National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

Environmental Monitoring & Modelling Research Group

KING'S College LONDON
University of London

Geostationary Data & Use Update……

Martin Wooster (Kings College London UK)

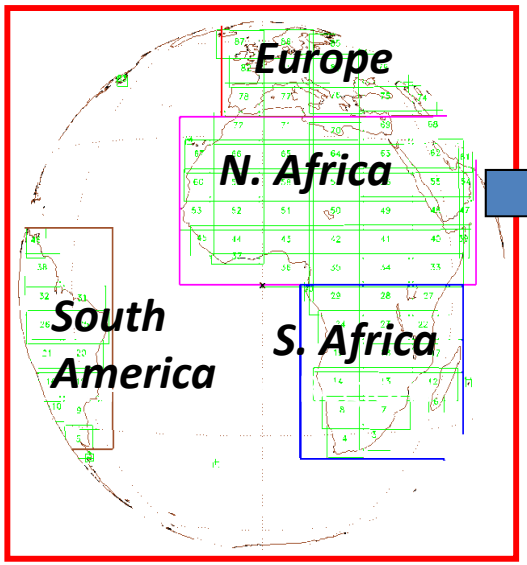
Slide contributions from many others @ KCL and
GFAS & Copernicus Service Development Team
(particularly Patrick Freeborn & Johannes Kaiser)

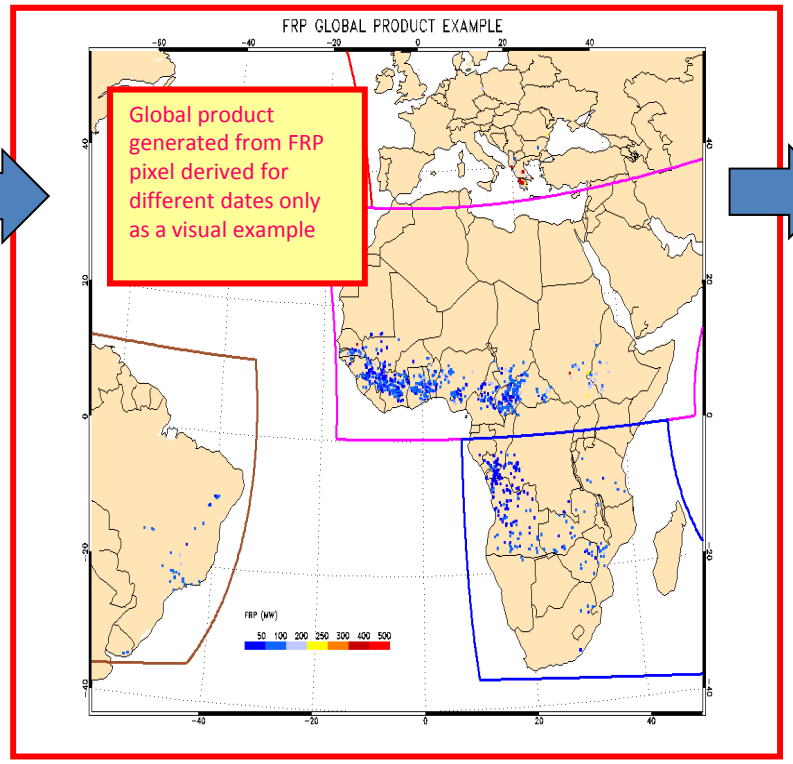
Environmental Monitoring and Modelling Research Group,
Dept. of Geography, King's College London, UK.

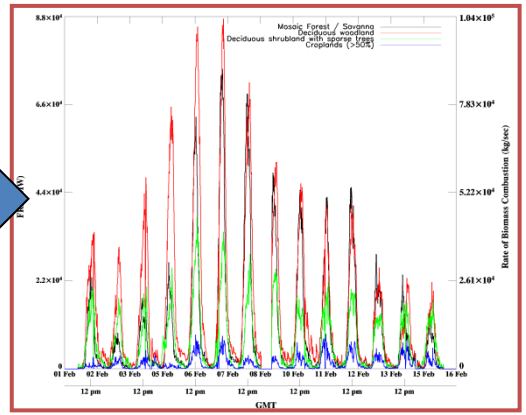
European Geostationary Products
[NRT Operational]

Operational SEVIRI FRP_Pixel Product

KING'S College LONDON
University of London







From 2015 all 15 min products will be full disk…

Available via FTP/EUMETCast from the EUMETSAT Land Surface Analysis Satellite Application Facility (LSA SAF)

http://landsaf.meteo.pt/ **- for data, ATBD, Product User Manual & Validation Report**

- **FRP Pixel Product** (native spatial/temporal resolution) – available within 30 mins
- **FRP Gridded product** - inc. adjustments for "small fires" and "clouds" also available.

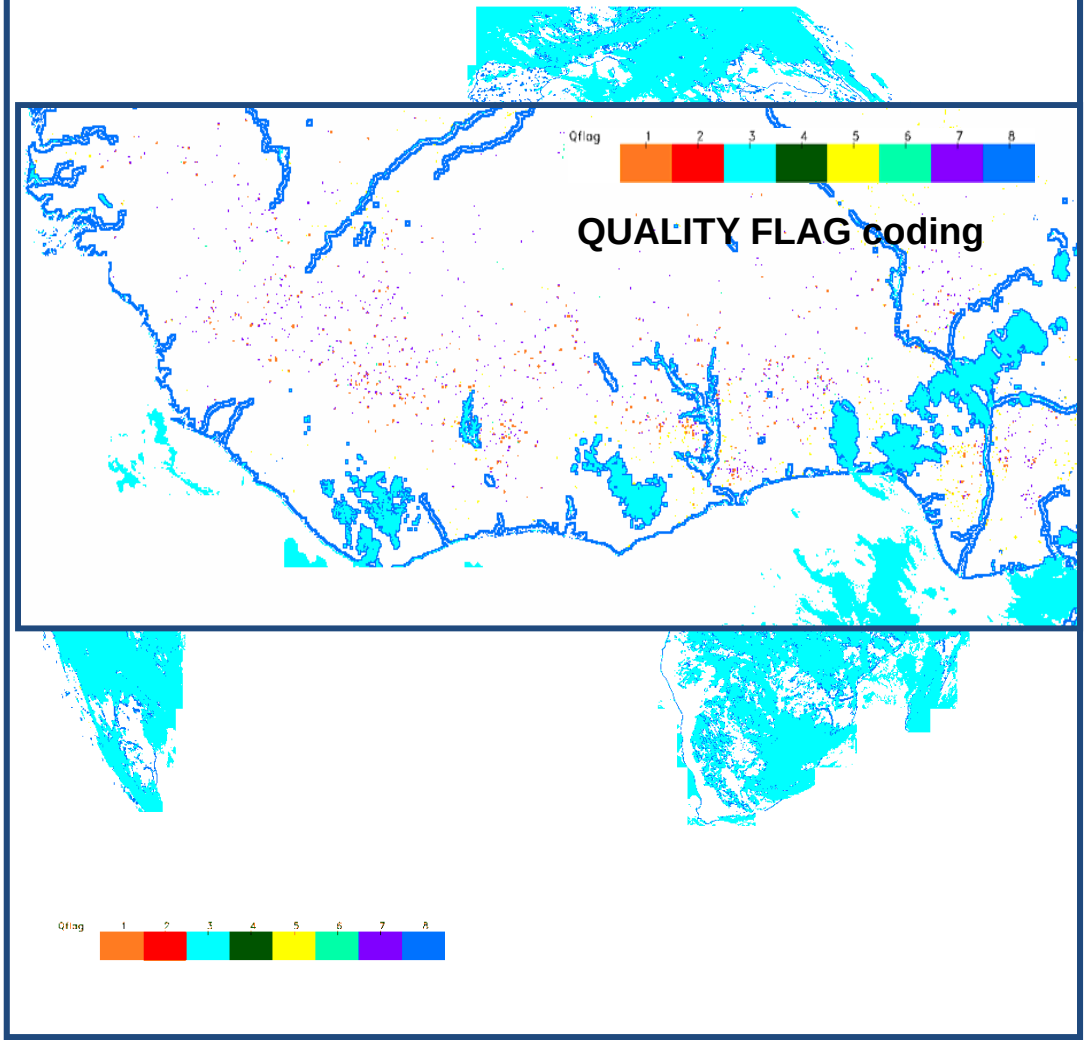
SEVIRI FRP_Pixel – Quality Product

Two HDF files for each slot

- "List Product"- Fire Data only
- Matching "Quality Product" reports the processing status of each pixel – Fire Detected & FRP measured, cloud-covered, etc.

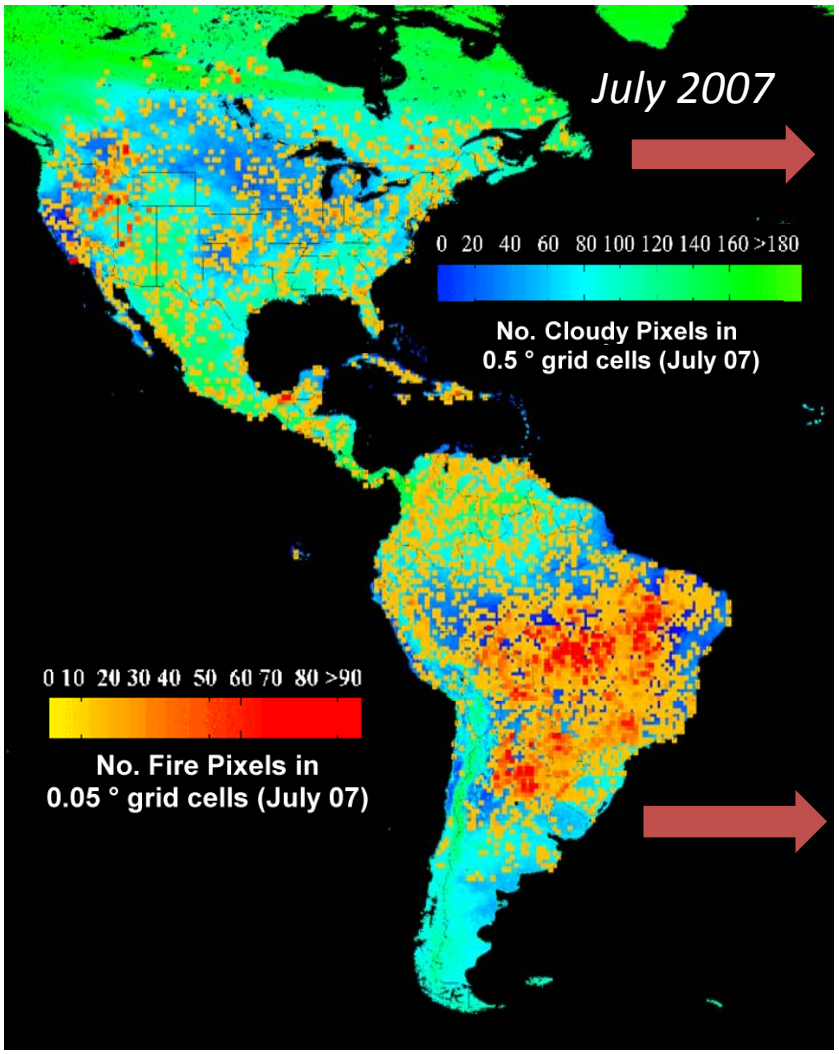
VALUE	MEANING
0	NOT POT FIRE
1	FRP OK
2	FRP SAT
3	CLOUDY
4	SUN GLINT
5	SUN GLINT RATIO
6	NO BCK
7	BAD BCK
8	CLOUD EDGE
254	NOT PROCESSED

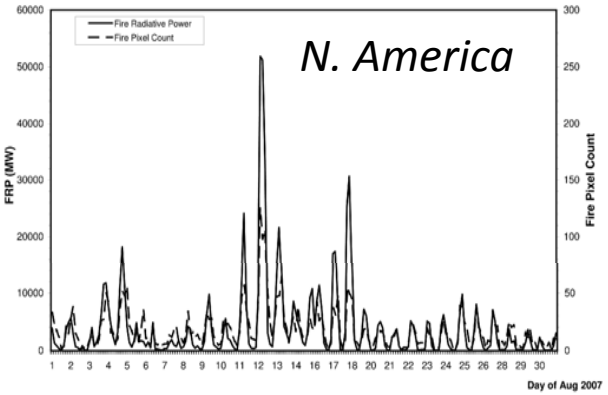
FRP_Pixel Quality Product File

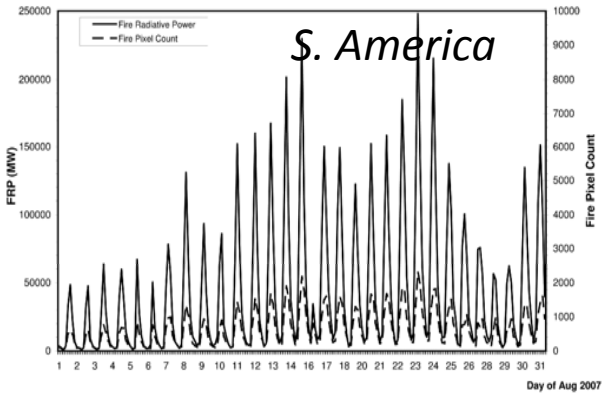


GOES FRP Product (America's)

