Fire Disturbance

CMUG Interaction meeting

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Points of discussion

- **Description of user requirements (URD): relations with GCOS and CMUG requirements.**
- **Description of product specifications (PSD).**
- **Product validation (PVP) and the Round Robin approach.**
- **Needs of ECMWF data.**
- **Common issues with other ECVs.**

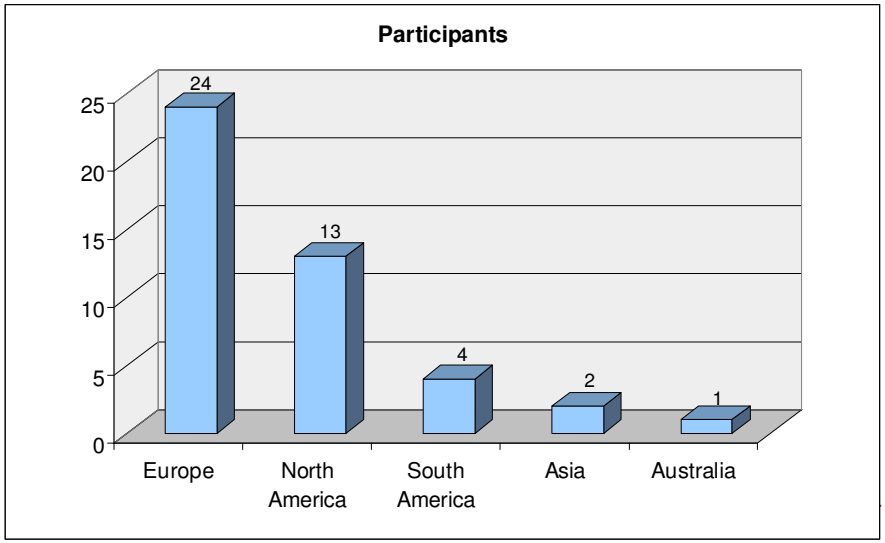
URD preparation

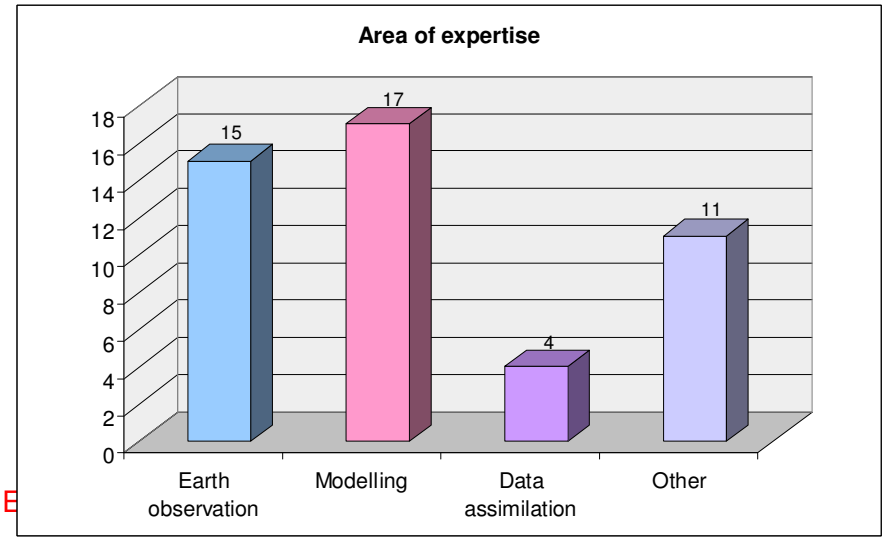
- First draft of URD questions (September).
- Revision by partners – ESA – CMUG.
- User questionnaire (October-November).
- Elaboration of answers and first draft (December-January).
- Revision by partners – ESA – CMUG (February).
- Revision by scientist who answered (March-April).

