THE SUOMI NPP VIIRS ACTIVE FIRE PRODUCT: STATUS AND EARLY EVALUATION RESULTS

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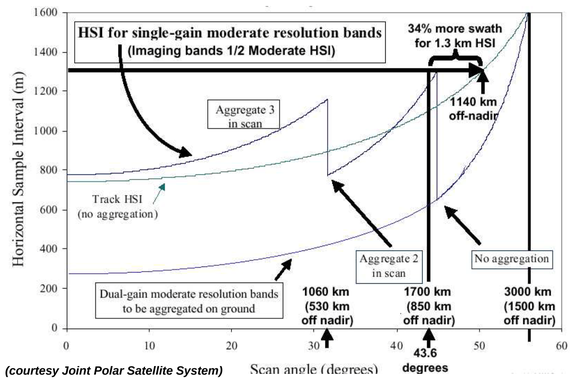
The Visible Infrared Imager Radiometer Suite (VIIRS) sensor on the Suomi National Polar-orbiting Partnership (Suomi NPP) satellite has capabilities for active fire detection and characterization. The Active Fire product is one of the standard operational products generated by the Interface Data Processing Segment (IDPS) of the Suomi NPP ground system. Development and validation of the operational product is carried out by Joint Polar Satellite System (JPSS) algorithm and product validation team. Further research is also done to take advantage of full sensor capabilities and ensure high quality fire observations to continue to data record started with the Moderate Resolution Imaging Spectroradiometer (MODIS) on the NASA Earth Observing System Terra and Aqua Satellites. Additional work being carried out to ensure maximum uptake of the new VIIRS active fire product by the end user community.

ALGORITHM AND PRODUCT STATUS

- The **community expects** and **society needs** the continuation of the **high quality fire observations** from the Moderate Resolution Imaging Spectroradiometer (**MODIS**) on the NASA Earth Observing System Terra and Aqua satellites
- Suomi NPP (National Polar-orbiting Partnership) was **launched** on October 28, 2011
- The Visible Infrared Imager Radiometer Suite (**VIIRS**) sensor was developed to allow for the **detection and characterization of hot targets**

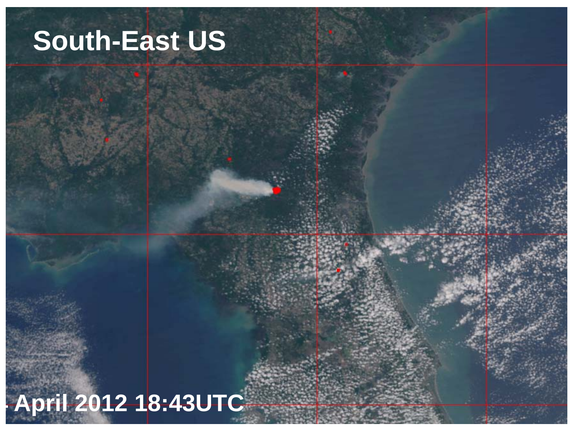
		Band No.	Wave-length (μm)	Horiz Sample Interval (km Downtrack x Crosstrack) Nadir	Horiz Sample Interval (km Downtrack x Crosstrack) End of Scan	Driving EDRs	Radi-ance Range	Ltyp or Ttyp
VSNIR	Silicon PIN Diodes	M1	0.412	0.742 x 0.259	1.60 x 1.58	Ocean Color Aerosols	Low High	44.9 155
		M2	0.445	0.742 x 0.259	1.60 x 1.58	Ocean Color Aerosols	Low High	40 146
		M3	0.488	0.742 x 0.259	1.60 x 1.58	Ocean Color Aerosols	Low High	32 123
		M4	0.555	0.742 x 0.259	1.60 x 1.58	Ocean Color Aerosols	Low High	21 90
		I1	0.640	0.371 x 0.387	0.80 x 0.789	Imagery	Single	22
		M5	0.672	0.742 x 0.259	1.60 x 1.58	Ocean Color Aerosols	Low High	10 68
		M6	0.746	0.742 x 0.776	1.60 x 1.58	Atmospheric Corr'n	Single	9.6
		I2	0.865	0.371 x 0.387	0.80 x 0.789	NDVI	Single	25
		M7	0.865	0.742 x 0.259	1.60 x 1.58	Ocean Color Aerosols	Low High	6.4 33.4
CCD		DNB	0.7	0.742 x 0.742	0.742 x 0.742	Imagery	Var.	6.70E-05
SMWIR	PV HgCdTe (HCT)	M8	1.24	0.742 x 0.776	1.60 x 1.58	Cloud Particle Size	Single	5.4
		M9	1.378	0.742 x 0.776	1.60 x 1.58	Cirrus/Cloud Cover	Single	6
		I3	1.61	0.371 x 0.387	0.80 x 0.789	Binary Snow Map	Single	7.3
		M10	1.61	0.742 x 0.776	1.60 x 1.58	Snow Fraction	Single	7.3
		M11	2.25	0.742 x 0.776	1.60 x 1.58	Clouds	Single	0.12
		I4	3.74	0.371 x 0.387	0.80 x 0.789	Imagery Clouds	Single	270 K
		M12	3.70	0.742 x 0.776	1.60 x 1.58	SST	Single	270 K
		M13	4.05	0.742 x 0.259	1.60 x 1.58	SST Fires	Low High	300 K 380 K
LWIR	PV HCT	M14	8.55	0.742 x 0.776	1.60 x 1.58	Cloud Top Properties	Single	270 K
		M15	10.763	0.742 x 0.776	1.60 x 1.58	SST	Single	300 K
		I5	11.450	0.371 x 0.387	0.80 x 0.789	Cloud Imagery	Single	210 K
		M16	12.013	0.742 x 0.776	1.60 x 1.58	SST	Single	300 K

