



The VIIRS active fire product suite and its key operational applications



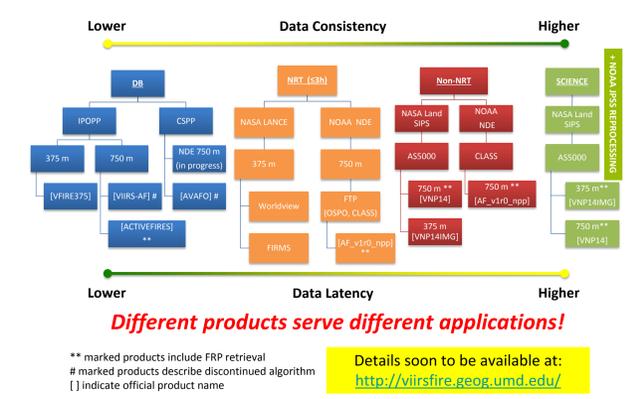
Ivan Csiszar, Shobha Kondragunta, Scott Rudlosky¹, Marina Tsidulko², Evan Ellicott³, Wilfrid Schroeder³, Louis Giglio³, Ravan Ahmadov^{4,5}, Eric James^{4,5}, Georg Grell⁵, Bill Sjoberg⁶, Zhaohui Cheng⁷, Mark Ruminski⁷, Jerry Guo⁸, Jade Williams⁹

¹ NOAA/NESDIS Center for Satellite Applications and Research, College Park, MD (ivan.csiszar@noaa.gov), ² I.M. Systems, Inc., ³ University of Maryland - College Park, MD, ⁴ CIRES, ⁵ NOAA ESRL, ⁶ GST, ⁷ NOAA/NESDIS/OSPO, ⁸ Maximus, ⁹ EMCS

ABSTRACT

This presentation provides an update on the status of Active Fire products from the Visible Infrared Imaging Spectroradiometer (VIIRS) on the Joint Polar Satellite System (JPSS) series, including the Suomi National Polar-orbiting Partnership (NPP) satellite launched in late 2011. The baseline products, generated from 750m moderate (M-band) as well as 375m imagery (I-band) measurements provide thematic fire mask classification for each VIIRS granule and fire radiative power (FRP) for detected fire pixels. The products are now available for the user community through near-real-time production and distribution systems. Algorithms to generate VIIRS fire products are also included in direct broadcast processing packages. VIIRS fire information is now used in key operational applications. VIIRS fire radiative power from NOAA's M-band product is used as input to NOAA's High Resolution Rapid Refresh (HRRR) Smoke modeling system to provide smoke analysis and forecast in real time. The data are also incorporated into eIDEA (enhanced Infusing satellite Data into Environmental Applications) to support air quality monitoring and predictions. There is now also capability to display VIIRS FRP in the Advanced Weather Interactive Processing System (AWIPS-II). NASA's I-band product, which is planned to be implemented also in NOAA operations, supports various fire management and science applications. Ongoing efforts include incremental algorithm and product improvements and the reprocessing of the Suomi NPP data record. NOAA's Fire and Smoke Proving Ground Initiative also includes capacity building and end user engagement through various collaborative efforts.

1. VIIRS active fire product lineage



2. NOAA VIIRS active fire product status

NDE VIIRS M-band product

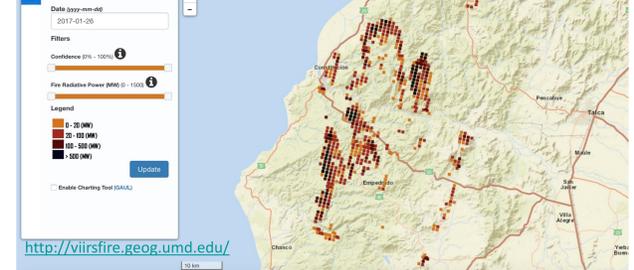
- M-band product in operations since March 15, 2016
- provides 750m fire mask and fire radiative power
- based on heritage MODIS algorithm
- replaced IDPS product

