



Semi-arid Wetlands: Assessment of their Degradation Status and Monitoring by Multi-Sensor Remote Sensing

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Presentation overview

- Objectives
- Project background
- Project team
- Study area
- Methodology
- Field work
- Available EO data
- Application of CHRIS data



Objectives

The aim is to apply a multi-sensor and multi-scale approach to study semi-arid wetlands in Spain using advanced Earth Observation Systems with the support of field spectroradiometry, and ancillary field and laboratory data.

In this case, data from the Compact High Resolution Imaging Spectrometer (CHRIS) aboard ESA's Proba will be used to obtain environmental information from target scenes within the different wetland areas in contrasting seasons (wet and dry) within the same year.

Specific objectives:

- Explore complex wetland characteristics -> shallow water bodies, hygrophytic vegetation, soil conditions (humidity) and characteristics (crusts, iron oxides).
- Identifying open water lamina and flooded vegetated areas.
- Determining wetland plant communities and invasive vegetation species.
- Detecting anthropogenic influences (agricultural management).
- Implementing CHRIS information to improve results obtained with multisensor data and to enhance monitoring studies.



Project background

- Wetlands in semi-arid regions are **complex** and **fragile** ecosystems and are especially important because of their role in **maintaining** and **controlling** the environmental quality and biodiversity and undergo extreme changes from the wet to the dry season.
- These wetlands are saline or non-saline and are very dynamic systems subject to **natural** (seasonal) as well as **man-induced** changes which produce alterations in wetland ecosystems.
- A reduction or disappearance of wetland areas are linked to the development of large irrigation systems in the regions with a significant reduction of the ground water resources, land use changes, water drainage, waste deposition and waste water effluence.
- The research presented for this project forms part of a greater ongoing investigation in wetlands that was initiated in 1995.

Combining traditional and well-established research methods with cutting-edge technology will:

- 1) Advance our knowledge in detecting, understanding and monitoring environmental changes occurring to these types of ecosystems.
- 2) Develop new methods for extracting indicators from multi-sensor data to determine their degradation status and trend in a timely and spatial manner.



Project team

This project is within the framework of the Spanish National project “Multidisciplinary analysis of geoindicators of degradation in protected wetlands (Las Tablas de Daimiel National Park” (CGL22005-06458-C02-02/HID).

Coordinator: Dr. Jose Gumuzzio from the Autonomous University of Madrid.

Team: 12 members -> multi-disciplinary (geology, hydrology, geomorphology, pedology, biology, remote sensing, geo-thematic mapping).

National collaboration:

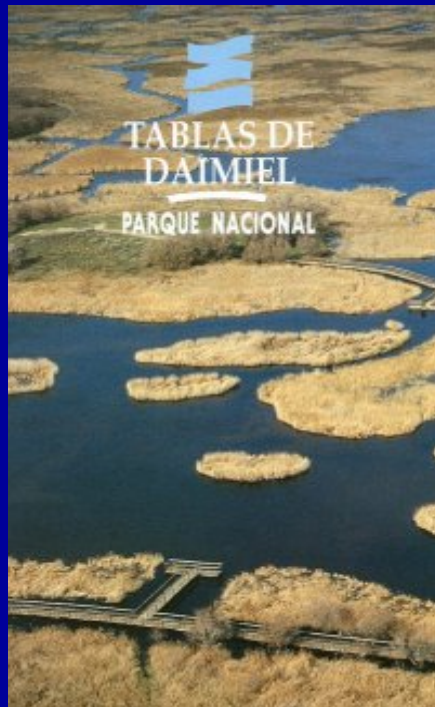
- Geological Survey of Spain (IGME)
- Centro de Estudios y Experimentación de Obras Públicas (CEDEX)
- Research Centre for Energy, Environment and Technology (CIEMAT)

International collaboration:

- Centre for Remote Sensing, Boston University (USA)
- School of Geography, Nottingham University (UK)



