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

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.

Copernicus Services

Europe's eyes on Earth

Atmosphere
(CAMS)

Marine Environment
(CMEMS)

Land
(CLMS)

Climate Change
(C3S)

Emergency Management
(EMS)

Security

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Emergency Management

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)**

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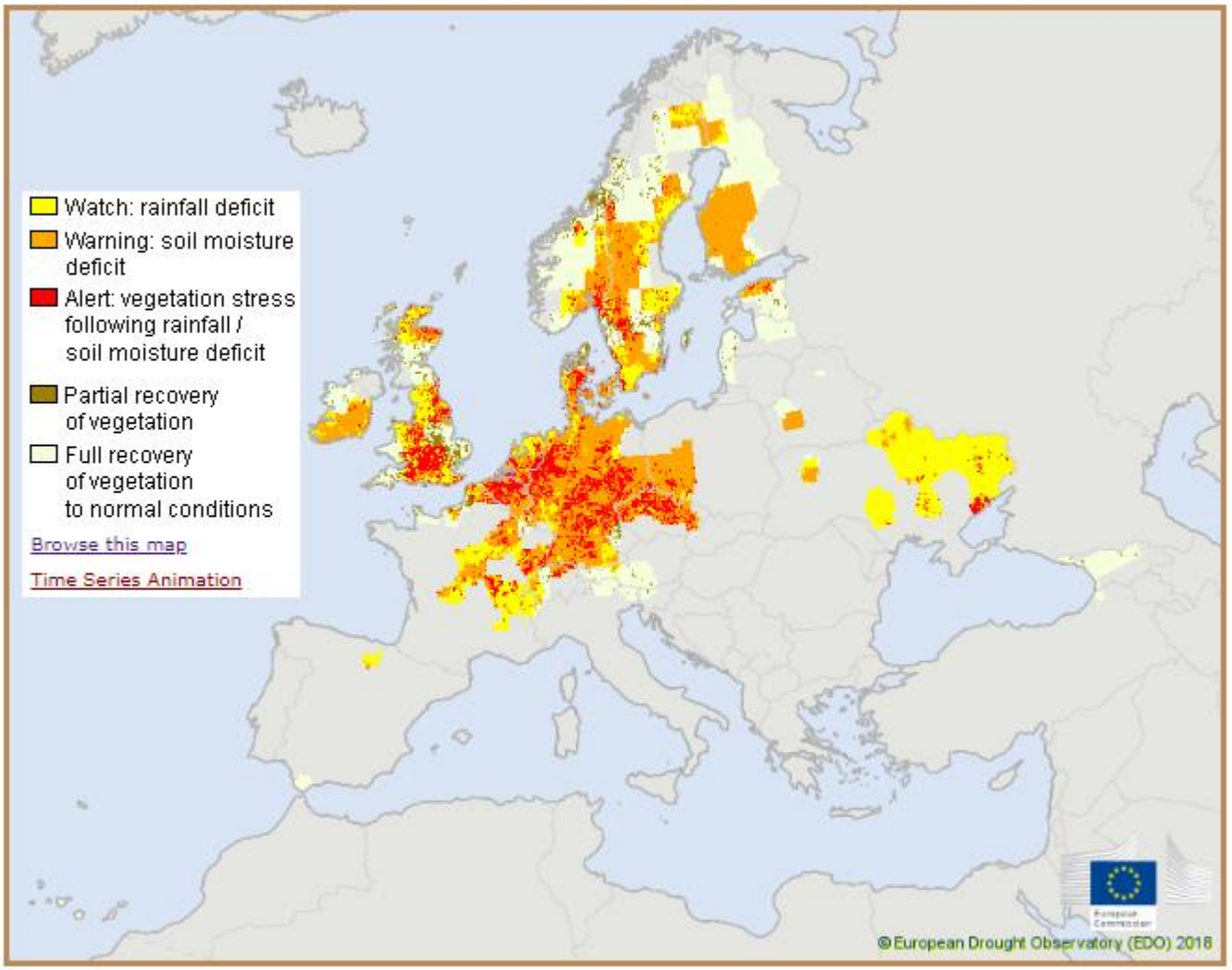
European Commission

EDO - European Drought Observatory

Copernicus Europe's eyes on Earth

Emergency Management Service

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



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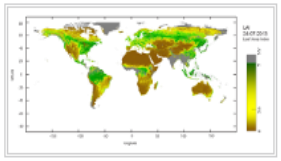
Global Land Service

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.

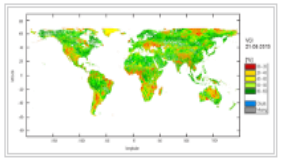
The products **are used to monitor the vegetation, the water cycle, the energy budget and the terrestrial cryosphere**.

VEGETATION PROPERTIES



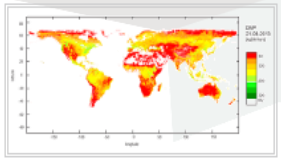
Collections

VEGETATION INDICATORS



Collections

DRY MATTER PRODUCTIVITY



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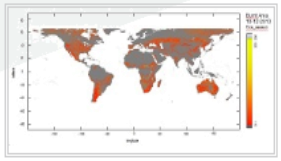
FIRE DISTURBANCE



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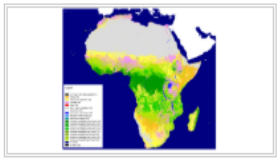
DYNAMIC LAND COVER



