

Lecture 3

REMOTE SENSING DATA

SPECTRAL SIGNATURE
VEGETATION, SOIL, WATER

SUMMARY OF LECTURE 1 and 2

Remote Sensing and its component

Planck's Law, peak emittance from sun and earth

Peak wavelength from sun and earth

Remote sensing type: Based on em spectrum or source

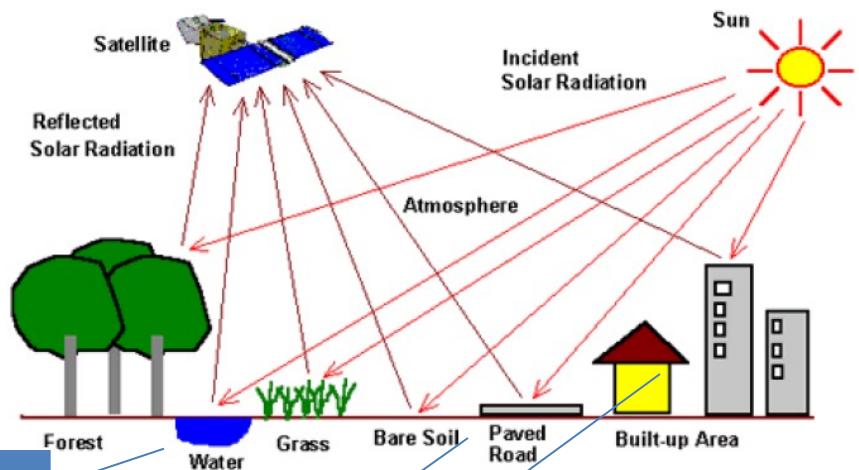
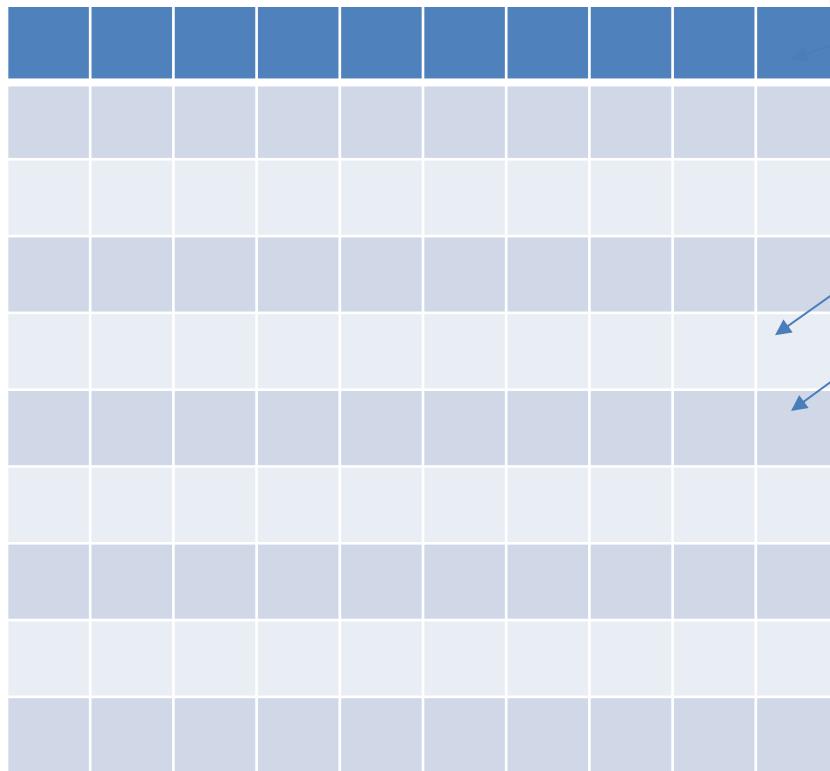
Advantages of Remote sensing

Measured quantity and instruments

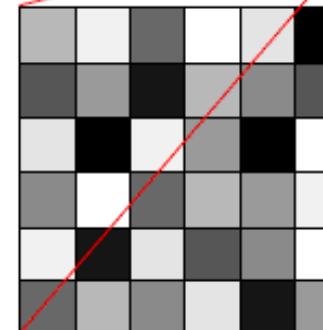
- Panchromatic, Natural color composite and false color composite**

WHAT IS REMOTE SENSING DATA

A TWO DIMENSIONAL DISTRIBUTION
OF REFLECTED ENERGY



© CCRS / CCT

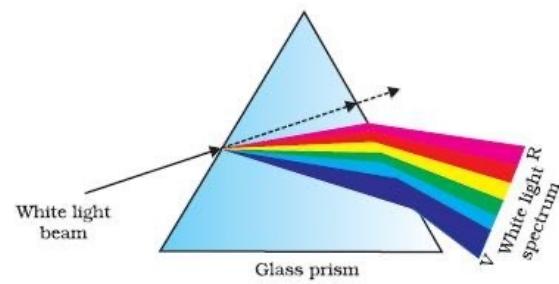
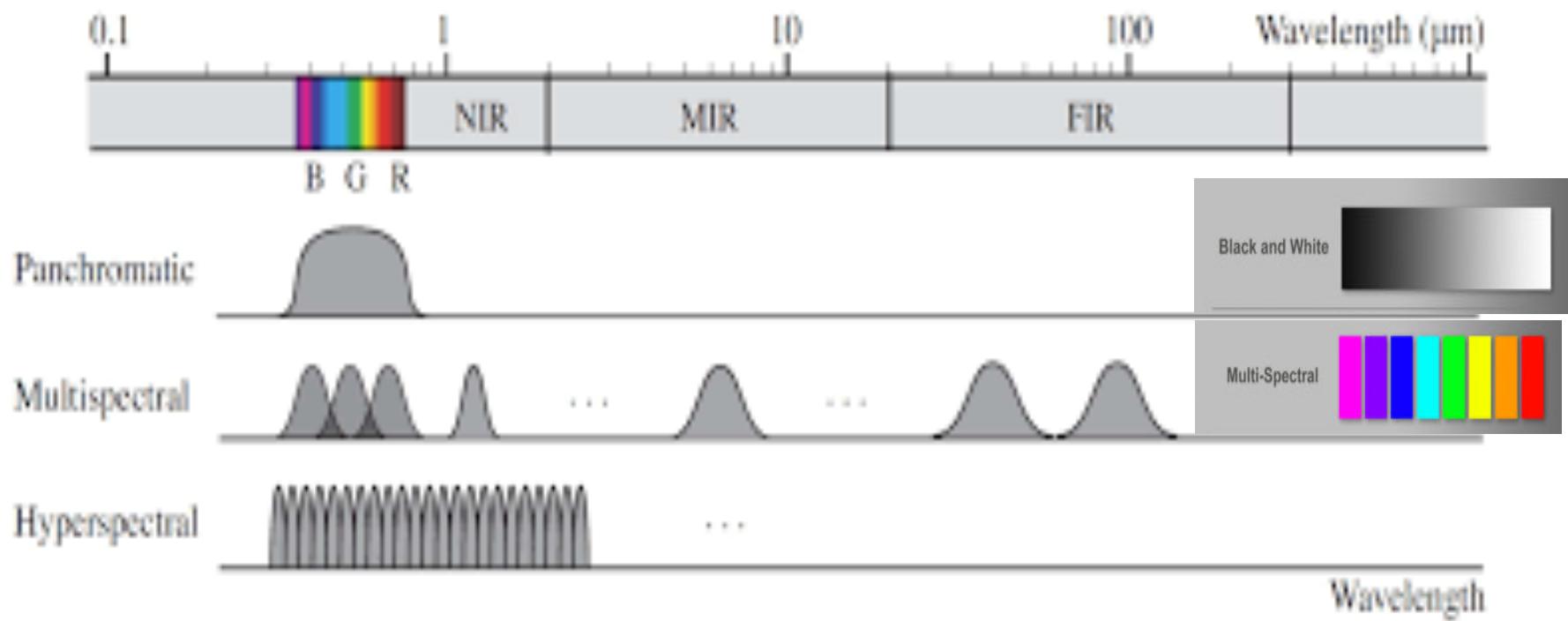


170	238	85	255	221	0
68	136	17	170	119	68
221	0	238	136	0	255
119	255	85	170	136	238
238	17	221	68	119	255
85	170	119	221	17	136

REMOTE SENSING DATA COLLECTION METHODS

OPTICAL/IR REMOTE SENSING

- **PANCHROMATIC**
- **MULTISPECTRAL**
- **HYPERSPECTRAL**



A panchromatic band (black and white band) is one band that usually contains a couple of hundred nanometers bandwidth. The bandwidth enables it to hold a high signal-noise, making the panchromatic data available at a high spatial resolution. This images can be gathered with a higher resolution since the spectral range give the smaller detectors allowance to be utilized while sustaining the high signal-noise ratio.

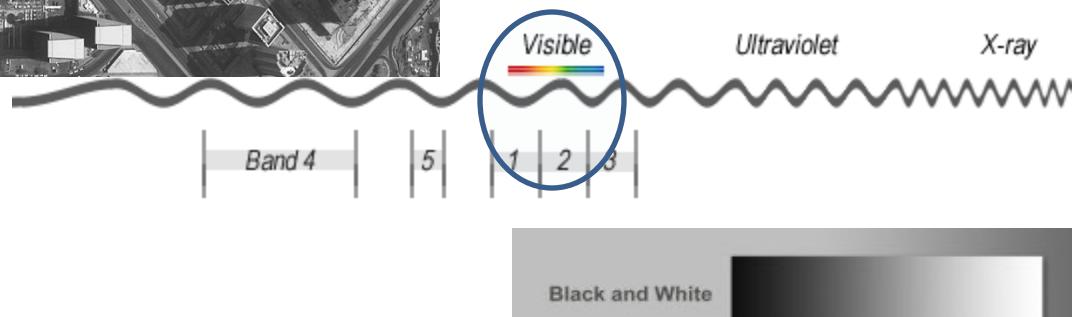


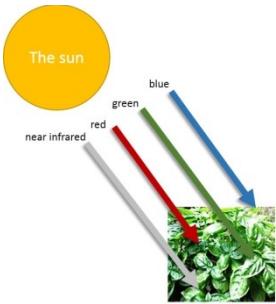
<https://eos.com/panchromatic/>

Advantage:
High SNR
High resolution

Cartosat-3 has a ground resolution of 0.25 m with 16 km swath
Doha

Cartosat-3





Display of Multispectral Image

- NATURAL color composite

Bands

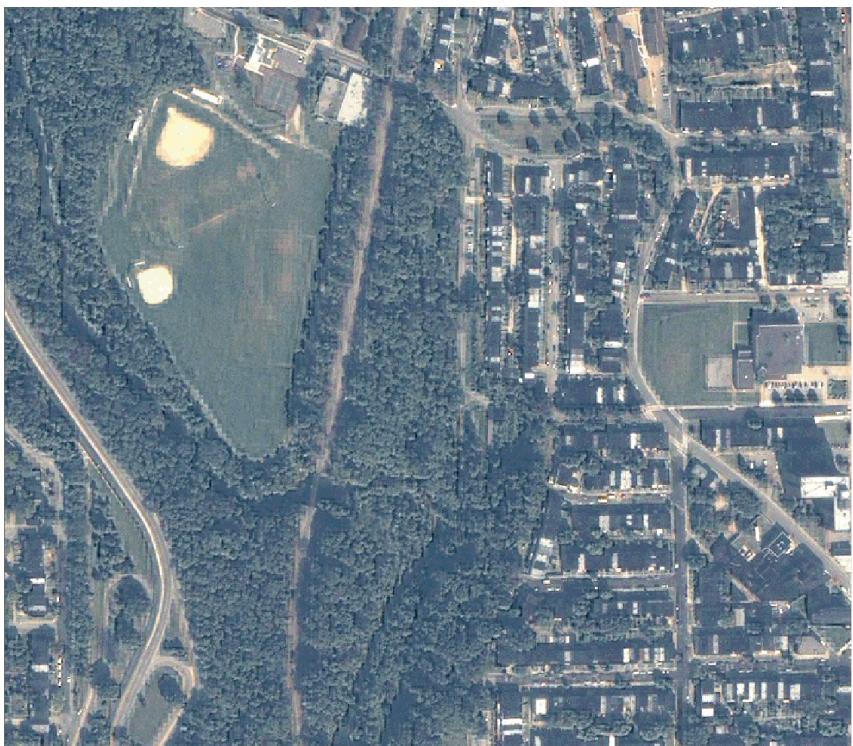
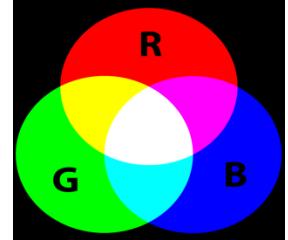


