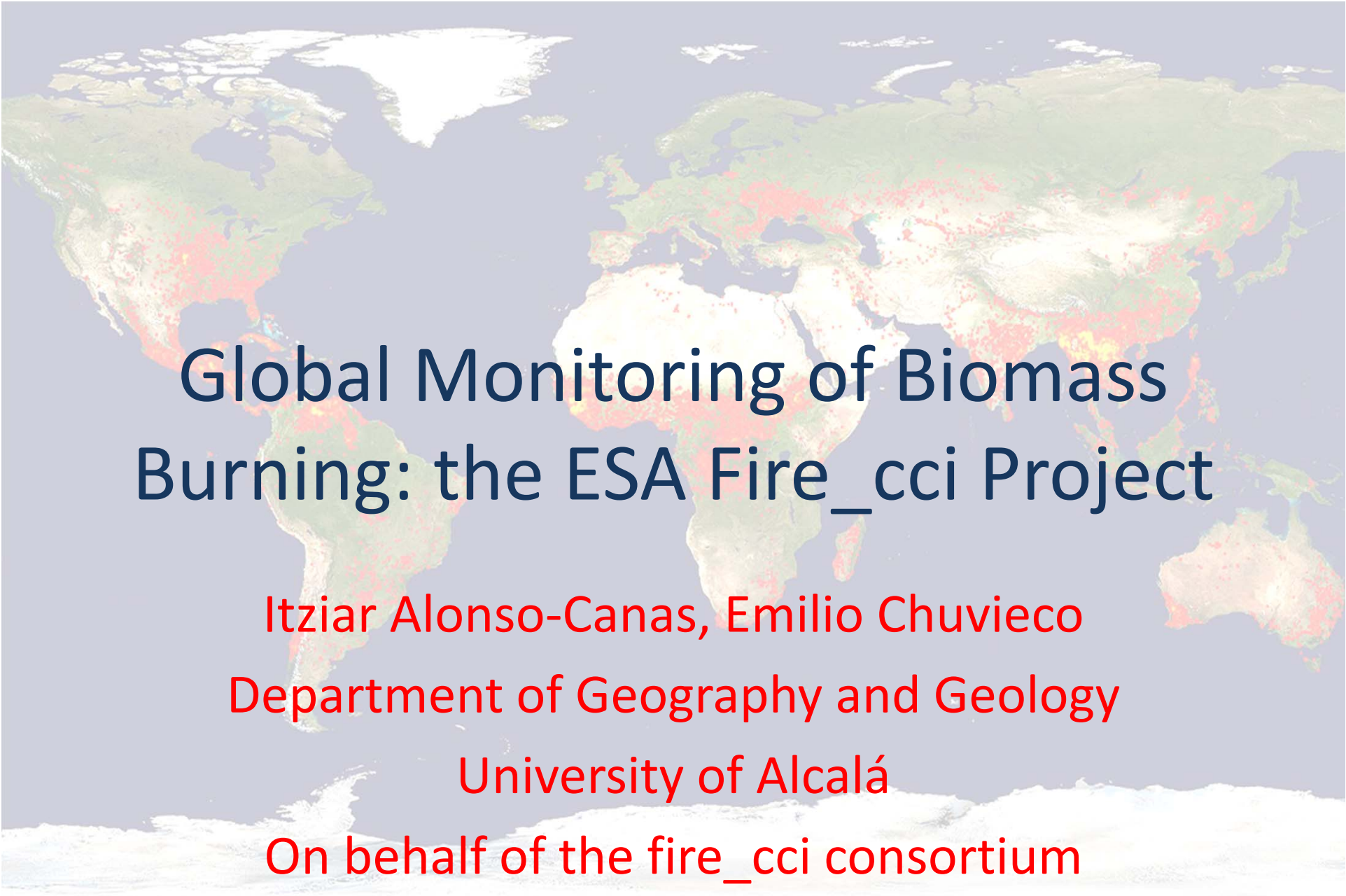


A world map with a light blue background. The landmasses are colored in shades of green and yellow, representing vegetation. Numerous small red dots are scattered across the map, indicating fire hotspots. These dots are particularly dense in North America, Europe, and parts of Asia and Africa.

Global Monitoring of Biomass Burning: the ESA Fire_cci Project

Itziar Alonso-Canas, Emilio Chuvieco

Department of Geography and Geology

University of Alcalá

On behalf of the fire_cci consortium

Outline



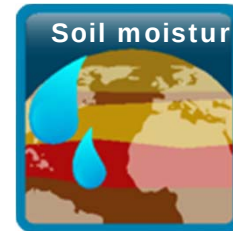
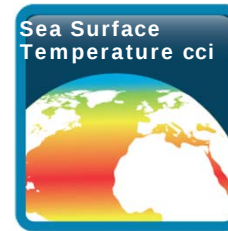
- Project overview.
- BA algorithms.
- Validation strategy.
- Intercomparison.

Outline



- **Project overview**
- BA algorithms
- Validation strategy
- Intercomparison

ESA-CCI programme

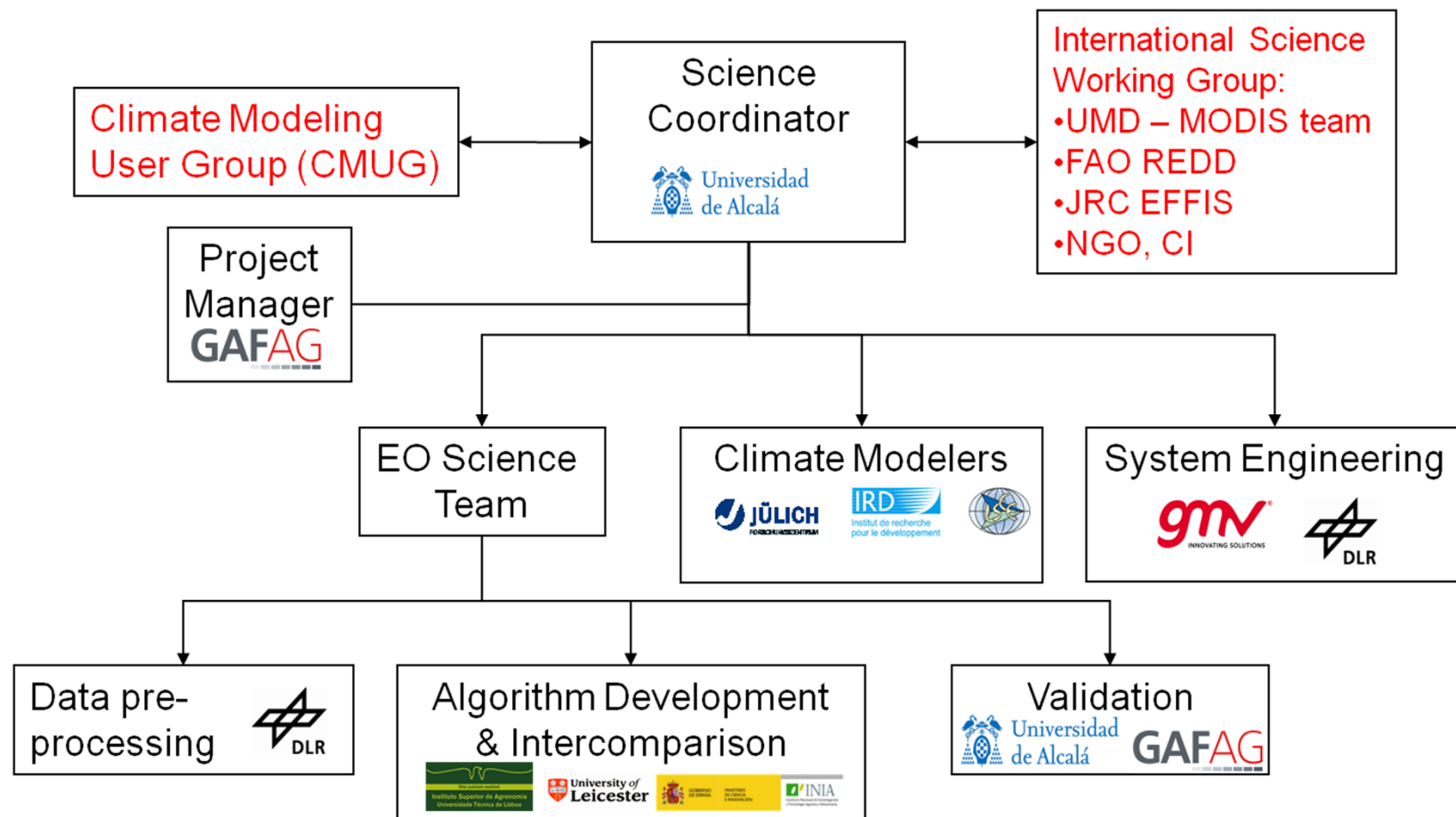


Fire_cci



Emilio Chuvieco: Science leader

University of Alcalá (Spain)

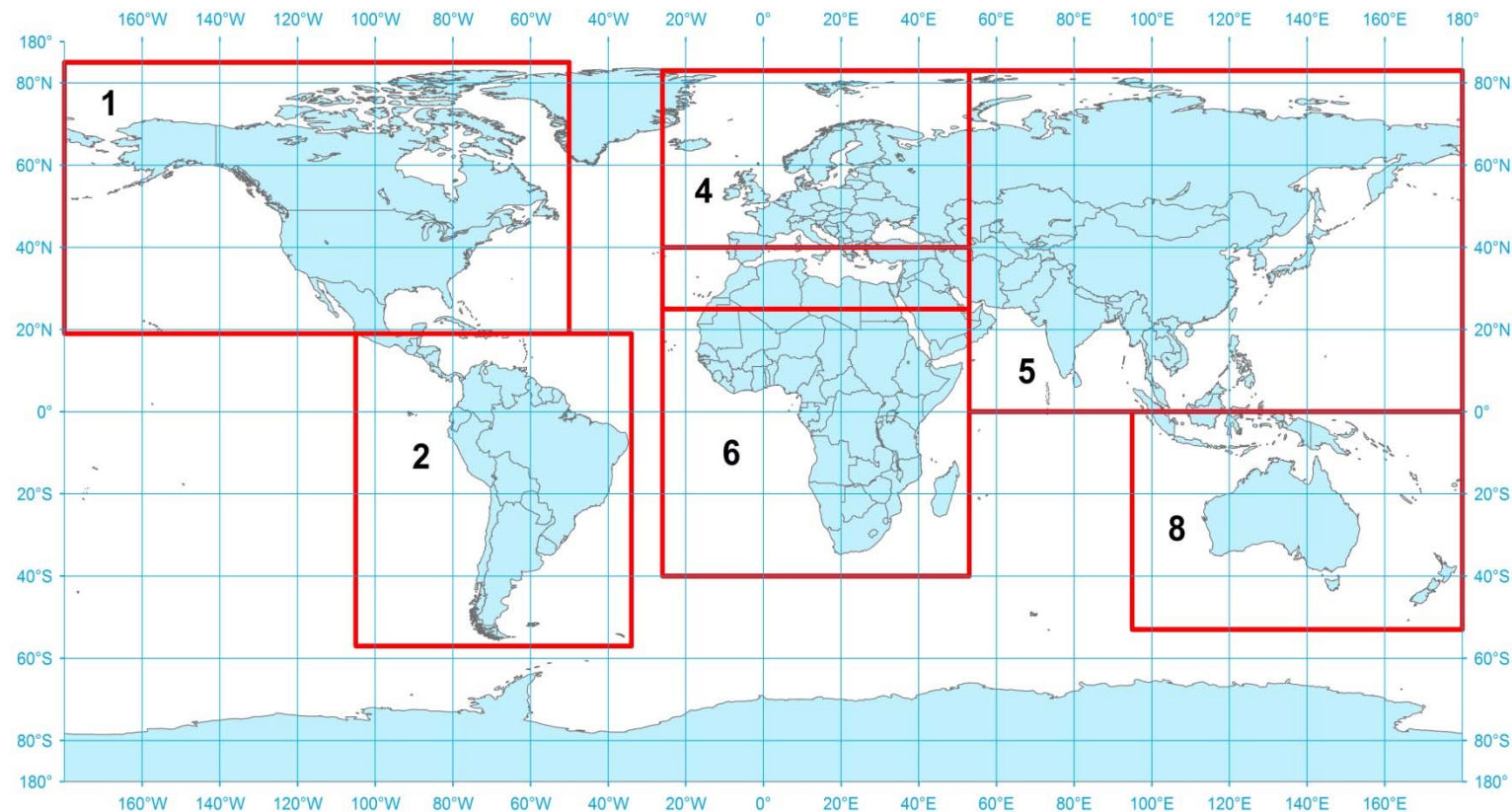


Objectives of fire_CCI



1. Refine definition of user requirements.
2. Improve current estimations of global burned area (based on European sensors: VGT-(A)ATSR-MERIS).
3. Strong emphasis on validation.
4. Intercomparison with existing BA global products.
5. Test improvements of climate-vegetation-carbon models with new BA data.

Target: global product

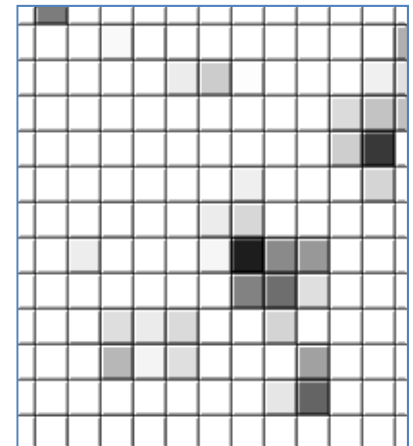


In addition to standard tiles, the user will have a web tool to interactively select his/her target site and apply for personal downloads

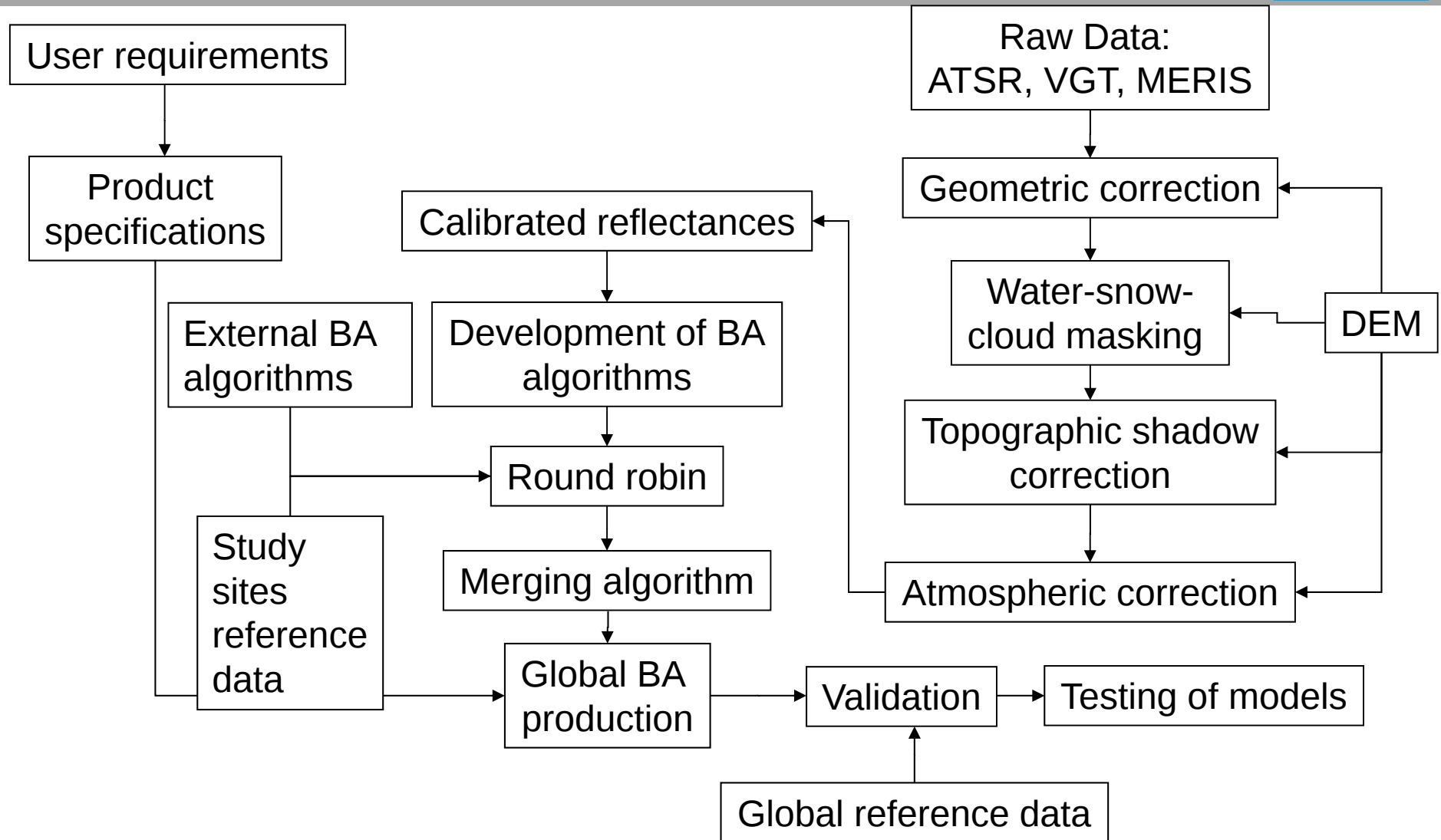
Target products



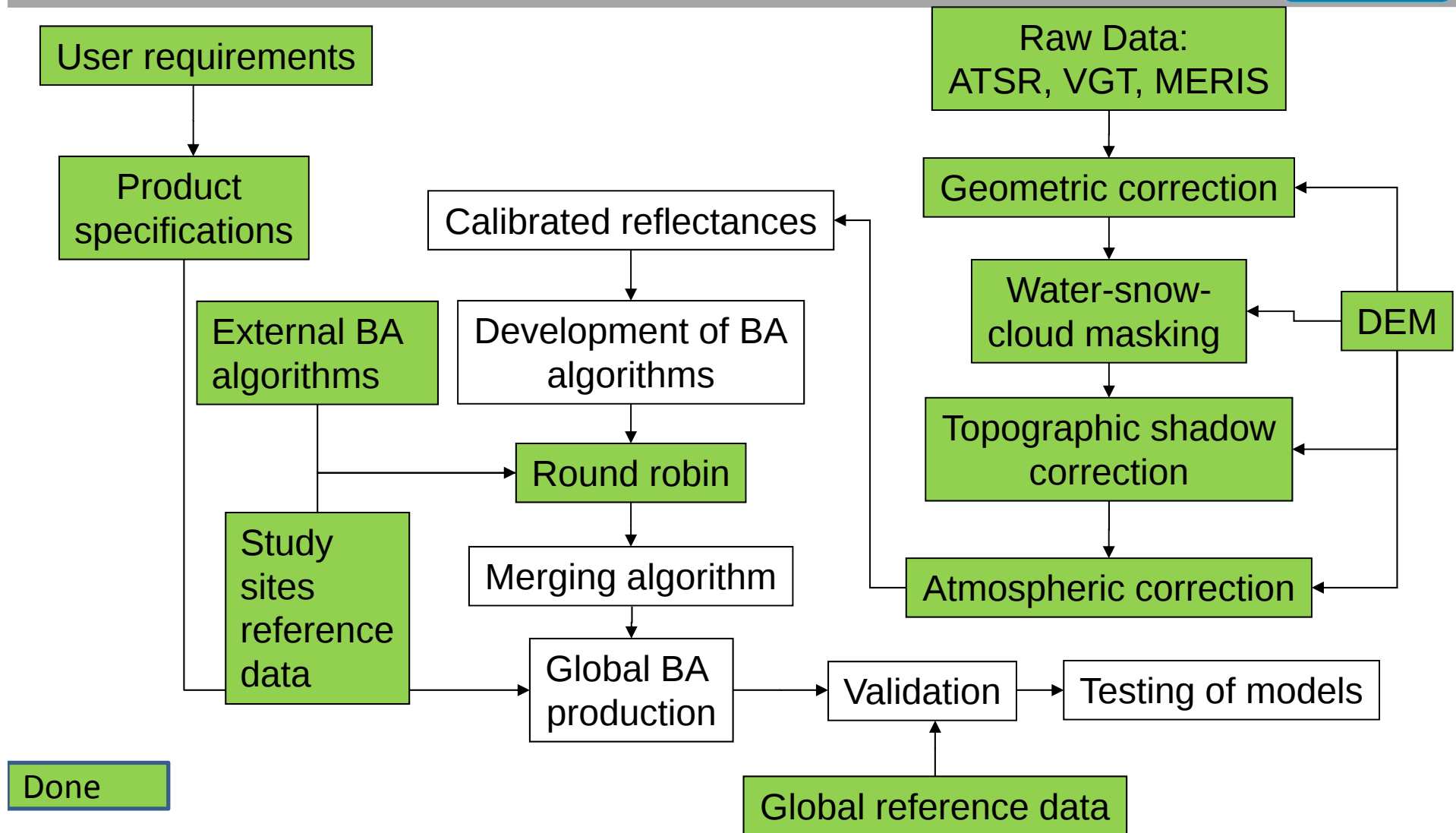
- Pixel level (mixing all three sensors whenever possible):
 - Monthly files with date of detection.
 - Include confidence level
 - GeoTiff format
- Grid level:
 - 15-day files at 0.5 x 0.5 degree (CGM).
 - Include standard error and burned land cover.
 - NetCDF format.