Collections

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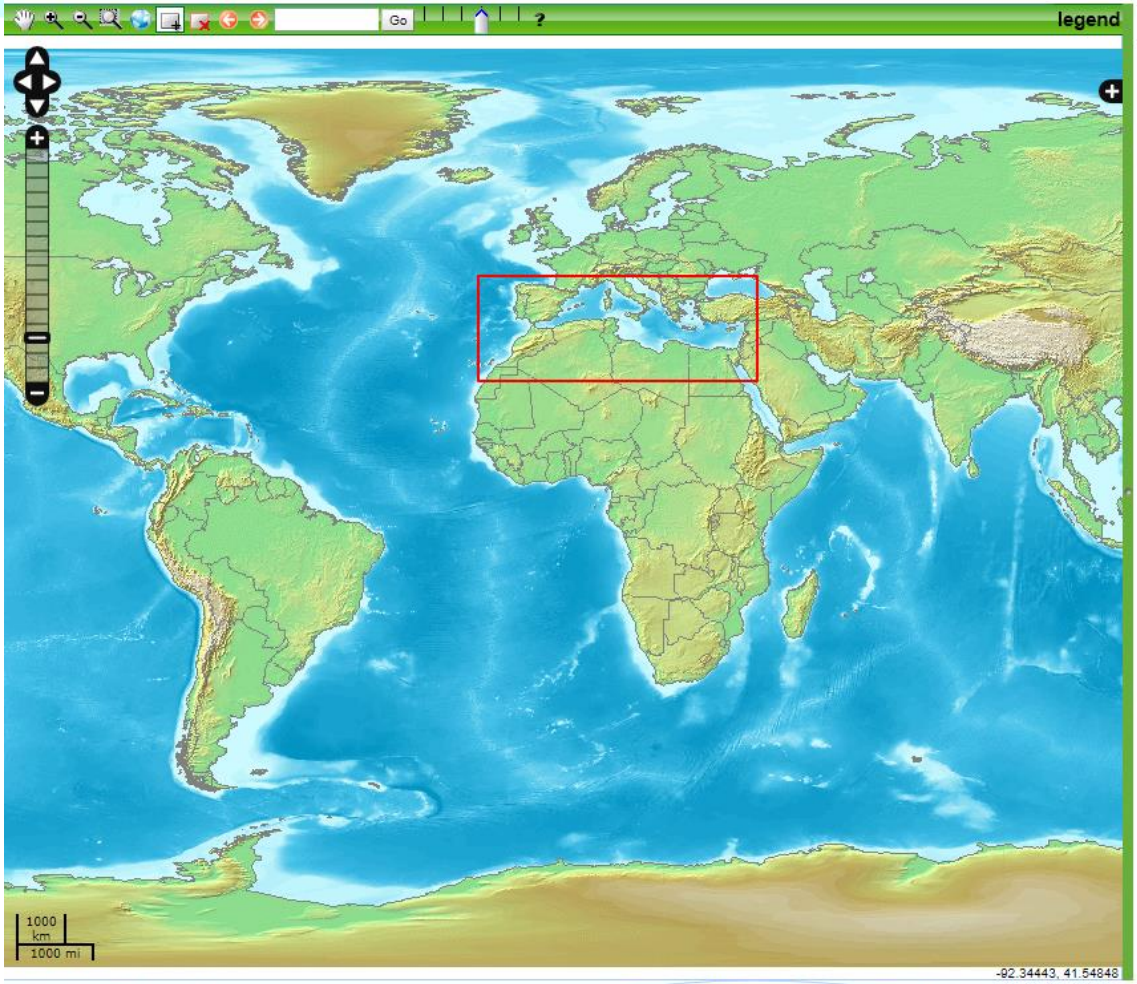

Catalogue search | Subscription

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

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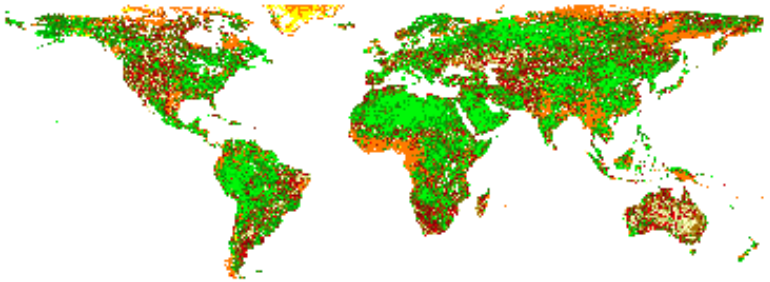
Vegetation Indicators - VCI V1

0 product selected on a total of 1 | 20 Per | << < 1 of 1 > >>

Select the product

Download	Product ID	Start Date	End Date	Size	Thumb
	VCI_201809010000_PROBAV_V1.0	01/09/2018	10/09/2018	158.6 MB	

Product Type (Collection)	BioPar_VCI_Tiles
Product ID	VCI_201809010000_PROBAV_V1.0
Parent ID	49158da0-3c6c-11e2-81c1-0800200c9a66
File ID	urn:eop:584aa144-d6cd-4170-ae52-b85bc606716c
Start Date	01/09/2018
End Date	10/09/2018
Polygon	-60 180 80 180 80 -180 -60 -180 -60 180
Size	158.6 MB
Platform	Proba-V
Instrument	VEGETATION_3
Projection information	EPSG:32662 WGS84
Production date	12/09/2018
Thumbnail	

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92.60492, -75.15195

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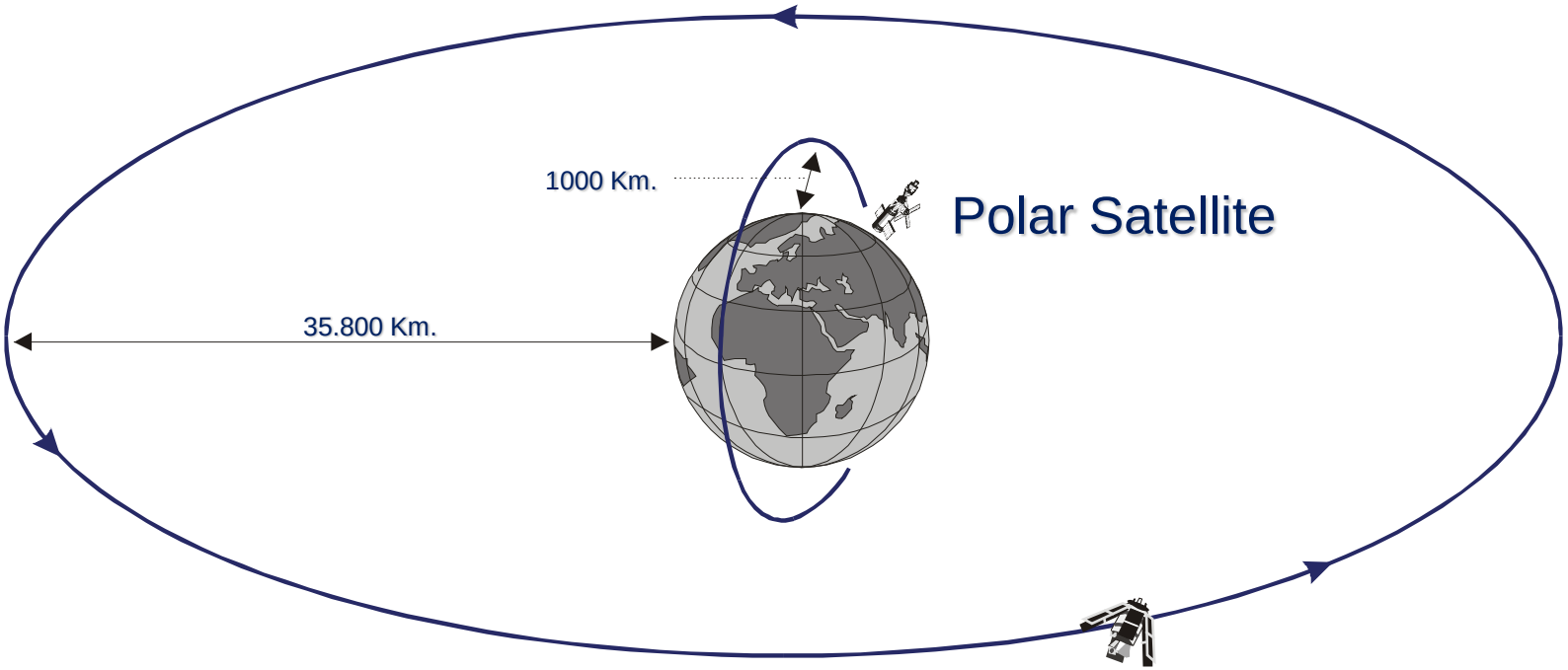
Type of satellites



