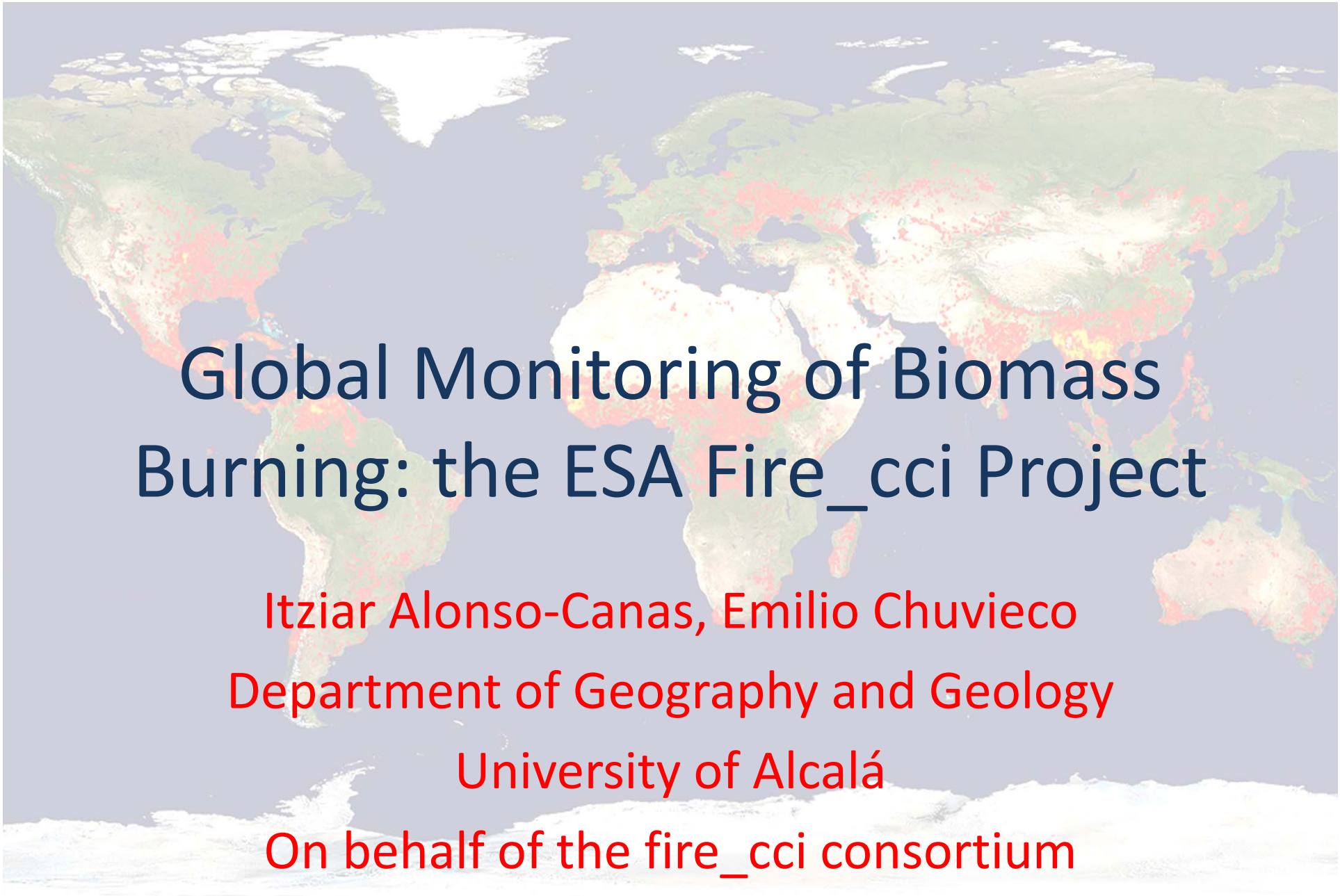


Global Monitoring of Biomass Burning: the ESA Fire_cci Project

Itziar Alonso-Canas, Emilio Chuvieco

Department of Geography and Geology

University of Alcalá

On behalf of the fire_cci consortium

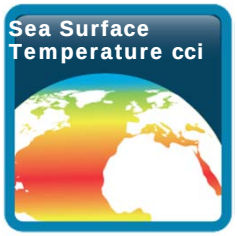
Outline

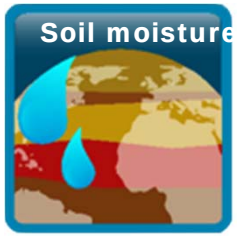
- Project overview.
- BA algorithms.
- Validation strategy.
- Intercomparison.

Outline

- Project overview
- BA algorithms
- Validation strategy
- Intercomparison

ESA-CCI programme

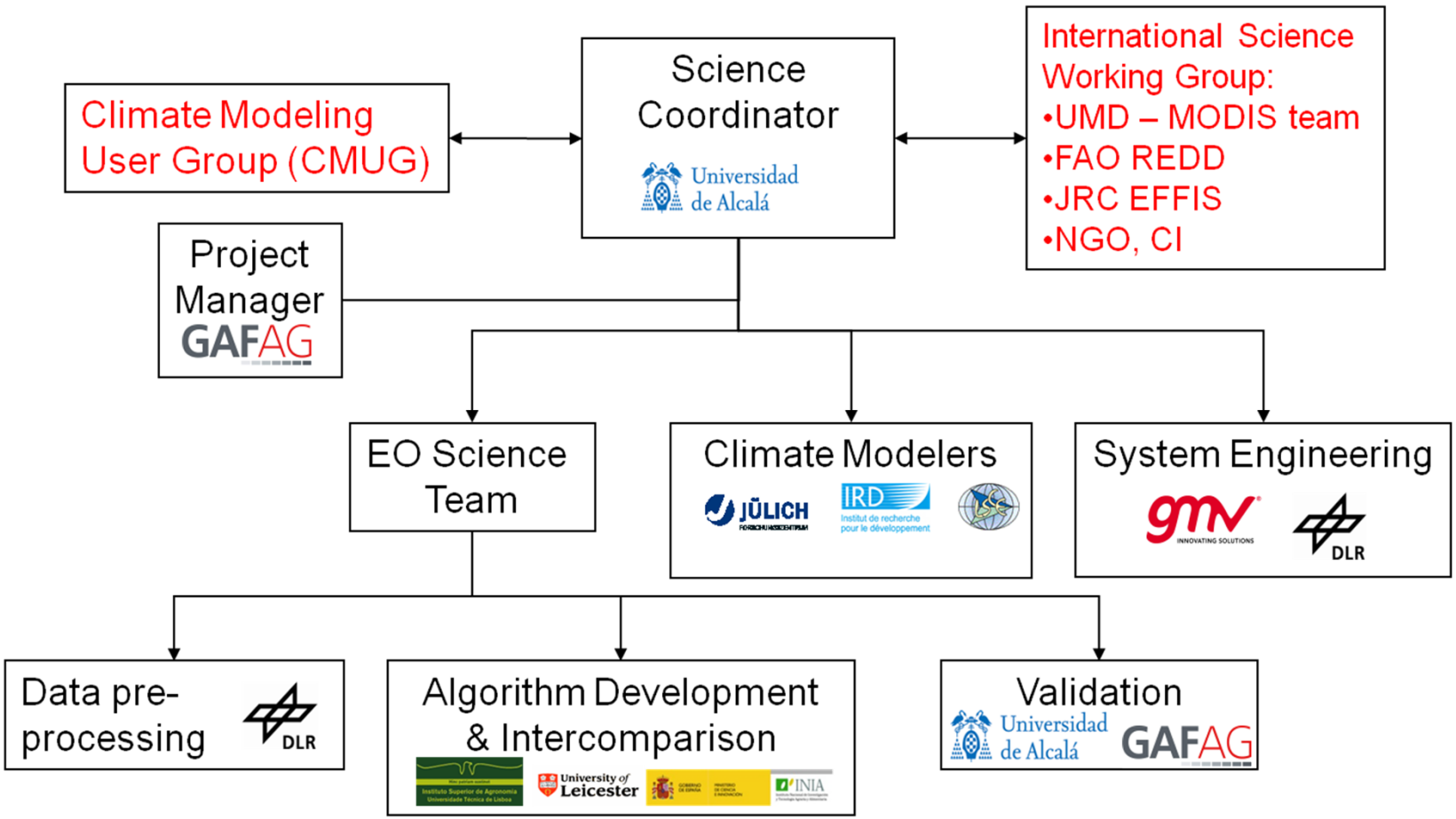




Fire_cci

Emilio Chuvieco: Science leader

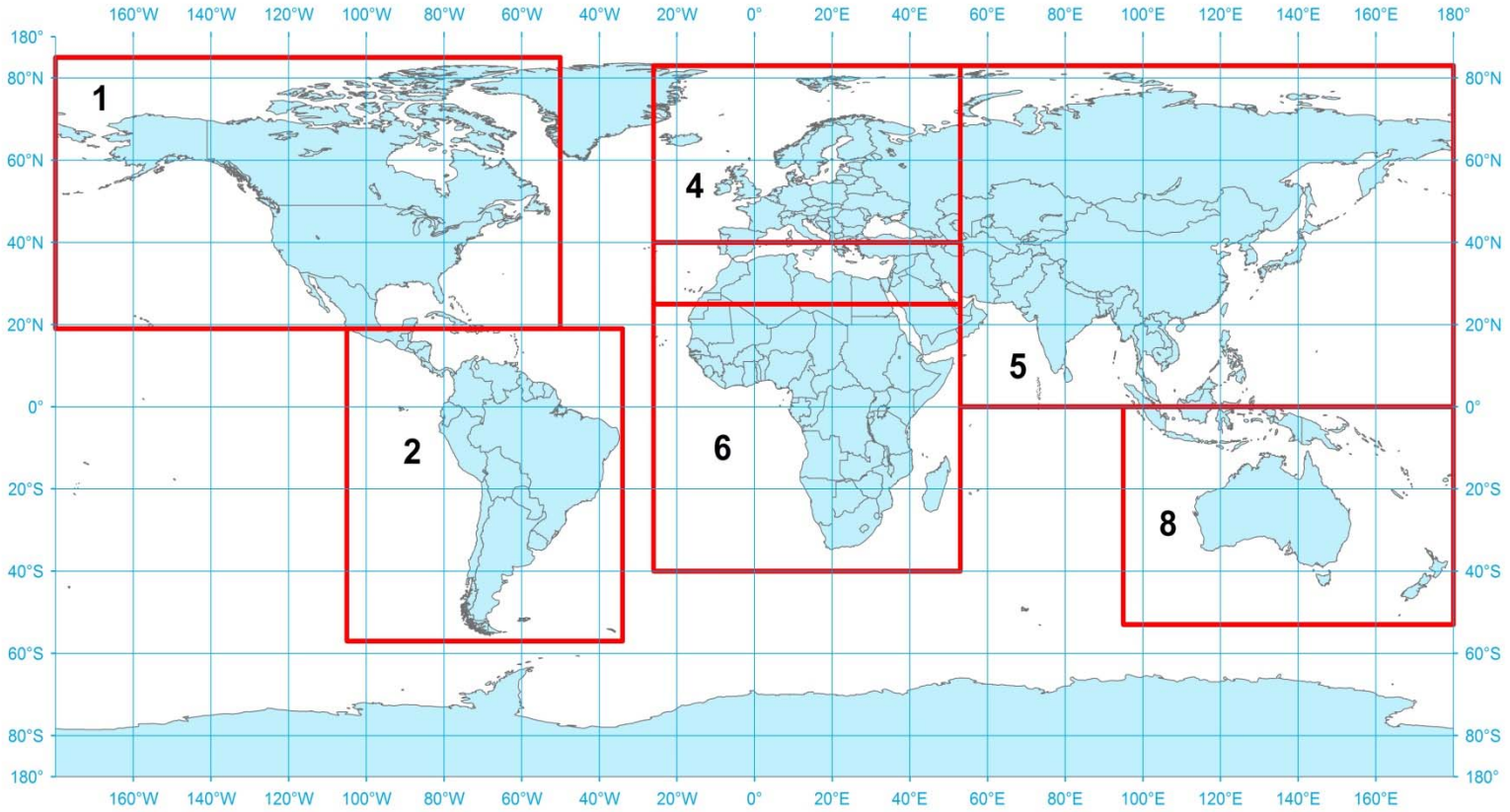
University of Alcalá (Spain)



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

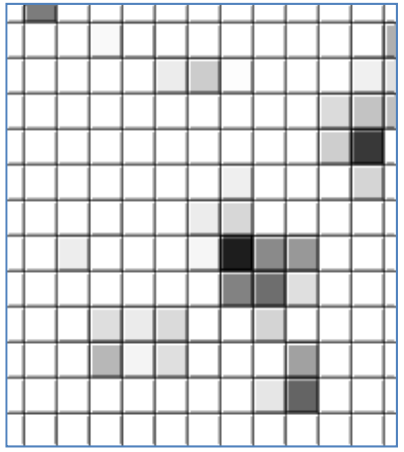


In addition to standard tiles, the user will have a web tool to interactively select his/her target site and apply for personal downloads

