VIIRS Imagery and the 2014 Funny River Fire in Alaska, and Plans for the 2015 Fire Season

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Introduction

The largest wildfire in an otherwise comparatively quiet fire season in Alaska in 2014 was the Funny River fire on Alaska's Kenai Peninsula southwest of Anchorage. The Funny River fire started on May 19th and under dry and windy weather conditions soon experienced dramatic growth, burning just under 200,000 acres by May 28th. While the Funny River fire was not declared contained and controlled until late August, its most dangerous behavior occurred in the two weeks immediately after ignition.

Figure 1: Photo of the Funny River fire, near 1:00am local time, May 21, 2014. Courtesy of Bill Roth at the Alaska Dispatch

Weather is often the determining factor in wildfire behavior, and Alaska's network of weather observing systems such as METARs and WSR-88D radars, is unfortunately quite sparse compared to the observing networks in the Lower 48. Alaska does have an advantage, however, with polar-orbiting weather satellites such as the Suomi National Polar-orbiting Partnership (S-NPP) satellite launched in October, 2011. Thanks to Alaska's high latitude and the low-earth polar orbit of satellites such as S-NPP, wildfires in Alaska will be observed by these satellites much more frequently than wildfires in the Lower 48.

The Visible Infrared Imaging Radiometer Suite (VIIRS) instrument on board S-NPP provides data that can be used to construct products helpful specifically to fire weather forecasters and fire behavior analysts.

VIIRS Imagery and the Funny River Fire on Alaska's Kenai Peninsula

A considerable advantage of the VIIRS is that it allows the generation of multispectral composites, or RGBs (meaning that the Red, Green, and Blue components of the finished composite are each a single VIIRS channel), that combine several images into new layered products. Given the number of I (imagery resolution) and M (moderate resolution) bands available from VIIRS, the number of possible RGB combinations is very large. Some of these RGBs have shown utility in the fire weather environment.

One potential disadvantage of RGBs is the learning curve required on the part of users encountering a seemingly strange array of colors in a new RGB. The VIIRS "True Color" RGB shown in figure 2 is thus a good starting point, since this product uses the 0.67µm M5 band as the red channel, the 0.56µm M4 band as the green channel, and the 0.49µm M3 band as the blue channel. These three bands reside in the visible portion of the electromagnetic spectrum and yield an RGB that looks much like a color image the human eye would perceive. In this figure, taken at 12:58pm local time, the location of the fire is indicated by the star, and the smoke plume can be seen curling down into the circulation of a weak cyclone in the Gulf of Alaska.

A somewhat less intuitive VIIRS RGB is the "Natural Color" image shown in figure 3. This RGB uses the 1.61µm I3 band for red, the 0.87µm I2 band for green, and the 0.64µm I1 band for blue. The resulting product includes wavelengths at the shorter end of the infrared spectrum but is still strongly influenced by incoming solar shortwave radiation and is highly sensitive to vegetation, which appears green. The image in figure 3 is zoomed into Alaska's Kenai Peninsula south of Anchorage and is from 5:48am local time, which means the sun is up but its angle of elevation is low. Shadow and texture effects very prominent, and, best of all, the smoke plume is well highlighted.

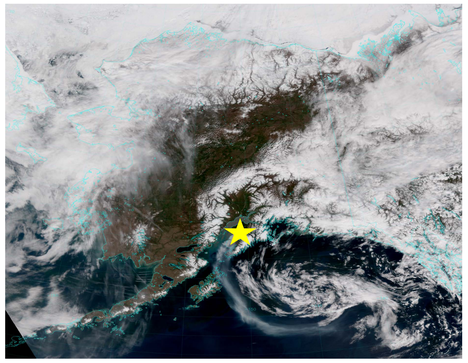

Figure 2: VIIRS True Color RGB, comprised of bands M3, M4, and M5, 2058UTC May 20, 2014.