KING'S College LONDON
University of London

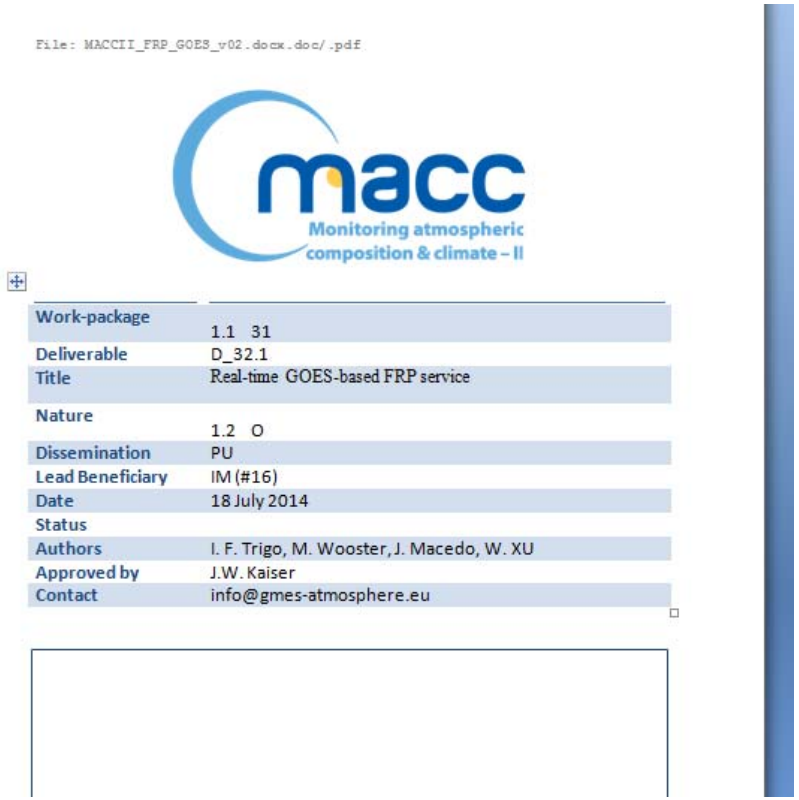






- *Available on request in NRT from KCL now (users ECMWF and Met Office Currently)*
- *Now processed as part of the Copernicus Service via LSA SAF*

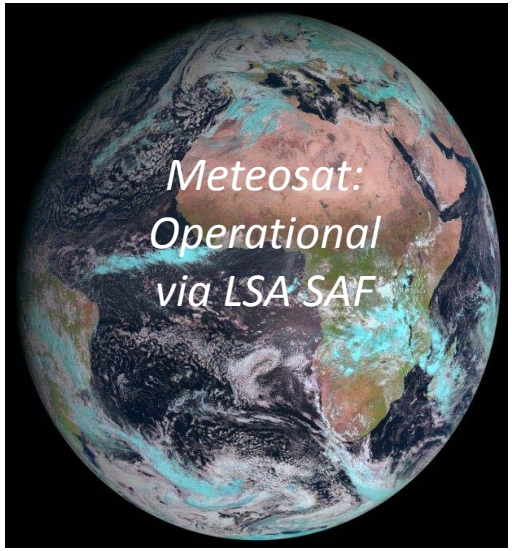
GOES FRP Product (America's)

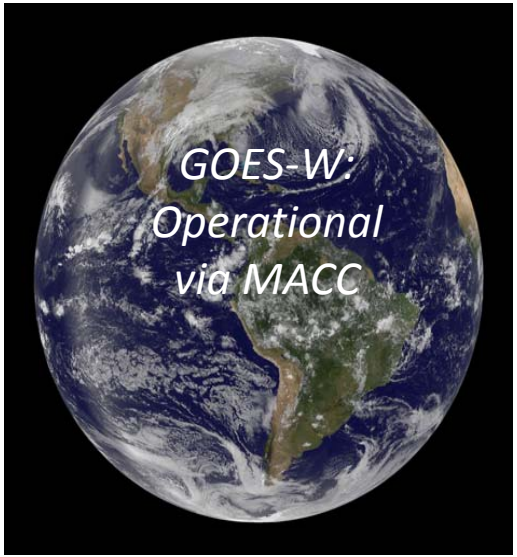


ftp://frp_public:frp@geoland2.meteo.pt

Global Geostationary System (via Europe)

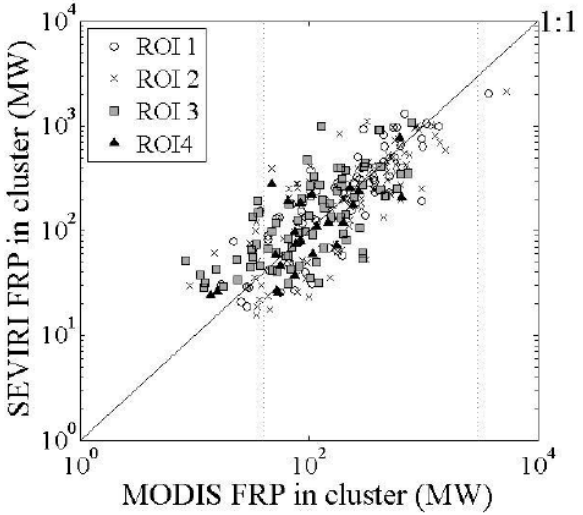
KING'S College LONDON
University of London





Non-Optimum 3.9 µm channel data quality

Non-Optimum 3.9 µm channel dynamic range



MODIS has uncertainty too..

KING'S College LONDON
University of London

Geophysical Research Letters

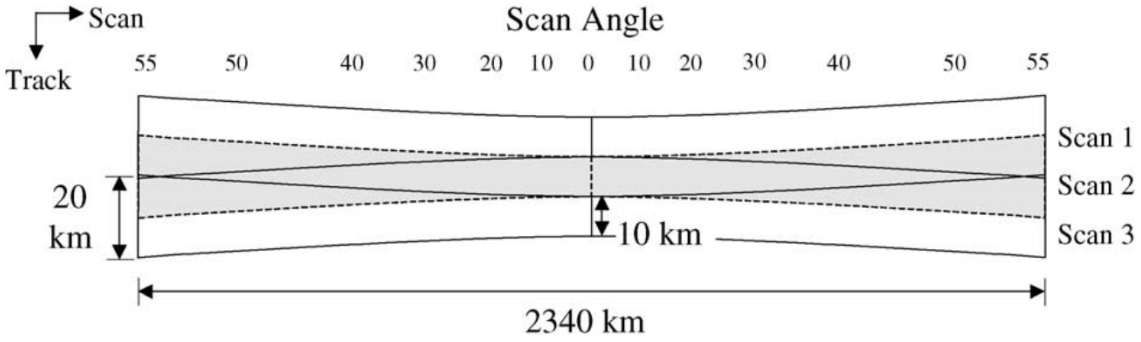
RESEARCH LETTER
10.1002/2013GL059086

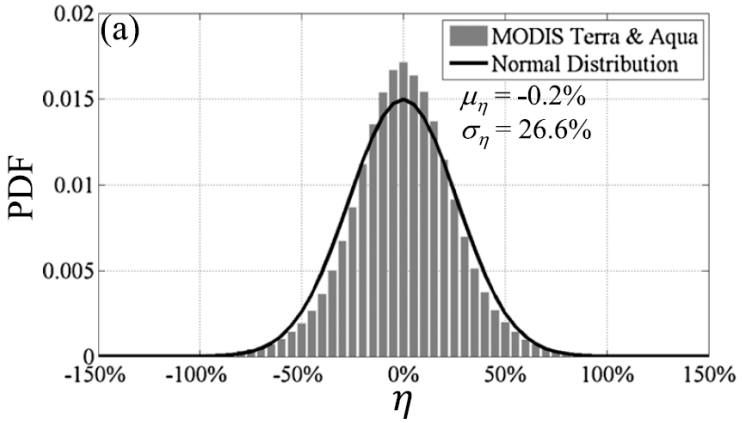
Key Points:
- Measurements of MODIS FRP have an uncertainty of 26.6% at the 1 sigma level
- Uncertainties in MODIS FRP are driven by the fire location within the PSF
- Uncertainties in MODIS FRP do not depend on scan angle

Quantification of MODIS fire radiative power (FRP) measurement uncertainty for use in satellite-based active fire characterization and biomass burning estimation

Patrick H. Freeborn[1], Martin J. Wooster[2,3], David P. Roy[1], and Mark A. Cochrane[1]

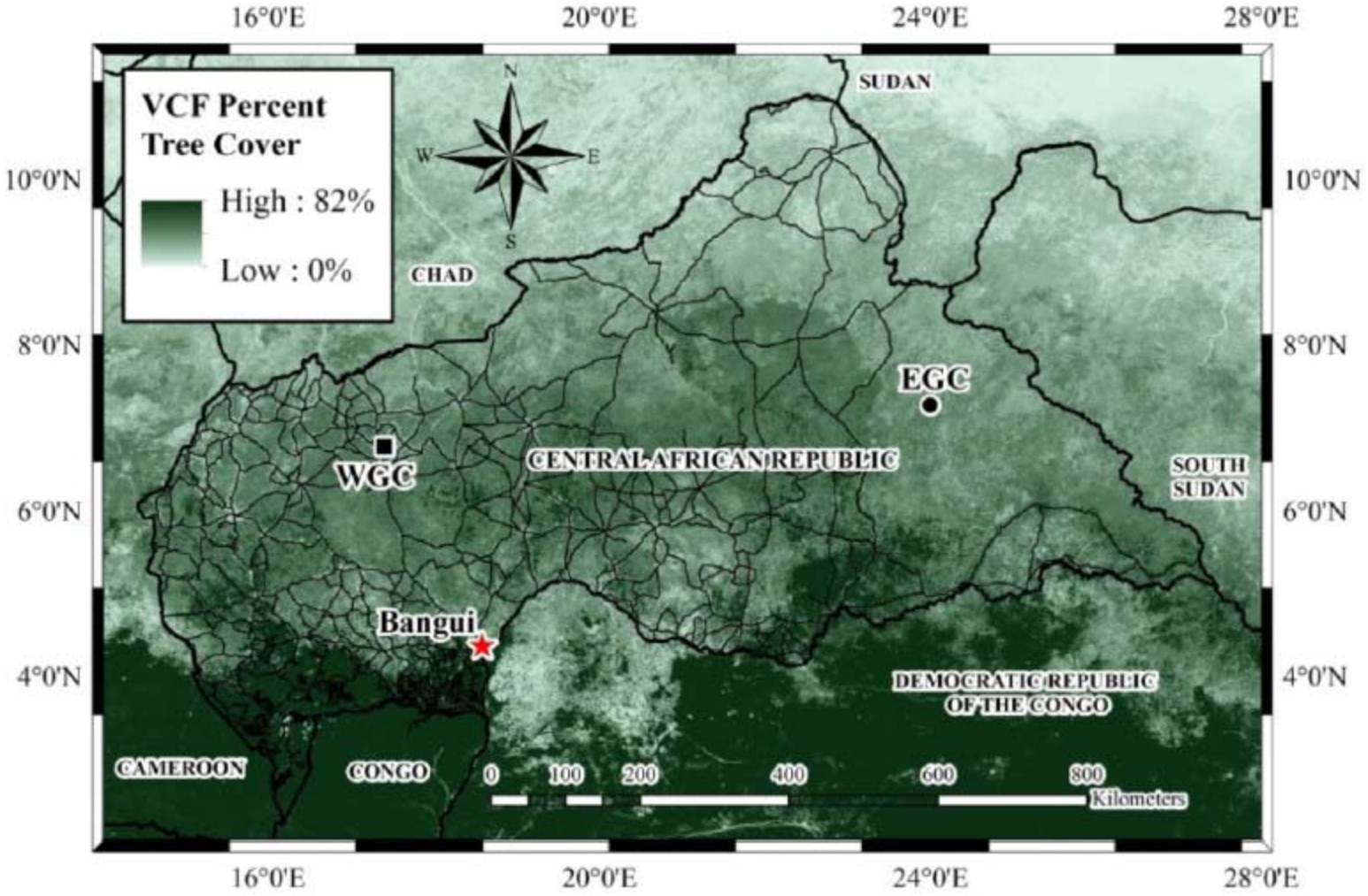
[1]Geographic Information Science Center of Excellence, South Dakota State University, Brookings, South Dakota, USA, [2]Earth and Environmental Dynamics Research Group, Department of Geography, King's College London, London, UK, [3]NERC National Centre for Earth Observation, UK





