www.csiro.au

Applications of hyperspectral data collected during the AACES field campaign

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with contributions from Guy Byrne (CLW), Mariano Oyarzabal (IFEVA) and

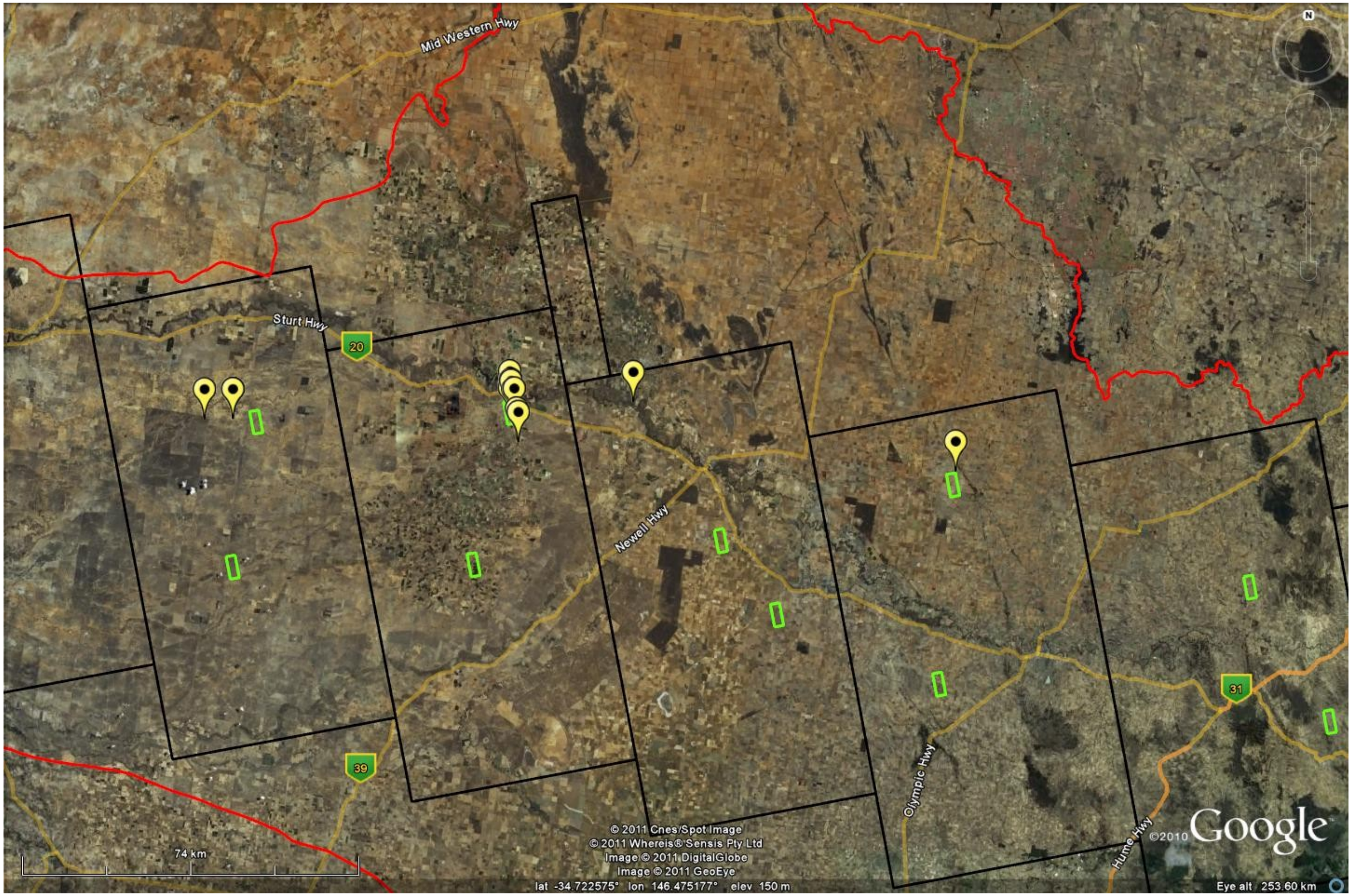
Sara Jurdao (UAH)

Overview

- Aims of the field data acquisition:
  - Validate and further improve a method for mapping vegetation fractional cover with MODIS
  - Validate a model of fuel moisture content estimation for fire risk analysis

- Coincident with the AACES campaign we collected additional data including
  - Vegetation cover
    - Photosynthetic
    - Non-photosynthetic
    - Bare soil
  - Vegetation moisture content
  - Vegetation spectral properties

Site locations



Murrumbidgee Catchment

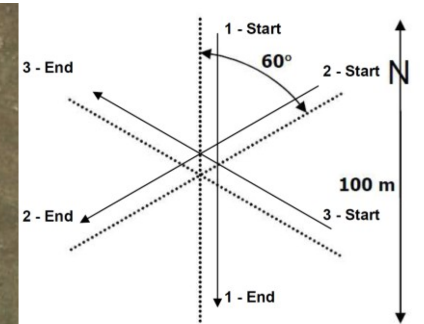
Core locations

Measurements

- “SLATS” star
  - Vegetation cover every meter along 3x100m transects in a star shape
  - 300 observations
  - Derivation of cover fractions
- Spectra
  - Integrated spectra along the 100m transects (ASD Field Spectrometer)
  - Spectra for “endmembers”
- Vegetation moisture content
  - Vegetation harvested and weighted wet and dry

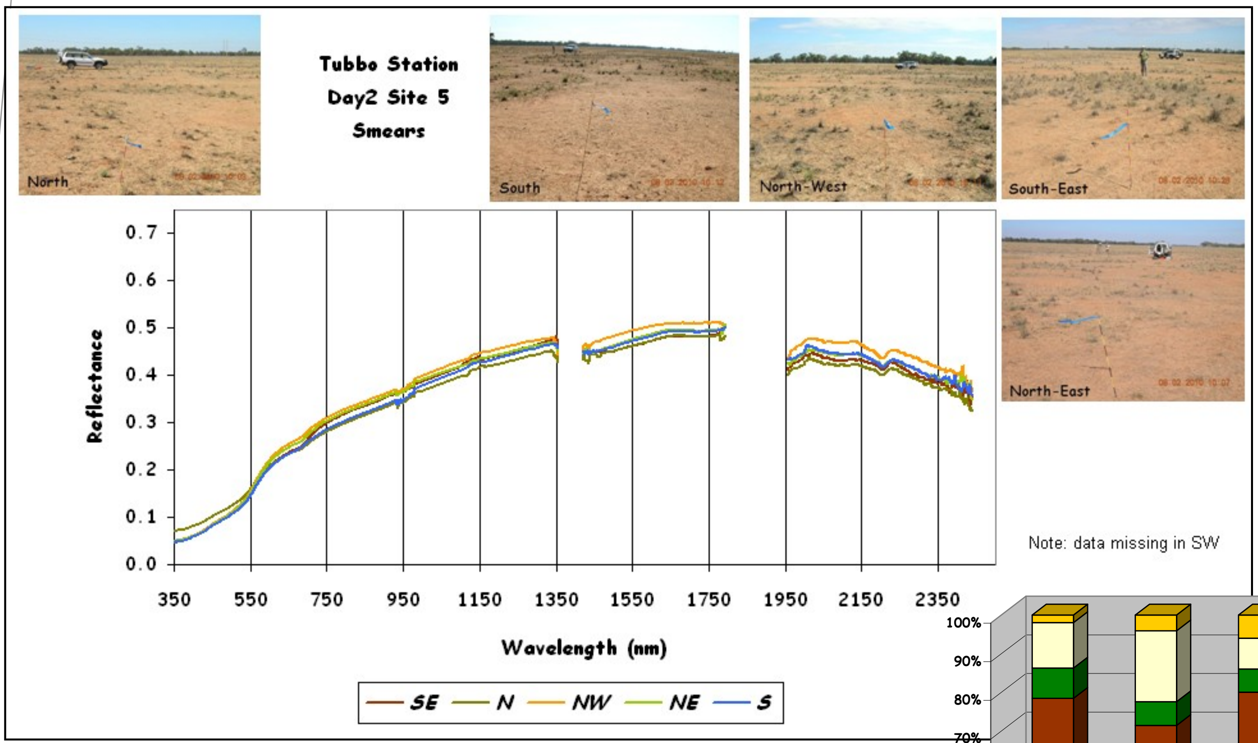
$$FMC(\%) = \frac{W_f - W_d}{W_d} \times 00$$

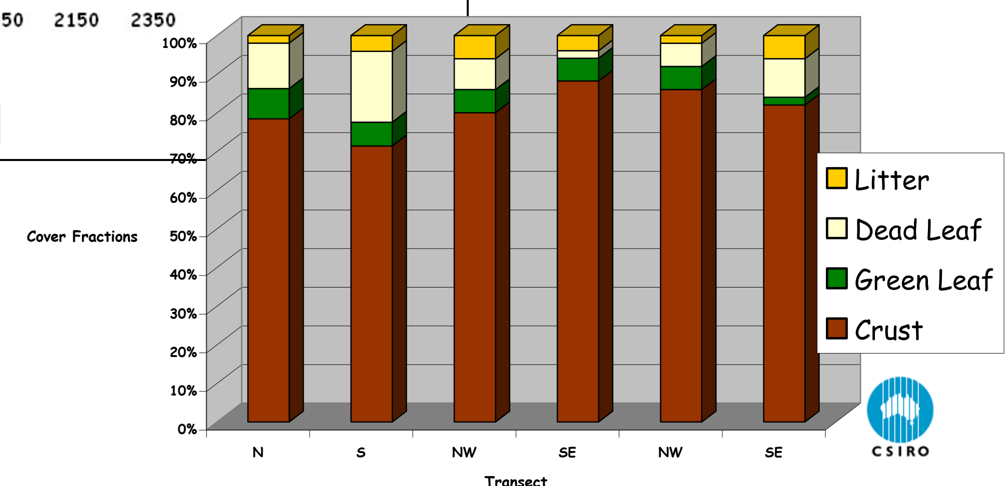
Where Wf=fresh weight; Wd= dry weight (48h, 60º);



Some results

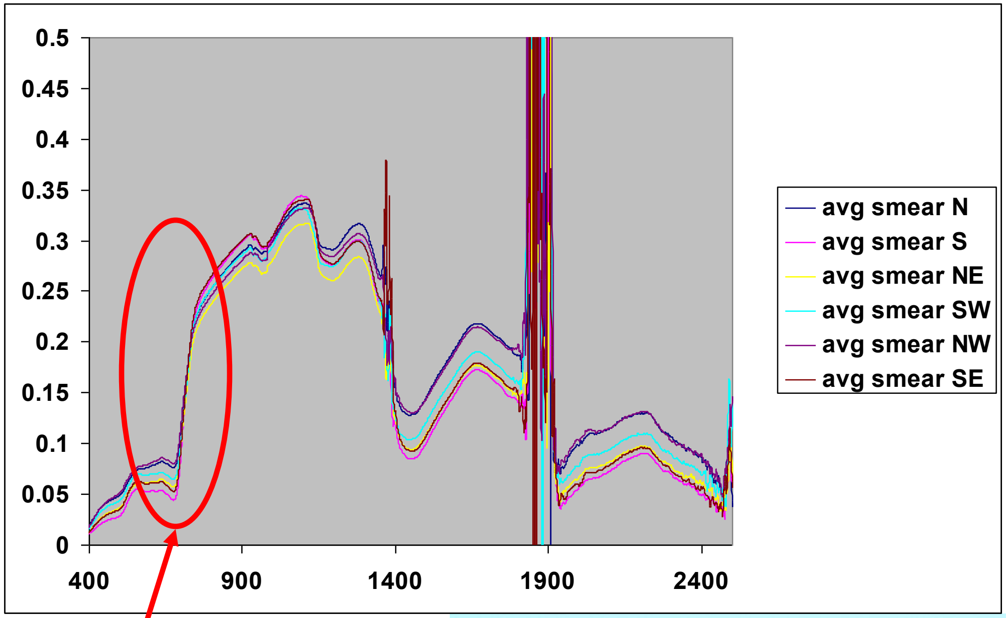
- Very low vegetation cover site (February)





Some results

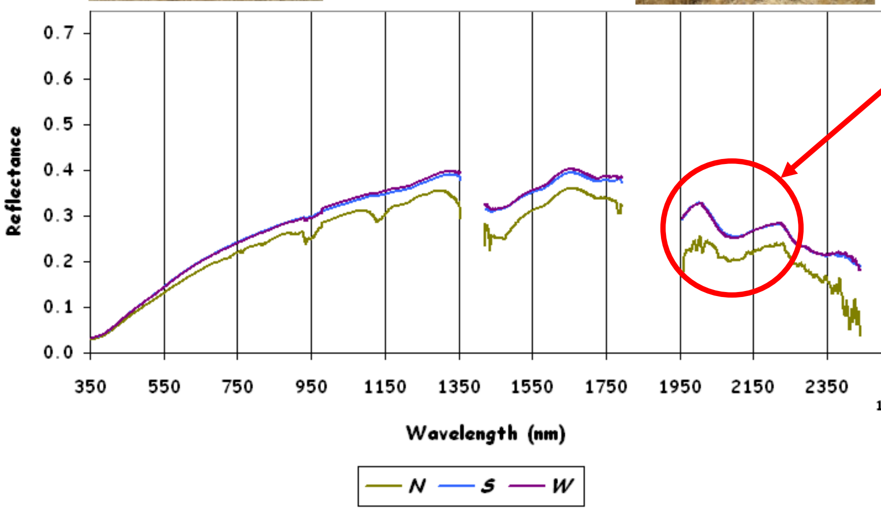
- High green vegetation (October)



Vegetation
“red edge”

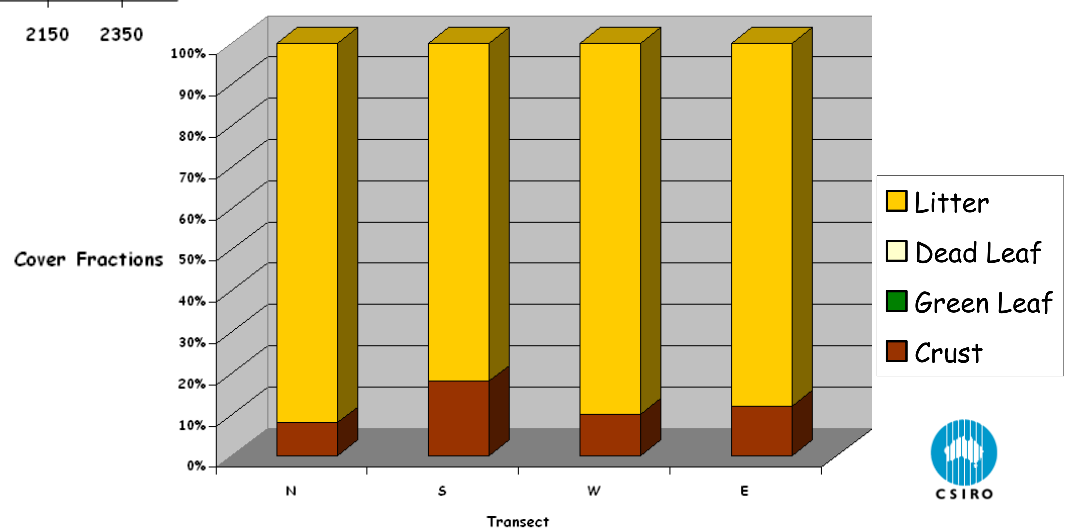
Some results

- High dry vegetation cover (wheat stubble)



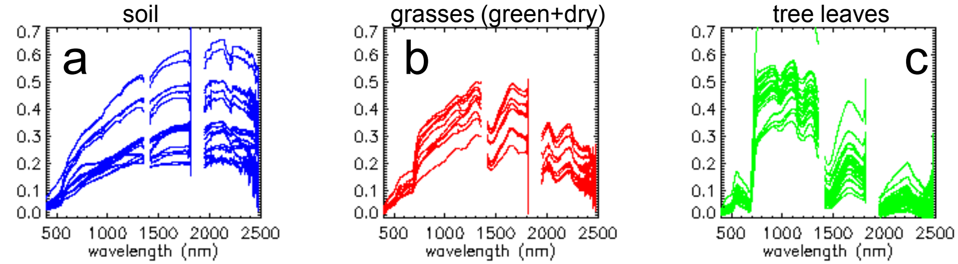
cellulose – lignin

Note : Smear to the east is missing and photo to the west missing



How the fractional cover method works

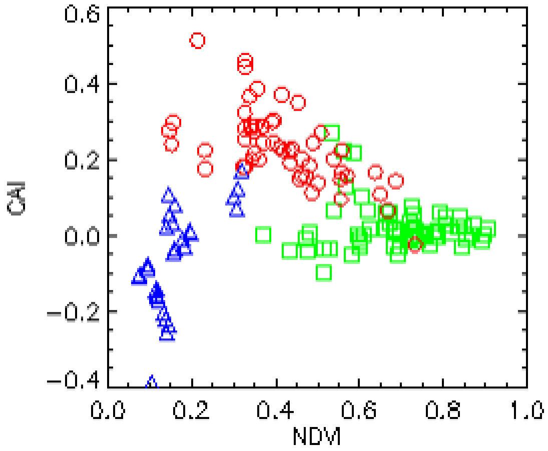
- Using hyperspectral data, the Cellulose Absorption Index (CAI) and the NDVI can separate the fractions of green veg, dry veg and soil



$$NDVI = (\rho_{NIR} - \rho_{RED}) / (\rho_{NIR} + \rho_{RED})$$

and

$$CAI = [0.5 \cdot (\rho_{2.0} + \rho_{2.2}) - \rho_{2.1}] \cdot 10$$



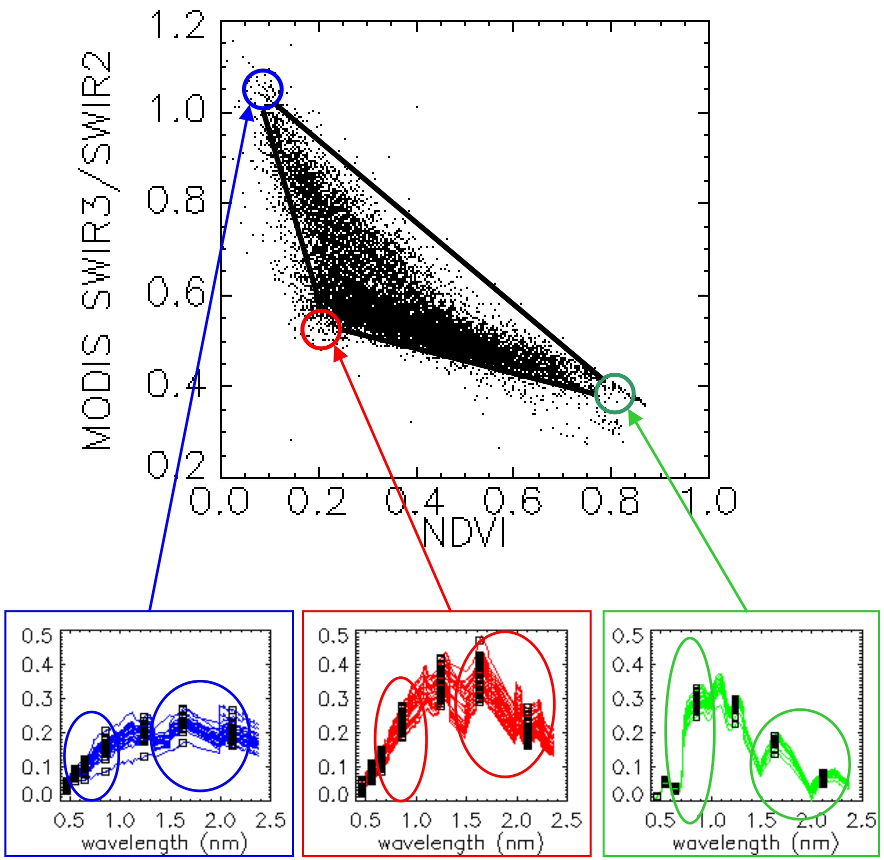
- Multispectral sensors like MODIS can't "see" the cellulose-lignin feature