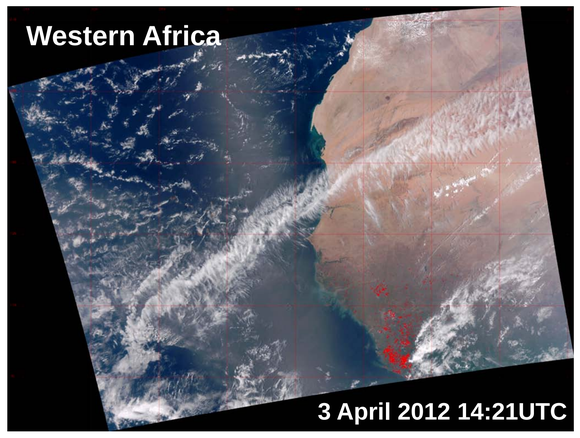


(courtesy Joint Polar Satellite System)

Basic VIIRS specifications

- **The current baseline VIIRS active fire product** generated by the Interface Data Processing Segment (IDPS) provides the **geolocation of pixels for which fires are detected** (no spatially explicit fire/clear land/cloud/water mask)
- The algorithm is a hybrid **thresholding and contextual** algorithm
- Uses **radiometric signals from M13 and M15**, and tests spatial heterogeneity to identify candidate pixels.
- Uses additional bands and a suite of tests for **internal cloud mask** and the rejection of **false alarms**.
- Current **IDPS Application Related Product (ARP)** product is based on the **MODIS Collection 4** algorithm



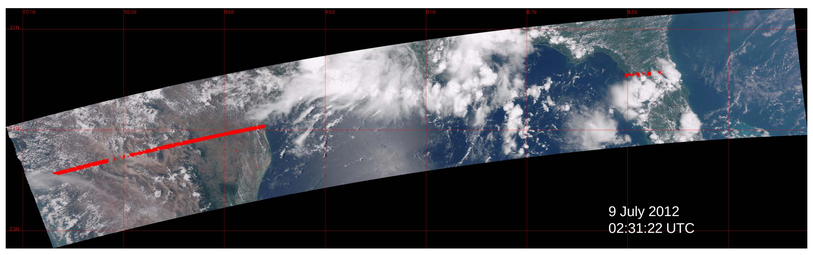


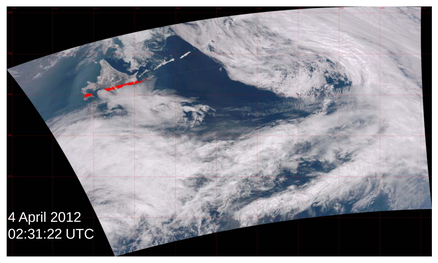
Examples of VIIRS fire detections: M5-M4-M3 RGB + IDPS Active Fire ARP (red)

- The product is planned to be declared to have **beta maturity status in August 2012**
- Once it is declared "beta", it will be **publicly available through NOAA CLASS** at https://www.class.noaa.gov
- Current major caveat is the occurrence of **spurious fire detections** over all clear land pixels of entire scanlines
- Spurious detections appear about **once a day**; a fix is being worked on

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***

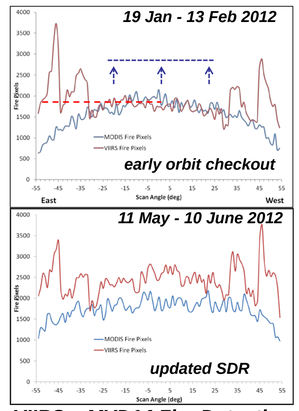




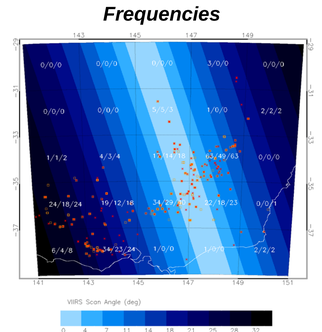
Examples of spurious VIIRS fire detections in the current IDPS product