- Measurements of MODIS FRP have an uncertainty of 26.6% at 1 σ
- Uncertainties in MODIS FRP are driven by fire location within the PSF
- Uncertainties in MODIS FRP do not depend on scan angle

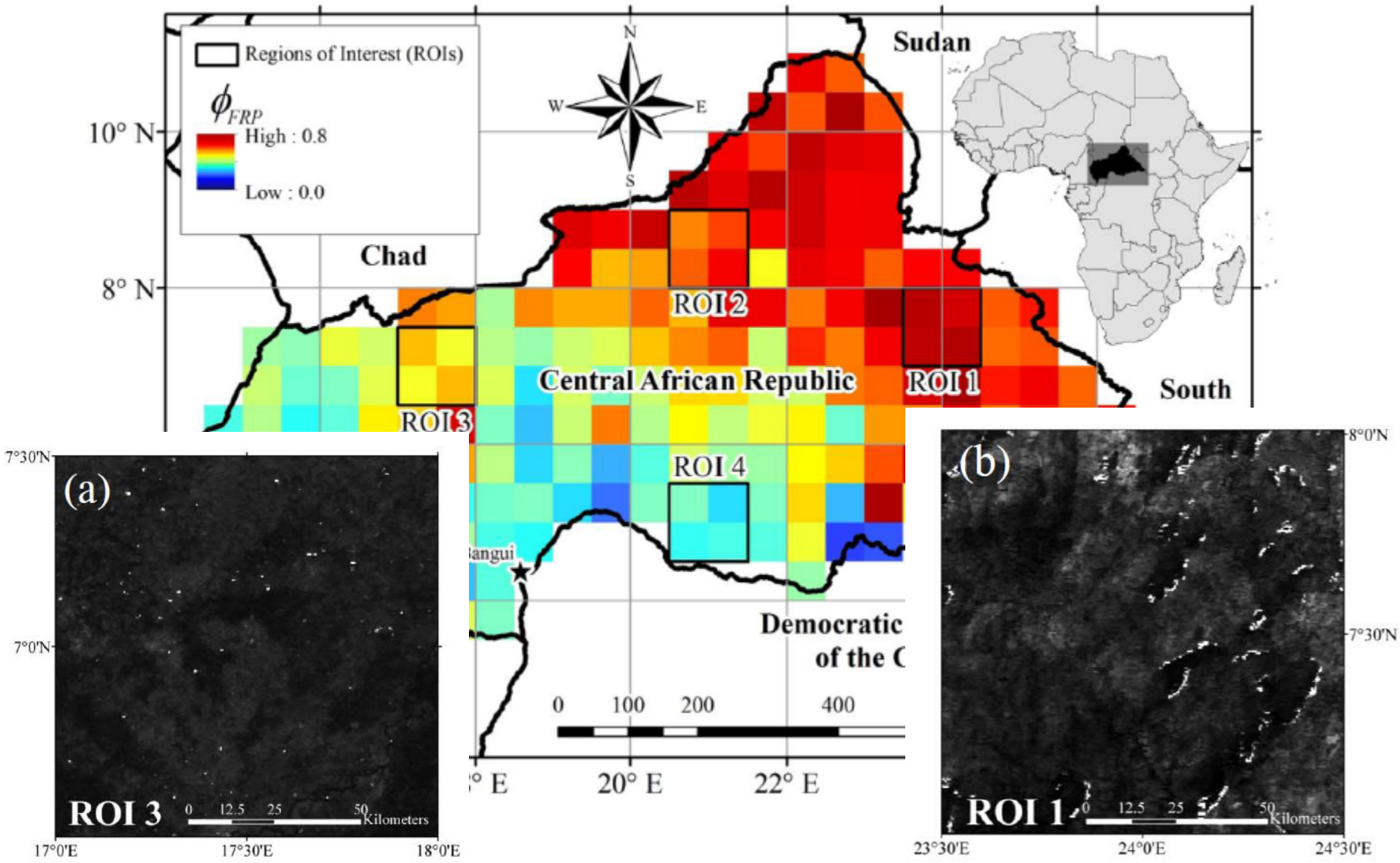
Fire Season & Fire Regime



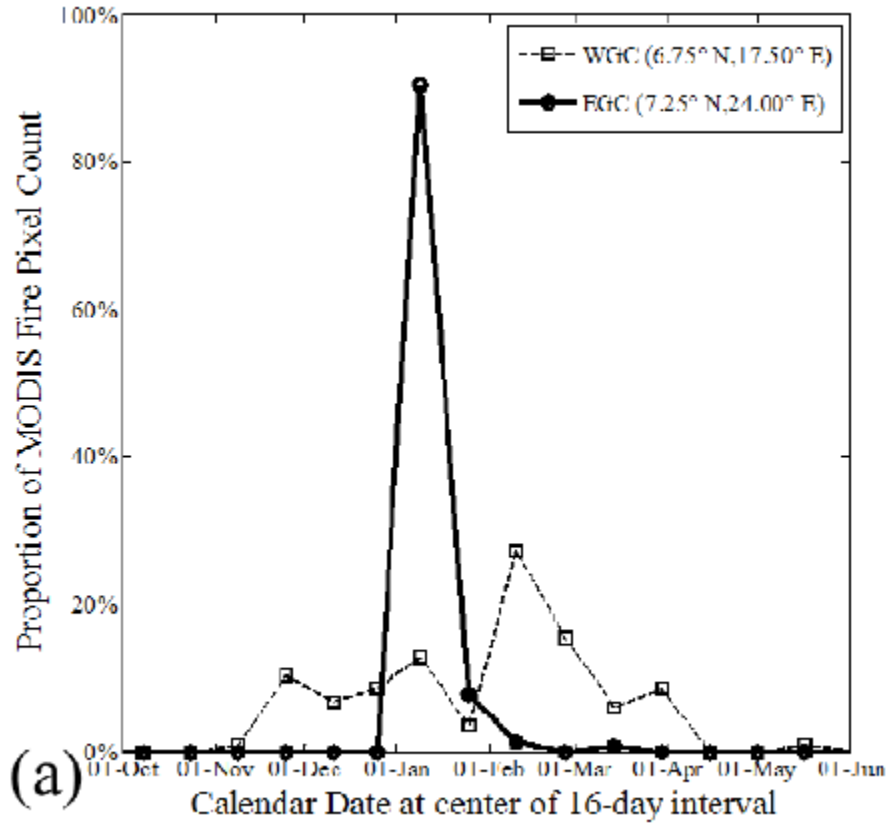
MODIS 10 yrs of data

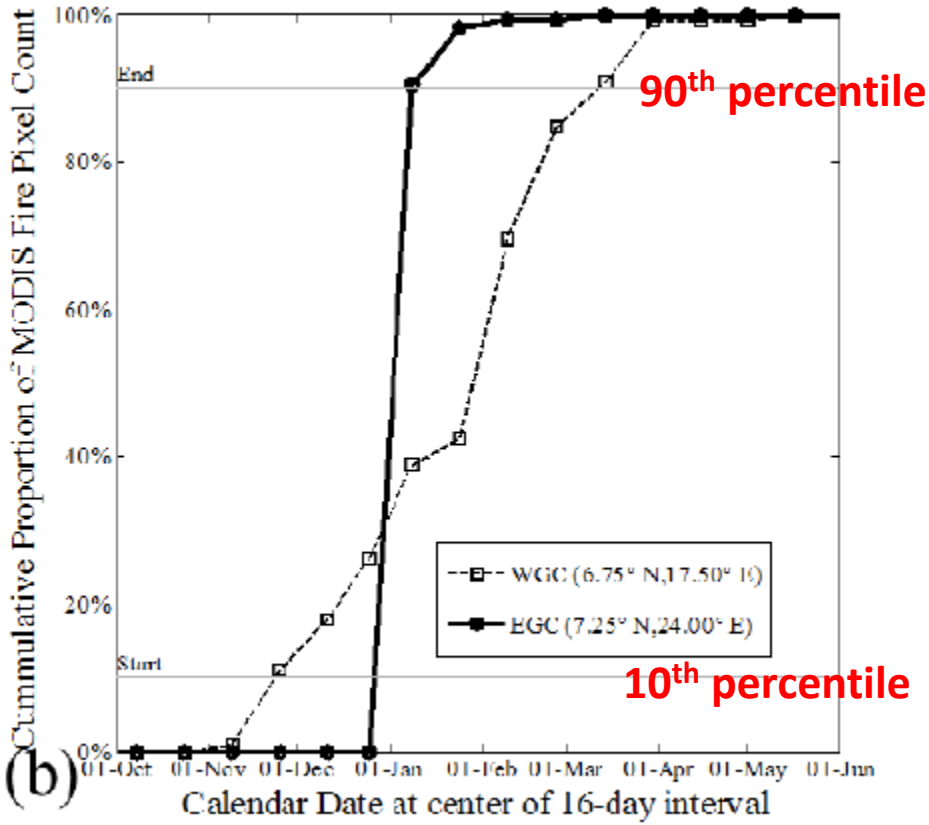
Freeborn et al. (2014) Remote Sens. ***2014, 6, 4061-4089; doi:10.3390/rs6054061***

SEVIRI to MODIS ΣFRP Ratio



Fire Season & Fire Regime

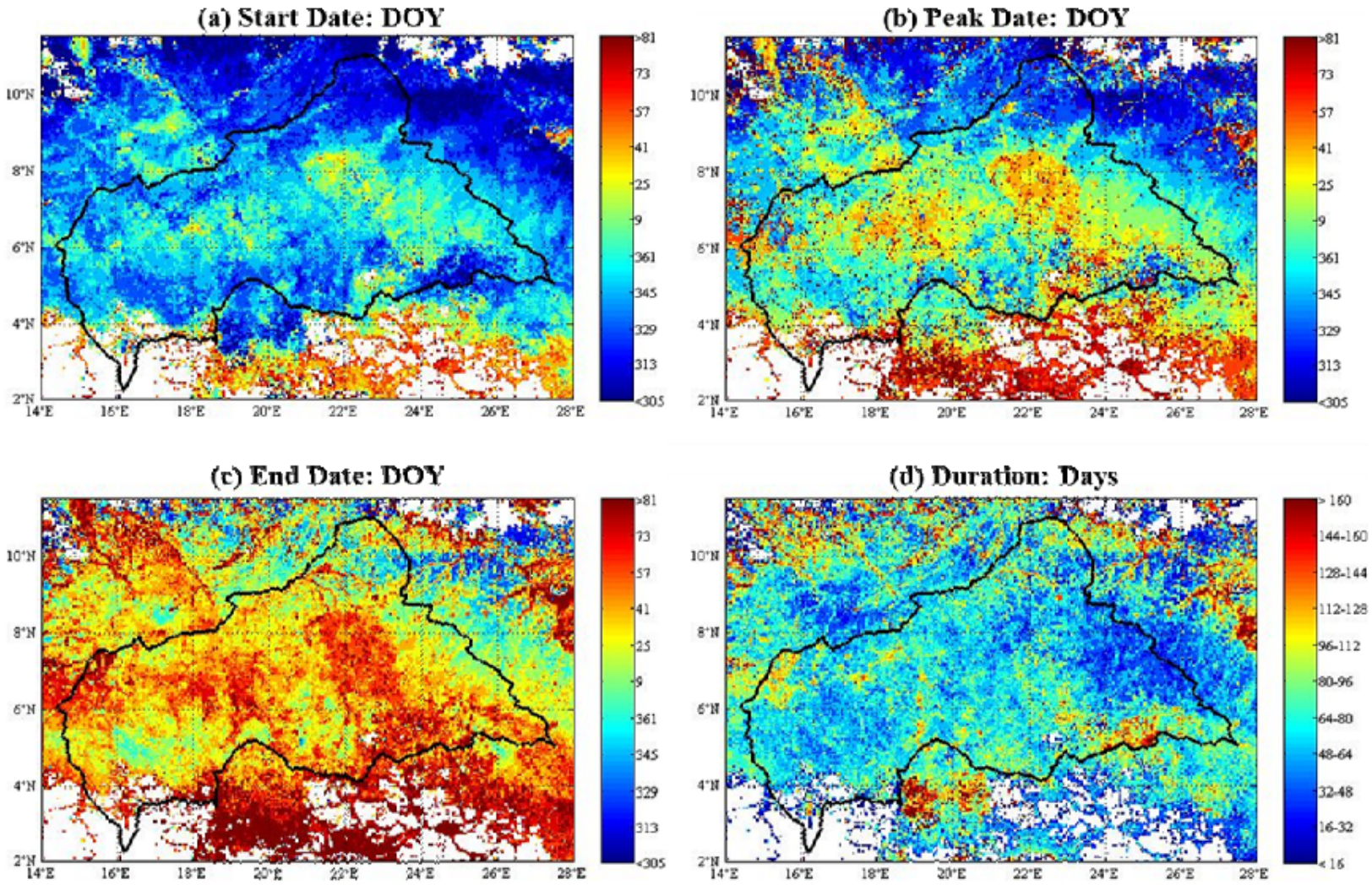




MODIS 10 yrs of data

Freeborn et al. (2014) Remote Sens. ***2014, 6, 4061-4089; doi:10.3390/rs6054061***

Fire Season & Fire Regime

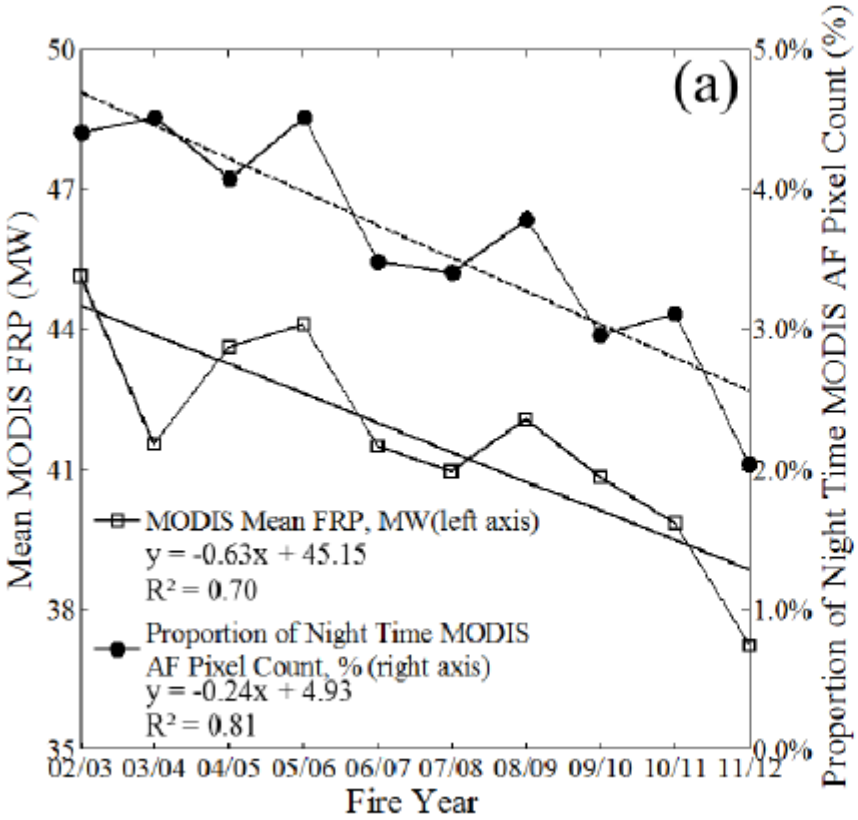


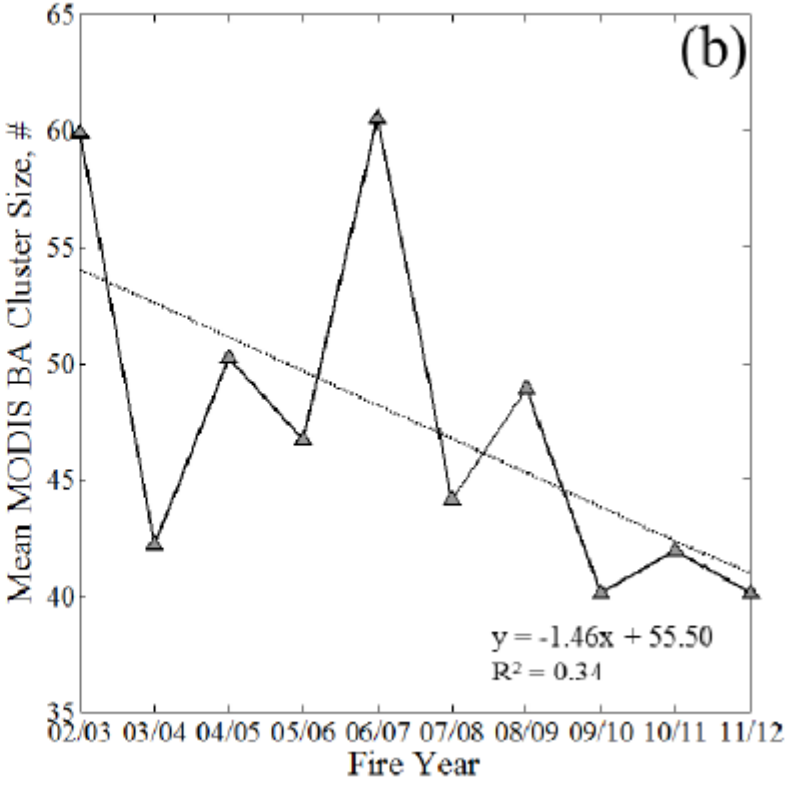
MODIS 10 yrs of data

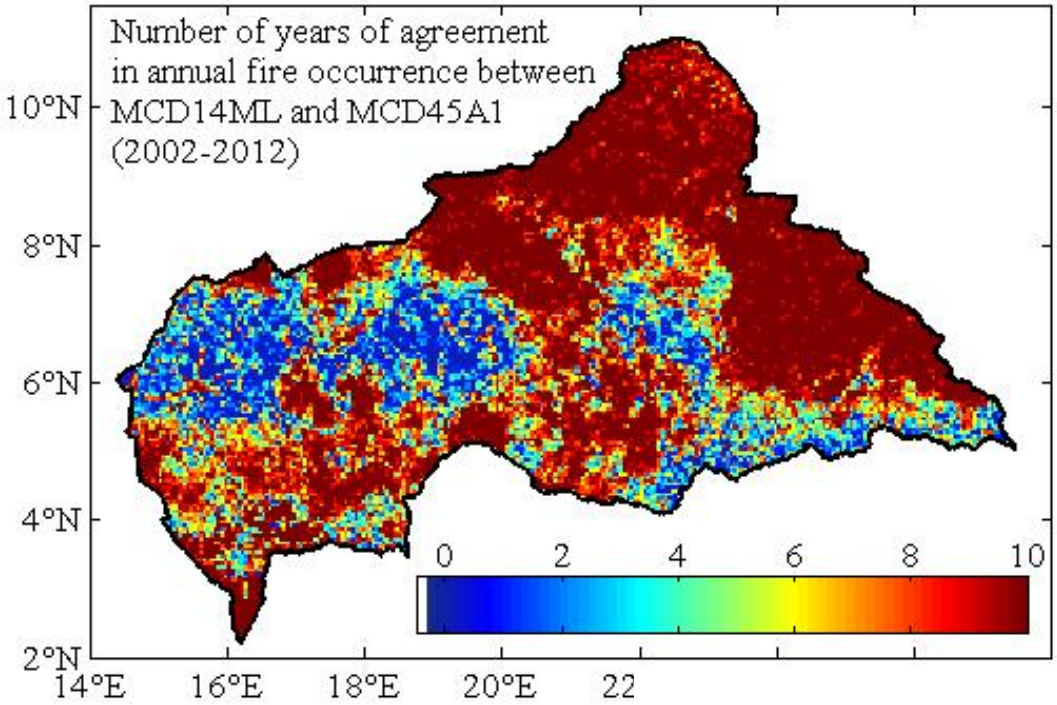
Freeborn et al. (2014) Remote Sens. ***2014, 6, 4061-4089; doi:10.3390/rs6054061***

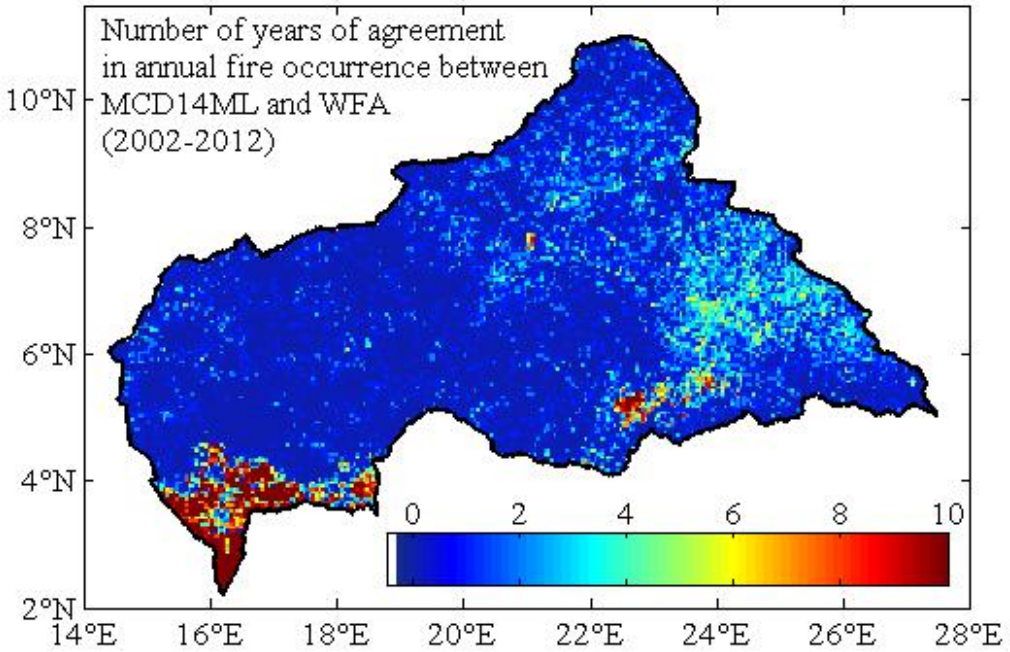
Fire Season & Fire Regime

KING'S College LONDON
University of London





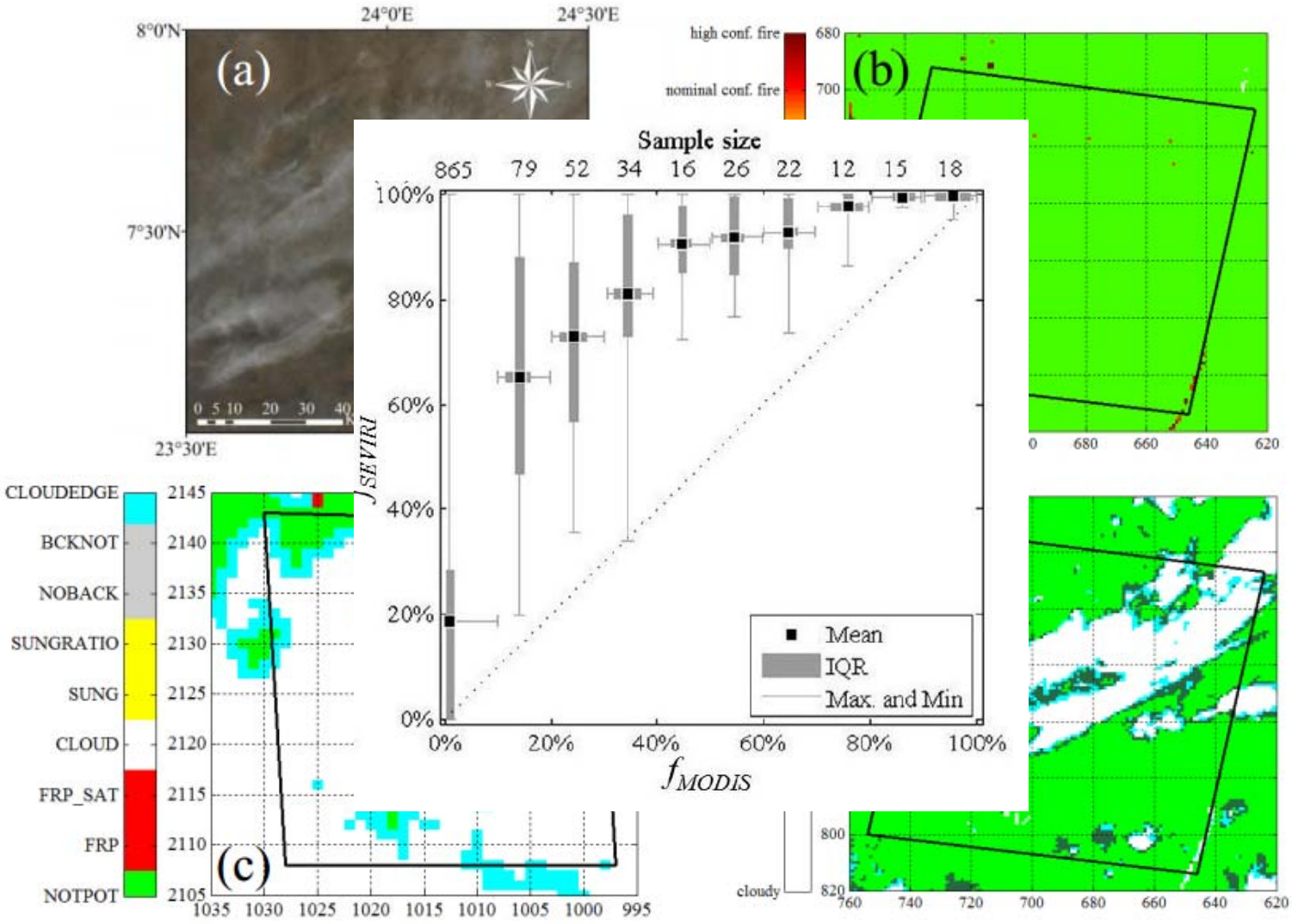

Number of years of agreement
in annual fire occurrence between
MCD14ML and MCD45A1
(2002-2012)
10°N
8°N
6°N
4°N
2°N
14°E
16°E
18°E
20°E
22
0
2
4
6
8
10