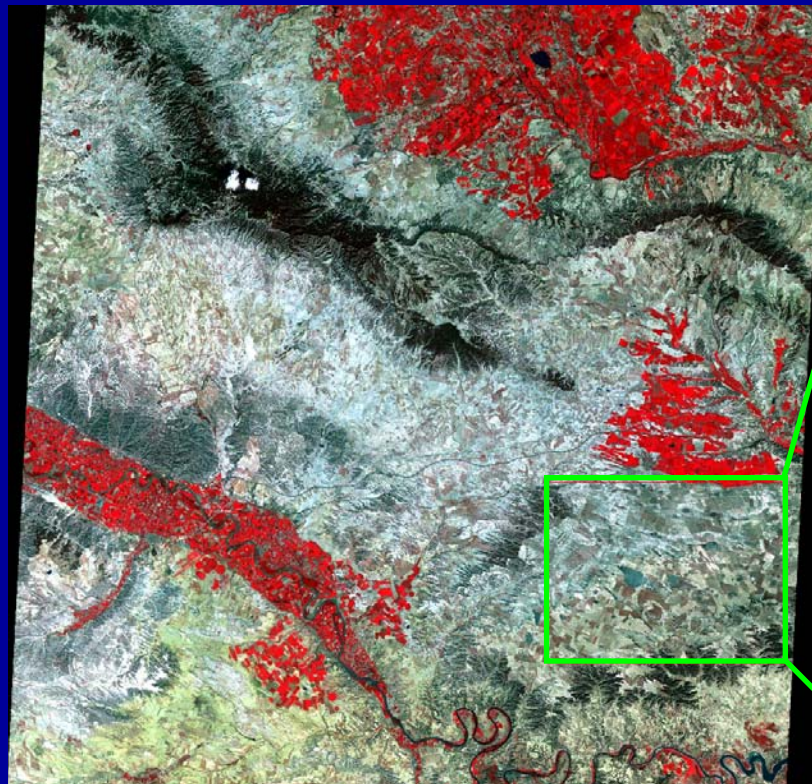
Study area



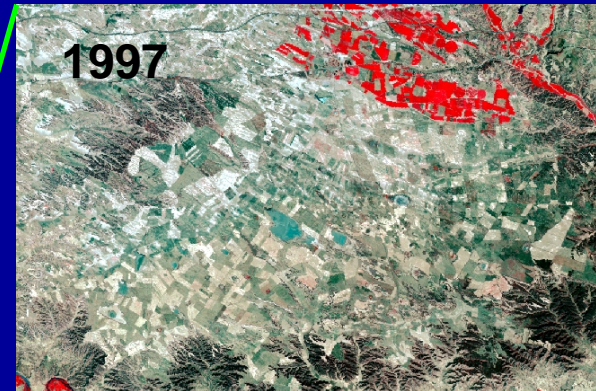
These test sites exemplify a global problem affecting many wetland areas, namely that population growth and expansion of agricultural areas are the main reasons for these wetlands to disappear and with them a valuable natural resource supporting biodiversity and wildlife habitats.



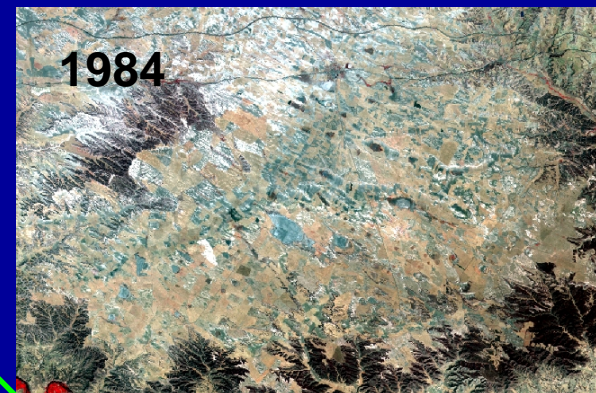
Study area in Los Monegros



ASTER 30/08/2002



TM 07/07/1997

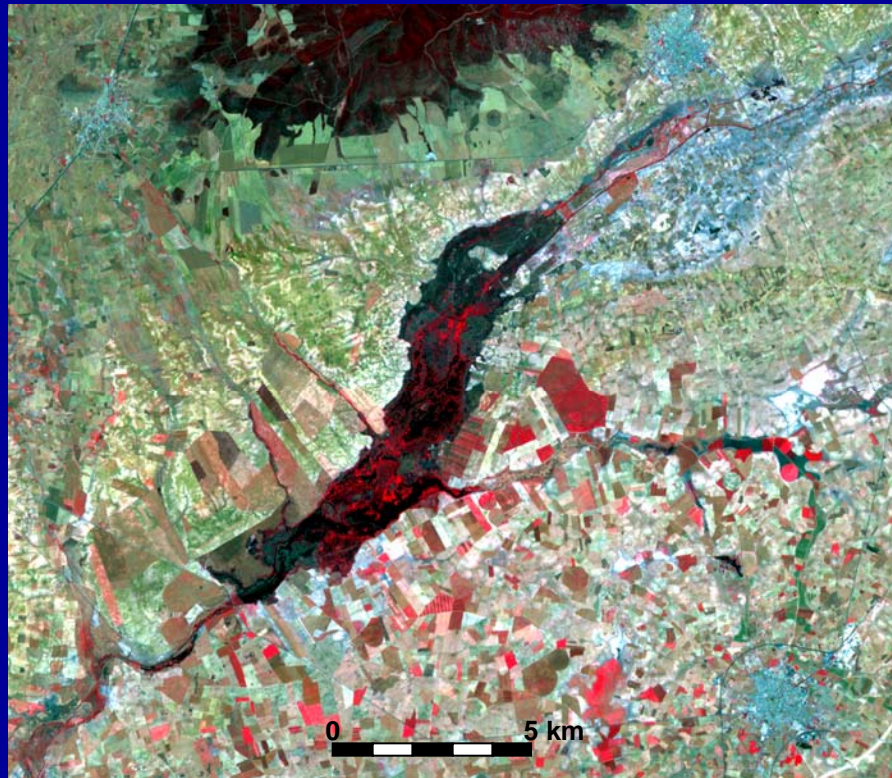


TM 20/08/1984

- Karstic environment enclosing numerous saline lakes (playa lakes).
- Introduction of irrigation systems in an area characterized by a semi-arid climate, closed basin hydrology, and karstic geology of evaporitic sediments, is changing the water balance and soil properties of the playa lakes and surrounding areas.
- The results are increased rates of soil and water salinization.



