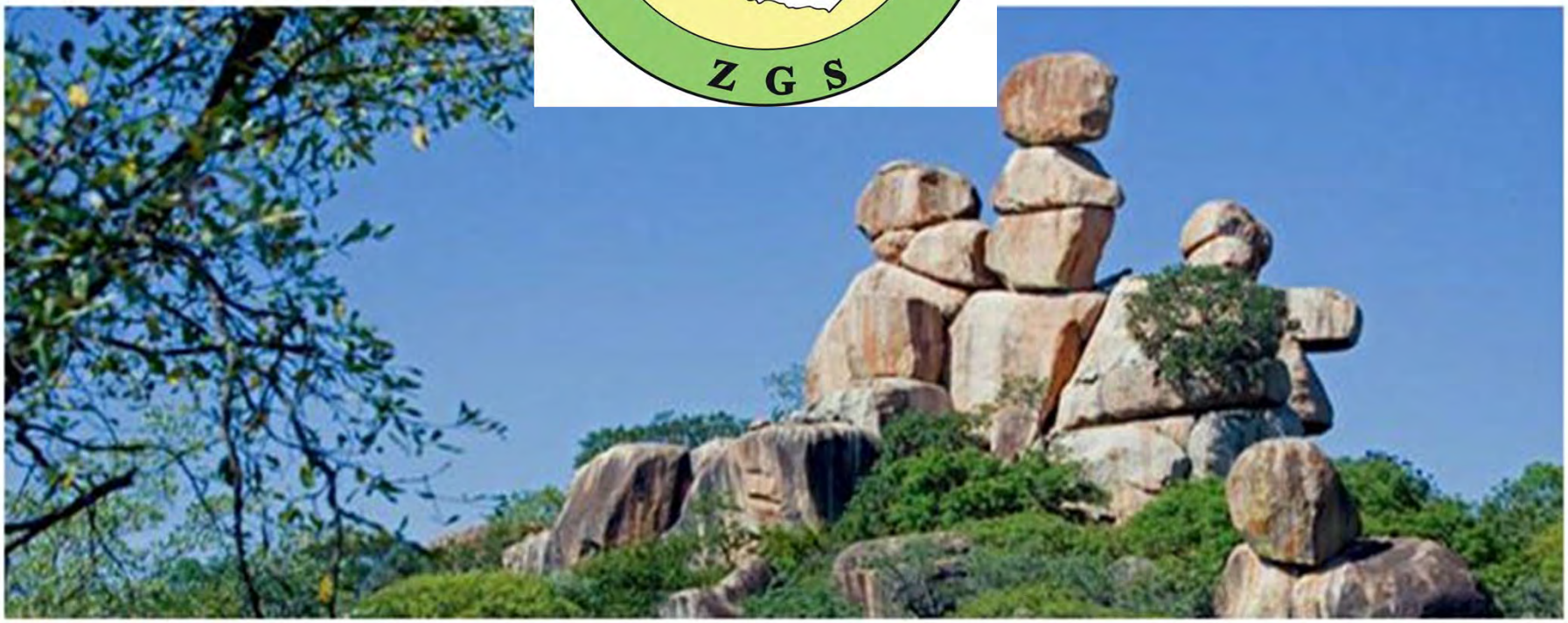
MINISTRY OF MINES AND MINING DEVELOPMENT

JAPANESE REMOTE SENSING PROJECT

ZIMBABWE GEOLOGICAL SURVEY

Z G S

2016



Signing of the Memorandum of Understanding between the Government of Zimbabwe and JOGMEC (Japan Oil, Gas and Metals National Corporation)

The MOU provides for the joint conduct of geological analysis with Zimbabwe Geological Survey by applying Remote Sensing, GIS techniques and field surveys; the training and transfer of Remote Sensing and GIS skills to Zimbabwe trainees; and the enhancement of geological information on Zimbabwe for the purpose of attracting mining investors, including Japanese companies.

Six of our geoscientists from the Department of Geological Survey have since undergone the first phase of training in Remote Sensing and Satellite Image analysis from the 7th - 20th February 2016 at the JOGMEC Remote Sensing Facility in Botswana and subsequent processing and ground truthing survey in Zimbabwe.

Remote Sensing Project with SADC countries

Botswana Geologic Remote Sensing Center

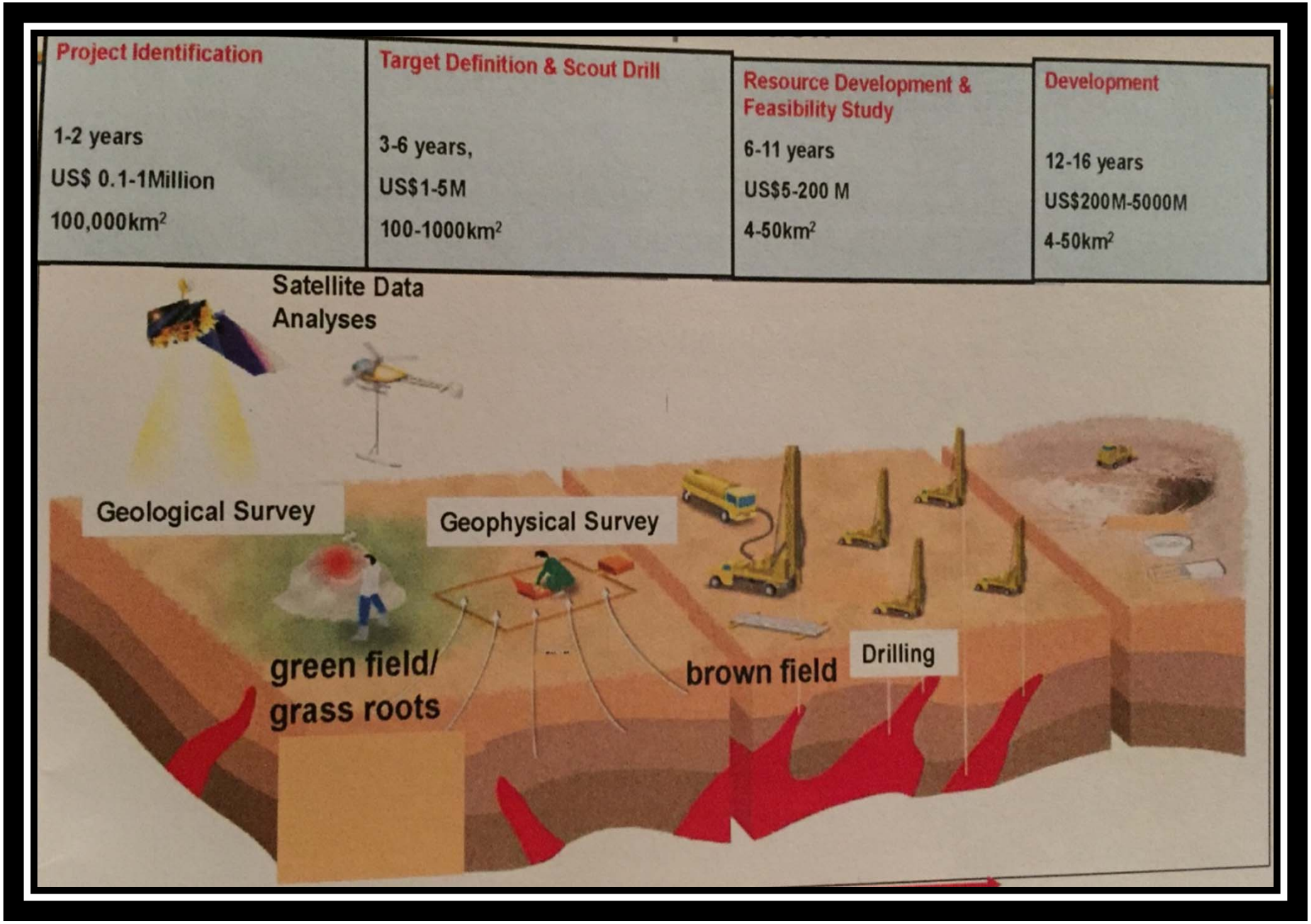
- Mineral Resource Exploration with Technical Transfer
- Since 2008 in Botswana
- Signed MOU with 13 SADC countries, including Zimbabwe

MOU Overview

- JOGMEC provides technical transfer of satellite image analysis at the center to geologists of Geological Survey Department of Zimbabwe (GSD).
- JOGMEC and GSD conduct a joint fieldwork to verify geological features and mineral deposits identified by remote sensing and geographical information system.

