

SWIM and Horizon 2020 Support Mechanism

Working for a Sustainable Mediterranean, Caring for our Future

Regional on-site training and study tour on “Drought Risk Management Mainstreaming” (REG-7 and ST-6)

Training session: Crop production and agricultural drought monitoring

Presented by:
Dr. Salomón MONTESINOS

24-27 September 2018, Murcia, Spain

This Project is funded by the European Union



umweltbundesamt®

ATKINS

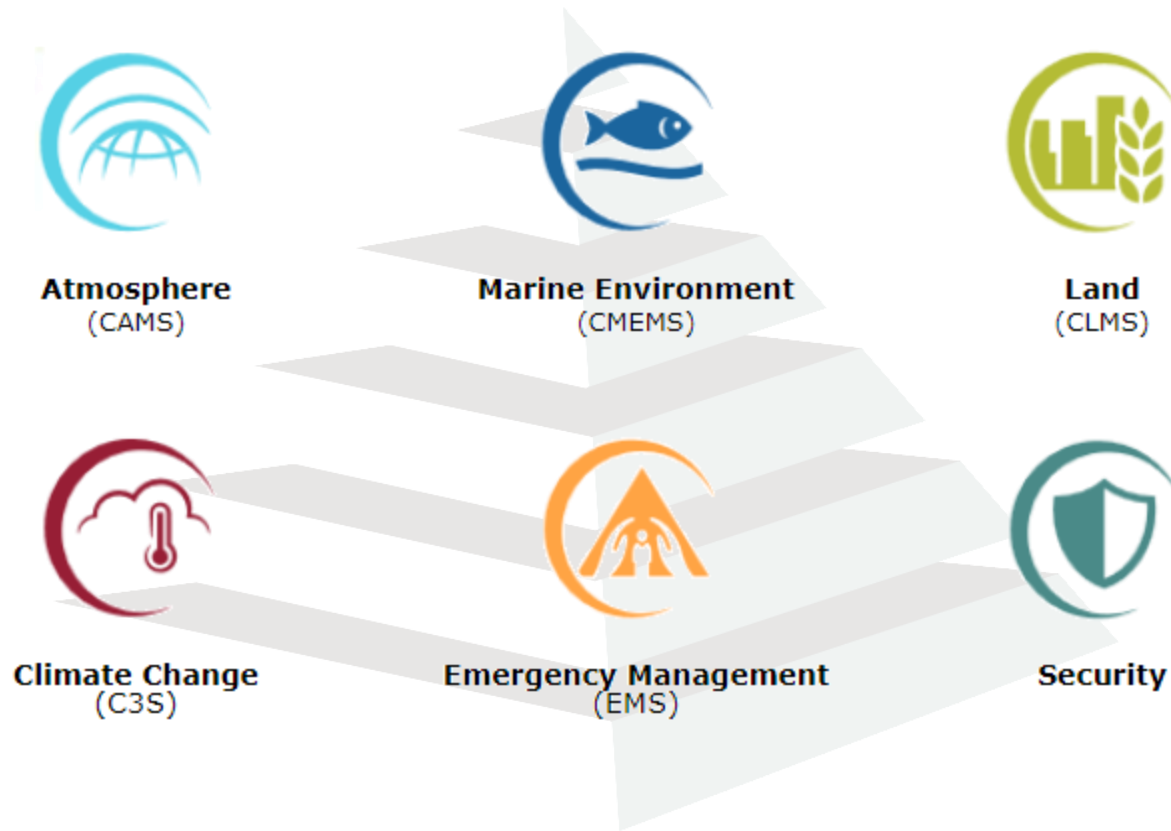
What is Copernicus ?

Europe's eyes on Earth

Copernicus is the European Union's Earth Observation Programme, looking at our planet and its environment for the ultimate benefit of all European citizens. It offers **information services based on satellite Earth Observation and in situ (non-space) data**.

The Programme is coordinated and managed by the European Commission. It is implemented in partnership with the Member States, the European Space Agency (ESA), the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), the European Centre for Medium-Range Weather Forecasts (ECMWF), EU Agencies and Mercator Ocean.

The information services provided are **freely and openly** accessible to its users.



The Copernicus Emergency Management Service (**Copernicus EMS**) provides all actors involved in the management of natural disasters, man-made emergency situations, and humanitarian crises with timely and accurate geo-spatial information derived from satellite remote sensing and completed by available in situ or open data sources.

The Copernicus EMS consists of **two components**:

- **Mapping with a worldwide coverage.**
- **Early warning with three different systems:**

[The European Flood Awareness System \(EFAS\)](#), which provides overviews on ongoing and forecasted floods in Europe up to 10 days in advance.

[The European Forest Fire Information System \(EFFIS\)](#), which provides near real-time and historical information on forest fires and forest fire regimes in the European, Middle Eastern and North African regions.

[The European Drought Observatory \(EDO\)](#), which provides drought-relevant information and early-warnings for Europe.