Red

Applied to color



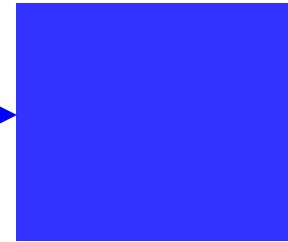
Resulting Image



Green

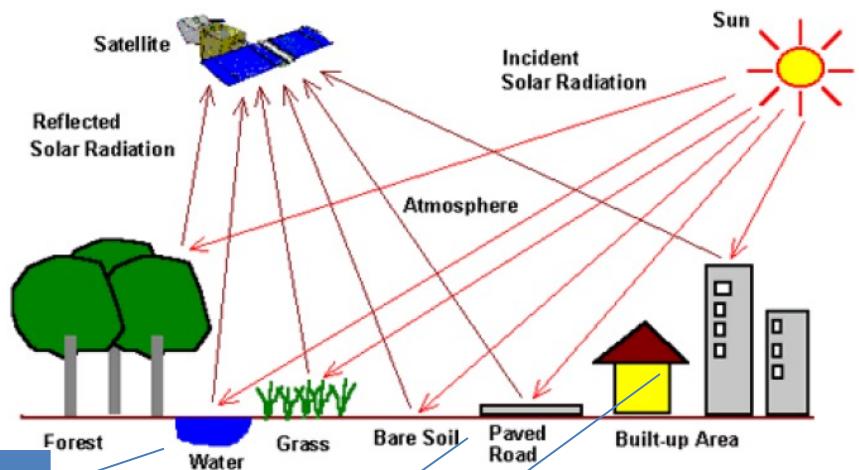
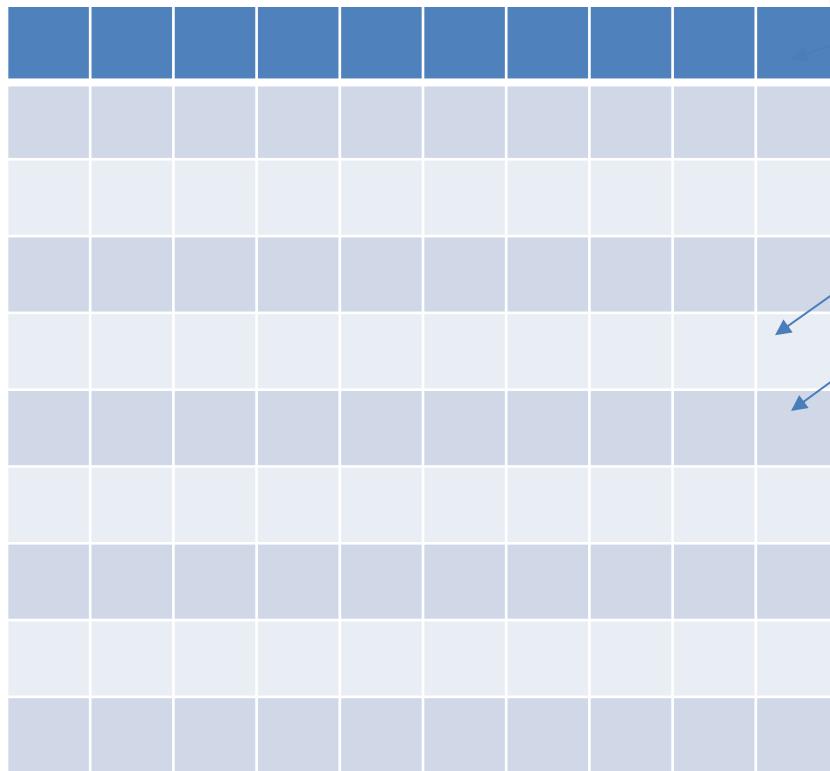


Blue

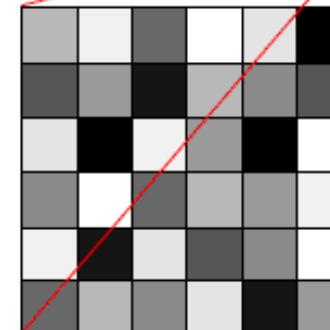


WHAT IS REMOTE SENSING DATA

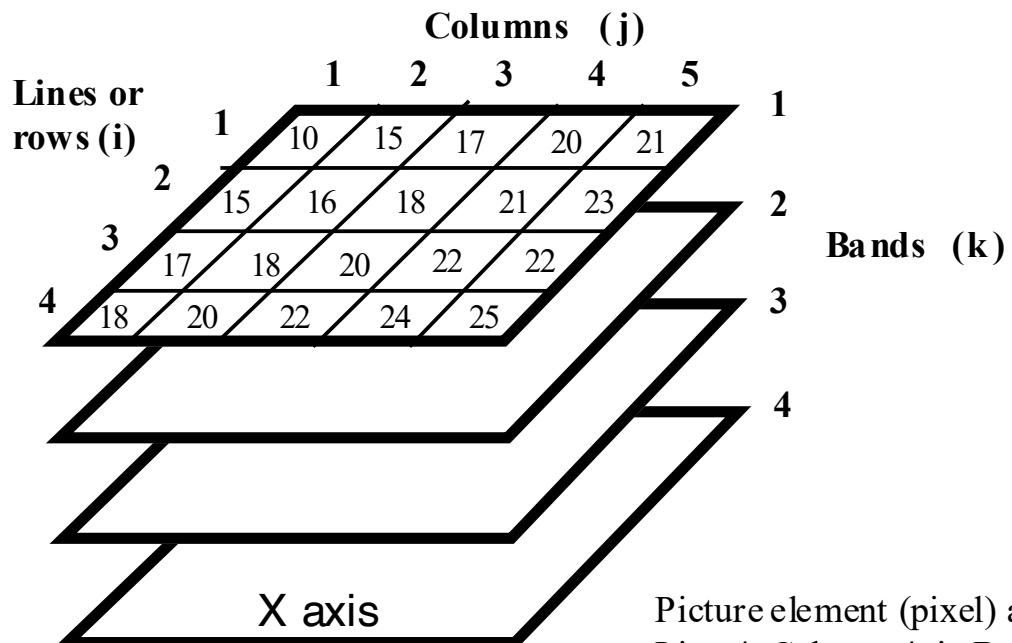
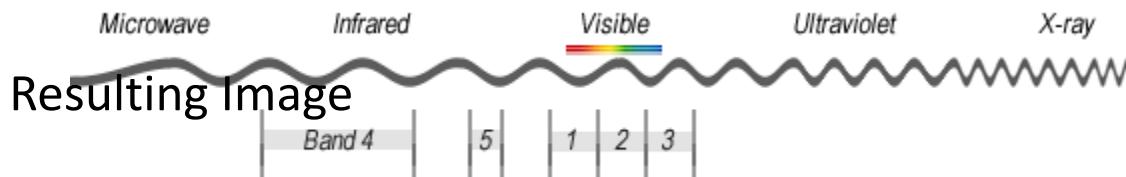
A TWO DIMENSIONAL DISTRIBUTION
OF REFLECTED ENERGY



© CCRS / CCT

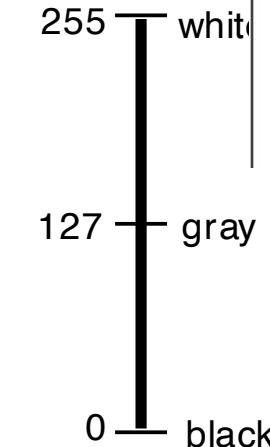
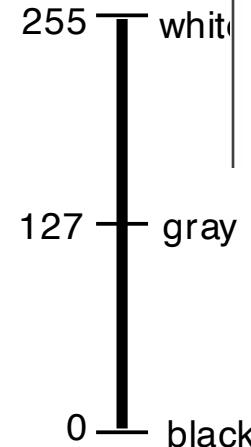


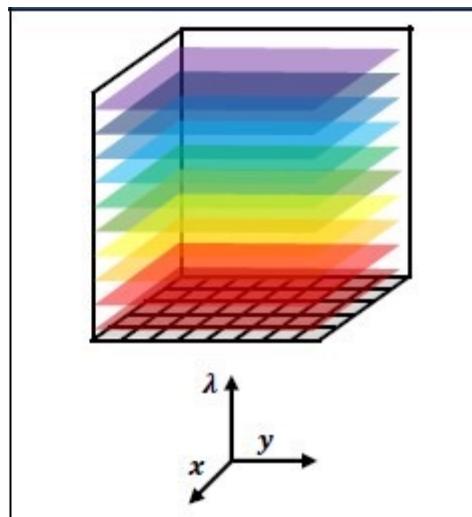
170	238	85	255	221	0
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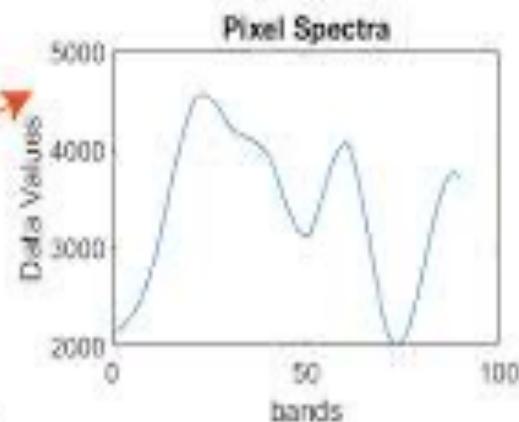
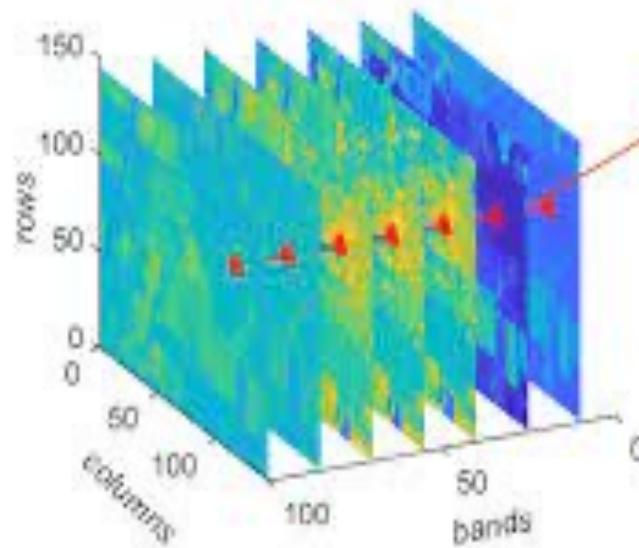
Picture element (pixel) at location Line 4, Column 4, in Band 1 has a Brightness Value of 24, i.e., $BV_{4,4,1} = 24$

Brightness value range (typically 8 bit)





Hyperspectral Data Cube



WHAT IS SPECTRAL SIGNATURE

Different surface types such as water, bare ground and vegetation reflect radiation differently in various channels. The radiation reflected as a function of the wavelength is called the spectral signature of the surface.

