

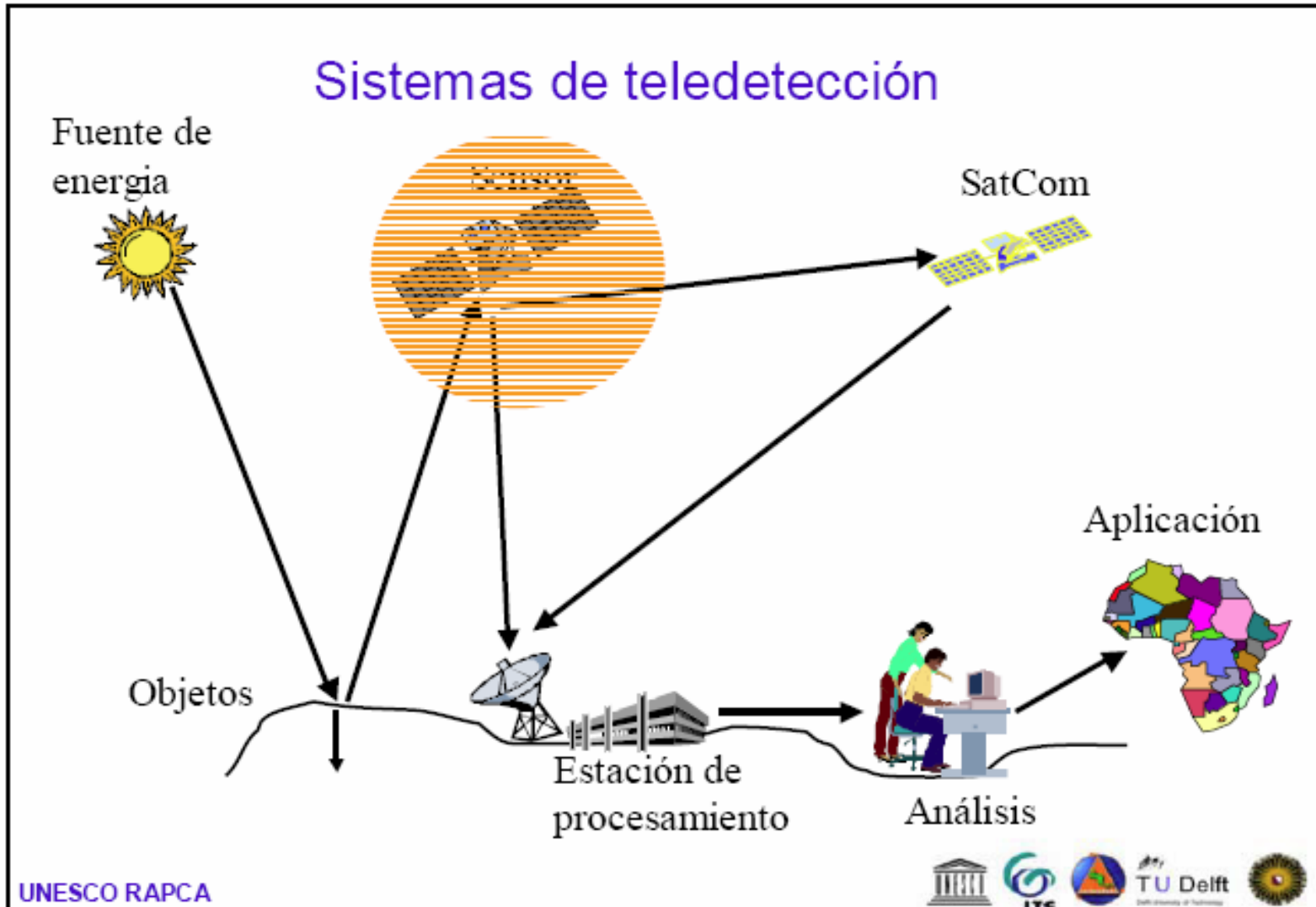
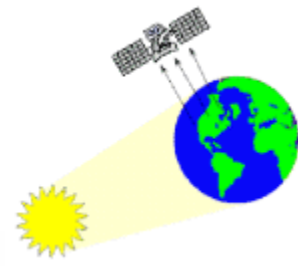
# *Teledetección desde el Espacio ...*

M<sup>a</sup> Eugenia Pérez González

**Universidad Complutense de Madrid**

Imágenes recogidas por el satélite Terra

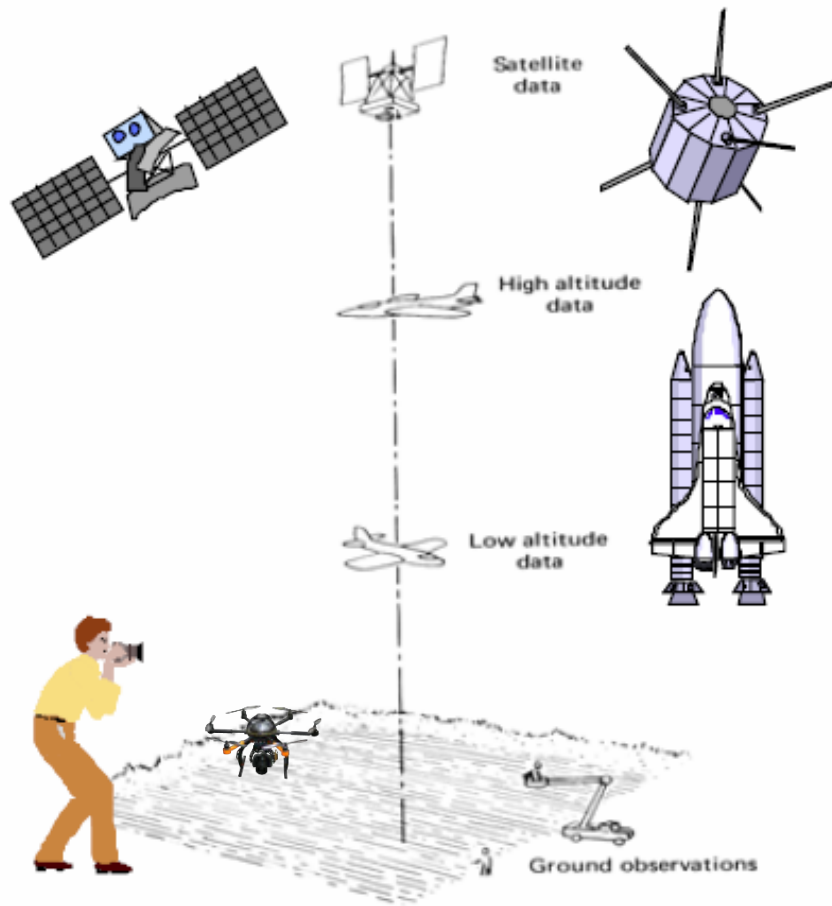
# ¿Qué es la teledetección?





# Fuentes de información

## Plataformas según altura



Rangos de altura varían desde unos pocos metros hasta 36,000 km de altura

Tipos de plataformas:

- Terrestres
- Aereas (dentro de la atmosfera)
- Espaciales (fuera de la atmosfera)



1900      1960      1970      1980      1990      2000...

Teledetección aérea

Teledetección espacial

Luz Visible / Infrarrojos

Radar

Serie Landsat

SEASAT

SPOT

Topex-Poseidon

IRS

JERS

ERS

Un poco de historia...

Mercury

Skylab

Transbordador Espacial

Gemini

Apollo

RADARSAT

SeaWiFS

ADEOS

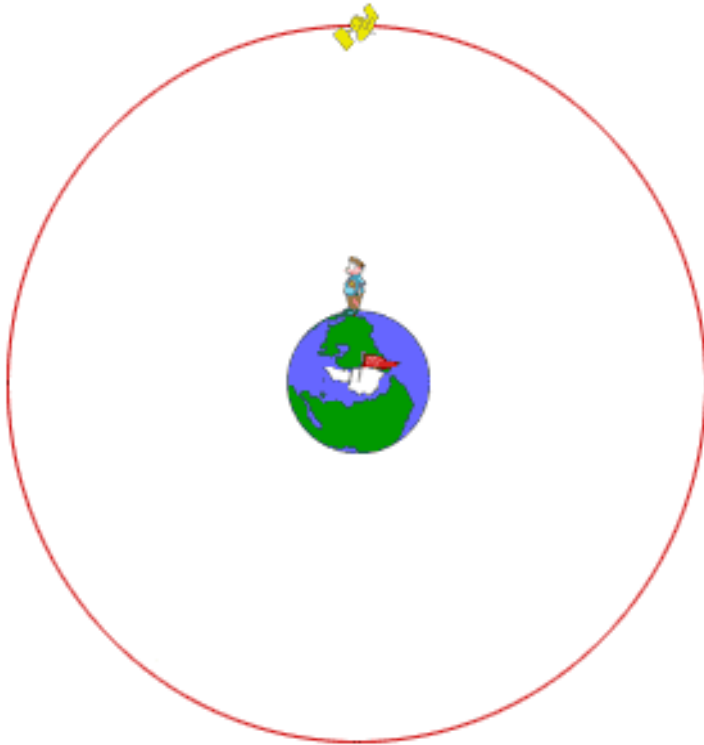
Estación Espacial MIR

Satélites meteorológicos

# Tipos de Satélites

✓ Según su órbita

**Geoestacionarios**



**Desde 1960 ...**

**Circumpolares**



**Desde 1970/78 ...**

# Geoestacionarios

**GOES W**

**1975**

**GOES-W**  
(USA)  
135°W



**FY-1D**  
(CHINA)



**GOES-9 JAPAN**  
(USA)  
155°E



**GMS-1977**

**MTSAT-1R**  
(JAPAN)  
140°E



**INSAT-1988**

**INSAT**  
(INDIA)  
93.5°E



**FY-2A**  
(CHINA)  
86.5°E



**METEOR**  
(RUSSIA)



**GOMS**  
(RUSSIA)  
76°E



**KALPANA-1**  
(INDIA)  
74°E



**METEOSAT-5**  
(EUMETSAT)  
63°E



**METEOSAT-6**  
(EUMETSAT)  
10°E



**METEOSAT-7**  
(EUMETSAT)  
0° Longitude



**METEOSAT-8**  
(EUMETSAT)  
3.4°W



**NOAA**  
(USA)



**GOES-E**  
(USA)  
75°W

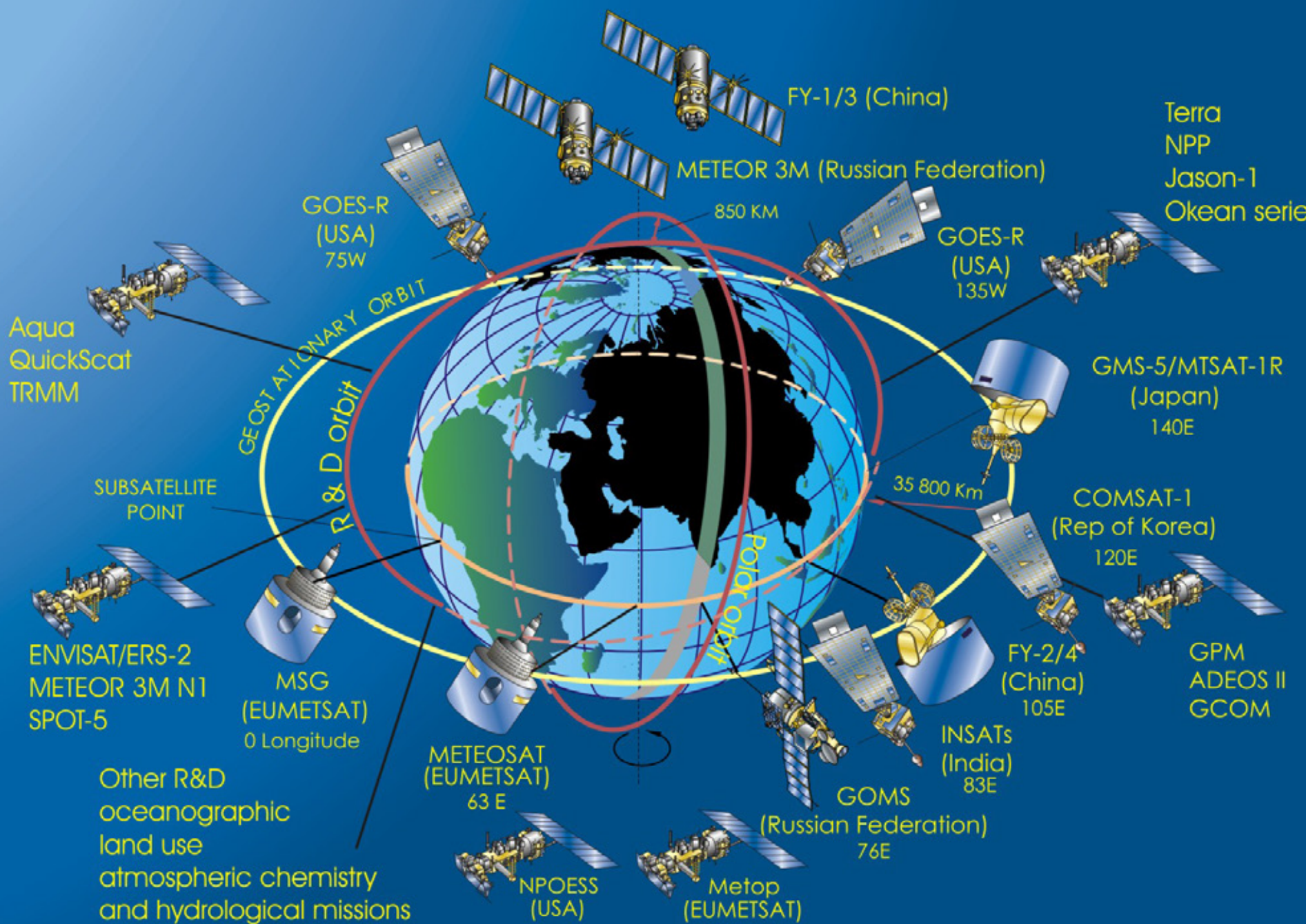


**GOES E**



**METEOSAT 1977**

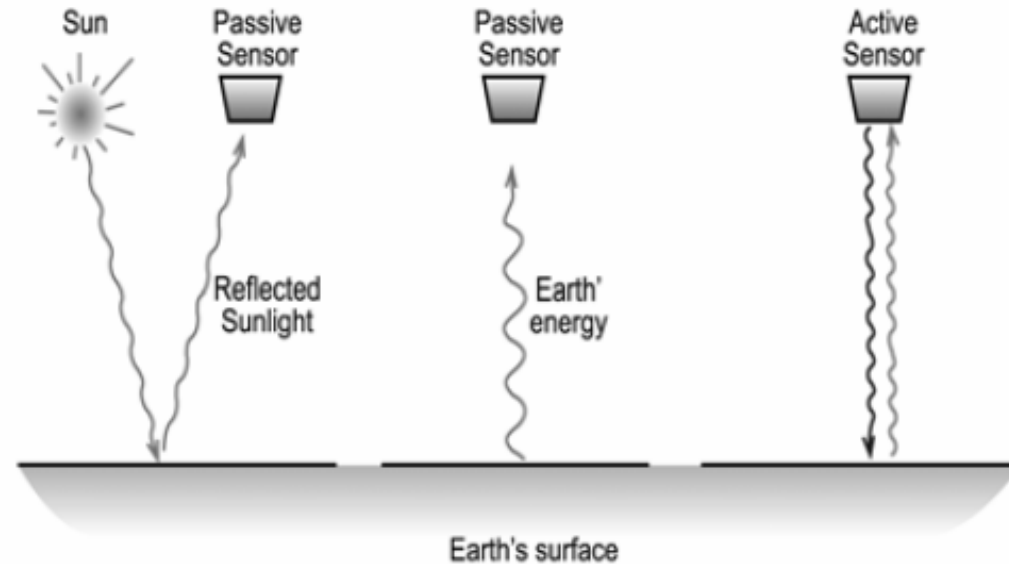




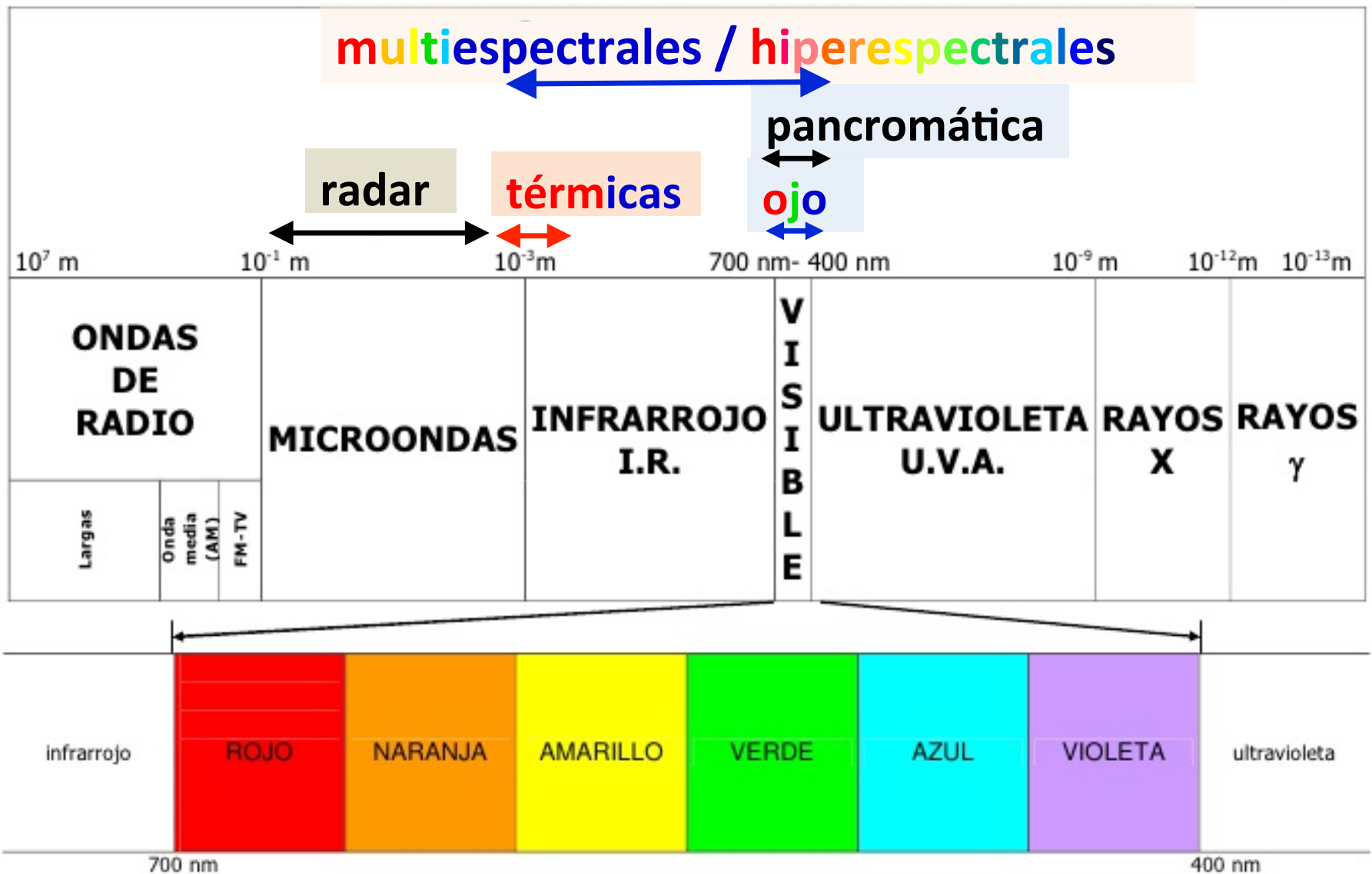
# ✓ Según el Tipo de sensor

## Sensores Pasivos / Activos

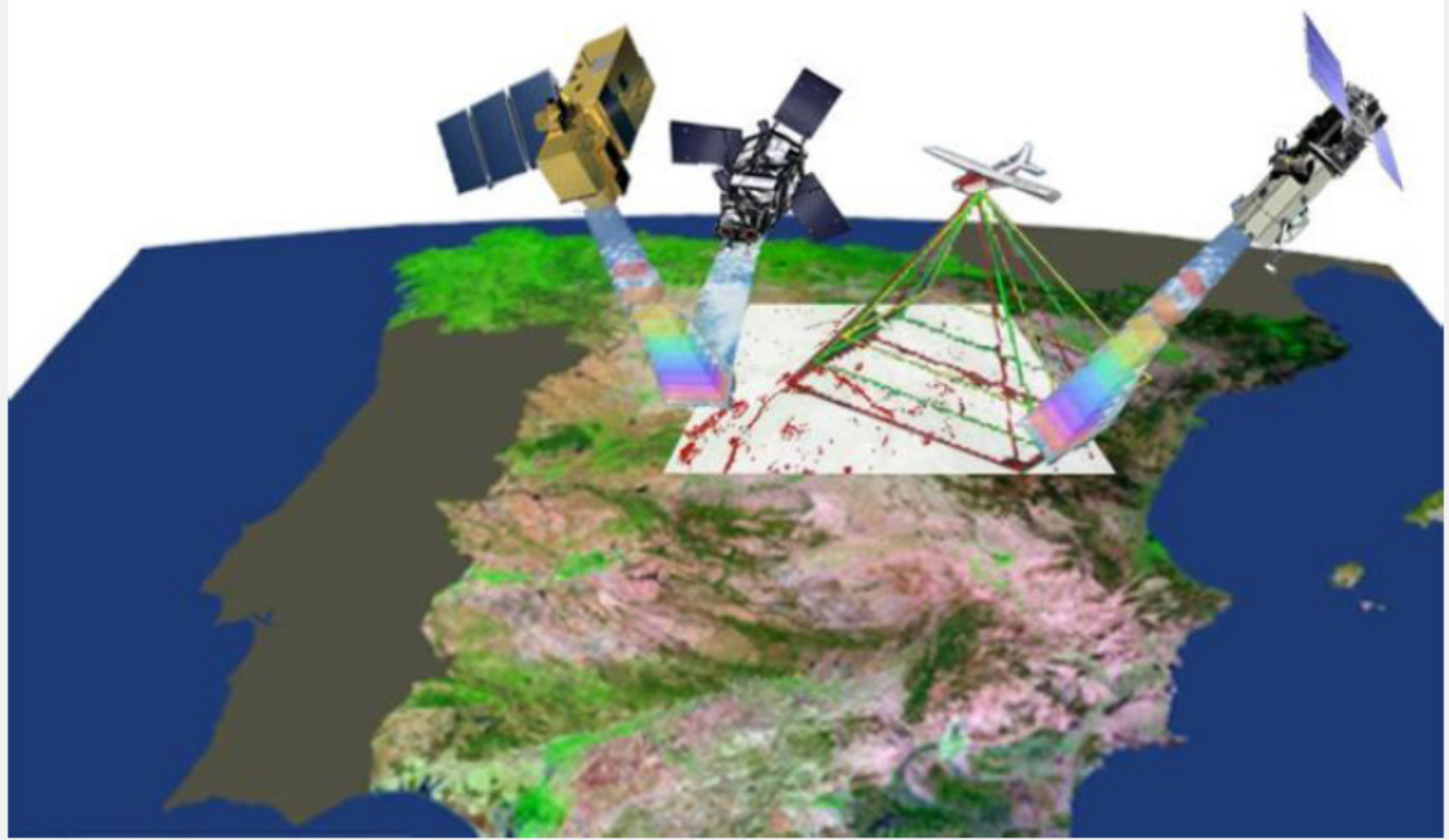
- Sensores pasivos registran
  - Luz reflejada
  - Emisión termal (TIR)
- Sensores activos poseen fuente propia de energia
  - pueden operar en la noche
  - pueden penetrar nubes
  - LIDAR, RADAR



# ESPECTRO DE RADIACIÓN ELECTRO-MAGNÉTICA





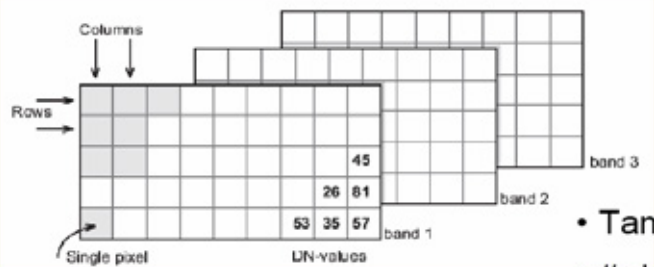




# ✓ Tipo de información

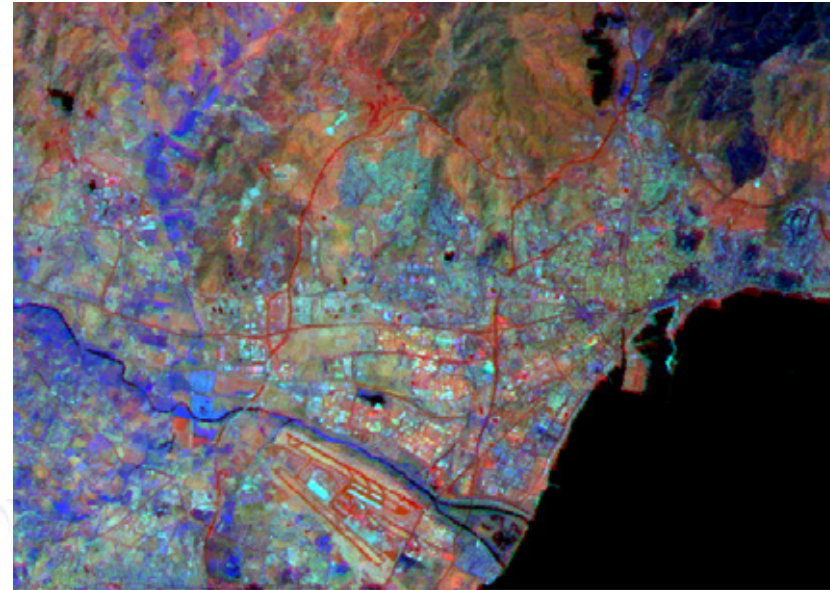
## 1. Visual

### imágenes-datos

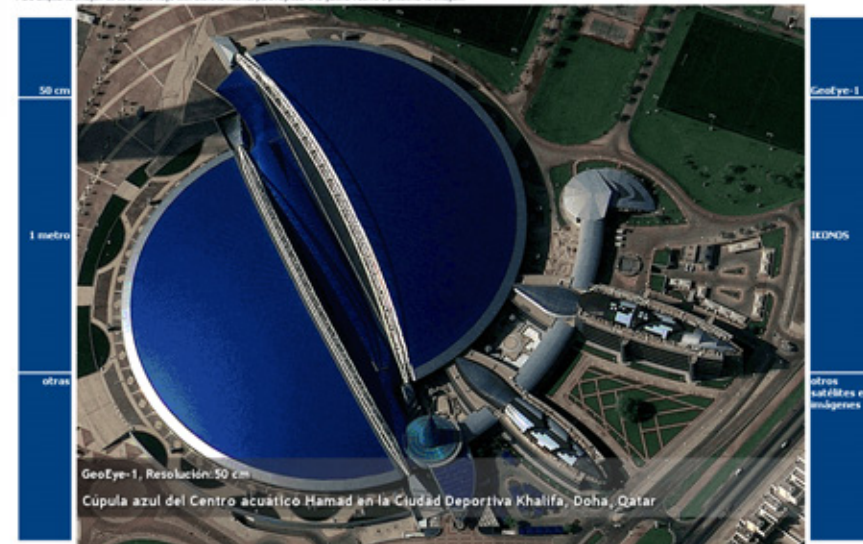


- Tamaño de la imagen
- # de bandas
- Cuantización
- Tamaño pixel

UNESCO RAPCA



Para ampliar la imagen de su interés haga clic sobre la misma, para regresar a la galería vuelva a presionar la imagen.