Study area Las Tablas de Daimiel



Diminishing water level.



Areas with temporal flooding.



Crop cultivation with intensive irrigation surrounding wetlands.

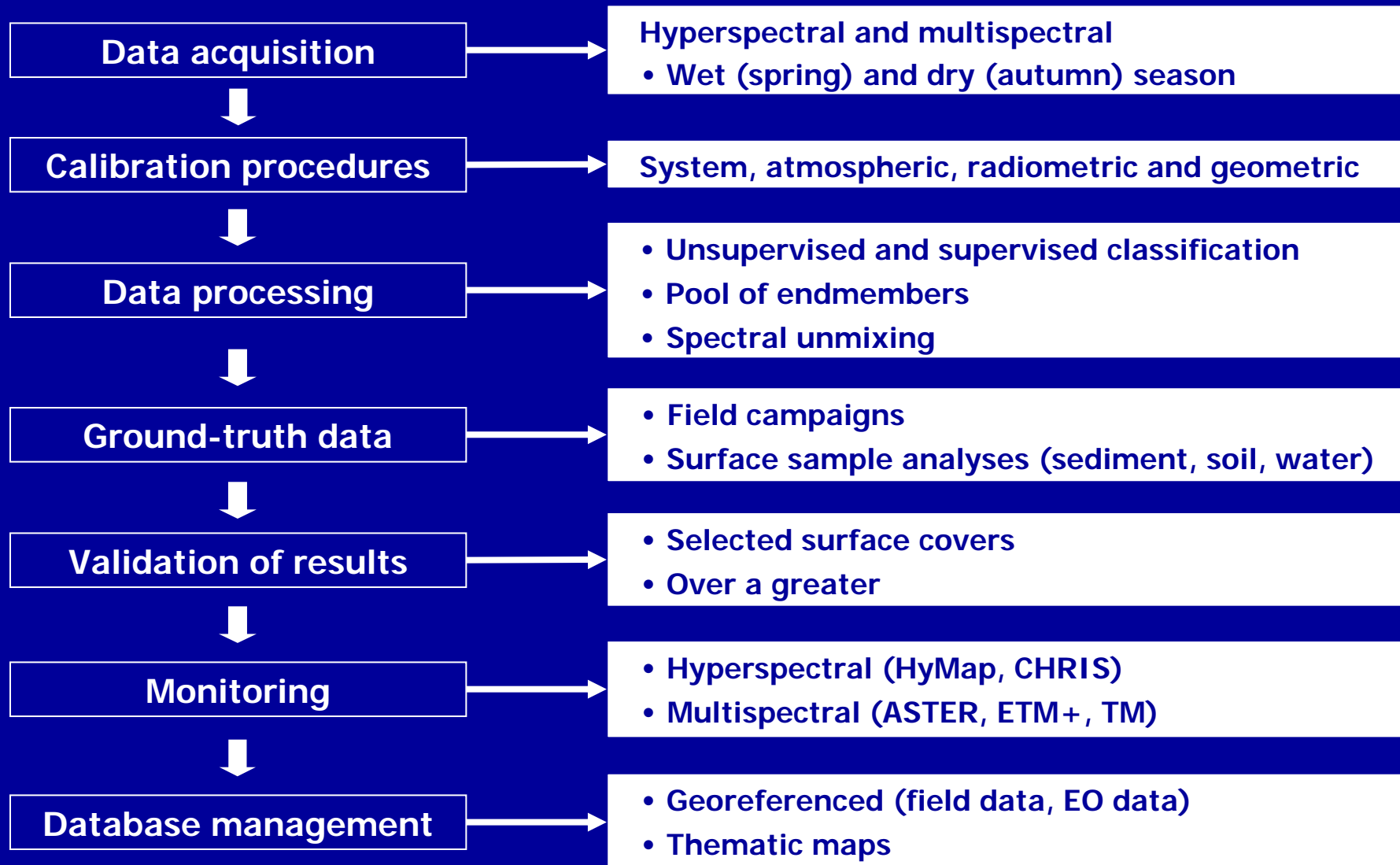


Salt efflorescence.

- National Park (UNESCO Man and Biosphere Reserve and Ramsar Convention)
- The area is in a depressed basin filled with Tertiary sediments, mainly of limestone and calcareous clays.
- Water sources: (1) Guadiana River (freshwater) and Cigüela River (brackish)
(2) Upwelling groundwater from underlying karstic aquifer.