3 March Seminar at Meikles Hotel

Coverage of JOGMEC Metals exploration from satellite data analysis up to Pre – feasibility stage.



- Mining is business, therefore cost saving but efficient exploration methods are key.

- Target area generation through desktop study and Remote sensing techniques to be employed

- Low cost local geological mapping, geochemical and geophysical survey are essential.

- Remote Sensing techniques will be the main focus.

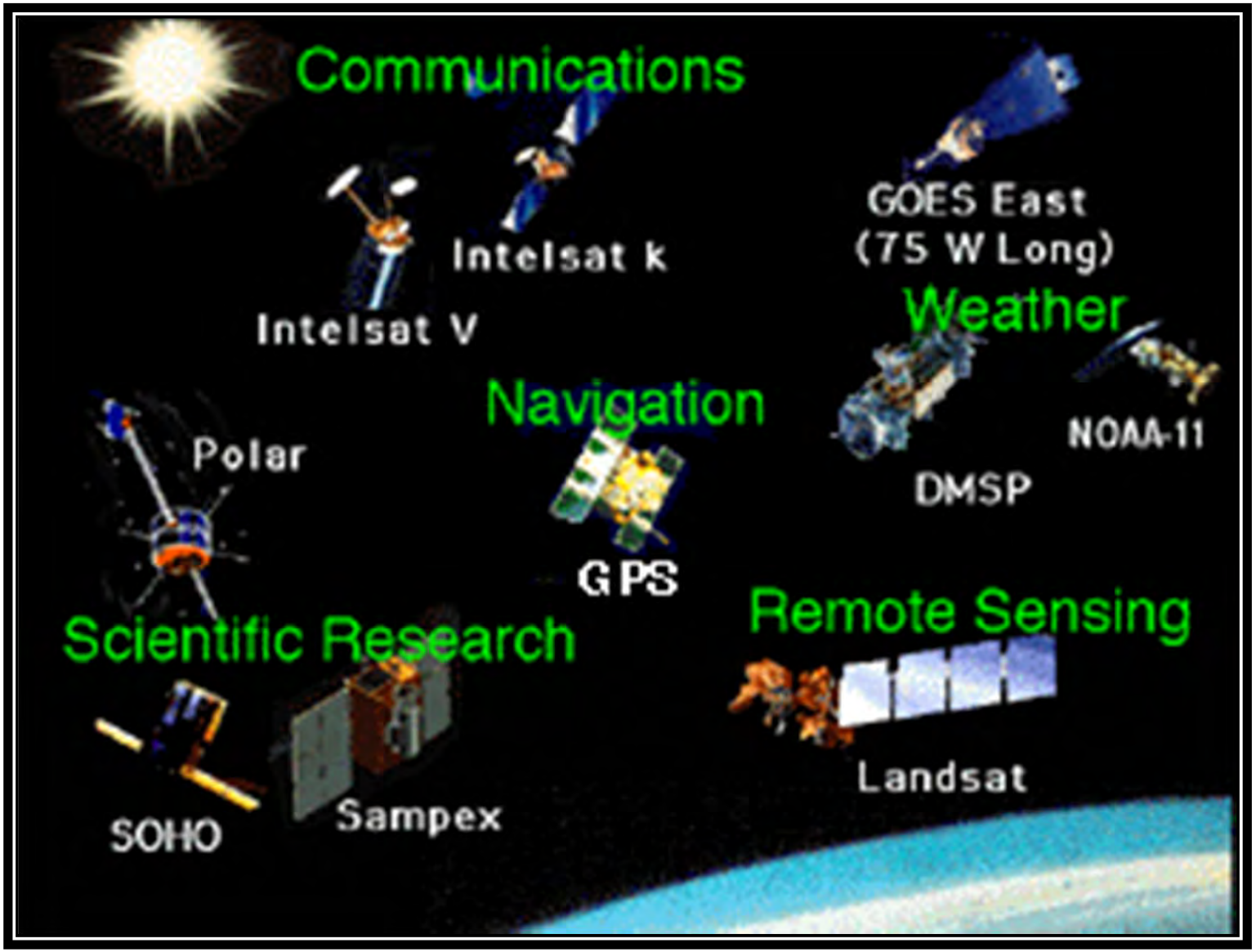
Remote Sensing

The Goddard Space Flight Center's lists 2,271 satellites currently in orbit. Russia has the most satellites currently in orbit, with 1,324 satellites, followed by the U.S. with 658.

Satellite multi-spectral systems offer consistent data sets that provide a wealth of geological and logistical information, especially for poorly mapped and remote locations.

