ECONOMIC COOPERATION ORGANIZATION (ECO)

TRAINING COURSE

The National Cartographic Center of Iran with the support of ECO Secretariat holds a training course on:

Application of Geospatial Data in Disaster Risk Reduction

16-17 December, 2024

The Role of Remote Sensing in Disaster Management

Application of Geospatial Data in Disaster Risk Reduction Training Course

Economic Cooperation Organization (ECO)

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Tehran, Islamic Republic of Iran

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- Activities of National Cartographic Center of Iran on sand and dust storm Disaster

Disaster

- It is a phenomenon that can cause damage to life and property and destroy the economic, social, and cultural life of people

- Disasters are categorized into two main types:
  - Natural
  - Human - made

Disaster

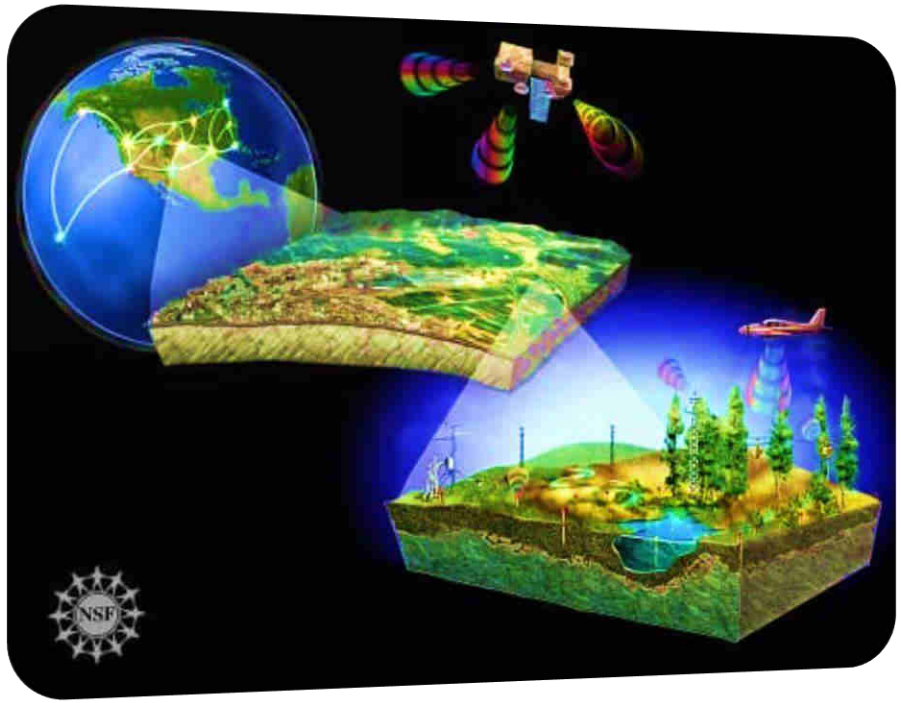
- Disaster is a natural or man-made hazard resulting in an event of substantial extent causing significant damage or destruction, loss of life, or drastic change to the environment

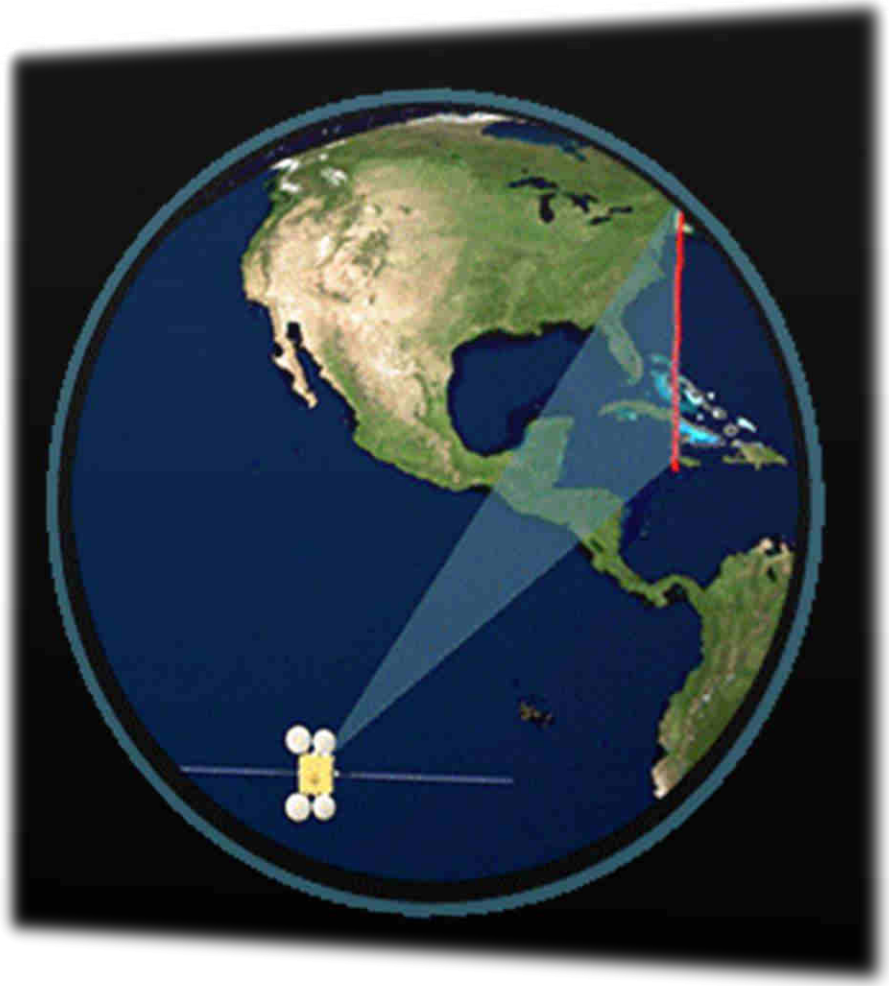
- Disasters are categorized into two main types:
  - Natural
  - Human - made

Remote Sensing

- Remote Sensing is a method of acquiring information about the properties of an object or phenomenon from a distance

- Three main categories of remote sensing platforms:
  - Ground-based
  - Airborne-based
  - Spaceborne-based





Disaster Management Cycle

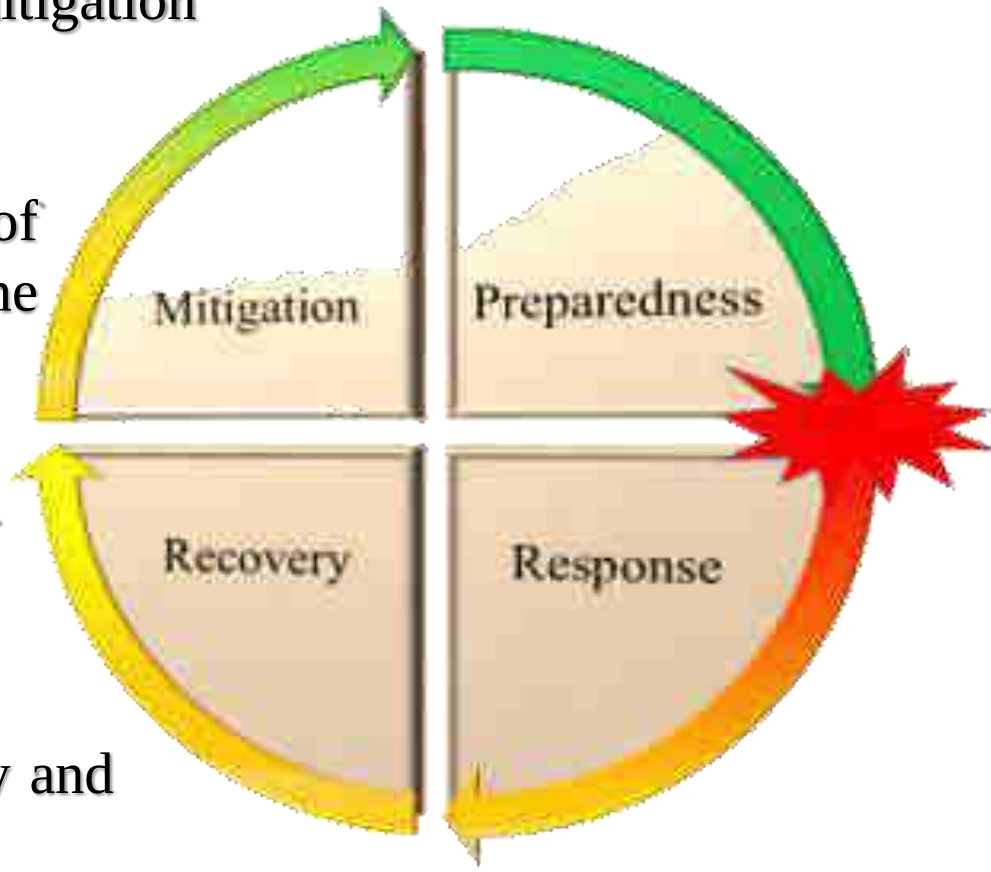
- Remote Sensing technology represents trustworthy source in the different phases of a disaster cycle:

- RS in mitigation: Organizing effective actions for disaster mitigation

- RS in preparedness and early warning: Detection of precursory signals in short-time hazard prediction and the activation of early warnings

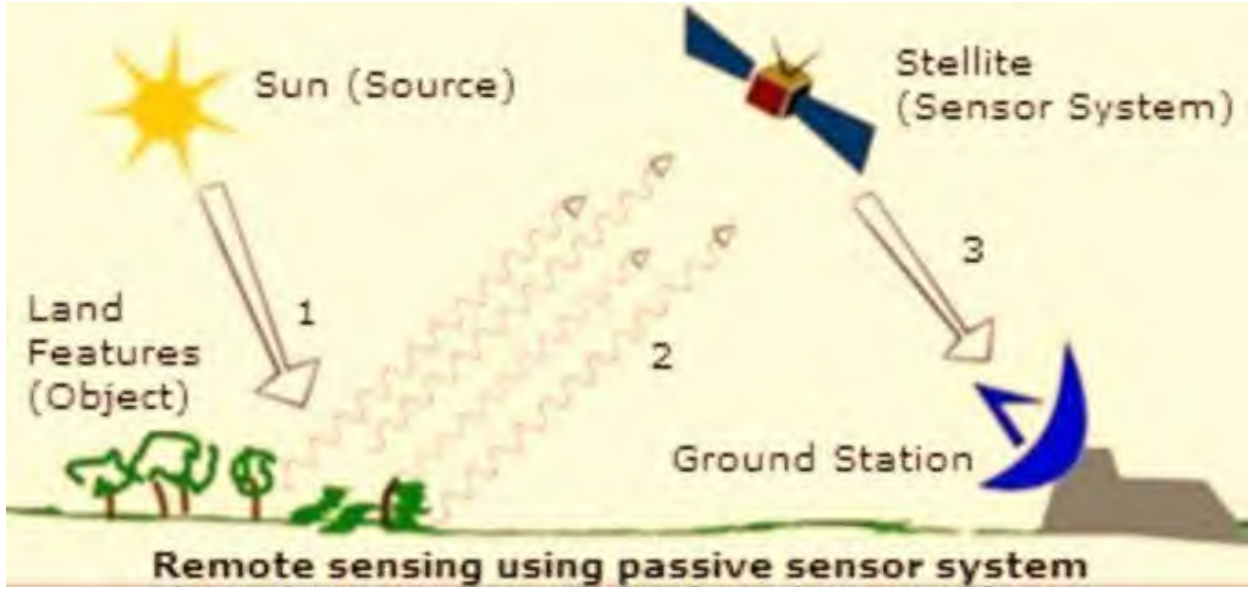
- RS in response: Rapid and efficient response activities after a disaster

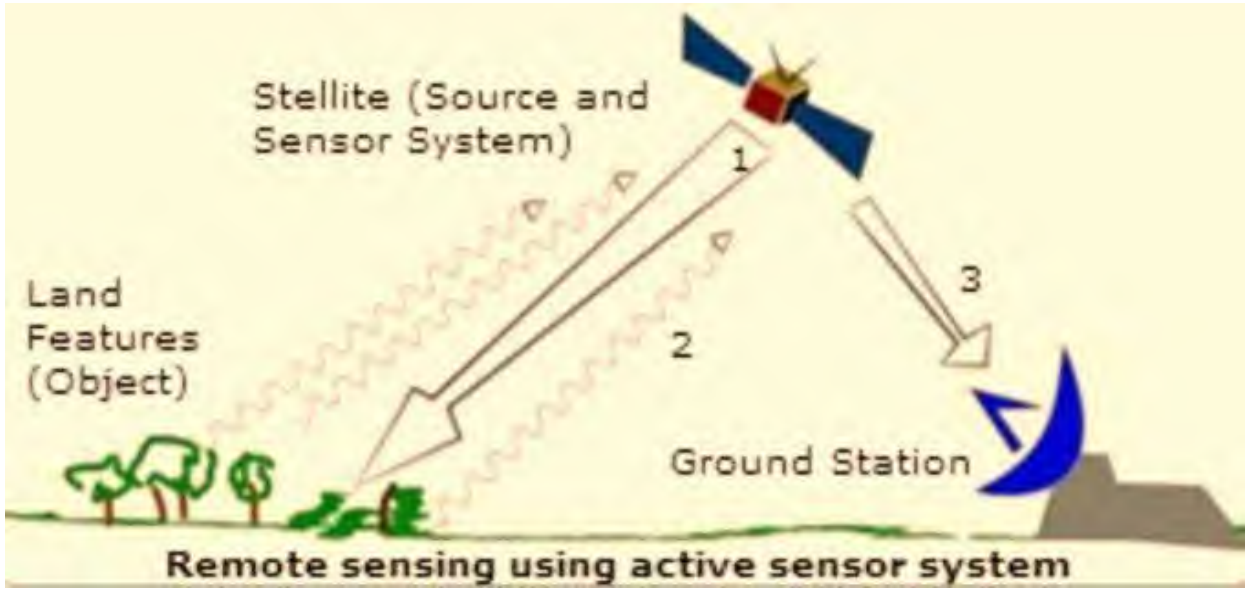
- RS in recovery: Monitoring and evaluation of the recovery and reconstruction actions