NDE VIIRS Active Fire output file content

| Name | Description | Type |
|---------------|---|--------------|
| fire mask | Fire mask 2D array (unit-less) | 8 bit Int |
| algorithm QA | Fire algorithm QA mask 2D array (unit-less) | 32 bit Int |
| FP_line | Fire pixel line Sparse data array | 16 bit Int |
| FP_sample | Fire pixel sample Sparse data array | 16 bit Int |
| FP_latitude | Fire pixel latitude Sparse data array (deg) | 32 bit Float |
| FP_longitude | Fire pixel longitude Sparse data array (deg) | 32 bit Float |
| FP_power | Fire radiative power Sparse data array (MW) | 32 bit Float |
| FP_confidence | Fire detection confidence Sparse data array (%) | 8 bit Int |
| FP_land | Land pixel flag Sparse data array | 8 bit Int |

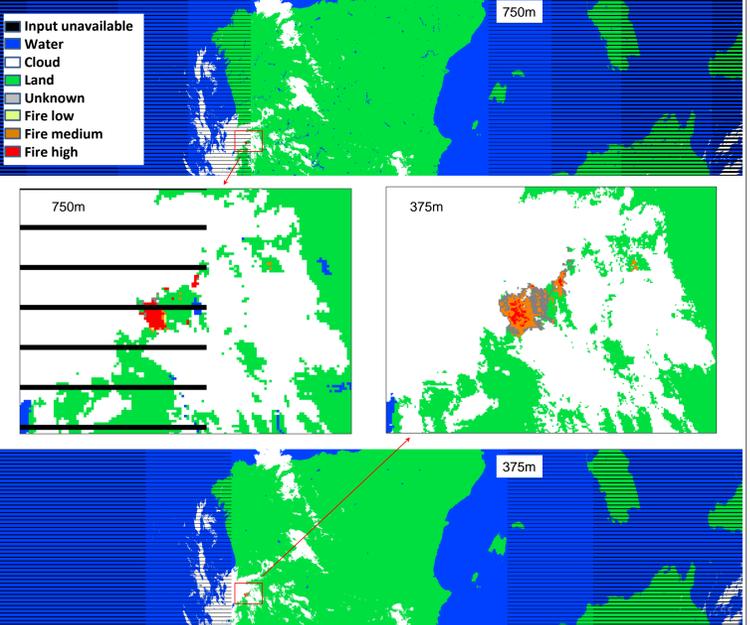
Total output for one granule: 11.7 Mb + number of fires * 79 bytes

NDE VIIRS fire detections and FRP in Chile on January 26, 2017



I-band product

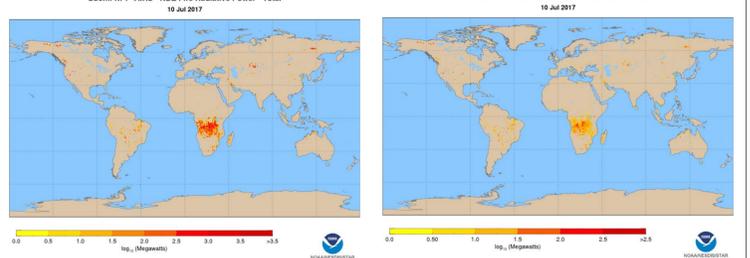
- I-band product generated within NASA production systems for science applications
- provides fire mask and fire radiative power at 375m resolution
- algorithm includes specific elements to handle I-band characteristics
- radiance measurements from the M-band are used for FRP retrieval for large fires
- algorithm has been integrated into NOAA STAR environment for testing and evaluation



Examples of fire masks from the M-band (top and middle left) and I-band (bottom and middle right) algorithms on 6/18/2017 02:04 UTC. The examples show observations of the catastrophic fire event in Portugal.