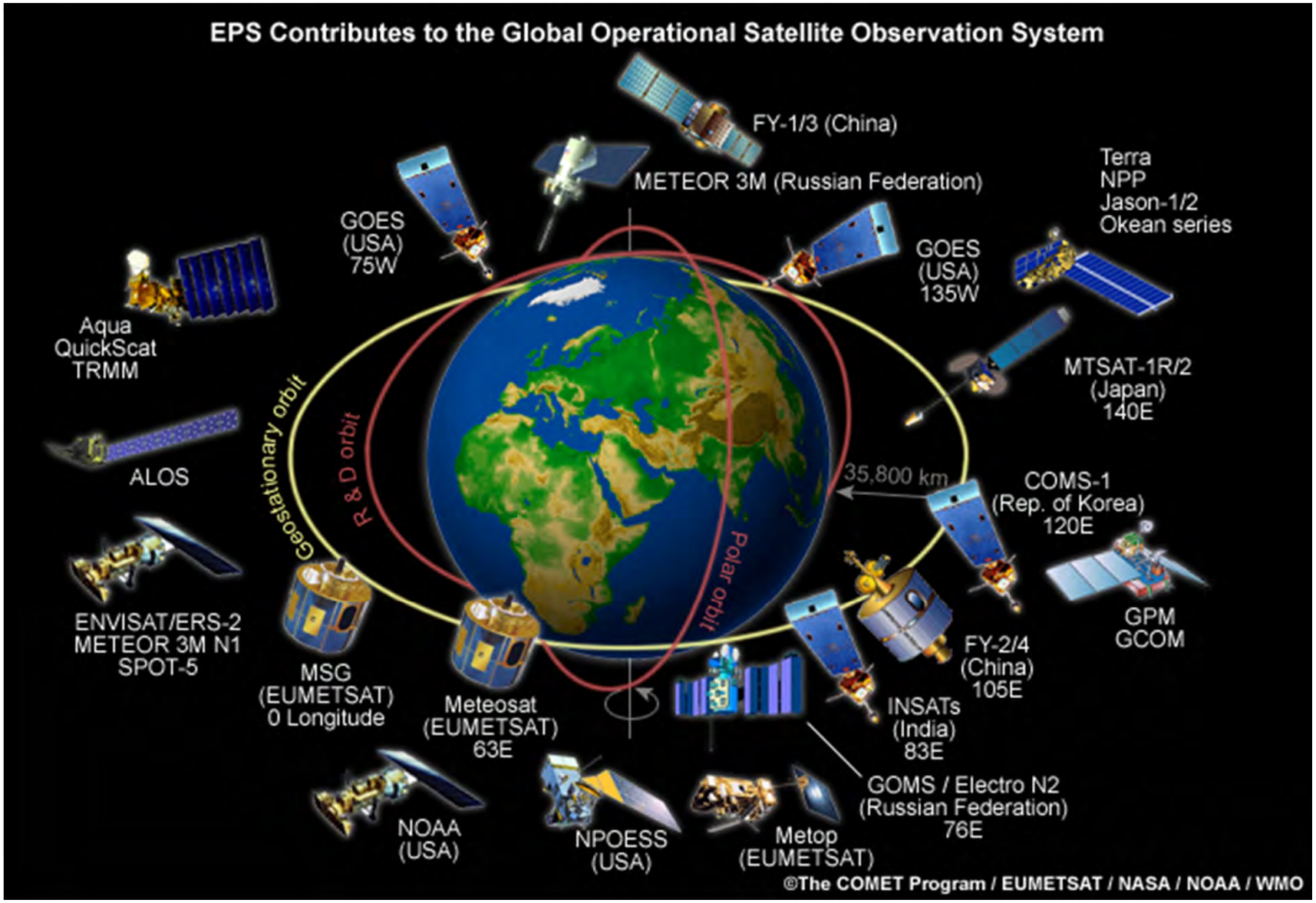
Remote Sensing

TYPES OF SATELLITES



Remote Sensing

TYPES OF SATELLITES



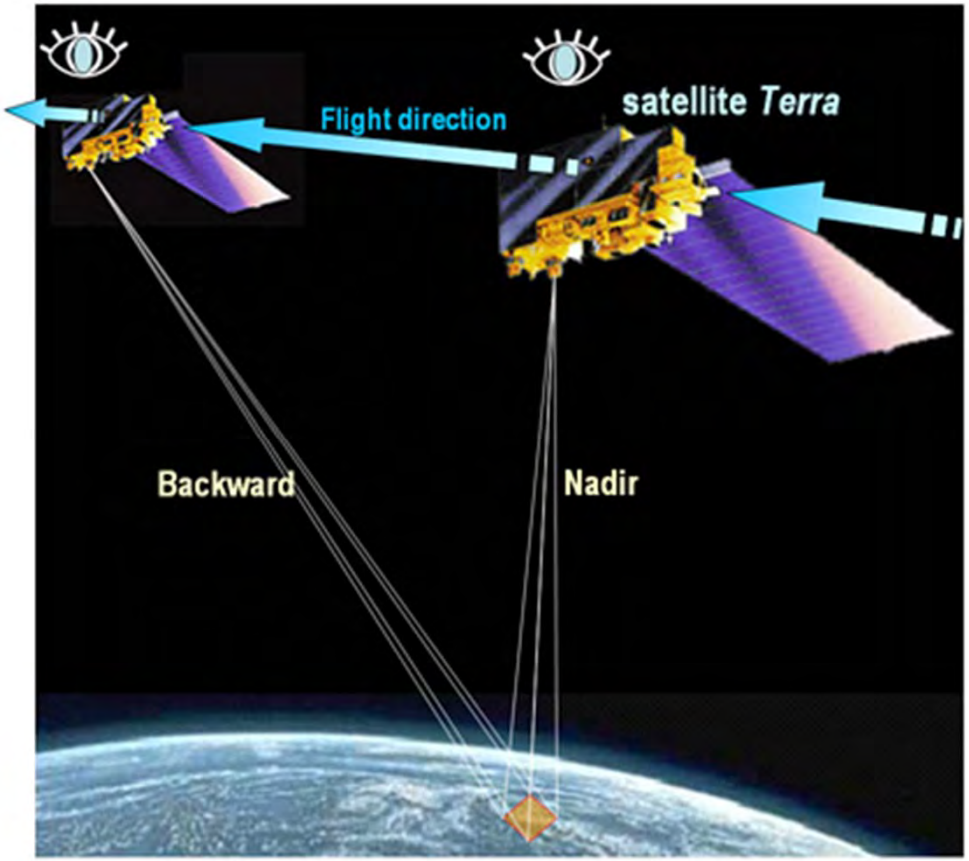
Remote Sensing

ASTER

The Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) is an imaging instrument onboard Terra, the flagship satellite of NASA's Earth Observing System (EOS) launched in December 1999.).

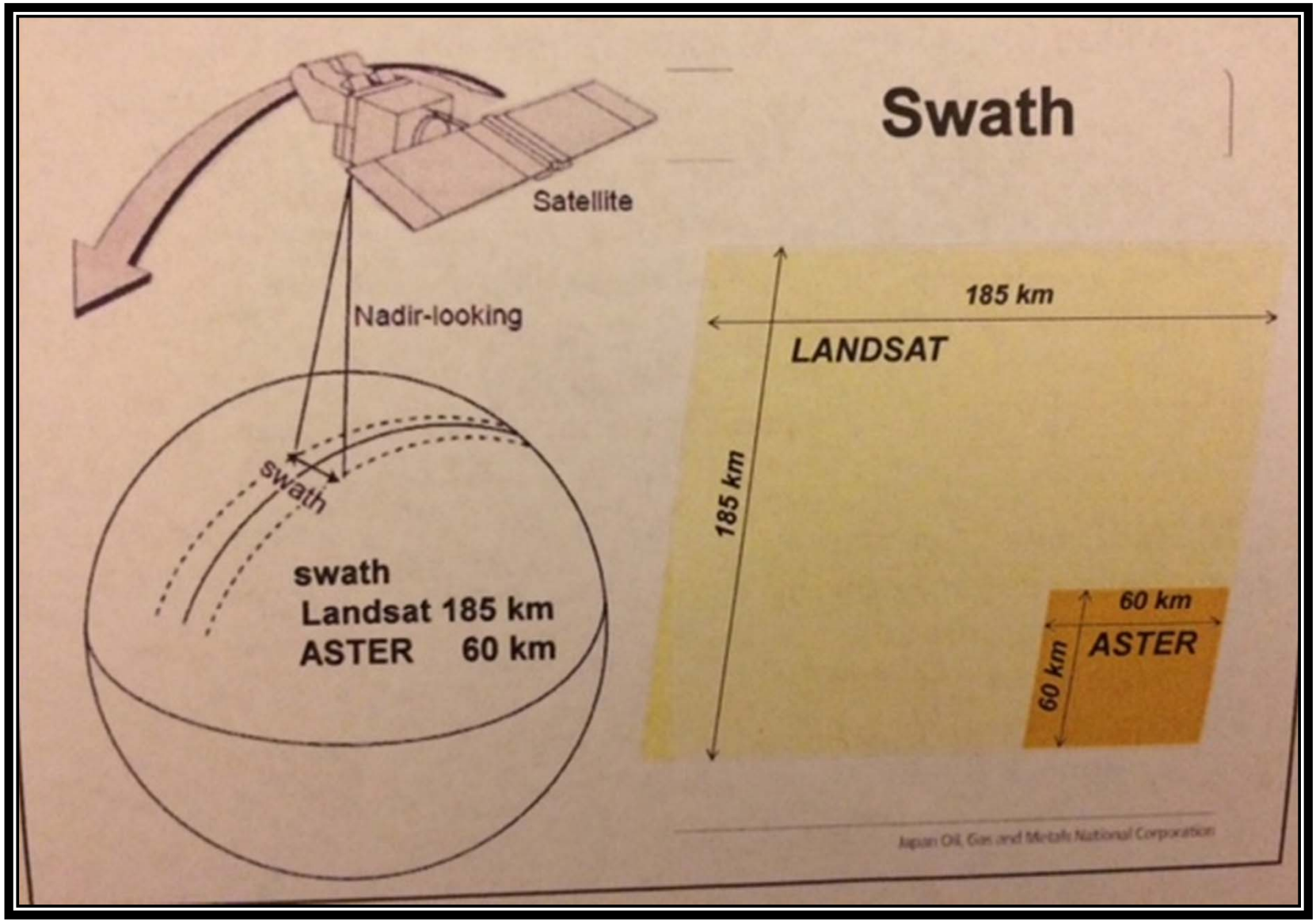
ASTER satellite sensor is one of the five state-of-the-art instrument sensor systems on-board Terra

ASTER is a cooperative effort between NASA, Japan's Ministry of Economy, Trade and Industry (METI), and Japan Space Systems



Remote Sensing

ASTER



Optical properties of a material influence the way optical radiation reacts when hitting its surface. Each material has its own specific spectral signature due to the degree of REFLECTION, ABSORPTION and TRANSMISSION at different wavelengths of the received radiation.

