# Observations of Major 2012 Fire Events in the United States from Suomi NPP: Product Evaluation and User Readiness

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**The 2012 fire season was particularly active over the Conterminous United States. Major fire events occurred in the Western US. These fire events caused major losses and gained widespread media attention. Monitoring multiple fires over such a large area is a challenge to fire management agencies. The 2012 fire season was also the first one in North America when observations from the Visible Infrared Imager Radiometer Suite (VIIRS), on the Suomi National Polar-orbiting Partnership (SNPP) satellite, were available. The standard VIIRS Active Fire Product, generated by the SNPP Interface Data Processing Segment (IDPS), processes radiometric measurements from the VIIRS 750m moderate resolution bands using a heritage algorithm from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the NASA Earth Observing System (EOS) Terra and Aqua satellites. To assist product evaluation and user readiness, the Joint Polar Satellite System (JPSS) Active Fire Algorithm Development and Validation team have developed a web-based data visualization, analysis, and distribution system that provides near-real-time data and a rolling archive of all VIIRS fire observations over North America. For select cases, near-simultaneous observations from Aqua MODIS were also presented for comparison. The data were also converted into geospatial formats to assist on-site fire managers in evaluating the usefulness of the product in daily operations. The JPSS Active Fire Team was also engaged in generating imagery for select fire events derived using an experimental detection algorithm from the 375m VIIRS Imager bands. This imagery was also provided for end user evaluation and to the public through various online outlets. This presentation will provide a summary of lessons learned during the 2012 fire season through examples of major fire events and plans for improved data products, data distribution, and applications.**

## SUOMI NPP VIIRS ACTICE FIRE CAPABILITIES AND PRODUCT STATUS

| VIIRS | | | MODIS Equivalent | | | AVHRR-3 Equivalent | | | OLS Equivalent | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Band | Range (um) | HSR (m) | Band | Range | HSR | Band | Range | HSR | Band | Range | HSR |
| DNB | 0.500 - 0.900 | 750 | NONE | | | Low light capabilities | | | HRD<br>PMT | 0.580 - 0.910<br>0.510 - 0.860 | 550 2700 |
| M1 | 0.402 - 0.422 | 750 | 8 | 0.405 - 0.420 | 1000 | | | | | | |
| M2 | 0.436 - 0.454 | 750 | 9 | 0.438 - 0.448 | 1000 | | | | | | |
| M3 | 0.478 - 0.498 | 750 | 3<br>10 | 0.459 - 0.479<br>0.483 - 0.493 | 500<br>1000 | NONE | | | Ocean Color, Aerosol | | |
| M4 | 0.545 - 0.565 | 750 | 4<br>12 | 0.545 - 0.565<br>0.546 - 0.556 | 500<br>1000 | | | | | | |
| I1 | 0.600 - 0.680 | 375 | 1 | 0.620 - 0.670 | 250 | 1 | 0.572 - 0.703 | 1100 | Imagery | | |
| M5 | 0.662 - 0.682 | 750 | 13<br>14 | 0.662 - 0.672<br>0.673 - 0.683 | 1000<br>1000 | 1 | 0.572 - 0.703 | 1100 | Ocean Color, Aerosol | | |
| M6 | 0.739 - 0.754 | 750 | 15 | 0.743 - 0.753 | 1000 | NONE | | | Atm Correction | | |
| I2 | 0.846 - 0.885 | 375 | 2 | 0.841 - 0.876 | 250 | 2 | 0.720 - 1.000 | 1100 | NDVI | | |
| M7 | 0.846 - 0.885 | 750 | 16 | 0.862 - 0.877 | 1000 | 2 | 0.720 - 1.000 | 1100 | Ocean Color, Aerosol | | |
| M8 | 1.230 - 1.250 | 750 | 5 | SAME | 500 | | | | Cloud Particle Size | | |
| M9 | 1.371 - 1.386 | 750 | 26 | 1.360 - 1.390 | 1000 | NONE | | | Thin Cirrus | | |
| I3 | 1.580 - 1.640 | 375 | 6 | 1.628 - 1.652 | 500 | | | | Snow Map | | |
| M10 | 1.580 - 1.640 | 750 | 6 | 1.628 - 1.652 | 500 | 3a | SAME | 1100 | Snow Fraction | | |
| M11 | 2.225 - 2.275 | 750 | 7 | 2.105 - 2.155 | 500 | NONE | | | Cloud | | |
| I4 | 3.550 - 3.930 | 375 | 20 | 3.660 - 3.840 | 1000 | 3b | SAME | 1100 | Imagery, Clouds | | |
| M12 | 3.660 - 3.840 | 750 | 20 | SAME | 1000 | 3b | 3.550 - 3.930 | 1100 | SST, Fire | | |
| M13 | 3.973 - 4.128 | 750 | 21<br>22<br>23 | 3.929 - 3.989<br>3.929 - 3.989<br>4.020 - 4.080 | 1000<br>1000<br>1000 | NONE | | | SST, Fire | | |
| M14 | 8.400 - 8.700 | 750 | 29 | SAME | 1000 | | | | Cloud Top Propoerties | | |
| M15 | 10.263 - 11.263 | 750 | 31 | 10.780 - 11.280 | 1000 | 4 | 10.300 - 11.300 | 1100 | SST, Fire | | |
| I5 | 10.500 - 12.400 | 375 | 31<br>32 | 10.780 - 11.280<br>11.770 - 12.270 | 1000<br>1000 | 4<br>5 | 10.300 - 11.300<br>11.500 - 12.500 | 1100<br>1100 | HRD | 10.300 - 12.900<br>Cloud Imagery | 550 |
| M16 | 11.538 - 12.488 | 750 | 32 | 11.770 - 12.270 | 1000 | 5 | 11.500 - 12.500 | 1100 | SST | | |