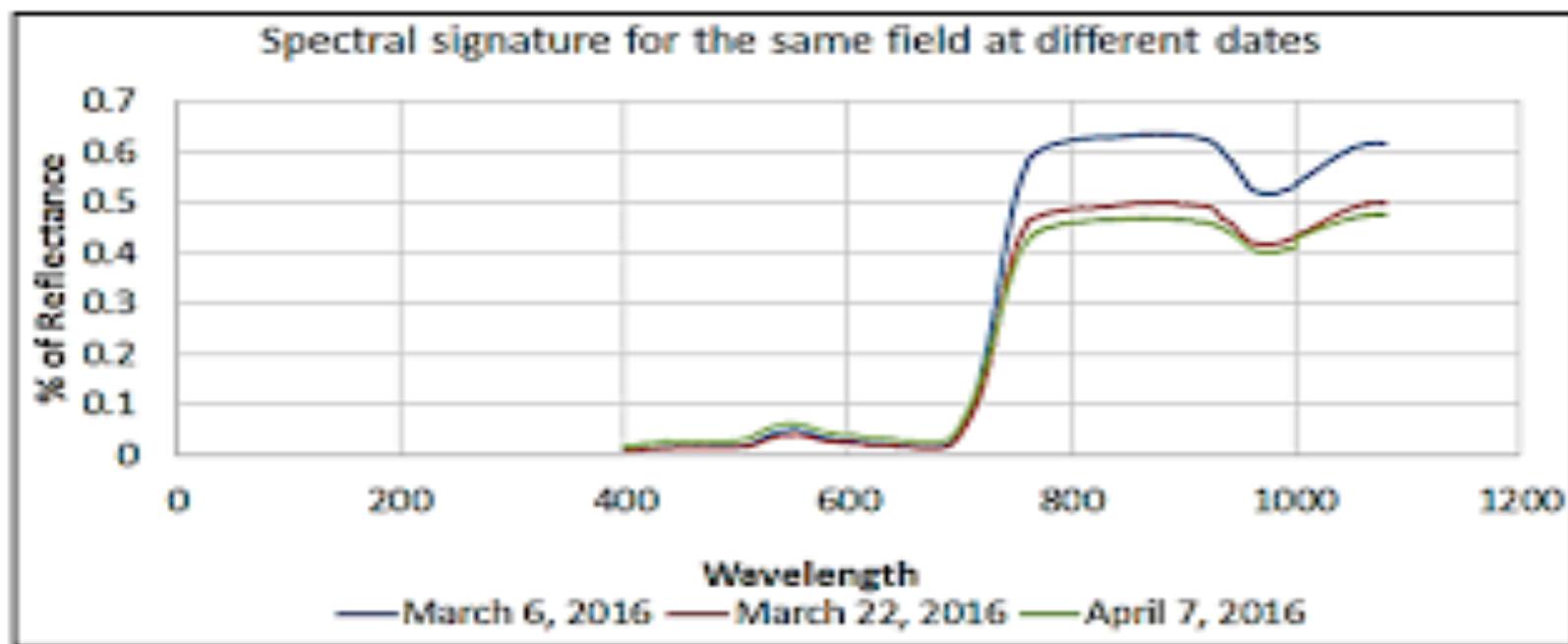
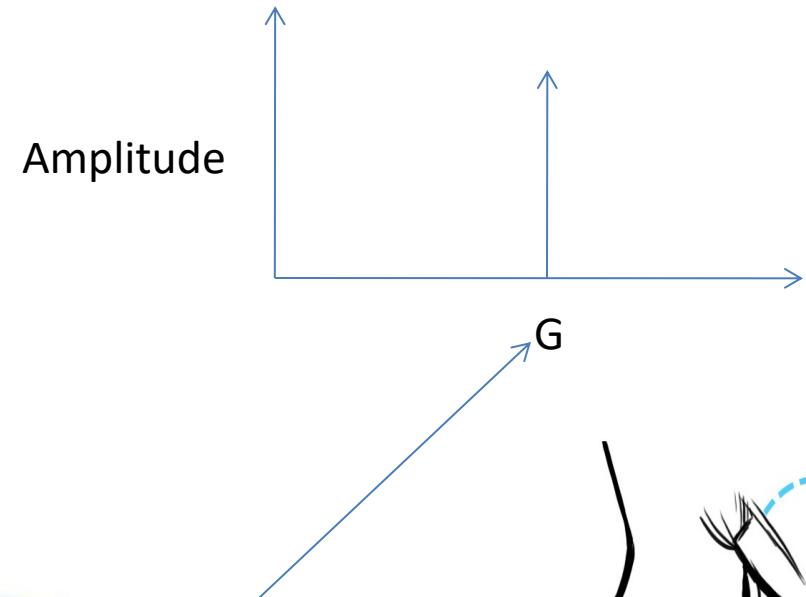
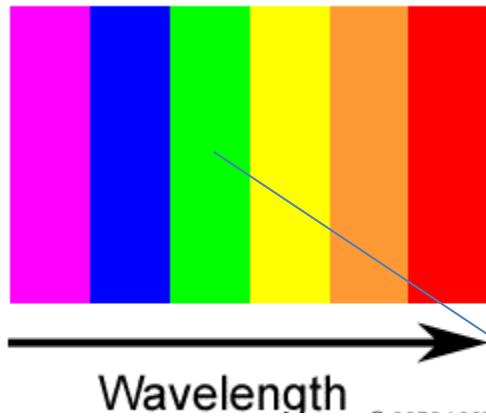


IMAGE INTERPRETATION REQUIRES AN UNDERSTANDING OF SPECTRAL SIGNATURE

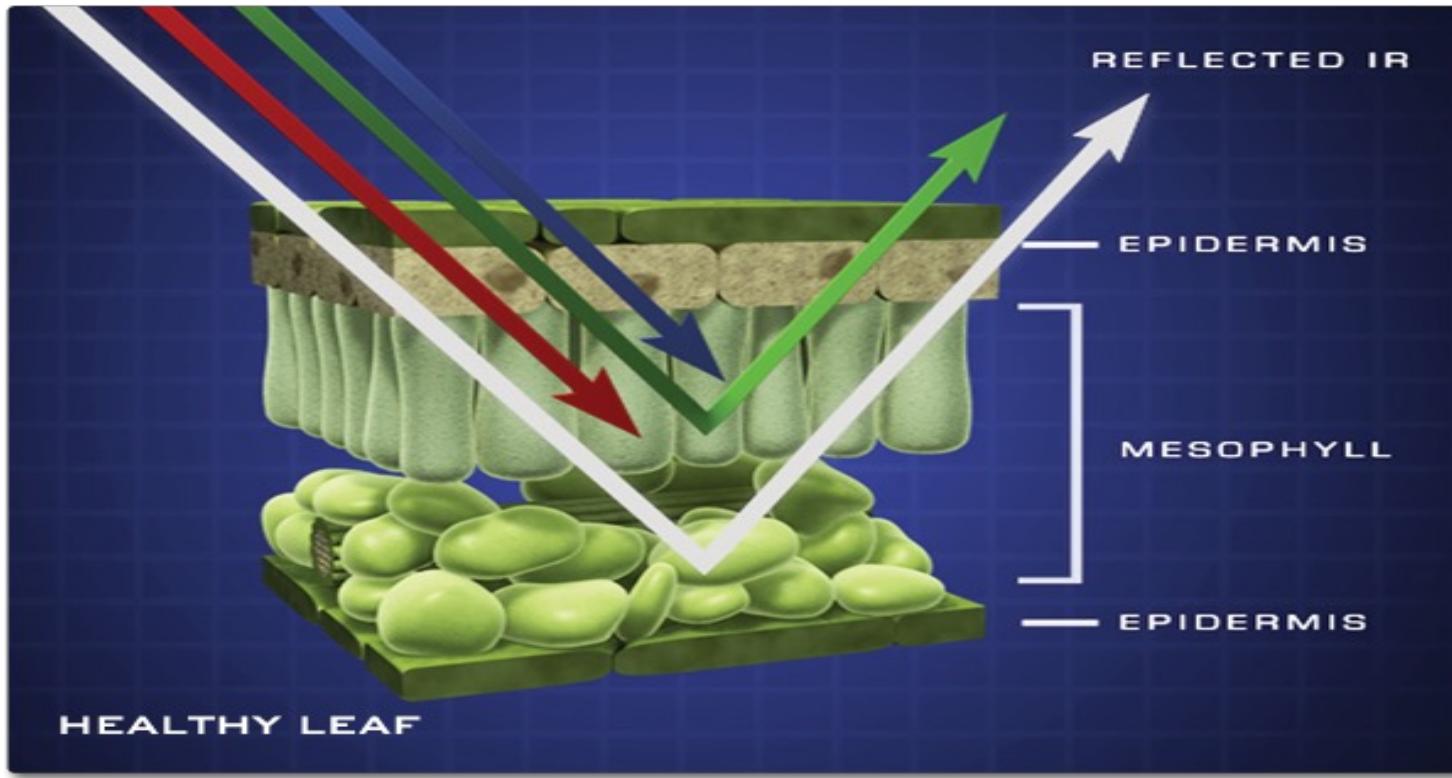
**SPECTRAL SIGNATURE:
VEGETATION, WATER, SOIL**





It absorbs energy from sunlight and helps converts it into chemical energy during the light dependent reactions of photosynthesis.

Strength of green light would depend upon vegetation type because of different concentration of chlorophyll



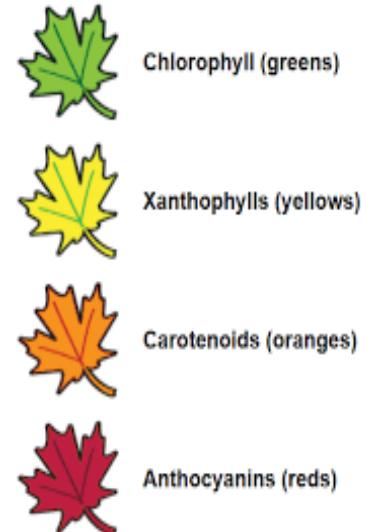
The word **mesophyll** comes from two Greek words; **mesos**, which means **middle** and **phyllo** meaning **leaf**.

mesophyll tissue is composed of two layers of cells (spongy and palisade cells), the mesophyll tissue in monocots is largely composed of isodiametric cells (cells that appear spherical or polyhedral in shape).

Photosynthetic Pigments

There are four different types of pigments present in leaves:

1. Chlorophyll a
2. Chlorophyll b
3. Xanthophylls
4. Carotenoids



**Human pigment: Melanin. Which gives color to our skin
Hemoglobin gives color to blood**



Blue



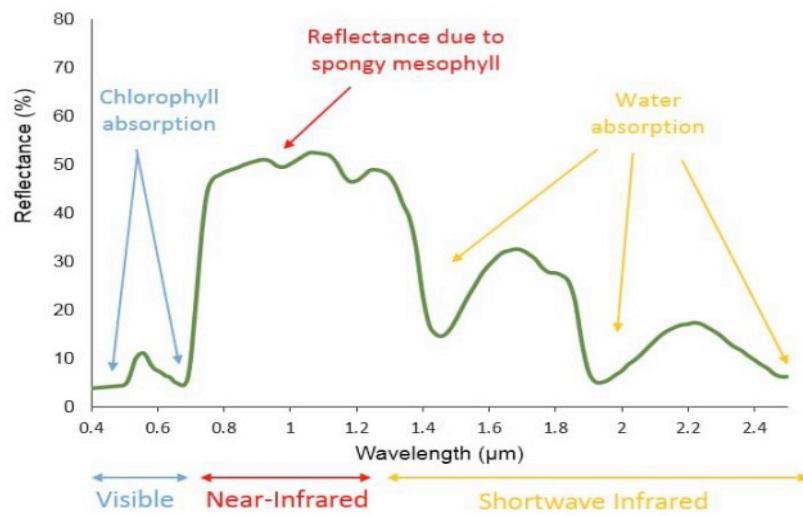
Green



Red



Infrared



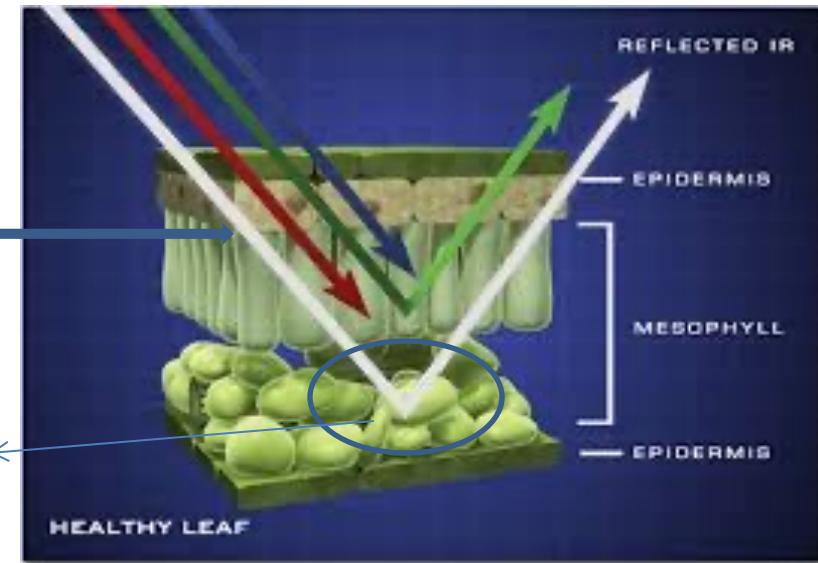
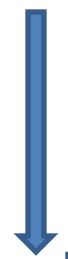
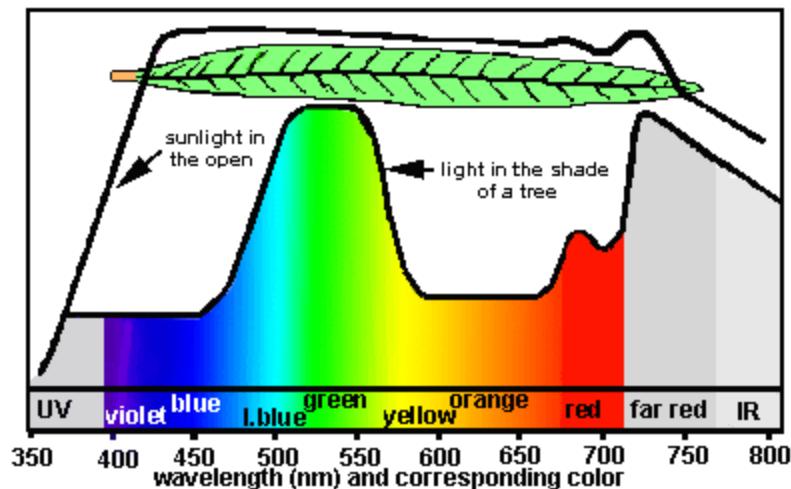
WHAT IS TOTAL INTERNAL REFLECTION

In general, total internal reflection takes place at the boundary between two transparent media when a ray of light in a medium of higher index of refraction approaches the other medium at an angle of incidence greater than the critical angle.