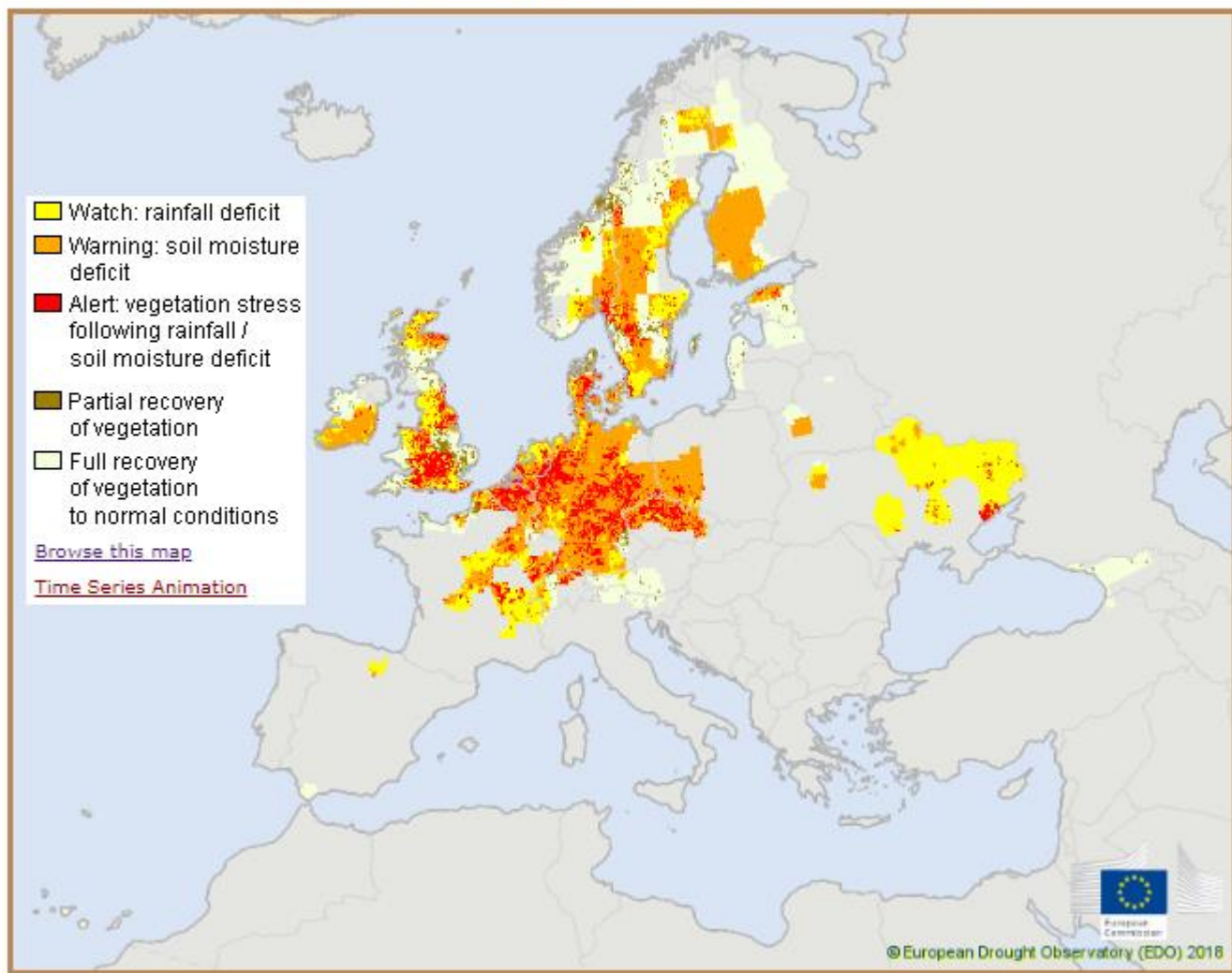
European Drought Observatory

The monitoring of droughts is based on the analysis of a **series of indicators**, representing different components of the hydrological cycle (e.g. precipitation, soil moisture, reservoir levels, river flow, groundwater levels) or specific impacts (e.g. vegetation water stress) that are associated with a particular type of drought.

EDO produces the following drought indicators at the European scale:

- **Standardized Precipitation Index (SPI)**
- **Standardized Snowpack Index (SSPI)**
- **Soil Moisture Anomaly (SMA)**
- **Anomaly of Vegetation Condition (fAPAR Anomaly)**
- **Low-Flow Index (LFI)**
- **Heat and Cold Wave Index (HCWI)**
- **Combined Drought Indicator (CDI)**

→ Situation of Combined Drought Indicator in Europe - 3rd ten-day period of August 2018

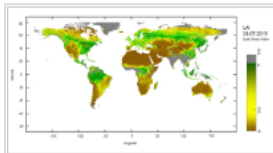


The Copernicus Global Land Service (**CGLS**) is a component of the **Land Monitoring Core Service** (LMCS) of Copernicus.

CGLS systematically produces a series of qualified bio-geophysical products on the status and evolution of the land surface, at global scale and at mid to low spatial resolution, complemented by the constitution of long term time series.

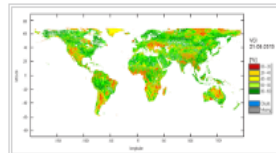
The products **are used to monitor the vegetation, the water cycle, the energy budget and the terrestrial cryosphere.**

VEGETATION PROPERTIES



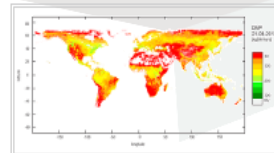
Collections

VEGETATION INDICATORS



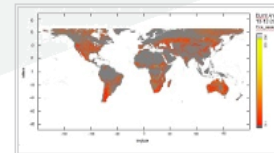
Collections

DRY MATTER PRODUCTIVITY



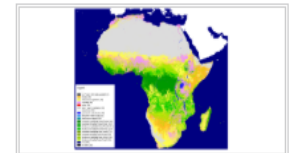
Collections

FIRE DISTURBANCE

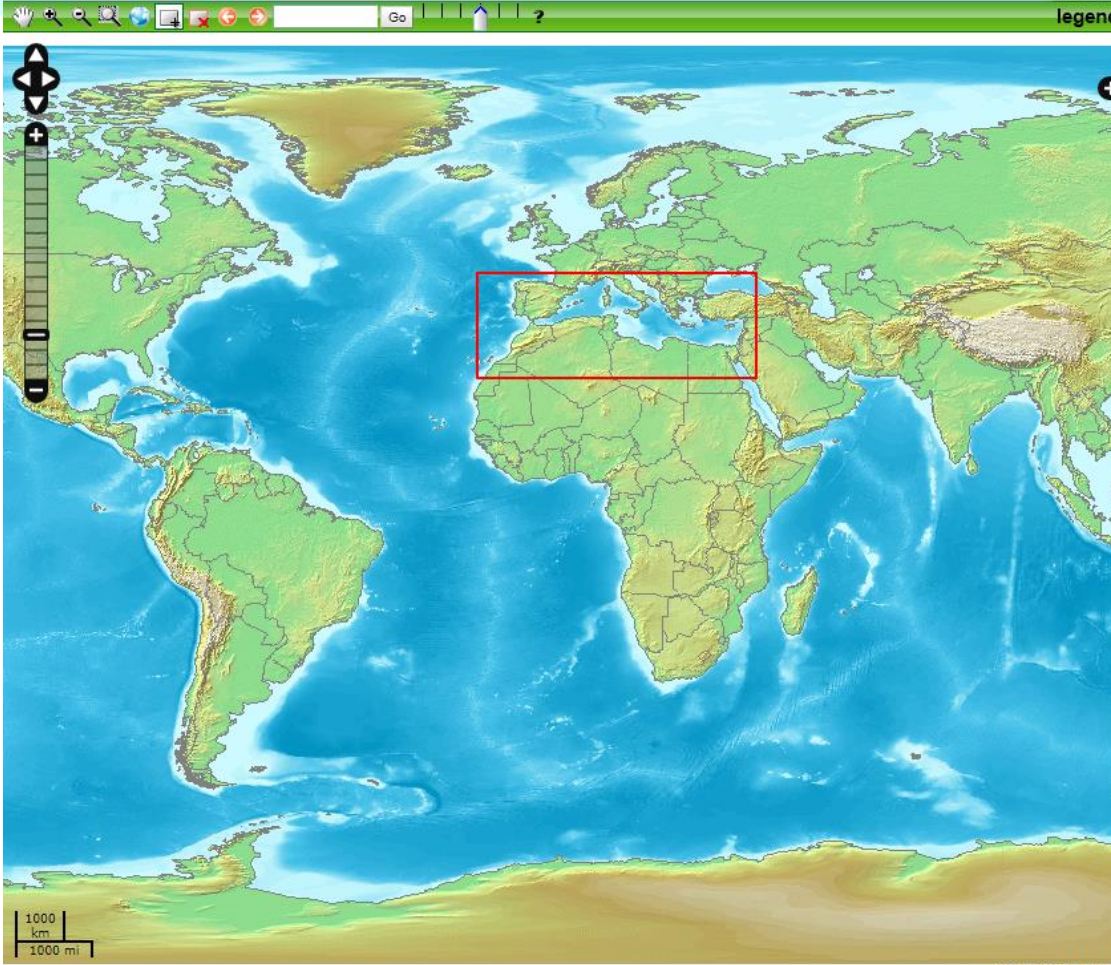


Collections

DYNAMIC LAND COVER



Collections



[Catalogue search](#) | [Subscription](#)

