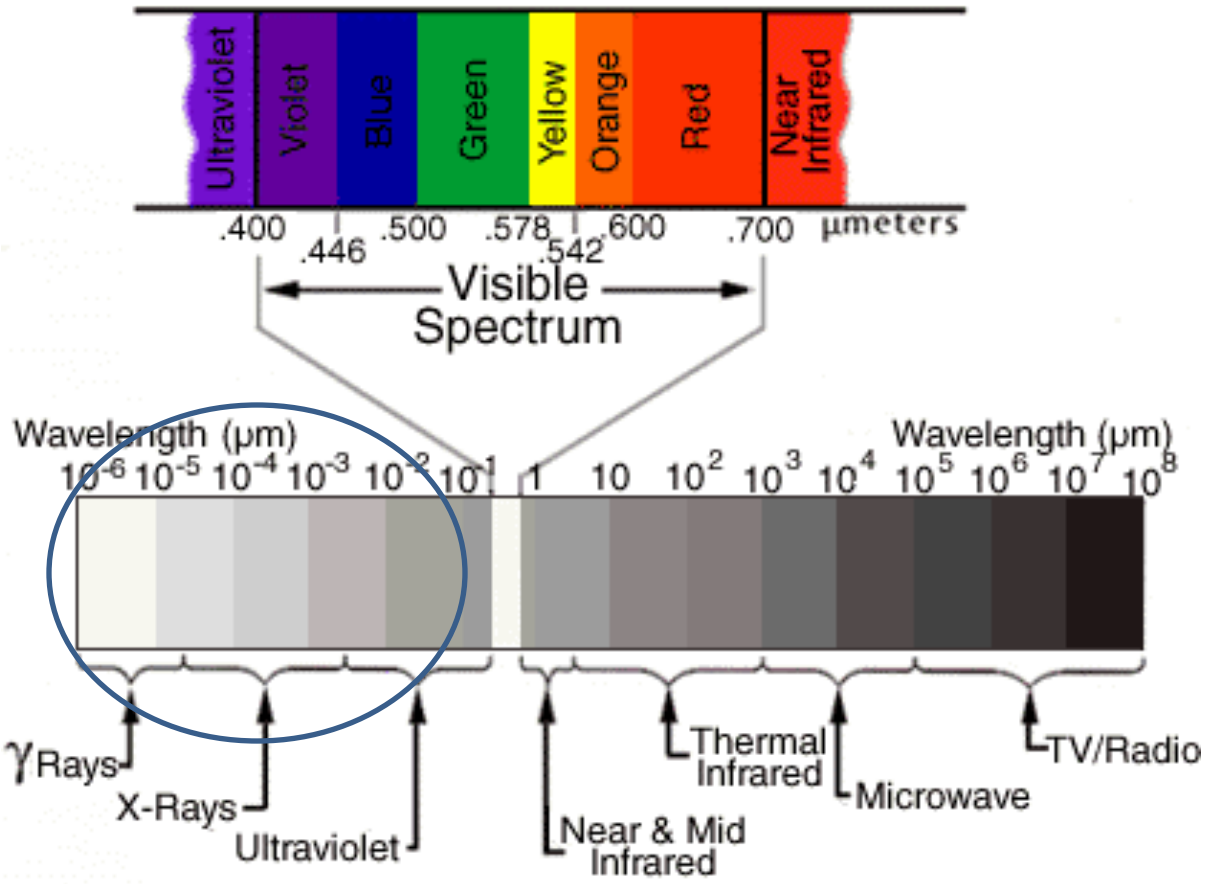
LESSON 10

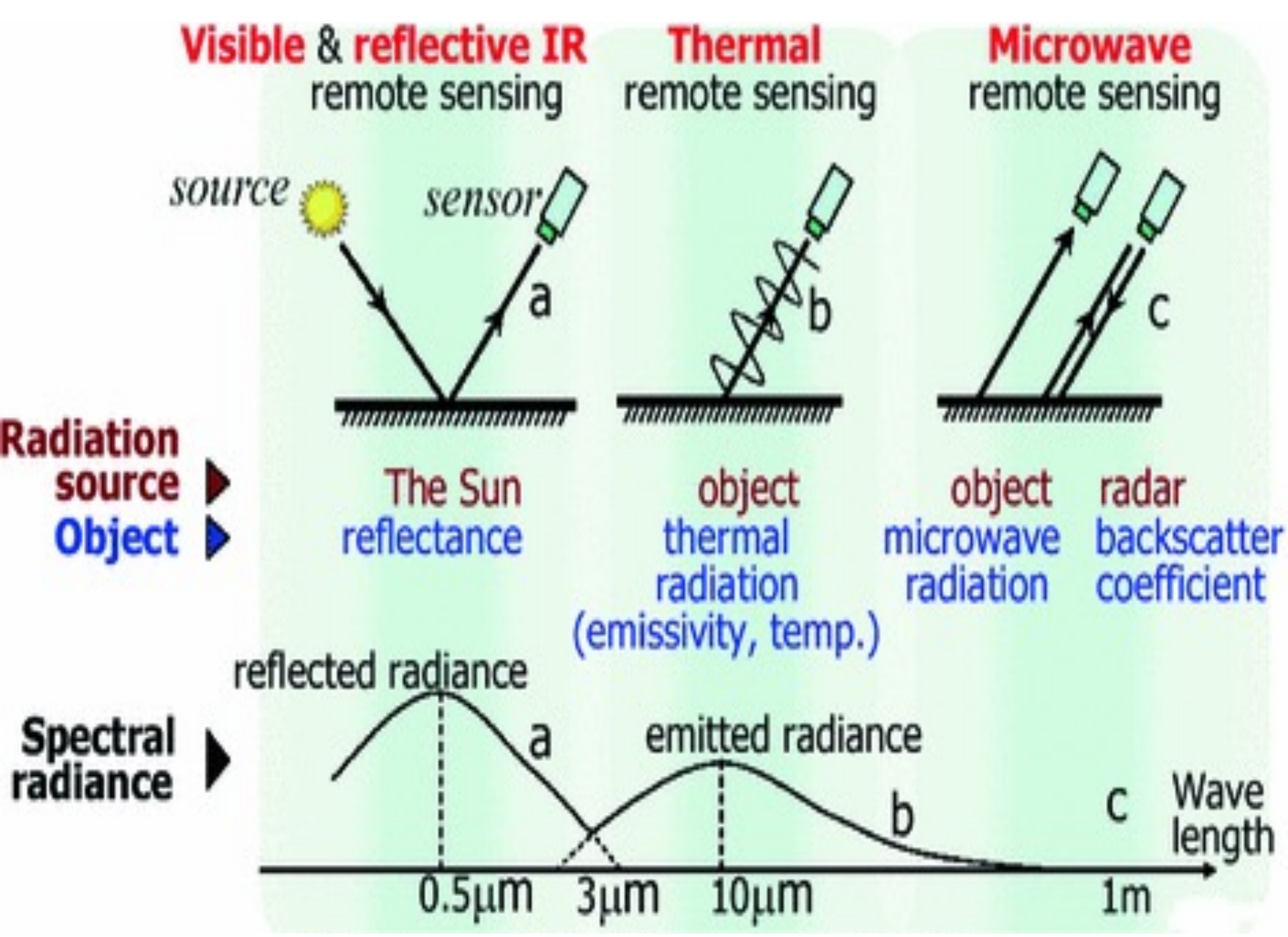
Remote Sensing Applications

REMOTE SENSING => EXTENDED VISION

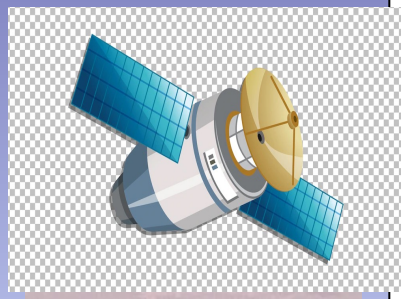
Electromagnetic Spectrum

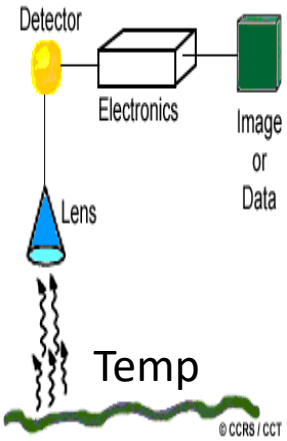


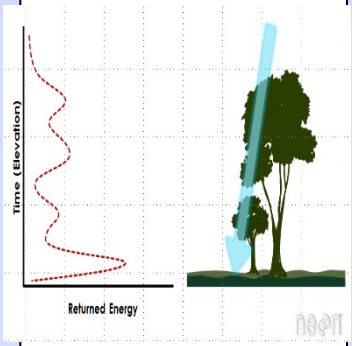
VISION BEYOND OPTICAL REGION

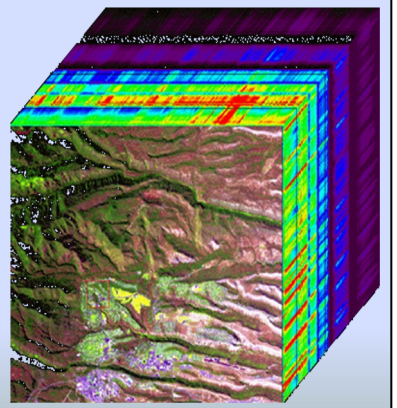

Visible & reflective IR remote sensing
Thermal remote sensing
Microwave remote sensing
source
sensor
a
b
c
Radiation source
Object
The Sun
reflectance
object
thermal radiation
(emissivity, temp.)
object
microwave radiation
radar
backscatter coefficient
Spectral radiance
reflected radiance
a
emitted radiance
b
c
Wave length
0.5μm
3μm
10μm
1m

Remotely Sensed Data









Panchromatic data

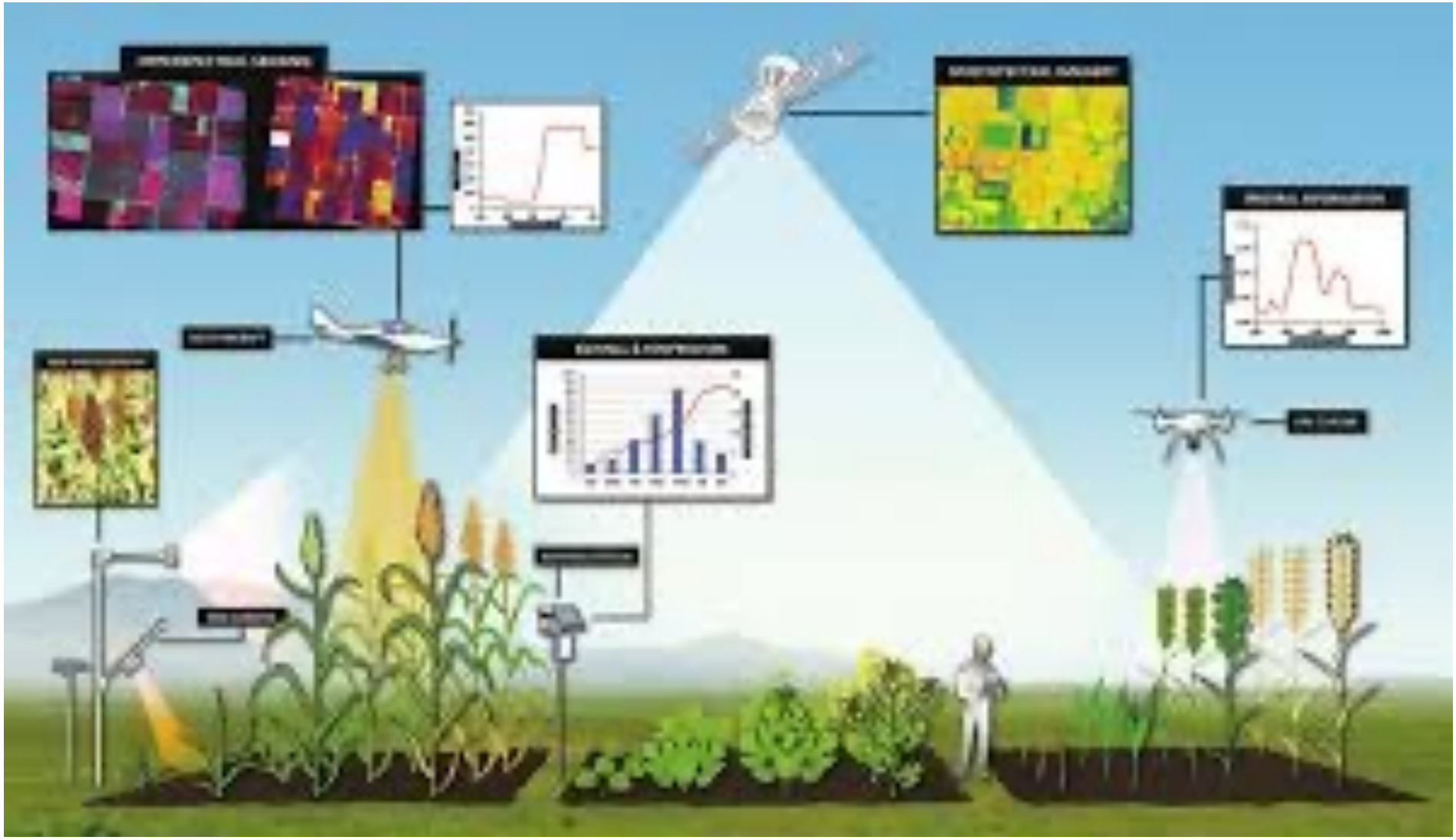
Multispectral Satellite

Radar Satellite

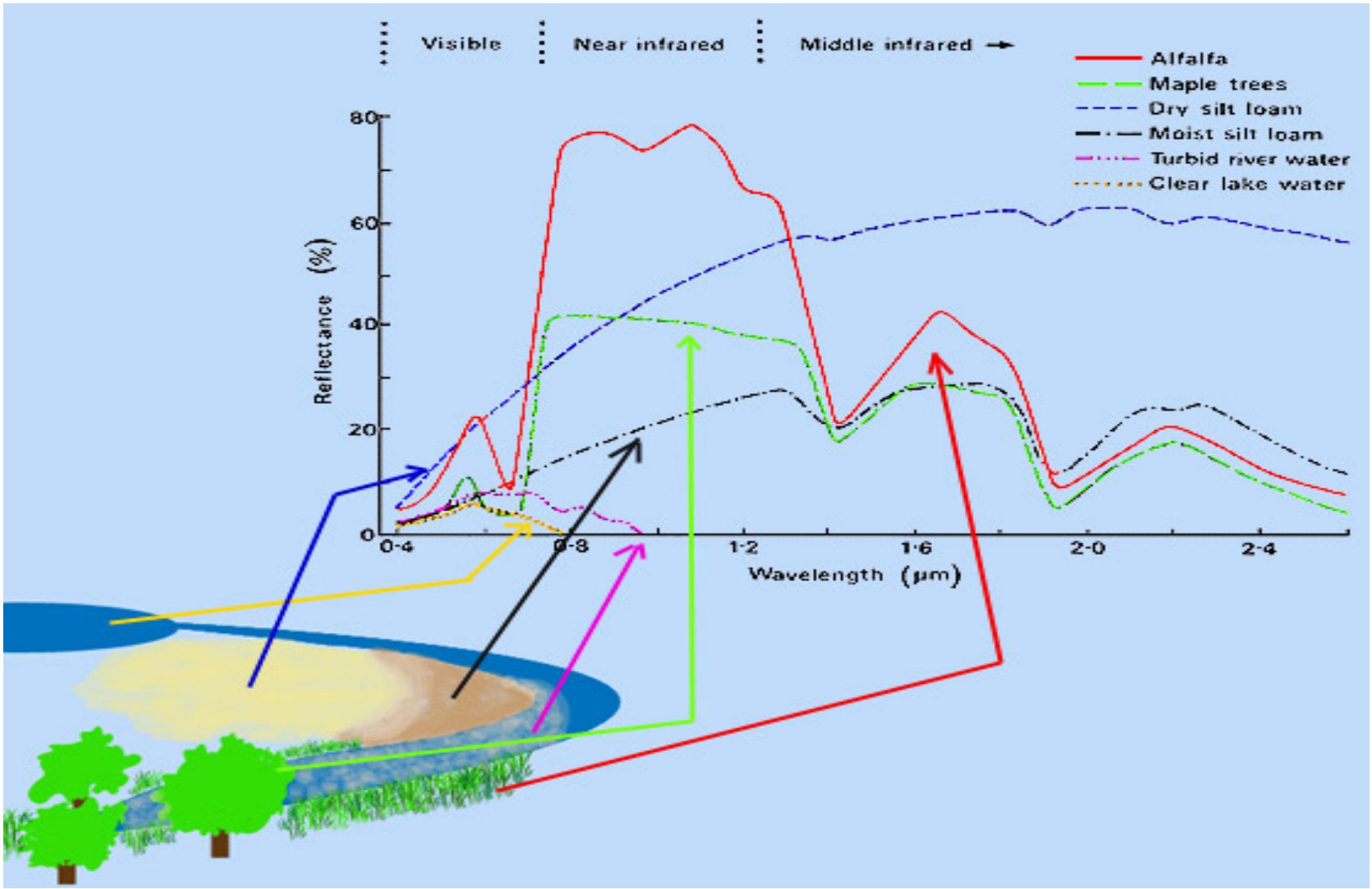
Hyperspectral Sensor

measurements

- Spectral Reflectivity (Multispectral/Hyperspectral sensors)
- Albedo (Panchromatic sensors)
- Temperature (Thermal sensors)
- Backscattering (Radar sensors)
- Height (Lidar sensor)



SPECTRAL REFLECTIVITY IS THE BASIS OF IMAGE CLASSIFICATION or LAND COVER MAP mapping



APPLICATIONS of Remote sensing : MULTI-DI*SCIPLINARY*

1. **Natural resource inventory (NRI): is the information collected to identify the location and character of natural resources.**

2. **Natural resource assessment (NRA):** is **an analysis of the NRI to aid in decision-making and management efforts**.

