The VIIRS active fire product suite and its key operational applications

Ivan Csiszar, Shobha Kondragunta, Scott Rudlosky1, Marina Tsidulko2, Evan Elliff2, Wilfrid Schroeder3, Louis Giglio2, Ravan Ahmadv1, Eric James4,5, Georg Grell1, Bill Spaiberg6, Zhaoqi Cheng,2 Mark Runk8, Jerry Guo4, Jade Williams8

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

ABSTRACT
This presentation provides an update on the status of Active Fire products from the Visible Infrared Imaging Spectrometer (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 2175m imagery (I-band) measurements provide thermal fire mask classification data 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 FRP products are also included in direct broadcast processing packages. VIIRS fire model information is now used in key operational applications. VIIRS night-time fire power (without nighttime correction) 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). NOAA’s M-band product, which is planned to be implemented in the near future, is expected to significantly improve the performance of the airborne fire detection and map products.

1. VIIRS active fire product suite

1.1. Directly detected fire algorithm

- I-band product
  - I-band product generated within NOAA production systems for science applications
  - provides fire mask and fire radiative power at 375 resolution
  - algorithm includes specific elements to handle I-band characteristics
  - radiation 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

1.2. NOAA NDE VIIRS 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

1.3. NOAA NDE VIIRS fire data access

1.3.1. NOAA CLASS (www.class.noaa.gov)
- Search in the group “S/FRP Data Exploitation-Grayscale Data (NDE. L2 FRP)”
- For VIIRS fire detections: [ftp://ftp.star.nesdis.noaa.gov/pub/IDP/VIIRSData/activeFire.html]

1.3.2. NOAA ODPS
- NOAA Office of Satellite and Product Operations. ODPS generates text files from the standard operational NDE VIIRS product. The text files include fire positions, confidence value, fire mask, mask quality, fire radiative power, and others.
- The text files are inputs to the Hazard Mapping System operated at the Satellite Analysis Branch (SAB), and used in the daily fire and smoke product generation process.

2. VIIRS fire product applications

3. Fire smoke analysis and air quality applications

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

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
  - Most recent AWIPS version includes tool for displaying active fires

5. Key online resources

1. Product information
- NASA Suomi NPP VIIRS Active Fire Science Team – https://visrsc.gsfc.nasa.gov/Products/NOAAFireESDhtml

2. VIIRS Science Team website
- http://viirs.geom.umd.edu/

3. Online visualization and download
- NASA WorldView - https://worldview.earthdata.nasa.gov
- U-W Madison SSEC RealEarth - http://realearth.ssec.wisc.edu

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

Example of 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 simple plume rise parameterization are based on the satellite FRP data;
- A rapid 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.

VIIRS fire data in HRRR-smoke for the Ft. McMurray fire in Canada.

Example of VIIRS fire detection from the M-band (top and middle left) and I-band (middle right) algorithms on 4 May 2016. The examples show the evolution of the event in time and space:

Examples of VIIRS fire detection and smoke forecasts from HRRR-smoke CONUS version.