Vegetation Indicators - VCI V1

Help
The "Catalogue search" tab allows you to define search criteria and start a search within the catalogue

- Collection**
- NDVI 300m V1 (168 products)
 - NDVI 1km V2.2 Global (735 products)
 - NDVI 1km V2.1 (1428 products)
 - NDVI 1km V1 (3885 products)
 - VCI V1 (1421 products)**
 - VPI V1 (1421 products)

Basic

Date	Slot
Start date	01/09/2018
End date	12/09/2018

45.4558
-16.5412 ROI 38.1620
24.8769

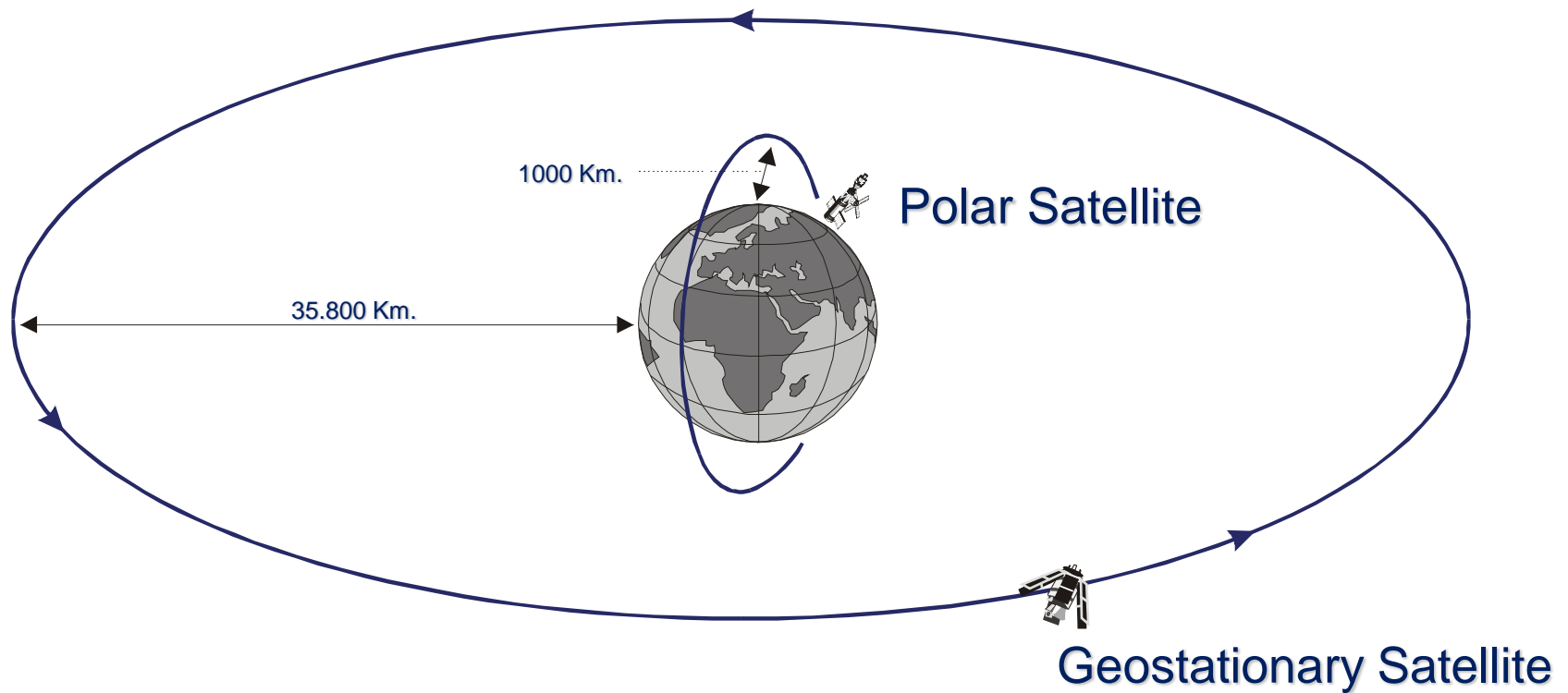
Coverage BioPar_VCI_Tiles
 BioPar_VCI_CONTINENTS