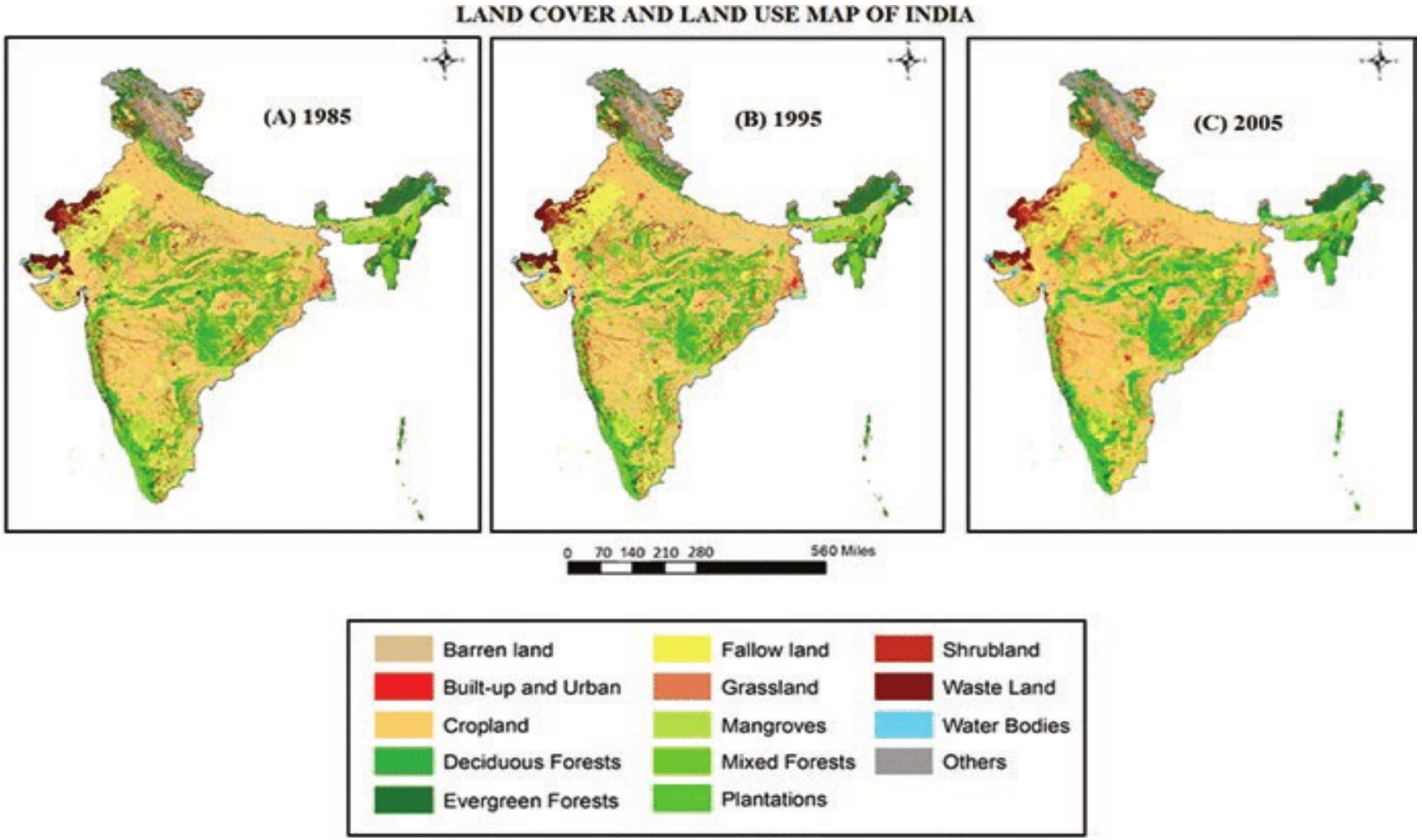
3. Monitoring

LANDUSE AND LAND COVER

INPUTS: Remote sensing data

Software: Data processing and analysis

Output: Landuse classes



Land cover and land use map of India prepared using satellite remote sensing data sets for the years (a) 1985, (b) 1995, and (c) 2005. (Openly Sourced from Roy et al. 2015)

Shrubland, scrubland, scrub, brush, or bush is **a plant community characterized by vegetation dominated by shrubs, often also including grasses, herbs, and geophytes**. Shrubland may either occur naturally or be the result of human activity

Mangrove forests, also called *mangrove swamps*, mangrove thickets or mangals, are productive wetlands that occur in coastal intertidal zones.

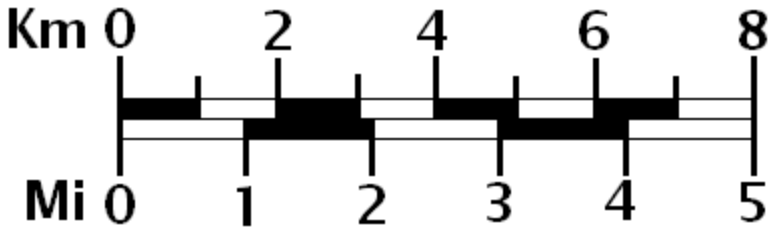
Tropical Evergreen Forest In India includes *the Western Ghats, forest areas in the Andaman and Nicobar Islands, the greater Assam region*,

Information at different scale:

- Global scale
- Regional scale
- Local scale

⇒Map scale

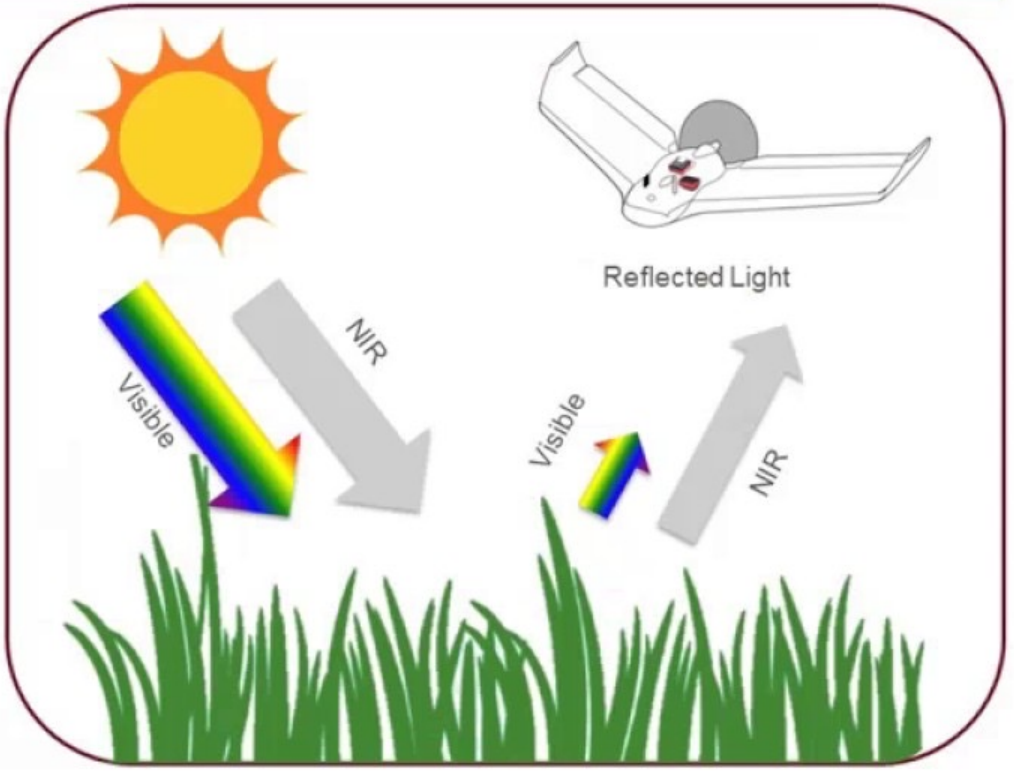
The scale of a map is the ratio of a distance on the map to the corresponding distance on the ground.



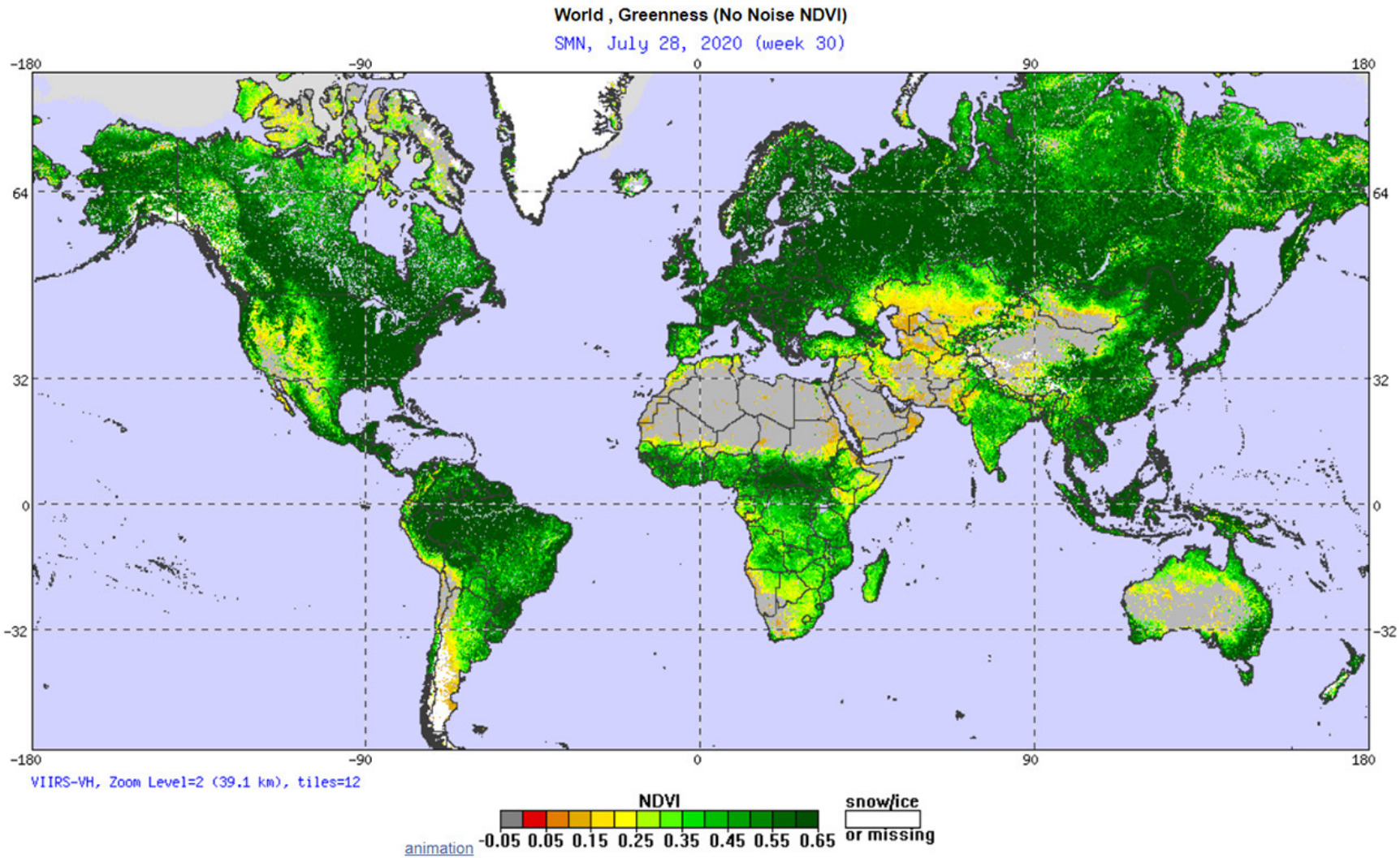
BASIS OF VEGETATION ANALYSIS

How Plants Interact With Sun Energy

- Light energy from sun is either:
  - Absorbed
  - Transmitted
  - Reflected



NIR = Near Infrared


World , Greenness (No Noise NDVI)
SMN, July 28, 2020 (week 30)
-180
-90
0
90
180
64
32
0
-32
VIIRS-VH, Zoom Level=2 (39.1 km), tiles=12
NDVI
-0.05 0.05 0.15 0.25 0.35 0.45 0.55 0.65
snow/ice
or missing
animation

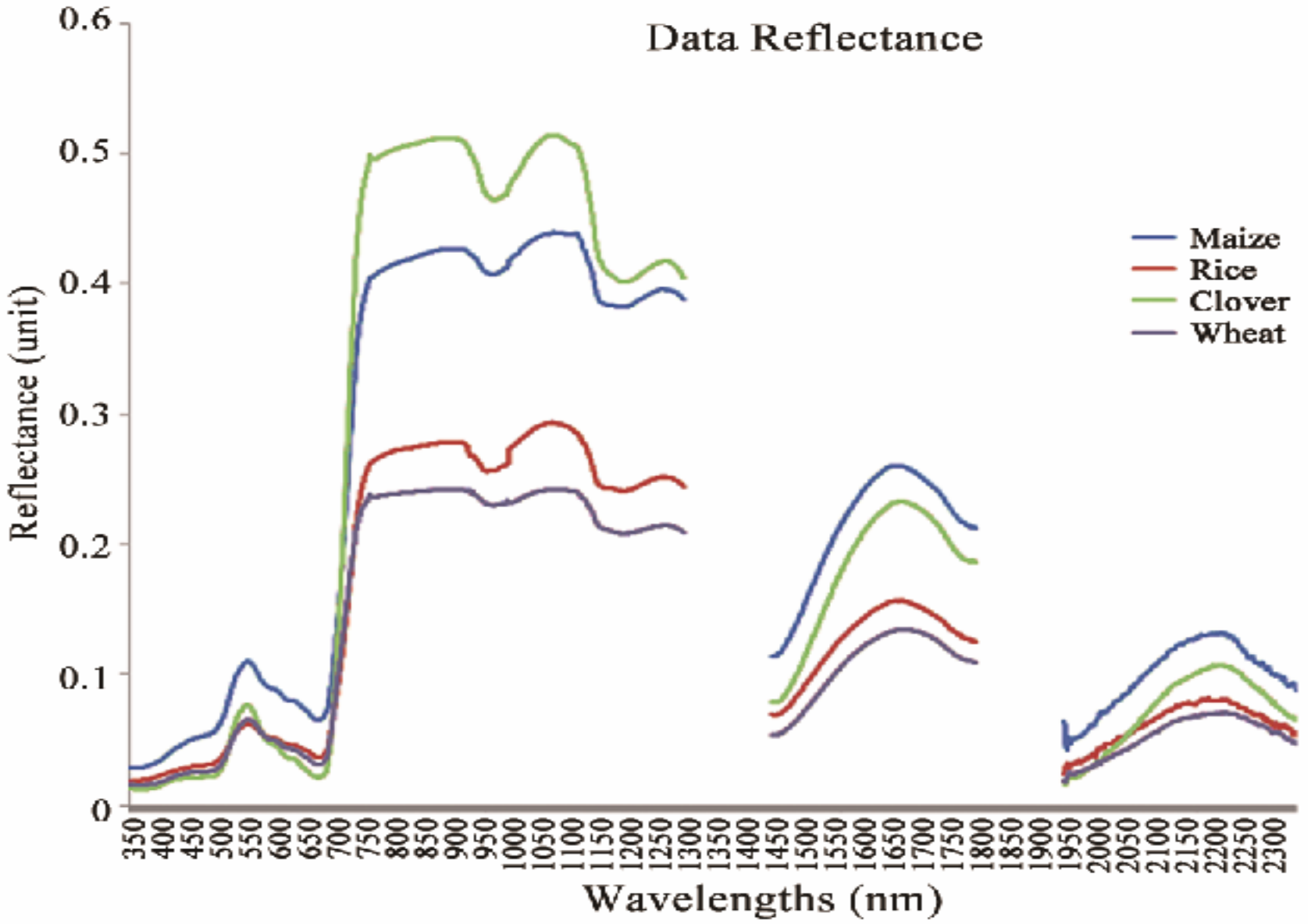
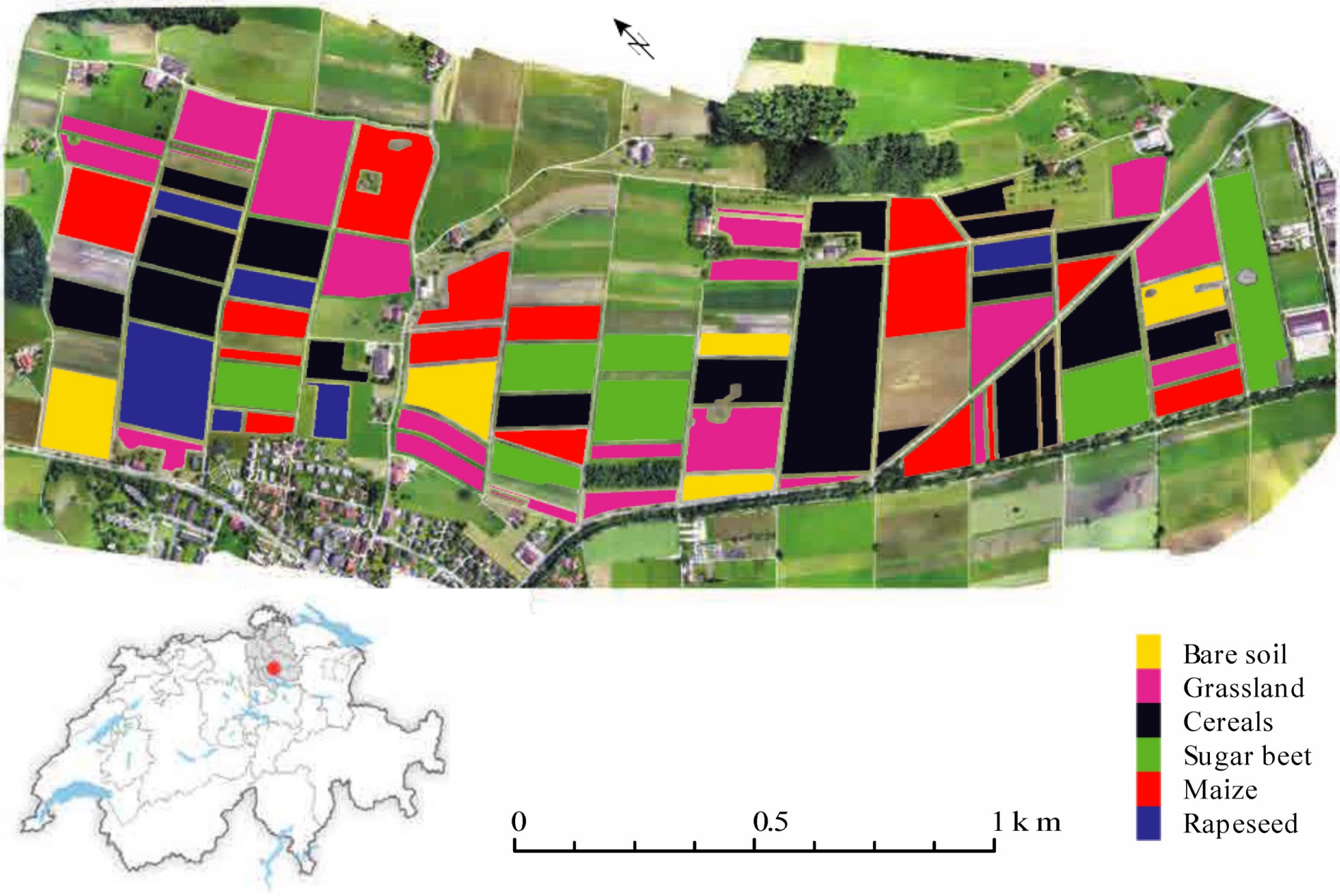
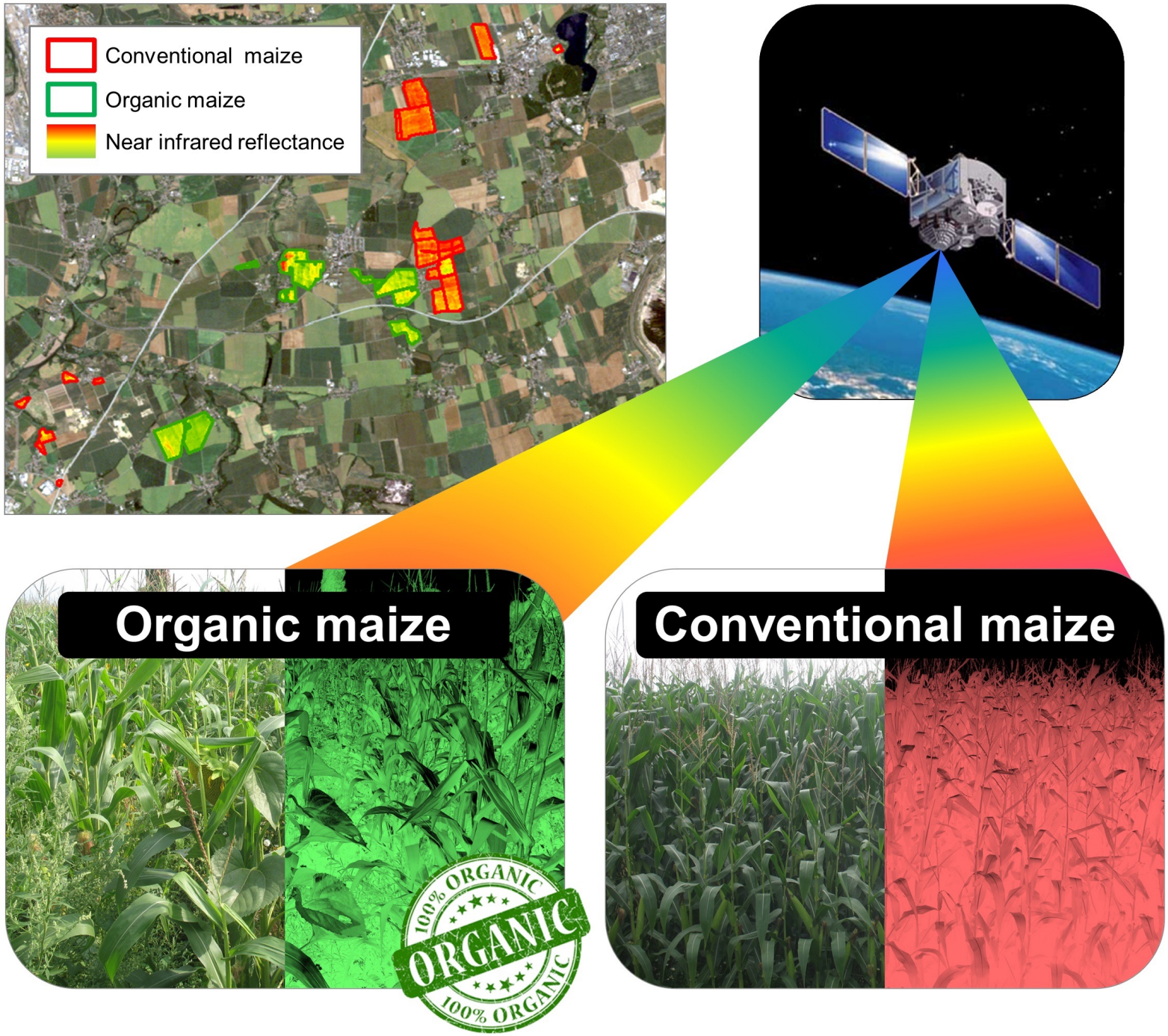


Figure 2. The spectral reflectance pattern for the different

Near Jaipur

https://blog.mapbox.com/new-satellite-imagery-for-cities-across-india-4b97ed7e3452


N
Bare soil
Grassland
Cereals
Sugar beet
Maize
Rapeseed
0
0.5
1 k m

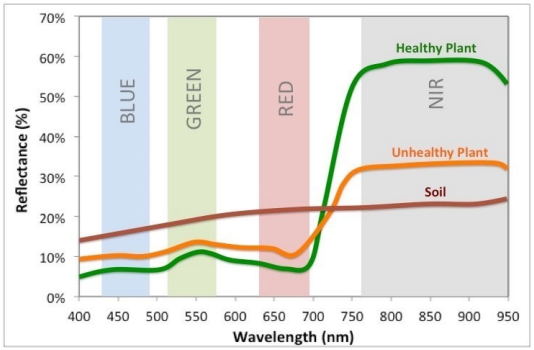

Conventional maize
Organic maize
Near infrared reflectance
Organic maize
Conventional maize
100% ORGANIC
ORGANIC
100% ORGANIC

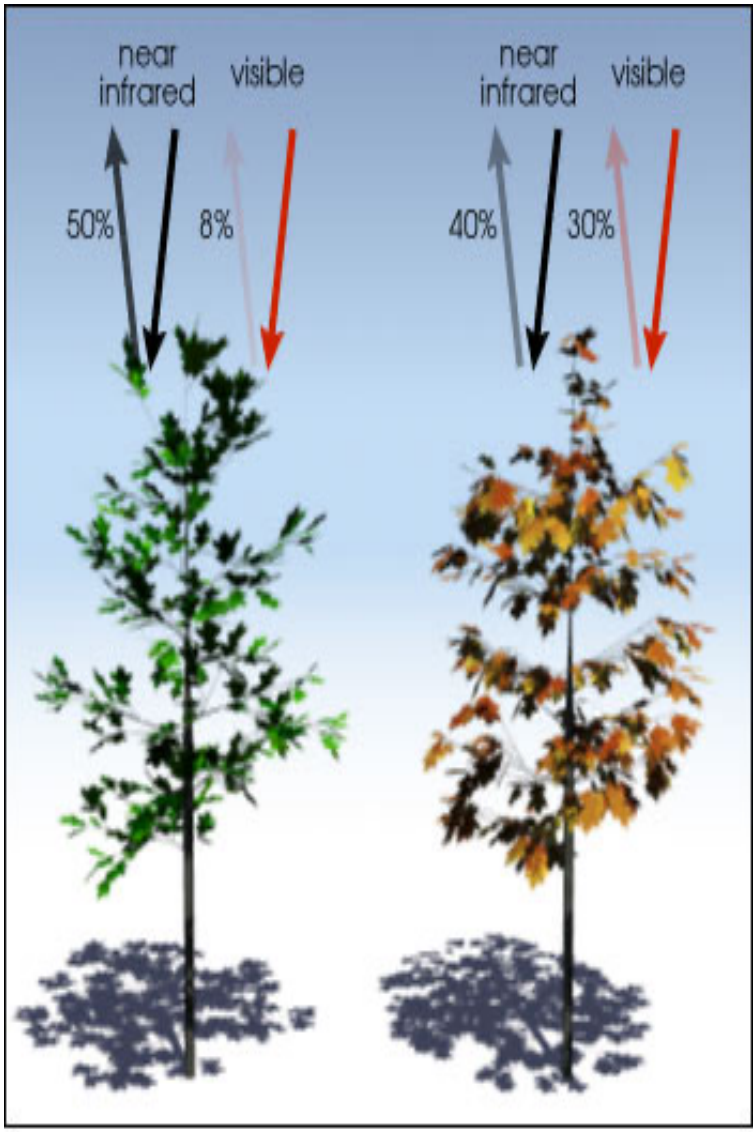
Normalized Difference Vegetation Index (NDVI)

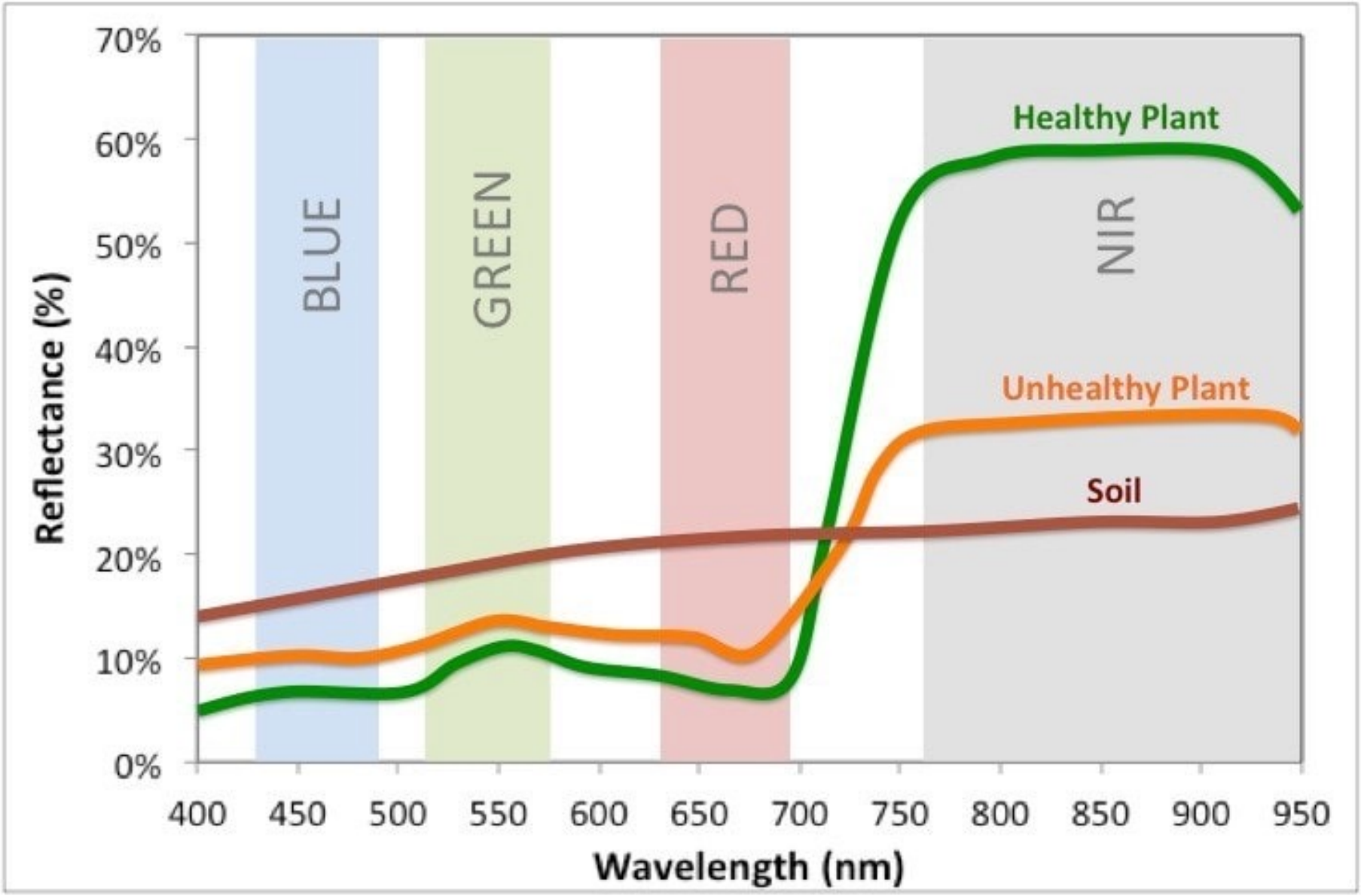
$$NDVI = \frac{\rho_{NIR} - \rho_{red}}{\rho_{NIR} + \rho_{red}}$$

ρ_{red} = Reflectance in red channel
ρ_{NIR} = Reflectance in NIR channel

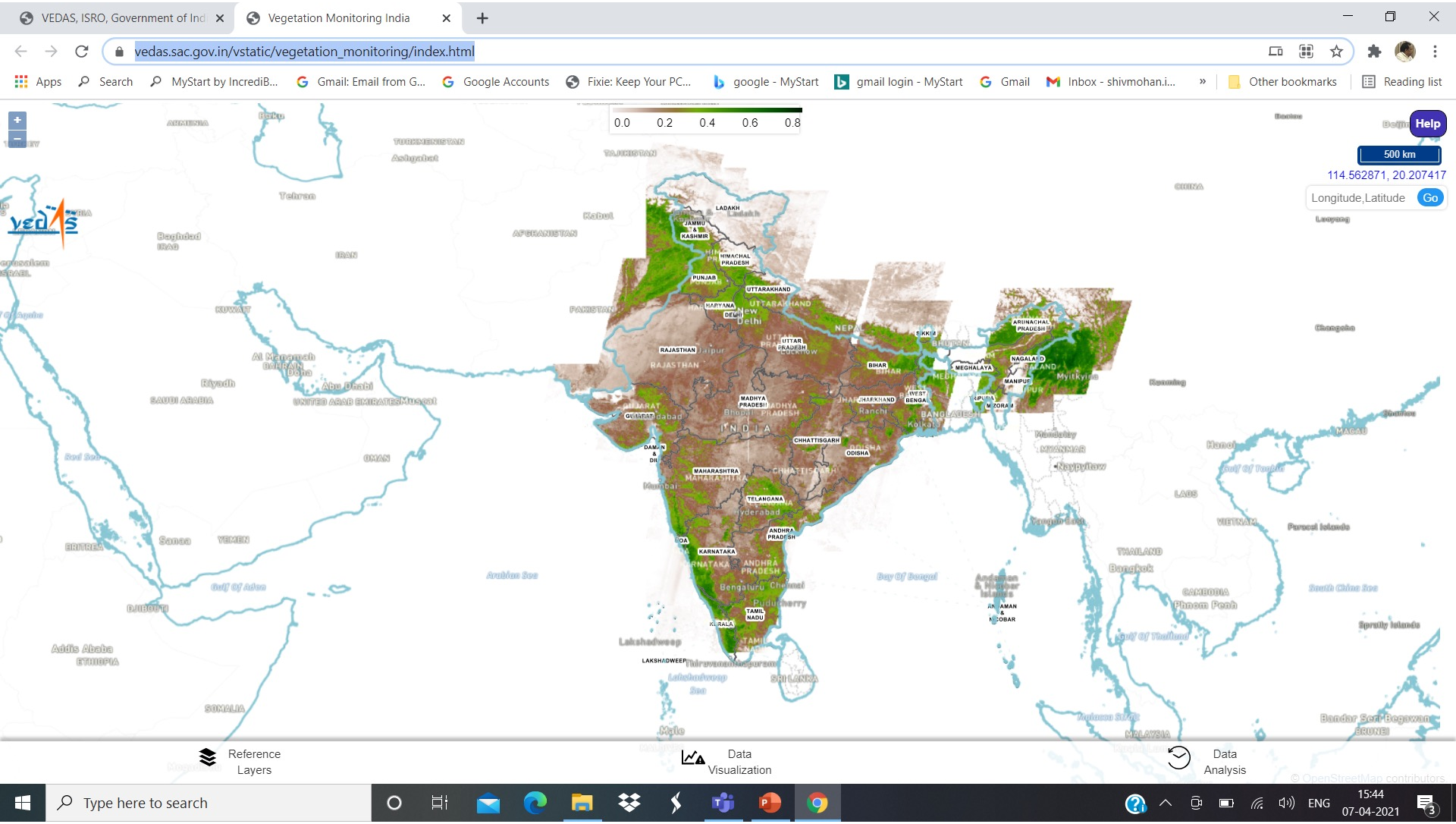
Healthy, dense vegetation has high NDVI
Stressed, or sparse vegetation produces lower NDVI
Bare rock, soil have NDVI near zero
Snow produces negative values of NDVI
Clouds produce low to negative values of NDVI






