Active Fire Detection

An Eye in the Sky for the Boots on the Ground

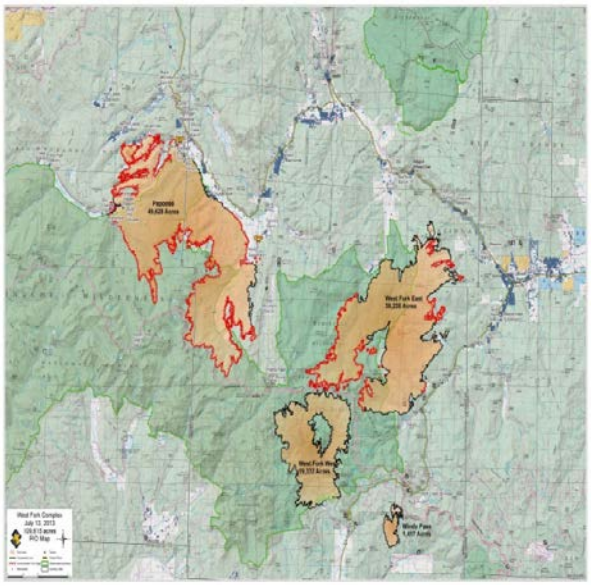
Smoke rising from the West Fork Complex fire on June 24, 2013. The satellite image inset shows fire detections from the Suomi NPP VIIRS sensor of the same fire. Photo by Evan Ellicott.

On Monday, June 24, 2013, Evan Ellicott landed in Denver, Colorado for the long drive south. His plan was to visit the West Fork Complex in southern Colorado. The national news was already full of stories of yet another group of Colorado fires. The West Fork Complex fire was soon to become one of the largest wildfires in Colorado history. Evan's goal was to get as close to the front line as possible and meet with the key people fighting the fire. He wanted to evaluate their use of remotely sensed data and determine how the new Joint Polar Satellite System (JPSS) Visible Infrared Imaging Radiometer Suite (VIIRS) capabilities could make a difference. Five days later as he drove away from the command post, the smoke still stinging his eyes, he realized how incredibly valuable it was to have his boots on the grounds of this fire.

Evan is a member of the Suomi National Polar-orbiting Partnership (SNPP) VIIRS Active Fire (AF) product development and evaluation team, which is organized under the JPSS Algorithm Development, Calibration/Validation, and Proving Ground and Risk Reduction Programs. He is responsible for organizing and evaluating user readiness and the proving ground effort. The team works closely with representatives of the end user community such as Peter Roohr of the National Weather Service (NWS), Office of Science and Technology, who is the liaison with the NWS Incident Meteorologist (IMET) community; and Brad Quayle of the USDA Forest Service Remote Sensing Applications Center, who is a key user of the VIIRS Active Fires product derived from direct readout data in daily operations to serve a number of end users.

Evan and Peter developed an interactive information briefing on VIIRS and the AF product, which they presented to IMETs during their annual spring training as another source of data for fire locations. IMETs are embedded in NWS offices around the country, and are deployed at a moment's notice to the front lines of volatile occurrences such as chemical and oil spills, wildfires or other incidents. They are the NWS equivalent of Special Forces, and they are sent to remote locations throughout the U.S. to provide on-site forecasting support. They provide tactical support to the fire management team, especially the fire behavior analysts from the U.S. Department of Agriculture's Forest Service (US Forest Service), the Department of Interior's Bureau of Land Management (BLM), and other federal, state and local fire control agencies who carry out the fire suppression operations. An IMET is generally requested when a Type 1 or 2 Incident Command Team (ICT) is asked to manage a fire. A Type 1 team is a national level team, while a Type 2 team is a regional team. Robyn Heffernan, the NWS liaison at the National Interagency Fire Center (NIFC) in Boise, ID, Peter, and Evan held follow-up discussions in which they wanted to find out how the VIIRS product was working for the end user. They also laid the groundwork for evaluating fire outbreaks to determine which fire presented the best conditions for Evan to visit. The CO fire outbreak in June provided the perfect opportunity. It was the goal of this team to see if one of their members could spend time at the command post of a forest fire to interact directly with people who were using satellite data to help fight the fire.

