Global Burnt Area Products

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Structure

- Why burnt area estimation is important
- Challenges to global burnt area mapping
- Data sets: Current
- Data sets: Future

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The need for burnt area

BB = A x D x á x â

A = area burned
D = biomass density
á = fraction of above-ground biomass
â = burning efficiency

G(X) = M x P x E
G = amount of gas X released
M = biomass loading per surface unit
P = % of biomass consumed
E = emission factor.

Seiler and Crutzen (1980)

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Justification

The area consumed by fire at both continental and global scales is one of the parameters that create the greatest uncertainty in calculating the amount of biomass burned and gases (e.g. CO, CO2, CH4) emitted at these scales

(Scholes et al., 1996; Barbosa et al., 1999; Andreae and Merlet, 2001; Isaev et al., 2002; Conard et al., 2002)

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The need for global products

- Regional/continental data computed using different methodologies
- Validation results differ or do not exist
- Source data for global products can be traced
- Data can be gridded and time composited
- Input data for GCMs and ecosystem models

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Challenges

- BA cannot be derived from active fire products
  - Signal saturation
  - Diurnal signal (detected by MODIS)
  - Useful for detection of below-canopy fires
  - Possibly useful for the confirmation that a fire occurred but limited in the temporal sense
- Scientists try it though -
  - Giglio et al., ACPD, 5, 2005
  - BA is proportional to fire count
  - Vegetation cover data, size of active fire cluster
  - Lots of assumptions that cannot easily be verified

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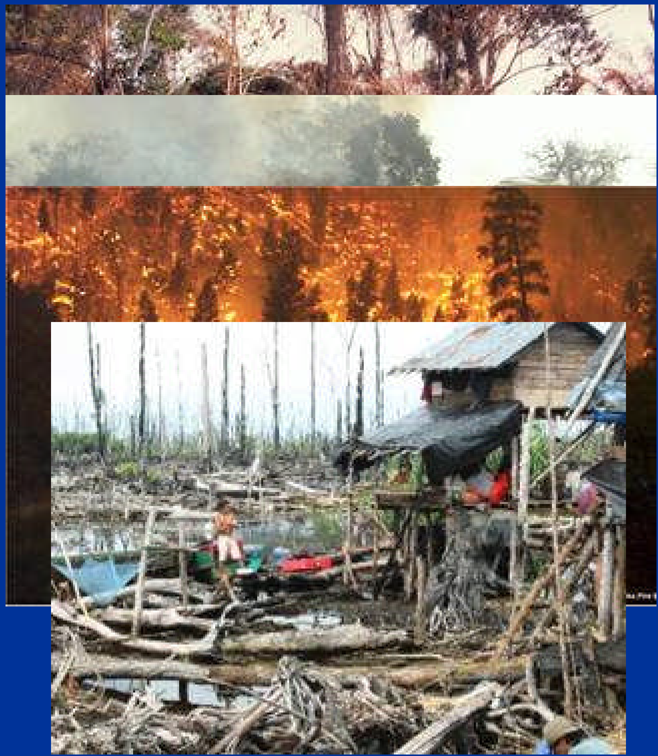
Challenges

- Fires occur in a number of different ecosystems
  - Intensity
  - Size
  - Production of ash
  - Flaming/smouldering
  - Time scale of scar visibility
  - Smoke/cloud cover
  - Leaf off conditions
  - Flooding
  - Annual variability



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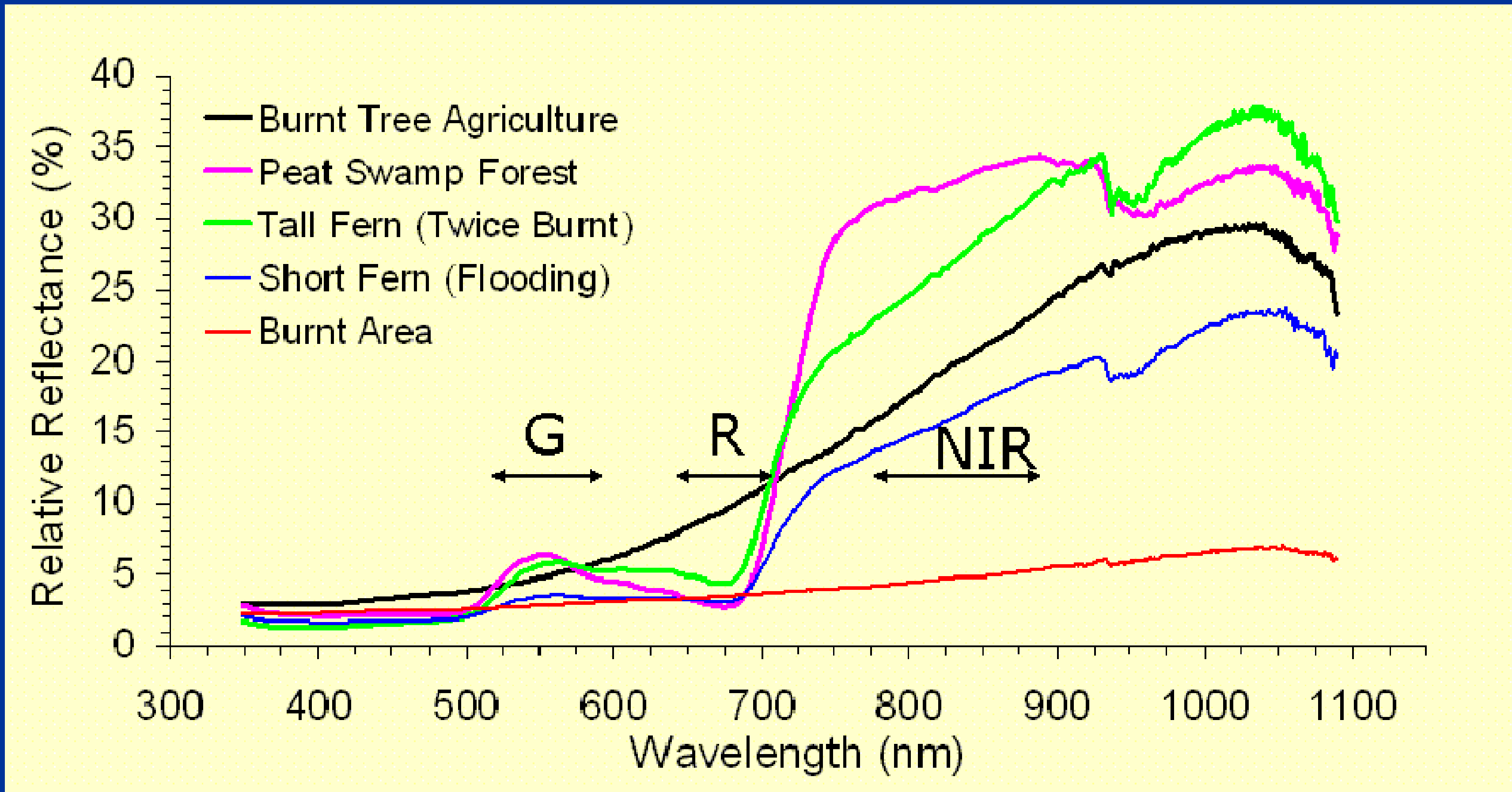
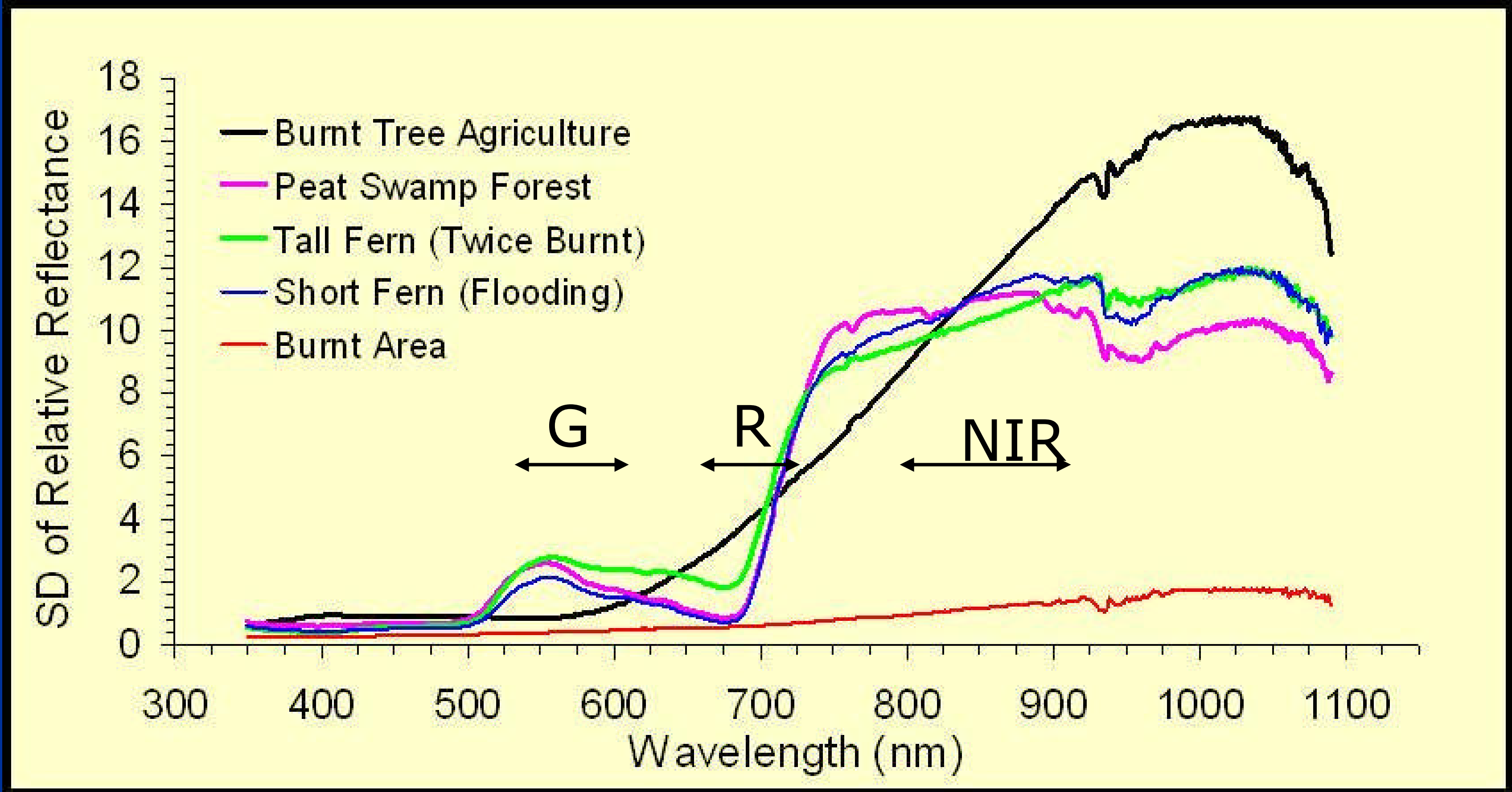


Burnt Tree Agriculture
Peat Swamp Forest
Tall Fern (Twice Burnt)
Short Fern (Flooding)
Burnt Area
G
R
NIR
Relative Reflectance (%)
Wavelength (nm)
0
5
10
15
20
25
30
35
40
300
400
500
600
700
800
900
1000
1100

CMWF, 6th February 2006



Current BA products

ECMWF, 6th February 2006

Product name Satellite-*sensor* **Product type**	Resolution *sensor* Product	Time step *sensor* Product	Coverage	Period	Source	Documentation
GBA2000 SPOT-*VGT* **Burnt area**	*1 km* 1 km^2	*day* month	globe	2000	JRC	Tansey et *al*., 2004 JGR(**109**) & Climatic Change (**67**) //www-gvm.jrc.it/fire/gba2000/index.htm
GLOBSCAR ERS-*AATSR* **Burnt area**	*1 km* 1 km^2	*day* month	globe	2000	ESA	Simon *et al*., 2004 JGR(**109**) //shark1.esrin.esa.it/ionia/FIRE/BS/ATSR/
GBA1982-1999 NOAA-*AVHRR* **Burnt area**	*5 km* 8 km^2	*day* week	globe	1982 to 1999	JRC	Carmona-Moreno *et al*., 2005 Global Change Biology (**11**/9) //www-gvm.jrc.it/tem/Disturbance_by_fire/index.htm

Information provided by Jean-Marie Gregoire (JRC)

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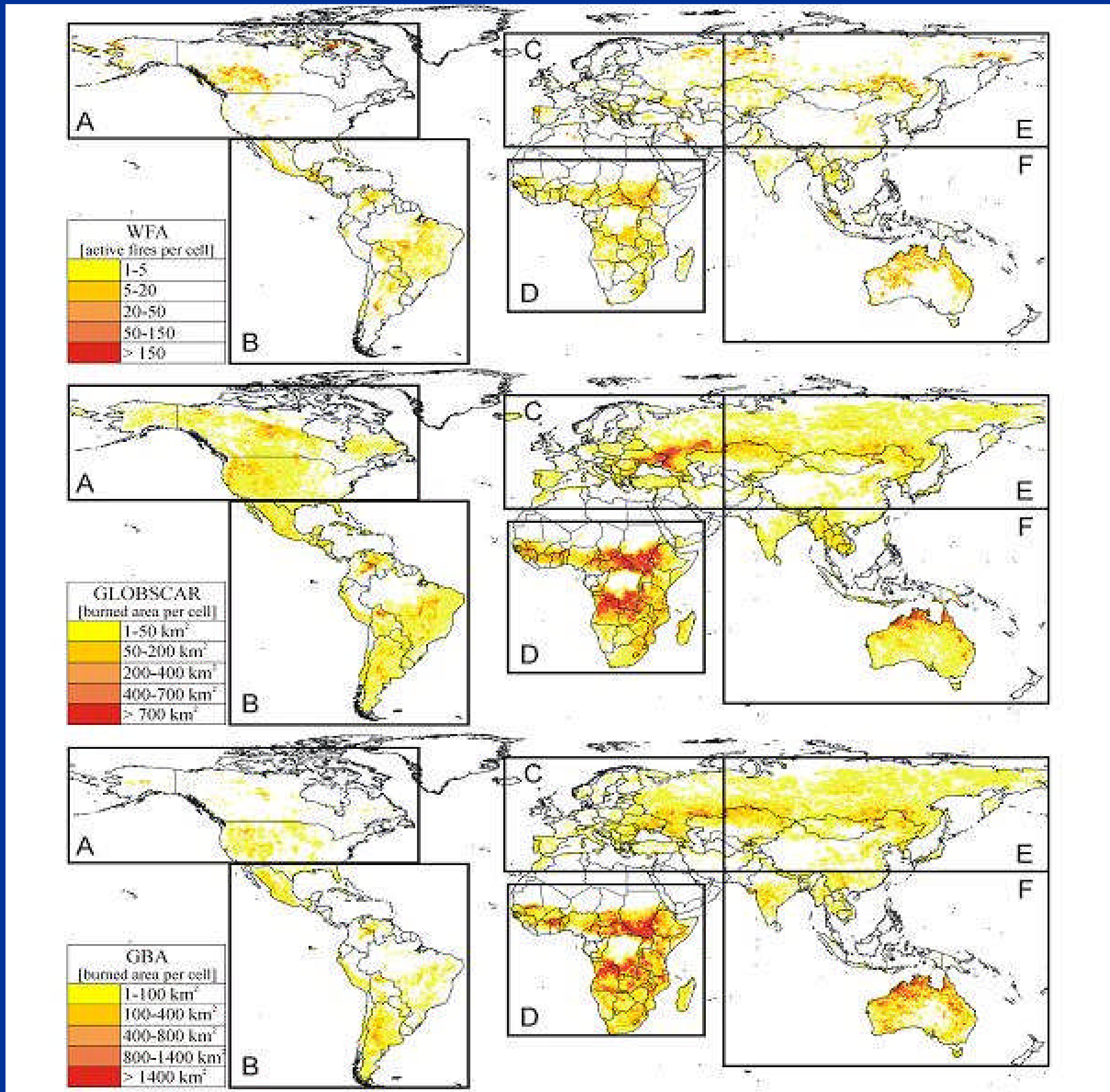
Inter-comparison of global fire products:
- World Fire Atlas (WFA)
- GLOBSCAR
- GBA2000



Boschetti et al., 2004

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Future BA products

PRODUCT NAME EO system	Resolution *sensor* product	Time step *sensor* product	Coverage	Period	Source	Documentation
GLOBCARBON ERS, ENVISAT, SPOT ATSR, AATSR, MERIS, VGT	*1 km* 8 km	*day* month	globe	1998-2003	ESA	http://dup.esrin.esa.it/projects/summaryp43.asp
VGT4Africa SPOT-VGT	*1 km* 1 km^2	*day* 10 days	Africa	2005-	JRC	http://www-gvm.jrc.it/tem/
GEOLAND GLOBCARBON/VGT	*1 km* 1 km	*day* 10 days	Africa & Eurasia	1998-2003	JRC	http://www-gvm.jrc.it/tem/ Restricted access (GEOLAND)
MODIS Burned Area TERRA, AQUA	*500 m* 500 m	*day* month	globe	2000-	UMD NASA	http://modis-fire.umd.edu/products.asp#8

Information provided by Jean-Marie Gregoire (JRC)

ECMWF, 6th February 2006

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GlobCarbon

- GlobScar algorithm applied to (A)ATSR-2
- 3 GBA2000 algorithms to VGT data
  - 1 - Mexico & Australia
  - 2 – Africa
  - 3 – Remaining land areas
- Merging of the two BA products
- Confidence Rating Index
- 1998-

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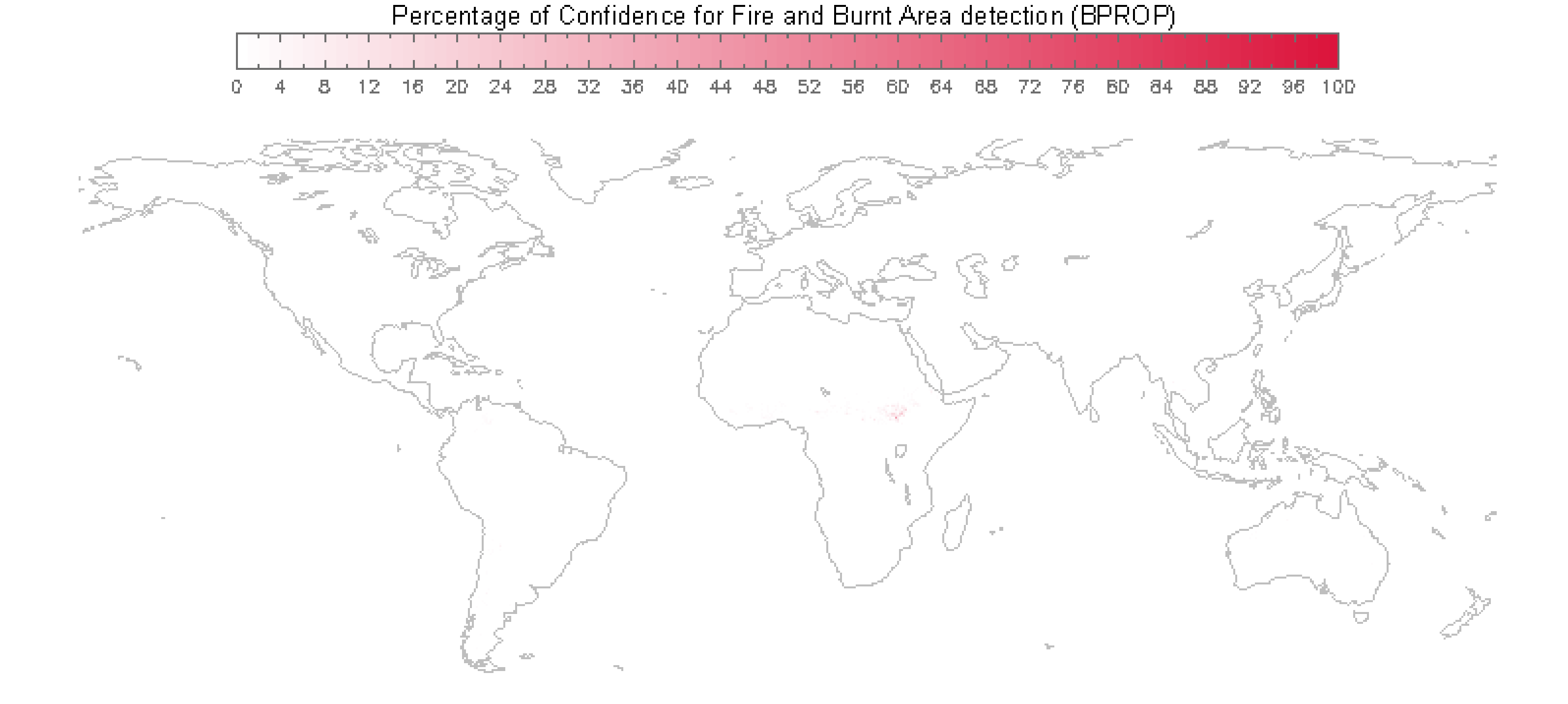
Results



January 1998

Australia Simulation

Mexico Simulation

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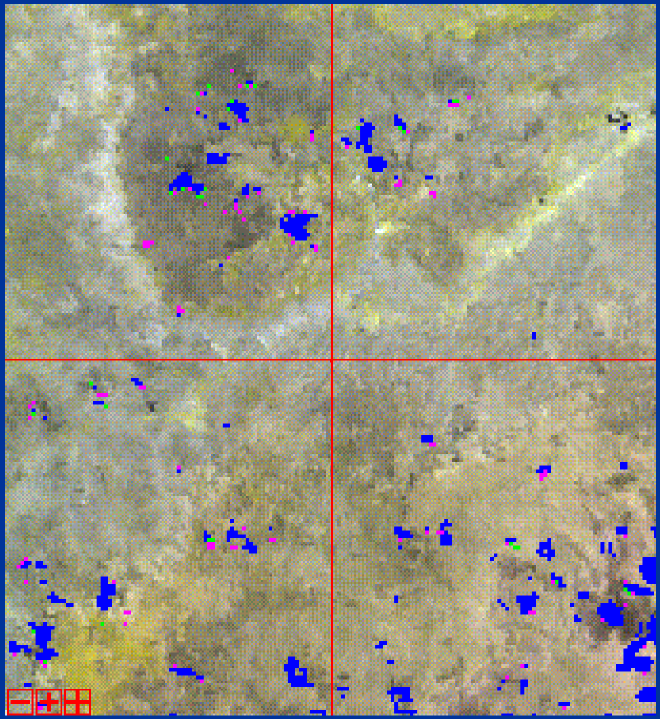
Information provided by Stephen Plummer (ESA-IGBP)

GlobCarbon - Results

Madagascar

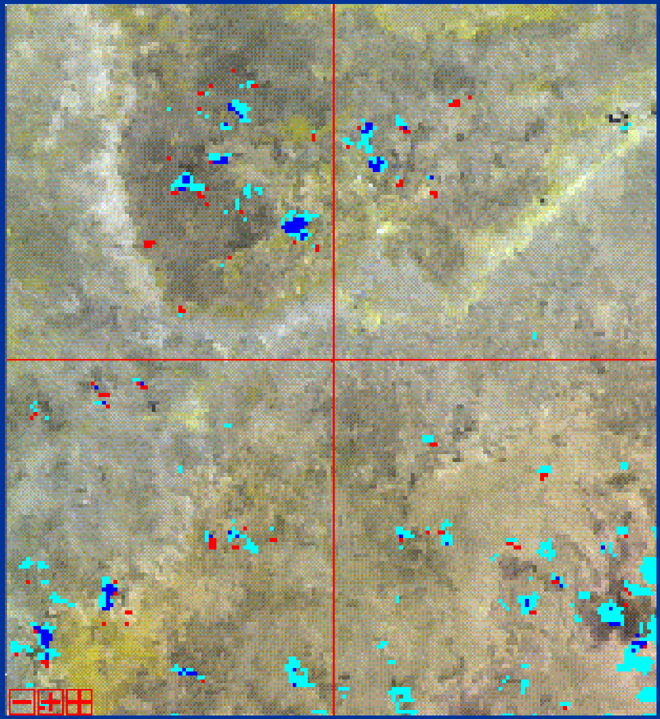


Confidence Rating Index

63-74%

75-87%

88-100%



Sensor Agreement

ATSR

VGT

Both

ECMWF, 6th February 2006

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Information provided by Stephen Plummer (ESA-IGBP)

MODIS Algorithm

Developed for systematic automated global mapping

- Not a classification approach requiring training data or human intervention
- Takes advantage of the robustly calibrated, atmospherically corrected, cloud-screened, geo-located data provided by MODIS data
- Physically-based algorithm less dependent upon imprecise but noise tolerant classification techniques
- Provides a route for the use of multiple data sources and observations of varying degrees of uncertainty within a rigorous modeling framework

Algorithm

- Change detection approach applied independently per pixel to daily gridded MODIS 500m land surface reflectance time series
- Thresholds defined by the noise characteristics of the reflectance data and knowledge of the spectral behavior of burned vegetation and spectrally confusing changes

=> **map 500m location and approximate day of burning**

Information provided by David Roy (SD State University)

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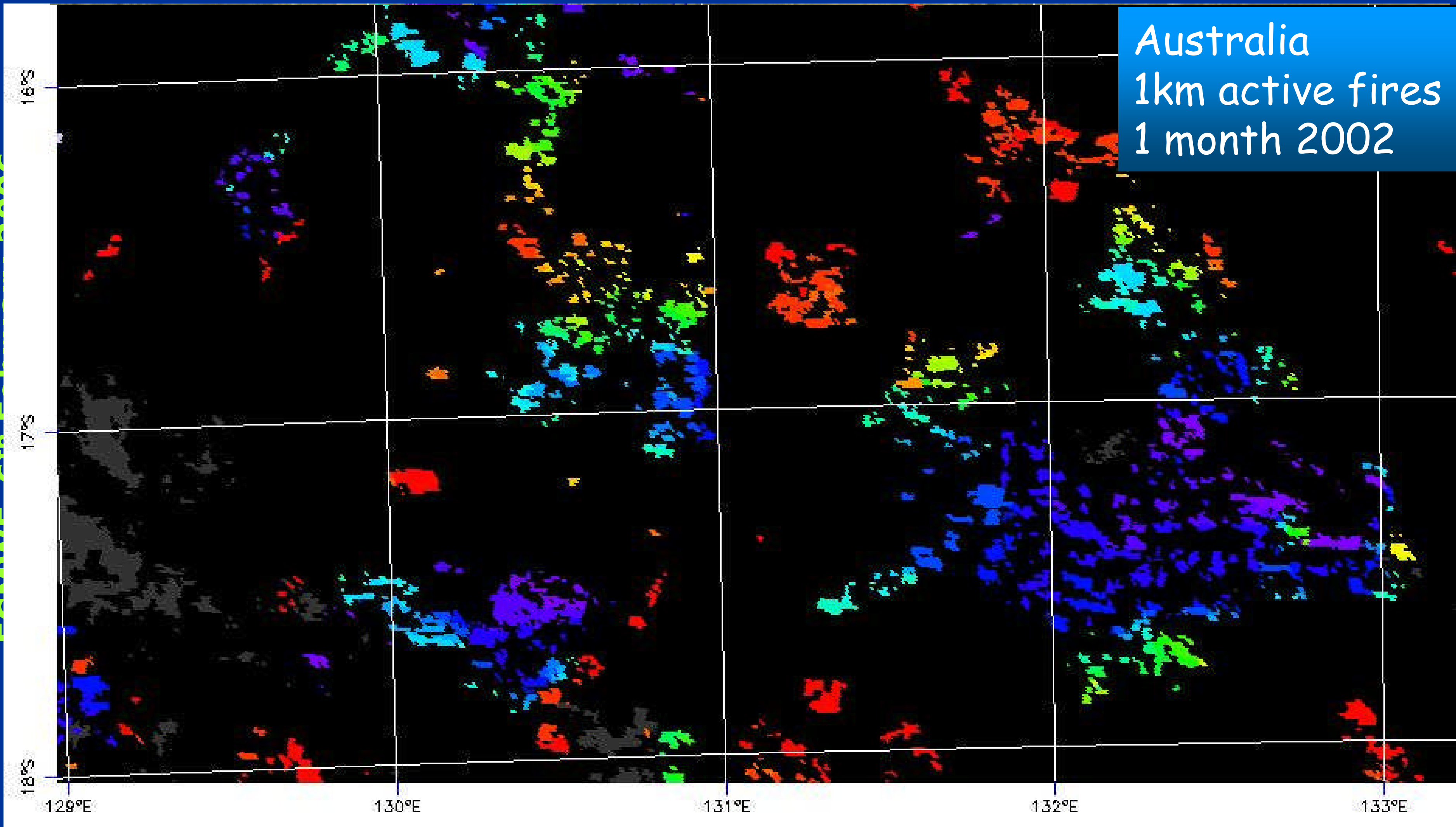
Blue = beginning of month
Red = end of month



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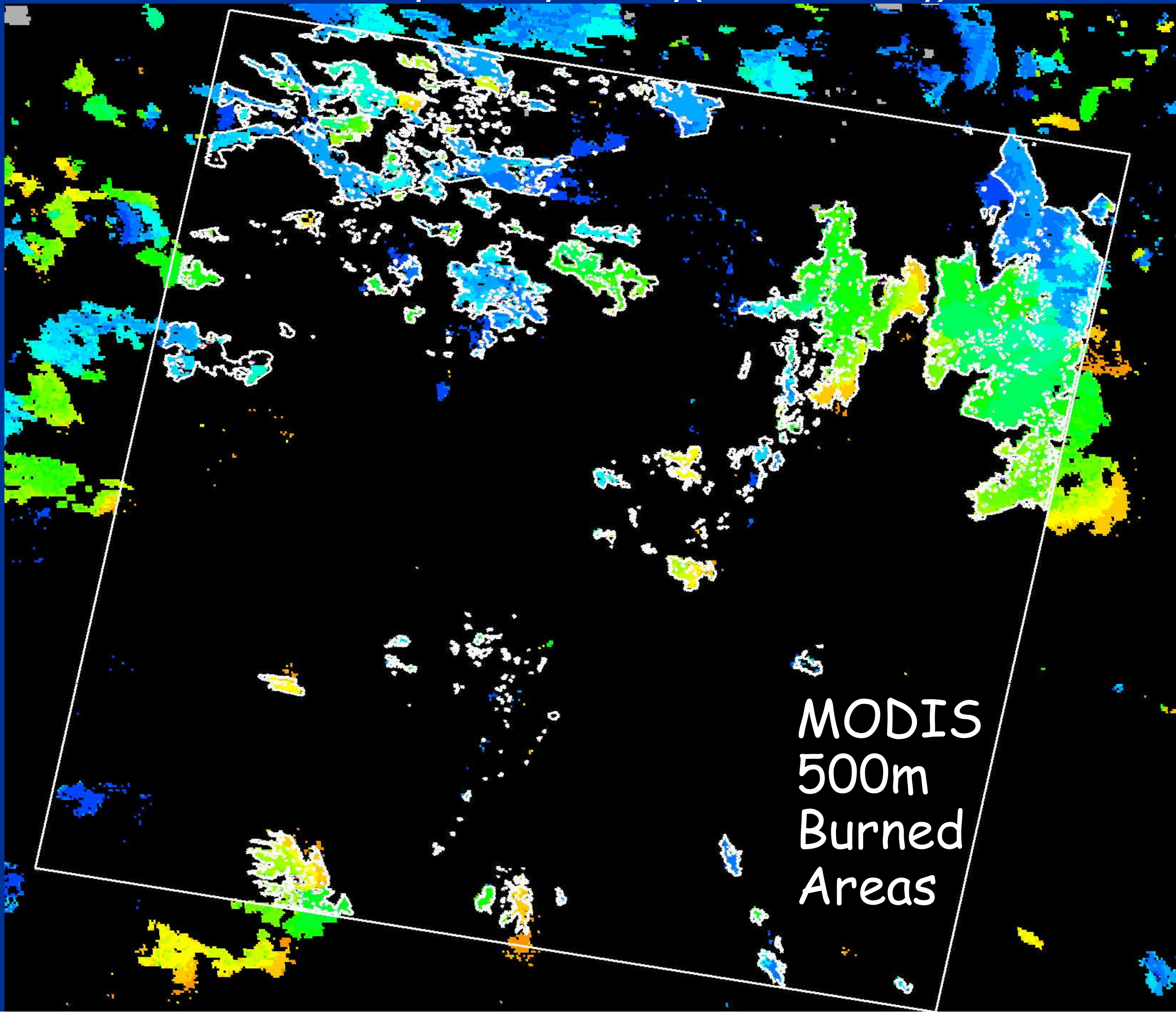

White vectors = ETM+ interpreted burned areas occurring between the two ETM+ acquisitions

European Global Daily BA Product

- University of Leicester initiative with
  - JRC – Technical Uni. of Lisbon – Catholic University of Louvain
- Improvement of a GBA2000 algorithm
- Multi-annual SPOT VGT data 1999-
- 1km^2 resolution
- Daily product – first date of detection
- Error sources are being addressed

Processing Module Inputs

- Input B2, B3 and MIR data for day x
- Intermediate composite products
  - B2, B3 and MIR
- Contaminated pixel mask
- Regional statistical algorithm
- First day of burn (FDOB) binary
  - Julian day
- View and solar angle information
- Land cover data

Processing Module Outputs

- Updated Intermediate composite products
  - B2, B3 and MIR
- Contaminated pixel mask
- Updated First day of burn (FDOB) binary
  - Julian day
- Probable burnt area product for day x
  - Summed with the existing burnt area product to give confidence indicator of burnt area
- Cloud cover frequency & gap frequency

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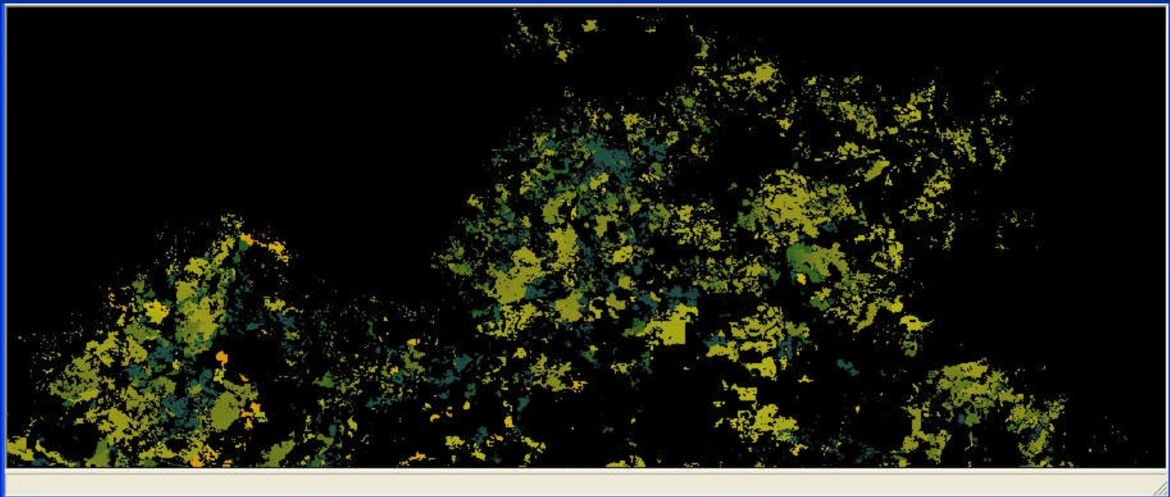
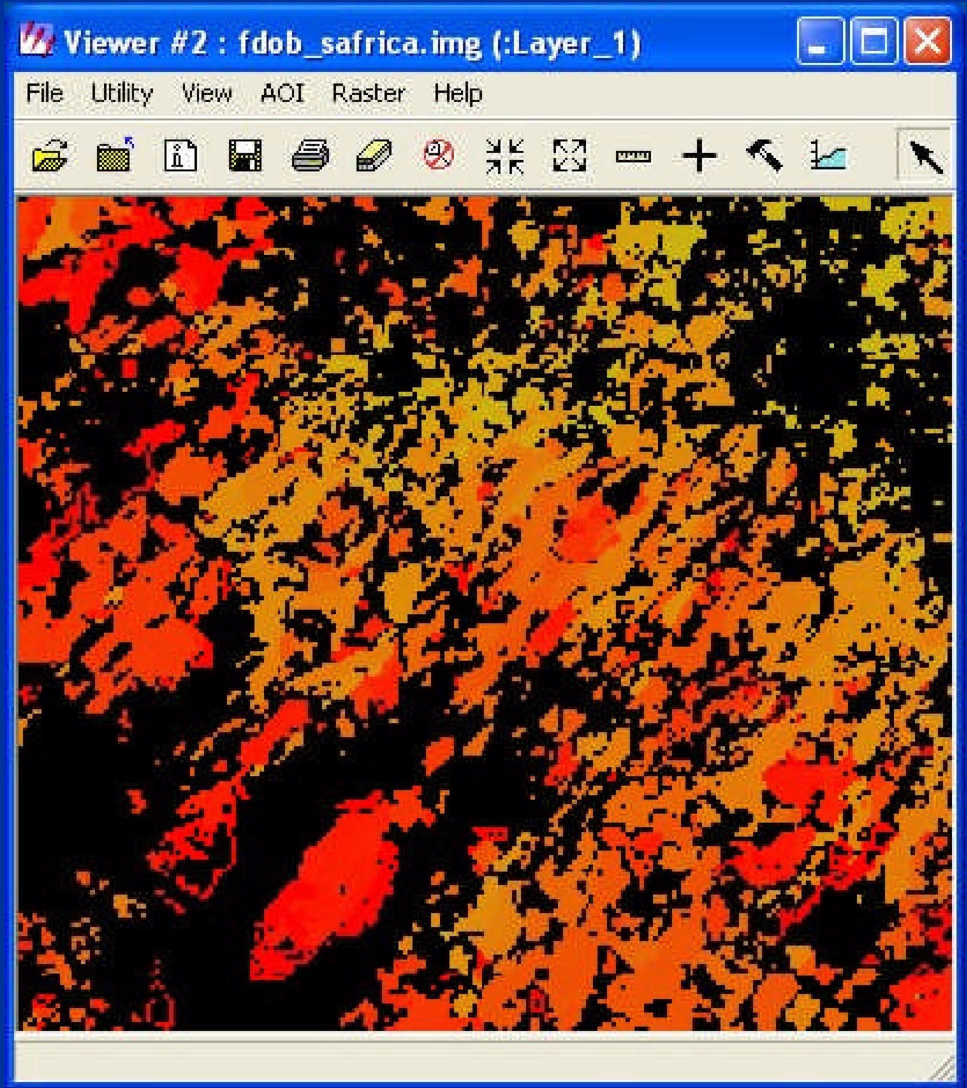
PBA Daily Results

ECMWF, 6th February 2006



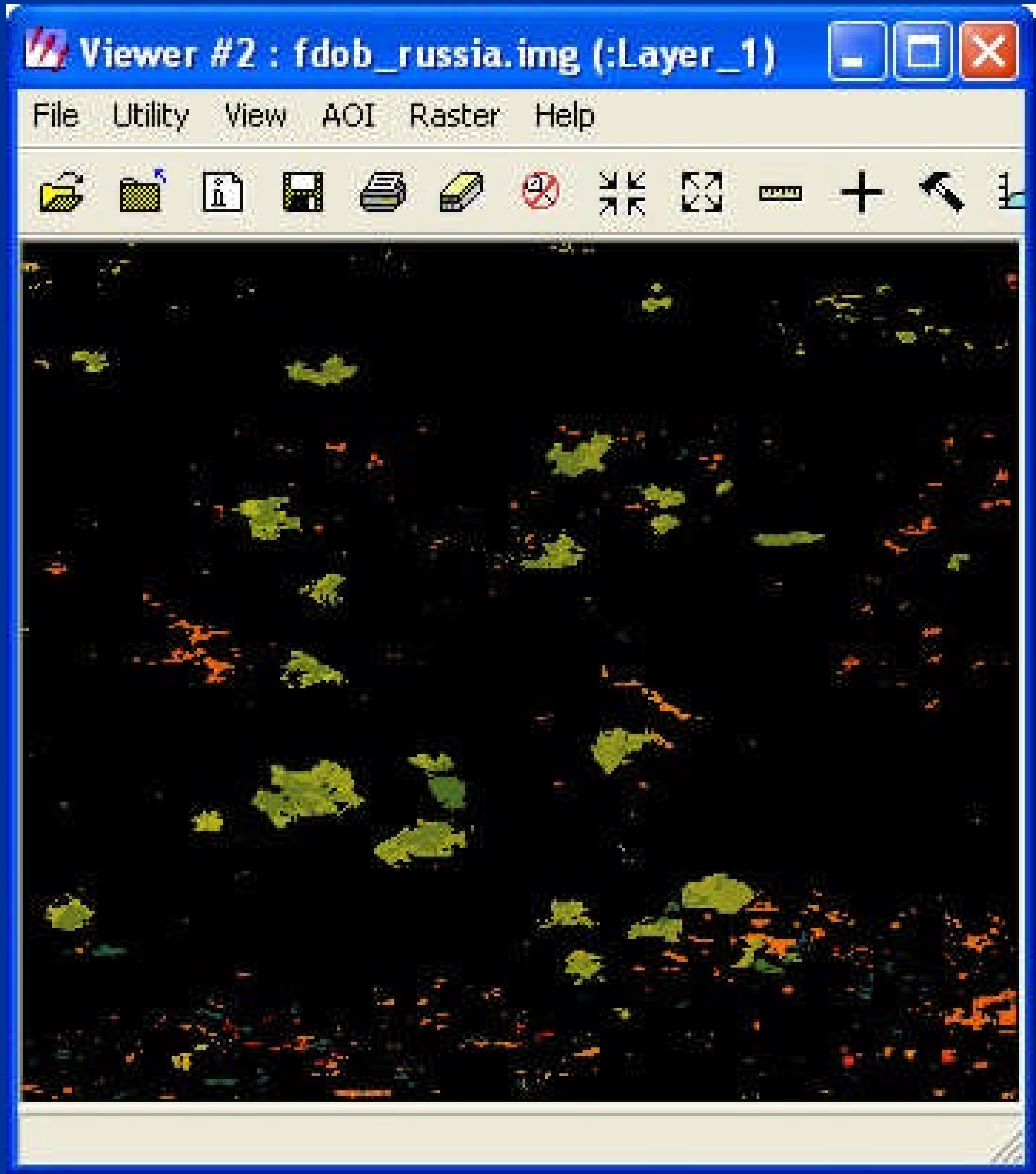
Row	Histogram	Color	Opacity
200	1369		1
201	1608		1
202	494		1
203	81		1
204	406		1
205	899		1
206	1298		1
207	519		1
208	0		1
209	203		1
210	1222		1
211	1540		1
212	0		1
213	345		1
214	287		1
215	1151		1
216	2389		1
217	1051		1
218	313		1
219	207		1
220	1581		1
221	2049		1
222	1317		1
223	246		1
224	7		1
225	1589		1
226	1875		1
227	1580		1
228	499		1
229	289		1
230	1346		1
231	1390		1
232	1448		1
233	1127		1
234	297		1
235	181		1
236	1806		1
237	2763		1
238	2288		1
239	304		1
240	575		1
241	883		1
242	2732		1
243	2046		1
244	570		1
245	165		1
246	778		1
247	2231		1
248	2859		1
249	520		1
250	32		1
251	697		1
252	1014		1
253	3846		1
254	1355		1
255	301		1
256	1127		1
257	3849		1

FDOB
Northern Australia



Row	Histogram	Color	Opacity
306	0		1
307	4		1
308	0		1
309	0		1
310	0		1
311	0		1
312	341		1
313	77		1
314	0		1
315	0		1
316	0		1
317	10		1
318	307		1
319	11		1
320	0		1
321	0		1
322	0		1
323	553		1
324	90		1
325	2		1
326	0		1
327	0		1
328	508		1
329	0		1
330	9		1
331	0		1
332	0		1
333	1036		1
334	1148		1
335	197		1
336	5		1
337	0		1
338	1168		1
339	1110		1
340	670		1
341	4		1
342	0		1
343	242		1
344	94		1
345	1208		1
346	349		1
347	0		1
348	10		1
349	1739		1
350	723		1
351	271		1
352	0		1
353	0		1
354	203		1
355	1535		1
356	281		1
357	0		1
358	0		1
359	736		1
360	664		1
361	453		1
362	2		1
363	0		1
364	1023		1
365	538		1

FDOB
Northern Africa



FDOB

Central Russia

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Concerns over Results

- Canada and Russia – leaf off conditions
- This will be corrected using existing data

Questions

- Hard and soft classifications:
  - Does the user community want or know how to handle probability data?
  - Do they still need burnt or not burnt information?

- How do we combine burnt area data with fire severity data for improved emissions estimates?

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