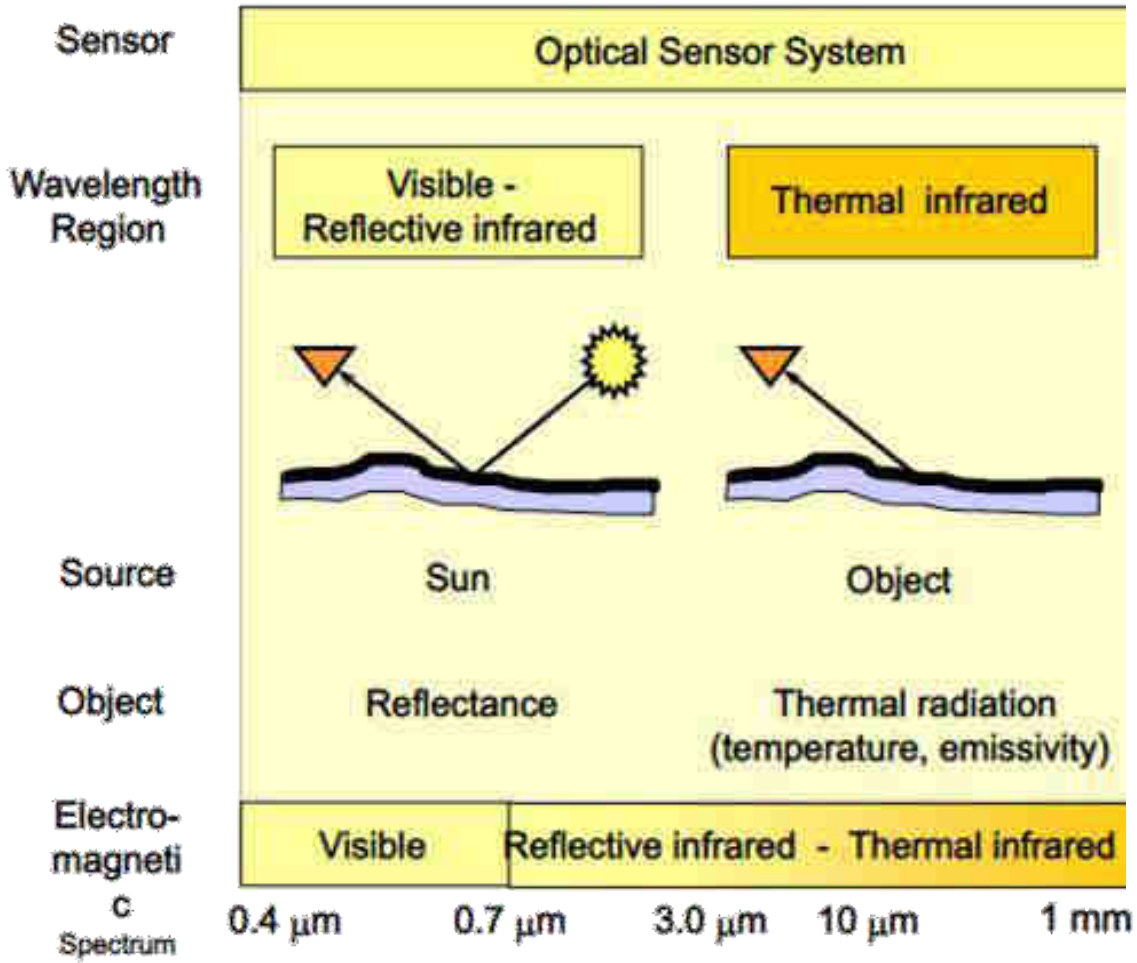
Remote Sensing Instruments

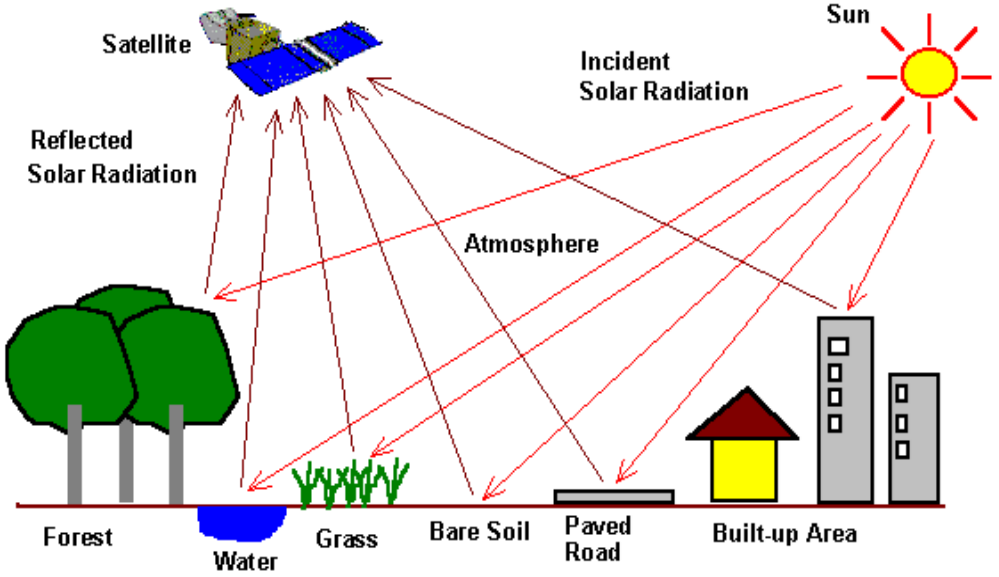
- Two categories of imaging sensors in remote sensing:
  - Passive sensors
  - Active sensors

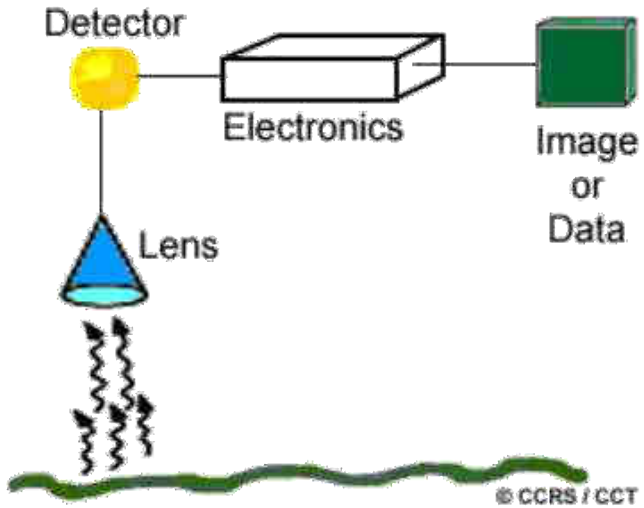




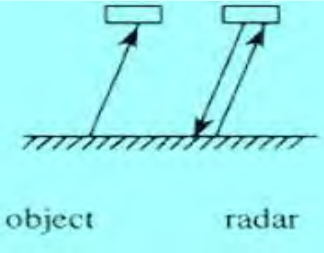
Types of Remote Sensing

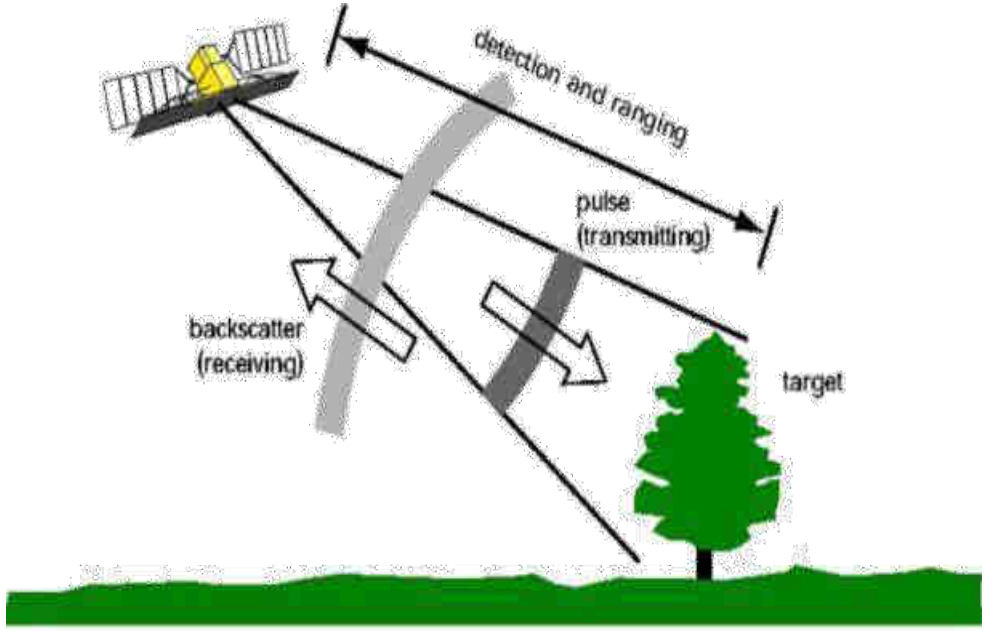




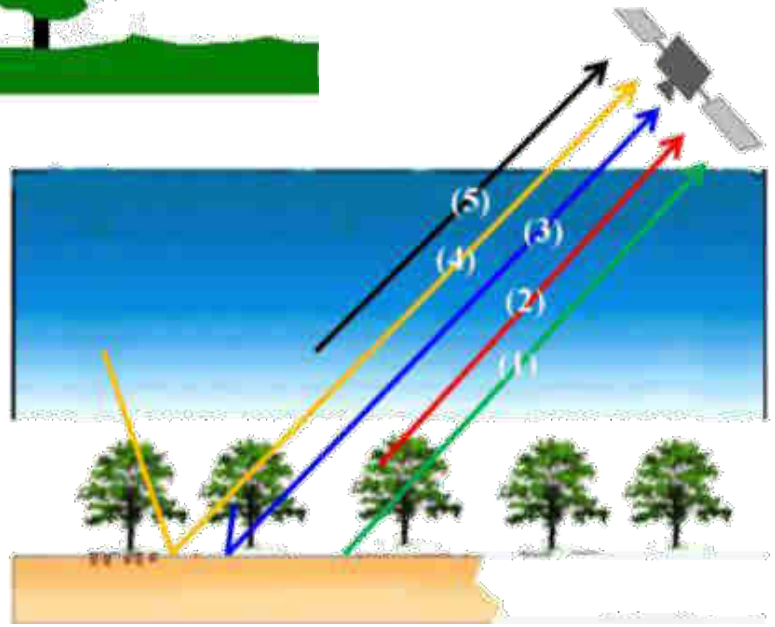


Types of Remote Sensing

Sensor	RADAR System
Wavelength Region	Microwave
	
Source	Transmitted by Remote sensing System
Object	microwave radiation / backscattering coefficient
Electro-magnetic Spectrum	Microwave
	1 mm



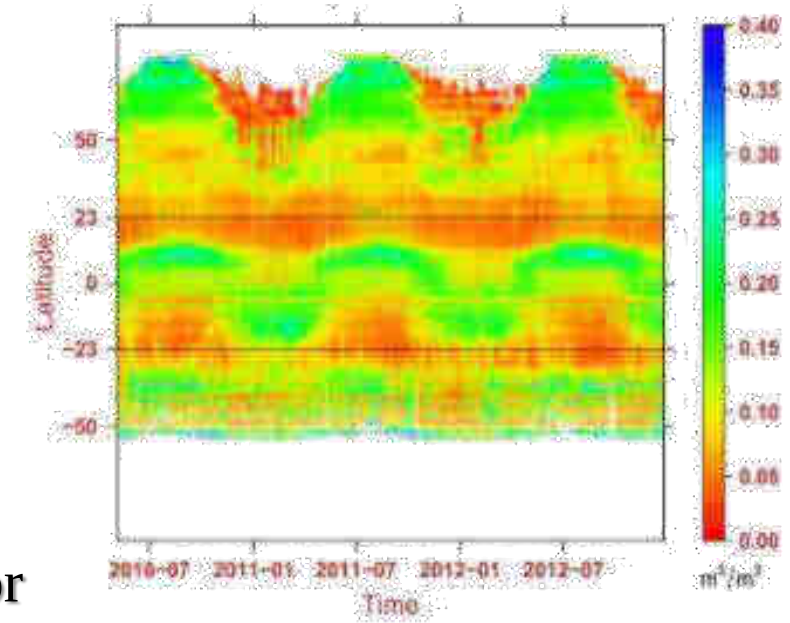
Active microwave



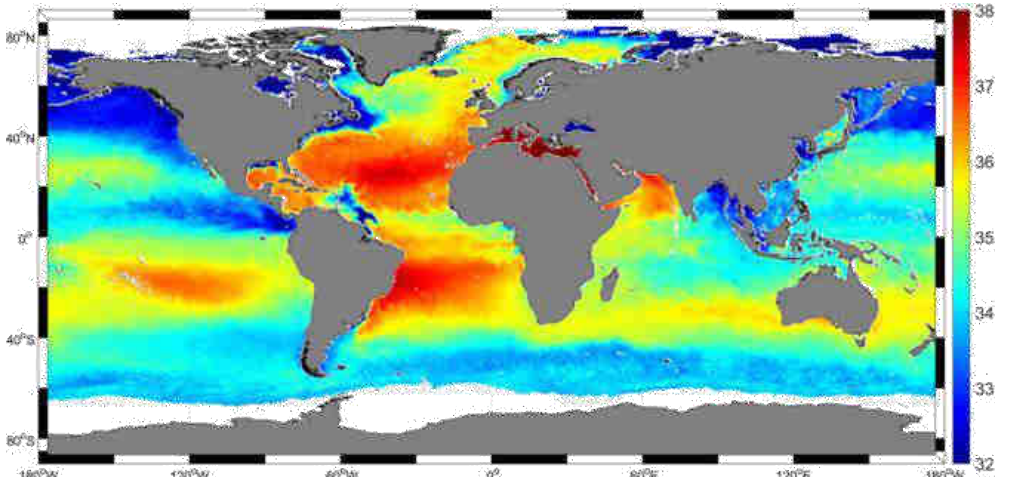
Passive microwave

Passive Microwave Applications

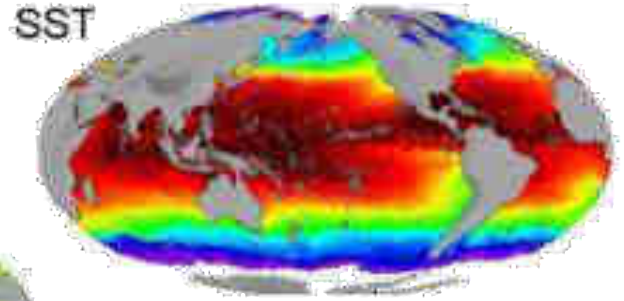
- Soil moisture
- Sea surface temperature
- Surface wind speed
- Atmospheric water vapor
- Sea/lake ice extent, concentration and type