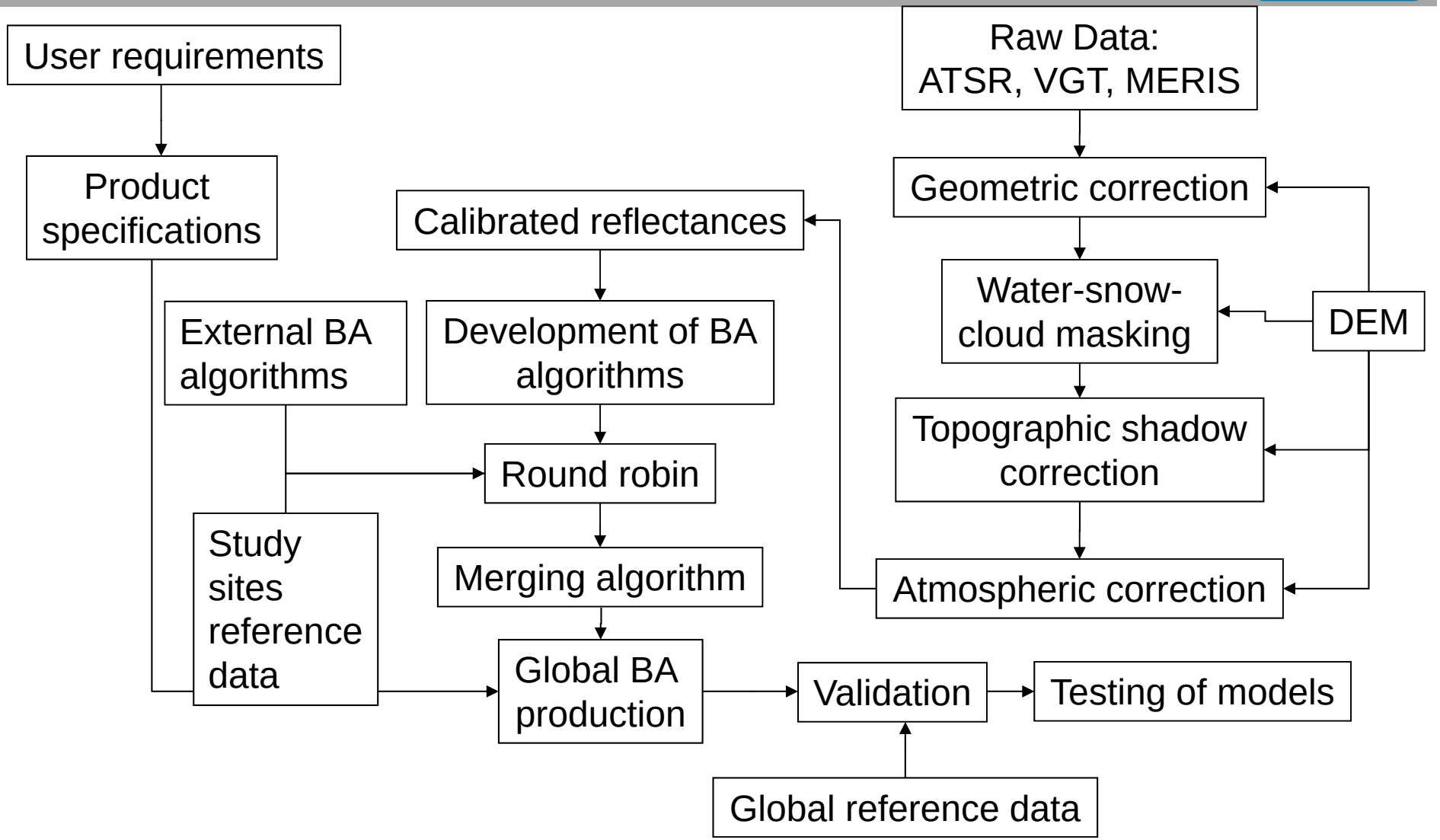
Target products

- Pixel level (mixing all three sensors whenever possible):
  - Monthly files with date of detection.
  - Include confidence level
  - GeoTiff format

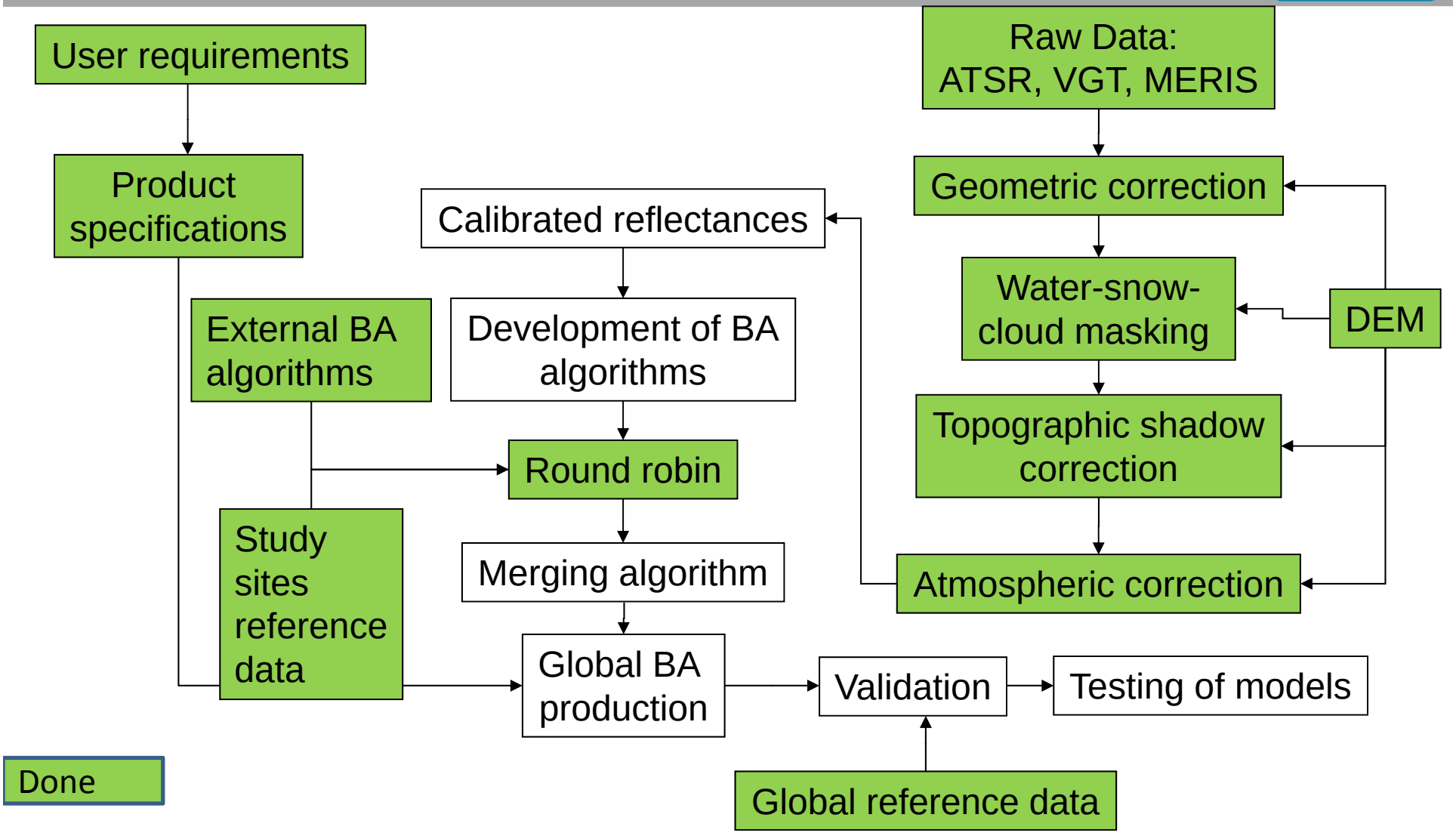
- Grid level:
  - 15-day files at 0.5 x 0.5 degree (CGM).
  - Include standard error and burned land cover.
  - NetCDF format.