(Guerschman et al, 2009, RSE)

How the fractional cover method works

- But vegetation, either green or dry, reflectance in the long IR (~2µm) are lower than in the medium IR (~1.6 µm)

- The ratio of MODIS bands 7 and 6 replaces the CAI



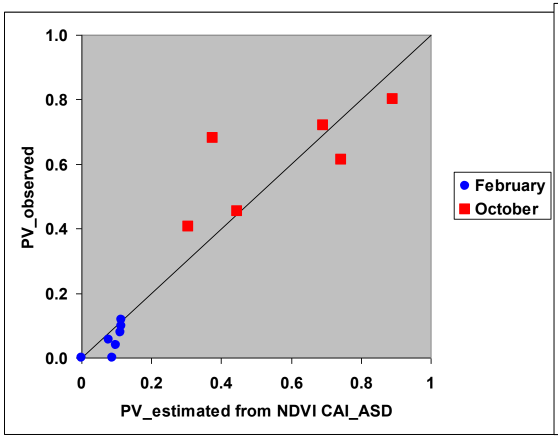
(Guerschman et al, 2009, RSE)

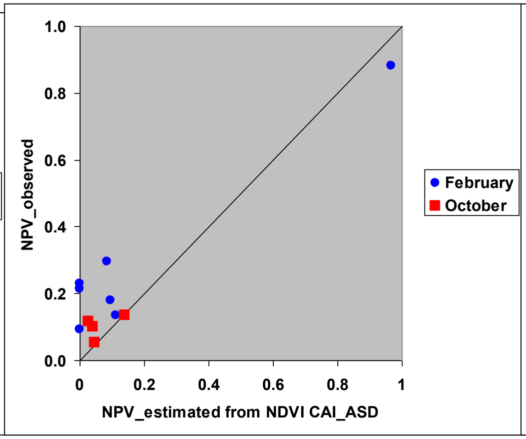
Collaborators

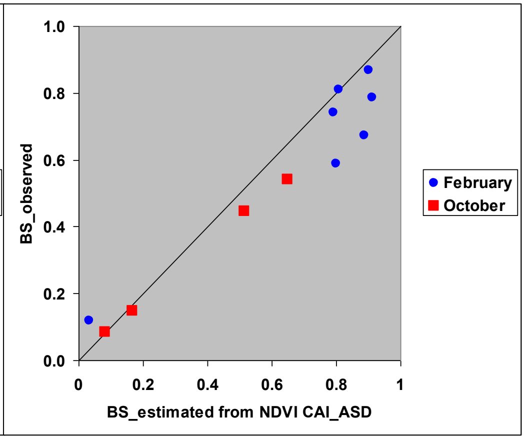
Some results

Photosynthetic Vegetation | Non-photosynthetic Vegetation | Soil

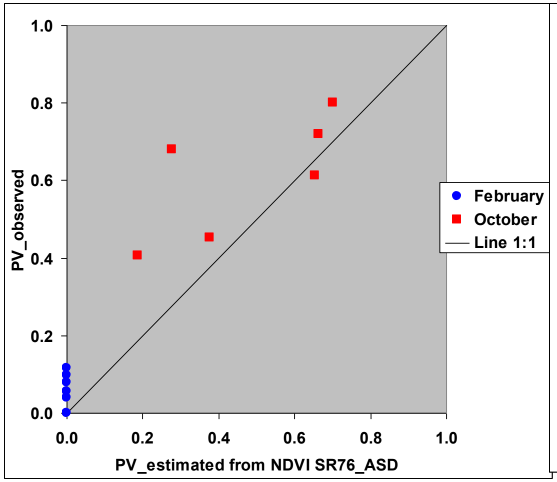
Hyperspectral model
(NDVI – CAI)

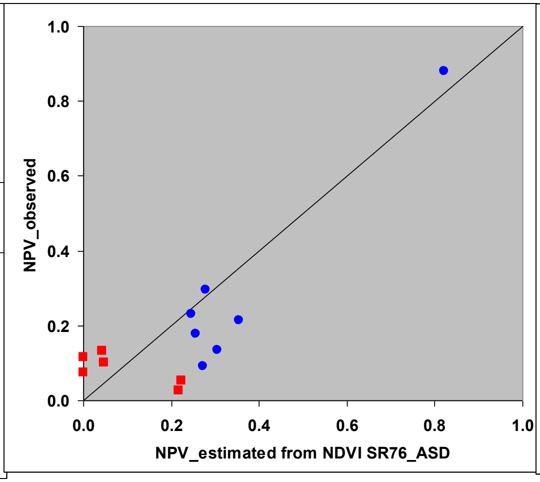


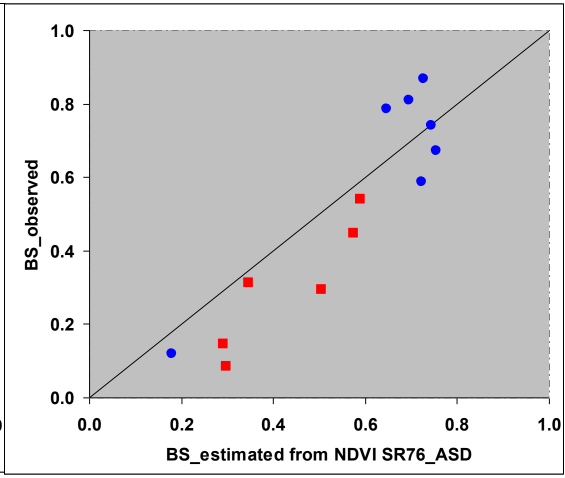




MODIS model
(NDVI – ratio bands 7 and 6)

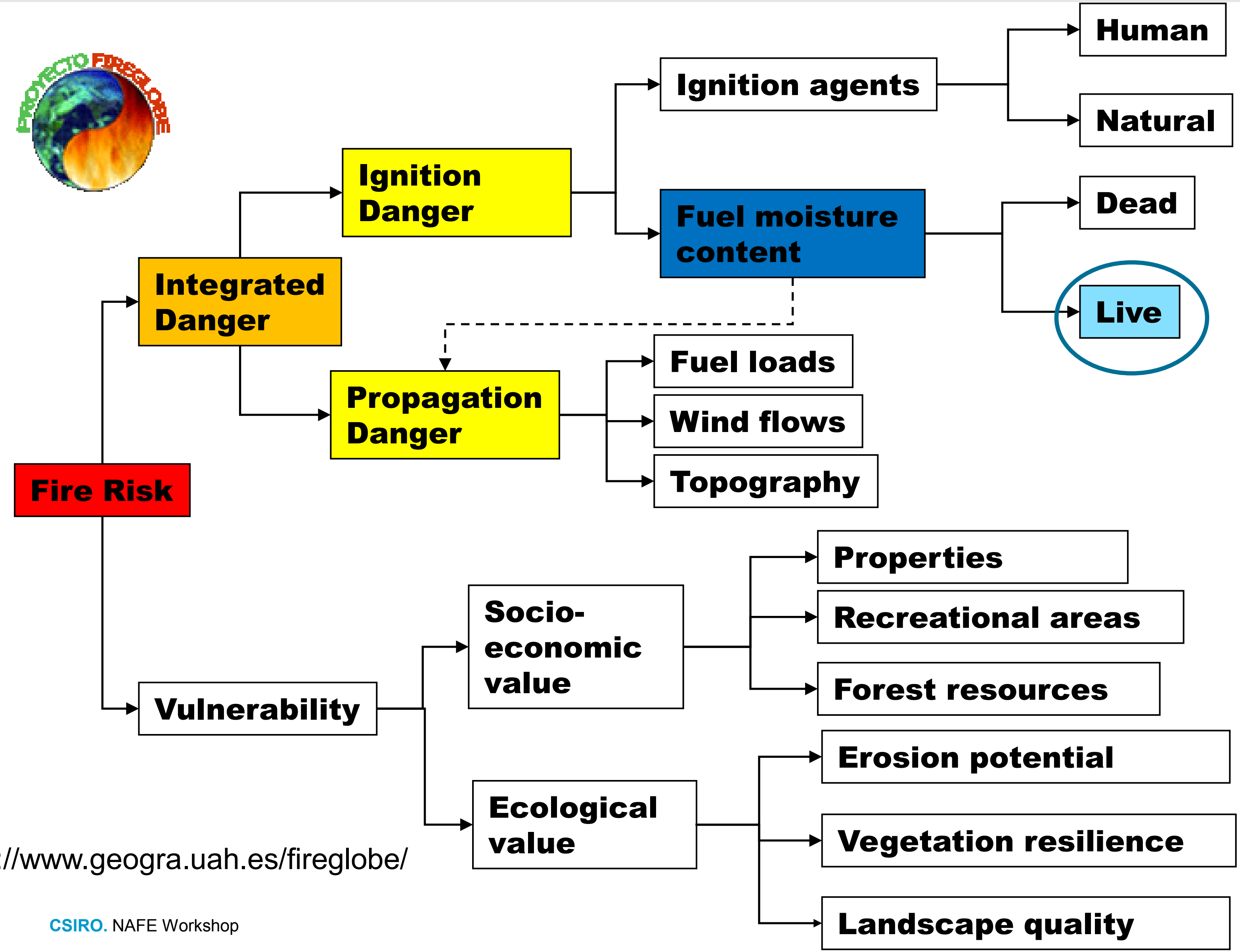






● February 2010
● October 2010

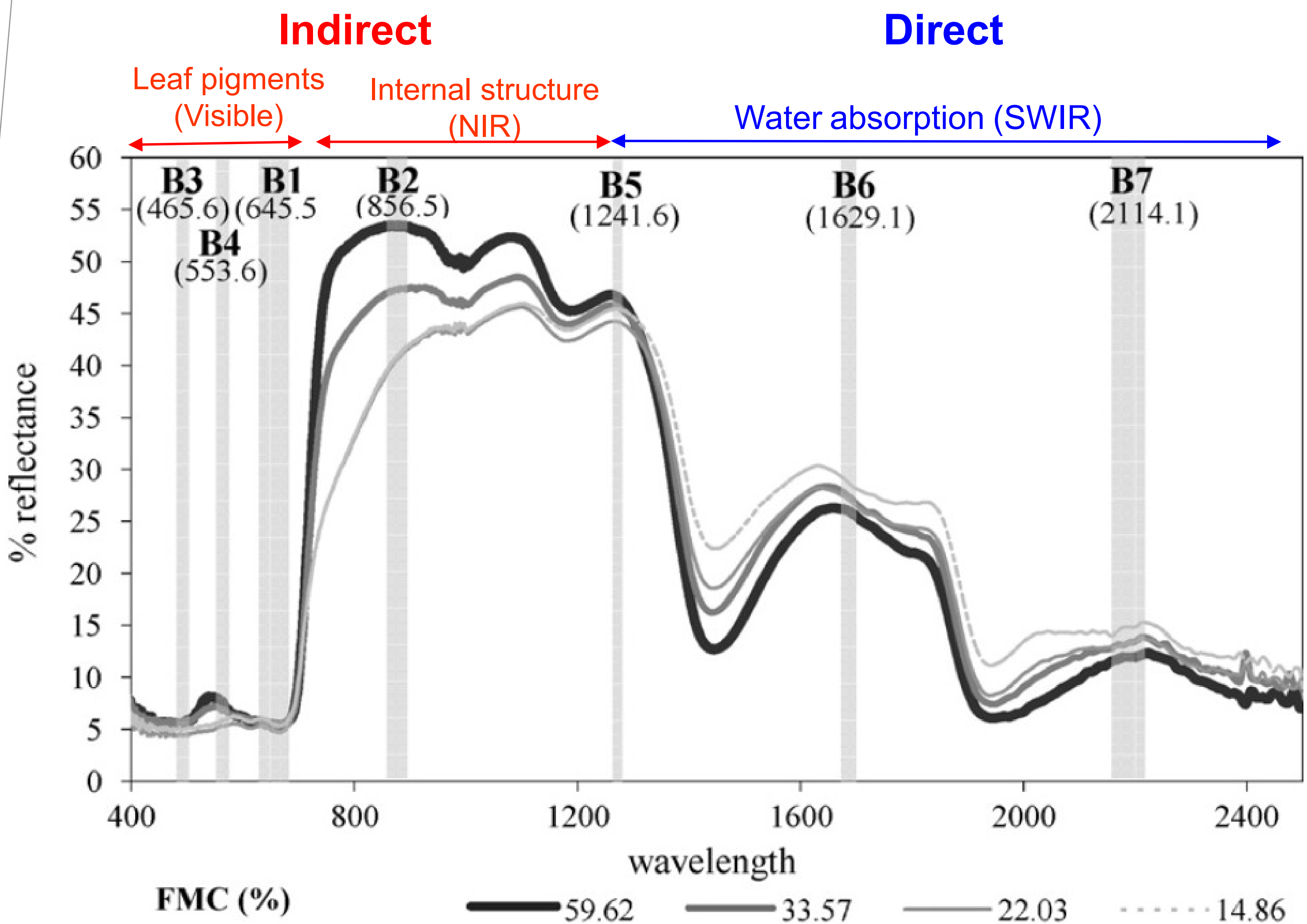
Fireglobe Proyect



http://www.geogra.uah.es/fireglobe/

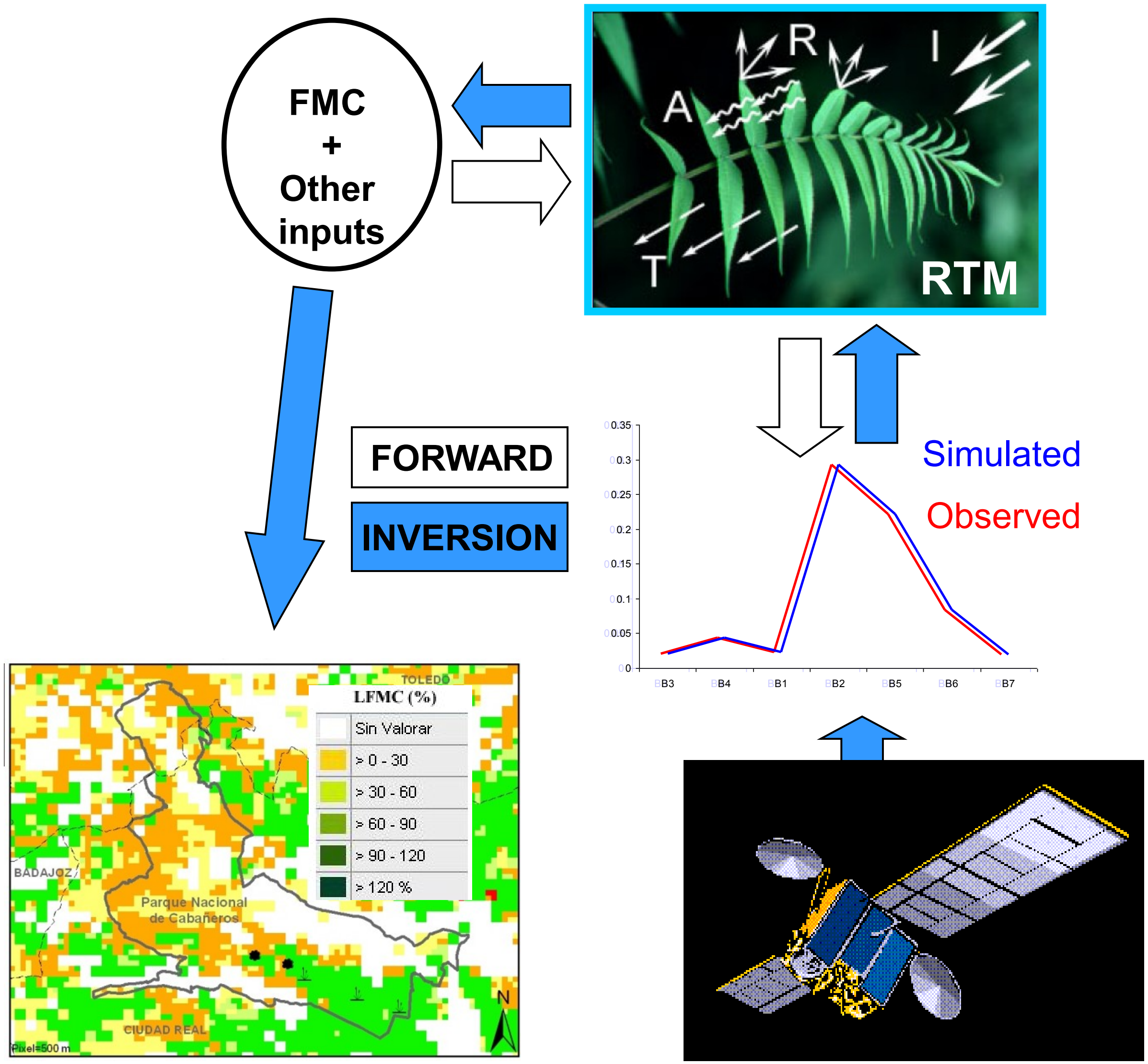
Basics of the FMC method works

Relationship between **FMC and spectral information**



(Yebra et al, 2008, AFM)

How the Fuel Moisture Content method works



How the Fuel Moisture Content method works

Look-Up Table (LUT)

PARAMETERS

SIMULATED REFLECTANCE

FMC

MF=0.05

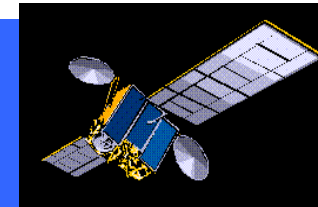
BEST CASE

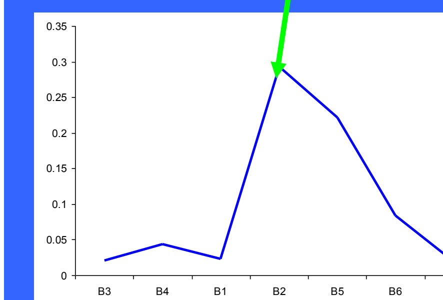
MF=0.04

MF=0.08

MF=0.08

MF=1

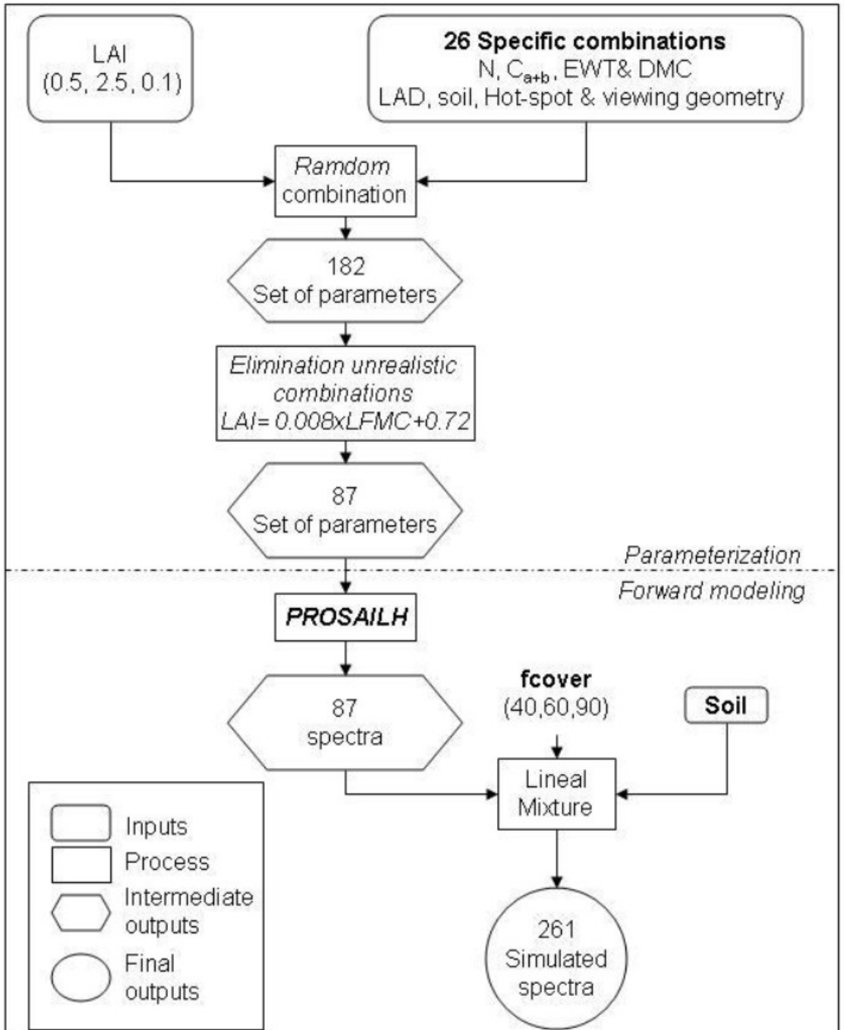




Observed reflectance

Comparison or Merit function (MF)

How the Fuel Moisture Content method works



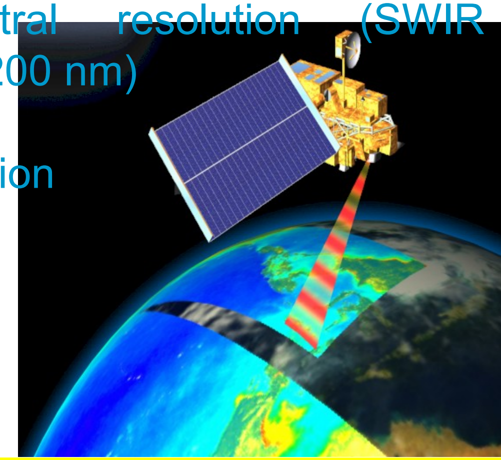
(Yebra & Chuvieco, 2009, RSE)

Terra MODIS
(Moderate Resolution Imaging Spectroradiometer)

1. Good spatial resolution for regional and global studies (250- 500-1000 m)

2. Wide spectral resolution (SWIR region: 1200-2200 nm)

3. Free acquisition

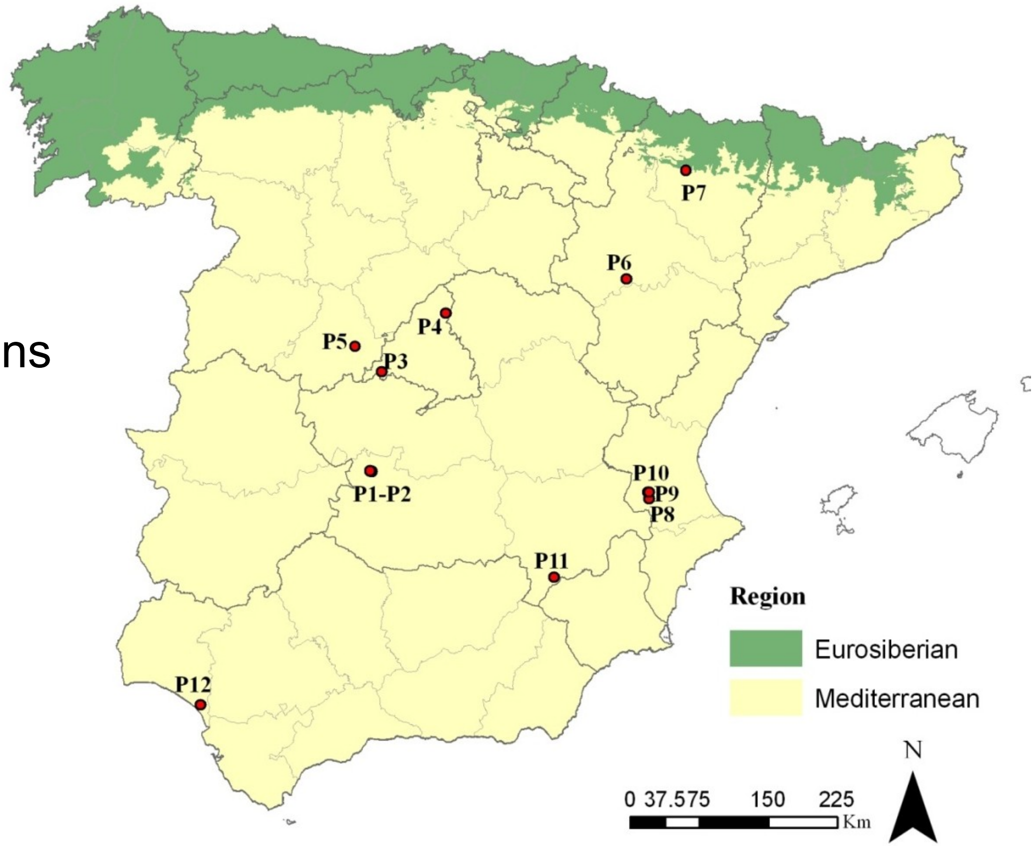


Comparison or Merit function (MF)
SPECTRAL ANGLE

$$SA(\vec{v}, \vec{w}) = \cos^{-1}\left(\frac{\vec{v} \times \vec{w}}{||\vec{v}|| \times ||\vec{w}||}\right)$$