Meteorological Satellites

METEOSAT (0º)
GOMS(70ºE)
GMS (140ºE)
GOES-W (140ºW)
GOES-E (70ºW)

NOAA

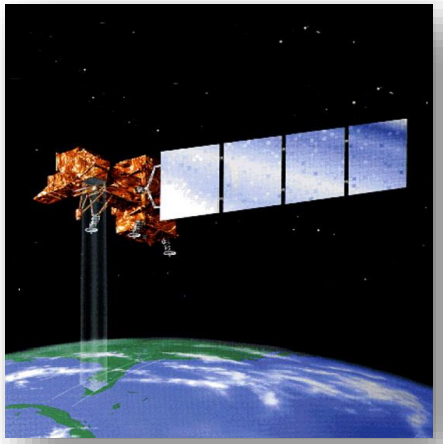
Height: **850 Km**
Temporal resolution: **12 hours**
Image size: **3.000 x 3.000 Km**
Pixel: **1,1 x 1,1 Km**
Bands: **Red, PI, MI, TI, TI**

MODIS

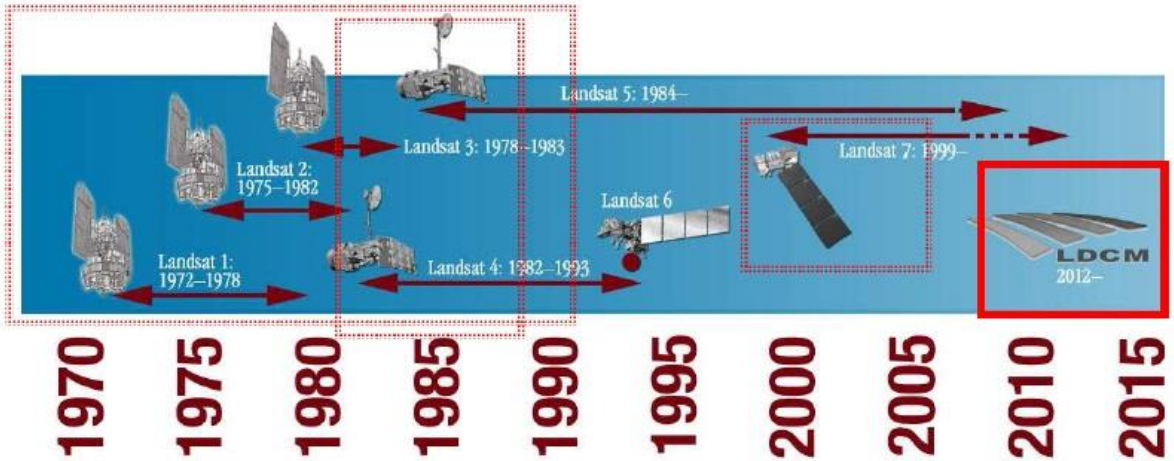
Satellites: **Terra** y **Aqua**
Launch: **1999 y 2002**
Temporal resolution: **1-2 days**
Pixel: **250 m (bandas 1–2)**
500 m (bandas 3–7)
1 km (bandas 8–36)
Bands: **36**