Number of years of agreement
in annual fire occurrence between
MCD14ML and WFA
(2002-2012)
10°N
8°N
6°N
4°N
2°N
14°E
16°E
18°E
20°E
22°E
24°E
26°E
28°E
0
2
4
6
8
10

SEVIRI to MODIS Cloud Cover Data

MODIS Image

MODIS MYD14 Fire Product



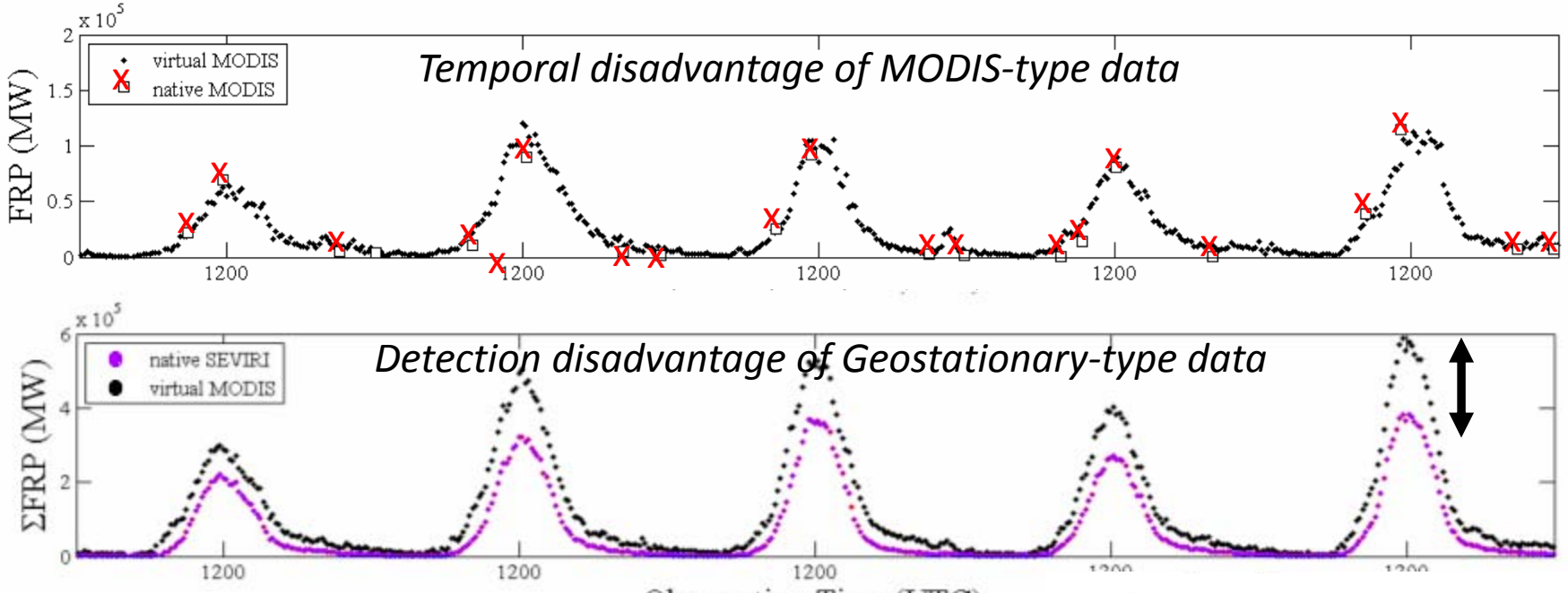
Cloud = white
Fire = red
Land = green

SEVIRI Fire Product Cloud Mask

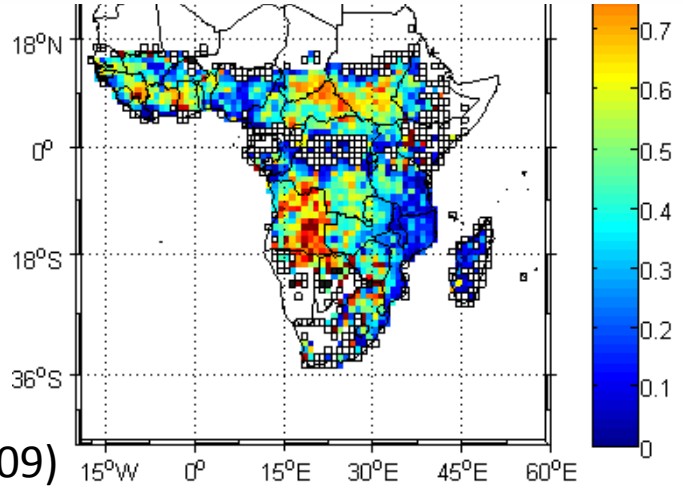
MODIS MYD35 Cloud Product Mask

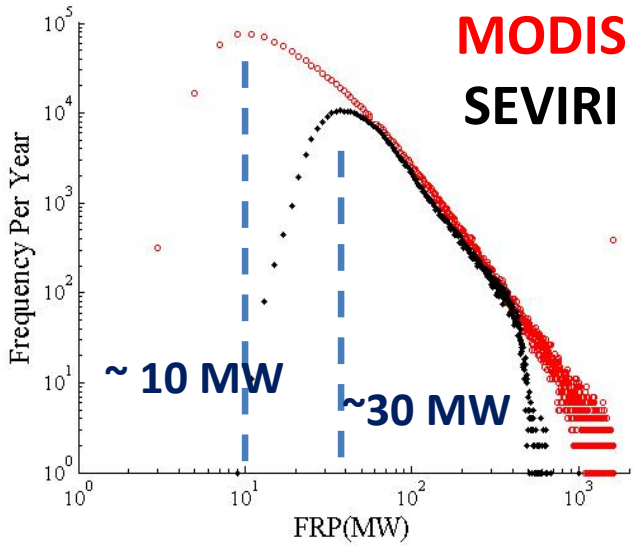
Merging GEO and LEO Datasets

KING'S College LONDON
University of London



Varying SEVIRI to MODIS FRP Ratio

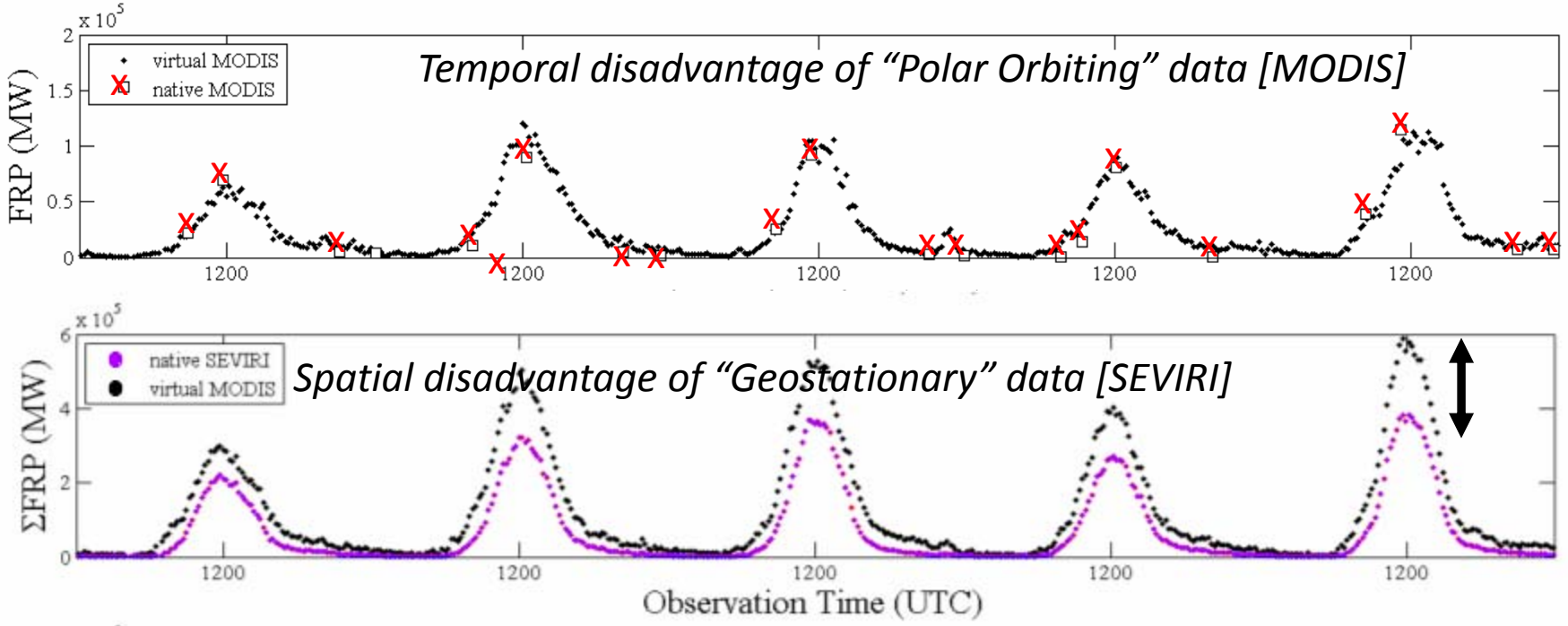


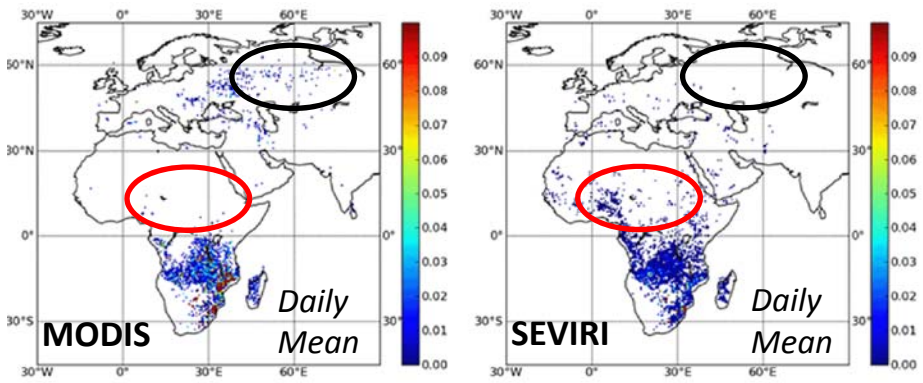


Freeborn *et al.* (2009)

Merging GEO and LEO Datasets

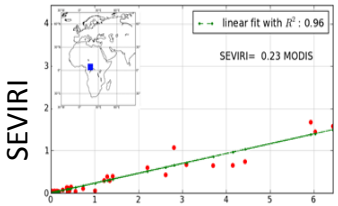
KING'S College LONDON
University of London



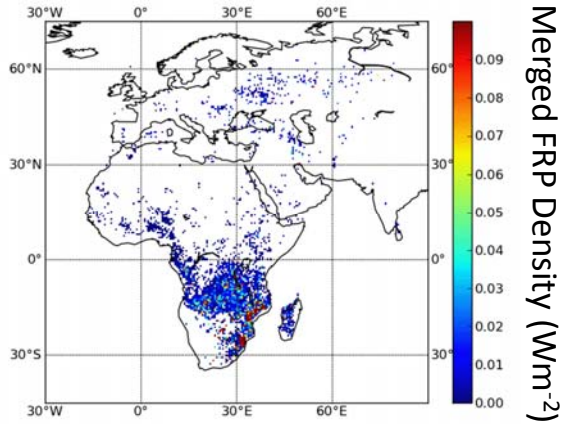


FRP density (Wm^{-2})

FRP Density (Wm^{-2})



transfer fn.