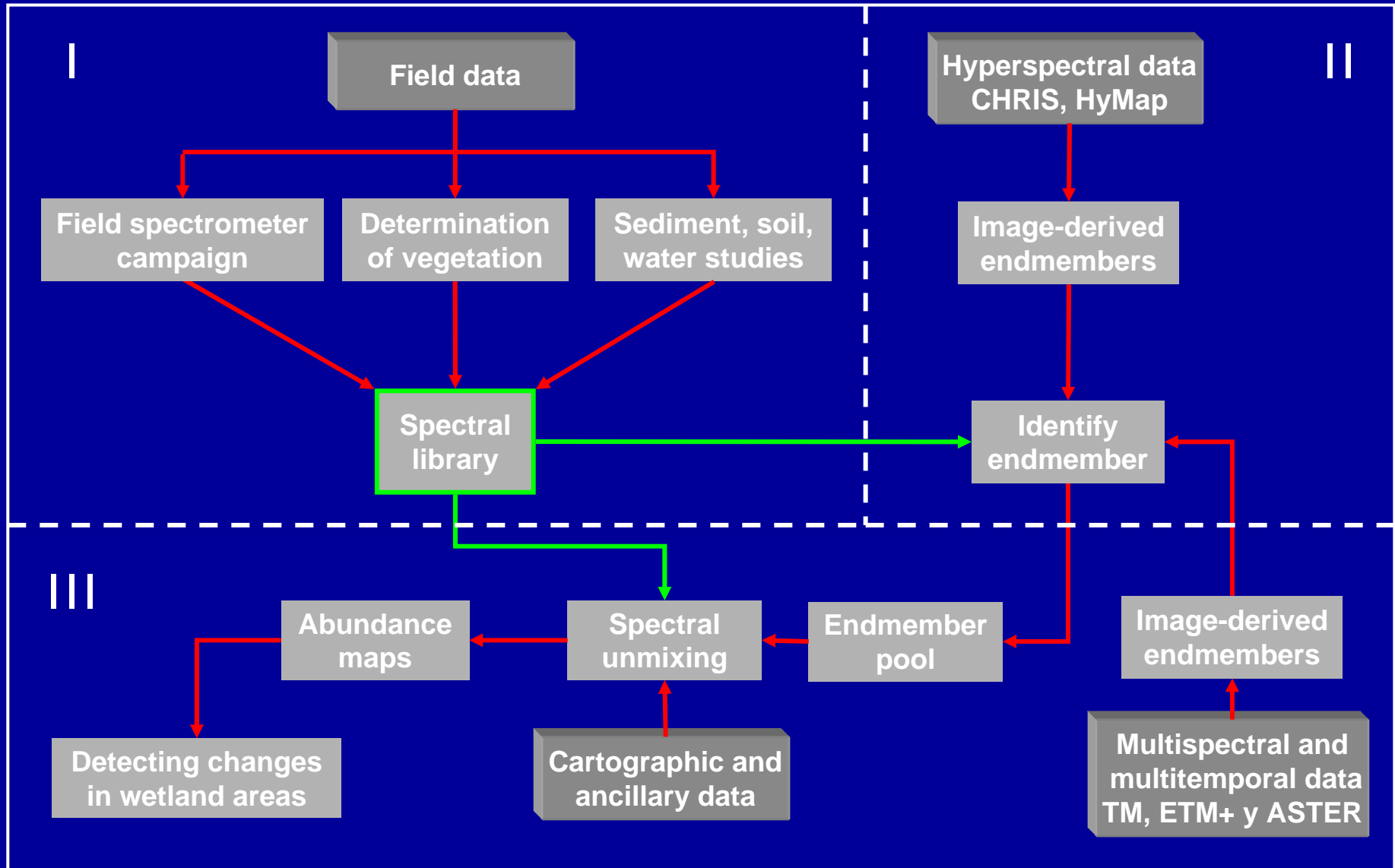


Methodology





Methodology





Field work

Spectral sampling



Soil characterisation and sampling



Water sampling





Spectral field library

Registration and location

Sample id: P8LS096T26E_Salt crust (H44)
 Acquisition date: 07/07/2003 Acquisition time: 13:21:04
 Location: La Lagunilla Municipality: Villafranca de los Caballeros
 UTM-Easting: 471423 UTM-Northing: 4365514 Elevation (m): 638

Abiotic and biotic characteristics

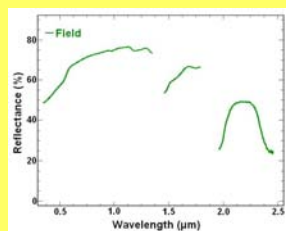
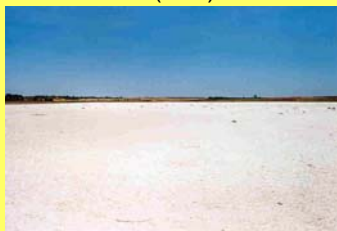
Geomorphic environment: Lacustrine
 Landscape: Lake plain
 Topography: Flat
 Slope class (%): 0 - 0.1 Slope form:
 Land use: Not used and not managed
 Anthropogenic influence: No influence
 Surface cover feature: Salt crust
 Parent material: Marl and gypsum sediments
 Landform: Lake bed
 Microtopography: Even
 Hillslope position:
 Vegetation: None

Soil properties

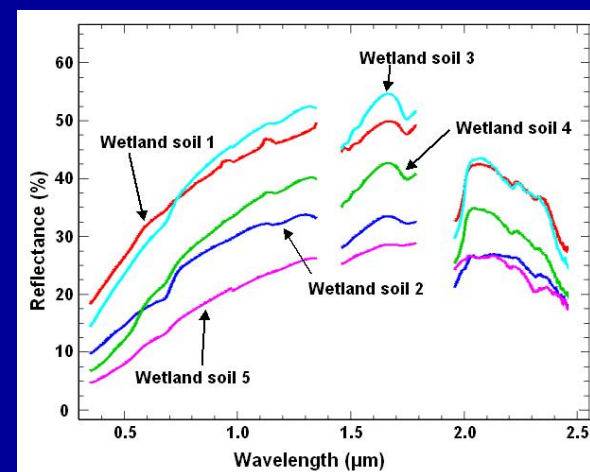
Carbonates (%): 7.2 pH (1:25 H₂O): 8.6
 Fe₂O₃ (%): 0.4 Organic matter (%): 2.4
 Electric conductivity (dSm⁻¹): 37.8
 Munsell colour: Dry 10YR8/2 (very pale brown) Wet 10YR6/2 (light brownish grey)