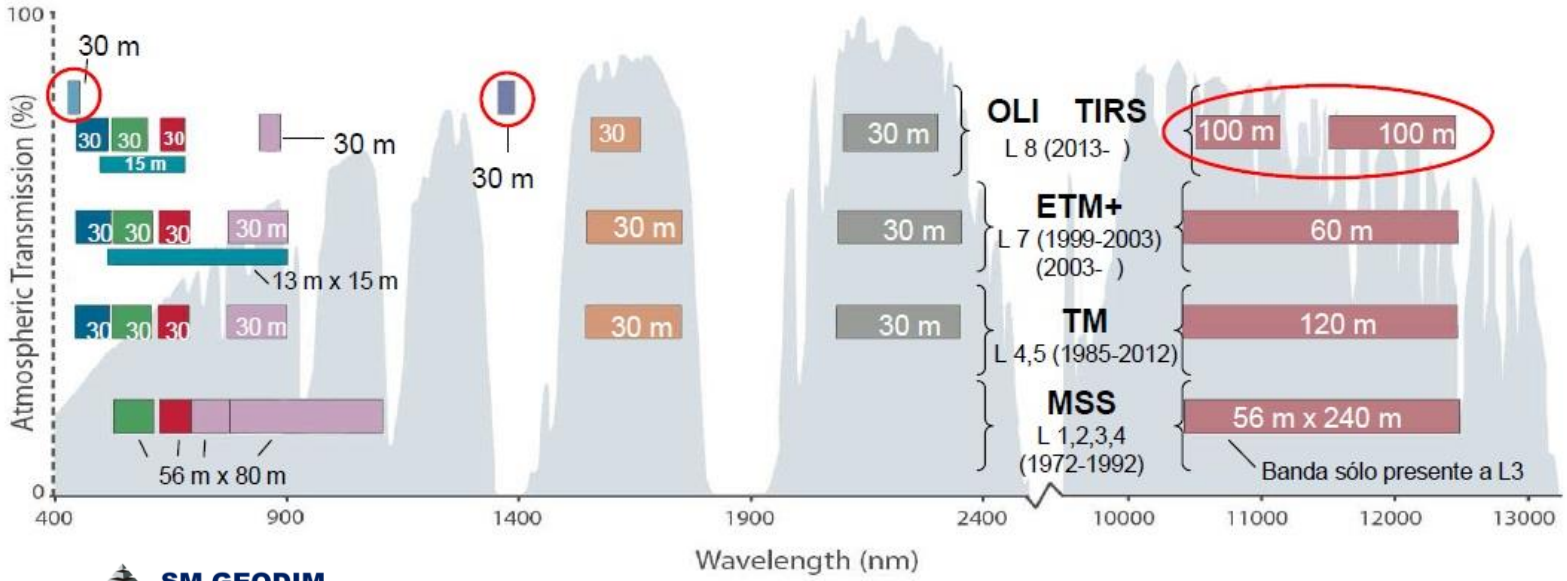
Landsat

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





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ASTER

Released: **1999**

Height: **705 Km**

Orbital period: **4-16 days**

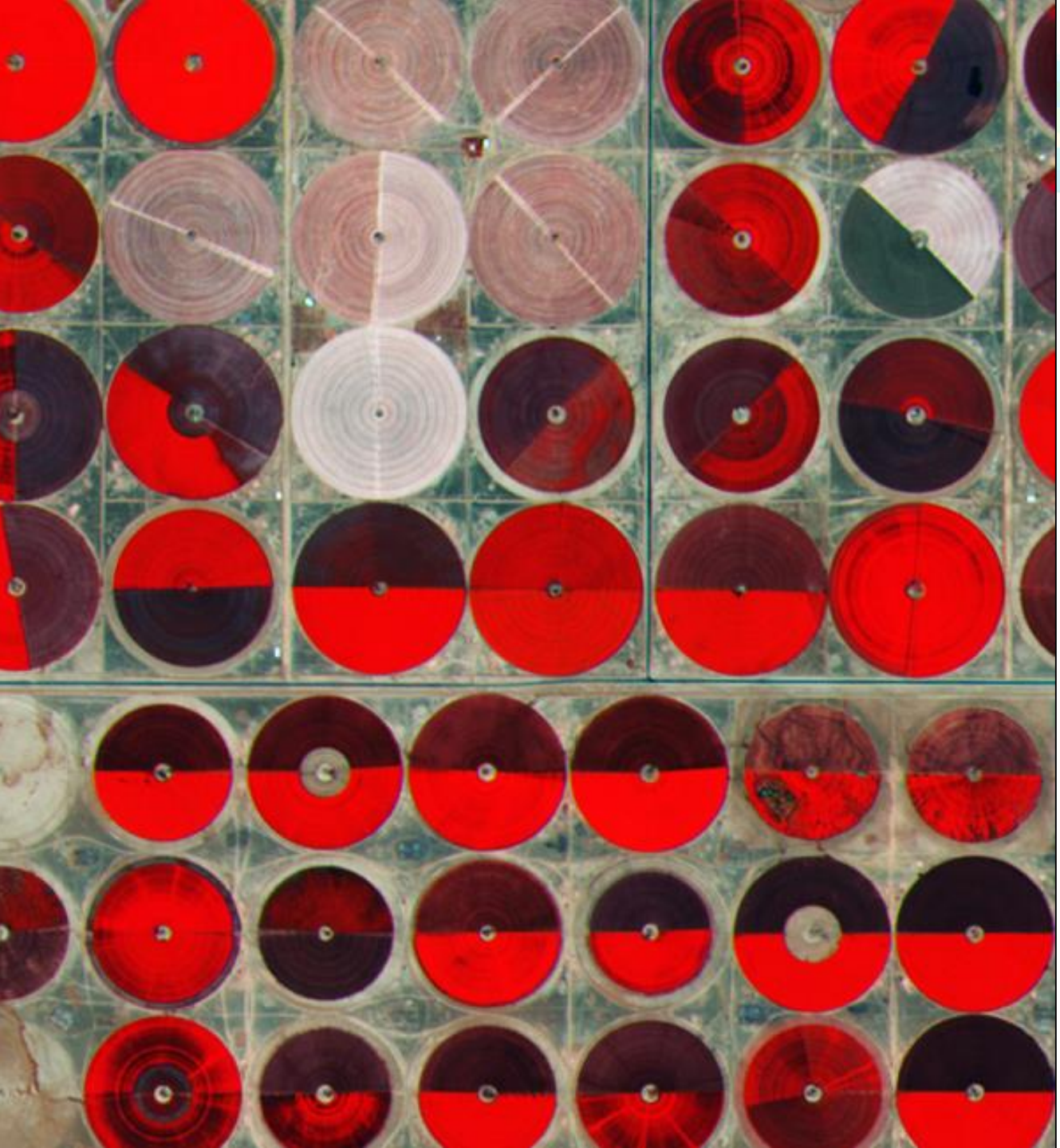
Sensor:

- **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**

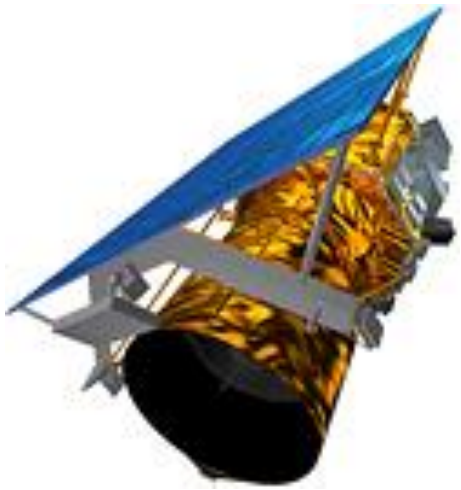
Coverage: **16,5 x 16,5 Km**

GeoEye

Launch: **2008**
Height: **684 Km**
Orbital period: **98’**
Sensors:
- **XS (0,45 – 0,92 μm)**
- **PAN (0,45 – 0,8 μm)**

Spatial resoltion:
- XS: **1,65 m**
- PAN: **0,41 m**

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



WorldView

Launght: **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.