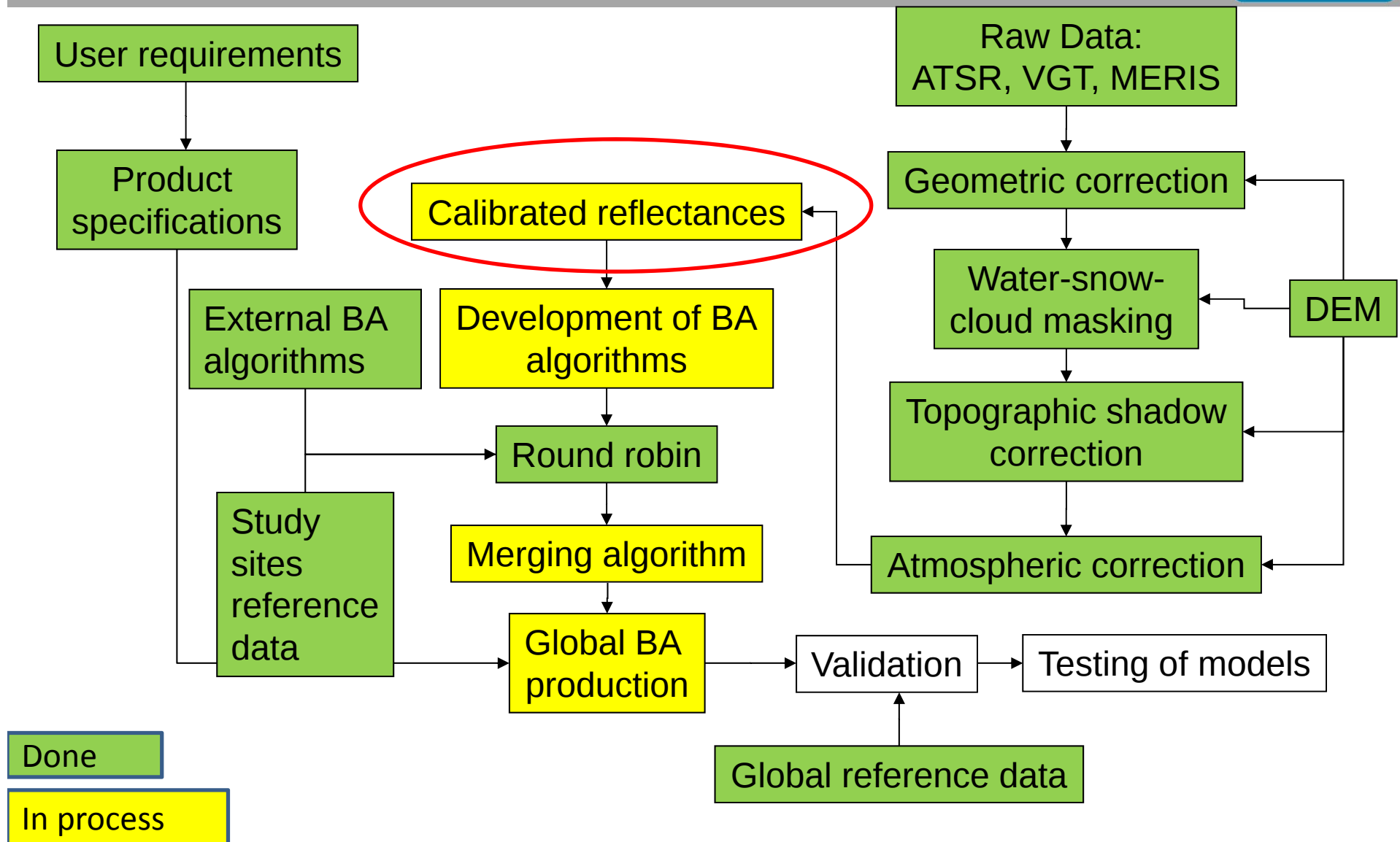
Project flowchart



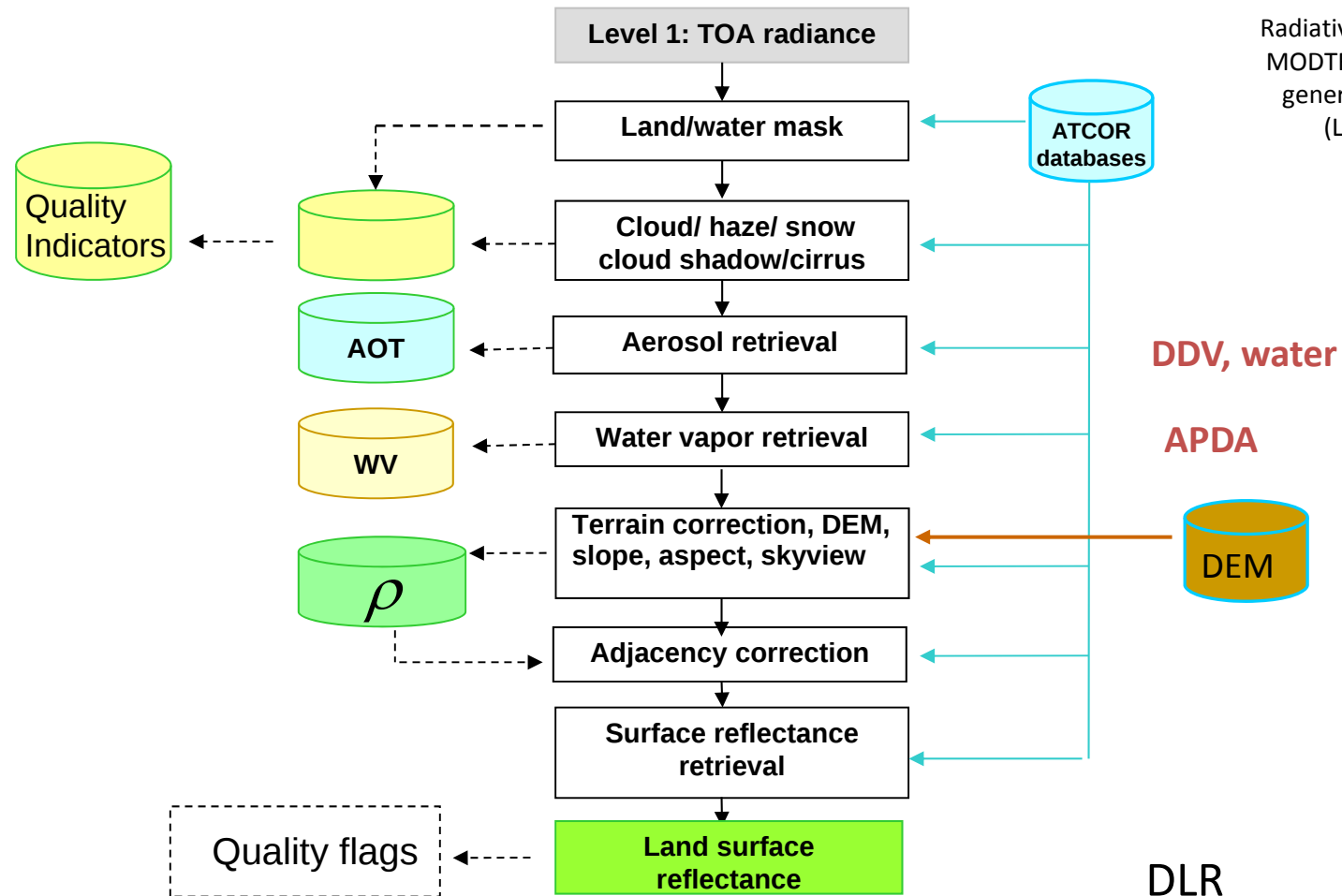
Project flowchart



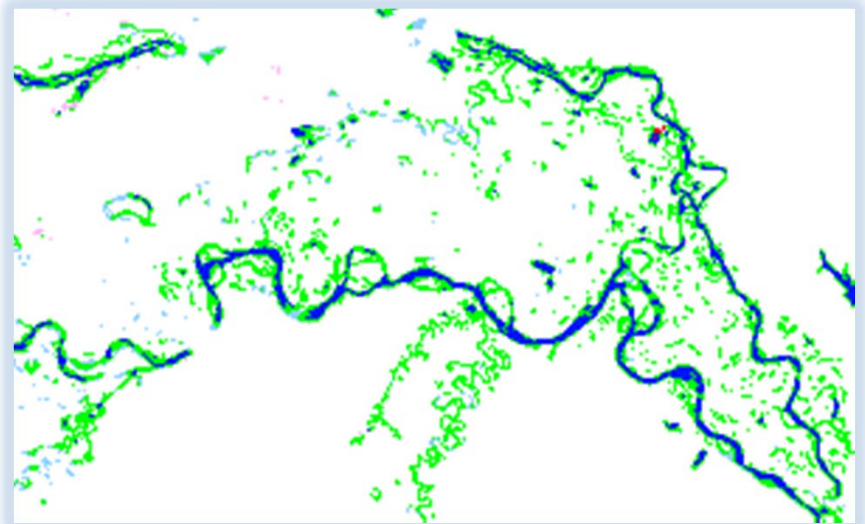
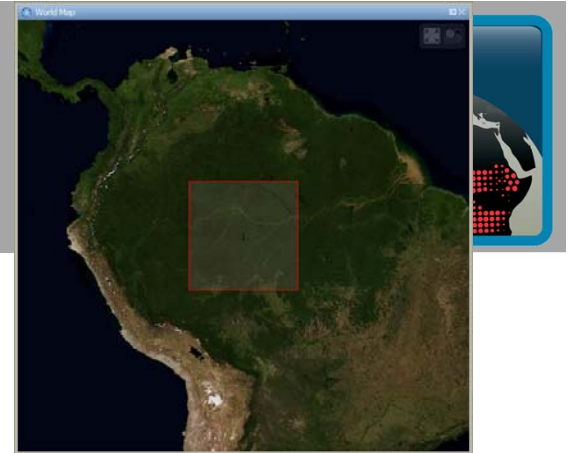
Project flowchart



Radiometric correction



Static and dynamic water mask



Legend

1	Blue	Stable Water
2	Green	Accepted Static Water
3	Light Blue	" " "
6	Red	Accepted Dynamic Water
0	White	Not Accepted as Water

Outline



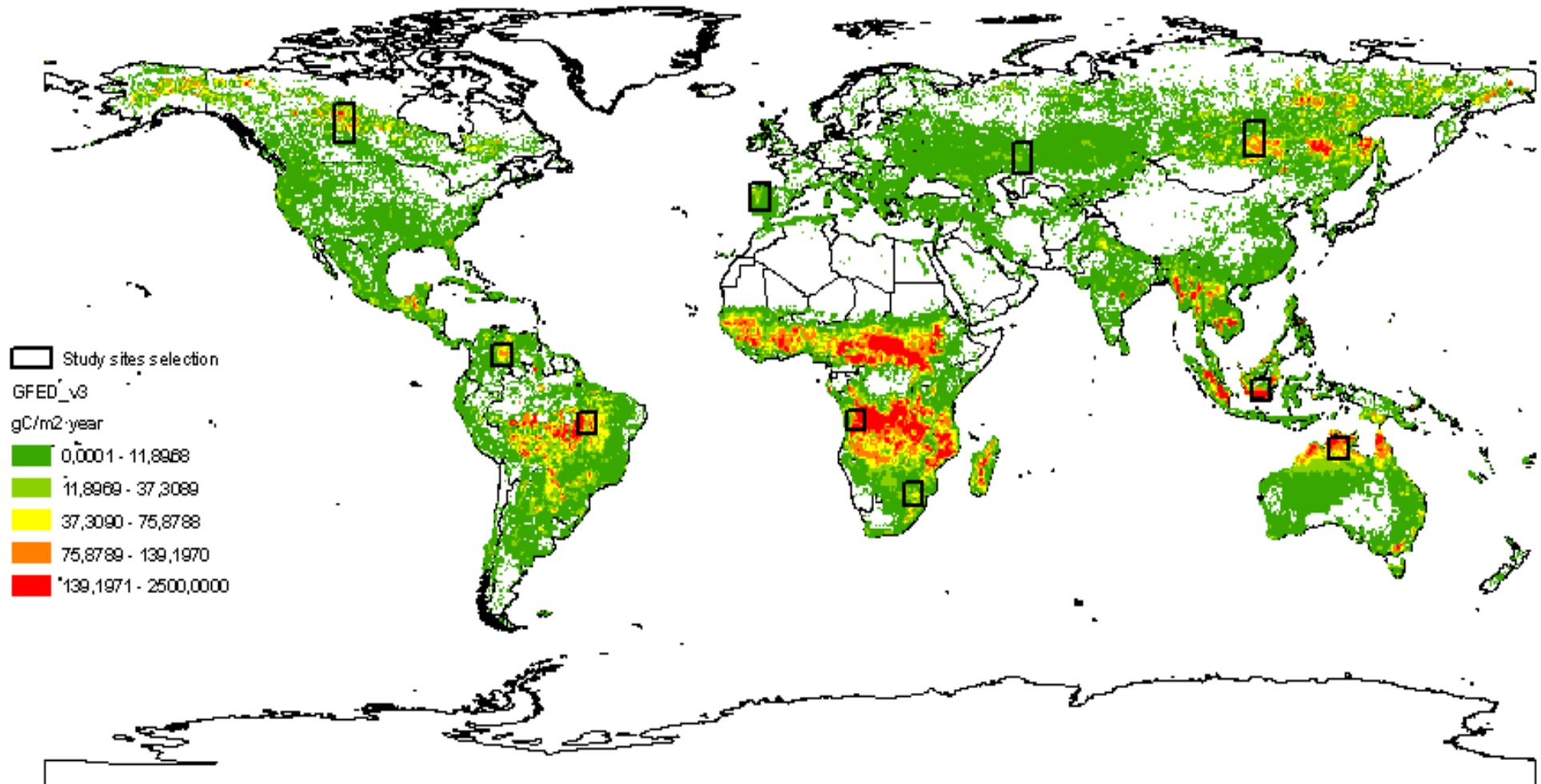
- Project overview
- **BA algorithms**
- Validation strategy
- Intercomparison

Burned area algorithms

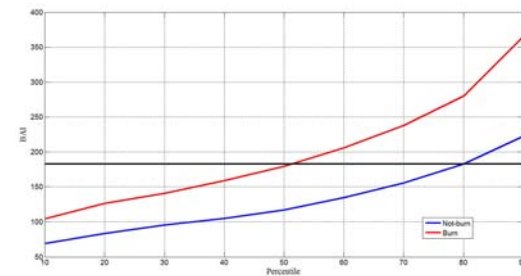
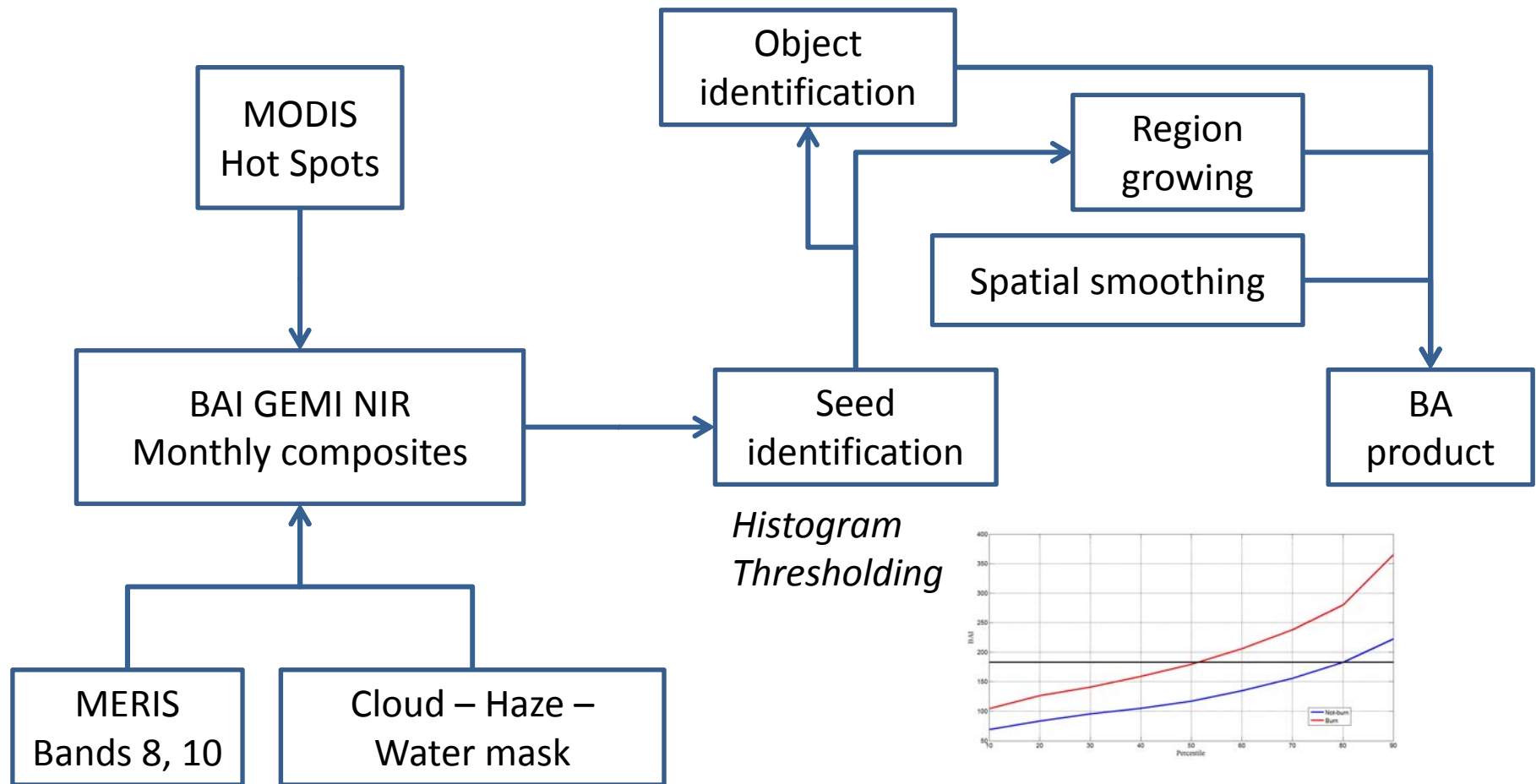


- Envisat MERIS:
 - Monthly composites.
 - Hotspots from MODIS.
- SPOT-VEGETATION and ERS-Envisat (A)ATSR:
 - Multitemporal daily series of NIR reflectance.
 - Sudden-permanent changes, Markov-fields.

Study sites

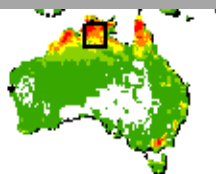


BA algorithm: MERIS v1

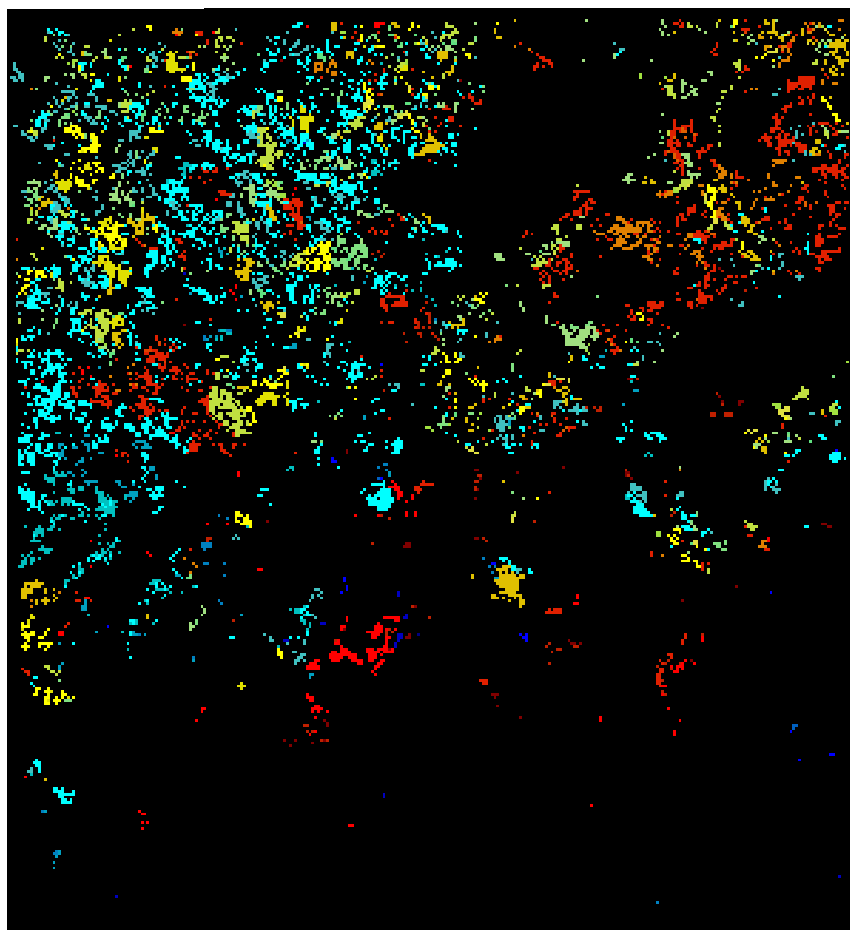


Alonso-Canas and Chuvieco, 2012

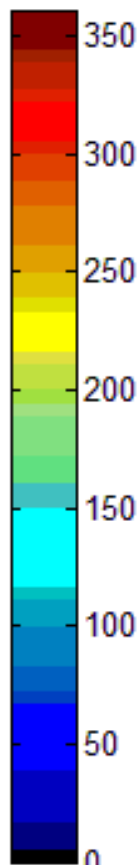
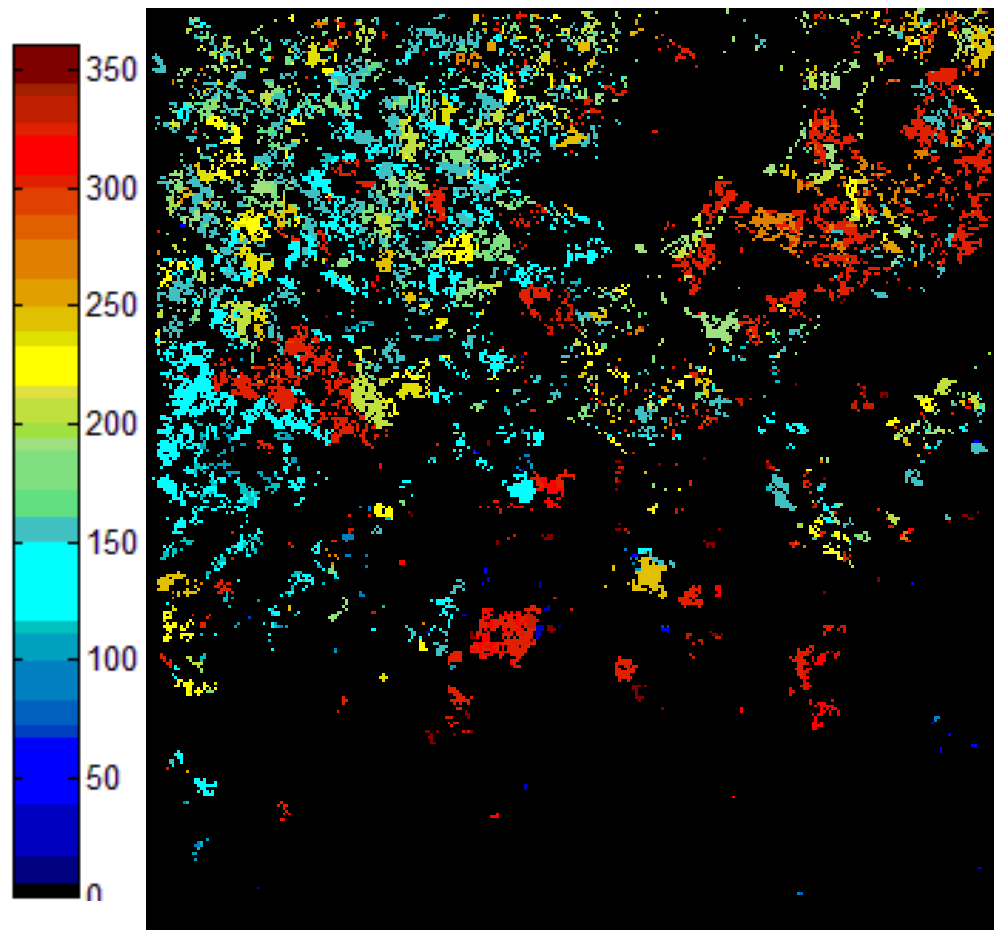
Australia 2005



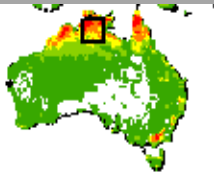
Seeds



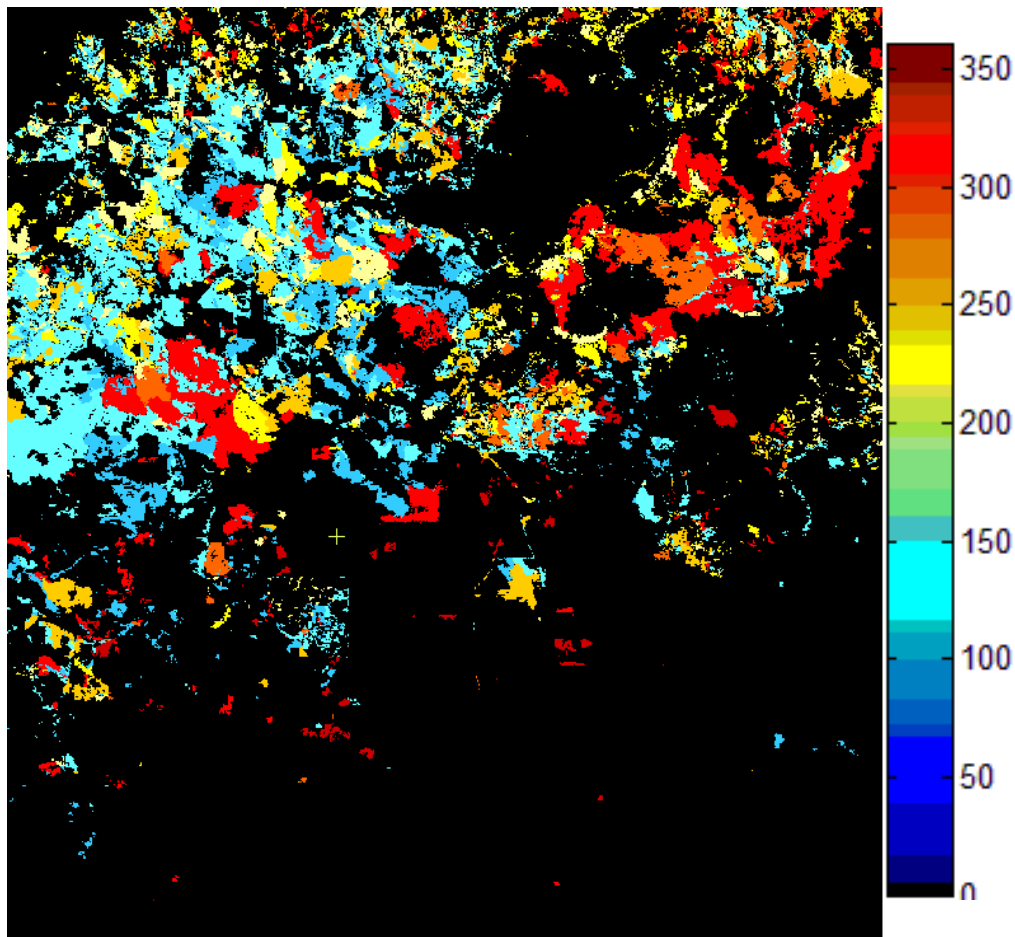
MERIS BA v1



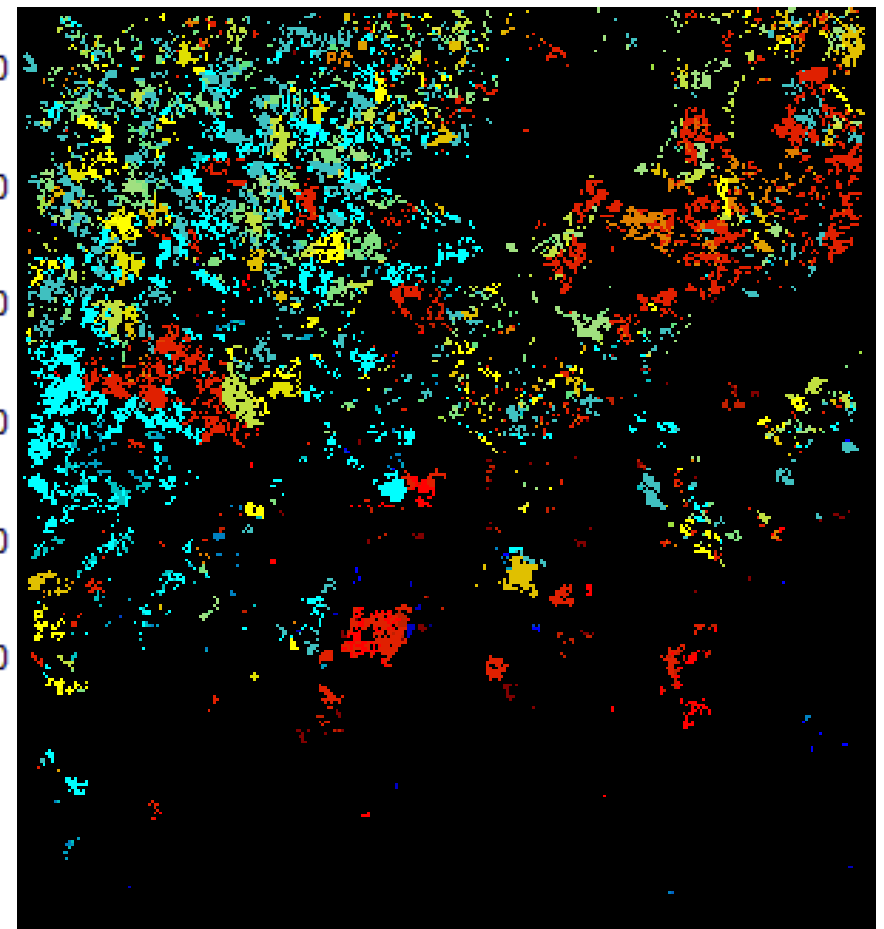
North Australian Fire Information comparison



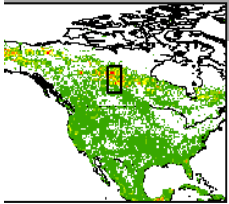
NAFI



MERIS BA v1



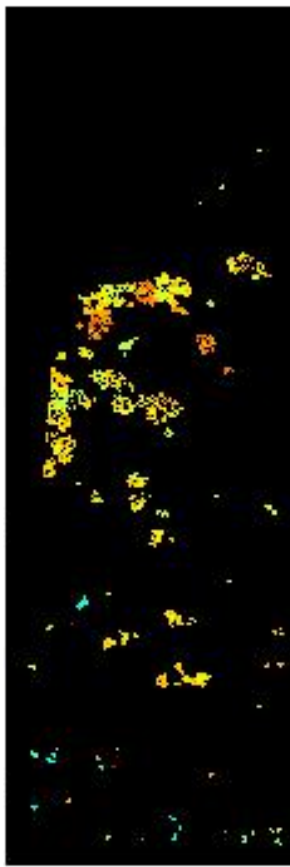
MERIS v1: Boreal Forest Canada



2005



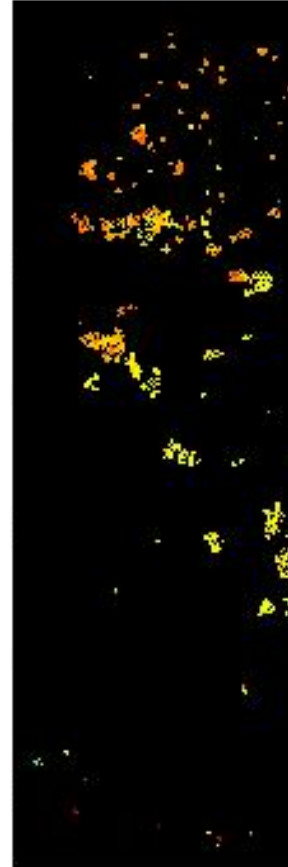
2006



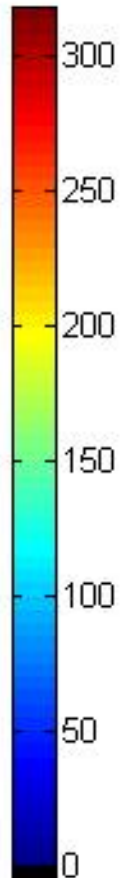
2007



2008



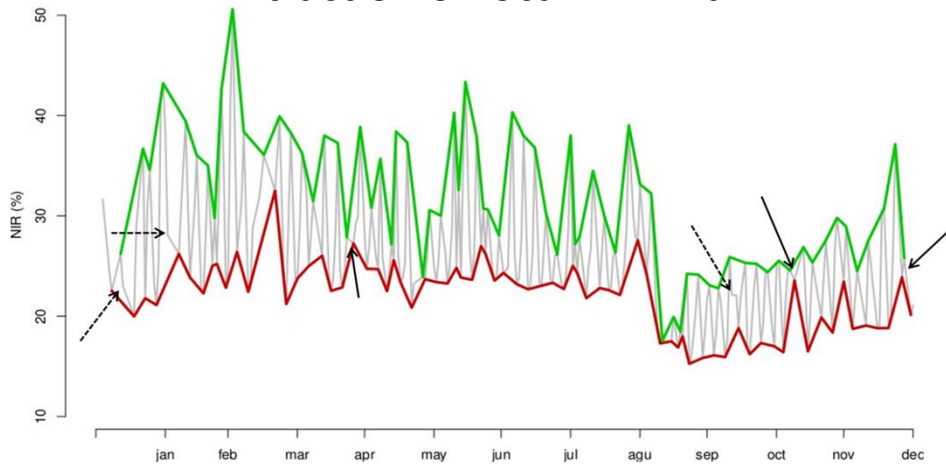
2009



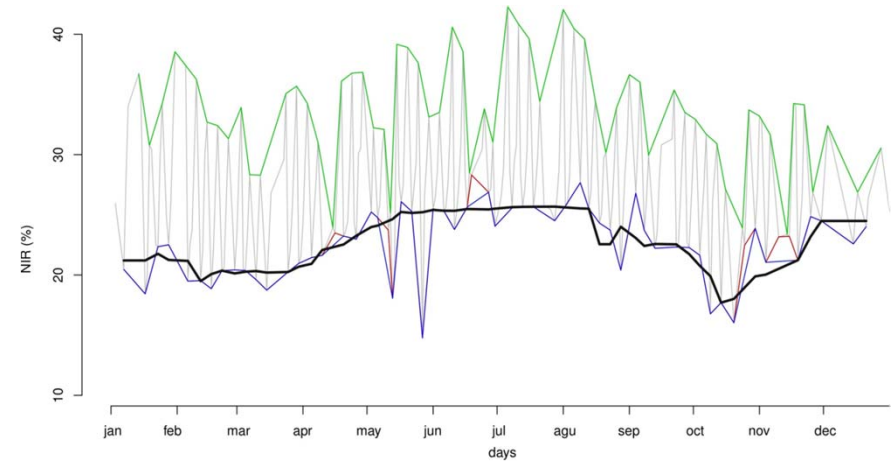
BA algorithm: VGT/ATSR v1 (ISA, Portugal)