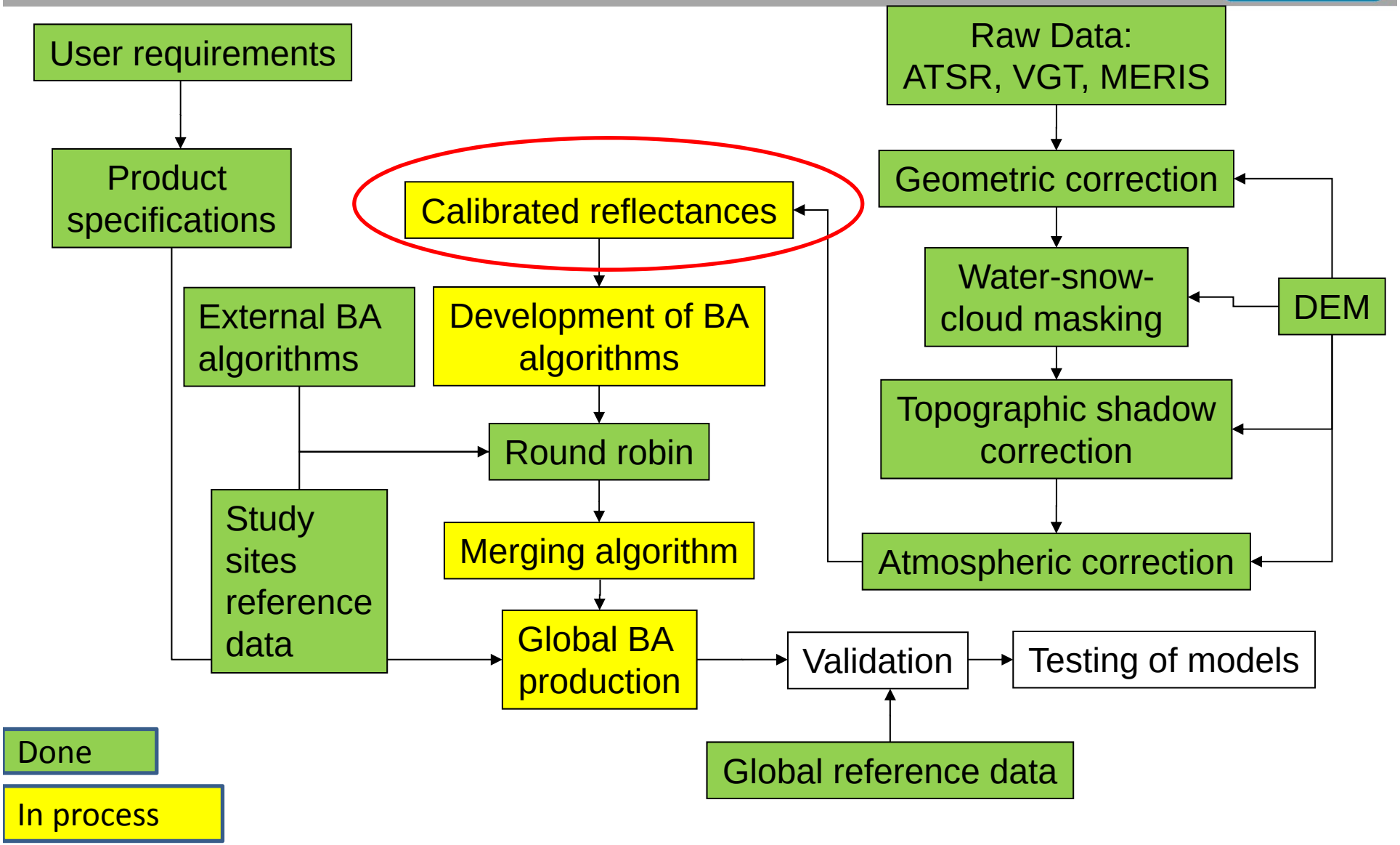
Project flowchart



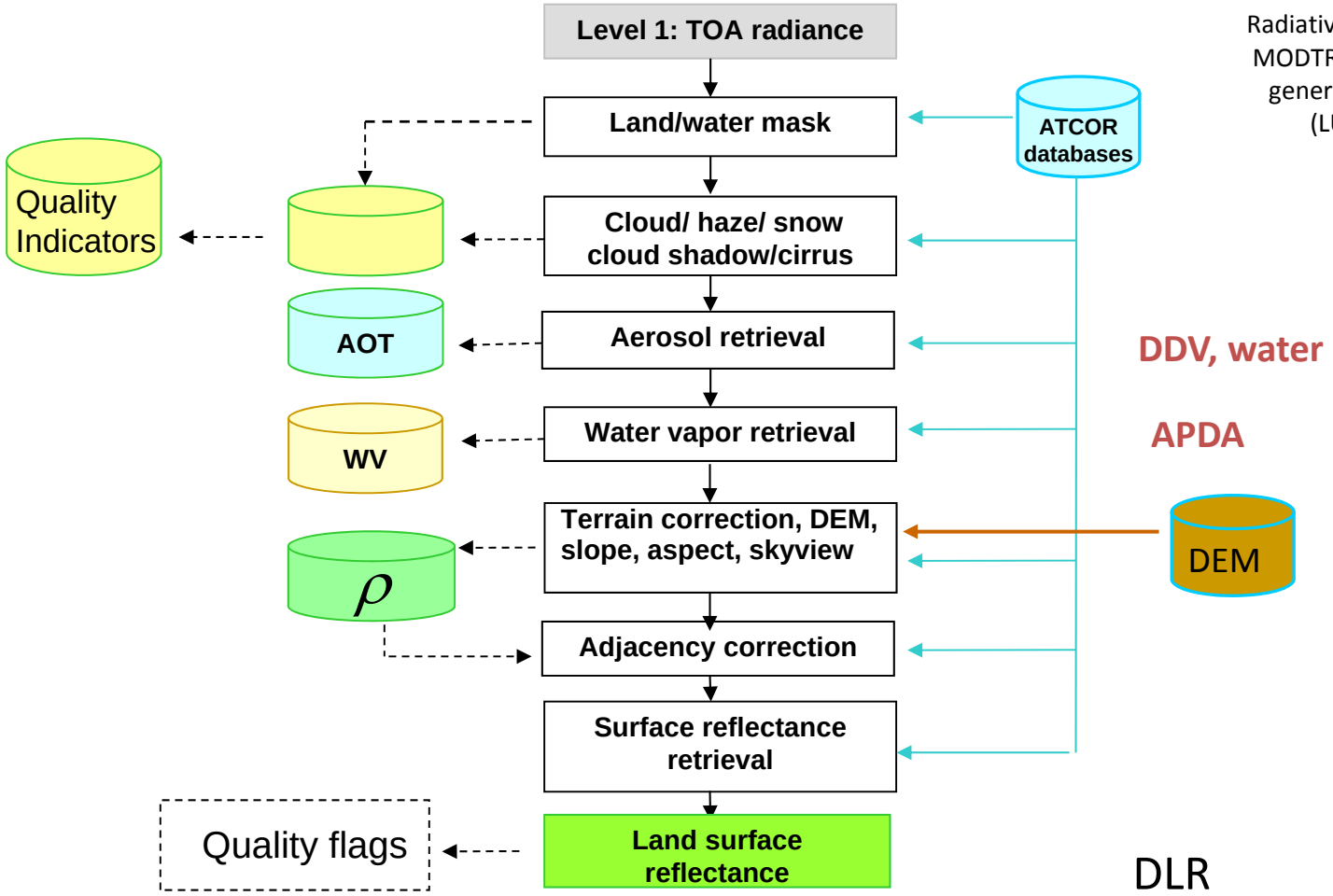
Project flowchart



Project flowchart



Radiometric correction

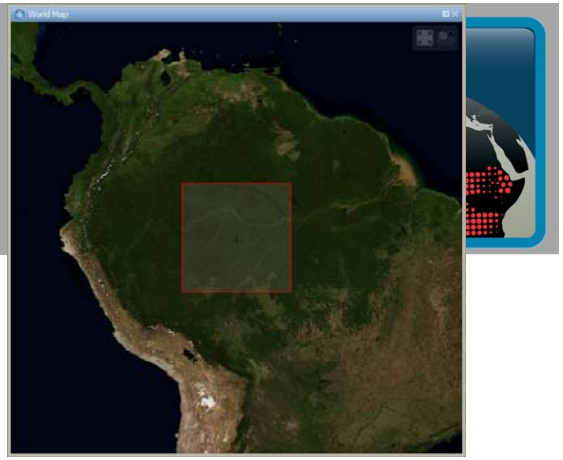


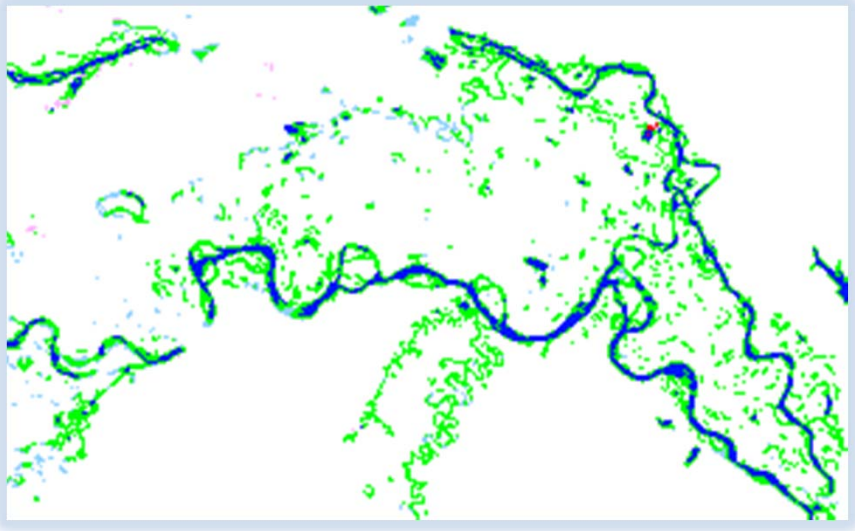
ATCOR

Radiative transfer code MODTRAN4 is used to generate data base (LUT based)

DLR

Static and dynamic water mask





Legend

1	Stable Water
2	Accepted Static Water
3	" " "
6	Accepted Dynamic Water
0	Not Accepted as Water

Outline

- Project overview
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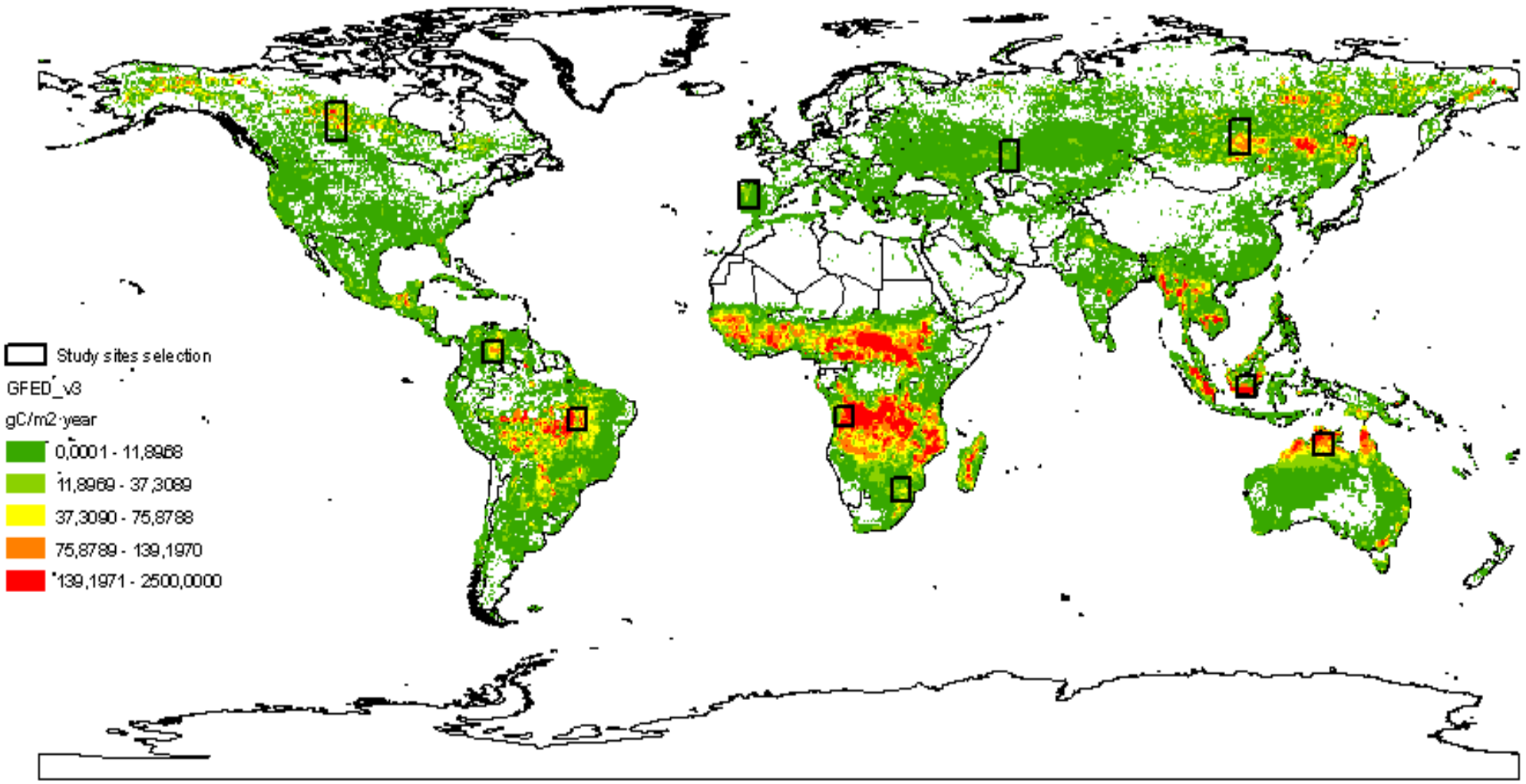
- Intercomparison

Burned area algorithms

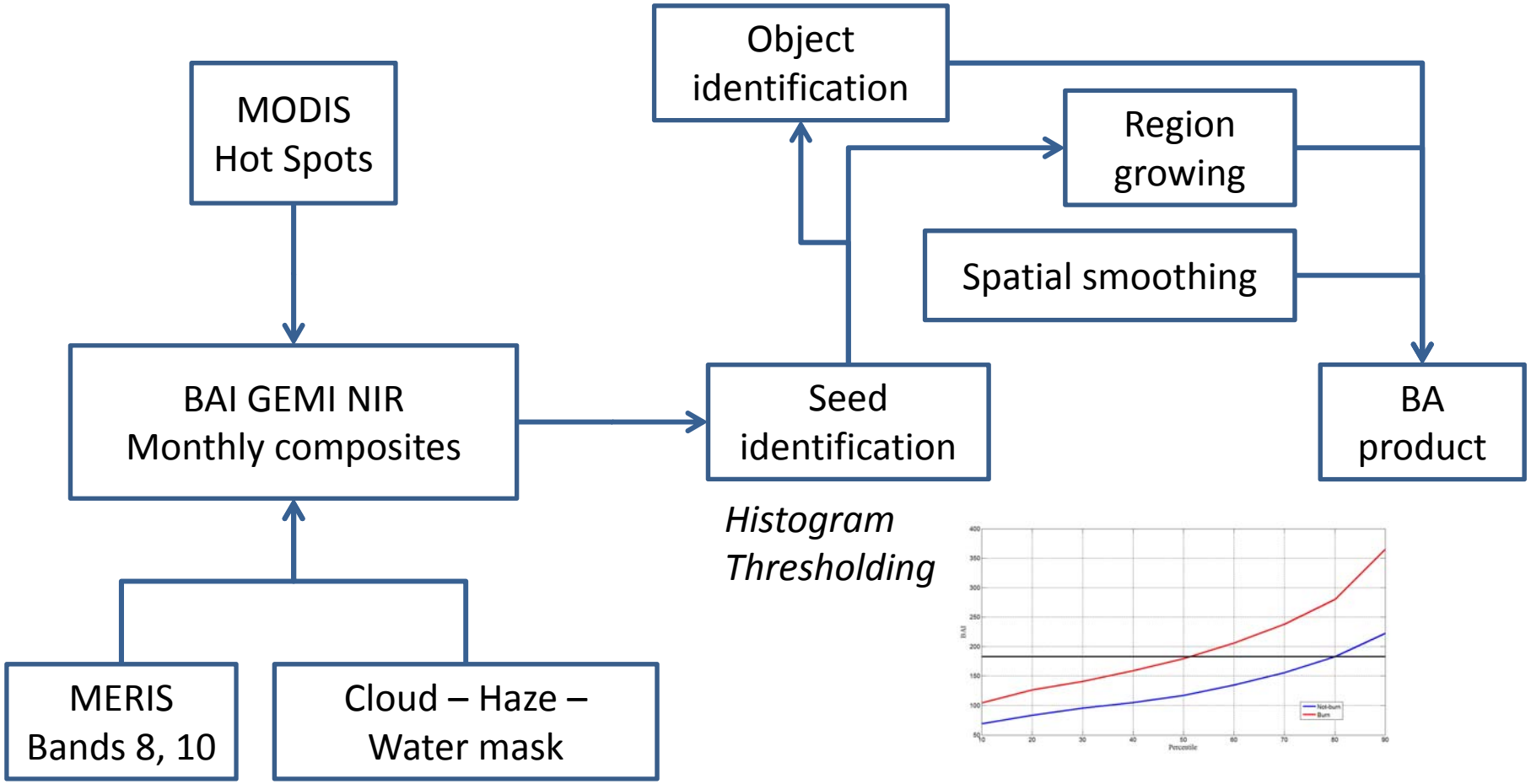
- Envisat MERIS:
  - Monthly composites.
  - Hotspots from MODIS.

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

Study sites

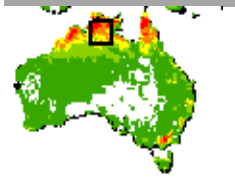

Study sites selection
GFED_v3
gC/m2·year
0,0001 - 11,8968
11,8969 - 37,3089
37,3090 - 75,8788
75,8789 - 139,1970
139,1971 - 2500,0000