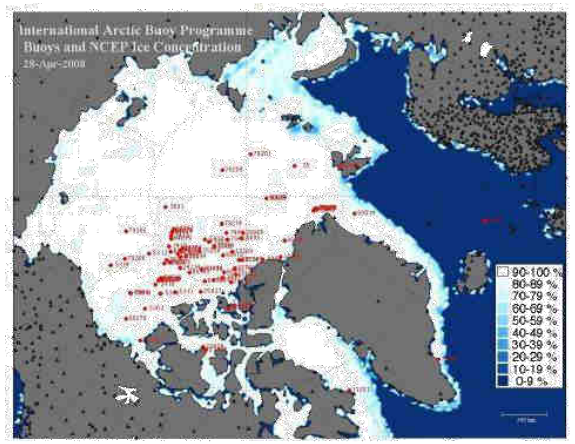
Soil moisture



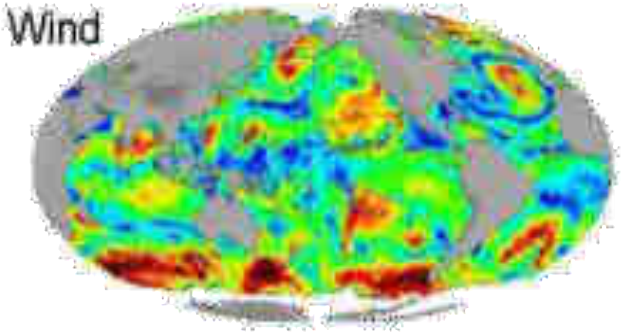
Sea surface salinity



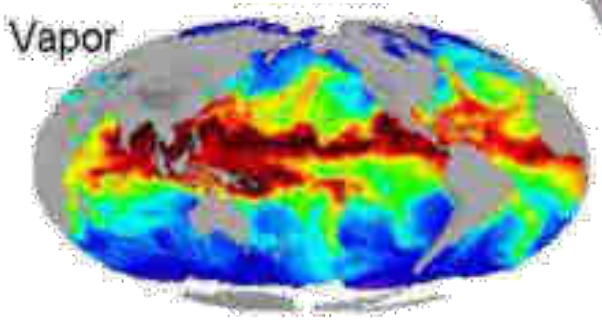
Sea surface temperature over the ocean



Sea ice concentration



Wind speed over the ocean

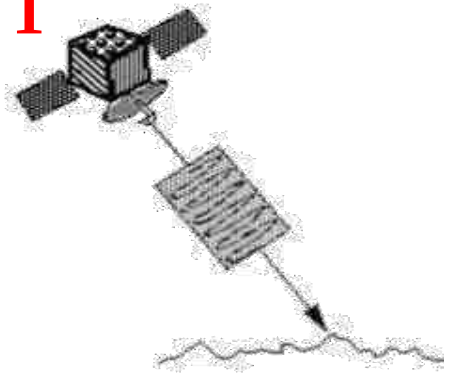


Atmospheric water vapor over the ocean

Active Microwave

- Radio detection and Ranging (Radar)
  - Time delay between the transmitted and backscattered signal
    - Determination the distance to the target
  - Strength of the backscattered signal
    - Discrimination between different targets
- Two types of imaging radars:
  - Real Aperture Radar (RAR)
  - Synthetic Aperture Radar (SAR)

1



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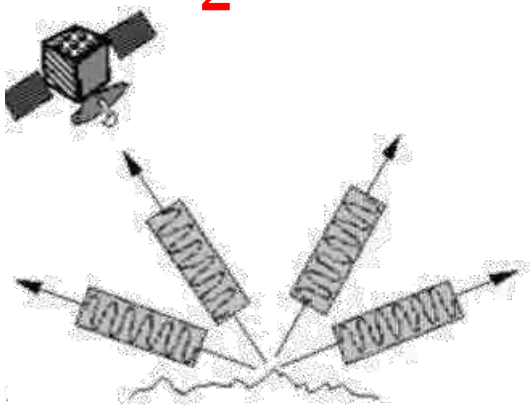

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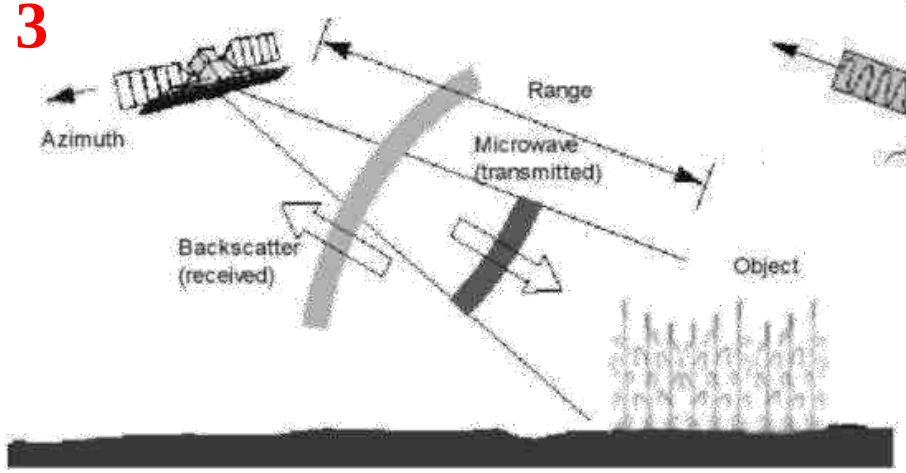
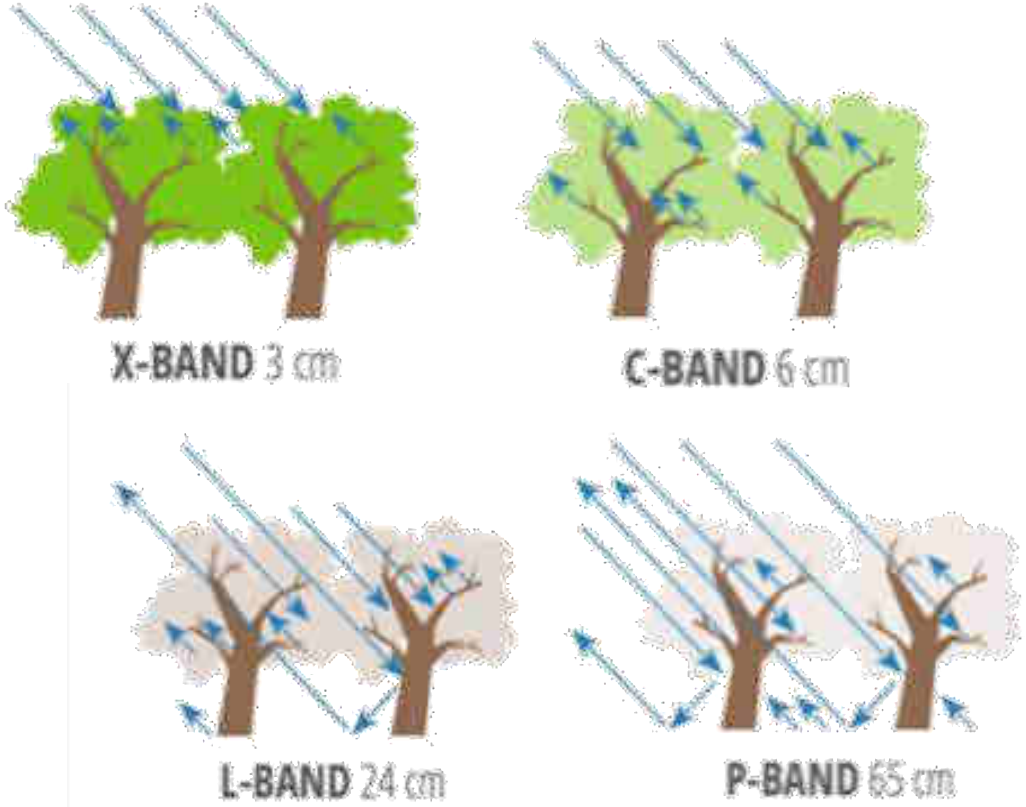
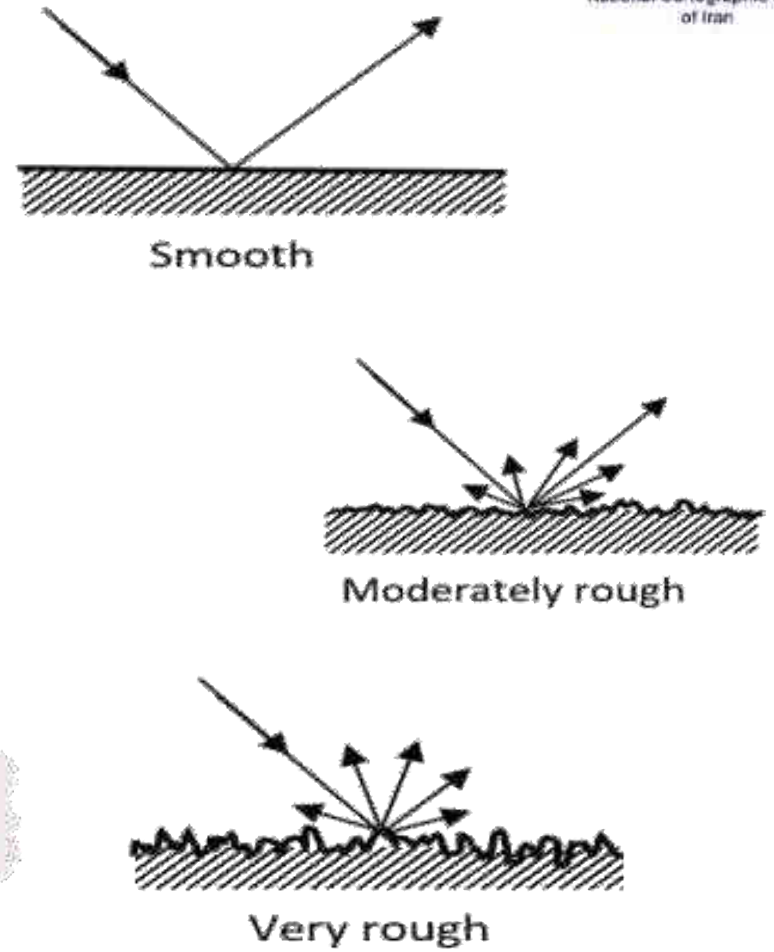


Radar Backscattering

- Radar backscattering behavior depends upon the:
  - Sensor parameters
    - Frequency
    - Polarization
    - Acquisition mode
    - Incidence angle
  - Target parameters:
    - Roughness
    - Dielectric constant
    - Geometry



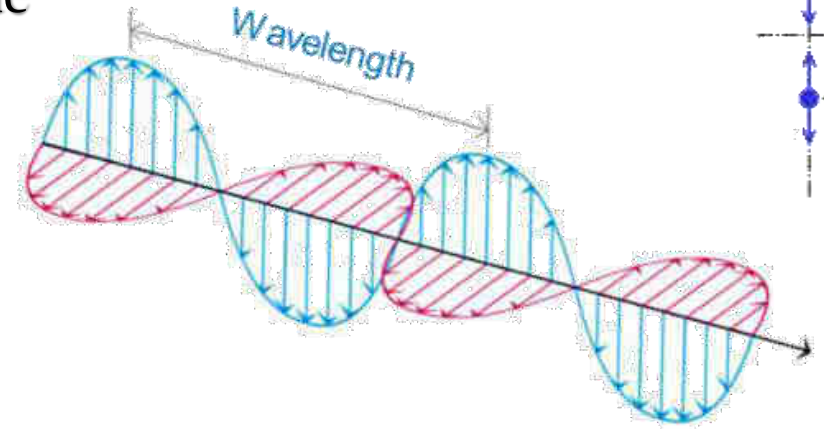
Penetration into the canopy at different wavelengths

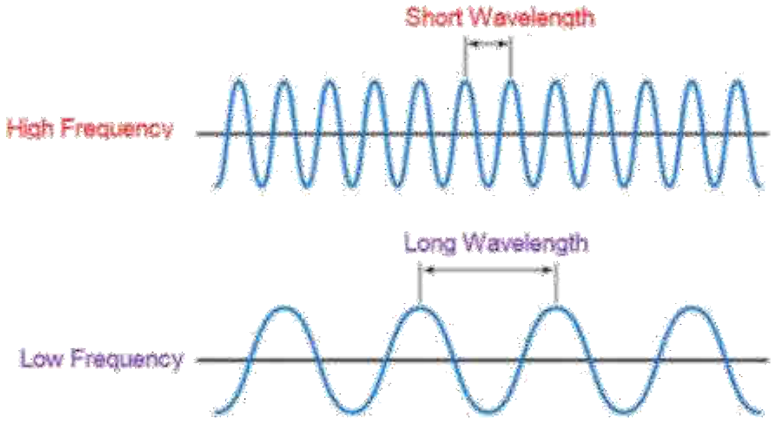


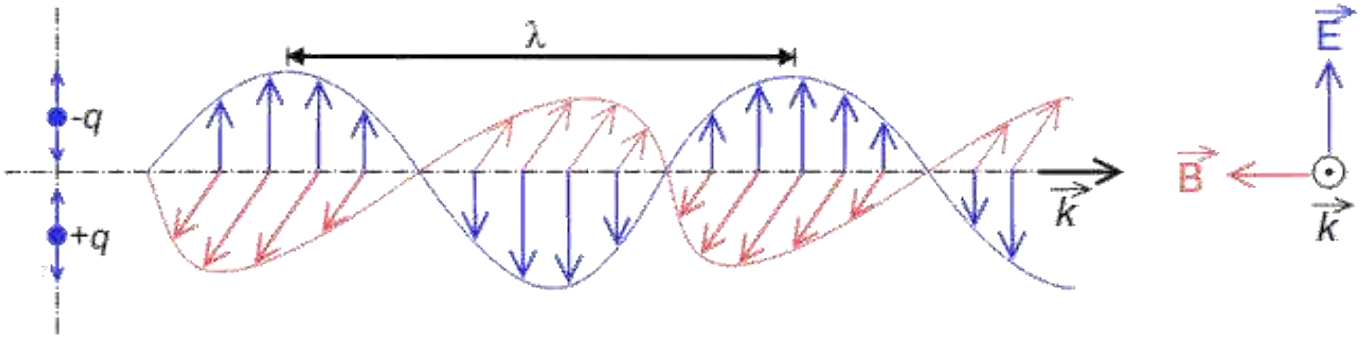
Reflection from surfaces with different roughness