Mineralogical composition*

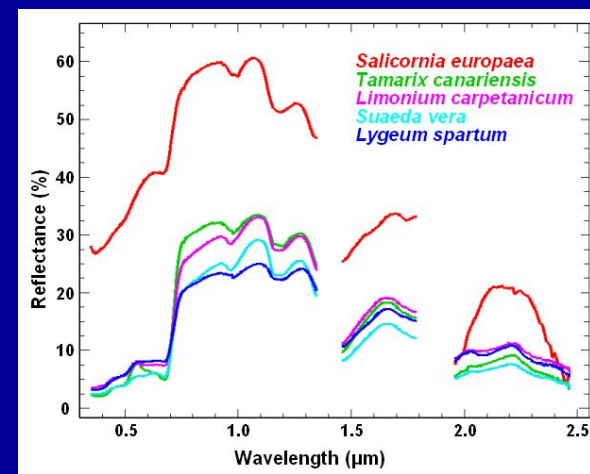
Bloedite: Halite: +
 Hexahydrite: Tr. Pentahydrite: +
 Starkeyite: + Tridimite:
 Gypsum: ++ Calcite: +
 Dolomite: Quartz: Tr.
 K-feldspar: + Na-feldspar:
 Phyllosilicates: + (illite)



*(Tr. - trace; + common; ++ abundant; +++ very abundant)



Wetland soil.



Wetland vegetation.