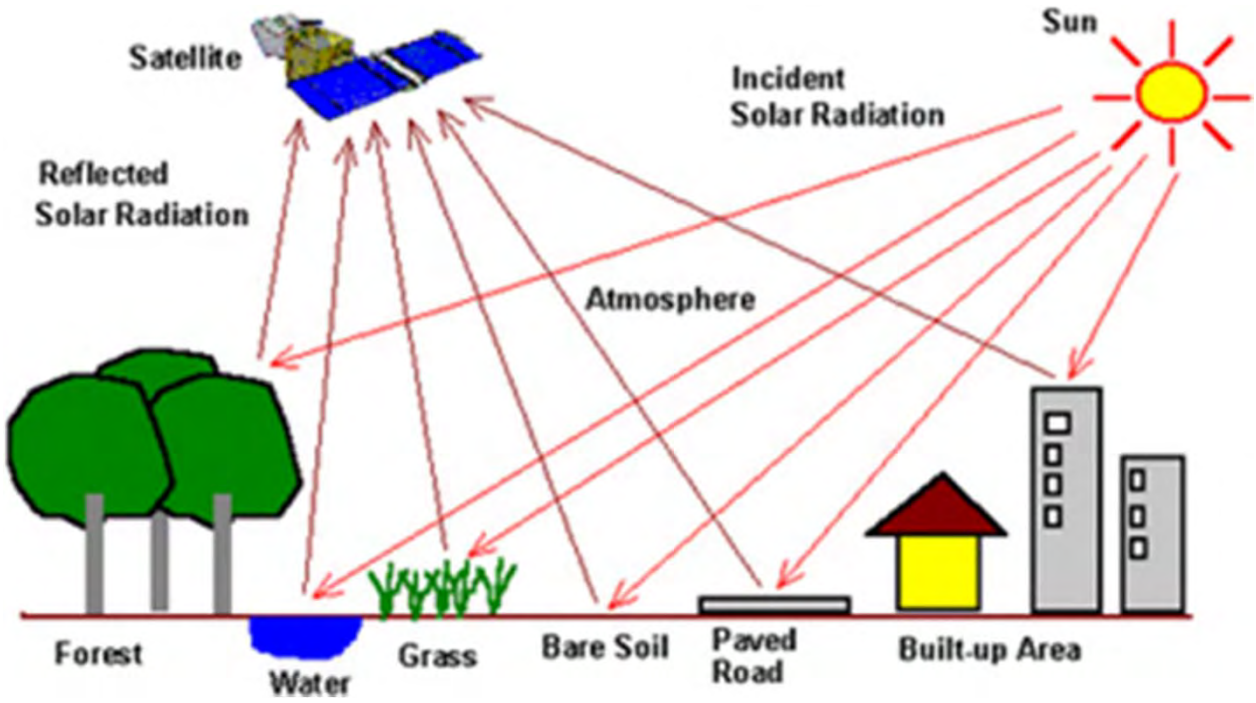
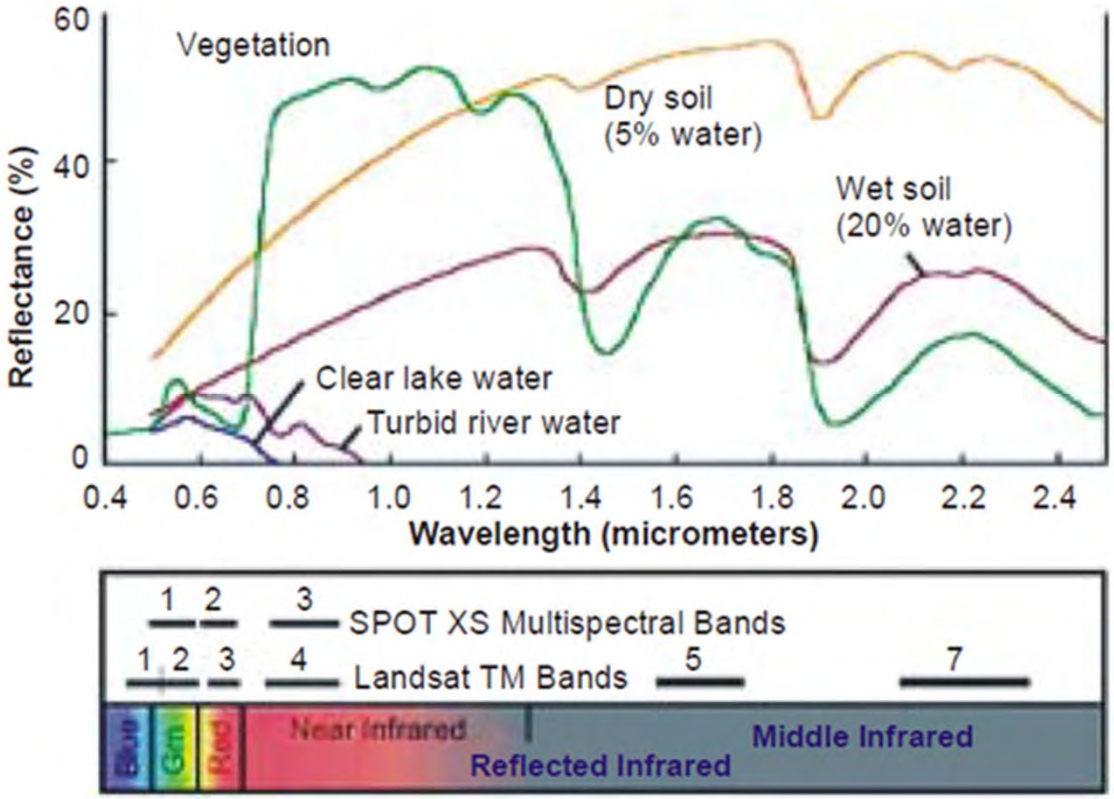
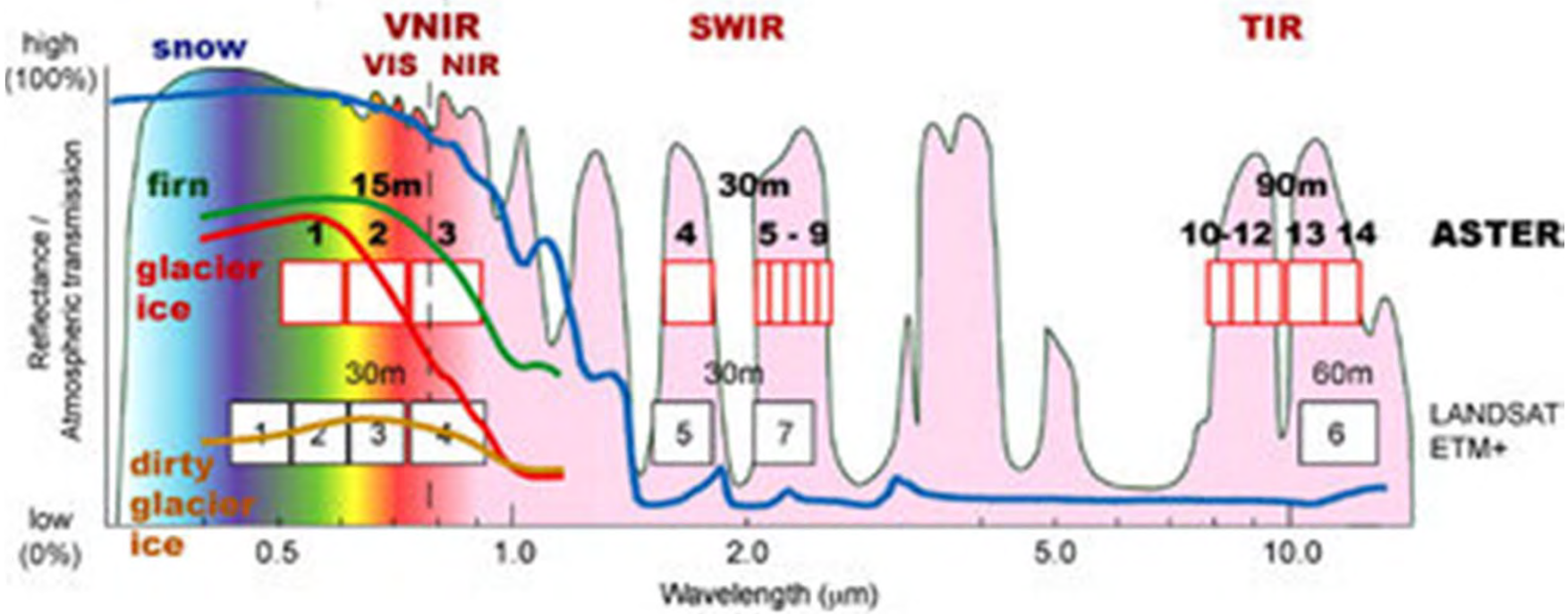

Satellite
Sun
Incident
Solar Radiation
Reflected
Solar Radiation
Atmosphere
Forest
Water
Grass
Bare Soil
Paved
Road
Built-up Area

