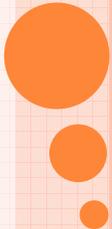
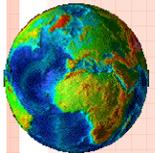


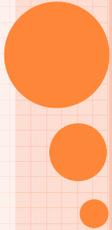
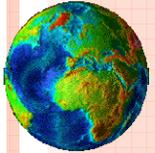
Integración de escalas en modelos de riesgo y efectos del fuego

Marta Yebra, Emilio Chuvieco, Sara Jurdao y Lucrecia Pettinari
Departamento de Geografía - Universidad de Alcalá



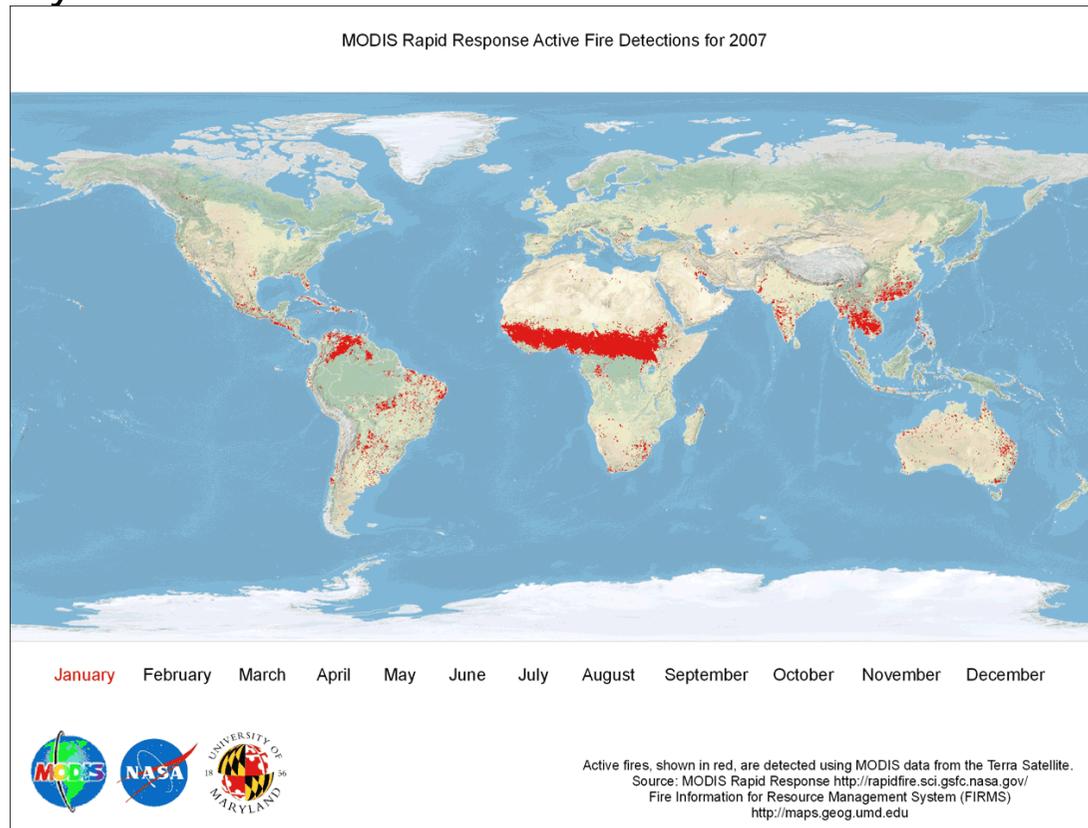
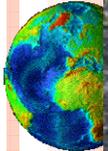
Esquema

- Integración de escalas.
- Riesgo de incendio:
 - Factores a considerar.
 - Técnicas para extraer información.
 - Métodos de integración.
 - Comunicación a usuarios.
- Efectos del fuego:
 - Componentes espectrales.
 - Variables objetivo.

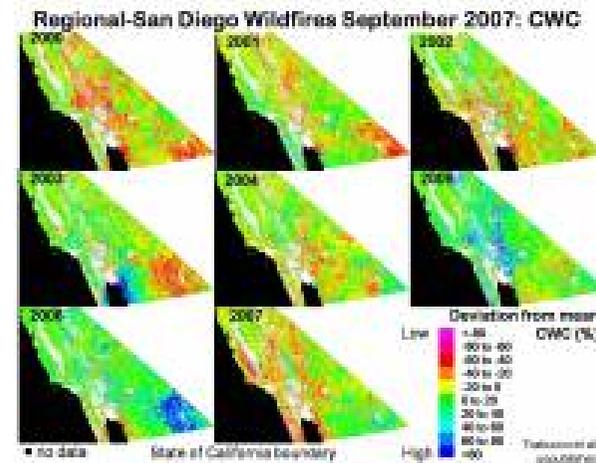
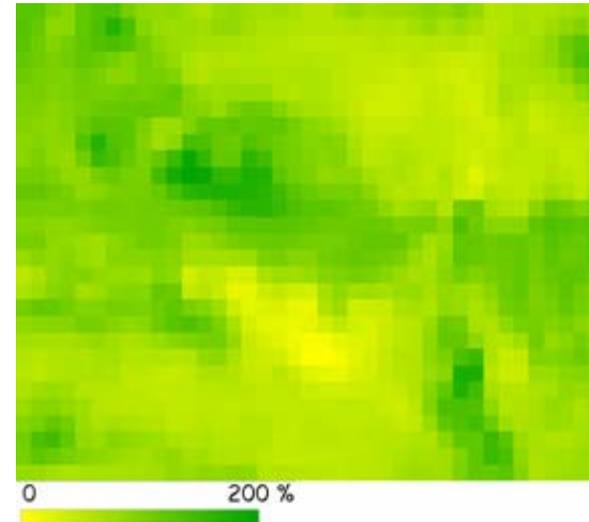
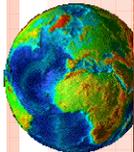


Integración de escalas

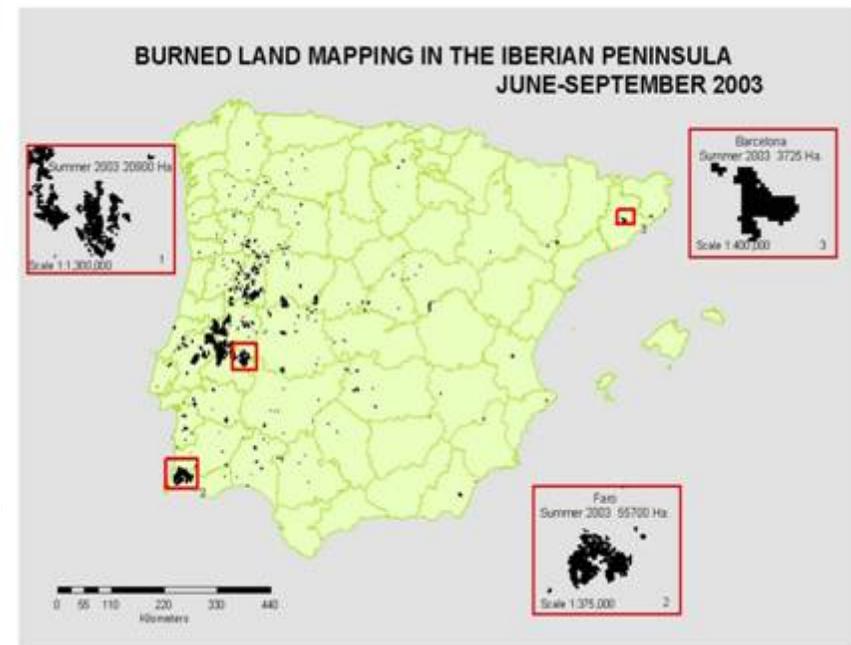
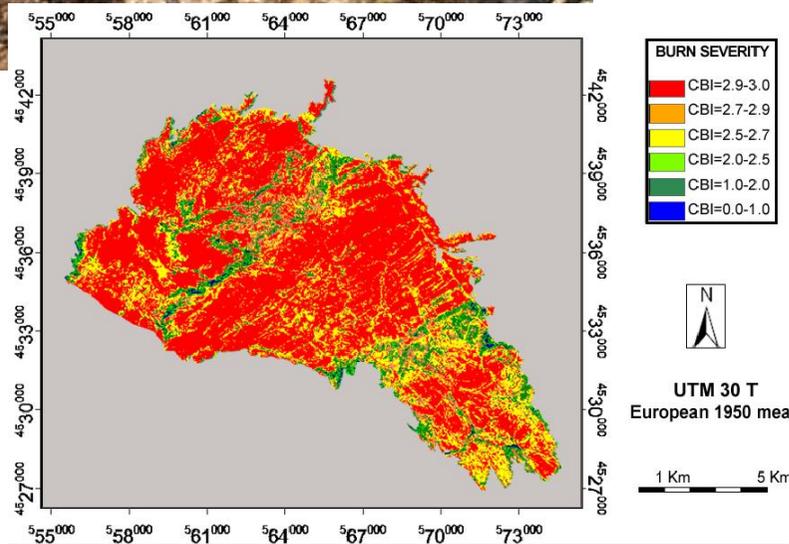
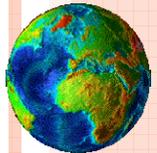
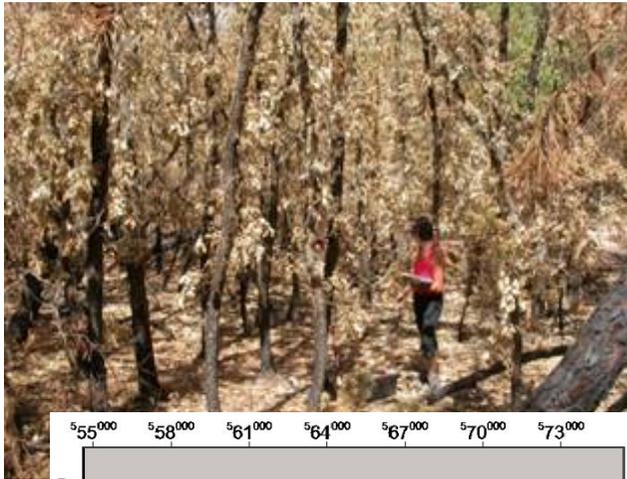
- Espaciales: El fuego es un fenómeno global que tiene implicaciones locales.
- Temporales: El fuego es un proceso dinámico, que afecta a factores variables y estructurales.



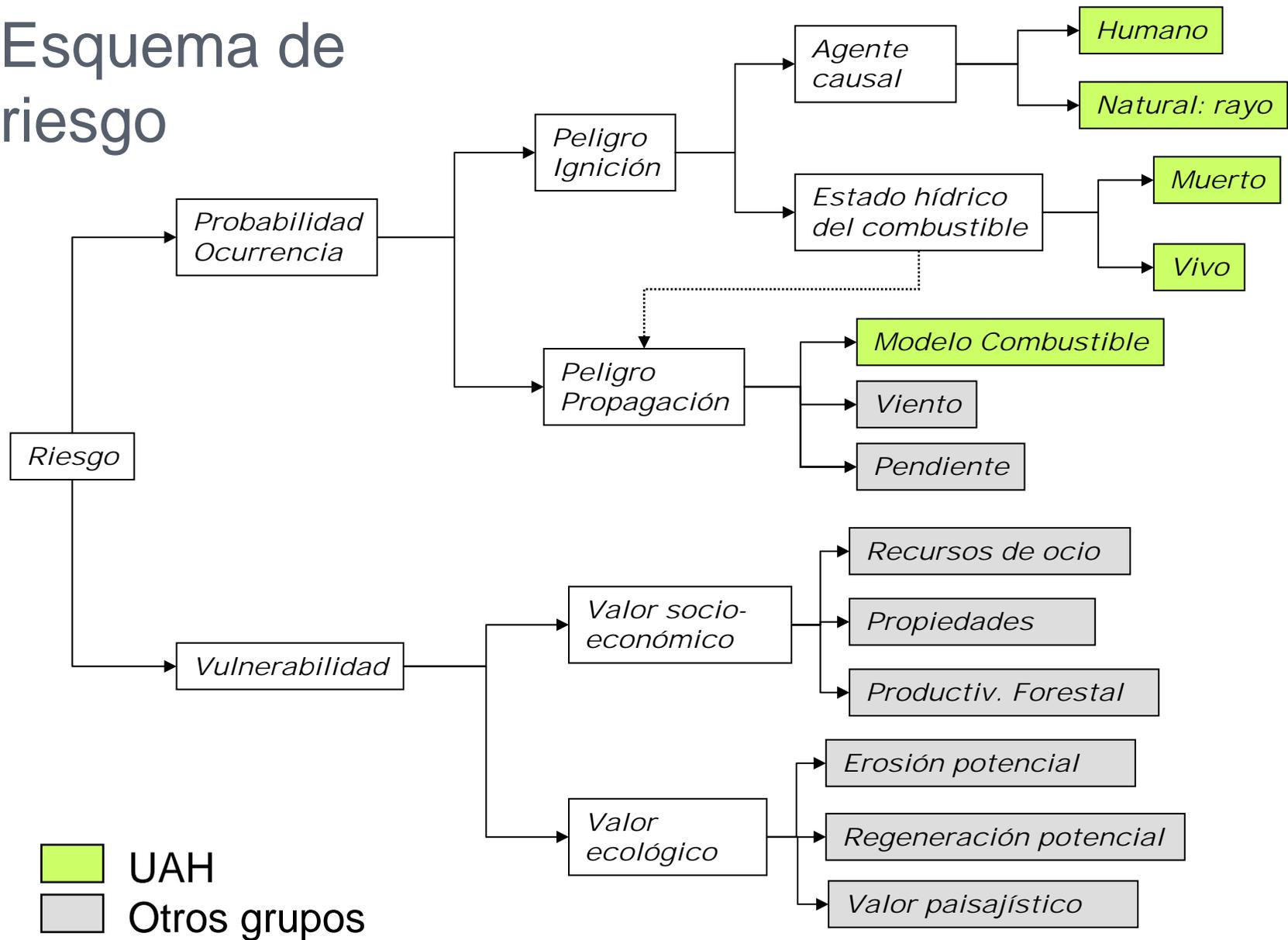
Las variables de riesgo pueden considerarse a nivel local, regional o global