The critical angle ϑ_c for a given combination of materials is thus

$$\theta_c = \sin^{-1}(n_2/n_1)$$

What is happening to invisible waves



Total Internal reflection

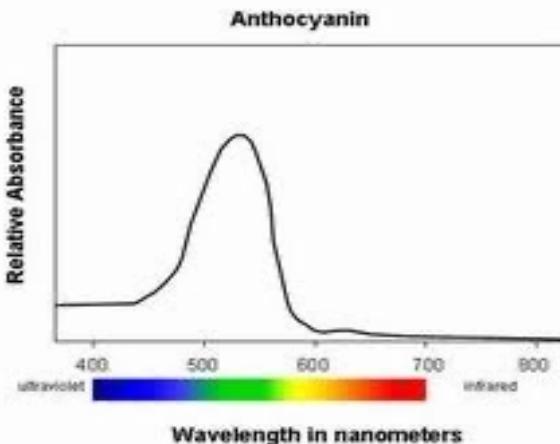
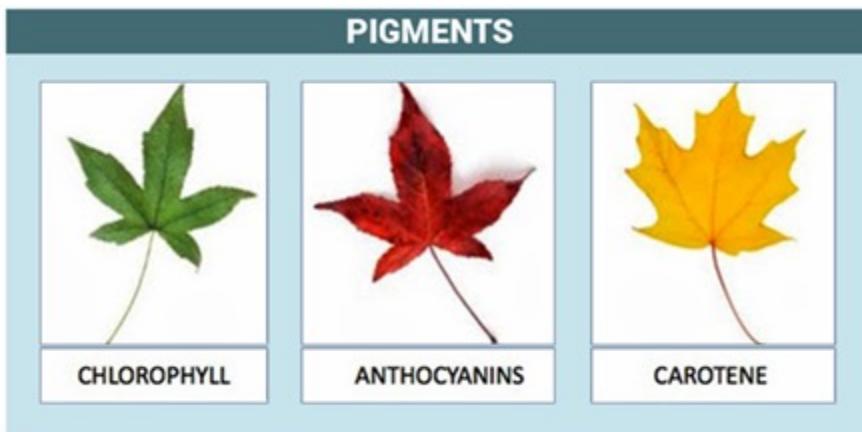
ABSORPTION OF LIGHT BY PLANT: Responsible for different colors in plant



© CanStockPhoto.com - csp66182946

In vegetation: Absorption of light is due to pigments

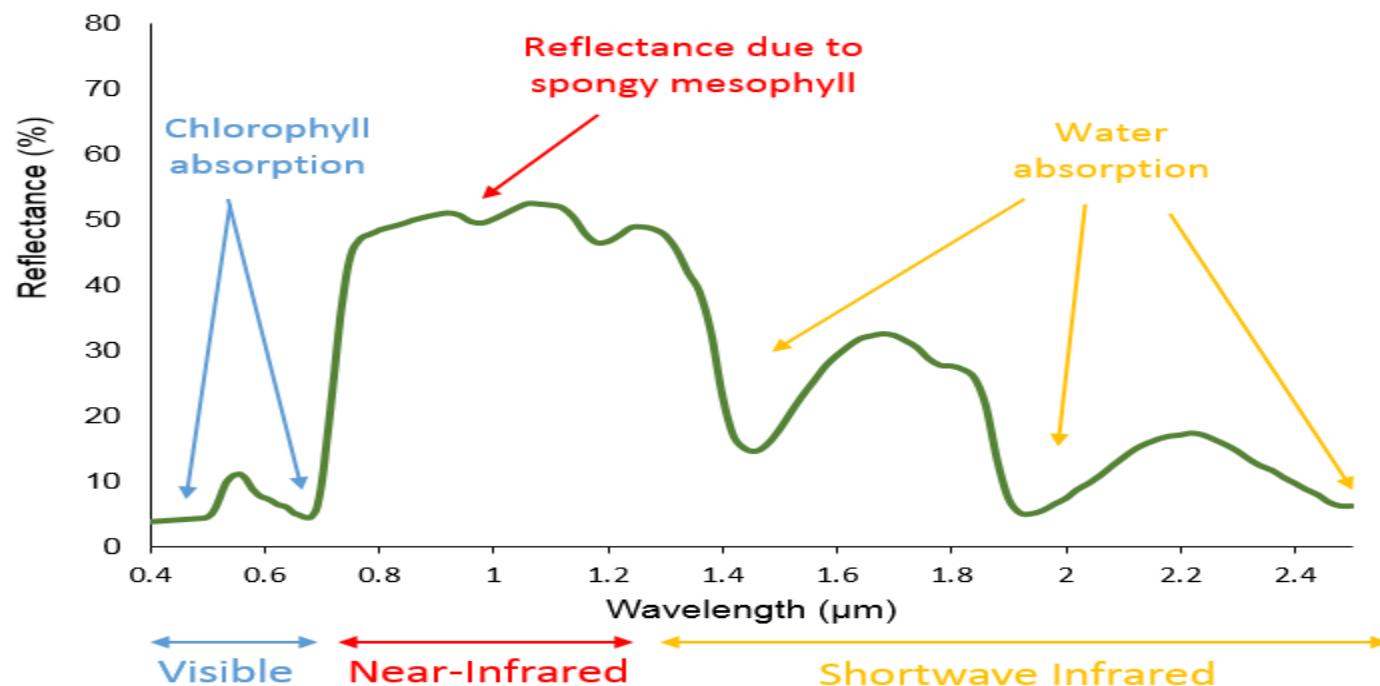
Other pigments



LEAF COLOR					
PIGMENT	CHLOROPHYLL	CAROTENE	LOW ANTHOCYANIN	HIGH ANTHOCYANIN	HIGH ANTHOCYANIN

Vegetation Spectral Reflectance Curves

Vegetation has a unique spectral signature, but different types of vegetation differ in their reflectance. Plants that are stressed or diseased can also be identified by their distinct spectral signatures. The leaf pigments, cell structure and water content all impact the spectral reflectance of vegetation. For example deciduous trees have a higher reflectance in the near infrared compared to conifers.



Visible

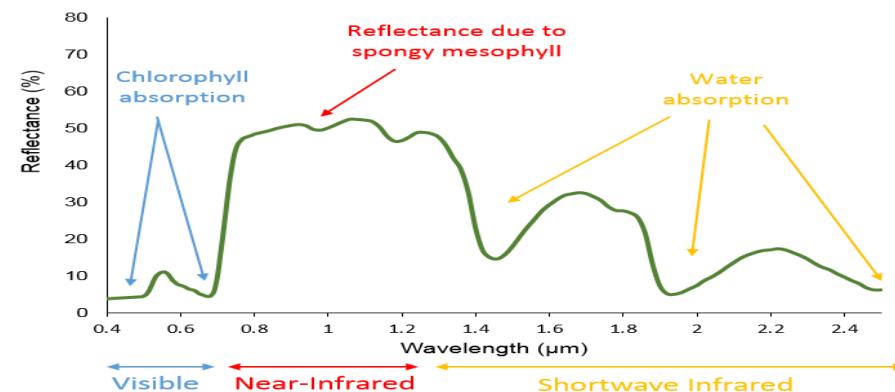
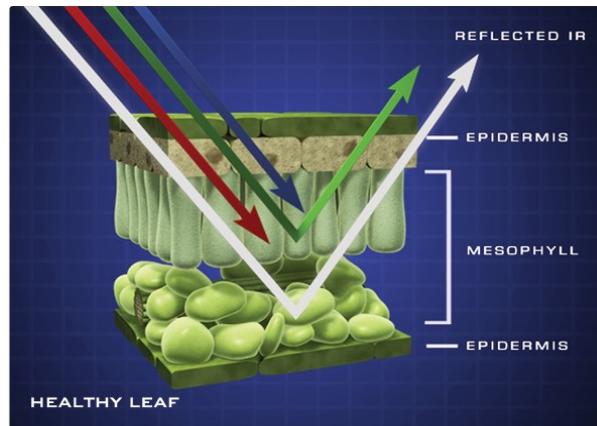
In the visible bands the reflectance is relatively low as the majority of light is absorbed by the leaf pigments. Chlorophyll strongly absorbs energy in the blue and red wavelengths and reflects more green wavelengths. This is why healthy vegetation appears green.

Near Infrared

For healthy vegetation, the reflectance is much higher in the near infrared (NIR) region than in the visible region due to the cellular structure of the leaves, specifically the spongy mesophyll. Therefore healthy vegetation can be easily identified by the high NIR reflectance and generally low visible reflectance.

Shortwave Infrared

The reflectance in the shortwave infrared wavelengths is related to the water content of the vegetation and its structure. Water has strong absorption bands around 1.45, 1.95 and 2.50 μm . Outside these absorption bands in the SWIR region, reflectance of leaves generally increases when water content in the leaf decreases.



Pigments Responsible for Leaf color Change

The changing leaf colors you witness each year boil down to a few chemicals in the leaves. Some are pigments, some are by-products produced by the leaf, and other are produced only in the fall. Here are the culprits:

Chlorophyll

Carotenoids

Anthocyanins

Tannins

Chlorophyll (reflects green)

The leaves of plants are responsible for absorbing light from the sun to convert it into energy for the plant.

it absorbs light; the pigment absorbs the blue and yellow and red wavelengths but not the green. The green is reflected back.

Carotenoids: (yellow/brown)

when chlorophyll breaks down (and doesn't get replaced in the leaves), the yellow colors start to appear

Anthocyanins produce **the reds and purples** that we see in maples, sumacs and dogwoods. They're produced in the fall from a reaction with anthocyanidins.

Tannins brown color are waste products, produced in the plants. E.g. tea .

The reflection from bare ground increases slightly from the visible to the infrared range of the spectrum. There are great differences between different types of soil, dry and humid land. Different mineral compositions of the surface are also reflected in the spectral signature. In the illustration only an average curve for bare ground (soil) is shown.

Factors affecting soil signature are:

Soil moisture content

Soil Texture

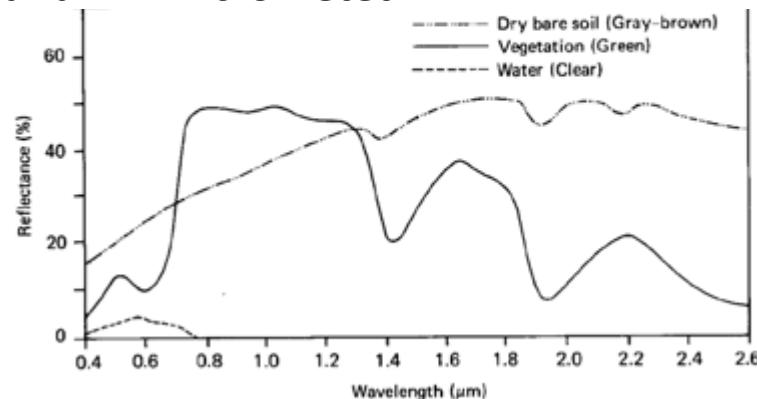
Surface roughness

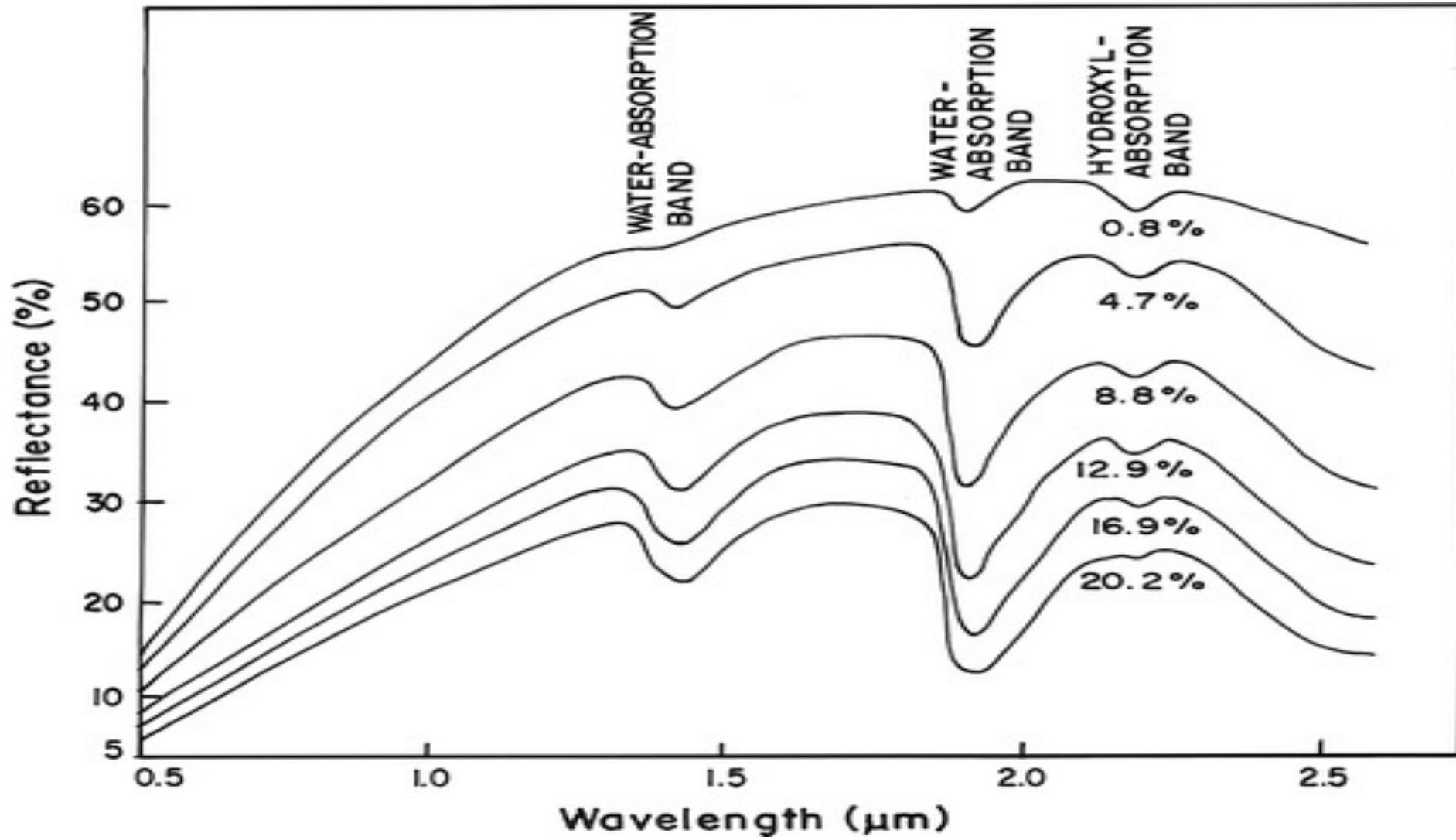
Iron oxide

Organic matter

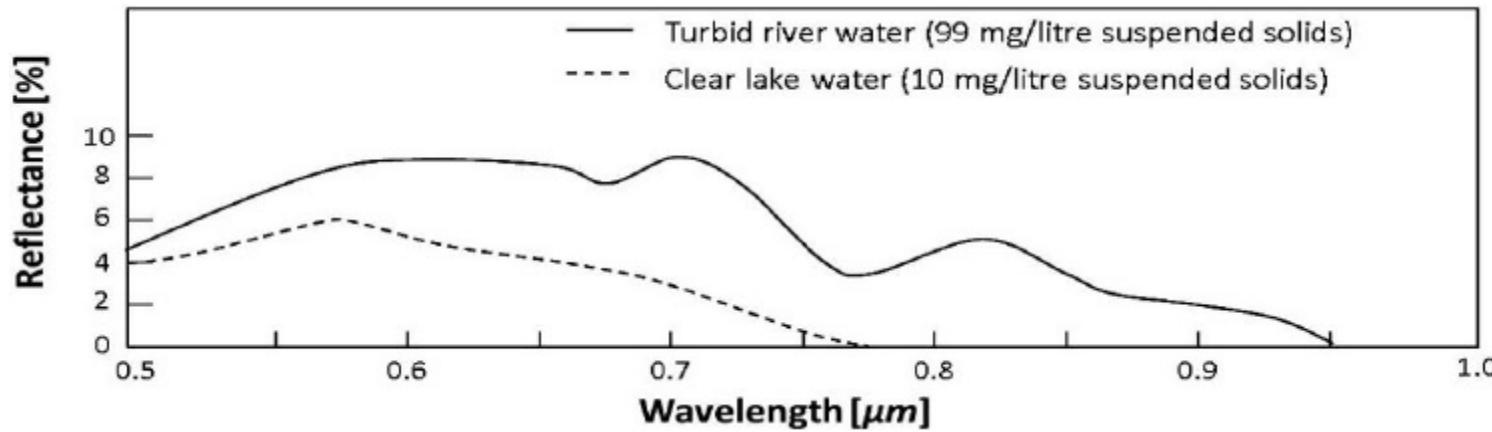
Water absorption band: 1.4, 1.9, 2.4 micro meter

Clay soil: Hydroxil ion absorption band at 1.4 and 2.2 micrometres





Generally, water only reflects in the visible light range. As water has almost no reflection in the near infrared range it is very distinct from other surfaces. Water surfaces will therefore be clearly delimited as dark areas (low pixel values) in images recorded in the near infrared range.



Vegetation

In general, healthy vegetation is a very good absorber of electromagnetic energy in the visible region. Chlorophyll strongly absorbs light at wavelengths around 0.45 (blue) and 0.67 μm (red) and reflects strongly in green light, therefore our eyes perceive healthy vegetation as green.

Healthy plants have a high reflectance in the near-infrared between 0.7 and 1.3 μm . This is primarily due to healthy internal structure of plant leaves. As this internal structure varies amongst different plant species, the near infrared wavelengths can be used to discriminate between different plant species.

Water

In its liquid state, water has relatively low reflectance, with clear water having the greatest reflectance in the blue portion of the visible part of the spectrum.

Water has high absorption and virtually no reflectance in near infrared wavelengths range and beyond. Turbid water has a higher reflectance in the visible region than clear water. This is also true for waters containing high chlorophyll concentrations.

Soil

Bare soil generally has an increasing reflectance, with greater reflectance in near-infrared and shortwave infrared. Some of the factors affecting soil reflectance are:

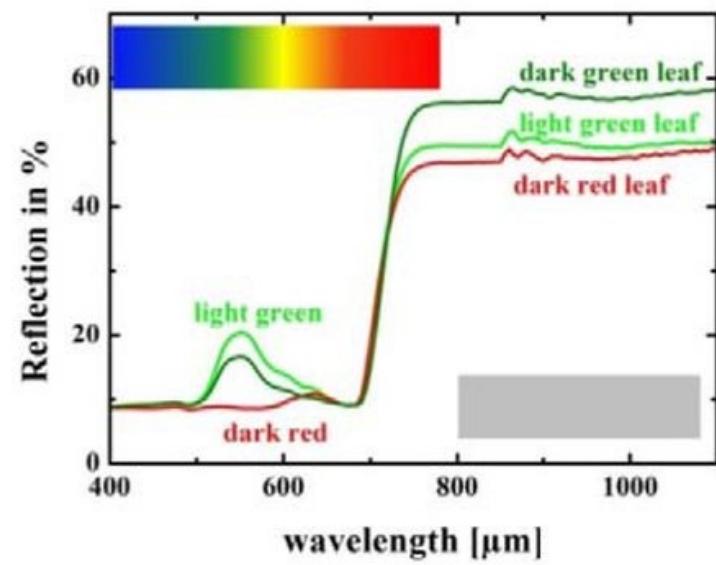
Moisture content

Soil texture (proportion of sand, silt, and clay)

Surface roughness

Presence of iron oxide

Organic matter content





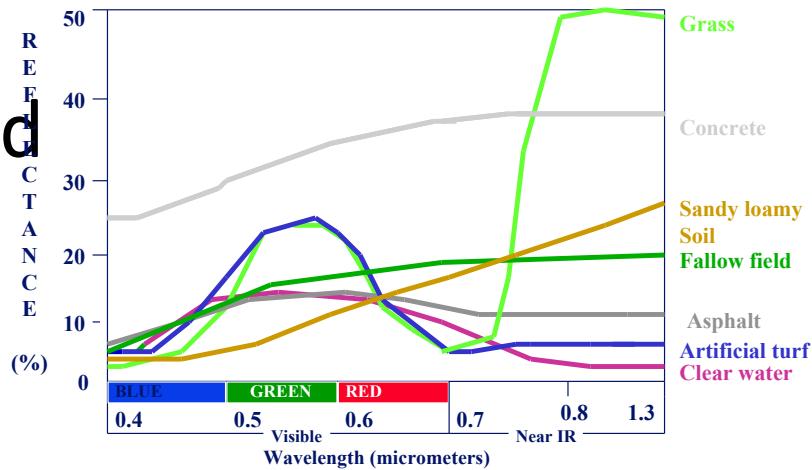
GREEN



NIR

VISUALIOSATION of Single Band

Three bands, green, red and near infra-red
displayed separately as grayscale



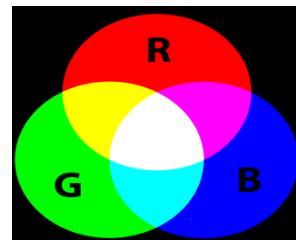
green



red
©2007 Austin Troy



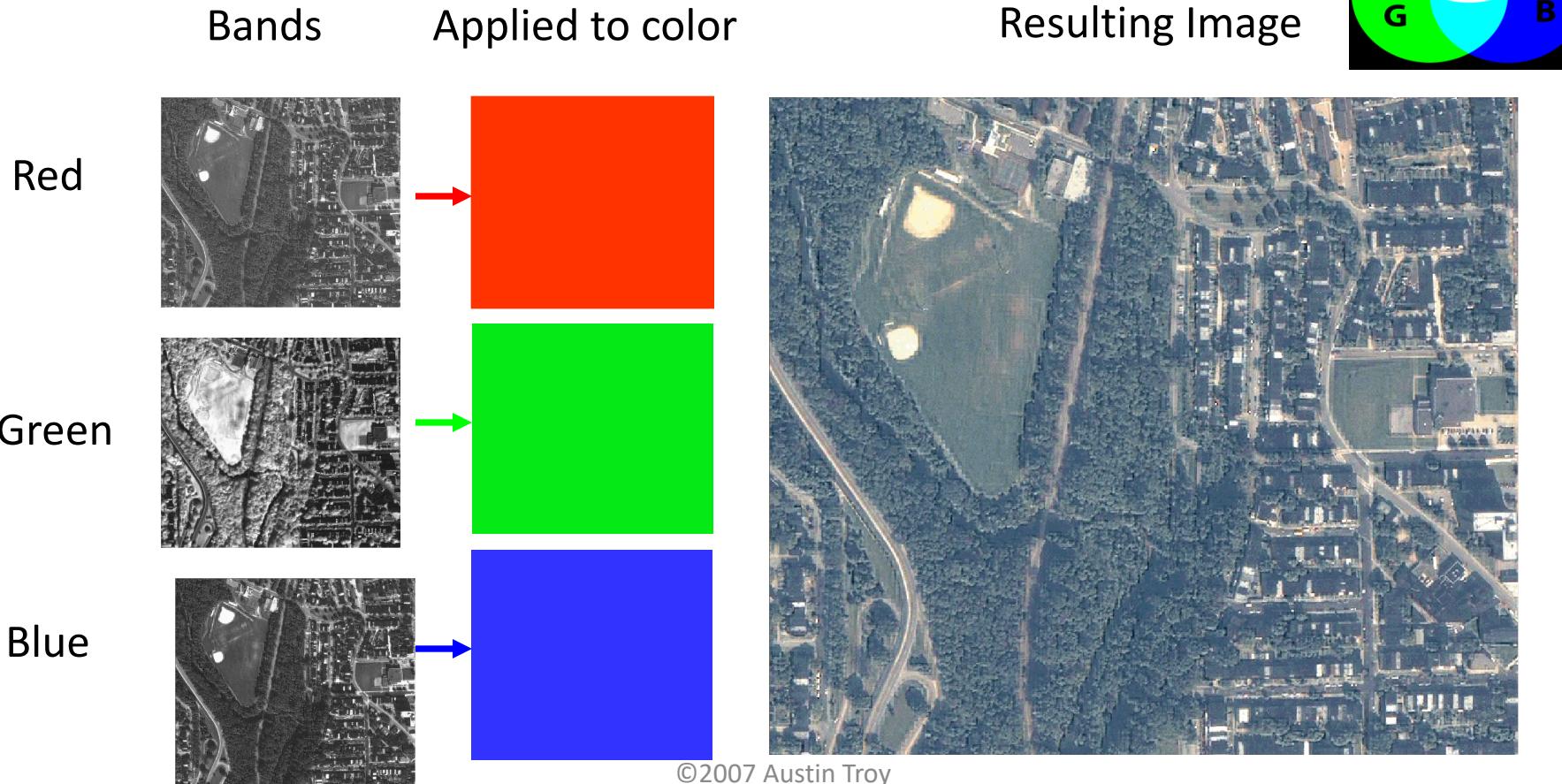
Near-infra red



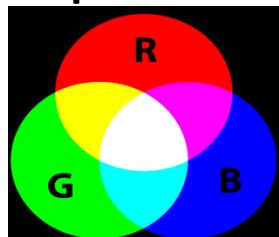


Display of Multispectral Image

- NATURAL color composite



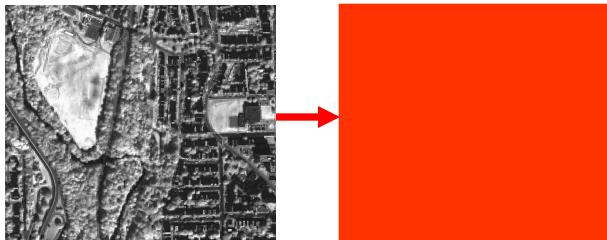
Display of Multispectral Image



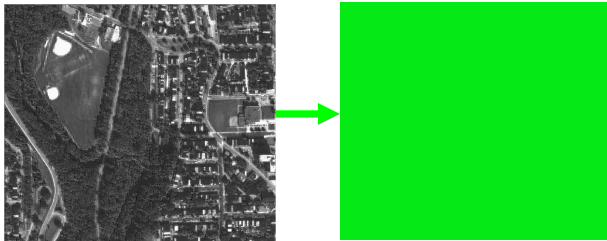
- False color composite

Bands Applied to color

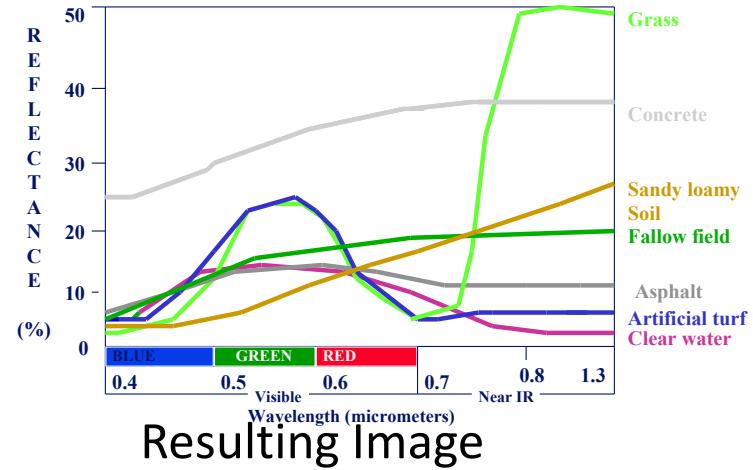
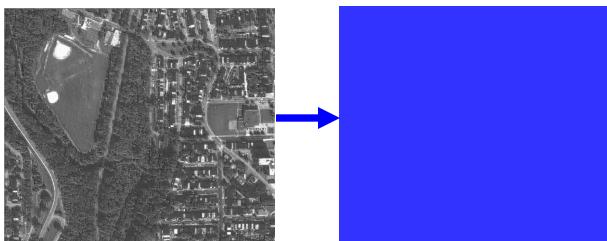
Near Infrared