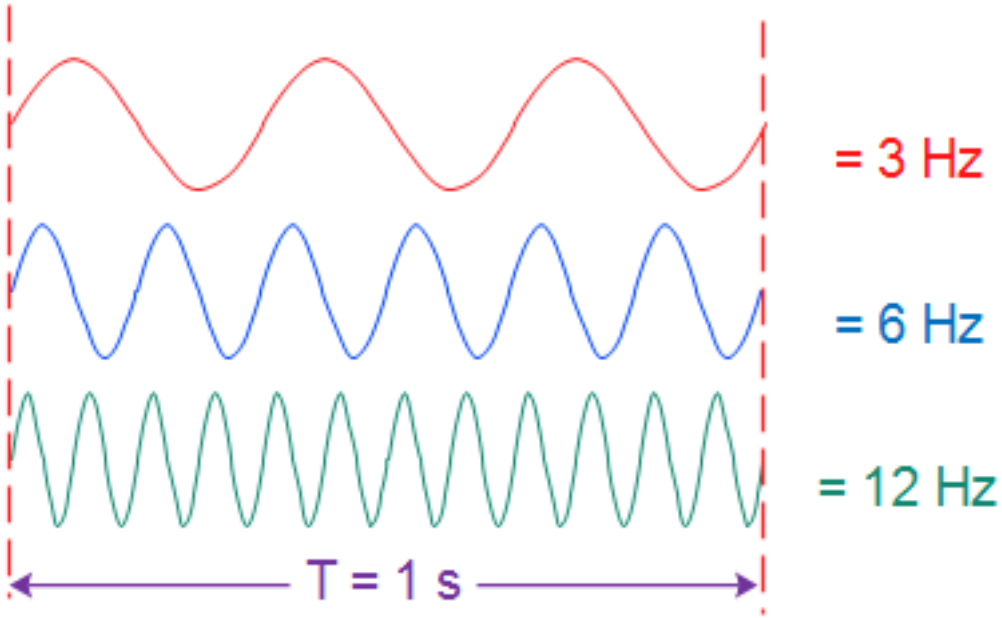
Electromagnetic Wave

- The most important characteristics of an electromagnetic wave:
  - Wavelength (Frequency)
  - Amplitude
  - Phase









Electromagnetic Wave

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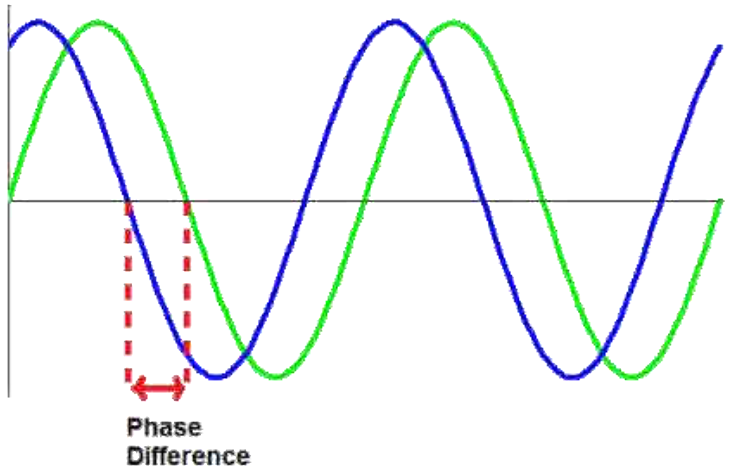
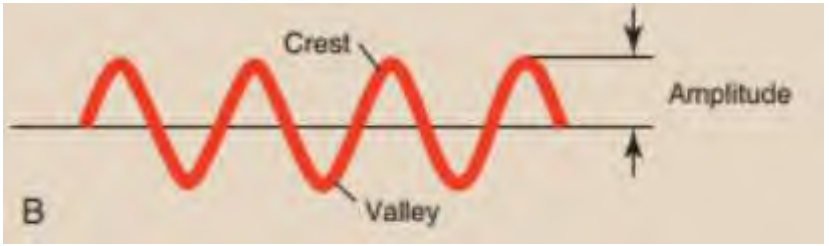
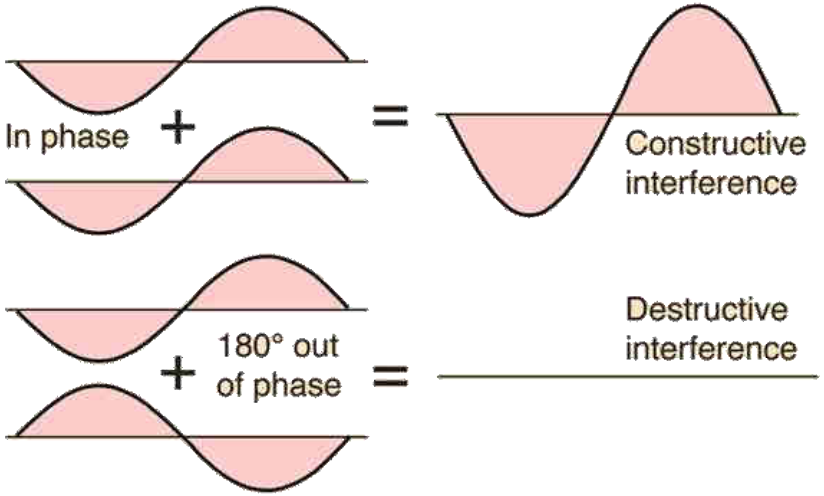
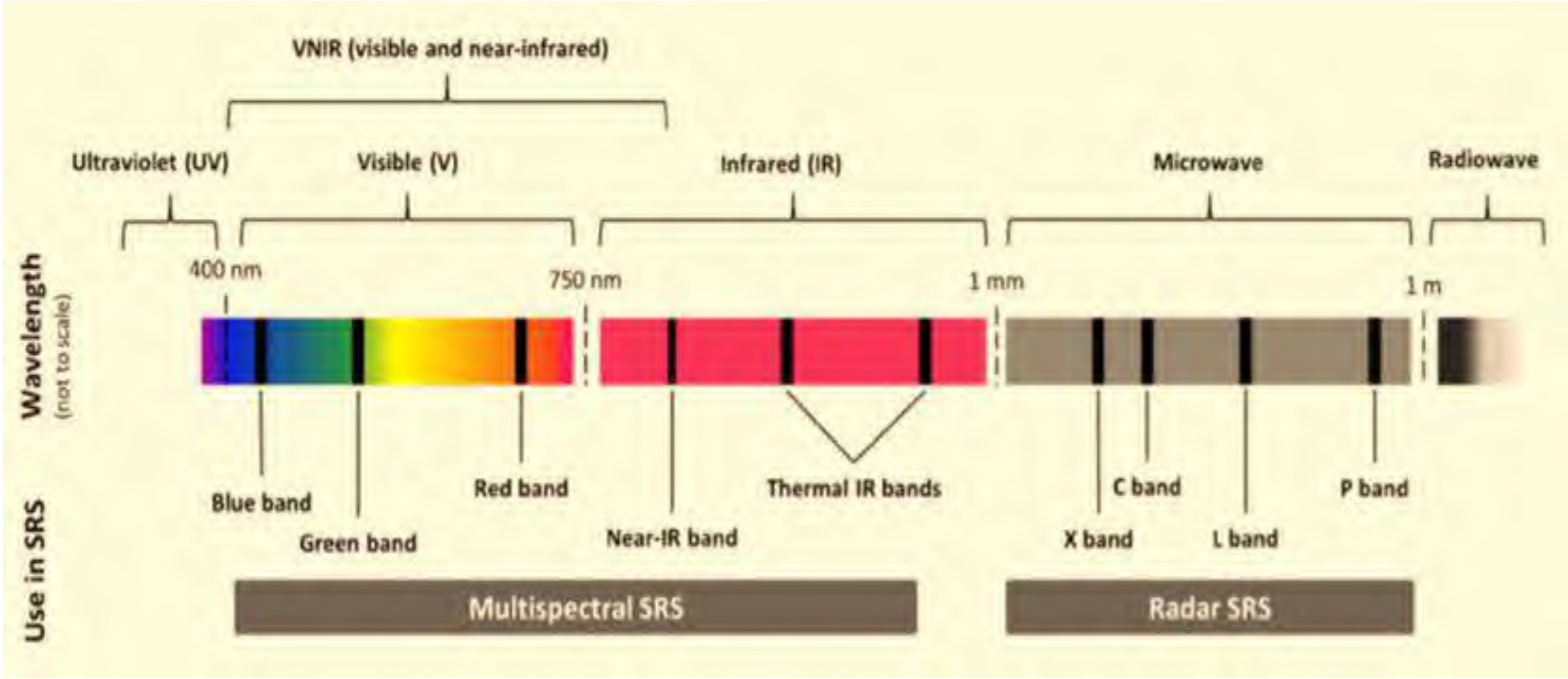




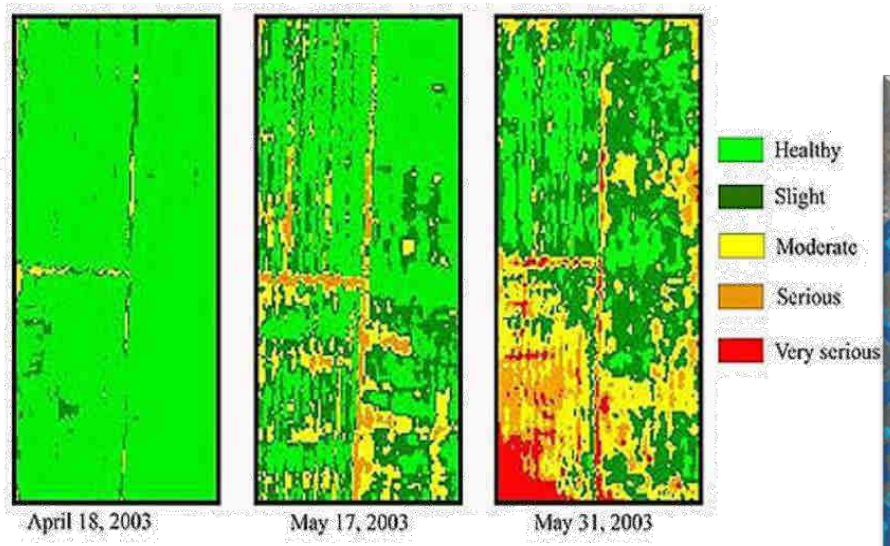


Electromagnetic Spectrum



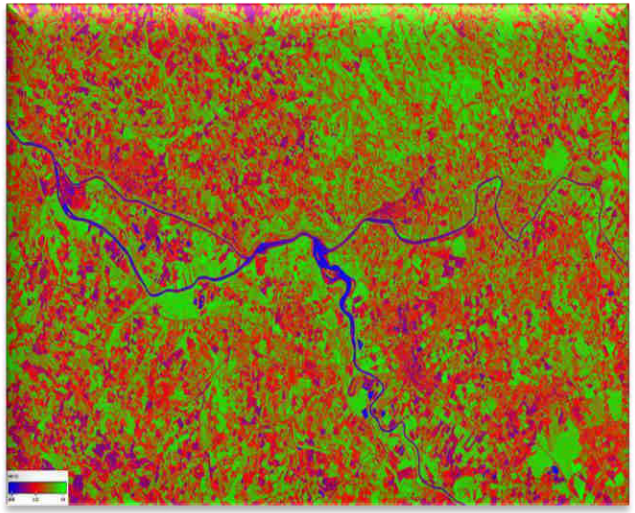
Remote Sensing Applications

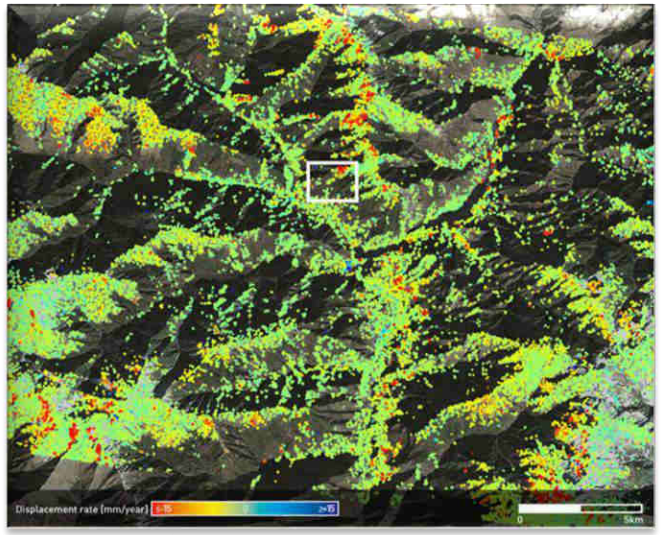
- Range of remote sensing includes:
  - Water resources
  - Soil mapping and degradation
  - Agriculture
  - Forestry
  - Land cover/land use mapping
  - Monitoring of land cover/land use changes
  - Natural or human-made disaster management
  - Urban studies