Las referencias de cada imagen aparecen haciendo clic sobre la misma en el extremo inferior izquierdo de la imagen ampliada.

## 2. Digital

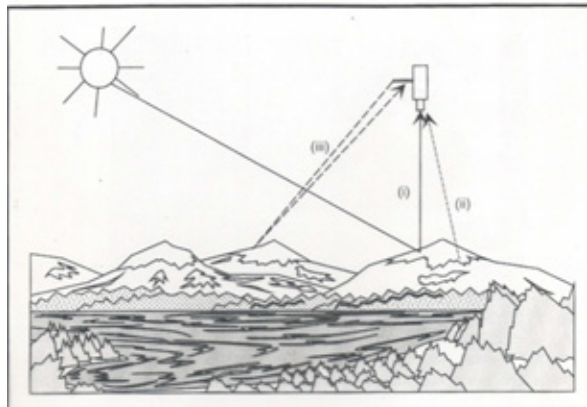
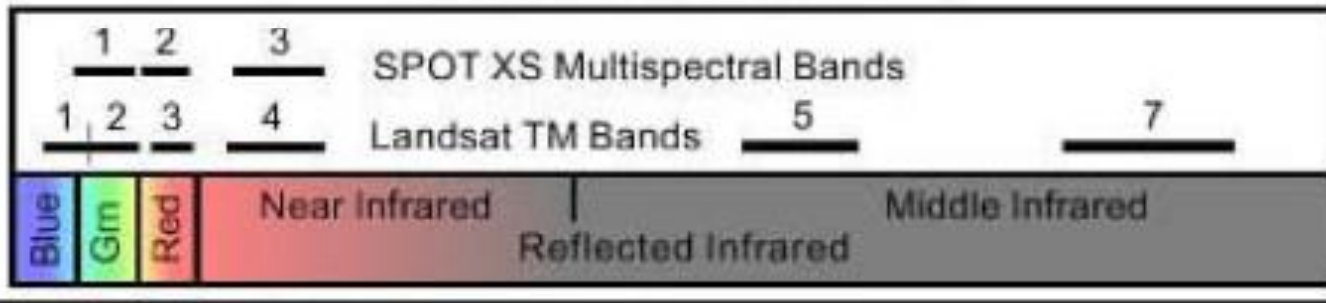
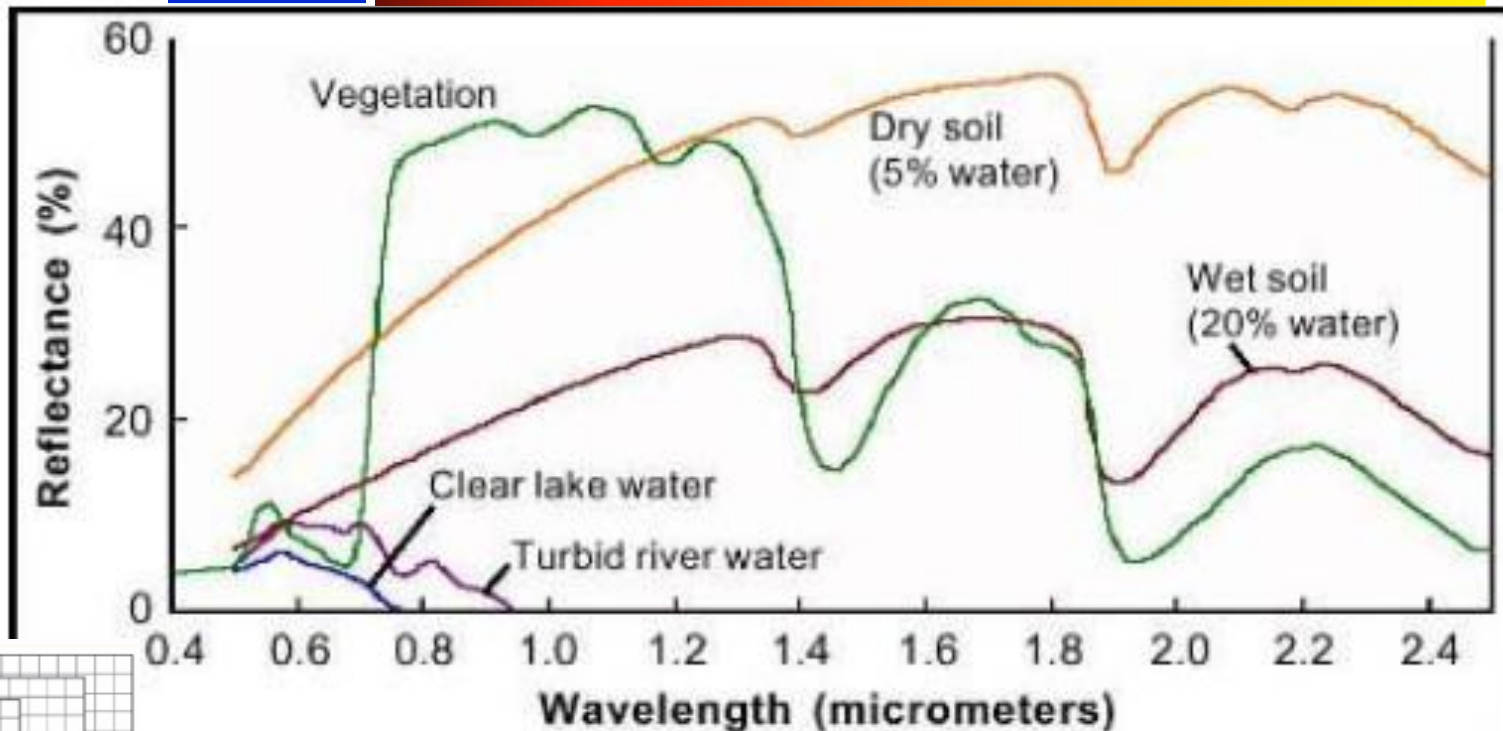


Fig. 2.1 - Formas de teledetección

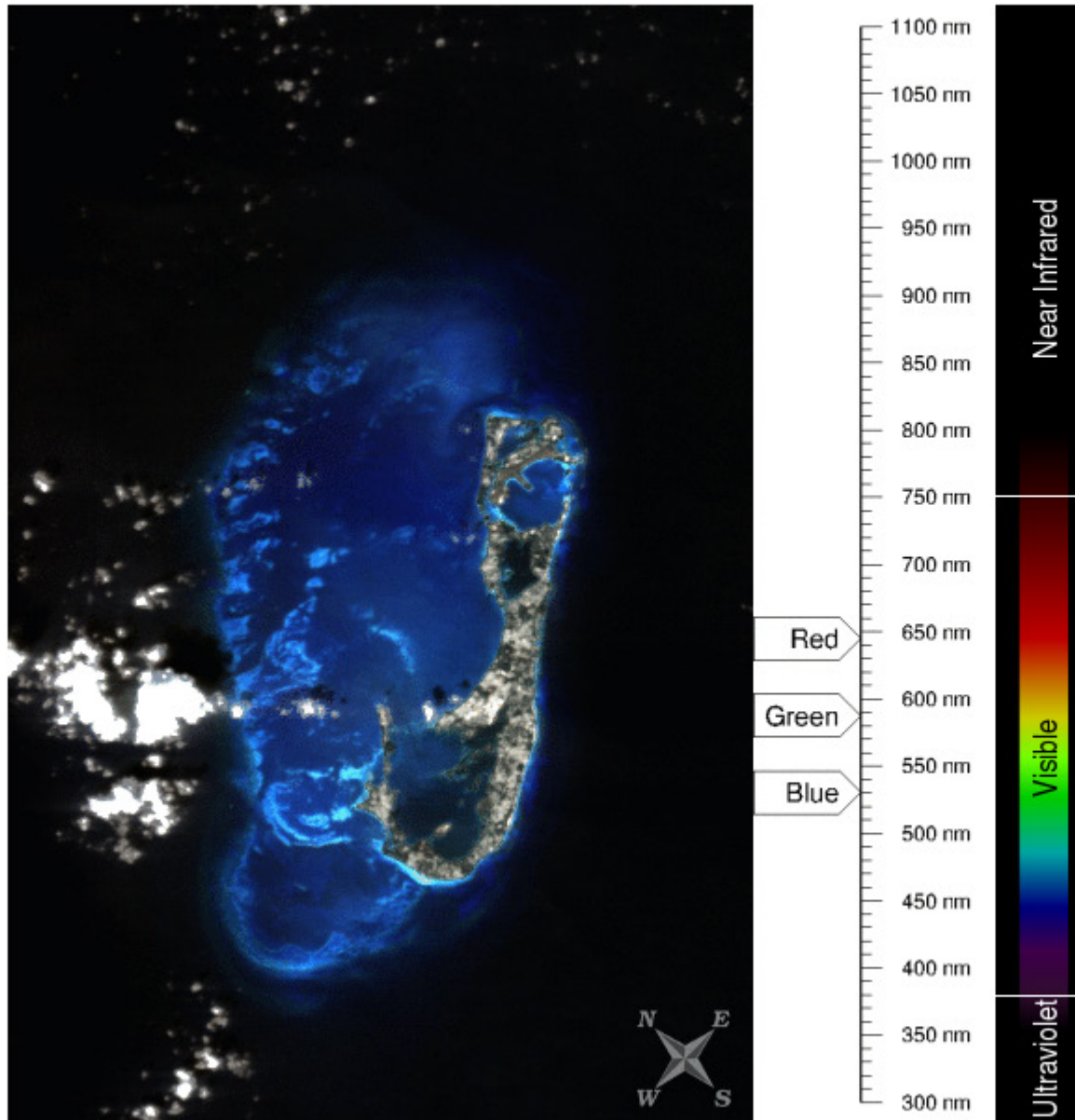
# Información espectral de la imagen: nº bandas del sensor

Visible

Infrarrojos



# The Coastal Ocean from a Hyperspectral Perspective



<http://oceancolor.gsfc.nasa.gov/FEATURE/H2013229192426.html>



# Aplicaciones a PEQUEÑA ESCALA: satélites de **baja resolución espacial**

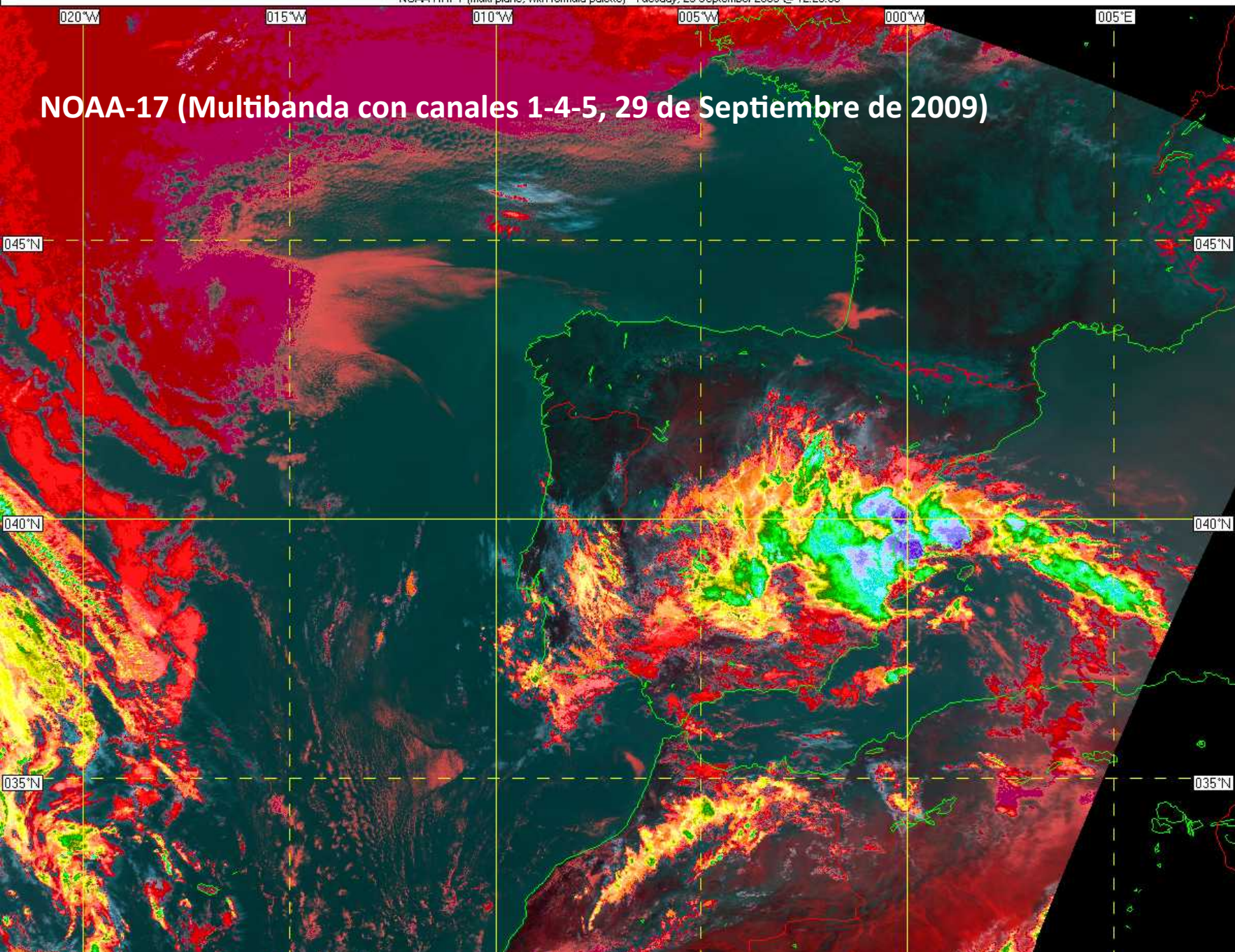
- **Meteosat**      - **Envisat**      - **GOES**      - **NOAA**



Meteorológicas  
Climáticas  
Oceanográficas



# NOAA-17 (Multibanda con canales 1-4-5, 29 de Septiembre de 2009)










## Coberturas del suelo

**GLCF**

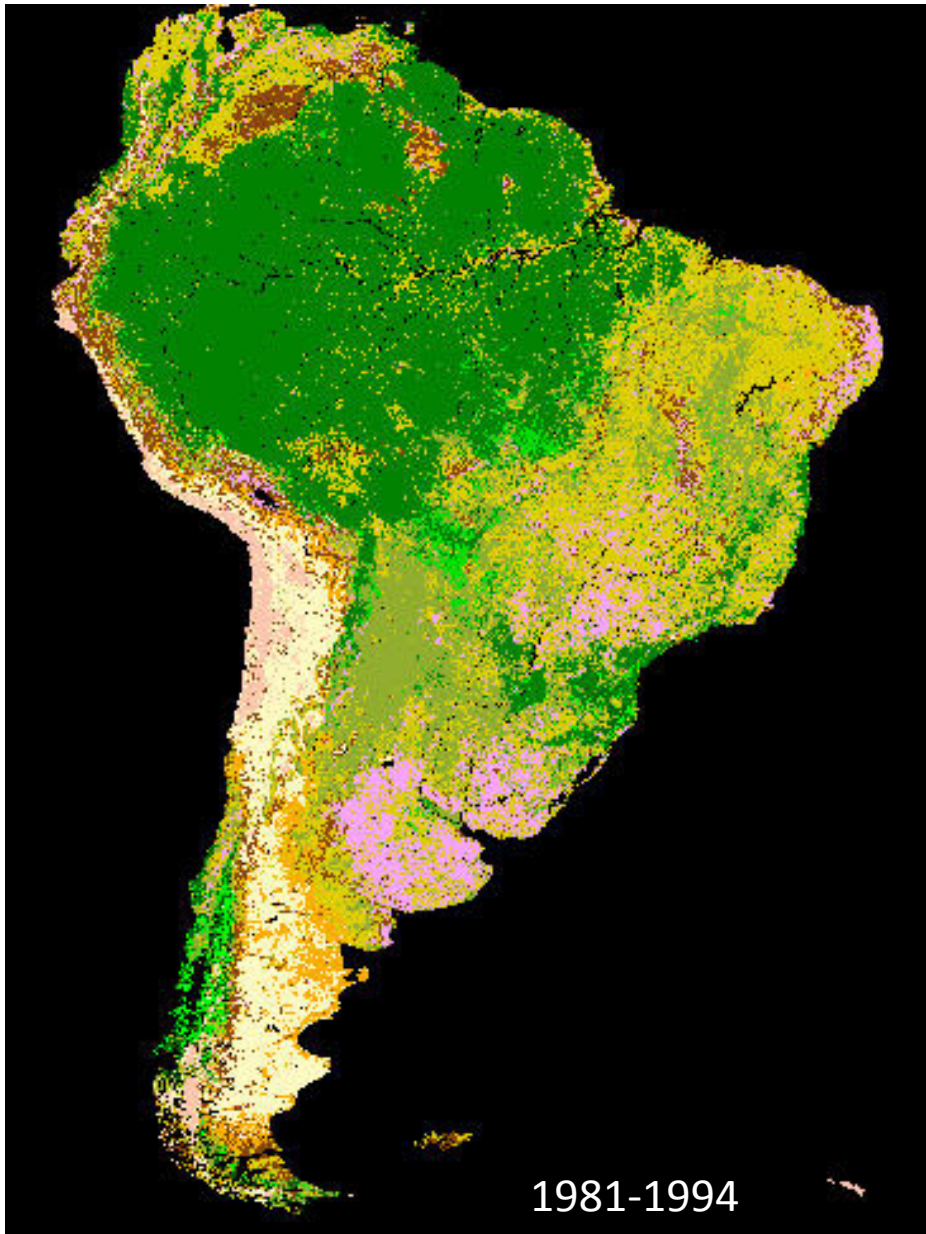
**2000-11-01 / 2001-11-01**

**Suramérica**

-  Suelo desnudo
-  Selva tropical
-  Forestal claro, arbustivo, herbáceo

# Global Land Cover, Regional

Satélite NOAA, sensor AVHRR

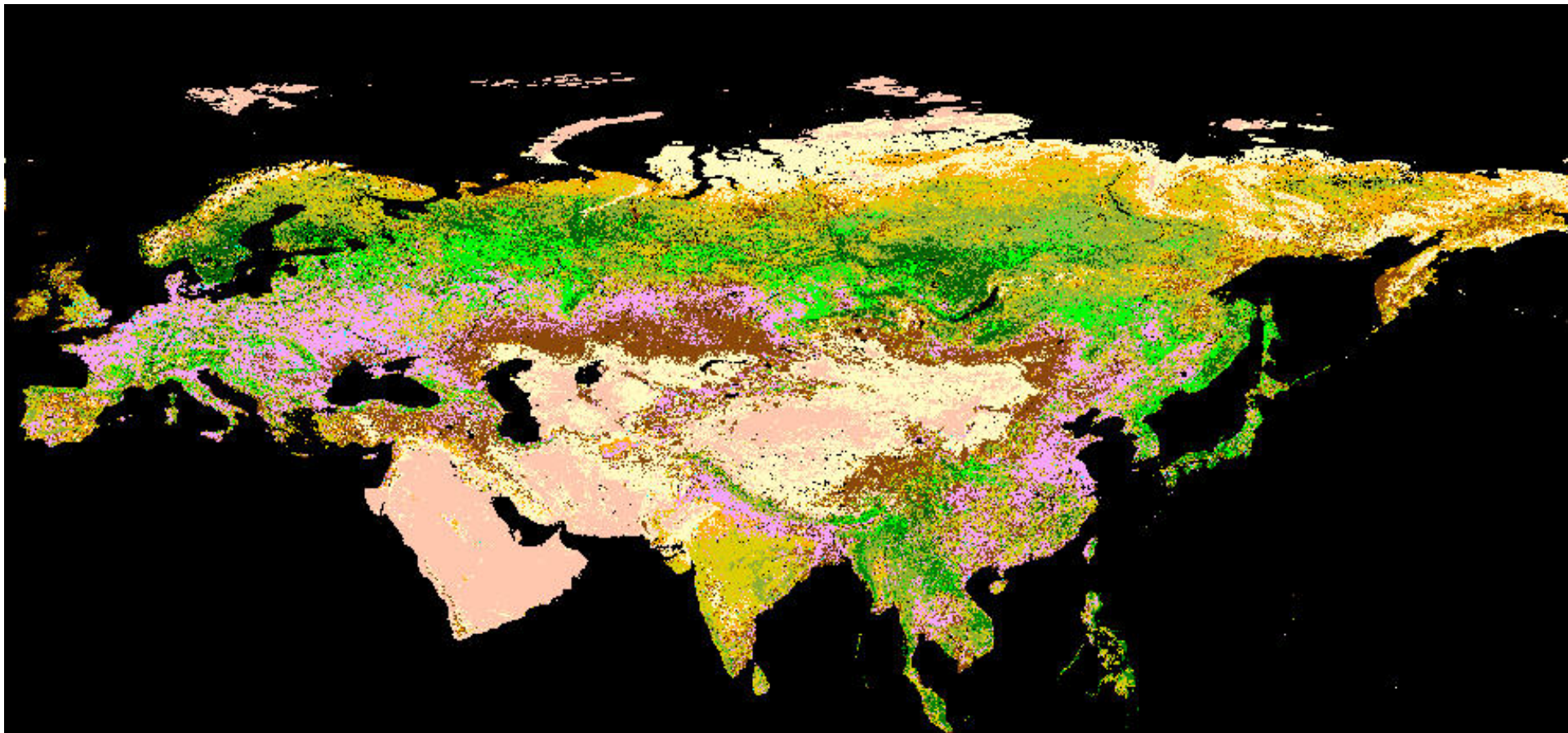


# Usos de suelo

1-1-1981 a 31-12-1994

- Agua
- B. Tropical denso
- B. Tropical claro
- Bosque coníferas claro
- Bosque caducifolio claro
- Bosque mixto
- Arbolado
- Dehesas
- Matorral denso
- Matorral claro
- Pastizales
- Cultivos
- Suelo desnudo
- Urbano







- Características del agua
- Corrientes marinas
- Materiales en suspensión
- Bancos de pesca





# Escala media: características de la vegetación, suelos, nubosidad, usos del suelo, cambios

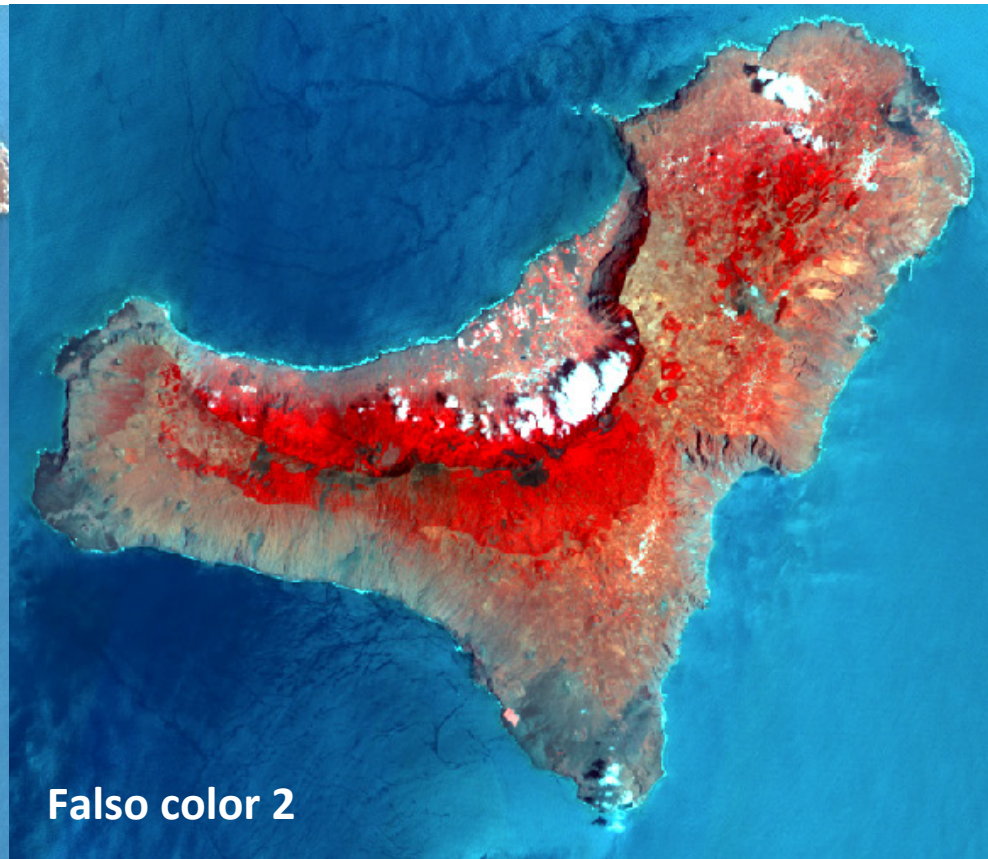
- Landsat

- Aster

- Spot

- Terra

- IRS



ADVANCED LAND IMAGE

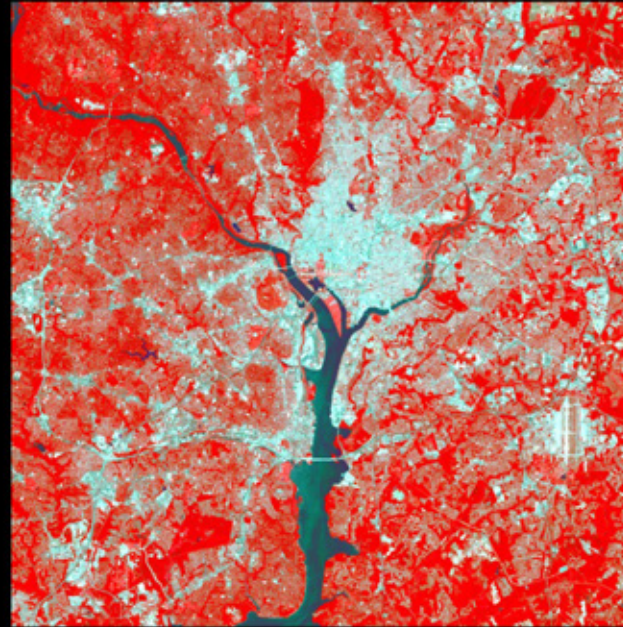


1972

2012



Landsat 1  
September 23, 1972



Landsat 7  
May 28, 2012



### 40 years of recording change

On July 23, the Landsat system will celebrate 40 years of continuous observations of the land forms of the planet. Over 7 million separate scenes have been collected by the six satellites in the series. The data from the satellites provide a permanent, objective record of land conditions and are routinely used to measure and monitor changes brought on by natural and anthropogenic events and actions. Floods, fires, tsunamis, urban growth, highway construction, mining, and clear cutting of tropical zone forests are among the studies illustrated by the data collected by Landsat satellites.

