REMOTE SENSING DATA ACQUISITION

“Remote sensing is, broadly but logically speaking, the collection of information about an object without making physical contact with it.”

“The whole electromagnetic spectrum can be used for detecting and measuring ever finer details of the emitted and reflected waves that contain the fingerprints of the medium with which they interact.”

Oldest example of remote sensing: airborne photography !

COURSE OUTLINE

- Electromagnetic radiation and its interaction with matter
- Optical systems
- Exercise on ray tracing (Beam Four software)
- Microwave systems

REFERENCE MATERIAL

Lesson slides: available for download from Moodle

<u>“Physical Principles of Remote Sensing”, W. G. Rees</u>, 3rd ed.,
Cambridge University Press, 2013.

<u>“Radar Handbook”, M. Skolnik</u>, 3rd ed., New York, McGraw-Hill, 2008.

EVALUATION

Written exam

CONTACT

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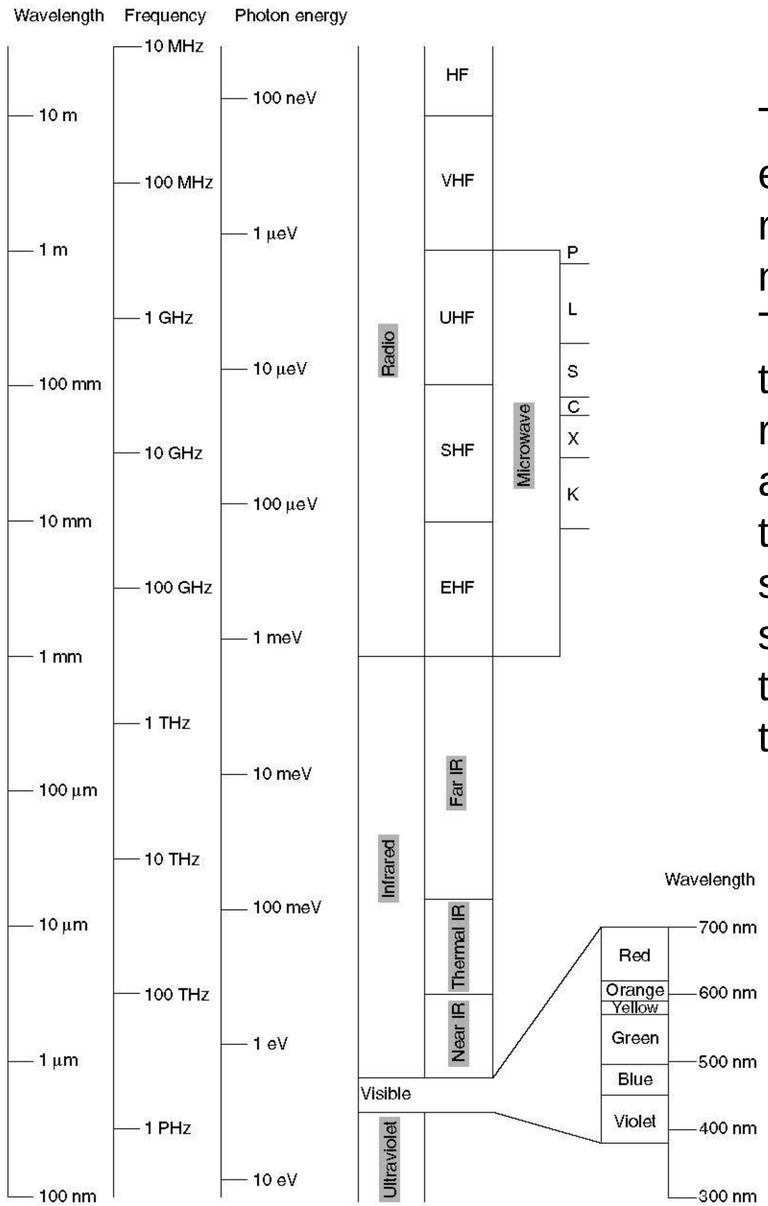
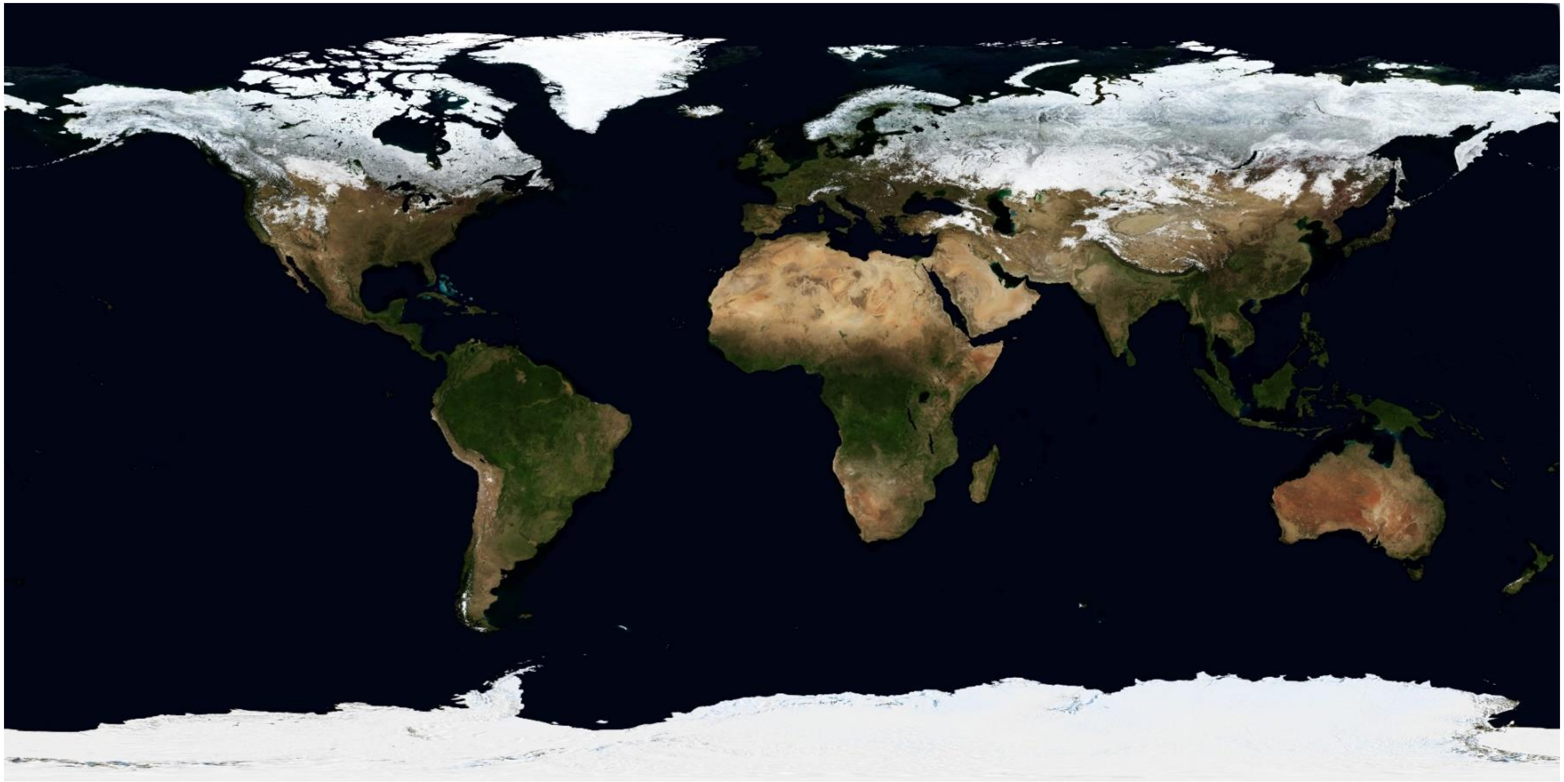