Advanced

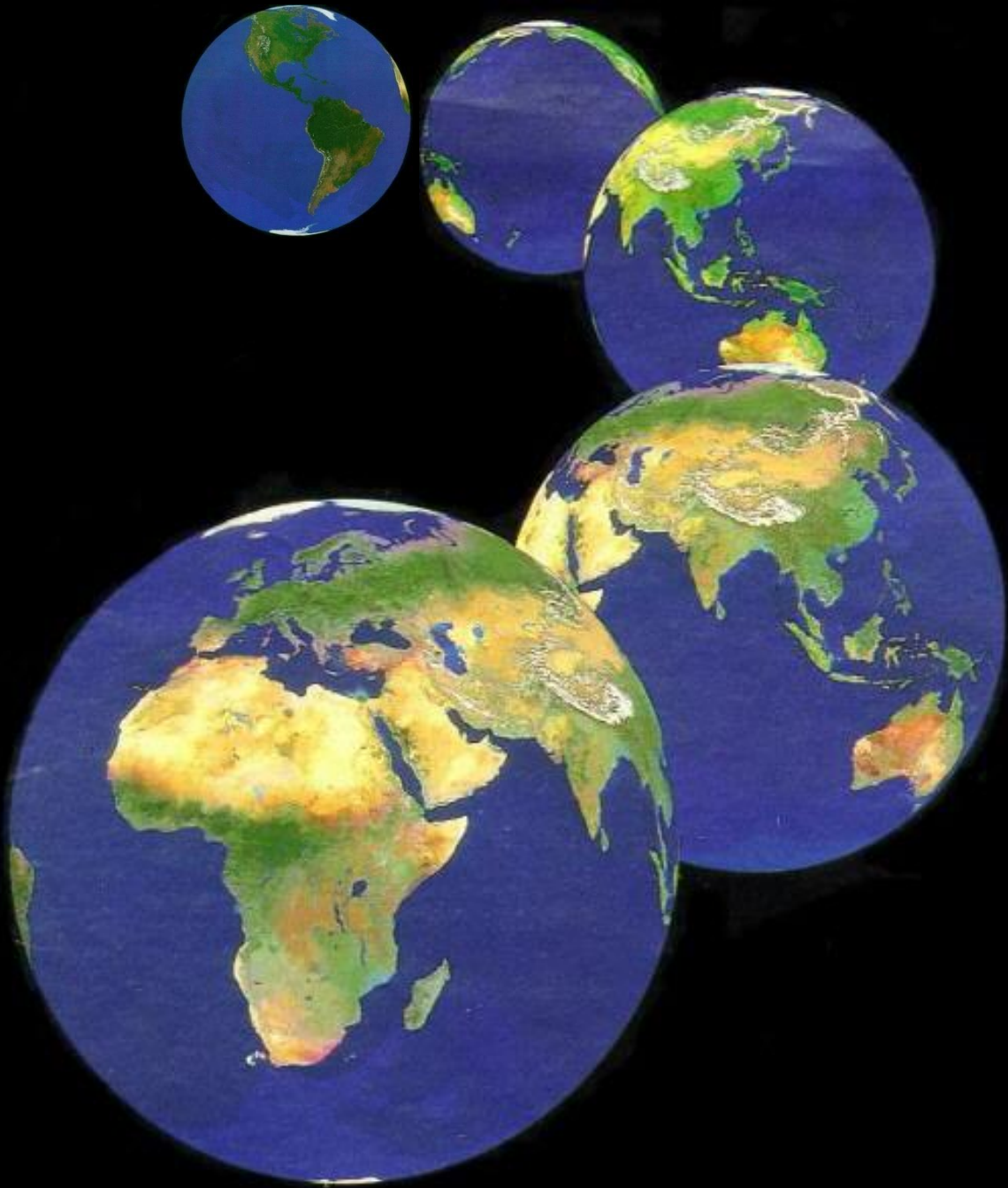
Search Reset

Number of results per page

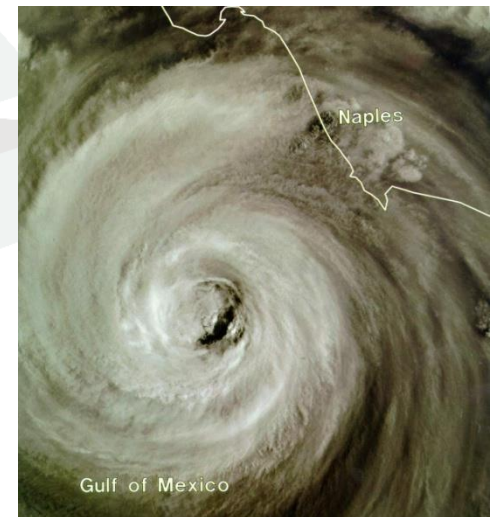
Type of satellites



Meteorological Satellites



METEOSAT (0°)
GOMS(70°E)
GMS (140°E)
GOES-W (140°W)
GOES-E (70°W)



NOAA

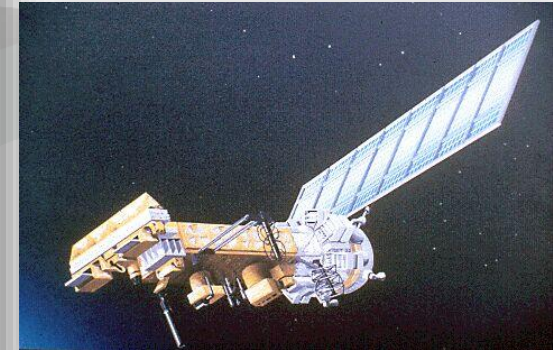
Height: **850 Km**

Temporal resolution: **12 hours**

Image size: **3.000 x 3.000 Km**

Pixel: **1,1 x 1,1 Km**

Bands: **Red, PI, MI, TI, TI**



MODIS

Satellites: **Terra y Aqua**

Launch: **1999 y 2002**

Temporal resolution: **1-2 days**

Pixel: **250 m (bandas 1-2)**

500 m (bandas 3-7)

1 km (bandas 8-36)

Bands: **36**



Landsat

Launch: **1972**

Height: **706 Km**

Orbital period: **16 days**

Sensors: **MSS**

TM

ETM

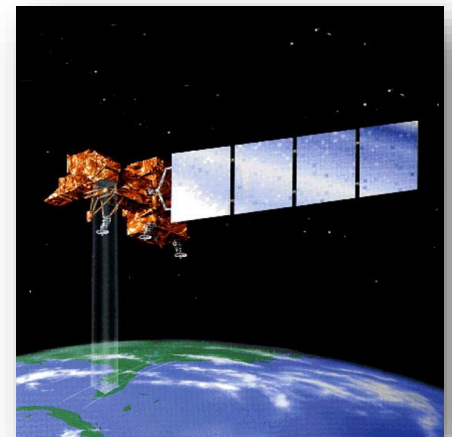
OLI

Spatial resolution:

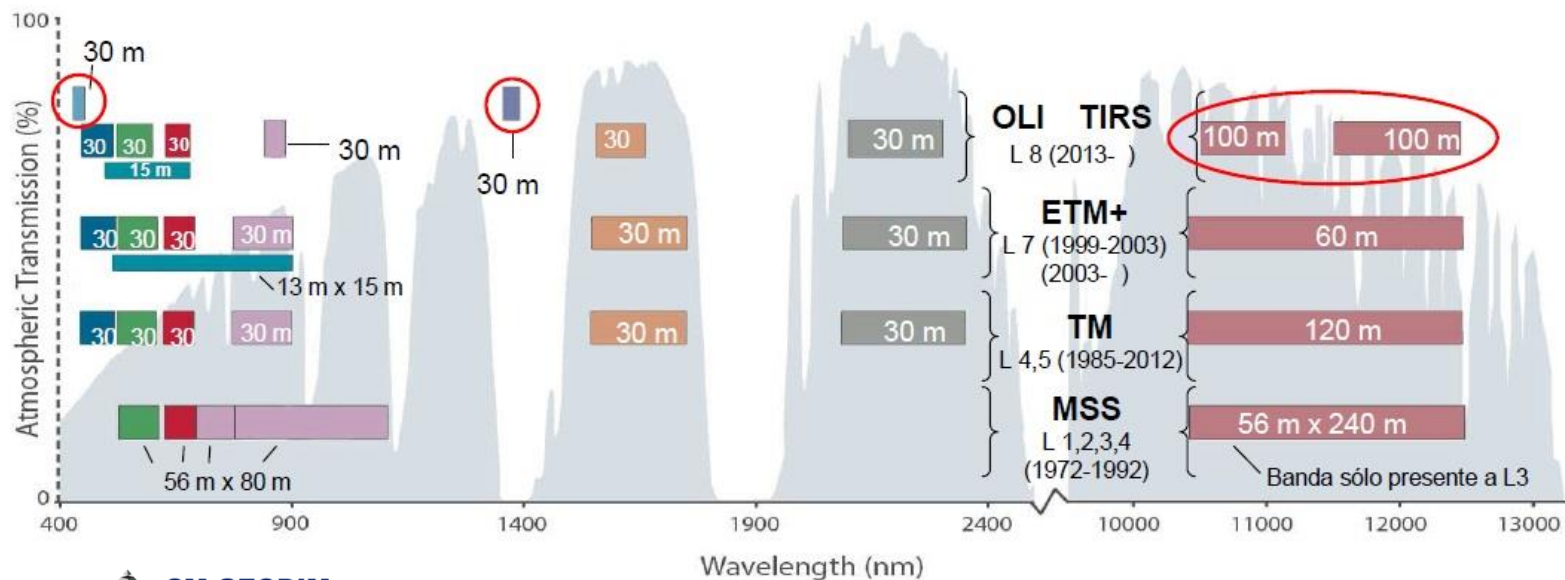
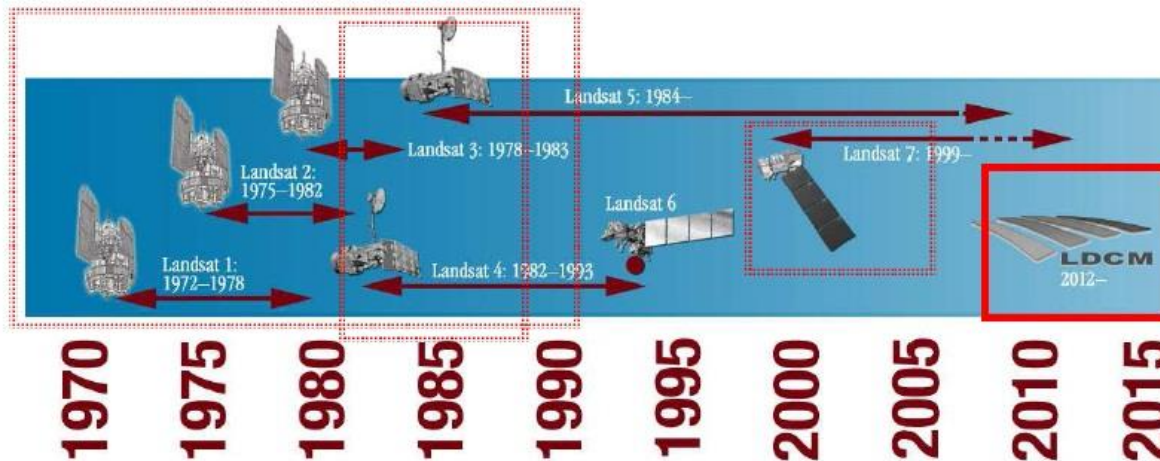
XS: 30 m