Target audience

- **Atmospheric emission scientists.**
- **Carbon budget modellers**
- **Vegetation dynamic modellers**
- **Natural hazards managers.**
- **Fire ecologists.**

47 scientists





Applications of BA information

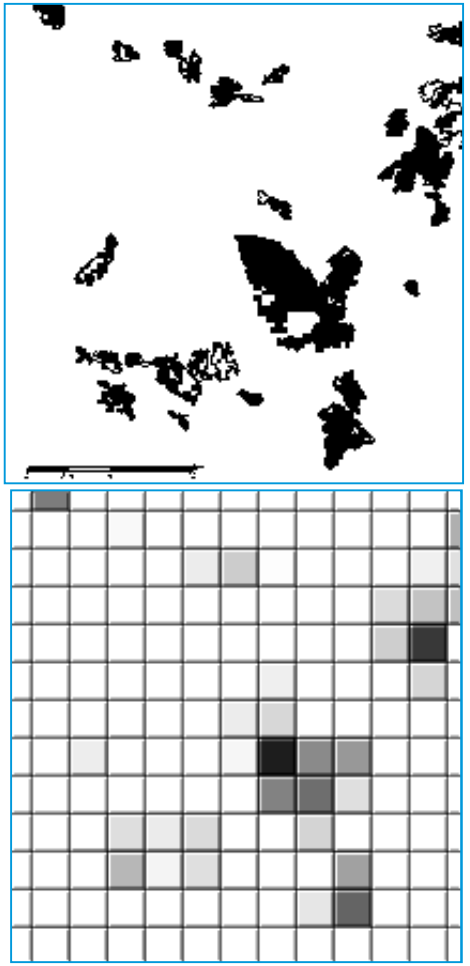
End-User	Application	Total of answers
Atmospheric Chemistry Community	Monitoring (i.e. observations and data assimilation) of trace gases, aerosols and emissions	20
	Operational use in atmospheric composition monitoring	9
	Modelling of atmospheric chemistry	8
	Air Pollution Control	7
Climate-Vegetation Community	Monitoring and modelling of carbon fluxes	26
	Vegetation dynamics (seasonal, interannual)	34
	Species migration	17
	Production of land cover maps	23
Earth Observation Community	Production of other ECVs	8
Natural Hazard Prevention Community	Fire hazard monitoring	28
	Desertification	10
Forest Services	Forest management	22
	Post-fire vegetation conditions	34

Models quoted

Model name	Type of Model	Domain	Typical Resolution
Community Land Model (CLM)	Dynamic vegetation/carbon model	Global	up to 1 deg.
ECMWF Integrated Forecasting System	Atmospheric Model	Global	15-25 km
CASA	Dynamic vegetation/carbon model	Global or regional	500 m – 0.5 deg
SEIB	Dynamic vegetation/carbon model	Global	ca. 0.5 deg.
IBIS, INLAND, SITE	Biosphere-atmosphere interaction	Global or regional	300 m – 1 deg.
FOFEM, CRBSUM, LANDSUM, FireBGC, FireBGCv2	Fire ecology	Regional to landscape	10's m – km
ORCHIDEE	Dynamic vegetation/carbon model	Global or regional	8 km – 0.5 deg.
Carbon Tracker	Carbon model	Regional	10 km
HYBRID	Dynamic vegetation/carbon model	Global	0.25 deg.
LPJ-GUESS	Dynamic vegetation/carbon model	Global	0.5 deg.

User Requirements

- **Accuracy, temporal and spatial resolution depend on the product.**
- **Alternatives:**
  - Pixel-based BA information:
    - Sensor.
    - Merged.
  - Gridded BA information.
- **It was not made explicit which product the requirements refer to!**



Average requirements

	GCOS	Ideal	Reasonable	Minimum
Thematic Accuracy[1]	5%	5 %	15 %	25 %
		10 %	20%	30%
Geolocation accuracy	--	1 km	3 km	6 km
Spatial resolution	250 m	pixel	Pixel-0.25º	0.5º
		0.25 km	0.85 km	10 km
Temporal resolution	daily	2. 3 days	6.1 days	8.8 days
		1 day	1.5 days	3 days
Stability	5%	5%	15 %	25 %
		5 %	5 %	5 %

URD CMUG

(1) Importance of balancing omission and commission errors

Average requirements

	GCOS	Ideal	Reasonable	Minimum
Formats	---	NetCDF-Shape	HDF-NetCDF	ASCII
Indicators	---	Burn severity, date detection	Clouds, water-top. contam.	Confidence level, dom. vegetation

URD

CMUG

Additional aspects

- **Documentation of the product.**
- **Quality flags.**
- **Utilities to transfer between formats.**
- **Sound validation and documentation about the process.**
- **Assure long-term archiving.**
- **Organize workshops with key user communities.**