Some results-Previous Study Sites

146 Observations



(Yebra & Chuvieco, 2009, RSE)

Some results-Previous Study Sites

FMC	Max.	Min.	$\overline{FMC}_P$	SDp	N	a	bx
All	135.68	45.98	86.62	28.58	146	19.05	0.74
<135.7	135.68	45.98	81.98	26.42	129	5.4	0.91
<105	135.68	45.98	75.27	24.31	102	1.60	0.97

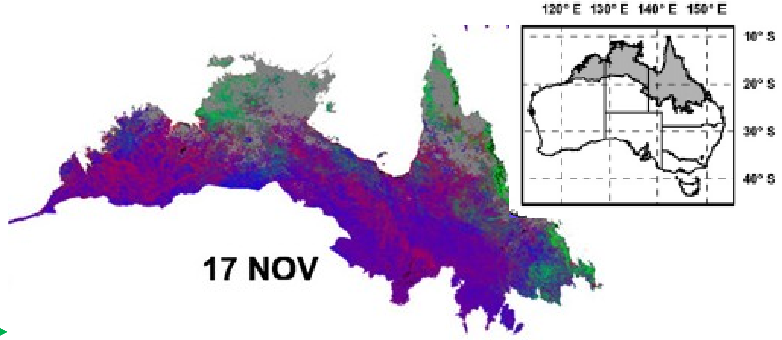
FMC	RMSE	RMSEs	RMSEu
All	19.77	9.51	17.34
<135.7	16.22	2.99	15.94
<105	16.14	0.82	16.11

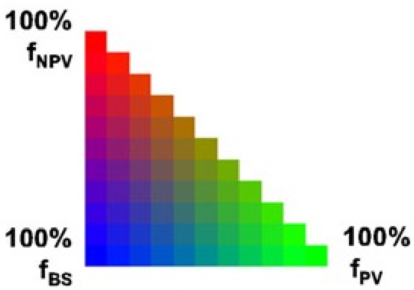
(Yebra & Chuvieco, 2009, RSE)

Field Observations: FMC (187.03-42.78%)

What's next!
Link between both objectives …

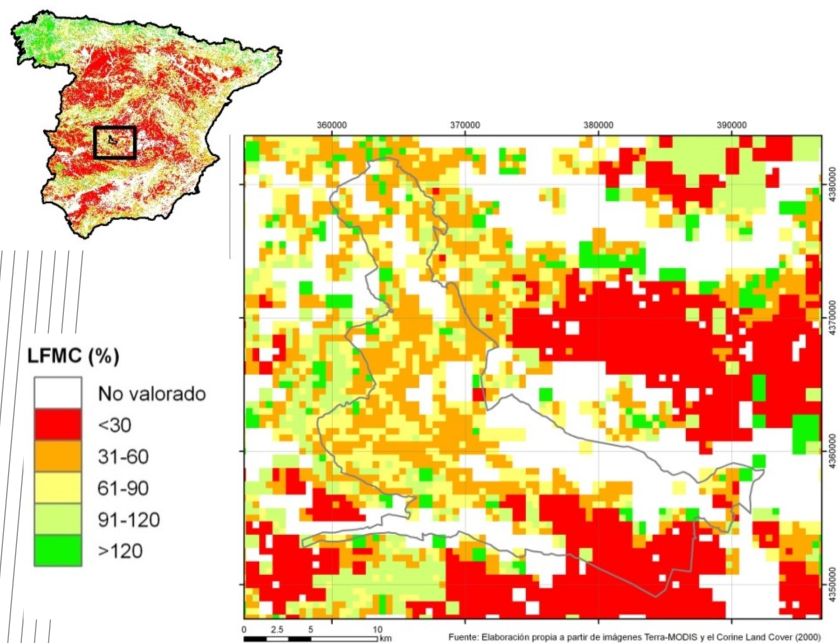
Improved
Guerschman et al 2009
algorithm





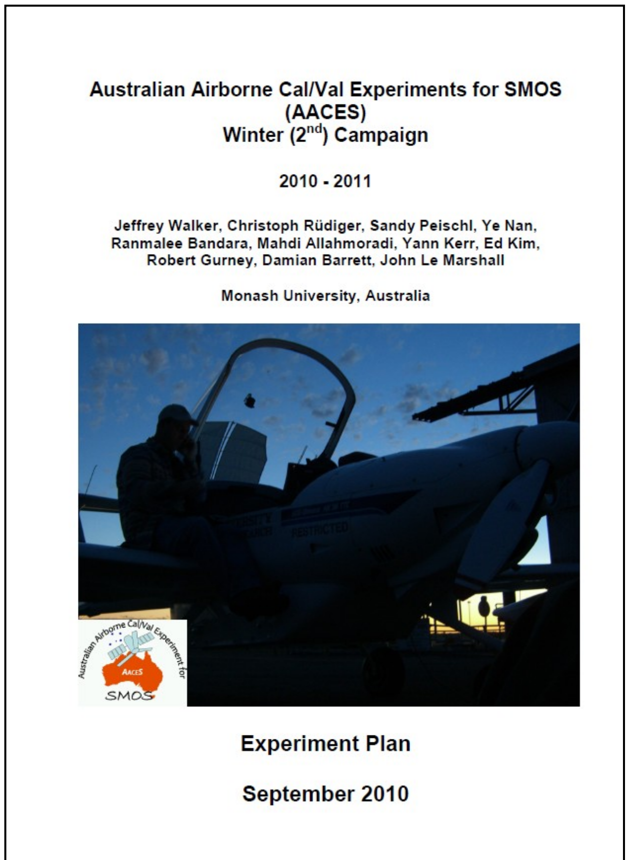
Constrain inversion!

Improved
Yebra et al, 2009
algorithm



OH OOOOH …. A BROWN SNAKE!!!!!

Always wear sturdy hiking boots and long work pants to avoid penetrating bites. Refer to http://www.australianfauna.com/australiansnakes.php for detailed info about the most common of Australian snake species. Treat all Australian snakes as potentially deadly. In 99.9% of all encounters, the snake will try to avoid any human contact (see First Aid note).



Australian Airborne Cal/Val Experiments for SMOS (AACES)
Winter (2nd) Campaign

2010 - 2011

Jeffrey Walker, Christoph Rüdiger, Sandy Peischl, Ye Nan, Ranmalee Bandara, Mahdi Allahmoradi, Yann Kerr, Ed Kim, Robert Gurney, Damian Barrett, John Le Marshall

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Experiment Plan

September 2010

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