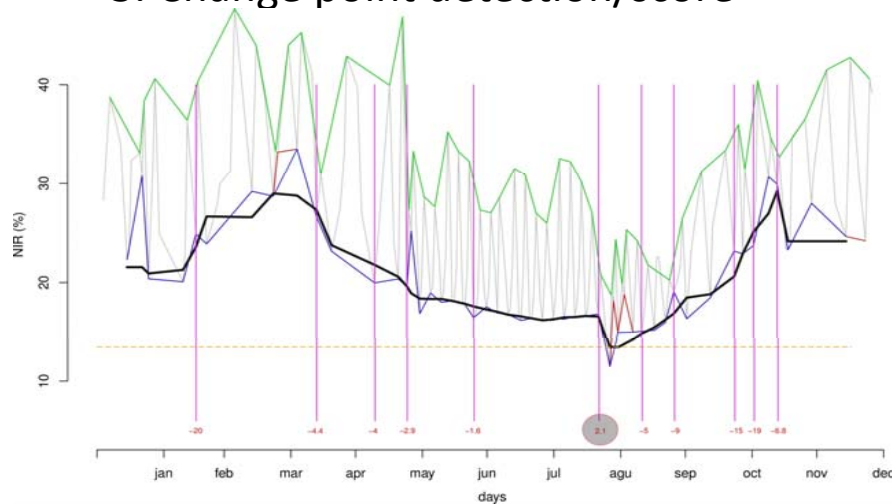
1. Extraction of local minima



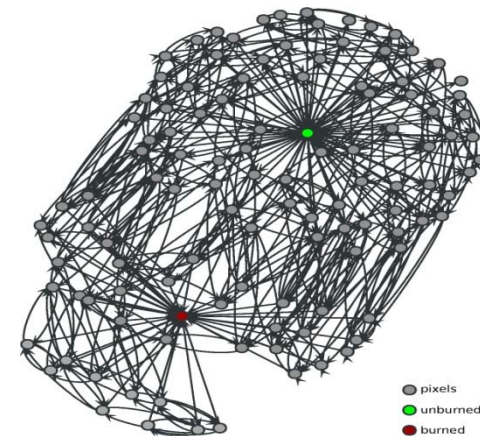
2. Robust filtering



3. Change point detection/score

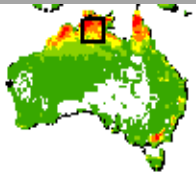


4. Markov Random Field Chain

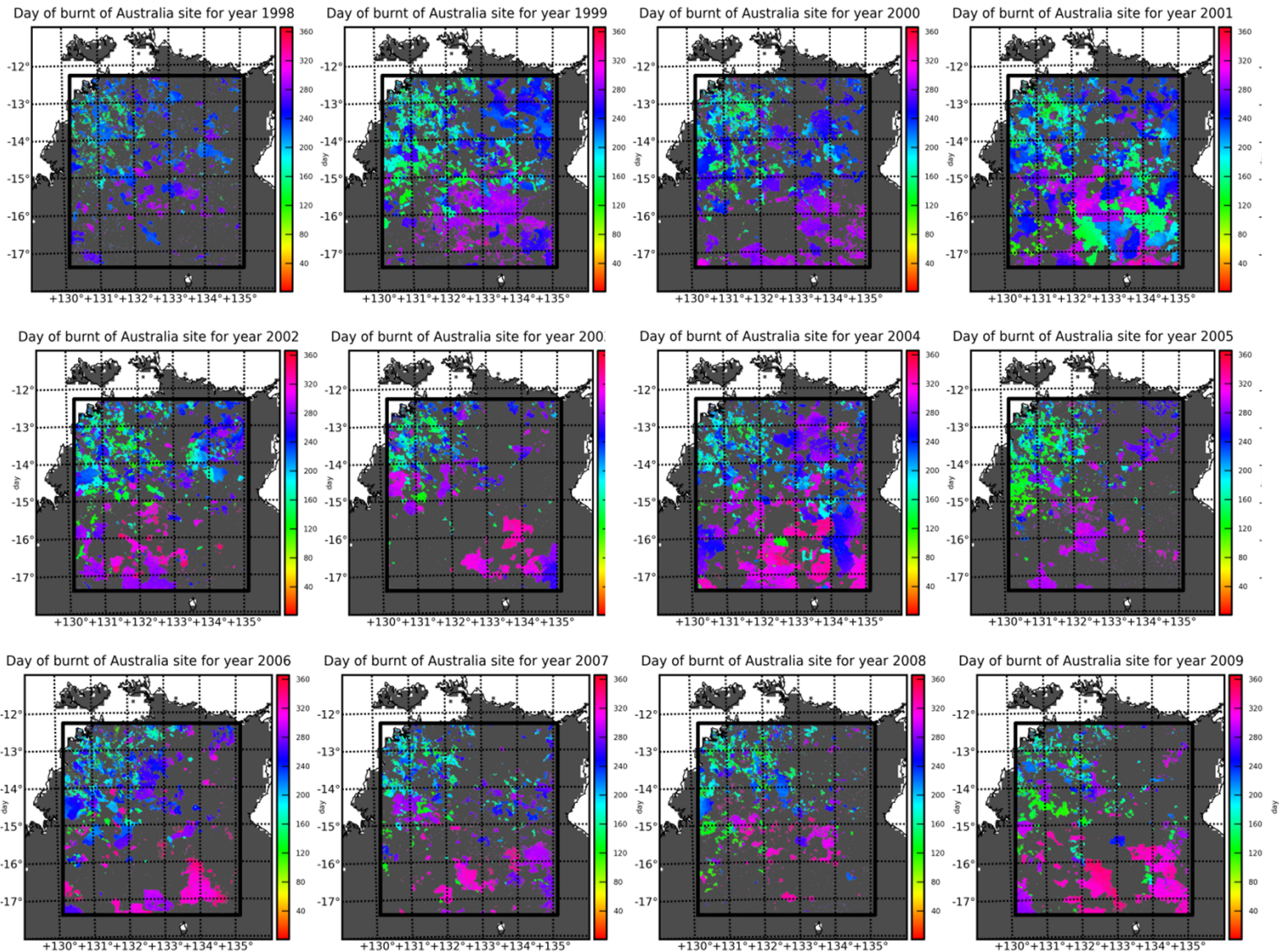


Pereira and Mota, 2012

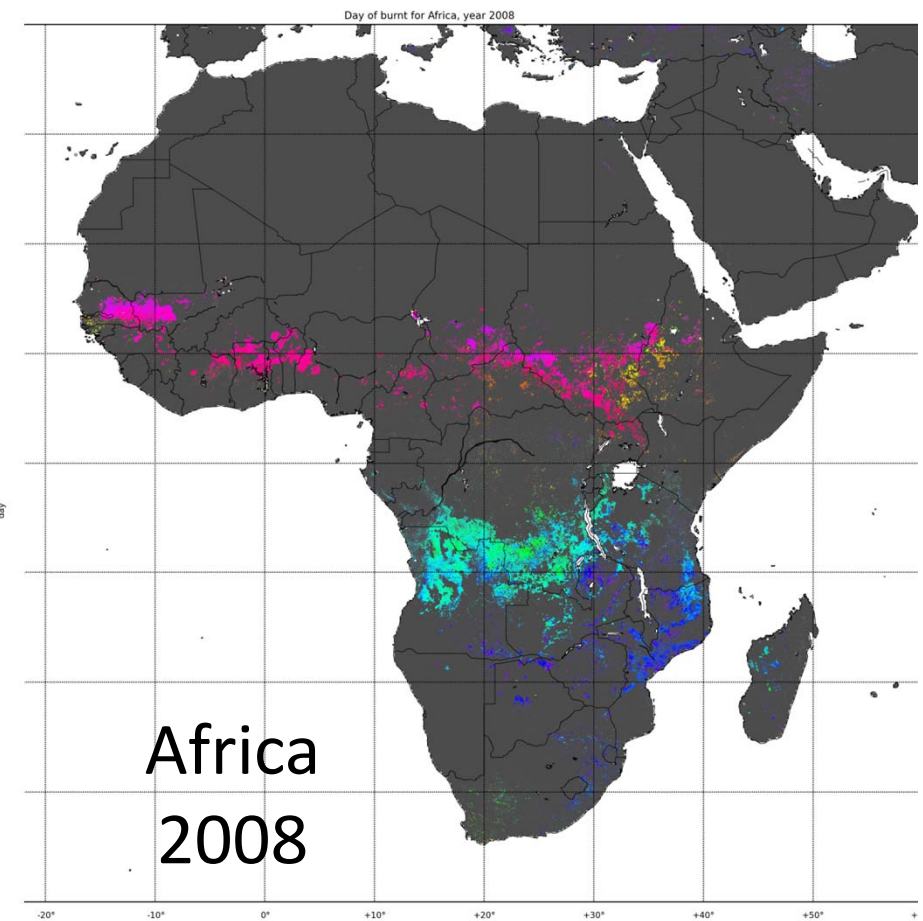
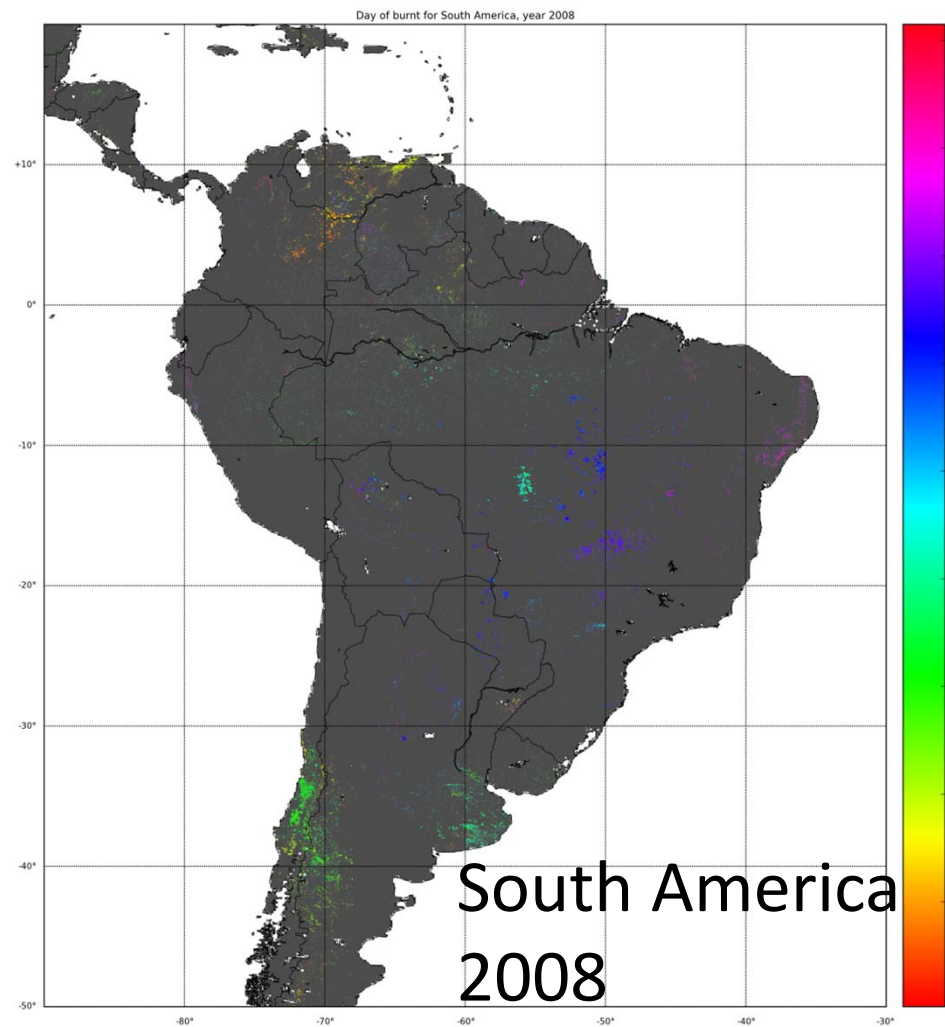
BA VGT v1 maps