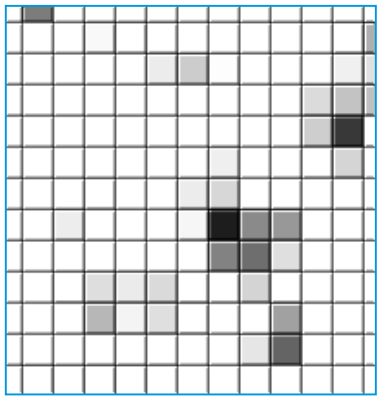
PSD proposals

Pixel based product

- **Suggested:**
  - Sensor-based BA (both monthly)
  - information (ATSR, VGT, MERIS).
- **Alternatives:**
  - Pixel merged BA information (both monthly)

Grid based product

- **Suggested:**
  - 0.1x0.1º biweekly
- **Alternatives:**
  - 0.1x0.1º monthly



Proposals for the PSD

	PSD proposal	URD Requirements		
	Pixel /grid	Ideal	Reasonable	Minimum
Thematic Accuracy	20%	5 %	15 %	25 %
		10 %	20%	30%
Geolocation accuracy	1 km	1 km	3 km	6 km
Spatial resolution	Pixel / 0.1 º grid	pixel	Pixel-0.25º	0.5º
		0.25 km	0.85 km	10 km
Temporal resolution	± 3.5 days	2. 3 days	6.1 days	8.8 days
		1 day	1.5 days	3 days
Stability	15%	5%	15 %	25 %
		5 %	5 %	5 %
Formats	HDF-NetCDF	NetCDF-Shape	HDF-NetCDF	ASCII

Minimum burned patch

Sensor	Spatial Resolution	Minimum BA patch mapped	Minimum number of contiguous pixels
ATSR	1000 m	5,000,000 m^2	5
AATSR	1000 m	5,000,000 m^2	5
VEGETATION	1000 m	5,000,000 m^2	5
MERIS-RR	1200 m	14,400,000 m^2	10
MERIS-FR	300 m	900,000 m^2	10

What proportion of the total BA is captured from that MMU?

- Mediterranean areas: > 500 ha is 51 %

Pixel indicators

Table 2 – Fields of the Target BA pixel based product

Layer	Attribute	Units	Data Type
1	Date of the first detection	Day of the year, from 1 to 365, 0 if it is unburned the whole period	Integer
2	Confidence level of BA algorithm[1]	0 to 100 (100 meaning highest probability of BA detection)	Byte
3	% of cloud contamination throughout the month (or average value of snow probability)	0 to 100[2]	Byte
4	% of cloud shadow contamination throughout the month	0 to 100[3]	Byte
5	Average water contamination throughout the month	0 to 100[4]	Byte
6	Number of cloud free observations throughout the month	0 to 31	Byte
7	Estimation of uncertainty associated to pre-processing	0 to 100[5]	Byte

Grid indicators

Table 4 – Fields of the BA grid products

Attribute	Units	Data Type
Sum of burned area	Square metres	Integer
Grid size	Square metres	Integer
Confidence level[6]	0 to 100	Byte
% of cloud contamination throughout the month	0 to 100	Byte
% of cloud shadow contamination throughout the month	0 to 100	Byte
% of water-snow contamination throughout the month	0 to 100	Byte
Homogeneity index = Mean fire size / total area burned	0 to 100	Byte