Red



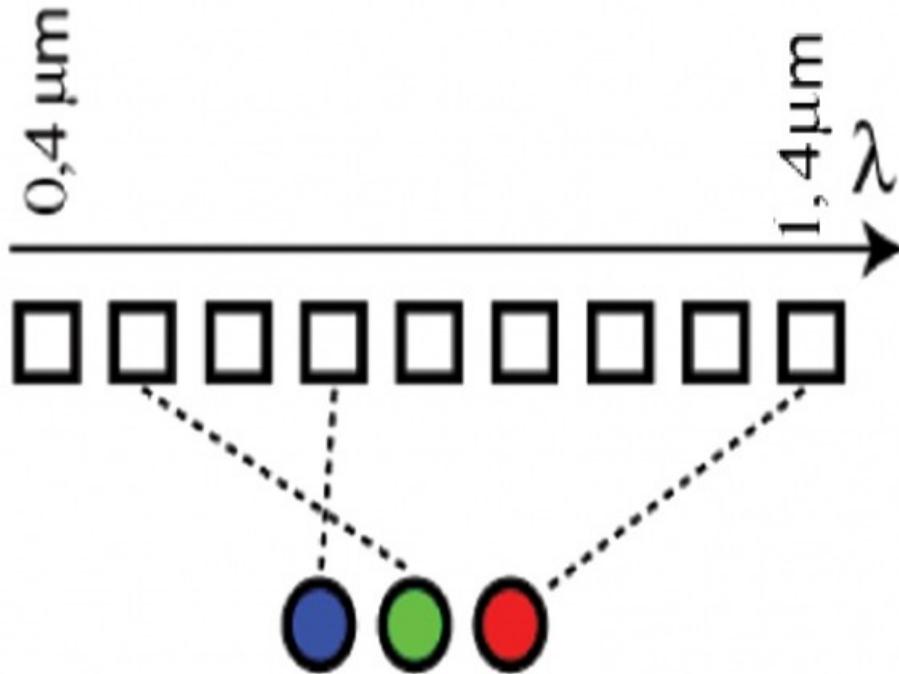
Green



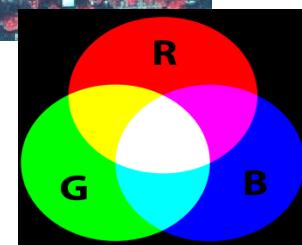
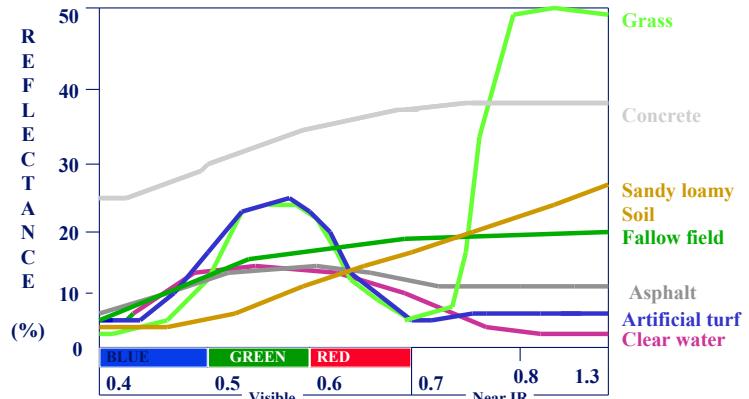
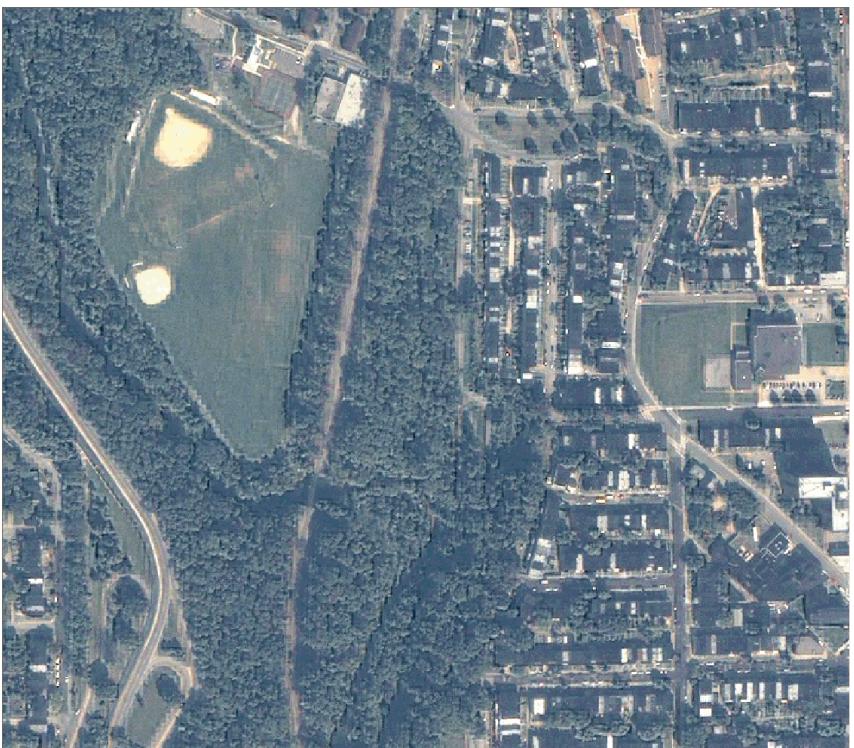
False colours

Spectral bands

Representation



● FALSE color composite



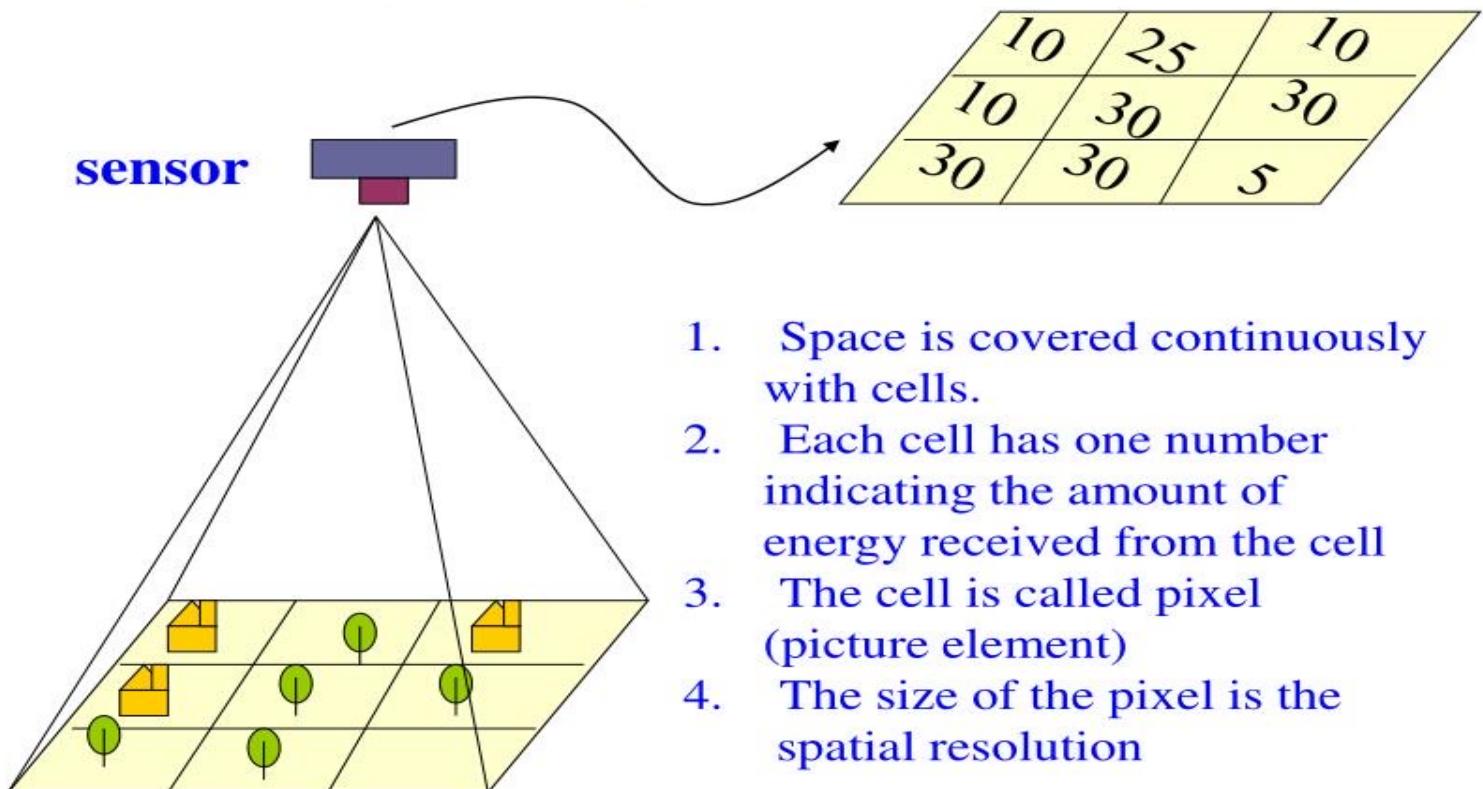
False color images are a representation of a multispectral image produced using any bands other than visible red, green and blue as the red, green and blue components of the display.

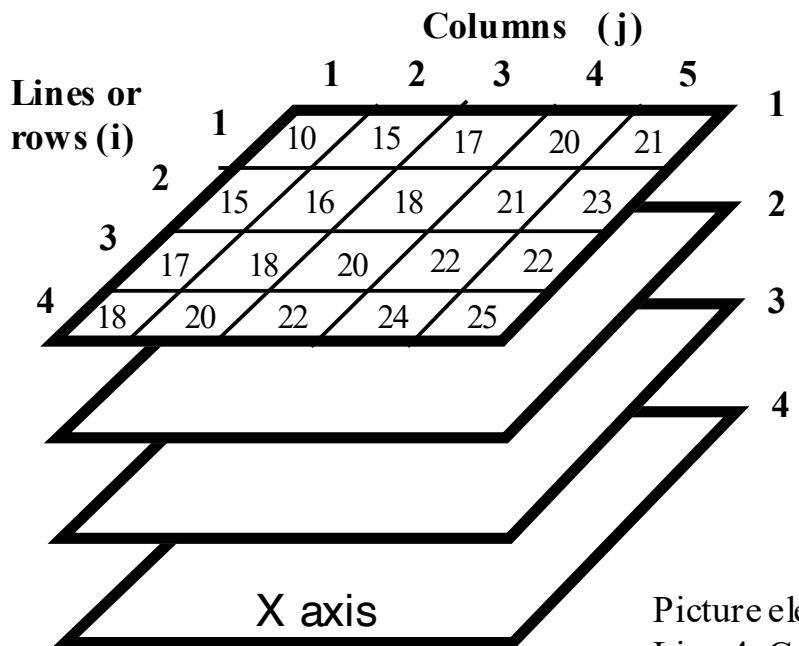
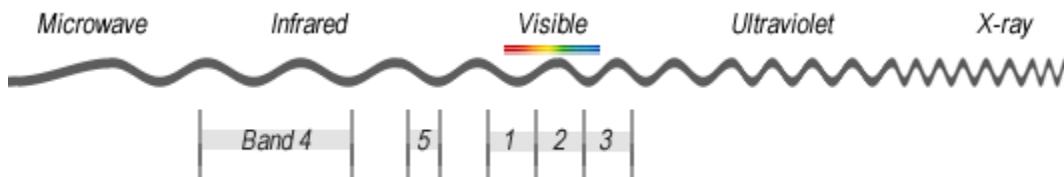
False color composites allow us to visualize wavelengths that the human eye can not see (i.e. near-infrared and beyond).