Wetland status



Natural area with Steppe vegetation



Invasive vegetation



Degraded area with invasive vegetation

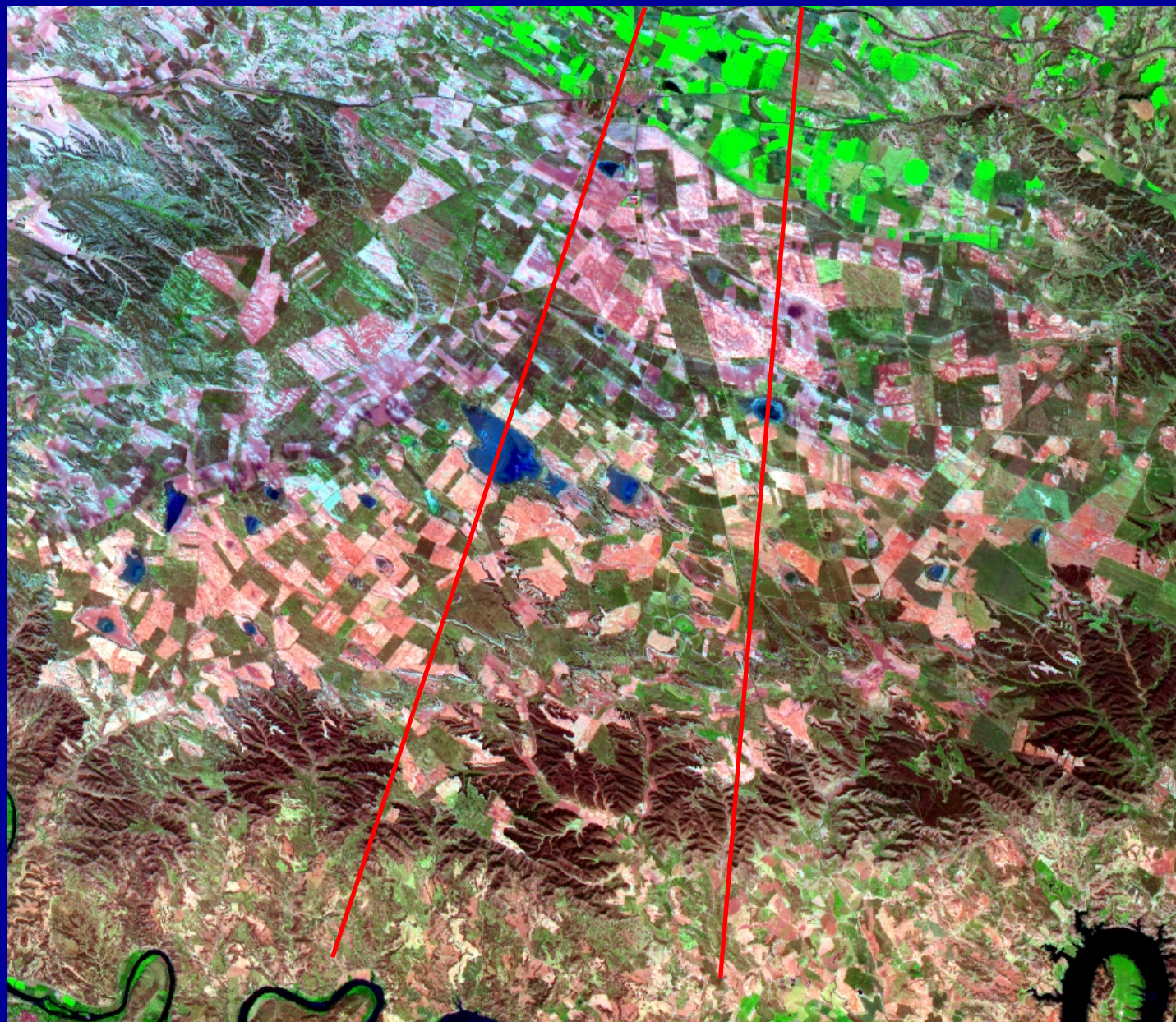


Land use change



Available EO data

	Los Monegros	Las Tablas de Daimiel
Hyperspectral	1 CHRIS scene 2006	1 CHRIS scene 2006
	Further CHRIS scenes	
	4 HyMap Scenes 2004	
Multispectral	2 TM 1984 - 1997	5 TM 1985 - 2003
	2 ETM+ 2002 - 2003	5 ETM+ 2001 - 2003
	4 ASTER 2003 - 2005	4 ASTER 2003 - 2005