Australian site
VGT BA
1998 - 2009



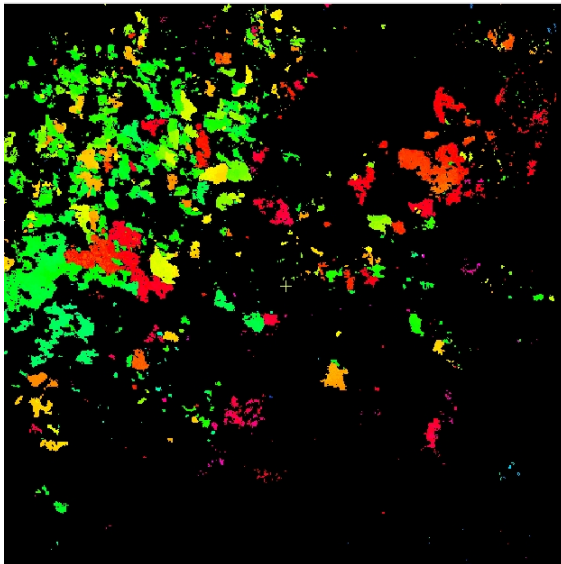
BA VGT v1 results



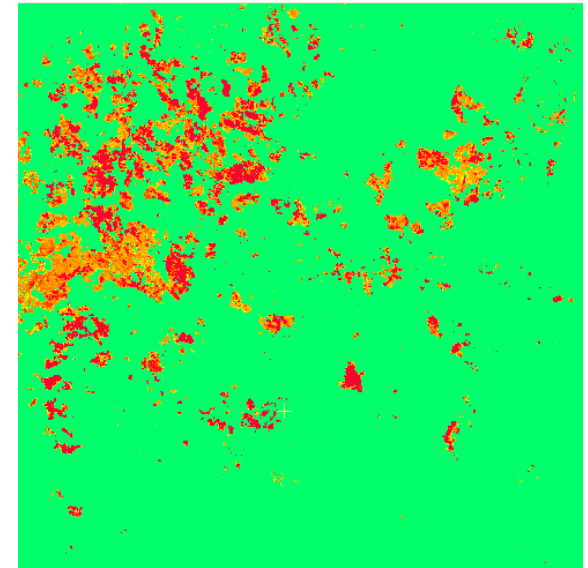
Pixel output: Merged product v1 (Australia)



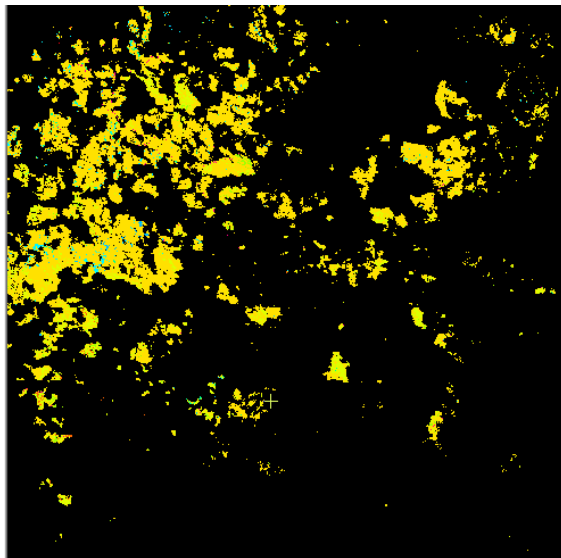
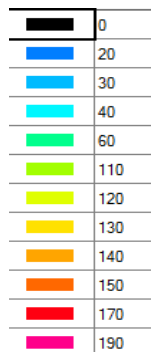
Day of detection



Confidence Level

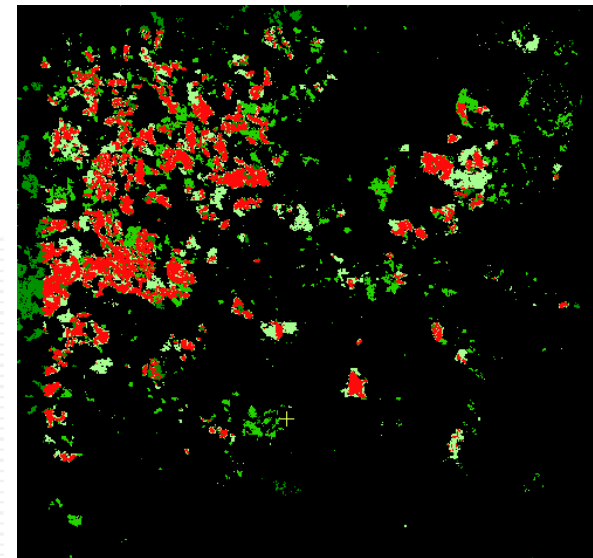


Land Cover Type



Sensor detecting

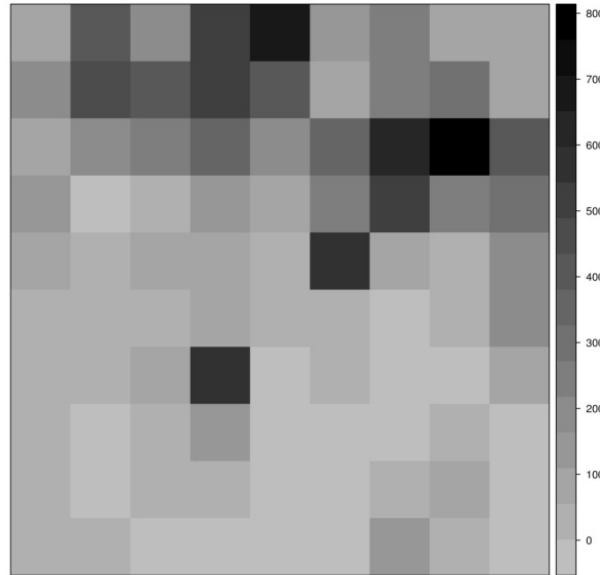
None
VGT + ATSR
ATSR + MERIS
VGT + MERIS
VGT + ATSR +
MERIS



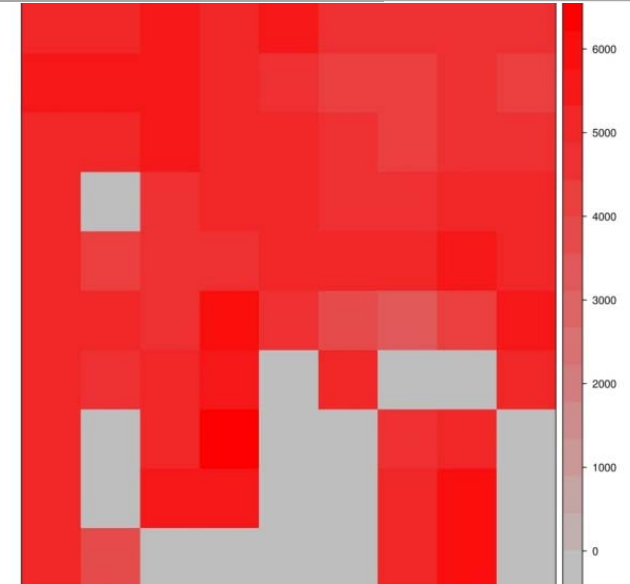
Grid output v1 (Australia)



**Total
burned
area
(km2)**

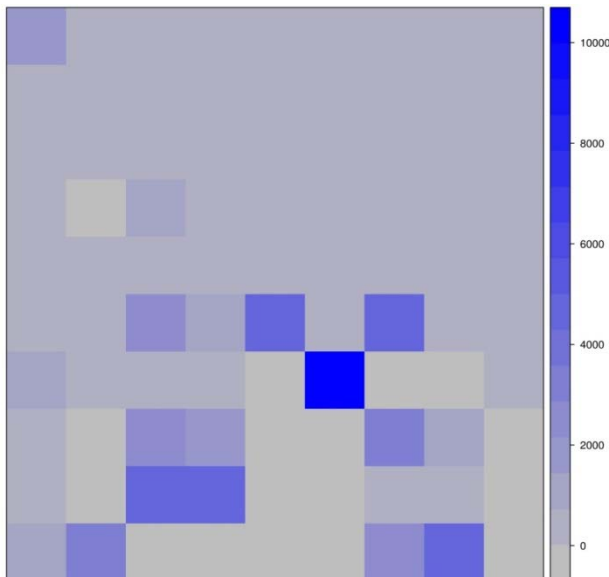


**Standard
Error**

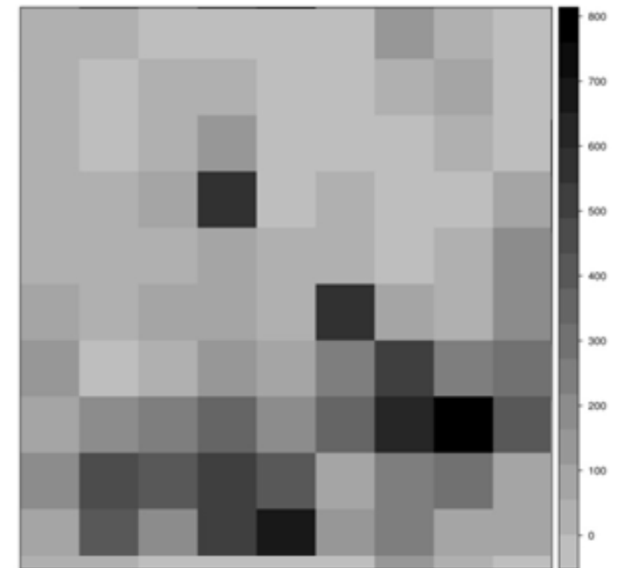


**Homogeneity
index**

Mean fire size /
total area burned



**Area
burned
of Land
cover X**

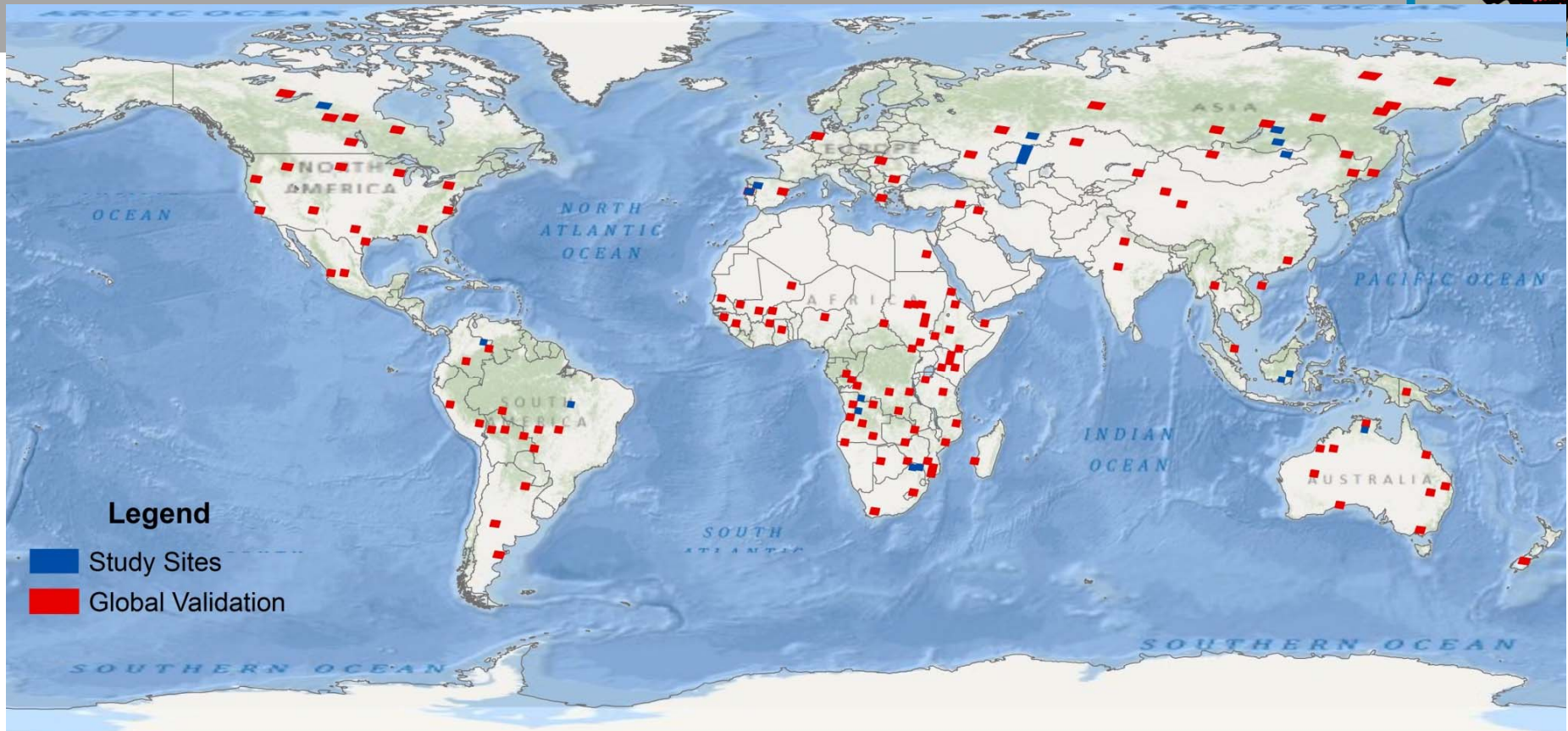


Outline



- Project overview
- BA algorithms
- **Validation strategy**
- Intercomparison

Validation



- 242 Pairs of Landsat TM/ETM+ images have been processed to generate validation files:
 - 130 pairs for spatial validation (red).
 - 112 pairs for temporal validation (blue).
- All files are documented following standard CEOS Cal-Val guidelines.