In 1972, the color infrared image processed from Landsat data illustrates the greater Washington, D.C. area. Intense red tones indicate forests and large grassy areas. Light tones indicate cleared fields and the highly reflective impervious areas of urban development, highways, and airport runways. The resolution of 1972 Landsat data was no better than 79 m. By 2012, Landsat sensors were offering data at 30 m, expanded band options, and limited 15 m data.

A comparison of the two images illustrates the significant growth in the greater D.C. area. Major urban development can be seen in surrounding communities including Rockville, Greenbelt, and Suitland, Maryland. The expanded Woodrow Wilson Bridge, connecting Springfield, Virginia, with Oxon Hill, Maryland, is evident, as is the Lake Barcroft reservoir between Falls Church and Alexandria.

The record of surface change is being used by urban planners and local and regional officials to evaluate the rate and direction of growth in the area.

# Cambios de usos y coberturas del suelo



# 40 años de imágenes



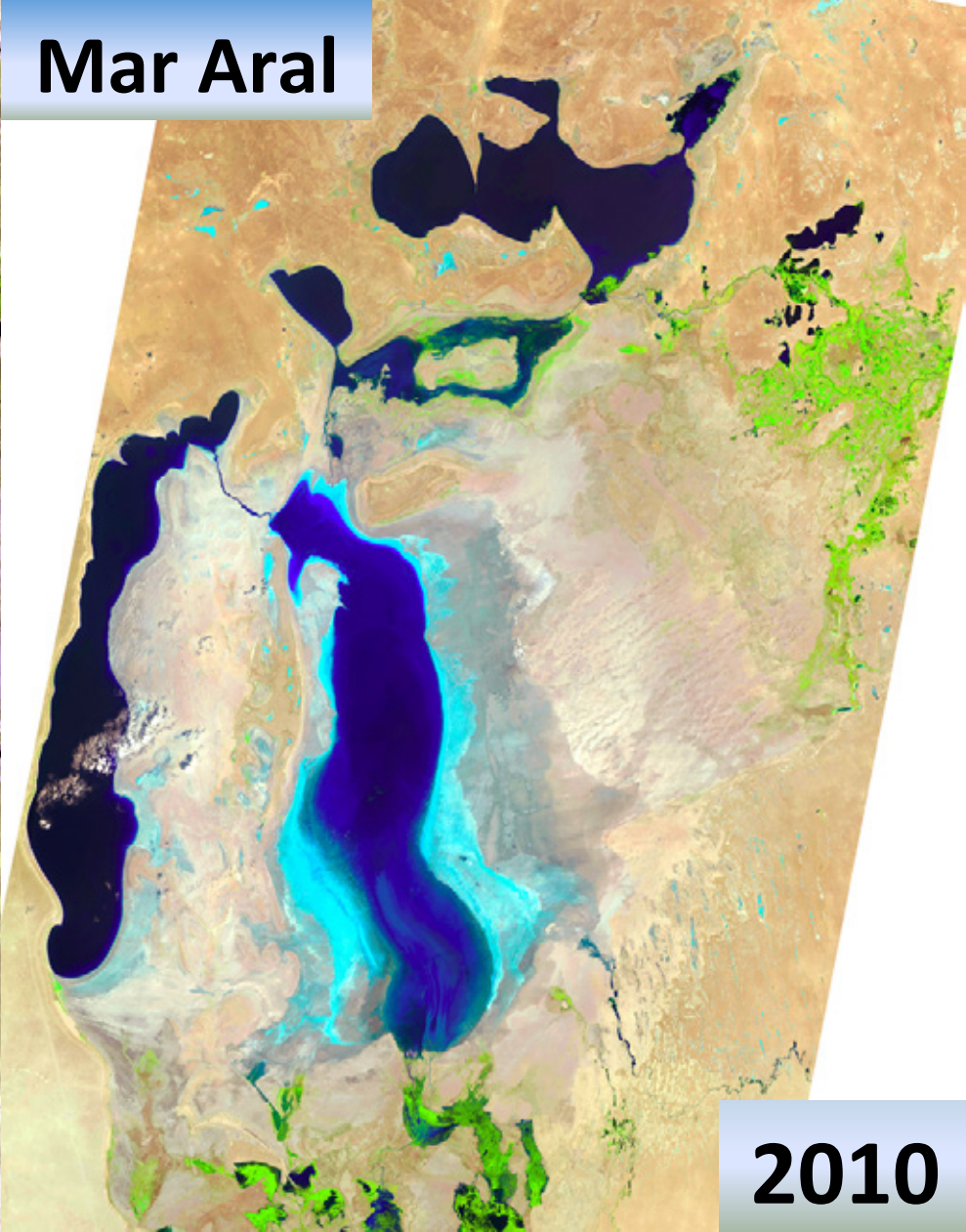


# Cambios multitemporales

Mar Aral

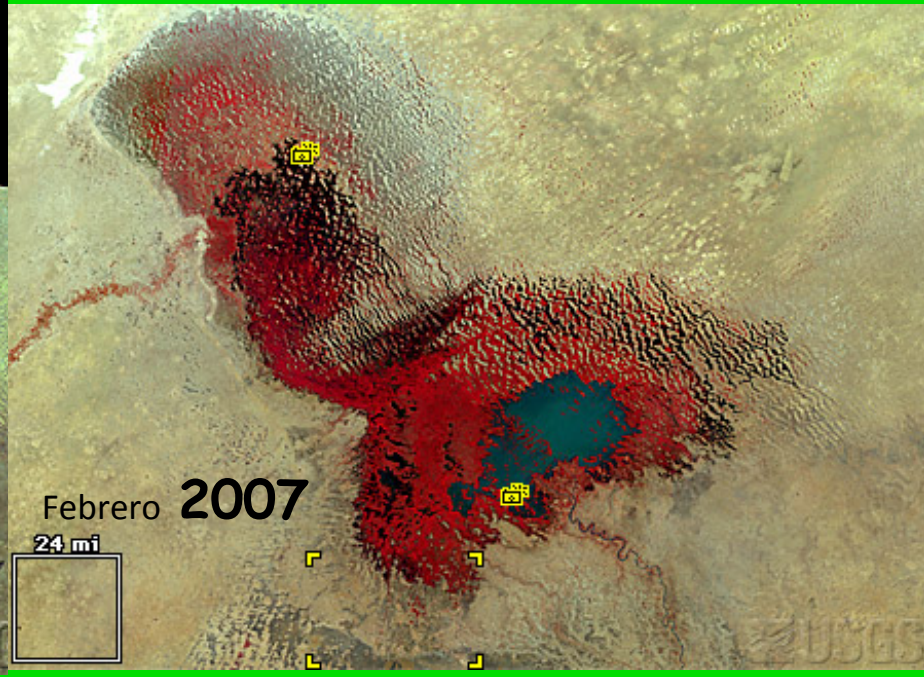
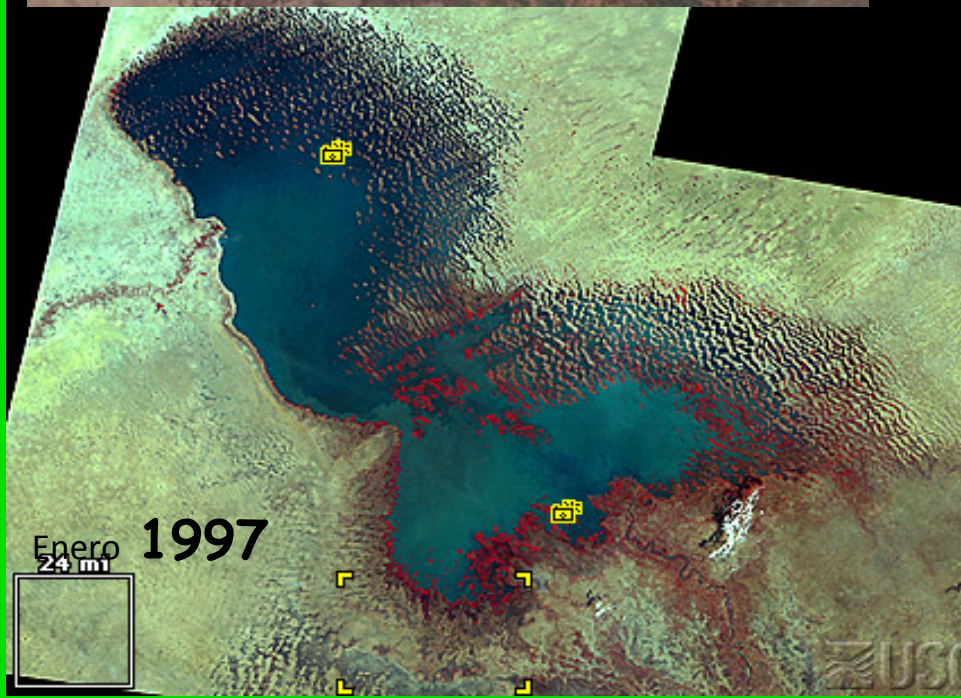
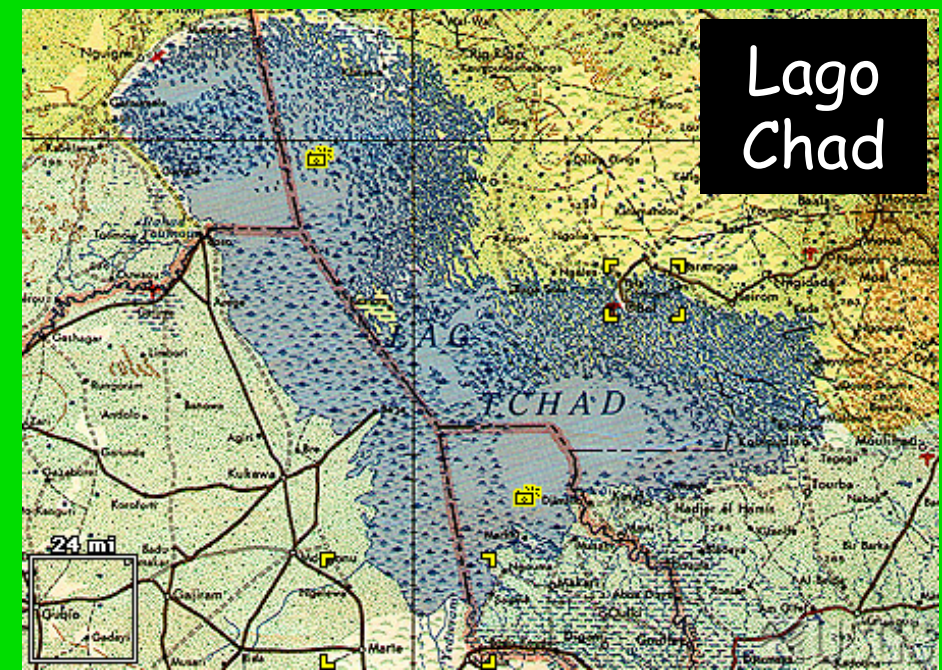


1977



2010









25,000 km<sup>2</sup>, **1963**

a

< 2,000 km<sup>2</sup>, **2013**

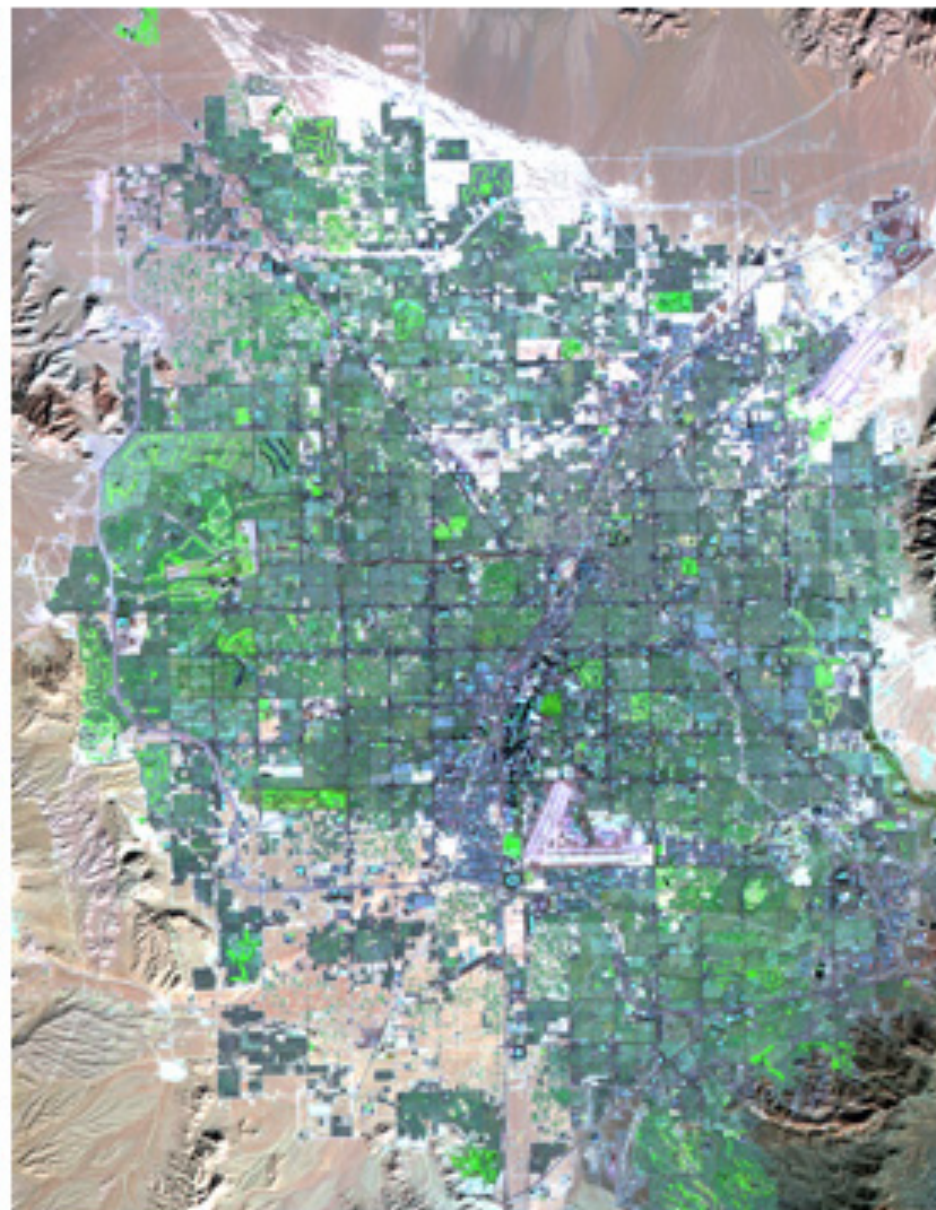
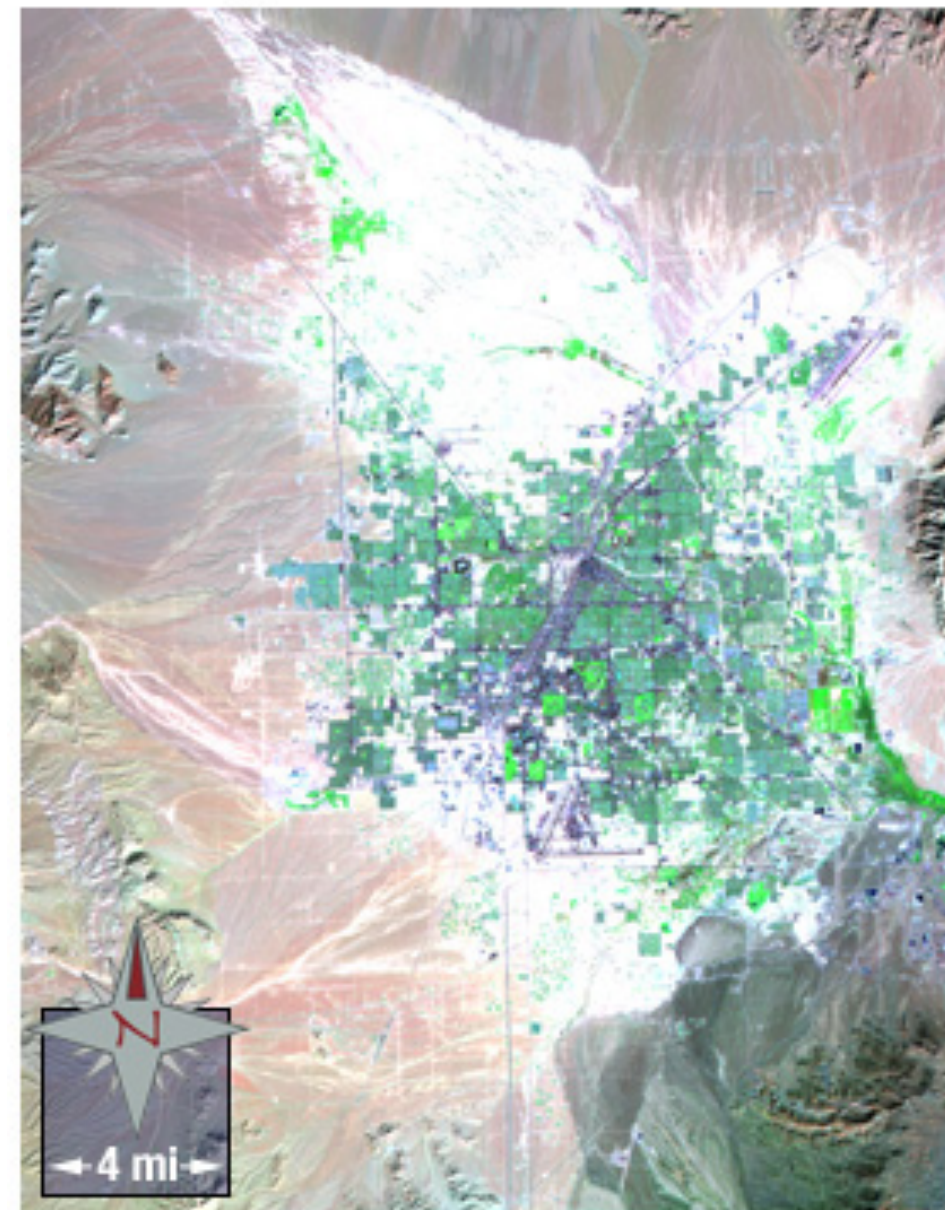


Las Vegas

1984

Crecimiento urbano

2009

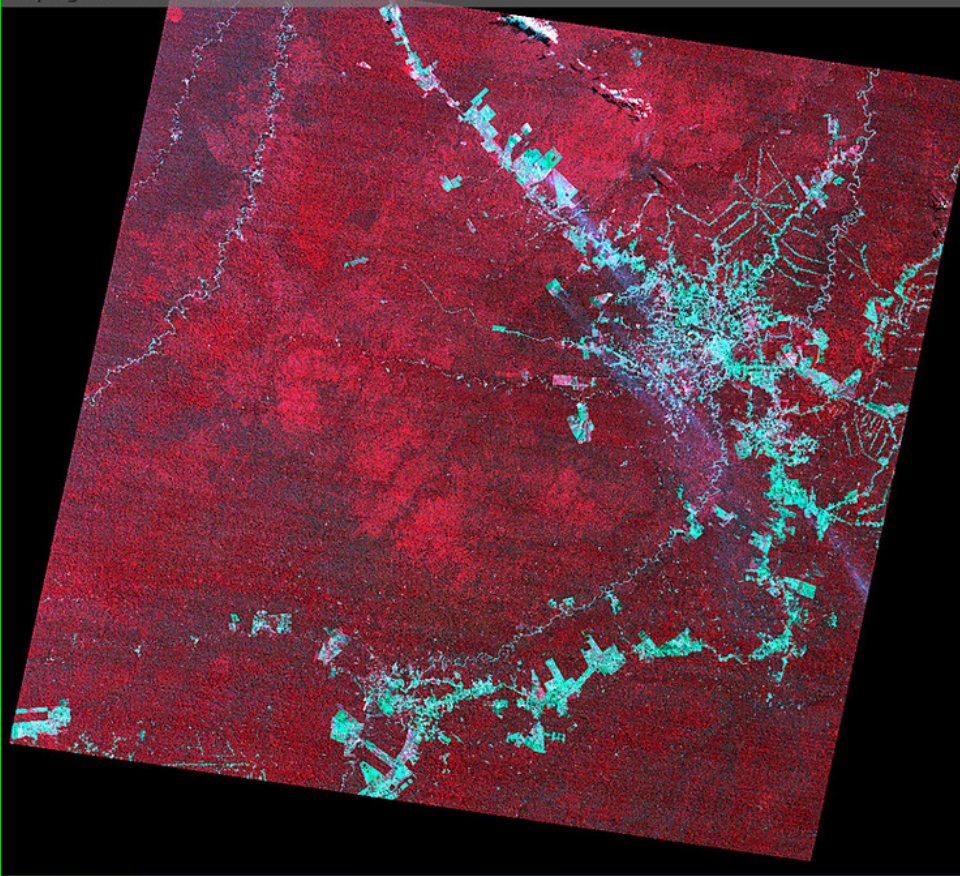




# Deforestación en Brasil

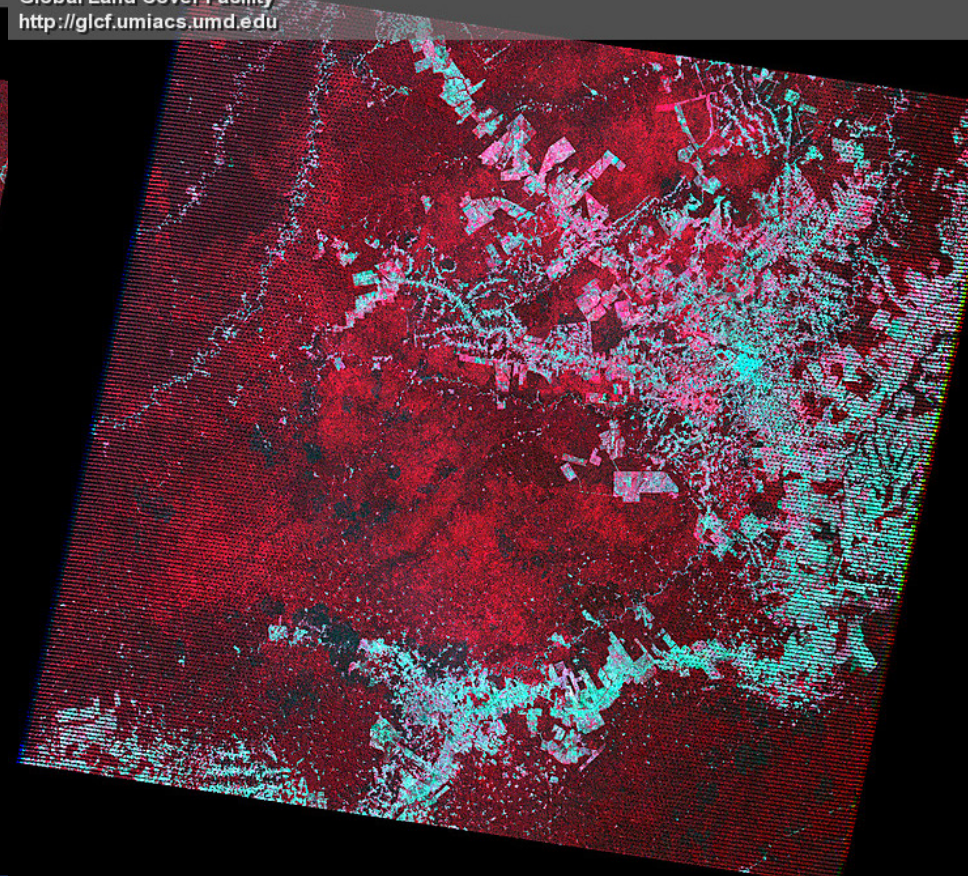


<http://glcf.umiacs.umd.edu>



22-8-1986

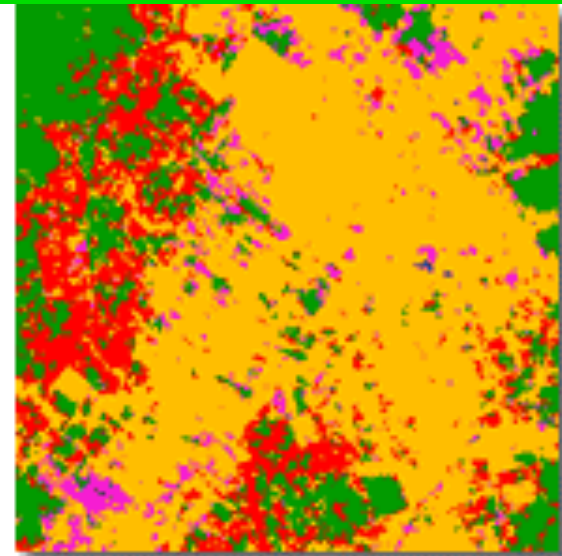
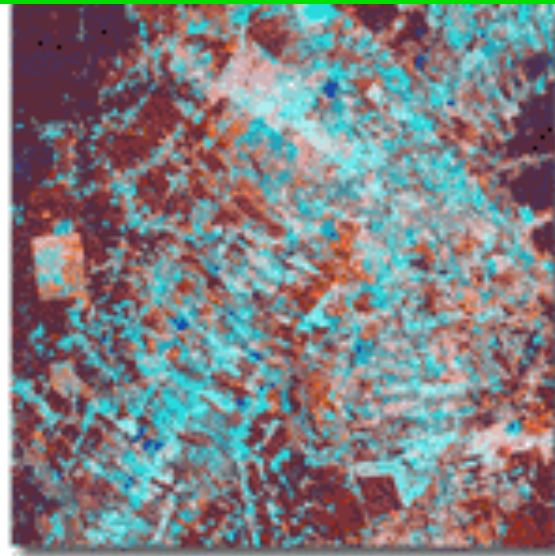
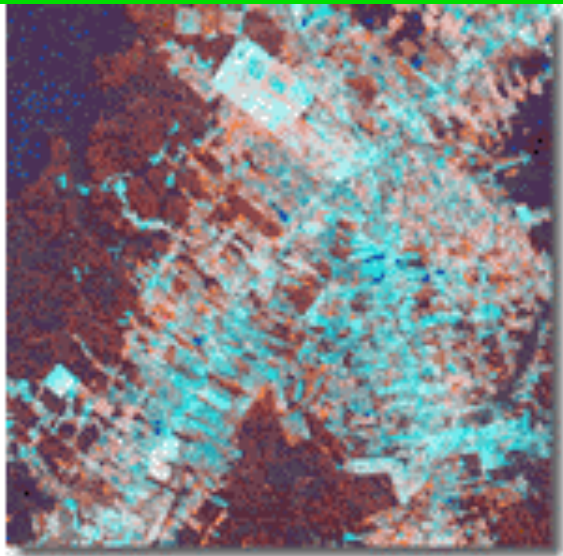
Global Land Cover Facility  
<http://glcf.umiacs.umd.edu>



4-7-2006



en Colombia ...



