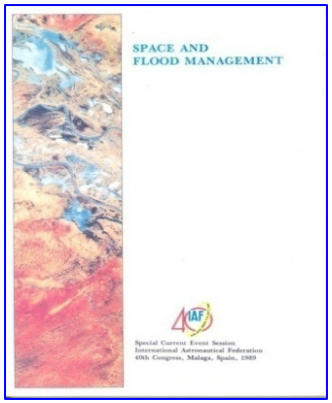
IRS Ground Stations

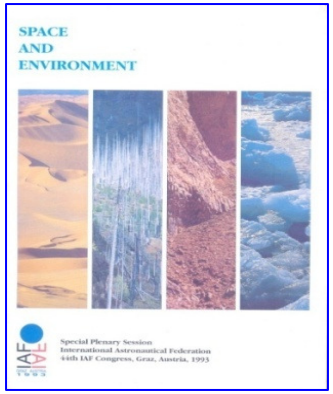


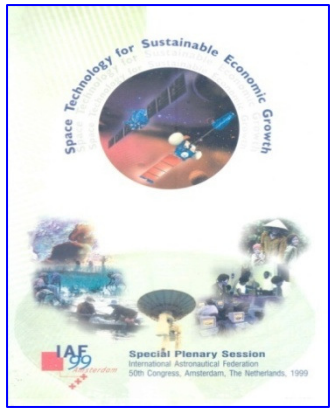
Total Number of Stations : 14

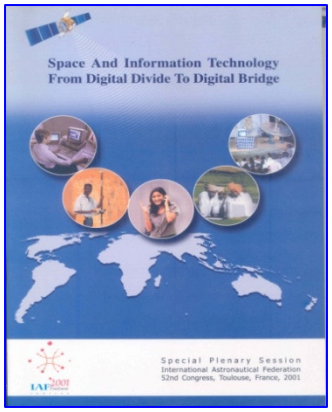
Committee for Liaison with International Organisations and Developing Nations (CLIODN)

CLIODN advises the International Astronautical Federation (IAF) on opportunities to foster international cooperation in space programmes and its application in developing countries.









THEMES OF CLIODN

1. Benefit of Human Kind – Brighton – 1987
2. Drought Management – Bangalore – 1988
3. Flood Management – Malaga – 1989
4. Forest Management – Dresden – 1990
5. Agriculture Management – Montreal – 1991
6. Space for Developing Countries – Washington – 1992
7. Environment – Graz – 1993
8. Rural Development – Jerusalem – 1994
9. Health Care – Oslo – 1995
10. Urban Environment – Beijing – 1996
11. Industrial Partnership – Turin – 1997
12. Transiting Economic Scenario – Melbourne – 1998
13. Sustainable Economic Growth – Amsterdam – 1999
14. Equitable Global Village – Rio de Janeiro – 2000
15. Information Technology – Toulouse – 2001
16. Building Partnership with All Stakeholders – Houston – 2002
17. Enhancement of Carrying Capacity – Bremen – 2003
18. National Disaster Management – Vancouver – 2004
19. Education and Capacity Building – Fukuoka – 2005
20. Water Resource Management – Valencia – 2006
21. Poverty Alleviation – Hyderabad – 2007
22. Imagination to Reality – Glasgow – 2008
23. Climate Change – Daejon – 2009
24. Human Benefit and Development – Prague – 2010
25. Environmental Security – Cape Town – 2011
26. Space Science and Technology for all – Naples – 2012

MUMBAI, INDIA

Thank You

Contact: