



Centre d'Etudes Spatiales de la BIOsphère
Unité Mixte de Recherche 5126
CNES-CNRS-UPS-IRD

A satellite with a yellow body and blue solar panels is shown in orbit over the Earth, specifically positioned over the European continent. The Earth's surface is visible, showing green landmasses and brownish-yellow desert regions.

CESBIO's JECAM Site

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CESBIO, bpi 2801, 18 avenue Edouard Belin 31401 Toulouse Cedex 9

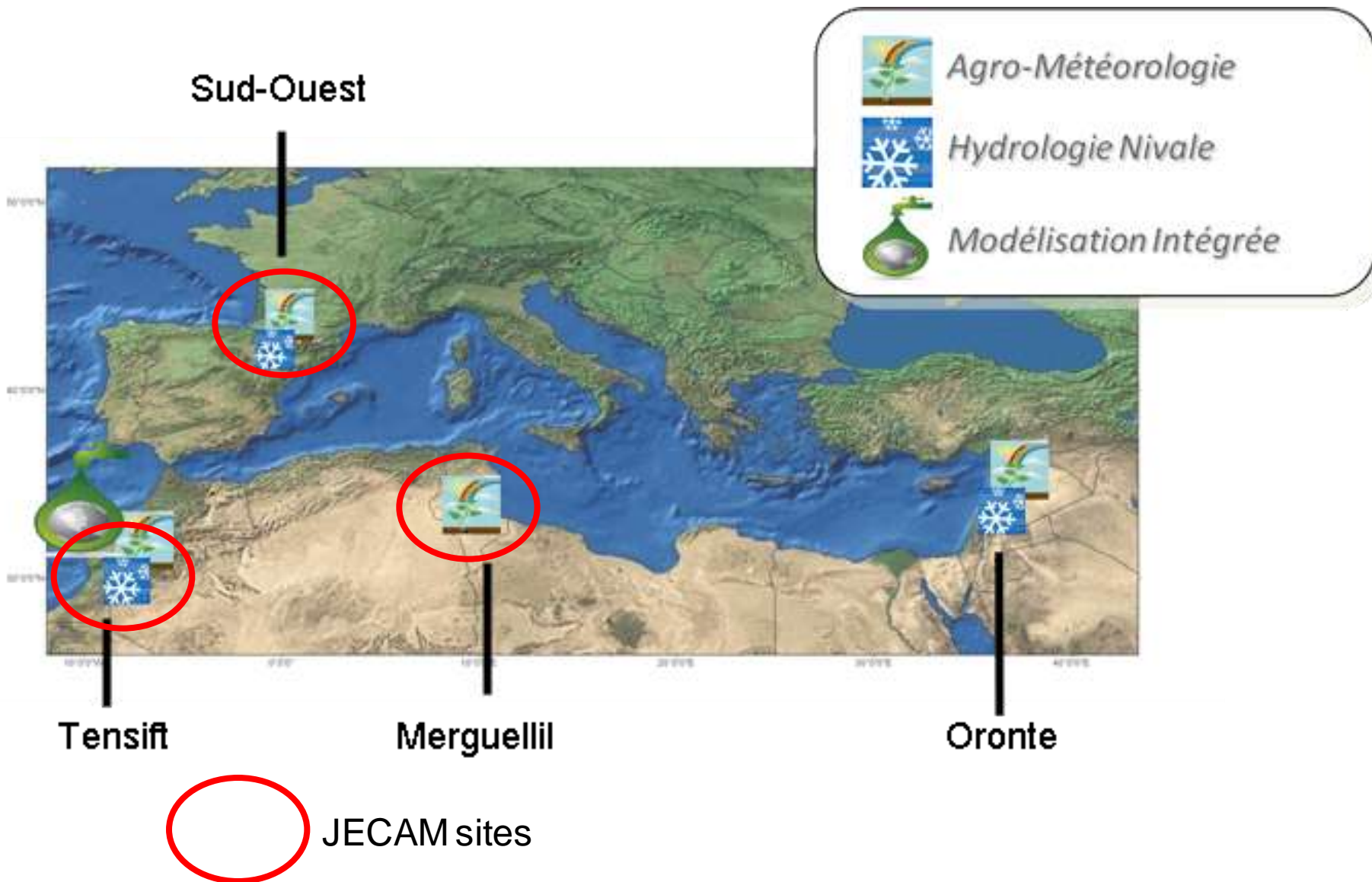
CESBIO's Objectives

- ❑ Contribute to the advancement of knowledge on the functioning of land surfaces and their interactions with climate and human, relying heavily on satellite data, field data and modeling

- ❑ CESBIO is a joint laboratory of
 - Centre National d'Etudes Spatiales (CNES)
 - Centre National de la Recherche Scientifique (CNRS)
 - Toulouse III - Paul Sabatier University (UPS)
 - Institut de Recherche pour le Développement (IRD)

And associated to the Observatoire Midi-Pyrénées

CESBIO's Experimental sites



Scientific objectives

- ❑ Research on the functioning of land surface: water and carbon fluxes, land cover/use, crop monitoring, ...
 - ◆ Calibration/validation of EO algorithms and products
 - ◆ Experimentations to prepare new EO missions (SMOS, Venµs, Sentinel 2)
- ❑ Approach: Long Term Experiment
 - ◆ Routine in situ measurements: fluxes at the soil/vegetation/atmosphere interface, LAI, biomass, etc
 - ◆ Partnerships with local actors
 - ◆ Distribution of the data through internet OGC services (ongoing work)
- ❑ A regional component of the French Land Thematic Centre (Théia)
- ❑ CESBIO : a member of the Théia network of scientific expert laboratories



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France JECAM Site

OSR Site

Midi Pyrénées

Eric **Ceschia**, Aurore Brut, Jean François Dejoux, Nicole Ferroni, Hervé Gibrin, Claire Marais-Sicre, Bernard Marciel, Raphaël Noual, Tiphaine Tallec, Bartosz Zawilski
Frédéric Baup, Benoit Coudert, Gérard Dedieu, Valérie Demarez, Olivier Hagolle, Jordi Inglada, Valérie Le Dantec, Patrick Mordelet, Vincent Rivalland, Silvia Valero

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Area of Study

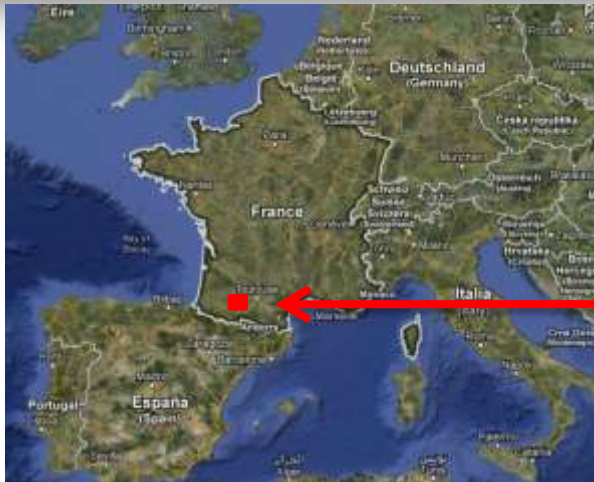
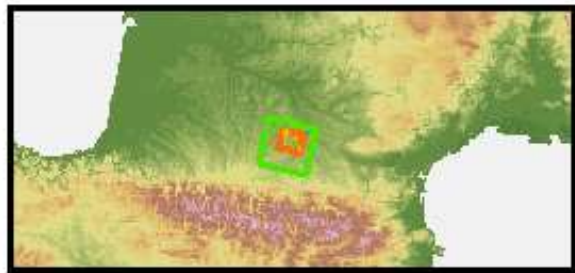
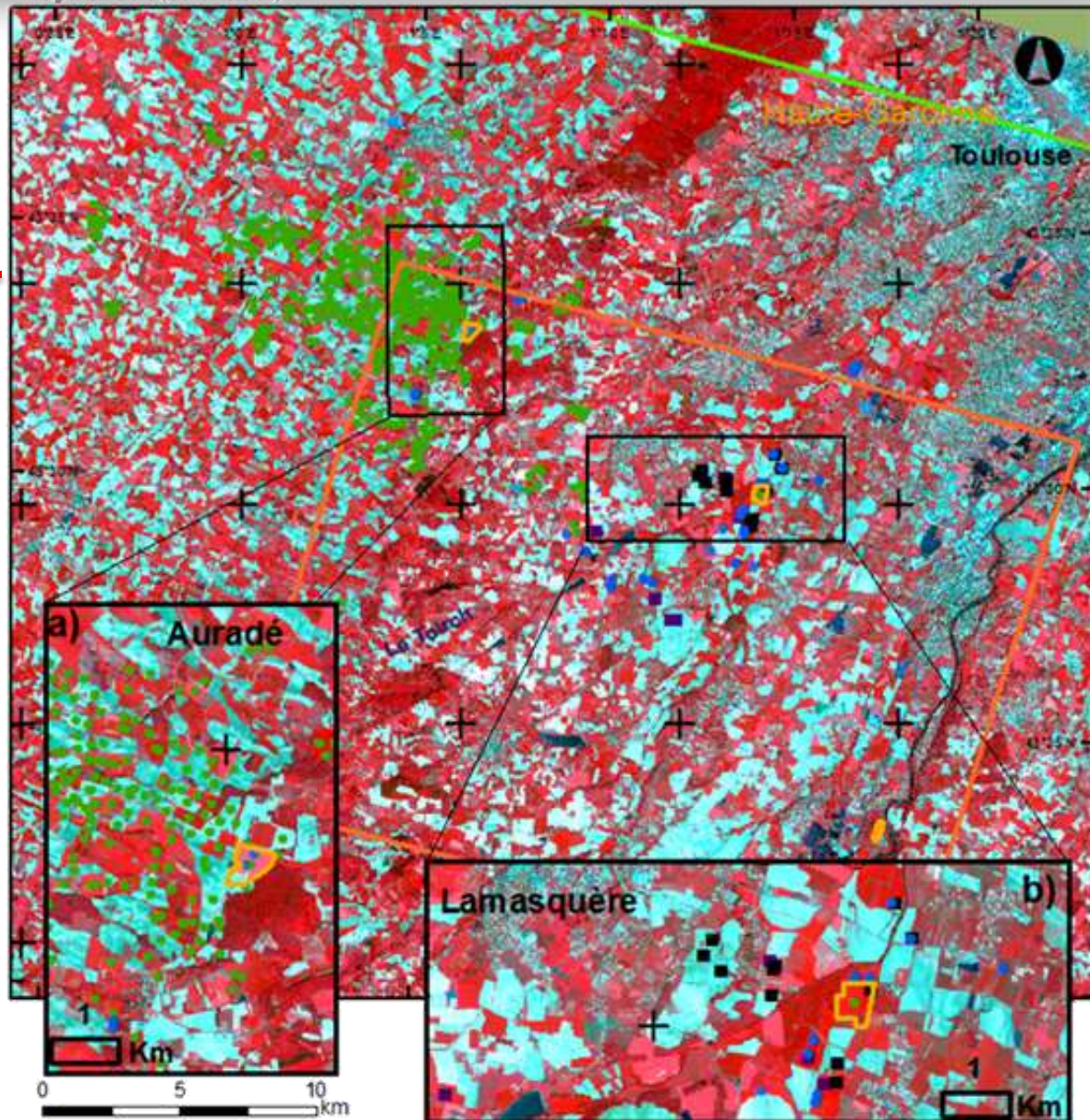


Image SPOT5 (30/04/2011)



Experimental Sites (Fluxnet, ICOS)

ESU Biomass & Yield Data (2011)

Yield Data (farmers surveys)

ESU LAI & Biomass Data (2008)

LAI & Biomass Data (2010)

SAFRAN grid

SPOT window (since 2002)

Formosat-2 window (since 2006)

Area of Study

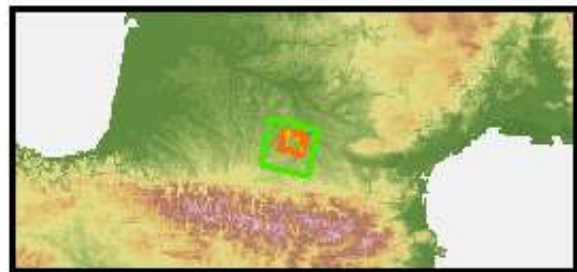
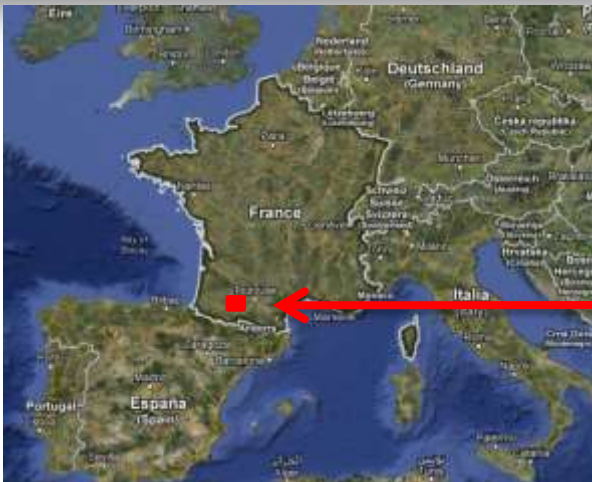
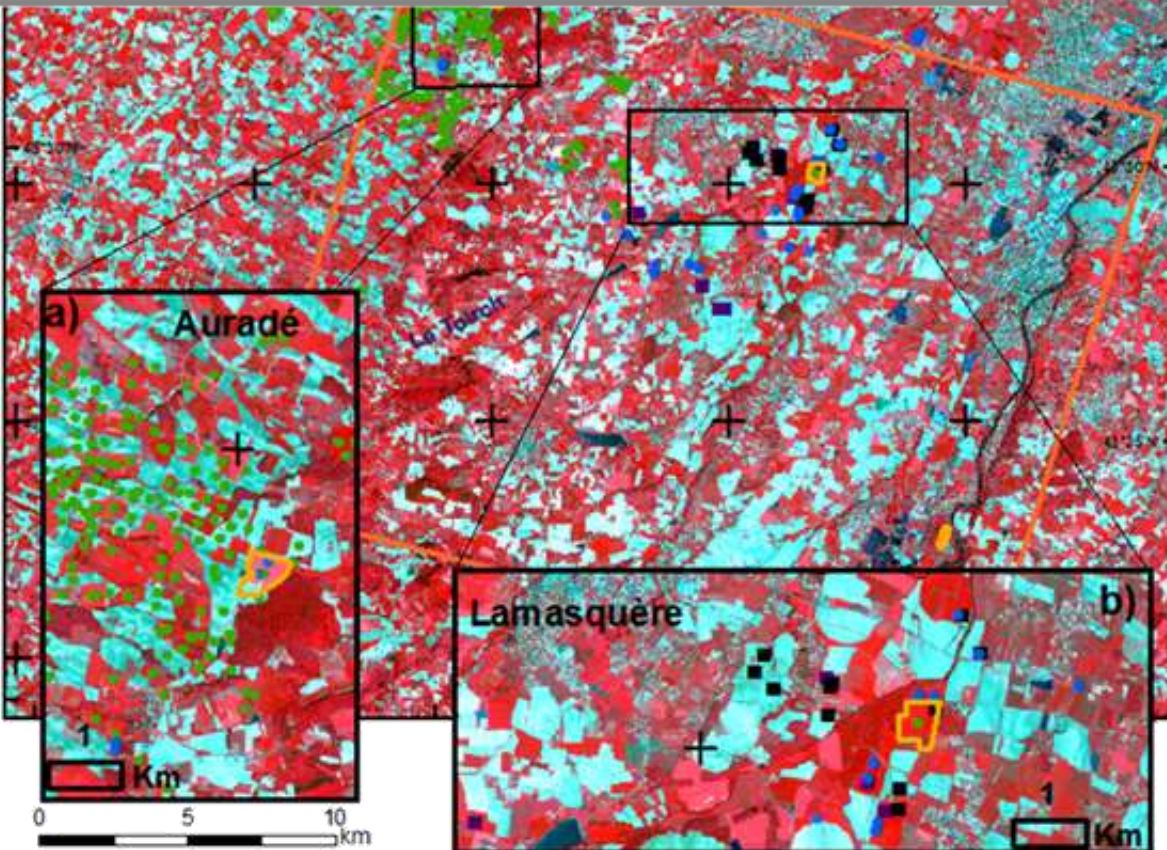


Image SPOT5 (30/04/2011)

Location : South west of Toulouse, France (area of study is approx 50*50 km) including 2 experimental plots (Auradé and Lamasquère Fluxnet/ICOS sites)



Experimental Sites (Fluxnet, ICOS)

ESU ● Biomass & Yield Data (2011)

● Yield Data (farmers surveys)

ESU { ■ LAI & Biomass Data (2008)

■ LAI & Biomass Data (2010)

+ SAFRAN grid

SPOT window (since 2002)

Formosat-2 window (since 2006)

Area of Study

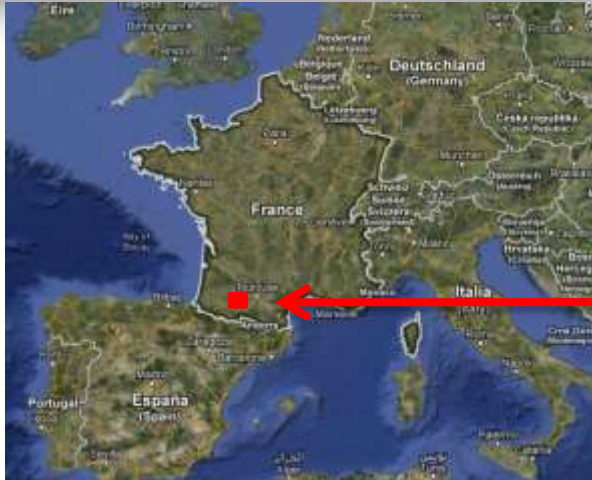
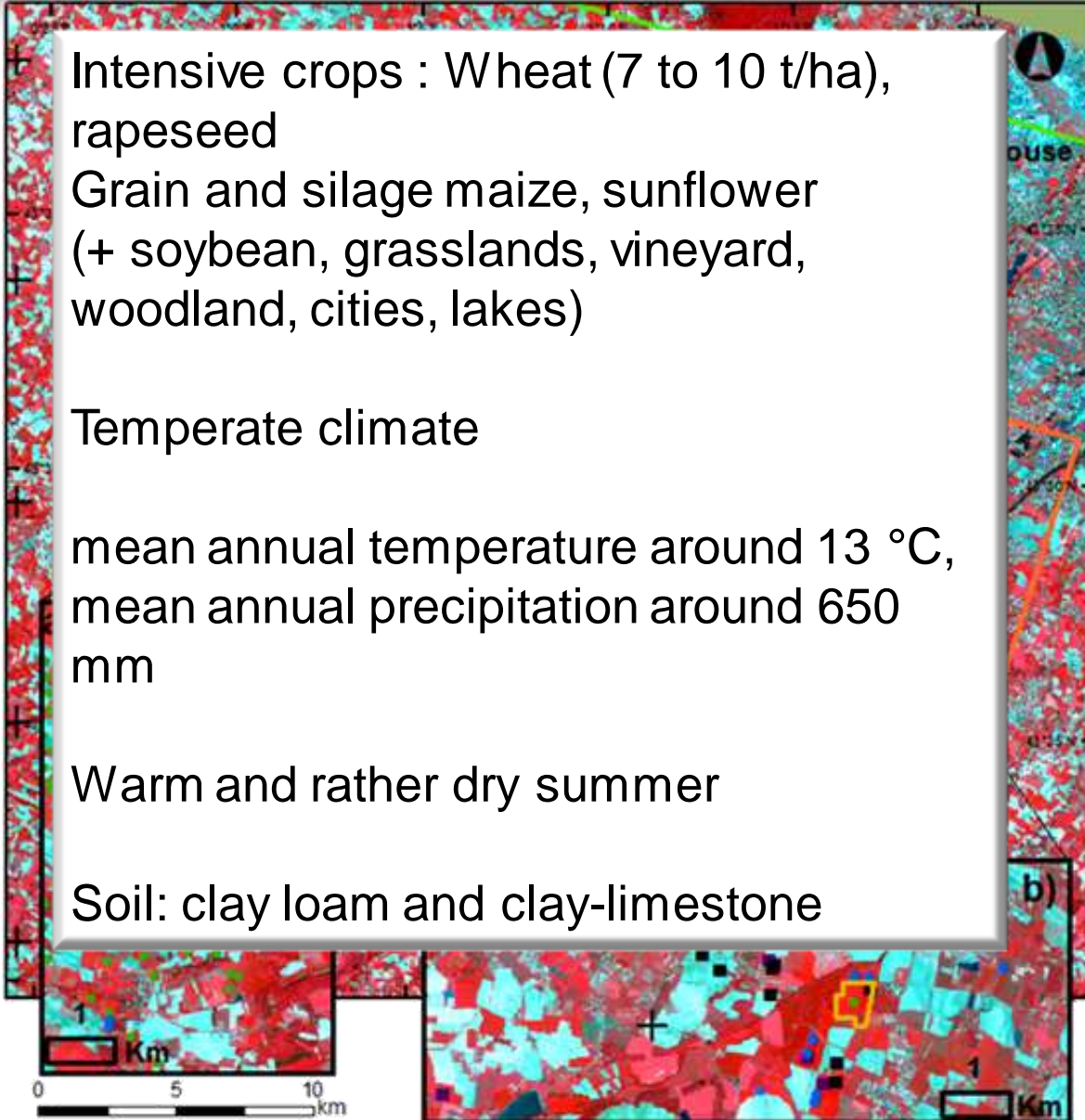


Image SPOT5 (30/04/2011)



Intensive crops : Wheat (7 to 10 t/ha), rapeseed

Grain and silage maize, sunflower (+ soybean, grasslands, vineyard, woodland, cities, lakes)

Temperate climate

mean annual temperature around 13 °C, mean annual precipitation around 650 mm

Warm and rather dry summer

Soil: clay loam and clay-limestone

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SPOT window (since 2002)

Formosat-2 window (since 2006)

0 5 10 km

0 5 10 km

Area of Study

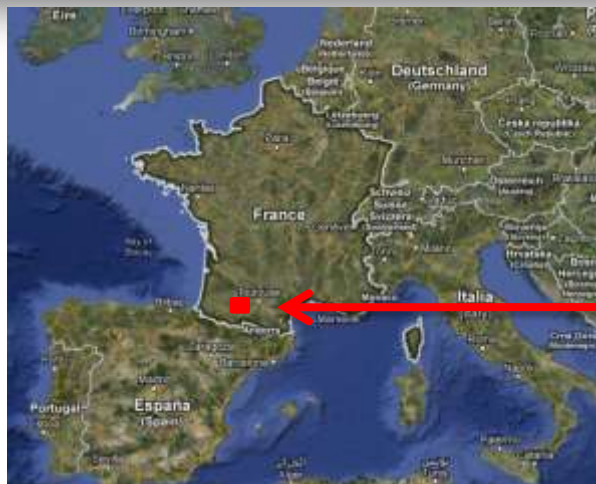
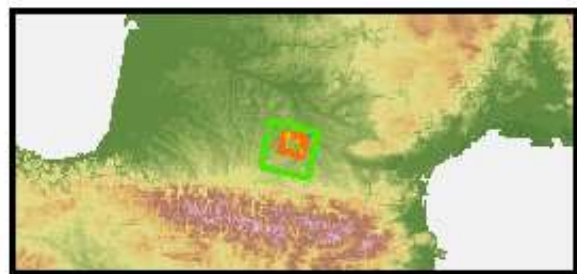
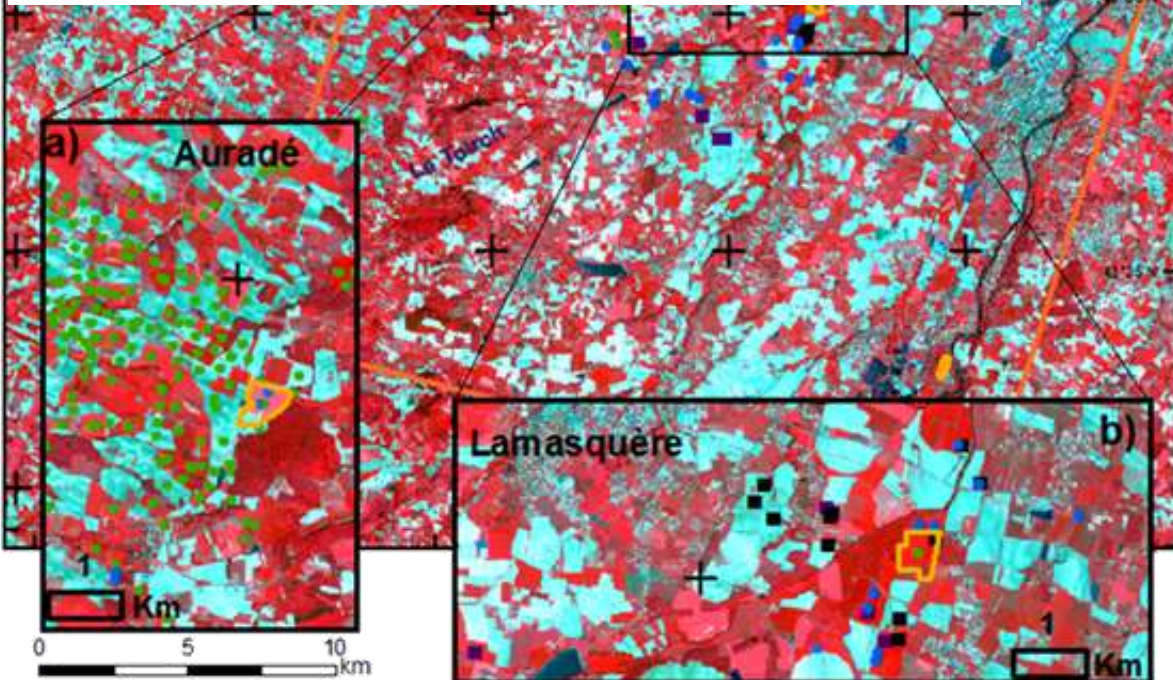


Image SPOT5 (30/04/2011)

- Sampling of land cover/use over ~300 fields
- LAI, biomass, farming practices on 10 to 30 fields
- Crop type from farmer declarations (thousands of fields)
- Irrigation from water authority



Experimental Sites (Fluxnet, ICOS)

ESU Biomass & Yield Data (2011)

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SAFRAN grid

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Area of Study

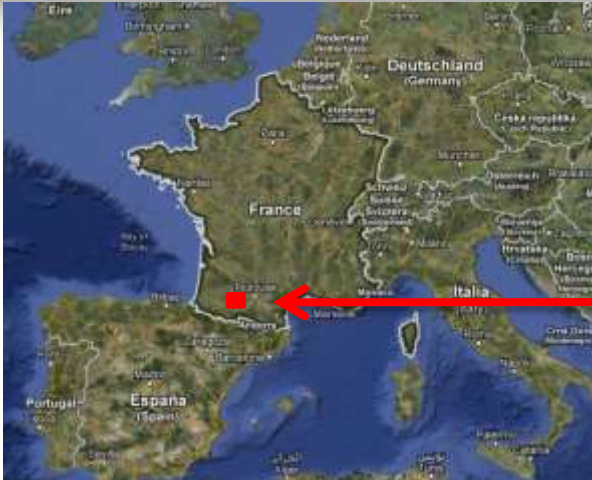
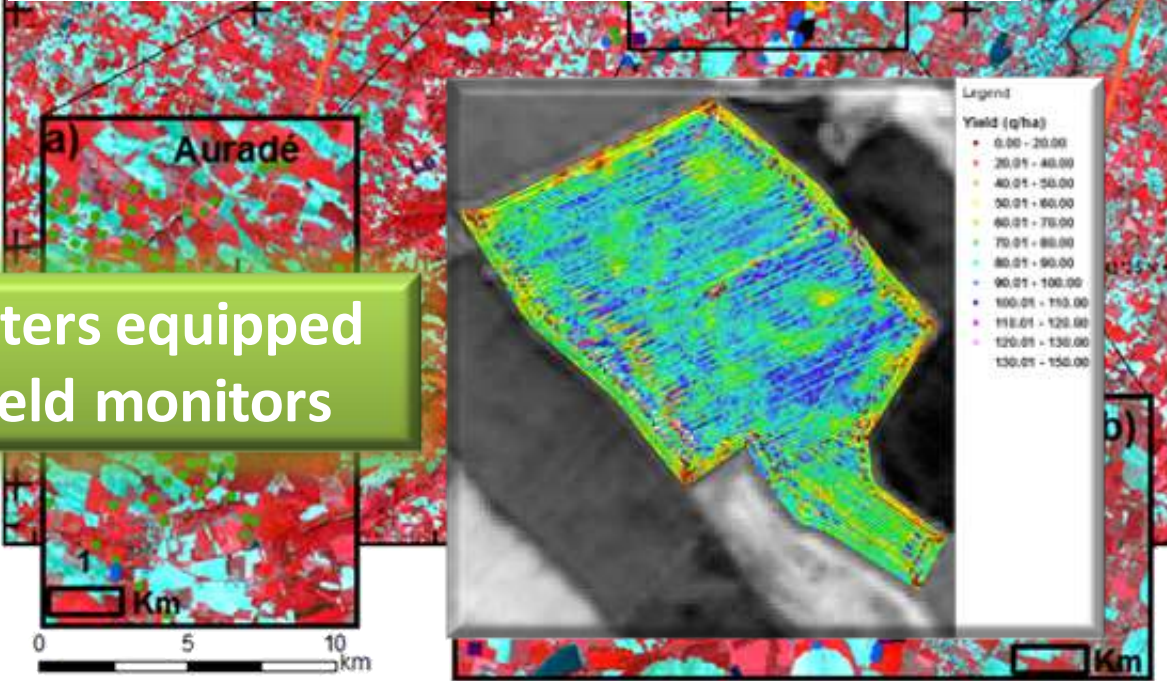


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Harvesters equipped with yield monitors

Experimental Sites (Fluxnet, ICOS)

ESU • Biomass & Yield Data

• Yield Data (farmers survey)

■ LAI & Biomass Data (2010)

■ LAI & Biomass Data (2010)

⊕ SAFRAN grid

□ SPOT window (since 2002)

□ Formosat-2 window (since 2006)

ESU {

Two flux sites, part of the european ICOS network

Lamasquère site 43.78°N 01.40°E (started 2004)

32 ha, flat

Crop types: maize for silage and winter wheat.

Wheat: October => July. Maize: April => August

Soil: Clay loam

Irrigation infrastructure for maize

Mineral and organic fertilization



Auradé site 43.91°N 1.17°E (started 2005)

23.5 ha

Crop types: winter wheat , rapeseed, sunflower

Wheat: October => July

Rapeseed September => June

Sunflower: April => August

Soil: Clay limestone



In both sites: 135 micro-meteorological variables are recorded every 30 minutes

Micro-meteorological measurements: weather, radiation, eddy correlation for CO₂ and H₂O, soil respiration and N₂O fluxes,

Surveys: LAI, biomass, yield+ farming practices, etc

more than 135 variables measured continuously : ICOS

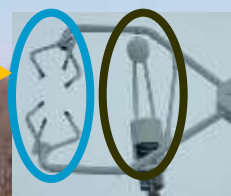
Lamasquère site



6 Automatic chambers for CO₂, N₂O

Radiation (albedo...) and vertical profiles of wind, T°C, HR%, CO₂

µmeteo variables (air/soil) + CO₂, LE, H fluxes



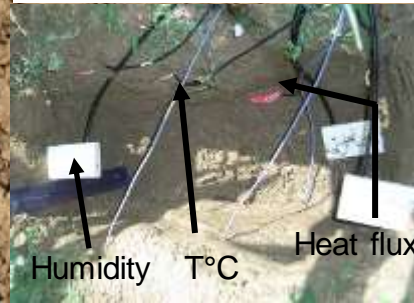
Eddy covariance 20Hz

4 soil respiration chambers

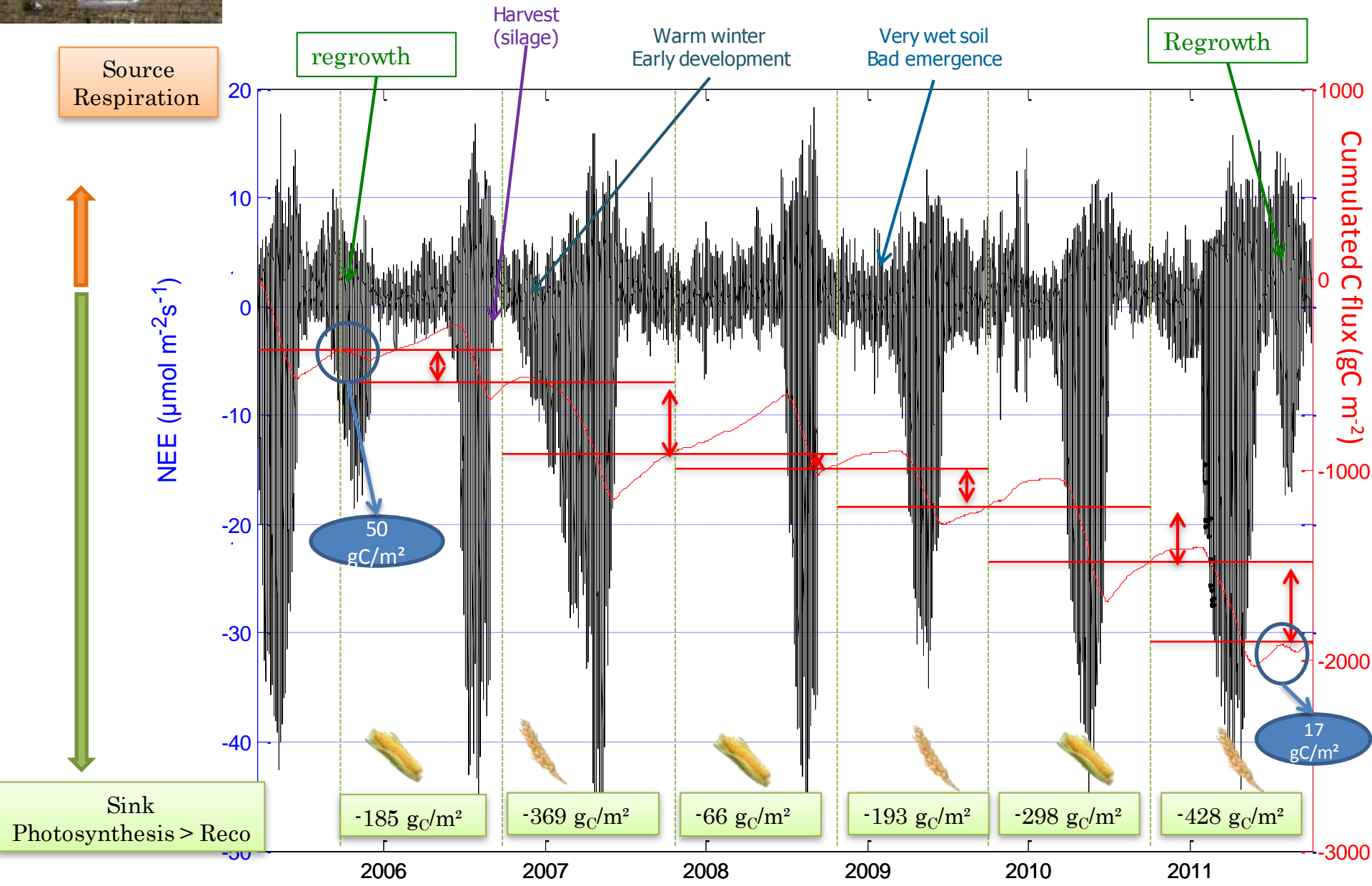


Footprint calculation

4 soil profiles (0 to 1m)



Analysis of net CO₂ fluxes at Lamasquère (2005 - 2011)

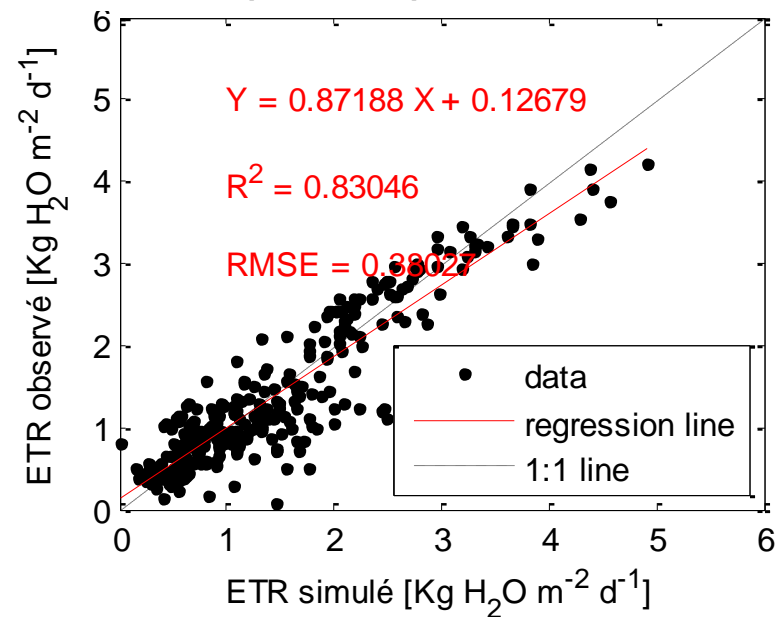
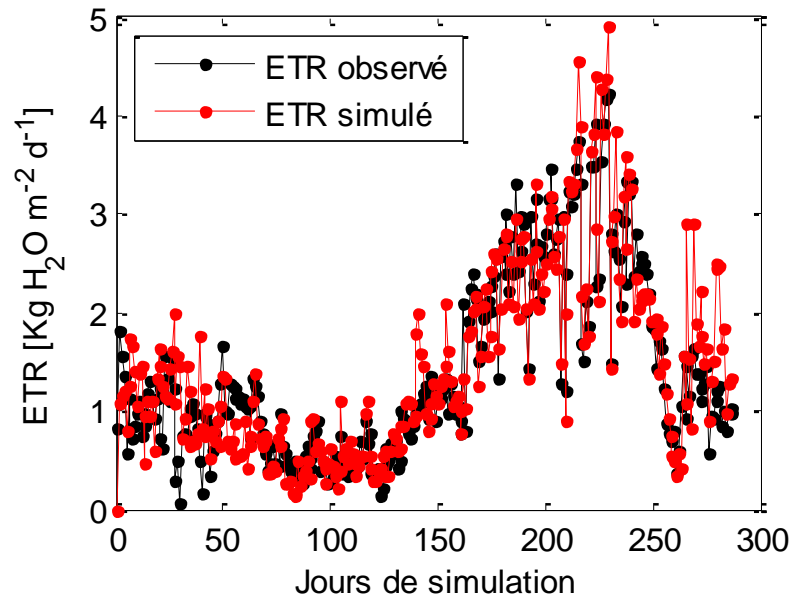


Observed ETR vs simulated ETR with SAFYE

SAFYE

Lamasquère Maize 2006

Observed and model simulated Evapotranspiration



Remote Sensing Data : OSR



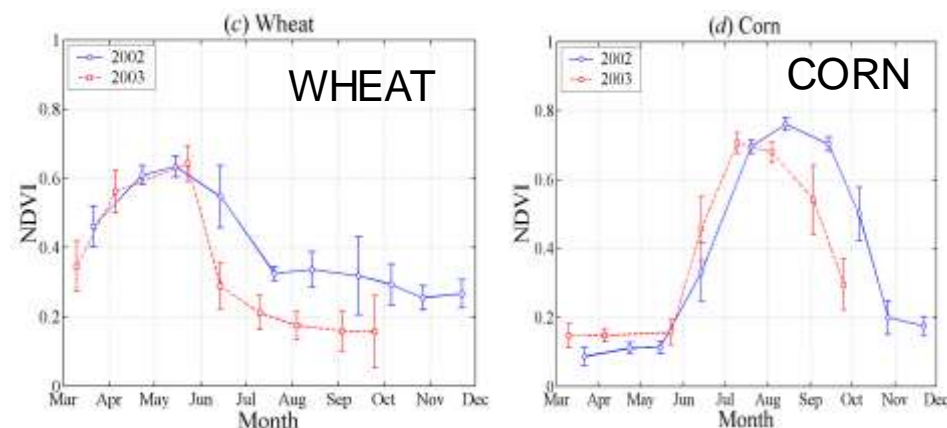
About 1 high resolution image per month since 2002

Formosat-2 & Spot (2,4,5) : 200 images

Take 5 site

Landsat 8 : systematic processing by CNES (TOC reflectance)

A unique High Spatial & Temporal Resolution remote sensing dataset



Mean and standard deviation of monthly NDVI over a 50x50 km area, in 2002 and 2003

Remote Sensing Data : OSR



About 1 high resolution image per month since 2002

Formosat-2 & Spot (2,4,5) : 200 images

Take 5 site

Landsat 8 : systematic processing by USGS/USDA/ESA

A unique High Spatial & Temporal



Over a 50x50 km area, in 2002 and 2005

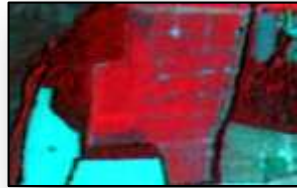
Field Data Acquisition Strategy



...for validation of the models/RS product...

Scale

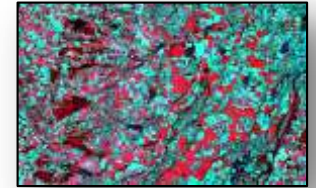
Plot : 2 flux sites
+ ESU



>350 fields



Region



GAI

↔ GAI in situ

**biomass,
yield,
management**

↔ sampling/survey

↔

Yield, management
from farmers

↔

Yield
statistics

Water

↔ EC fluxes

↔

Irrigation from farmers
(dates, doses)

↔

Water agency
& irrigating
collectivities

CO₂

↔ EC fluxes

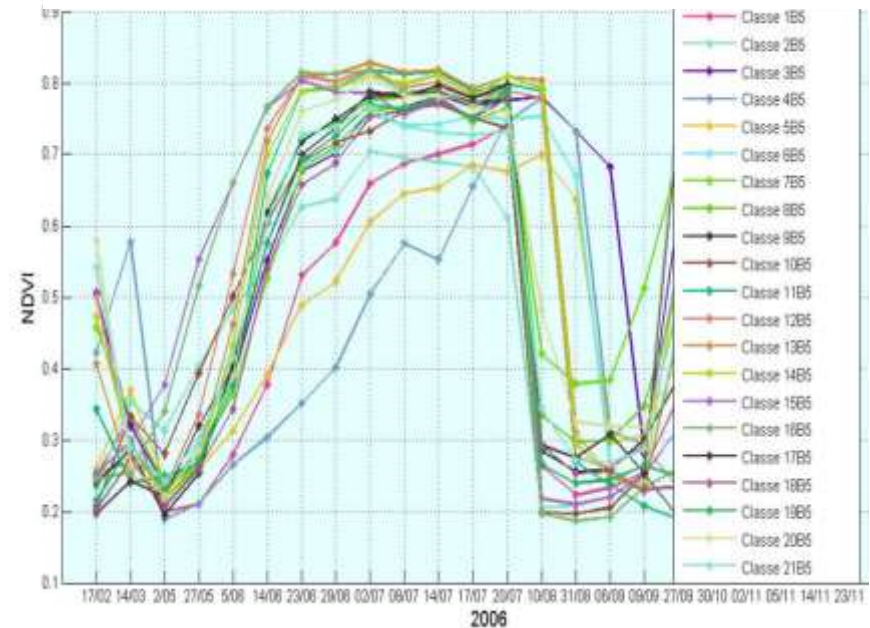
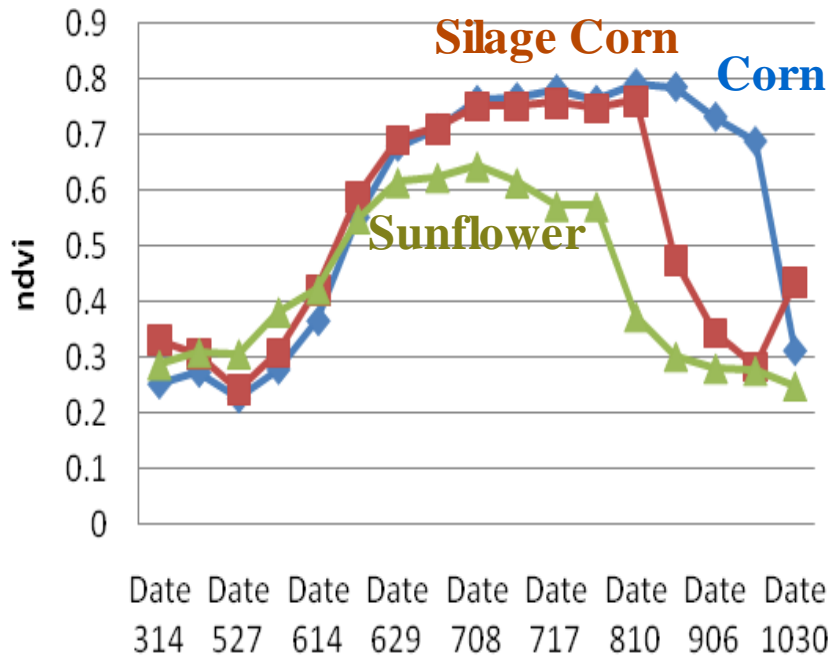
↔

