Kerala State Disaster Management Authority

Training Program Report - March 21st 2022

Training Title	:	Application of Remote Sensing For Disaster Management
Presented by	:	Consultant Disaster Management , KSDMA
Resource Person	:	Dr. Karunakaran Akhil Dev
Mode of meeting	:	Online Training
Platform	:	Google Meet
Link and Schedule	:	https://meet.google.com/fgo-rspo-wke
Audience	:	Public
Date of Meeting	:	21/03/2022
Timing	:	11:30 AM to 1:00 PM
Welcome Addressed	:	Mr. Clint Mathew, Social Capacity Building Specialist

Officials Present :

1. Dr. Sekhar L. Kuriakose, Member Secretary, KSDMA
2. Mr. Joe George State Project Officer KSDMA
3. Mr. Pradeep G.S Hazard Risk Analyst, KSEOC
4. Mr. Clint Mathew, Social Capacity Building Specialist

Brief of the training :

The training was conducted for public, to provide insights on applications of remote sensing for Disaster Management. The program was presented online for public awareness and reach. The training was conducted by the resource person interactive session and consisted college, university students, government officials, public of Kerala State. Total slides were 99 from Cover Slide/ Title Slide to the end slide thank you slide (Appendix I). Total participants for the program was 38 (Table 1.).

General Questions addressed

1) Do we have any remote sensing satellite onboard placed that penetrates into earth for earth core studies?
2) What level of remote sensing technique required or suitable for Kerala region?
3) Policy level change needed for provision of Remote Sensing data for free for government departments?
4) How to channelize and need of Digital Elevation Model in temporal scales, we only rely on single year DEM data for model, please comment?

Conclusion:

The perspectives of disasters, disaster management, basics of remote sensing, utility of remote sensing for different disasters, assessment mechanism, techniques of RS was rendered through this program (Appendix I).

Table 1. List of Participants/ Attendees

Sl.No	First name	Last name
1	ANI	
2	Shalikh	
3	Supriya	Baburaj M
4	Agina	Chandran
5	Pratheesh	C Mammen
6	afra	cp
7	Joe John	George
8	Gauri	Ghosh
9	Dr. Karunakaran Akhil Dev	
10	Shalikh	
11	Supriya	Baburaj M
12	Agina	Chandran
13	Pratheesh	C Mammen
14	afra	cp
15	Amrutha	Kolangad
16	DEOC	KOTTAYAM
17	Member Secretary	KSDMA
18	clint	mathew
19	Asha V K	Menon
20	Noushaba	Nas
21	Prem G	Prakash
22	Praveen	P U
23	Vijeesh	Pulparambil
24	Remya	R
25	Gowtham	Raj
26	Hazard and	Risk Analyst SEOC
27	Ruksana	Salim
28	Aiswarya	Sathianadhan
29	Ahmed	Shafeeque
30	Arunlal	sudakaran
31	syam	sunny
32	Adharv	Suresh
33	Rajeev	t.r
34	neethu	thomas
35	JOHN RICHARD	THOMAS
36	Basil	Varkey
37	Shinu Sheela	Wilson
38	FAHEED	

Application of Remote Sensing forDisaster Management

Myself

Dr. Karunakaran Akhil Dev

Consultant Disaster Management

Kerala State Disaster Management Authority

Government of Kerala

Thiruvananthapuram , Kerala, India - 695033

karunakaranakhildev@gmail.com Phone: 9847231604

Year 2022

Only insight

Contents

1	Disasters, Disaster Management
2	Remote Sensing (RS), Satellite, Types, Sensors, RS Data Types
3	Agencies for Remote Sensing Data
4	Disaster Management Phases & Remote Sensing Utility
5	Some Disasters & Remote Sensing Utility
6	Advantages and Disadvantages of Remote sensing
7	Questions ?

Disaster

Definitions

a sudden accident or a natural catastrophe that causes great damage or loss of life **Oxford Dictionary**

A disaster is an occurrence disrupting the normal conditions of existence and causing a level of suffering that exceeds the capacity of adjustment of the affected community **WHO**

Any catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or man made causes, or by accident or negligence which results in substantial loss of life or human suffering or damage to, and destruction of, property, or damage to, or degradation of, environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area

The Disaster Management Act, 2005

Types of Disaster

Based on Origin it is divided into two

***Natural**:* Geological, water and climate related and biological

***Man made**:* Accident related, chemical industrial and nuclear

Based on Nature it is divided into three

1. **Rapid** : Cyclone, fire, Earthquake, Landslides.
2. **Rapid /slow** : War, Epidemic, civil unrest.
3. **Slow** : Drought, Desertification, and Pollution.

Categories of Disaster

Category 1- Hydro Meteorological Disasters.

a) Flood
b) Drought
c) Costal erosion
d) Thunder and Lightening
e) Cyclone and Storms etc.

Category 2- **Geologically Related Disasters**

a) Landslides and Mudflows
b) Earthquakes
c) Dam failures
d) Tsunami

(KSDMA Policy, 2010)

karunakaranakhildev@gmail.com Phone:
9847231604

Categories of Disaster

Category 3- Chemical Industrial and Nuclear Related Disasters

a) Leakage of hazardous materials at the time of their manufacture, processing and transportation. Disasters due to manufacture, storage, use and transportation of products,

b) Pesticides etc and waste produced during the manufacturing process etc.

Category 4- Biological Related Disasters

a) Epidemics

b) Cattle epidemics

c) Fish diseases

d) Pest attacks etc

(KSDMA Policy, 2010)

karunakaranakhildev@gmail.com Phone: 9847231604

Categories of Disaster

Category 5- Man-Made Disasters

a) Forest fire
b) Urban fire
c) Village fire
d) Festival related disasters
e) Road, Rail and Air Accidents
f) Boat capsizing
g) Oil spill
h) Major building collapse
i) Serial Bomb blast
j) Illicit Liquor Tragedy
k) Drug abuse
l) Drowning
m) Tanker lorry mishaps
n) Pollution (water, air and soil)
o) Family suicides
p) Environmental disasters
q) Communal riots
r) Stampede etc

(KSDMA Policy, 2010)

https://sdma.kerala.gov.in/wp-content/uploads/2018/12/a5KSDMA-Policy-2010.pdf

Disasters

Can also be Classed into **Westen C.V., 2000**

Natural disasters

Events caused purely natural phenomena and bring damage to human societies.

Ex: Earthquakes, volcanic eruptions, hurricanes

Human-made disasters

Events which are caused by human activities.

Ex: atmospheric pollution, industrial chemical accidents, major armed conflicts, nuclear accidents, oil spills

Human-induced disasters

are natural disasters that are accelerated/aggravated by human influence

Classification of disaster in a gradual scale between purely natural and purely human -made

Natural	Some human influence	Mixed natural /human influence	Some natural influence	Human
Earthquake	Flood	Landslides	Crop disease	Armed conflict
Tsunami	Dust storm	Subsidence	Insect infestation	Land mines
Volcanic eruption	Drought	Erosion	Forest fire	Major (air-, sea-, land-) traffic accidents
Snow storm / avalanche		Desertification	Mangrove decline	Nuclear / chemical accidents
Glacial lake outburst		Coal fires	Coral reef decline	Oil spill
Lightning		Coastal erosion	Acid rain	Water / soil / air pollution
Windstorm		Greenhouse effect	Ozone depletion	Groundwater pollution
Thunderstorm		Sealevel rise		Electrical power breakdown
Hailstorm Tornado				Pesticides
Cyclone/ Hurricane				
Asteroid impact				
Aurora borealis				

Westen C.V., 2000

International Archives of Photogrammetry and Remote Sensing. Vol. XXXIII, Part B7. Amsterdam 2000

Disaster Management (DM) ?

Disaster Management (DM)

Definitions

A continuous and integrated process of planning, organizing, coordinating and implementing measures which are necessary or expedient for-

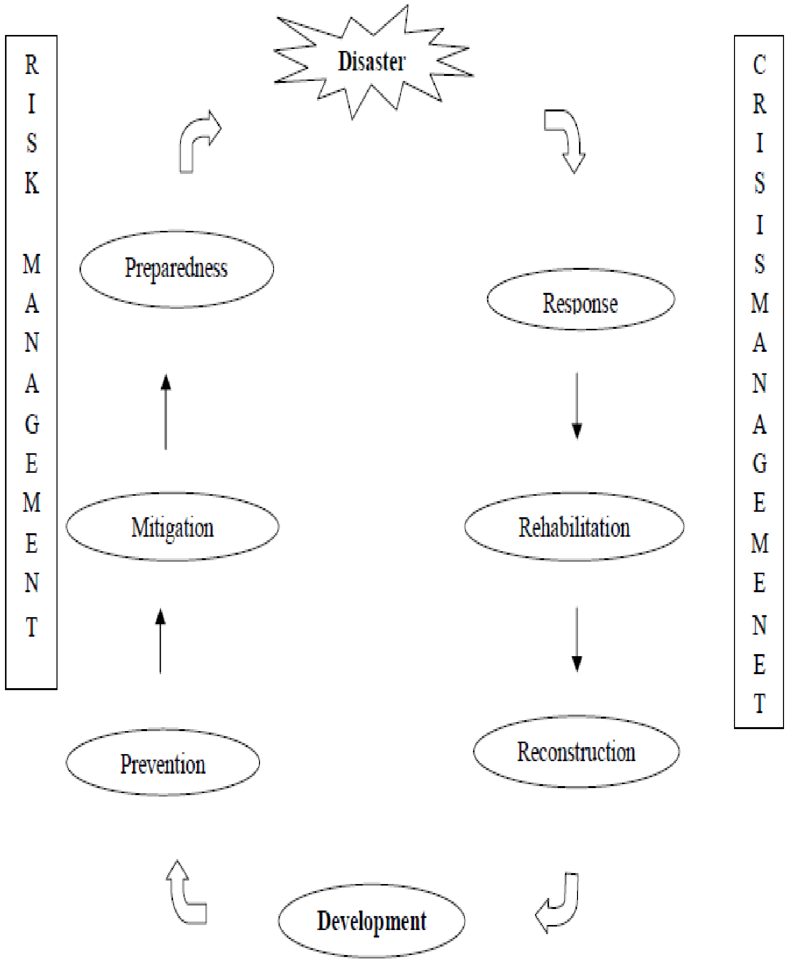
(i) Prevention of danger or threat of any disaster;
(ii) Mitigation or reduction of risk of any disaster or its severity or consequences;
(iii) Capacity-building;
(iv) Preparedness to deal with any disaster;
(v) Prompt response to any threatening disaster situation or disaster;
(vi) Assessing the severity or magnitude of effects of any disaster;
(vii) Evacuation, rescue and relief;
(viii) Rehabilitation and reconstruction

The Disaster Management Act, 2005

DM Cycle

Development **Disaster**

DM Cycle



(Enos, 2002; Sowmya etal., 2012)

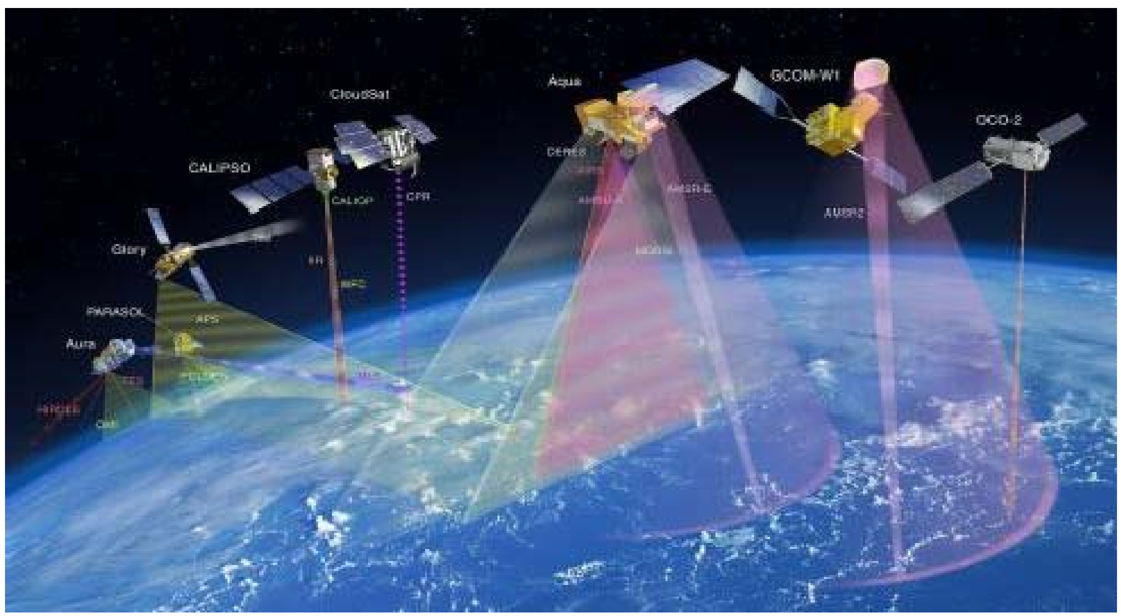
karunakaranakhildev@gmail.com Phone: 9847231604

Remote Sensing ?

Remote Sensing (RS)

Definition

Remote Sensing is defined as the science and technology by which the characteristics of objects of interest can be identified, measured or analyzed the characteristics without direct contact.

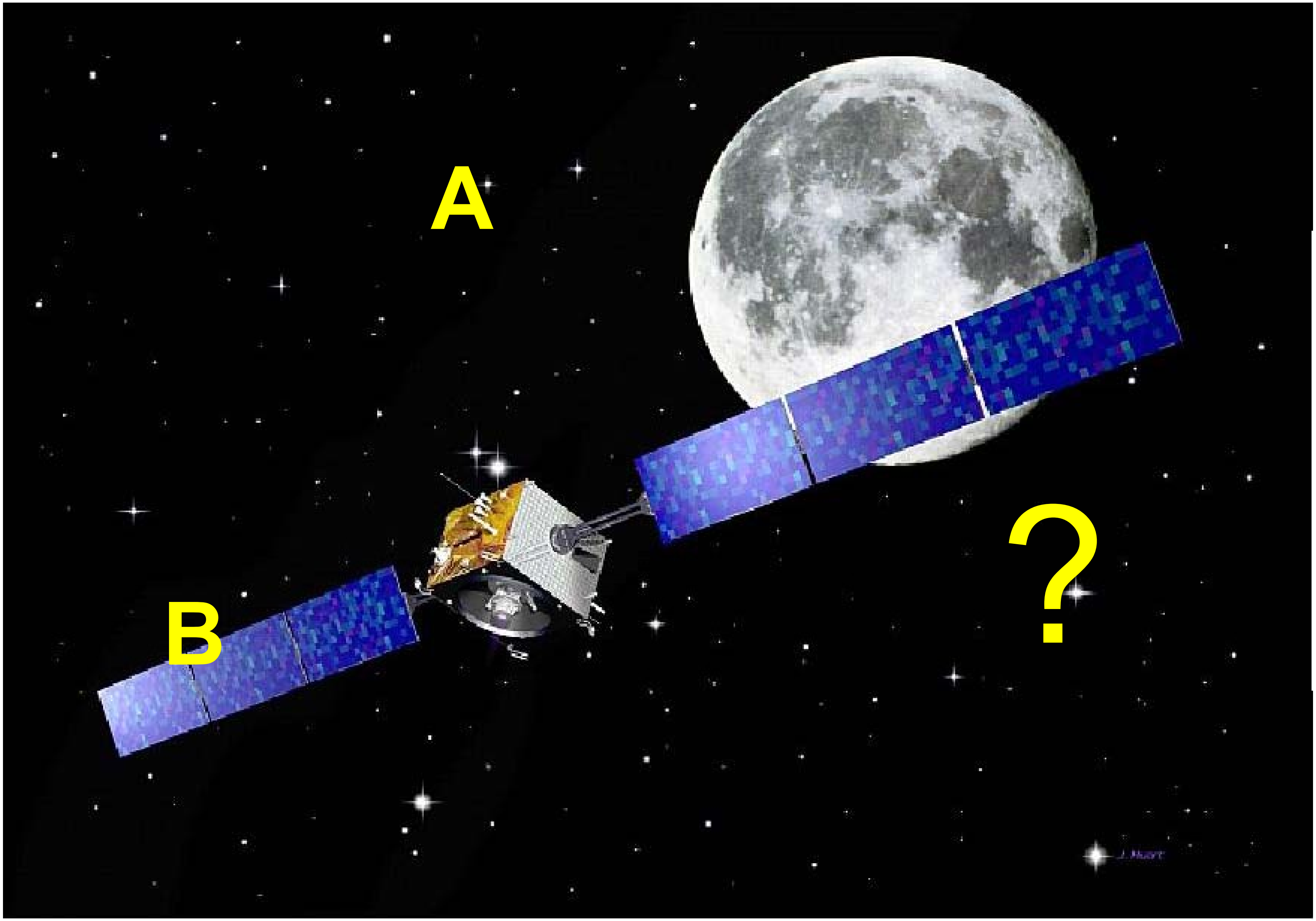


Phone: 9847231604

Remote Sensing (RS)

It is a technology for sampling electromagnetic radiation to acquire and read non-immediate geospatial data from which to pull info more or less features and objects on his Earths land surface, seas, and air.

karunakaranakhildev@gmail.com
Phone: 9847231604


A
B
?

Satellite ?

An eye in the sky that does not tell lie

Satellite

Artificial
Satellite

refers to a machine that is launched into space and moves around Earth or another body in space.

A satellite is an object that has been intentionally placed into orbit. These objects are called artificial satellites to distinguish them from natural satellites such as Earth's Moon.

NASA

Satellite pictures

Satellite imagery consists of photographs from which collected by satellites.