Merged & Bias-Corrected

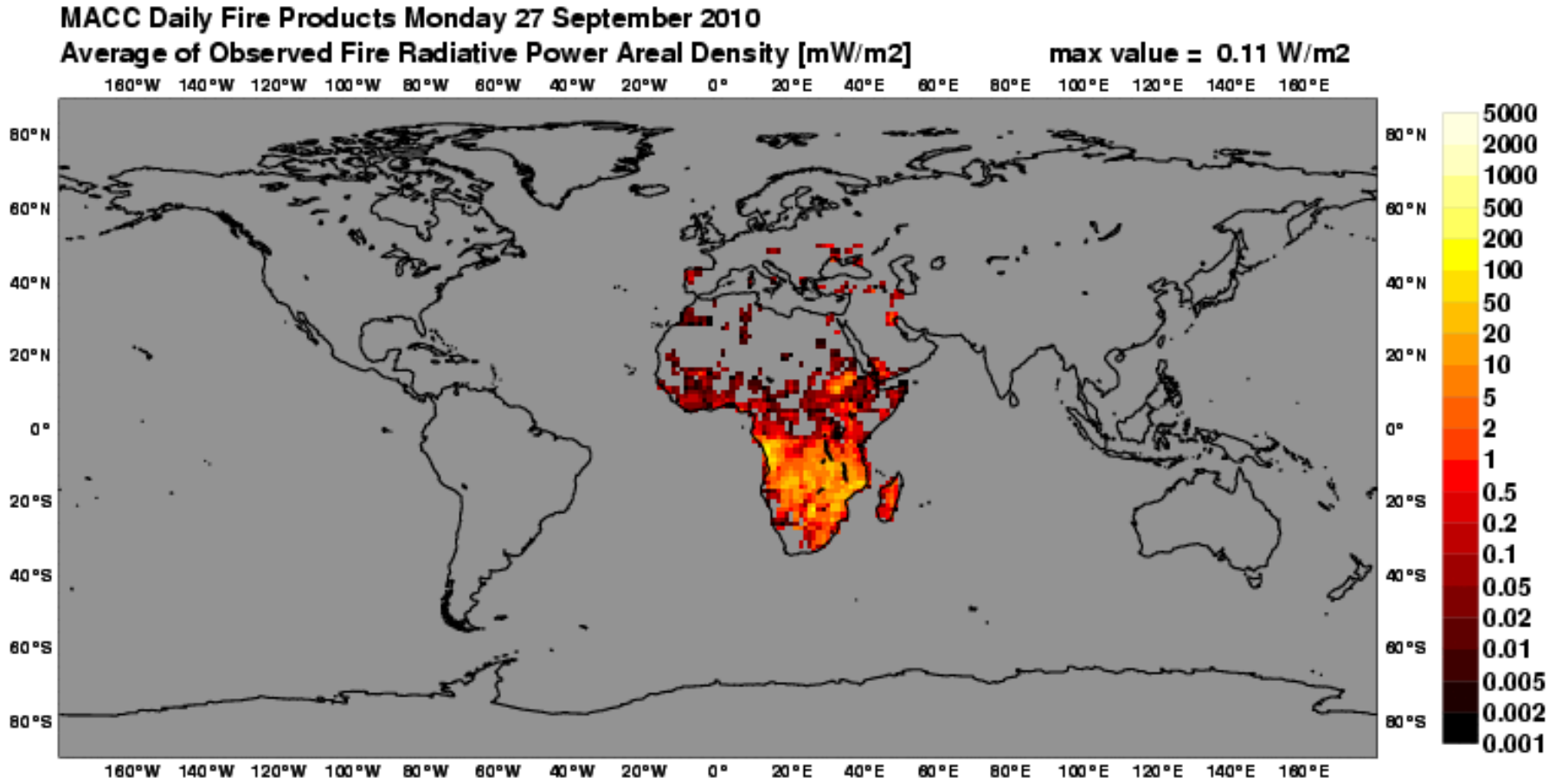
KING'S College LONDON
University of London

Global Fire Assimilation System (GFAS)

Global FRP and Atmospheric Emissions Dataset

[NRT Operational and Reanalysis]

GFAS FRP Density from SEVIRI



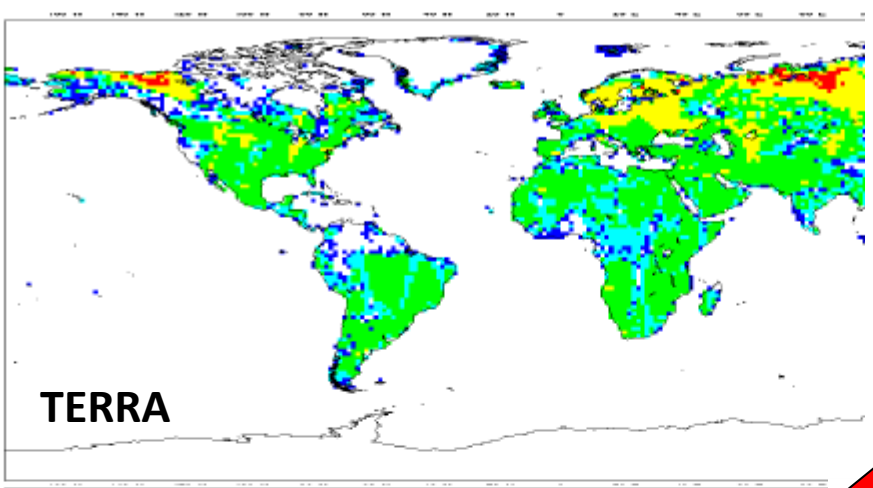
Daily Mean FRP density [W m^{-2}] calculated from SEVIRI @ 0.5°

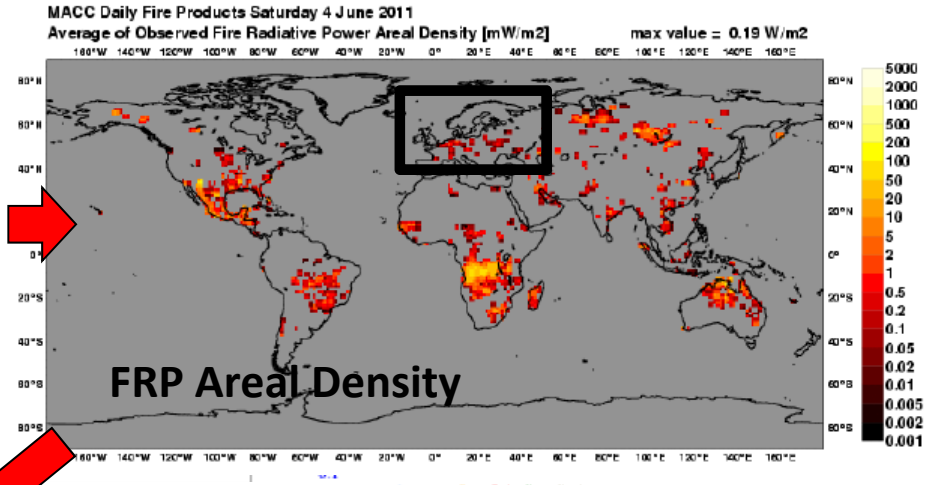
Global Fire Assimilation System developed to run part of Copernicus Atmosphere Service.

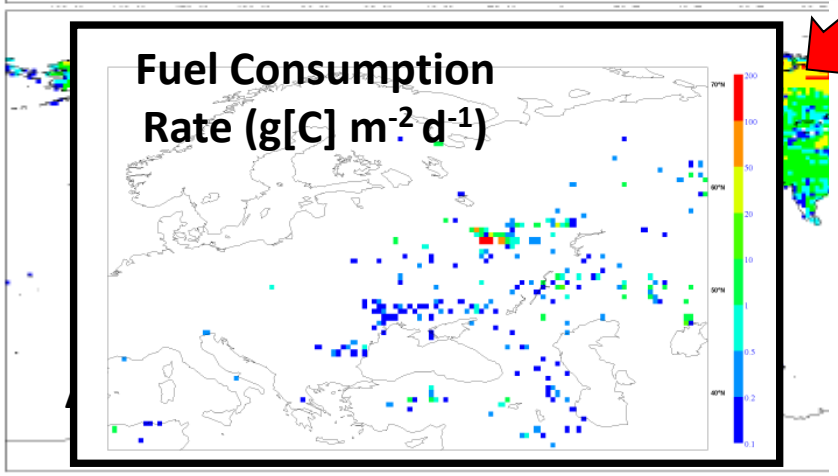
Global Fire Assimilation System (GFAS v1)

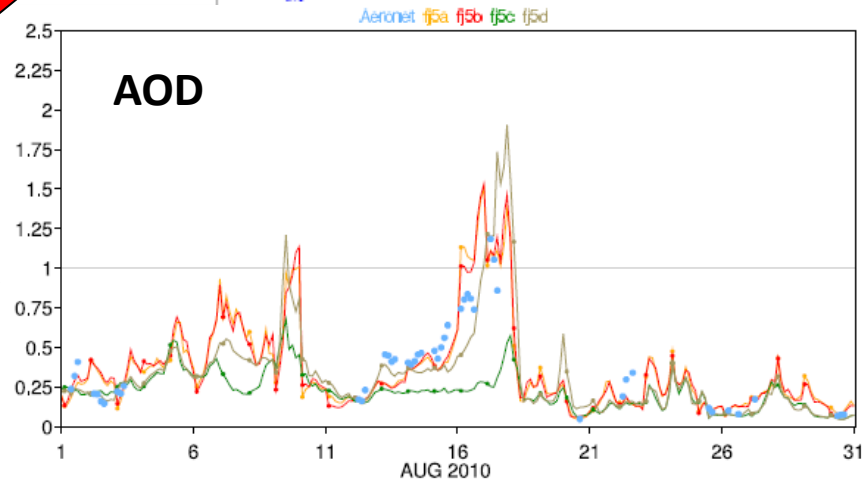
KING'S College LONDON
University of London

NUMBER OF MODIS OSBERVATIONS









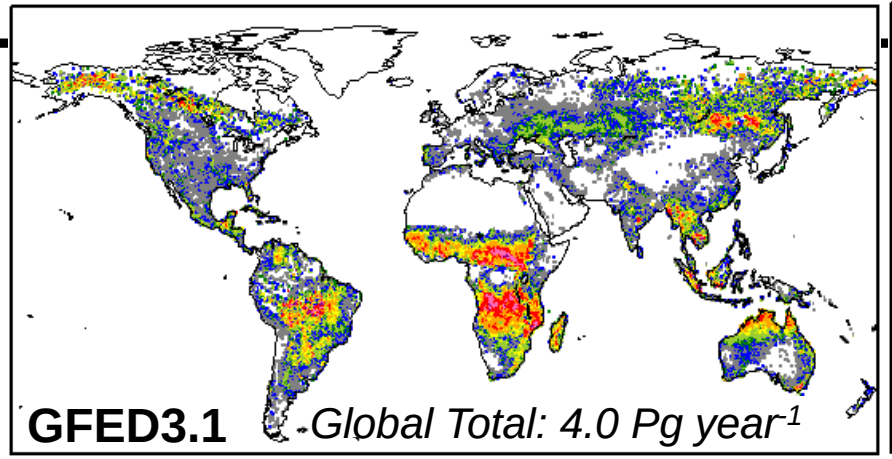
Part of the EU FP7 Monitoring Atmospheric Chemistry and Climate (MACC) Project: Products @ www.gmes-atmosphere.eu

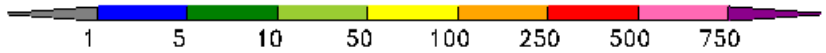
Kaiser et al. (2011) www.biogeosciences-discuss.net/8/7339/2011/bgd-8-7339-2011.html

Mean Annual Fuel Consumption 2003-2009

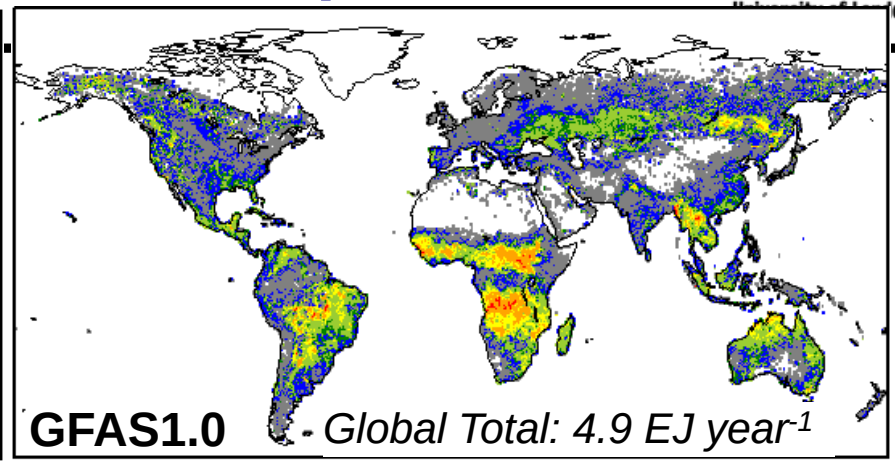
[Spatial Patterns and Ratio]

