Western Hemisphere Diurnal Fire Activity 1995-2012: Description and Initial Fire Trend Analysis of the GOES-East Version 6.5 WF_ABBA Data Archive

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The Global WildFire Automated Biomass Burning Algorithm (WF_ABBA) and LBA/GIMPAP

The current Geostationary Operational Environmental Satellite (GOES) series has had the ability to detect and characterize biomass burning since the launch of GOES-8 in 1995. The Global Wildfire Automated Biomass Burning Algorithm (WF_ABBA) provides fire detections and fire characteristics (instantaneous fire size and fire temperature, and fire radiative power). The metadata available since the recent Global WF_ABBA update provides users with fire observations as well as an explanation for why fires were not found due to certain conditions. This data set will allow for more in depth studies of diurnal fire activity and a fire climatology in the Western Hemisphere since 1995. This effort was made possible through funding from the NASA Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA) and GOES I/M Product Assurance Plan (GIMPAP).

Mask Data

Version 6.5 Global WF_ABBA output includes pixel codes that can be used to determine the coverage rate of the satellite (which varies widely over South America), the reasons why specific pixels were not processed for possible fires such as opaque clouds, the presence of water, block out zones, and the fire category for detected fires.

Mask Codes	Definition
0	Non-processed region of input/output image
10/20/30	Processed fire pixel / removed by sampling screen / temporally filtered
11/21/31	Saturated fire pixel / removed by sampling screen / temporally filtered
12/22/32	Cloud contaminated fire pixel / removed by sampling screen / temporally filtered
13/23/33	High probability fire pixel / removed by sampling screen / temporally filtered
14/24/34	Medium probability fire pixel / removed by sampling screen / temporally filtered
15/25/35	Low probability fire pixel / removed by sampling screen / temporally filtered
40	Space pixel
50	Satellite zenith angle block-out zone, greater than threshold of 80 degrees
60	Reflectance (glint) angle or solar zenith angle block-out zone, within respective thresholds, 10 deg for both
100	Processed region of image
120 / 121 / 123 / 124	missing data, 3.9 micron / missing data, 11.2 micron / saturation, 3.9 micron / saturation, 11.2 micron
125	Invalid reflectivity product input (value <0). Can be indicative of localized spikes in reflectivity product/bad data
126	Unusable input data: 3.9 micron less than minimum threshold (200 K)
127	Unusable input data: 11.2 micron less than minimum threshold (200 K)
150	Invalid ecosystem type
151	Sea water
152	Coastline Fringe
153	Inland Water and other Land/water mix
160	Invalid emissivity value
170	No background value could be computed
180	Error in converting between temperature and radiance
182	Error in converting adjusted temperatures to radiance
185	Values used for bisection technique to hone in on solutions for Dozier technique are invalid
186	Invalid radiances computed for Newton's method for solving Dozier equations
187	Errors in Newton's method processing
188	Error in computing pixel area for Dozier technique
200	11.2 micron threshold cloud test
205	3.9 micron minus 11.2 micron negative difference threshold cloud test
210	3.9 micron minus 11.2 micron positive difference threshold cloud test
215	Albedo threshold cloud test (daytime only)
220	12.3 micron threshold cloud test (only used when data available)
225	11.2 micron minus 12.3 micron negative difference threshold cloud test
230	11.2 micron minus 12.3 micron positive difference threshold cloud test
240	Along scan reflectivity product test to identify and screen for cloud edge used in conjunction with 3.9 micron threshold
245	Along scan reflectivity product test to identify and screen for cloud edge used in conjunction with albedo threshold

The Global WF_ABBA

The Global WF_ABBA uses inputs consisting of geostationary satellite data, total precipitable water from numerical forecast models, and an ecosystem map, which are used to detect and characterize fires in near real-time. Users such as the National Oceanic and Atmospheric Administration and the hazards community are provided with high temporal and spatial resolution fire data. Today WF_ABBA processes all data generated by GOES-East/-West/-South, Meteosat, and MTSAT, detecting fires within a satellite zenith angle of 80˚ (covering the better part of the visible hemisphere). The Global WF_ABBA algorithm requires a minimum 3.9 µm and 11 µm bands that meet certain performance requirements. The latest version of WF_ABBA also uses the 12 micron and visible bands – when available – for improved cloud masking and algorithm performance.

Process for Creating the Satellite/Cloud Coverage Corrected Binned Fire Files

Step 1: Create 0.25˚ X 0.25˚ latitude/longitude binned mask histogram files. The latitude range is 60˚ South to 70˚ North while the longitude range is 30˚ to 130˚ West. For each image time the satellite pixels are binned to 0.25˚ X 0.25˚ and counts for each mask value code are kept track of in each bin.

Step 2: Create 0.25˚ X 0.25˚ latitude/longitude binned satellite coverage corrected fire files for each image time from the binned mask histogram files. Certain mask code values are grouped together to calculate totals for each category (listed below) for each bin---MV stands for Mask Value

***ClearFieldOfView(FOV)Pixels=MV10+MV11+MV12+MV13+MV14+MV15+MV20+MV21+MV22+MV23+MV24+MV25+MV100

***CloudyFOVPixels=MV200+MV205+MV210+MV215+MV220+MV225+MV230+MV240+MV245

***BlockOutZonePixels=MV50+MV60

***ErrantPixels=MV0+MV120+MV125+MV160+MV170+MV180+MV182+MV185+MV186+MV187+MV188

***WaterPixels=MV150+MV151+MV152+MV153

***SpacePixels=MV40

***TotalPixels=SUM OF ABOVE 6 TOTALS OF PIXELS

***Number of Non-Coverage Corrected Fire Pixels for each Fire Category = MV10 for processed fires, MV11 for saturated fires, MV12 for cloudy fires, MV13 for high possibility fires, MV14 for medium possibility fires, and MV15 for low possibility fires

The Total Number of Satellite Coverage Corrected Fire Pixels for each Fire Category (fire category ranges from 0 to 5; 0 is processed fire, 1 is saturated fire, 2 is cloudy fire, 3 is high possibility fire, 4 is medium possibility fire and 5 is low possibility fire) is calculated as follows for each bin:

Number of Satellite Coverage Corrected Fire Pixels[fire category] = Number of Total Pixels * (Number of Non-Corrected Fire Pixels[fire category] / Number of Clear FOV Pixels)

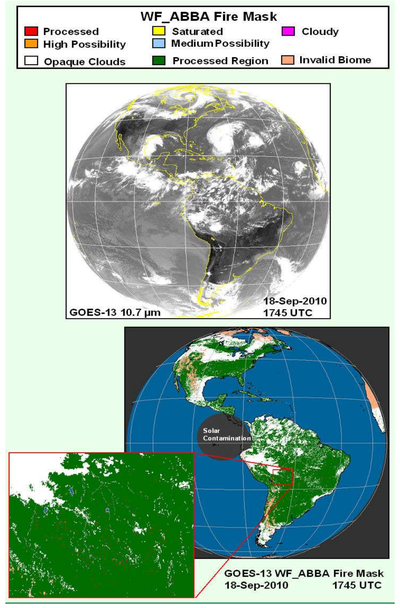
The Total Number of Cloud Coverage Corrected Fire Pixels for each Fire Category is calculated as follows for each bin:

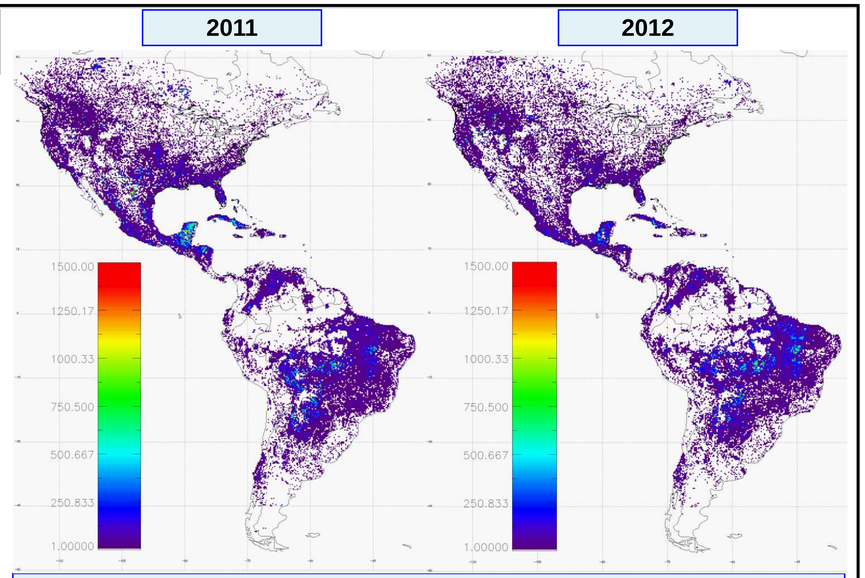
Number of Cloud Coverage Corrected Fire Pixels[fire category] = (Number of Clear FOV Pixels + Number of Cloudy FOV Pixels) * (Number of Non-Corrected Fire Pixels[fire category] / Number of Clear FOV Pixels)