CarboEurope
Regional Experiment¹⁸

Multi-T Land Cover Maps

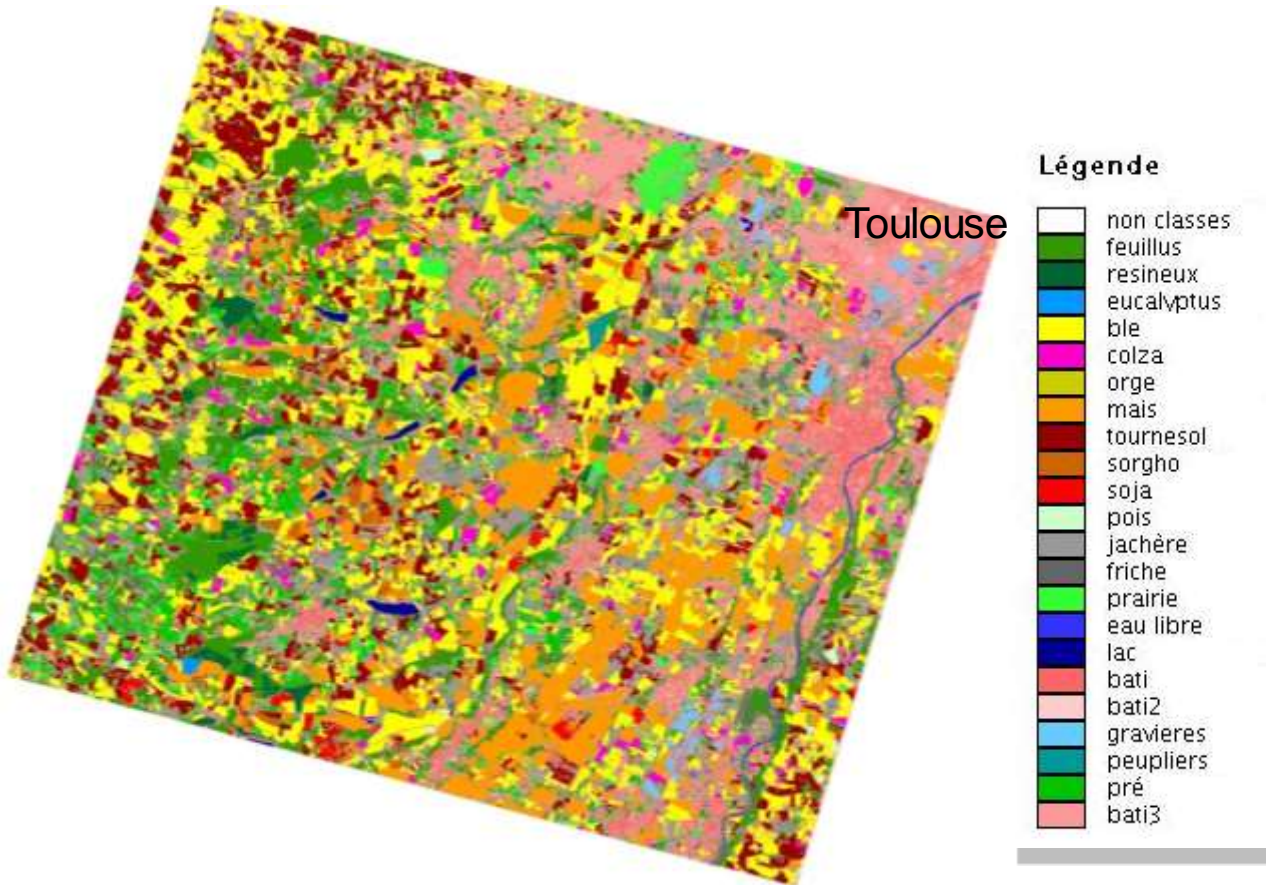
- Solving Corn/Sunflower confusions
- More classes: distinction between silage and grain corns
- Characterization of the heterogeneity

Silage maize: variability of NDVI for different fields



Multi-T Land Cover Maps

- Land cover and land use mapping: support to decision making and monitoring public policies