ELECTROMAGNETIC SPECTRUM

The diagram shows those parts of the electromagnetic spectrum that are important in remote sensing, together with the conventional names of the various regions of the spectrum. The letters (P, L, S, etc.) used to denote parts of the microwave spectrum are in common use in remote sensing, being standard nomenclature amongst radar engineers in the USA. Note also that various terminologies are in use for the subdivisions of the infrared (IR) part of the spectrum. The thermal IR band contains most of the power emitted by black bodies at terrestrial temperatures.

Visible light: 380 - 750 nm
Near infrared: 0.75 - 3 µm (or 0.75 - 8 µm)
Thermal infrared: 8 - 15 µm
Far infrared: 15 µm - 1 mm

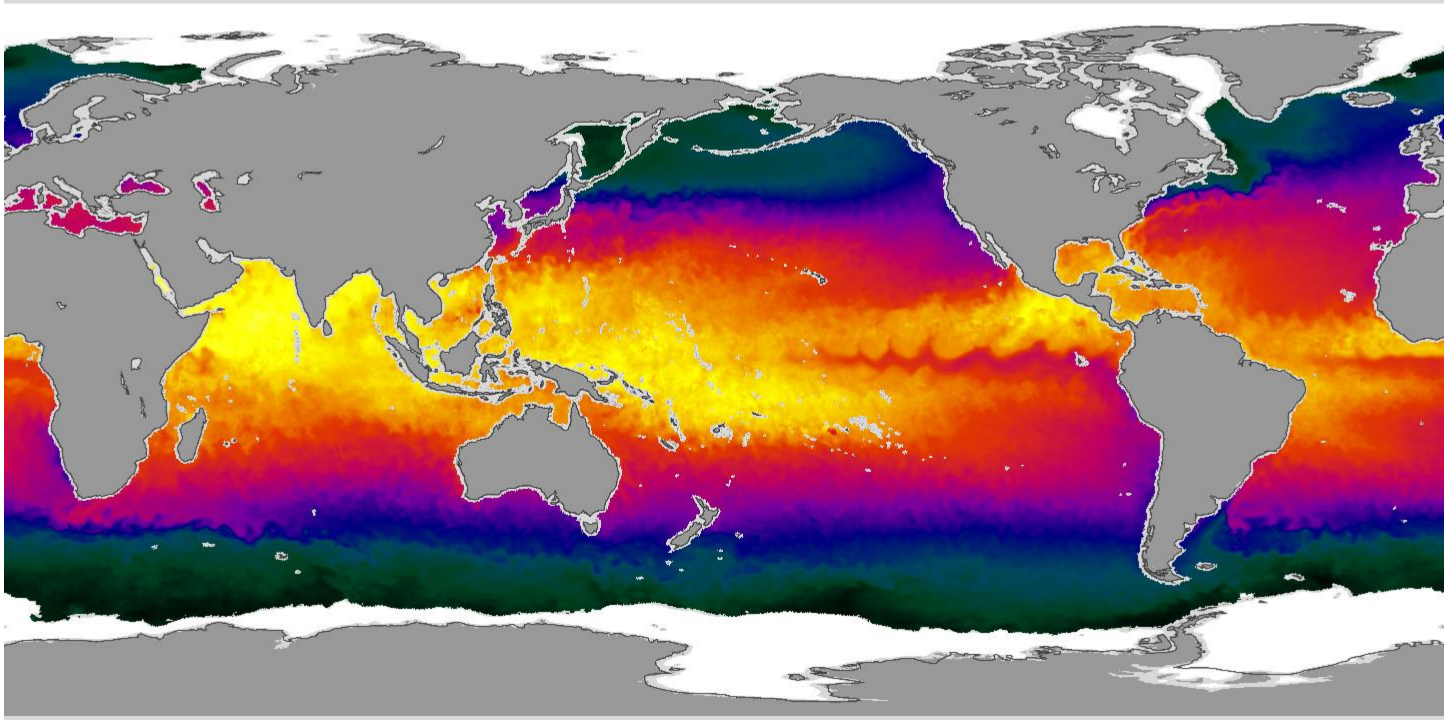


Blue Marble Next Generation offers greater spatial detail of the surface and spans a longer data collection period than the original. The original Blue Marble was a composite of four months of MODIS observations with a spatial resolution (level of detail) of 1 square kilometer per pixel. Blue Marble Next Generation offers a years worth of monthly composites at a spatial