Product validation Plan

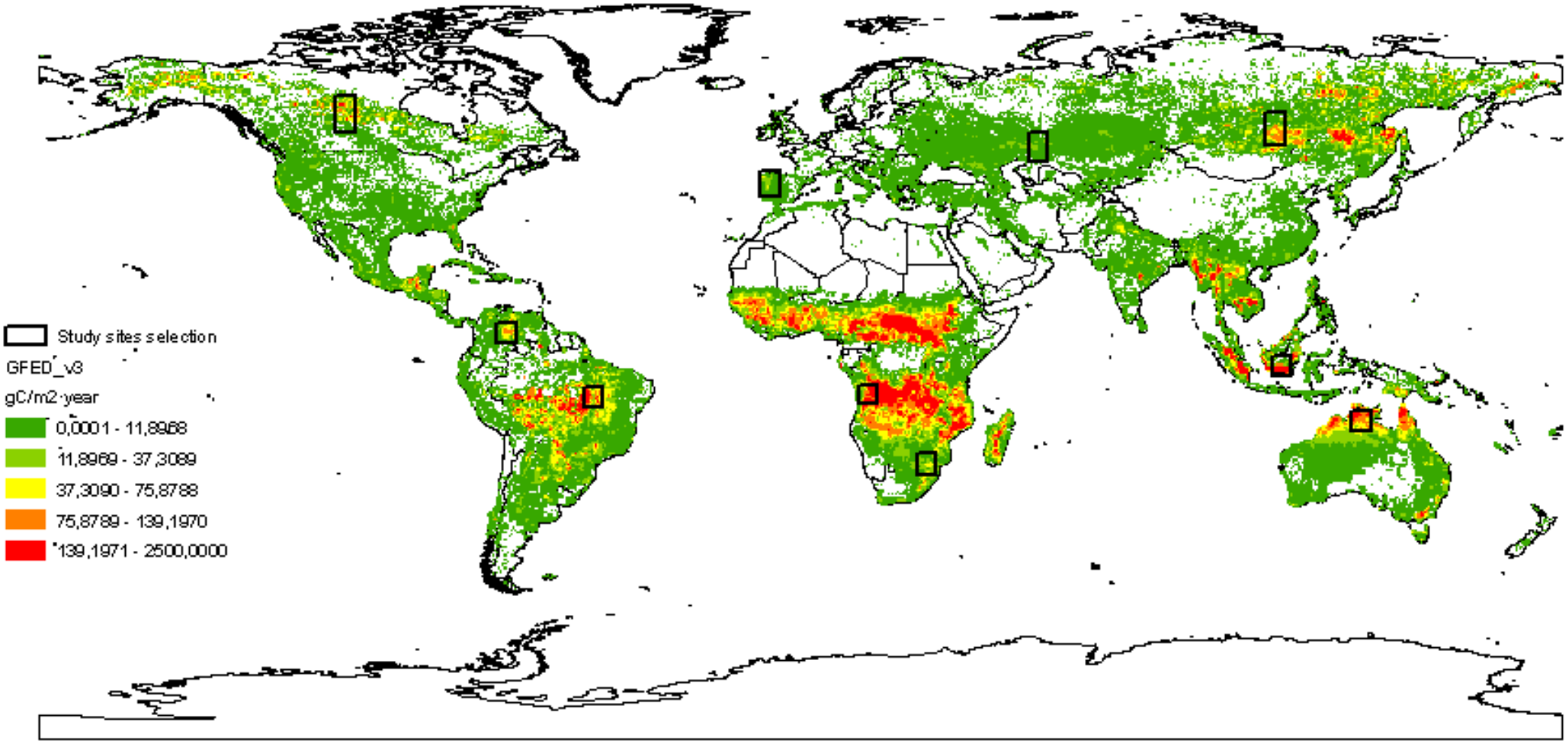
- **Standard methods (CEOS cal_val).**
- **Definition of a common protocol for reference data.**
  - Higher resolution images (Landsat mainly).
  - Fire perimeters (+Landsat images).
  - Available reference information (previous projects).