BA algorithm: MERIS v1



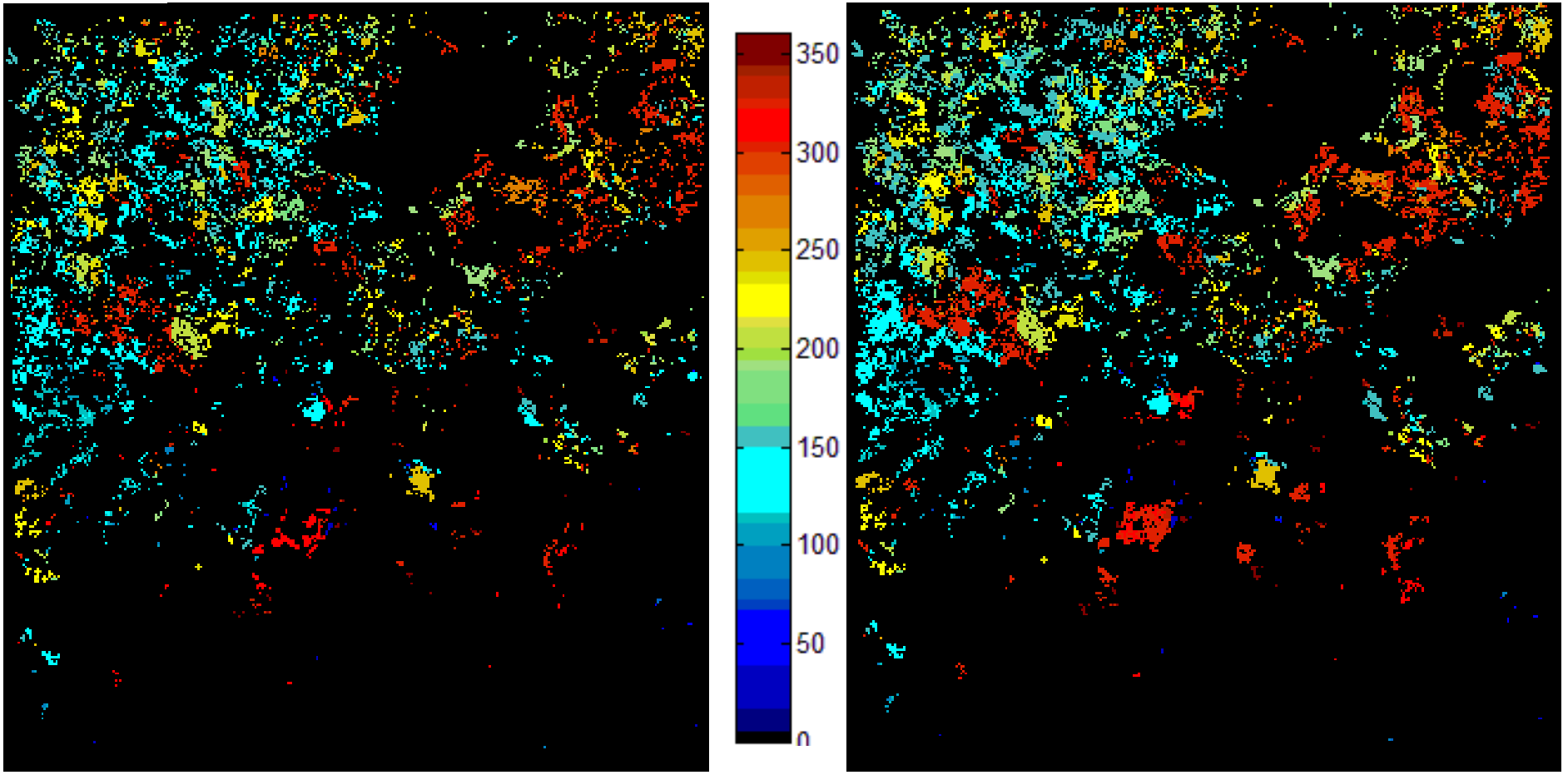
Alonso-Canas and Chuvieco, 2012

Australia 2005

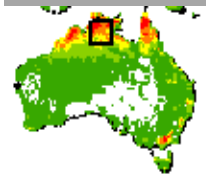


Seeds

MERIS BA v1

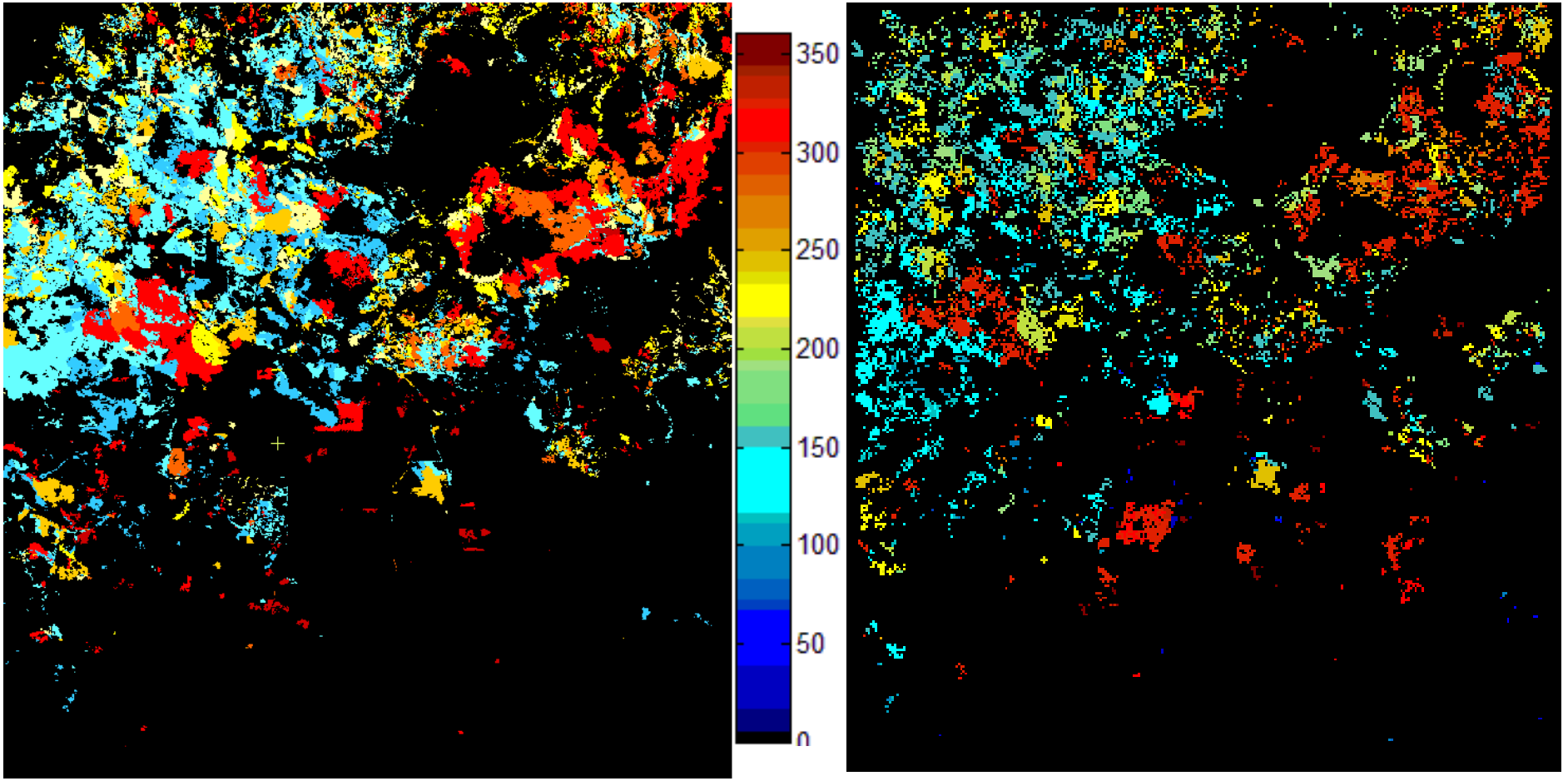


North Australian Fire Information comparison

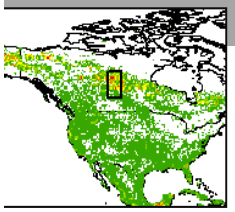


NAFI

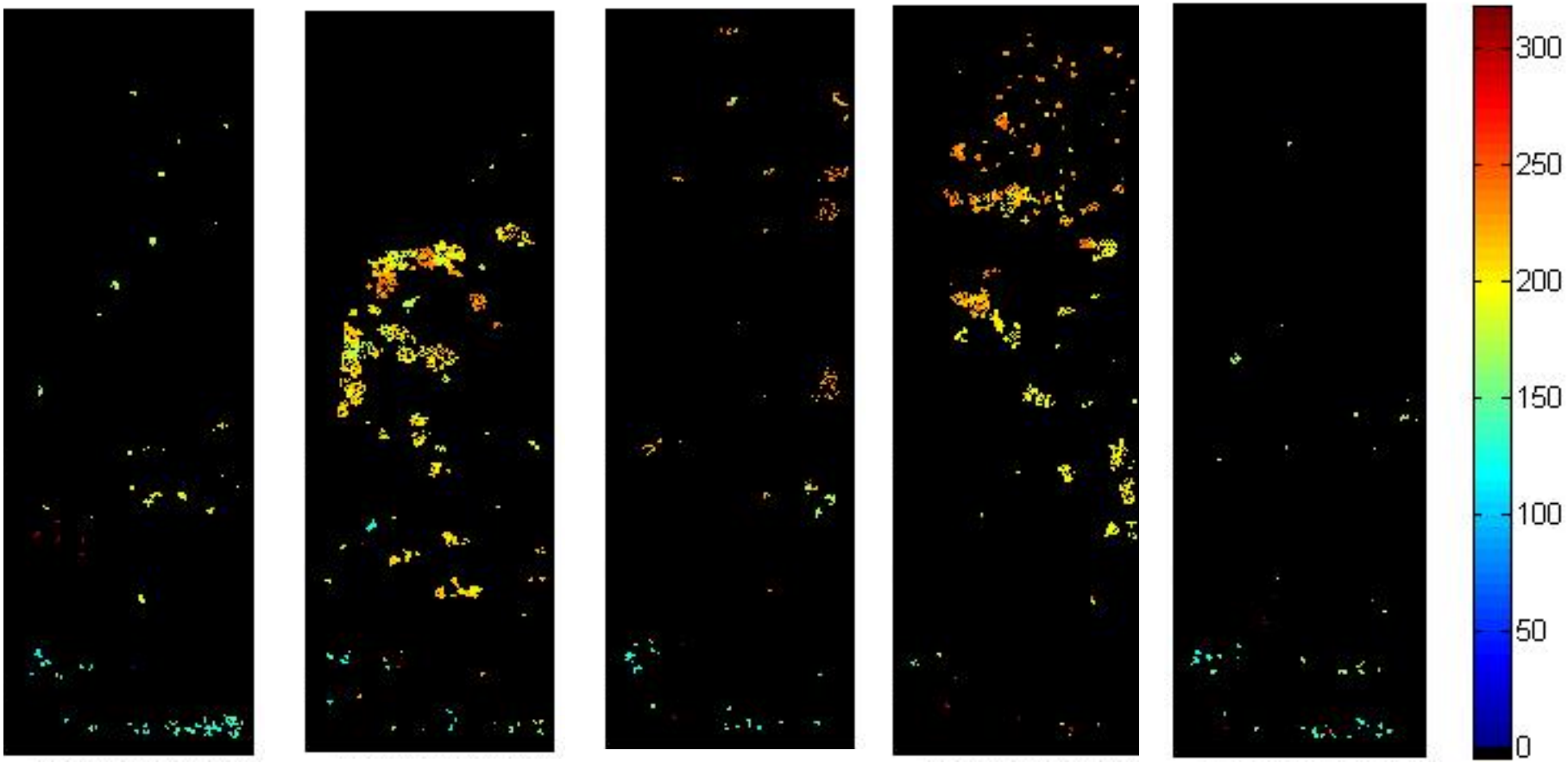
MERIS BA v1



MERIS v1: Boreal Forest Canada

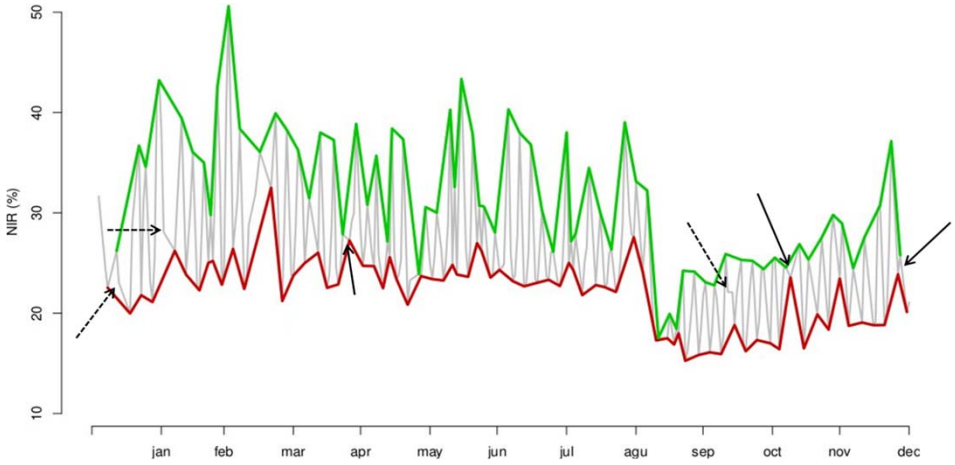


2005 2006 2007 2008 2009

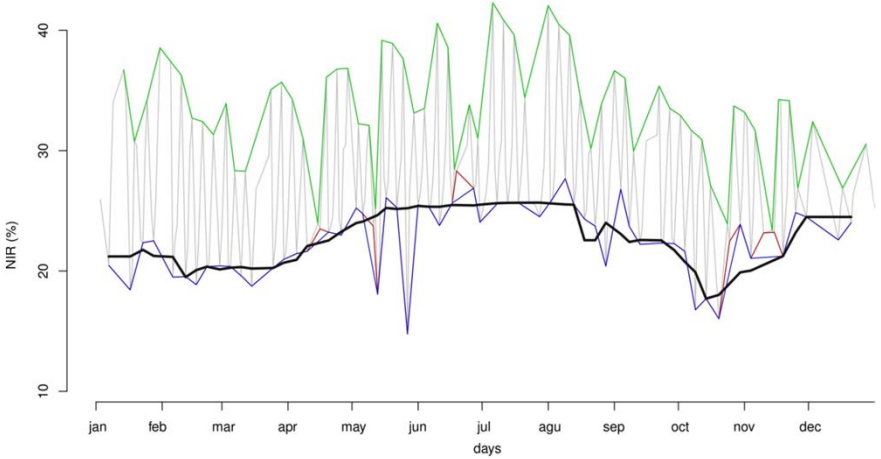


BA algorithm: VGT/ATSR v1 (ISA, Portugal)

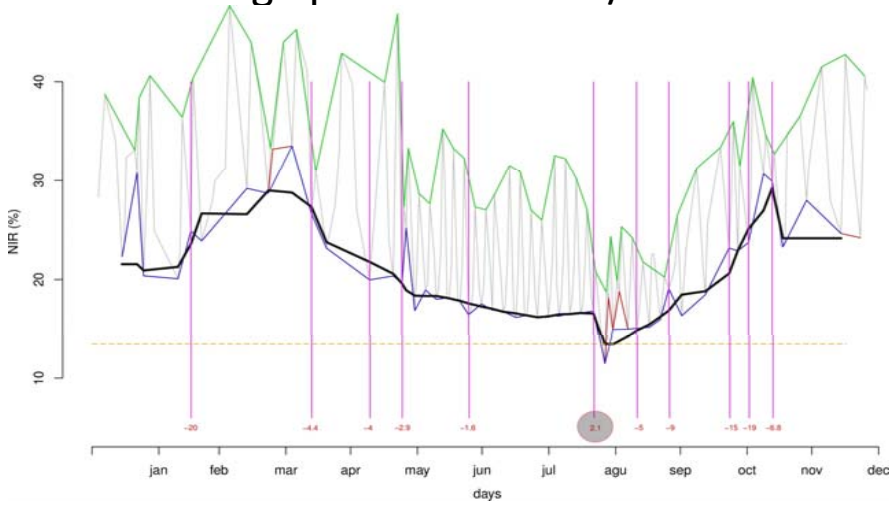
1. Extraction of local minima



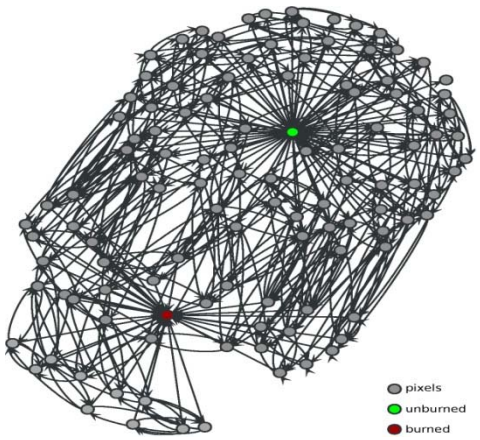
2. Robust filtering



3. Change point detection/score

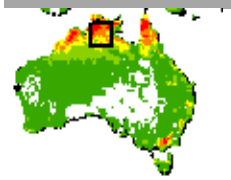


4. Markov Random Field Chain

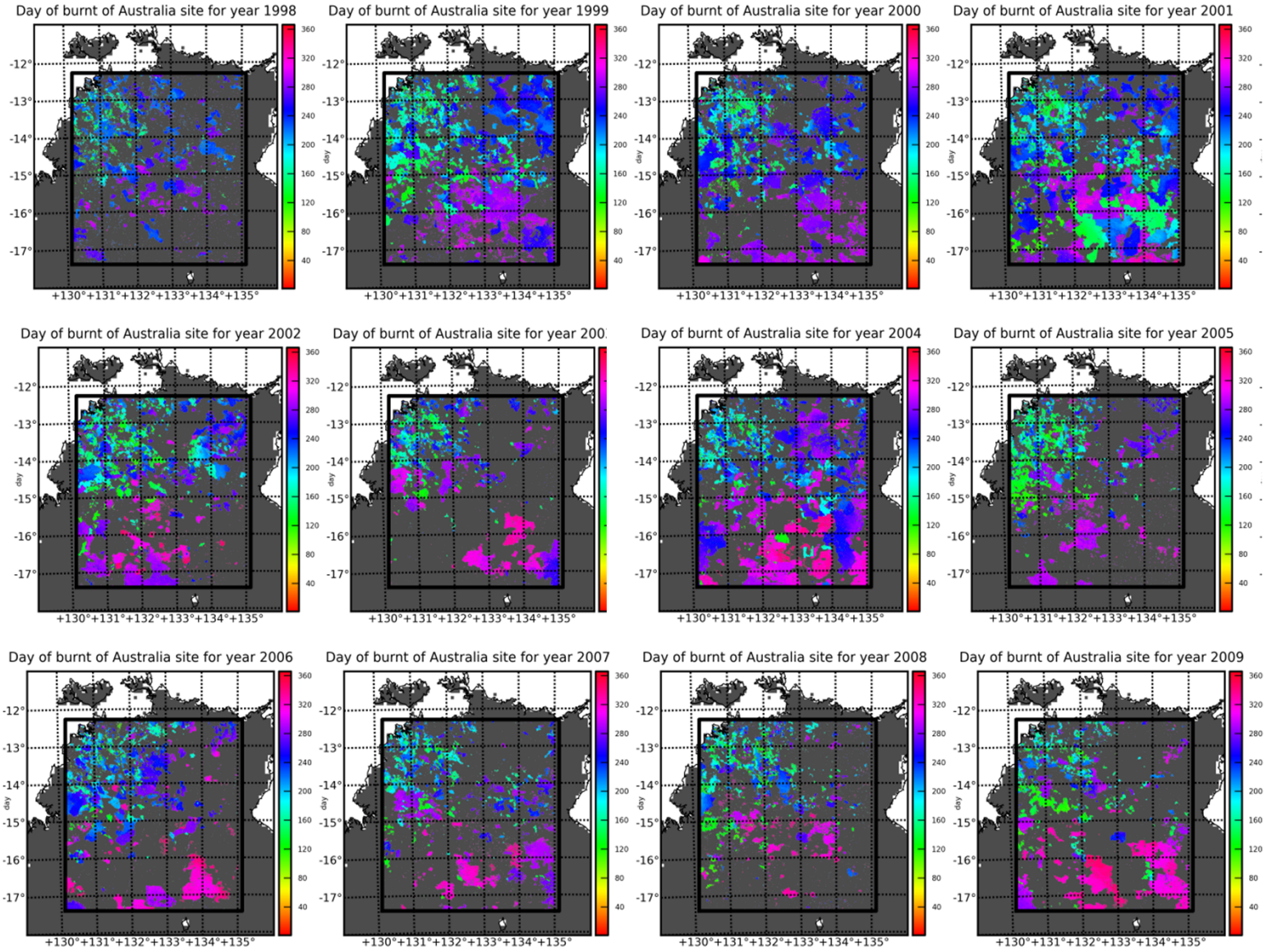


Pereira and Mota, 2012

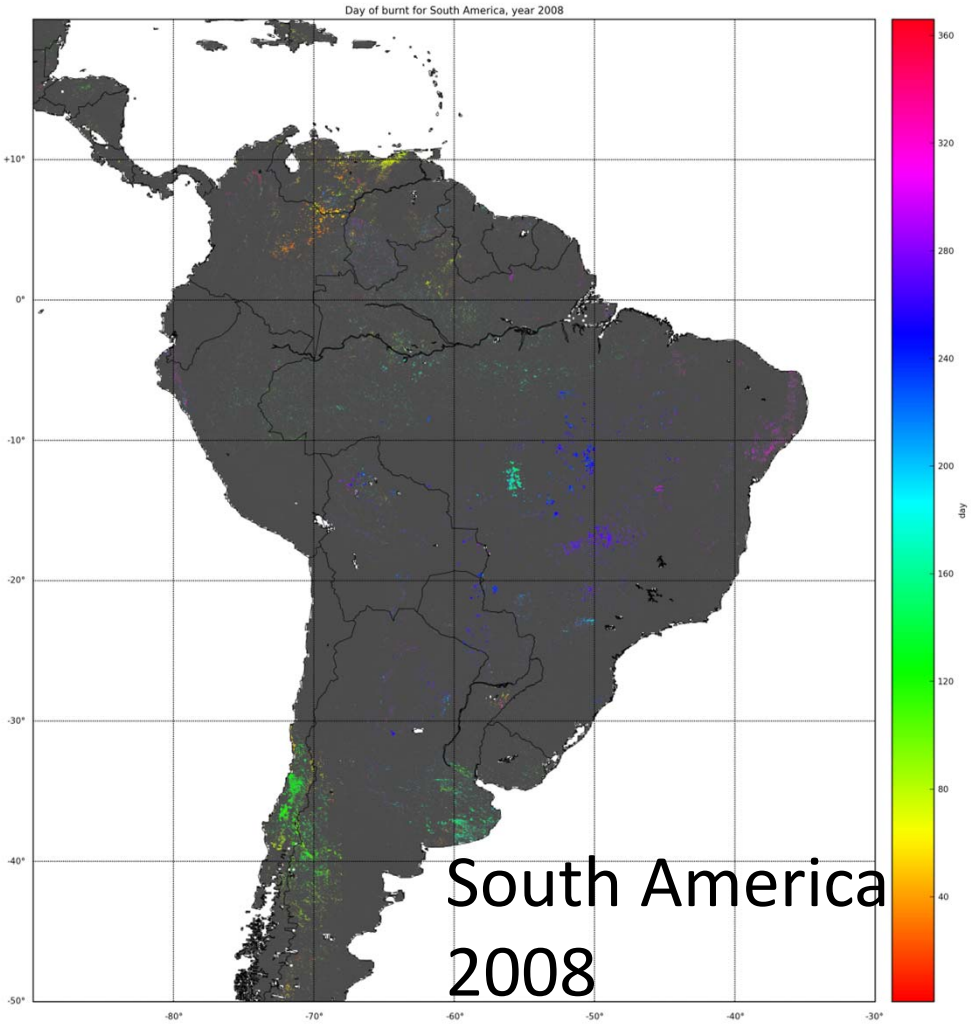
BA VGT v1 maps

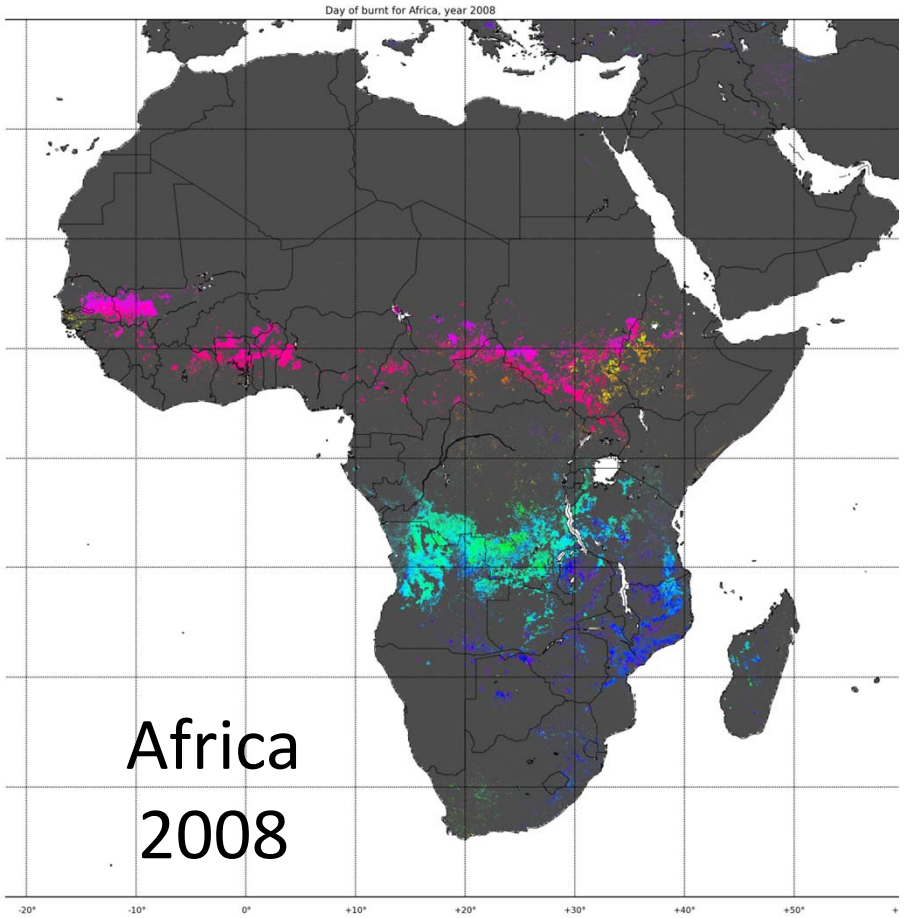


Australian site
VGT BA
1998 - 2009



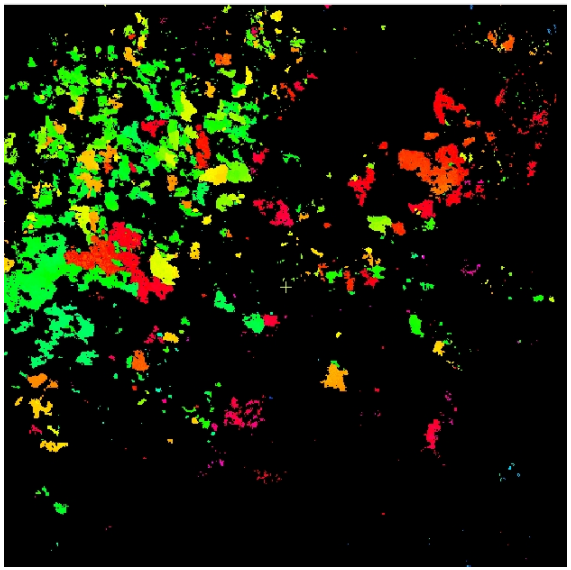
BA VGT v1 results



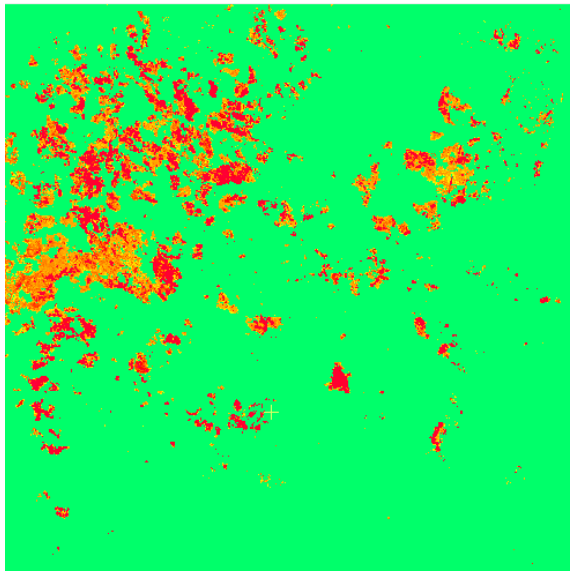


Pixel output: Merged product v1 (Australia)