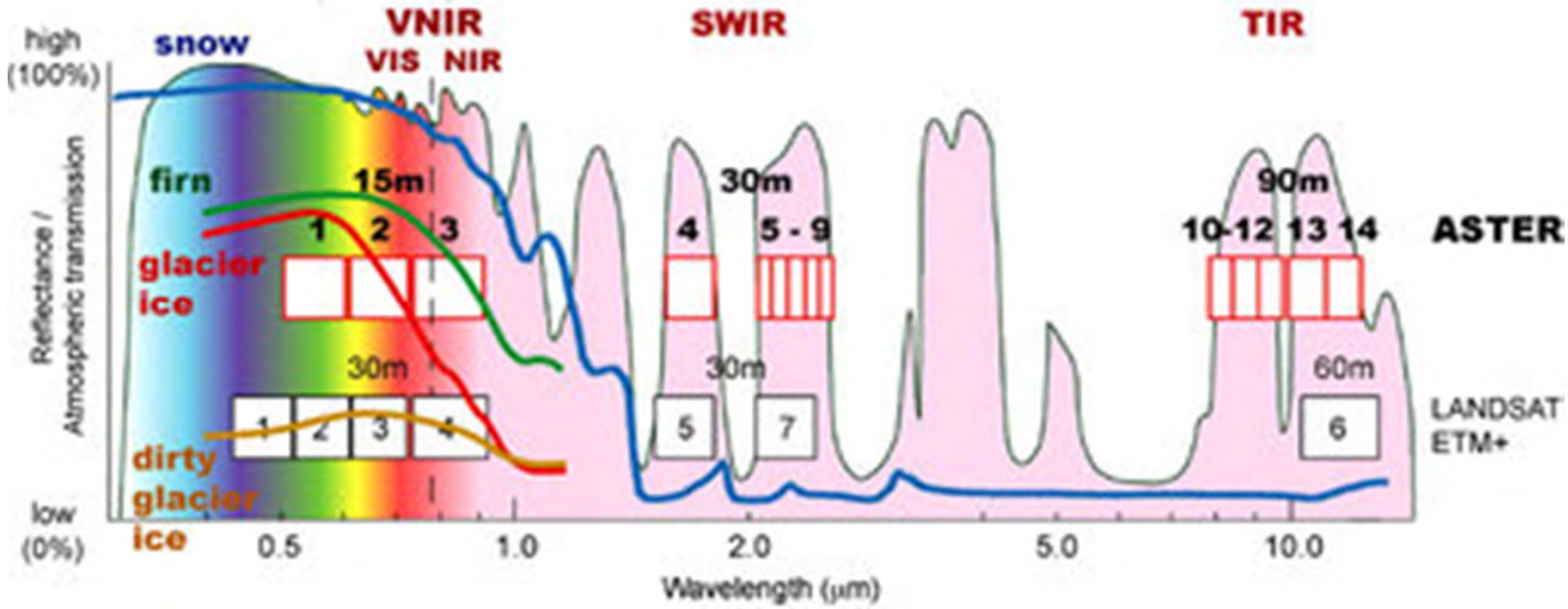
Figure 1: Spectral curves of some common materials (Smith 2012)



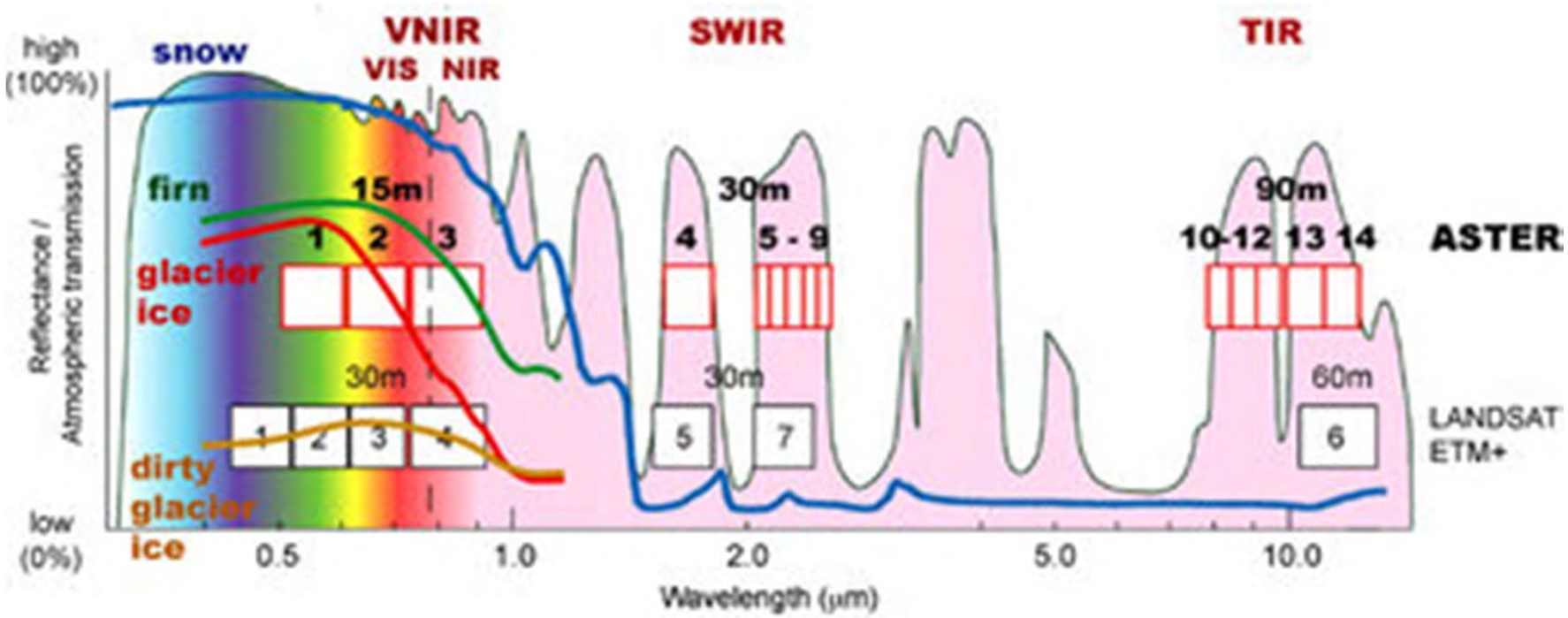


The coloured area in the above graphic indicates the degree to which the Earth's atmosphere enables electromagnetic radiation of a certain wavelength to pass through. Zones with high atmospheric transmission are suitable to observe the Earth from space. The numbered rectangles indicate the spectral bands at which sensors, here ASTER and Landsat Thematic Mapper, record radiation.

In terms of multispectral images, although Landsat has been used in most geological mapping projects, its use is limited by the low spectral resolution. **ASTER** has been more successful because it has a higher spectral resolution, **14 bands** as opposed to the **7 bands of Landsat**. The differences between **Landsat** and **ASTER** are shown below.