70%
60%
50%
40%
30%
20%
10%
0%
Reflectance (%)
BLUE
GREEN
RED
NIR
Healthy Plant
Unhealthy Plant
Soil
400
450
500
550
600
650
700
750
800
850
900
950
Wavelength (nm)

https://vedas.sac.gov.in/vstatic/vegetation_monitoring/index.html

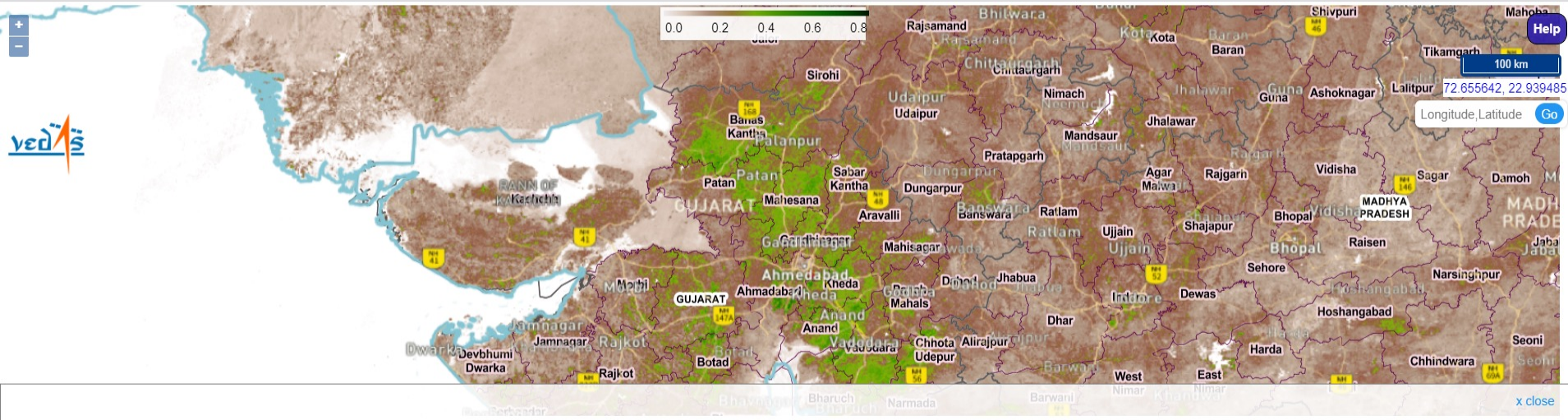


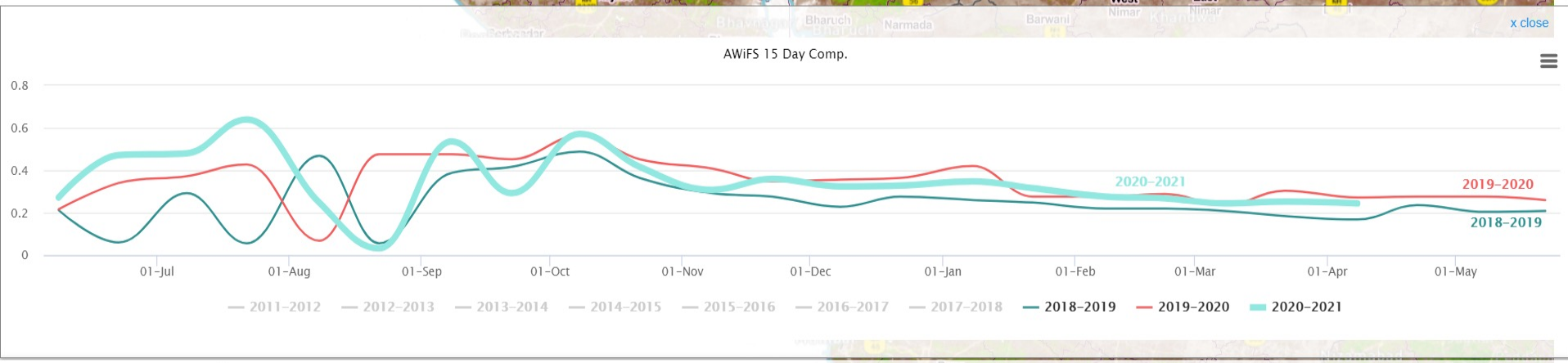
https://vedas.sac.gov.in/vstatic/vegetation_monitoring/index.html

VEDAS, ISRO, Government of Ind | Vegetation Monitoring India

vedas.sac.gov.in/vstatic/vegetation_monitoring/index.html

Apps | Search | MyStart by IncrediB... | Gmail: Email from G... | Google Accounts | Fixie: Keep Your PC... | google - MyStart | gmail login - MyStart | Gmail | Inbox - shivmohan.i... | Other bookmarks | Reading list





Reference Layers | Data Visualization | Data Analysis

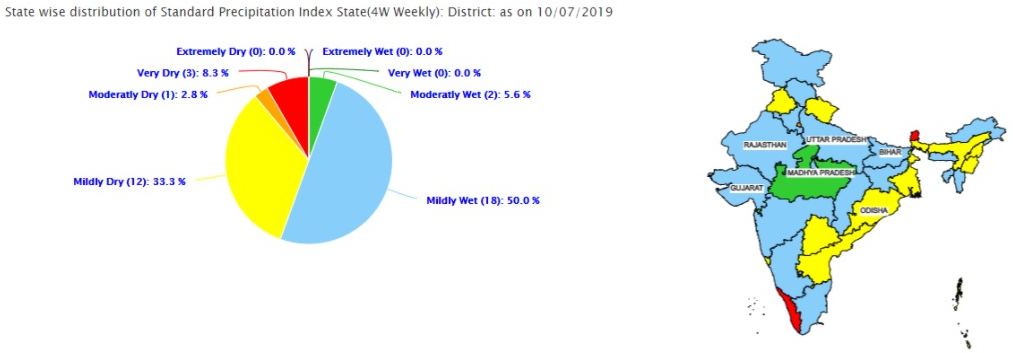
Type here to search

ENG 15:49 07-04-2021

SPI and VCI based real time drought monitoring for Indian region

Drought is a complex natural phenomenon which impact agriculture enormously. Early detection of drought helps stakeholders to take counter measures and provide timely advisories. VEDAS has newly added drought monitoring functionality in its basket by providing widely used Standard Precipitation Index (SPI) and Vegetation Condition Index (VCI).

VEDAS is providing monthly and running 1-month weekly SPI at state as well as taluka levels. Monthly SPI is being calculated using CHIRPS precipitation data while running 1-month weekly SPI is being calculated using NOAA and CHIRPS rainfall data based on 1981-2018 CHIRPS precipitation data. It is available at its vegetation condition dashboard. It is also enabled with spatial analysis (map) as well as data analysis (pie chart and bar chart) functionalities.



Click to visualise SPI

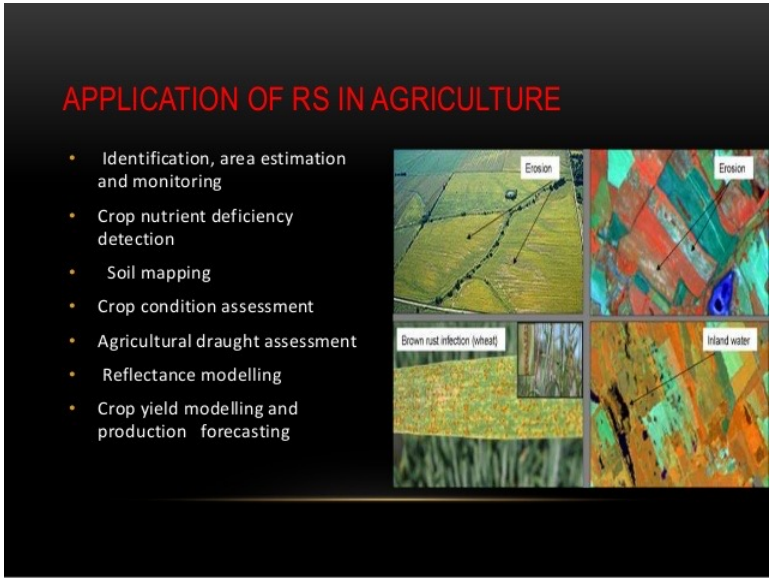
Experimental short range water level and inundation forecast for the Brahmaputra river

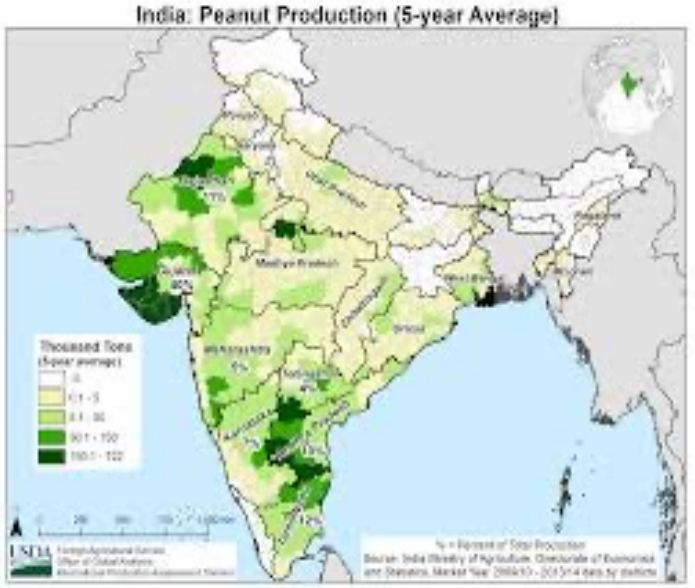
Being the highest specific discharge river system in the world, the Brahmaputra river experiences number of long-duration flood waves during the monsoon season annually. Therefore, WRF-Hydro model is setup and is used to predict 3-day water level and inundation probability during the monsoonal flood condition in the Brahmaputra river at Guwahati gauge station and this prediction is visualised on VEDAS.

Crop discrimination
Crop acreage and production
Health
Forecasting
Disease
Irrigation
Drought

User: MOA

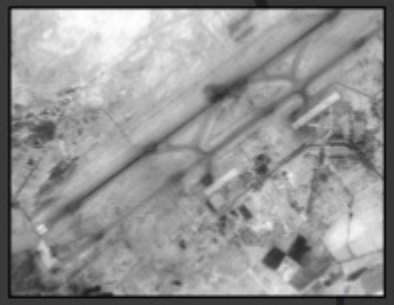
planners (e.g niti ayog)
Mandi
Agriculture producer, middleman,

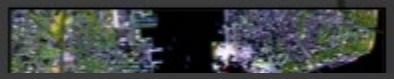




Application of Remote sensing

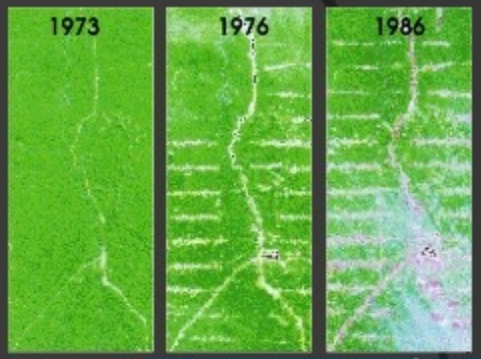
- National Security
  - -Targeting
  - -Disaster mapping and monitoring
  - -Damage assessment
  - -Weapons monitoring
  - -Homeland security
  - -Navigation
  - -Policy
  - -Telecommunication planr
  - -Coastal mapping

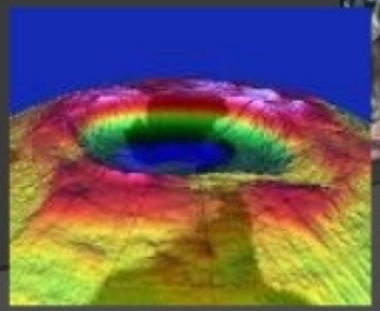




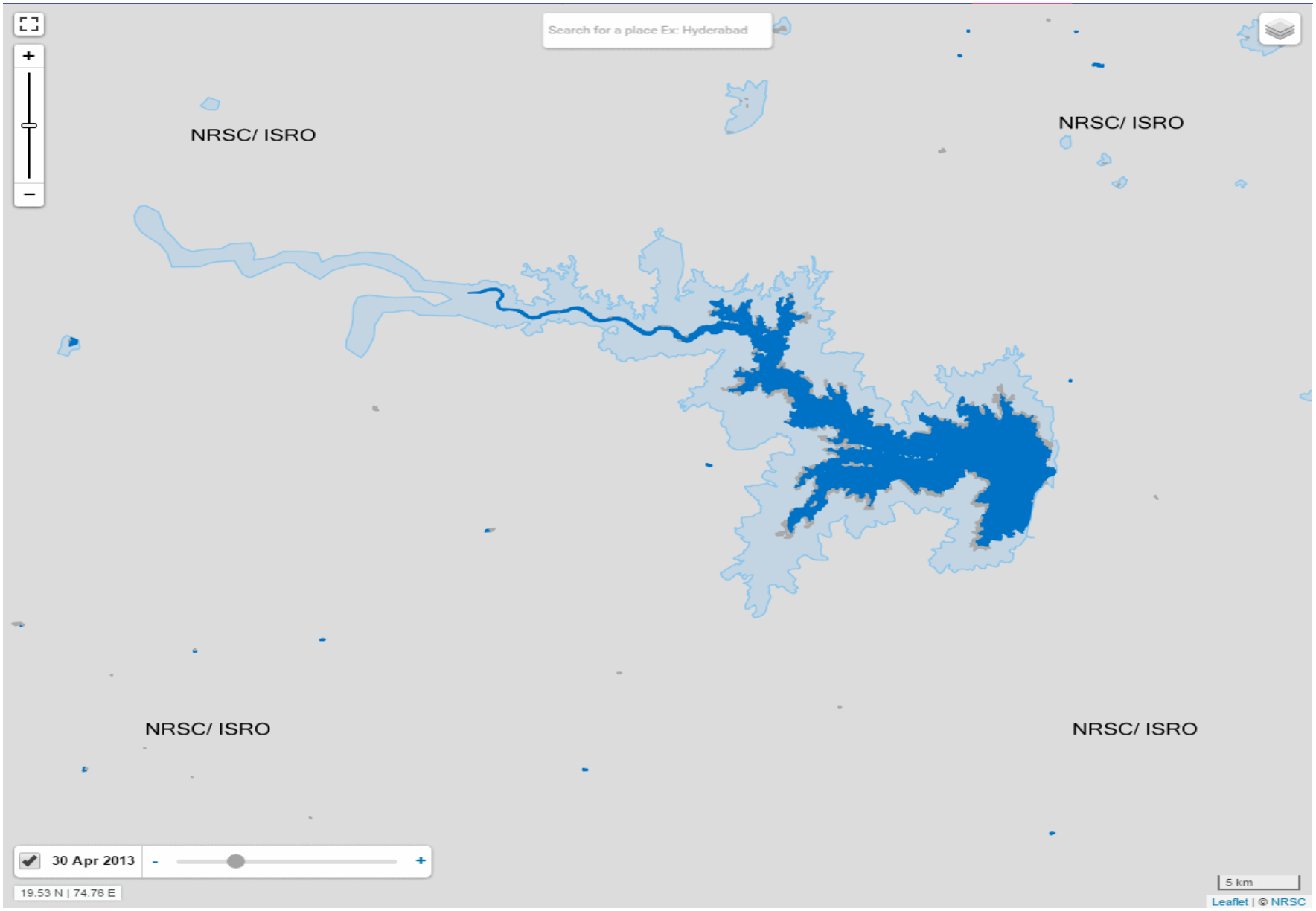
Application of Remote sensing

- Natural Resource Management
  - Habitat analysis
  - Environmental assessment
  - Pest/disease outbreaks
  - Impervious surface mapping
  - Lake monitoring
  - Hydrology
  - Landuse-Landcover monitoring
  - Mineral province
  - Geomorphology
  - Geology





Water spread status

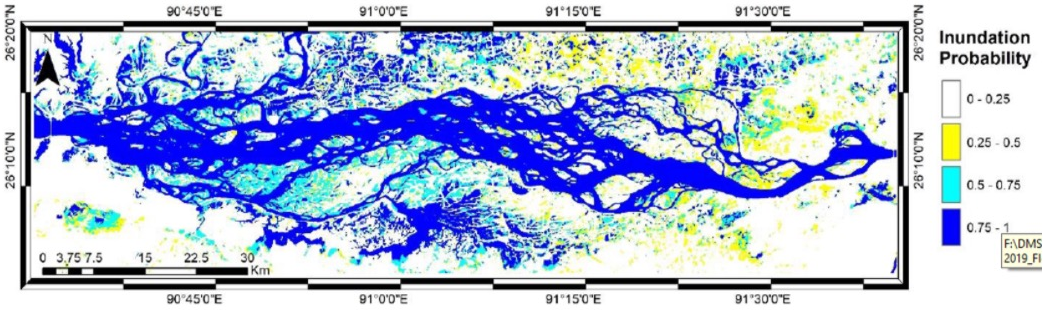


Click to visualise SPI

Experimental short range water level and inundation forecast for the Brahmaputra river

Being the highest specific discharge river system in the world, the Brahmaputra river experiences number of long-duration flood waves during the monsoon season annually. Therefore, WRF-Hydro model is setup and is used to predict 3-day water level and inundation probability during the monsoonal flood condition in the Brahmaputra river at Guwahati gauge station and this prediction is visualised on VEDAS.

Water level of various waterbodies over India derived from satellite altimetry is also visualised in Hydrology Application.