resolution of 500 meters. These monthly images reveal seasonal changes to the land surface: the green-up and dying-back of vegetation in temperate regions such as North America and Europe, dry and wet seasons in the tropics, and advancing and retreating Northern Hemisphere snow cover.

Blue Marble Next Generation improves the techniques for turning satellite data into digital images. Among the key improvements is greater detail in areas that usually appear very dark to the satellite (because a large amount of sunlight is being absorbed), for example in dense tropical forests. The ability to create a digital image that provides great detail in darker regions without washing out brighter regions, like glaciers, snow-covered areas, and deserts is one of the great challenges of visualizing satellite data.

http://visibleearth.nasa.gov/view.php?id=74218

http://earthobservatory.nasa.gov/Features/BlueMarble/?src=ve



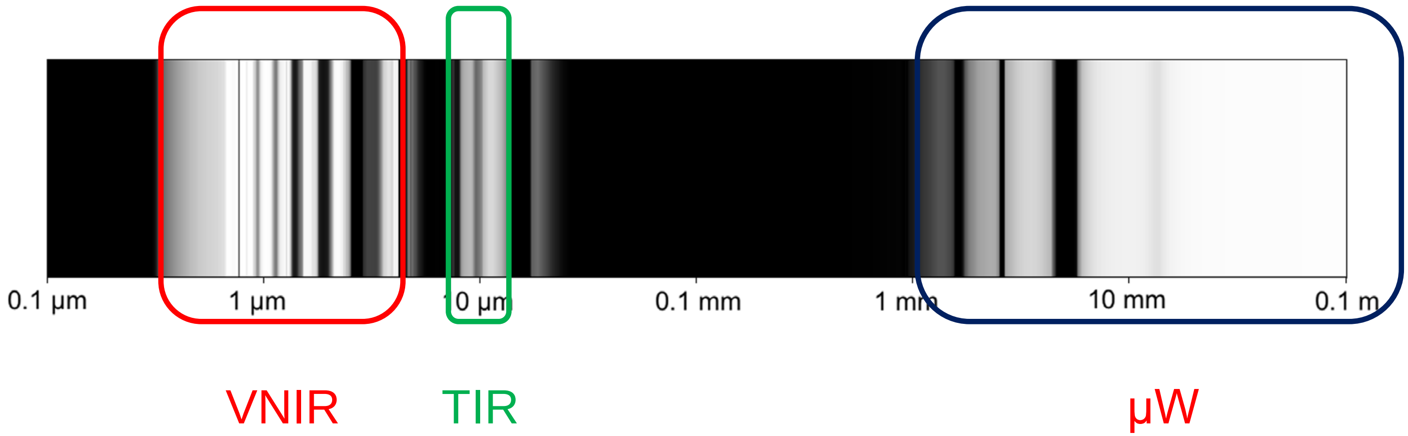
The image above shows global sea surface temperature as measured on June 1, 2003, by NASDA's Advanced Microwave Scanning Radiometer for EOS (AMSR-E) aboard the satellite.