: M-band 750m (nadir) MIR/TIR detection and characterization (IDPS and experimental replacement products)

: I-band 375m (nadir) MIR/TIR detection (experimental product)

: DNB -band 750m (nadir) nighttime visible detection (experimental product); not discussed further in this presentation)

## VIIRS Active Fire Product Development

**NOAA: "real-time (NOAA) operational applications"**

- Operational product generated by IDPS (Interface Data Processing Segment)
- Part of integrated processing chain
- Low latency
- Detections only
- Locations only (no fire mask)

Algorithm updates ⟷ Upstream processing updates

**NASA: "science, long-term continuity + added value NRT"**

- Experimental MODIS continuity product produced by LandPEATE (Product Evaluation and Test Element)
- Detections and Fire Radiative Power
- Spatially explicit fire mask
- Spatial and temporal aggregates

algorithm synchronization end user feedback

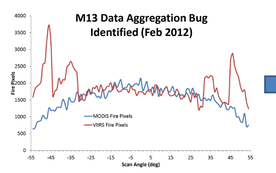
**DIRECT READOUT**

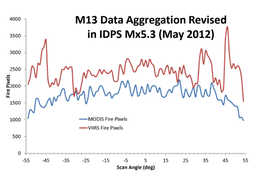
- Can run IDPS, NASA or locally developed code
- Stand-alone

**viirsfire.geog.umd.edu**

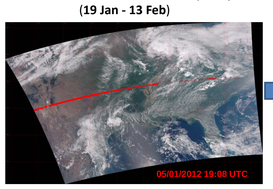

- Product information
- Evaluation portal
- User-friendly formats
- Limited data distribution

## IDPS Product Evaluation and Improvements

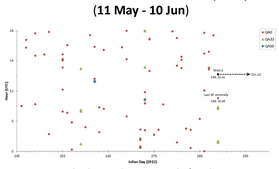



VIIRSxMYD14 Fire Detection Frequency (19 Jan - 13 Feb)




VIIRSxMYD14 Fire Detection Frequency (11 May - 10 Jun)



M13 dual-gain data anomaly fixed in IDPS Mx6.3 (October 2012)

**CODE CHANGES LEADING TO THE IMPROVEMENT OF THE IDPS ACTIVE FIRES PRODUCT HAVE BEEN IMPLMENTED IN VARIOUS IDPS BUILDS**

**In October 2012 the SNPP Active Fires product was declared to have Beta maturity status**

**It is publicly available through NOAA CLASS at https://www.class.noaa.gov**

**The start date of the released data record is May 3, 2012 (the start of IDPS Mx 5.3)**

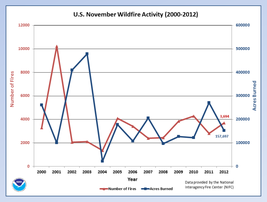

***Suomi NPP Environmental Data Record (EDR) beta maturity:***

- *Early release product*
- *Minimally validated*
- *May still contain significant errors*
- *Versioning not established until baseline is determined*
- *Available to allow users to gain familiarity with data formats and parameters*
- *Product is not appropriate as the basis for quantitative scientific publications, studies and applications*