Crop disease monitoring

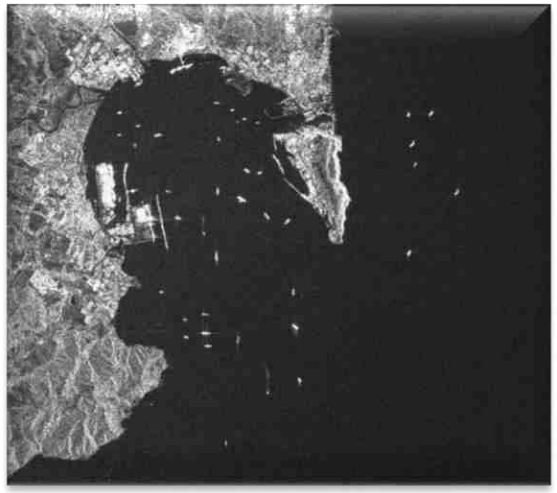

Flood mapping


Strength of the vegetation

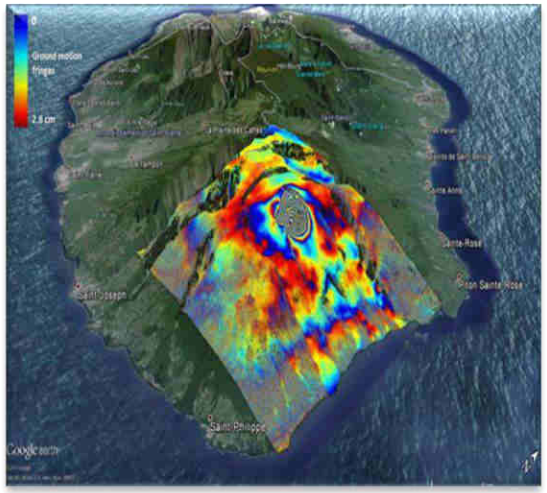

Landslide monitoring

Remote Sensing Applications

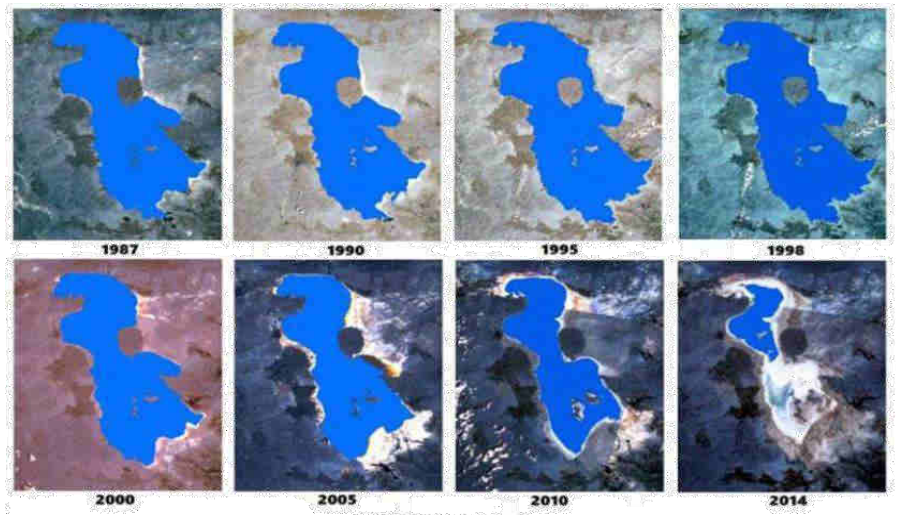
- Coastal studies
- Oceanography
- Climatology
- And so on



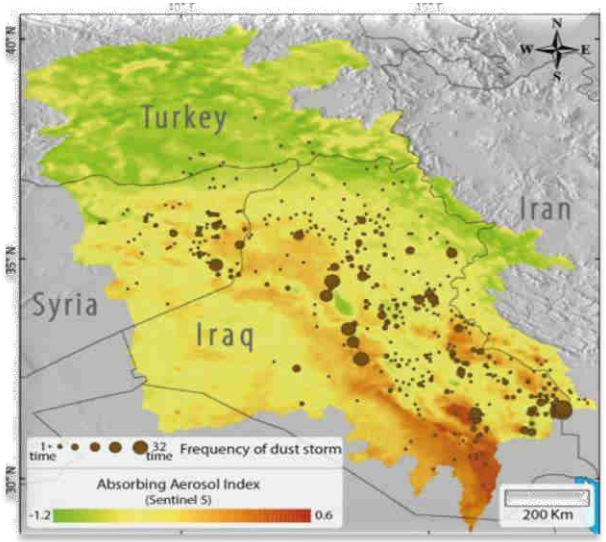
Ship detection & monitoring



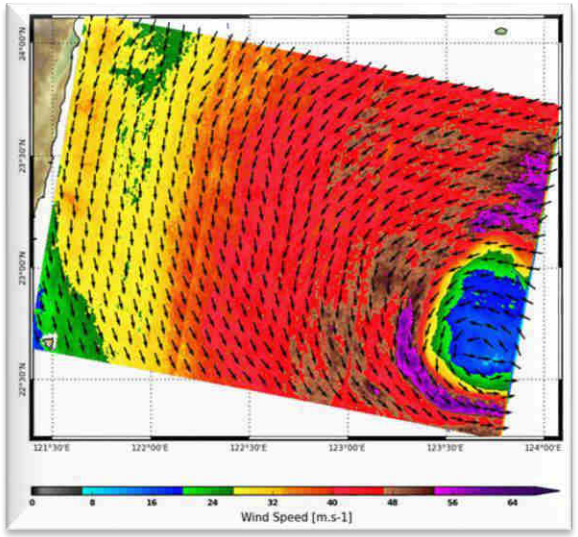
Volcano monitoring



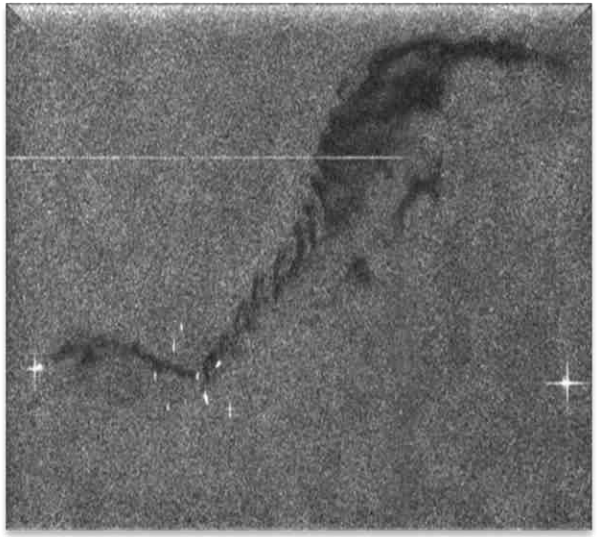
Monitoring Urmia lake area



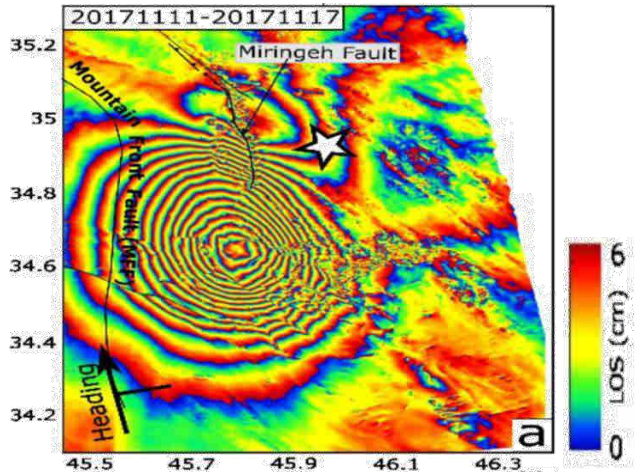
Dust storm



Wind speed on ocean surface



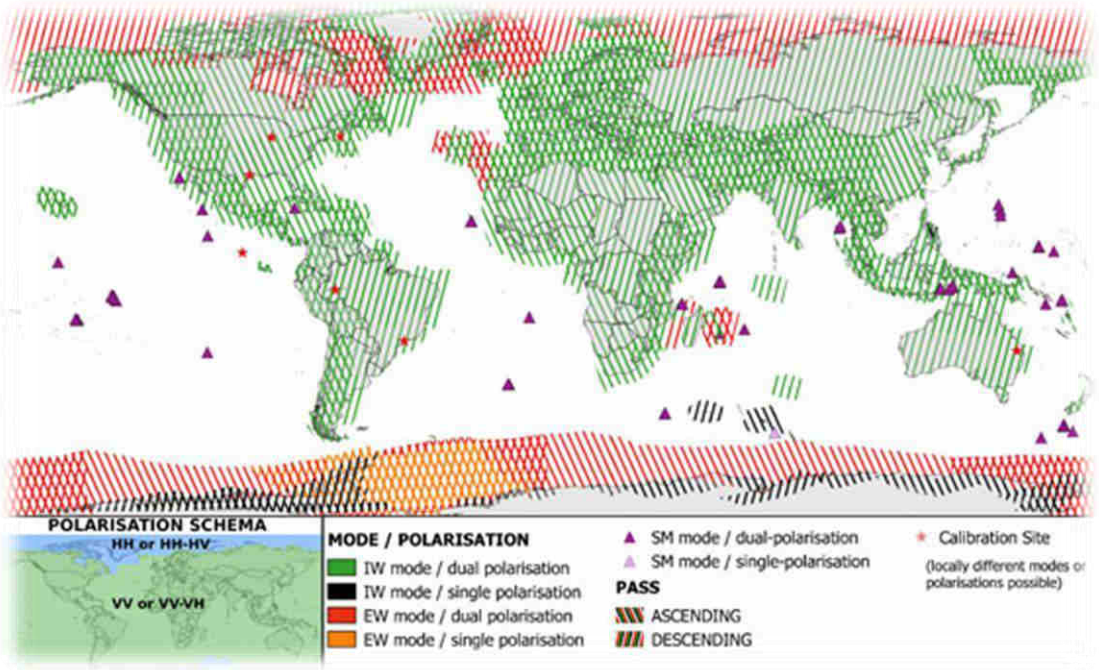
Oil pollution monitoring

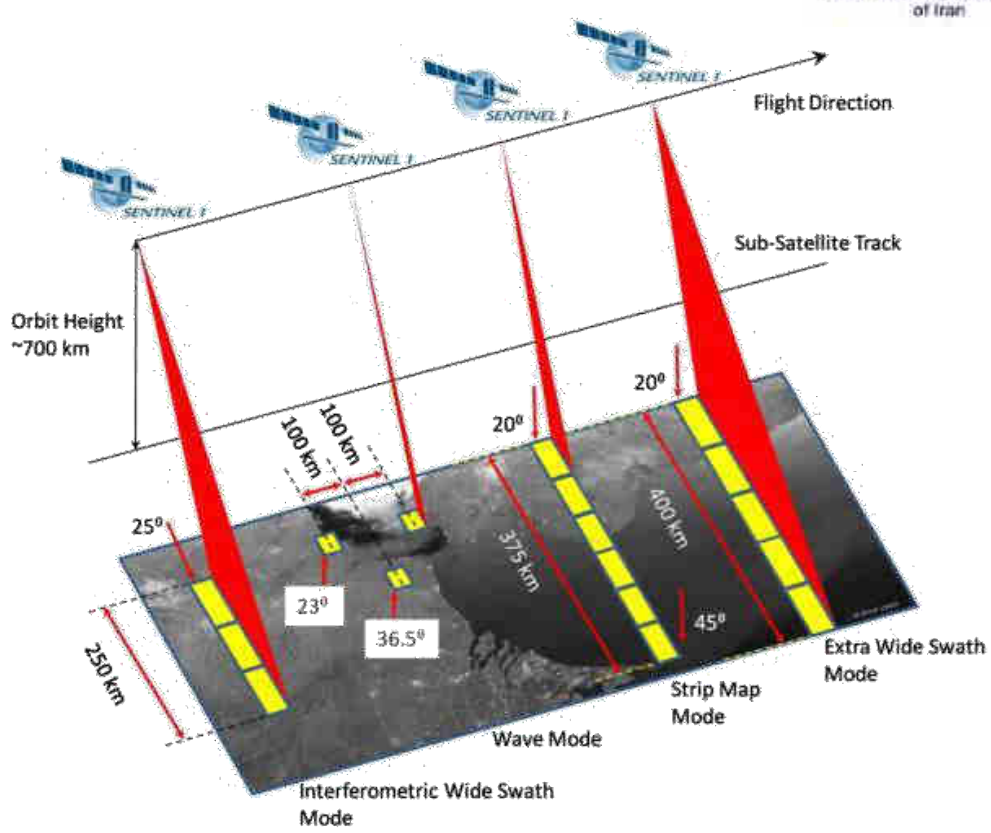


Earthquake Analysis

Sentinel – 1 Satellite

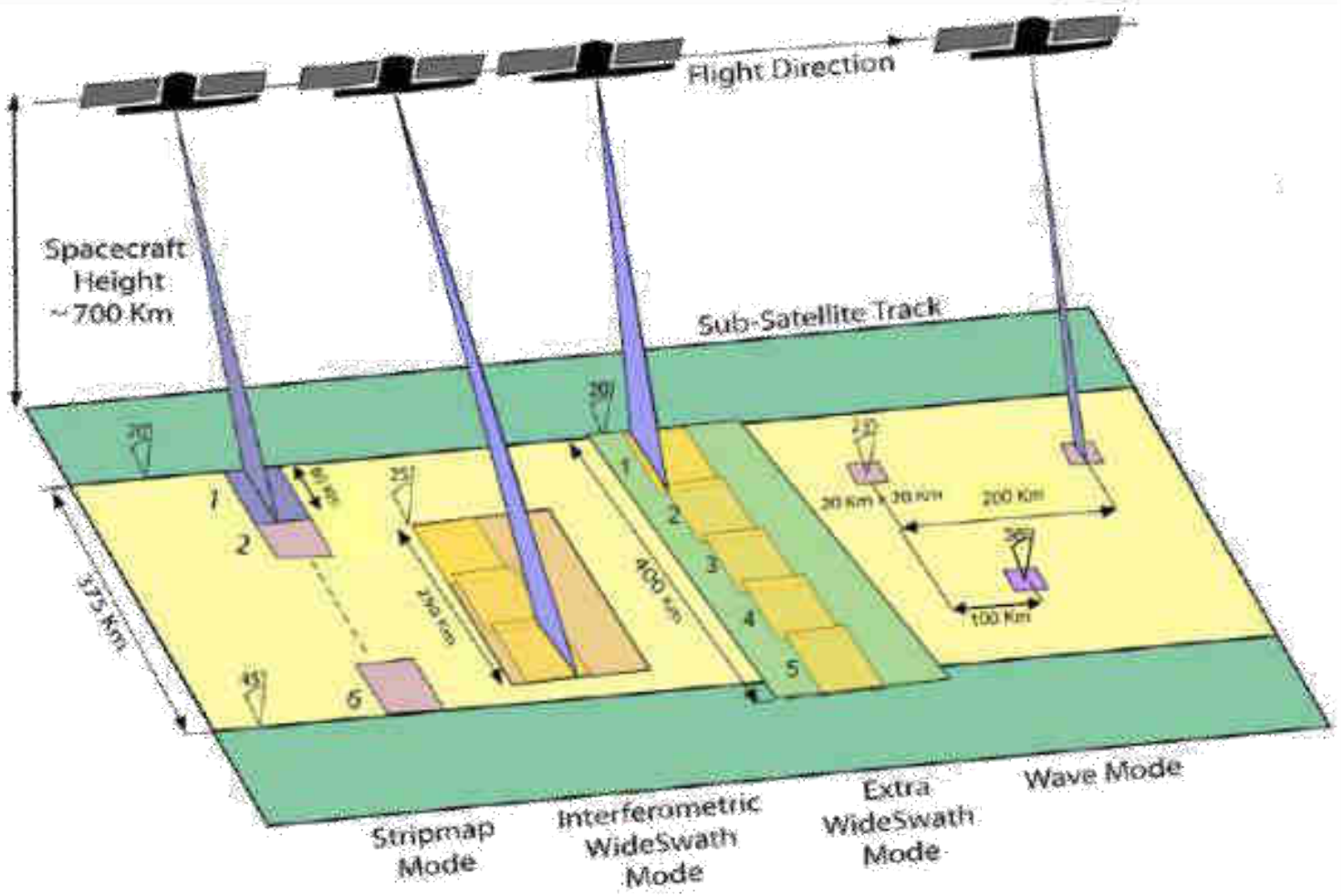
- Sentinel – 1A & 1B operate in four acquisition modes:
  - Stripmap
  - Interferometric Wide (IW) Swath
  - Extra Wide (EW) Swath
  - Wave