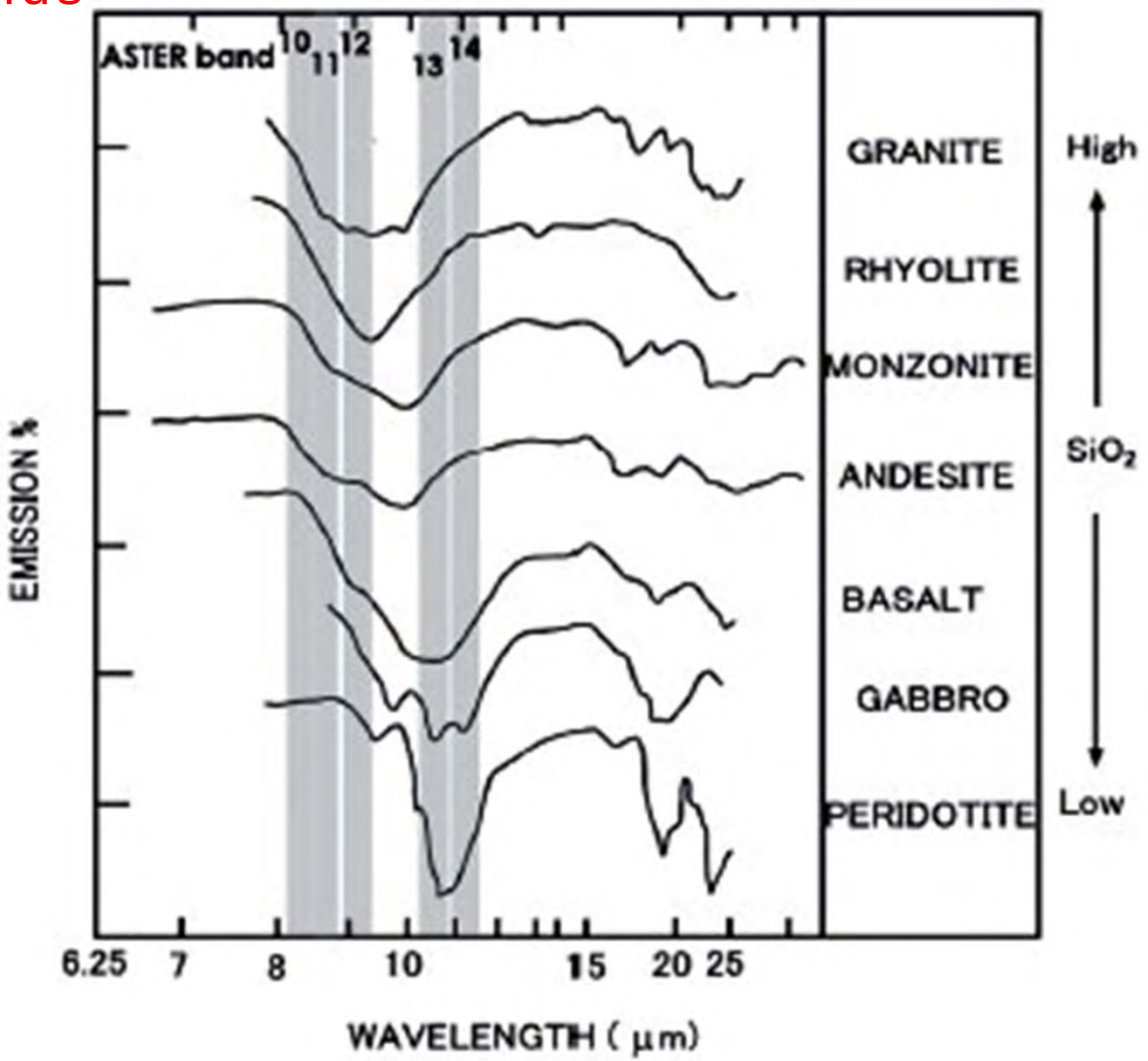


ASTER spectral bands, compared to Landsat ETM+. Atmospheric transmission with wavelength (background curve) with spectral band positions indicated (red boxes: ASTER, black boxes: Landsat ETM+). The respective spatial resolution is given for sections of the light spectrum: VNIR (visible and near infrared), SWIR (short-wave infrared), and TIR (thermal infrared) (Kaab, 2002).



Remote Sensing

Spectral characteristics of igneous rocks in thermal infrared región. Vertical gray bands indicate the ranges of five ASTER TIR bands



Remote Sensing

More Spectral characteristics

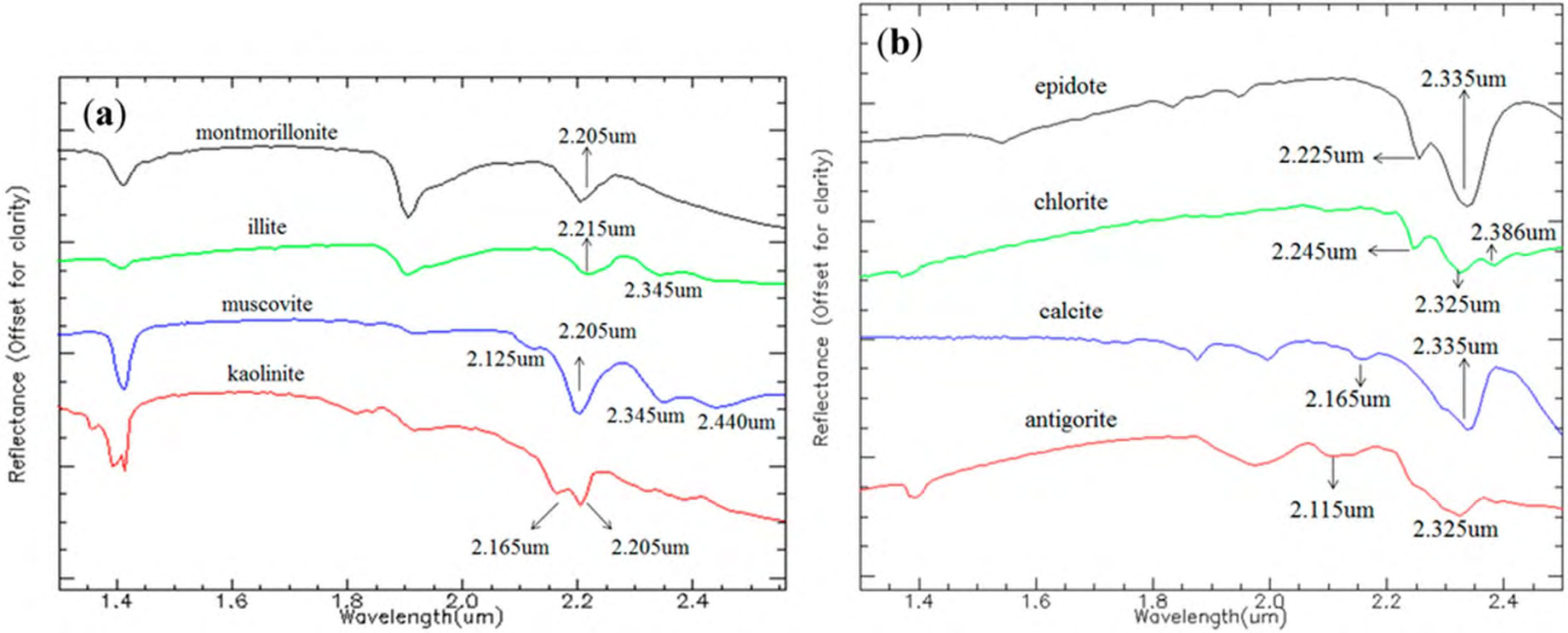


Image Processing

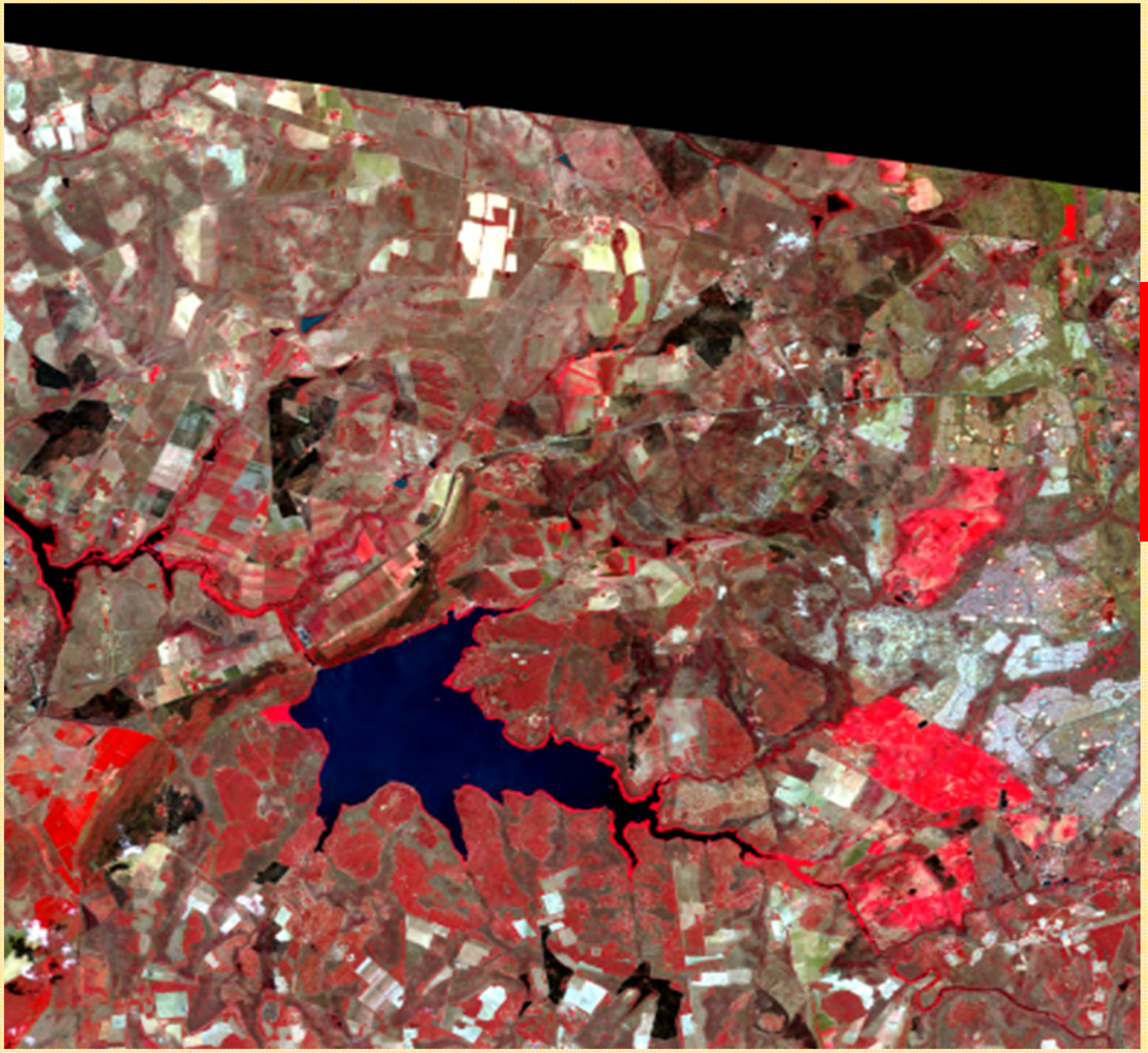
1. Preprocessing: involves the removal of unwanted data on images that might affect the quality of the results. This includes masking of edge of the image, water bodies like lakes, oceans and rivers, vegetation and clouds which are not needed for geology and metallogeny.