## EXAMPLES OF SNPP FIRE OBSERVATIONS IN 2012

Year-to-Date Wildfire Statistics*

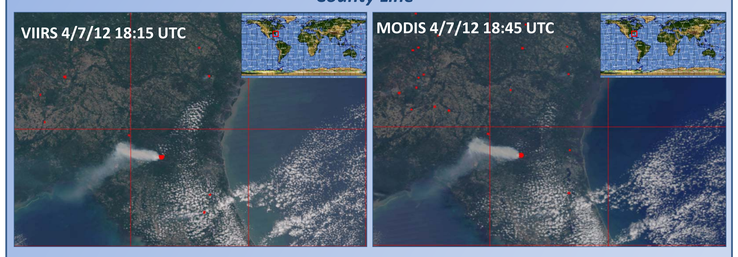
| | January–November | Rank (out of 13 years) | Record Value | Record Year | 10-Year Average (2001-2010) |
|---|---|---|---|---|---|
| Acres Burned | 9,156,278 | 2nd Most<br>12th Least | 9,508,251 | 2006 | 6,346,769.6 |
| Acres Burned/Fire | 165.0 | Most on Record<br>13th Least | 165 | 2012 | 88.5 |



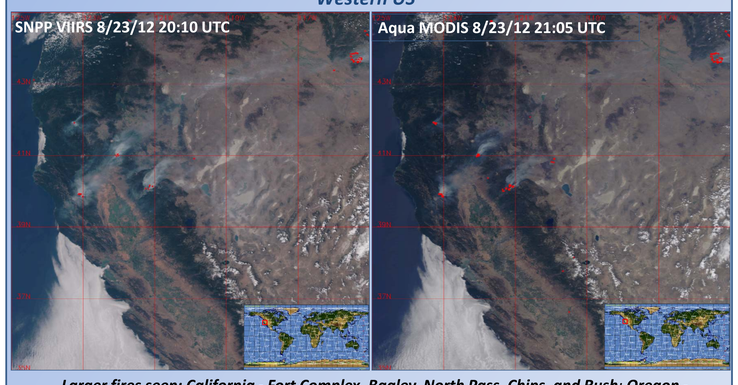

*Some basic statistics of the 2012 US fire activity. (National Interagency Fire Center; www.nifc.gov)*

## M-band IDPS Product and Comparisons with Near-coincident Aqua MODIS

### County Line




### Western US




*Larger fires seen: California - Fort Complex, Bagley, North Pass, Chips, and Rush; Oregon - Waterfalls 2; Idaho - Trinity Ridge, and Halstead.*