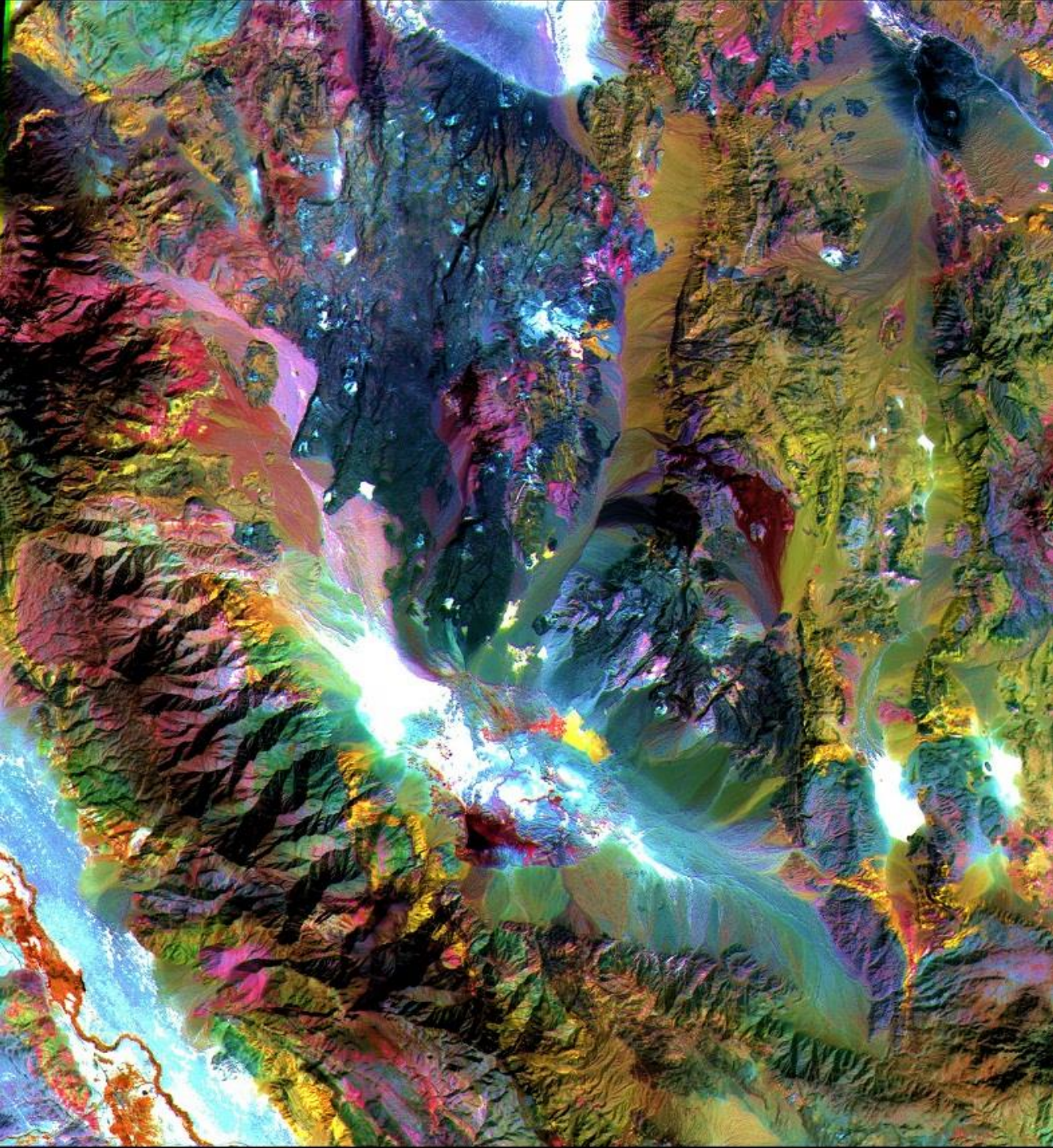
PAN: 15 m

Coverage: **185 x 179 Km**



Landsat Serie





ASTER

Released: **1999**

Height: **705 Km**

Orbital period: **4-16 days**

Sensor:

VIR (0.52 - 0.86 μm)

SWIR (1.6 a 2.43 μm)

TIR (8.12 a 11.65 μm)

Spatial resolution:

VIR: 15 m

SWIR: 30 m

TIR: 90 m

Coverage: **60 x 60 Km**





Sentinel 2

Launch: **2015**

Height: **786 Km**

Orbital period: **10 days**

Spectral resolution: **13 bands**

4 bands in the VIS and NIR

6 bands in the red edge and SWIR

3 bands with atmospheric correction

Spatial resolution:

VIS/NIR: **10 m**

SWIR: **20 m**

ACB: **60 m**

Image wide: **290 Km**



SPOT

Released: **1986**

Height: **832 Km**

Orbital Period: **26 days**

Sensors: **HRV**

XS (0,5 – 0,89 μm)

PAN (0,5 a 0,73 μm)

Spatial resolution:

XS: 20-5 y 2,5 m

PAN: 10-5 y 2,5 m

Coverage: **60 x 60 Km**





IKONOS

Launch: **1999**

Height: **681 Km**

Orbital period: **98'**

Sensors:

XS (0.45 - 0.9 μm)