Inundation probability for downstream of the Brahmaputra river w.r.t. river stage condition on July 16-17, 2019 at Guwahati gauge station

Click to visualise Hydrology Application and forecast

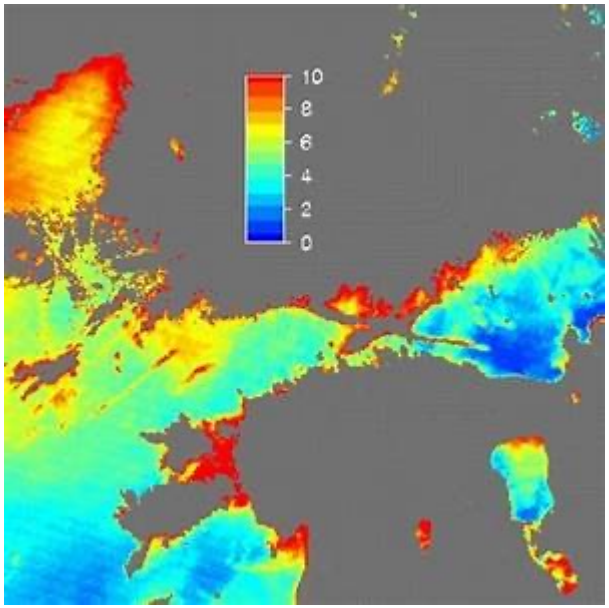
show older

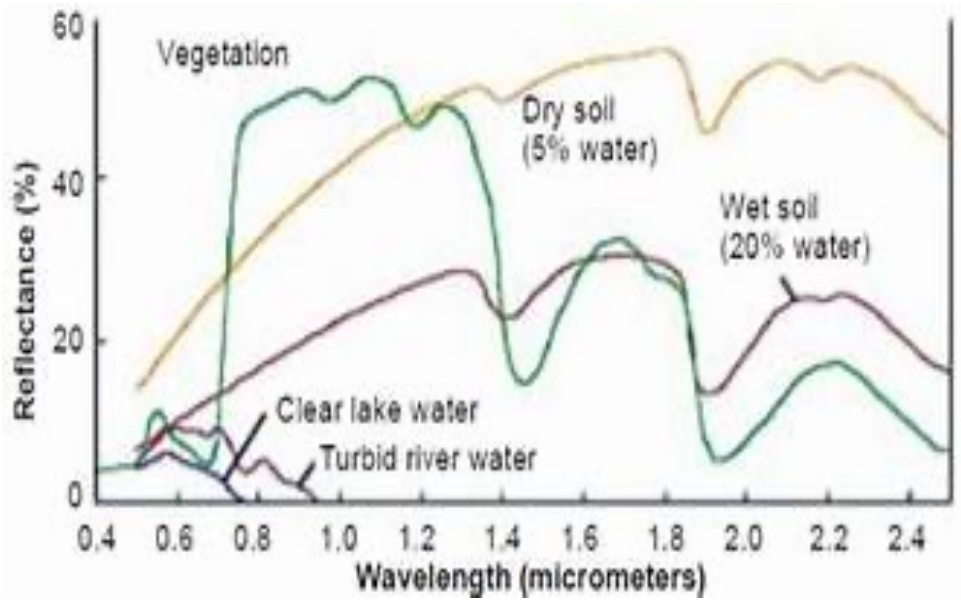
drying of Lake Puzhal (Red Hills lake) between October 2018 and May 2019. The lake is a primary water source for the city.

https://www.geospatialworld.net/blogs/indias-environmental-challenges-in-10-images/

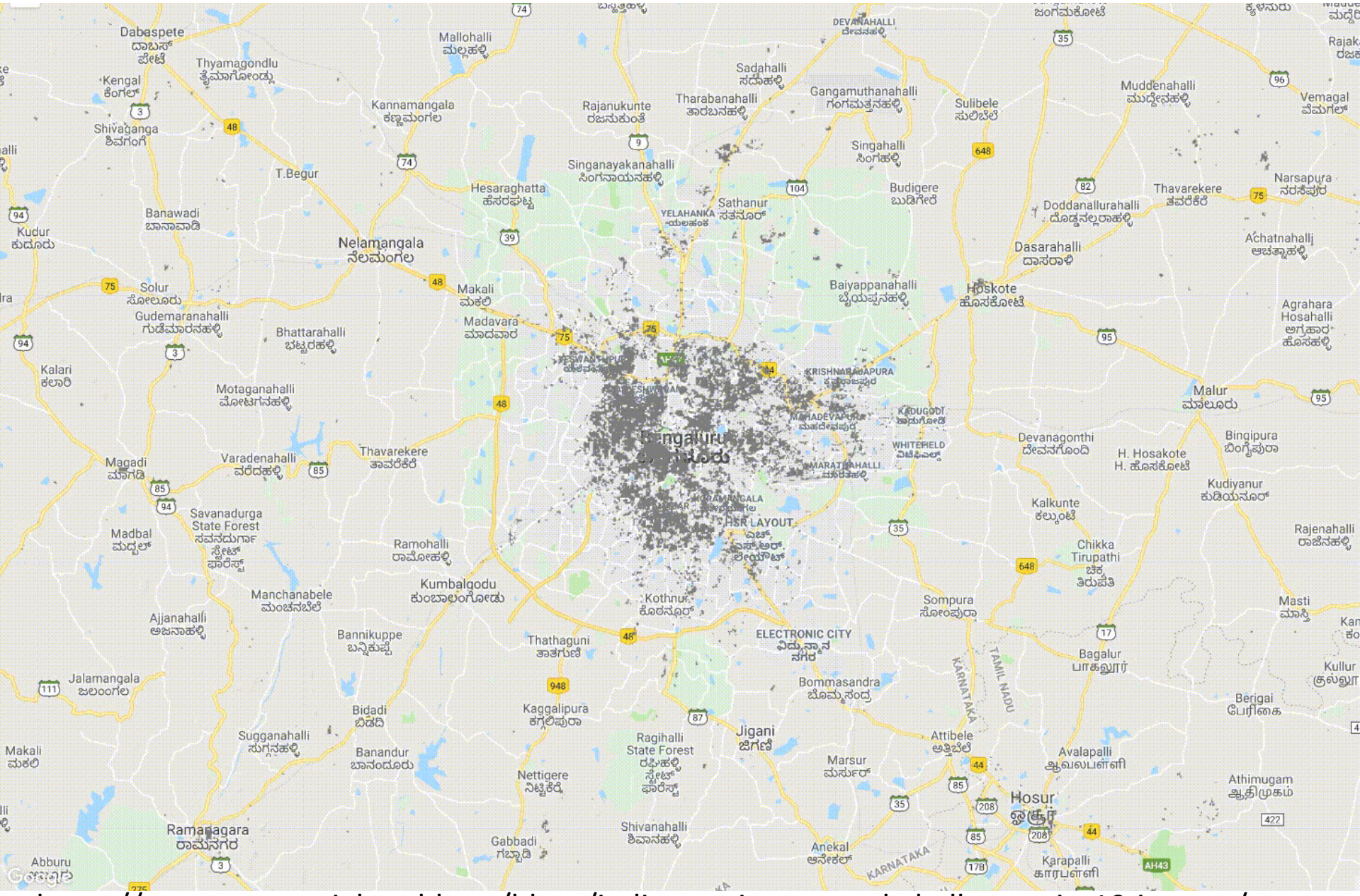
SURFACE WATER quality MAPPING

Water quality : DRINKING WATER





This image shows the growth of Bangalore between 1990 and 2015.



https://www.geospatialworld.net/blogs/indias-environmental-challenges-in-10-images/

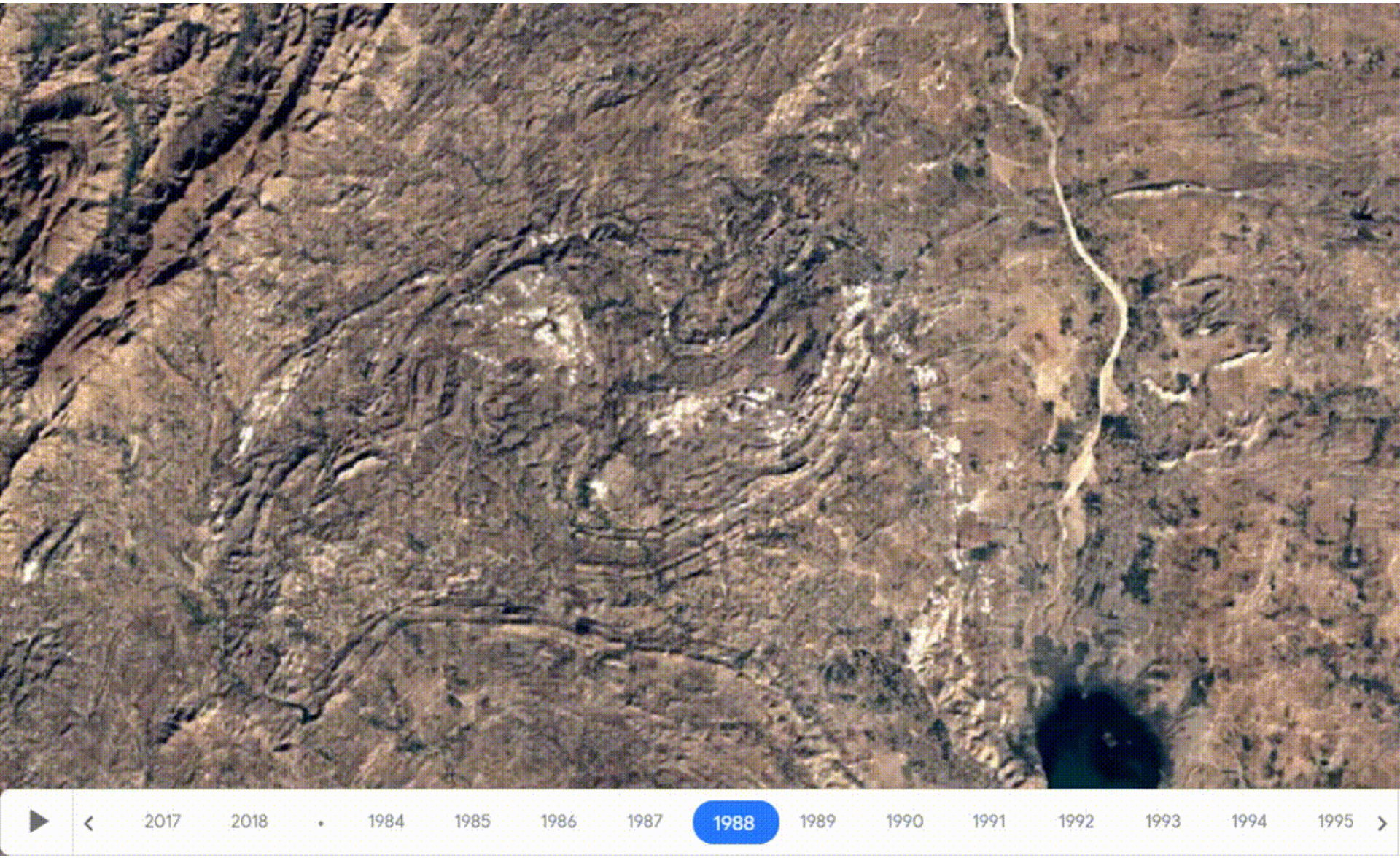
https://blog.mapbox.com/new-satellite-imagery-for-cities-across-india-4b97ed7e3452

https://blog.mapbox.com/new-satellite-imagery-for-cities-across-india-4b97ed7e3452
Zam Bazaar market,Chennai

onstruction of roads and other human settlements inside forests and hilly terrains have resulted in slope failures, eventually leading to landslides especially during the monsoon season. August 2018, regions along the Western Ghats experienced severe landslides. This image shows before and after images of the landslides that affected the Kodagu district of Karnataka in the aftermath of heavy rainfall.

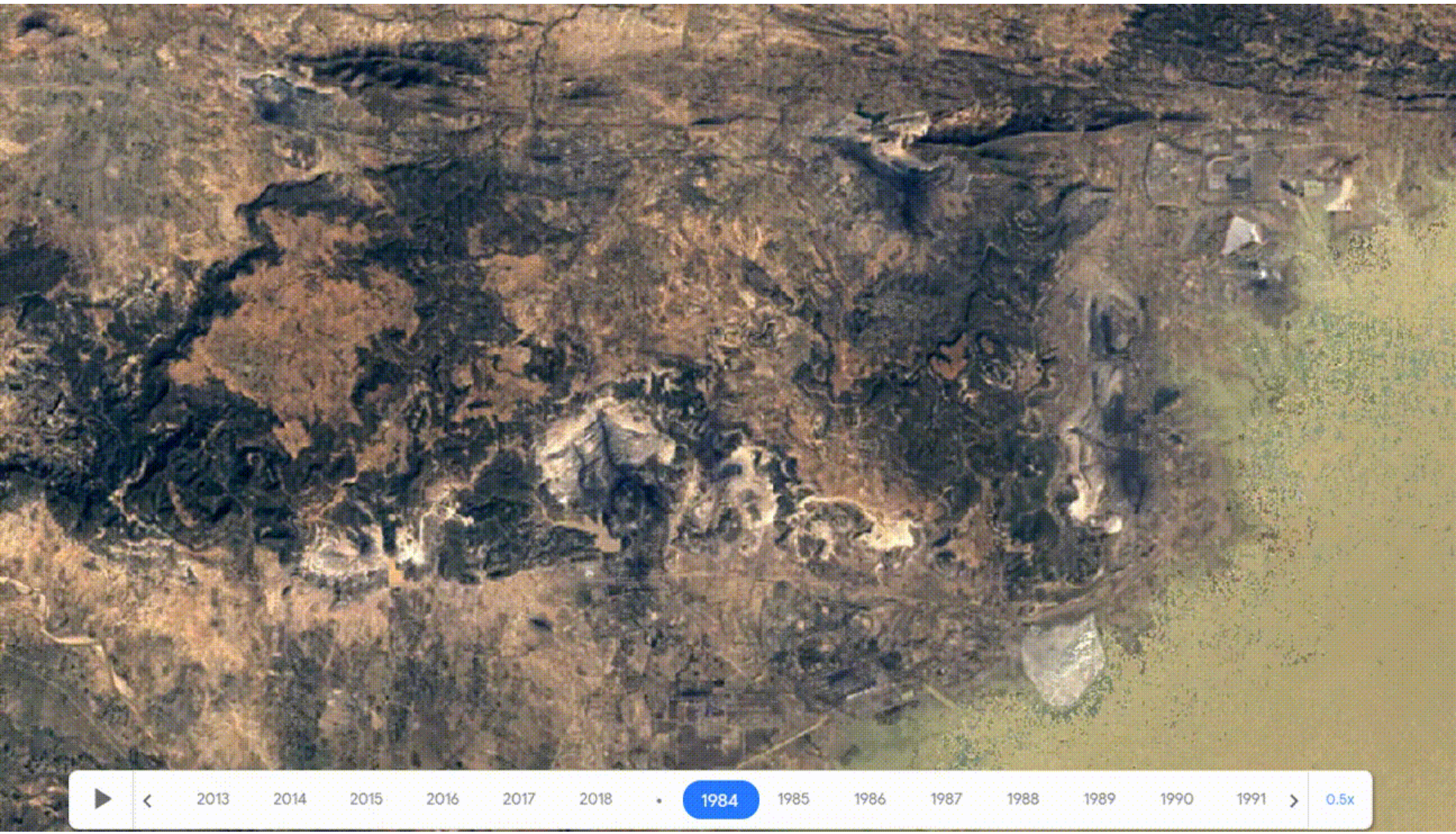
https://www.geospatialworld.net/blogs/indias-environmental-challenges-in-10-images/

expansion of mining areas in the Aravalli Hills in Rajasthan between 1988 and 2018.

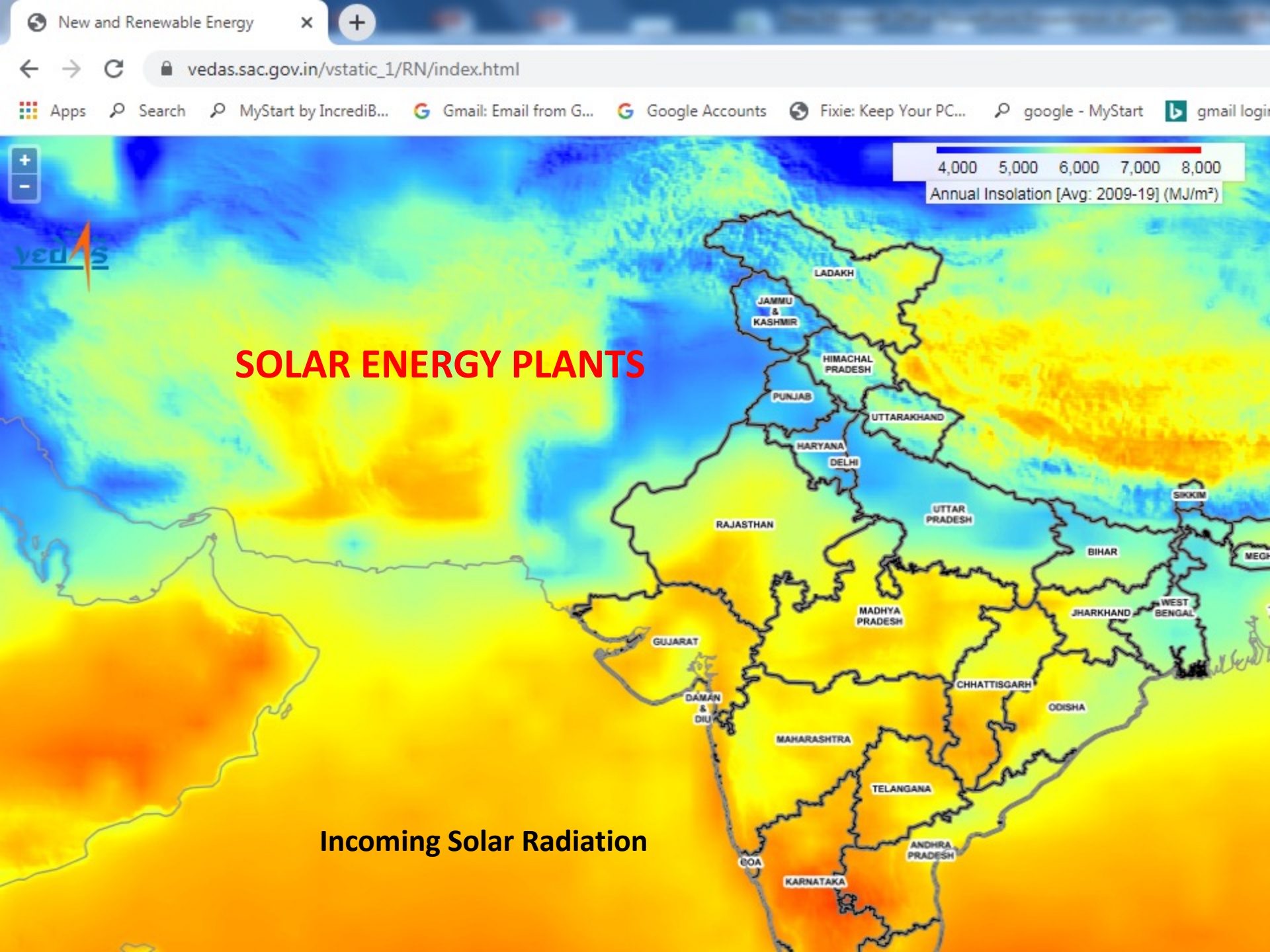


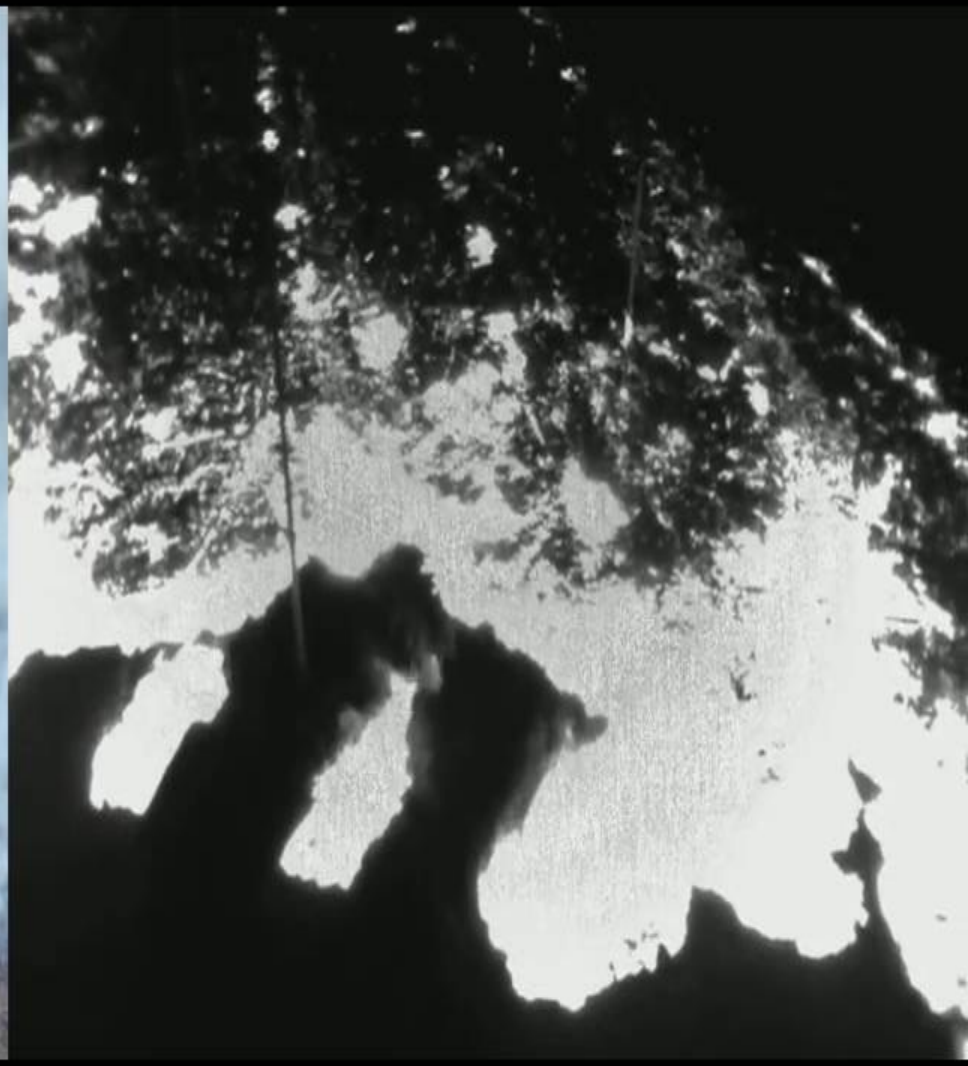
https://www.geospatialworld.net/blogs/indias-environmental-challenges-in-10-images/