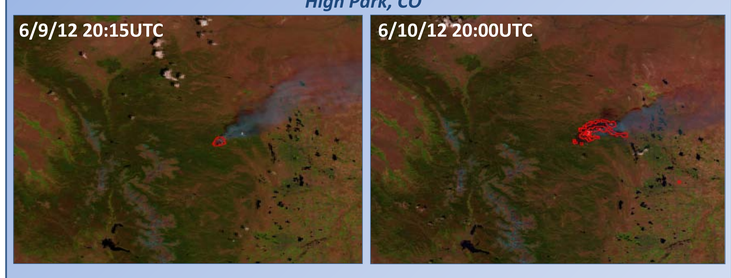
### Idaho



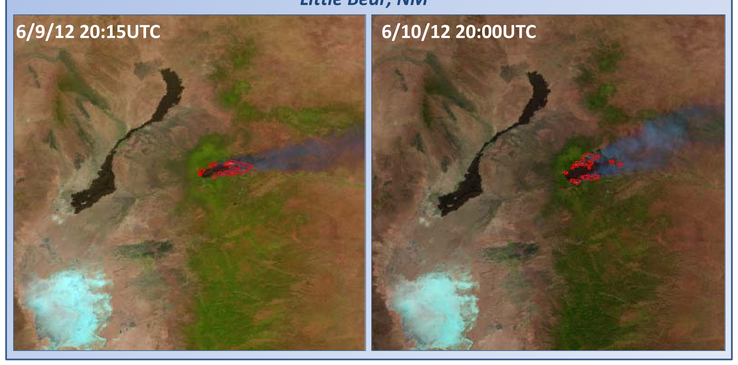

*Wesley, Sheep, McGuire, Porcupine, Mustang, Halstead and Trinity Ridge.*

## I-band Experimental Product

### High Park, CO




### Little Bear, NM



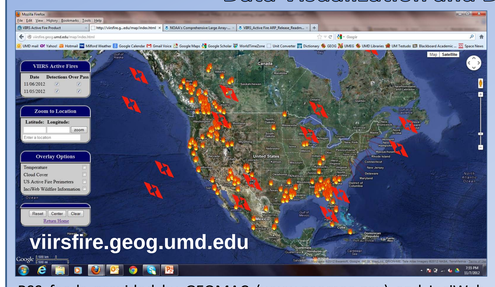

## PROVING GROUND AND RISK REDUCTION

**The goals of VIIRS AF data proving ground project is the development of a near-real-time enhanced VIIRS AF product delivery system to NOAA end users.**

Core activities:

- Web-based near real-time data visualization, evaluation and distribution
  - Background information and VIIRS-MODIS comparisons are also included to help product evaluation
- VIIRS active fire algorithm improvement and evaluation
  - The system is also a testbed for evaluating enhanced and experimental algorithms
- Partnership with end users for enhanced data services and user outreach
  - USDA Forest Service, NWS iMETS
- International outreach through GOFC-GOLD Regional Networks
  - GOFC-GOLD: Global Observation of Forest and Landcover Dynamics; a panel of the Global Terrestrial Observing System

## Data Visualization and Distribution




RSS feeds provided by GEOMAC (www.geomac.gov) and InciWeb (www.inciweb.org). Data are available in ASCII, GeoTIFF and KMZ formats. Note: this is an experimental, non-operational system. For the official IDPS product visit the NOAA CLASS data portal (www.class.ncdc.noaa.gov).

| Timestamp | Date | Ascii | TIFF | KMZ |
|---|---|---|---|---|
| NPP_VIIRS_20121107_212542_213122 | 2012-11-07 | Download | Download | Download |
| NPP_VIIRS_20121107_162406_162947 | 2012-11-07 | Download | Download | Download |
| NPP_VIIRS_20121107_180050_180631 | 2012-11-07 | Download | Download | Download |
| NPP_VIIRS_20121107_194316_194856 | 2012-11-07 | Download | Download | Download |
| NPP_VIIRS_20121107_194858_195438 | 2012-11-07 | Download | Download | Download |
| NPP_VIIRS_20121107_193734_194315 | 2012-11-07 | Download | Download | Download |
| NPP_VIIRS_20121107_180632_181212 | 2012-11-07 | Download | Download | Download |
| NPP_VIIRS_20121106_214853_215432 | 2012-11-06 | Download | Download | Download |
| NPP_VIIRS_20121106_164137_164717 | 2012-11-06 | Download | Download | Download |
| NPP_VIIRS_20121106_182402_182943 | 2012-11-06 | Download | Download | Download |
| NPP_VIIRS_20121106_214312_214852 | 2012-11-06 | Download | Download | Download |
| NPP_VIIRS_20121106_200046_200627 | 2012-11-06 | Download | Download | Download |
| NPP_VIIRS_20121106_200628_201208 | 2012-11-06 | Download | Download | Download |
| NPP_VIIRS_20121106_181821_182401 | 2012-11-06 | Download | Download | Download |
| NPP_VIIRS_20121105_220622_221202 | 2012-11-05 | Download | Download | Download |
| NPP_VIIRS_20121105_220042_220621 | 2012-11-05 | Download | Download | Download |
| NPP_VIIRS_20121105_201816_202357 | 2012-11-05 | Download | Download | Download |
| NPP_VIIRS_20121105_202358_202938 | 2012-11-05 | Download | Download | Download |
| NPP_VIIRS_20121105_184132_184713 | 2012-11-05 | Download | Download | Download |

## Analysis of Major Individual Fire Events

INCIDENT - WEATHER UNIT OPERATIONS REPORT

I. INCIDENT IDENTIFICATION DATA

| | | | |
|---|---|---|---|
| NAME OF INCIDENT: | Whitewater | BEGINNING DATE: | 05/16/2012 |
| REQUESTING AGENCY: | USFS Gila NF | CONTROL DATE: | |
| OTHER AGENCIES RECEIVING MU FORECASTS: | | MU RQSTD: | TIME: |
| NM State Forestry, Catron County (Emergency Management) | | 5/19/2012 | 0833 MST |

FORECASTER(S):
Rob Balfour

LOCATION AND TOPOGRAPHY (in detail): LAT: 33.3447 LON: -108.71

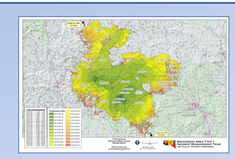
Southwest New Mexico, Gila NF, northwest corner of Gila Wilderness, Mogollon Mountains. Elevations affected range between 7200 feet and 10783 ft MSL. The main drainages are more or less aligned east to west. Minor creeks and canyons are aligned north northeast to south southwest.