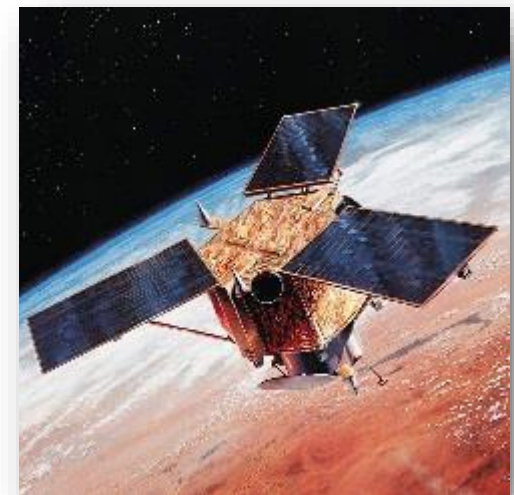
PAN (0.45 - 0.9 μm)

Spatial resolution:

XS: 4 m

PAN: 1 m

Coverage: **11 x 11 Km**



QuickBird

Launch: **2001**

Height: **450 Km**

Orbital period: **93,5'**

Sensors:

XS (0,45 – 0,9 μm)

PAN (0,45 – 0,9 μm)

Spatial resolution:

XS: 2,44 m

PAN: 0,61 m

Coverage: **16,5 x 16,5 Km**



GeoEye

Launch: **2008**

Height: **684 Km**

Orbital period: **98'**

Sensors:

XS (0,45 – 0,92 μm)

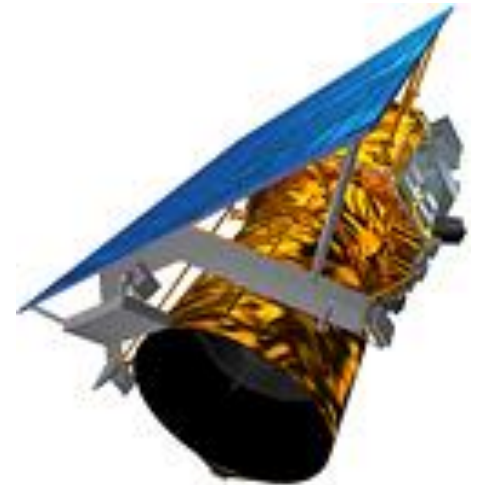
PAN (0,45 – 0,8 μm)

Spatial resolution:

XS: 1,65 m

PAN: 0,41 m

Coverage: **16,5 x 16,5 Km**





WorldView

Laught: **2009**

Height: **770 Km**

Orbital period: **100'**

Sensors:

XS (0,4 – 1,04 μm)

PAN (0,45 – 0,8 μm)

Spatial resolution:

XS: 1,84 m

PAN: 0,46 m

Coverage: **16,5 x 16,5 Km**



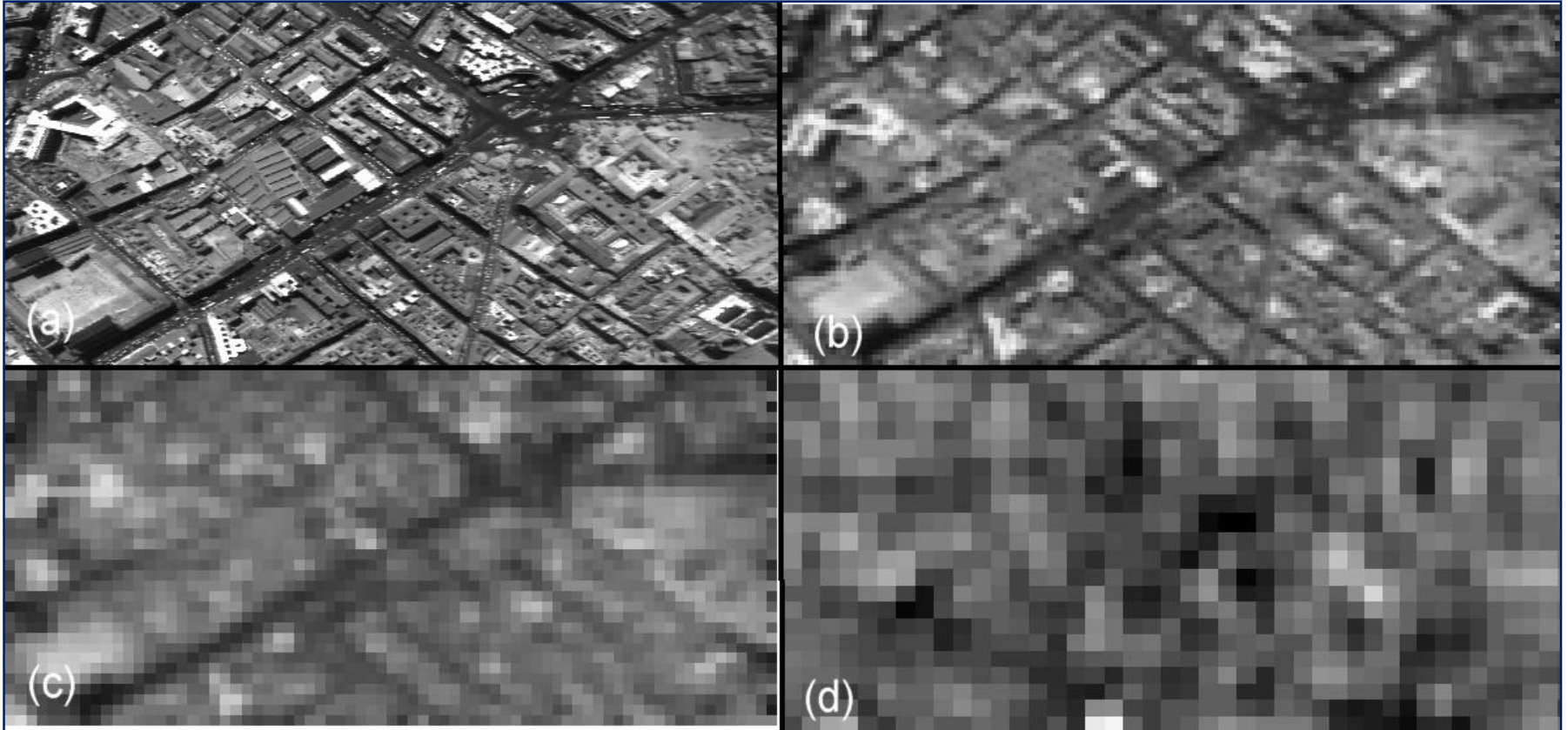
Temporal resolution

Satellites fly over the same area every short time, at the same solar time, allowing us to track the covers and processes of the earth's surface.