  - Automatic process + visual inspection + cloud removal

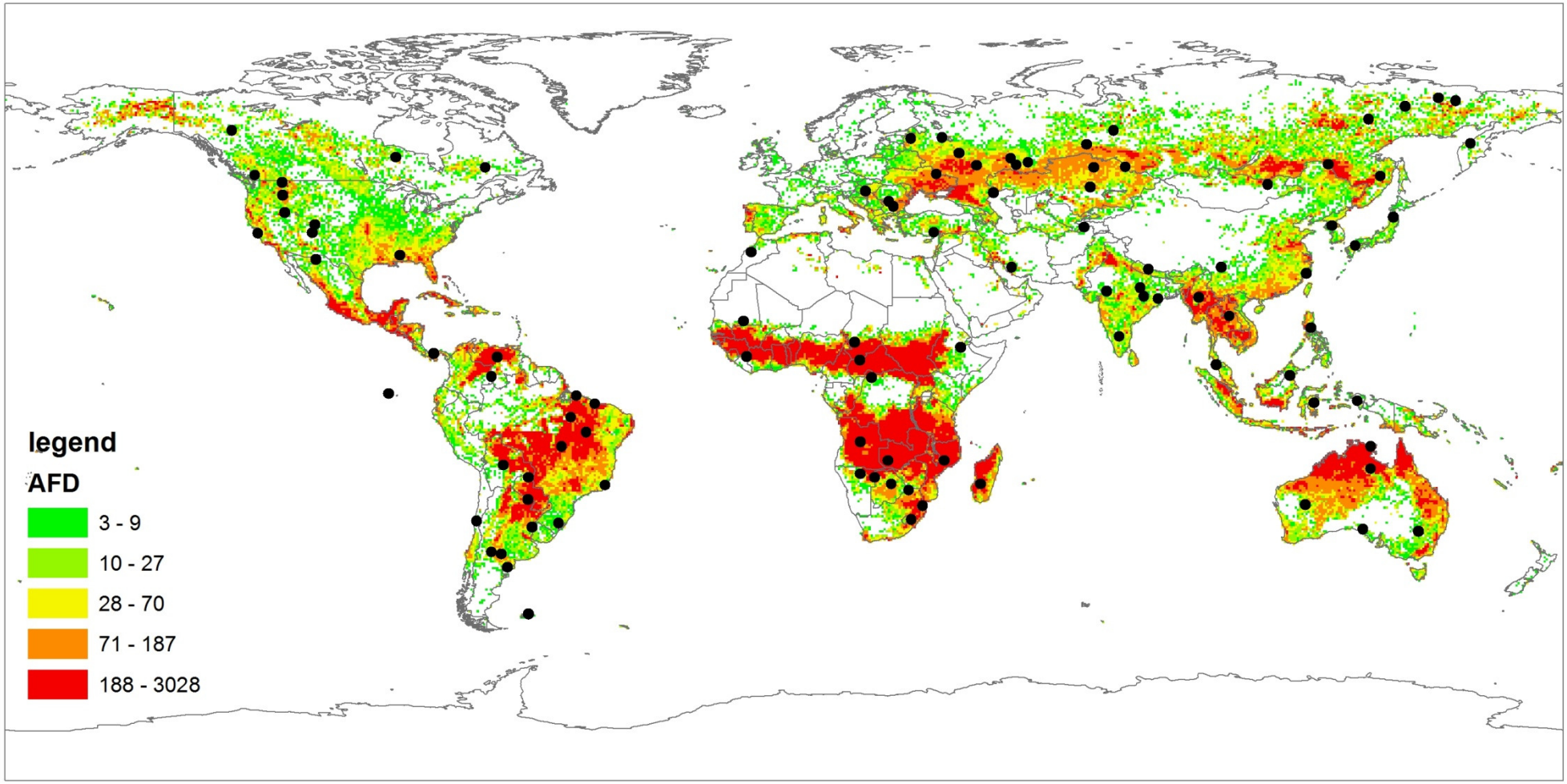
Product validation Plan

- **Validation phases:**
  - Internal:
    - Calibration.
    - Temporal consistency: time series on study sites
    - Spatial variability: additional global sampling.
  - External:
    - Round Robin.
    - Global Open (after production)