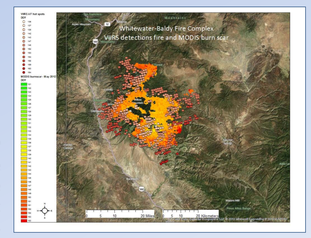
| ICP | DATE | TIME | RELEASED BY: |
|---|---|---|---|
| ARRIVAL OF MU: | 5/19/2012 | 1054 MDT | |
| RELEASE: | 5/25/2012 | 0730 MDT | Bob Cordts, PLSC |

LOCATION OF INCIDENT COMMAND POST:
Dog Flat, off Gila NF Road 28, @3 miles south of Negrito Work Center (junction of Gila NF Road 28 and Gila NF Road 141(aka NM Hwy 435), and about a mile south of the junction with N Bar Park/ranch road/sign. Approx. 15 miles southeast (as the crow flies) of the town of Reserve, NM and 15 miles east (as the crow flies) of the town of Glenwood, NM

| INCIDENT COMMANDER: | PLANS CHIEF: |
|---|---|
| John Pierson | PLSC Bob Cordts; Deputy PLSC Jim Silva; PLSC (T) Wayne Robbie |

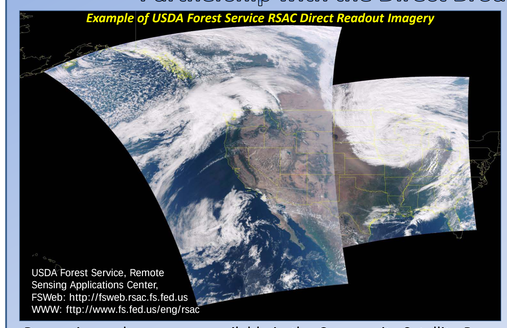
FIRE BEHAVIOR ANALYST(S):
Galen Roeder

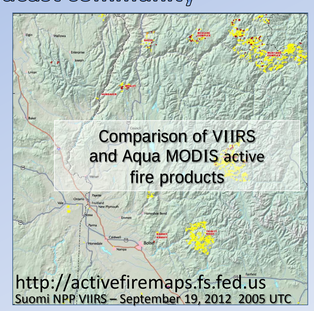





Front page of the Incident Report, Fire Progression Map and SNPP VIIRS fire detections (over a MODIS burned area map) for the Whitewater-Baldy fire event. Evaluation is ongoing to analyze the utility of VIIRS fire information to assist on-site fire management support by National Weather Service Incident Meteorologists (IMETs).

## Partnership with the Direct Broadcast community




Processing codes are now available in the Community Satellite Processing Package (CSPP; University of Wisconsin) and International Polar Orbiter Processing Package (IPOPP; NASA Direct Broadcast Laboratory).The Active Fires product team works with the providers of CSPP and IPOPP to ensure that the latest algorithms are included.

## Online Articles

**First Fire Images from VIIRS (January 26, 2012)**
http://earthobservatory.nasa.gov/IOTD/view.php?id=77025

**NASA/NOAA Satellite Sees Western U.S. High Mountain Blazes (July 13, 2012)**
http://www.nasa.gov/mission_pages/NPP/news/west-blazes.html

**NASA Finalizes Contracts for NOAA's JPSS-1 Mission (August 10, 2012)**
http://www.nasa.gov/centers/goddard/news/releases/2012/12-066.html

**Complex Interactions between Wildfires and Lightning during Summer 2012 (December 12, 2012 by Scott Rudloski)**
http://essic.umd.edu/joom2/index.php/outreach-main/its-severe-blog/1229-complex-interactions-between-wildfires-and-lightning-during-summer-2012

## Summary and Conclusions

**Assessment** of the VIIRS fire product using 2012 fire observations is **encouraging**

Active Fires product has been declared **Beta maturity** and is publicly available

**User Readiness and Proving Ground** activities are reaching out to various users

Implementation of **Direct Readout processing systems** is underway

***Acknowledgment***

***This work was supported by the NOAA JPSS Office (NJO) through the JPSS Proving Ground and the JPSS Algorithm Development and Validation programs.***