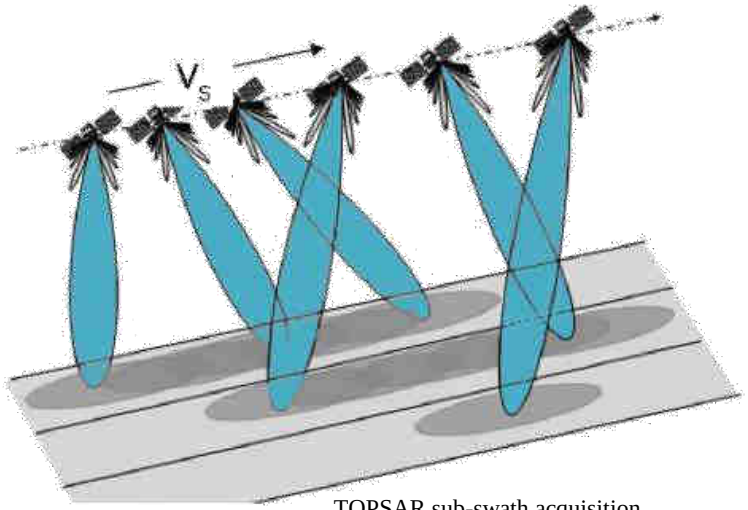
Sentinel – 1 Satellite

- Sentinel – 1A & 1B operate in four acquisition modes:
  - Stripmap
    - Swath width : 80 km
    - Resolution : 5m × 5 m
  - Polarization options:
    - Dual: HH+HV, VV+VH
    - Single: HH, VV
  - Incidence angle : 18.3 – 46.8 degree

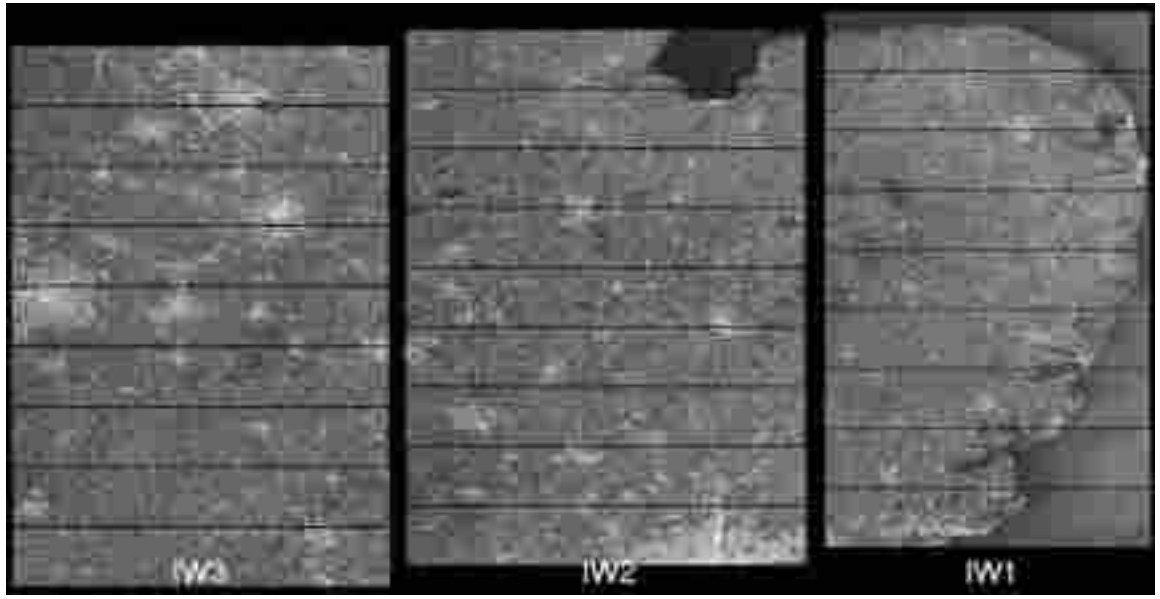


Sentinel – 1 Satellite

- Sentinel – 1A & 1B operate in four acquisition modes:
  - Interferometric Wide (IW)
    - Swath width : 250 km
    - Resolution : 5m × 20 m
  - Polarization options:
    - Dual: HH+HV, VV+VH
    - Single: HH, VV
  - Incidence angle : 29.1 – 46.0 degree



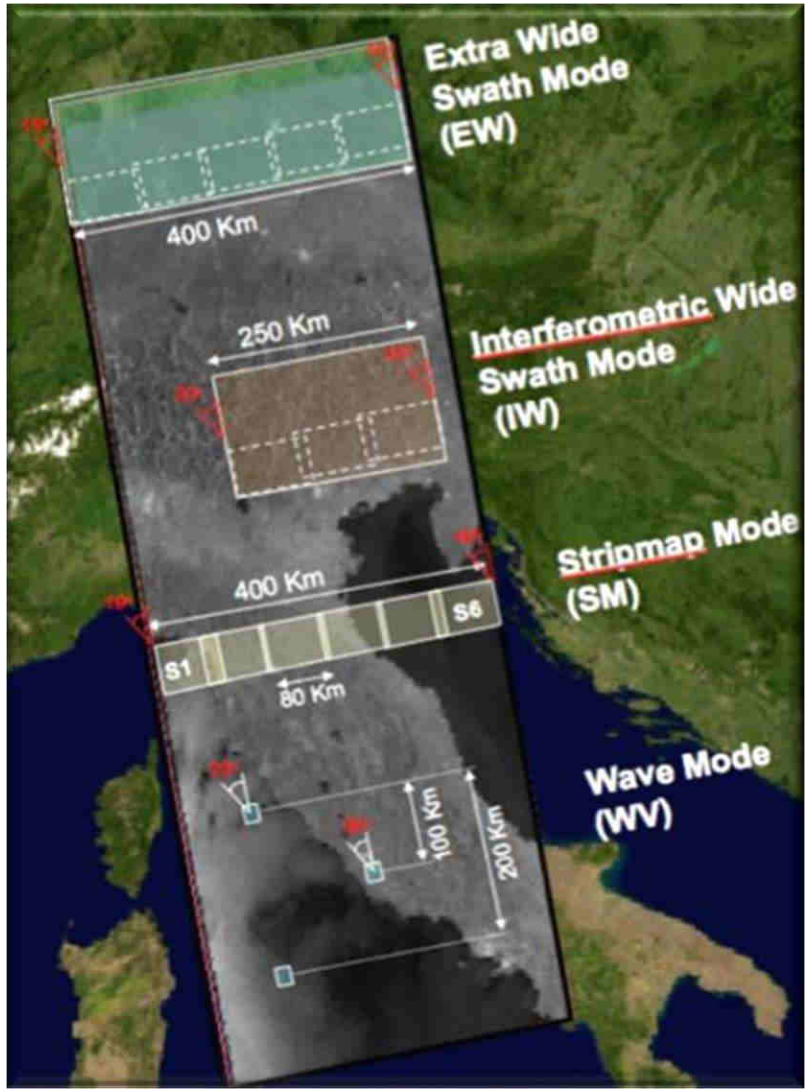
TOPSAR sub-swath acquisition



IW bursts and sub-swaths

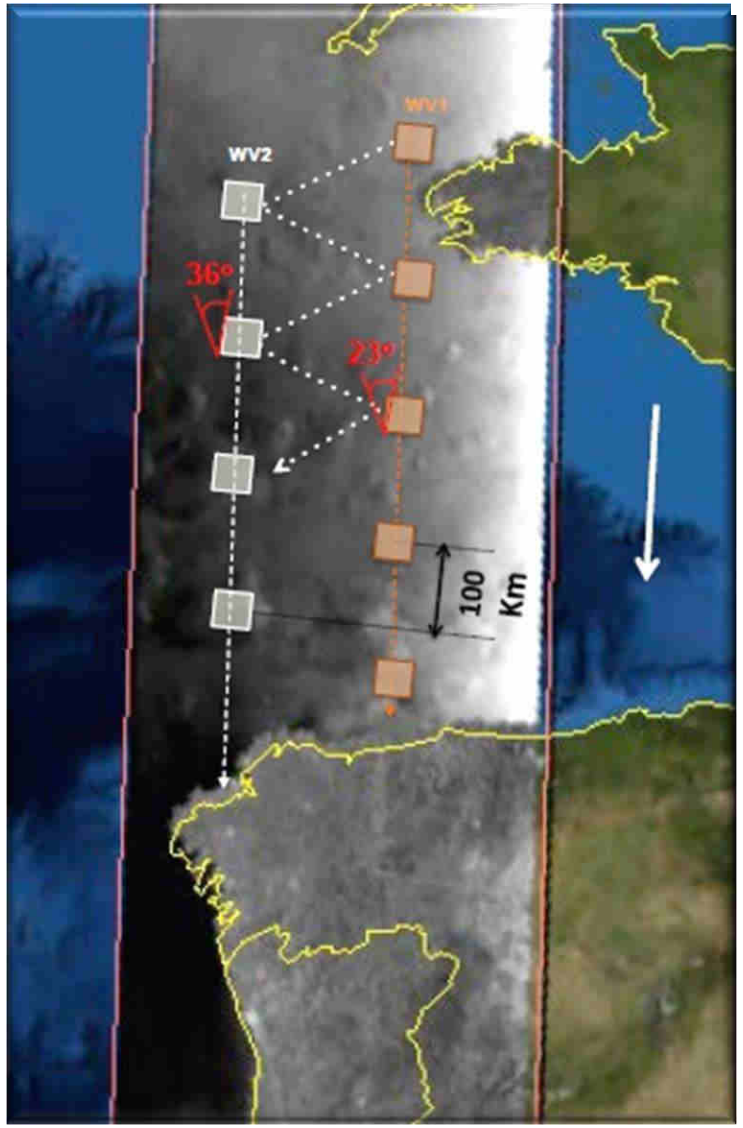
Sentinel – 1 Satellite

- Sentinel – 1A & 1B operate in four acquisition modes:
  - Extra Wide (EW)
    - Swath width : 410 km
    - Resolution : 20m × 40 m
  - Polarization options:
    - Dual: HH+HV, VV+VH
    - Single: HH, VV
  - Incidence angle : 18.9 – 47.0 degree



Sentinel – 1 Satellite

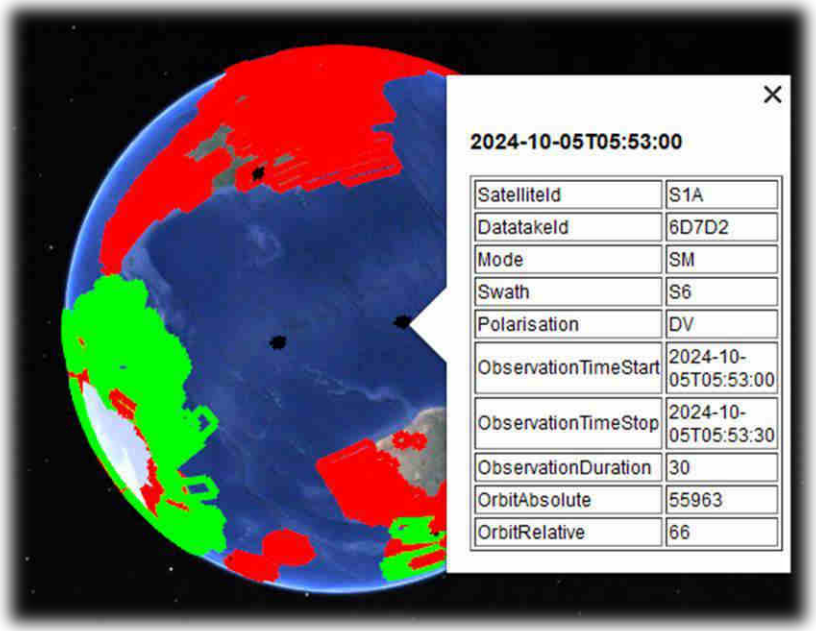
- Sentinel – 1A & 1B operate in four acquisition modes:
  - Wave
    - Vignette ground coverage: 20m × 40 m
    - Resolution : 5m × 5 m
  - Polarization options:
    - Single: HH, VV
  - Incidence angle:
    - 21.6 – 25.1 degree
    - 34.8 – 38.0 degree