Biome distribution

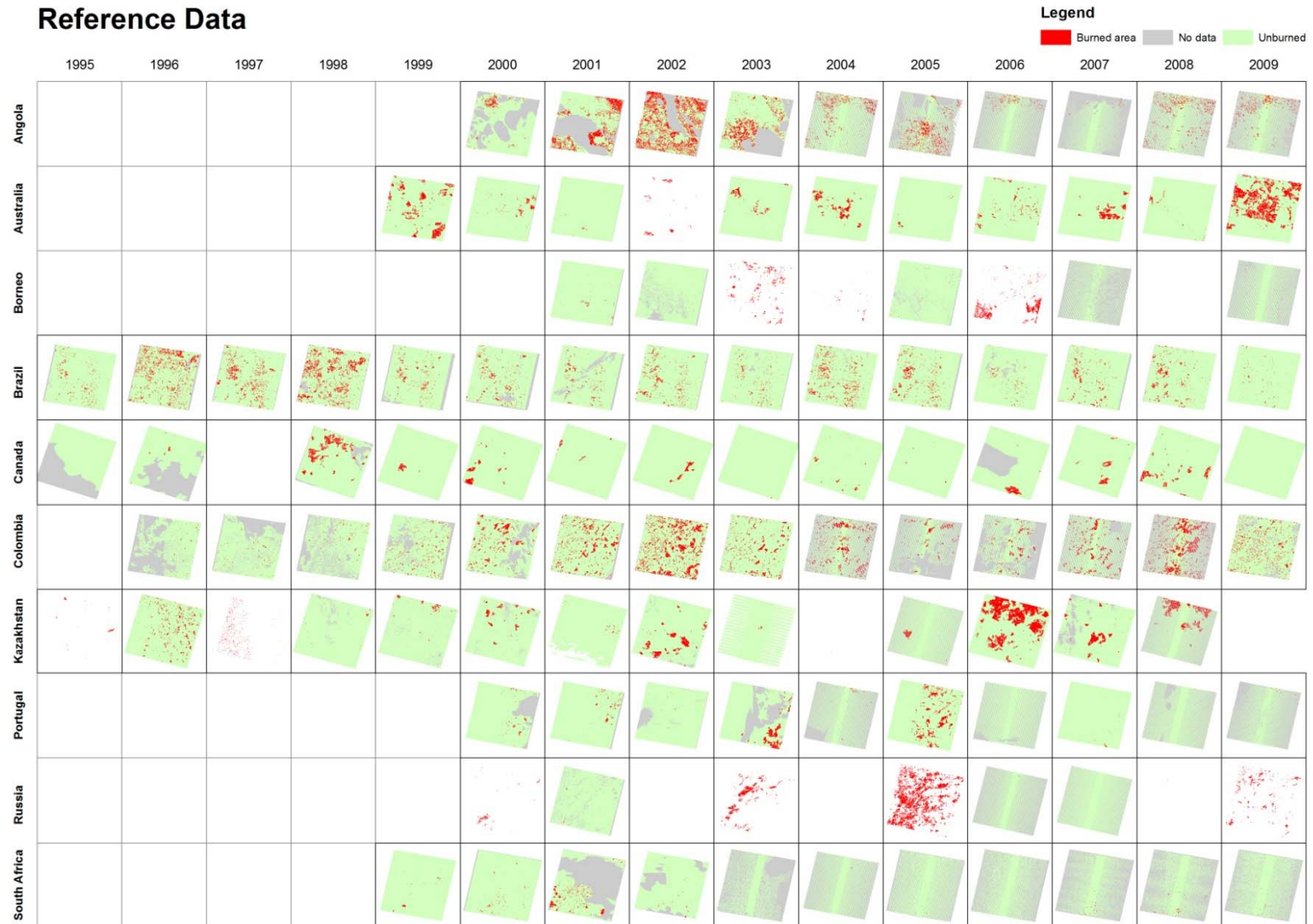


Biomes	Frames	Fire perimeters	Burned area (km ²)
Tropical Forest	42	50.157	24.475
Temperate grassland	29	3.467	13.189
Others biomes	8	384	89
Temperate Forest	16	1.223	186
Mediterranean Forest	18	2.327	5.230
Tropical Savanna	94	89.365	74.971
Boreal Forest	35	1.071	8.040
Total	242	147.994	126.180

Temporal validation



Reference Data



Generation of reference perimeters



- ABAMS: (Bastarrika et al. 2011). Based on a two-phase algorithm:
 - Seed detection.
 - Region-growing.
 - Includes multitemporal images.
- Results are visually reviewed and cross-check with another interpreter.
- Standard documentation protocol (CEOS).

Burned Area Mapping Algorithm Configuration

Temporal strategy

☐ Unitemporal ☒ Multitemporal

Multitemporal_severe.ba Save BA Algorithm

40-18 -> [3 Post scenes] [1 Previous reference scenes]

Phase 1 (Seeds)

TM1_post
TM2_post
TM3_post
TM4_post
TM5_post
TM7_post
TM1_pre
TM2_pre
TM3_pre

Example: $BAIM_post > 144 \text{ AND } MIRBI_post > 1.95$

$NBR_post < -0.15 \text{ AND } (NDVI_post - NDVI_pre) < -0.18$
 $\text{AND } (BAIM_post - BAIM_pre) > 56.2 \text{ AND } MIRBI_post > 1.85$
 $\text{AND } MASK_post == 1 \text{ AND } MASK_pre == 1$

Minimum Seed patch (ha)

0.2

Phase 2 (Contextual Region Growing)

TM1_post
TM2_post
TM3_post
TM4_post
TM5_post
TM7_post
TM1_pre
TM2_pre
TM3_pre

Example: $LR_post > 35$

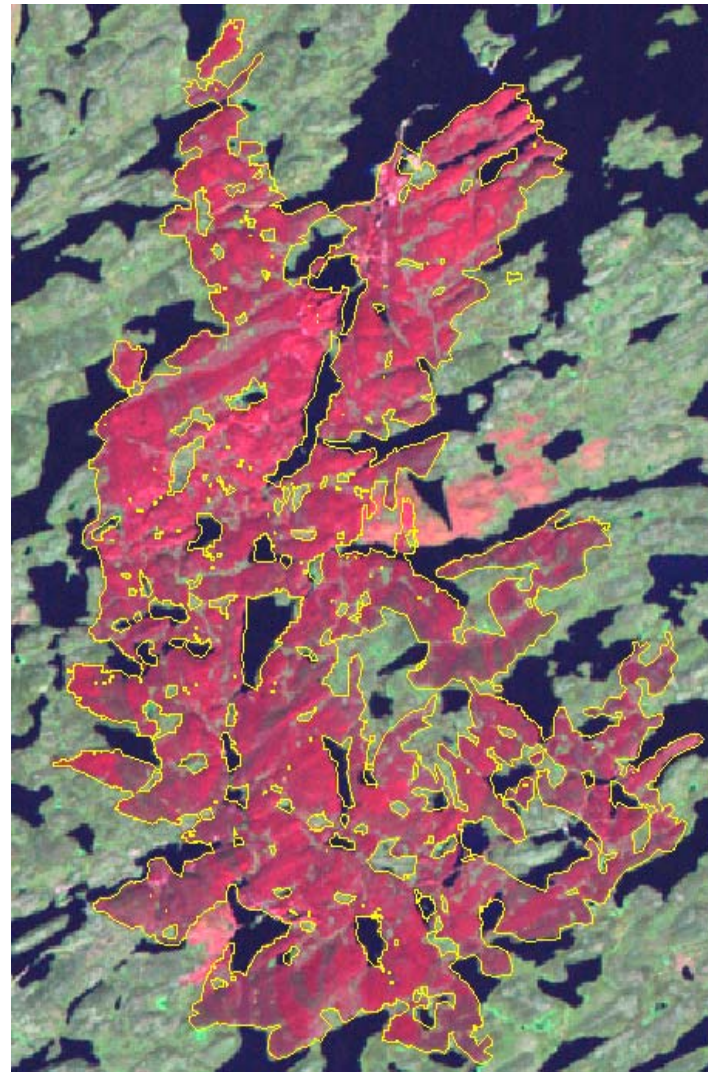
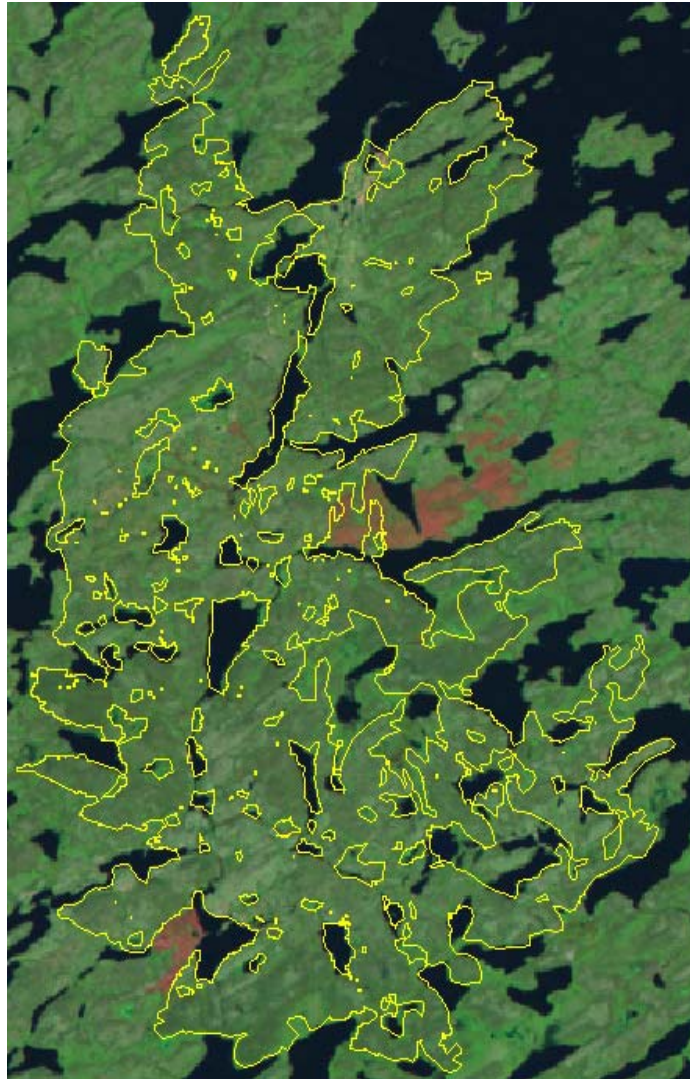
$LR_multi > 35 \text{ AND } TM4_post < 0.25 \text{ AND } MASK_post == 1 \text{ AND } MASK_pre == 1$

Minimum burned patch (ha)

1

Cancel Back Execute BA

Examples of fire reference data



Canada

Validation metrics (following user requirements)

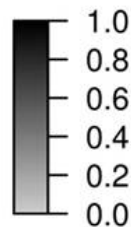
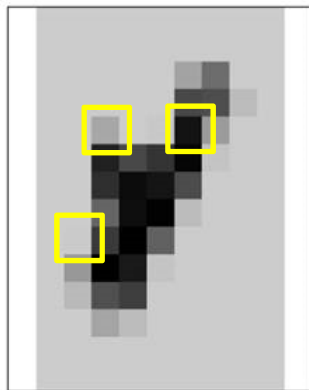


- Validation Accuracy (agreement global-reference data).
- Error balance (over-under estimation).
- Temporal consistency.

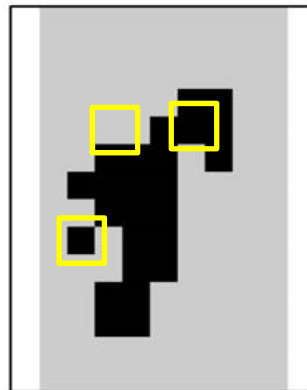
Fuzzy error matrix



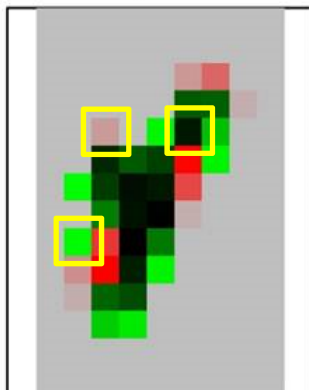
Reference Data



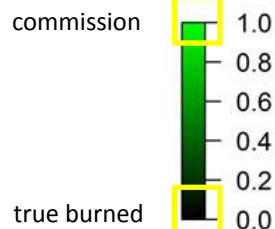
Global product



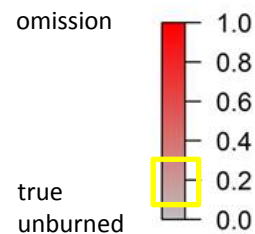
Comparison



Commission
if GP = 1



Omission
if GP = 0



Error matrix

Global product	Reference data		Global total
	Burned	Unburned	
Burned	p_{11}	p_{12}	p_{1+}
Unburned	p_{21}	p_{22}	p_{2+}
Reference Total	p_{+1}	p_{+2}	$p=1$

Outline



- Project overview
- BA algorithms
- Validation strategy
- **Intercomparison**

Intercomparison analysis



- Trends between products:
 - Burned pixels.
 - Detection Dates.
- Comparison with reference sites:
 - Average accuracy.
 - Error balance.
 - Temporal stability.

Products compared

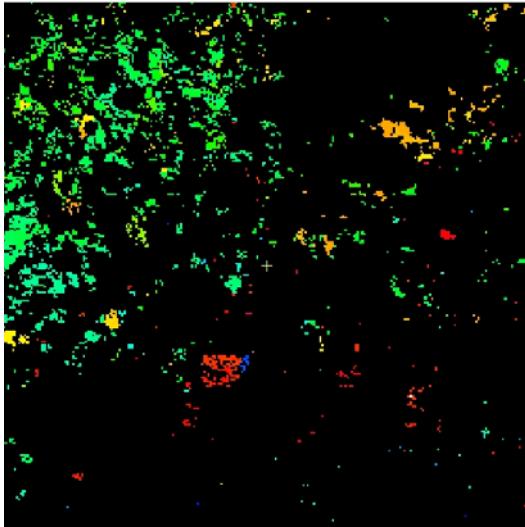


Product	Sensor	Period
Fire_cci Burned Area merged product	ATSR (AATSR) VEGETATION MERIS	1995-2009
GlobCarbon	ATSR (AATSR) VEGETATION	1999-2007
L3JRC	VEGETATION	1999-2007
MCD45	MODIS	2000-...
MCD64	MODIS	2000-...