Spatial resolution



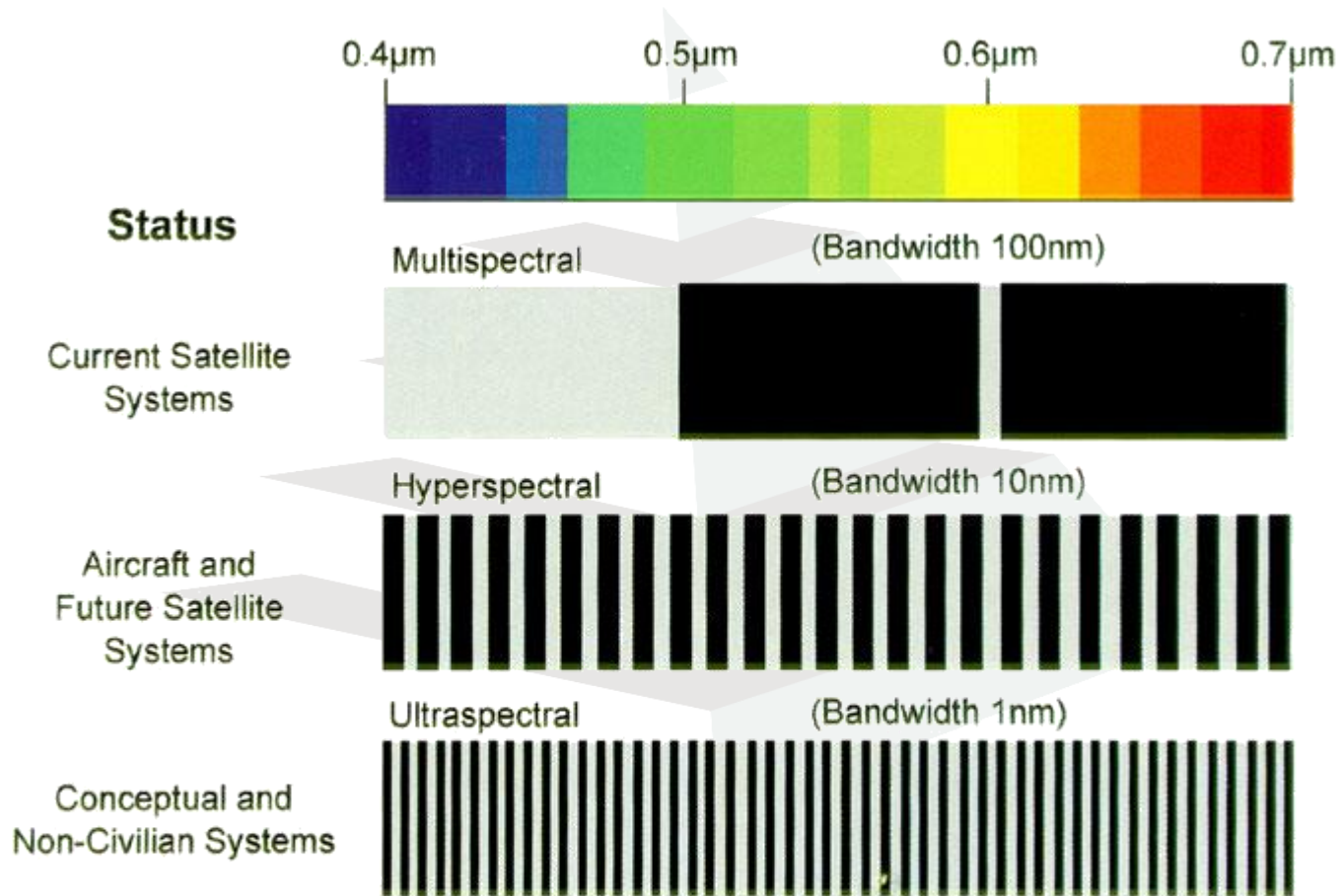
Source: Chuvieco, 2002

(a) 1 m; (b) 5 m; (c) 10 m; (d) 30 m

Scale = Pixel size / Maximum tolerable error



Spectral resolution



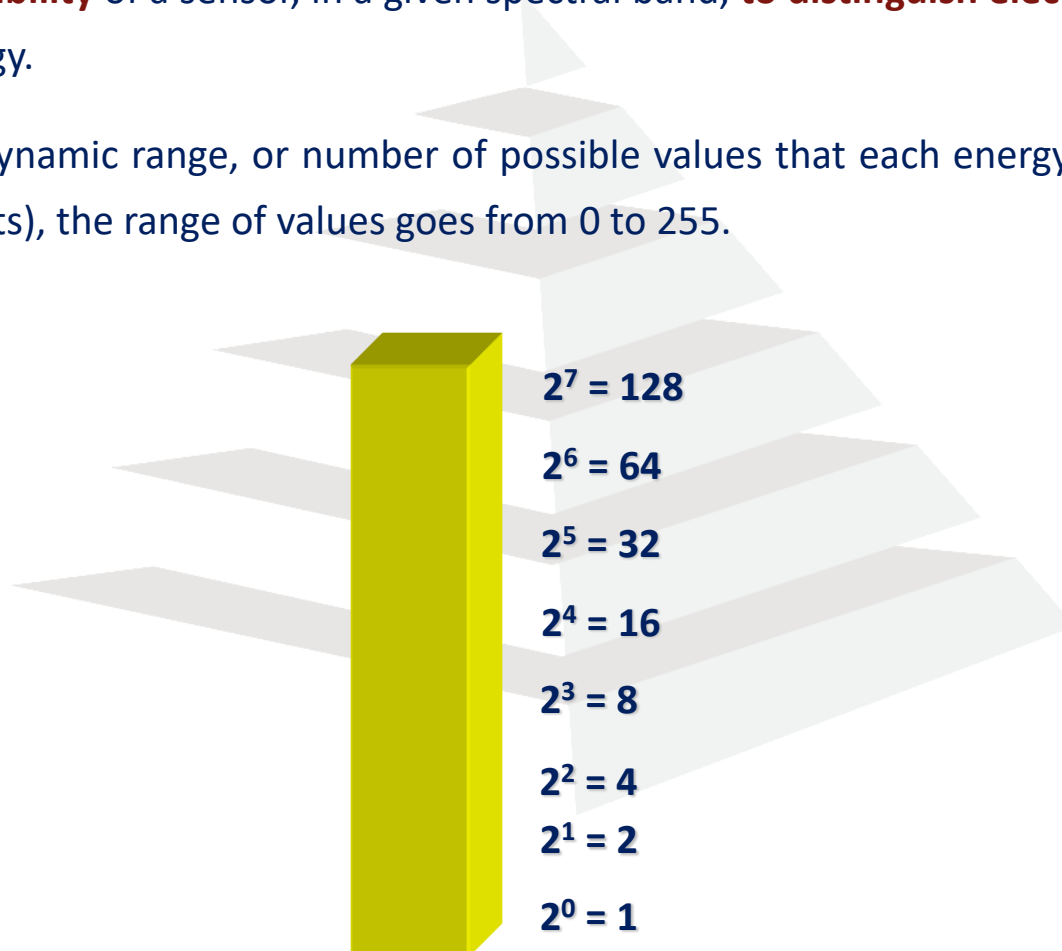
Spectral Bands

Satélite	Resolución	Año	Spectral Bands															
Landsat 4-7	30	1984	0,45	0,52	0,52	0,60	0,63	0,69	0,76	0,90	1,55	1,75	2,08	2,35	10,42	12,50		
	15		Banda 1	Banda 2	Banda 3	Banda 4	Banda 5	Banda 7	Banda 6	Banda 8								
SPOT 4	20	1998	0,50	0,59	0,61	0,68	0,79	0,89	1,58	1,75								
	10		Banda 1	Banda 2	Banda 3	Banda 4	Banda M											
SPOT 5	10; b4 (20)	2002	0,50	0,59	0,61	0,68	0,78	0,89	1,58	1,75								
	2,5 6 5		Banda 1	Banda 2	Banda 3	Banda 4	Pancromática											
Landsat 8	30	2013	0,43	0,45	0,52	0,52	0,60	0,63	0,68	0,85	0,89	1-36-1,39	1,56	1,66	2,10	2,30	10,30	12,50
	15		B1	Banda 2	Banda 3	Banda 4	Banda 5	Banda 9	Banda 6	Banda 7	Banda 10 y 11	Banda 8						
DEIMOS-1	22	2009	0,52	0,60	0,63	0,69	0,77	0,90										
			Banda 2	Banda 1	Banda 0													
IKONOS	4	1999	0,45	0,52	0,52	0,60	0,63	0,69	0,76	0,90								
	1		Banda 1	Banda 2	Banda 3	Banda 4	Pancromática											
QuickBird	2,44-2,88	2001	0,45	0,52	0,52	0,60	0,63	0,69	0,76	0,90								
	0,61-0,72		Banda 1	Banda 2	Banda 3	Banda 4	Pancromática											
Geoeye-1	1,65-2	2008	0,45	0,51	0,51	0,58	0,66	0,69	0,78	0,92								
	0,41-0,5		Blue	Green	Red	NIR 1	Pancromática											
WorldView-2	1,84-2,08	2009	0,45	0,51	0,52	0,58	0,63	0,69	0,77	0,90	0,86-1,04							
	0,46-0,52		Blue	Green	Y	Red	edge	NIR 1	NIR 2	Pancromática								

Radiometric resolution

It expresses the **ability** of a sensor, in a given spectral band, **to distinguish electromagnetic signals** of different energy.

It refers to the dynamic range, or number of possible values that each energy measure can take. With 1 byte (8 bits), the range of values goes from 0 to 255.



Tasks

- How Download QGIS software?
- How Download satellite images?
- Open Layers
- Cartographic Reference System (EPSG)
- Spectral bands
- Color composition
- Indices calculation
- Data integration
- Information Extraction

Download QGIS

QGIS is a user friendly **Open Source Geographic Information System** (GIS) licensed under the GNU General Public License. QGIS is an official project of the Open Source Geospatial Foundation (OSGeo). It runs on Linux, Unix, Mac OSX, Windows and Android and supports numerous vector, raster, and database formats and functionalities.

Download: <https://www.qgis.org/en/site/forusers/download.html>

Download Long term release according your operating system x32 o x64 bits!

Long term release repository (most stable):


		QGIS Standalone Installer Version 2.18 (64 bit)
	md5	
		QGIS Standalone Installer Version 2.18 (32 bit)
	md5	

Image Acquisition

The screenshot shows the EarthExplorer web application. At the top, there is a navigation bar with the USGS logo and the text "science for a changing world". Below this is the "EarthExplorer" header with a "Page Expires In 1:58:26" indicator. The main content area is divided into a search criteria panel on the left and a map on the right.

Search Criteria Summary (Show) Clear Criteria

1. Enter Search Criteria
To narrow your search area: type in an address or place name, enter coordinates or click the map to define your search area (for advanced map tools, view the [help documentation](#)), and/or choose a date range.

Address/Place Path/Row Feature Circle

Show Clear

Coordinates Predefined Area Shapefile KML

Degree/Minute/Second Decimal

No coordinates selected.

Use Map Add Coordinate Clear Coordinates