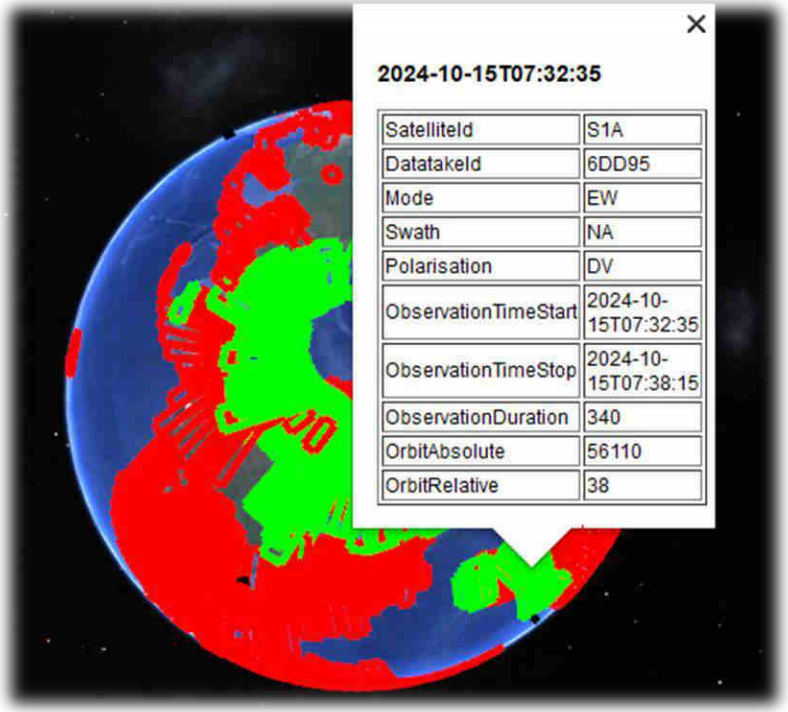


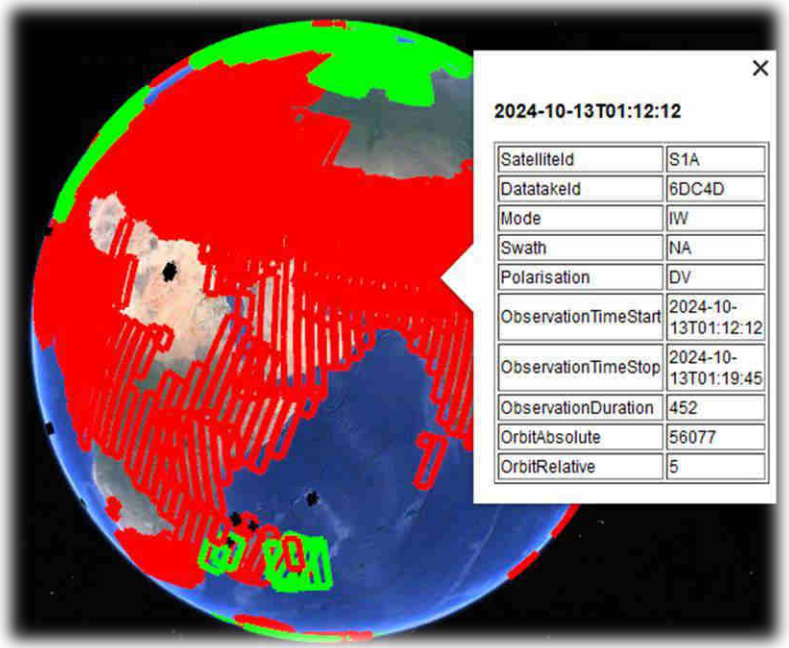
Sentinel – 1 Satellite

- Acquisition segments archive:

https://sentinel.esa.int/web/sentinel/copernicus/sentinel-1/acquisition-plans



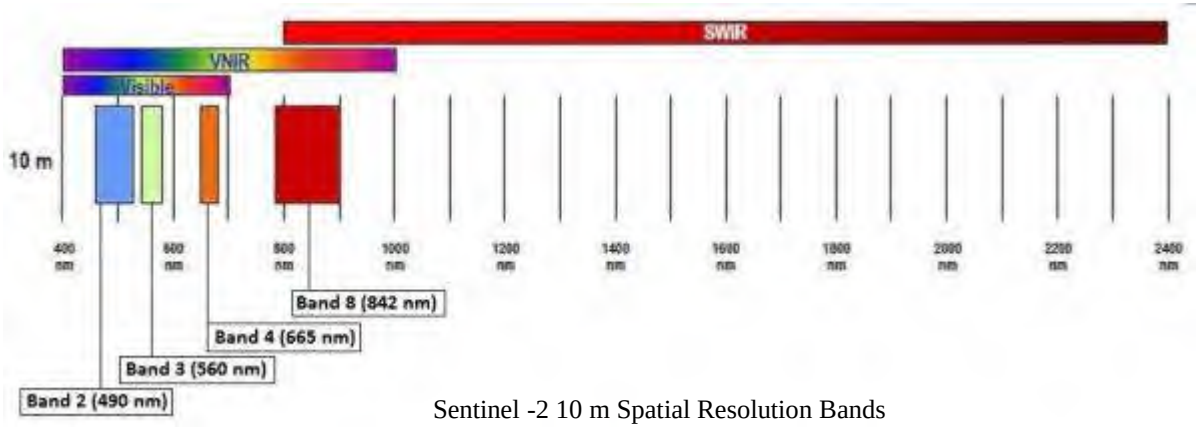




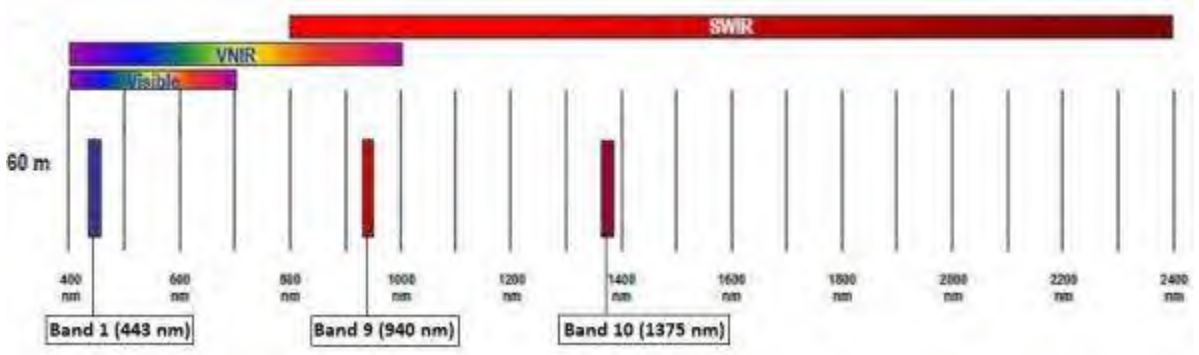
Sentinel – 2 Satellite

National Cartographic Center of Iran

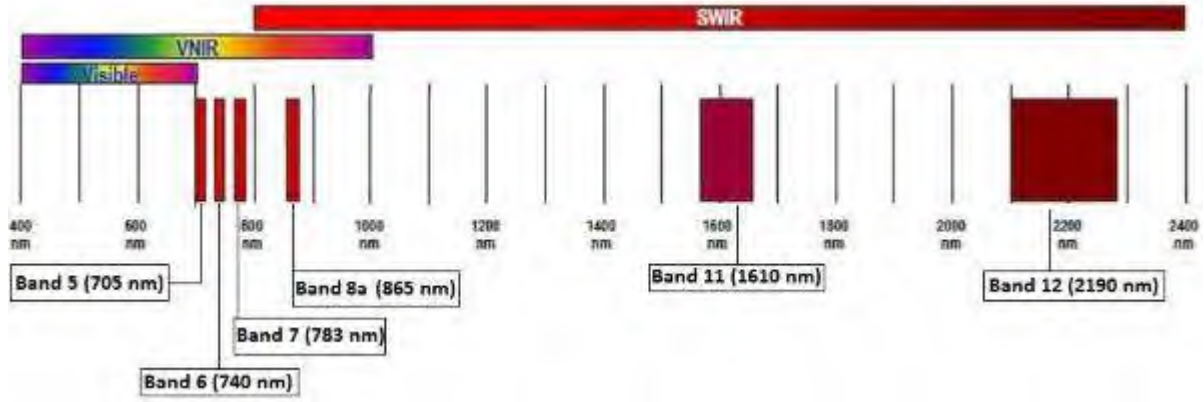
- Sentinel – 2 mission consists of two identical satellites, Sentinel – 2A and Sentinel – 2B
- Sentinel – 2 delivers 13 spectral bands ranging 10 to 60 m pixel size



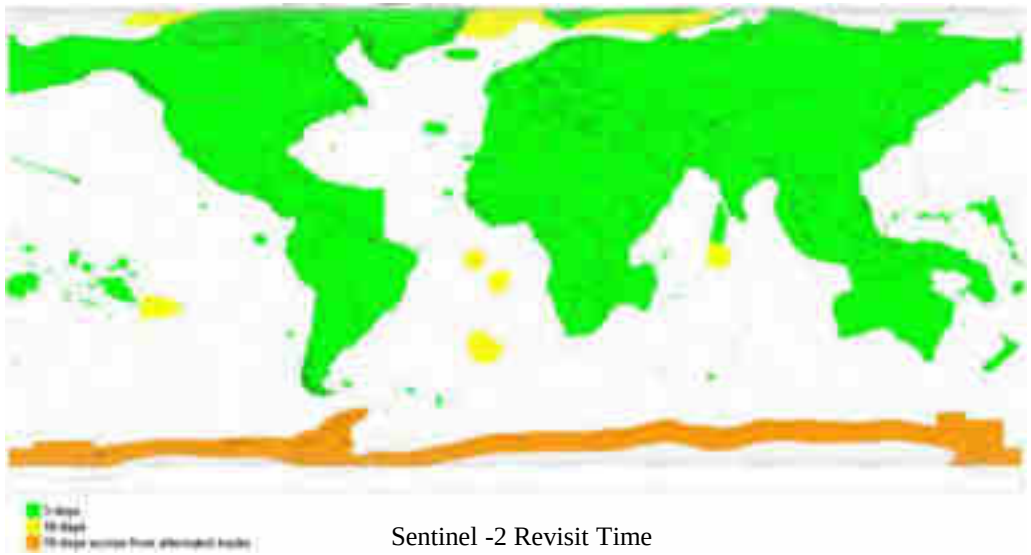
Sentinel -2 10 m Spatial Resolution Bands



Sentinel -2 60 m Spatial Resolution Bands



Sentinel -2 20 m Spatial Resolution Bands

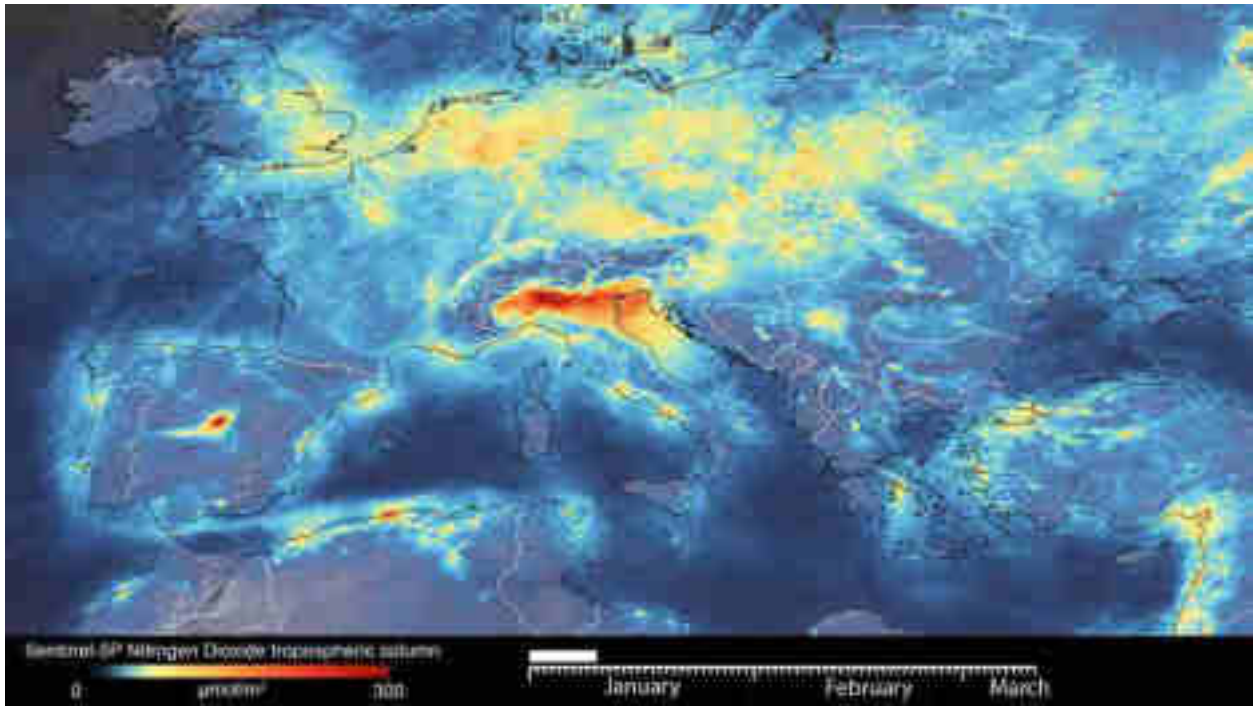


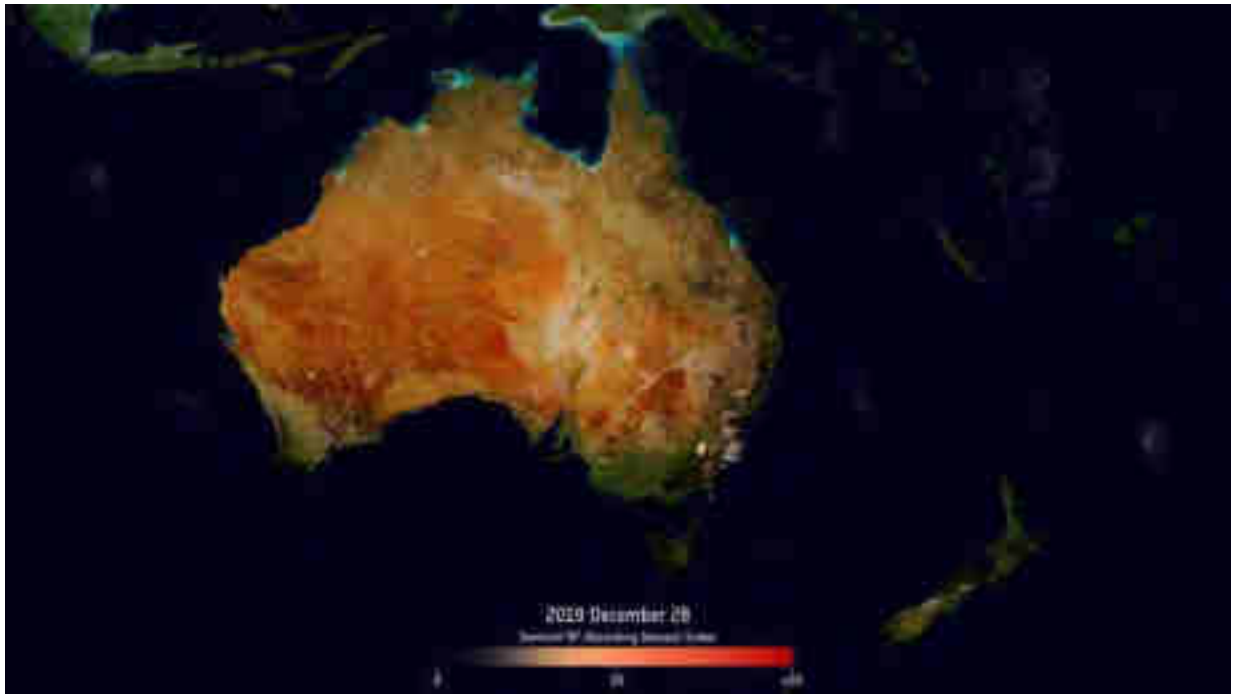
Sentinel -2 Revisit Time

Sentinel – 5 Satellite

National Cartographic Center of Iran

- Sentinel – 5P Carries Tropomi instrument to monitor a multitude of trace gases such as nitrogen dioxide, ozone, formaldehyde, sulphur dioxide, methane, carbon monoxide and aerosols