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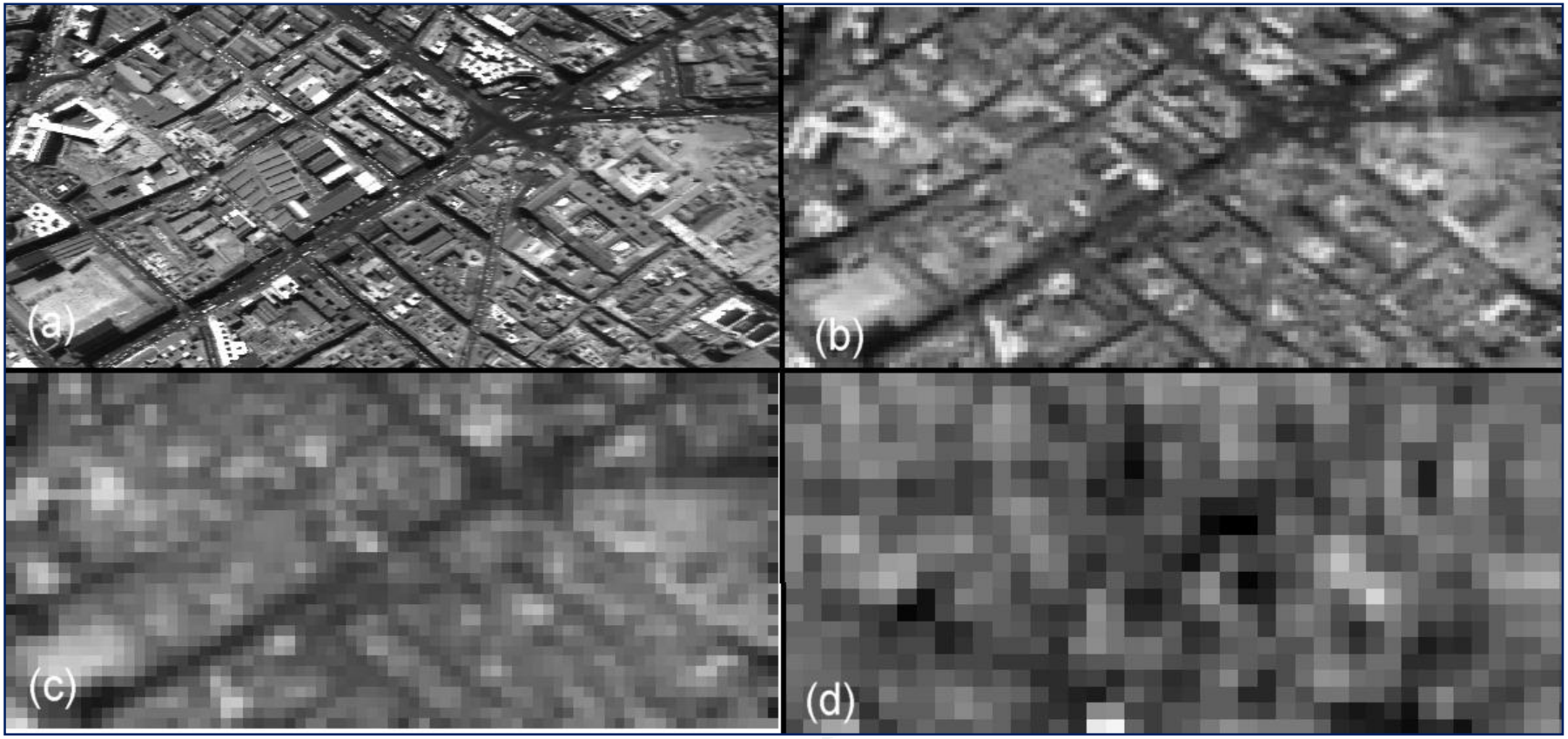
Spatial resolution