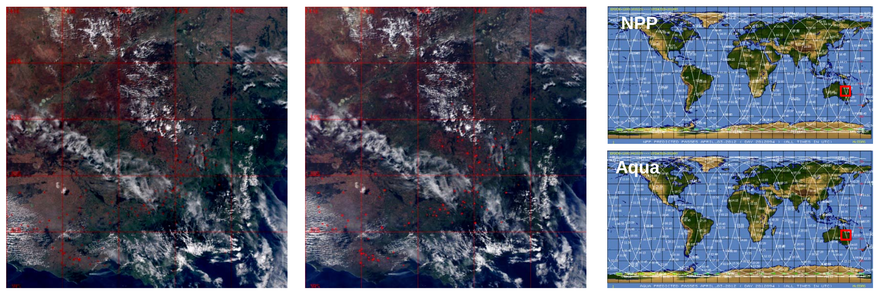
EARLY PRODUCT VALIDATION: Suomi NPP VIIRS vs. Aqua MODIS

- Aqua and NPP have **similar overpass times (1:30pm)**
  - sampling of the diurnal fire cycle is similar
- Saturation levels of the primary bands allow **unsaturated radiance measurements** for most fire
  - Bands 21/22 for MODIS and M13 for VIIRS
- Some differences in **spectral placement**
- Processing **algorithms are compatible**
  - Current VIIRS algorithm is based on MODIS, albeit an earlier version
  - Differences can be resolved and the impact can be minimized
- **Primary driver** of differences is **spatial sampling**
  - Pixel size
  - Variations along scanline (aggregation schemes)
  - Variations within pixels (line-spread function, aggregation)
  - Differences in swath width (VIIRS has no gaps at low latitudes)

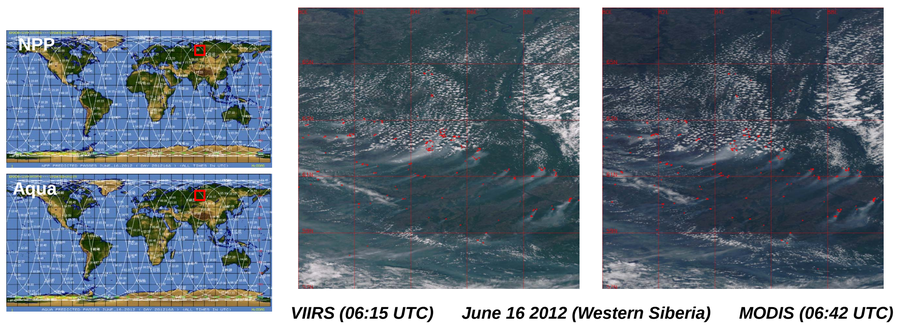


VIIRS x MYD14 Fire Detection Frequencies



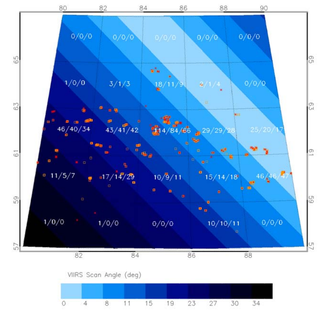


VIIRS (03:55 UTC) April 3 2012 (SE Australia) MODIS (04:05 UTC)



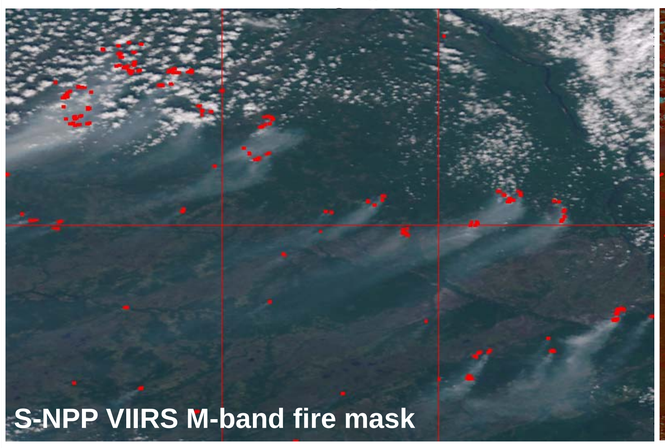
VIIRS (06:15 UTC) June 16 2012 (Western Siberia) MODIS (06:42 UTC)

Gridded statistics: AA/BB/CC
AA – number of VIIRS fire pixels (red)
BB – number of VIIRS fire pixels with overlapping Aqua/MODIS fire pixels
CC – number of Aqua/MODIS fire pixels (orange)



PRODUCT ENHANCEMENTS AND USER READINESS

I4: Higher resolution, but lower saturation than



June 16 2012 06:15 UTC (Western Siberia)

VIIRS Active Fire Product Website

viirsfire.geog.umd.edu

VIIRS active fire product development strategy

NOAA: real-time operational applications

- Operational product generated by IDPS
- 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

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

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