Evan arranged his trip with the NWS fire weather staff at the National Interagency Coordination Center (NICC) in Boise Idaho, including Robyn Heffernan and Larry Van Bussum, Operations Section Chief. The NICC is the focal point for coordinating the mobilization of resources for wildland fire and other incidents throughout the United States. Working together, they identified the West Fork Complex Fire as the candidate for his visit. On Monday, June 24, 2013, Evan was on the ground in CO. He visited the West Fork Complex to meet with incident team members such as the IMETs from the National Weather Service, Fire Behavior Analysts (FBANs) from the US Forest Service, GIS analysts, and other fire incident decision support cadre.



The final map of the West Fork Complex issued July 13, 2013. The fire was 50 percent contained at this point.

At the time of Evan's visit, the West Fork Complex fire was burning at 16 percent containment and was expected to burn for at least a month. Wildfires in Colorado were spreading fast and furious and the command post was well established and approved Evan's travel.

West Fork Complex Fire

The West Fork Complex consisted of three lightning-caused wildfires, West Fork, Windy Pass, and Papoose,

which burned on the San Juan and Rio Grande National Forests and private lands in southern Colorado.

The biggest fire, known as the West Fork Fire, started after lightning struck in the San Juan National Forest backcountry on June 5. The Windy Pass Fire, which ignited on June 13, was the second and the smallest fire, growing at a much slower rate than the others. The third fire, known as the Papoose Fire, started Friday June 21, and was the most active at the time of Evan's visit.

Due to its size and complexity, the ICT tactically decided to switch the operations of the West Fork Complex into two zones, the West Zone in Pagosa Springs and the East Zone in Del Norte. The West Zone (Windy Pass and Western Part of West Fork Fires) Incident Command Post (ICP) was located at the local airport in Pagosa Springs, and was manned by a Type 2 fire management team. The East Zone (Papoose and Eastern Part of West Fork Fires) ICP was located at Del Norte High School and was manned by a Type 1 fire management team. The Type 1 team worked in conjunction with the U.S. Forest Service National Incident Management Organization (NIMO), to manage the three fires that made up the West Fork Complex, which was occurring in a vast complex area and difficult terrain. The NIMO team is usually called in when a fire has reached a size and level of complexity that requires further oversight. The personnel on the ground at the command post included all the team members that were needed to manage the fires from above and on the ground, i.e., incident commanders, safety operations, GIS specialists, fire behavior analysts and long term analysts from the U.S. Forest Service, logistics personnel (National Guard), smoke analysts from the U.S. Fish and Wildlife Service (USFWS), firefighting crews (BLM) and IMETs (NOAA). For the National Guard unit, this was the first time it has been deployed in such a capacity.

Boots on the Ground during Daily Operations

Evan arrived at the ICP in Pagosa Springs where IMET Mark Loeffelbein was dispatched. Another IMET, Kelly Hooper arrived the same day. He was dispatched to the West Fork Complex to provide an IMET for each zone, and thus added weather forecasting support. Both IMETs provided critical input to daily operations briefings as decision makers moved their resources to meet the changing fire scene.

Two standard briefings were held every morning and evening in both fire zones. The morning meetings occurred at the West Fork spike camp, where a team of fire fighters were camped. Once the operations commander came out, the information officer would provide a detailed recap of the previous day's events. Next, the IMET and fire behavior analysts would provide a briefing on the weather, which would be followed by briefings from logistics, operations, safety, and communications.

The morning meetings were critical to the team members on the ground. It was these meetings where they received their Incident Action Plans (IAPs), which included assignments, night infrared maps, logistics information, and weather forecast information. Nighttime data were collected using infrared (IR) flights, or National Infrared Operations (NIROPS). These aircraft collect thermal infrared data at the

incidents, which provide information on heat perimeters and sources of intense heat. As this information was not available during the day when the fire was really taking off, Evan noted that this was an opportunity in which VIIRS data could be used when the NIROPS were unavailable.

