

Supplement of Atmos. Chem. Phys., 15, 13217–13239, 2015
<http://www.atmos-chem-phys.net/15/13217/2015/>
doi:10.5194/acp-15-13217-2015-supplement
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Atmospheric
Chemistry
and Physics
Open Access
EGU

Supplement of

LSA SAF Meteosat FRP products – Part 1: Algorithms, product contents, and analysis

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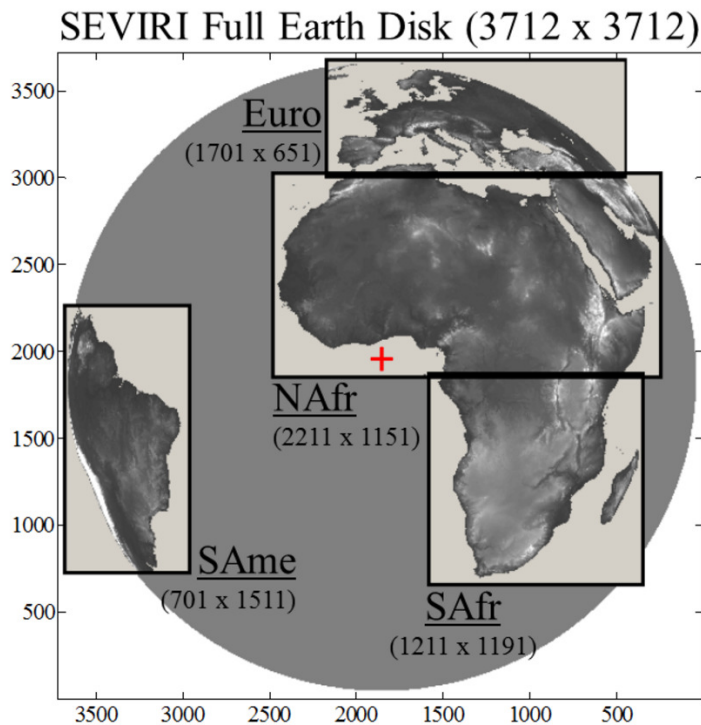
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Supplementary Material

S1. SEVIRI DISK

Figure S1 shows the full geographic coverage of SEVIRI, along with the four geographic regions (Europe, South America, southern Africa, northern Africa) that LSA SAF products are currently delivered in.



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Figure S1. The four regions of the Meteosat disk currently used for deriving the LSA SAF products (shown here as an elevation map). Oceanic areas are not processed by the LSA SAF, and for most LSA SAF products information from each geographic region is delivered in separate product files. The location of the sub-satellite point (SSP) is shown as the red cross. Later in 2015 the LSA SAF will switch to delivering full-disk data for most products, including the FRP products described herein.

S2. LSA SAF FRP PRODUCT ACCESS AND FILE STRUCTURE

S2.1. Product Data Access

25 Users can access the LSA SAF FRP-PIXEL and FRP-GRID products from the
26 following three sources:

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28 (i) in real time via EUMETCast using very low-cost Digital Video Broadcast (DVB-
29 S2) technology to receive multiple EO datasets and products
30 (<http://www.eumetsat.int/website/home/Data/DataDelivery/EUMETCast/index.html>).

31 EUMETCast primary transmissions is via Eutelsat's Eurobird-9 satellite (in Ku band)
32 and can be received across most of Europe, and is relayed via Eutelsat's Atlantic
33 Bird 3 (in C band, covers Europe and Africa) and SES New Skies' NSS-806 (in C
34 band, covers both Americas). EUMETCast is part of the wider GEONETcast service,
35 a near real time, global network of satellite-based data dissemination systems
36 designed to distribute space-based, airborne and *in situ* data, metadata and products,
37 led by Eumetsat in Europe (services in Europe, Africa and South America), the
38 Chinese Meteorological Administration (CMA) in the Asia-Pacific region
39 (FengYunCast), and NOAA in the Western Hemisphere (GEONETCast Americas).
40 FRP-PIXEL product dissemination on GEONETcast is described at
41 www.eumetsat.int/website/home/Data/Products/index.html

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43 (ii) in real time via FTP, contact the LSA SAF (landsaf.helpdesk@ipma.pt and
44 <http://landsaf.ipma.pt>) to review the current options, and to obtain the FRP product
45 Algorithm Theoretical Basis Document (ATBD) and User Manuals.

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47 (iii) in archive form via the EUMETSAT Earth Observation (EO) Portal
48 (<http://eoportal.eumetsat.int>) for which use registration is required.

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50 **S2.2. FRP-PIXEL Product Files**

51 All FRP products from the aforementioned sources are stored in the HDF5 file
52 format. A new FRP-PIXEL Product (both the List and Quality Product files) is
53 delivered every 15 mins for each of the four LSA SAF geographic regions, with file
54 names constructed according to the following convention:

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56 HDF5_LSASAF_MSG_FRP_ListProduct_<Area>_YYYYMMDDHHMM.h5

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58 HDF5_LSASAF_MSG_FRP_QualityProduct_<Area>_YYYYMMDDHHMM.h5

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60 Where <Area>, YYYY, MM, DD, HH and MM respectively denote the geographical
61 region (Euro, NAfr, SAfr, SAm), and the year, month, day, hour and minute of the
62 data acquisition. The time specified in the filename refers to the relevant image
63 acquisition start time (with SEVIRI scanning South to North as described in
64 Section 2).

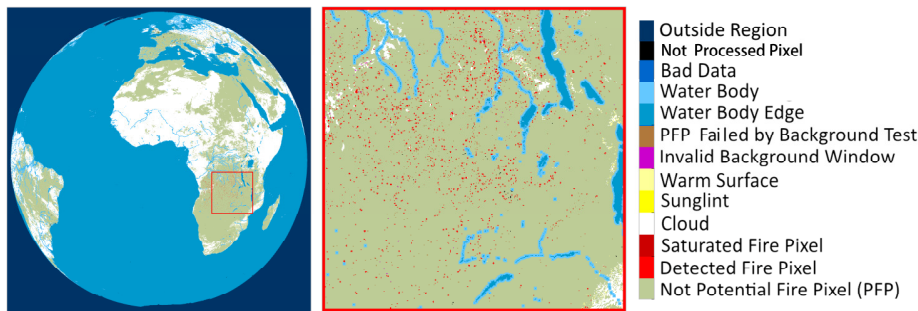
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66 Since the FRP-PIXEL List Product file stores outputs (e.g. FRP, FRP uncertainty,
67 active fire pixel location etc), algorithm information (e.g. size of the background
68 window) and input data (e.g. IR3.9 and IR10.8 brightness temperatures) at the pixel

69 locations of detected active fire pixels only, it is typically only some kilobytes in size.
 70 The full list of variables is detailed in the FRP Product User Manual (PUM) available
 71 on the LSA SAF web site (<http://landsaf.ipma.pt>) and many users will be content to
 72 use only this (very small) product file. The FRP-PIXEL Quality Product files are
 73 significantly larger (~ 0.05 - 0.2 Mb), since they store values at all SEVIRI pixels
 74 whether a fire is detected or not, but the additional information (e.g. on why an active
 75 fire was not recorded at a certain ground locations) can be extremely useful, for
 76 example for emissions modelling and when comparing to other datasets e.g. (Freeborn
 77 *et al.* 2014a; Georgiev and Stoyanova, 2013) and is used with the FRP-based Global
 78 Fire Assimilation System (Kaiser *et al.*, 2012). Both List and Quality Product files are
 79 mandatory inputs to the algorithm that generates the FRP-GRID product. Table S1
 80 shows the coding present within each SEVIRI pixel recorded in the Quality Product
 81 file, whilst Figure S2 shows an example.

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85 Figure S2. FRP-PIXEL quality product classification scheme applied to the Meteosat
 86 full disk data taken at 13:00 UTC on 5th July 2015, with a colour palette applied. The
 87 figure on the left shows the full disk, whilst a zoom over where the majority of fires
 88 are occurring at this time is at right. The panel shows the classification names, also
 89 detailed in Table S1.

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92 Table S1. QUALITY FLAG coding within the FRP-PIXEL Quality Product files.

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NAME	VALUE	STATUS	REASON
FRP_APL_NOTPOT	0	FRP NOT Estimated	Not a potential fire pixel (see ATBD Section 3.4)
FRP_APL_FRP	1	FRP Estimated	Successful fire detection and FRP estimation.
FRP_APL_FRP_SAT	2	FRP Estimated	FRP estimated but with a saturated 3.9 micron channel signal. Please refer to the ATBD Section 3.6 for FRP estimation over saturated pixels.
FRP_APL_CLOUD	3	FRP NOT Estimated	The pixel is classed as cloud contaminated - fire detection was not attempted
FRP_APL_SUNG	4	FRP NOT Estimated	The pixel is classed as being affected by sun glint due to the sun-land-sensor angular condition - fire detection was not