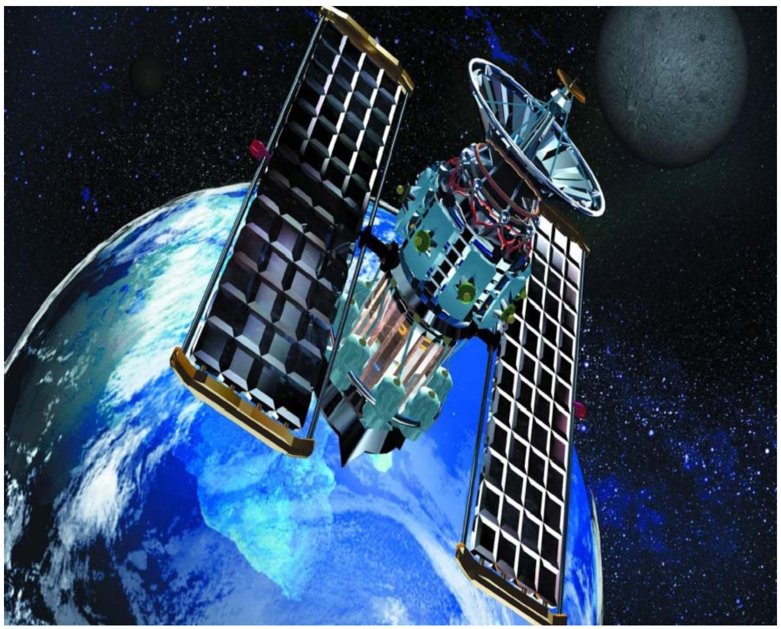
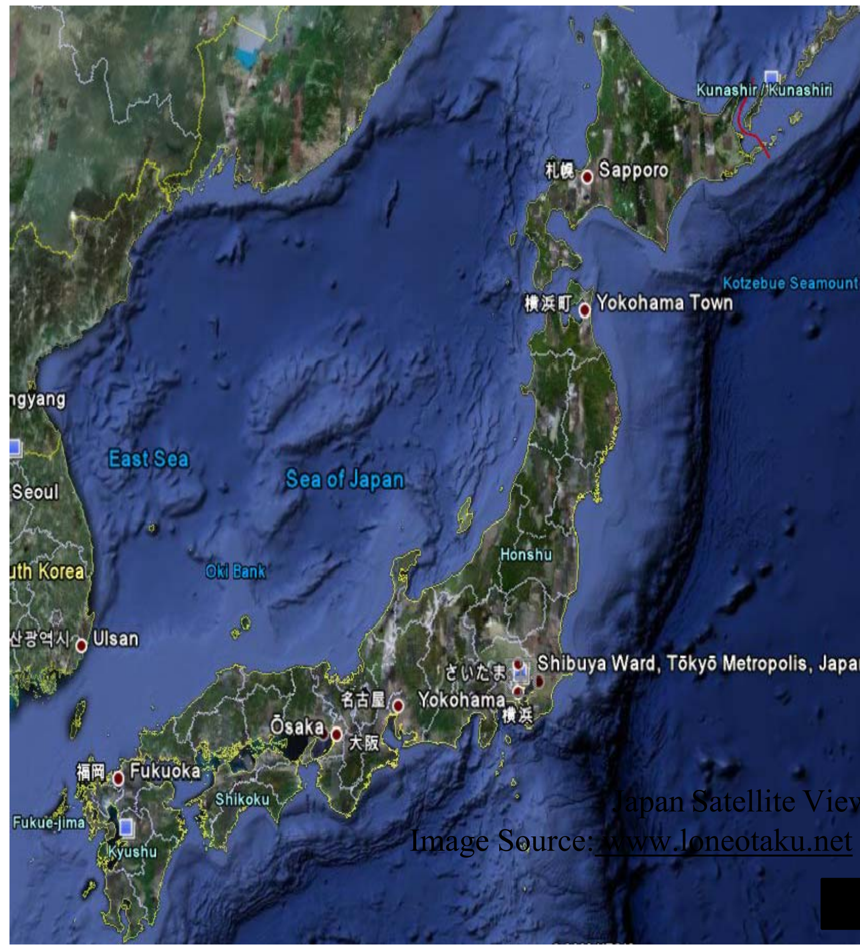
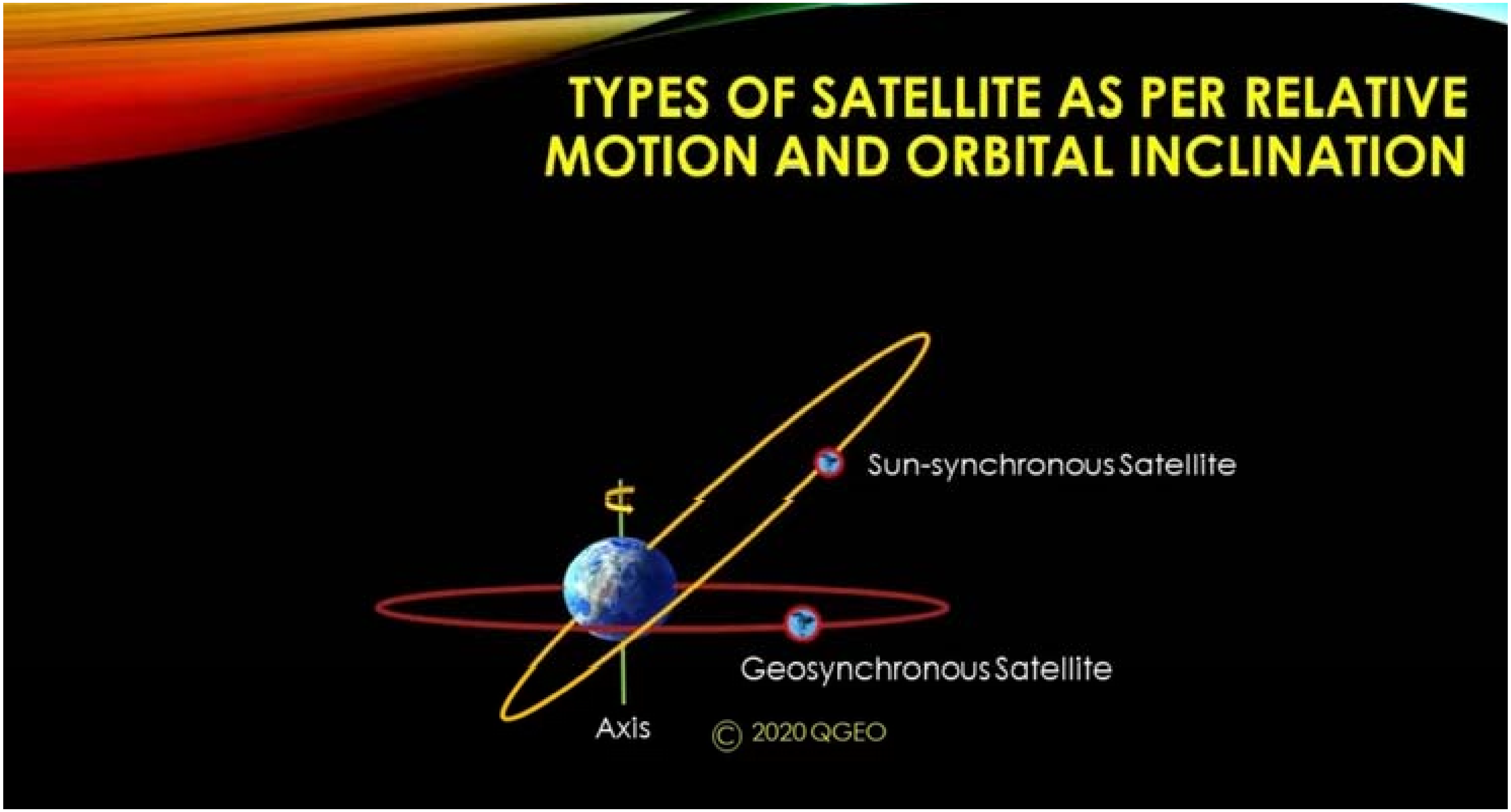


Image Source: www.wonderwhizkids.com



Japan Satellite View
Image Source: www.loneotaku.net


TYPES OF SATELLITE AS PER RELATIVE MOTION AND ORBITAL INCLINATION
Sun-synchronous Satellite
Geosynchronous Satellite
Axis
© 2020 QGEO

1

Geostationary Satellites

A geostationary satellite is one of the satellites which is getting remote sense data and located satellite at an altitude of approximately 36000 kilometres and directly over the equator.

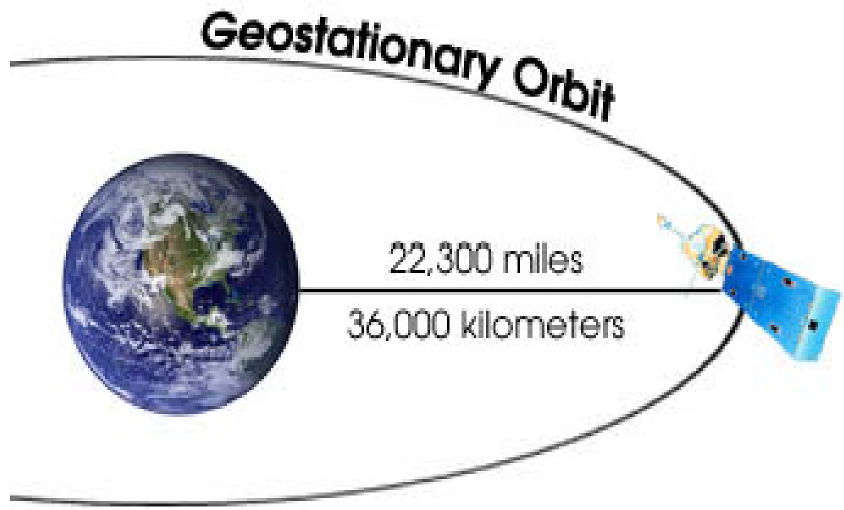
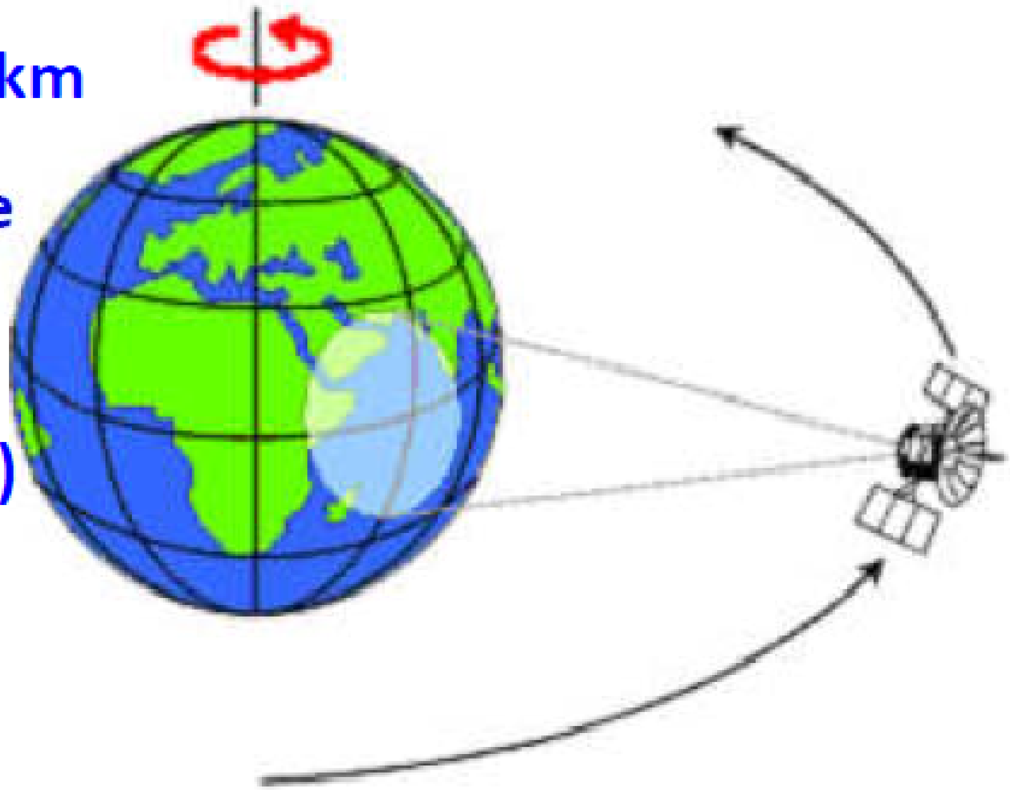


Image Source: cimss.ssec.wisc.edu

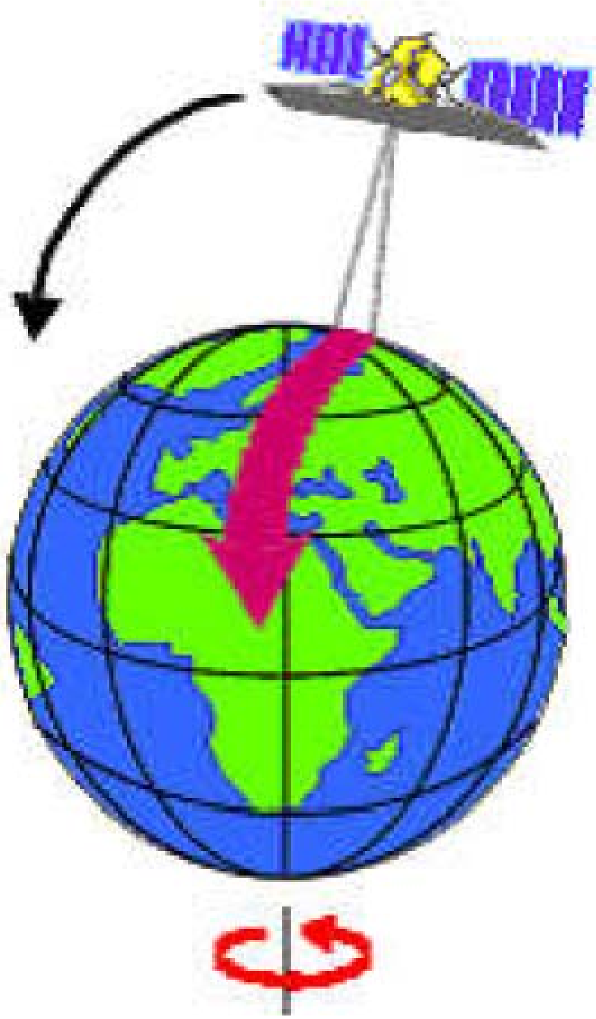
Geo-stationery



- Approximately – 36000 km altitude
- Velocity – 3075 m/s (Earth's speed in its axis)
- Orbital period – 24 Hrs
- West to East
- Applications – Meteorological, Communication

Example: INSAT

Sun Synchronous



- Lower altitude – 817 km
- High resolution

Example

IRS – 1C

karunakaranakhildev@gmail.com
Phone: 9847231604

Polar-Orbiting Satellites

A polar orbit is a satellite which is located near to above of poles. This satellite mostly uses for earth observation by time.

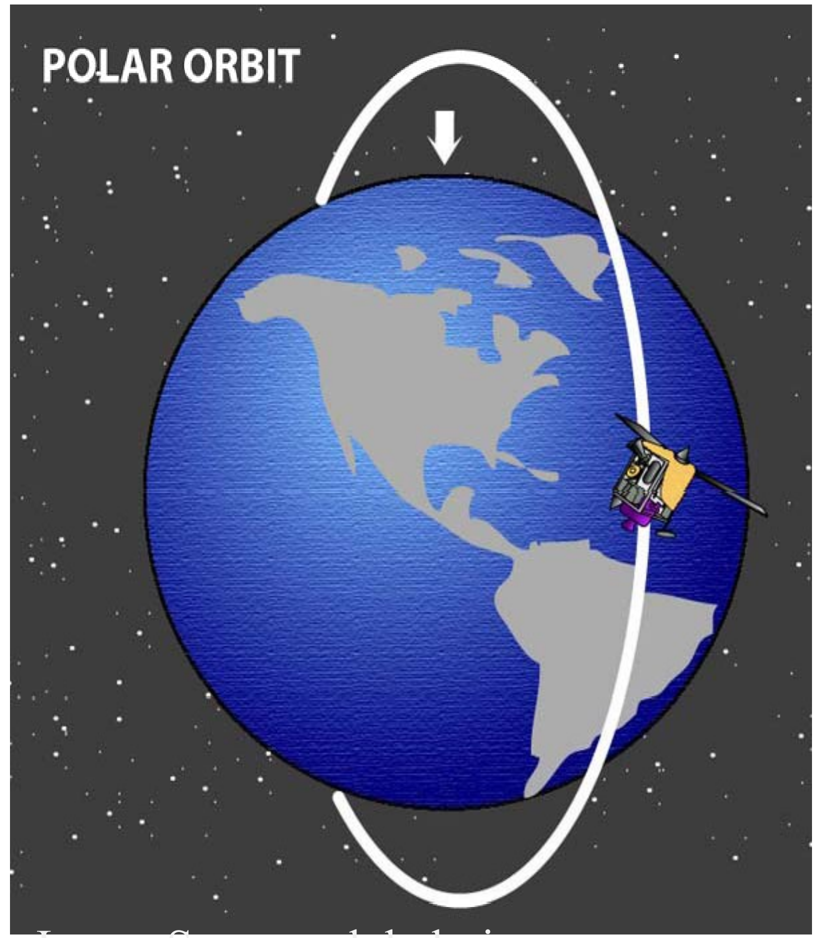
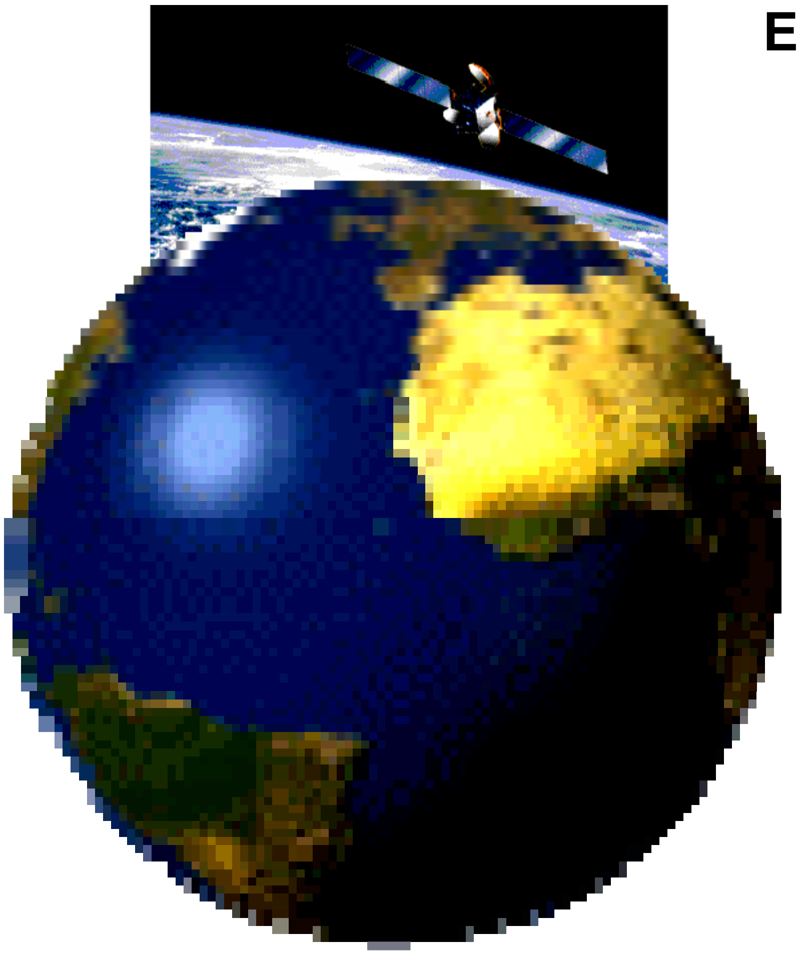