Source: Chuvieco, 2002

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

Scale = Pixel size / Maximum tolerable error

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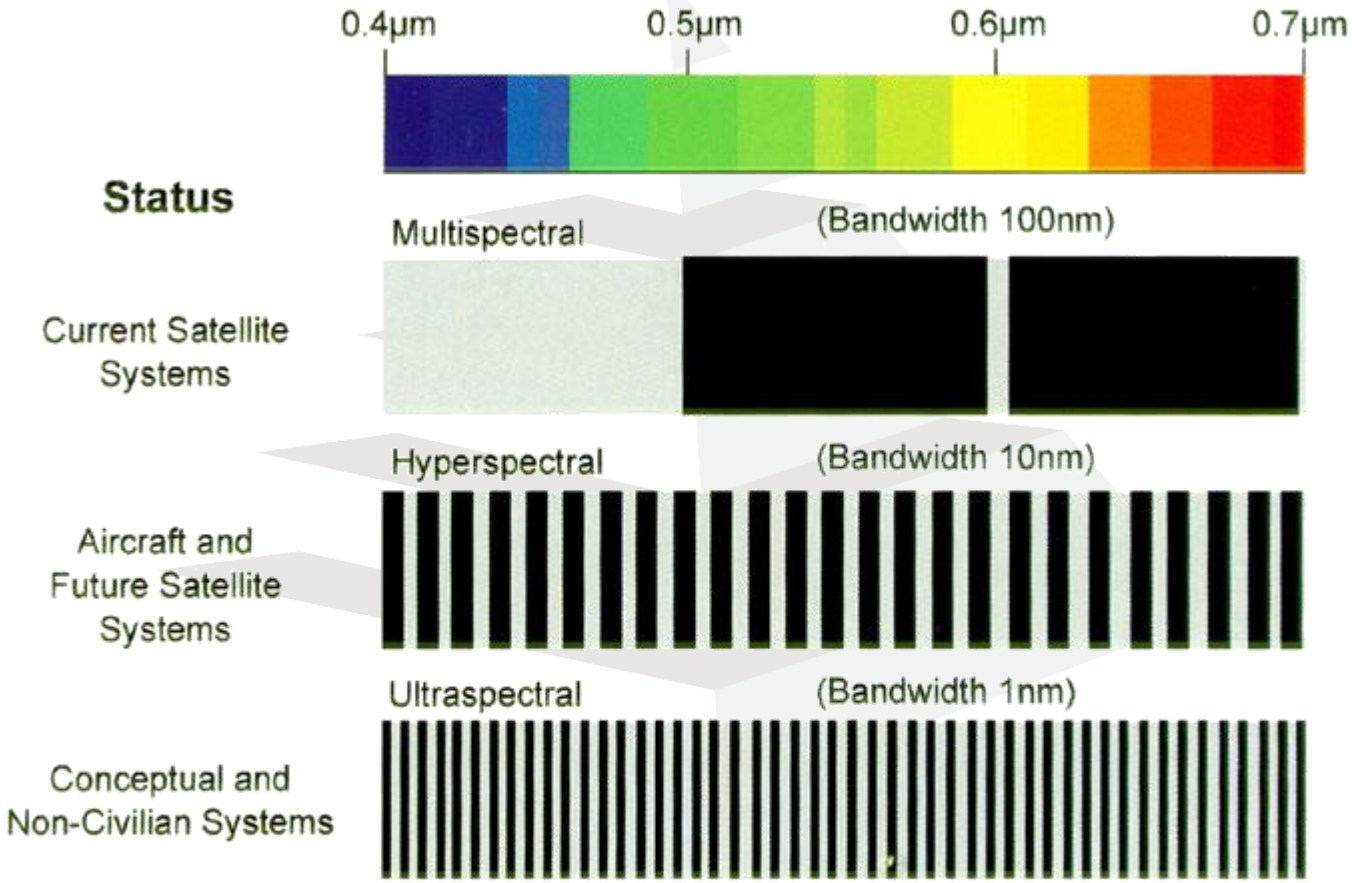
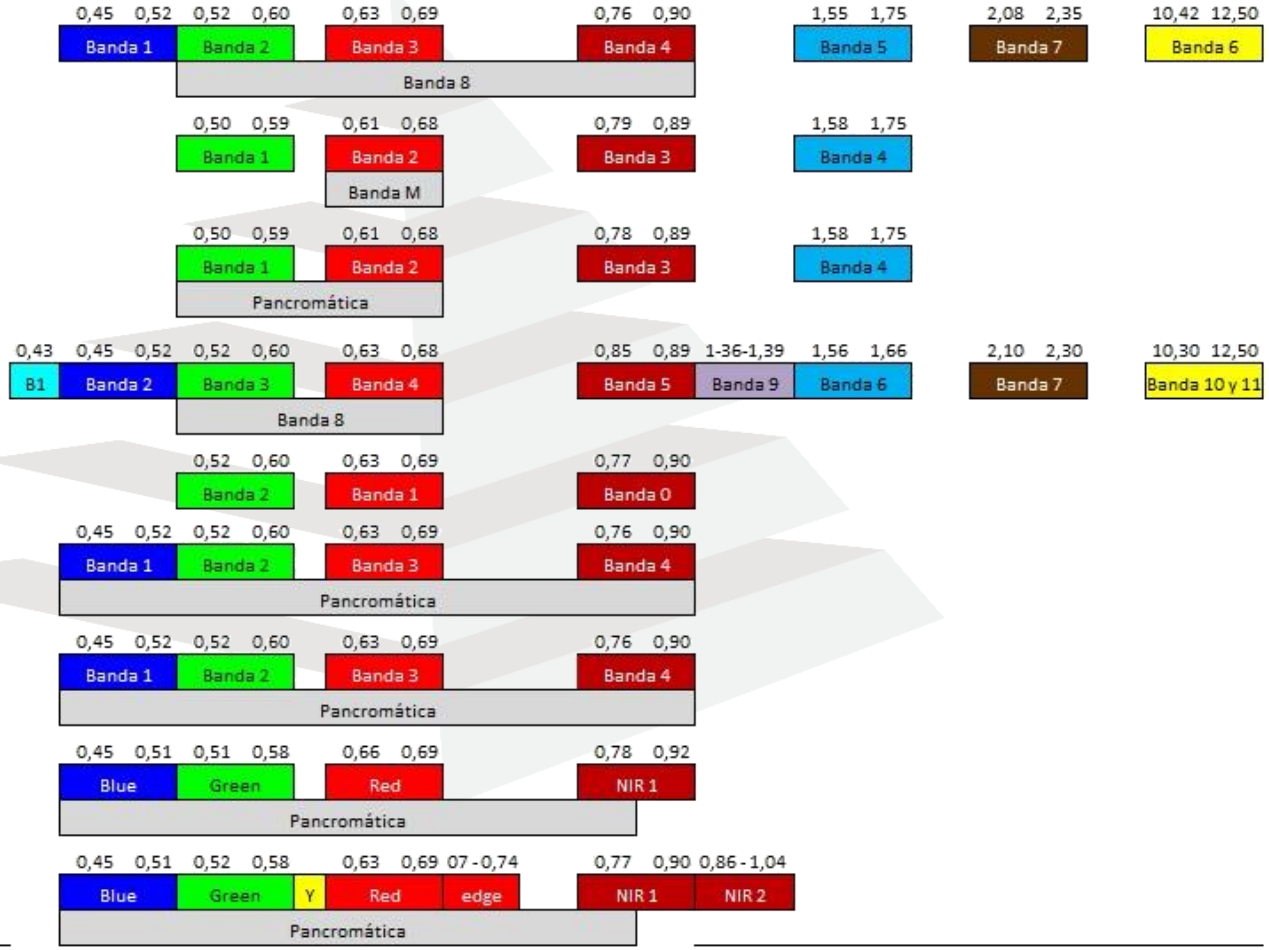
Spectral resolution



Spectral Bands

Satélite	Resolución	Año
Landsat 4-7	30	1984
	15	
SPOT 4	20	1998
	10	
SPOT 5	10; b4 (20)	2002
	2,5 ó 5	
Landsat 8	30	2013
	15	
DEIMOS-1	22	2009
IKONOS	4	1999
	1	
QuickBird	2,44-2,88	2001
	0,61-0,72	
Geoeye-1	1,65-2	2008
	0,41-0,5	
WordView-2	1,84-2,08	2009
	0,46-0,52	



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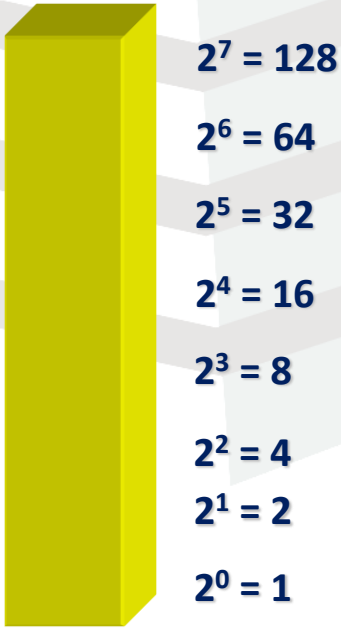
Radiometric resolution

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!