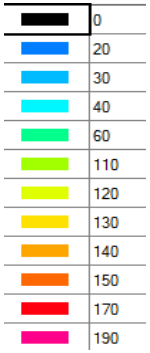
Day of detection

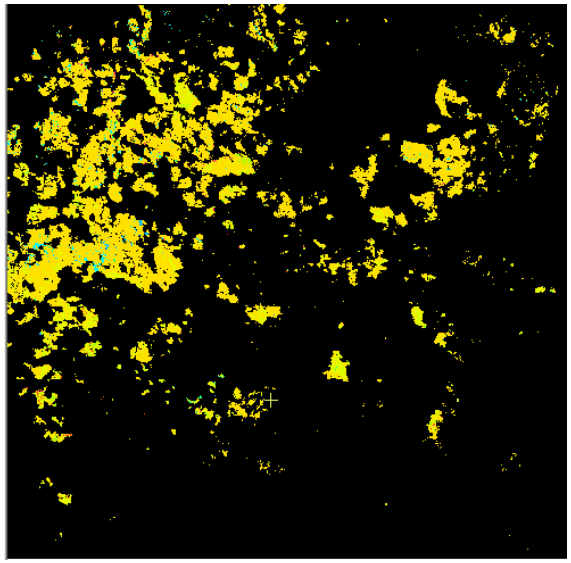


Confidence Level



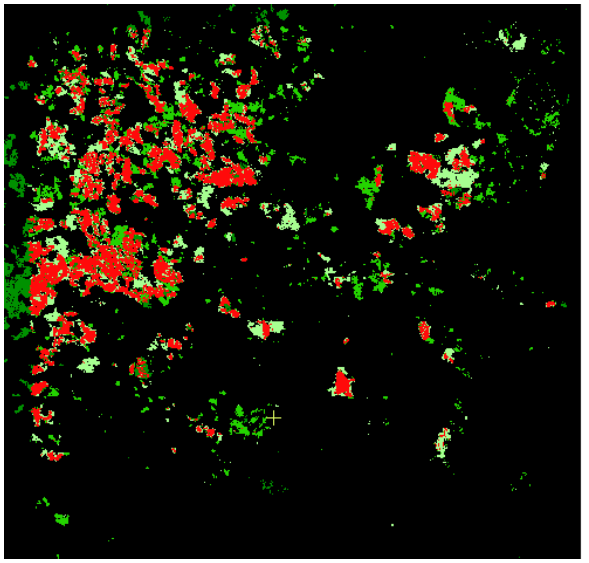
Land Cover Type





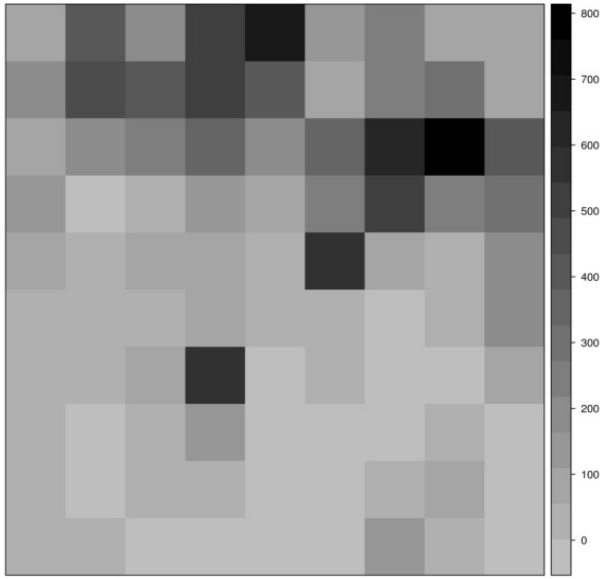
Sensor detecting

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

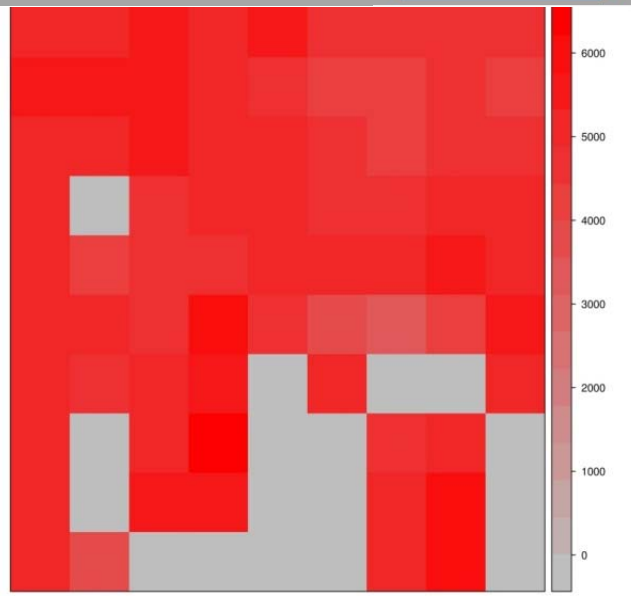


Grid output v1 (Australia)

Total burned area (km2)

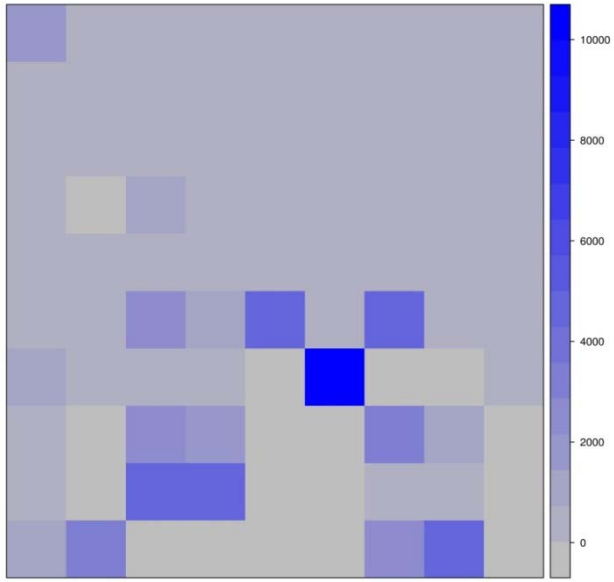


Standard Error

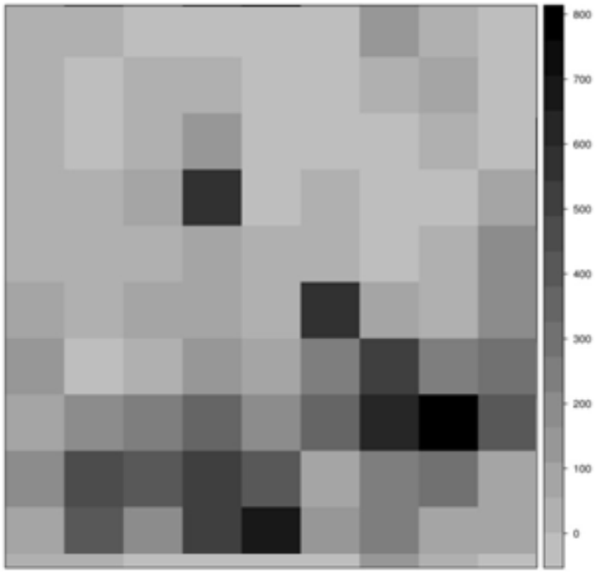


Homogeneity index

Mean fire size / total area burned



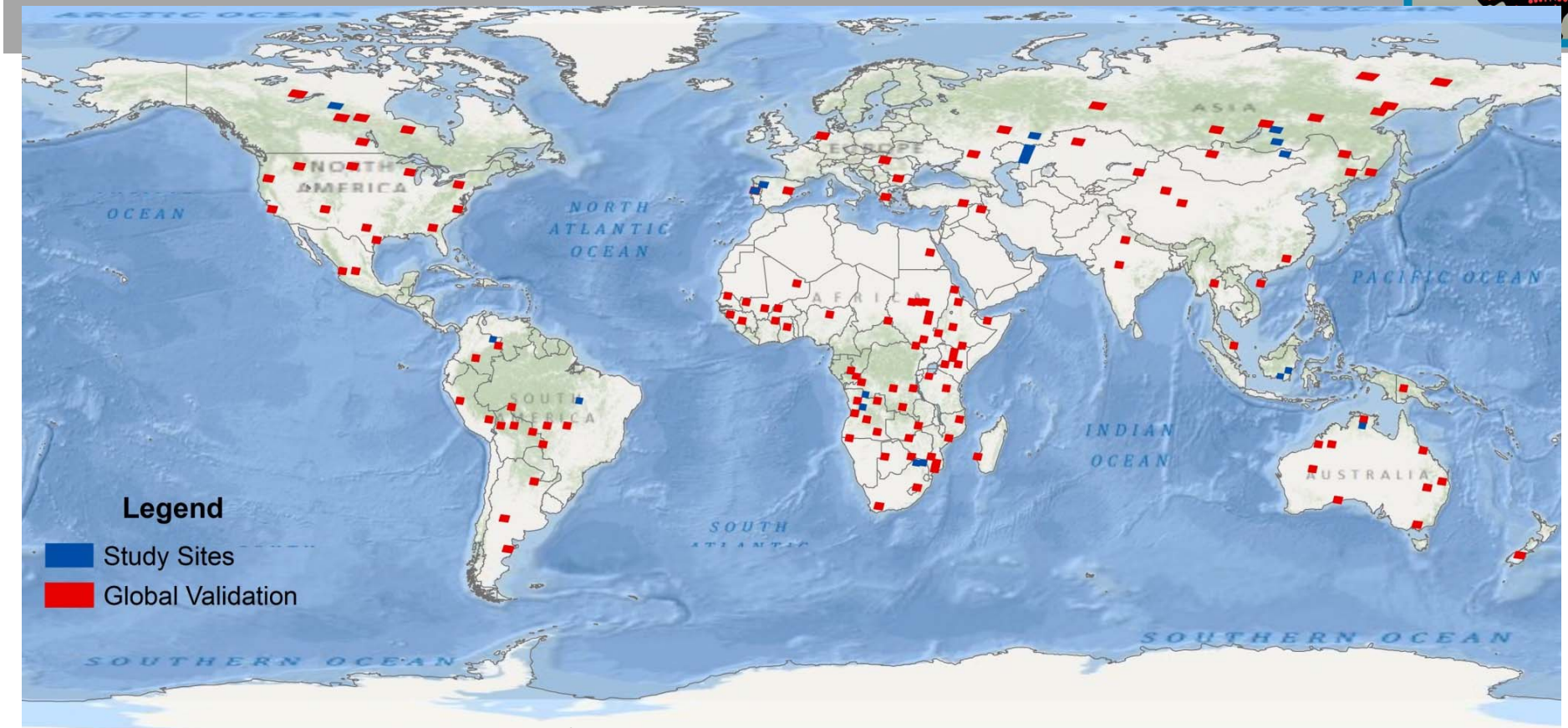
Area burned of Land cover X



Outline

- Project overview
- BA algorithms
- Validation strategy
- Intercomparison

Validation

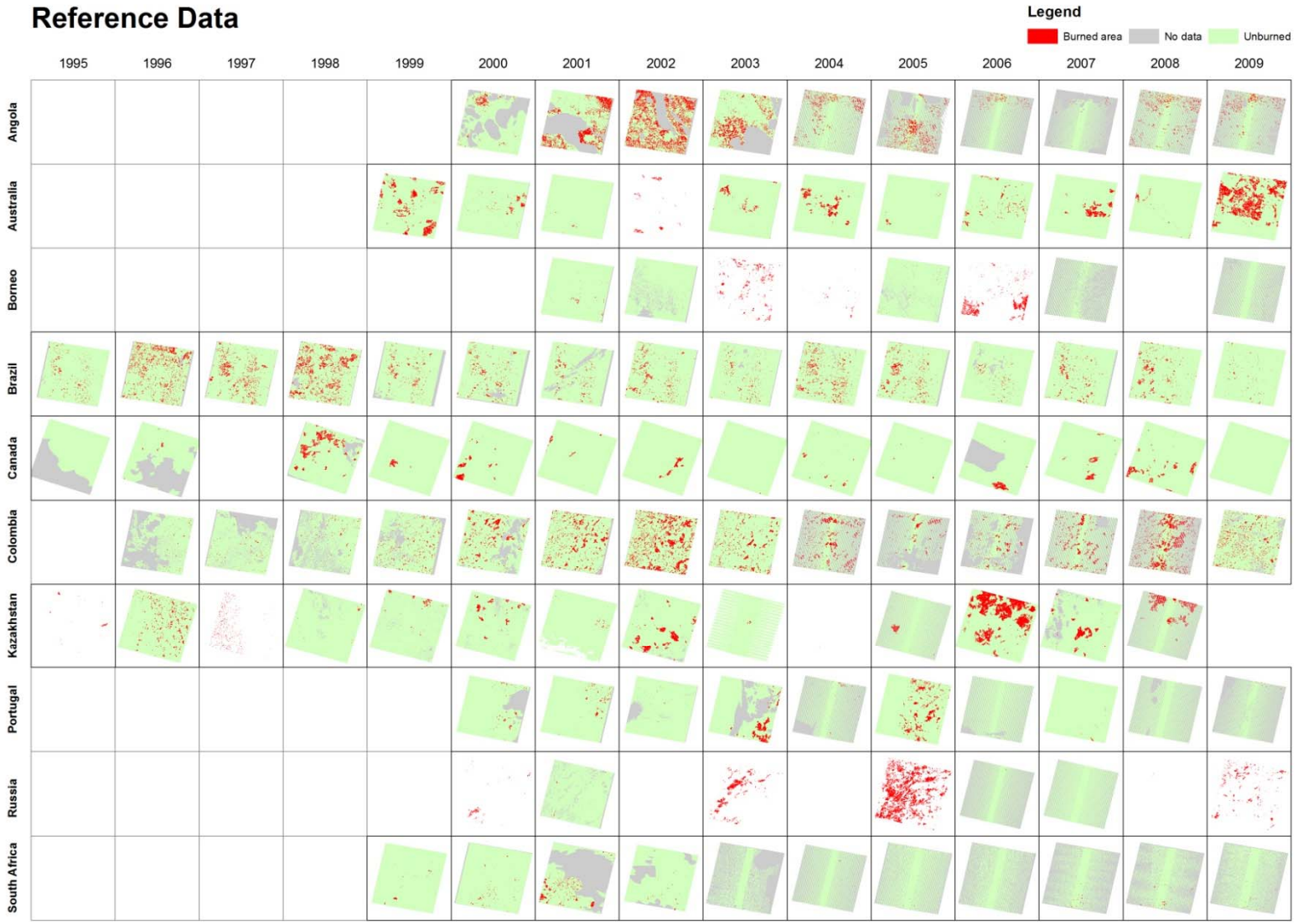


- 242 Pairs of Landsat TM/ETM+ images have been processed to generate validation files:
  - 130 pairs for spatial validation (red).
  - 112 pairs for temporal validation (blue).
- All files are documented following standard CEOS Cal-Val guidelines.