Image Source: globalmicrowave.org

Types



Earth Observation Satellite

Planetary Satellites

karunakaranakhildev@gmail.com
Phone: 9847231604

Sensors

Types of Sensor:

Passive sensors

Active sensors

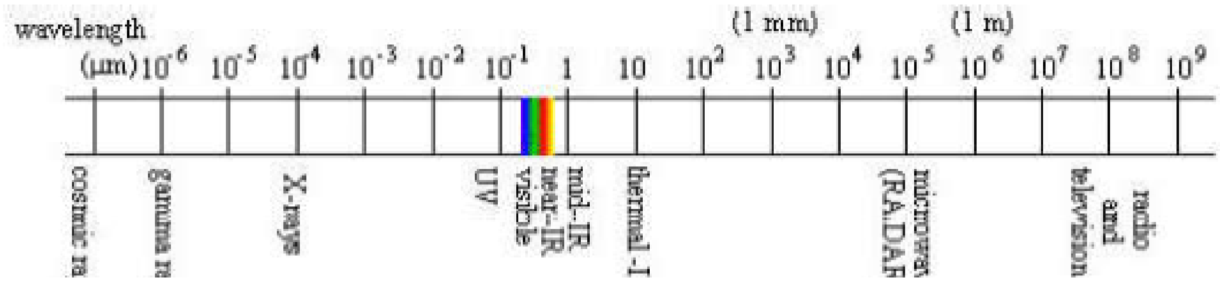
Own source

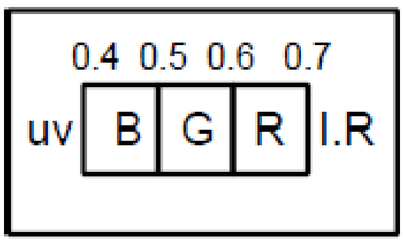
Other source

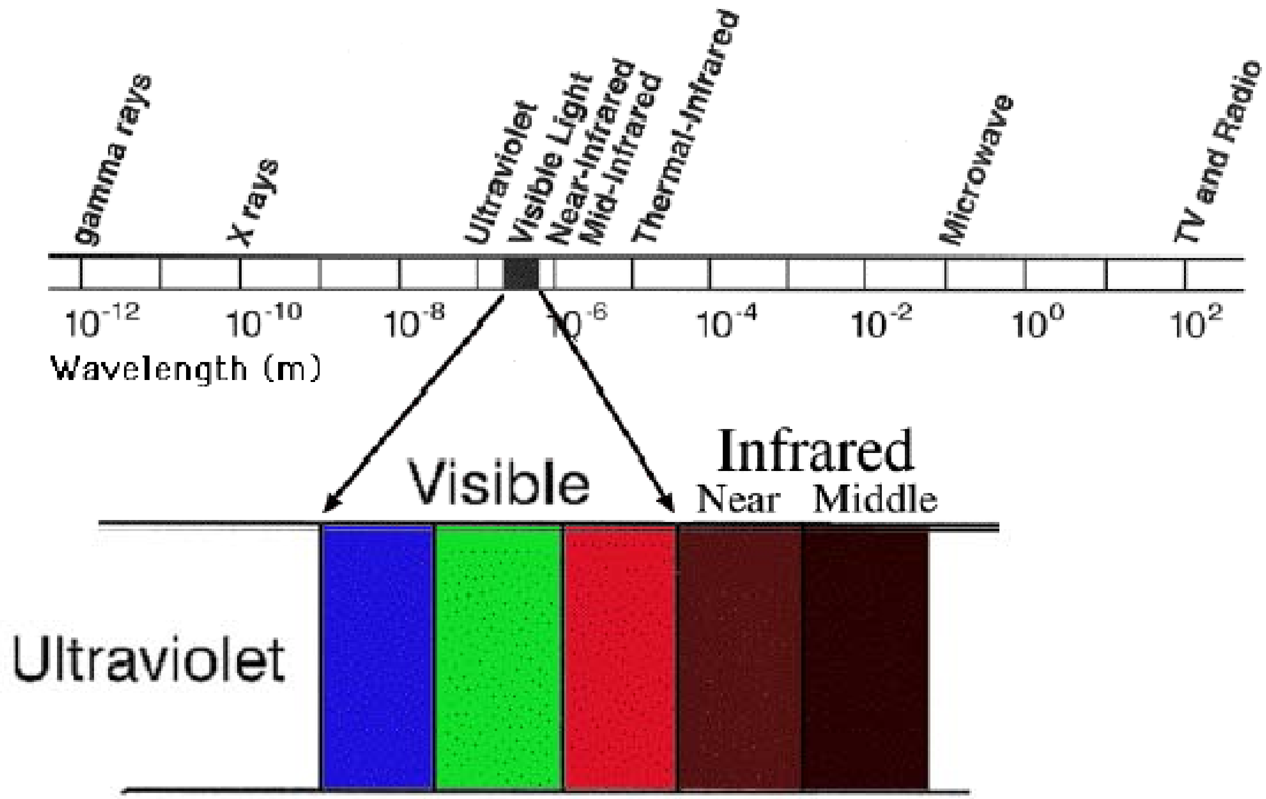
Example
Camera without flash
Camera with flash

Remote Sensing Systems

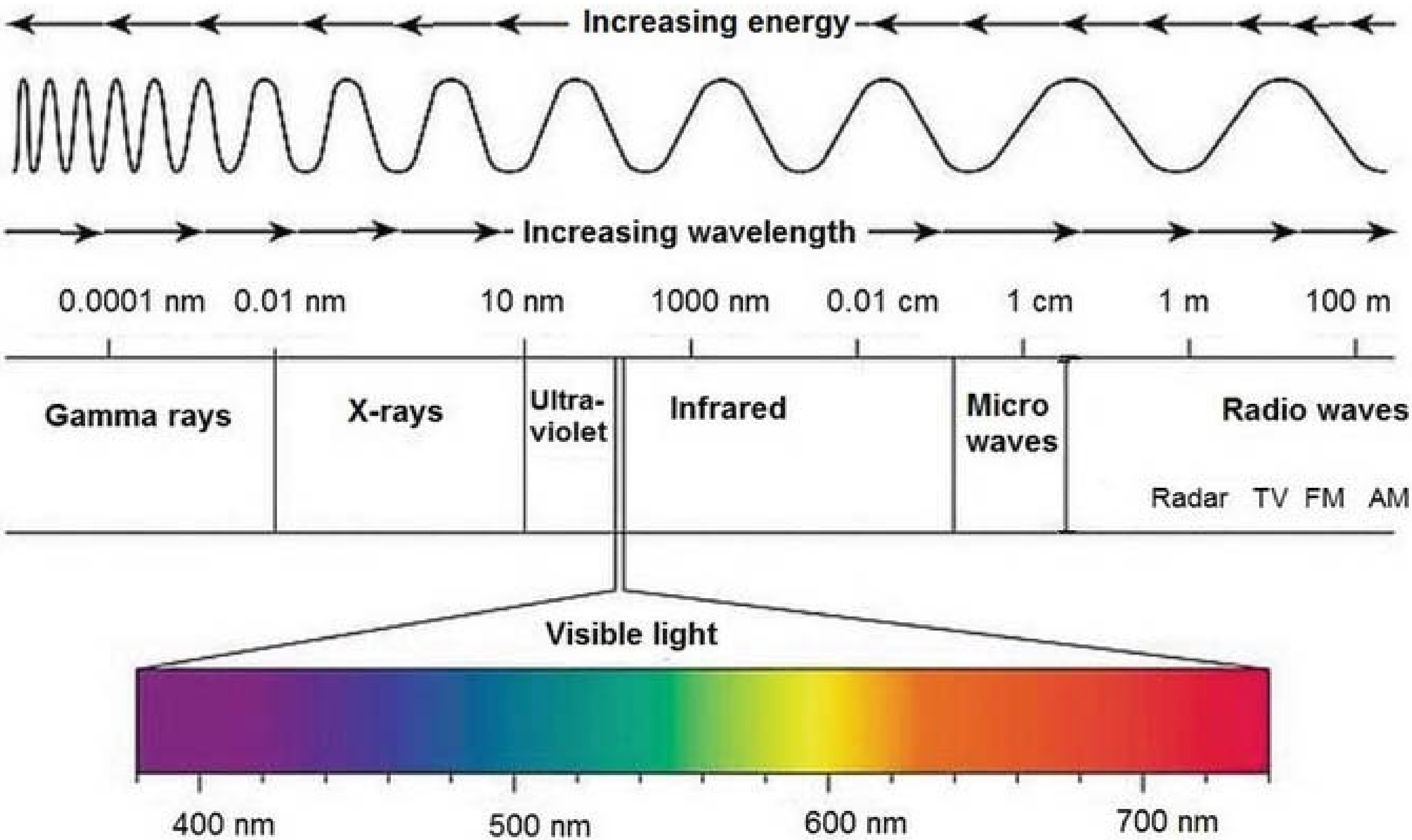
Electro Magnetic Spectrum







karunakaranakhildev@gmail.com
Phone: 9847231604


Increasing energy
Increasing wavelength
0.0001 nm
0.01 nm
10 nm
1000 nm
0.01 cm
1 cm
1 m
100 m
Gamma rays
X-rays
Ultra-
violet
Infrared
Micro
waves
Radio waves
Radar
TV
FM
AM
Visible light
400 nm
500 nm
600 nm
700 nm

Electro Magnetic Spectrum

0.4 μm – 0.7 μm – visible range

1 μm – 0.1 mm infrared

10 mm microwave

1 m and above radio wave

10^{-2} μm – 0.4 ultra violet

10^{-4} μm to 10^{-2} μm X-ray

Less than 10^{-4} μm Gamma ray

Sensors

A **sensor** is a device, machine, or subsystem use to take observation of and send the information to other electronic circuitry linked with it.

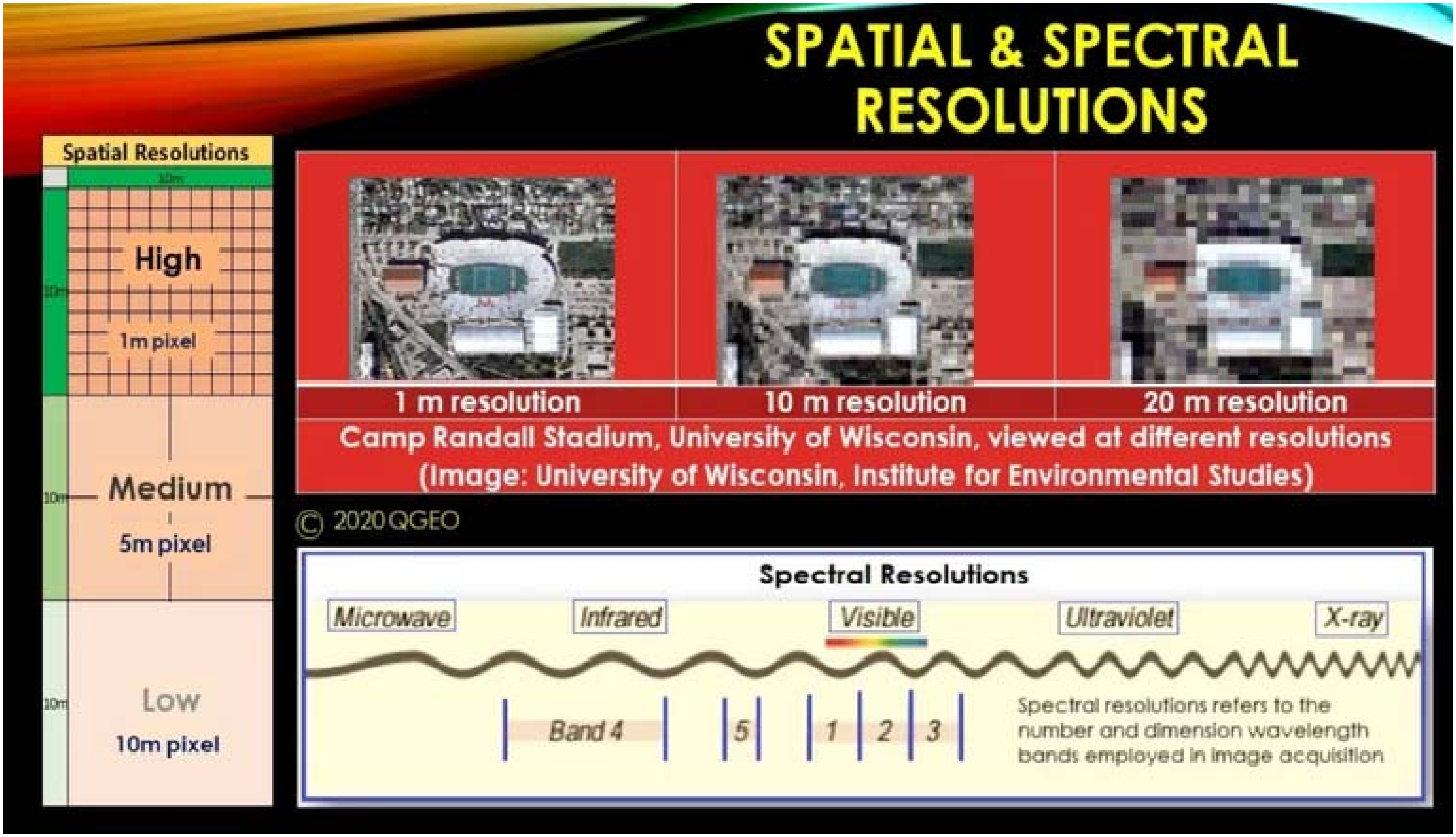
quality of a sensor depends upon the performance & ***resolutions***

Spatial Resolutions: **Spectral Resolutions** **Temporal Resolutions**

Radiometric Resolutions

karunakaranakhildev@gmail.com
Phone: 9847231604

Sensors


SPATIAL & SPECTRAL RESOLUTIONS
Spatial Resolutions
High
1m pixel
Medium
5m pixel
Low
10m pixel
1 m resolution
10 m resolution
20 m resolution
Camp Randall Stadium, University of Wisconsin, viewed at different resolutions
(Image: University of Wisconsin, Institute for Environmental Studies)
© 2020 QGEO
Spectral Resolutions
Microwave
Infrared
Visible
Ultraviolet
X-ray
Band 4
5
1
2
3
Spectral resolutions refers to the number and dimension wavelength bands employed in image acquisition

According to the energy source

Active sensor:

The sensor which detects the reflected response from target objects which are irradiated from an artificial source.

Ex. RADAR (Radio Detection and Ranging) LIDAR (LIGHT Detection and Ranging) or camera with flashlight.

Passive Sensor:

The sensor detects the reflected or emitted electromagnetic radiation from a natural source.

Ex. All remote sensing sensors or cameras without flashlight when take photographs in daylight.

Other Sensor: Some other sensors are used for the different purposes of remote sensing. They are a Panoramic Camera, Microwave Radiometer, and optical scanner.

Phone: 9847231604

Sensor Types

According to the use of Sensor in RS

Arial Camera
Single-lens
Multi lens
Strip camera

Electronic Camera

Multi-Spectral Scanner (MSS)

Whiskbroom MSS
Push broom MSS

Example,
The use in:

Landsat 1, 2, and 3 carrying a multispectral scanner (MSS); Landsat 4 and 5 carried a Thematic Mapper sensor (TM). Landsat 7 carries an Enhanced Thematic Mapper (ETM). Landsat 8 carries the Operational Land Imager (OLI).