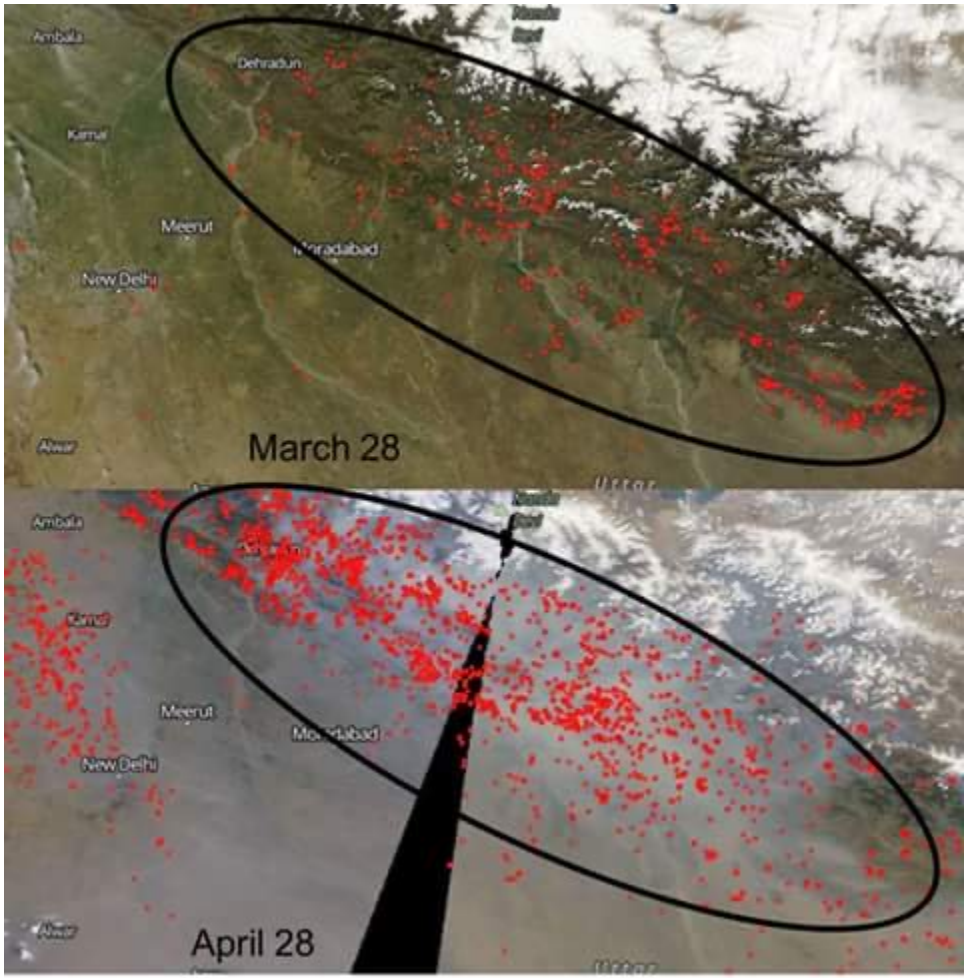
mining activity between 1998 and 2018 in the Singrauli, one of the largest coal fields in India.



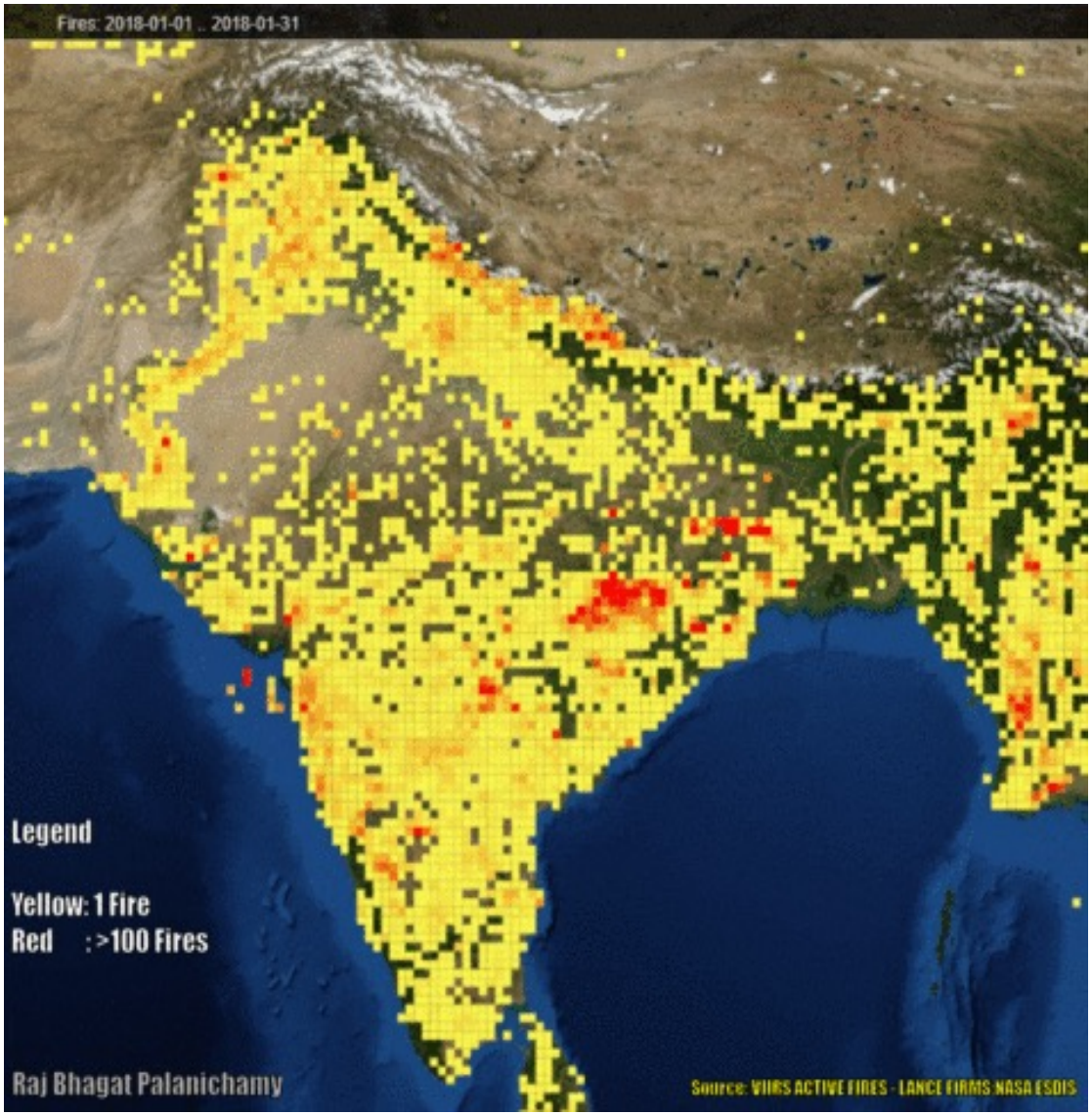
https://www.geospatialworld.net/blogs/indias-environmental-challenges-in-10-images/


New and Renewable Energy
vedas.sac.gov.in/vstatic_1/RN/index.html
Apps
Search
MyStart by IncrediB...
Gmail: Email from G...
Google Accounts
Fixie: Keep Your PC...
google - MyStart
gmail login
4,000
5,000
6,000
7,000
8,000
Annual Insolation [Avg: 2009-19] (MJ/m²)
SOLAR ENERGY PLANTS
LADAKH
JAMMU & KASHMIR
HIMACHAL PRADESH
PUNJAB
UTTARAKHAND
HARYANA
DELHI
RAJASTHAN
UTTAR PRADESH
SIKKIM
BIHAR
MADHYA PRADESH
JHARKHAND
WEST BENGAL
GUJARAT
CHHATTISGARH
ODISHA
DAMAN & DIU
MAHARASHTRA
TELANGANA
ANDHRA PRADESH
GOA
KARNATAKA
Incoming Solar Radiation





Uttarakhand forests are burning. Amounts to colossal loss of flora and fauna and serious impacts on ecosystem goods and services. Satellite imagery is the only unbiased source of information on fire incidences. Forests could be pre-rated for fire risk. Fire danger rating would enable the foresters work out strategies for avoiding such incidences. Most forest fires in India are human-made and it is not a problem which has no solution.

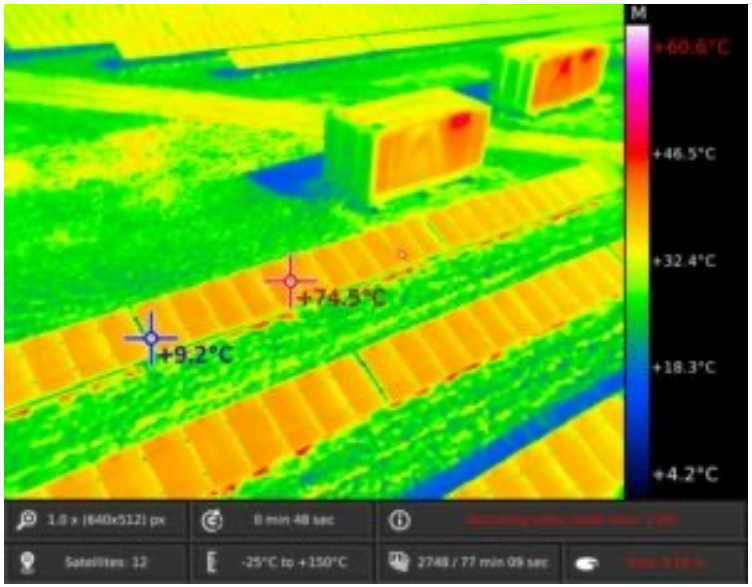

Fires: 2018-01-01 .. 2018-01-31
Legend
Yellow: 1 Fire
Red : >100 Fires
Raj Bhagat Palanichamy
Source: VIIRS ACTIVE FIRES - LANCE FIRMS NASA ESDIS

Urban Heat Island (UHI) effect and mitigation

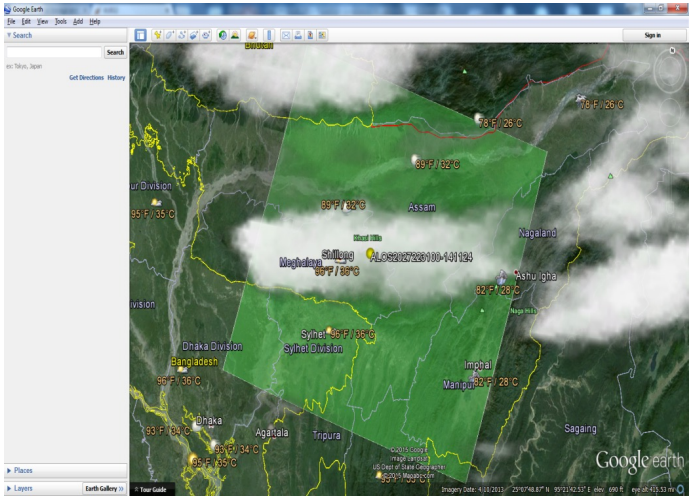
- 2 to 10°F (1 to 6°C) hotter than nearby rural areas
- Elevated temperature can impact us by increasing peak energy demand, air conditioning costs, air pollution levels (ozone), rainfall, and heat-related illness and mortality
- Hard surfaces and vegetation loss contribute to flooding and water quality deterioration

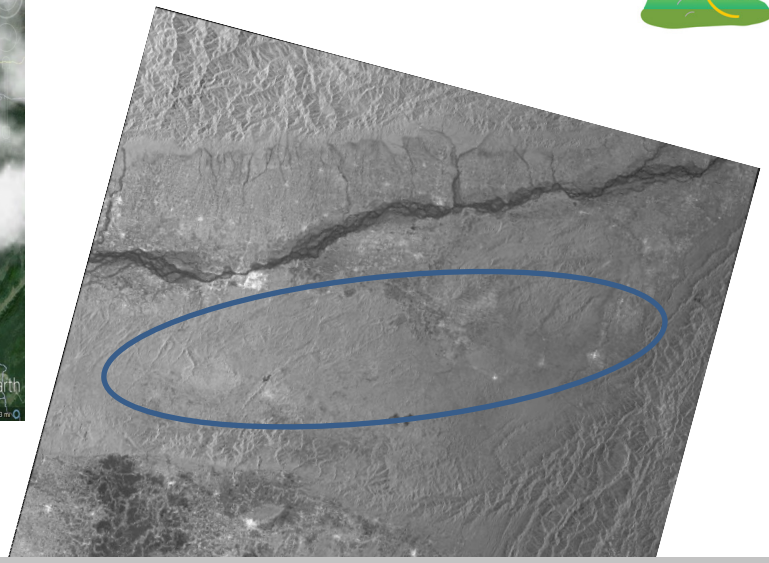
- Cool technologies - reflective and green roofing, paving with light colored or porous materials, and a greatly expanded forest canopy

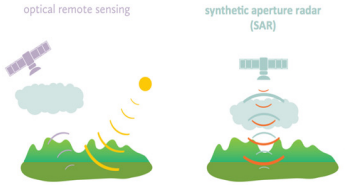

OK

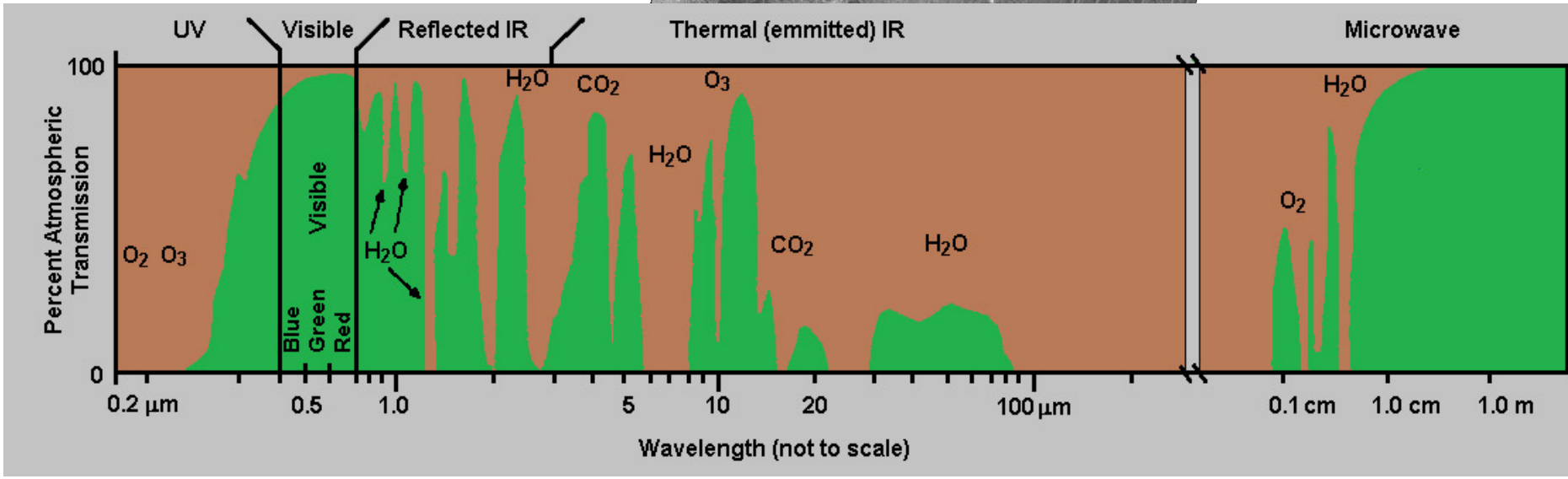

M
+60.6°C
+46.5°C
+32.4°C
+18.3°C
+4.2°C
+74.5°C
+9.2°C
1.0 x (640x512) px
0 min 48 sec
Satellites: 12
-25°C to +150°C
2748 / 77 min 09 sec