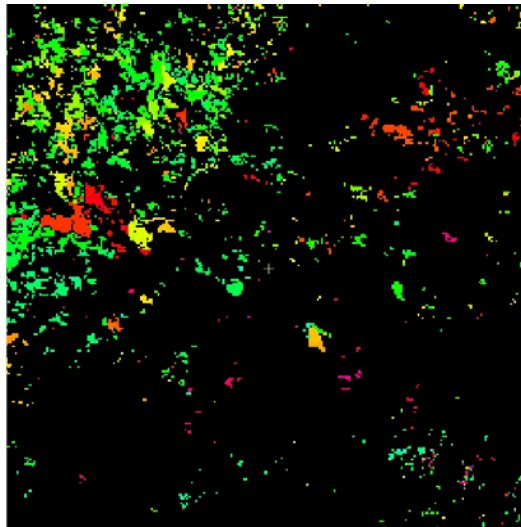
Intercomparison analysis (2005, Australia)



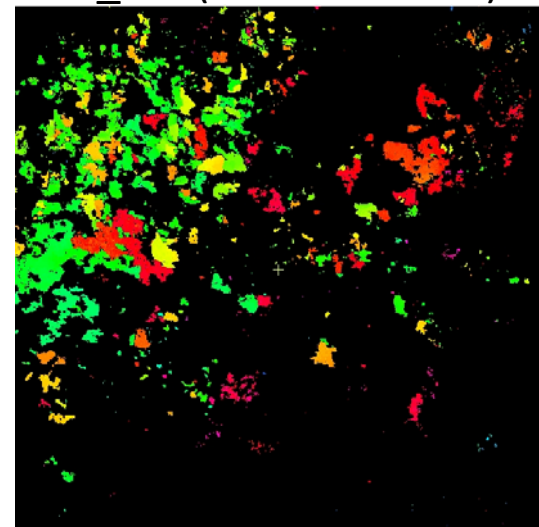
Globcarbon



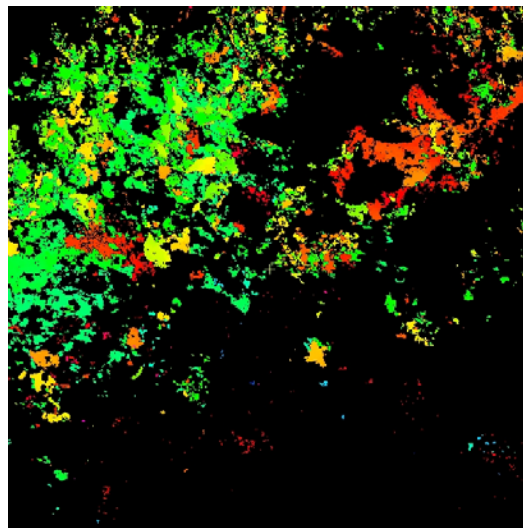
L3JRC



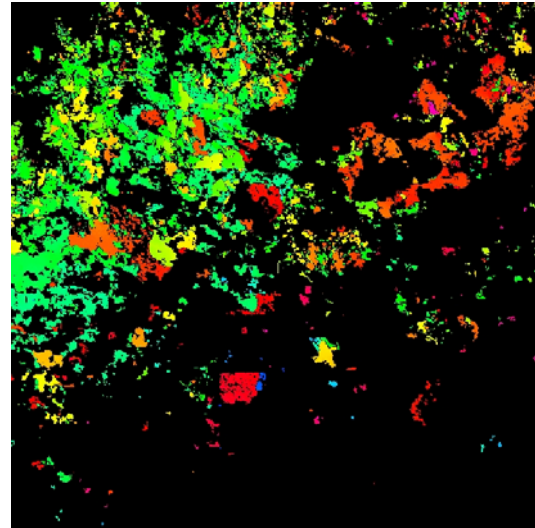
Fire_CCI (**PRELIMINARY**)



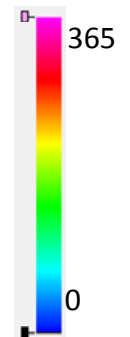
MCD45



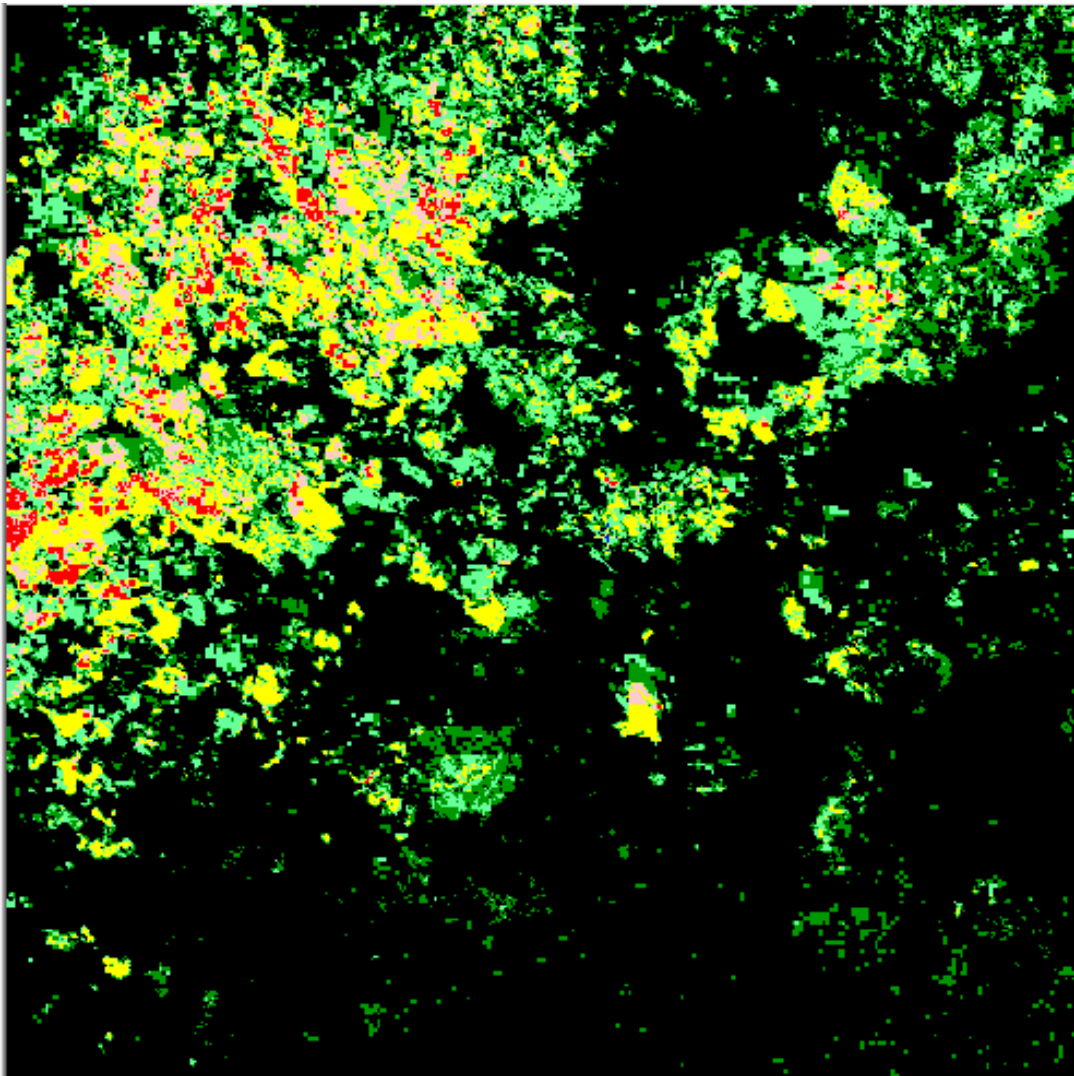
MCD64



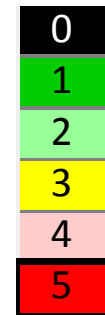
0 20 40 80 120 160 Kilometers



Intercomparison analysis (2005, Australia)

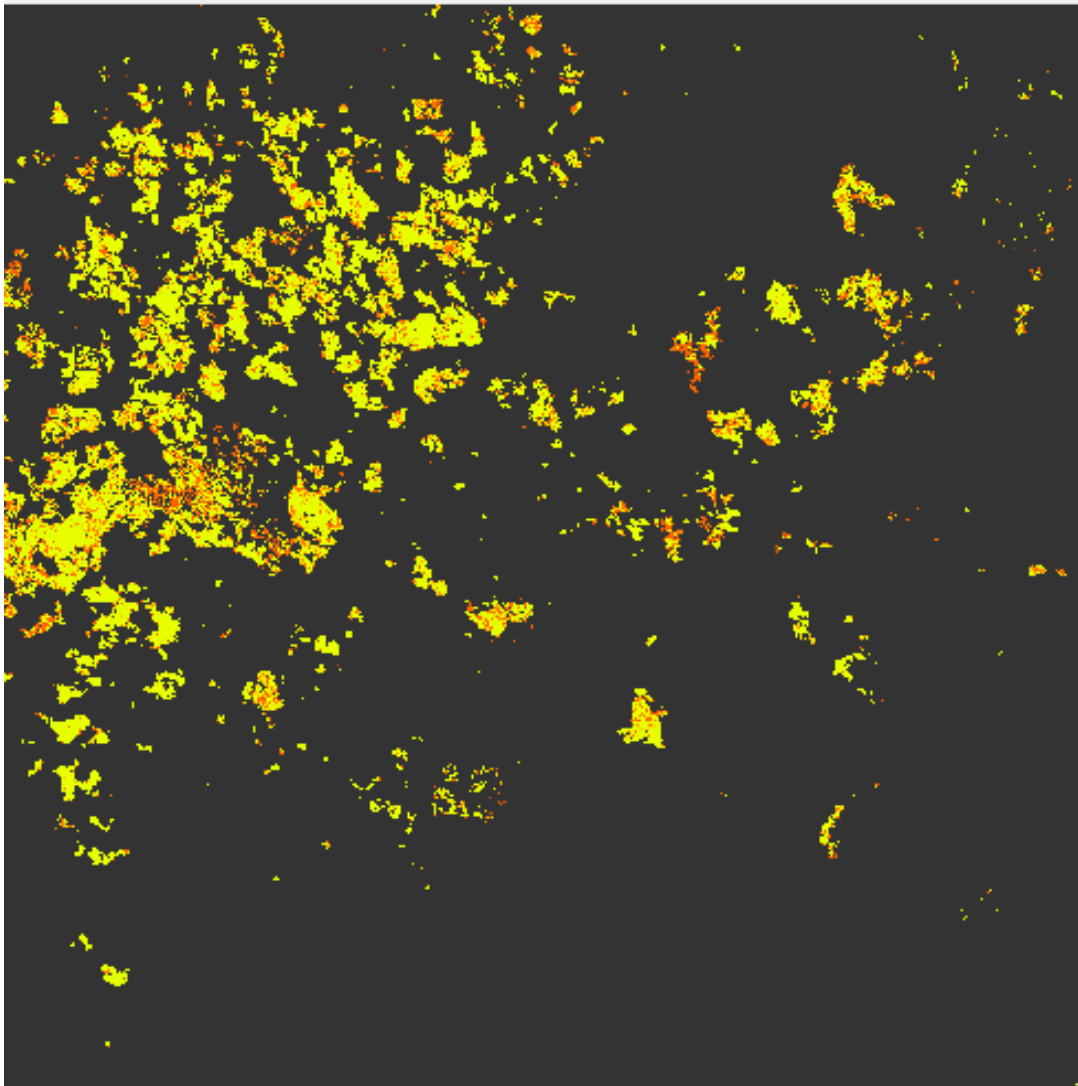


Products
detecting BA pixels

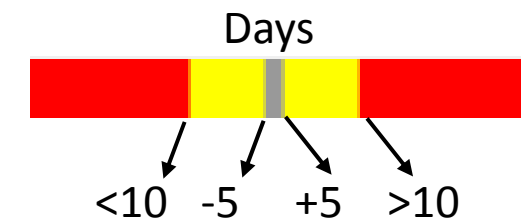


0 20 40 80 120 160 Kilometers

Intercomparison analysis (2005, Australia)



Detection dates difference
Fire_cci and MCD64



Total burned area 2005 (km²)



Product	Australia	Canada	Kazakhstan	Portugal
Fire_cci merged product	3173	96	1922	303
GlobCarbon	1794	698	1708	240
L3JRC	2352	1008	2861	72
MCD45	4969	48	1501	345
MCD64	4981	75	1196	372

- MODIS products are the most similar ones, particularly in Tropical regions
- Fire_cci estimations are closer to MODIS than to Globcarbon and L3JRC
- Globcarbon and L3JRC tend to underestimate in Tropics and Temperate and overestimate in Boreal forest

Summary



- URD report soon to be published.
- Global pre-processing implementation has caused major delays.
- Time series of study sites processed with Algo v1. Preliminary results look good.
- Algo v2 in process (need first global outputs).
- Temporal and spatial validation files ready.

iThank you!



esa climate change initiative European Space Agency

ESA | CCI | aerosol | cloud | smug | ghg | glaciers | land cover | ocean colour | ozone | sea level | sat

Fire

Comprehensive Project Documentation - Activities, Achievements and Outcomes from the First Fire CCI Project Year
8 October 2011 - 12:11

What type of information is needed by the scientific and research climate, atmospheric and ecosystem modeller communities in relation to burned areas? Identifying and analysing those communities needs was one of the first major tasks that has been conducted during the first year of the Fire CCI project.

[Read more](#)

Navigation

- Home
- Information
- Development
- Resources
- Support

Featured Content

Comprehensive Project Documentation - Activities, Achievements and Outcomes from the First Fire CCI Project Year
8 October 2011 - 12:11

The Round-Robin Exercise - Including International Expertise and Strengthening Global Cooperation
8 July 2011 - 12:11

Fire_cci Project Website launched
1 - November 2010

Fire_cci Newsletter Issue 1 - November 2010 published

Upcoming Events

Second ESA CCI Collocation Meeting
12 Oct 2011 - 20:00 - 14 Oct 2011 - 17:00 - Paris, France

ESA Fire CCI & GOFC-GOLD Fire IT Workshops
17 Oct 2011 - 09:00 - 19 Oct 2011 - 18:00 - Bonn, Germany

WCRP Open Science Conference
14 Oct 2011 - 19:00 - 20 Oct 2011 - 17:00 - Bonn, Germany

emilio.chuvieco@uah.es

<http://www.esa-fire-cci.org/>

Figure 1 is a scatter plot showing the time series of reflectance (%) from 2005 to 2009. The y-axis represents Reflectance (%) from 0 to 100. The x-axis represents Time (years) from 2005 to 2009. The plot includes black dots for observations, a solid red line for the trend, and dashed red lines for the 3% and 5% confidence intervals. Shaded gray vertical bars indicate periods of low reflectance.

Bulk pre-processing



- For the 10 SS a total of 69.198 images have been processed:
 - 42.820 VGT (1998-2009).
 - 18.760 ATSR/AATSR (1995-2009)
 - 7.618 MERIS (2005-2009).
- For global datasets:
 - MERIS: one year is 16 Tb. Pre-processing implies 30 days of 20 PCs.
 - VGT: Every image is 40.320 x 14.673 pixels (11 bands: ρ + angles + QF) = 96 GB daily.