The colors in this false-color map represent temperatures of the ocean's surface waters, ranging from a low of -2°C in the darkest green areas to a high of 35°C in the brightest yellow-white regions. Sea ice is shown as white and land is dark gray. Note the continuous coverage that AMSR-E provides around the world: because it can make measurements through clouds, as well as under clear conditions, there are few gaps in the data.

http://aqua.nasa.gov

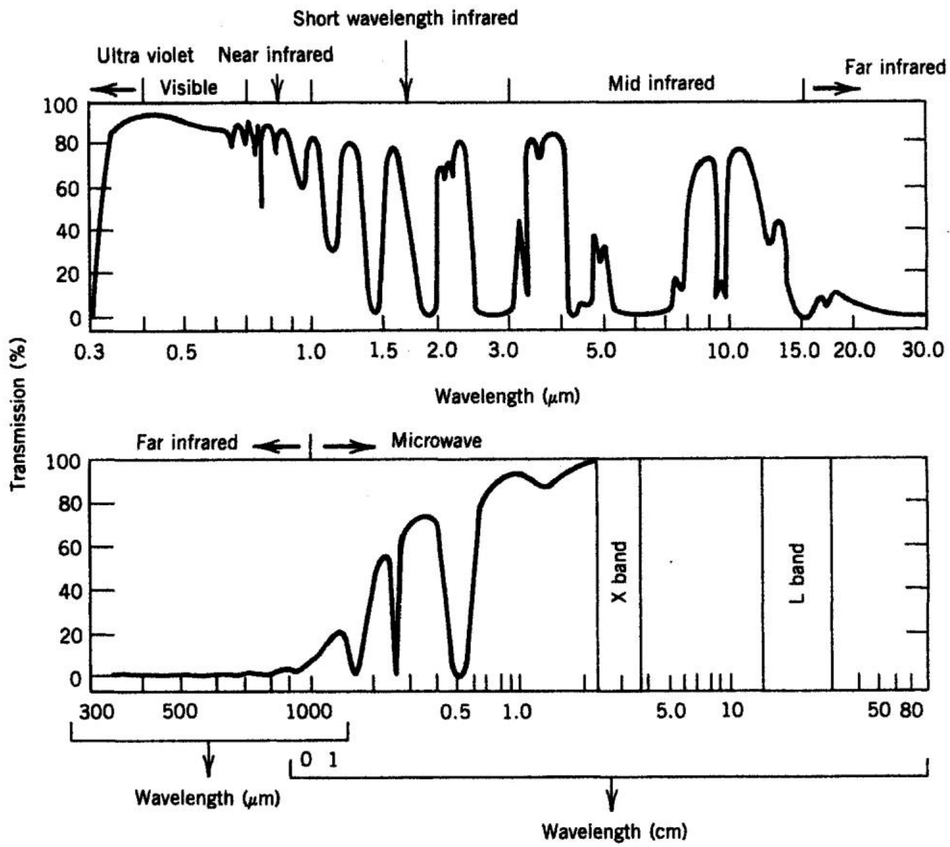
https://aqua.nasa.gov/content/instruments

Transparency of the Earth's atmosphere as a function of wavelength: black regions are opaque, white regions transparent.



There are three transparent windows in the atmosphere:

- ✓ Visible and near infrared, VNIR: λ=0.38 - 3 µm
- ✓ Thermal infrared radiation, TIR: λ=8 - 15 µm
- ✓ Microwave region, µW: λ=1 mm - 1 m



Generalized absorption spectrum of the Earth's atmosphere at the zenith: the curves show the total atmospheric transmission.

	PASSIVE SYSTEMS sensors collect the thermal radiation or the scattered solar radiation	ACTIVE SYSTEMS the target is illuminated by and artificial source and sensors measure the reflected radiation
VNIR Visible and Near-Infrared Radiation λ= 0.3 - 3 μm	Camera Electro-optical systems	Laser profiler LIDAR (Light detection and ranging)
TIR Thermal infrared radiation λ= 8 - 15 μm	TIR imaging systems	
MICROWAVE λ= 1 mm - 1 m	Passive microwave radiometer	Radar altimeter RADAR (Radio detection and ranging) Microwave scatterometer Imaging radar