July 22, 1986, Path 006 Row 066

October 16, 1996, Path 006 Row 066

Land Cover Change

Deforestation | Non Forest | Forest

1986

1996

Cambios entre  
imágenes



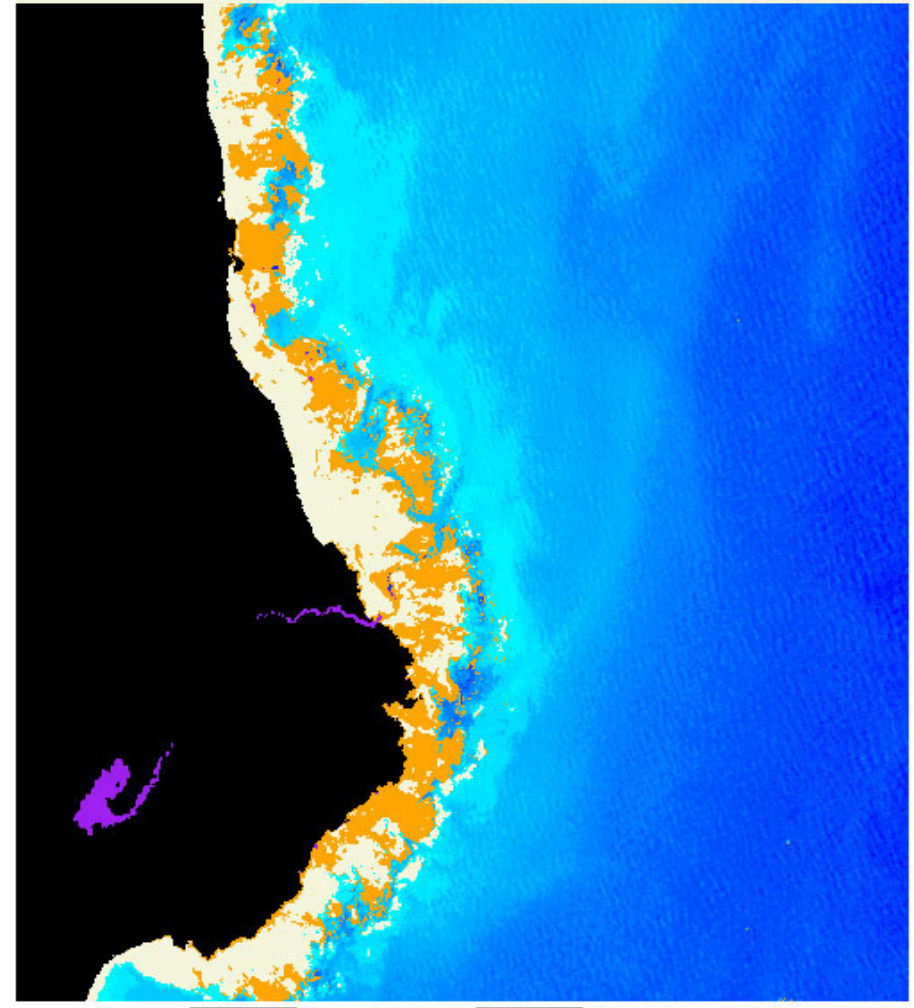
# Cambios geomorfológicos



Imágenes del satélite ASTER: Delta del río Amarillo, China

# Aplicaciones oceanográficas: arrecifes de coral

ASTER Coral Reef Classification in Bahia - Brazil 2002



 Tipo A  Tipo B



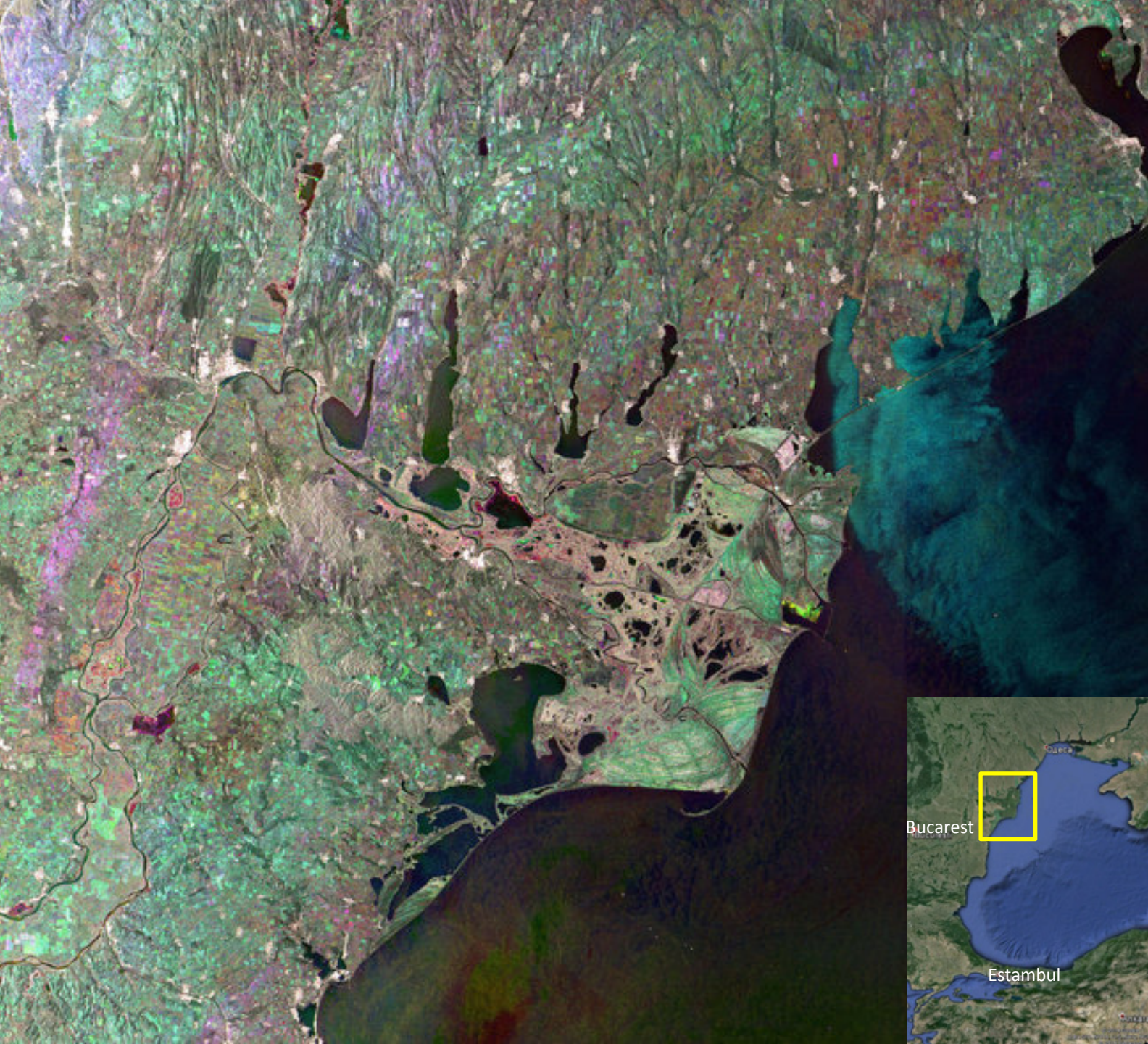


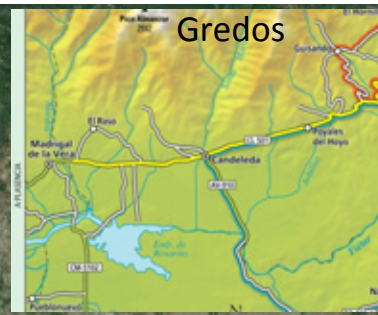
Imagen  
radar

Delta  
del  
Danubio



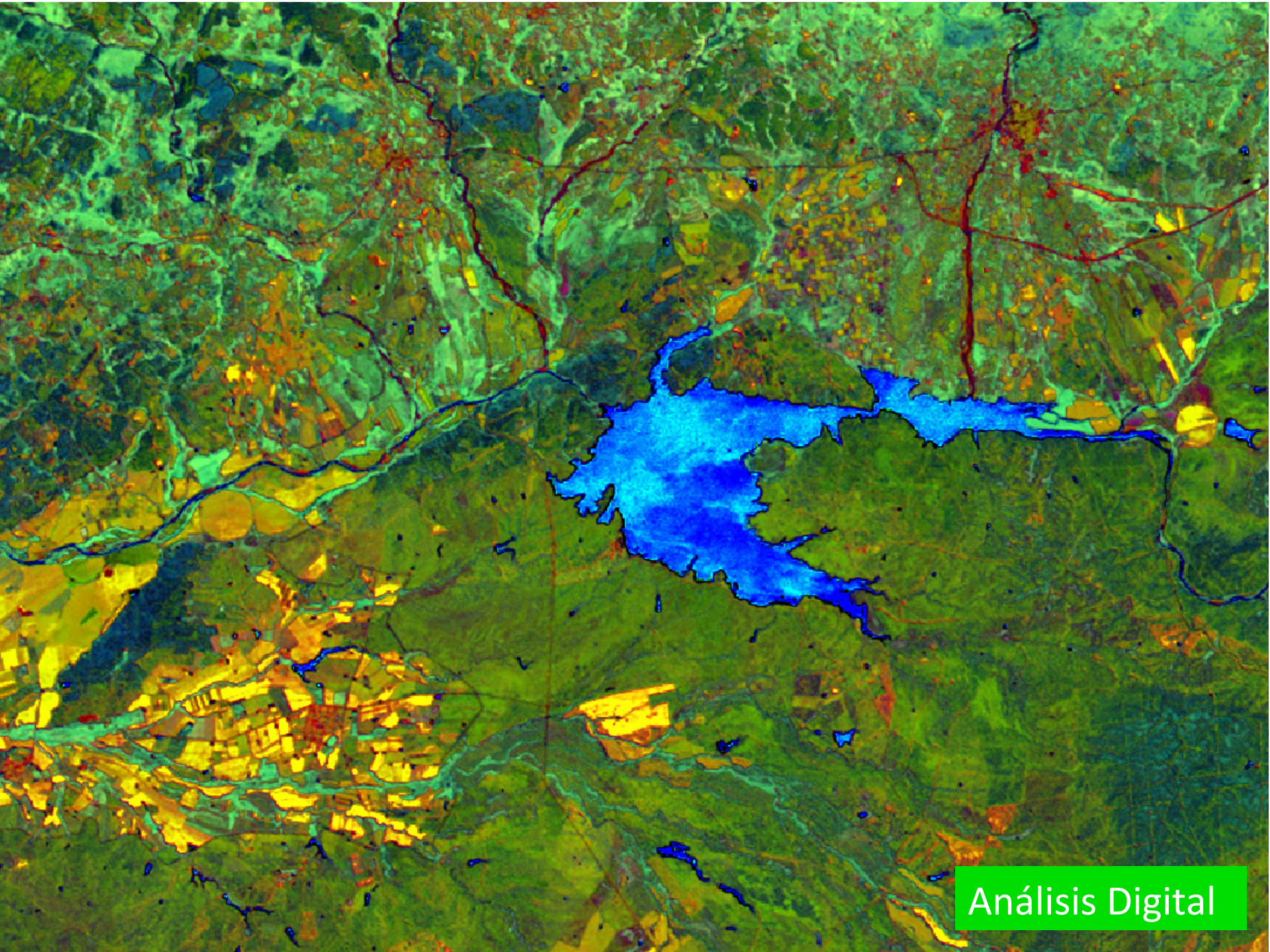


¿Cómo se trabaja?



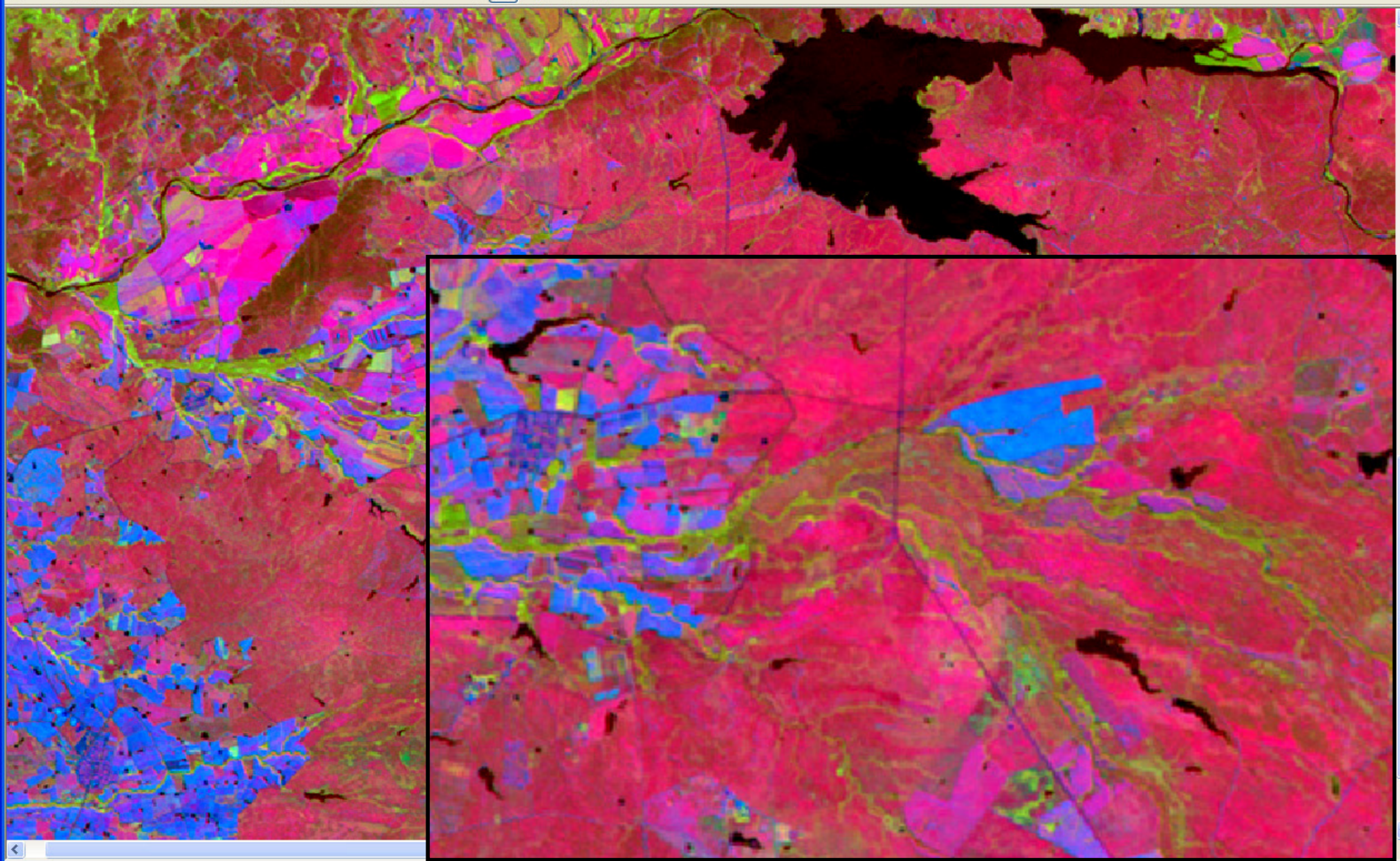
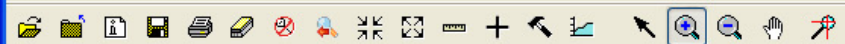
Análisis visual





Análisis Digital



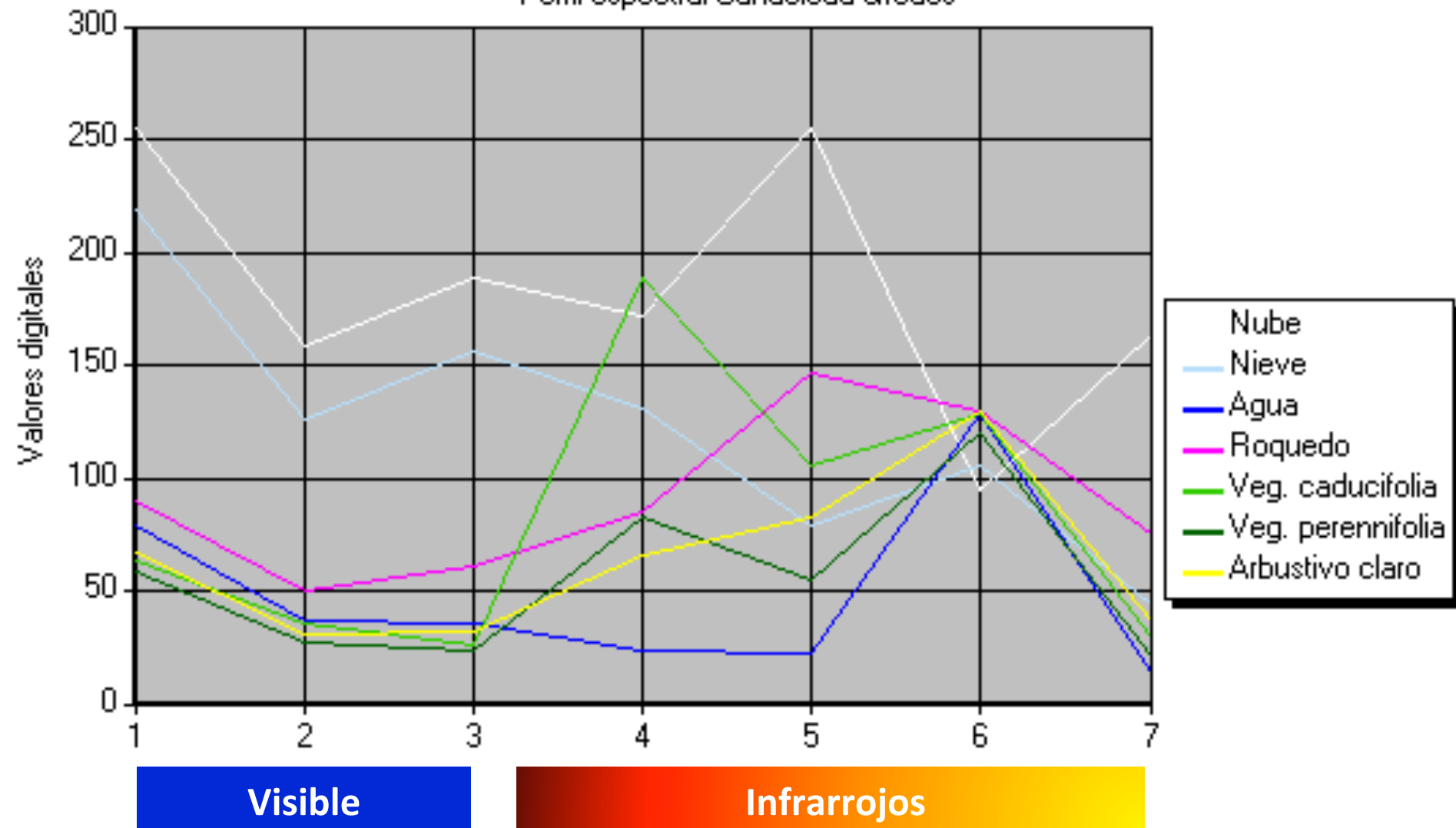


305526.78, 4431461.21 (UTM / WGS 84)

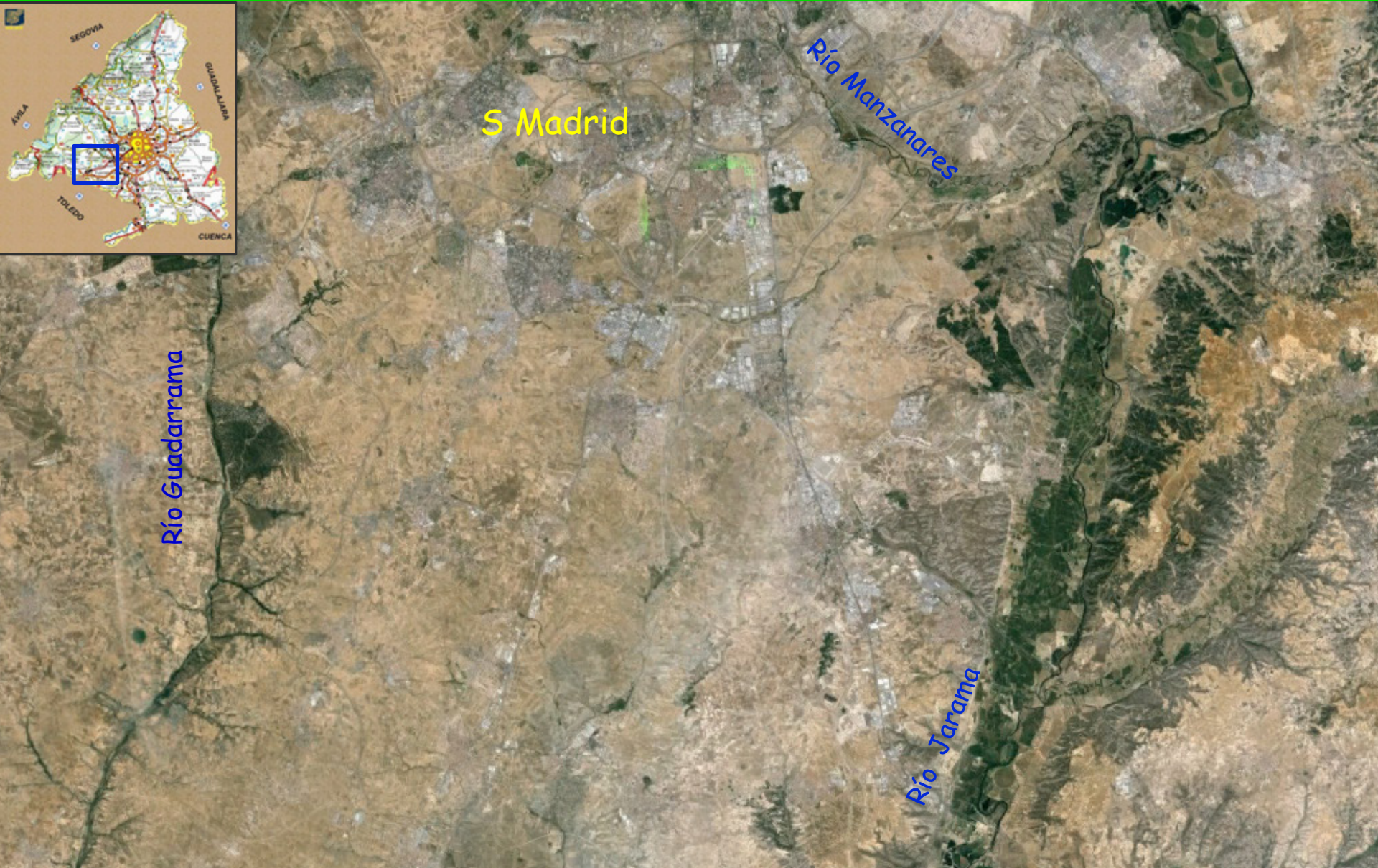
**7 COMPONENTES: 3-2-1**

# Perfiles espectrales: de la imagen y del espectrorradiómetro

Perfil espectral Candeleda-Gredos

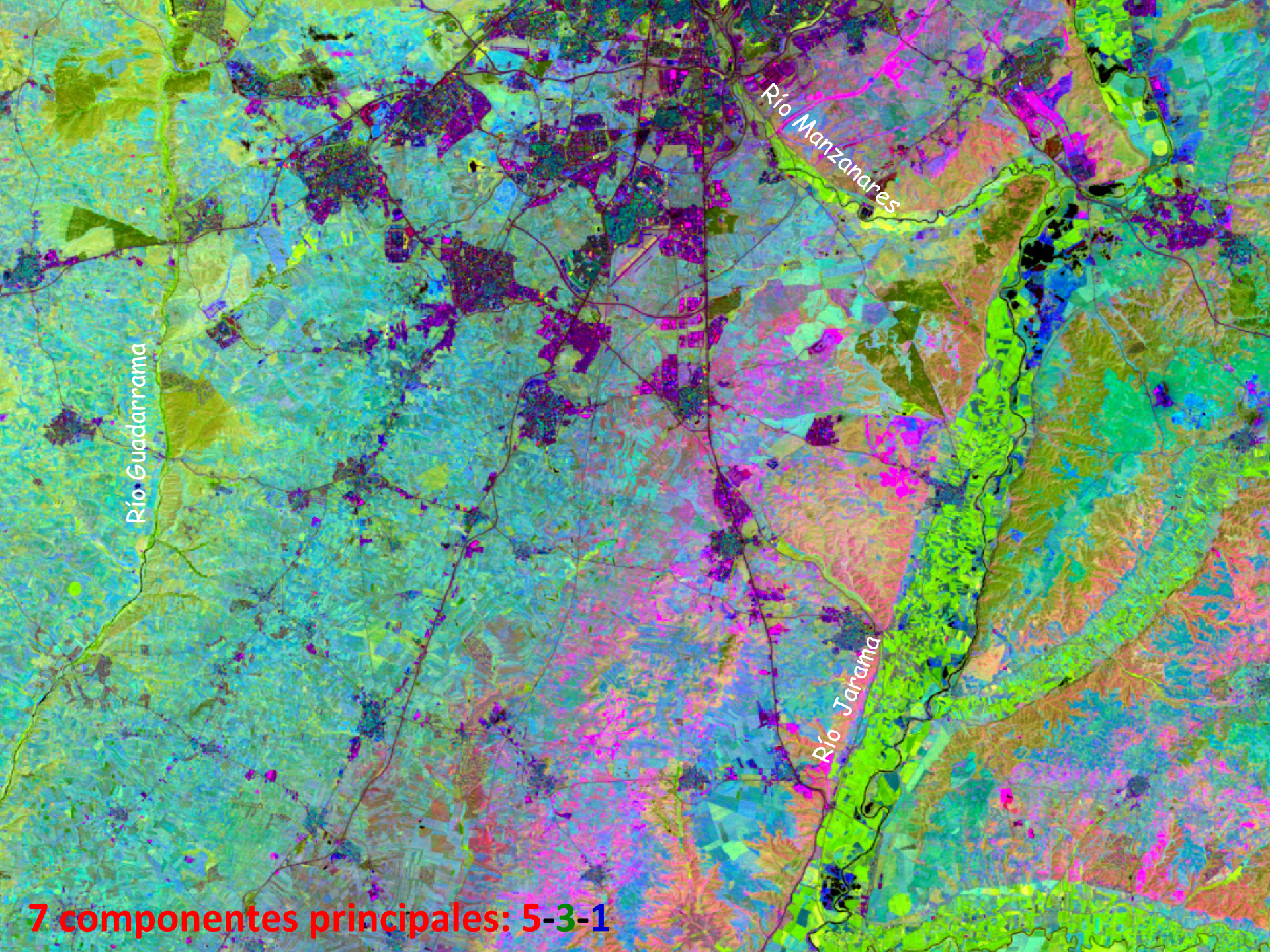






Características de los suelos, coberturas, vegetación, etc.