Biome distribution

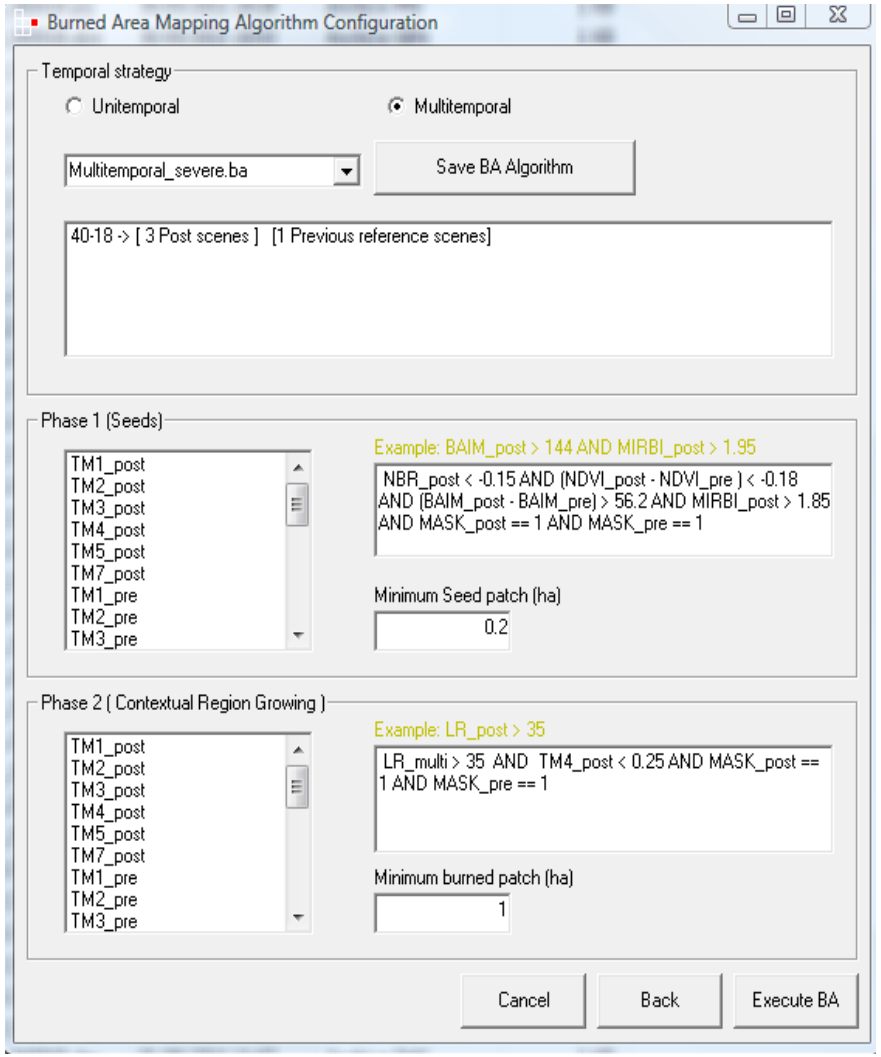
Biomes	Frames	Fire perimeters	Burned area (km²)
Tropical Forest	42	50.157	24.475
Temperate grassland	29	3.467	13.189
Others biomes	8	384	89
Temperate Forest	16	1.223	186
Mediterranean Forest	18	2.327	5.230
Tropical Savanna	94	89.365	74.971
Boreal Forest	35	1.071	8.040
Total	**242**	**147.994**	**126.180**

Temporal validation

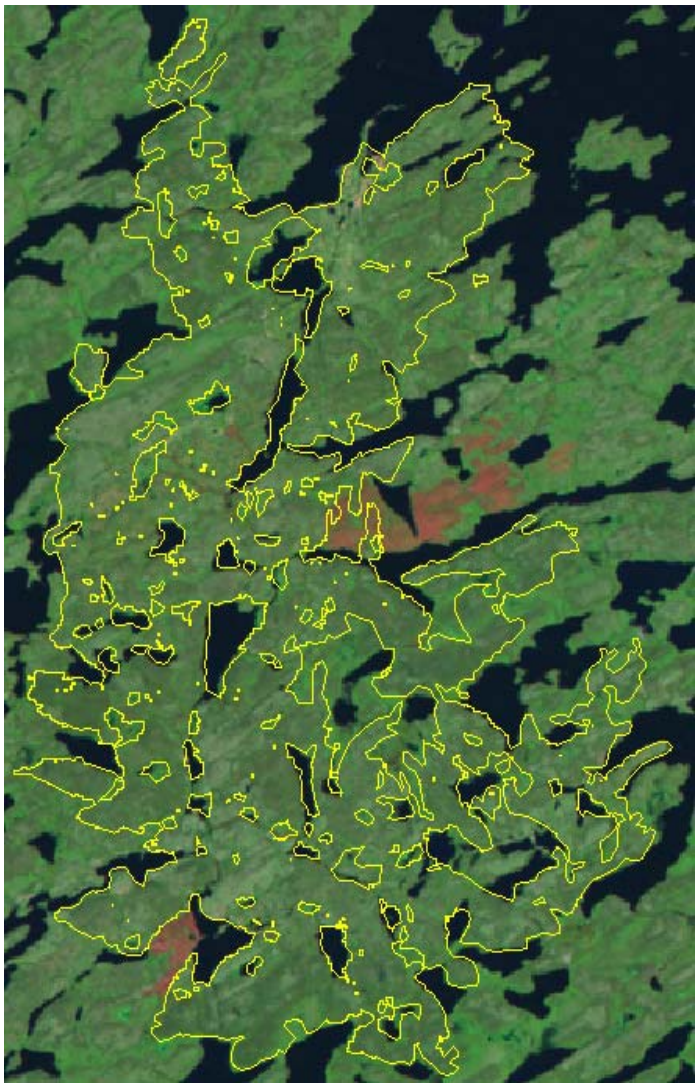


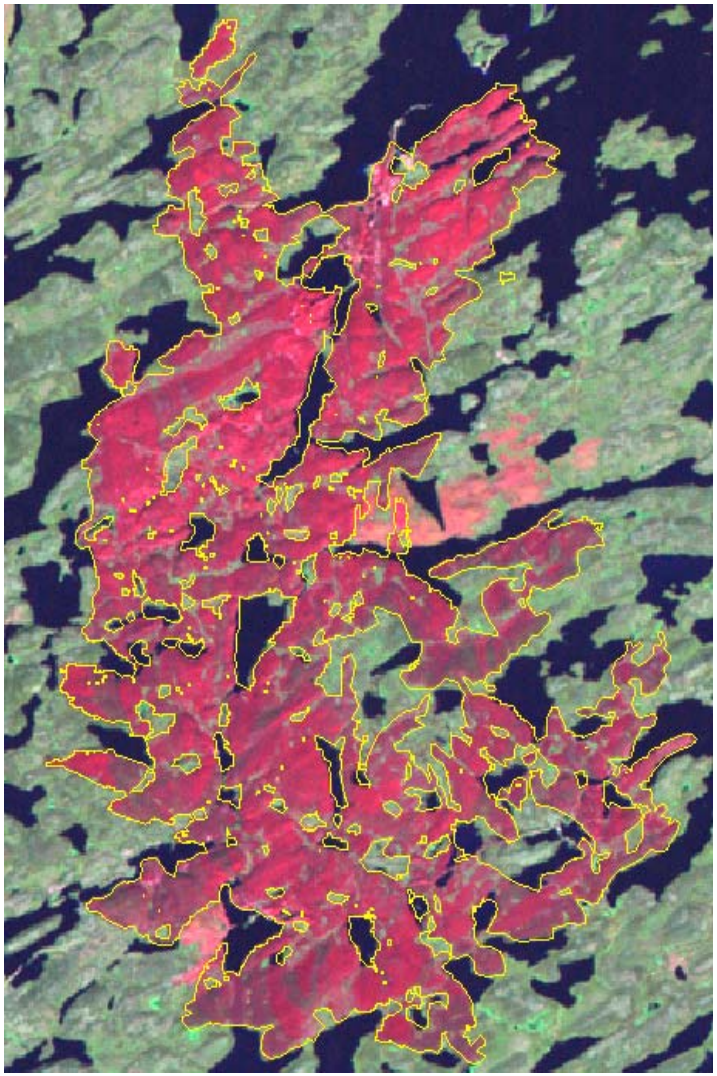
Generation of reference perimeters

- 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).



Examples of fire reference data



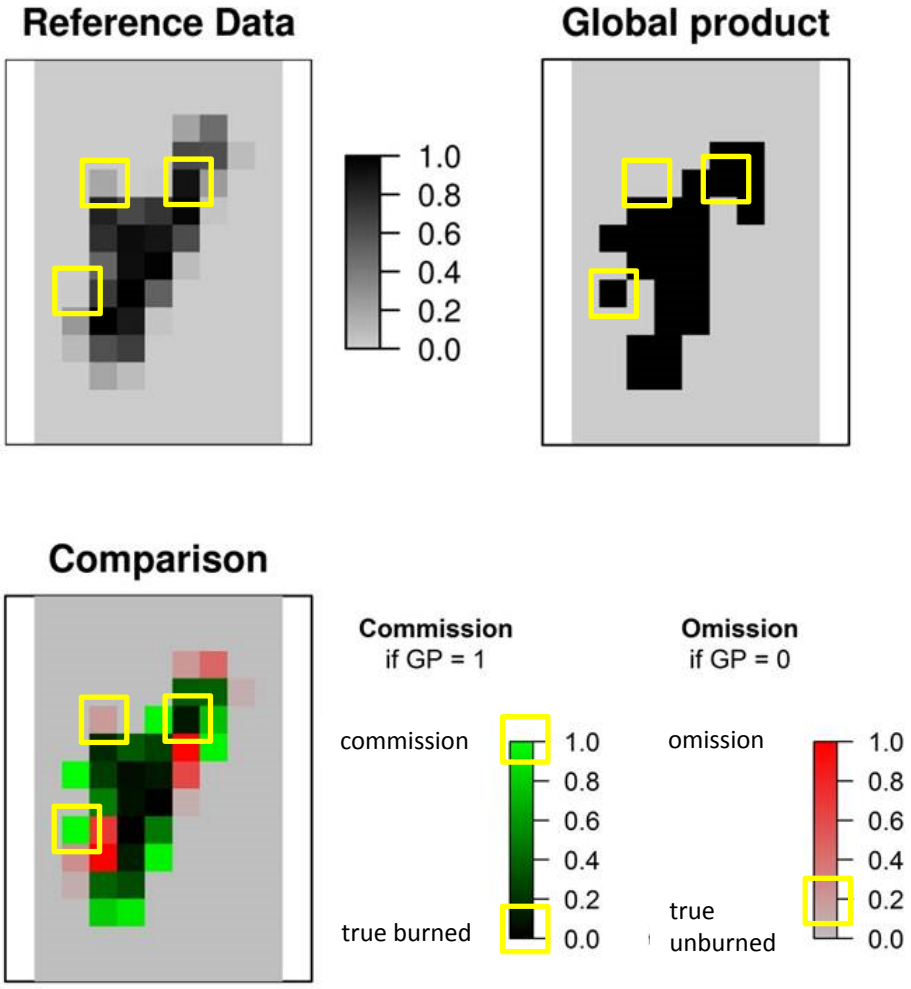


Canada

Validation metrics (following user requirements)

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

Fuzzy error matrix



Error matrix

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

Outline

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Intercomparison analysis

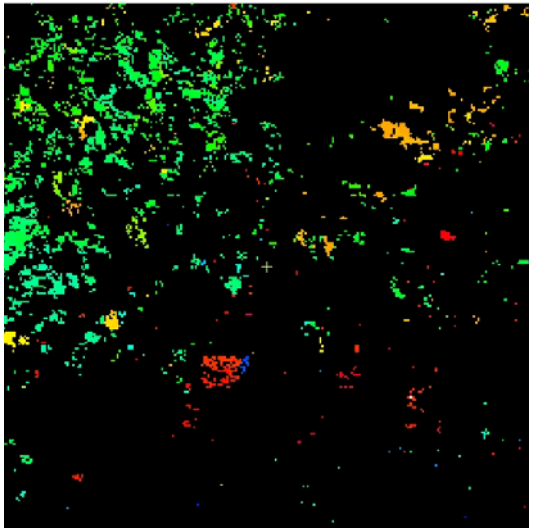
- Trends between products:
  - Burned pixels.
  - Detection Dates.
- Comparison with reference sites:
  - Average accuracy.
  - Error balance.
  - Temporal stability.

Products compared

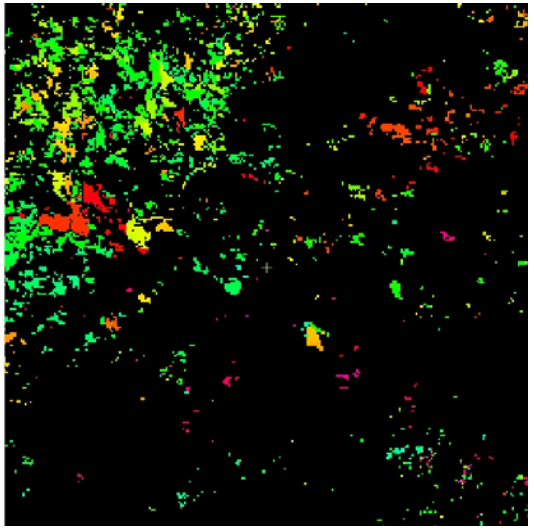
Product	Sensor	Period
Fire_cci Burned Area merged product	ATSR (AATSR) VEGETATION MERIS	1995-2009
GlobCarbon	ATSR (AATSR) VEGETATION	1999-2007
L3JRC	VEGETATION	1999-2007
MCD45	MODIS	2000-…
MCD64	MODIS	2000-…

Intercomparison analysis (2005, Australia)