2. Image processing for extracting lithology such as mafic rocks (like greenstone rocks) and felsic (like granitic rocks) units. This processing generates and reveals alteration zones that manifest near or at the surface. This is done using false and natural color composite images like RGB 321,468 and band ratios.

3. Extraction of geological structures is done using digital elevation data(DEM Data)

Here geological contacts, structures like faults, shear zone, folds and others are extracted.

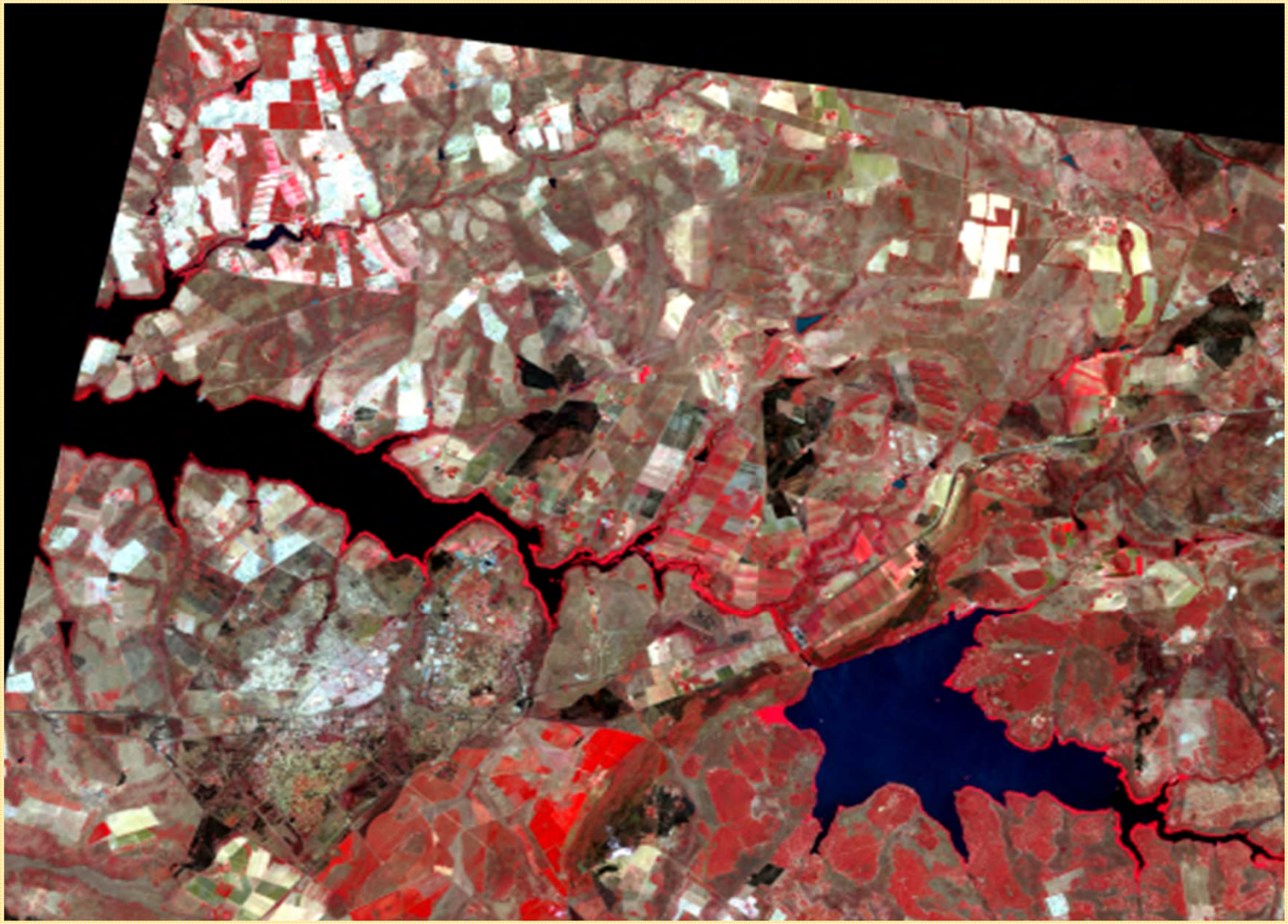
FCC321 RAW



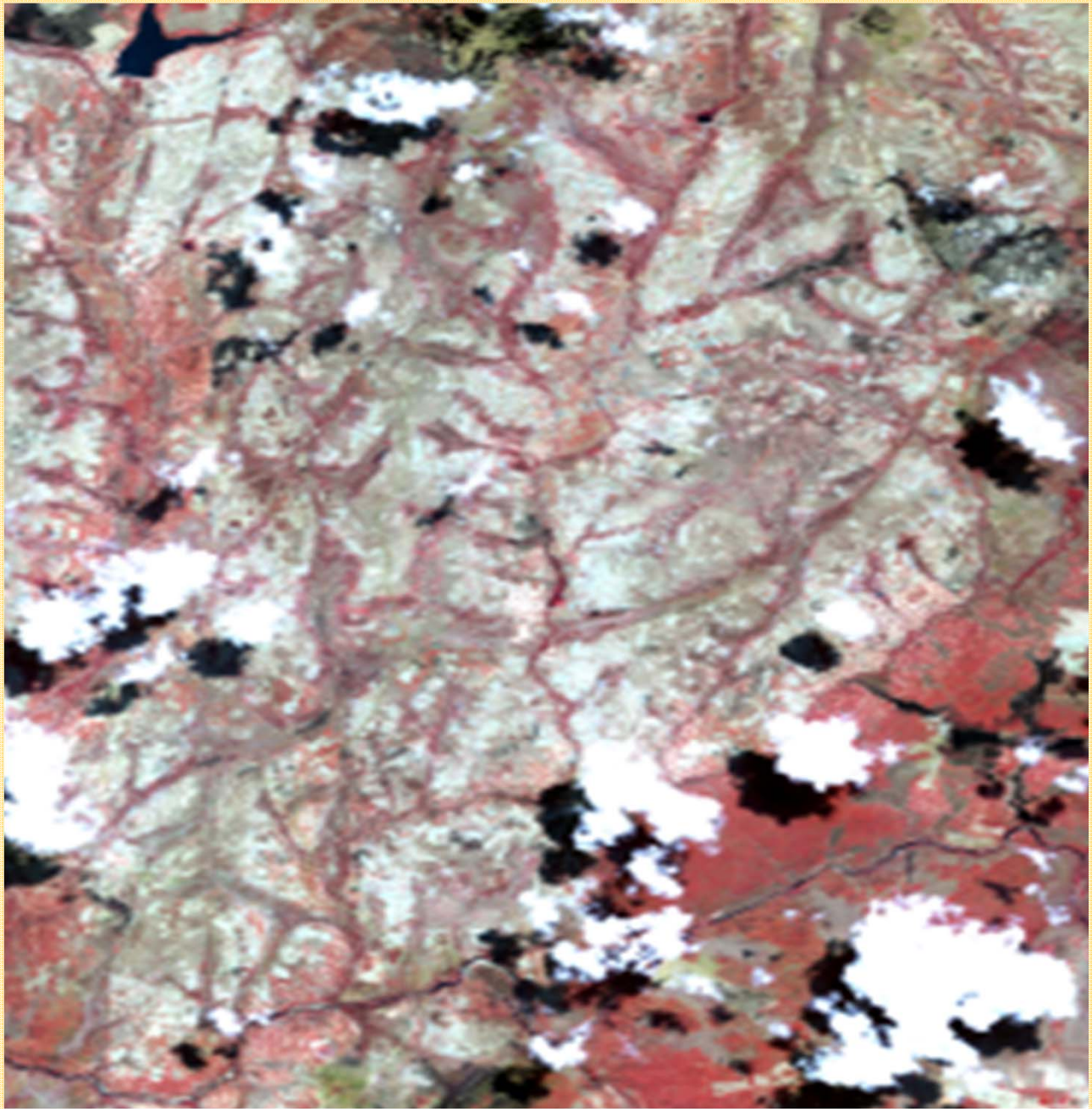
RED colour shows VEGETATION

FCC321 RAW

BLUE BLACK show WATER



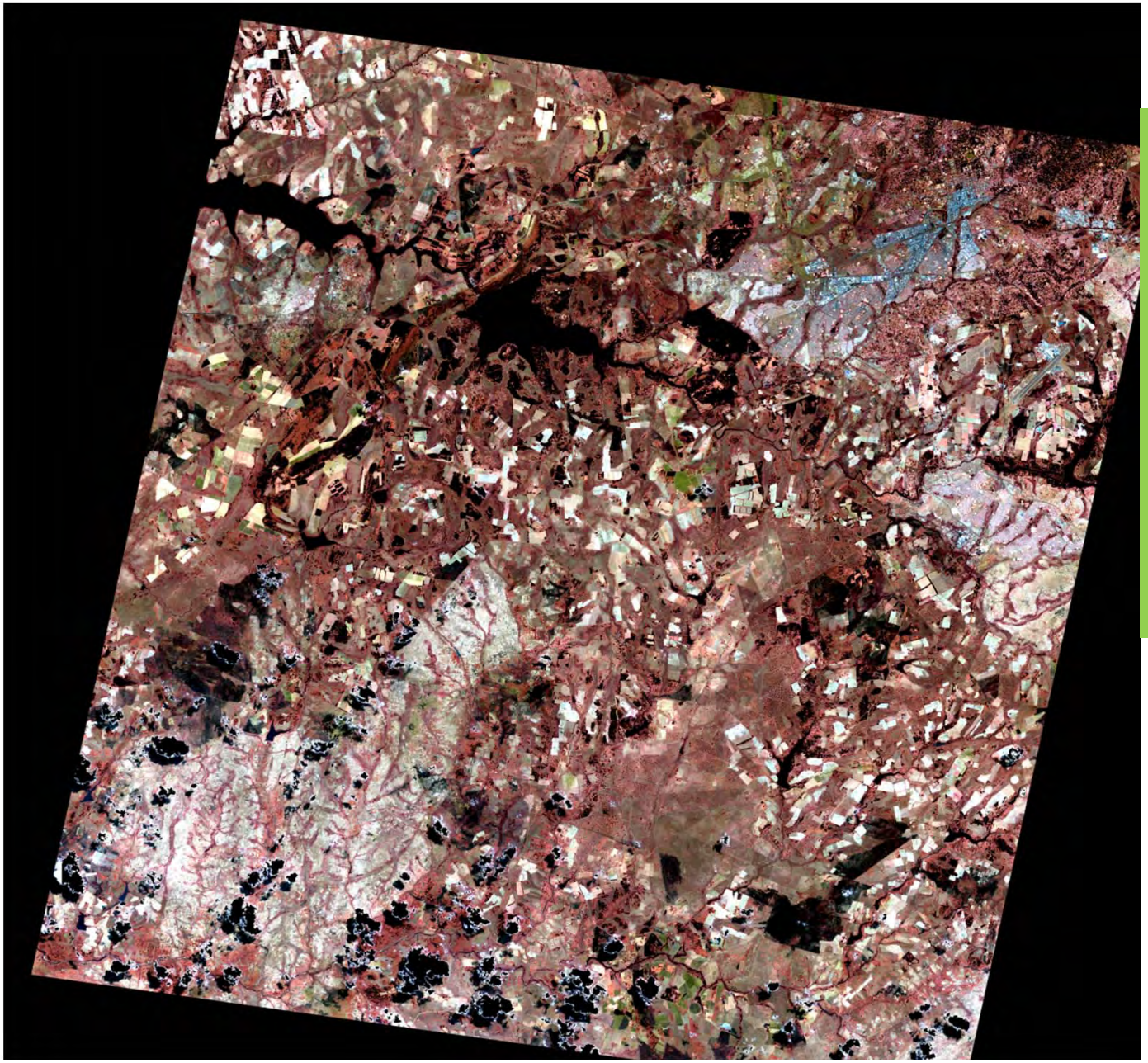
FCC321 RAW



CLOUDS

are shown in white

FCC321 PROCESSED



WATER +

CLOUDS +

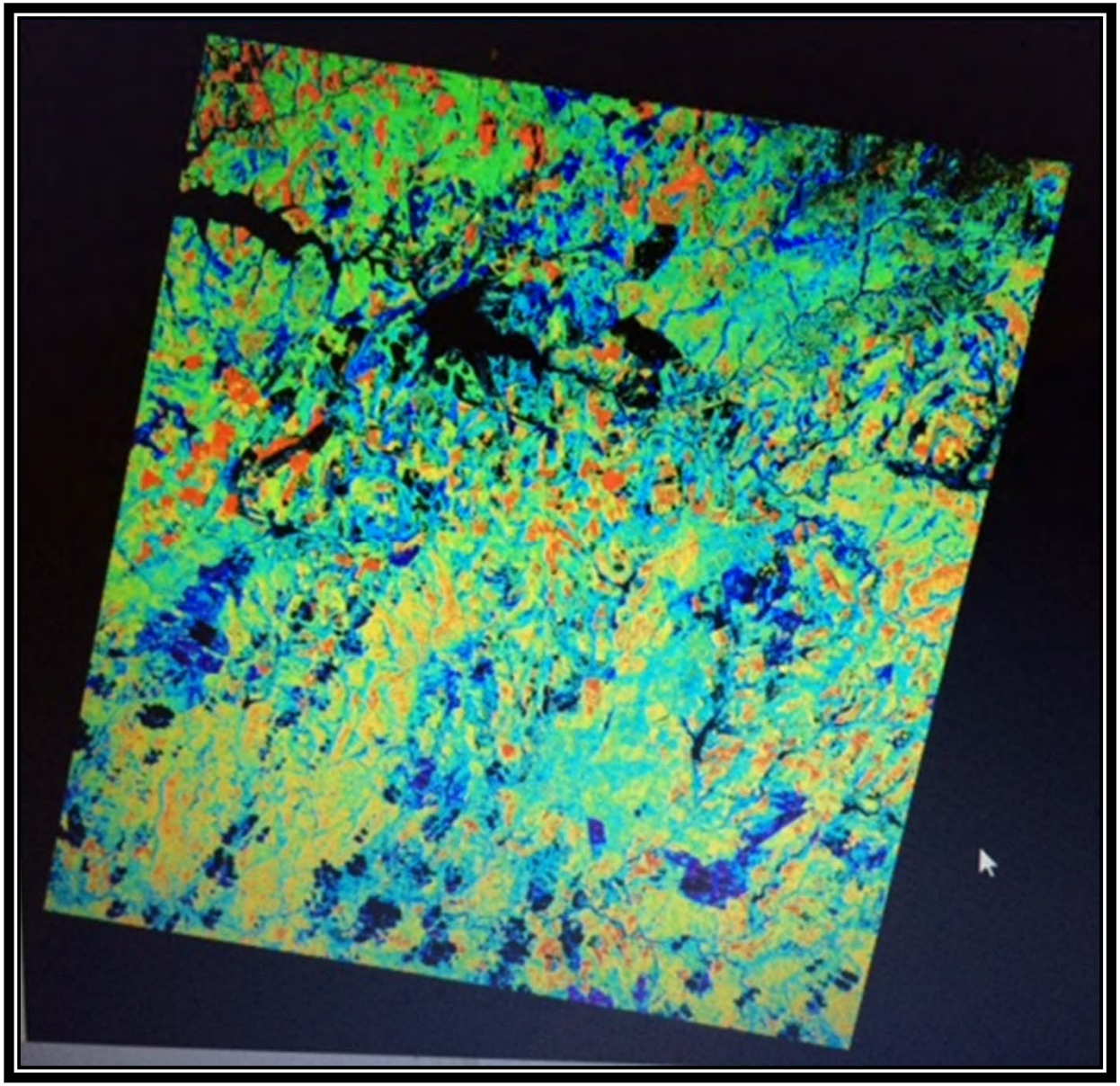
VEGETATION +

EDGE +

masked

Remote Sensing

IMAGE
Showing IRON INDEX



Remote Sensing

IMAGE
Showing CARBONATE INDEX