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29/5/03



HyMap
17 May 2004

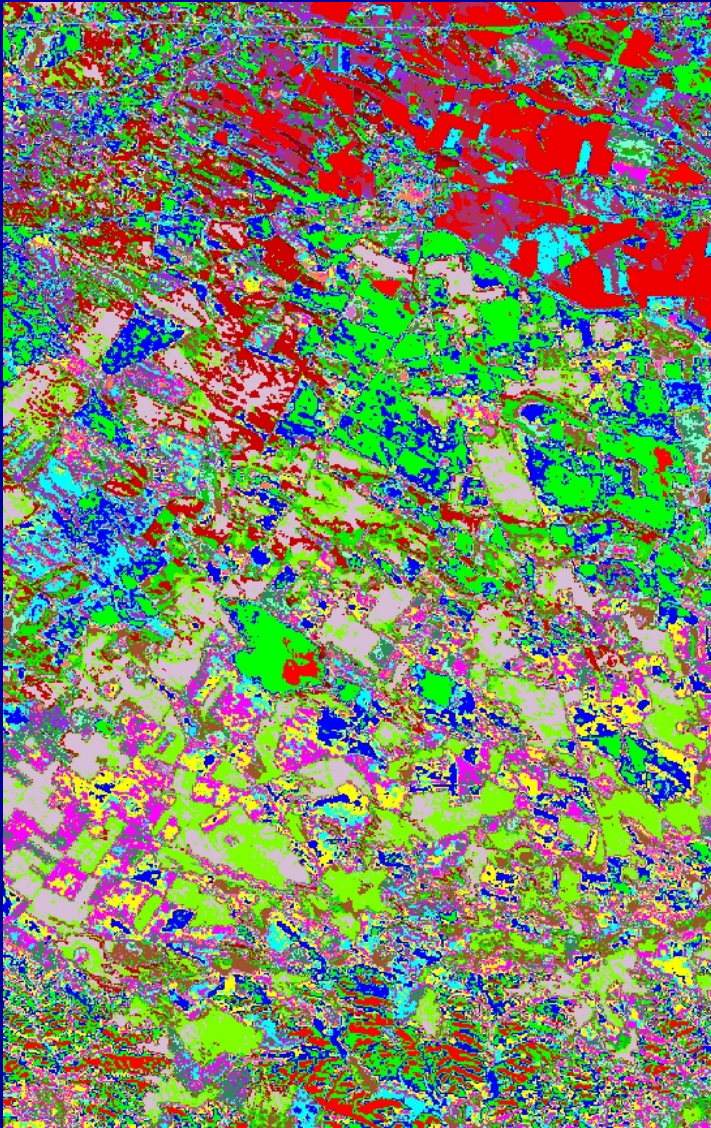


HyMap
12 August 2004



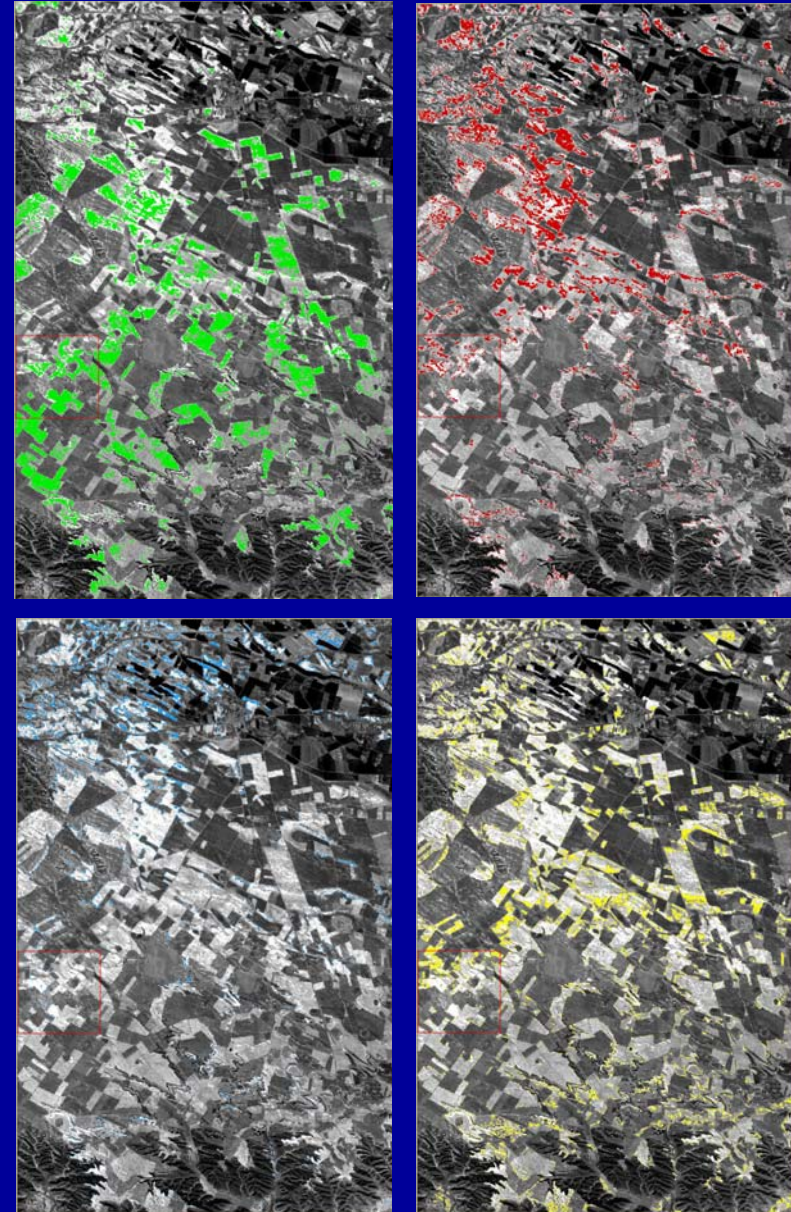


IsoData Classification



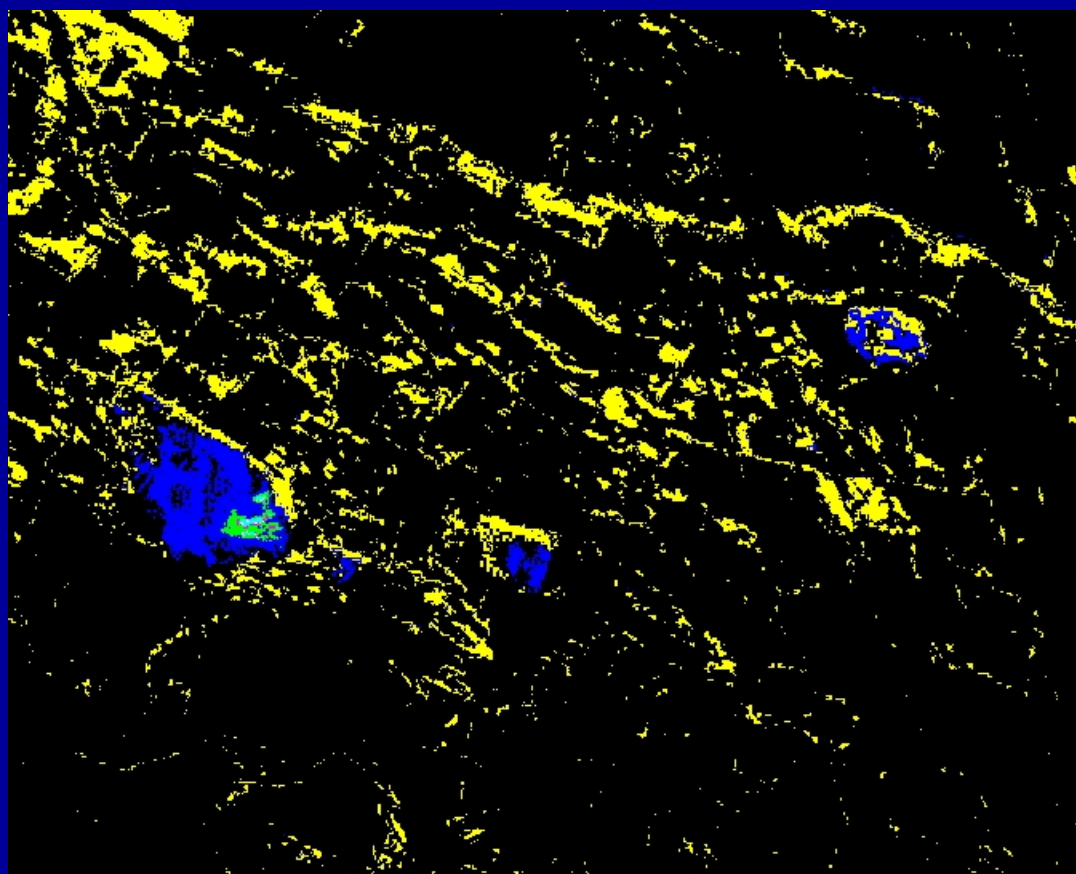
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Soil Classes – SAM classification