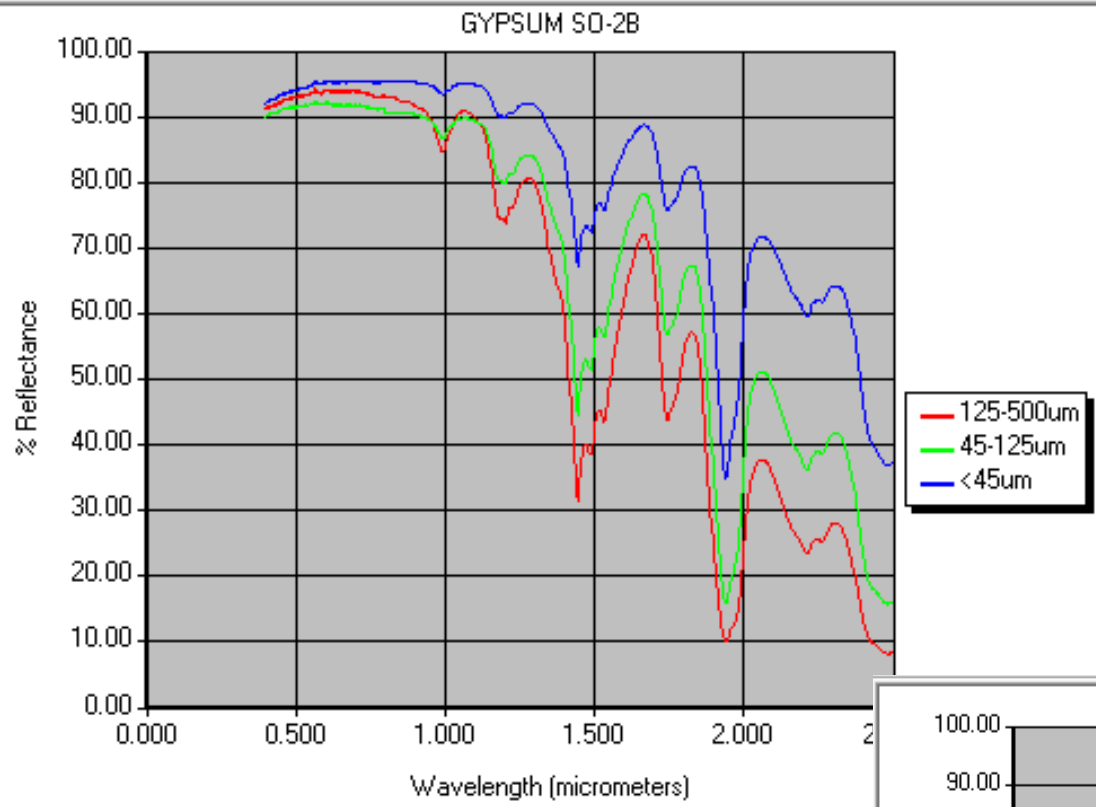
Río Guadarrama

Río Manzanares

Río Jarama

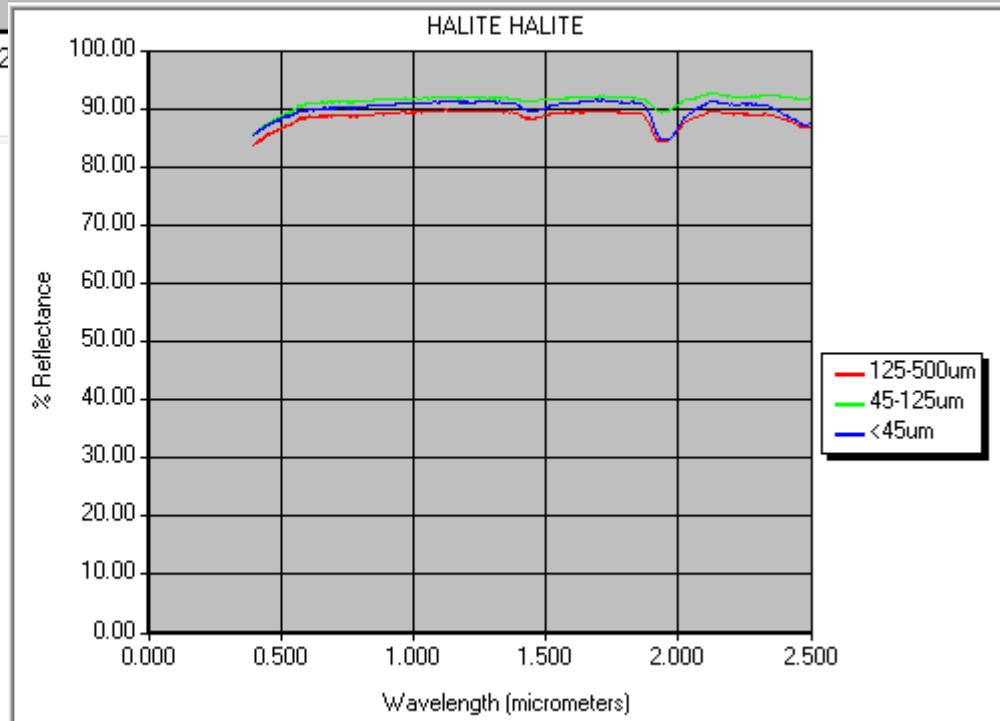
**7 componentes principales: 5-3-1**



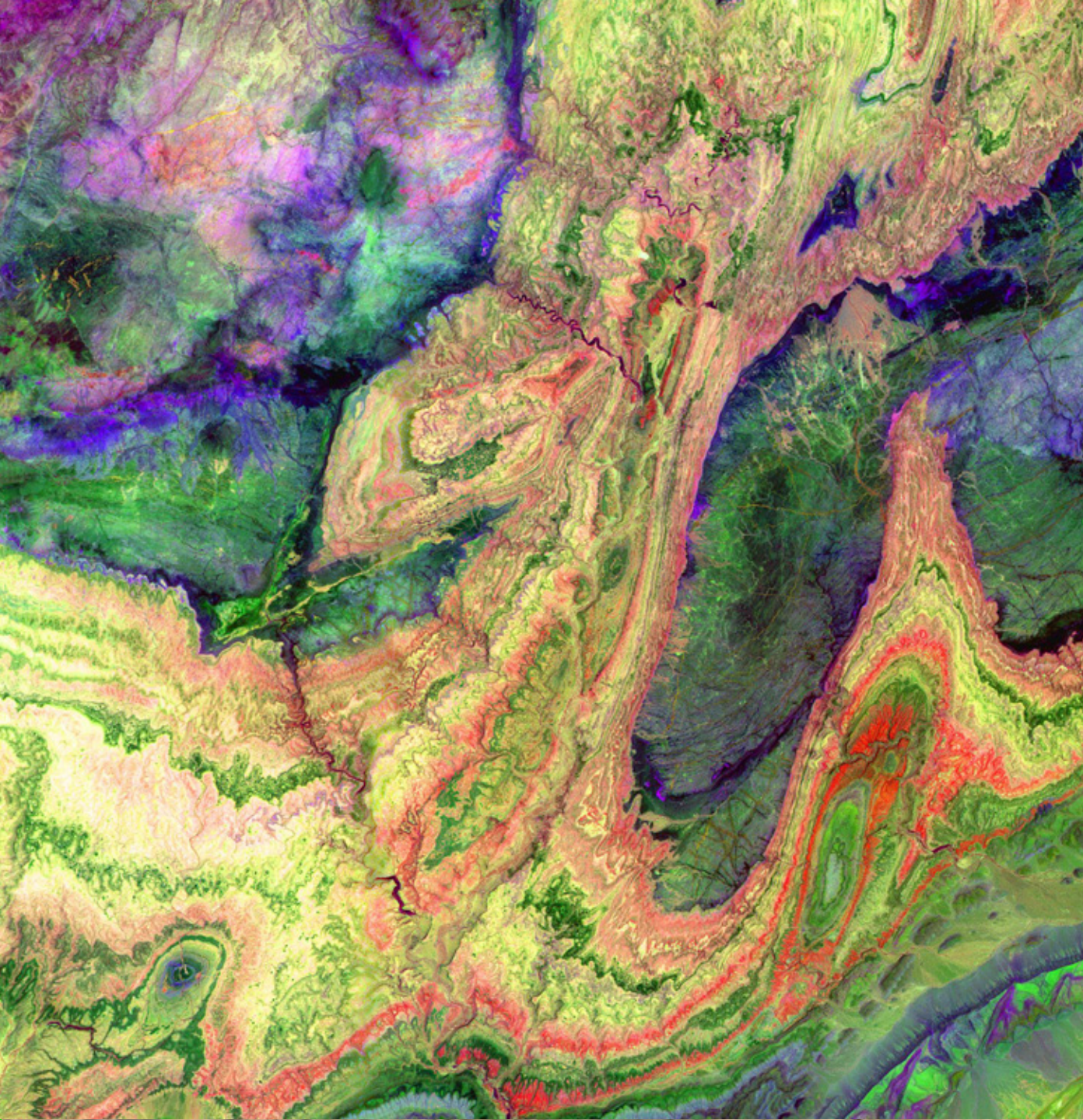


Datos obtenidos del espectrorradiómetro de minerales

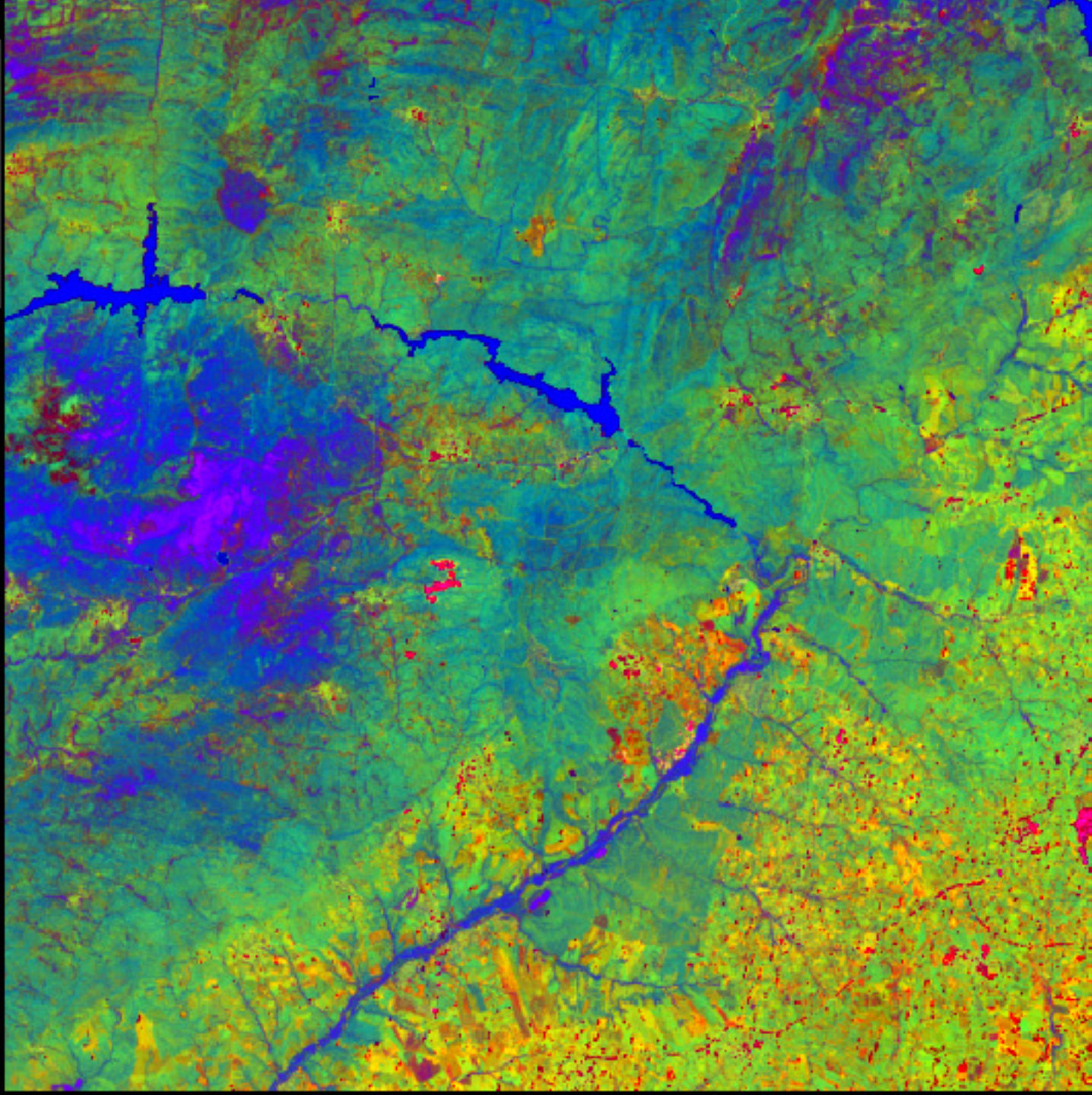
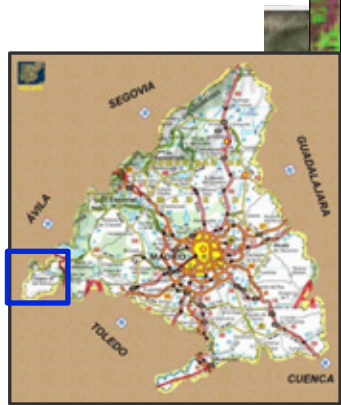
Perfiles teóricos y reales (campo)



# Aplicaciones en Geología y Geomorfología

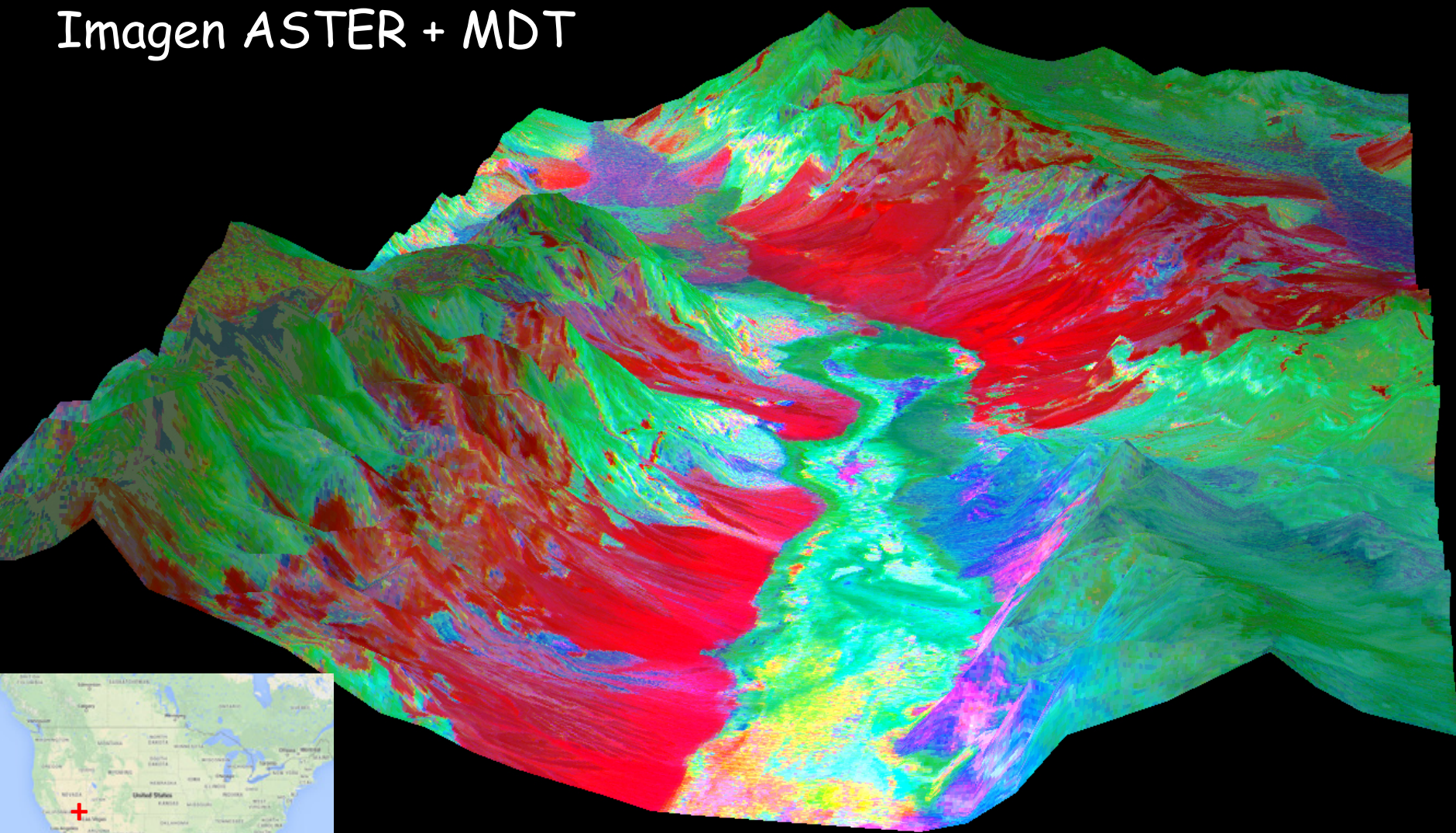




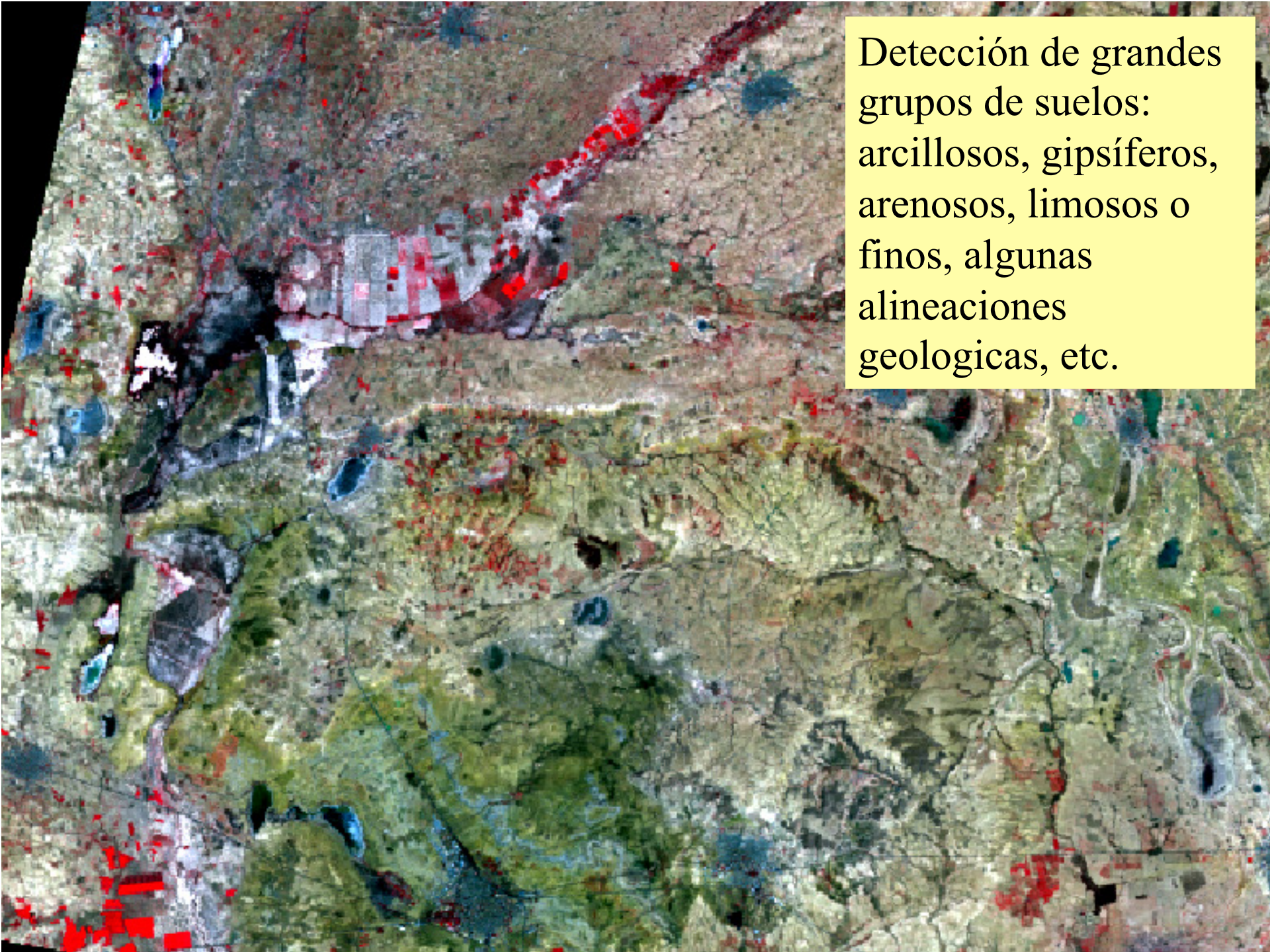




# Valle de la Muerte Imagen ASTER + MDT





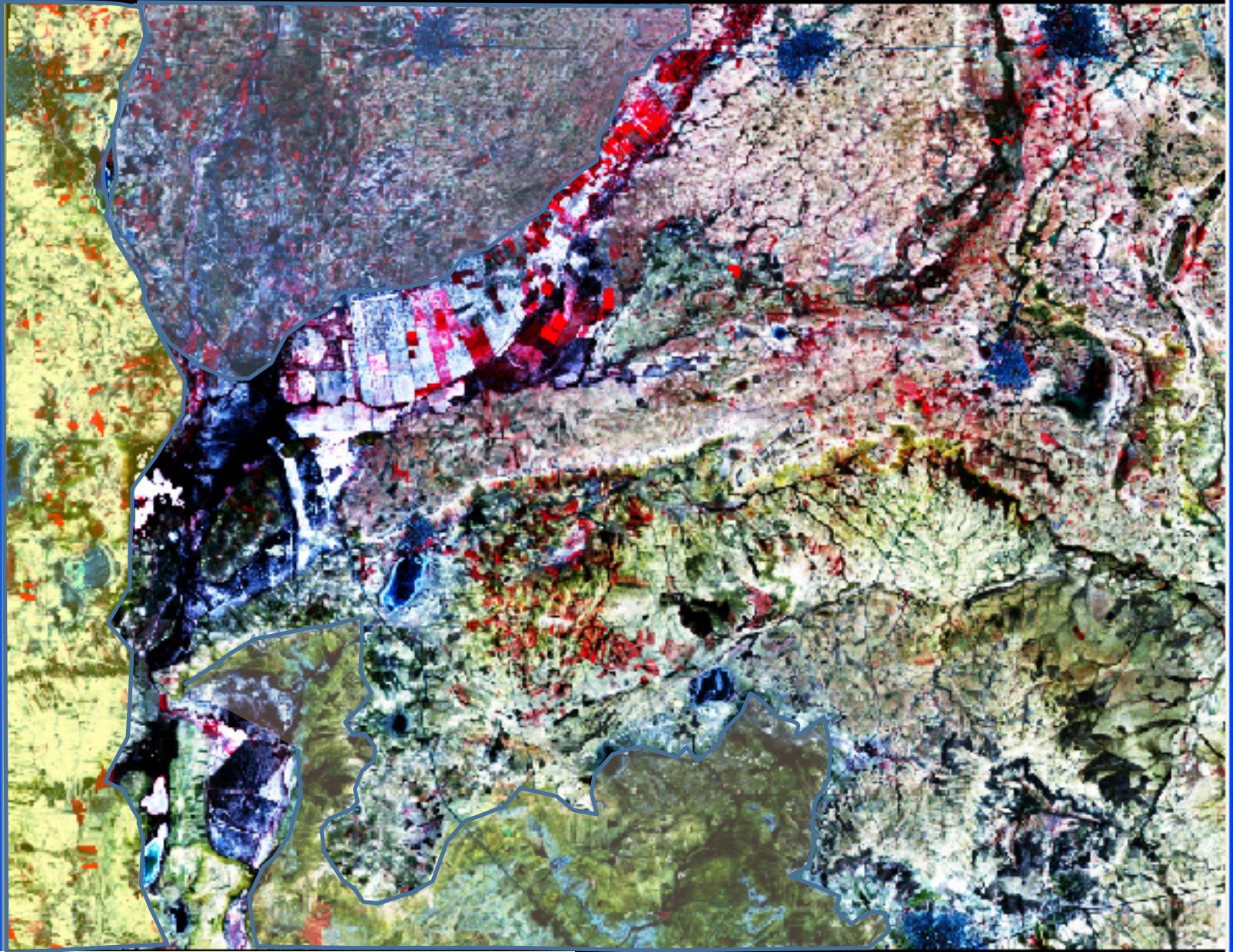
An aerial photograph showing a complex landscape with various soil types and geological features. The terrain is characterized by a mix of colors, including shades of green, brown, and red, indicating different soil compositions. A prominent feature is a large, irregularly shaped area in the center-left, which appears to be a large group of soils. The text box in the top right corner provides a detailed description of these soil types and geological features.

Detección de grandes grupos de suelos: arcillosos, gipsíferos, arenosos, limosos o finos, algunas alineaciones geológicas, etc.