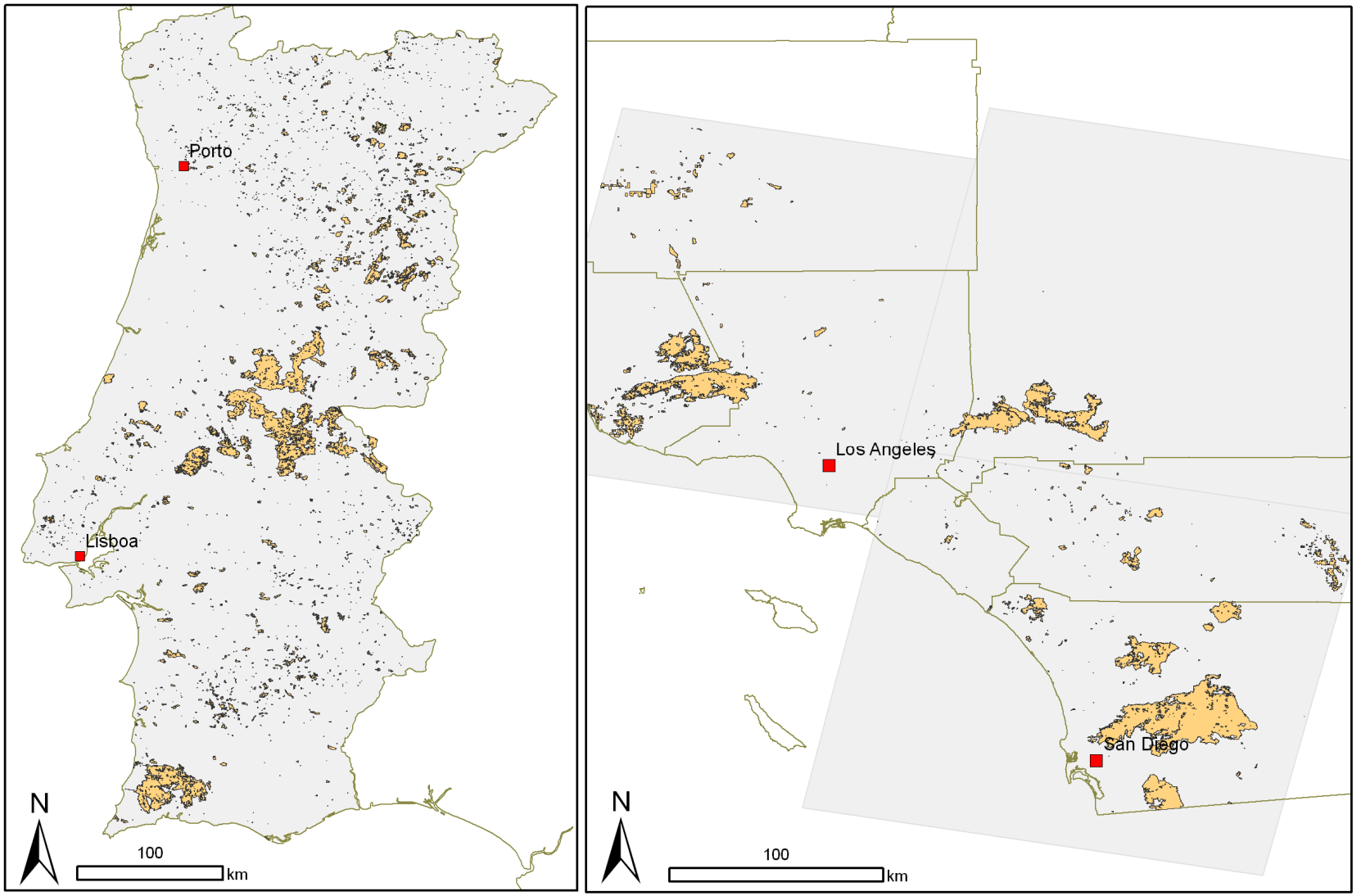
Study sites (Temporal validation)



Validation sites (spatial validation)



Automatic generation of BA perimeters



Bastarrika et al., 2011, RSE

Factors of Uncertainty

- **Input data:**
  - Sensor limitations.
  - Image problems (reception, calibration problems)
  - Preprocessing errors (atmospheric correction, cloud-water-snow-topo shadows removal)
- **BA Algorithm:**
  - Time after burn.
  - Burn conditions
    - Ecosystem – cover - climatic zones).
    - Burned area size.
- **Validation process (reference data).**

R-R database

- **Calibrated reflectances from ATSR, VGT and MERIS**
- **Reference BA perimeters**
- **Auxiliary information: land cover data, hot spots, ecoregions, etc.**
- **Optional: Alternative sites from user.**

- **Single quality indices need to be defined from validation metrics. For instance, how to weight?:**
  - Omission and commission errors
  - Temporal consistency.
  - Spatial consistency (fire-prone ecosystems)