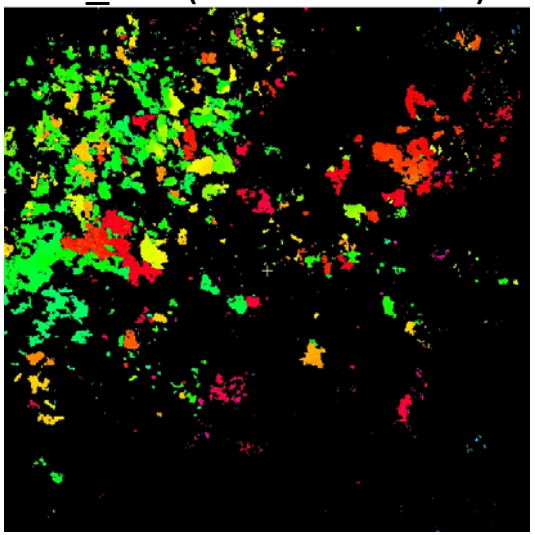
Globcarbon



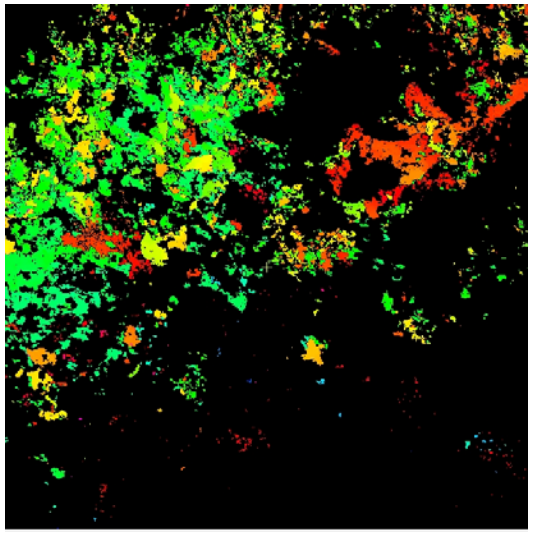
L3JRC



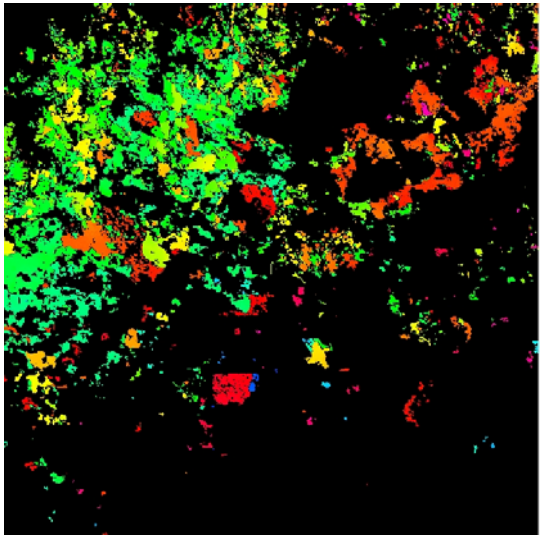
Fire_CCI (**PRELIMINARY**)

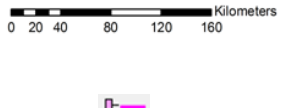


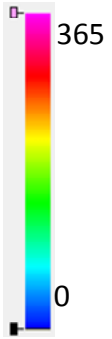
MCD45



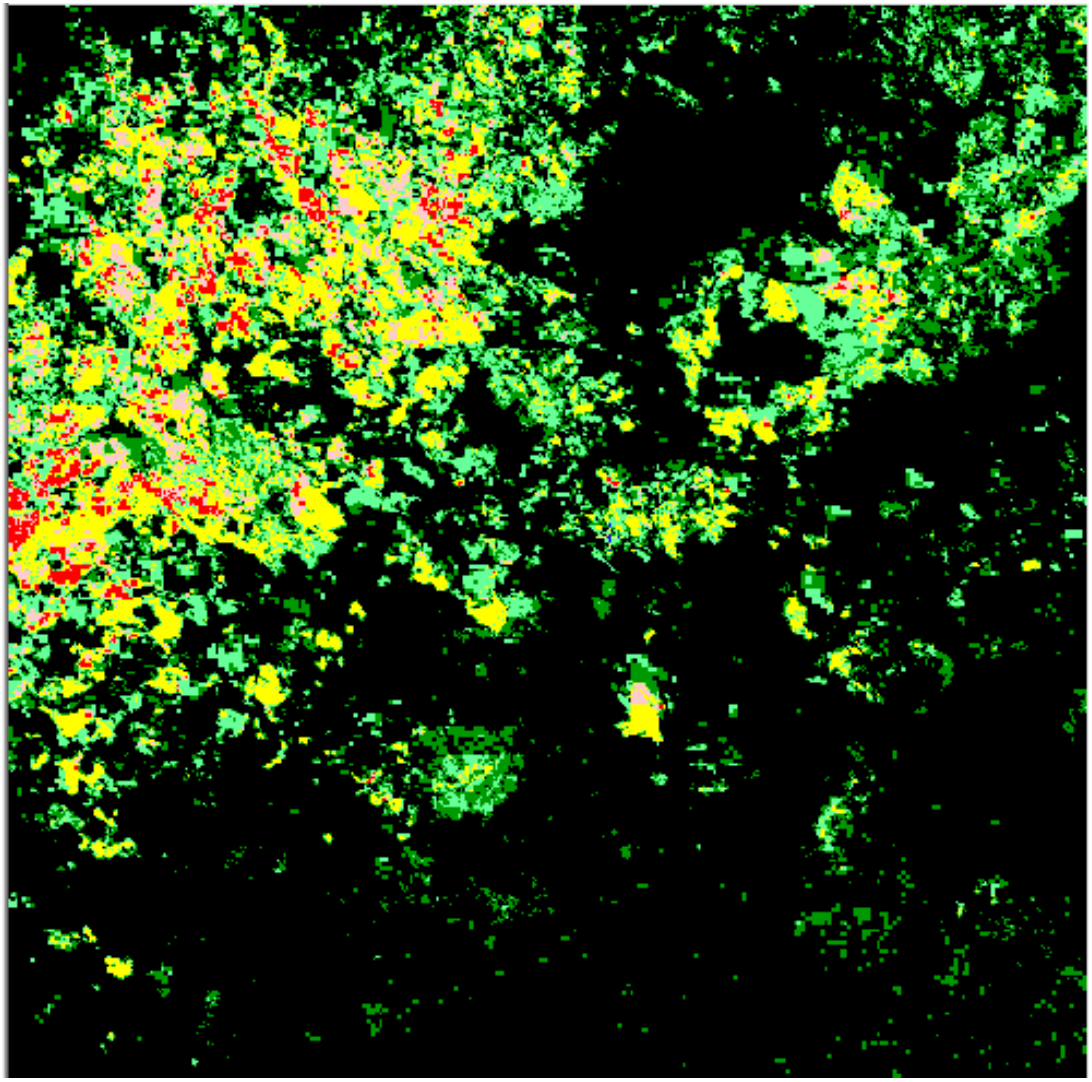
MCD64







Intercomparison analysis (2005, Australia)

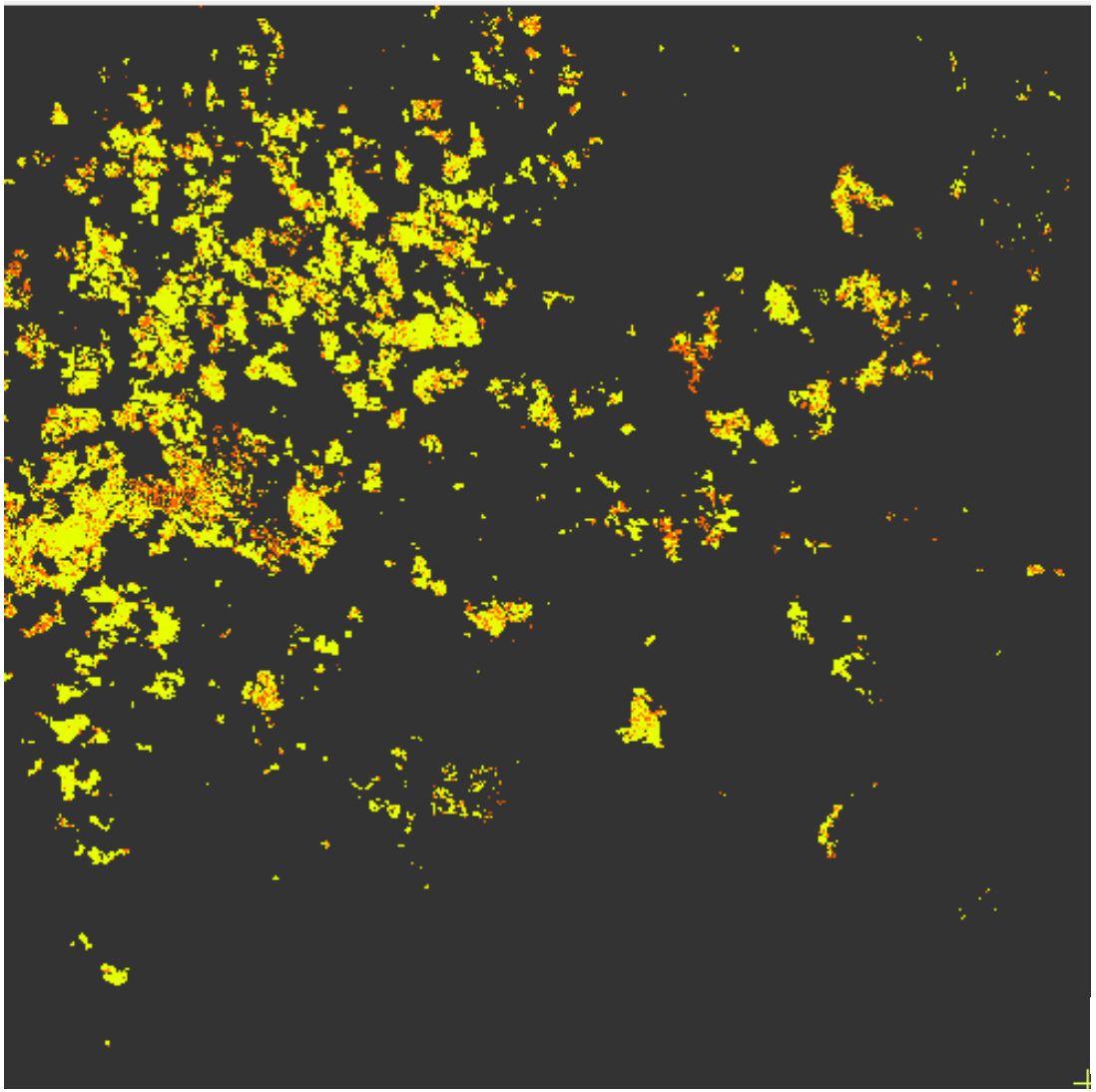


Products detecting BA pixels

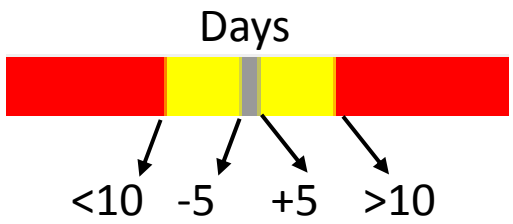
0
1
2
3
4
5

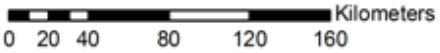
Kilometers
0 20 40 80 120 160

Intercomparison analysis (2005, Australia)



Detection dates difference
Fire_cci and MCD64





Total burned area 2005 (km^2)

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.

¡Thank you!

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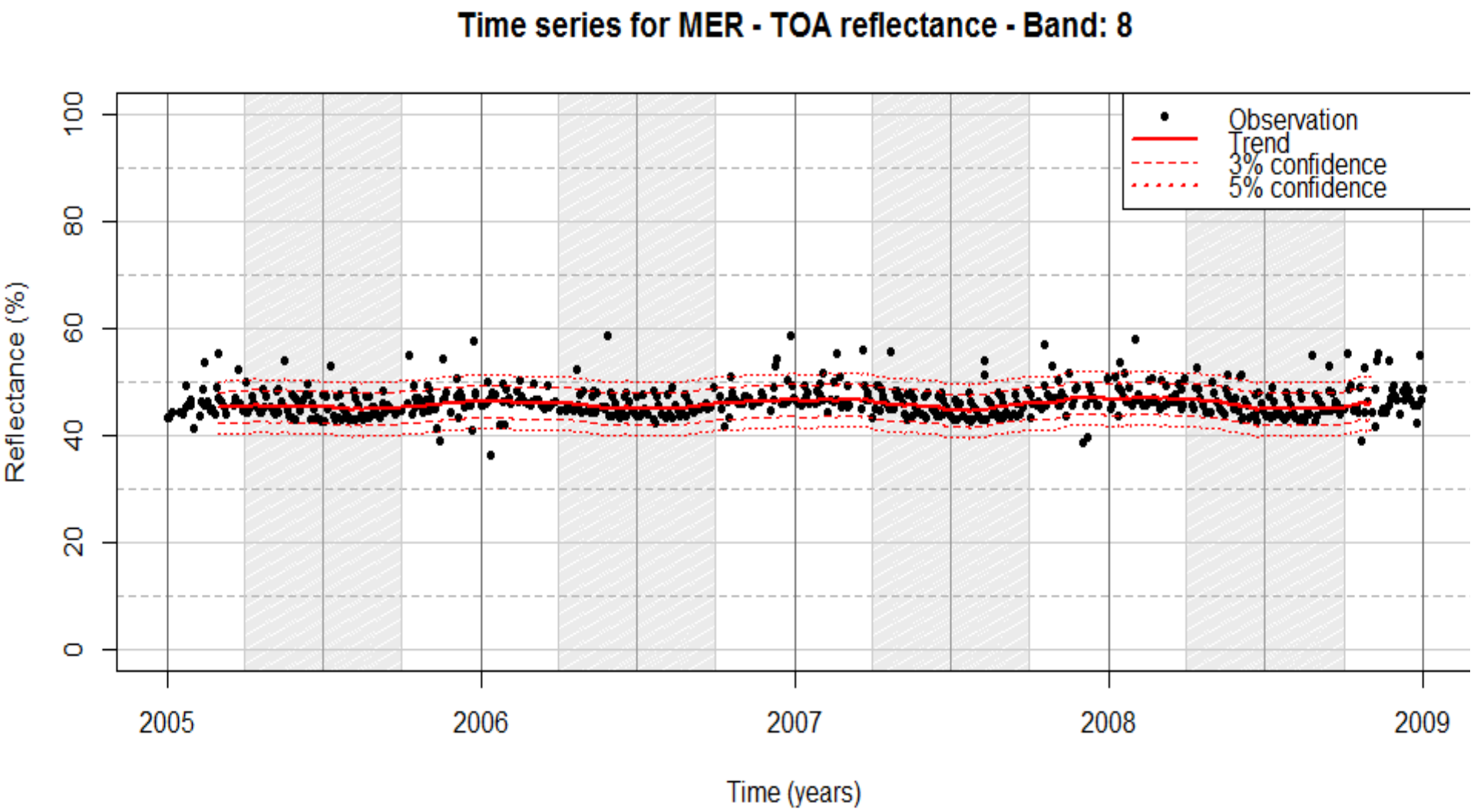
http://www.esa-fire-cci.org/

MERIS Band 8 – 681nm - O



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.