Sedimentos limosos

Material arenoso



detectar tipos de materiales

Sedimentos arcillosos



# Geomorfología e Hidrogeografía



Algeria - Tamanrasset  
SPOT 5 2.5-m color

© Cnes 2006 - Distribution Spot Image



CONTINENTALES

Cartografía hidrogeográfica

Cartografía de humedales

Inundaciones

Sequías

Deseccación y salinización de humedales y lagos

Cambio en la morfología fluvial

Seguimiento de la calidad de las aguas

Seguimiento de la contaminación hídrica

Explotación y vulnerabilidad de acuíferos

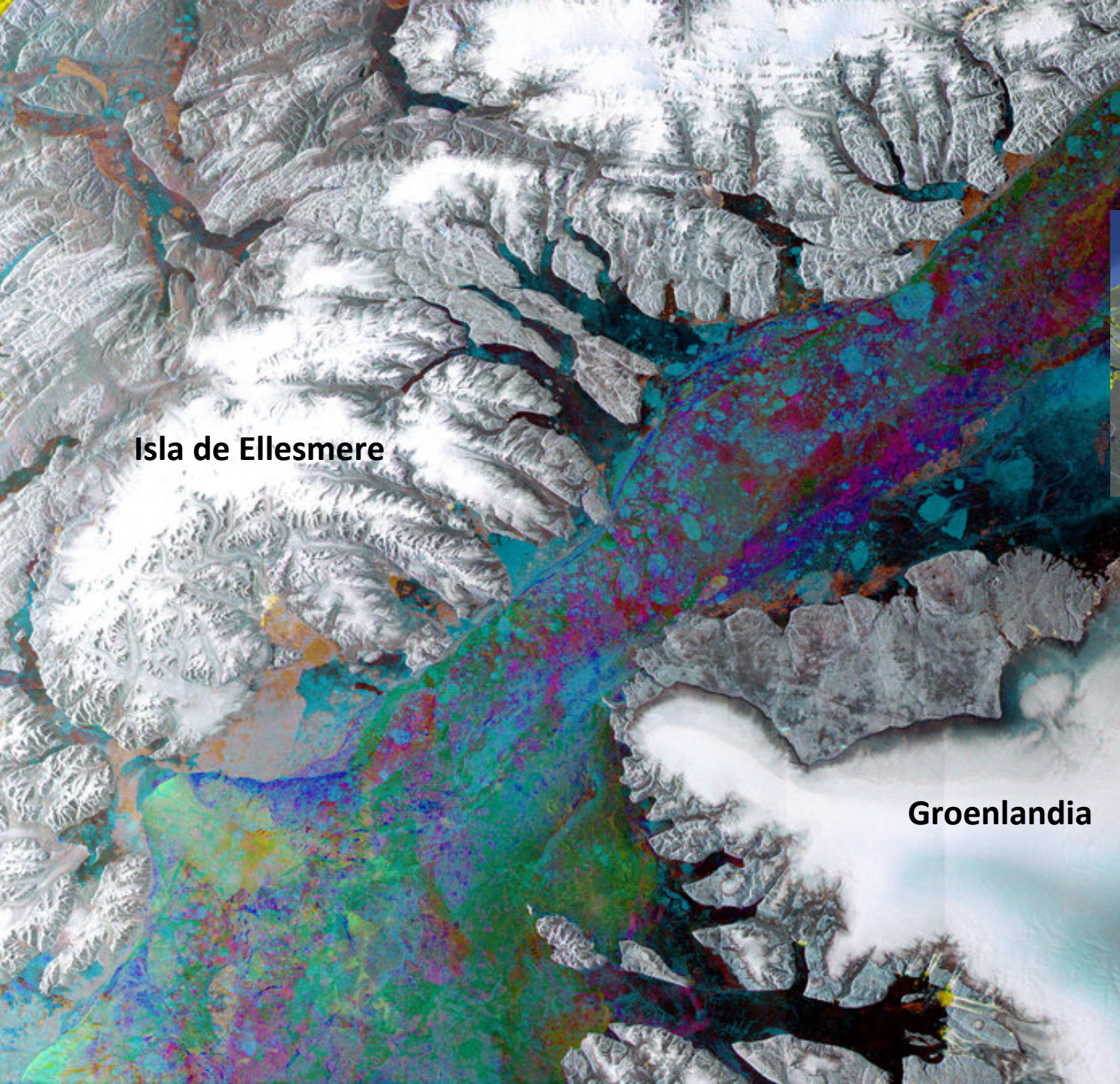
Evolución de glaciares

Evolución de hielos

Detección de aguas subterráneas

**Aplicaciones  
en  
Hidrología e  
Hidrogeografía**





Isla de Ellesmere

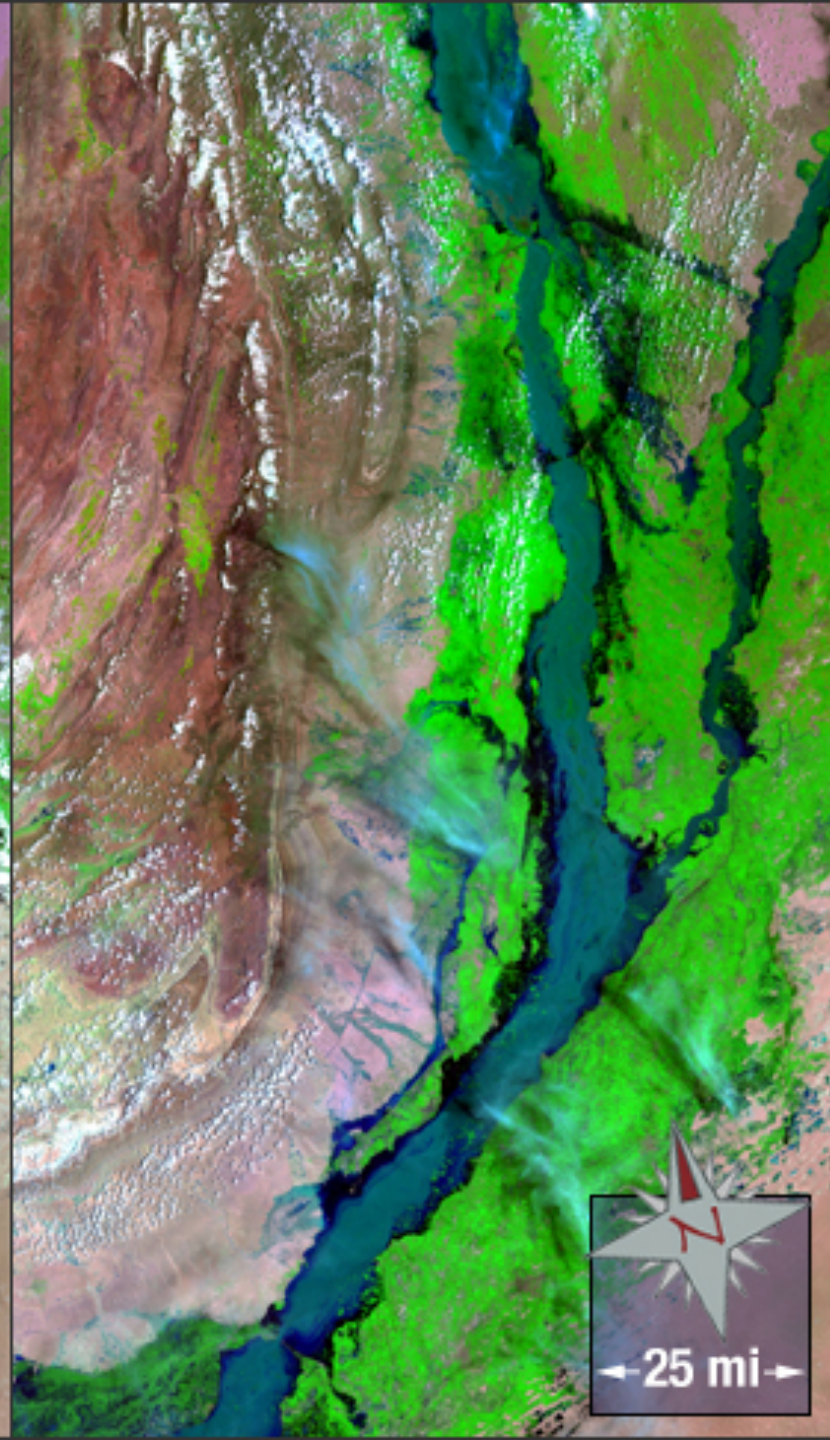
Groenlandia



Imagen  
**radar**  
Envisat



Riesgo  
de  
inundaciones





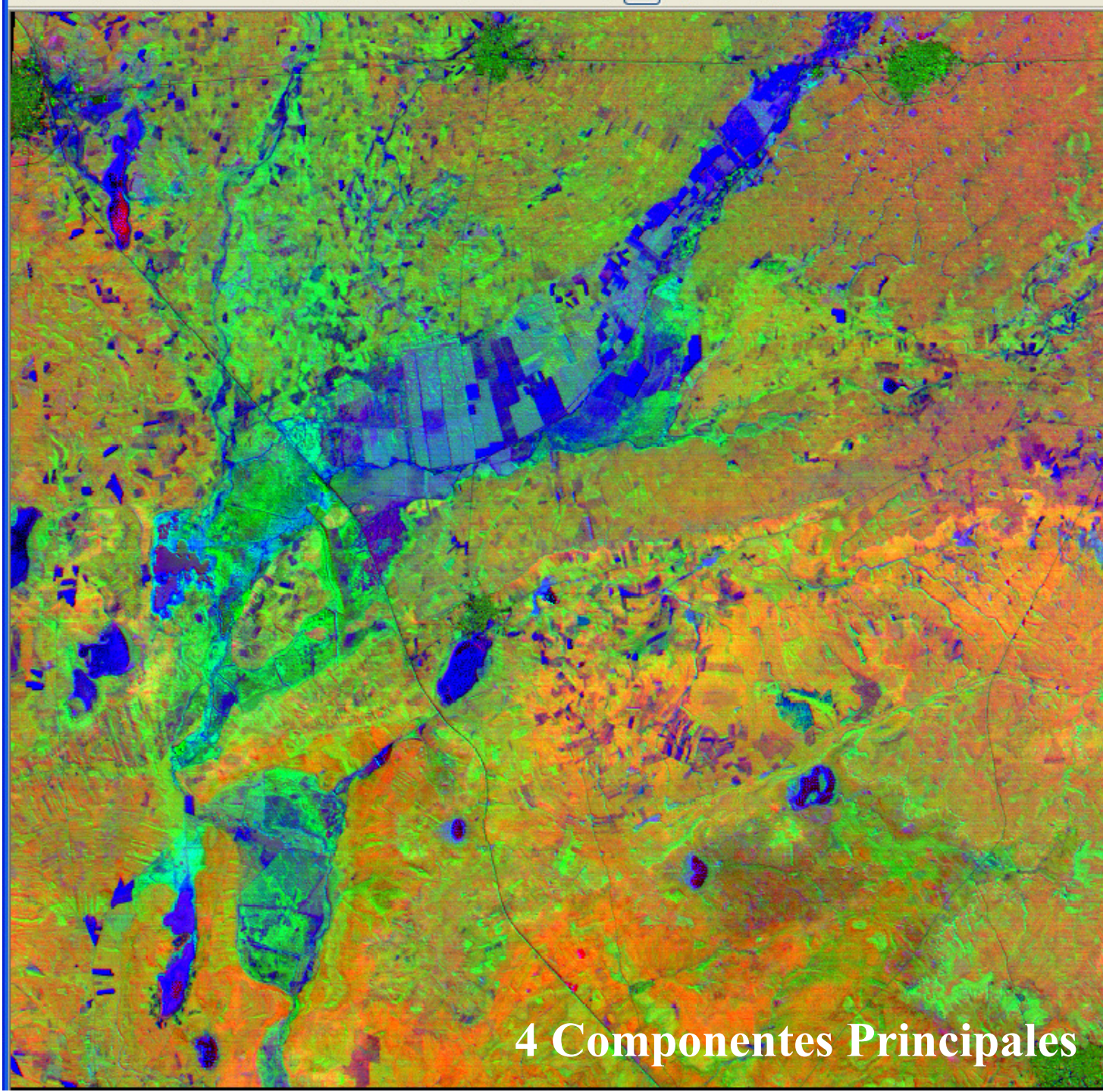
**Inundación**

**o**

**inundabilidad**

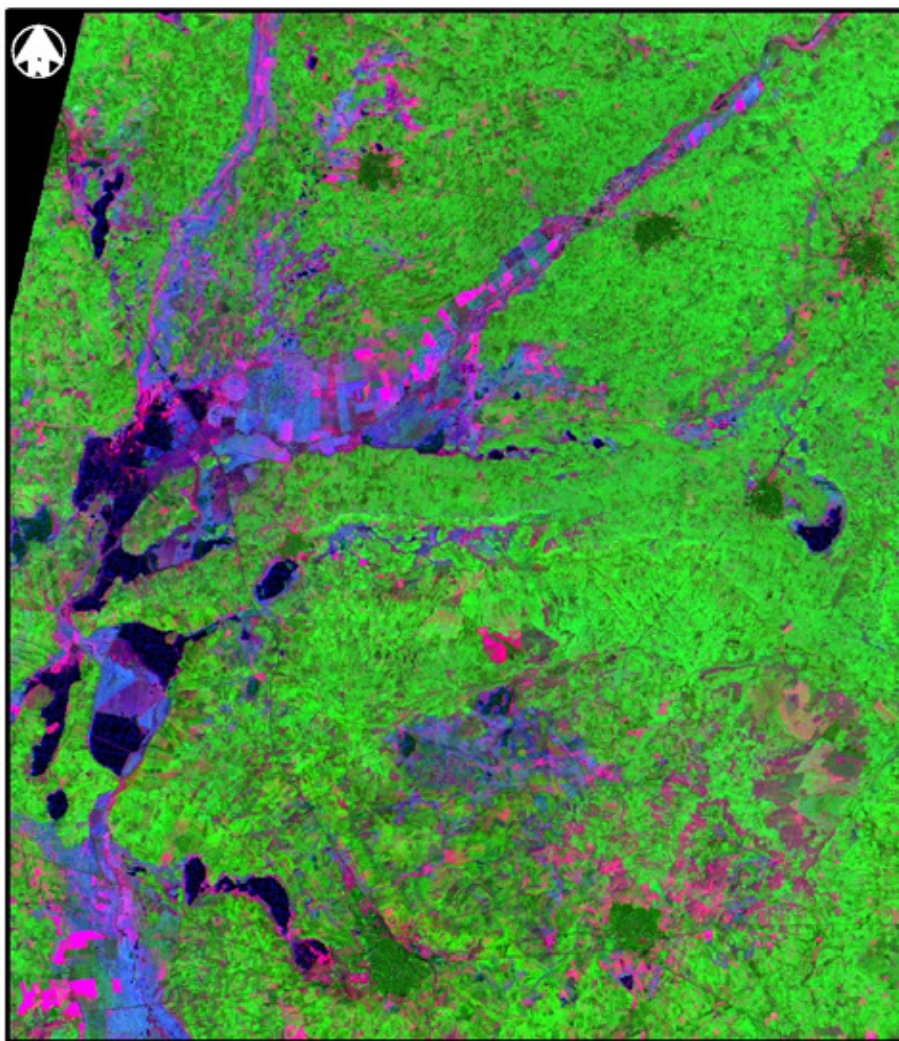
**DETECTAR  
TERRENO  
INUNDABLE**

Selección de la  
fecha de la  
imagen



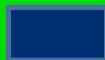
**4 Componentes Principales**



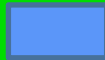


5.000 m 0 5 km

## Índice hidrotermal

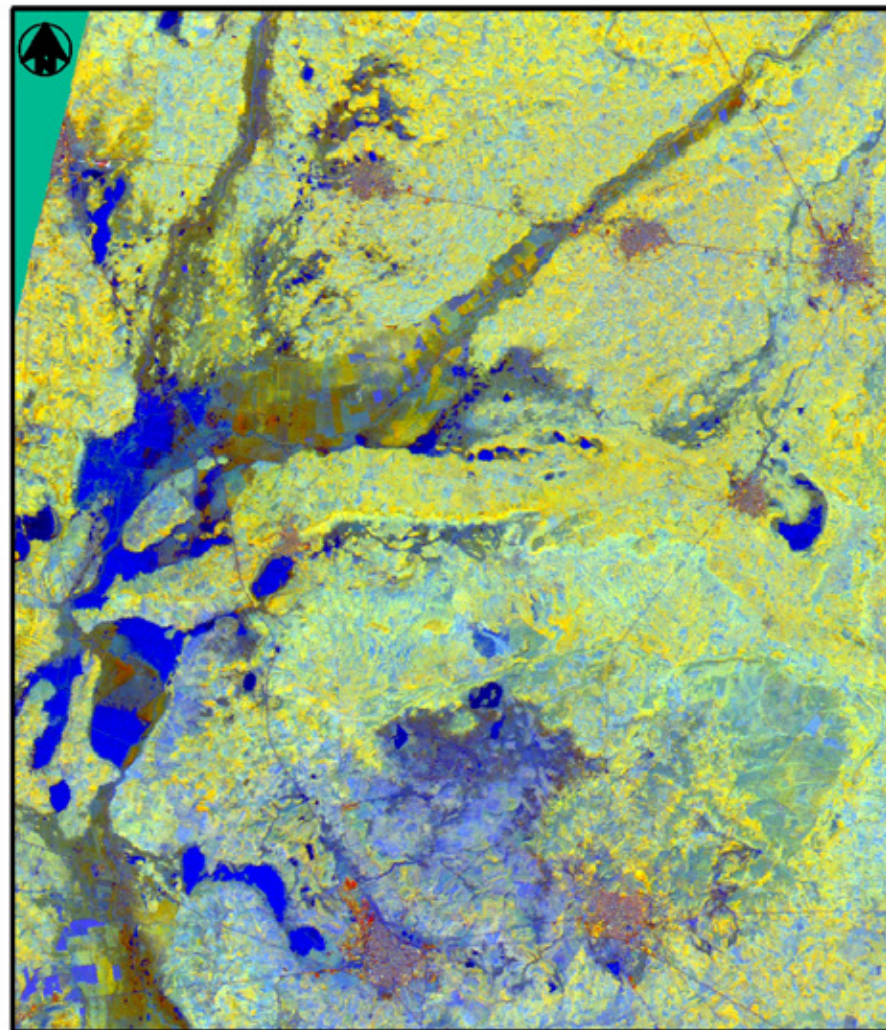


**Laguna**



**Llanura de inundación**

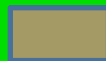
5.000 m 0 5 km



## Componentes principales



**Laguna**



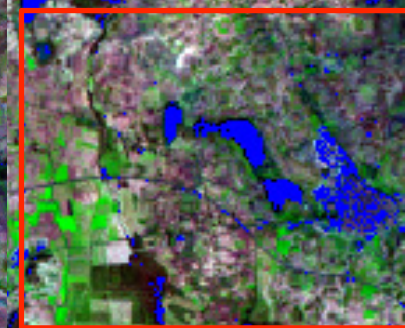
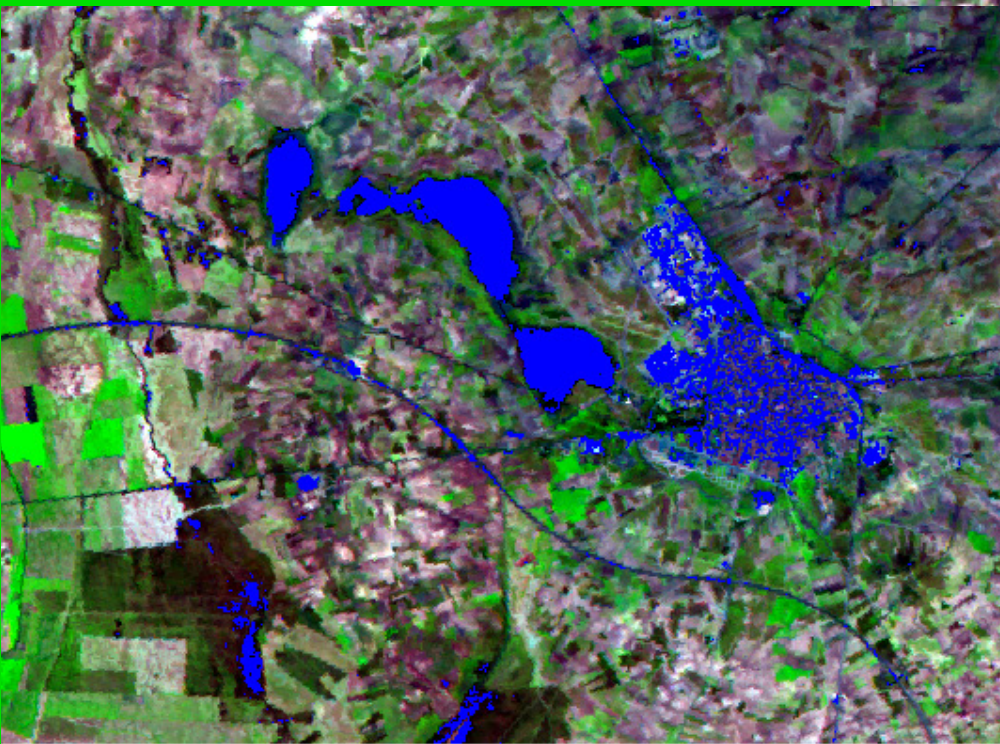
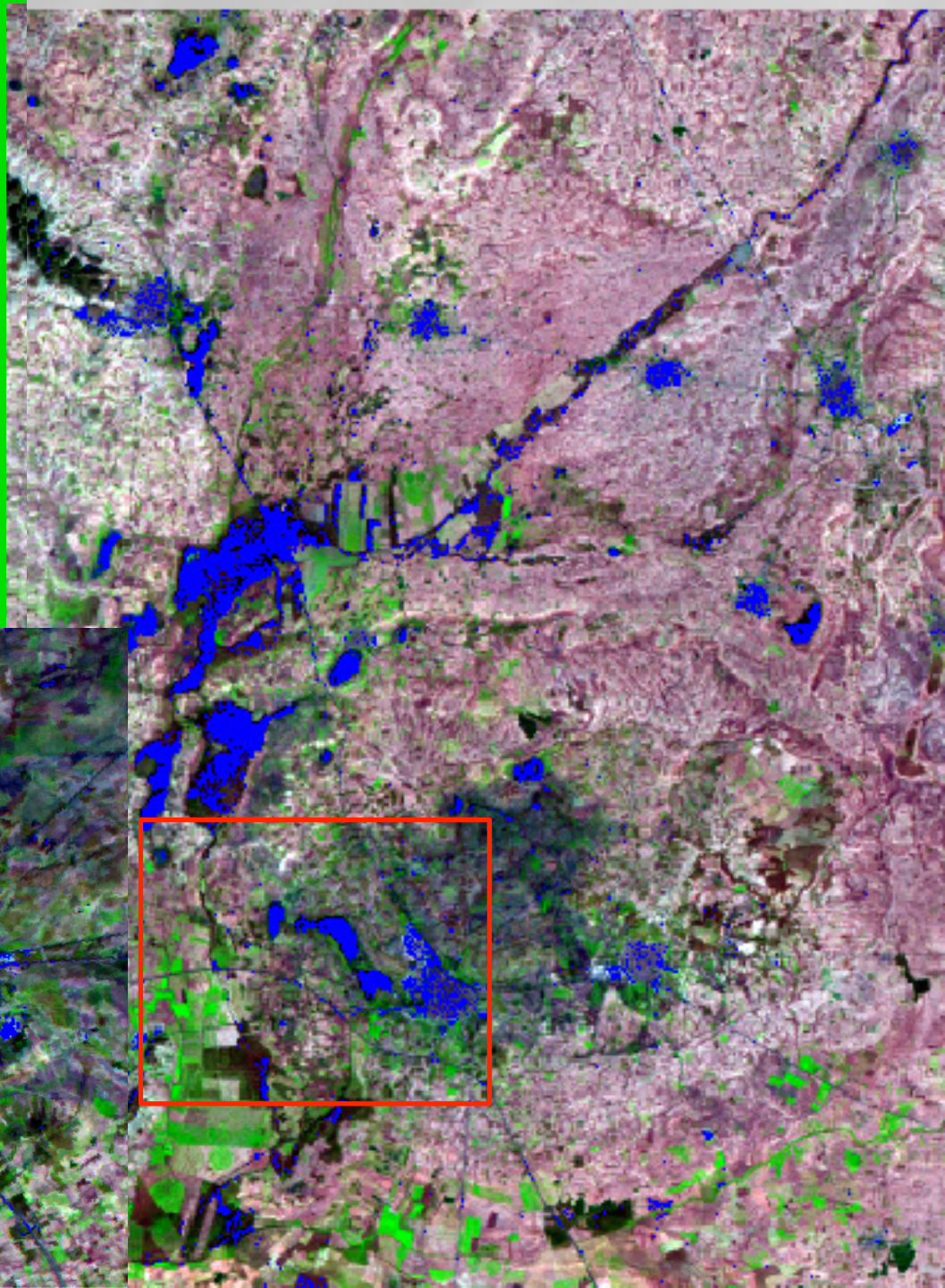
**Llanura de inundación**



**Terrenos inundables**



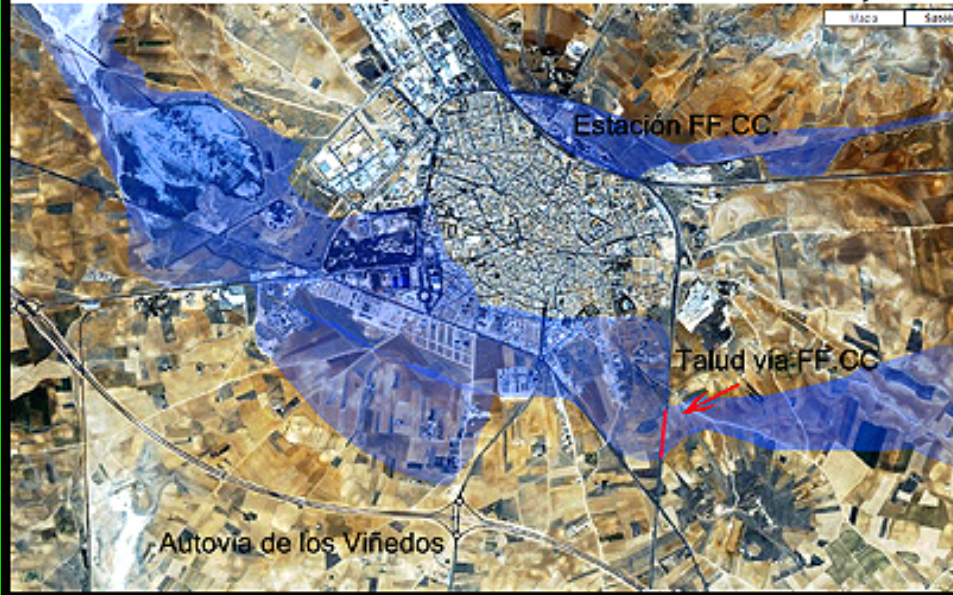
Superficies  
inundadas: lagunas,  
llanuras de inundación,  
pueblos, carreteras,  
etc.