Needs for ECMWF data

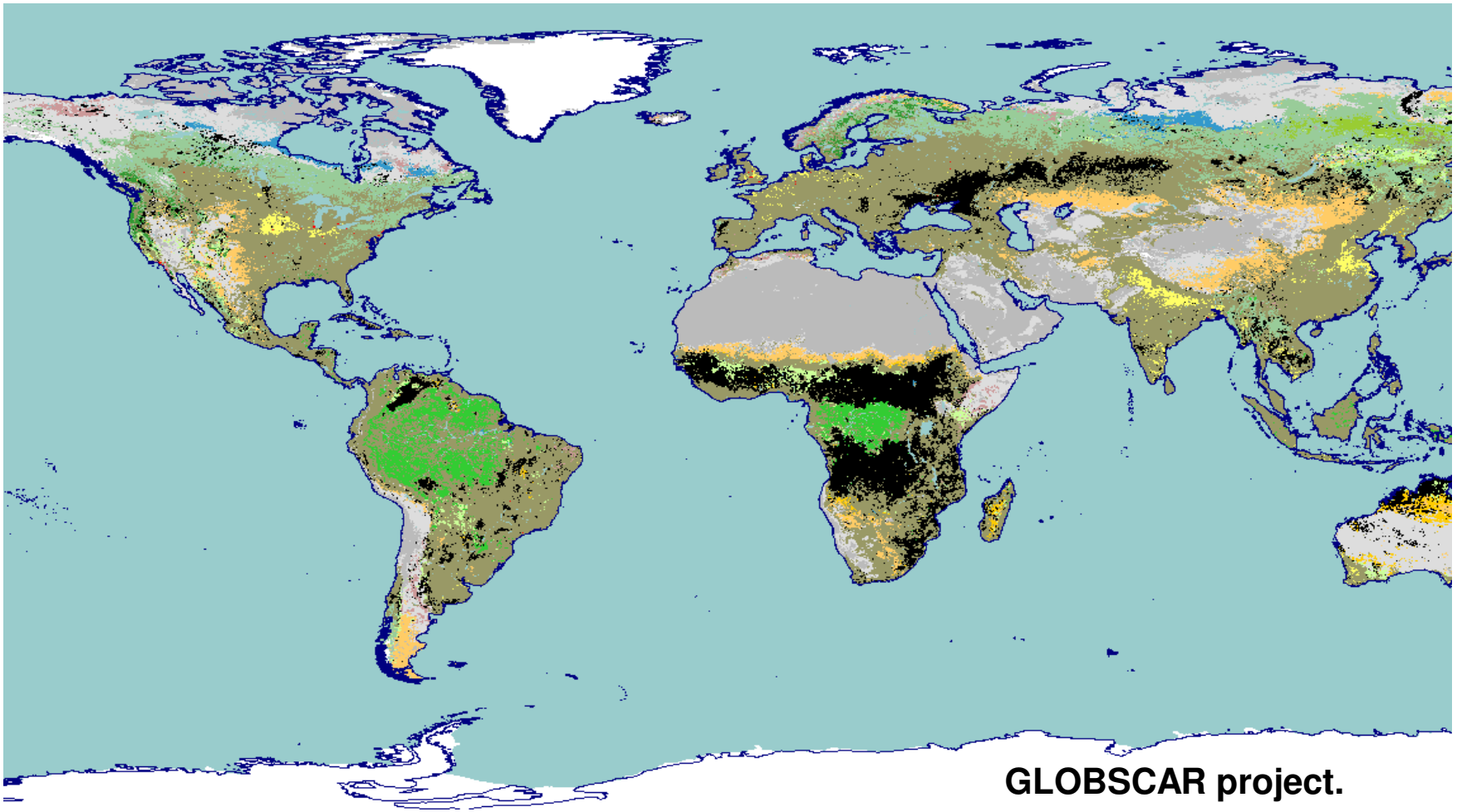
- **No needs for ECMWF were identified. DLR is in charge of pre-processing.**
- **Atmospheric correction:**
  - Vis-NIR based algorithms for automatic retrieval of dark objects for estimating aerosol optical thickness (AOT).
  - Water vapor is calculated for MERIS using the atmospheric precorrected differential absorption (APDA) method and the cell-based atmospheric LUTs.
  - The ozone column for sea level is fixed at 330 DU, decreasing with elevation as defined in the mid-latitude summer atmosphere of the MODTRAN code.

Common issues to other ECVs

- **Common Input data?**
- **Common algorithms for pre-processing?**
  - Geometric correction.
  - Atmospheric correction.
  - Cloud mask.
  - Land-Water mask (SRTM + GSHHS or dynamic)
- **Common areas?**
  - Geographical projection.
  - Subsets
- **Common File standards:**
  - Formats
  - File name structure.
  - Metadata.