Image Acquisition

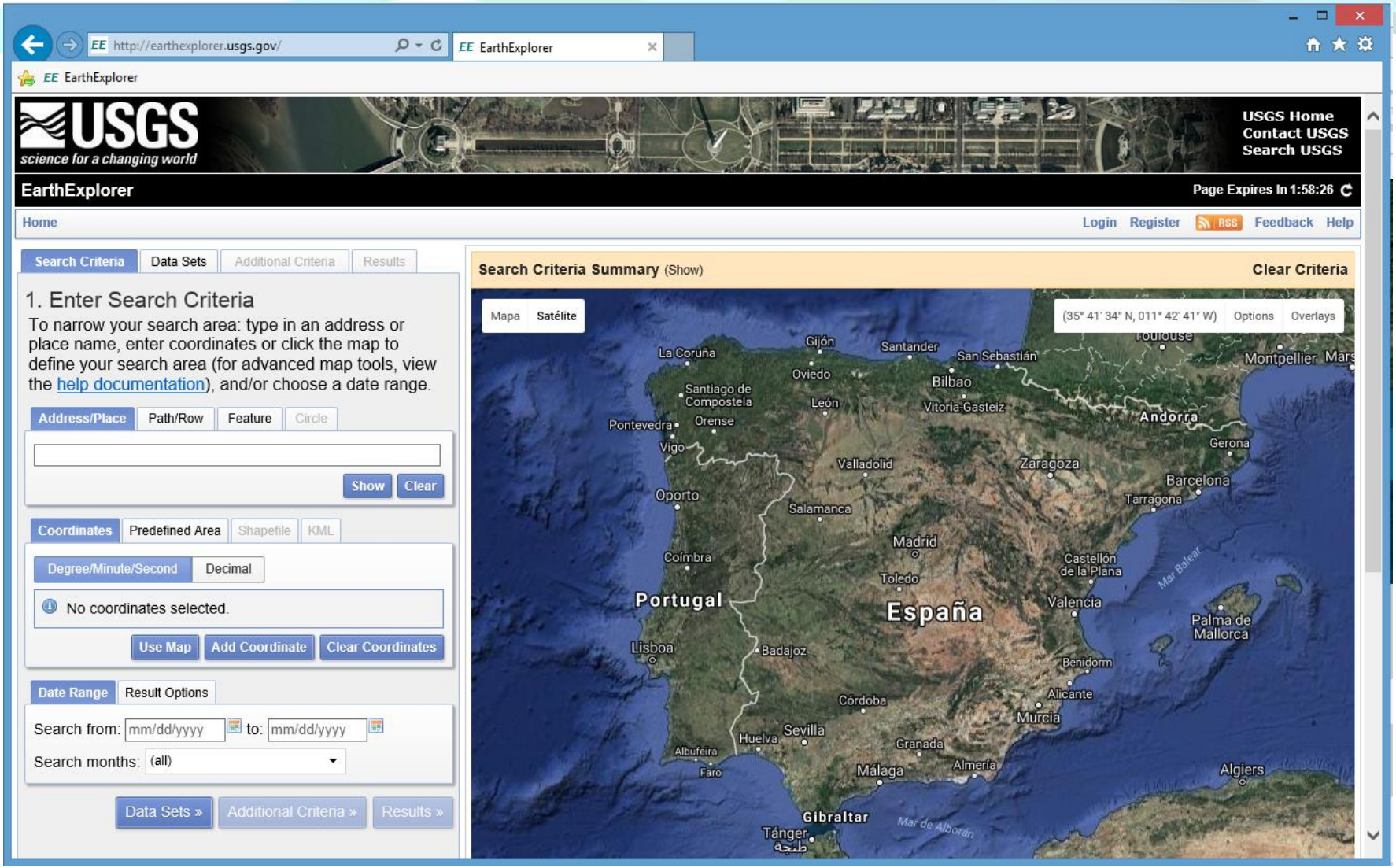


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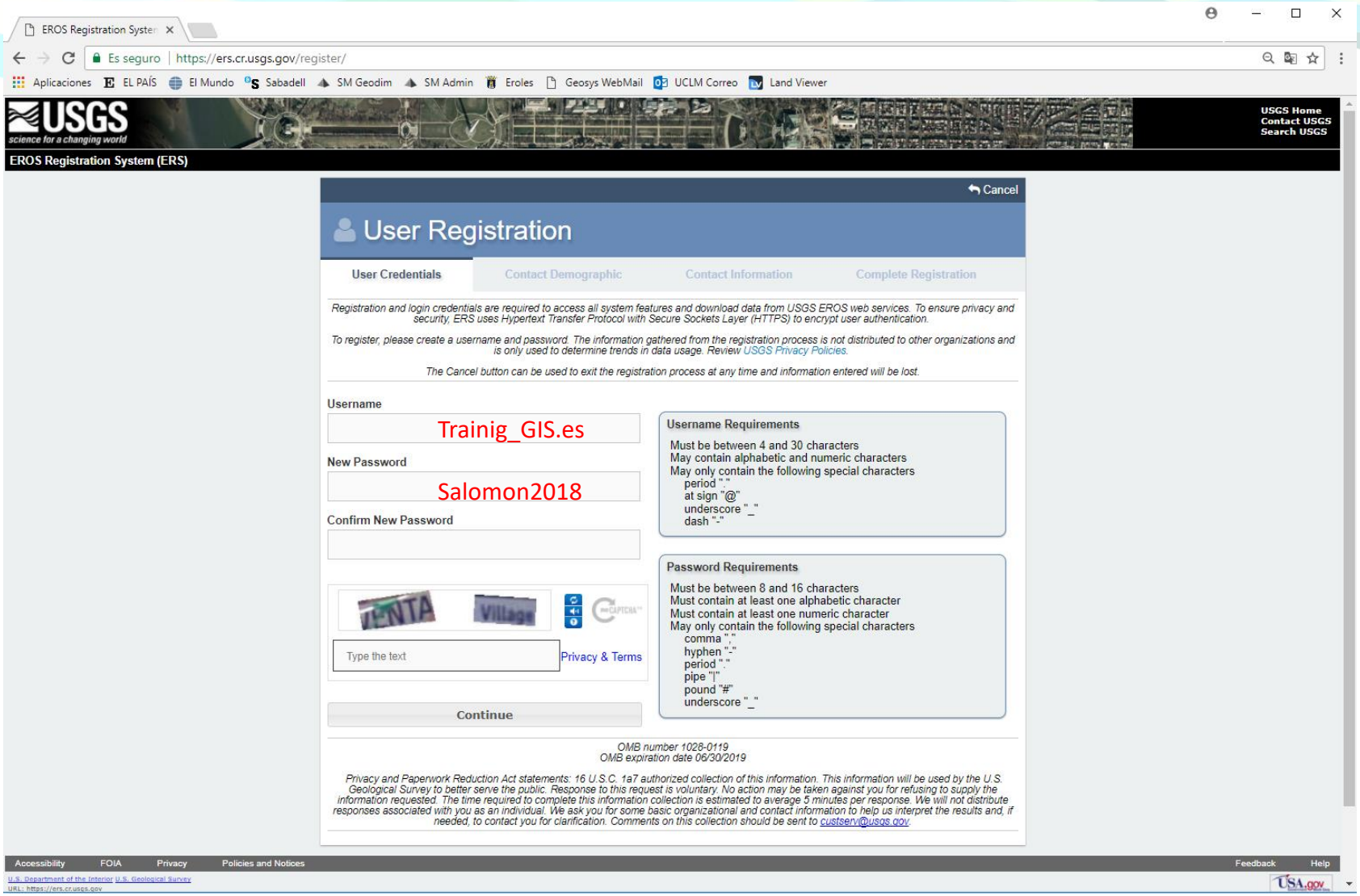
Image Acquisition