DATA SOURCES

WHAT IS REMOTE SENSING DATA

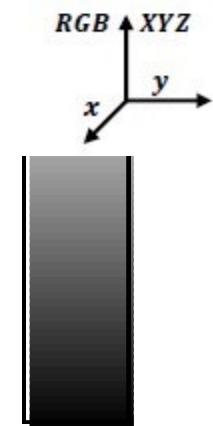
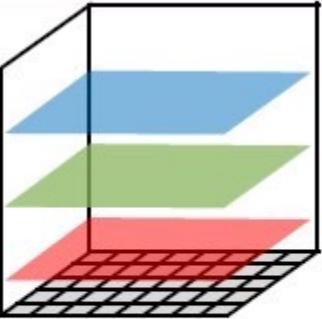
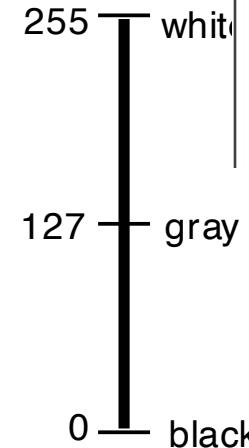
Digital Images





Picture element (pixel) at location
Line 4, Column 4, in Band 1 has a
Brightness Value of 24, i.e., $BV_{4,4,1} = 24$.

Brightness value range (typically 8 bit)



Who will provide data: GOVT SPACE AGENCIES

Six government space agencies—the China National Space Administration (CNSA), the European Space Agency (ESA), the Indian Space Research Organisation (ISRO), the Japan Aerospace Exploration Agency (JAXA), the (US) National Aeronautics and Space Administration (NASA), and the Russian Federal Space Agency (RFSA)

List of space agencies with extraterrestrial landing capability

ESA, NASA, JAXA, ISRO, RFSA, CNSA

List of space agencies with human spaceflight capability

NASA, RFSA, CNSA,

72 different government agencies (195 countries)

DATA SOURCES

Free data sources

Government Agency (NASA, ESA, JAXA, ISRO)

Private sector (sample data)

IMPORTANT SATELLITES:

Landsat

SENTINEL-1 and 2

IRS/Resourcesat

ALOS

1.0 USGS Earth Explorer

<https://earthexplorer.usgs.gov/>

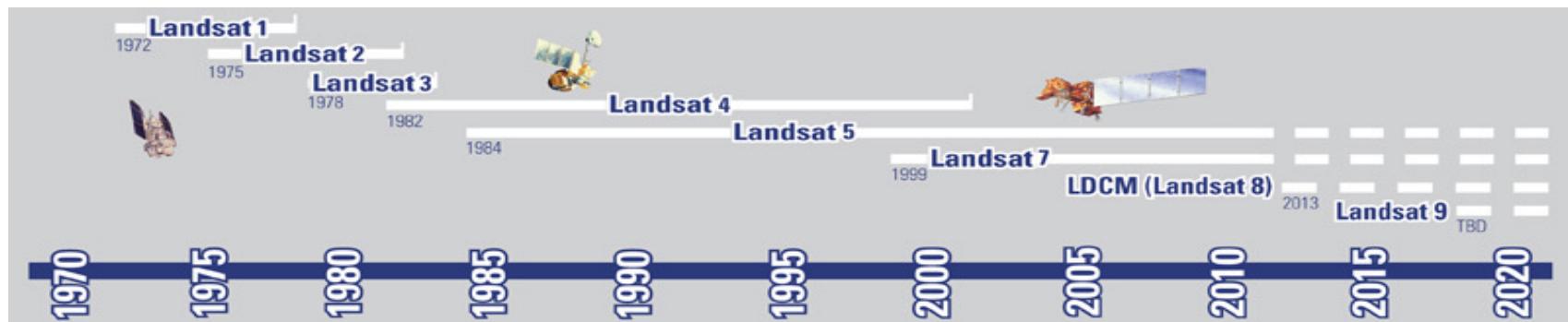
LANDSAT: – 40 years

ELEVATION: ASTER and SRTM

HYPERSPECTRAL: Hyperion

One of the best portal for fetching Remote sensing data from various satellites and aerial images, a wide range of search criteria . Full access to NASA's Land Data Products and Services such as **Hyperion' s hyperspectral data**, disperse **Radar data** and **MODIS & AVHRR land surface reflectance**.

Within, you will find open source datasets that were formed under collaboration with ISRO and ESA. This is Resourcesat-1 and 2 as well as Sentinel-2. Also you will find a lot of commercial hi-res sources like IKONOS-2 OrbView-3 and historical SPOT data.



USGS Earth Explorer

<https://earthexplorer.usgs.gov/>

The map shows a detailed view of the Asian continent, focusing on the region from Kazakhstan in the north to the Philippines in the south. The terrain is color-coded to represent elevation, with darker shades indicating higher elevations. Major rivers and lakes are also visible. Numerous cities are marked with dots and labeled, including Beijing, Shanghai, Hong Kong, Taipei, Seoul, Tokyo, and numerous cities in India, Pakistan, and Afghanistan. The map is overlaid with national borders and some state/province boundaries. A legend in the bottom right corner identifies the data source as Leaflet | Tiles © Esri — Source: Esri, i-cubed, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, UPR-EGP, and the GIS User Community, ESRI.

Use Data Set Prefilter (What's This?)

Data Set Search:

Declassified Data

- Digital Elevation
 - CoNED TBDEM
 - EDNA
 - GMTED2010
 - GTOPO30
 - GTOPO30 HYDRO 1K
 - IFSAR Alaska
- SRTM
 - SRTM 1 Arc-Second Global
 - SRTM Non-Void Filled
 - SRTM Void Filled
 - SRTM Water Body Data
- Digital Line Graphs
 - DLG 1:100K
 - DLG Large Scale
- Digital Maps
 - National Atlas
- + EO-1
- + Global Fiducials

[Clear All Selected](#) [Additional Criteria »](#) [Results »](#)

Search Criteria Data Sets Additional Criteria Results

4. Search Results

If you selected more than one data set to search, use the dropdown to see the search results for each specific data set.

Note: You must be logged in to download and order scenes

Show Result Controls

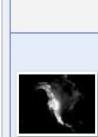
Data Set

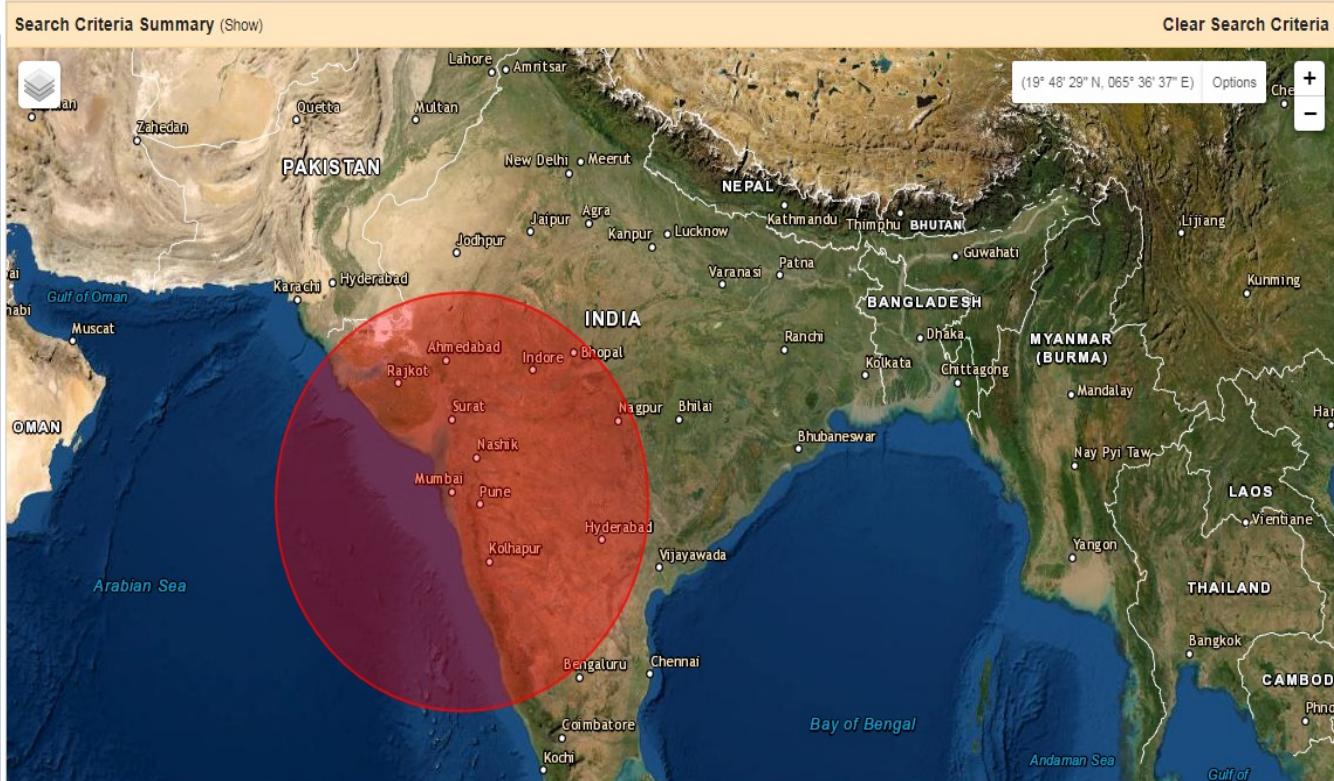
Click here to export your results »

GLCC


Entity ID: GLCCEAG20
Area of Coverage: Eurasia
Projection: Goode
Acquisition Date: 1992-04-01


Entity ID: GLCCGBG20
Area of Coverage: Global
Projection: Goode
Acquisition Date: 1992-04-01


Entity ID: GLCCNAG20
Area of Coverage: North America
Projection: Goode
Acquisition Date: 1992-04-01



Landsat-9

#	Band	Minimum Lower Band Edge (nm)	Maximum Upper Band Edge (nm)	Center Wavelength (nm)	Maximum Spatial Resolution At Nadir (m)
1	Coastal / Aerosol	433	453	443	30
2	Blue	450	515	482	30
3	Green	525	600	562	30
4	Red	630	680	655	30
5	NIR	845	885	865	30
6	SWIR 1	1560	1660	1610	30
7	SWIR 2	2100	2300	2200	30
8	Panchromatic	500	680	590	15
9	Cirrus	1360	1390	1375	30
10	Thermal	10300	11300	10800	100
11	Thermal	11500	12500	12000	100

2. Copernicus Open Access Hub (previously known as Sentinels Scientific Data Hub) provides complete, free and open access to Sentinel-1, Sentinel-2 and Sentinel-3 user products, starting from the In-Orbit Commissioning Review (IOCR). The ESA's sentinel data is chasing the USGS Earth Explorer with more bands and better resolution.

Sentinel 1 A/B
C-band SAR, VV,VH mode

Sentinel-2

Copernicus Open Access Hub

<https://scihub.copernicus.eu/dhus/#/home>

SENTINEL-1: C-band SAR

SENTINEL- 2: 10 m resolution, spectral bands in

The screenshot shows the Copernicus Open Access Hub interface. On the left, there is an "Advanced Search" sidebar with various filters for searching satellite data. The filters include:

- Sort By: Ingestion Date (Descending)
- Sensing period: Two date input fields.
- Ingestion period: Two date input fields.
- Mission: Sentinel-1 and Sentinel-2 checkboxes.
- Satellite Platform and Product Type dropdowns.
- Polarisation and Sensor Mode dropdowns.
- Relative Orbit Number (from 1 to 175) and Collection dropdowns.

On the right, a map of South and Central Asia is displayed, showing countries like India, Pakistan, China, and others. Numerous cities are marked with pins across the region. The map includes labels for major cities and regions, such as New Delhi, Mumbai, Bangalore, Chennai, Hyderabad, Dhaka, Yangon, and many others. The interface has the Copernicus, esa, and OpenStreetMap logos at the top.

