CHRIS-Proba images to monitor Doñana shallow marshes
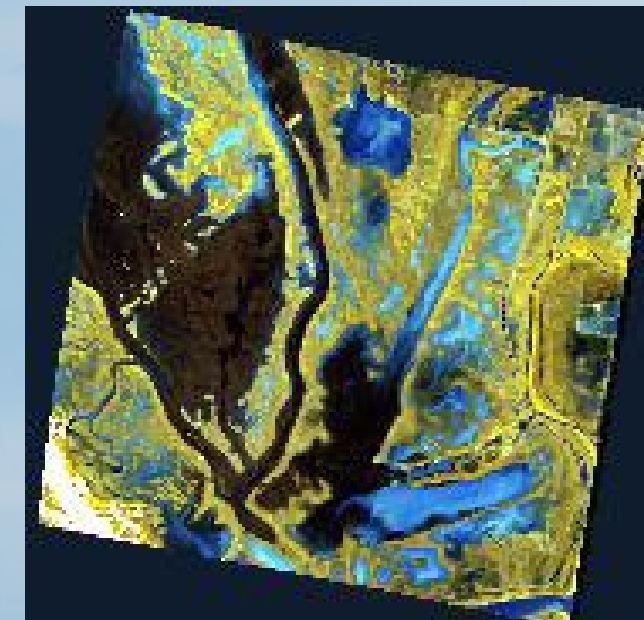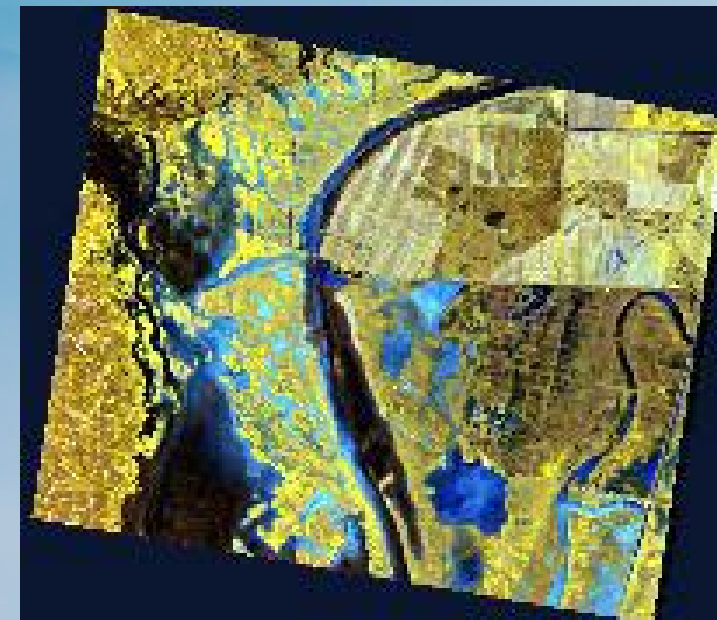
CHRIS-Proba images to map inundation levels, water turbidity and aquatic vegetation of Doñana shallow marshes

by Ricardo Díaz-Delgado
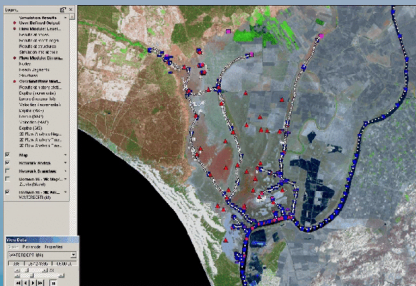
rdiaz@ebd.csic.es
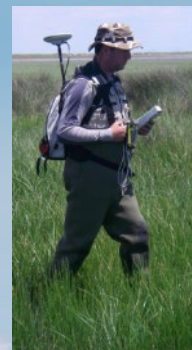
Overview of Doñana Wetlands

Biodiversity hotspot

Doñana complex wetlands include large seasonal marshes marshes and ponds. A major biodiversity hotspot in Europe Europe (300 bird species, 14 mammals, 12 amphibians, 8 reptiles, etc.)

Long-term monitoring

Permanent in situ plots and sensors enable validation of Earth Observation images and products
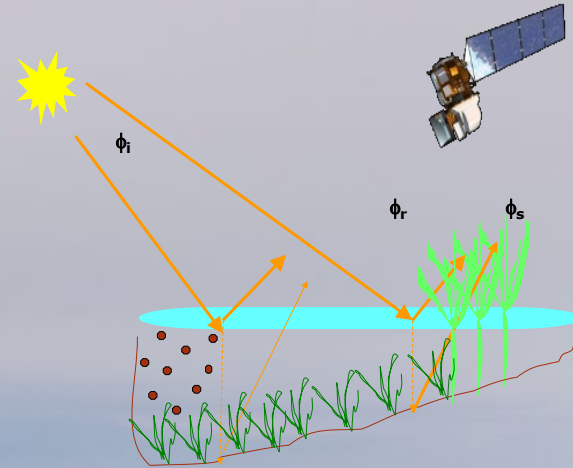
Conservation & Management

Mapping marsh inundation levels, hydroperiod, invasive species, aquatic vegetation and water turbidity and depth to assist in conservation management