Alcázar de San Juan, zonas aproximadas de inundación el 24 de mayo 2007 //inundacionesenalcazar.wordpress.com/

30-09-1989



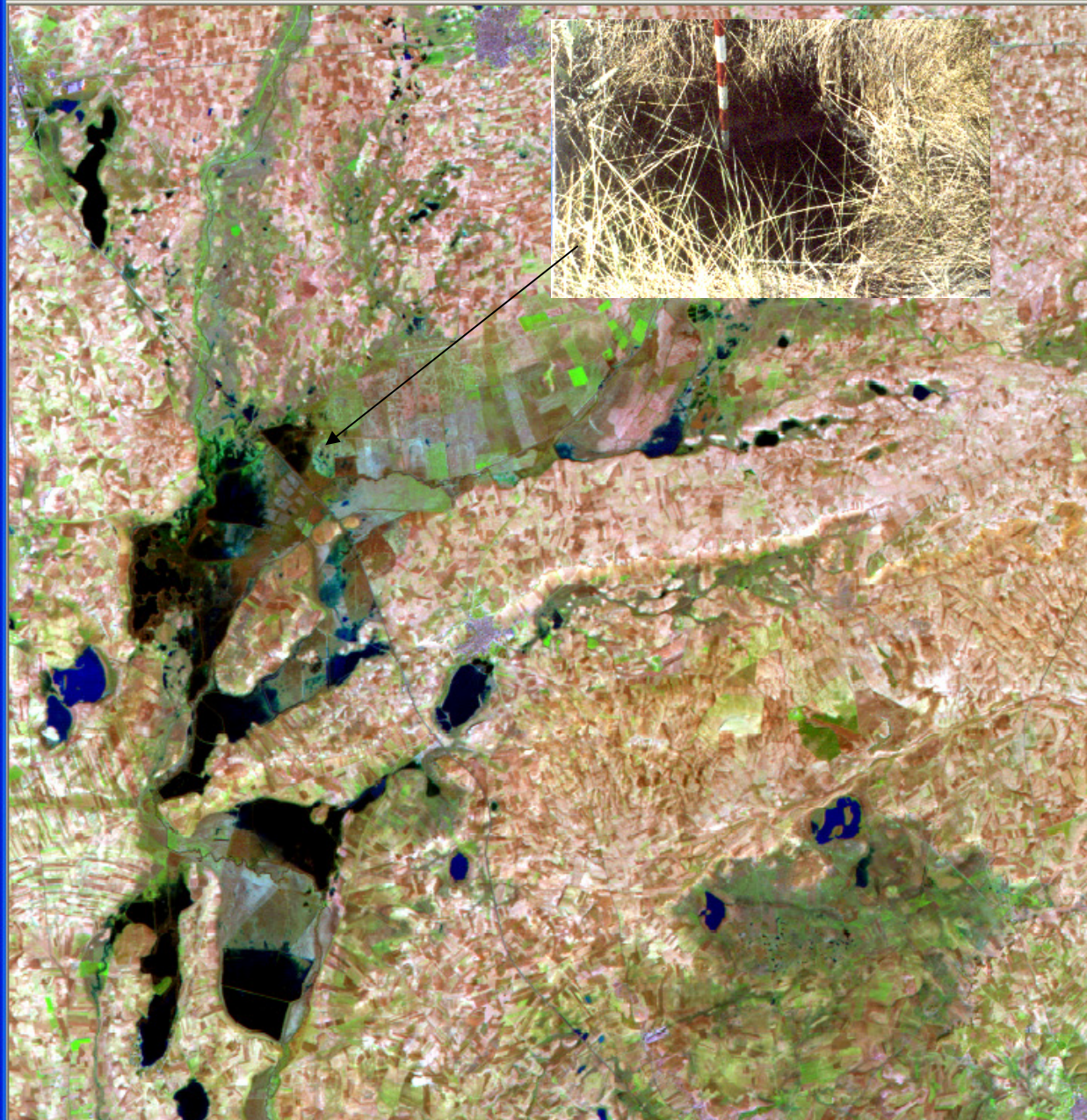




ALCAZAR  
DE SAN JUAN  
ALBACET  
CM-400  
CM 42  
N-420  
CUENCA  
CIUD



# Análisis de las láminas de agua



Identificación, extensión  
y profundidad



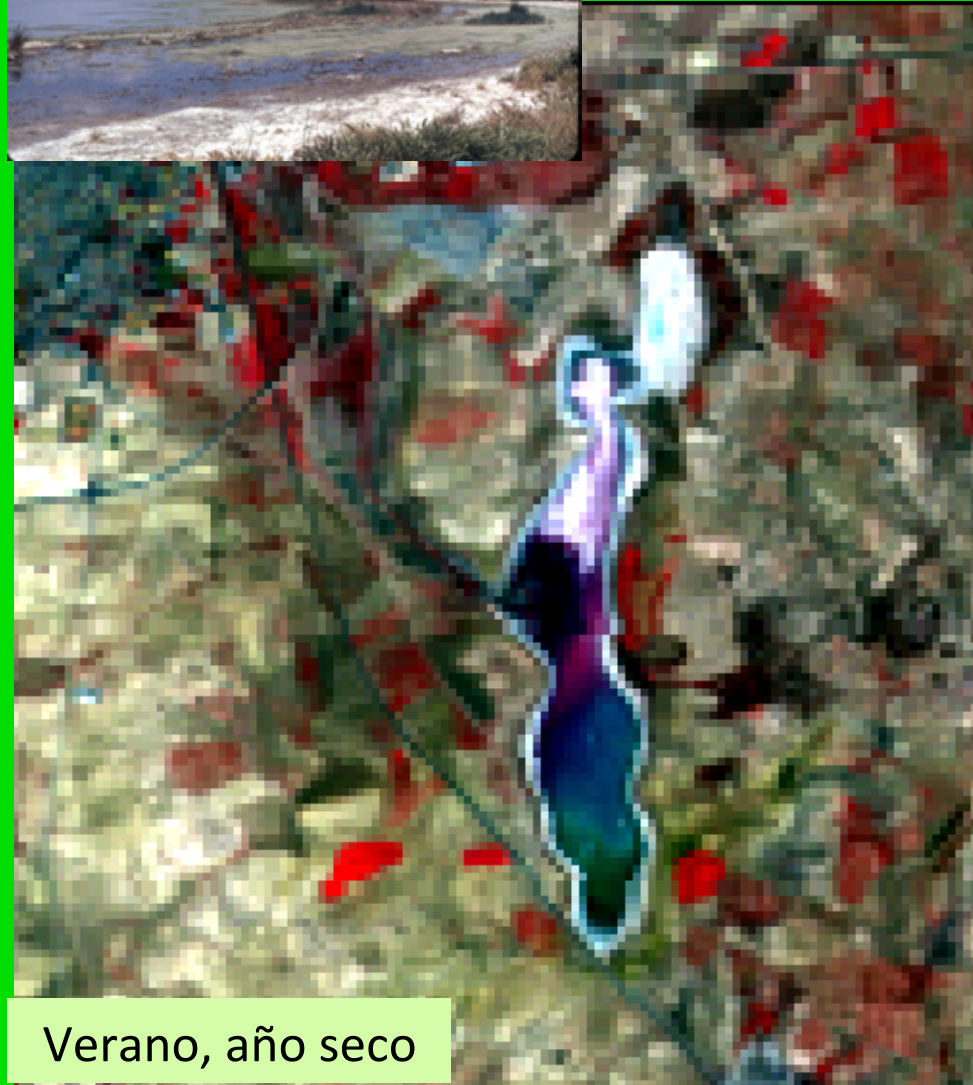
Según **fechas**:

- máxima extensión  
lámina de agua
- posibles impactos con  
infraestructuras



# Extensión, contaminantes, salinidad

Variabilidad intra/interanual



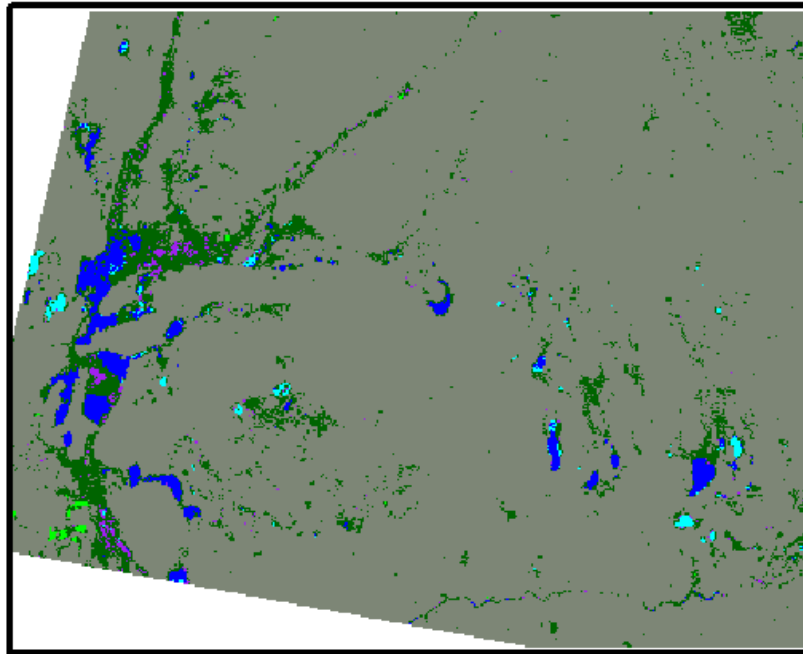
Verano, año seco



Invierno, año húmedo



# Clasificaciones



## Leyenda

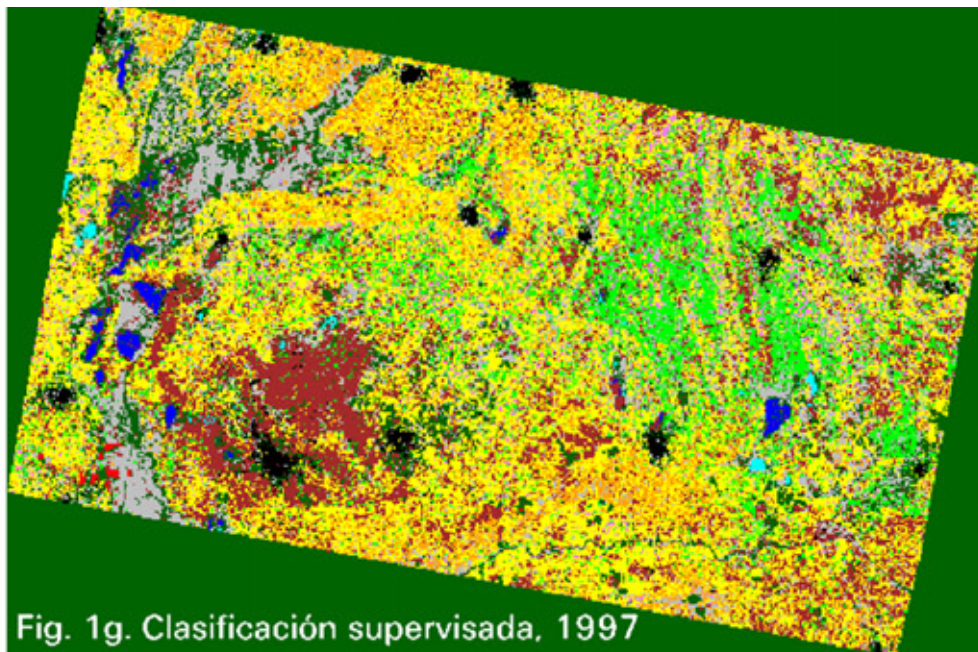
- Laguna más profunda
- Laguna somera
- Vegetación higrófica
- Regadíos
- Suelo encharcable
- No clasificado

Raster Attribute Editor - clasiaguas\_feb97.i

File Edit Help

Layer Number:

Row	Class_Names	Area
0	Unclassified	91745.9
1	Laguna más profunda	3220.02
2	Laguna somera	788.04
3	Vegetación higrófica	13094.8
4	Regadíos	160.92
5	No clasificado	173310
6	Suelo encharcable	795.6



## Leyenda

- Urbano
- Laguna profunda
- Laguna somera
- Regadio
- Llanura inundación
- Arcillas
- Calizas
- Margas-arenas cretácicas
- Sedimentos finos neógenos
- Sedimentos gruesos neógenos
- Vegetación ribera



Fig. 1g. Clasificación supervisada, 1997



# Vegetación y estrés hídrico

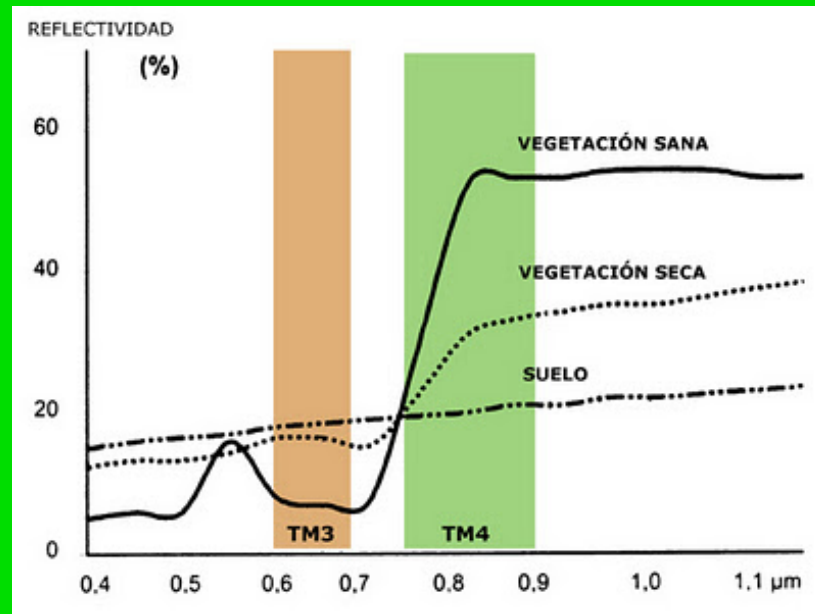
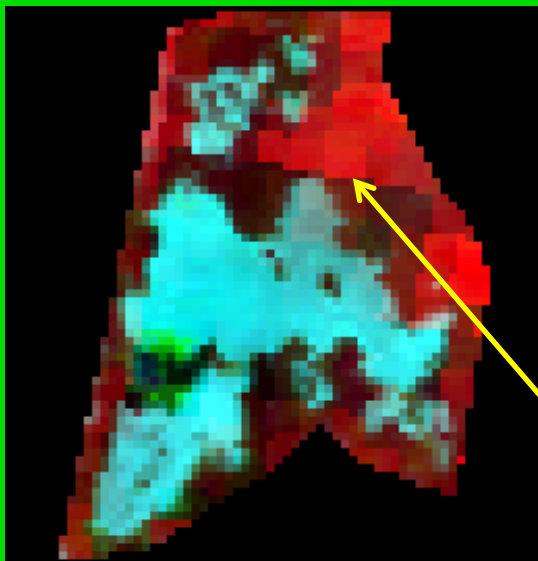
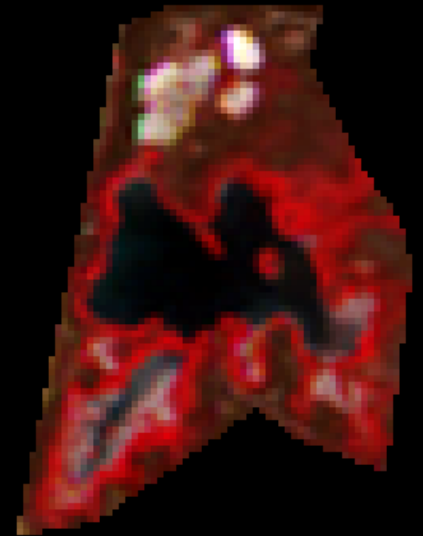




Estrés hídrico



Vegetación hidratada

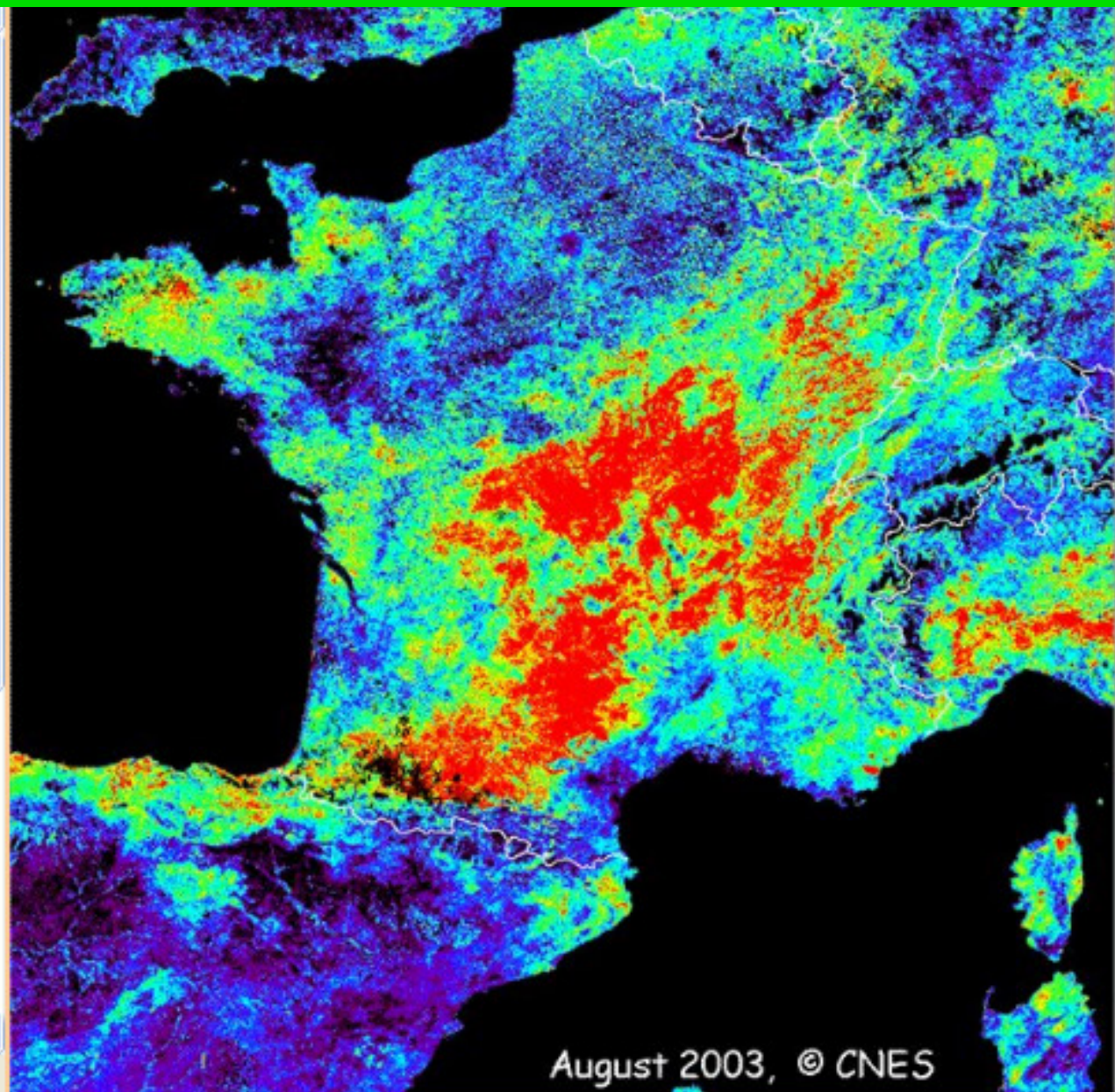


6-4-3: detección del estrés vegetación higrófila con el **canal térmico e IRp**



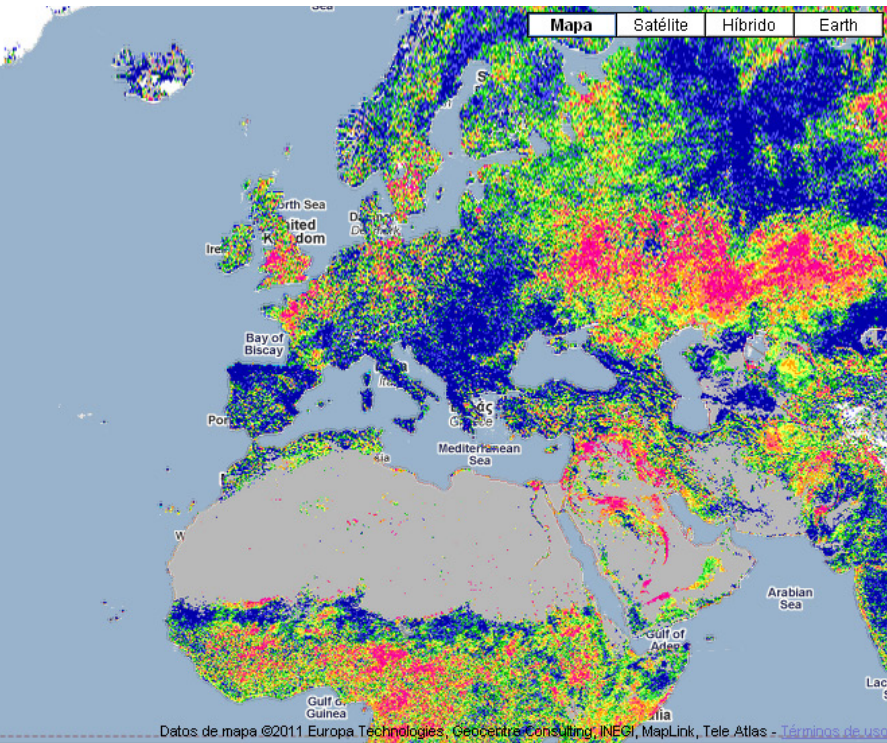
## Secheresse

The effects of the drought on vegetation beginning July and August 2003 is clearly visible on the two images below. The images represent the variation of the vegetation index of the summer of 2003 compared to the summer of 2002. The bleu coloured zones on the map represent a vegetation condition in 2003 similar to the one in 2002. Spain appears in blue as 2003 was as dry as 2002. Also villages appear in blue as their VEGETATION cover is very sparse. Above all the dryness affects the South Western part of France, the Central Massive and the Northern part of Italy. This can be linked to several factors: the turning yellow or early fall of the leaves, early harvesting, forest fires. In the red colour on the image of August we remark the fires of the Var region and Corsica. We can also note the increase of drought in August. Finally one can approach these images as well from the maps who show the deficit in precipitation during the first semester (source: Bulletin de Situation Hydrologique"). The deficit of



**SEQUÍA 2003:** en azul similar al 2002, en rojo: más seco

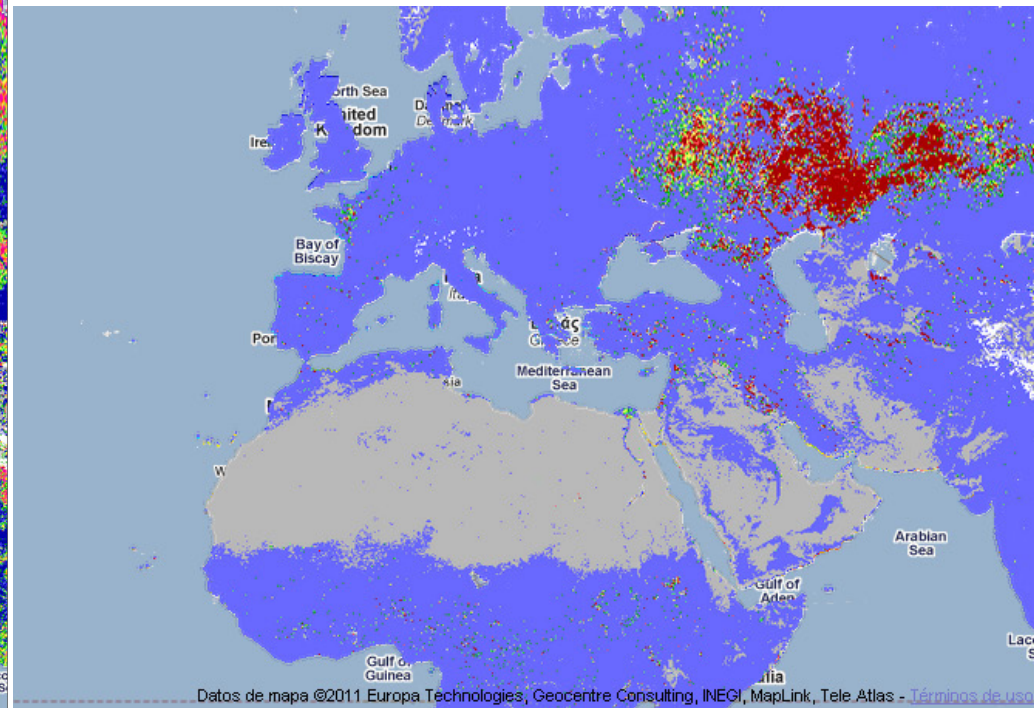




..\\VHimages\_gviz\\Visual\_Lab\\VCI\\VCI-Weekly-2010-225.png  
 Vegetation Condition Index, Week 33, 2010

Stressed	VCI	Favorable	snow/ice	Desert
0	12	36	60	84

Índice o estado  
 vegetación  
 Semana 33, 2010



..\\VHimages\_gviz\\Visual\_Lab\\FireRisk\\FireRisk-Weekly-2010-225.png  
 Fire Risk, Week 33, 2010