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Vegetation Index

$RATIO = \frac{NIR}{R}$	NIR = near infrared, R = red, B = blue, L = Soil adjustment factor, C_1 and C_2 are constants, G is a gain factor	Birth and McVey (1968)
$NDVI = \frac{NIR-R}{NIR+R}$		Rouse *et al*. (1974)
$SAVI = \frac{NIR-R}{(NIR+R)}(1+L)$		Huete (1988)
$TVI = \sqrt{\frac{(NIR-R)}{NIR+R}} + 0.5$		Deering *et al*. (1975)
$CTVI = \frac{NDVI+0.5}{ABS\,(NDVI+0.5)} \times \sqrt{ABS\,(NDVI+0.5)}$		Perry and Lautenschlager (1984)
$TTVI = \sqrt{ABS\,(NDVI+0.5)}$		Thiam (1997)
$RVI = \frac{R}{NIR}$		Richardson and Wiegand (1977)
$NRVI = \frac{RVI-1}{RVI+1}$		Baret and Guyot (1991)
$EVI = G\frac{NIR-R}{NIR+C_1R-C_2B+L}(1+L)$		Huete *et al*. (1999)

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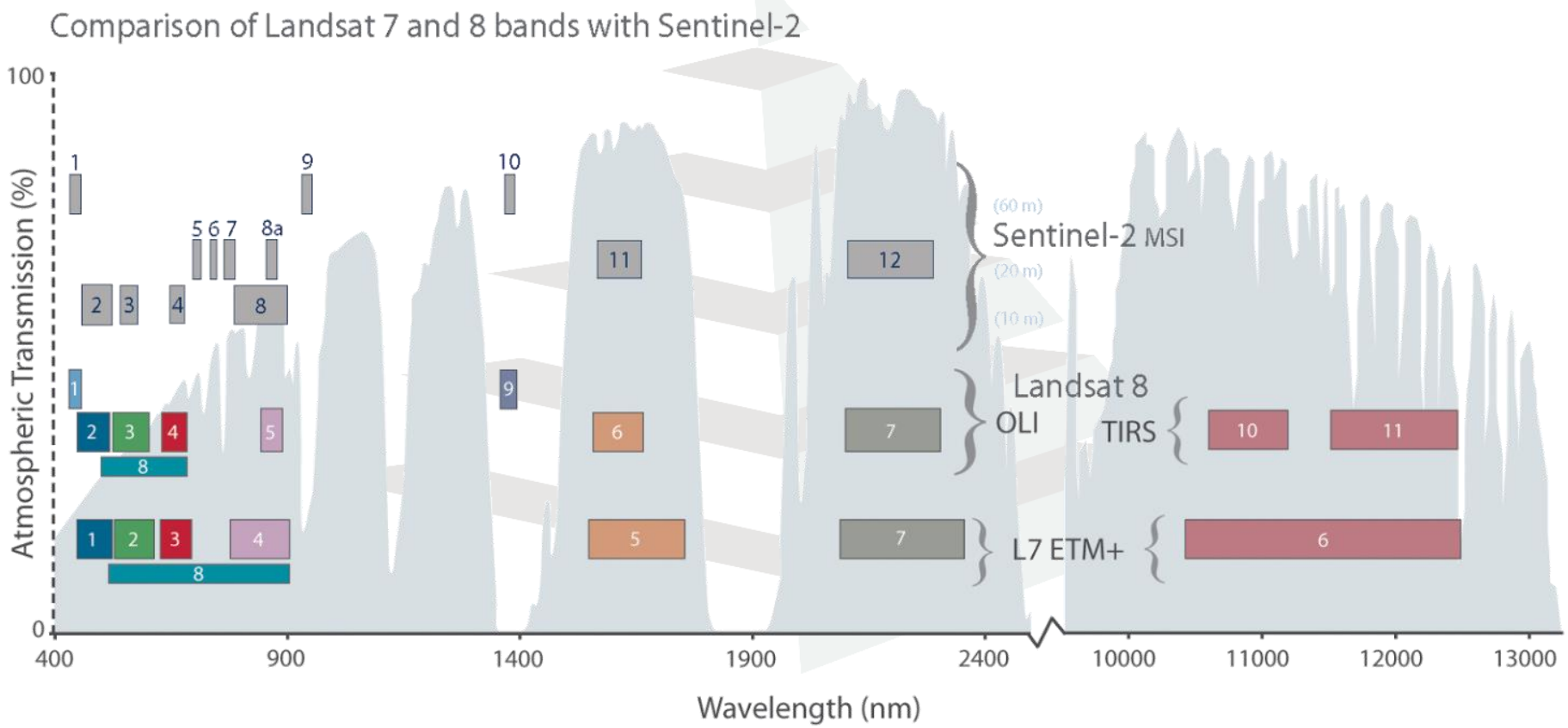
Sentinel-2 *vs* Landsat



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