NOAA VIIRS fire long-term monitoring

- long-term monitoring of the operational NOAA VIIRS active fire products is done at NOAA/NESDIS/STAR
- daily global maps are available for the entire operational production period
- the system has been used to detect data anomalies related to algorithm, input data quality and production issues
- reprocessing of the Suomi NPP data record uses lessons learned from product monitoring and evaluation



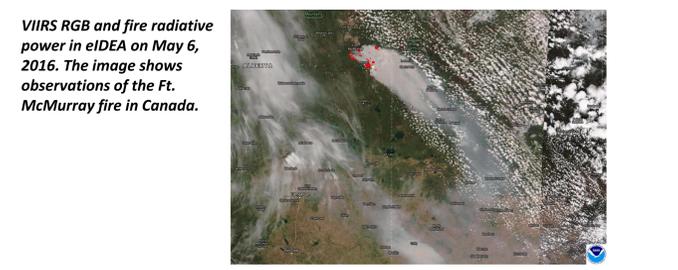
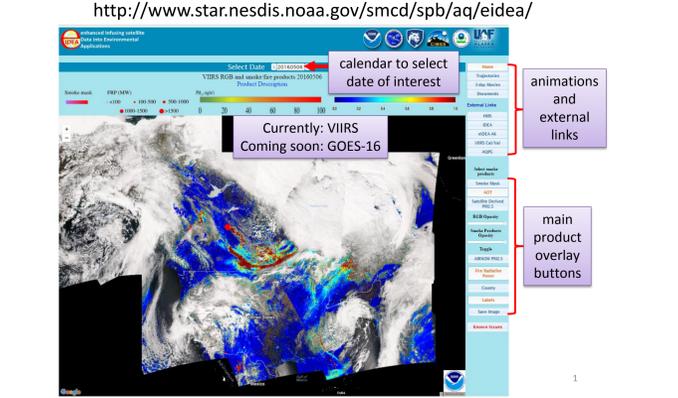
Daily global maps of fire detection, total FRP and mean FRP for long-term monitoring purposes https://www.star.nesdis.noaa.gov/jps/EDRS/products_activeFires.php

NOAA NDE VIIRS fire data access

- NOAA CLASS (www.class.noaa.gov)
 - Search in the group "S-NPP Data Exploitation Granule Data (NDE_L2)
 - <ftp://ftp-npp.class.ngdc.noaa.gov/> -> [date folder] -> NDE-L2 -> VIIRS-Active-Fire-EDR-NOAA-Enterprise-Algorithm/
- NOAA OSPO
NOAA Office of Satellite and Product Operations (OSPO) generates text files from the standard operational NDE product. The text files include fire positions, confidence value, fire mask, brightness temperature, fire radiative power, and other metadata.
The text files are input to the Hazard Mapping System operated at the Satellite Analysis Branch (SAB), and used in the daily fire and smoke analysis.
<http://satopsanone.nesdis.noaa.gov/FIRE/fire.html> A daily quicklook image of NDE fire data on the OSPO site

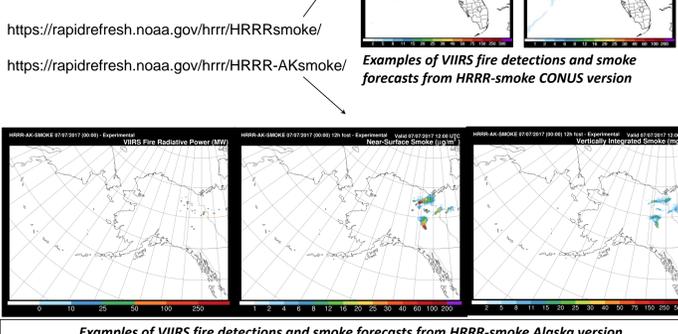
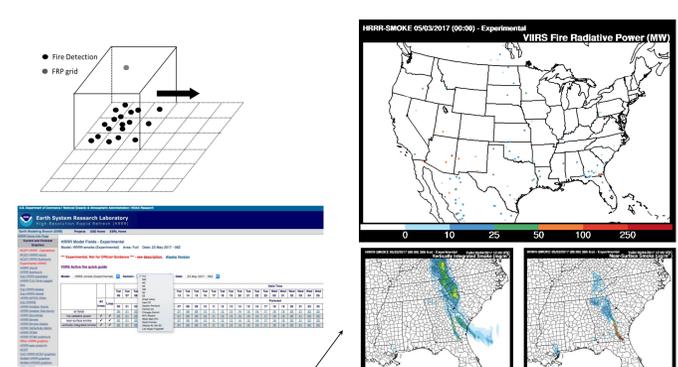
3. Smoke analysis and air quality applications