Los efectos del fuego también se analizan a nivel local, regional, global

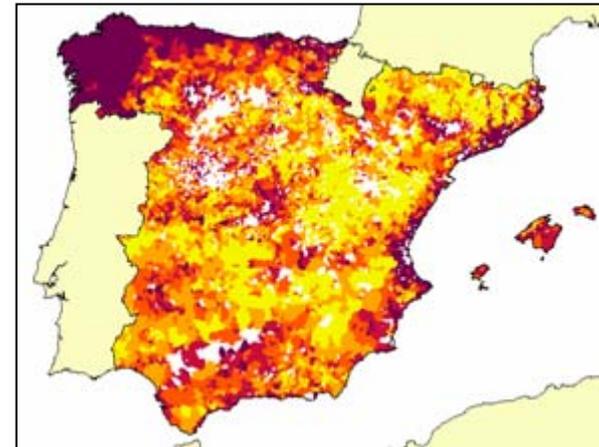


Esquema de riesgo

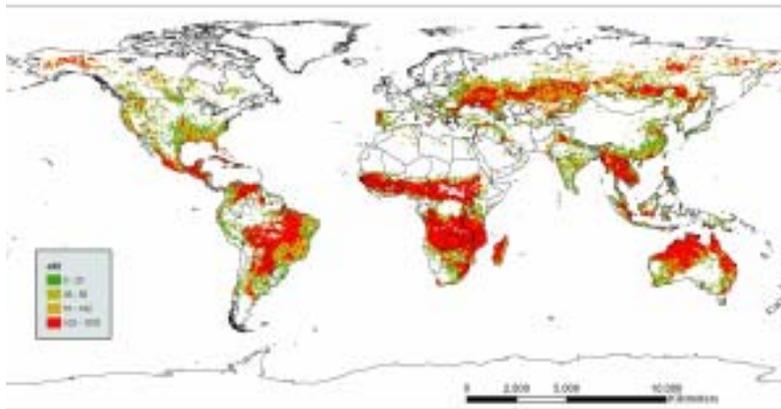


Riesgo humano

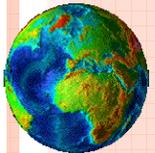
- Determinación de variables más significativas.
- Modelización espacial:
 - España (1 km²)
 - Global (0.5 grados)



Probabilidad de Ignición humana:
Martínez et al., 2008, JEM



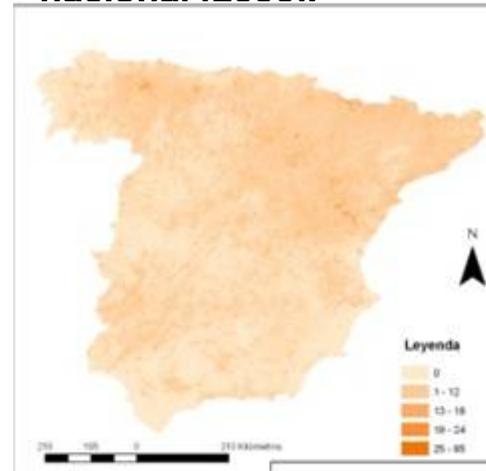
Occurrencia global, regímenes de incendio:
Chuvieco et al., 2008, GCB



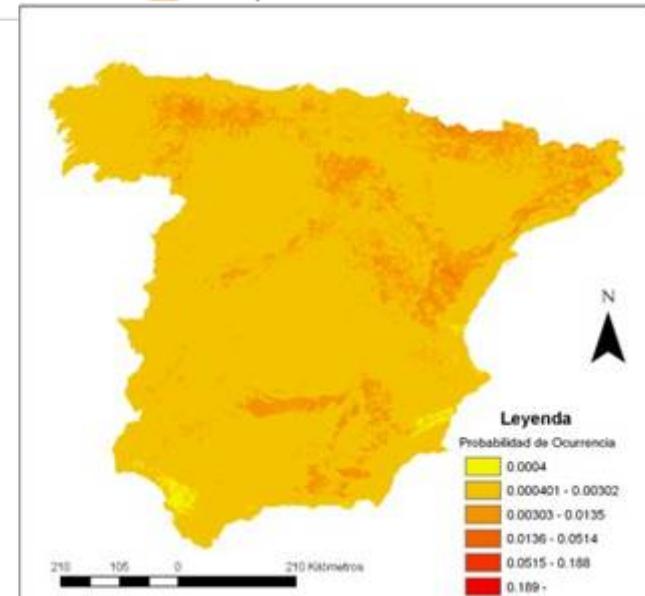
Probabilidad de ignición: Rayos

- Modelización de factores que causan que una descarga se convierta en un incendio causado por rayo.
- Factores estructurales (territorio, vegetación).
- Factores dinámicos: índices meteorológicos.

Distribución espacial de las descargas a escala nacional (2006).

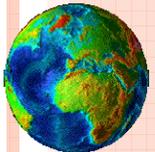


Fuente: K.W. Weise, a partir de datos AEMET.



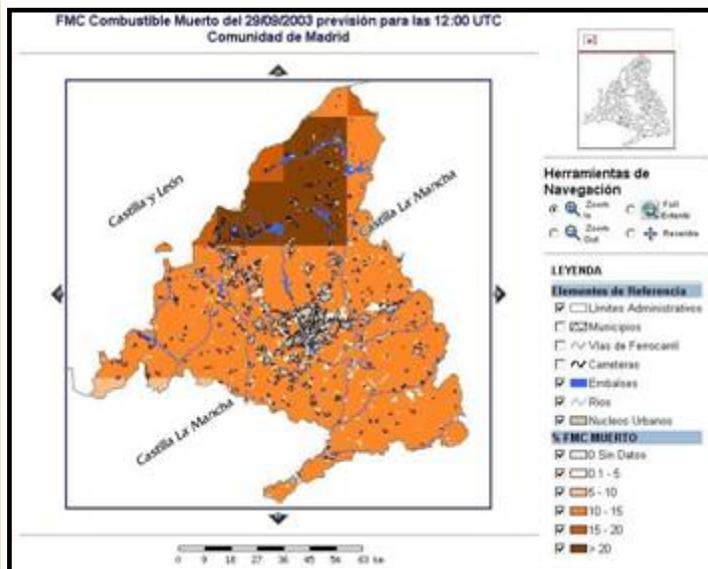
Modelo de ignición natural

Nieto et al., en revisión

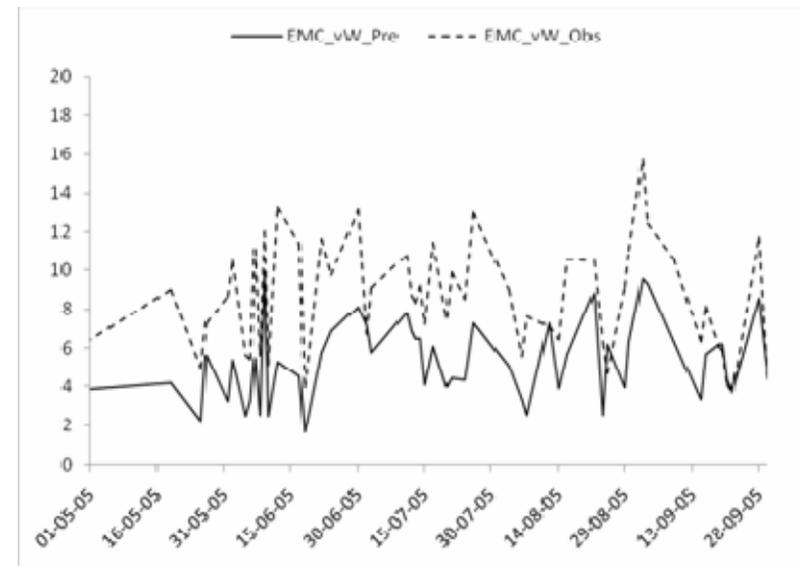


Combustible muerto

- Revisión de índices meteorológicos más ajustados a condiciones mediterráneas.
- Mediciones en campo (hojarasca y pasto).
- Estimación DFMC a partir de MSG.



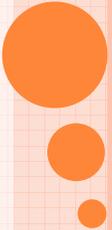
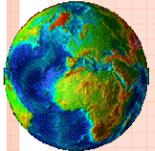
Estimación del FMC a partir de predicciones meteorológicas diarias
Aguado et al., 2007, IJWF



Estimación del EMC a partir de datos Meteosat, Nieto et al., en revisión

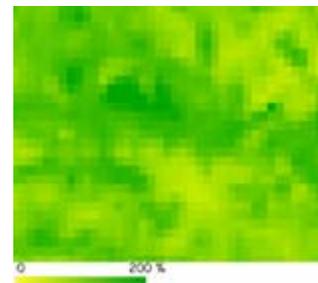
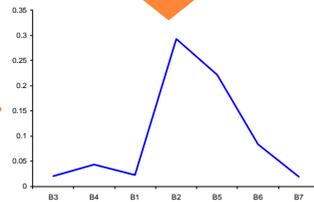
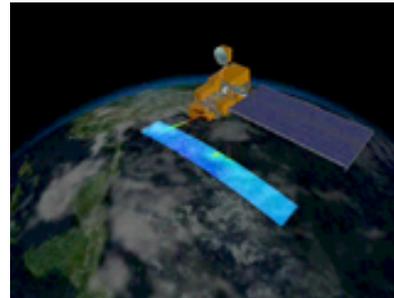
FMC

- Mediciones de laboratorio, espectroradiómetros.
- Trabajo de campo: 1996-2009.
- Ajustes empíricos: Landsat-TM, NOAA-AVHRR, Terra-MODIS.
- Modelos de inversión: Terra-Aqua MODIS.

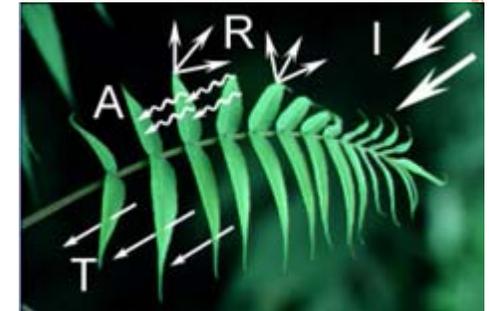
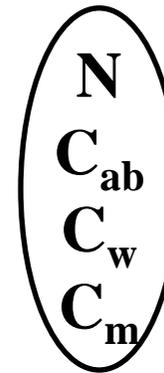


Enfoques metodológicos

- Ajustes empíricos

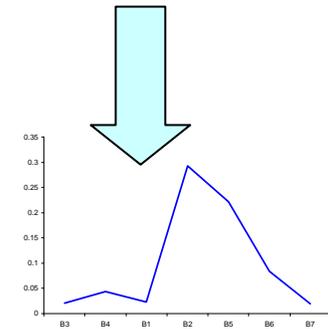


- Modelos de simulación



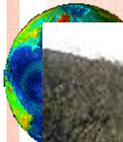
DIRECTO

INVERSO

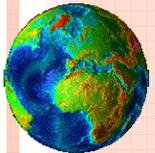
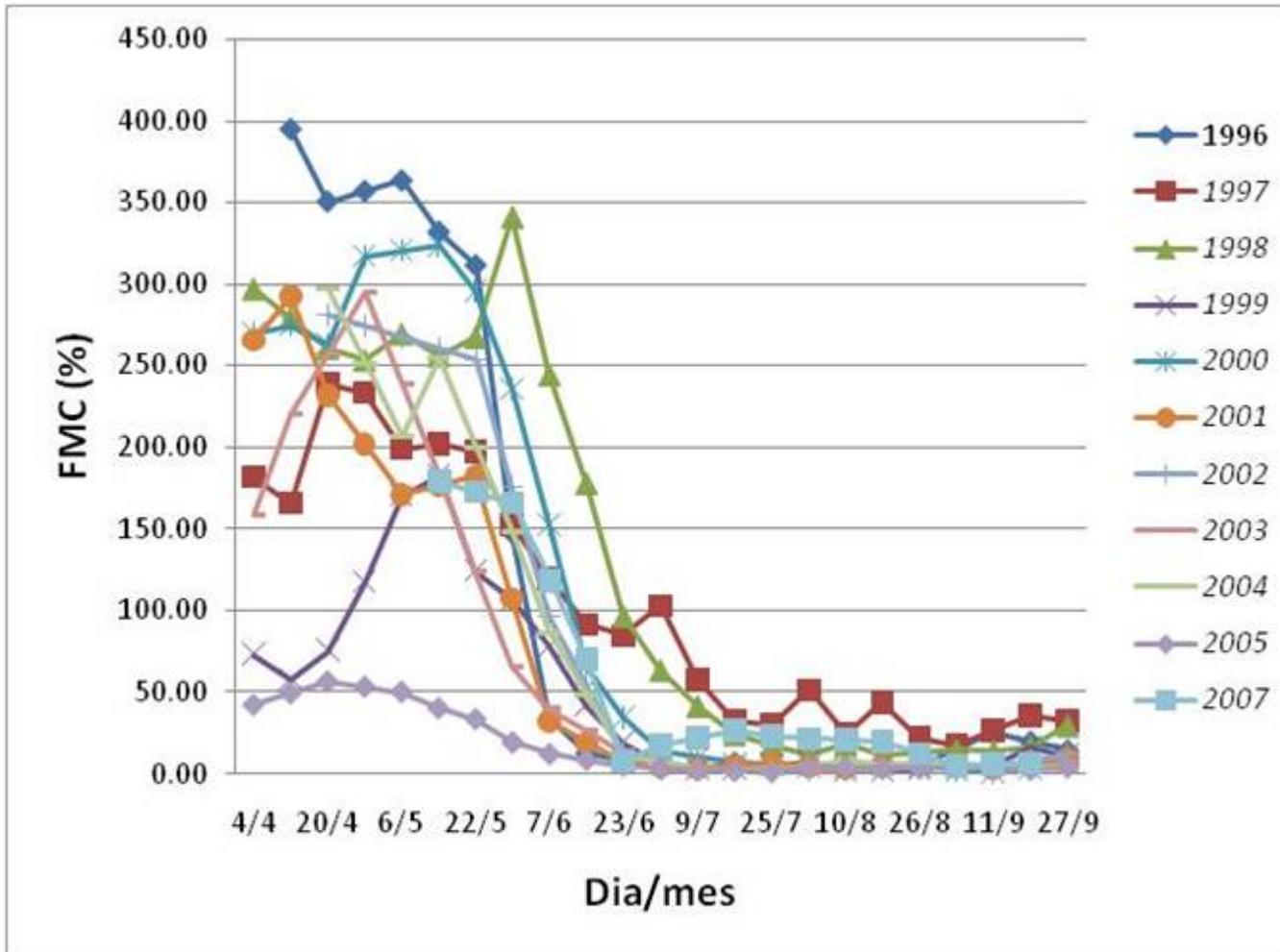


Trabajo de campo: variables para parametrizar los modelos

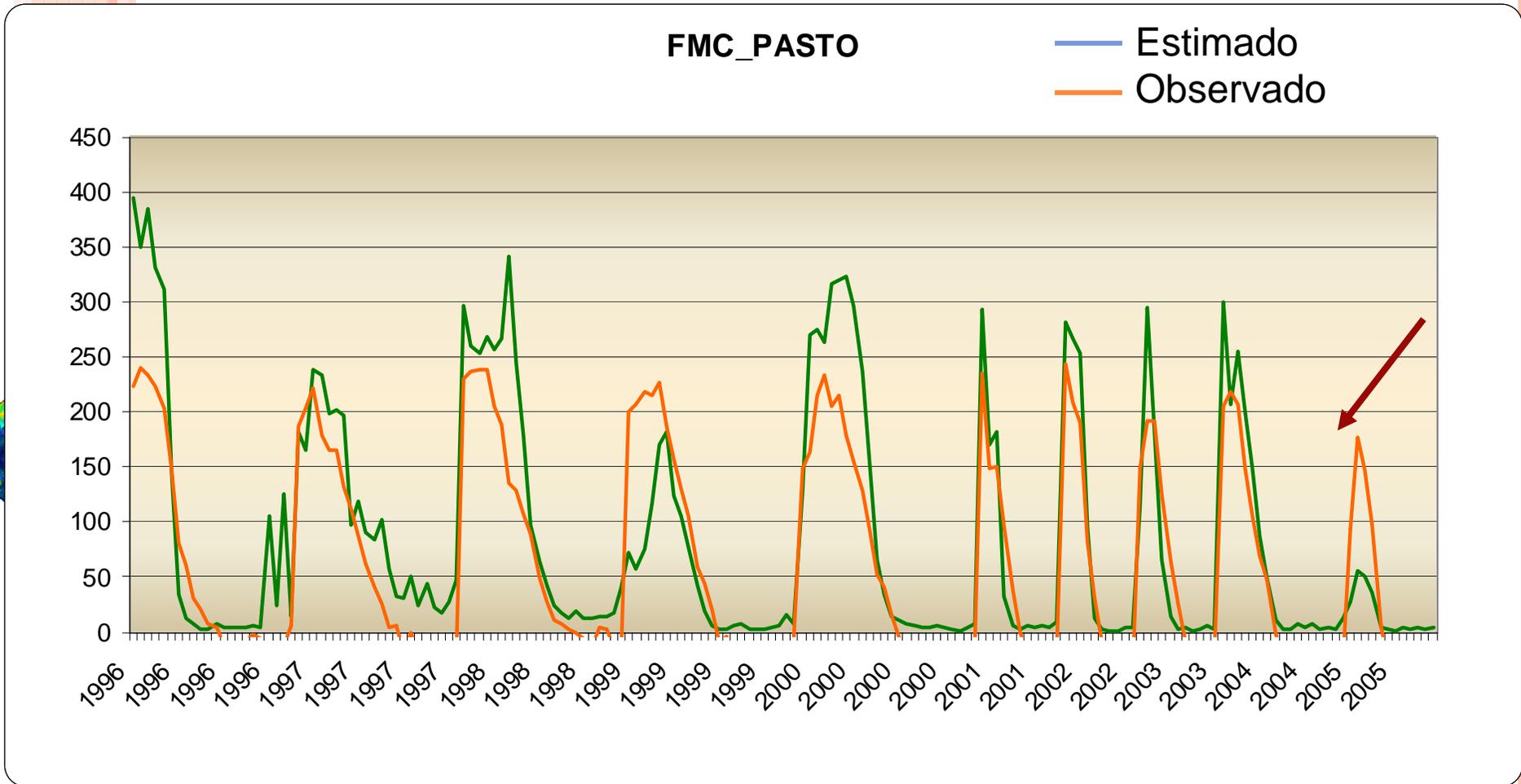
- Clorofila
- Peso específico
- Espesor de agua
- LAI



Variación interanual FMC Cabañeros (1996-2007)



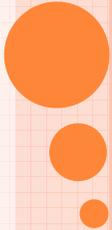
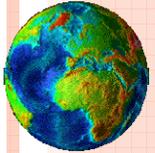
Modelos empíricos: Problema con años secos (1996-2005): pasto



García et al. 2008, RSE

Modelos de simulación

- Generalizan mas, pero tienen problemas de inversión no singular.
- Soluciones:
 - Ajustes de regresión sobre casos previsibles (eliminar combinaciones anómalas).
 - Simulación para condiciones ecológicas.

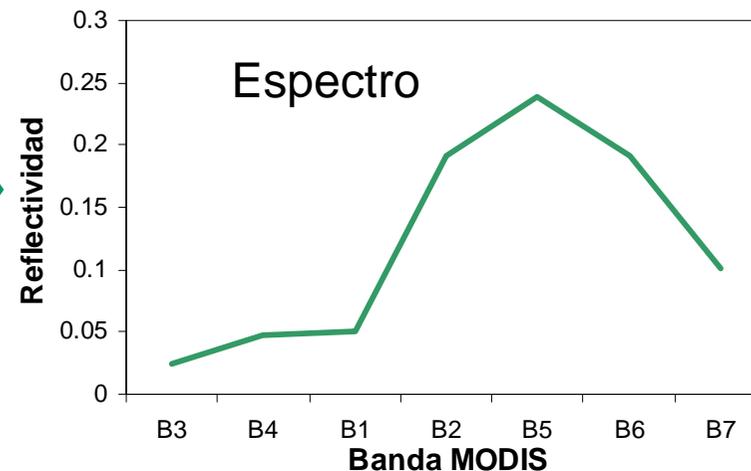
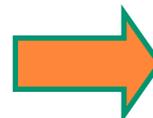


Realidad

Inversión no singular

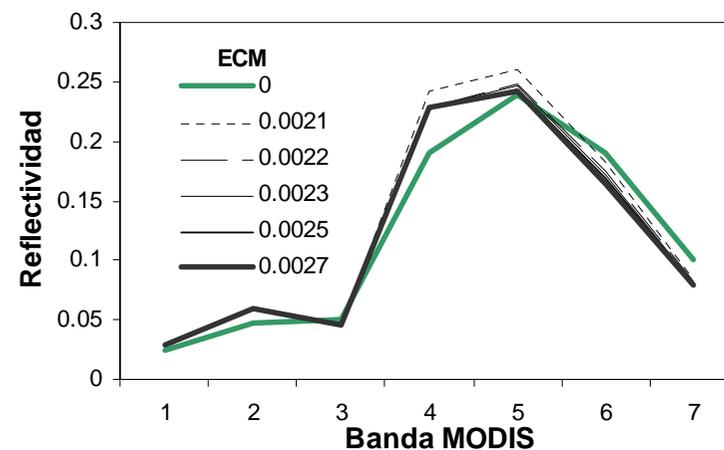
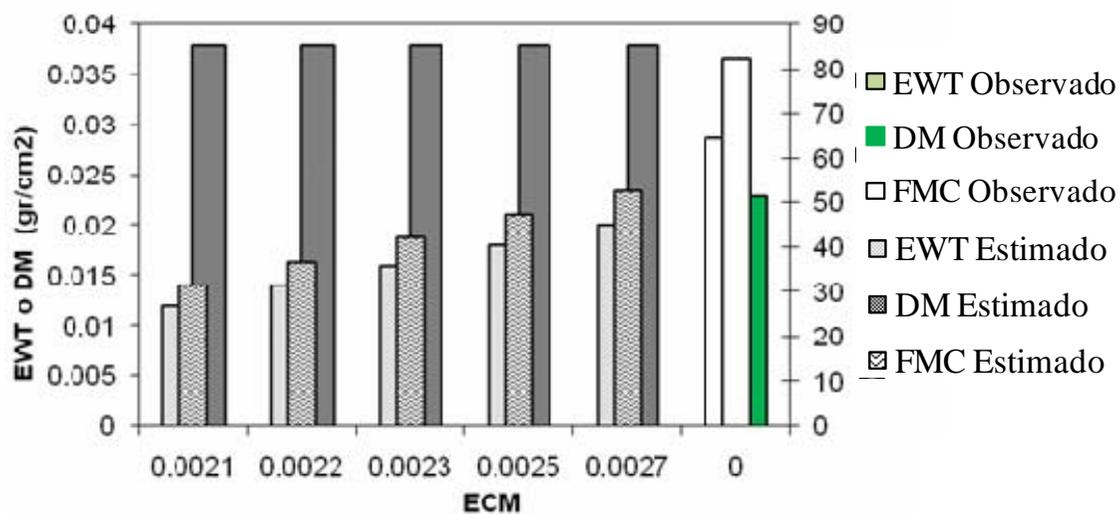


Parámetros
N: 2.03
Ca+b: 77
EWT: 0.016
DM: 0.019
 (De Santis et al. 2006), JGR

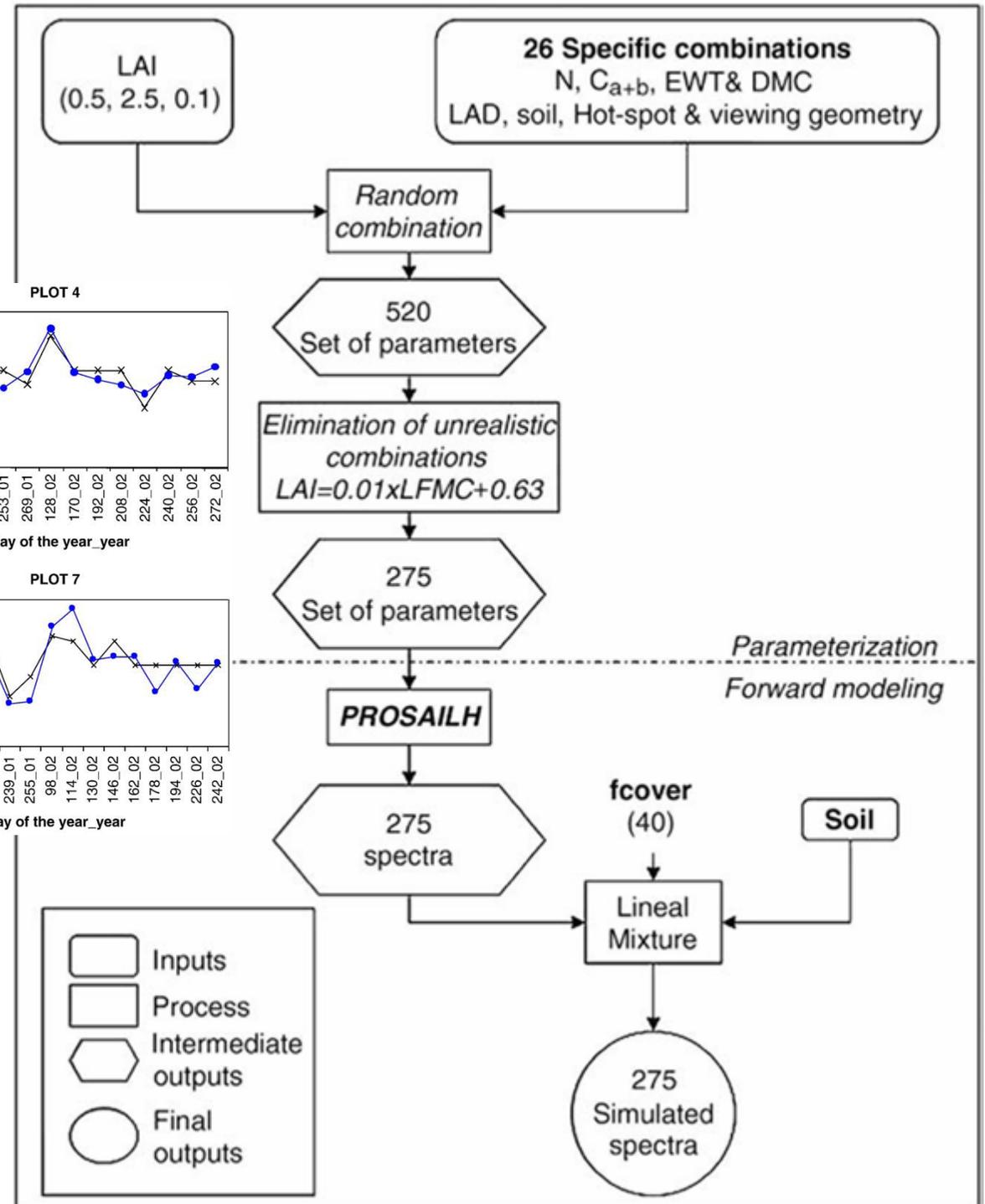
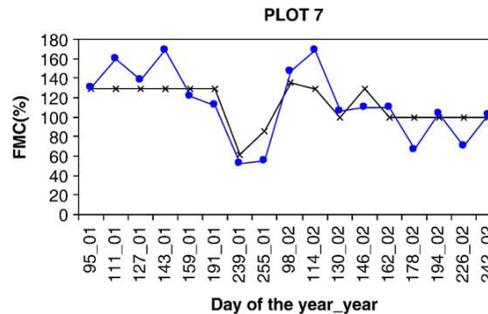
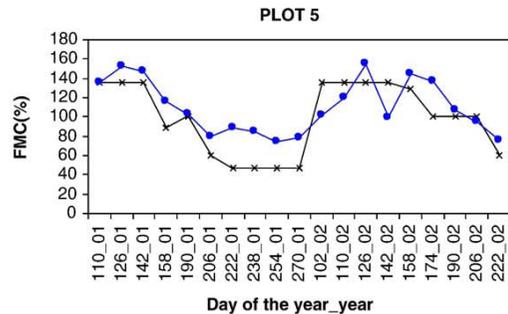
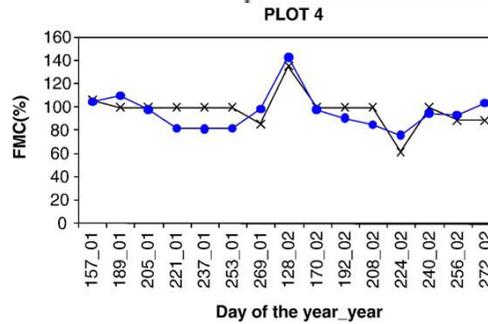
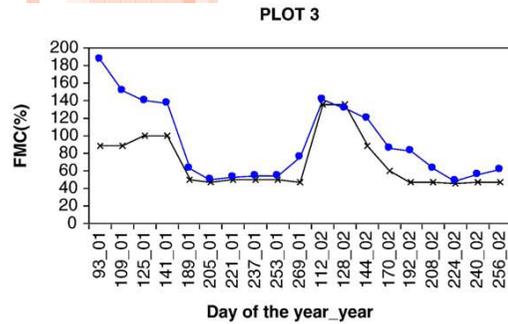


TODOS LOS ESPECTROS SIMULAN:
FMC MENOR, EWT menor, DM mayor

Espectros similares al medido
(Todos ECM<0.003)



LUT para determinadas especies

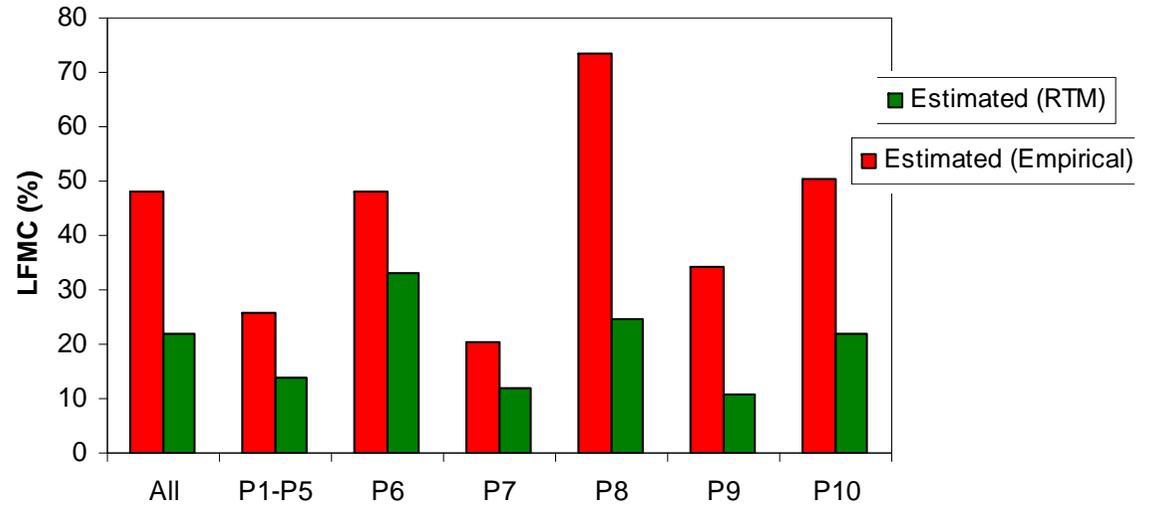


Matorrales

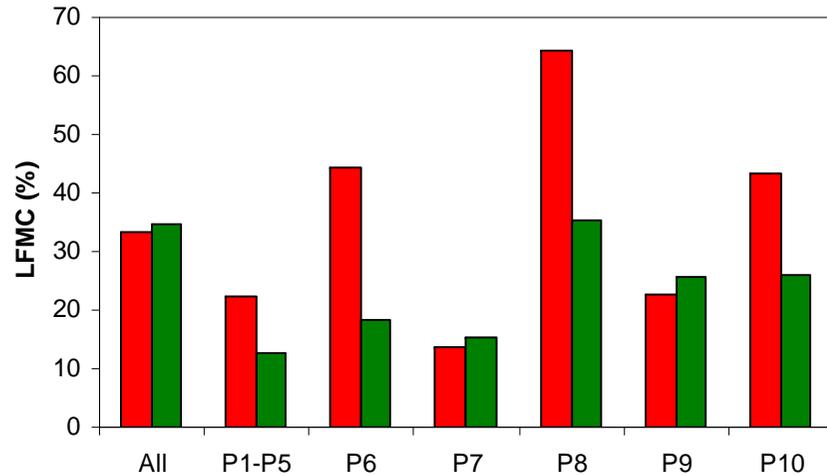


Using 10 plots in 3 different regions of Spain

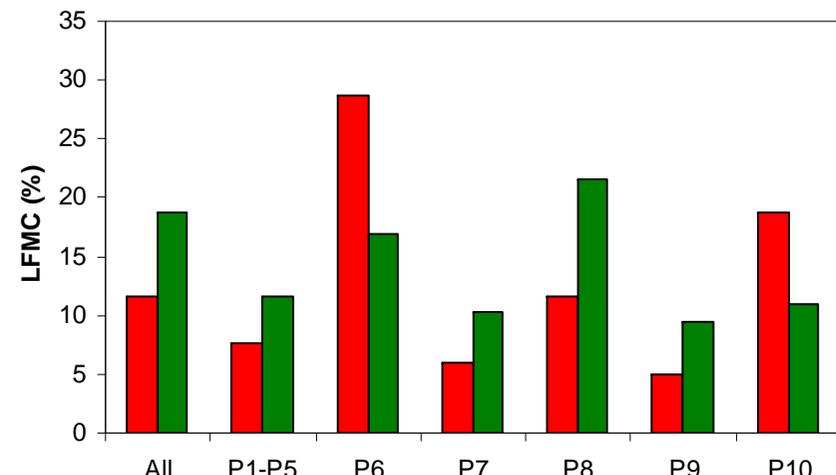
RMSE (%)



Empirical



RTM

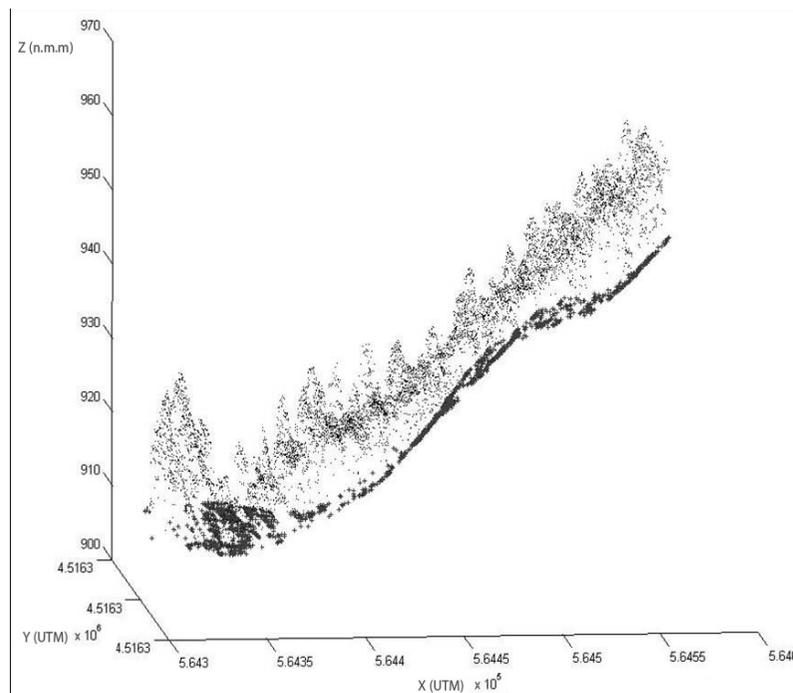
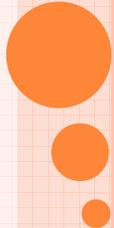
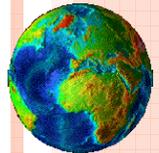


■ Systematic ■ Unsystematic

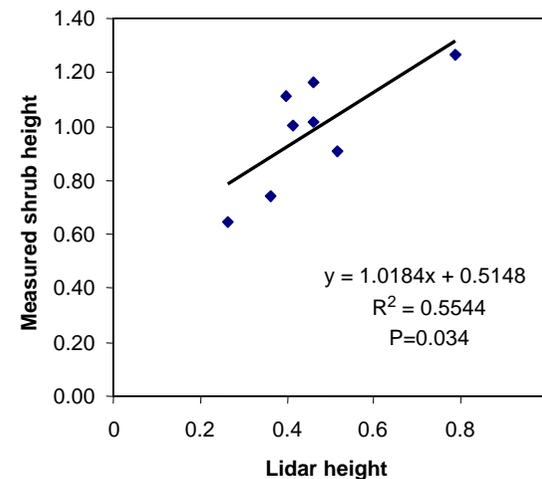
■ Systematic ■ Unsystematic

Cartografía de combustibles

- Clasificación convencional: Landsat-TM
- Clasificación orientada a objetos: Quickbird.
- Tratamiento de datos lidar.



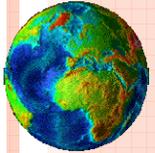
Mediciones en arbolado-matorral
García et al., 2009, Geofocus



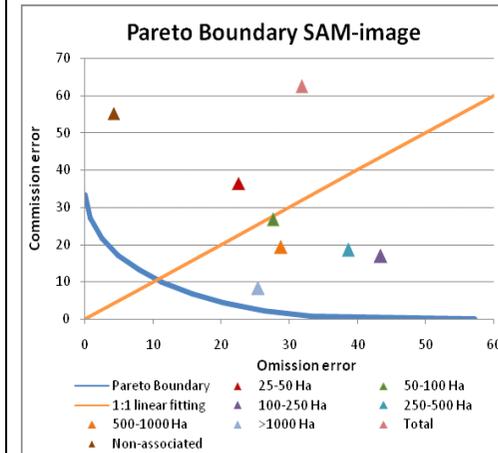
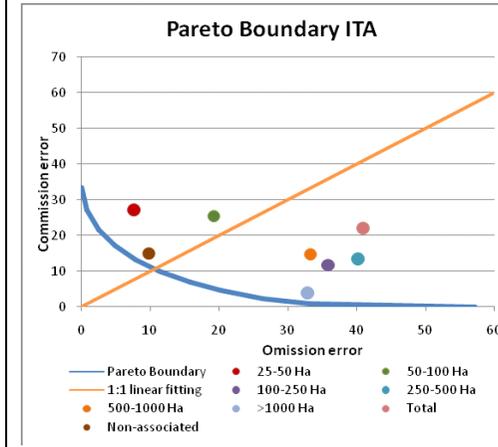
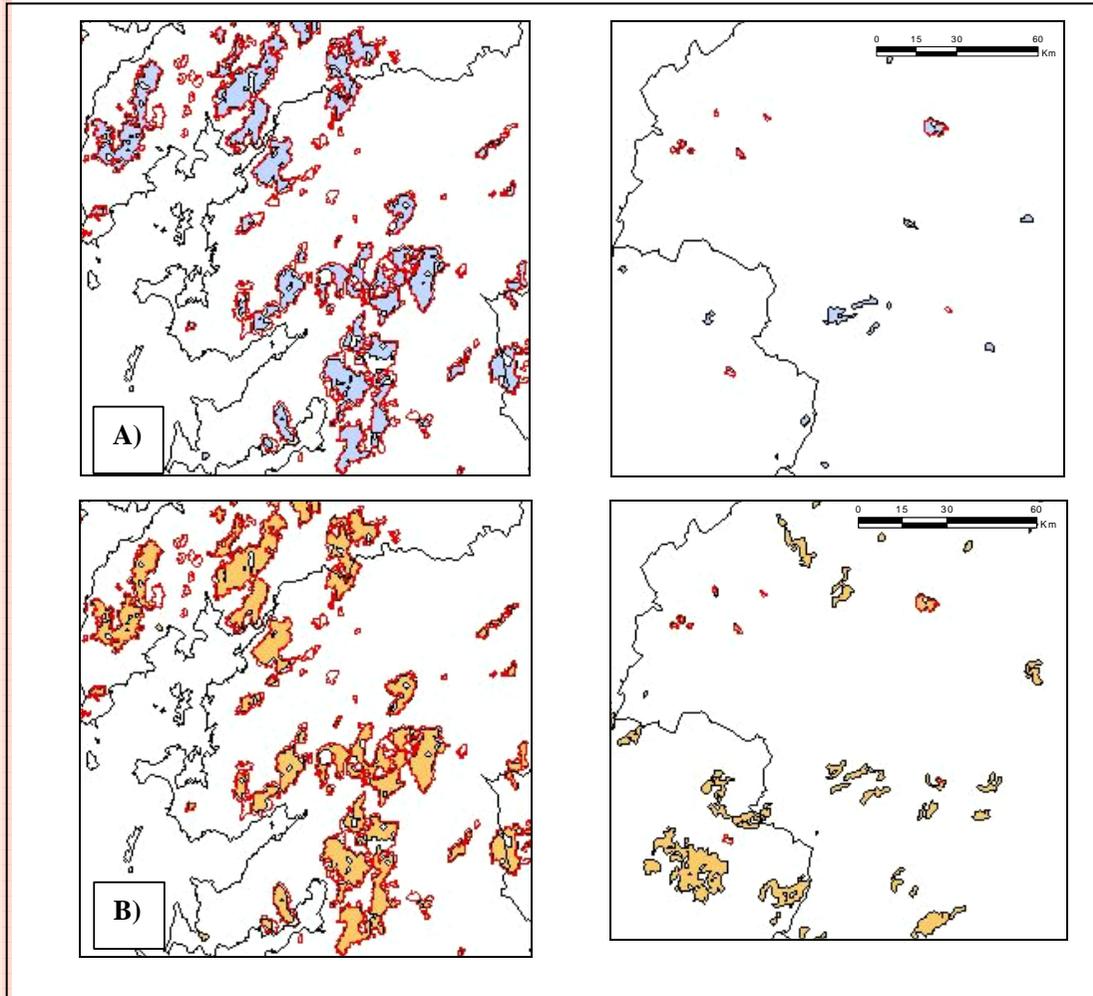
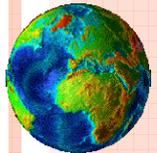
Mediciones en matorral
Riaño et al., 2007, IJWF

Cartografía de área quemada

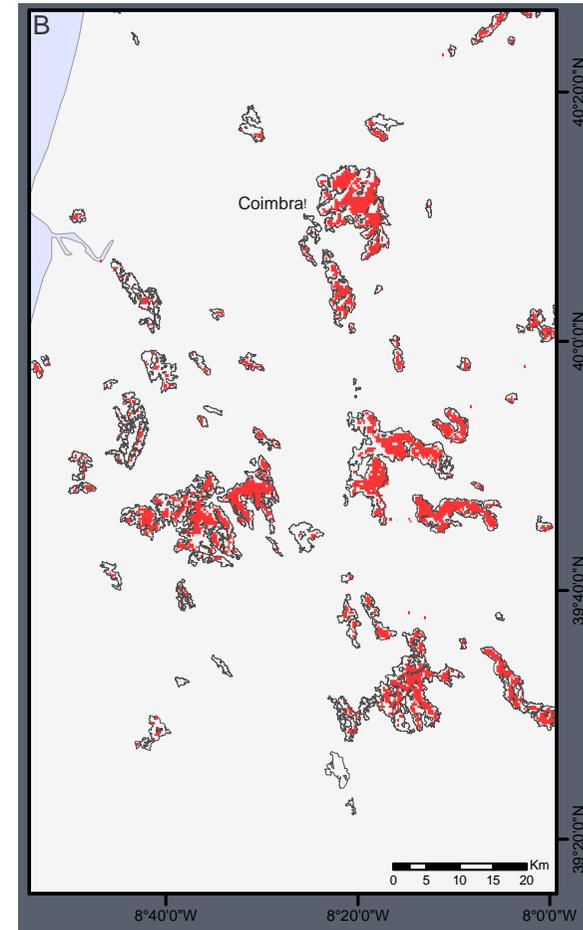
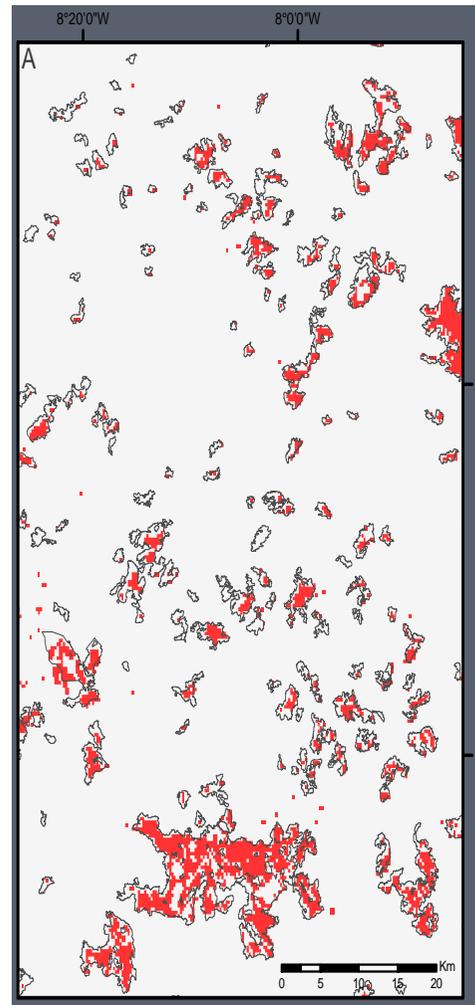
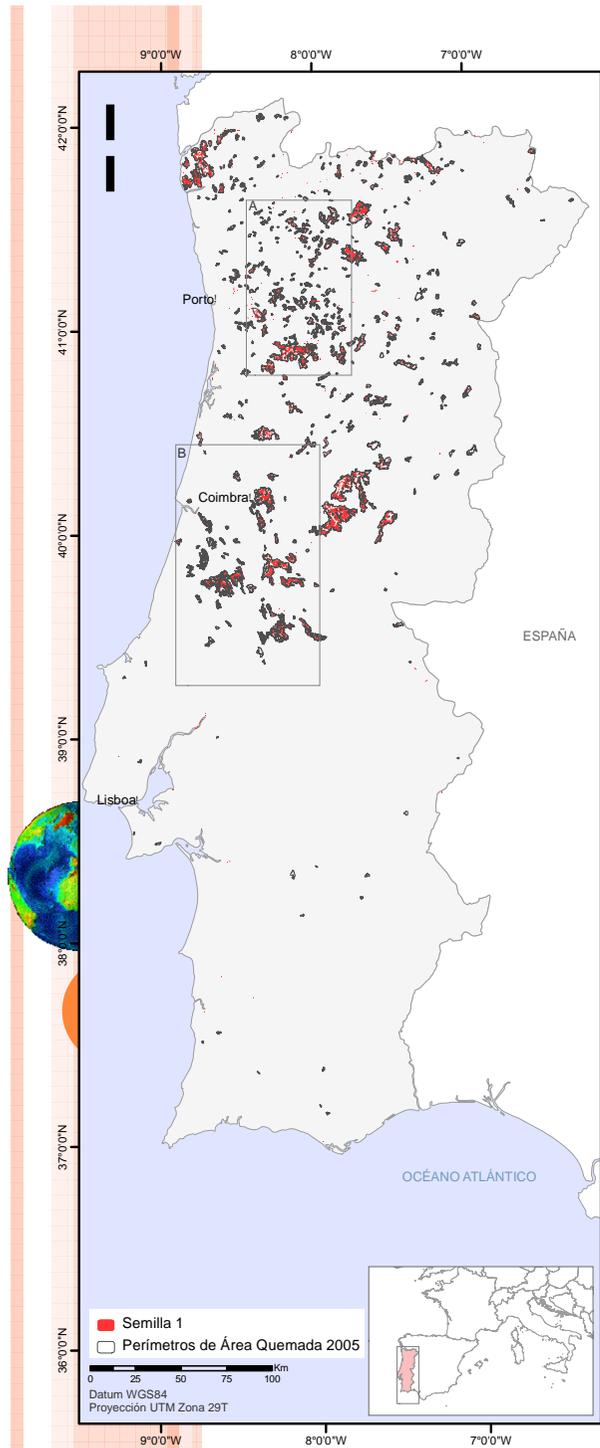
- Caracterización espectral: campo y laboratorio.
- Area quemada:
 - Algoritmos multitemporales: NOAA-AVHRR, Landsat-TM.
 - Algoritmos en dos fases: Landsat-TM, Envisat-MERIS, NOAA-AVHRR, Terra-MODIS.
- Severidad:
 - Modelos de simulación: Landsat-TM, MERIS, MODIS.
- Estimación de emisiones



Cartografía con MERIS

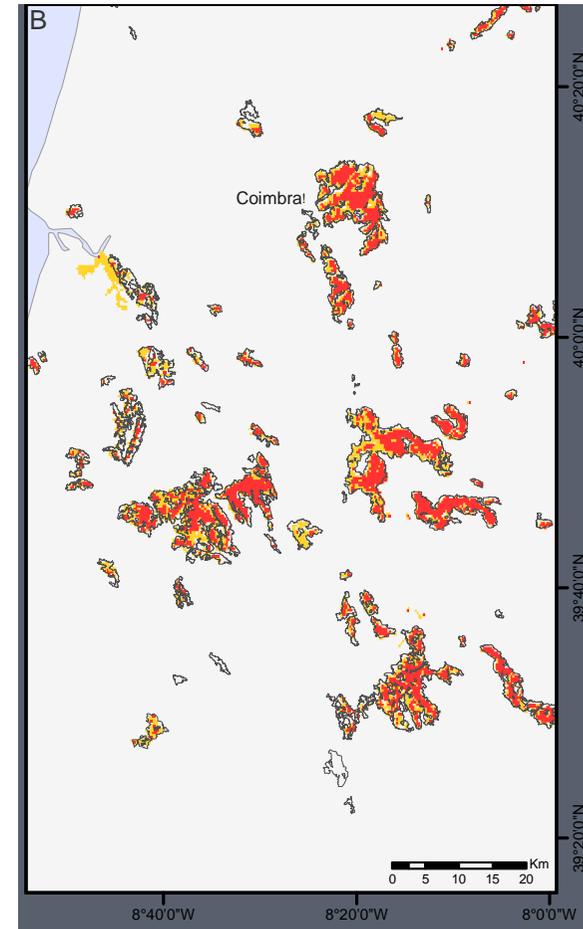
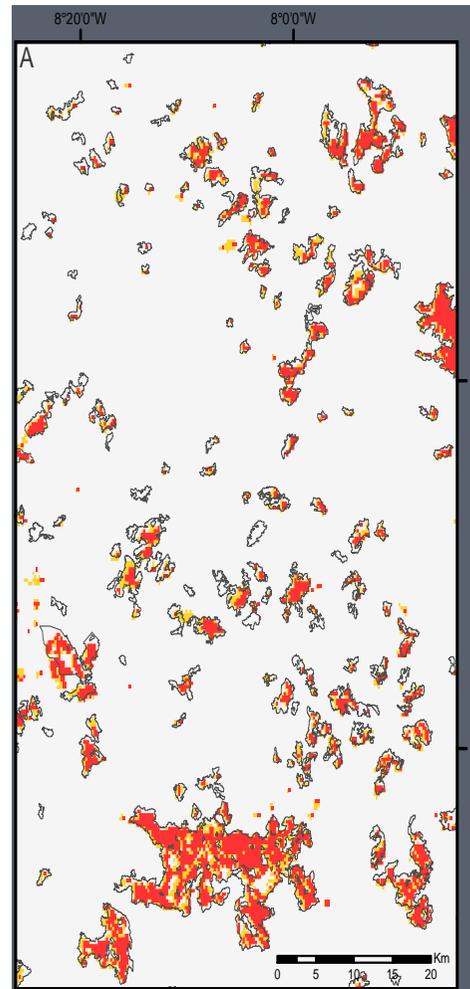
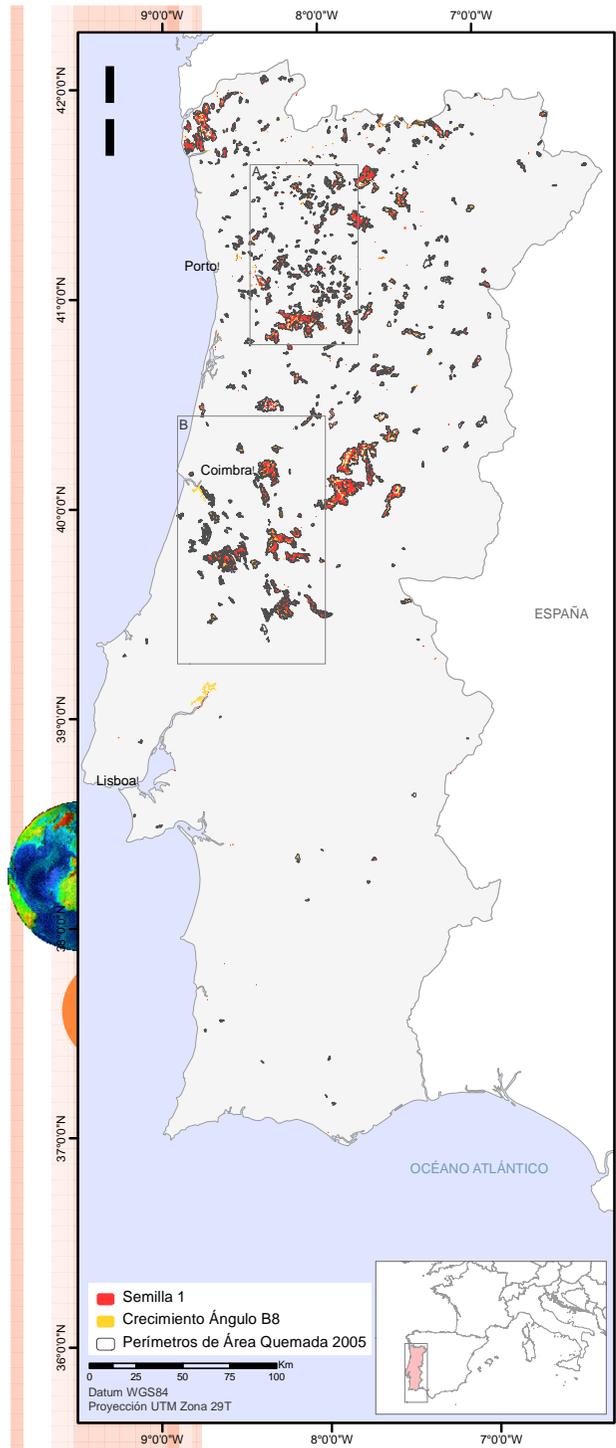


1ª Fase: Selección de Píxeles semilla

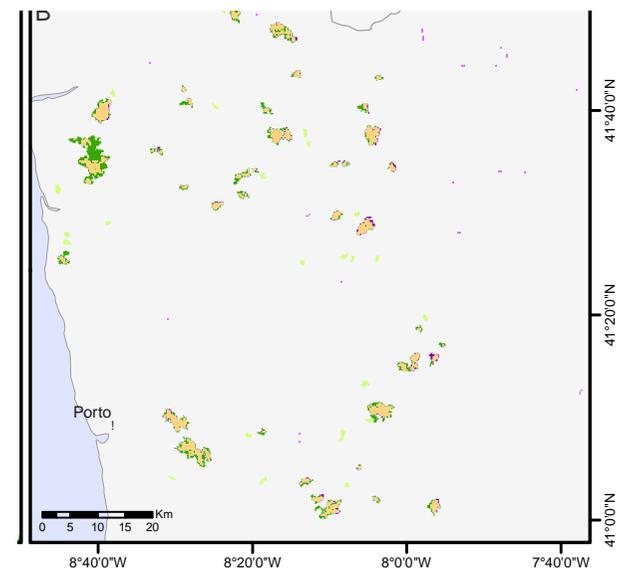
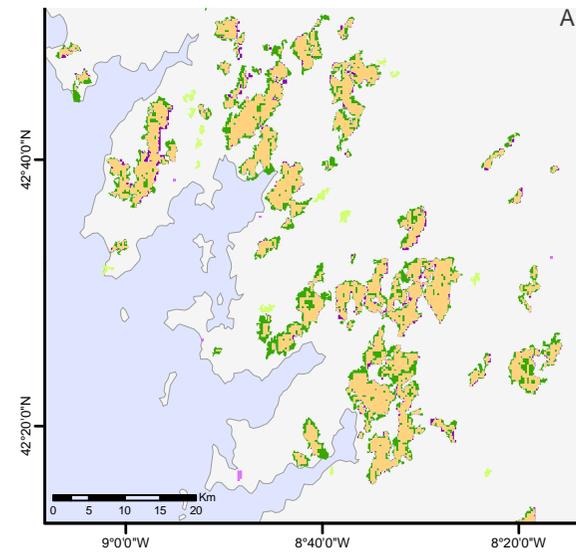
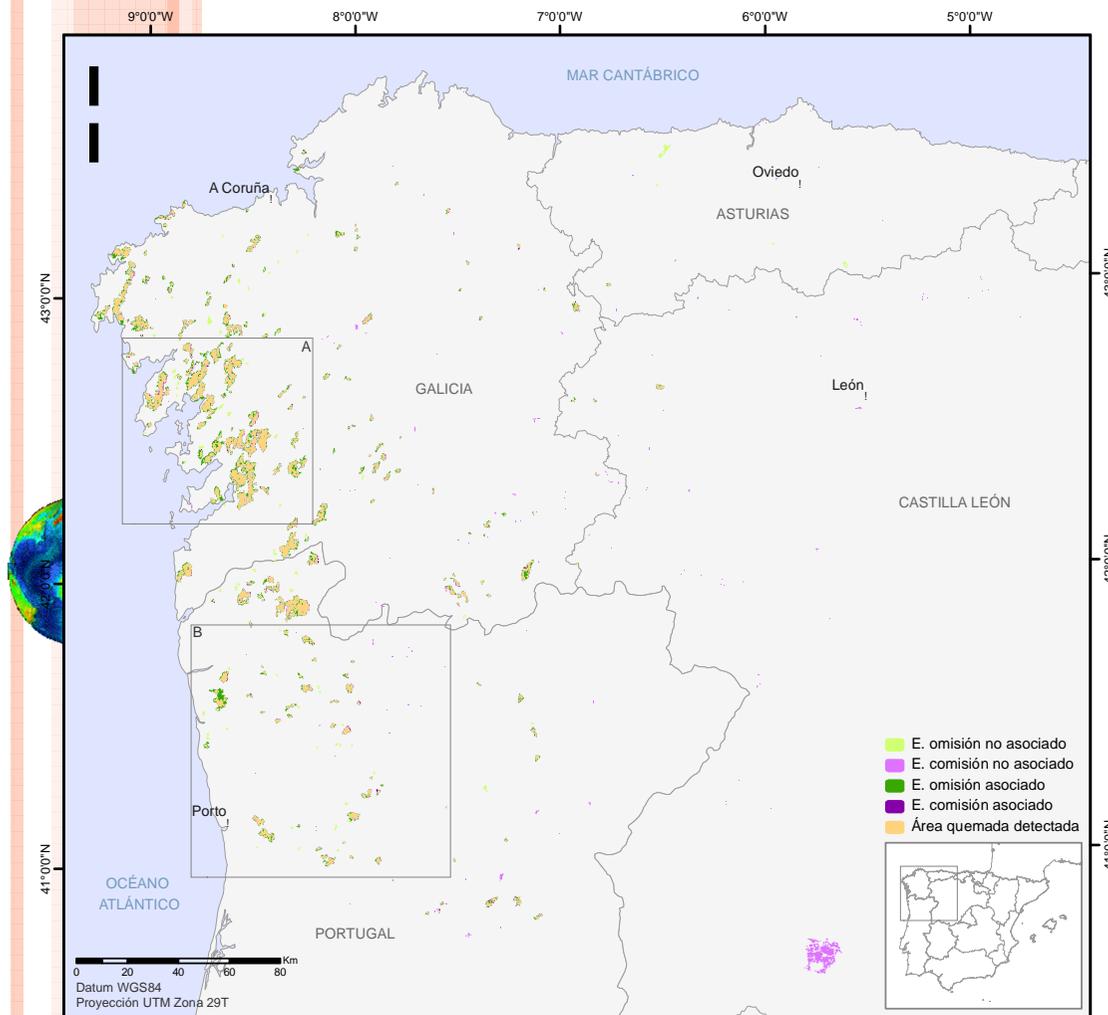


Oliva, 2010

2ª Fase: Algoritmo de crecimiento de regiones

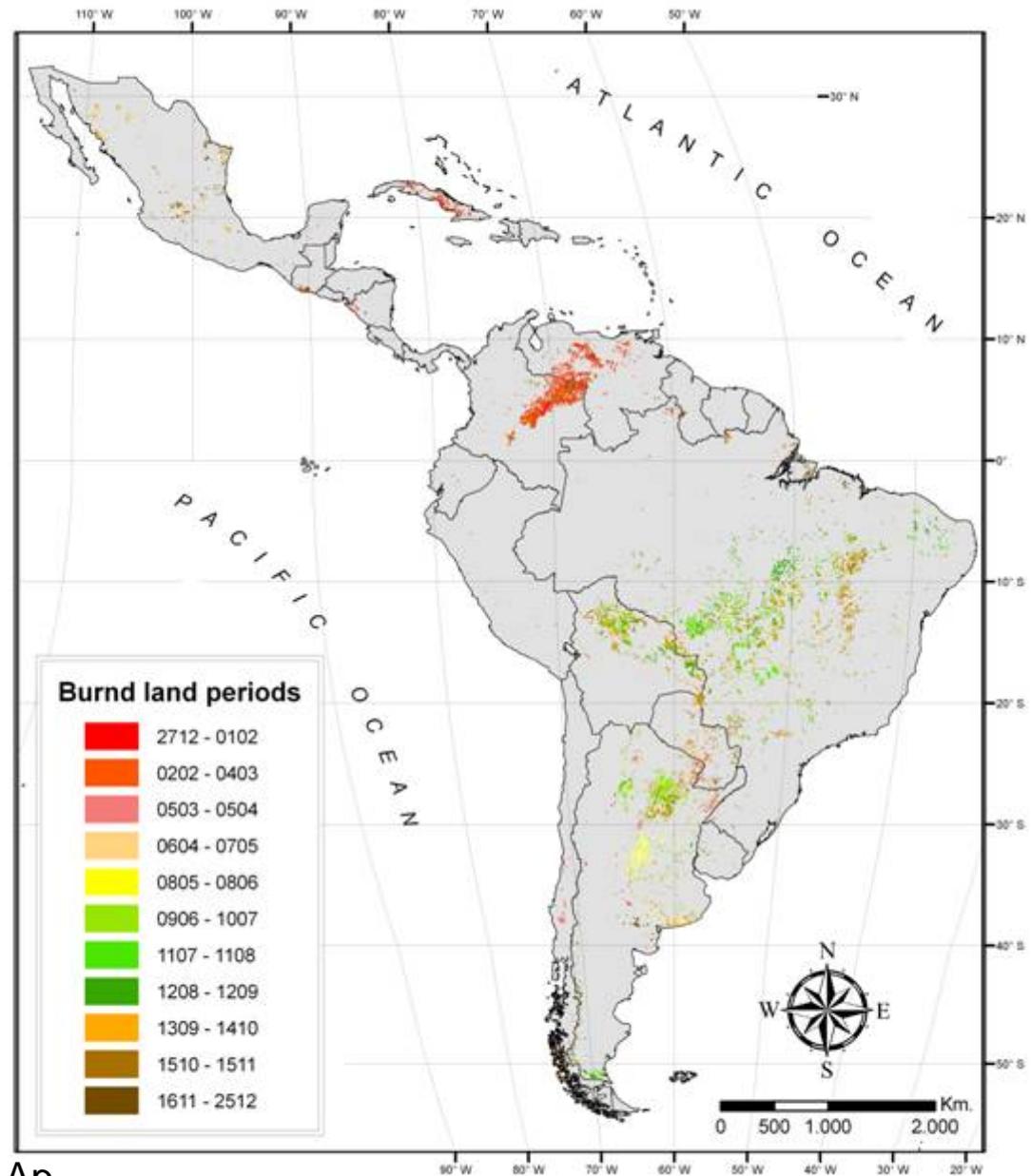
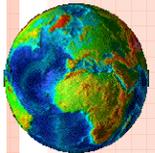


Validación independiente



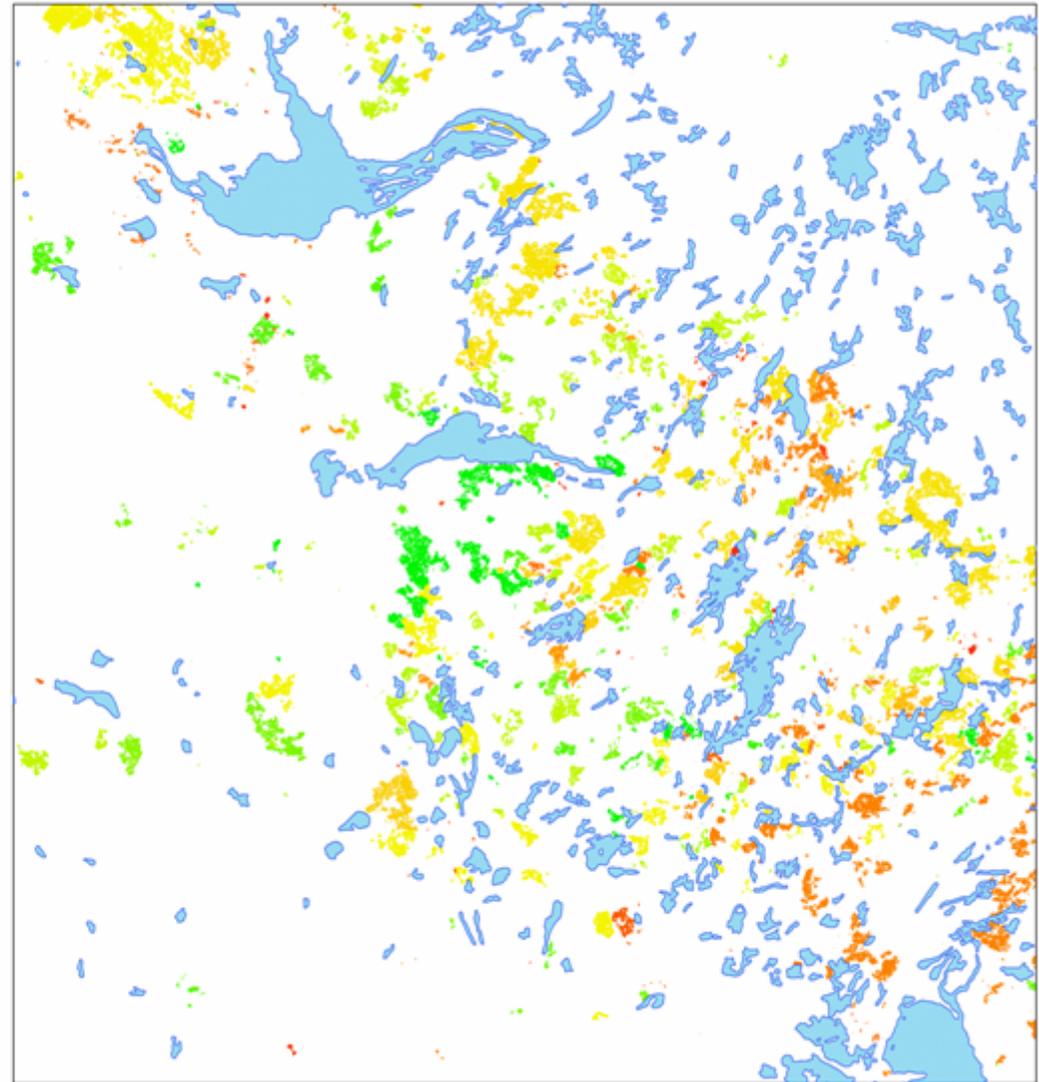
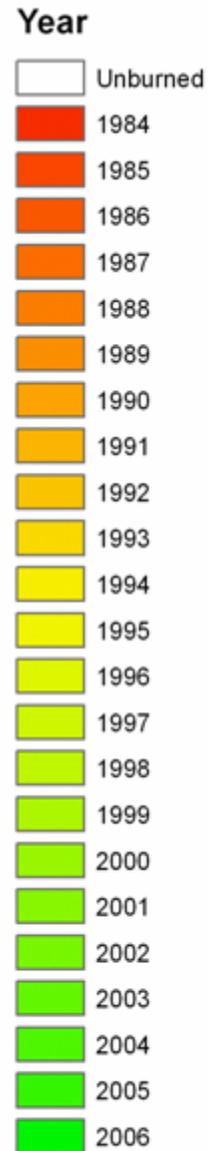
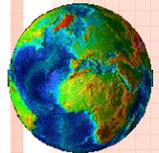
Terra-MODIS Proyecto AQL2004

con Redlatif



Chuvieco et al., 2008, Ecol Ap

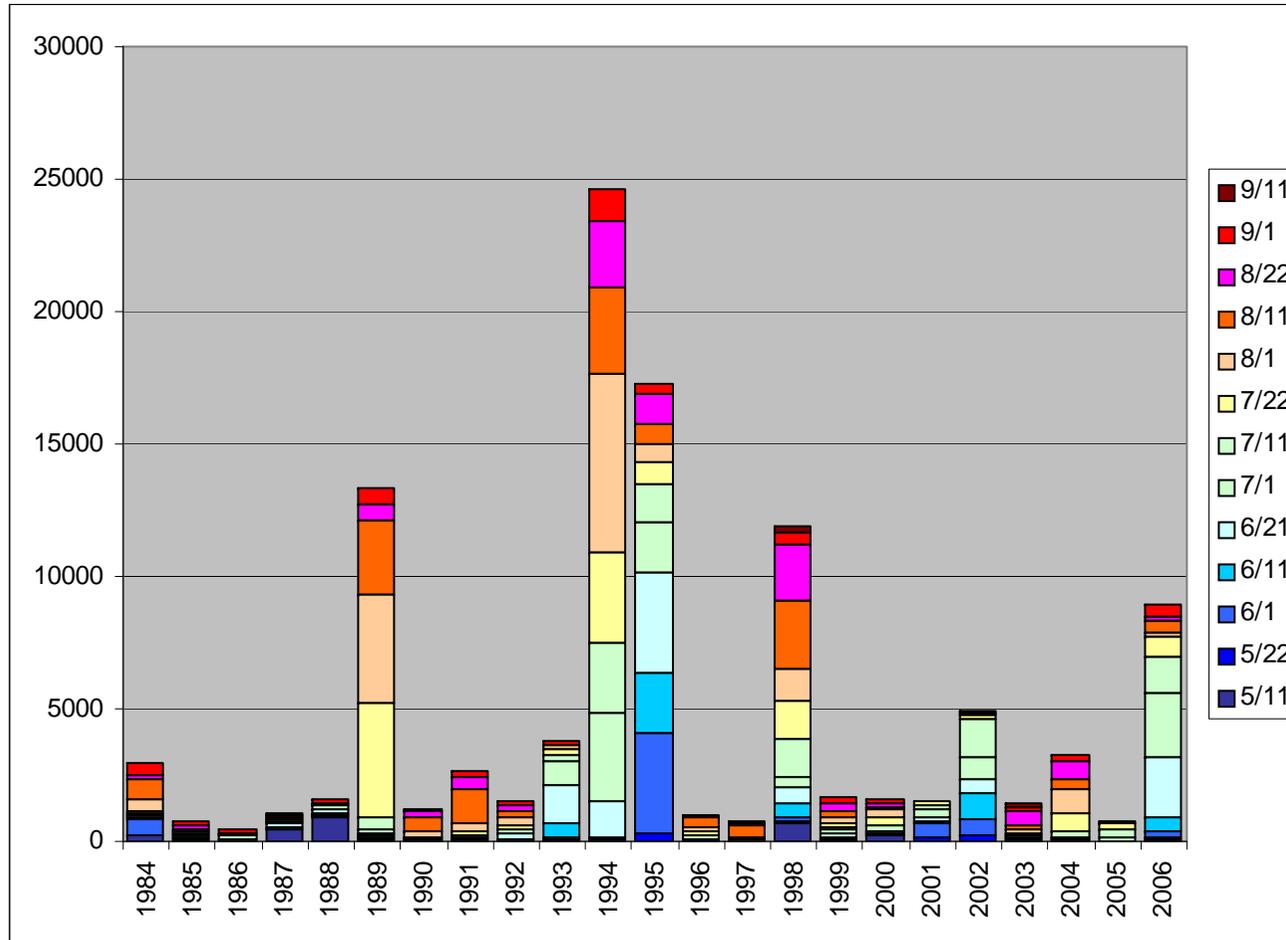
Series temporales con NOAA-AVHRR



Lakes

Chuvieco et al., 2008, RSE

Area quemada por periodos



Chuvieco et al., 2008, RSE

Análisis de tendencias post-incendio

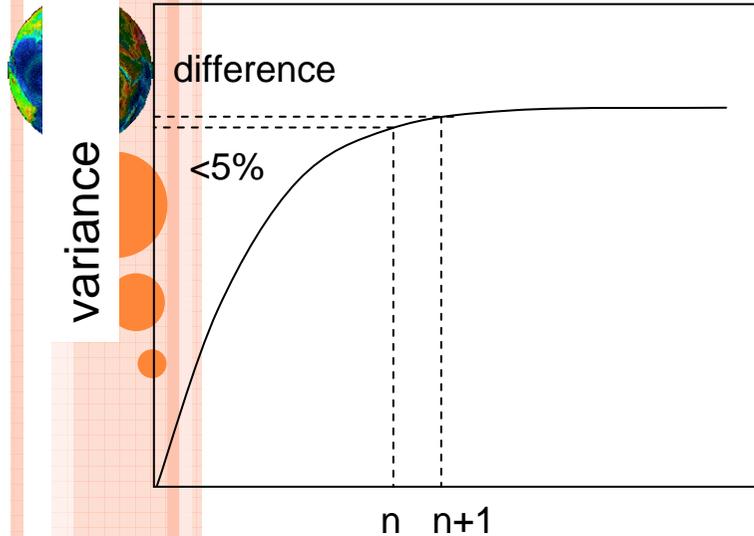
Bootstrap analysis:

Sample size

-N corresponding to an increase in cumulated variance lower than 5%

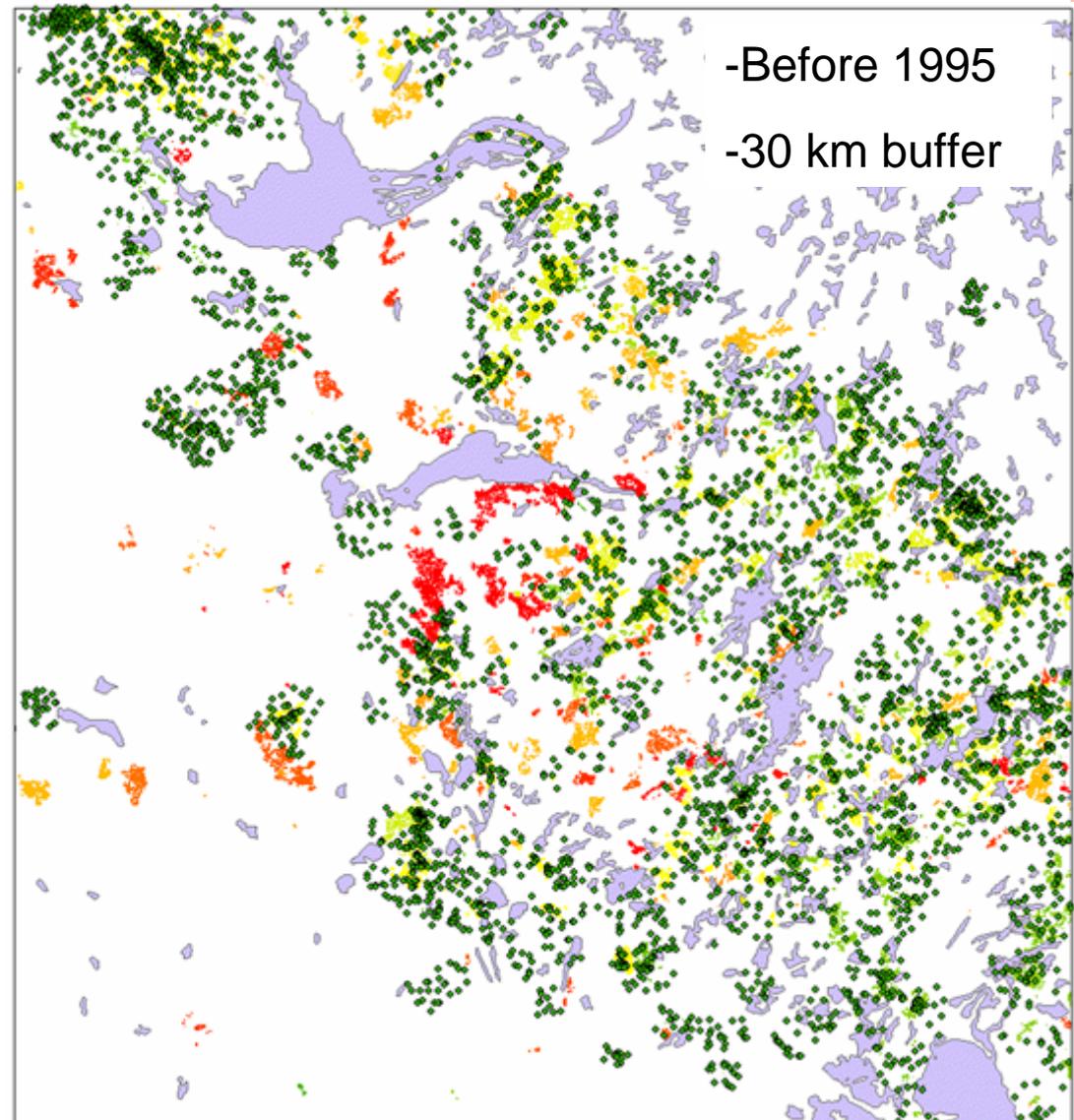
- 1000 repetitions

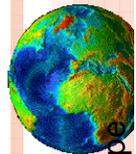
-Sample size = mean N



Alcaraz et al., 2009, GCB

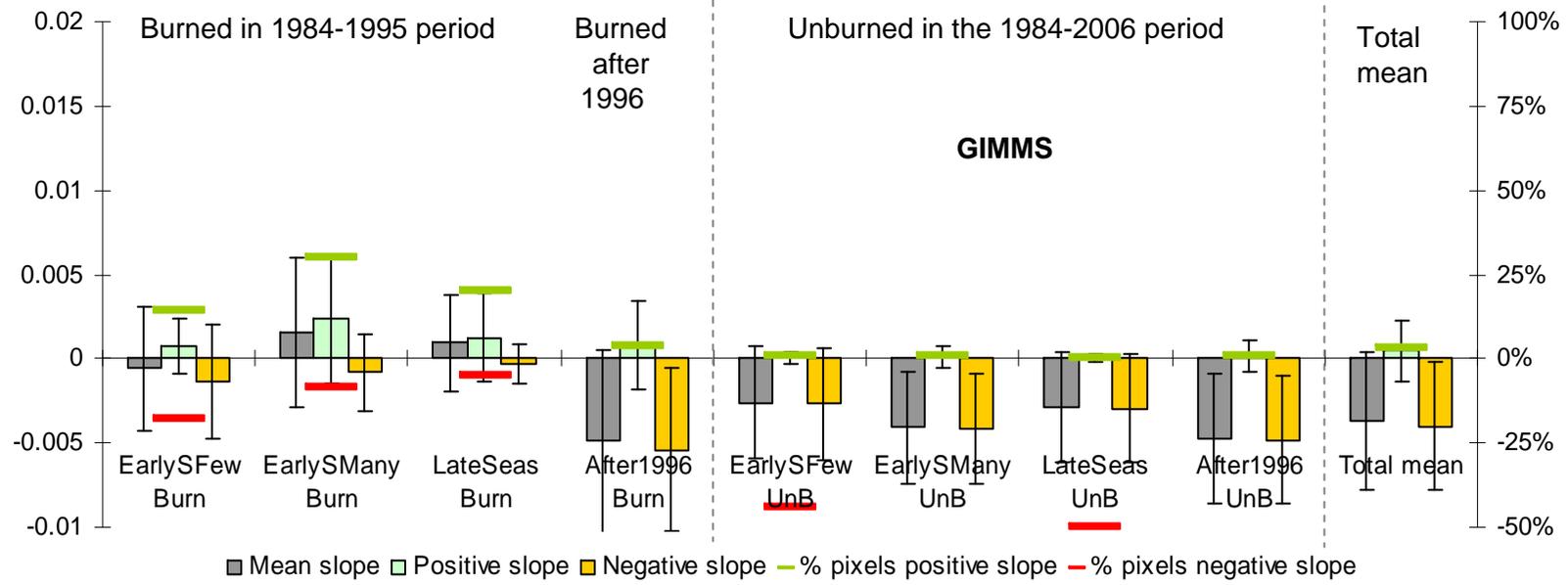
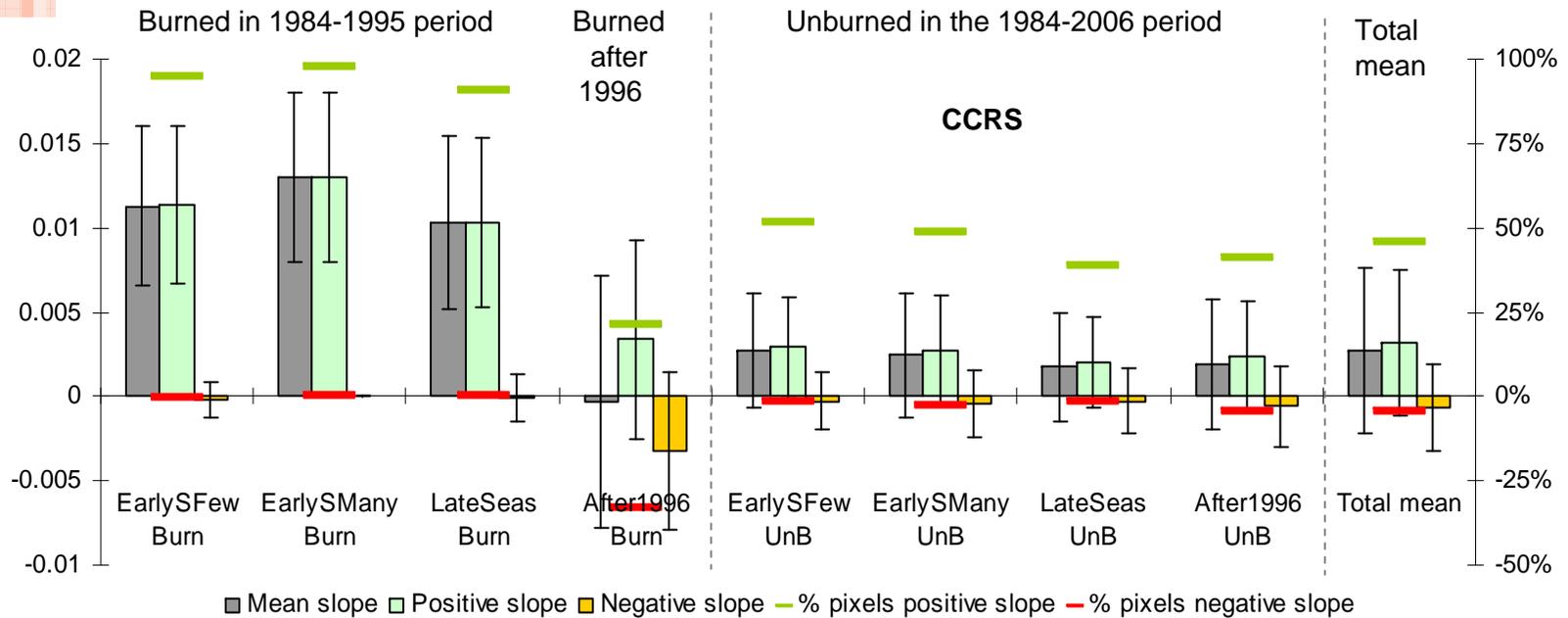
Original random sampling (4500)