Future Work

•Expand Trend Analysis/Climatology of Fires to other past, present and future Geostationary Satellites
•Work with user community to develop more useful real-time and climatological fire datasets

WF_ABBA Fire Mask Example – Clouds and Block Out Zones

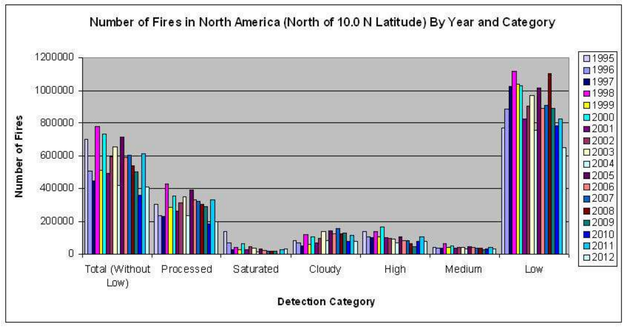


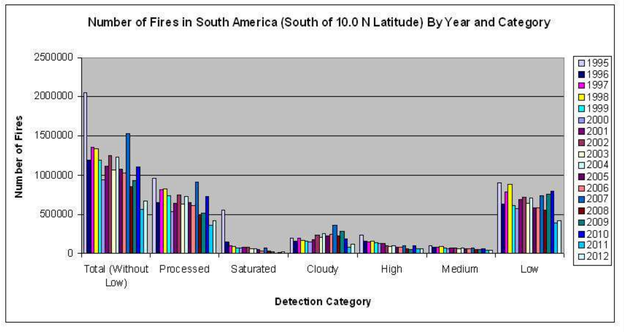


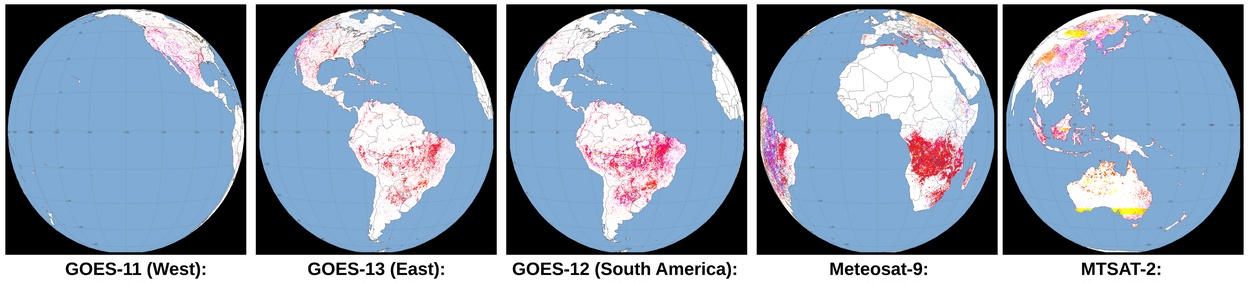
Annual Composites of WF_ABBA Version 6.5 Binned Satellite Coverage Corrected Fires for 2011 and 2012. 2011 was a more active fire year compared to 2012 especially over the Yucatan Peninsula, Cuba, and Northern Florida. There were over 200,000 more North America fire detections in 2011 compared to 2012. However, in South America, 2012 was a slightly more active fire year compared to 2011.

GOES-East temporally filtered WF_ABBA data was used to generate the satellite/cloud coverage corrected binned fire files which were then used to produce the fire stats below and to make the composites above. Temporal filtering keeps a fire if there was another detection within the previous 12 hours within 0.1˚ of its location. All fire categories but low possibility are included in the composites. The "low possibility" category is often indicative of false alarms in North America and along cloud edges and at high viewing angles at sunrise and sunset, but should be monitored over time. All fire categories are shown in the fire stats below.

North America domain:
10˚ - 70˚ North
45˚ - 130˚ West
South America domain:
10˚ North - 60˚ South
30˚ - 90˚ West







GOES-11 (West): SEP 2011 | **GOES-13 (East): AUG 2012** | **GOES-12 (South America): AUG 2012** | **Meteosat-9: AUG 2012** | **MTSAT-2: SEP 2012**