			attempted.
FRP_APL_SUNGRATIO	5	FRP NOT Estimated	The SUNGRATIO test failed (see ATBD Section 3.4, Equation 30)
FRP_APL_NOBCK	6	FRP NOT Estimated	It was not possible to define the background temperature of the candidate potential fire pixel.
FRP_APL_BCKNOT	7	FRP NOT Estimated	The signal of the potential fire pixel was not sufficiently above that of the background window – so the pixel was not confirmed as a true fire (see ATBD Section 3.6)
FRP_APL_CLOUDEDGE	8	FRP NOT Estimated	No fire detection took place because the pixel is too close to a cloud or water edge (this class was used in previous versions of the FRP-PIXEL products, but is not used in version 2.0 onwards (i.e. since end 2015))
FRP_APL_BADINPUT	9	FRP NOT Estimated	Some input files are incomplete or corrupted .
FRP_APL_WATER	10	FRP NOT Estimated	Water body and so not processed for fire detection, introduced in version 2.0.
FRP_APL_WATEREDGE	11	FRP NOT Estimated	No fire detection took place because the pixel is close to a water body.
FRP_APL_NOTPROC	254	FRP NOT Estimated	The pixels have not been processed (i.e. they are urban, snow and ice or other non-processed pixels).
FRP_OUTSIDE_ROIS	255	FRP NOT Estimated	Celestial background (outside the full disk area, introduced in version 2.0)

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S3. FRP-GRID Product Files

98 Every hour the LSA SAF processing chain generates one FRP-GRID output file (~

99 850 Kb) for the entire Meteosat disk, according to the following name convention:

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HDF5_LSASAF_MSG_FRP_Frp_Grid_Global_YYYYMMDDSSSE.h5

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103 where YYYY, MM, DD, SS and EE respectively denote the year, the month, the day,

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the starting and end hour of the analysed period.

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106 Table S2 indicates the content of each FRP-GRID file, where the value of each

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variable is obtained according to the following formula:

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$$\text{Real_value} = \text{Stored_value} / \text{Scale_factor}$$

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Where the Stored_value is the two byte integer recorded in the FRP-GRID product

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file. An example of the content of an FRP-GRID Product file was shown as Figure 16

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in the main paper. The value stored in each grid cell also includes a code for where no

112 | fires have been found, either due to “input data missing” (32767) or “no detected fire
 113 | in the grid cell” (0).

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Table S2. FRP-GRID product file datasets (stored at each 5° grid cell as a 2D matrix).

VARIABLE	MEANING	UNITS	SCALE FACTOR	RANGE
GFRP	Grid cell atmospherically corrected, bias-adjusted FRP. Calculated as an hourly average, with the bias-adjustment factors of Table 5 and the cloud cover correction applied.	MW	0.1	> 0
GFRP_RANGE	Max - min difference in the FRP values recorded in the grid cell within the 1 hour period	MW	1	> 0
GRIDPIX	Number of SEVIRI pixels in the 5.0° grid cell used for the estimation of the BURNTSURF parameter	p.n.	1	> 0
NUMIMG	Number of SEVIRI images used for the temporal average (max = 4)	p.n.	1	>=0
NUMFIRES	Mean number of fire pixels detected in the grid cell during the 1 hour period	p.n.	100	>= 0
BURNTSURF	Percentage of pixels in the grid that had an active fire detection within them in the 1 hour period	p.n.	100	[0,100]
LATITUDE	Latitudinal centre of the grid cell	Deg	100	[-90,90]
LONGITUDE	Longitudinal centre of the current grid cell	Deg	100	[-180,180]
GFRP_CLOUD_CORR	Factor accounting for cloud coverage in the 5.0° grid box, averaged over 1 hour (1 means cloud free). Divide the GFRP value by this value to remove the cloud cover correction.	p.n.	100	[0,1]
ATMTRANS	Mean atmospheric transmittance in the 5.0° grid cell, taken from the contributing FRP-PIXEL products	p.n.	10000	[0,1]
GFRP_ERROR	Total error associated with GFRP, taking into account FRP_UNCERTAINTY from the FRP-PIXEL List Product, as well as the errors associated with the region-specific adjustment factors	MW	1	>0
GFRP_ERR_FRP	Error in GRP attributed solely to FRP_UNCERTAINTY in the FRP-PIXEL List Product	MW	1	>0

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GFRP_QI	Quality indicator associated with the estimation of GFRP	p.n	100	[0,1]
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