Thermal Scanner

Microwave Sensor

RADAR

L
I
D
A
R

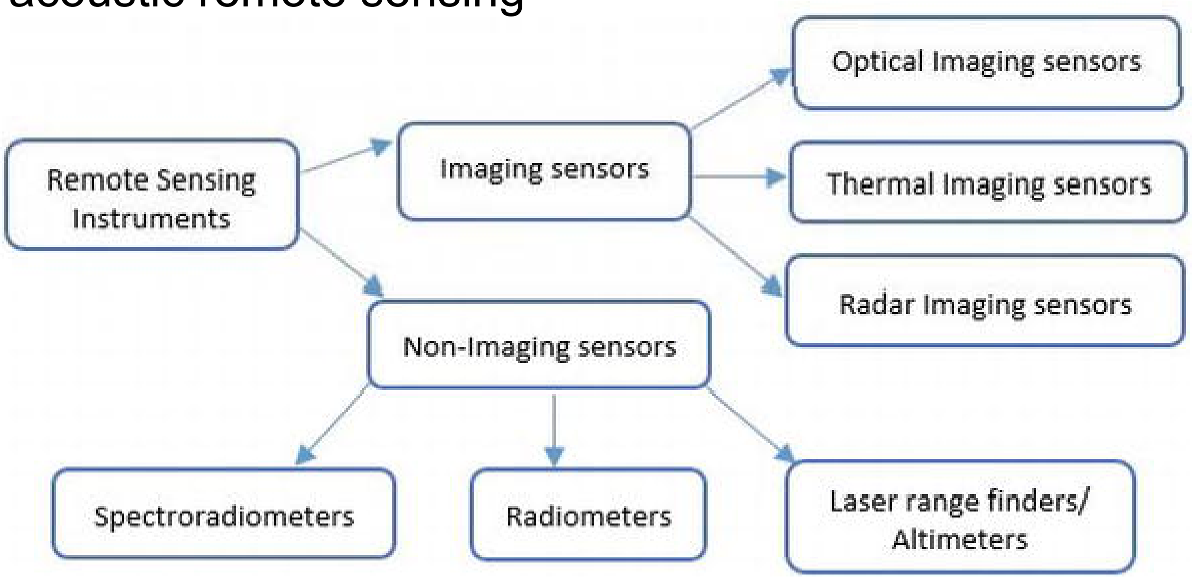
Microwave Scanning Radiometer

Remote Sensing Types

RS Data Types

Types of Remote Sensing Systems

- Visual Remote Sensing System such as human visual system
- Optical Remote Sensing
- Infrared Remote Sensing
- Microwave Remote Sensing
- Radar Remote Sensing
- Satellite Remote Sensing
- Airborne Remote Sensing
- Acoustic and near-acoustic remote sensing



karunakaranakhildev@gmail.com
Phone: 9847231604

RS Processing Software

Example

- ERDAS Imagine
- ENVI : **Environment for Visualizing Images**
- ILWIS : **Integrated Land and Water Information System**
- Arc GIS
- Q - GIS

Agencies for RS Data

Name	Status	Agency	Launch [note 1]
ALOS-2	Active	JAXA	2014
Alsat-2A and 2B	Active	Algerian Space Agency (ASAL)	2016
Amazônia-1	Active	Brazil's National Institute for Space Research (INPE)	2021
Aqua	Active	NASA	2002
ASNARO-2	Active	JAXA	2018
Aura	Active	NASA	2004
Badr-B	Active	Pakistan's Space and Upper Atmosphere Research Commission (SUPARCO)	2001
CALIPSO	Active	NASA and CNES	2006
Cartosat-1	Active	Indian Space Research Organization (ISRO)	2005
Cartosat-2A and 2B	Active	ISRO	2007
Cartosat-2C, 2D, 2E, and 2F	Active	ISRO	2016
Cartosat-3	Active	ISRO	2019
CBERS-4	Active	China National Space Administration (CNSA) and INPE	2014

karunakaranakhildev@gmail.com
Phone: 9847231604

https://en.wikipedia.org/wiki/List_of_Earth_observation_satellites

Chollian 1, 2A, and 2B	Active	KARI	2010
CloudSat	Active	NASA	2006
COSMO-SkyMed 1 to 4	Active	Italian Space Agency (ASI)	2007
CryoSat-2	Active	ESA	2010
CYGNSS	Active	NASA	2016
DSCOVR	Active	NASA	2015
DubaiSat-1 and 2	Active	Mohammed bin Rashid Space Centre (MBRSC)	2009
Elektro-L No. 1, 2, and 3	Active	Russia's Roscosmos	2011
Fengyun 2D to 4A	Active	China Meteorological Administration	2006
Formosat-5	Active	Taiwan's National Space Organization (NSPO)	2017
Gaofen-2	Active	CNSA	2014
Gaofen-3	Active	CNSA	2016
GOES-16 and 17	Active	NASA	2016
Gokturk-1	Active	Turkish Ministry of National Defense	2016
Gokturk-2	Active	Turkish Ministry of National Defense	2012
GPM	Active	NASA and JAXA	2014

GOES-16, -17	Active	NASA	2016
GRACE-FO	Active	NASA	2018[13][14]
GOSAT	Active	JAXA	2009
Himawari 8 and 9	Active	Japan Meteorological Agency	2014
ICESat-2	Active	NASA	2018
IMS-1	Active	ISRO	2008
ISS	Active	NASA, Roscosmos, JAXA, ESA, and CSA	1998
Jason-3	Active	NASA and CNES	2016
KhalifaSat	Active	MBRSC	2018
KOMPSAT-2	Active	KARI	2006
KOMPSAT-3, 3A, and 5	Active	KARI	2012
LAGEOS-1 and 2	Active	NASA	1976
Landsat-7	Active	NASA and USGS	1999
Landsat-8	Active	NASA and USGS	2013
Landsat-9	Active	NASA and USGS	2021
Megha-Tropiques	Active	CNES and ISRO	2011
Meteor-M No. 1 and 2	Active	Roscosmos	2009

Meteosat 8	Active	EUMETSAT	2002
MetOp A, B, and C	Active	NASA, ESA, and NOAA	2006
Mohammed VI-A and VI-B	Active	Arianespace and Morocco	2017
NigComSat-1R	Active	NASRDA	2009
NigeriaSat-1 and 2	Active	NASRDA	2003
NOAA-15, 18, and 19	Active	NASA, ESA, and NOAA	1998
NOAA-20	Active	NASA and NOAA	2017
Oceansat-2	Active	ISRO	2009
OCO-2	Active	NASA	2014
PakTES-1A	Active	SUPARCO	2018
Paz	Active	Spain's Instituto Nacional de Técnica Aeroespacial	2018
Pleiades 1A and 1B	Active	CNES	2011
PRISMA	Active	Italian Space Agency (ASI)	2019
PROBA-V	Active	ESA	2013
PRSS-1	Active	SUPARCO	2018
RCM	Active	CSA	2019
RADARSAT-2	Active	CSA	2007
RASAT	Active	TÜBITAK-UZAY	2011

Resourcesat-1 and 2	Active	ISRO	2003
Resurs-P No.1 and 2	Active	Roscosmos	2013
SAOCOM	Active	CONAE	2018
SARAL	Active	ISRO	2013
Sentinel-1A and B	Active	ESA	2014
Sentinel-2A, B, and C	Active	ESA	2015
Sentinel-3A and B	Active	ESA	2016
Sentinel-6	Active	ESA	2020
SMAP	Active	NASA	2015
SORCE	Active	NASA	2003
Suomi NPP	Active	NASA	2011
TanDEM-X	Active	DLR	2010
Terra	Active	NASA	1999
TerraSAR-X	Active	DLR	2007
THEOS	Active	GISTDA	2008
TIMED	Active	NASA	2001
VNREDSat-1A	Active	VAST	2013

Etc…

Prominent Fame RS Providers

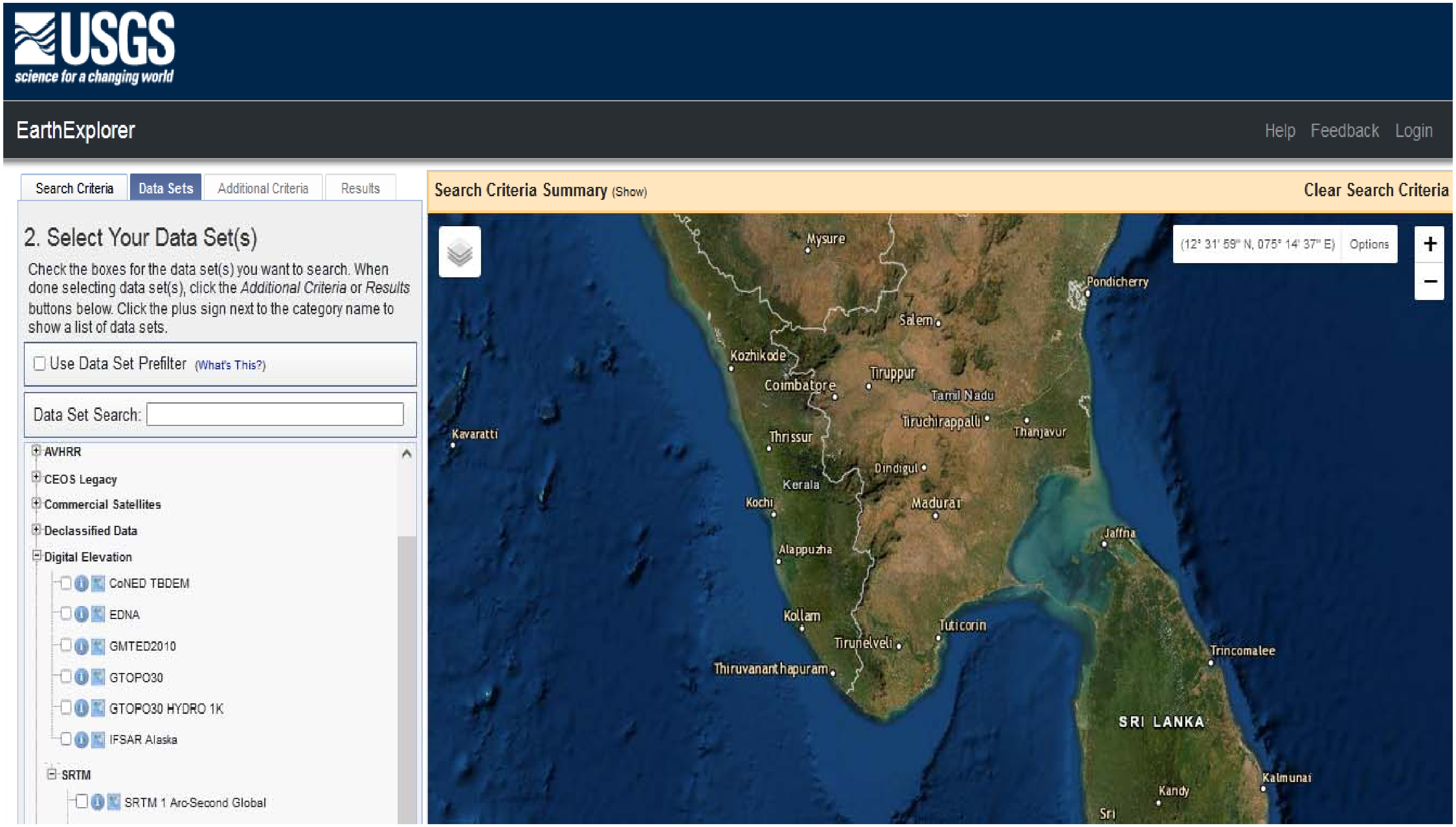
- USGS – Platform Earth Explorer
- ISRO – Bhuvan
- JAXA - Japan Aerospace Exploration Agency
- ASF - Alaska Satellite Facility

Prominent Satellite Data

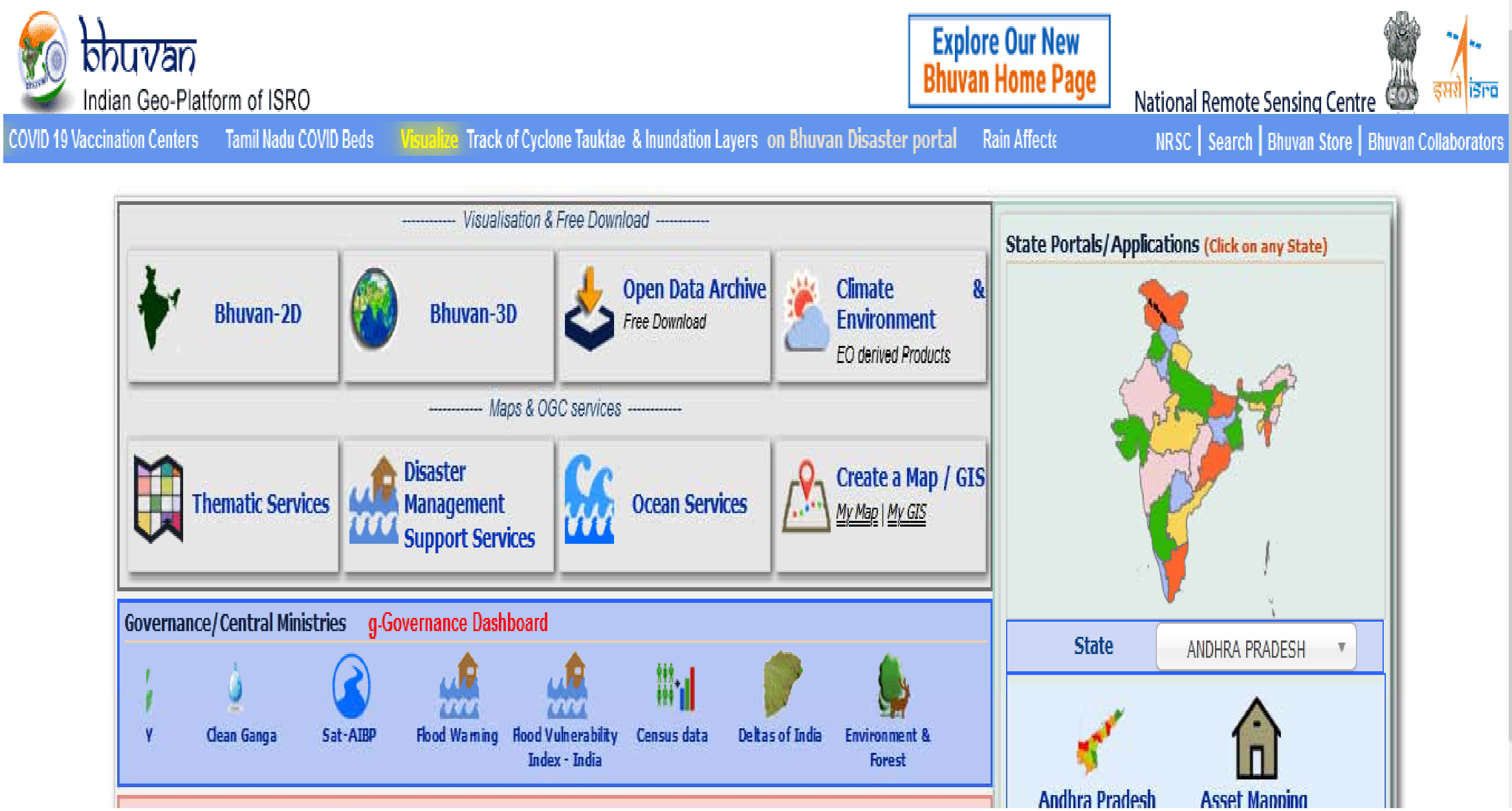
Landsat – TM 5, 6, 7 8 (TIRS OLI)
SRTM – Shuttle Radar Topography Mission
ASTER - Advanced Spaceborne Thermal Emission and Reflection Radiometer
CARTOSAT -
LISS III, IV - Linear Imaging Self-Scanning Sensor
Sentinel A & B
World View – Commercial

USGS EarthExplorer

https://earthexplorer.usgs.gov



karunakaranakhildev@gmail.com
Phone: 9847231604



karunakaranakhildev@gmail.com
Phone: 9847231604

Applications of RS for DM

Mostly RS depends upon Sensor based Applications

By Users

Example Optical sensors

	Panchromatic systems	Multispectral systems	Hyperspectral systems
Spectral range (nm)	~430–720	~430–720 ~750–950	~470–2000
Satellites	QuickBird, SPOT, IKONOS	SPOT, QuickBird, IKONOS	TRW Lewis, EO-1
Spectral band	Monospectral, black and white, gray-scale image	Several spectral bands	10 to 100 of spectral bands
Spatial resolution	Submeter	Up to 1–2 m	Up to 2 m
Applications	Earth observation and reconnaissance applications	Red-green-blue (true color): visual analysis; Green-red-infrared: vegetation and camouflage detection; Blue-NIR-MIR: visualizing water depth, vegetation coverage, soil moisture content, and the presence of fires, all in a single image	(i) Agriculture; (ii) eye care; (iii) food processing; (iv) mineralogy; (v) surveillance; (vi) physics; (vii) astronomy; (viii) chemical imaging; (ix) environment