Evaluating the Operational Use of Satellite Data

Evan's first meeting with Mark Loeffelbein was vital to Evan's goal to learn more about the role of an IMET at the incident. As he watched Mark go through the process of developing his forecasts he was able to see what data was used and to understand what strengths and limitations VIIRS data poses for an IMET. Discussions surrounding topics of data latency, access, and format, spatial resolution, and spectral channel availability followed. These informal talks allowed for a dialogue for Evan to better understand what the IMETs needed, and the hurdles they face in providing environmental support to the command post decision makers. It also allowed him to educate Mark about the VIIRS sensor and its products, particularly the active fires product.

Evan also met with several FBANs from the US Forest Service. The FBANs provide critical information about what they expect the fire to do over the coming hours to days based on fuels, terrain, and weather. Eric and Chris were both eager to learn more about how remotely sensed data could aid their job and Evan was happy to talk with them and demonstrate the data from VIIRS. On Thursday, June 27th, Evan accompanied the FBANs as they moved closer to the fire line. Evan was able to get a first-hand view of the FBANs in action and evaluate the variables they considered when making their daily fire behavior forecasts. In turn, Evan was able to provide imagery and fire detections in various formats such as Geographic Information Systems (GIS), as wells KMLs for Google Maps and Google Earth, which illustrated the potential of the VIIRS AF product. He also demonstrated direct broadcast capabilities to address the concerns of latency.

Finally, Evan met with other members of the Planning Section, including Mike Broughton, Air Resource Advisor, Cody Wienk, Long Term Analyst (LTAN), as well as the West Zone Incident Commander (IC), Curtis Heaton. These interactions provided invaluable intelligence on what the IC team faces in the short and long term and what value remotely sensed data provides to them.

Path Forward

The AF team spent a lot of time developing the VIIRS AF product and making it available in a way that is operationally useful. Evan set out on a fact finding mission to see how things were going and used this trip as an opportunity to demonstrate the use of polar orbiting satellite data to get a handle on fire detections. The NICC compiles annual wildland fire statistics for federal and state agencies. The center reported that in 2012 there were 67,774 wildfires with 9,326,238 acres burned. While fire suppression costs in 2012 were not the most expensive at $1,902,446,000, four fires namely, the Waldo Canyon fire, the Whitewater-Baldy (NM), White Draw (SD), and Long Draw (OR) made it onto the list of historically significant wildland fires. This trip revealed which end users were using VIIRS data. And, for those who were not, Evan used this opportunity to educate them on the potential of the VIIRS AF product. It was also educational for Evan as he obtained knowledge from the end user on what kind of data they