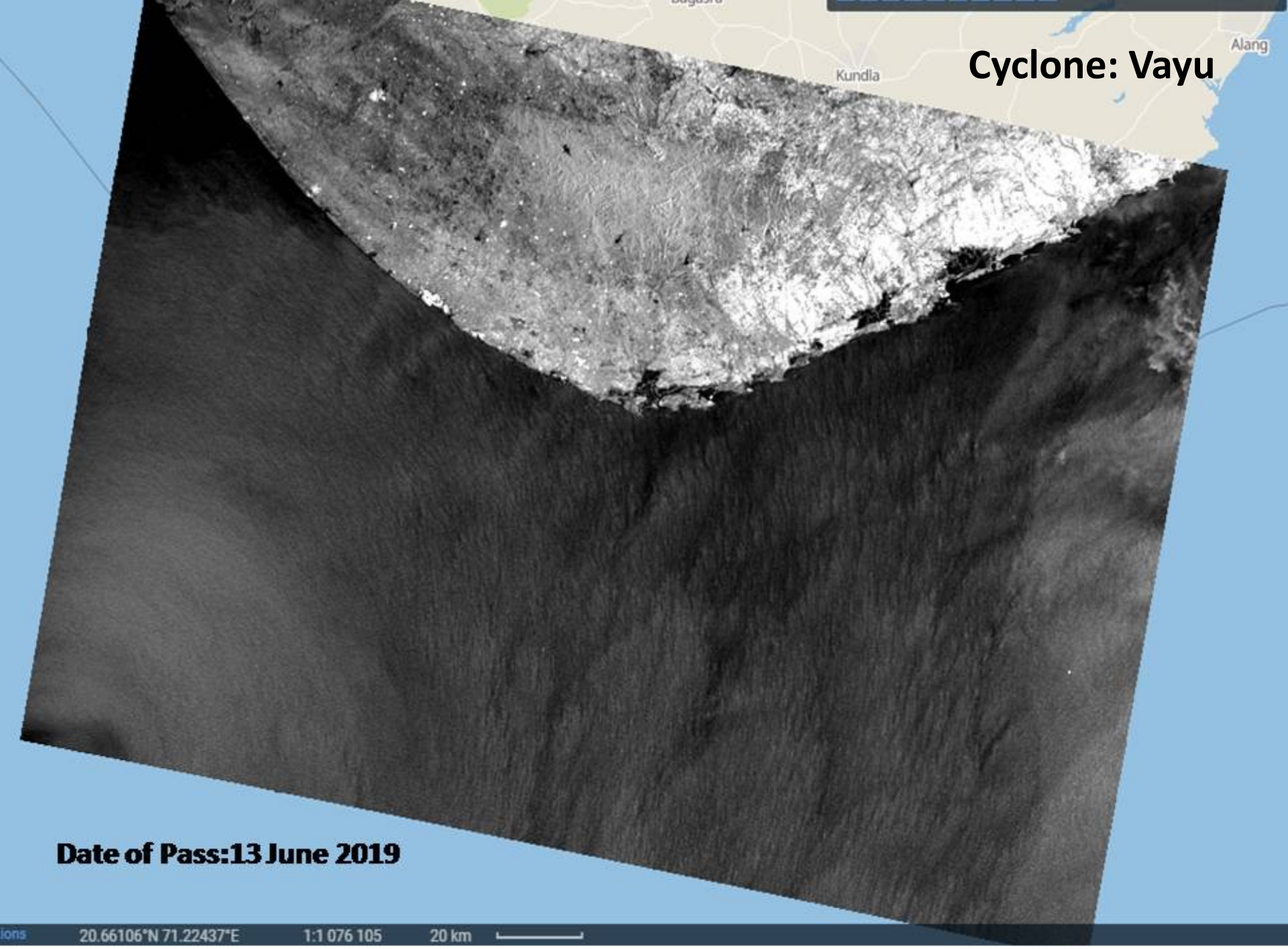
Why Radar Remote sensing?





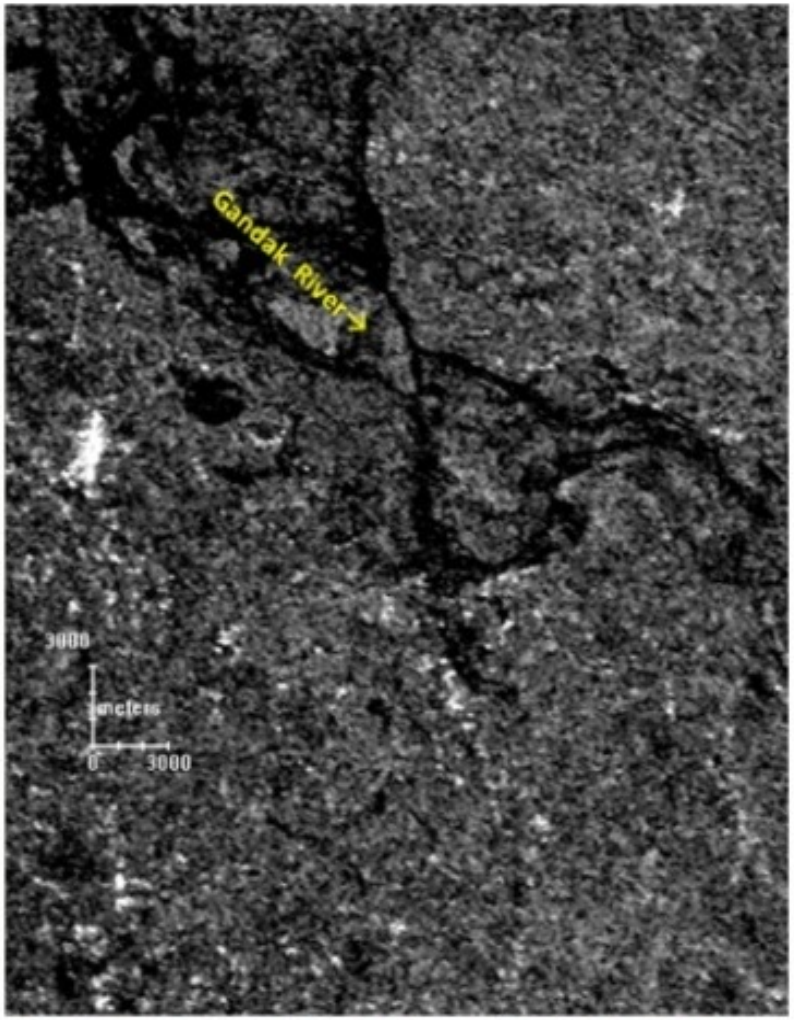




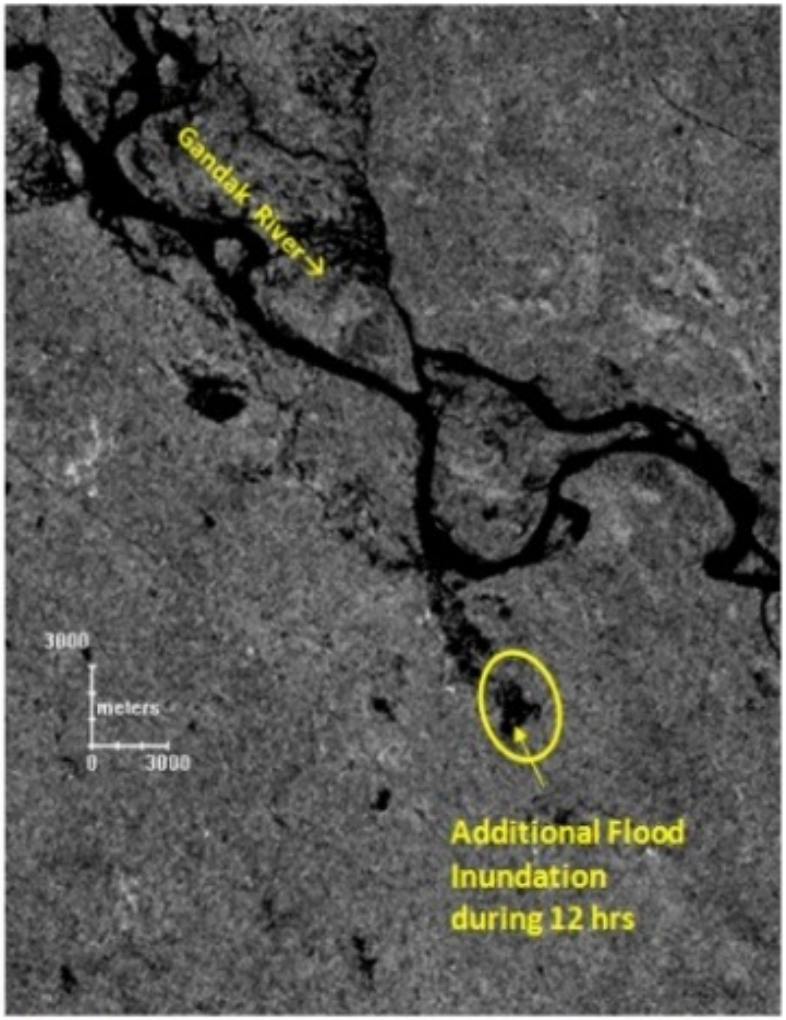

Kundla
Alang
Cyclone: Vayu
Date of Pass:13 June 2019
20.66106°N 71.22437°E
1:1 076 105
20 km

Morning

Evening

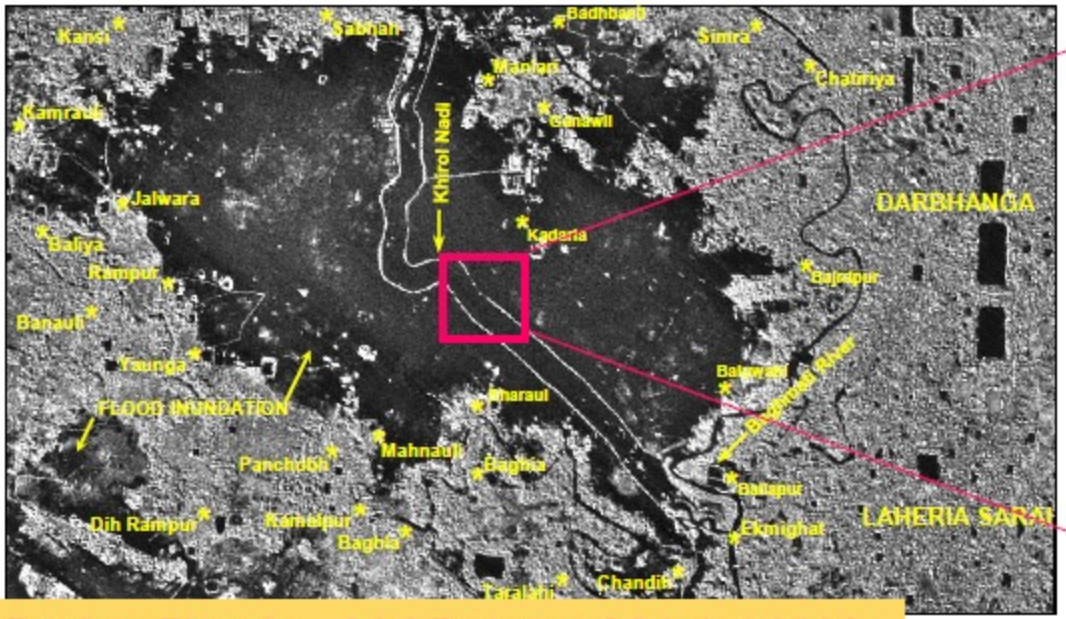


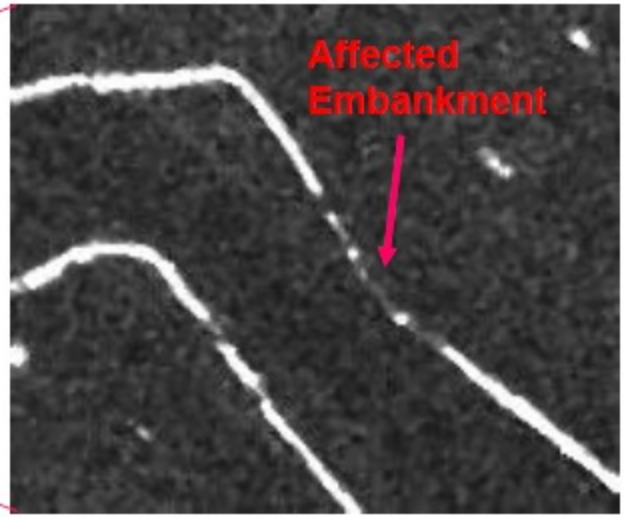
RADARSAT Microwave Image of 20-September-2010 at 6.00 A.M



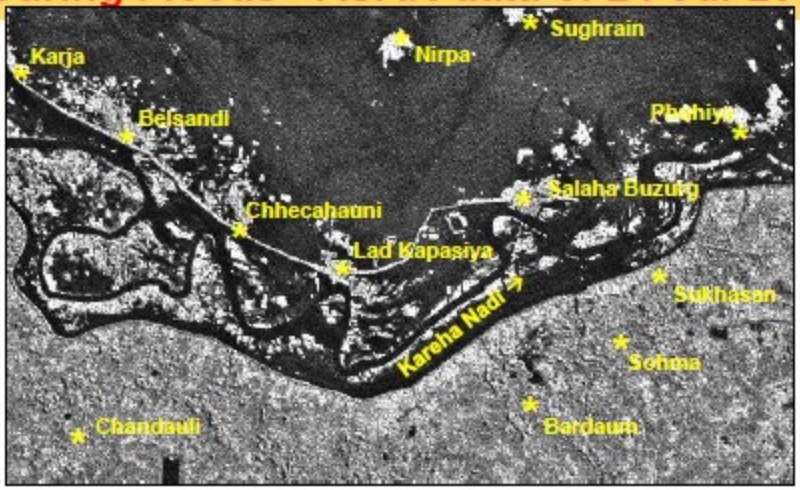
RADARSAT Microwave Image of 20-September-2010 at 6.00 P.M