Thermal IR Applications of RS

Sensor	Operational wave band	Definition	Satellites sensors	Applications
IR imaging radiometer	UV, mid-to-far-infrared, or microwave	Measures the intensity of electromagnetic radiation	ASTER	Volcanological, mineralogical, and hydrothermal studies, forest fires, glacier, limnological and climatological studies and DEM
Imaging spectroradiometer	Infrared	Measure the intensity of radiation in multiple spectrums	MODIS, ASAS, IRIS	Sea surface temperature, cloud characteristics, ocean color, vegetation, trace chemical species in the atmosphere
Infrared imaging camera	Mid-far infrared	Measure reflected energy from the surface		Volcanology, determining thunderstorm intensity, identifying fog and low clouds

https://www.intechopen.com/chapters/57384

Radar (Microwave) Applications of RS

Band	Frequency (GHz)	Wavelength (cm)	Key characteristics
Ka	40–27	0.75–1.11	Usually for astronomical observations
K	27–18	1.11–1.67	Used for radar, satellite communications, astronomical observations, automotive radar
Ku	18–12	1.67–2.5	Typically used for satellite communications
X	12.5–8	2.4–3.75	Widely used for military reconnaissance, mapping and surveillance
C	4–8	3.75–7.5	Penetration capability of vegetation or solids is limited and restricted to the top layers. Useful for sea-ice surveillance
S	4–2	7.5–15	Used for medium-range meteorological applications, for example, rainfall measurement, airport surveillance
L	2–1	15–30	Penetrates vegetation to support observation applications over vegetated surfaces and for monitoring ice sheet and glacier dynamics
P	1–0.3	30–100	So far, only for research and experimental applications. Significant penetration capabilities regarding vegetation canopy, sea ice, soil, and glaciers

karunakaranakhildev@gmail.com
Phone: 9847231604

Non Imaging Sensors Applications of RS

Sensor	Operational wave band	Definition	Application
Radiometer	Ultraviolet, IR, microwave	To measure the amount of electromagnetic energy present within a specific wavelength range	Calculating various surface and atmospheric parameters
Altimeter	IR, microwave/radiowave, sonic	To measure the altitude of an object above a fixed level	Mapping ocean-surface topography and the hills and valleys of the sea surface
Spectrometer	Visible, IR, microwave	To measure the spectral content of the incident electromagnetic radiation	Multispectral and hyperspectral imaging
Spectro-radiometer	Visible, IR, microwave	To measure the intensity of radiation in multiple spectrums	Monitoring sea surface temperature, cloud characteristics, ocean color, vegetation, trace chemical species in the atmosphere

Sensor	Operational wave band	Definition	Application
LIDAR	Ultraviolet, visible, NIR	To measure distance and intensity Doppler LIDAR: measure the wave number for speed; Polarization effects of LIDAR: shape	Ocean, land, 3D topographic mapping Meteorology, cloud measurements, wind profiling and air quality monitoring
Sonar	Acoustic	Measure the distance to an object; determine the depth of water beneath ships and boats	Navigation, communication and security (e.g., vessels) and underwater object detection. For example, handheld sonar for a diver
Sodar	Acoustic	As a wind profiler, sodar systems measure wind speeds at various heights above the ground and the thermodynamic structure of the lower layer of the atmosphere	Meteorology: atmospheric research, wind monitoring (typically in a range from 50 to 200 m above ground level)
A radio acoustic sounding system (RASS)	Radio wave and acoustic wave	Measuring the atmospheric lapse rate using backscattering of radio waves from an acoustic wave front to measure the speed of sound at various heights above the ground	Is added to a radar wind profiler or to a sodar system

karunakaranakhildev@gmail.com
Phone: 9847231604

Commonly used RS satellites

Mission	Country	Launch year	Sensors	Height of orbit (km)	Swath (km)	Revisit (day)	Channels	Spatial resolution
Landsat	USA	1972, 1975, 1978,1982, 1984,1993, 1999,2013, 2020	Panchromatic and multispectral sensor	705	185, 183	16	7–11	120 m, 100 m, 60 m, 30 m, 15 m
SPOT	USA	1986, 1990, 1993, 1998, 2002, 2012	Imaging spectroradiometer	694	60	1–3	Panchromatic, B, G, R, NIR	2.5 m, 5 m, 10 m, 20 m
ERS	ESA	1991, 1995	IR radiometer, microwave sounder, Radiomet	er, SAR		782–785	5–100 km (AMI) - 500 km(ATSR)	

karunakaranakhildev@gmail.com
Phone: 9847231604

3, 35, 336	SAR	26 m across track and 6 – 30 m along track

Commonly used RS satellites

Mission	Country	Launch year	Sensors	Height of orbit (km)	Swath (km)	Revisit (day)	Channels	Spatial resolution
ADARSAT	Canada	1995, 2007, 2018	SAR	793–821, 798, 592.7	45–100, 18–500, 5–500	1	SAR	8–100 m, 3–100 m, 3–100 m
MODIS	USA	1999, 2002	Imaging spectroradiometer	705	2330	1	36	1000 m, 500 m, 250 m
IKONOS	USA	1999	Imaging spectroradiome	681	11.3	3	Panchroter	Panchro

Phone: 9847231604

, G, R,NIR	matic:80 cm B, G, R,NIR:3.2 m

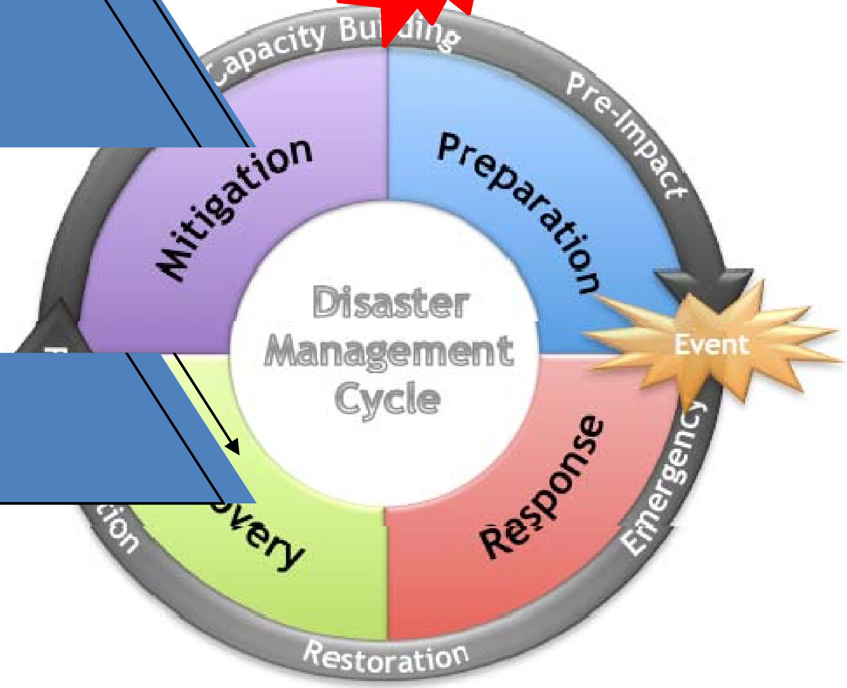
Mission	Country	Launch year	Sensors	Height of orbit (km)	Swath (km)	Revisit (day)	Channels	Spatial resolution
QuickBird	USA	2000, 2001	Imaging spectroradiometer	482, 450	16.8–18	2.4–5.9	Panchromatic, B, G, R, NIR	Panchromatic:65 cm /61 cm B, G, R, NIR:2.62 m/2.44 m
Envisat	ESA	2002	ASAR, MERIS, AATSR, RA-2, MWR, GOMOS, MIPAS, SCIAMACHY, DORIS, LRR	790	1150 km, 100 km, 400 km	35 days	15 bands (VIS, NIR), C-band	300 m, 30–150 m
GeoEye	USA	2008	Imaging spectroradiometer	681	15.2	8.3	Panchromatic, B, G, R, NIR	Panchromatic:41 cm B, G, R, NIR: 1.65 m

Mission	Country	Launch year	Sensors	Height of orbit (km)	Swath (km)	Revisit (day)	Channels	Spatial resolution
WorldView	USA	2007 2009 2014 2016.9	Imaging spectroradiometer, Laser altimeter	496, 770, 617, 681	17.6 km 16.4 km 13.1 km 14.5 km	1.7 1.1 <1 3	Panchromatic; Panchromatic and eight multispectrum; Panchromatic and eight multispectrum; Panchromatic, B, G, R, NIR	Panchromatic 0.5 m; Panchromatic and stereo images:0.46 m multispectral: 1.84 m; Panchromatic 0.34 m and multispectral 1.36 m
Sentinel 1–6	ESA	2014, 2015, 2016, 2017, 2021	Radar and super-spectral imaging	693, 786, 814	250 km 290 km, 250 km,	12, 10, 27	C-SAR, 12 bands (VIS, NIR, SWIR), 21 bands (VIS, NIR), S-band & X-band	5–20 m, 5–40 m, 10 m & 20 m & 60 m

DM Phases & Remote Sensing Utility

PLANNING

Disaster



Disaster
Management

MITIGATION

LEARNING

karunakaranakhildev@gmail.com
Phone: 9847231604

DM Phases & Remote Sensing Utility

Modelling
Assessment
Prediction
Contingency

PLANNING

Disaster

Disaster
Management

Research

LEARNING

MITIGATION

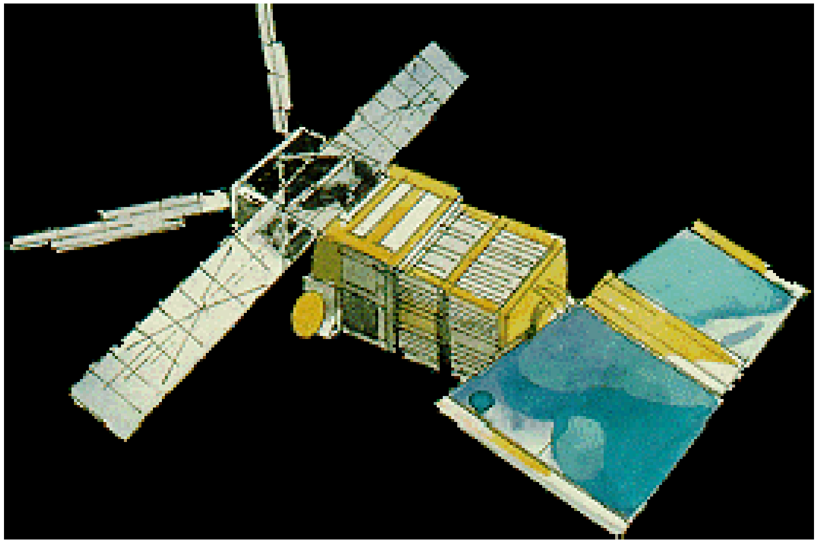
Monitoring situations
Deployment of resources
Decision-making

P
h
o

Public relations

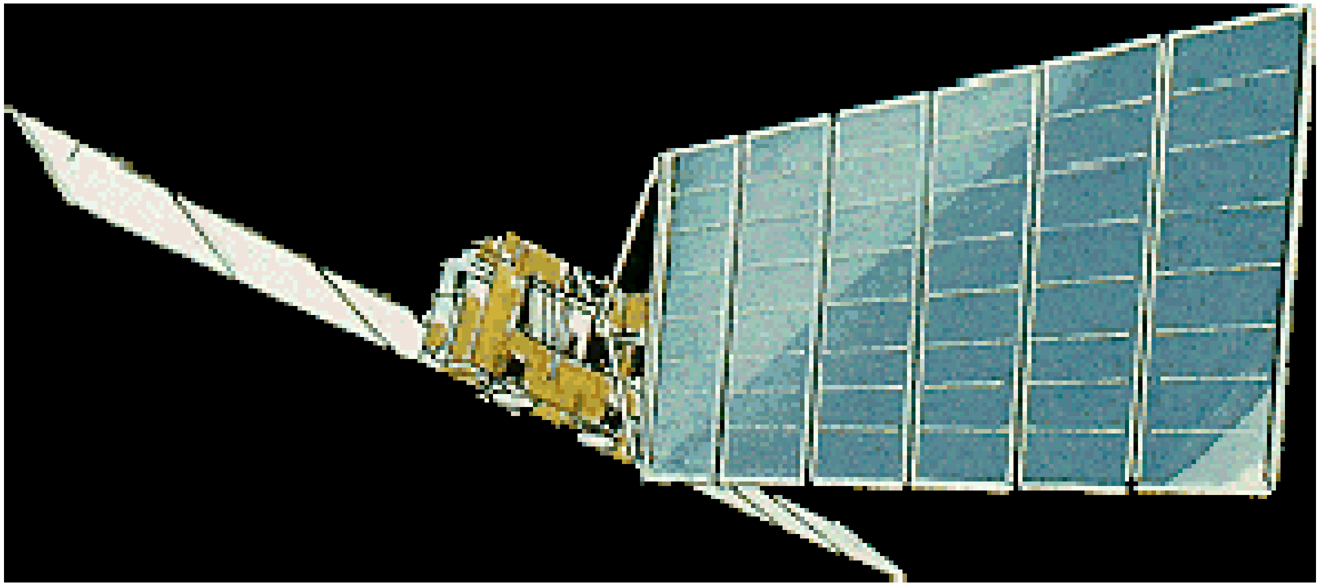
Applications of RS data for DM

- European Remote Sensing Satellite
- all weather 25-500 meter land and sea observations, radar and Synthetic Aperture Radar
- **3 dimensional mapping, oil spill detection, flood extent, damage assessment, night coverage**



Applications of RS data for DM

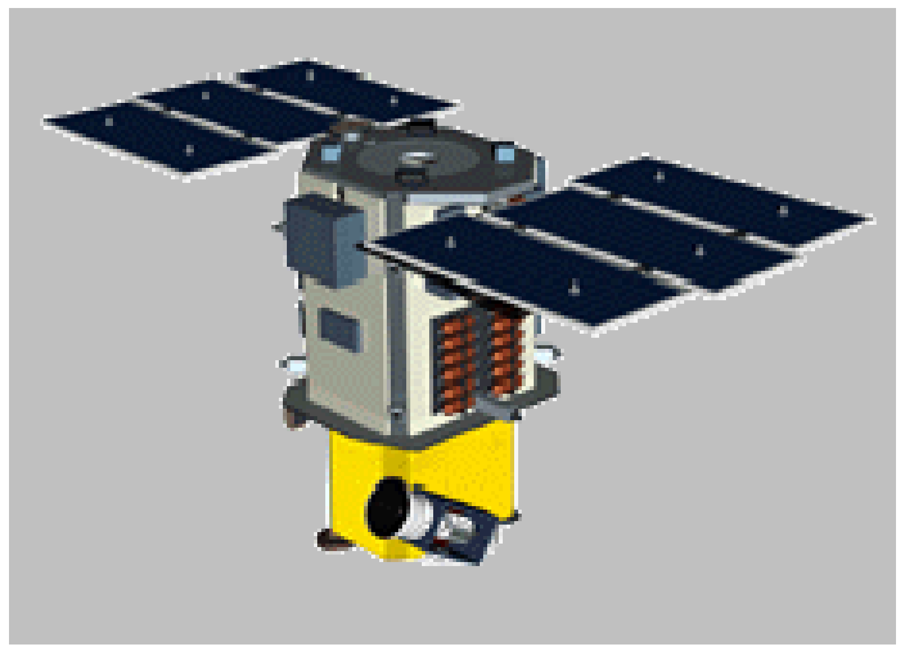
- Japanese Earth Resources Satellite
- all weather 18 meter land and sea observations
- **3 dimensional mapping, oil spill detection, flood extent, damage assessment**.



Applications of RS data for DM

- Launched in 1998
- visual 1 metre land observations
- **high-resolution mapping, infrastructure identification, terrain analysis**

QuickBird



Fires

Fire detection by satellite provides a highly efficient means of detecting and eradicating forest fires without large numbers of ground-based workers

Thermal infrared imagery shows "hotspots" that may be distinguished from clouds of similar albedo

Fires

A fire detection and management system should have the following aims:

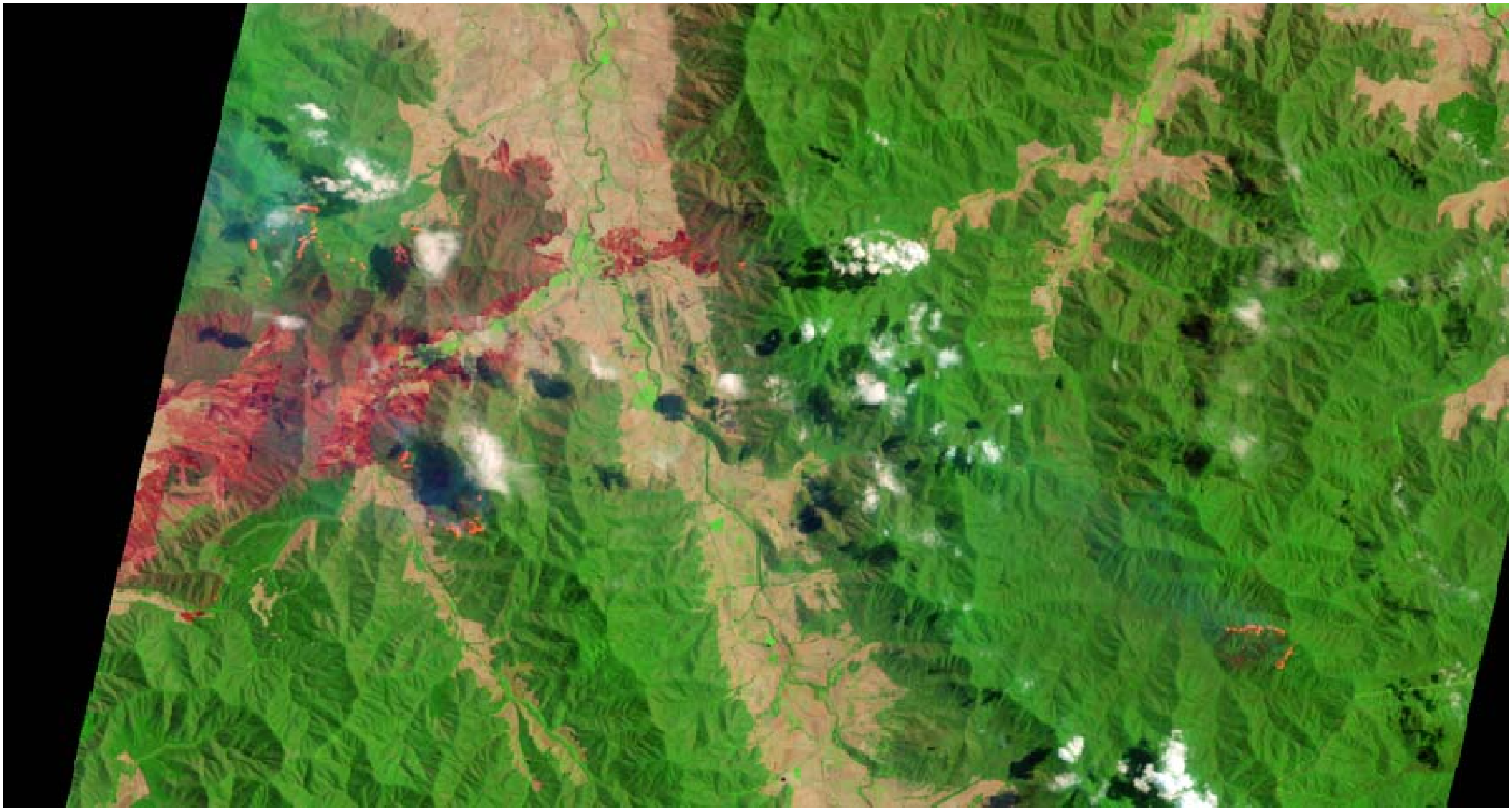
- **A measure of the geographical limits of the fire-front**
- **An estimate of fire intensity**
- **Monitoring of burnt area to look for latent fires**
- **Mapping of burnt areas to aid restoration**