Doñana protected area   1.166 km2
LTSER platform   2.736 km2
National Park   537 km2
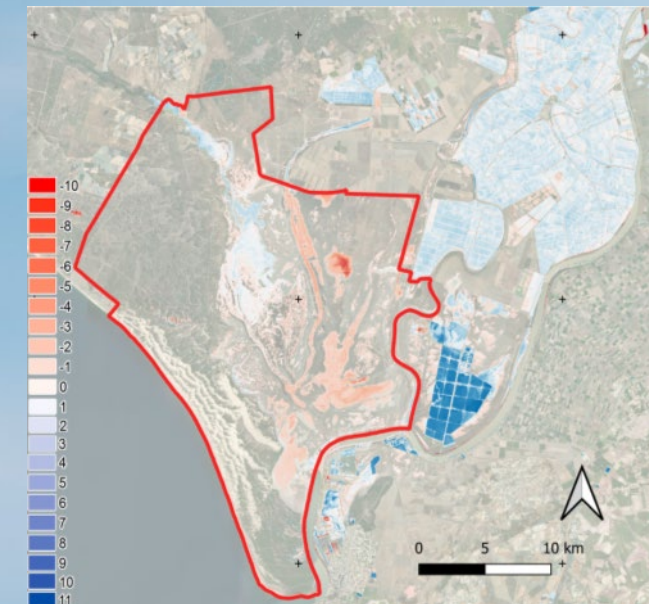
Hydroperiod trend (1974-2022)

Mapping targets

**1** **Inundation & hydroperiod**

Seasonal inundation defines yearly hydroperiod and aquatic flora and fauna.

2 **Aquatic plants & alien species**

Macrophytes and helophytes offer suitable habitat for breeding and food. food. Invasive plant species reduce biodiversity.

3 **Water turbidity & depth**

Aquatic plants retain suspended solids reducing reducing water turbidity but increasing water water depth and habitat diversity
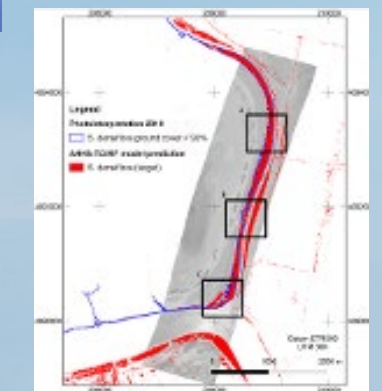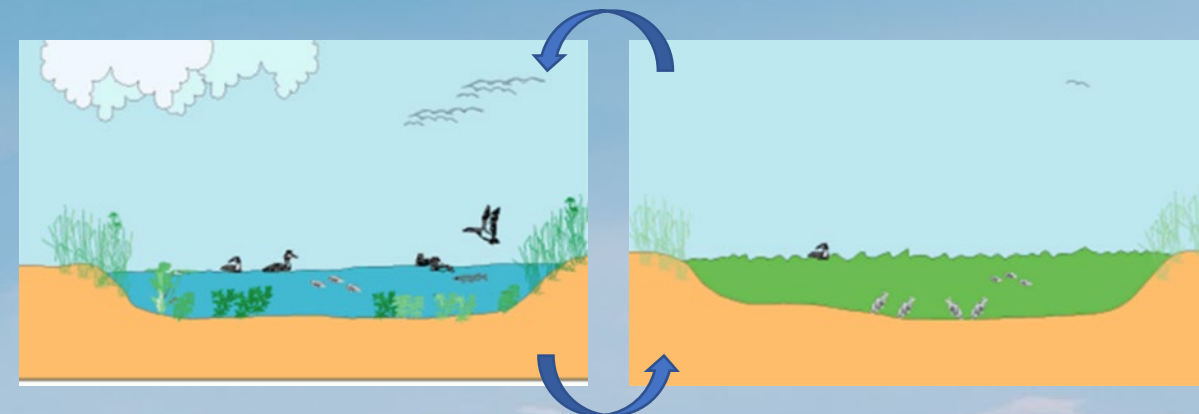
CHRIS-Proba for Monitoring Doñana wetlands

Mode 2

Full spatial resolution, full swath, 18 bands for water studies (Mode 2).

*Some of them acquired in mode 3*

Two acquisition zones

Seeking for full coverage of Doñana marshes.

Many of them out from the requested center coordinates

Processing

- Stripe removal
- Geometric correction (GCPs)
- Atmospheric correction
- Ground-truth sampling

RMSE increases with satellite zenith and observation angles

Bands for High Resolution Water Studies

MERIS bands

MODIS bands

Wavelength (nm)
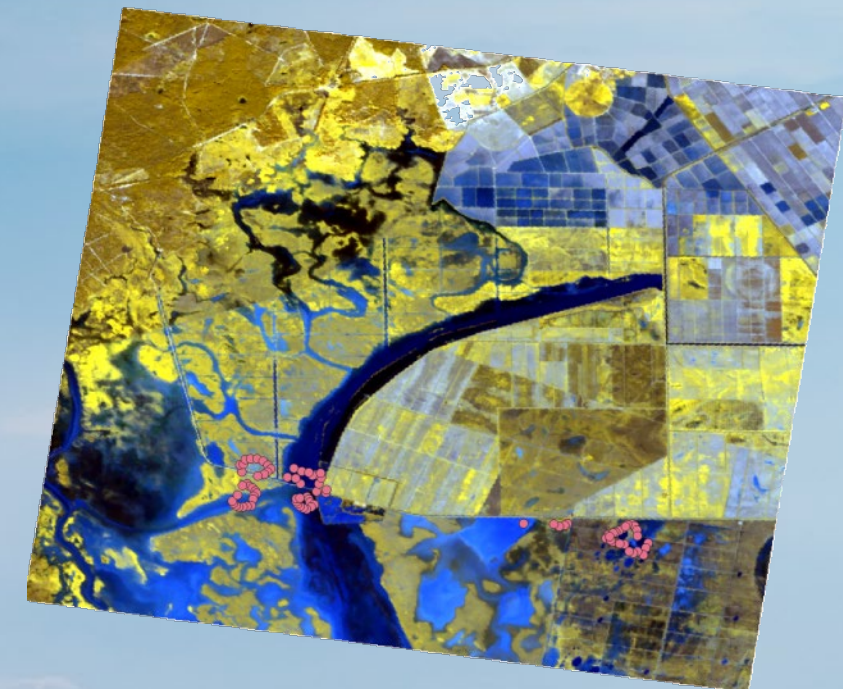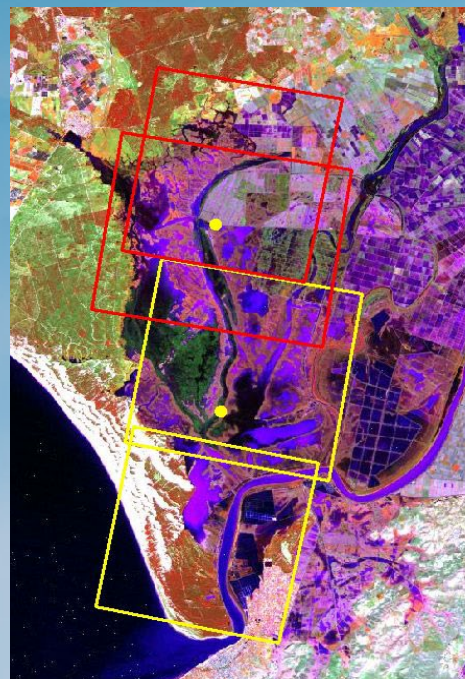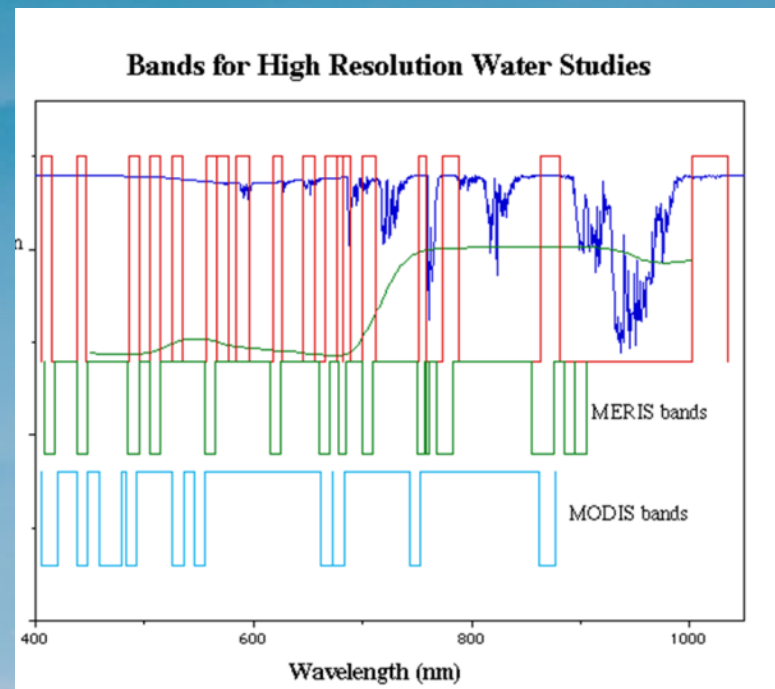
Radiometric assessment CHRIS-Proba mode 2

- Quick evaluation of Guanter et al. (2005) atmospheric correction for wetlands with in situ ASD FieldSpec Spectroradiometer shows an underestimation of water reflectance for visible bands (2-14).
- Bands in the NIR (15-16) are fairly coupled to on-the-ground measures but 17 and 18 bands are overestimated.
- Nonetheless, overall spectral behaviour in the VIS range fits the characteristic spectral signature of water bodies.
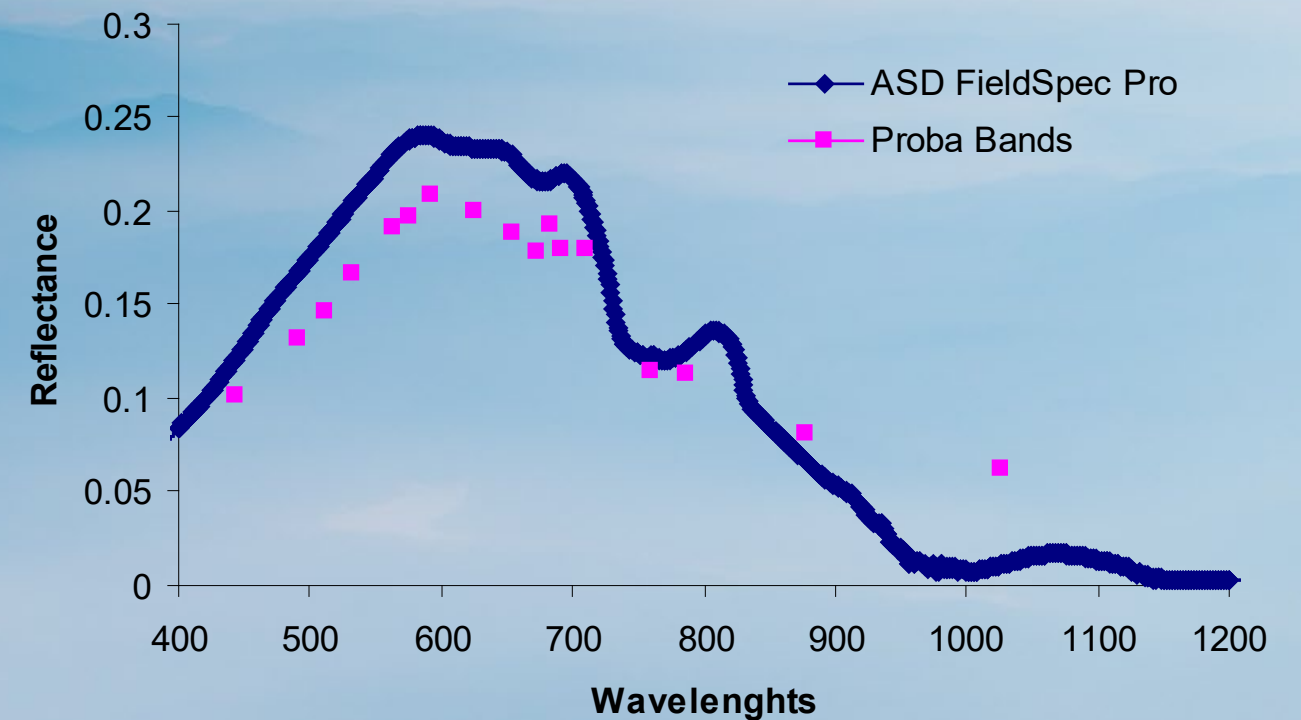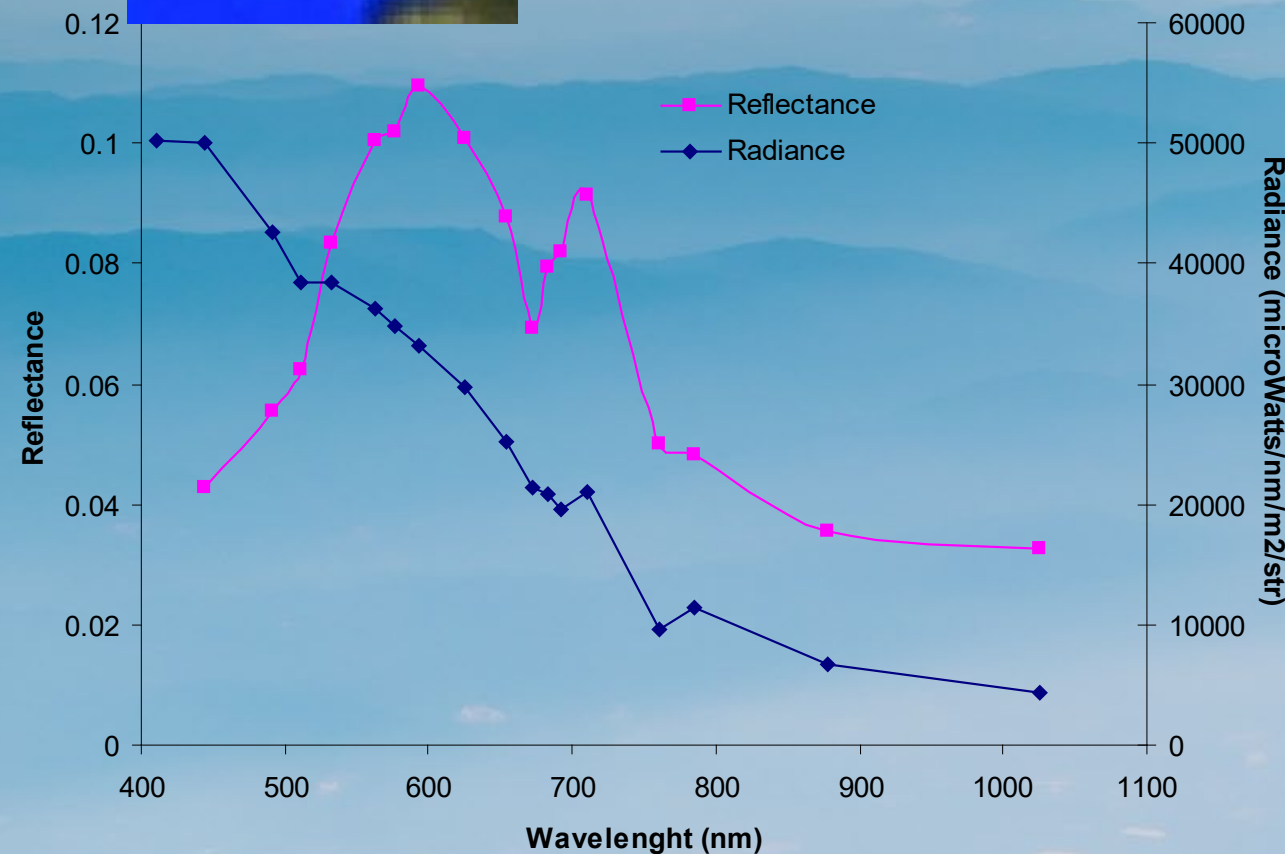
TIPO INUNDACION

cod	descripción
In	Inundado, agua >75%
En	Encharcado, 25-75 % agua
Emp	Empapado (<25% agua)
Sh	suelo humedo, sin agua
Ss	suelo seco

Analysis of best CHRIS bands

1 **Spectral separability based on ground-truth data**

Normalized difference among classes was used to identify the best bands.

Spectral indices — **2**

Several multispectral water indices were were used to assess accuracy in wetlands wetlands mapping
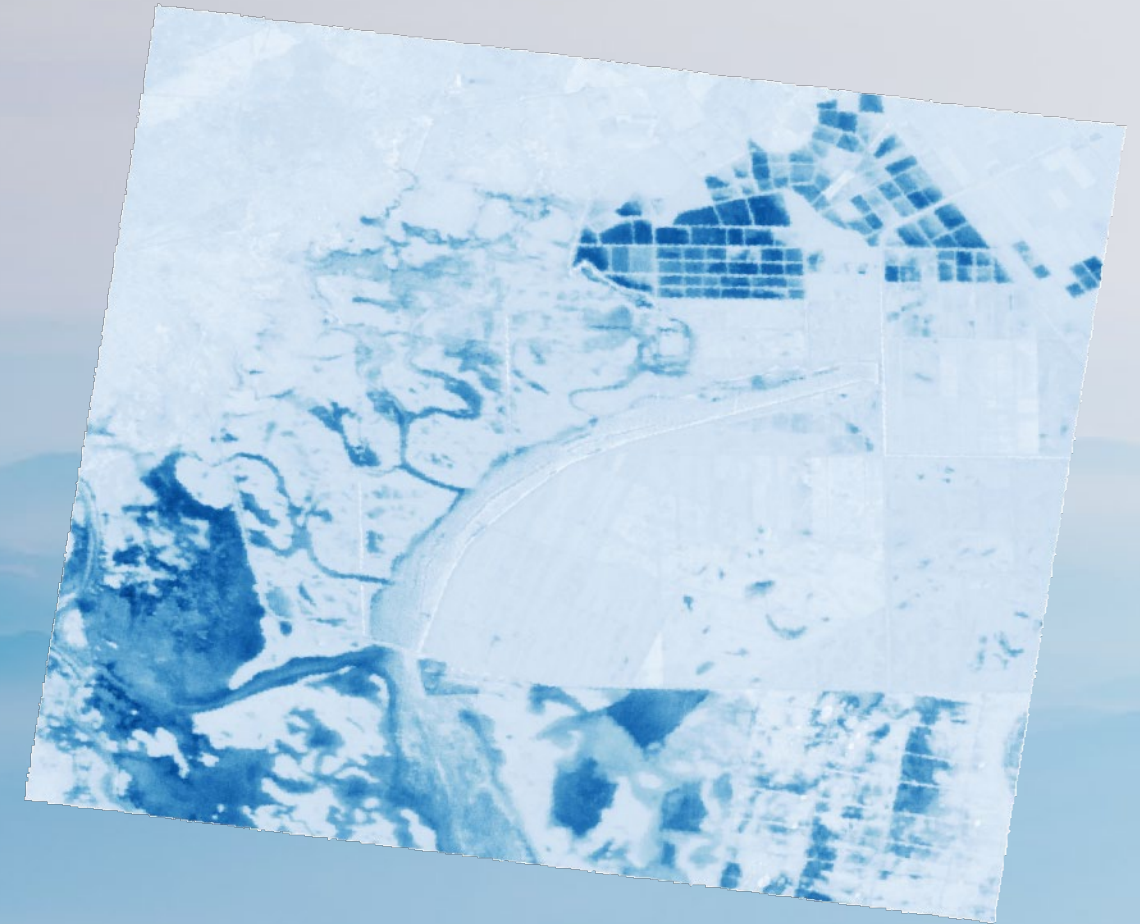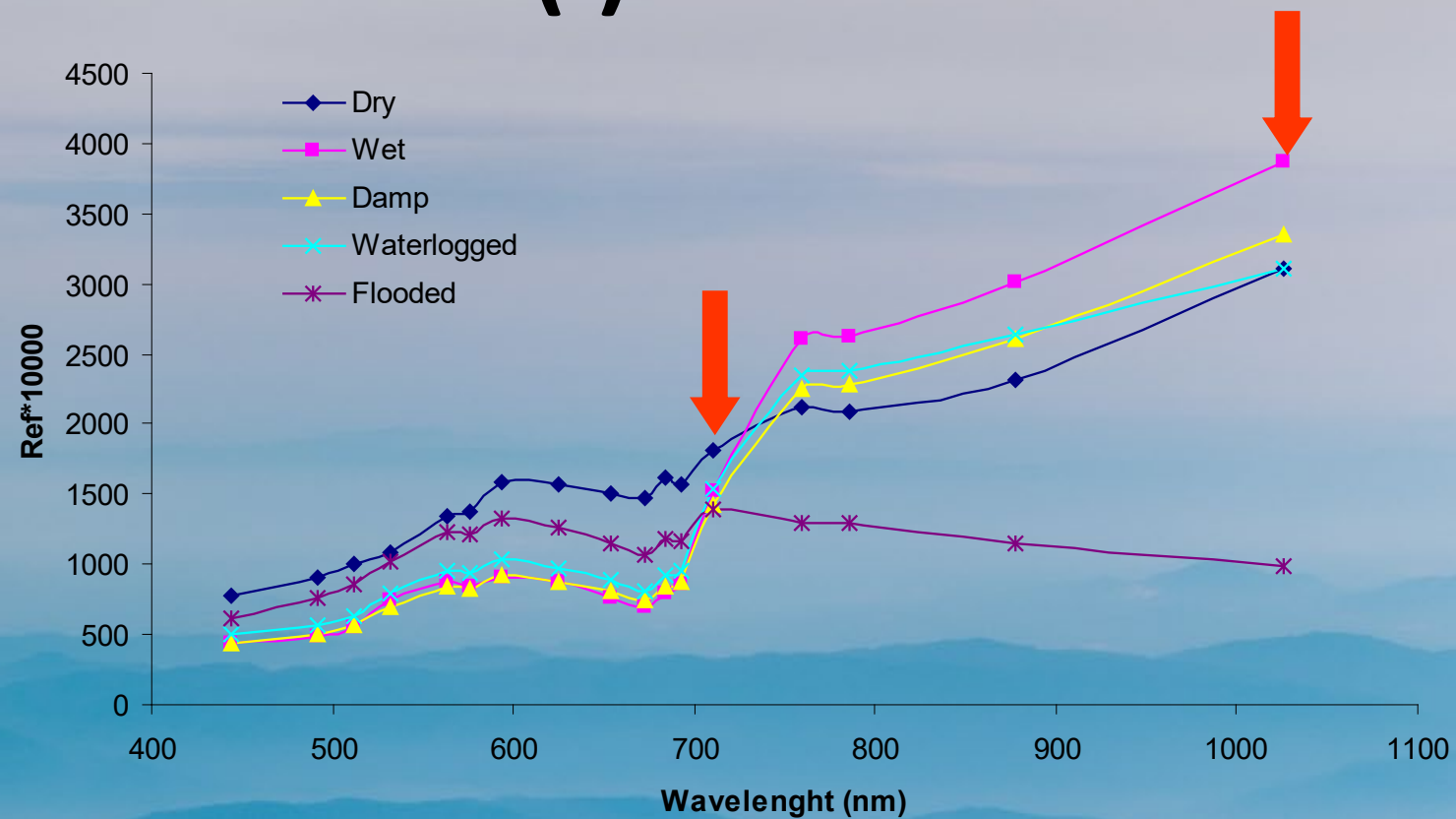
3 **Mapping wetland condition**

Maps were produced for inundation levels, aquatic plant cover, alien species species and water turbidity using the most most accurate bands/indices

COBERTURA

Cod.	descripción
0	Ausencia
1	1-5 % presencia
2	5-25 %
3	25-75 %
4	>75 %

Results (I)

Inundation classes: Band 18 (1025 nm) works for all levels, despite its radiometric bias, while Band 14 (710 nm) is most accurate for waterlogged and damp classes.
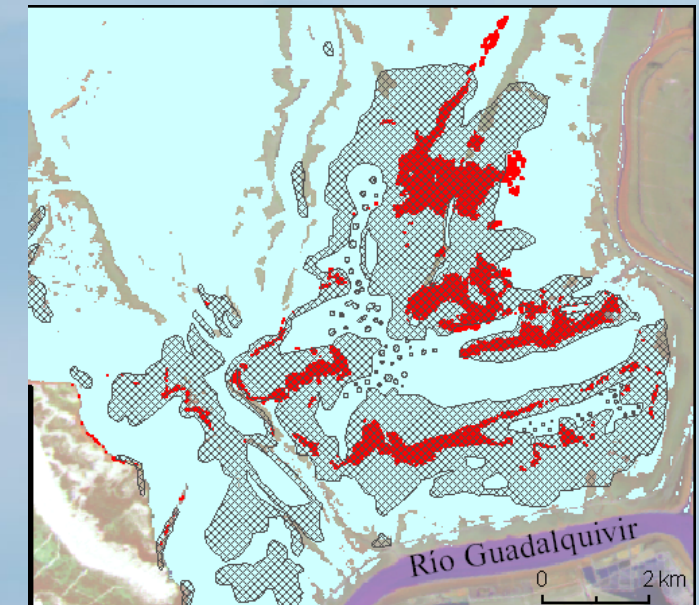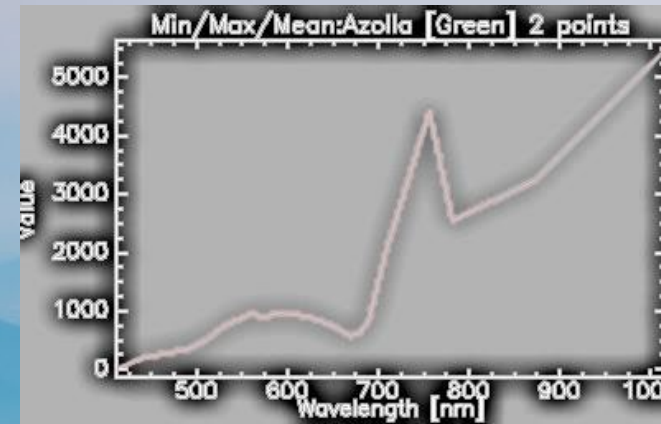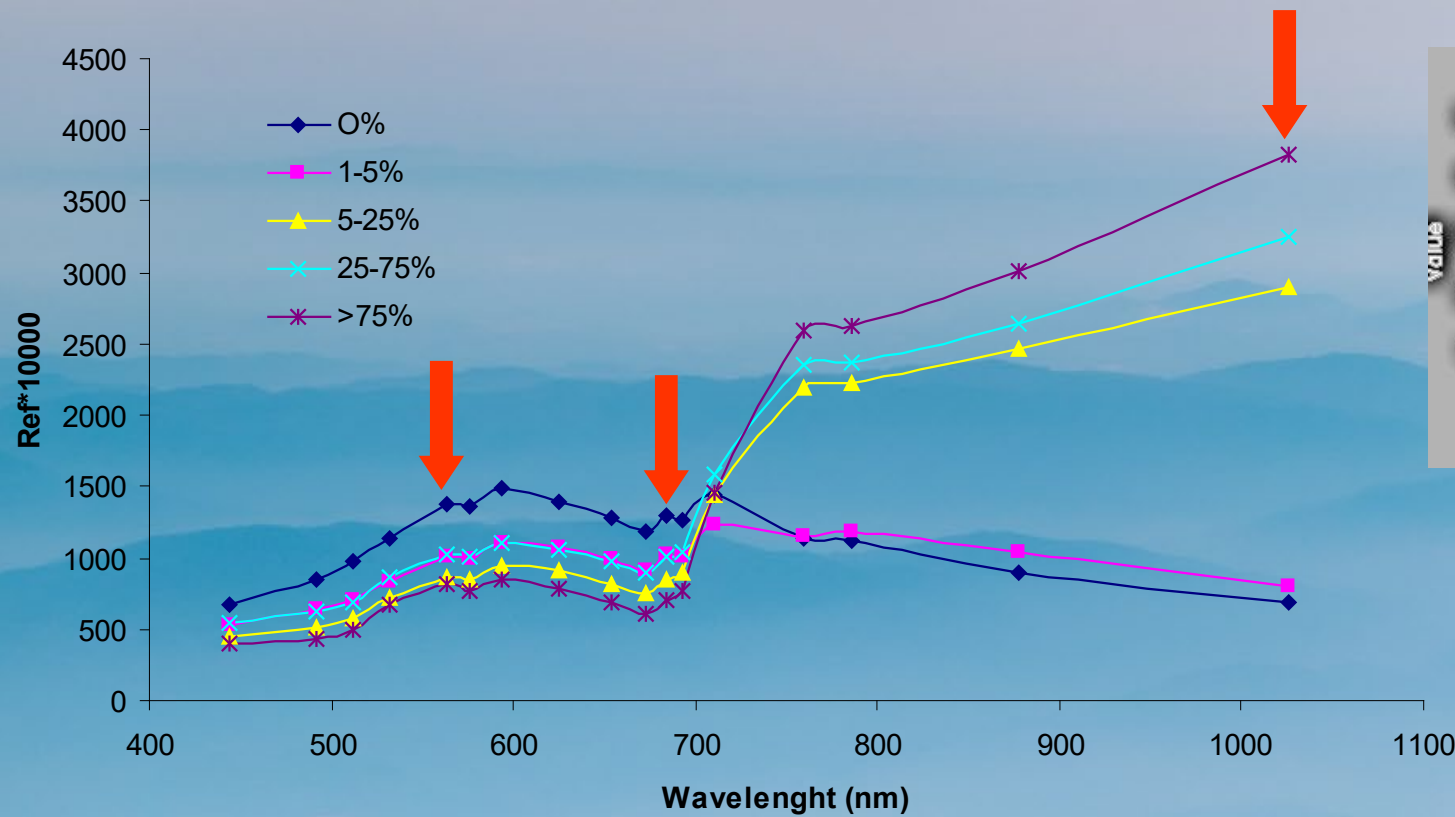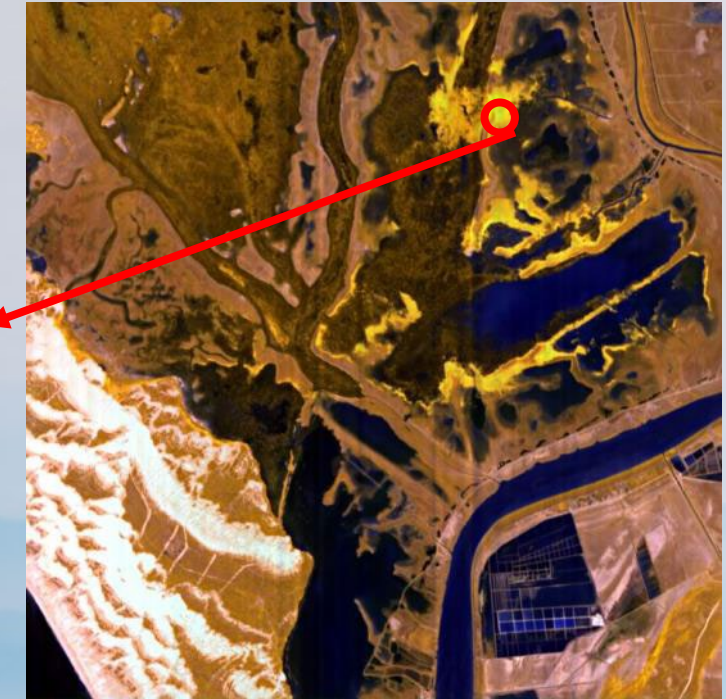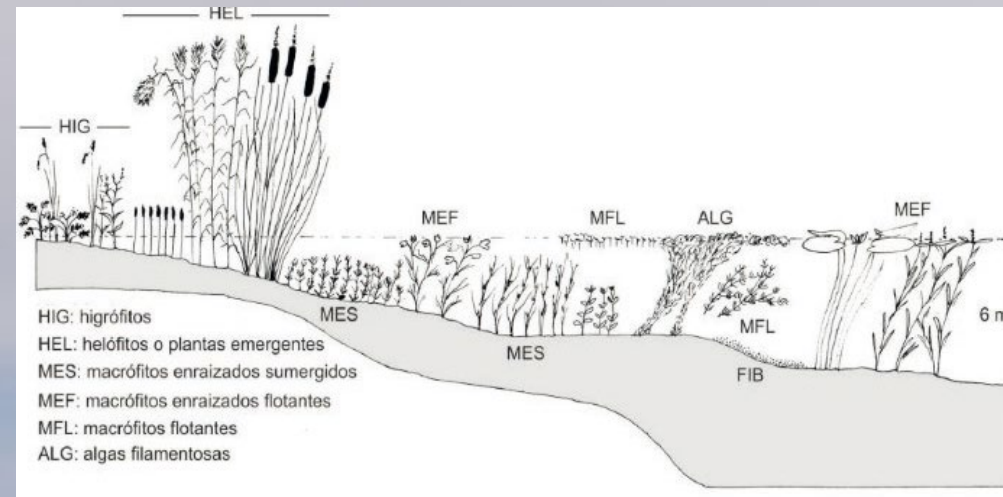
Percent water cover: Band 18 (1025 nm) works for all levels while for low water covered pixels B15 and B14 yield better separabilities (0% vs 1-5% and 5-25% vs 1-5% respectively).

Water indices: NDWI using bands 17 and 18 accurately mapped inundation classes (Kappa = 0.73)
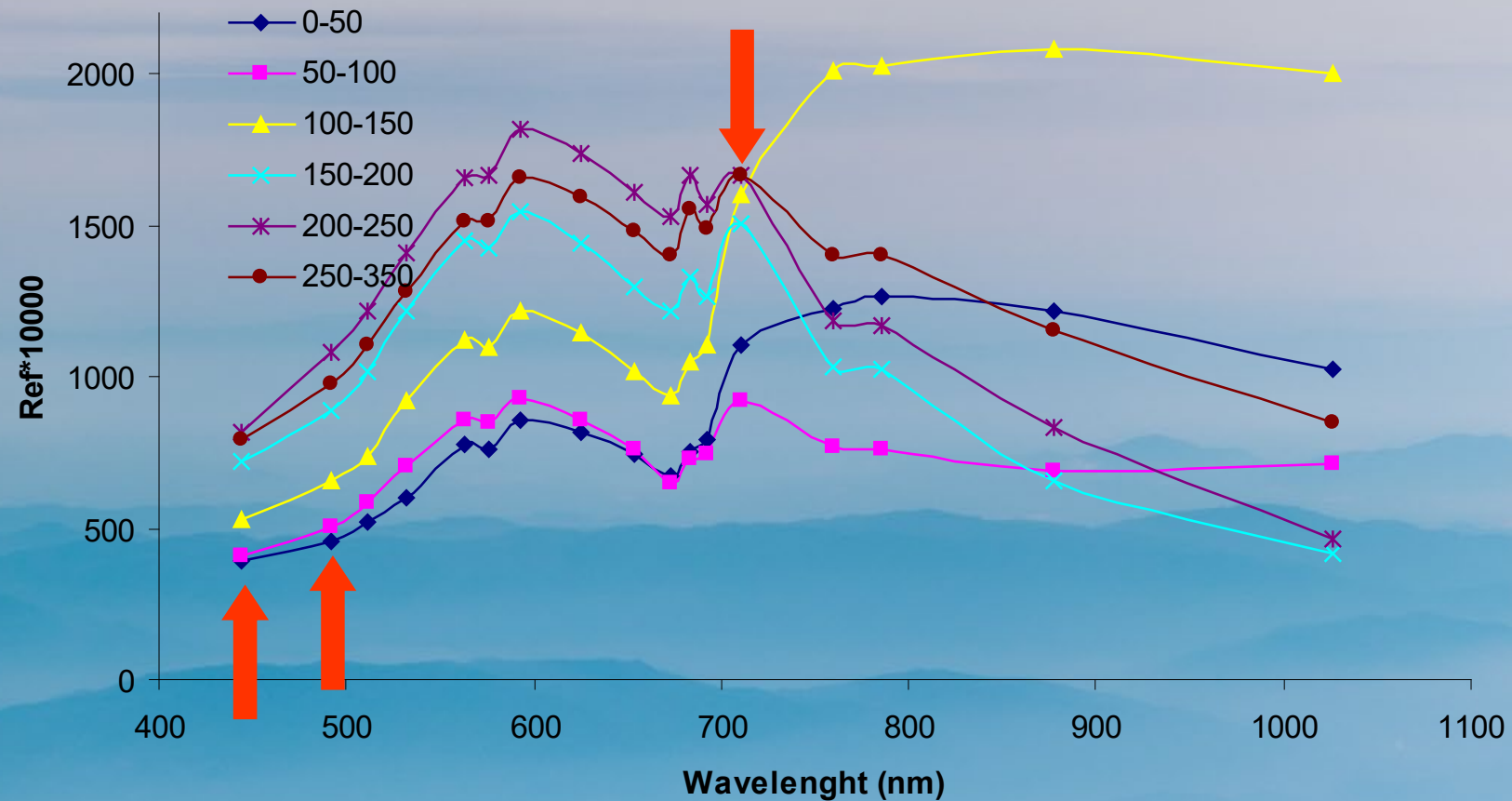
Results (II)

12/5/2007

Percent plant cover: Band 18 (1025 nm) works for all levels while B12 (683 nm) and B6 (563 nm) also yielded best separability for emergent aquatic plants (helophytes)

Azolla cover: B15 accurately discriminated Azolla dense cover (Kappa = 0.84)

Results (II)

Water turbidity classes: Although quantitatively measured, NTU was classified in order to check spectral separability. Band 14 (710 nm) is the best band to discriminate turbidity classes. However, classes are not properly ranked by B14 unlike B2 and B3 which, in addition accumulates the maximum global separability across the turbidity gradient
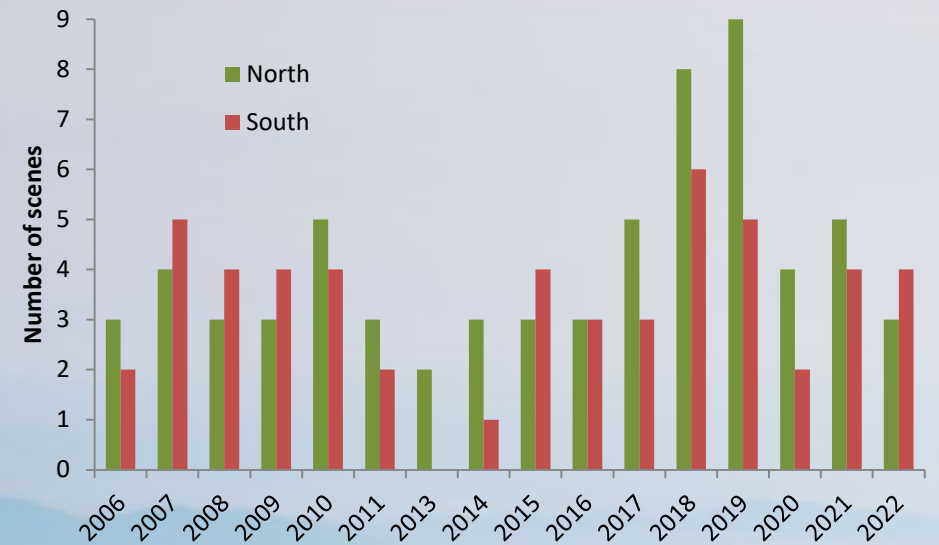
Conclusions

1

Still useful time series of CHRIS images

- Enables the historical reconstruction of extensive information over Doñana Doñana complex wetlands with a total of 119 scenes over 16 years.
- Angular resolution to be checked for aquatic vegetation.

2

Comparability with other satellite sensors

- It showed better results than Lansat TM and ETM+ for inundation levels and and turbidity. However hydroperiod estimation was not feasible.
- Pending comparison with Sentinel-2 MSI.

3

Spectral libraries

CHRIS spectral signatures can be considered as "hyperspectral" for its range. range.

Such spectral signatures are included in the LAST-EBD spectral data bank.