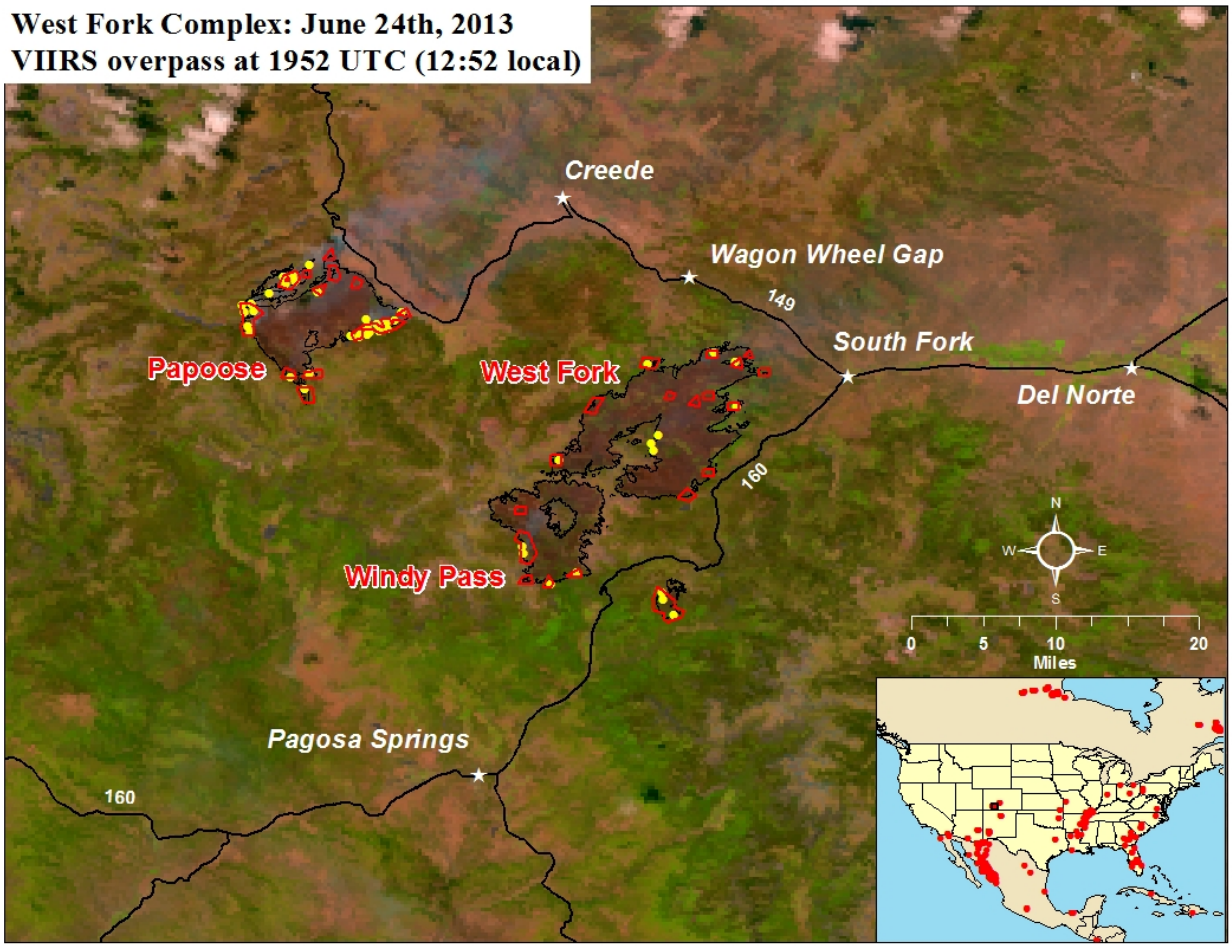
needed, and how they needed it. This fact-finding mission also helped Evan envision the kind of pressures and hurdles the end user faced when out in the field responding to an environmental event.

Next Steps

The issues of data latency and connectivity were evident during this trip. ***This fire revealed that VIIRS detection data needs to be available in time for the two daily meetings and integrated into the suite of information used for the planning and decision making process.*** In addition, timely updates during the day can provide valuable information to support decisions on specific firefighting actions. ***This can be achieved by ensuring access to direct broadcast data from various receivers across the country, typically 30 minutes or less after the satellite overpass.*** Timely access to NOAA's centralized data processing system, providing a stable data source with two-hour latency, as a backup data source should also be established. ***The information regarding the fire needs to be available in a compressed format that can be easily downloaded through low-bandwidth cell phone and wireless networks, which then can be combined with other geospatial information on-site.*** Until a robust data access system is set up, the SNPP VIIRS Active Fire team is planning to provide ad-hoc remote support to end users for select fire events through partnerships established in part through Evan's visit to the West Fork Complex.

Further work is also needed to ensure the full capabilities of the VIIRS sensor to provide fire information at various spatial details during daytime as well as nighttime. ***VIIRS also has a capability to provide not only the location of fires, but also an indication of their intensity through the parameter called Fire Radiative Power (FRP). This information can help identify the most intense burning along extensive fire fronts, which might not be evident from other ground-based on airborne observations***. Continuous interaction with the end users also helps identify shortcomings of the fire detection scheme and thus supports further product improvements by the active fire product development team. Options for various data products, data formats, and background material are provided through the Active Fires Product Data and Evaluation Portal at http://viirsfire.geog.umd.edu.

This fact finding mission also highlighted that the JPSS program office is interacting with its key users in trying to find a way to ensure that its products are of most value to the missions of those users.



Remote sensing observations of the West Fork Complex fire. The image is a false color composite using VIIRS' 375m resolution Imagery bands (I-bands) from June 24th, 12:52 local time. The three fires are evident by the distinct burn scars in the center of the image, as is smoke emitted primarily from the Papoose fire. The yellow dots and red polygons denote fire detections from the VIIRS 750m resolution Moderate Bands (M-bands) and the I-bands, respectively. The black polyline is the latest fire area perimeter from the previous night's Night Infrared Operations (NIROPS) flight.