(Barducci *et al*. 2002)

S.E Australian Fires
February 2009
NASA Earth Observatory
http://earthobservatory.nasa.gov/NaturalHazards/

S.E Australian Fires (10th February 2009)
NASA Earth Observatory

http://earthobservatory.nasa.gov/NaturalHazards/

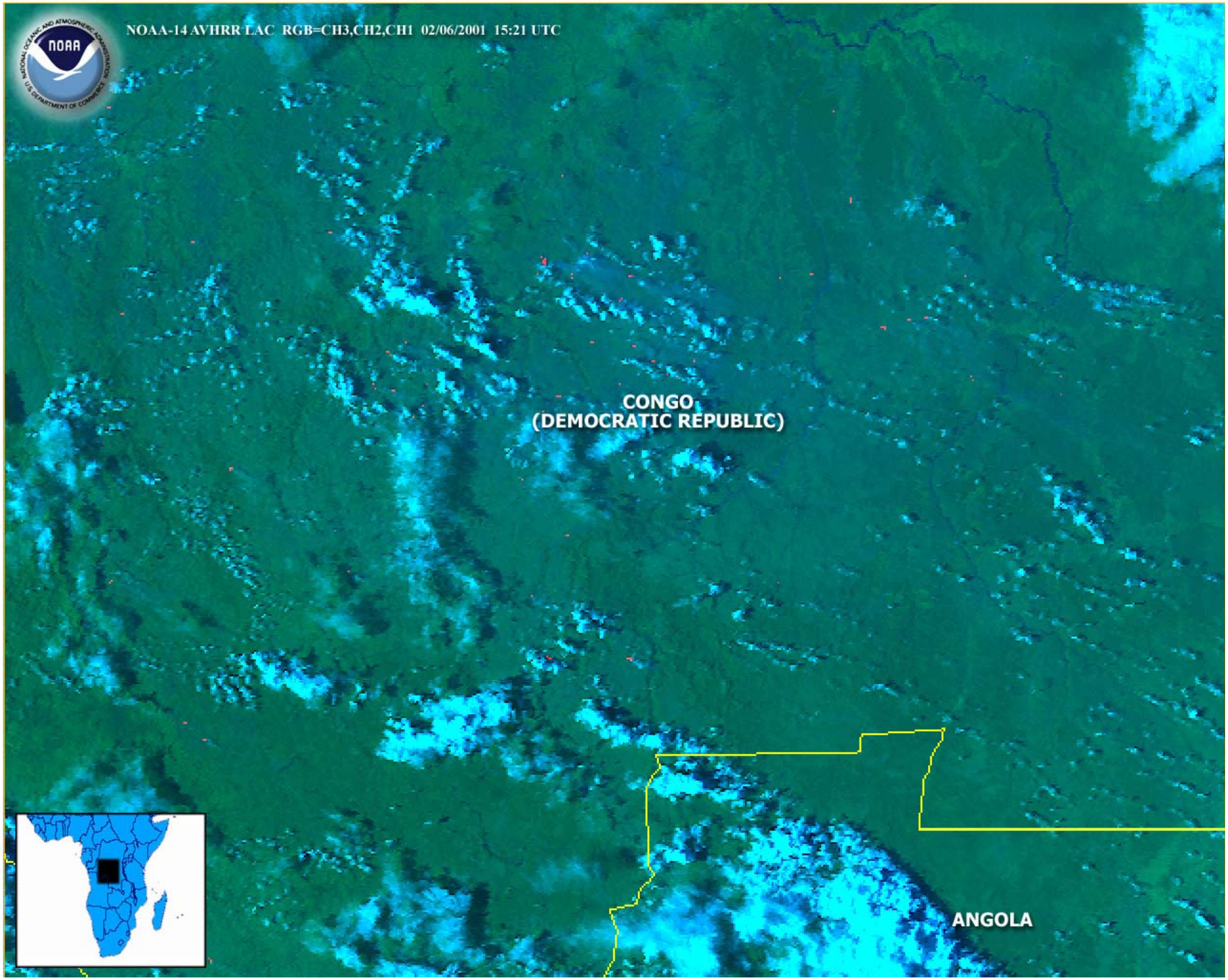


From the Advanced Land Imager on NASA's Earth Observing-1 satellite

Thermal Infrared (TIR) analysis of scene showing hot anomalies

Heat signatures (red) and smoke (light blue) are visible from fires burning in Congo.

CREDIT: NOAA



Flooding

Floods are easily seen from space - particularly over very large areas. Sometimes the view of the ground can be obscured by clouds - not a problem if the flooding was due to a large storm system

GIS models allow us to estimate the risk of flooding before it happens. Monitoring by both NOAA and Meteosat helped disaster mitigation activities in Mozambique during 2001

Applications of RS data for DM

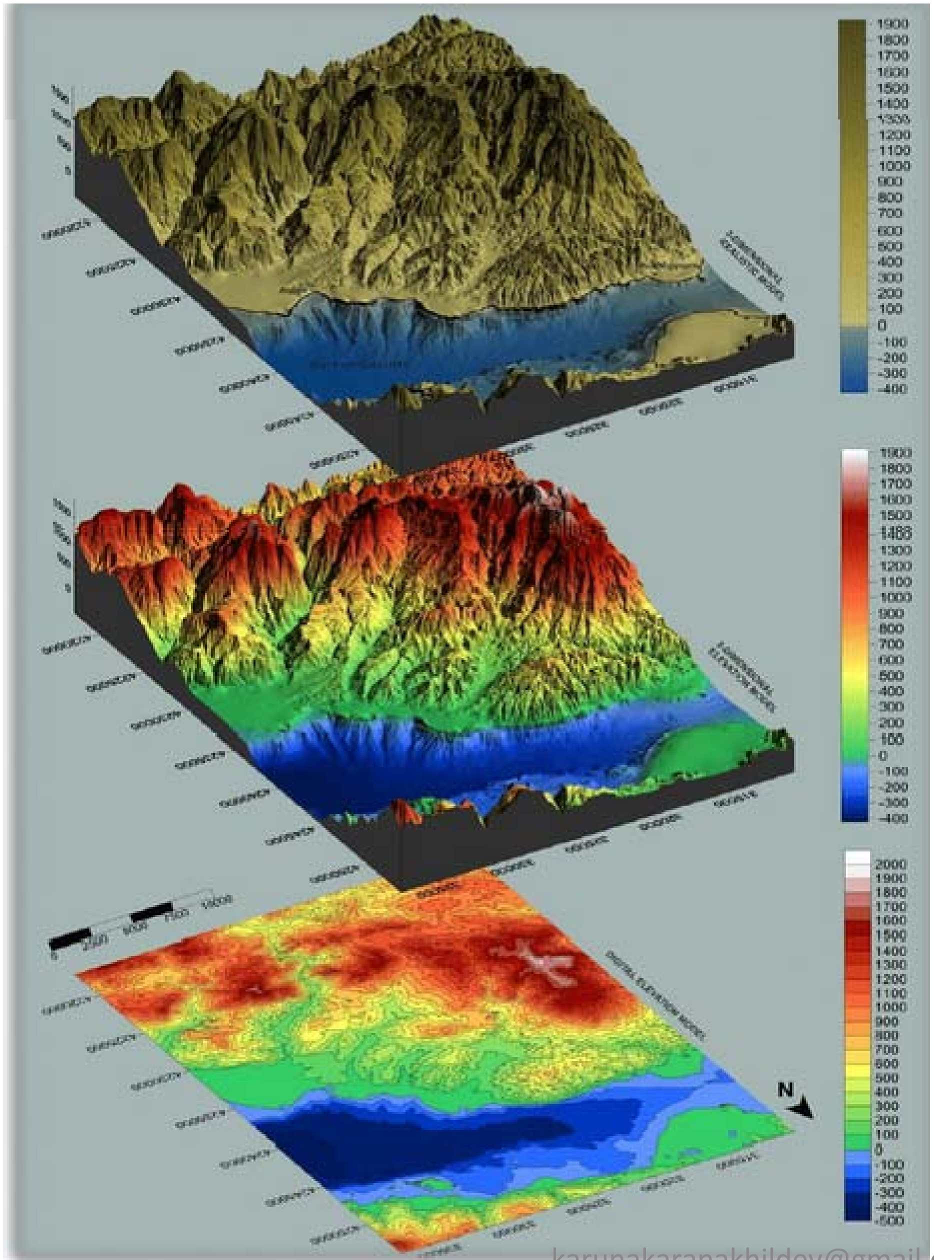
Flooding

A combination of both optical and radar remote sensing can provide a model for estimating likelihood of floodplain inundation (Townsend and Walsh, 1998)

Often, detailed hydrological models are as important as the remotely sensed data to estimate risk and undertake effective post-disaster management

Flooding

While the ‘before’ image was taken by the Landsat 8 satellite’s operational land imager on February 6, the ‘after’ one was clicked by the multispectral instrument on the European Space Agency’s Sentinel-2 satellite last Wednesday(Photos: Earth Observatory/Nasa)



DEM Flood

karunakaranakhildev@gmail.com
Phone: 9847231604

Applications of RS data for DM

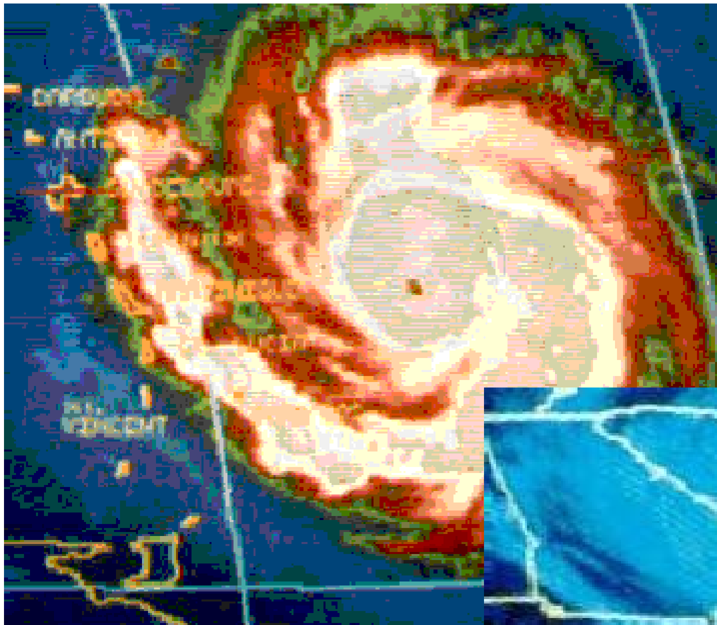
Extreme Weather

Many natural disasters result from extreme weather events such as hurricanes, typhoons and cyclones.

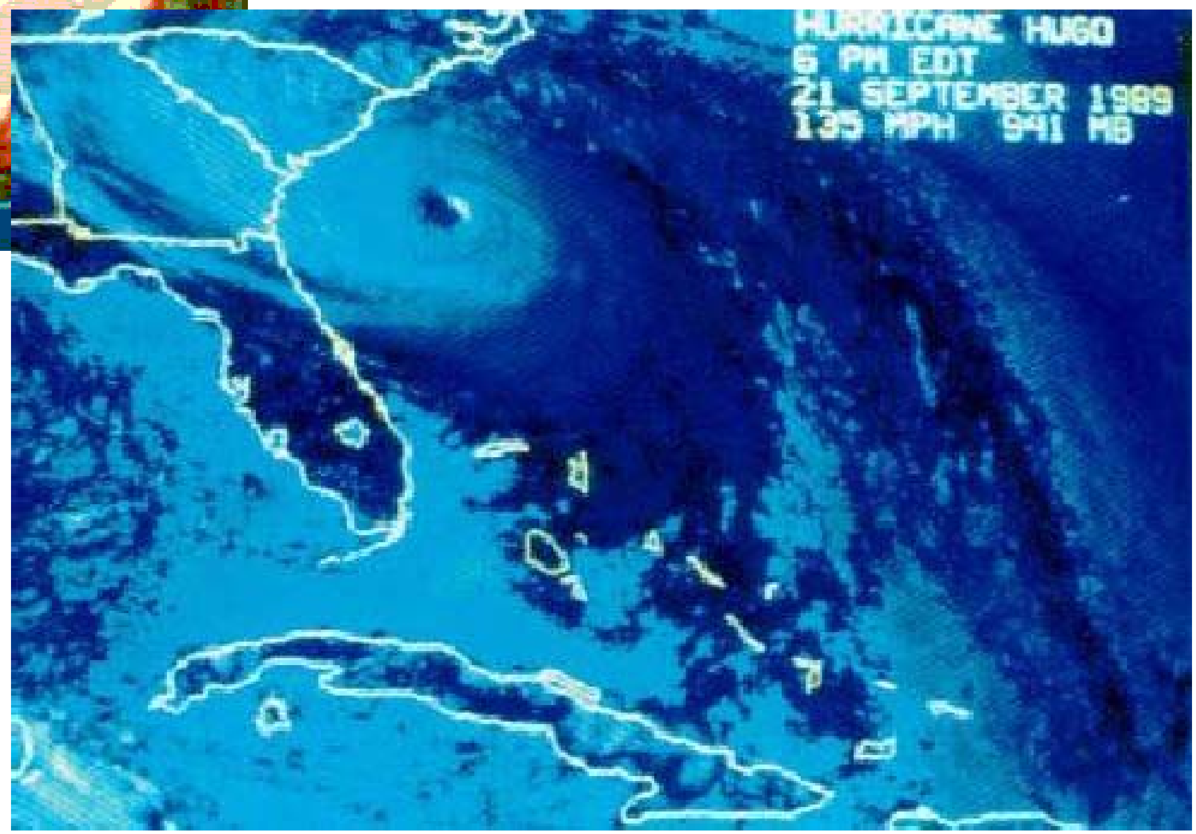
These meteorological phenomena are typically large-scale and can be seen from space.

Satellites allow us to track these phenomena, determine the likelihood of them affecting human population and hence undertake mitigation activities.

The role of remote sensing for support of geoengineering activities for mitigation is discussed by Bauer *et al*. 1999



Hurricane Hugo in 1989



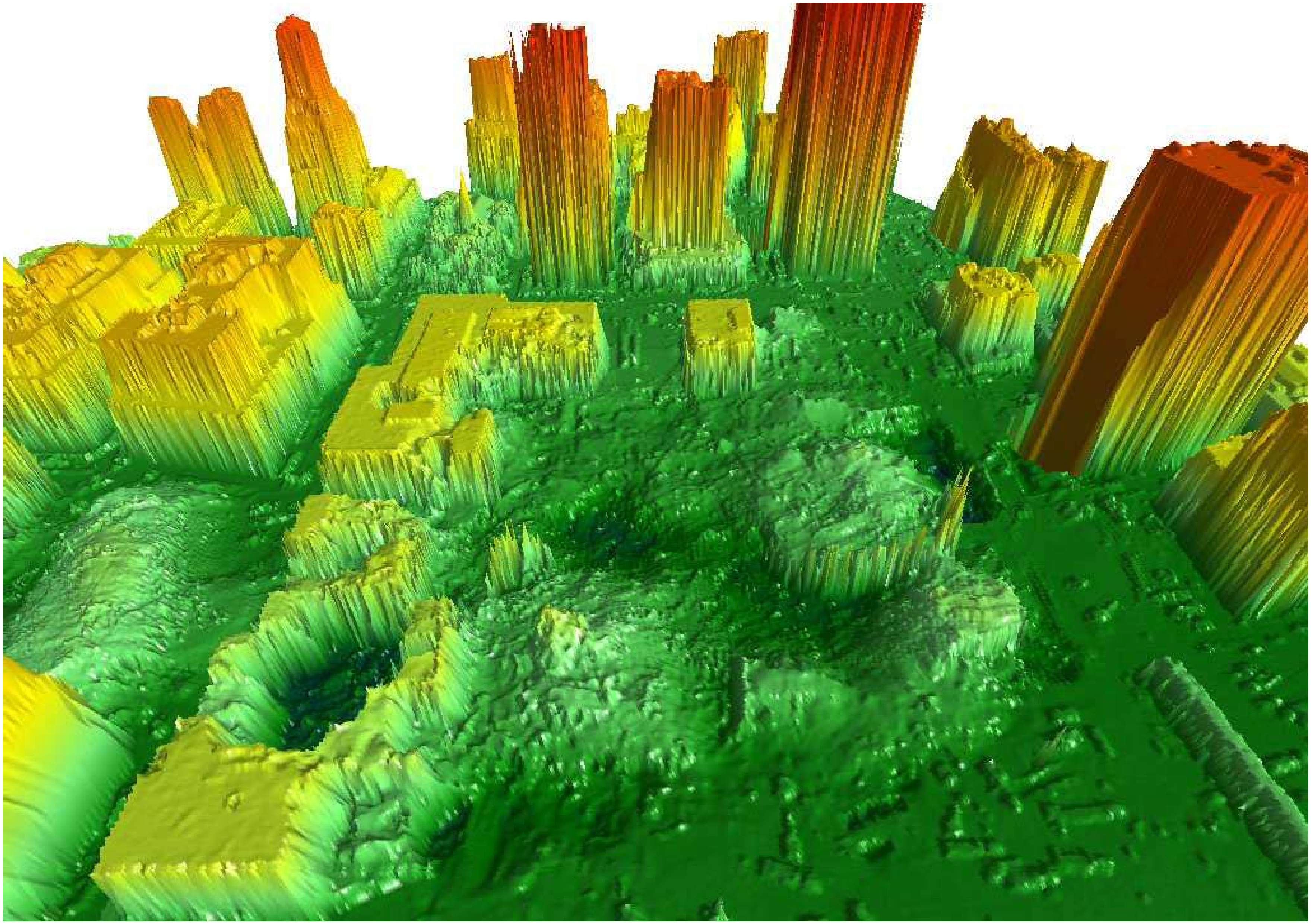
Applications of RS data for DM

Terrorism

Following the assault on the World Trade Center in New York on september 11th in 2001, the Ikinos and NOAA satellites were used to obtain detailed images of the site affected.