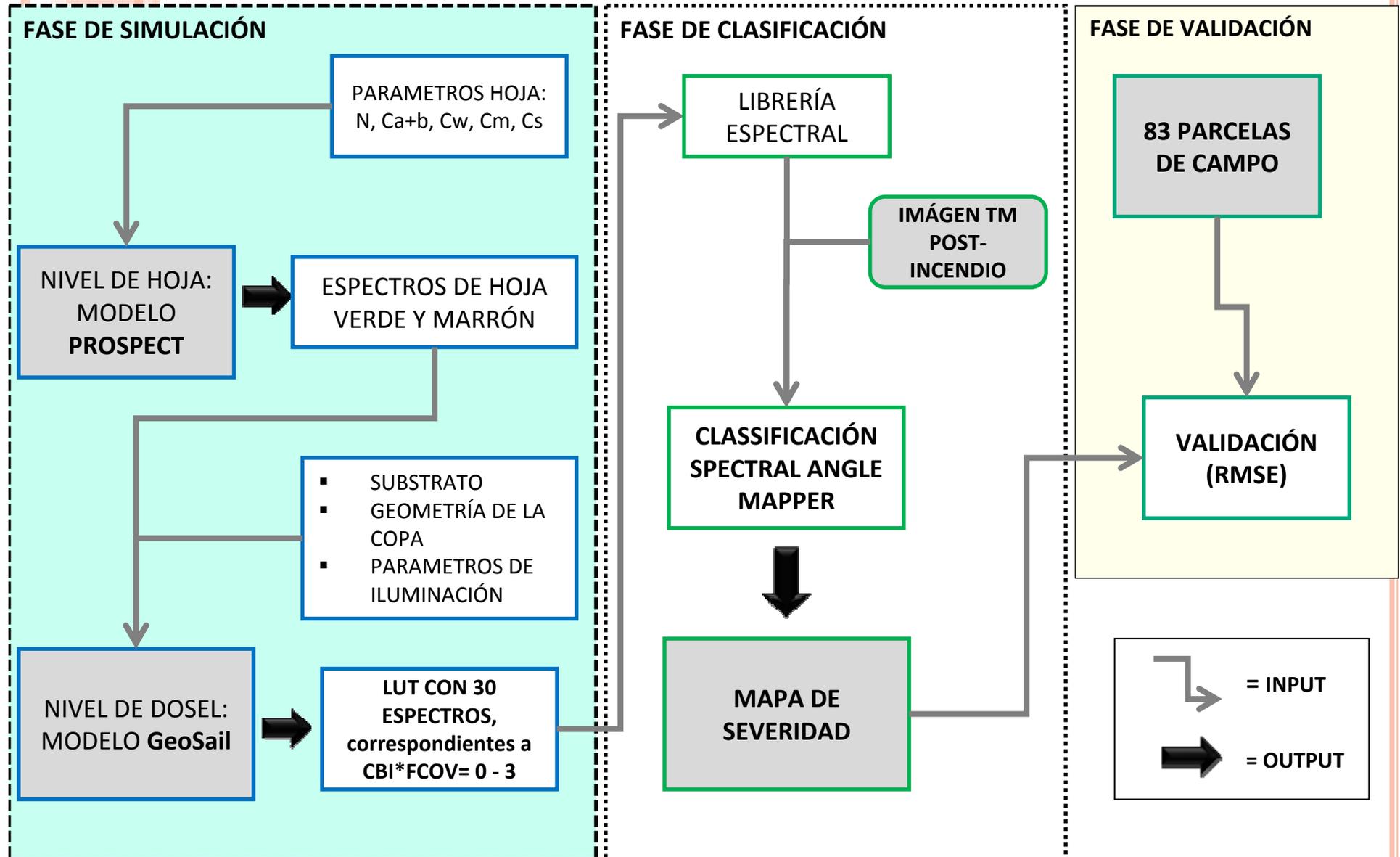


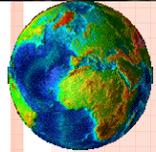
Slope

Slope

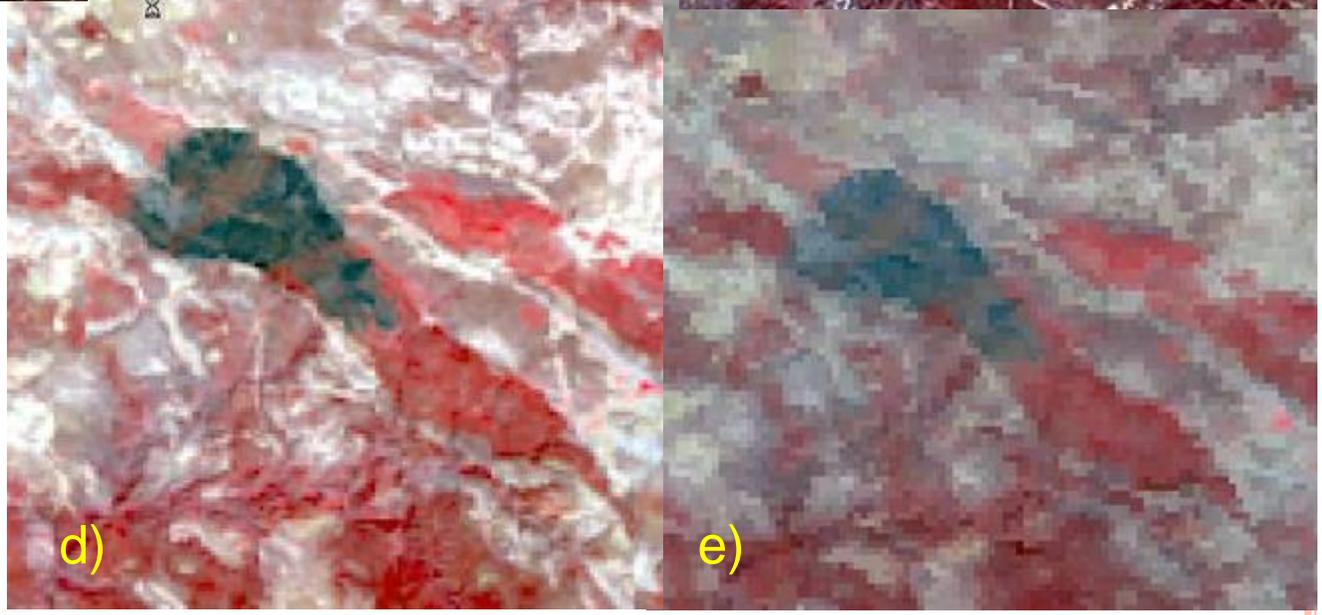


Severidad, simulación





a) SPOT-HRV, b)
Landsat-TM, c)
IRS-AWIFS, d)
ENVISAT-
MERIS, e)
TERRA-MODIS



Chuvieco et al., 2007

Comparación RTM y empírico



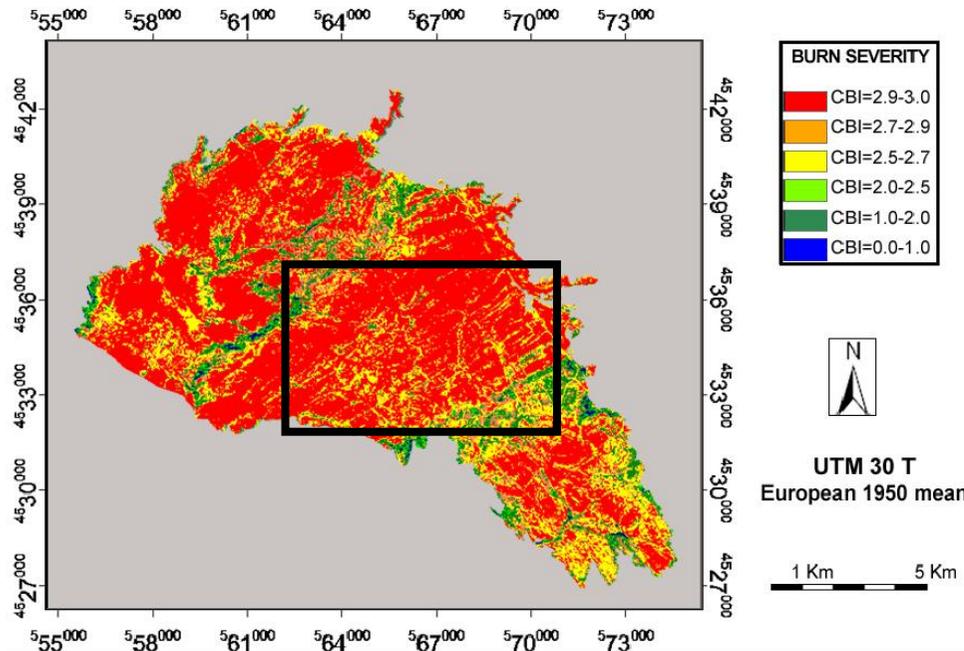
$R^2 = 0.66$

Variables included:

dNDVI+Sat

Tendency to smooth CBI

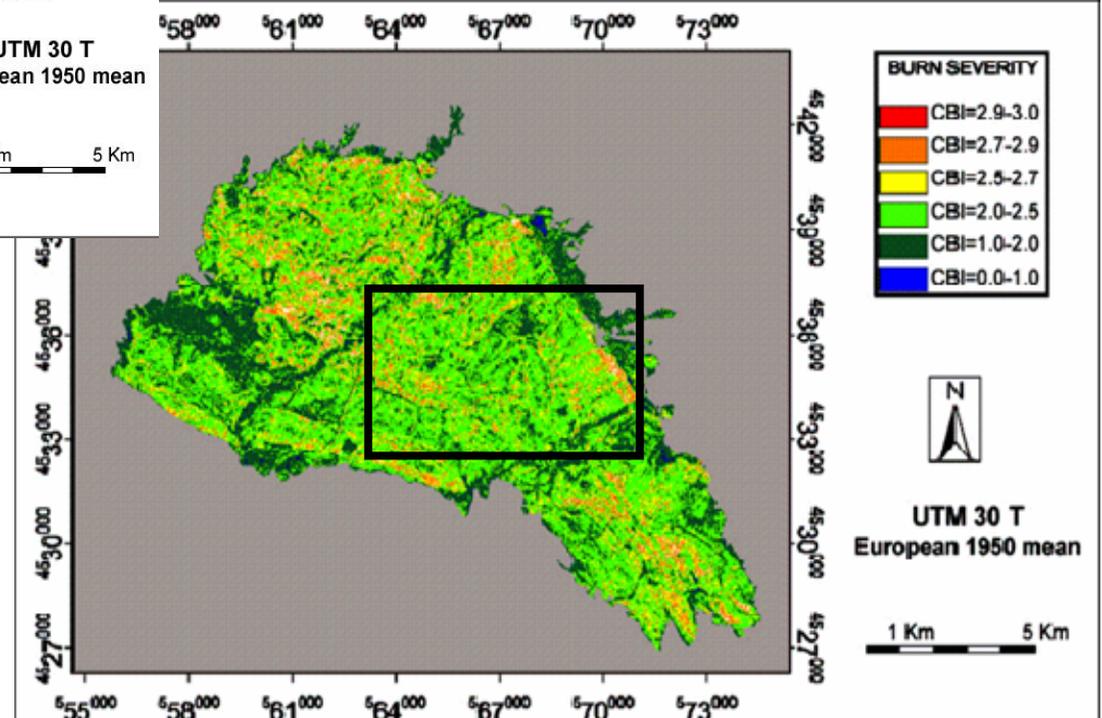
values



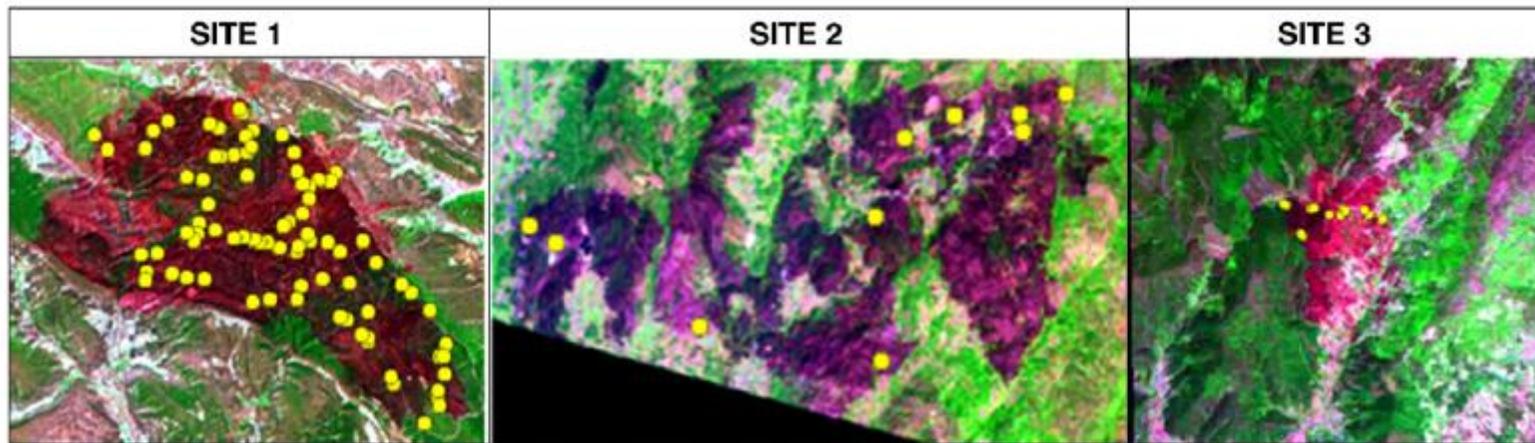
$R^2 = 0.63$

Supervised simulation

(De Santis y Chuvieco, 2007)



Otros lugares



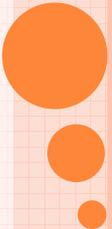
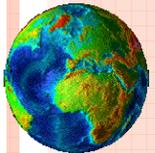
Validation results for the three study areas

	Site 1	Site 2	Site 3
Linear regression	$y=0.963x+0.032$	$y=0.495x+1.443$	$y=1.046x-0.062$
R^2	0.43	0.69	0.96
RMSE	0.19	0.18	0.21

De Santis et al, 2009, RSE

Estimación de emisiones

El valor estimado de emisiones de CO₂ de 9,45 Tg año⁻¹ podría subir a 11 Tg año⁻¹ si corregimos por subestimación en área quemada, y este a su vez, podría variar entre 9,7 Tg año⁻¹ hasta 17 Tg año⁻¹ si utilizamos el método RGI o simplemente los BES como factores de emisión



Anaya, 2009