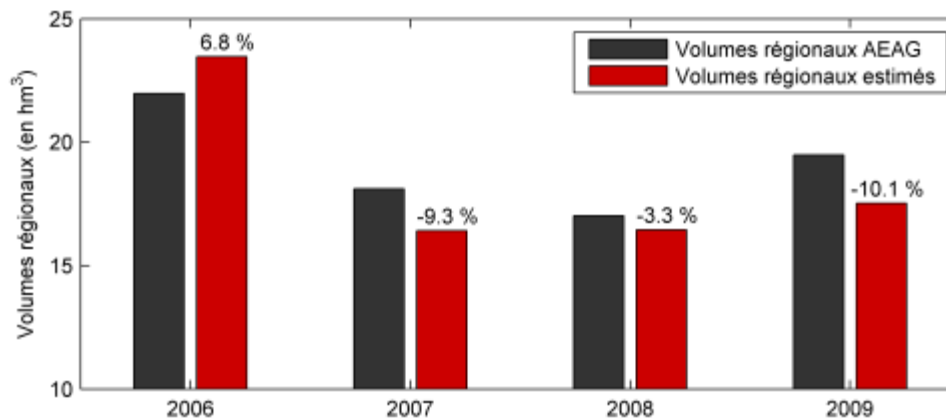
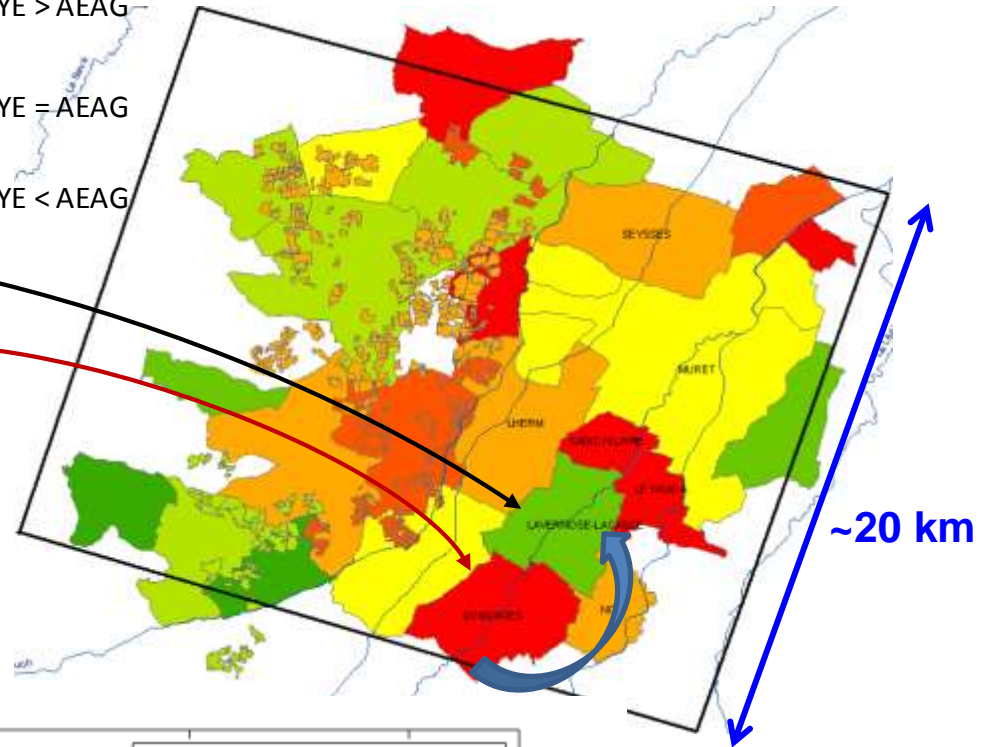
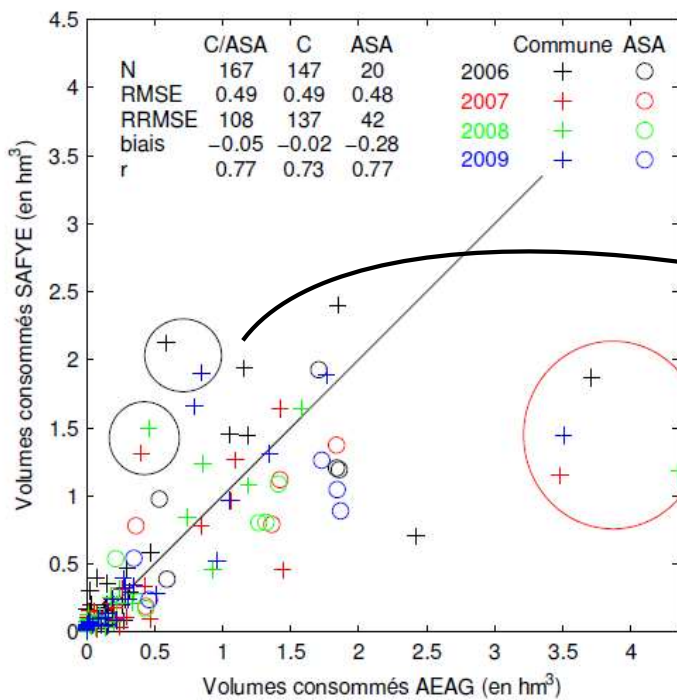
Sustainable development indicators:

- Arable and permanent crop land
- Land use change
- Proportion of land area covered by forests
- Fragmentation of habitat

Land cover is a prerequisite for most applications

All data from the Cesbio's regional observatory (OSR)

Regional estimates of irrigation vs observed

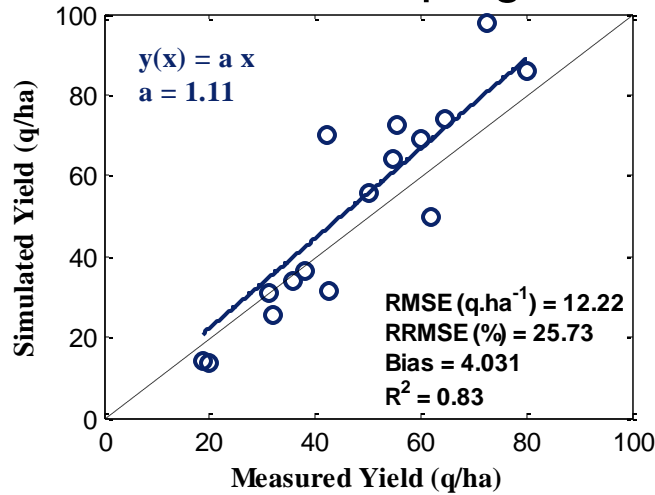


Water transfer from one village to the other cause local imbalance but quite good regional estimates

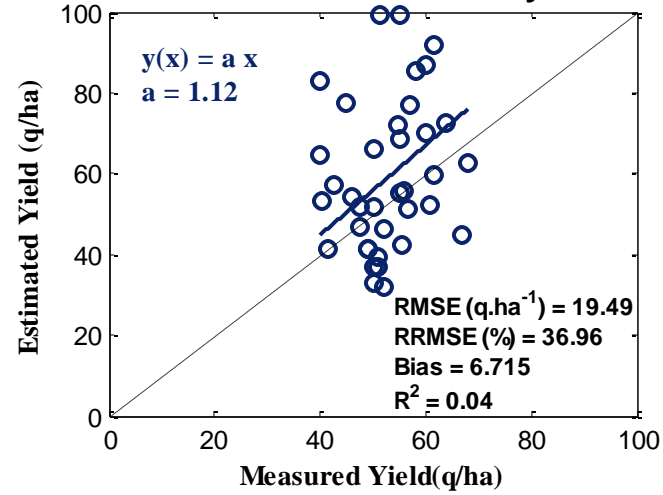
Validation of Yield estimates



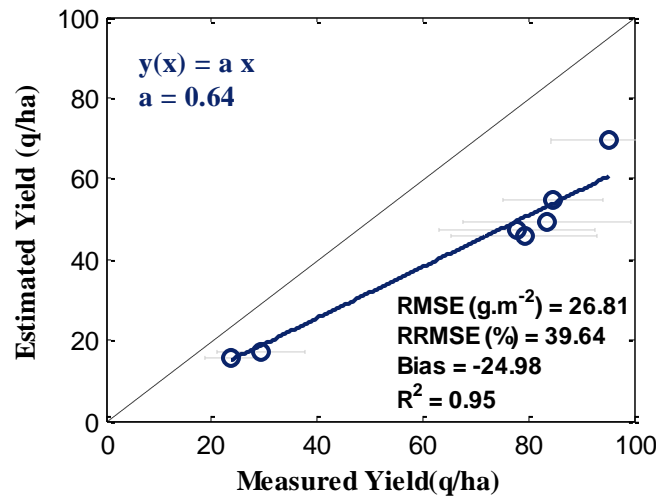
Field campaign



Farmers surveys



Yield monitors



Yield monitor from the combine harvester needs to be calibrated

Thank you for listening

And many thanks to the colleagues from CNES and CESBIO and to the partners in France, Morocco and Tunisia

<http://www.cesbio.ups-tlse.fr>

SMOS'Blog :

http://www.cesbio.ups-tlse.fr/SMOS_blog/

Take 5 / SPOT-4 Blog :

<http://www.cesbio.ups-tlse.fr/multitemp/>