Lidar radar sweeps were used to “cut through” dust and build up a picture beneath

RS data helped inform disaster management crews



Applications of RS data for DM

Tsunami

Like coastal flooding, Tsunami events may be modelled and within a GIS.

Complex computational fluid dynamics (CFD) requires very detailed bathymetric and topographic data retrieved from remote sensing missions. Earthquakes and landslides that contribute to tsunami formation can be assessed by different remote sensing techniques.

QuickBird used extensively throughout Asian Tsunami Disaster

QuickBird used extensively throughout Asian Tsunami Disaster

QuickBird used extensively throughout Asian Tsunami Disaster

QuickBird used extensively throughout Asian Tsunami Disaster

QuickBird used extensively throughout Asian Tsunami Disaster

QuickBird used extensively throughout Asian Tsunami Disaster

Applications of RS data for DM

Earthquakes

The aftermath of an earthquake is clearly highly visible from space using high resolution satellites and aerial photography

Detailed image analysis can assist ground crews to locations where electrical pylons, ruptured gas/oil pipes or urban fires require immediate attention.

(See Wu *et al*. 2000)

Japan

IMAGE RESOLUTION COMPARISON

\- The collapsed part of the Hanshin expressway -

IFOV=10m

IFOV=2m

IFOV=8m

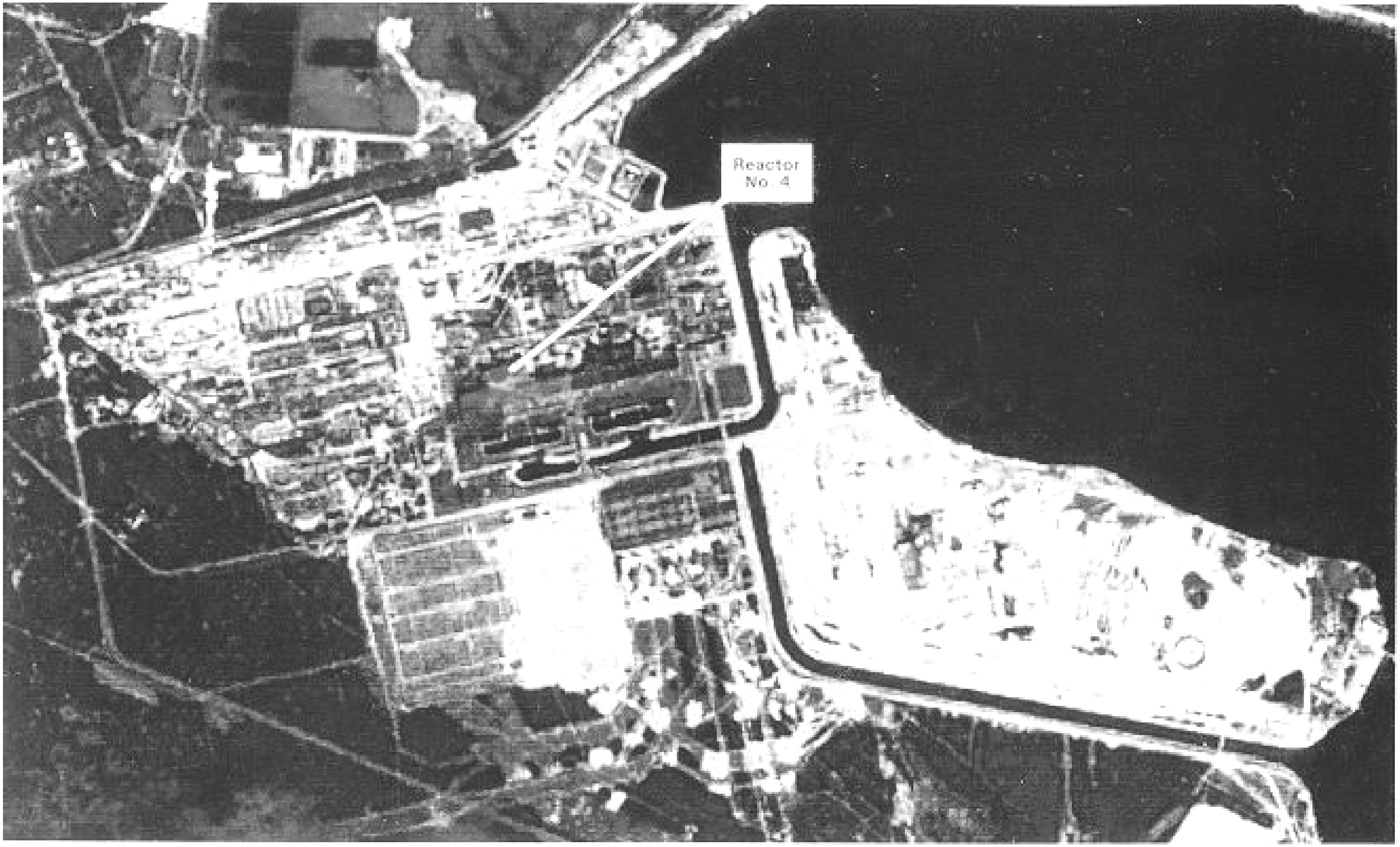
IFOV=1m

IFOV=4m

Source:Aerial Photo(Nakanihon)
Date:1995.1.18

Image Processing by TRIC

IFOV=1m



115. *Site of Chernobyl Nuclear Disaster (SMP 1987)*

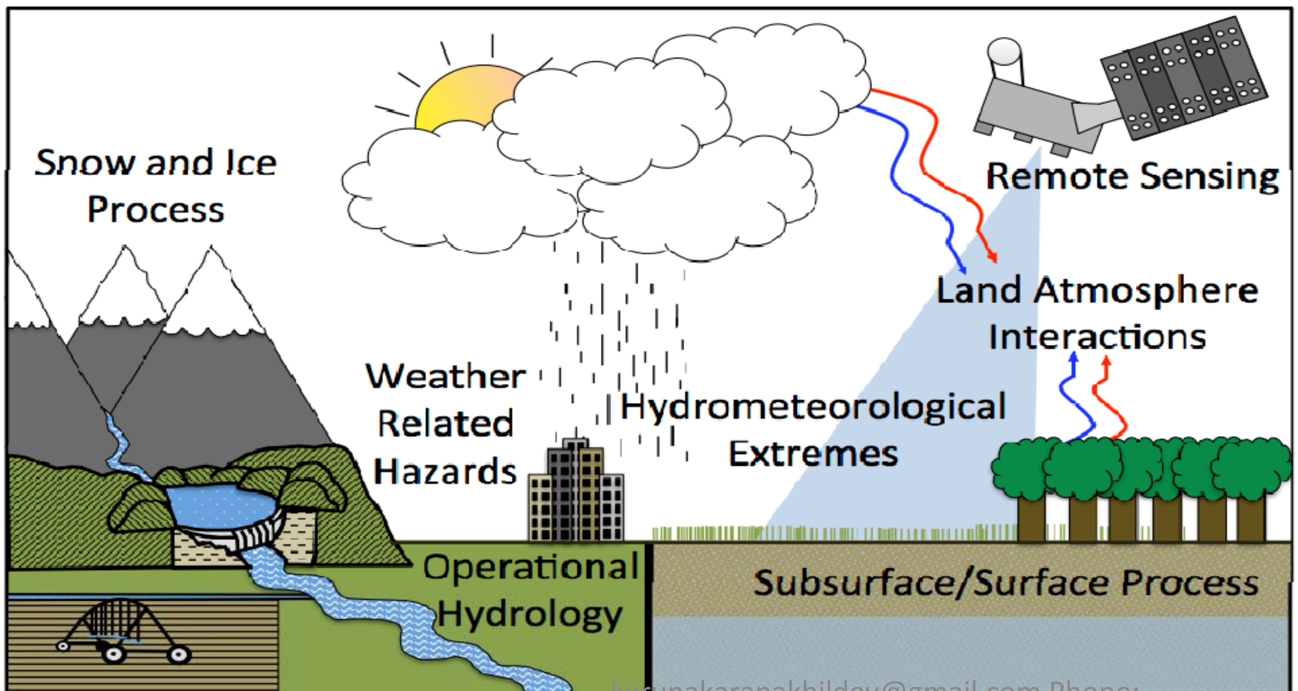
Chernobyl reactor disaster **Ukraine**

Applications of RS for DM

Category 1- Hydro Meteorological Disasters.

a) Flood
b) Drought
c) Costal erosion
d) Thunder and Lightening
e) Cyclone and Storms etc.

RS Technique

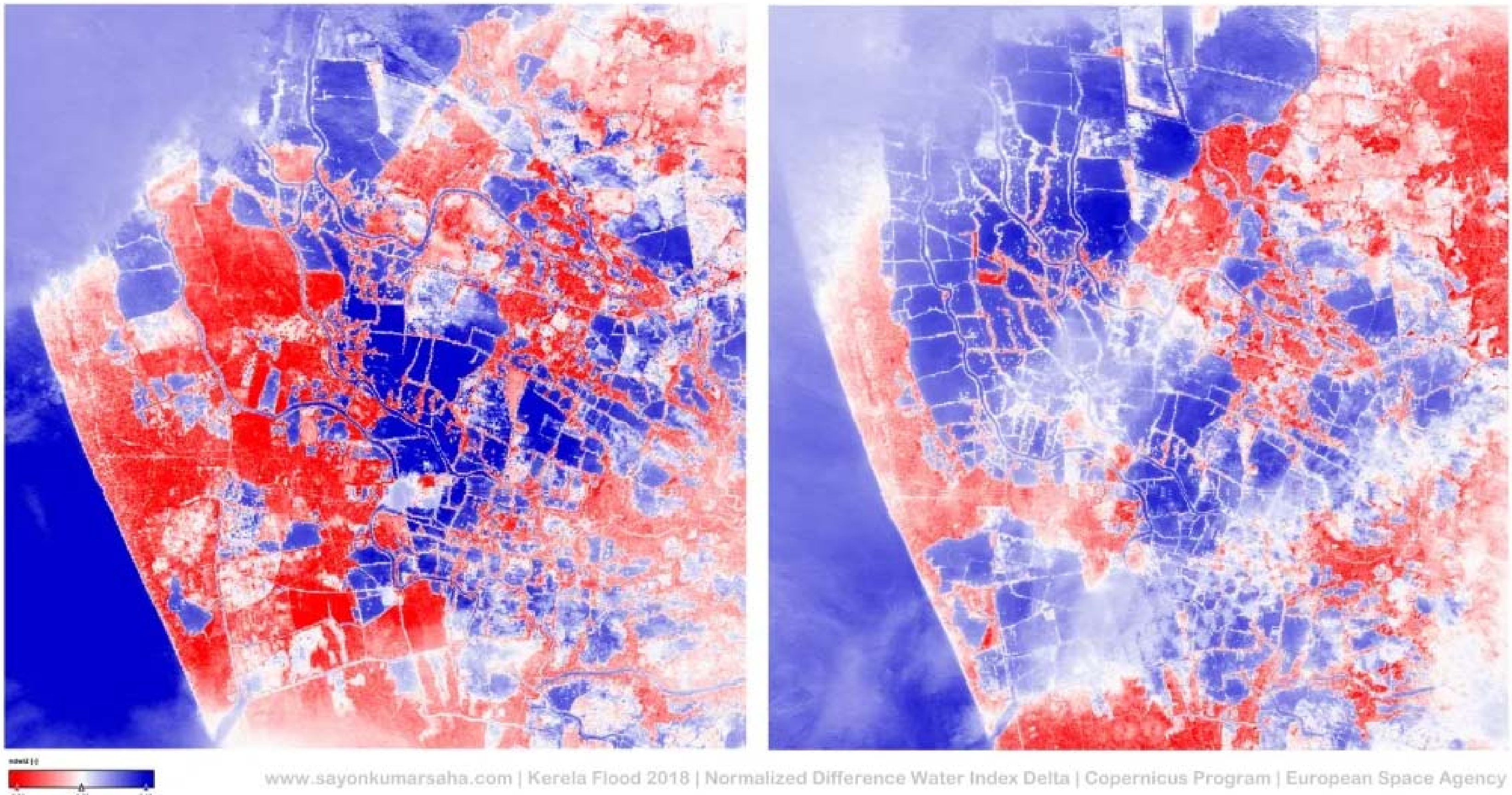


Optical RS

Microwave RS
Radar

Thermal IR

Flood

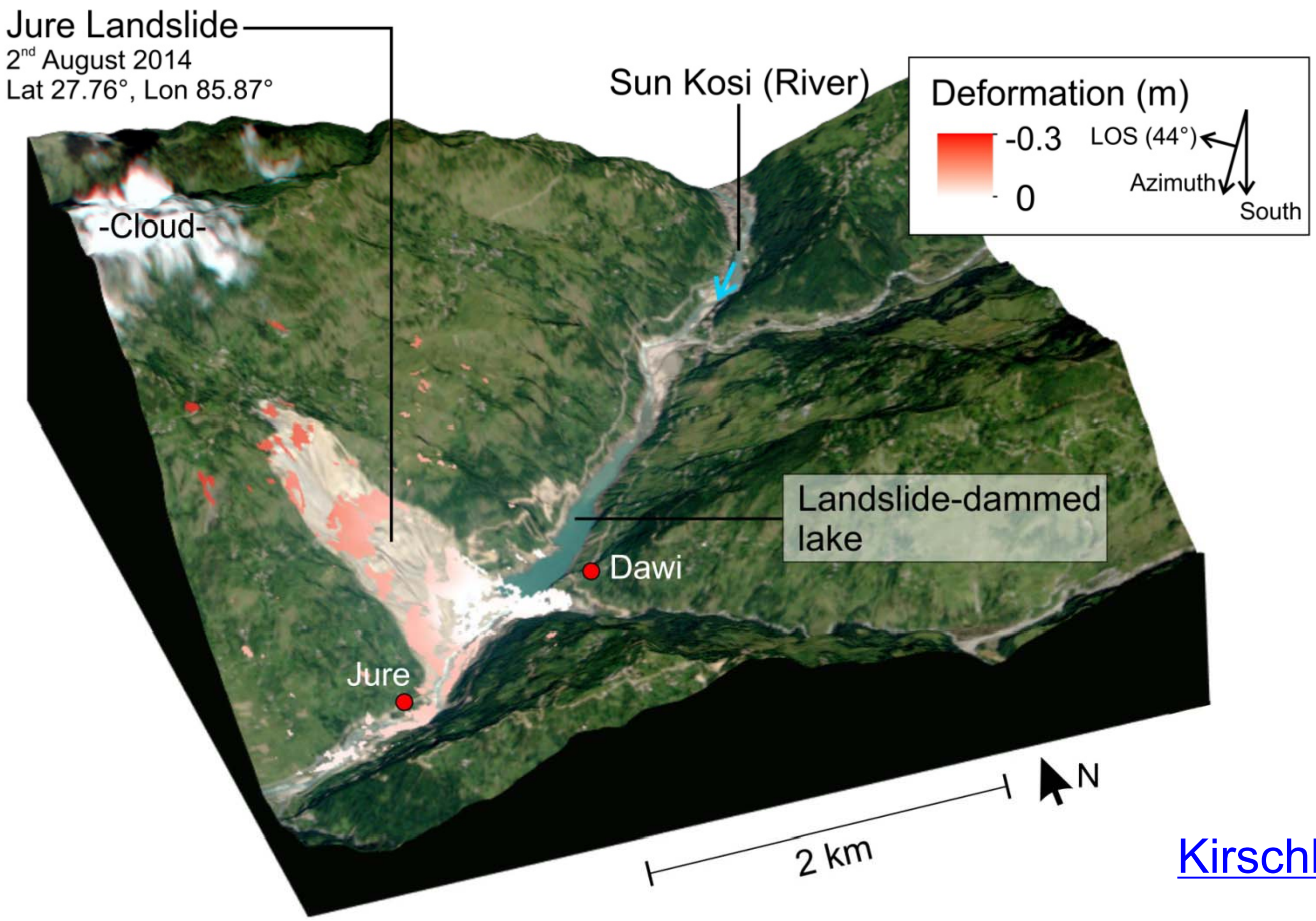


Rise in Water Level before and after the flood spotted by computing Normalized Difference Water Index (using Python, GDAL & SNAP) on multi-spectral satellite imagery (20kmx 20km in the image) of Kerala sensed and ingested by Sentinel-2A of [ESA](ESA).