VIIRS fire data in eIDEA (enhanced IDEA - Infusing satellite Data into Environmental Applications)



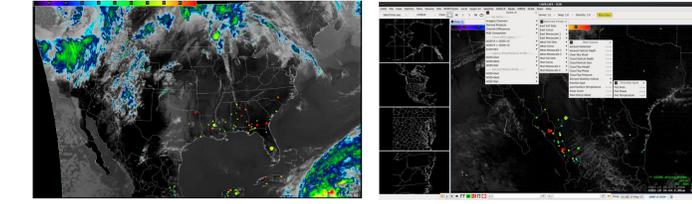
VIIRS fire data in HRRR-smoke (High Resolution Rapid Refresh - Smoke)

- HRRR is a numerical weather prediction system running operationally at 3km resolution over the CONUS domain;
- VIIRS FRP data are included in a coupled air quality model High spatial resolution allows simulation of mesoscale flows and smoke dispersion over complex terrain;
- Full coupling between meteorology and smoke: feedback of smoke on predicted radiation, cloudiness, and precipitation;
- Biomass burning emissions and inline plume rise parameterization are based on the satellite FRP data;
- A rapidly updating data assimilation cycle for meteorology;
- The forecast lead time is 36 hours. Four times a day (00, 06, 12 and 18UTC) a new forecast starts.



4. Incorporation of VIIRS fire data into AWIPS-II

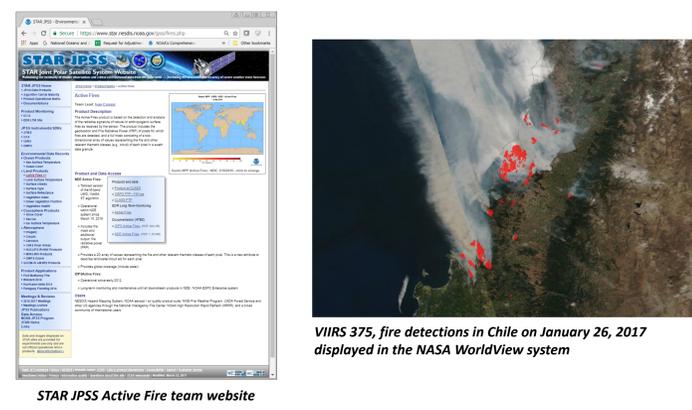
- AWIPS Active Fire Tool**
- Developed by the Experimental Products Development Team (EPDT)
- Initially deployed as part of an RPM package from the Tower-S team
- Most recent AWIPS version includes tool for displaying active fires



Examples of VIIRS active fire data in AWIPS-II. The size of the circle represents fire radiative power. The color of the circle represents detection confidence.

5. Key online resources

- Product information
 - NOAA JPSS VIIRS Active Fire Product Team - <https://www.star.nesdis.noaa.gov/jps/fires.php>
 - NASA Suomi NPP VIIRS Active Fire Science Team - <https://viirsland.gsfc.nasa.gov/Products/NASA/FireESDR.html>
- VIIRS Fire Science Team website - <http://viirsfire.geog.umd.edu/>
- Online visualization and download
 - NASA LANCE - <https://earthdata.nasa.gov/earth-observation-data/near-real-time/rapid-response>
 - NASA WorldView - <https://worldview.earthdata.nasa.gov>
 - UW-Madison SSEC RealEarth - <http://realearth.ssec.wisc.edu>



STAR JPSS Active Fire team website

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Key references

Csiszar, I., W. Schroeder, L. Giglio, E. Ellicott, K. P. Vadrevu, C. O. Justice, B. Wind, 2014: Active fires from the Suomi NPP Visible Infrared Imaging Radiometer Suite: Product status and first evaluation results, *J Geophys Res Atmos*, 119, doi:10.1002/2013JD020453.
Schroeder, W., P. Oliva, L. Giglio, I. A. Csiszar, The New VIIRS 375 m active fire detection data product: Algorithm description and initial assessment, Remote Sensing of Environment, Volume 143, 5 March 2014, Pages 85-96, ISSN 0034-4257, <http://dx.doi.org/10.1016/j.rse.2013.12.008>