Date Range Result Options

Search from: mm/dd/yyyy to: mm/dd/yyyy

Search months: (all)

Data Sets » Additional Criteria » Results »

The map on the right shows a satellite view of the Iberian Peninsula, with labels for "Portugal", "España", and "Gibraltar". Major cities like Madrid, Barcelona, and Valencia are marked. A search box at the top of the map displays the coordinates (35° 41' 34" N, 011° 42' 41" W). The map also includes "Mapa" and "Satélite" tabs, and "Options" and "Overlays" links.

Image Acquisition

EROS Registration System (ERS)

User Registration

[User Credentials](#) | [Contact Demographic](#) | [Contact Information](#) | [Complete Registration](#)

Registration and login credentials are required to access all system features and download data from USGS EROS web services. To ensure privacy and security, ERS uses Hypertext Transfer Protocol with Secure Sockets Layer (HTTPS) to encrypt user authentication.

To register, please create a username and password. The information gathered from the registration process is not distributed to other organizations and is only used to determine trends in data usage. Review [USGS Privacy Policies](#).

The Cancel button can be used to exit the registration process at any time and information entered will be lost.

Username

New Password

Confirm New Password

Username Requirements
Must be between 4 and 30 characters
May contain alphabetic and numeric characters
May only contain the following special characters
period "."
at sign "@"
underscore "_"
dash "-"

Password Requirements
Must be between 8 and 16 characters
Must contain at least one alphabetic character
Must contain at least one numeric character
May only contain the following special characters
comma ","
hyphen "-"
period "."
pipe "|"
pound "#"
underscore "_"

Type the text [Privacy & Terms](#)

OMB number 1028-0119
OMB expiration date 06/30/2019

Privacy and Paperwork Reduction Act statements: 16 U.S.C. 1a7 authorized collection of this information. This information will be used by the U.S. Geological Survey to better serve the public. Response to this request is voluntary. No action may be taken against you for refusing to supply the information requested. The time required to complete this information collection is estimated to average 5 minutes per response. We will not distribute responses associated with you as an individual. We ask you for some basic organizational and contact information to help us interpret the results and, if needed, to contact you for clarification. Comments on this collection should be sent to custserv@usgs.gov.

Accessibility | FOIA | Privacy | Policies and Notices | Feedback | Help

U.S. Department of the Interior U.S. Geological Survey
URL: <https://ers.cr.usgs.gov>

Vegetation Index

$$RATIO = \frac{NIR}{R}$$

$$NDVI = \frac{NIR - R}{NIR + R}$$

$$SAVI = \frac{NIR - R}{(NIR + R)} (1 + L)$$

$$TVI = \sqrt{\frac{(NIR - R)}{NIR + R}} + 0.5$$

$$CTVI = \frac{NDVI + 0.5}{ABS(NDVI + 0.5)} \times \sqrt{ABS(NDVI + 0.5)}$$

$$TTVI = \sqrt{ABS(NDVI + 0.5)}$$

$$RVI = \frac{R}{NIR}$$

$$NRVI = \frac{RVI - 1}{RVI + 1}$$

$$EVI = G \frac{NIR - R}{NIR + C_1 R - C_2 B + L} (1 + L)$$

NIR = near infrared,
R = red,
B = blue,
L = Soil
adjustment factor, C₁ and C₂ are
constants, G is a gain factor

Birth and McVey (1968)

Rouse *et al.* (1974)

Huete (1988)

Deering *et al.* (1975)

Perry and Lautenschlager (1984)

Thiam (1997)

Richardson and Wiegand (1977)

Baret and Guyot (1991)

Huete *et al.* (1999)

Sentinel-2 vs Landsat

Comparison of Landsat 7 and 8 bands with Sentinel-2