http://www.sayonkumarsaha.com/satellite-image-kerela-flood/

Category 2- Geologically Related Disasters

a) Landslides and Mudflows
b) Earthquakes
c) Dam failures
d) Tsunami

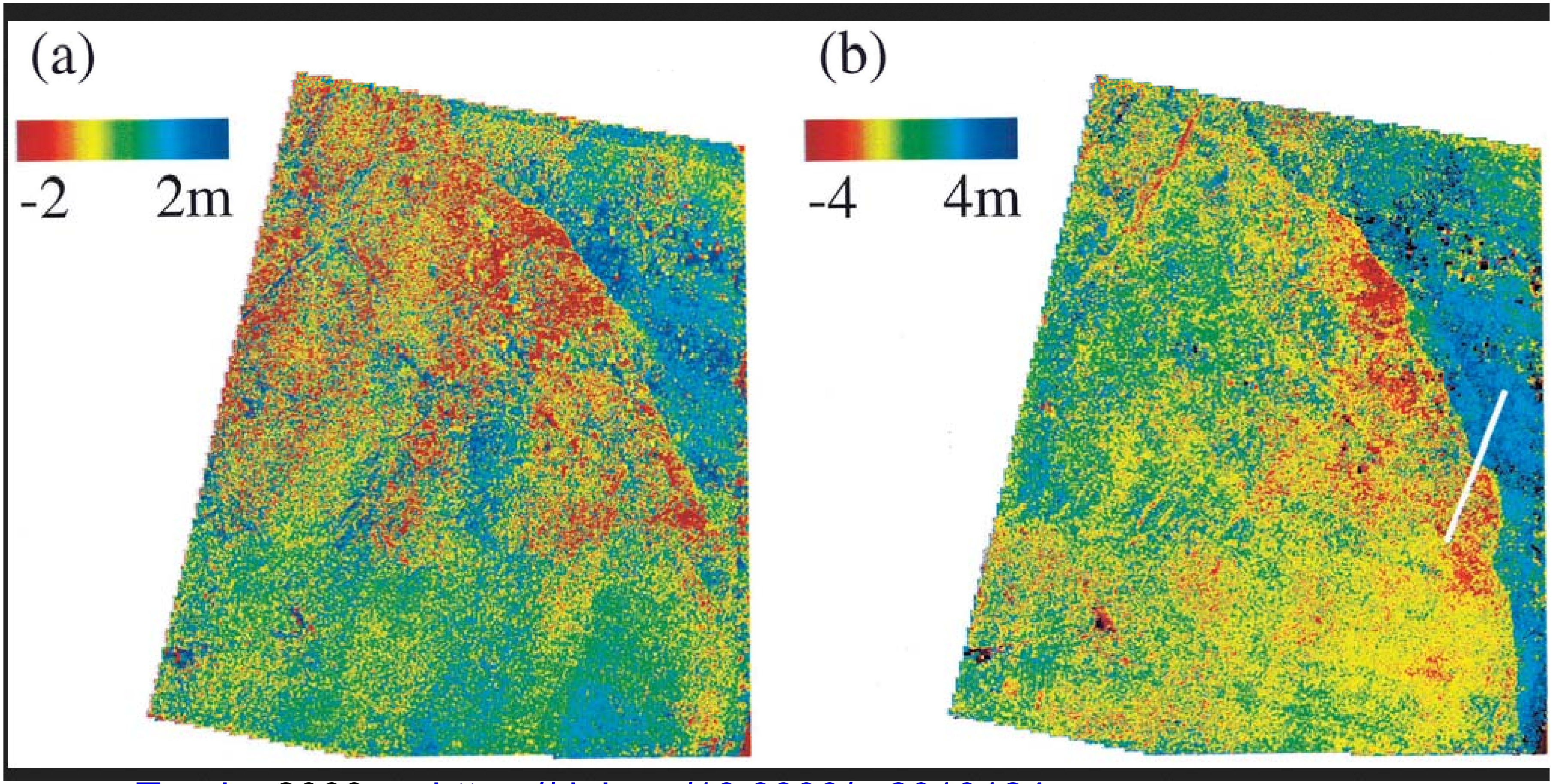


Kirschbaum D et.al. 2019

https://www.frontiersin.org/articles/10.3389/feart.2019.00197/full

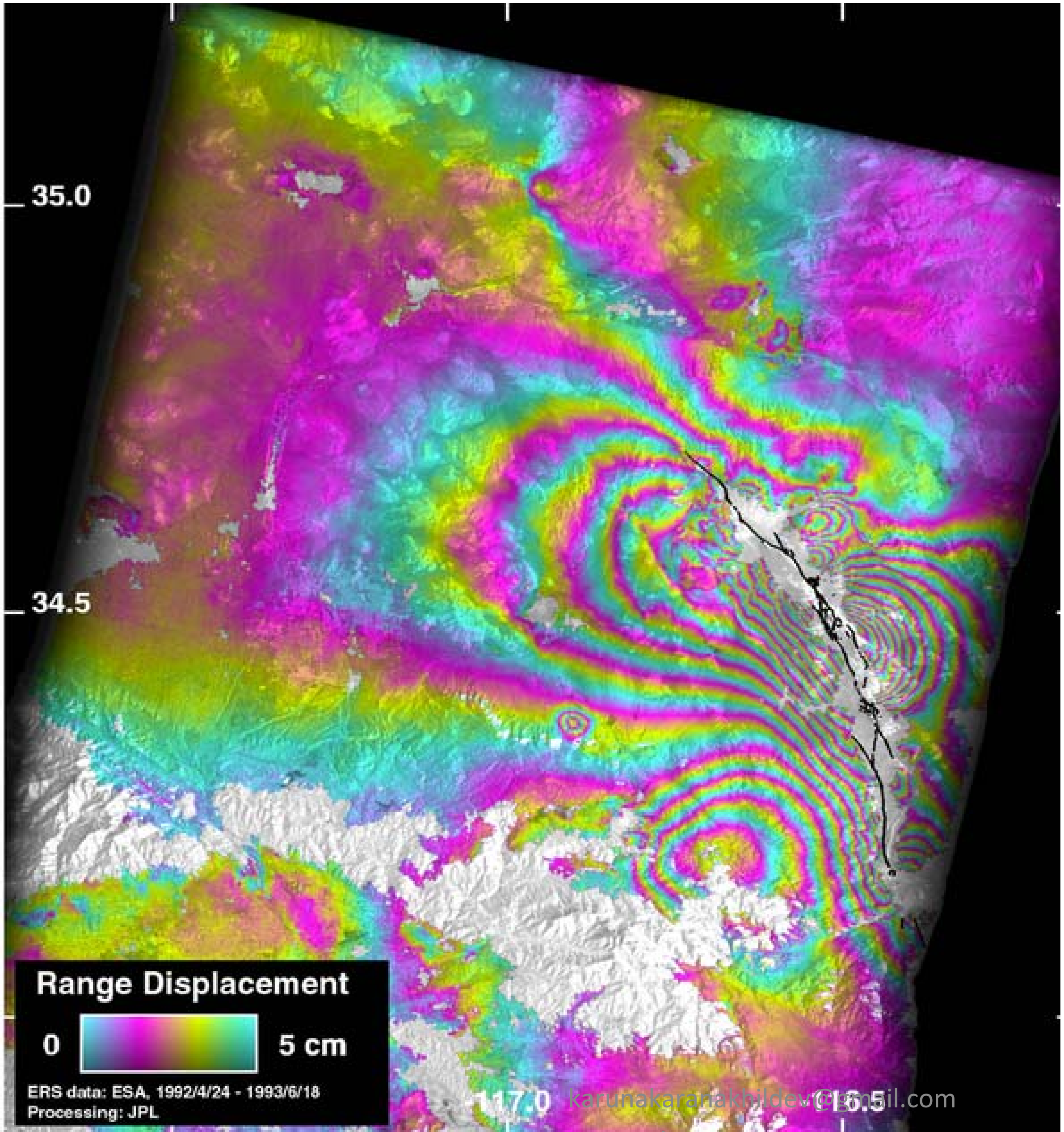
Earthquake

Horizontal ground displacement induced by the Landers earthquake measured from SPOT2



Tronin, 2009 https://doi.org/10.3390/rs2010124

Observed co-seismic interferogram for the Landers earthquake



1992 *Landers earthquake* occurred on Sunday, June 28

[Tronin](https://doi.org/10.3390/rs2010124), 2009
https://doi.org/10.3390/rs2010124

Applications of RS data for DM

Category 3- Chemical Industrial and Nuclear Related Disasters

a) Leakage of hazardous materials at the time of their manufacture, processing and transportation. Disasters due to manufacture, storage, use and transportation of products,

b) Pesticides etc and waste produced during the manufacturing process etc.

Category 4- Biological Related Disasters

a) Epidemics

b) Cattle epidemics

c) Fish diseases

d) Pest attacks etc

karunakaranakhildev@gmail.com Phone: 9847231604

Category 5- Man-Made Disasters

a) Forest fire
b) Urban fire
c) Village fire
d) Festival related disasters
e) Road, Rail and Air Accidents
f) Boat capsizing
g) Oil spill
h) Major building collapse
i) Serial Bomb blast
j) Illicit Liquor Tragedy
k) Drug abuse
l) Drowning
m) Tanker lorry mishaps
n) Pollution (water, air and soil)
o) Family suicides
p) Environmental disasters
q) Communal riots
r) Stampede etc

karunakaranakhildev@gmail.com Phone: 9847231604

Advantages of RS

- Real time data
- Area coverage
- Variety of themes
- Repetitive coverage
- Data of inaccessible area
- Different purposes and applications
- Digital data

karunakaranakhildev@gmail.com
Phone: 9847231604

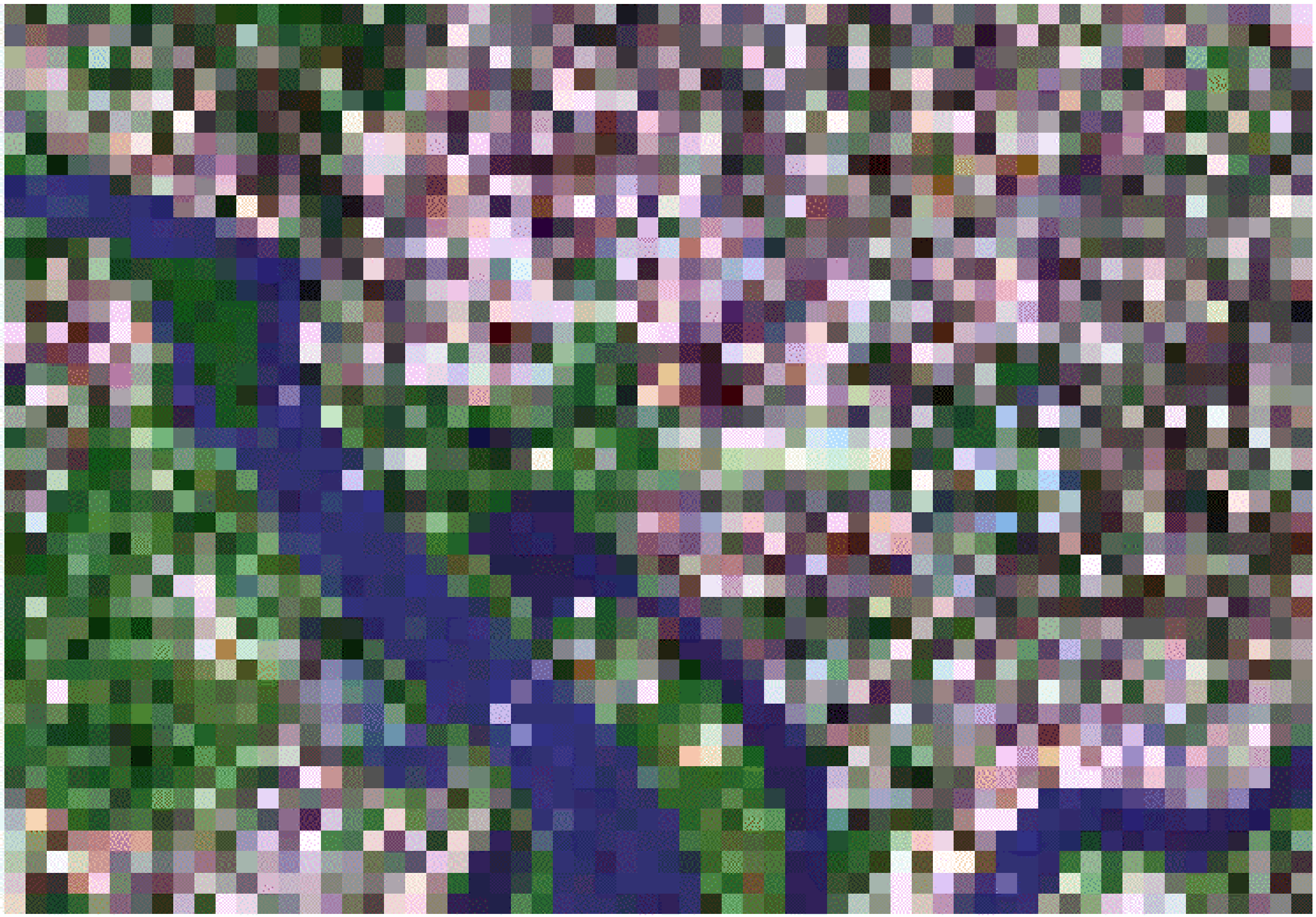
Challenges of RS

- Continuity of services
- Explore new areas of application
- Human training
- Strengthen infrastructure
- International participation
- Global market
- Resolution, Temporal resolution and Cloud cover
- Storing of data
- Management of data

karunakaranakhildev@gmail.com
Phone: 9847231604

Advantages and Disadvantages of RS

Resolutions Play a vital role in RS

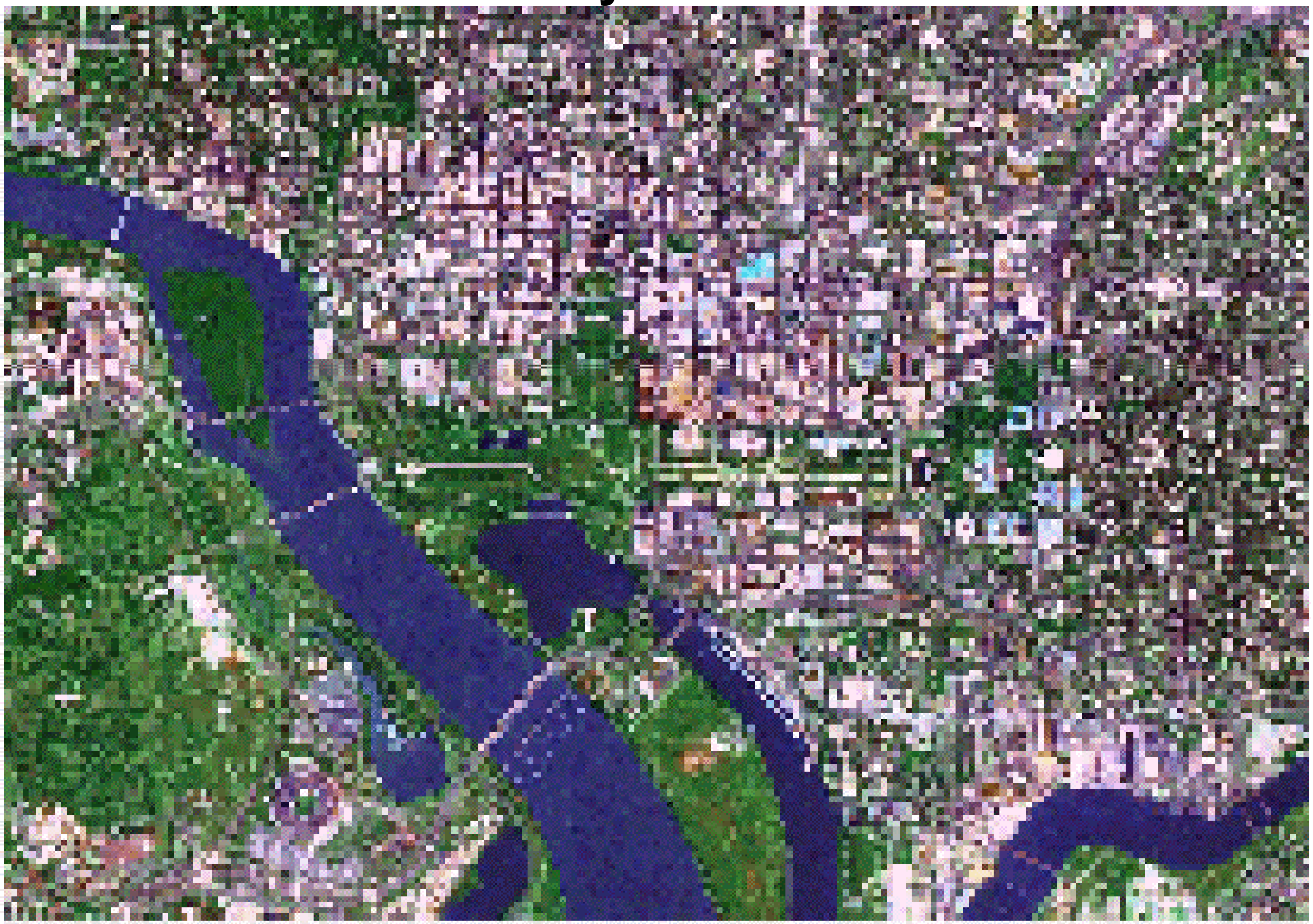


100 meter resolution

karunakaranakhildev@gmail.com
Phone: 9847231604

Advantages and Disadvantages of RS

Resolutions Play a vital role in RS



30 meter resolution

Advantages and Disadvantages of RS

5 meter resolution

karunakaranakhildev@gmail.com

Location UnKnown

Phone: 9847231604

Resolutions

Spectral

Temporal (revisits – Swath change)

Radiometric

Mal function of Sensors

(Landsat 7 – Scan Line Error)

Phone: 9847232604
karunakaran...@gmail.com

Questions?

Thank you

karunakaranakhildev@gmail.com
Phone: 9847231604