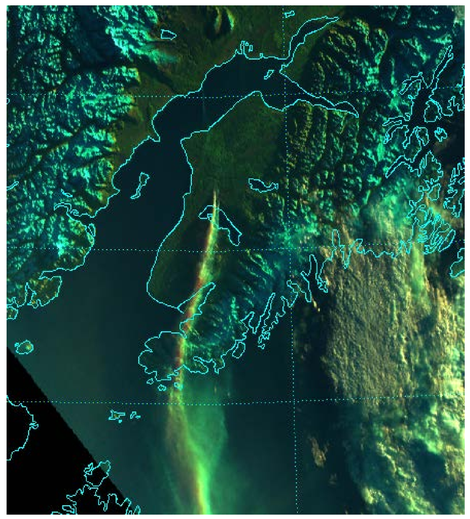

Figure 3: VIIRS "Natural Color" RGB, comprised of bands I3, I2, and I1,1348UTC May 20, 2014

The "Fire Temperature" RGB shown in figure 4 brings us even farther into the infrared, with the 1.61µm M10 band as red, the 2.25µm M11 band as green, and the 3.70µm M12 band as blue. This RGB clearly highlights the temperatures associated with the active fire front, and, due to its reliance on infrared wavelengths, can be helpful even at night. This RGB does suffer the common limitation of not being able to see through clouds, however.

A single-band VIIRS image should also be noted here for its utility during wildfire events such as the Funny River fire. The 3.74µm I4 band shown in figure 5 has been enhanced with a color curve highlighting the active fire front. Similarly to the Fire Temperature RGB, the I4 band is useful at night, but can also fail to depict a fire if higher clouds are present.

All of these VIIRS products are made even more helpful if a series of images are looped over time, and Alaska spans a range of latitudes that allow for several S-NPP passes per day.

Each example shown here was generated at the Cooperative Institute for Research in the Atmosphere (CIRA).

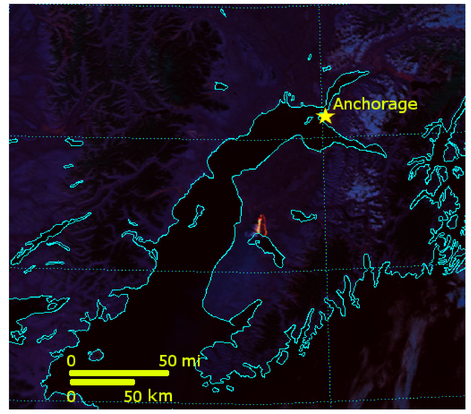

Figure 4: "Fire Temperature" RGB comprised of VIIRS bands M10, M11, and M12, 2159UTC May 20, 2014.

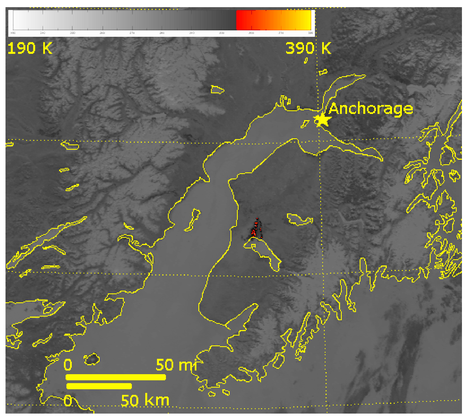

Figure 5: VIIRS midwave IR (3.74µm) band I4 colored to highlight active fire fronts, 2159UTC May 20, 2014. Colors begin at a brightness temperature of 340K.

Plans for the 2015 Wildfire Season

A goal for the 2015 wildfire season is to produce VIIRS-based fire weather products via an approach similar to that already used for MODIS (Moderate Resolution Imaging Spectroradiometer) products and to deliver them to the National Weather Service and Alaska Fire Service, and to do so on a routine, reliable basis with as little latency as possible, and in file formats appropriate to users' particular missions.

The methodology of generating these products demonstrated by CIRA could be performed on Alaska VIIRS data at GINA, perhaps on a virtual machine (VM) administered by CIRA and hosted by GINA. The University of Wisconsin's Community Satellite Processing Package (CSPP) software is also used at GINA and can play a role in product generation.

Data Cited and Acknowledgment

VIIRS imagery from the CIRA blog entry of May 23, 2014 http://rammb.cira.colostate.edu/projects/alaska/blog/index.php/uncategorized/funny-river-isnt-laughing/

Background image is a "Landcover" VIIRS RGB image over Alaska made from data received at GINA via direct broadcast, 2225Z May 24, 2014, and archived by GINA online at http://feeder.gina.alaska.edu

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