Low	Fire Risk	High	snow/ice	Desert
0	1	2	3	4

Riesgo incendios  
 Semana 33, 2010



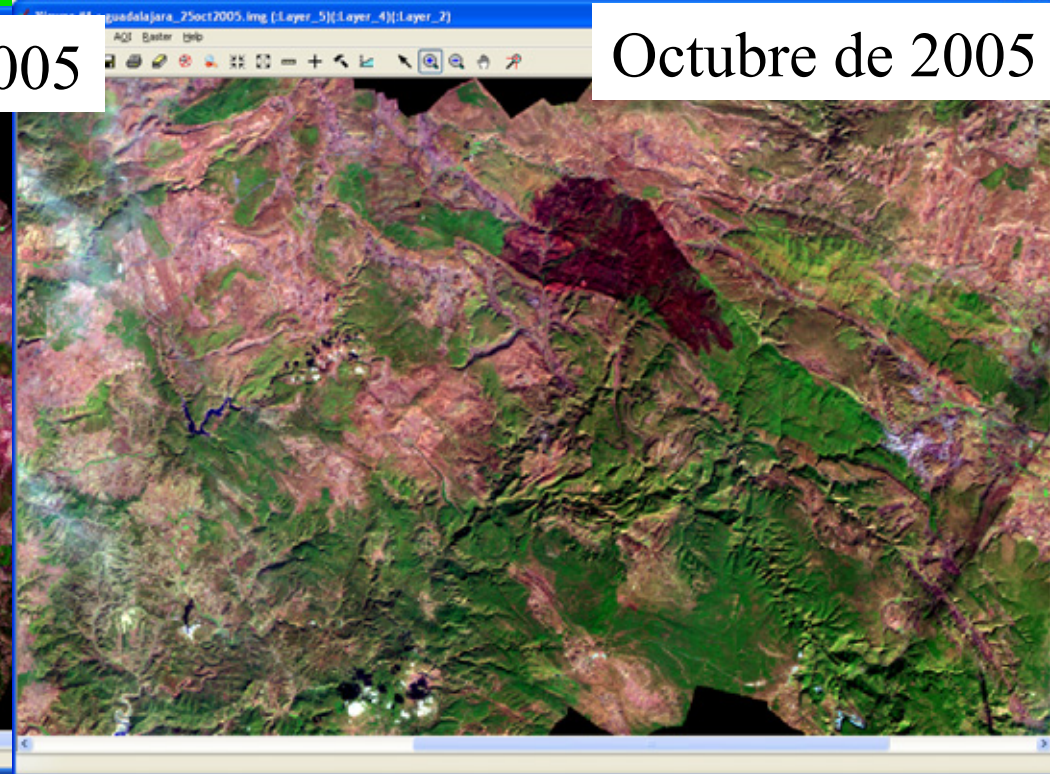
# Aplicaciones en incendios

Guadalajara, incendio de 2005

Junio de 2005



Octubre de 2005



## VARIABLES Y SATÉLITES/SENSORES

- Temperatura de la superficie
- Índices de Vegetación
- Satélites con aplicaciones en incendios

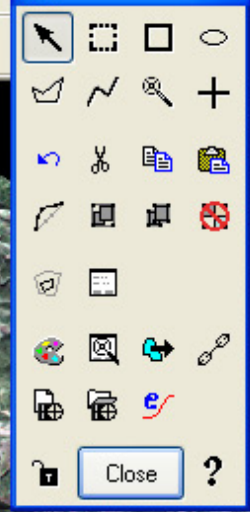


# Color natural

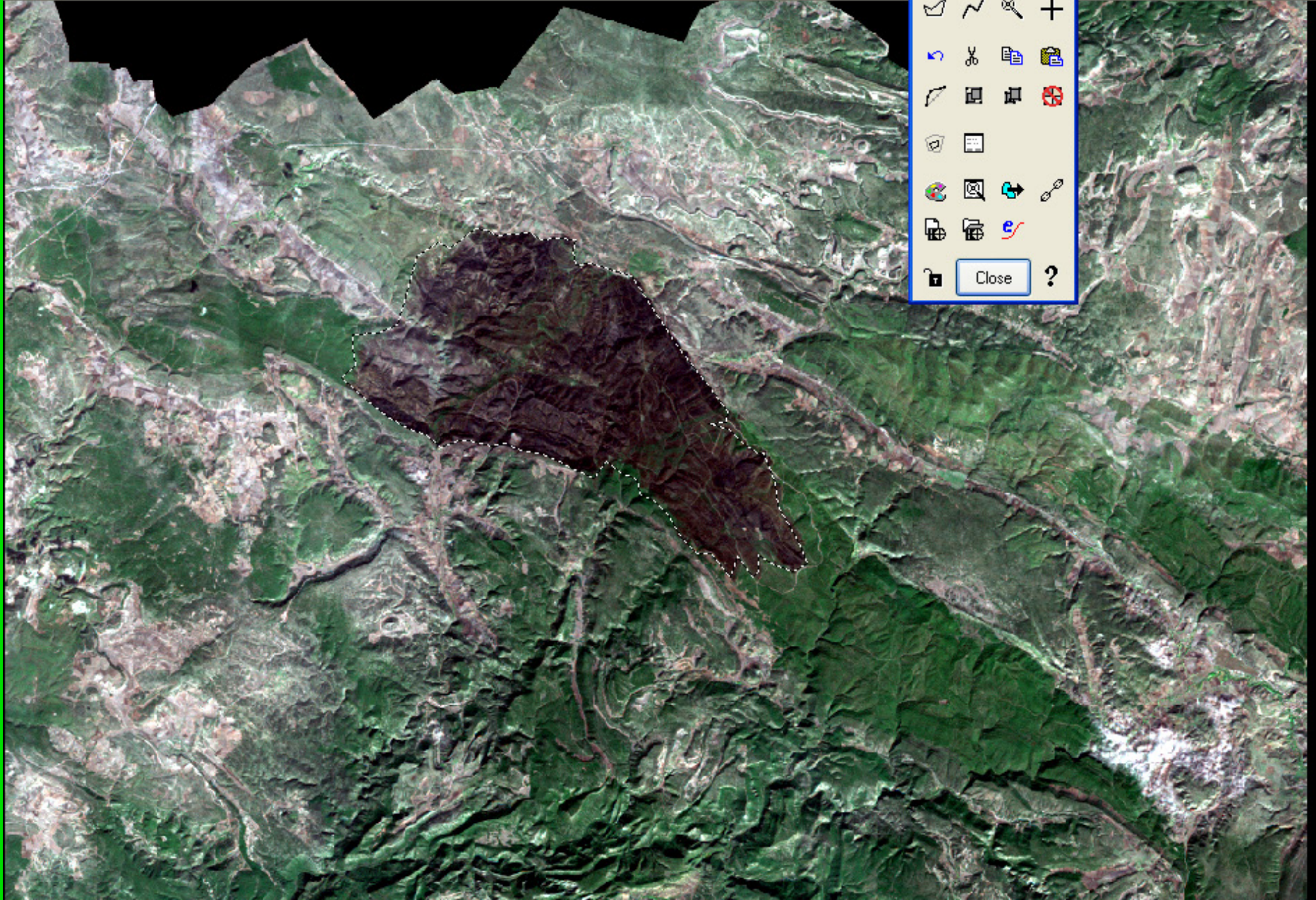
)(:Layer\_2)(:Layer\_3)



AOI

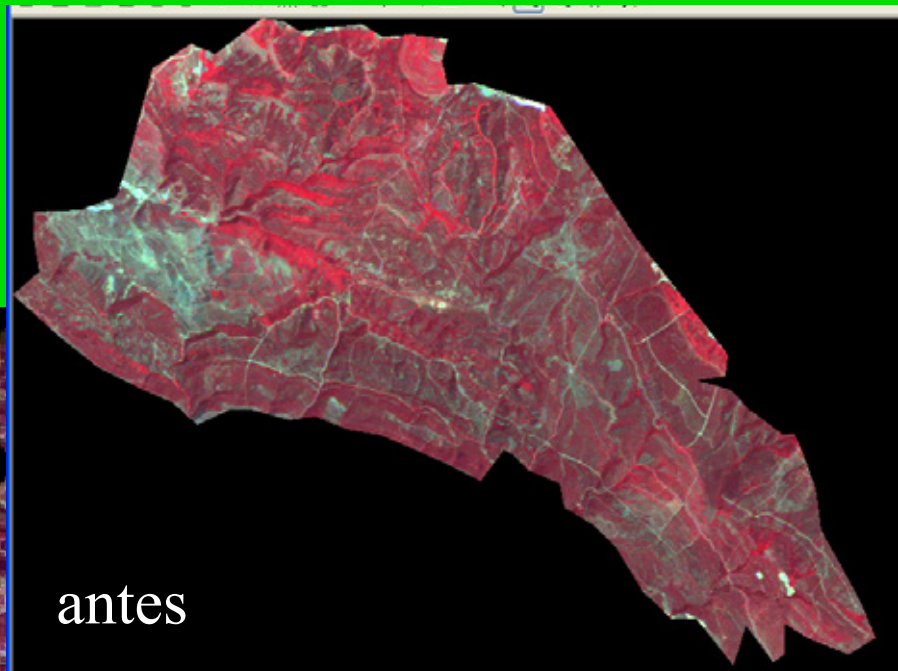
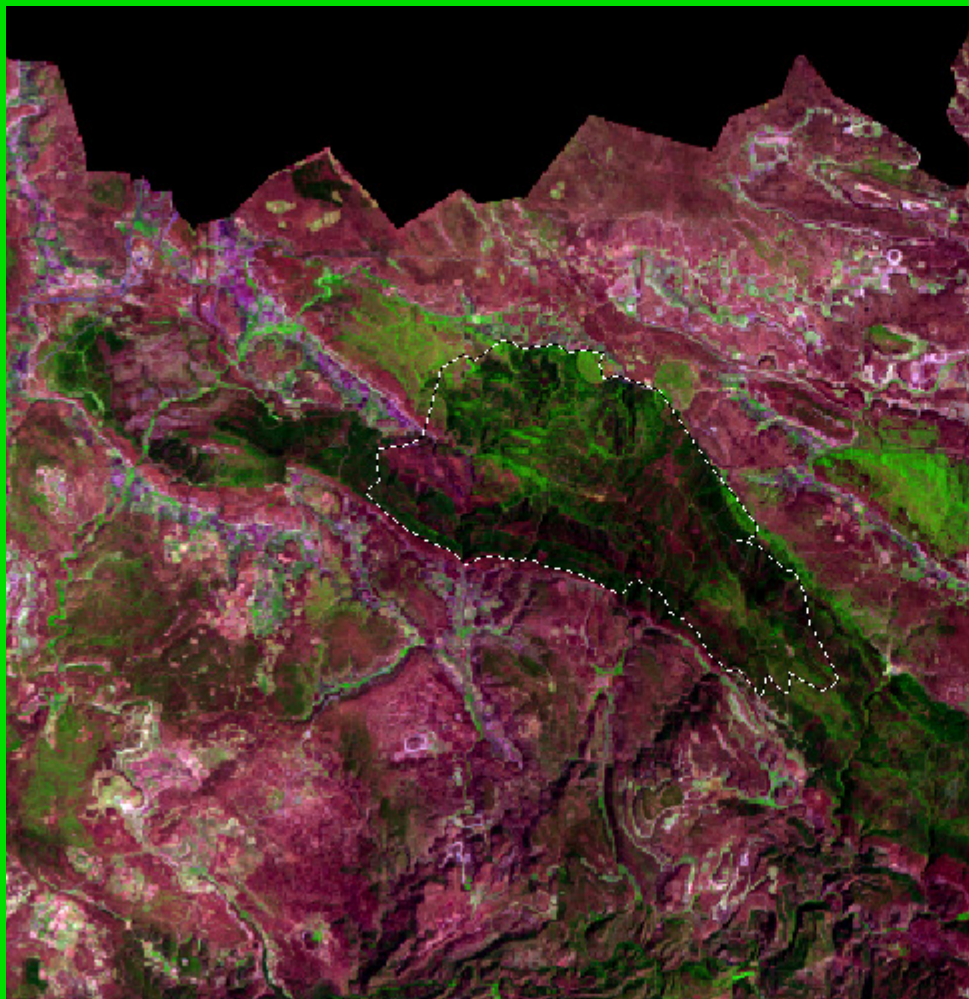


Close ?





# Intensidad de la superficie afectada

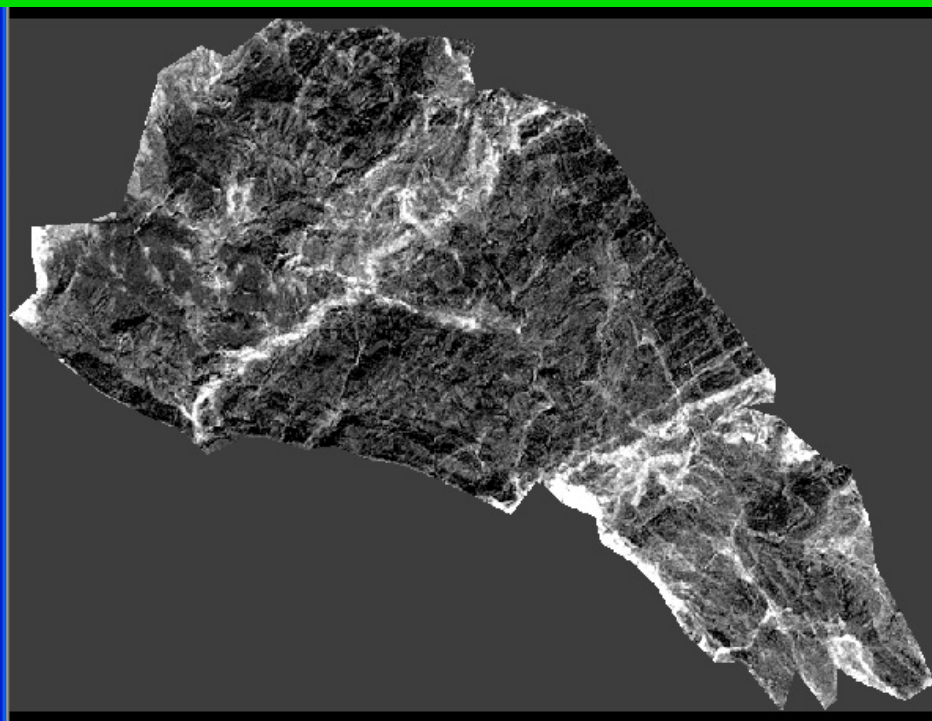




# Medidas más precisas mediante índices



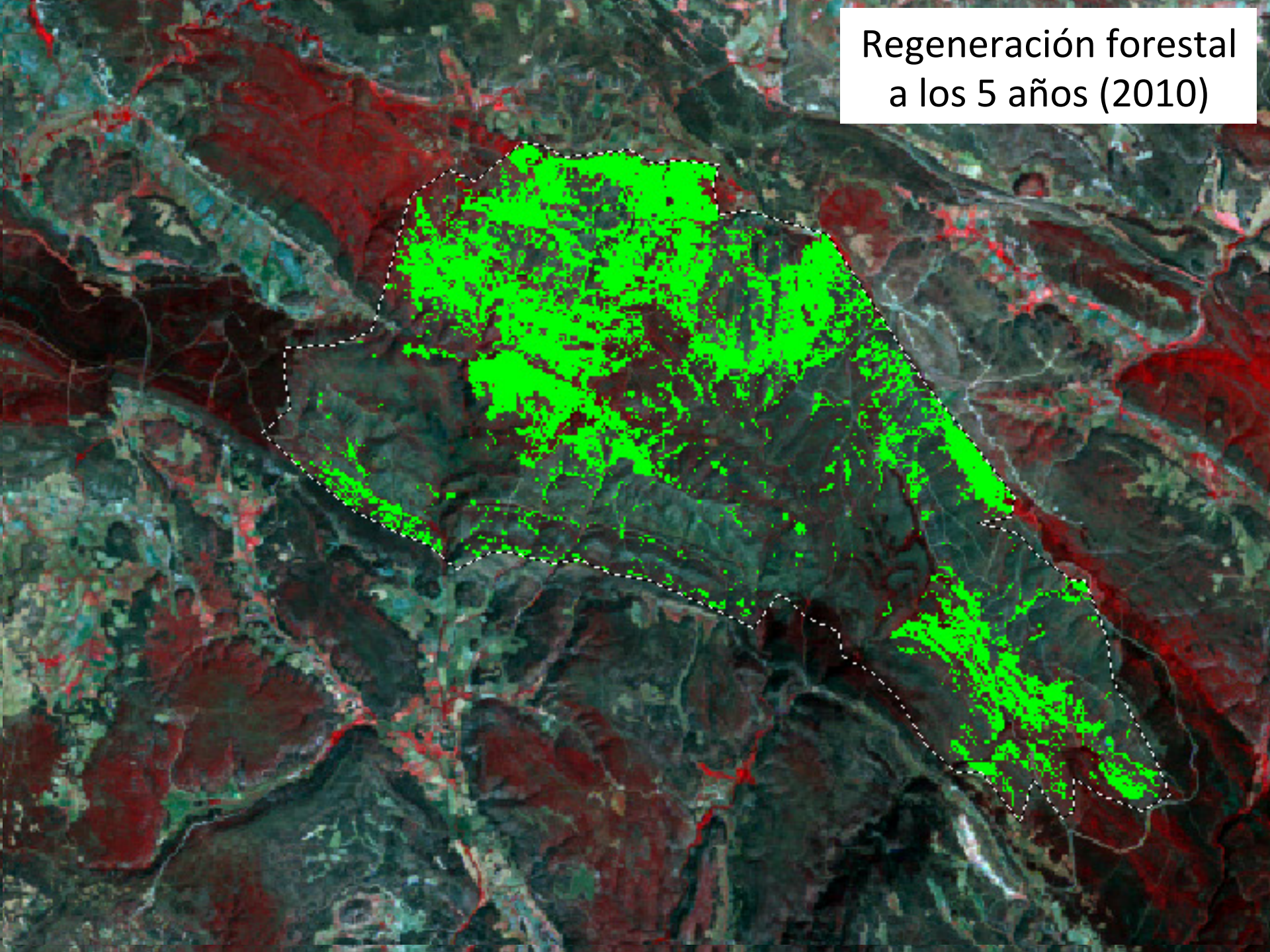
**Antes del incendio**



**Después del incendio**

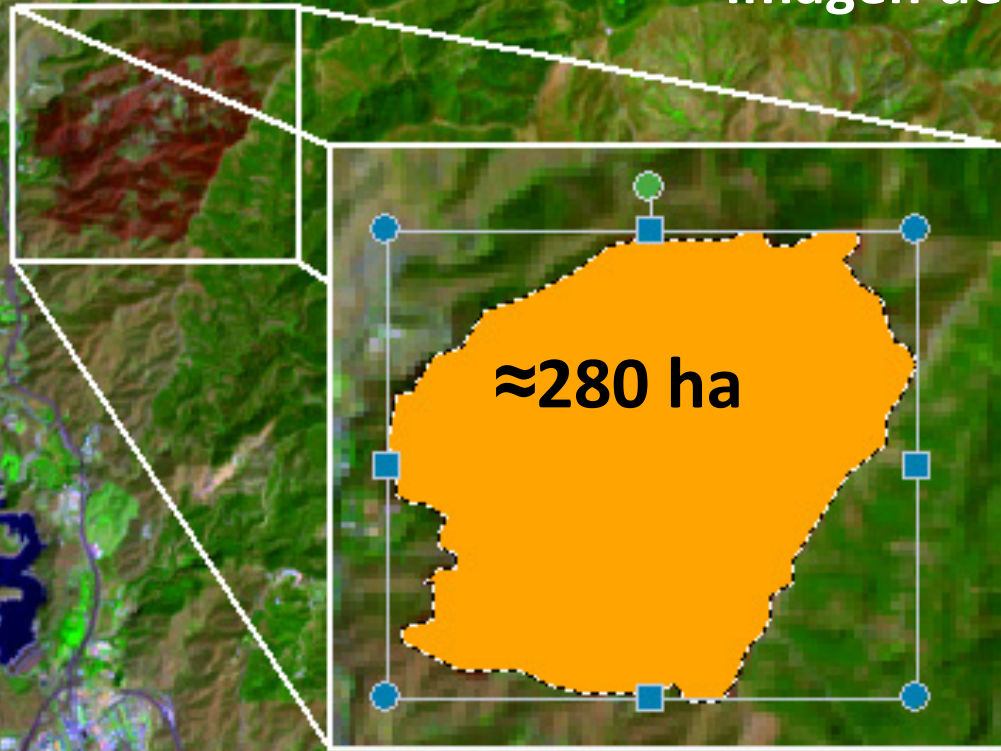


Regeneración forestal  
a los 5 años (2010)

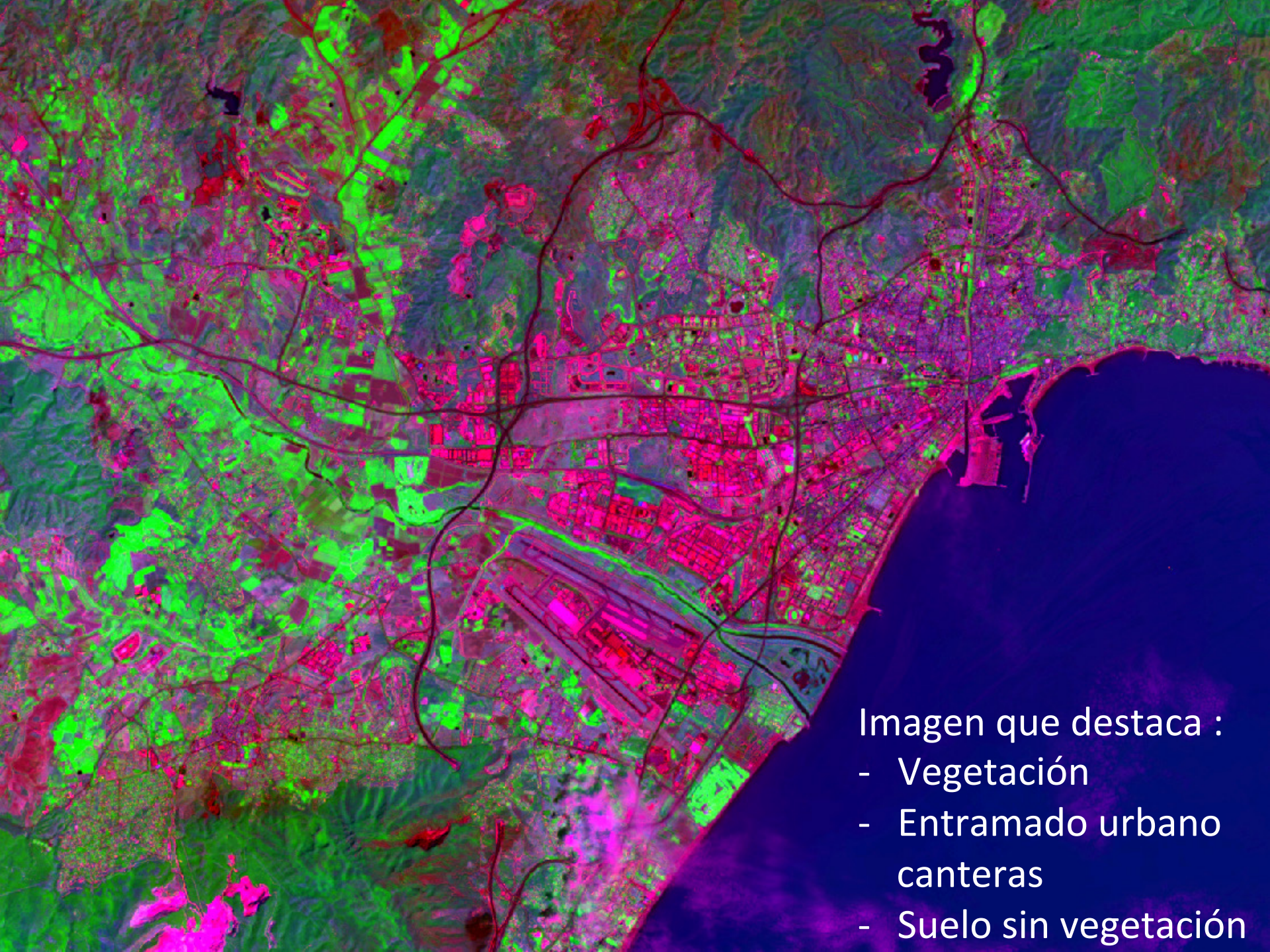




Incendio 10-8-2014  
Imagen del 21-8-2014







- Imagen que destaca :
- Vegetación
  - Entramado urbano  
canteras
  - Suelo sin vegetación





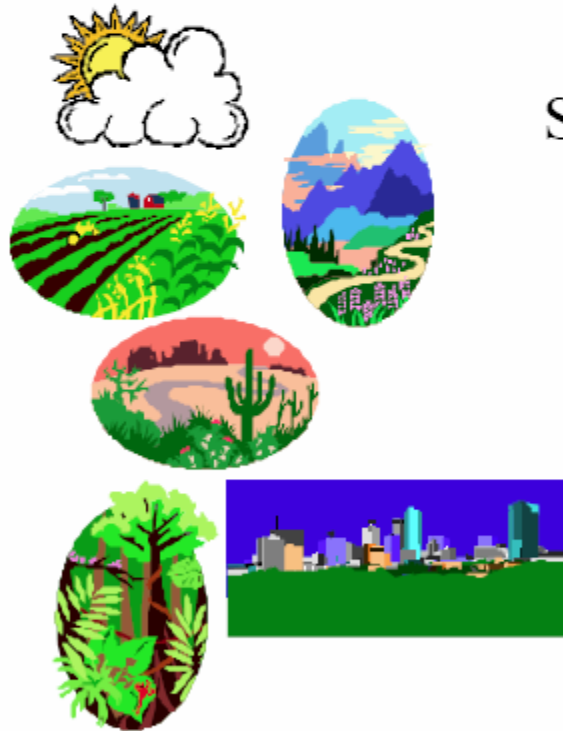
\*Torre del mar

\*Nerja

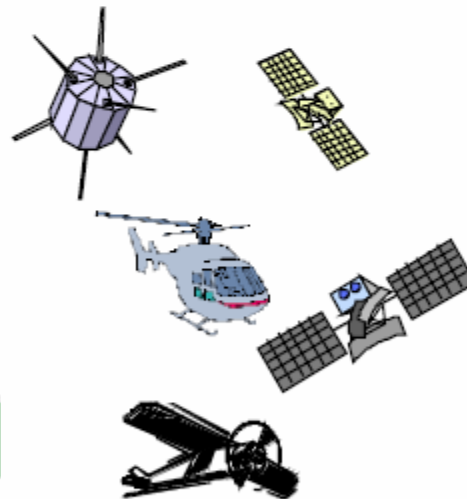


# Data selection criteria

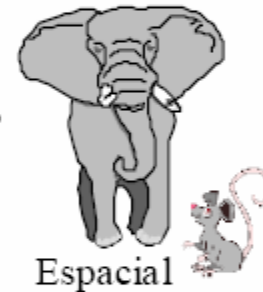
## Aplicaciones



## Sensores/plataformas



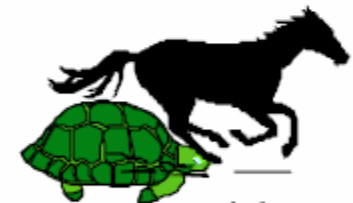
## Características datos



Espacial



Cuando



Ciclo



Esppectral



iMuchas gracias  
por vuestra  
atención!