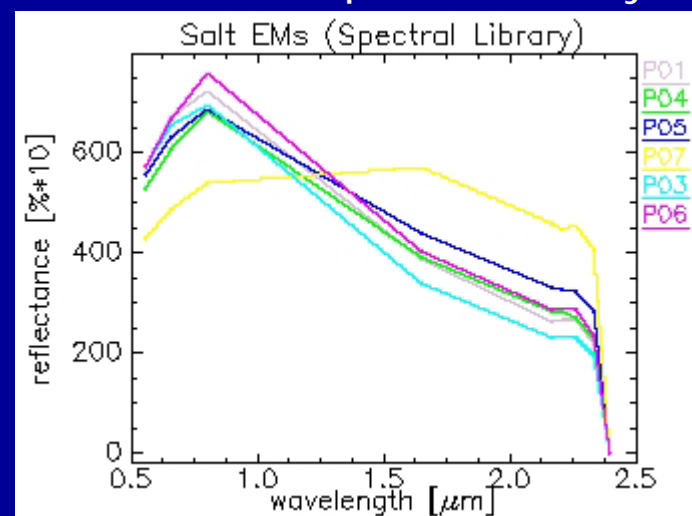


SAM Classification (saline soils)



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La Mancha Spectral Library



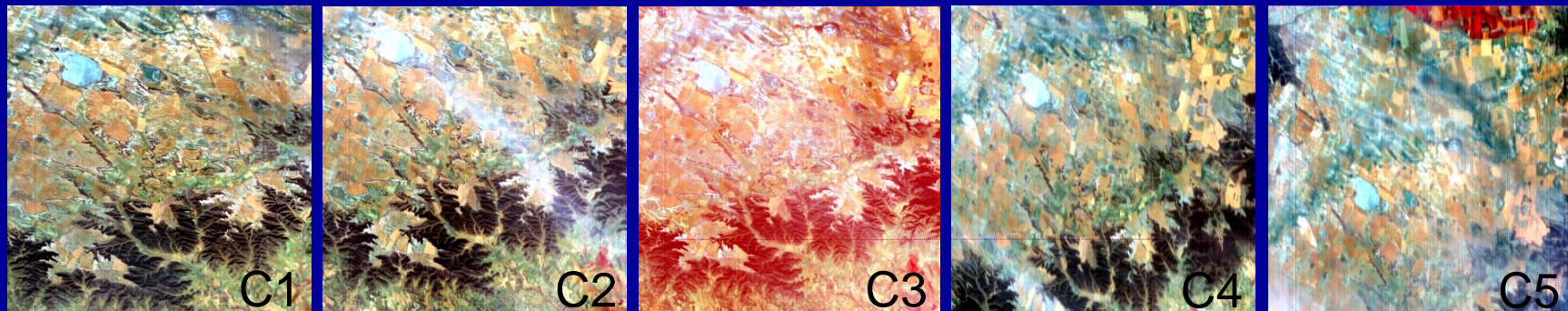
Resampled spectra



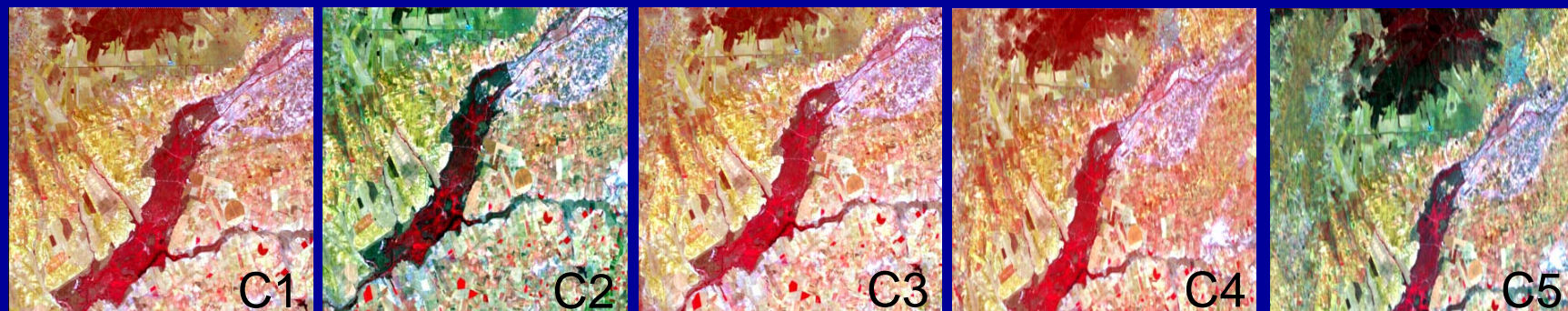
CHRIS acquisition

Las Tablas de Daimiel (22 May 2006) —————→ Cloudy

Los Monegros (Chris-LN-060607-6D92-41)



Las Tablas de Daimiel (Chris-LT-060703-6F45-41)



Further acquisition: Las Tablas de Daimiel 6 October 2006

Los Monegros 13 October 2006



Application of CHRIS data

- Spectral information to determine complex wetland characteristics.
- Angular information to obtain structure of vegetation and the water body.
- Detect wetland changes between the dry and wet seasons.
- Monitoring these ecosystems by integrating the CHRIS data to historical EO data.



Acknowledgements

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Thank you