Single Global BA files

For MERIS FR 1.8 Gb per period in HDF5 format; 12 Gb in GeoTIFF



GLOBSCAR project.

Should we use common tiles?

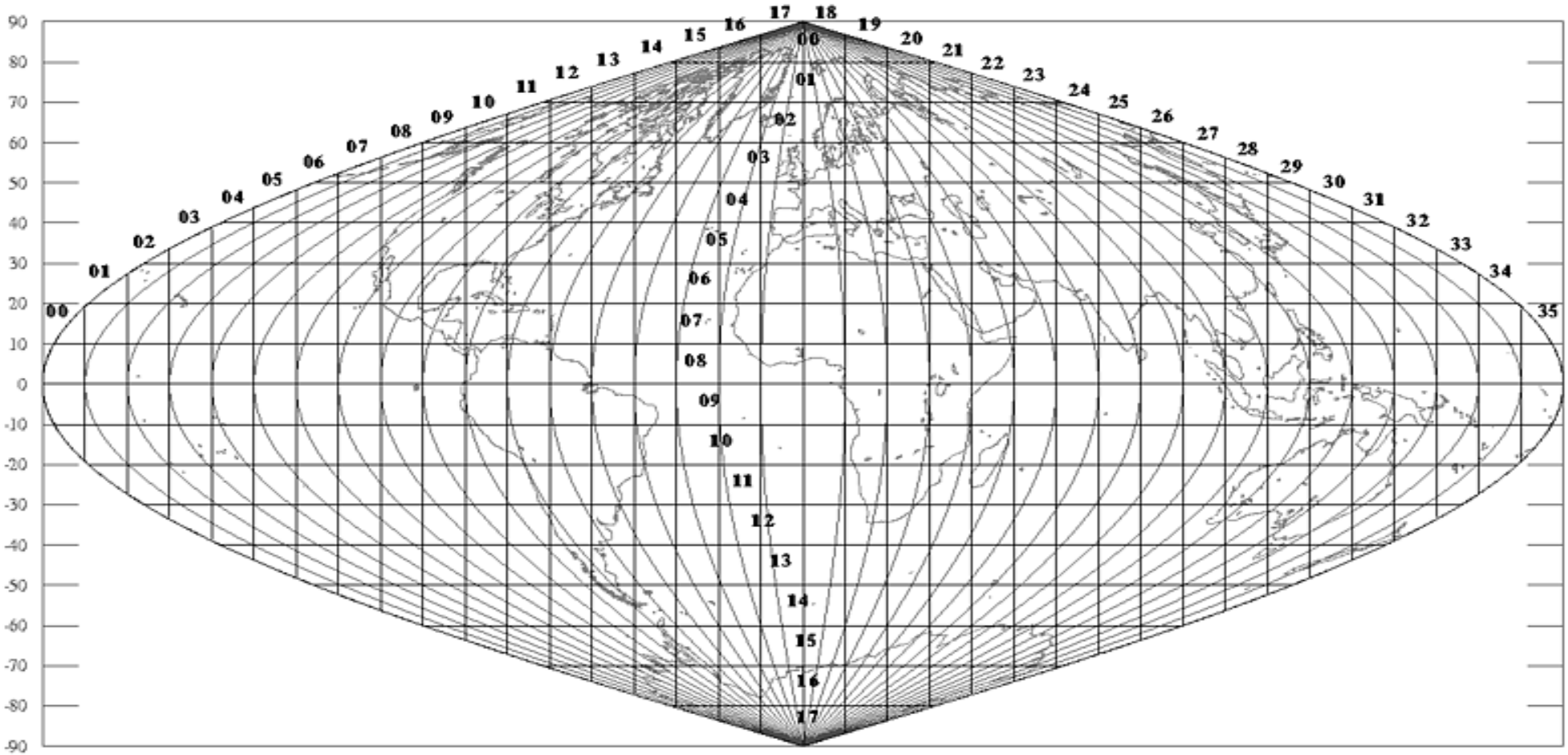


Illustration of the MODIS Land L2G/L3/L4 tile grid (*provided by Jacques Descloitres*).

MODIS BA spatial subsets