North Bihar: Gopal ganj – 20-9-2010

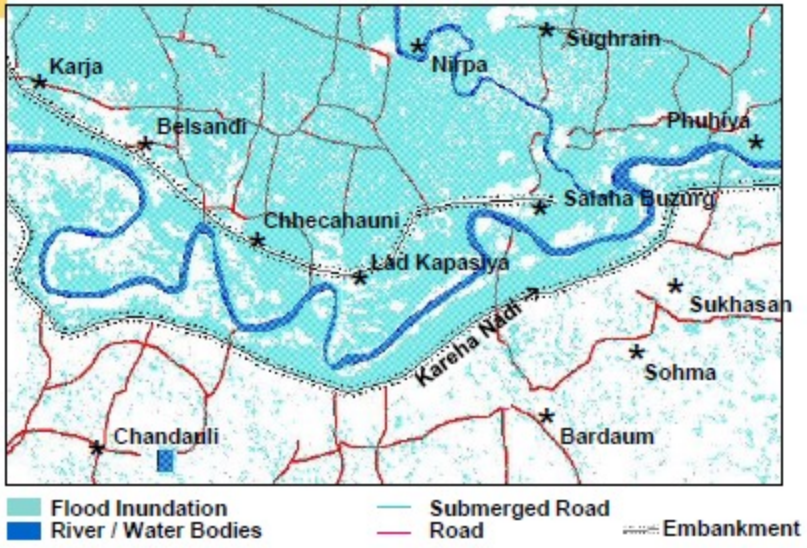




During Floods - ASAR data of 24-Jul-2003

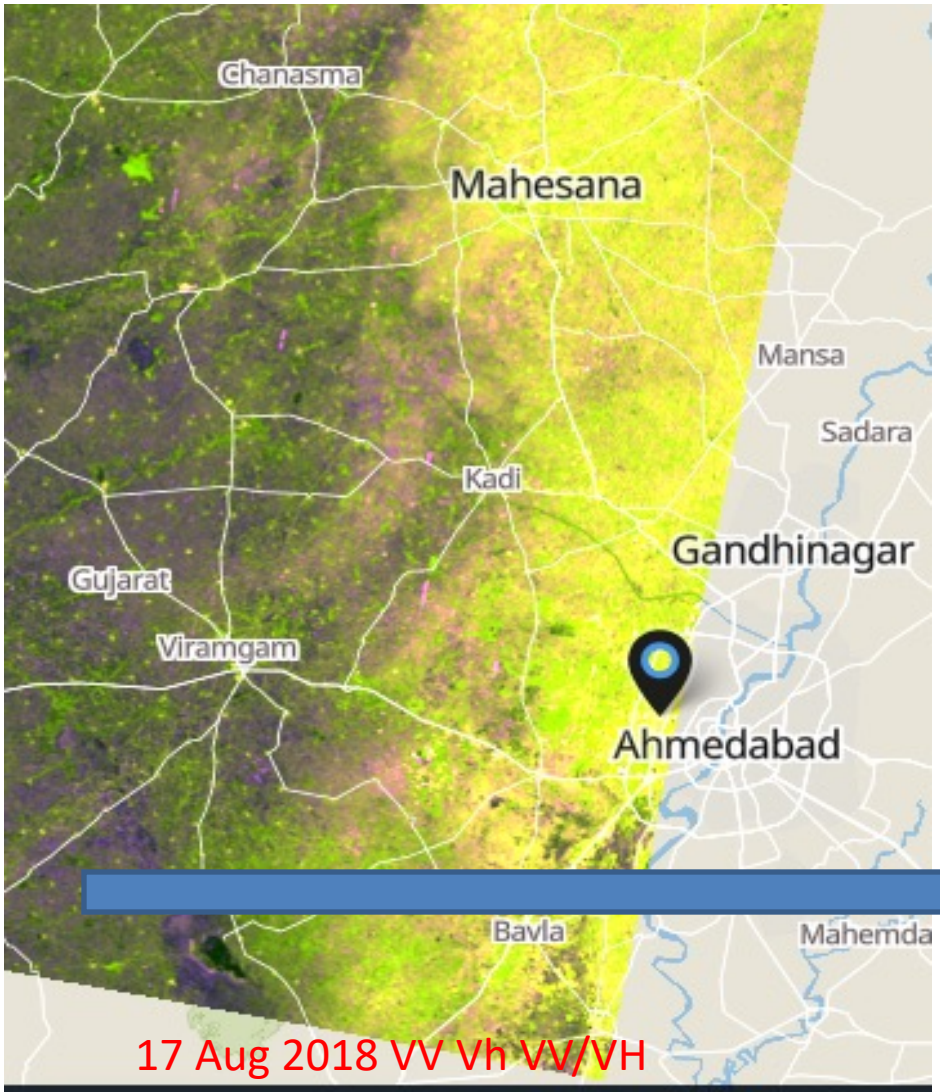


Flood Map

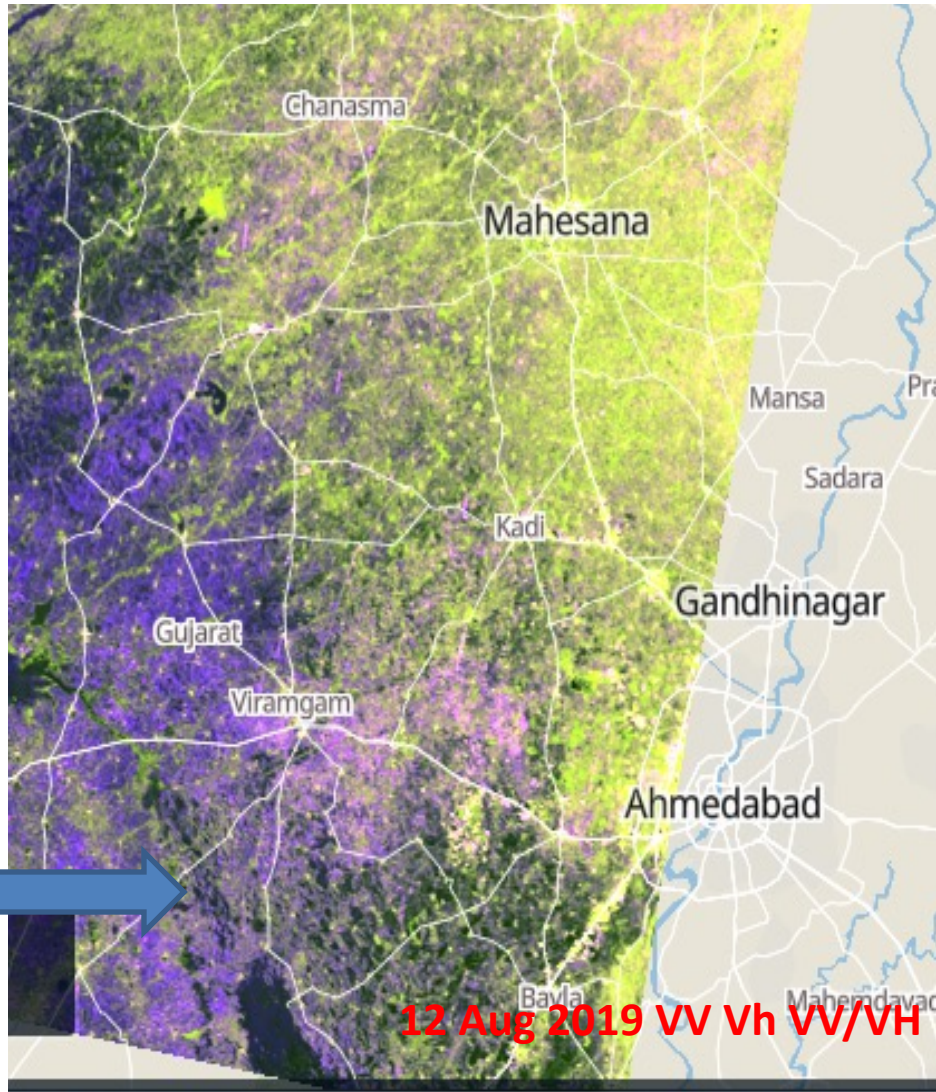


Around 75% crop damaged due to excess rain: Faldu

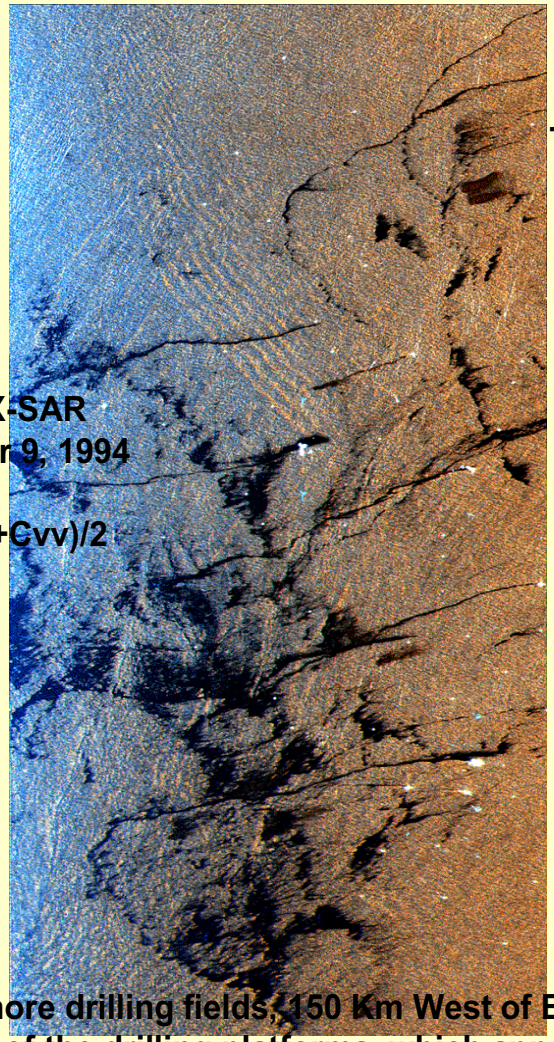
TNN | Updated: Oct 2, 2018, 4:28 IST



17 Aug 2018 VV Vh VV/VH



12 Aug 2019 VV Vh VV/VH



SIR-C/X-SAR
October 9, 1994
R: Lvv
G:(Lvv+Cvv)/2
B: Cvv

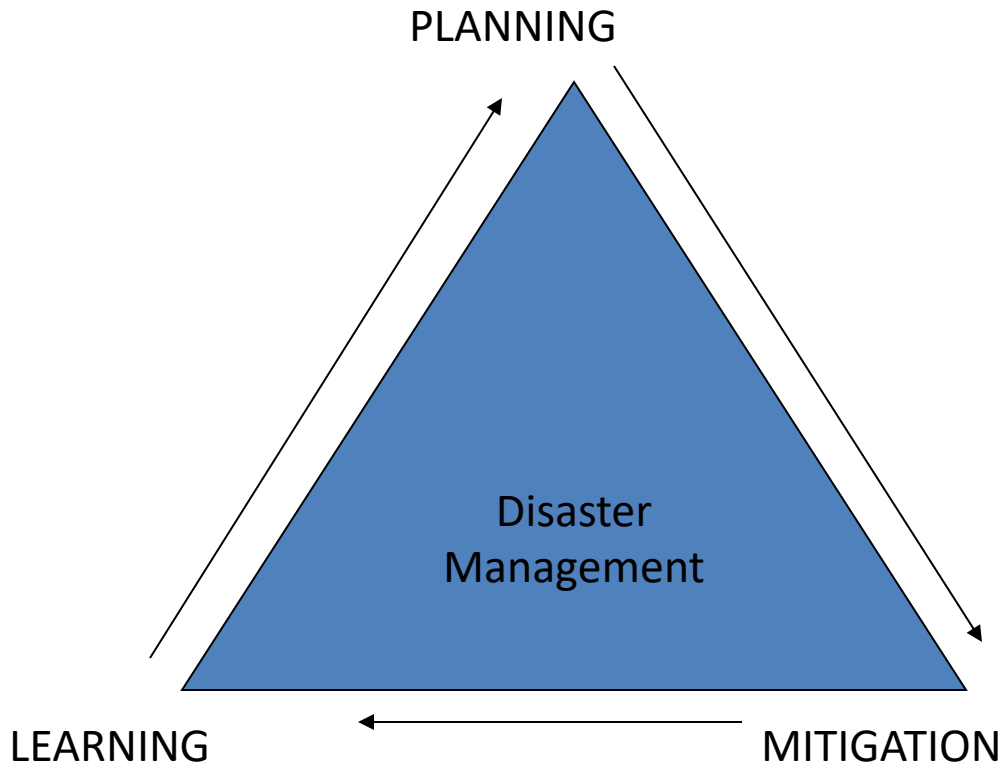
Internal wave (Larger Wave)

These waves are formed below the ocean surface at the boundary between layers of warm and cold water and they appear in the radar image because of the way they change the ocean surface.

Ocean swells, which are waves generated by winds, are shown throughout the image but are most distinct in the blue area adjacent to the internal waves.

Off shore drilling fields, 150 Km West of Bombay The dark streaks are extensive oil slicks surrounding many of the drilling platforms, which appear as bright white spots. The long, thin streaks extending from many of the platforms are spreading across the sea surface, pushed by local winds. The larger dark patches are dispersed slicks that were likely discharged earlier than the longer streaks, when the winds were probably from a different direction. The dispersed oil will eventually spread out over the more dense water and become a layer which is a single molecule thick.
Scene Centre: 19.25 N, 71.34 degrees E , area 20 km by 45 km

Uses of RS for Disaster Management



Disaster monitoring and damage assessment

- Power of High resolution images

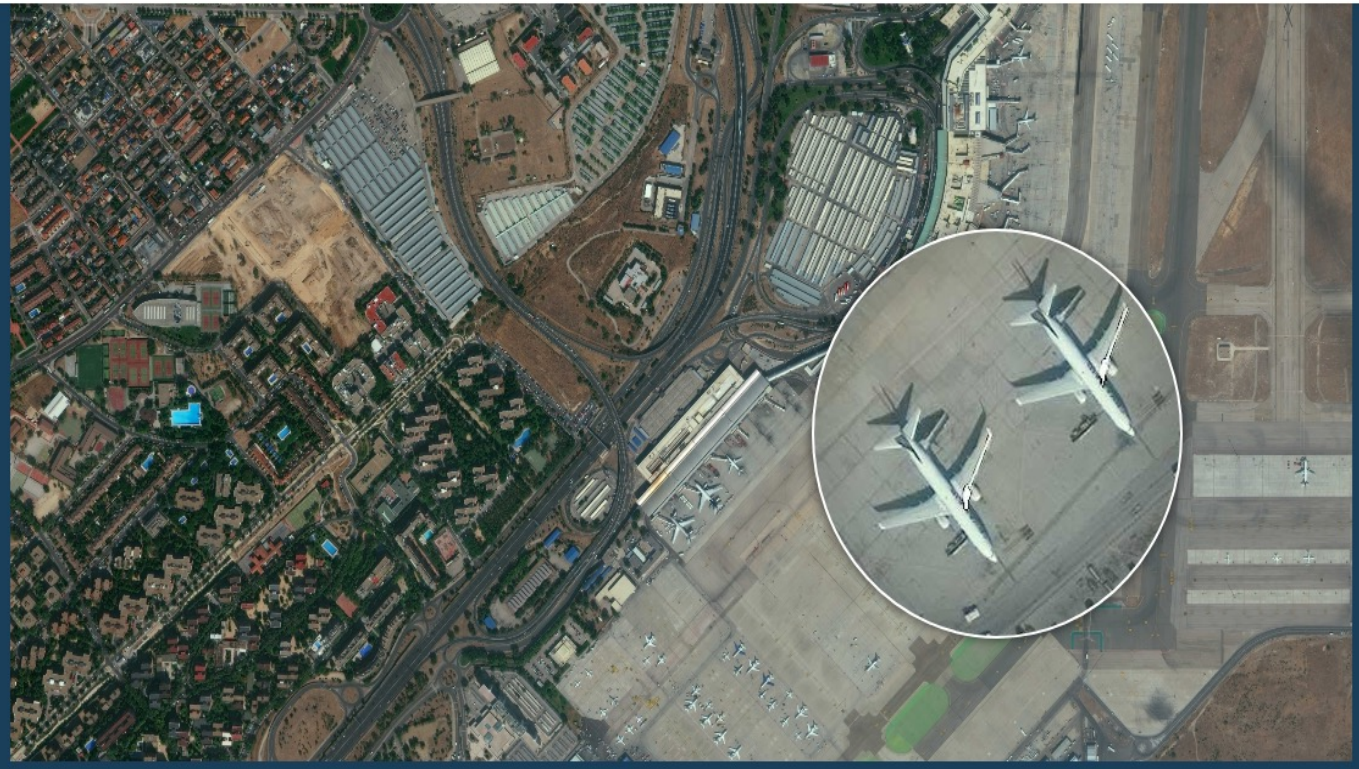
high ressolution satellite images | 30 cm Resolution Satellite Image

euspaceimaging.com/30-cm/

Apps | Search | MyStart by IncrediB... | Gmail: Email from G... | Google Accounts | Fixie: Keep Your PC... | google - MyStart | gmail login - MyStart | Gmail | Inbox - shivmohan.i... | IEEE GRSS Gujarat -... | Other bookmar

EUROPEAN SPACE IMAGING

HOME PRODUCTS INDUSTRIES RESOURCES ABOUT CONTACT



Madrid-Barajas Airport | Madrid, Spain

Uber will use high-res satellite imagery to improve pickups

DigitalGlobe
30 cm

Remote sensing applications:

Updating base map using current data

e.g land use/land cover

River map

Forest map

Vegetation map, hydrology, flood

Road network etc

Highway projects etc

Who need them: Geographer, Planner, Infrastructure – project etc

LANUSE

AGRICULTURE

FORESTRY

GEOLOGY

HYDROLOGY

OCEAN

Urban

Infrastructure

ENERGY

Many more applications:

- **Land slides**
- **Land subsidence**
- **Urban disaster**
- **Earthquake pre-cursor**
- **Post earthquake monitoring**
- **Tsunami disaster**
- **Forest fire**
- **Oil spills**
- **Damage assessment**
- **Extreme Rainfall, snow fall etc**

For defense and intelligence analysts, the ability to process multispectral imagery can help answer key intelligence questions such as:

- **Is there excavated material from the construction of an underground facility?**
- **Will the health of the crops in this area provide food security?**
- **Are illicit crops being grown?**
- **Have reinforcing materials been applied to this facility?**
- **Has equipment been camouflaged from view?**
- **Are there significant features that might otherwise be overlooked?**
- **Defense /Intelligence input**

Welcome to Bhuvan | ISRO's Geo

bhuvan.nrsc.gov.in/bhuvan_links.php#

Apps | Search | MyStart by IncrediB... | Gmail: Email from G... | Google Accounts | Fixie: Keep Your PC... | google - MyStart | gmail login

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Thematic Services

Disaster Management Support Services

Ocean Services

Create a Ma

My Map | My GIS

Governance/Central Ministries g-Governance Dashboard

ents | Chaman | Hailstorm | PMKSY | Clean Ganga | Sat-AIBP | Flood Warning | Flood Vulnerabili

Application Sectors

Collaborative applications - Platform to share your data and create governance applications

Agriculture | Forestry | E-Governance | Water | Tourism | Urban | Rural

Tourism

Archaeology

Tourism-GIS

Special Applications

Data Discovery

Decision Support Dashboard

Hydrological Products

Image Gallery

International Disasters

Multilingual Translation

Online Shapefile Creation

OSCAT-3D

Smart Tracking

Suvidha

Welcome to Bhuvan | ISRO's Geo

bhuvan.nrsc.gov.in/bhuvan_links.php#

Apps | Search | MyStart by IncrediB... | Gmail: Email from G... | Google Accounts | Fixie: Keep Your PC... | google - MyStart | gmail login

bhuvan

Indian Geo-Platform of ISRO

Space Based Inputs: Near Real-time Flood/Cyclone Mapping, Runoff (PAN India) and Flood Progression and Recess

---------- *Visualisation & Free Download* ----------

Bhuvan-2D

Bhuvan-3D

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Thematic Services

Disaster Management Support Services

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Create a Ma
My Map | My GIS

Governance/Central Ministries g-Governance Dashboard

Hailstorm | **PMKSY** | **Clean Ganga** | **Sat-AIBP** | **Flood Warning** | **Flood Vulnerability Index - India** | **Census data**

Application Sectors

Collaborative applications - Platform to share your data and create governance applications

Agriculture | **Forestry** | **E-Governance** | **Water** | **Tourism** | **Urban** | **Rural**

Rural

Ground Water | **Watersheds** | **MGNREGA**

Special Applications

VEDAS, ISRO, Government of Ind

vedas.sac.gov.in/vcms/en/home.html

Apps | Search | MyStart by IncrediB... | Gmail: Email from G... | Google Accounts | Fixie: Keep Your PC... | google - MyStart | gmail login - MyStart | Gmail | Inbox - shivmohan.i... | Other bookmarks | Reading list

Government Of India
भारत सरकार

Visualisation of Earth Observation Data and Archival System

Space Applications Centre, ISRO

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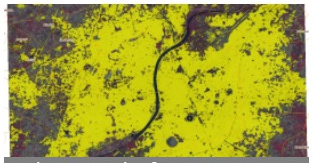
A- A A+


Earth Observation


Vegetation and Crop Monitoring


New and Renewable Energy


Urban Sprawl Information System

Announcements

Vegetation Condition Index (VCI) Dashboard

ERTD Training Announcement (New)

Geospatial Calculator

AdVance HYperspectral data Analysis Software (AVHYAS-version-1)

AdVance HYperspectral data Analysis Software (AVHYAS)

(Developed by Hyperspectral Techniques Development Division (AMHTDG, EPSA, SAC, ISRO, Ahmedabad, Gujarat-380015)

Type here to search

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ENG 12:39 07-04-2021

https://vedas.sac.gov.in/en/#

Question Bank

1. Explain some of the agricultural applications of remote sensing

2. What do you mean by infra project. How remote sensing can help for planning and execution of project.

3. Explain disaster management applications using remote sensing

4. What is NDVI. Role of NDVI in drought detection.

5. Which sensor is suitable for surface temperature measurement?

6 Which sensor provides information about earth surface even during cloudy condition?

7. Can you explain some advantages of high resolution images?

8. Can inventory of natural resources be done using remote sensing?

9. Role of spectral signature for water quality mapping.

10. What is the basis of delineating landcover

11. How remote sensing can be used for selection of Solar energy plant location

12. Explain role of remote sensing in surface water mapping,

13 Explain few applications using thermal sensors.