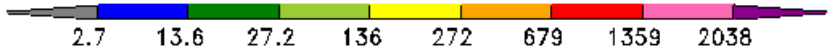
KING'S College LONDON





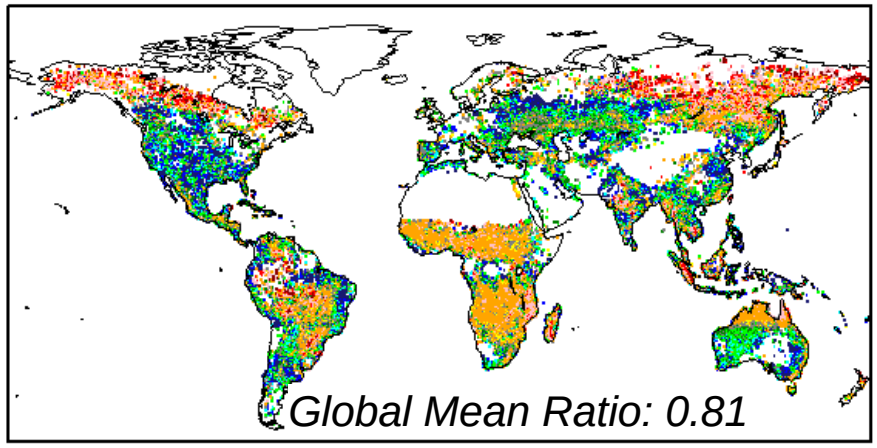
DM burned [g DM m^{-2} $year^{-1}$]

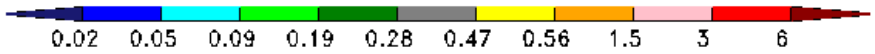




FRE [kJ m^{-2} $year^{-1}$]

CF_W-DM equivalent (DME): 1.8 Pg year^{-1}



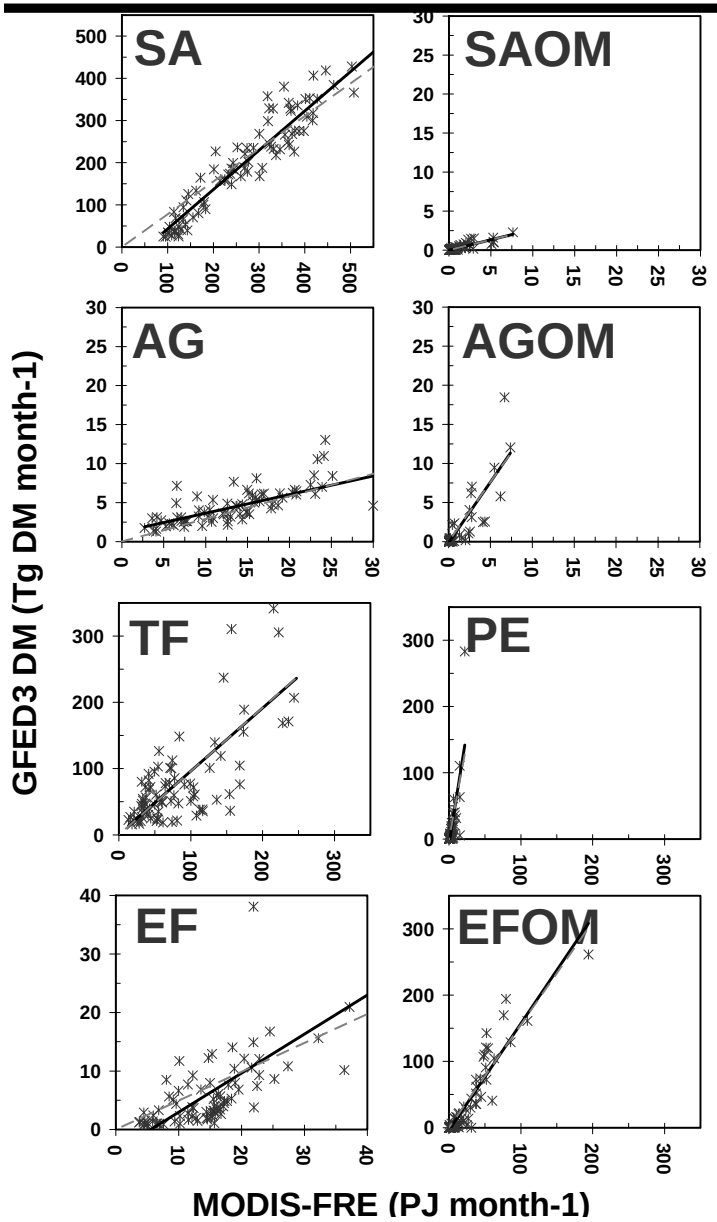


CF GFED3.1/GFAS1.0 [g kJ^{-1}]

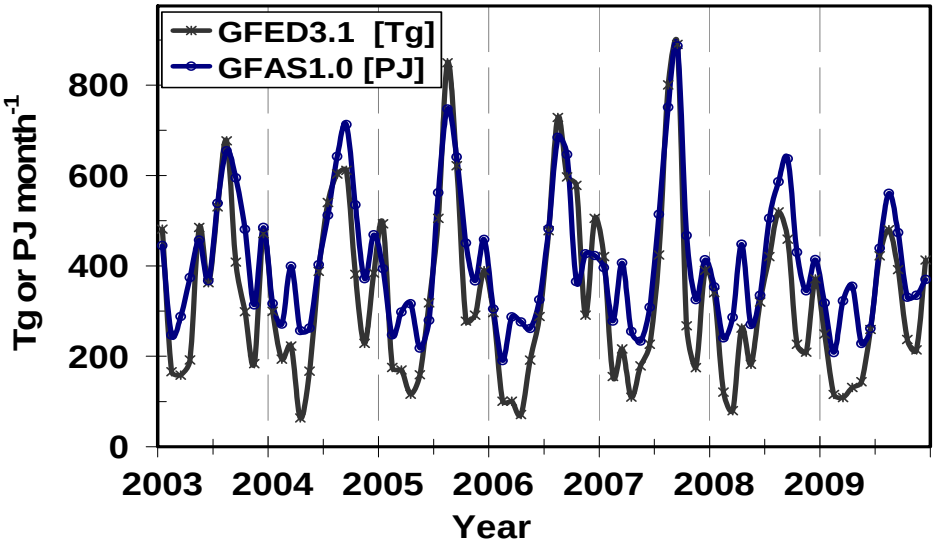
CF_W: 0.368 g kJ^{-1}

- → GFED3.1 DM estimates 2.2 times higher than GFAS1.0 DME globally
- → GFED3.1 notably higher in the boreal belt and in the tropics
- → GFAS1.0 higher in NH temperate regions
- → GFAS1.0 greater spatial extent of areas affected by fire

Effective fuel-type dependent CF scaled to GFED3.1



Derivation of conversion factors (CF) from linearly regressing monthly GFED3.1 DM with GFAS1.0 FRE



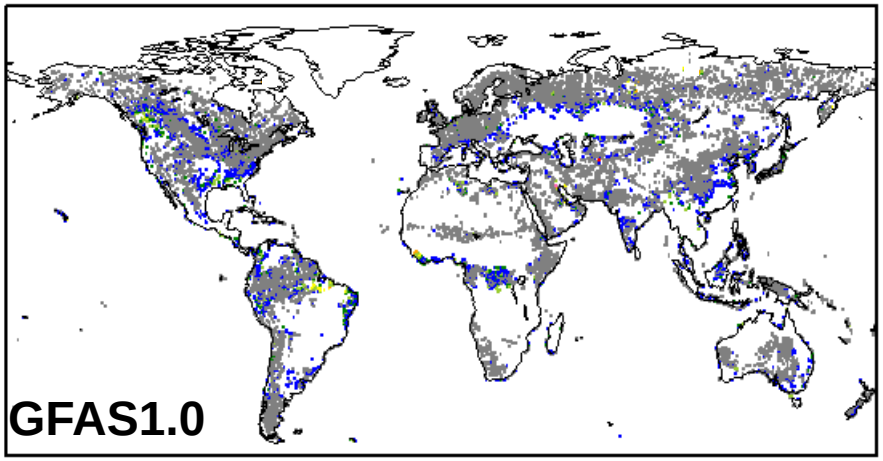
Predominant Fuel Class									
Linear Regres.	**SA**	**AG**	**DF**	**EF**	**SAOM**	**AGOM**	**PEAT**	**EFOM**	**ALL**
R^2	86%	58%	55%	50%	77%	54%	57%	86%	74%
Slope [g kJ^{-1}]	**0.78**	**0.29**	**0.96**	**0.49**	**0.26**	**0.13**	**5.87**	**1.55**	**0.85**

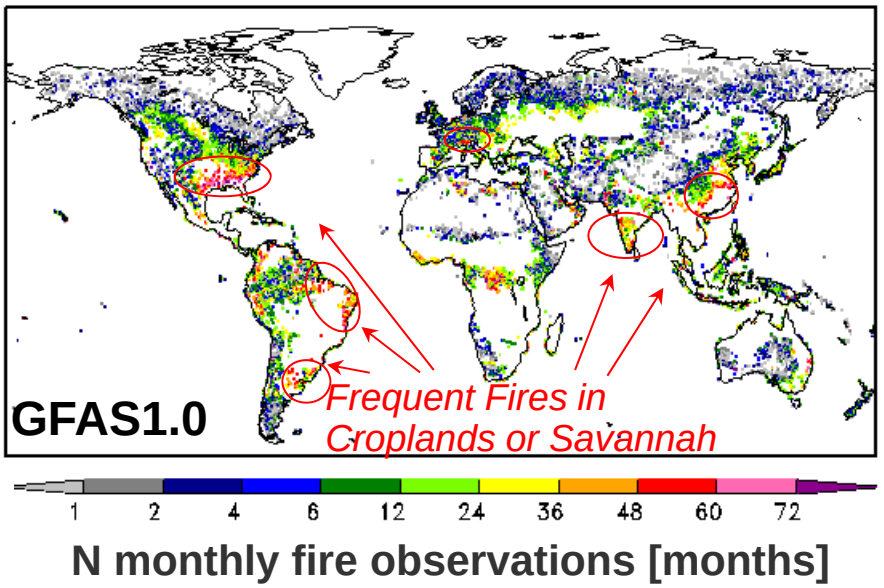
CF_W: 0.368 g kJ^{-1}

Kaiser et al. (2011) www.biogeosciences-discuss.net

GFED3.1 Non-Detection Areas 2003-2009

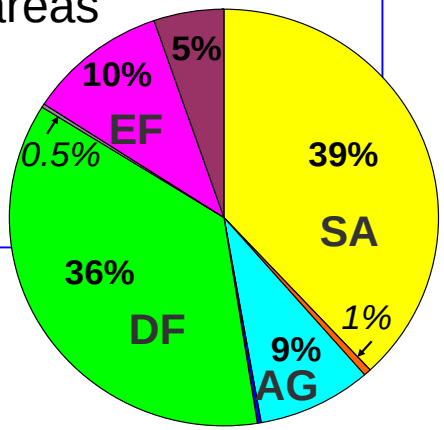
Areas where GFAS1.0 shows Burning but GFED3.1 not





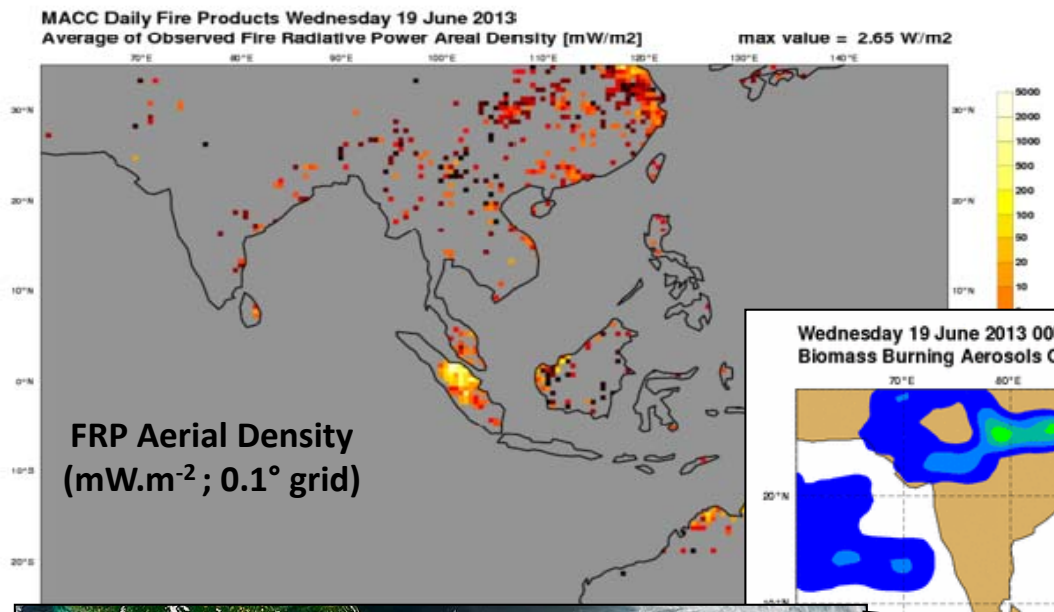
→ 33% of grid cells with GFAS1.0 fire observations not detected by GFED3.1:
- typically low fuel consumption (< 2.7 kJ m^{-2} $year^{-1}$)
- repeated small fires in savanna, deforestation and agricultural areas
- contribute < 3% to global FRE