Past Satellites

- [Aryabhata, 1975](#)
- [Bhaskara I, 1979](#)
- [Bhaskara II, 1981](#)
- [Rohini Series, 1980-83](#)
- [SROSS Series, 1985-92](#)
- [IRS-1A, 1988](#)
- [IRS-P1, 1993](#)
- [IRS-1B, 1991](#)
- [IRS-P2, 1994](#)
- [IRS-1C, 1995](#)
- [IRS-P3, 1996](#)
- [IRS-1D, 1997](#)
- [IRS-P4, 1999 \(Oceansat\)](#)
- [IRS-P6, 2003 \(Resourcesat-1\)](#)
- [IRS-P5, 2005 \(Cartosat-1\)](#)
- [IRS-P7, 2007 \(Cartosat-2\)](#)
- [IRS-P6, 2011 \(Resourcesat-2\)](#)
- [RISAT-1, 2012 \(RISAT-1\)](#)
-

Name of the Satellite	Launch Date	Launch Vehicle	Orbit Type	Application
EOS-01	7-Nov-20	PSLV-C49/EOS-01	LEO	Disaster Management System, Earth Observation
RISAT-2BR1	11-Dec-19	PSLV-C48/RISAT-2BR1	LEO	Disaster Management System, Earth Observation
Cartosat-3	27-Nov-19	PSLV-C47 / Cartosat-3 Mission	SSPO	Earth Observation
RISAT-2B	22-May-19	PSLV-C46 Mission	LEO	Disaster Management System, Earth Observation
HysIS	29-Nov-18	PSLV-C43 / HysIS Mission	SSPO	Earth Observation
Cartosat-2 Series Satellite	12-Jan-18	PSLV-C40/Cartosat-2 Series Satellite Mission	SSPO	Earth Observation
Cartosat-2 Series Satellite	23-Jun-17	PSLV-C38 / Cartosat-2 Series Satellite	SSPO	Earth Observation
Cartosat -2 Series Satellite	15-Feb-17	PSLV-C37 / Cartosat -2 Series Satellite	SSPO	Earth Observation
RESOURCESAT -2A	7-Dec-16	PSLV-C36 / RESOURCESAT -2A	SSPO	Earth Observation
SCATSAT-1	26-Sep-16	PSLV-C35 / SCATSAT-1	SSPO	Climate & Environment
INSAT-3DR	8-Sep-16	GSLV-F05 / INSAT-3DR	GSO	Climate & Environment, Disaster Management System
CARTOSAT-2 Series Satellite	22-Jun-16	PSLV-C34 / CARTOSAT-2 Series Satellite	SSPO	Earth Observation
INSAT-3D	26-Jul-13	Ariane-5 VA-214	GSO	Climate & Environment, Disaster Management System
SARAL	25-Feb-13	PSLV-C20/SARAL	SSPO	Climate & Environment, Earth Observation
RISAT-1	26-Apr-12	PSLV-C19/RISAT-1	SSPO	Earth Observation
Megha-Tropiques	12-Oct-11	PSLV-C18/Megha-Tropiques	SSPO	Climate & Environment, Earth Observation

Name of the Satellite	Launch Date	Launch Vehicle	Orbit Type	Application
EOS-01	7-Nov-20	PSLV-C49/EOS-01	LEO	Disaster Management System, Earth Observation
RISAT-2BR1	11-Dec-19	PSLV-C48/RISAT-2BR1	LEO	Disaster Management System, Earth Observation
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RISAT-2B	22-May-19	PSLV-C46 Mission	LEO	Disaster Management System, Earth Observation
HysIS	29-Nov-18	PSLV-C43 / HysIS Mission	SSPO	Earth Observation
Cartosat-2 Series Satellite	12-Jan-18	PSLV-C40/Cartosat-2 Series Satellite Mission	SSPO	Earth Observation

Name of the Satellite	Launch Date	Launch Vehicle	Orbit Type	Application
EOS-01	7-Nov-20	PSLV-C49/EOS-01	LEO	Disaster Management System, Earth Observation
RISAT-2BR1	11-Dec-19	PSLV-C48/RISAT-2BR1	LEO	Disaster Management System, Earth Observation
Cartosat-3	27-Nov-19	PSLV-C47 / Cartosat-3 Mission	SSPO	Earth Observation
RISAT-2B	22-May-19	PSLV-C46 Mission	LEO	Disaster Management System, Earth Observation
HysIS	29-Nov-18	PSLV-C43 / HysIS Mission	SSPO	Earth Observation
Cartosat-2 Series Satellite	12-Jan-18	PSLV-C40/Cartosat-2 Series Satellite Mission	SSPO	Earth Observation

3.0 Bhuvan Indian Geo-Platform of ISRO

<https://bhuvan-app3.nrsc.gov.in/data/download/index.php>

The screenshot shows the Bhuvan Indian Geo-Platform of ISRO website. At the top left, there are two tabs: "GIS 15 Free Satellite Imagery Data Sets" and "Bhuvan | NRSC Open EO Data Archive". The main title "Bhuvan | NRSC Open EO Data Archive" is also visible in the address bar. The header includes the "bhuvan" logo, the text "Indian Geo-Platform of ISRO", and the "National Remote Sensing Centre" logo. The top navigation bar contains links for "Welcome User", "Login", "Logout", "Backlog", "Download List", "Tools", "Updates", "Bhuvan Store", "Help", and "Home". Below the header, there is a search bar with the placeholder "Enter City or Lat,Lon(ex:chennai or ...)" and a magnifying glass icon. A blue box highlights the "Select Category" section, which includes radio buttons for "Satellite/Sensor" (selected), "Theme/Products", and "Program/Projects". A dropdown menu titled "Select SubCategory" is open, showing options under "Select under Satellite/Sensor": SCATSAT-1: Scatterometer, Oceansat-2: OCIM, Resourcesat-1/Resourcesat-2: LISS-III, IMS-1: Hyperspectral Imager(HSI), Cartosat-1, and Resourcesat-1/Resourcesat-2: AWIFS. To the right of the dropdown is a map of India with state boundaries and names. A legend on the left side of the map indicates elevation levels. A scale bar at the bottom left shows distances of 0, 200, and 400 kilometers. The bottom right corner of the map displays coordinates 58.07, 18.99.

QUESTION BANK

- 1. EXPLAIN SPECTRAL SIGNATURE OF VEGETATION,SOIL AND WATER**

- 2. WHAT IS standard FALSE COLOR COMPOSITE**

- 3. WHAT IS THE REASON OF HIGH IR SPECTRAL REFLECTACE IN PLANTS**

<https://nptel.ac.in/content/storage2/courses/105105110/pdf/m6l03.pdf>

<https://nptel.ac.in/courses/105/108/105108077/>

<https://nptel.ac.in/courses/105/108/105108077/>



Bhuvan - Geographical Indications (GI) of India

Visualization Of Geographical Indications All Over India



Latest Updates

Rajapura, Tembhi Khodave, Virar West, Saravali) Heavy Rains 2021 on [Bhuvan Disaster portal](#)

1 Week Certificate Webinar on "LBS using Bhuvan Geop



Visualisation & Free Download

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

<https://bhuvan.nrsc.gov.in/home/index.php>

ISRO GEOPLATFORM



Bhuvan 2D



Bhuvan 3D



Open Data Archive



Climate & Environment

Application Sectors

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



Water

View the water applications



Forestry

View the forestry applications



E - Governance

View the e-governance



Tourism

View the tourism applications

Downloads



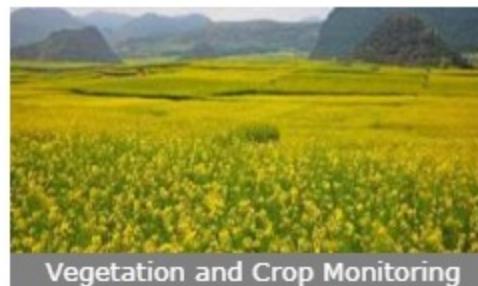
सत्यमेव जयते

Visualisation of Earth Observation Data and A

Space Applications Centre, ISRO

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Earth Observation



Vegetation and Crop Monitoring



New and Renewable

Announcements

[Vegetation Condition Index \(VCI\) Dashboard](#)[3D City Model - Ahmedabad \(New\)](#)[Geospatial Calculato](#)[AdVance HYperspect](#)

https://scihub.copernicus.eu/dhu x Sentinel-2 - Missions - Sentinel x +

scihub.copernicus.eu/dhus/#/home

Paused

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European Commission esa Copernicus

Copernicus Open Access Hub

Insert search criteria...

Advanced Search

Sort By: Ingestion Date Order By: Descending

Sensing period

Ingestion period

Mission: Sentinel-1

Satellite Platform Product Type

Polarisation Sensor Mode

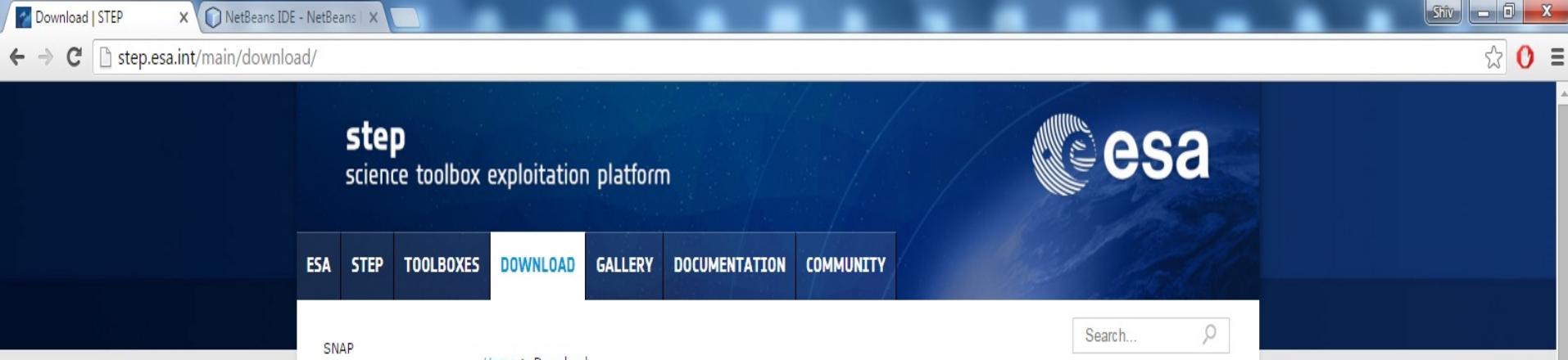
DD

Type here to search

Open Street © Data © OpenStreetMap contributors. Rendering © MapServer and EOx

31°C ENG 21:53 15-08-2021 6

The screenshot shows the Copernicus Open Access Hub website. The main feature is a map of India with numerous city names labeled. A sidebar on the left contains an 'Advanced Search' section with various filters like 'Ingestion Date', 'Sensing period', and 'Mission: Sentinel-1'. At the bottom, there's a search bar and a system tray with icons for weather, battery, and system status.



step

science toolbox exploitation platform

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SNAP

[Sentinel 1 Toolbox](#)[Sentinel 2 Toolbox](#)[Sentinel 3 Toolbox](#)[SMOS Toolbox](#)[Download](#)[Community](#)[Home > Download](#)

Download

Here you can download the latest installers for SNAP and the Sentinel Toolboxes.

Data provision is available to all users via the [Sentinel Data Hub](#).

Current Version

The current version is **2.0.2** (28.01.2016 18:25).

We offer three different installers for your convenience. Choose the one from the following table which suits your needs. During the installation process each toolbox can be excluded from the installation. Toolboxes which are not initially installed via the installer can be later downloaded and installed using the plugin manager. Please note that SNAP and the individual Sentinel Toolboxes also support numerous sensors other than Sentinel.

	Windows 64-Bit	Windows 32-Bit	Mac OS X	Unix 64-bit
Sentinel Toolboxes	These installers contain the Sentinel-1 , Sentinel-2 , Sentinel-3 Toolboxes			
	Download	Download	Download	Download
SMOS Toolbox	These installer contains only the SMOS Toolbox . Download also the Format Conversion Tool (Earth Explorer to NetCDF) and the user manual .			
	Download	Download	Download	Download

 Search...**seom**scientific exploitation
of operational missions

EO Science 2.0

6th ESA Advanced Training Course
on Land Remote Sensing4th ESA Advanced Training Course
on Ocean Remote Sensing

step.esa.int/downloads/2.0/esa-snap_sentinel_windows_2_0_2.exe

 esa-snap_sentinel_wi...exe
Canceled esa-snap_sentinel_wi...exe
Canceled

Show all downloads...

SENTINEL DATA HUB

<https://scihub.copernicus.eu/>

Launch: 23 June 2015: MSI covering 13 spectral bands (443–2190 nm), with a swath width of 290 km and a spatial resolution of 10 m (four visible and near-infrared bands), 20 m (six red edge and shortwave infrared bands) and 60 m (three atmospheric correction bands).

Sentinel 2B : July 2016

Sentinel-2 Bands	Central Wavelength (μm)	Resolution (m)
Band 1 - Coastal aerosol	0.443	60
Band 2 - Blue	0.490	10
Band 3 - Green	0.560	10
Band 4 - Red	0.665	10
Band 5 - Vegetation Red Edge	0.705	20
Band 6 - Vegetation Red Edge	0.740	20
Band 7 - Vegetation Red Edge	0.783	20
Band 8 - NIR	0.842	10
Band 8A - Vegetation Red Edge	0.865	20
Band 9 - Water vapour	0.945	60
Band 10 - SWIR - Cirrus	1.375	60
Band 11 - SWIR	1.610	20
Band 12 - SWIR	2.190	20

PRACTICE:

DATA DOWNLOAD : multispectral MSI

<https://scihub.copernicus.eu/>

EXPLORING SIGNATURES FROM SENTINEL-2 DATA

<https://step.esa.int/main/download/snap-download/>

Visualization of images

False color composite

color combination

SIGNATURE: water , vegetation and soil

QUESTION BANK

1. EXPLAIN SPECTRAL SIGNATURE OF VEGETATION,SOIL AND WATER
2. WHAT IS FALSE COLOR COMPOSITE
3. WHAT IS THE REASON OF HIGH SPECTRAL REFLECTACE IN PLANTS IN NIR REGION
4. Advantage of FCC
5. Advantages of multispectral Remote sensing

Additional Reading:

<https://nptel.ac.in/content/storage2/courses/105105110/pdf/m6l03.pdf>

<https://nptel.ac.in/courses/105/108/105108077/>

<https://nptel.ac.in/courses/105/108/105108077/>