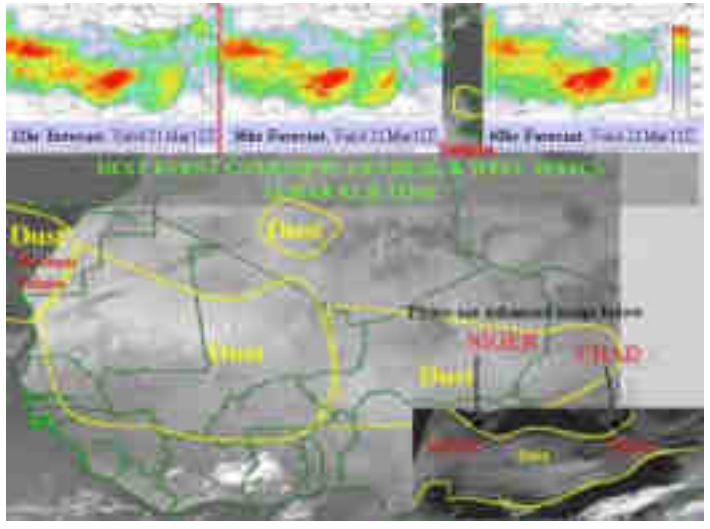
Sand & Dust Storm

National Cartographic Center of Iran

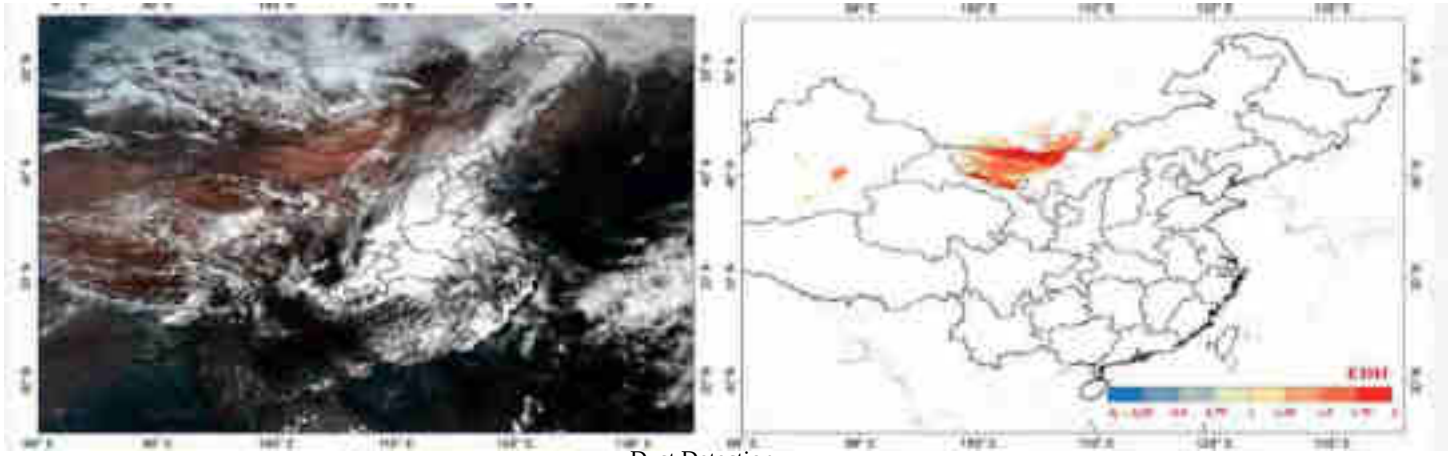
- Impacts of sand and dust storm (SDS) on sustainable development goals:

Sand & Dust Storm

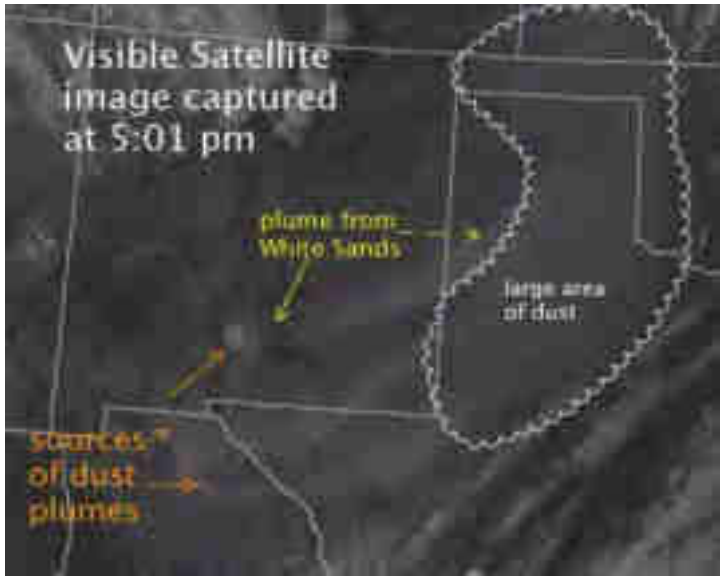
- Enhancing observation systems an methodologies to monitor sand & dust storm:
  - Satellite Technology
  - Ground-Based Observation Points
  - Automated Weather Stations
  - Standardized Methodologies
  - Citizen Science Initiatives
  - Improving Forecasting Models
  - Data Sharing and Collaboration
  - Early Warning Systems
  - Long-Term Monitoring and Analysis



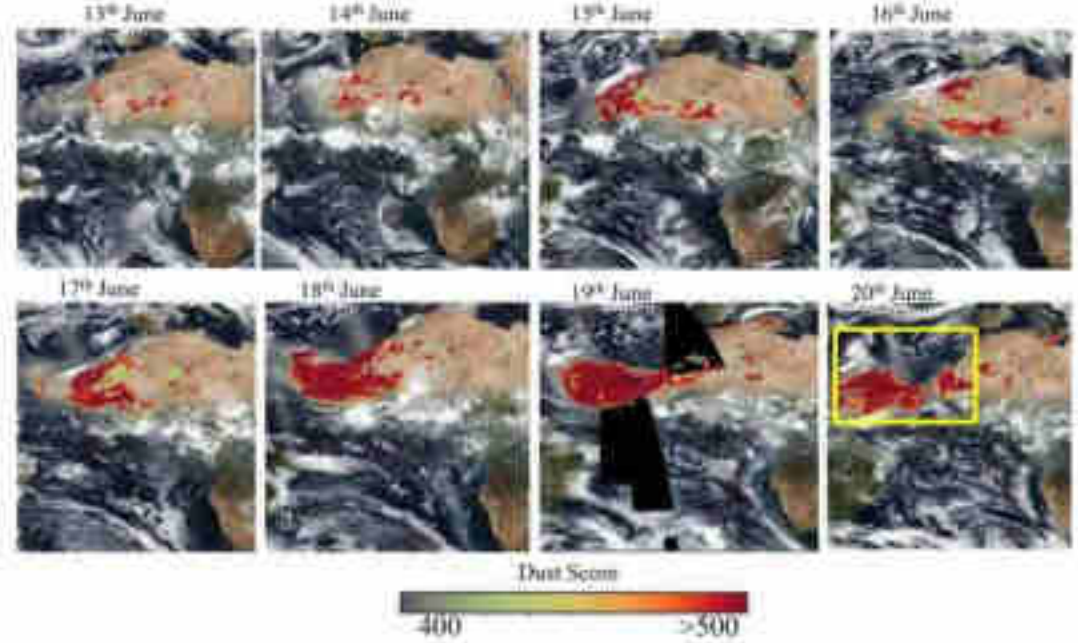
Remote Sensing for Sand & Dust Storm



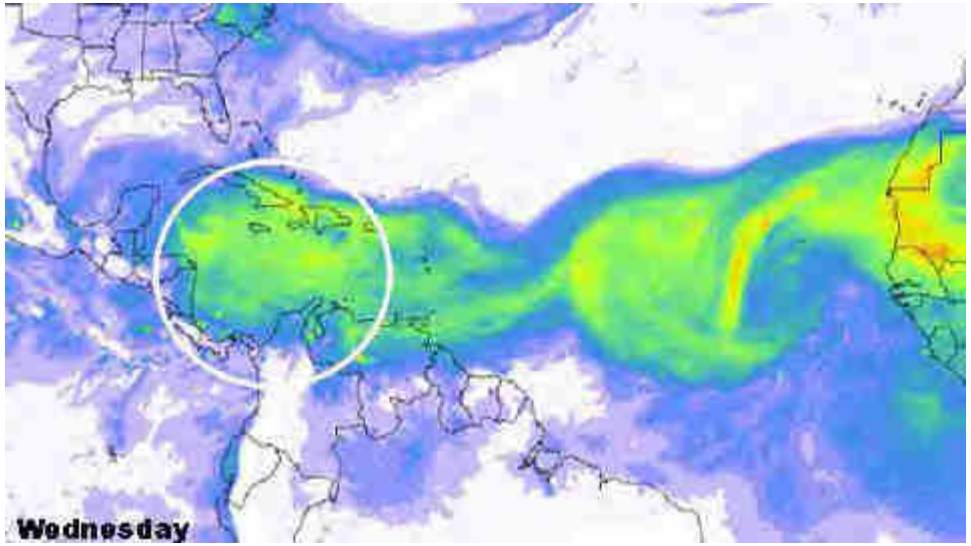
Dust Detection



Dust Storm identification

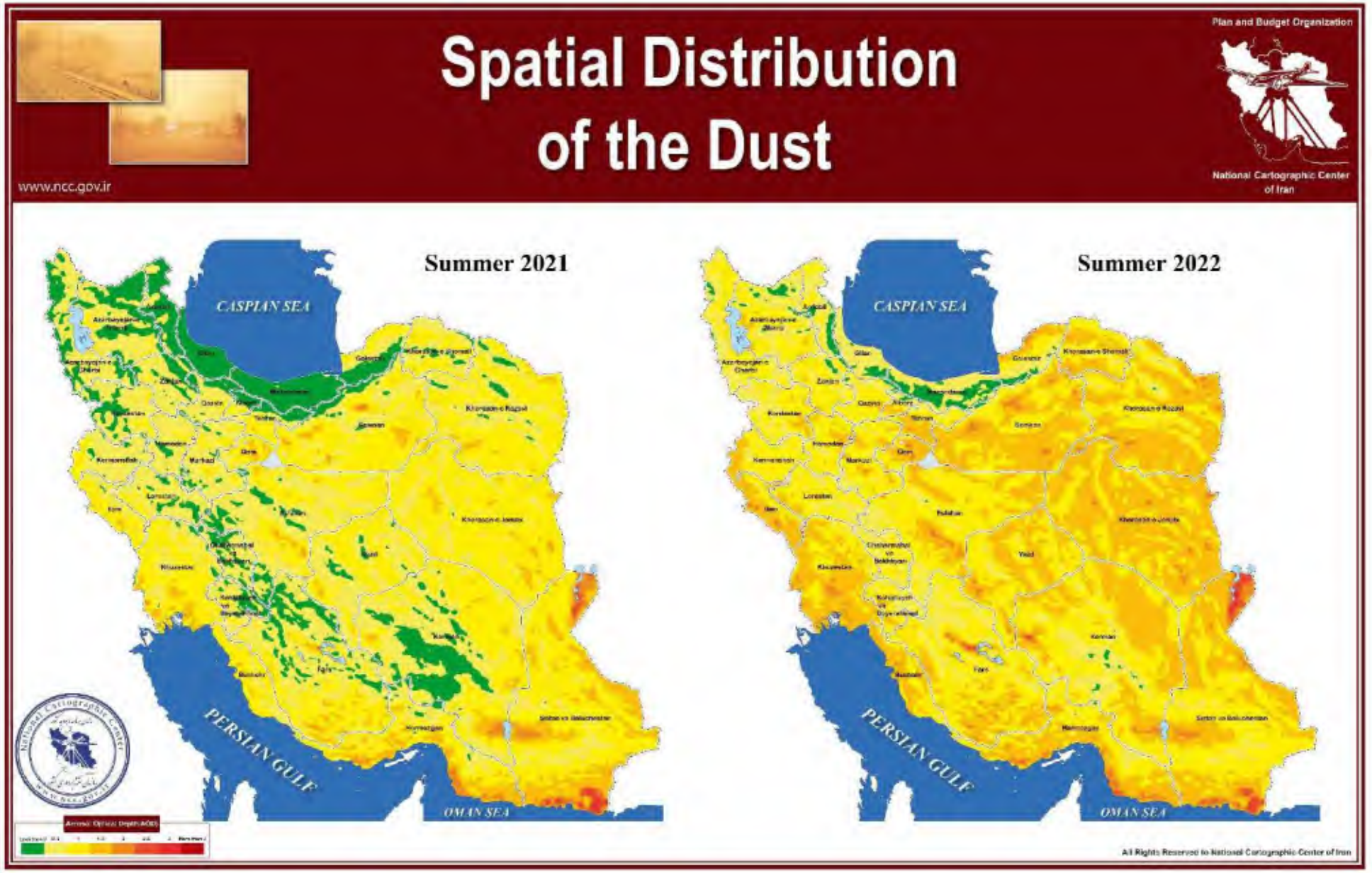


Dust Storm Monitoring



Dust Spread

Dust Monitoring in NCC



Thank you for your attention!