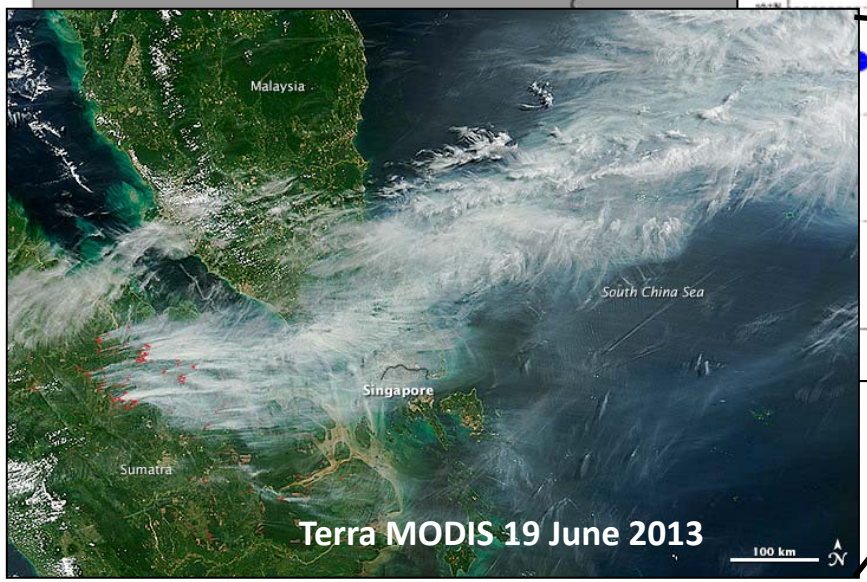
→ Only 0.1% of grid cells with GFED3.1 fire observations not detected by GFAS1.0



www.biogeosciences-discuss.net/8/7339/2011/bgd-8-7339-2011.html

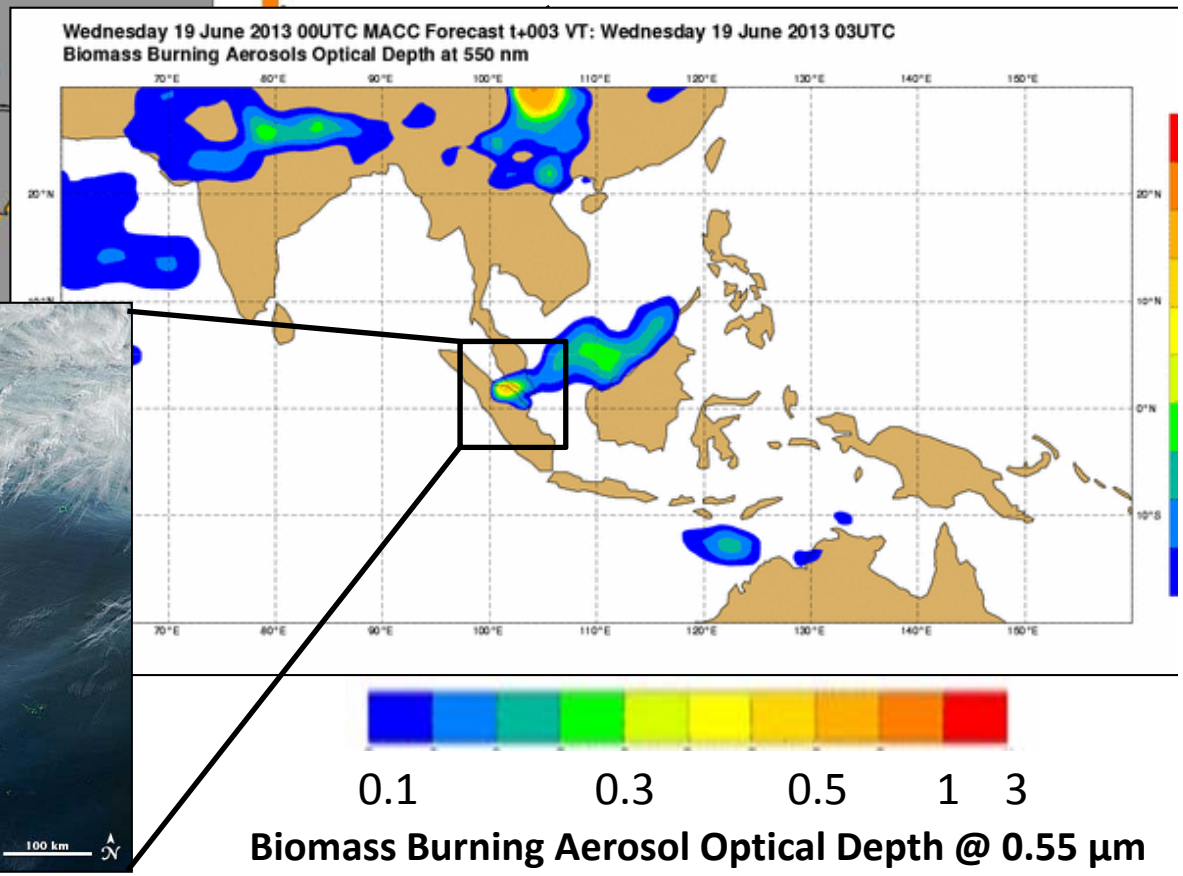
Modelling BB Air Pollution





19-24 June 2013

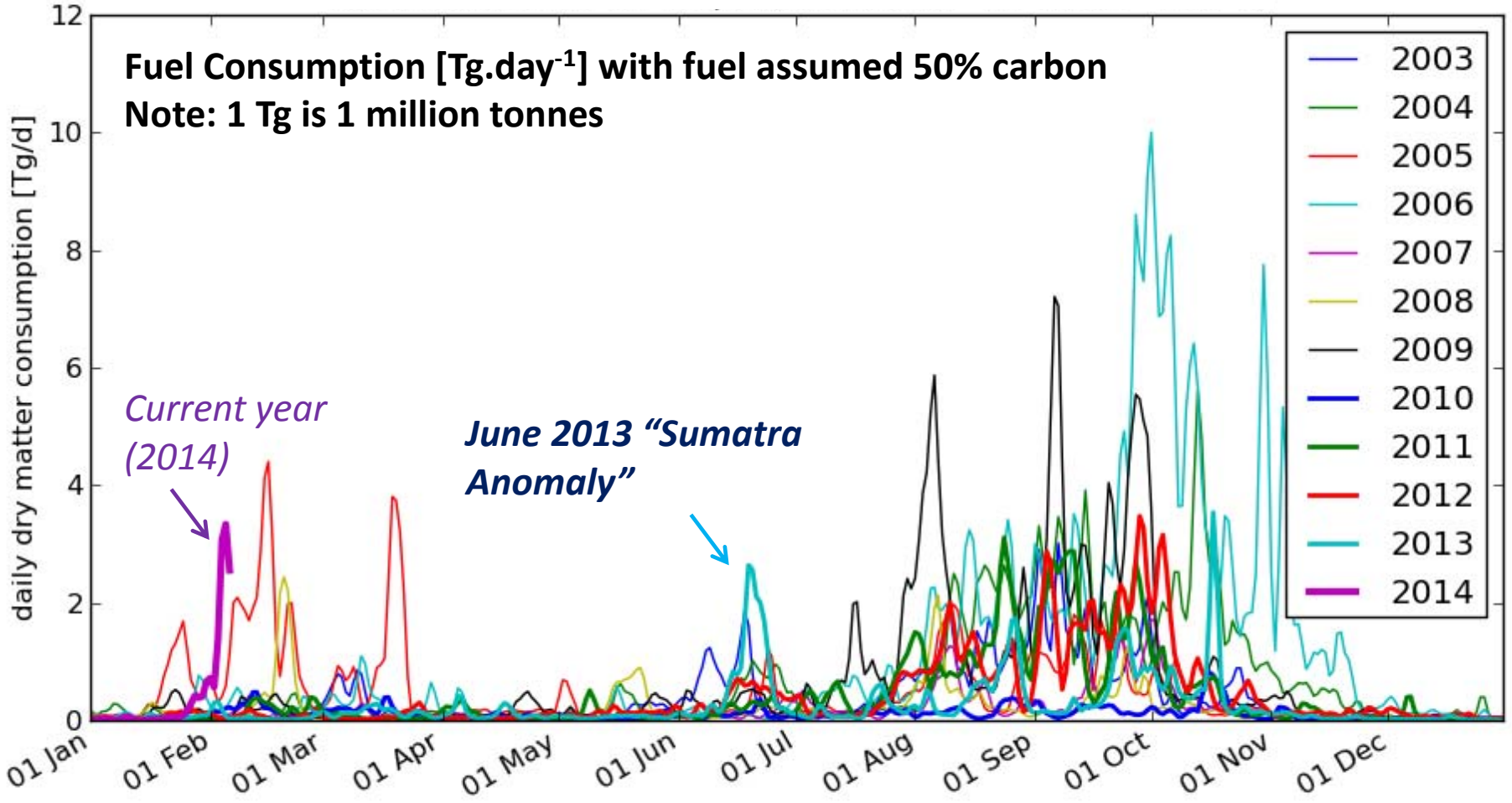
Worst air pollution ever in Sumatra, Singapore, Malaysia :PSI>400.



Daily Fuel Consumption 2003-2014

KING'S College LONDON
University of London

Example for Topical Asia (-10° to + 10° N, 60° to 190°E)



FUTURE GEOSTATIONARY

KING'S College LONDON
University of London

- **EUMETSAT Meteosat Third Generation Imager and Sounder**
  - Launch in 2016/18, six satellites in series, 3 axis stabilised
  - High spectral IR Sounder 700-1210 and 1600-2175cm^{-1}
  - 16 channel VIS+IR Imager (10 min scan, 2km fov)
  - Lightning Imager
  - UVNS Sounder for atmospheric chemistry (Sentinel-4)
- **NESDIS GOES-R Series**
  - -R launch in 2015, -S launch in 2017
  - Advanced Imager
  - Lightning Mapper
  - Space Weather instrument suite
  - http://www.goes-r.gov/ for more details
- CMA FY-4 series (IR Sounder, MW Sounder): 2015-2020 launches
- KMA COMS-Next for geostationary environmental monitoring
- ISRO INSAT-3D launched in 2013

MTG FLEXIBLE COMBINED IMAGER

KING'S College LONDON
University of London

- Full Disk Scan (FDS), with a basic repeat cycle of 10 mins.
- European Regional-Rapid-Scan (RRS) with a repeat cycle of 2.5 mins.

▼ Details

CHANNEL	CENTRE WAVELENGTH, Δ0	SPECTRAL WIDTH, ΔΛ0	SPATIAL SAMPLING DISTANCE (SSD)
VIS 0.4	0.444 µm	0.060 µm	1.0 km
VIS 0.5	0.510 µm	0.040 µm [TBC]	1.0 km
VIS 0.6	0.640 µm [TBC]	0.050 µm [TBC]	1.0 km; 0.5 km*
VIS 0.8	0.865 µm [TBC]	0.040 µm [TBC]	1.0 km
VIS 0.9	0.914 µm [TBC]	0.020 µm [TBC]	1.0 km
NIR 1.3	1.380 µm [TBC]	0.030 µm [TBC]	1.0 km
NIR 1.6	1.610 µm	0.050 µm	1.0 km
NIR 2.2	2.250 µm [TBC]	0.050 µm [TBC]	1.0 km; 0.5 km*
IR 3.8 (TIR)	3.800 µm	0.400 µm	2.0 km; 1.0 km*
WV 6.3	6.300 µm	1.000 µm	2.0 km
WV 7.3	7.350 µm	0.500 µm	2.0 km
IR 8.7 (TIR)	8.700 µm	0.400 µm	2.0 km
IR 9.7 (O_3)	9.660 µm	0.300 µm	2.0 km
IR 10.5 (TIR)	10.500 µm	0.700 µm	2.0 km; 1.0 km*
IR 12.3 (TIR)	12.300 µm	0.500 µm	2.0 km
IR 13.3 (CO_2)	13.300 µm	0.600 µm	2.0 km

450 K MWIR channel