**VIIRS Aerosol Science and Operational Users Workshop**

**November 21-22, 2013**

**Case Study Worksheet for Operational Applications**

**Goals:** The goals of this breakout session are to give you the opportunity to view S-NPP VIIRS aerosol optical thickness (AOT) and true color (RGB) imagery in detail, anticipate how they will enhance air quality forecasting and/or analysis, and provide feedback to NOAA on data visualization and format options.

**Instructions:** There are two case studies to consider: September 9, 2013 (Rim Fire in California and smoke/haze in Mississippi River Valley) and July 2, 2012 (fires in southeastern Canada).

The two accompanying Power Point files contain general **air quality and meteorological information** about the events; review this information first to familiarize yourself with the air quality events. Then review the **S-NPP VIIRS AOT and RGB imagery** for the event, which are available on a special section of the NOAA IDEA website. Use the steps below to guide your analysis.

***Please answer the questions about the VIIRS products on the accompanying Case Study Questionnaire.*** Your answers will be the basis of the Group Discussion this afternoon.

**September 9, 2013 Case Study**

**Case Study Event Summary:** The Rim Fire was burning in central California, near Yosemite National Park, resulting in localized Code Yellow (Moderate), Code Orange (Unhealthy for Sensitive Groups) and Code Red (Unhealthy) PM2.5 conditions. An area of haze combined with smoke from agricultural fires was widespread across the Mississippi River Valley (MRV) and portions of the Great Lakes, Mid-Atlantic, and Southeast regions, resulting in widespread Code Yellow PM2.5 conditions.

1. **Open the accompanying “Sept 9 2013\_AQI\_Met” Power Point file and activate it in “slide show” mode*.*** The file can be downloaded from the VIIRS workshop website (<http://alg.umbc.edu/aqpg/viirs_workshop/>).

Review the air quality and meteorological information in the Power Point file:

* **24-hour average PM2.5 Air Quality Index (AQI) values for the CONUS (slide 2)**
* **Synoptic surface analysis and radar for 12-15 UTC (slides 3-4)**
* **NOAA Hazard Mapping System (HMS) Fire and Smoke Product (slide 5).** The HMS Fire and Smoke Product is a map of fire “hotspots” (red dots) and smoke plumes (grey areas) in the United States, Canada, and Central America. NOAA analysts prepare the map using data from GOES, MODIS, and other satellites, in conjunction with expert analysis.
* **Aqua MODIS RGB and AOD images (slides 6-7).** The Aqua satellite has an afternoon overpass (just like S-NPP), so these images correspond to observations at approximately 1:30 PM local time. Note the dark grey smoke plumes in central-east CA associated with the Rim Fire and the more diffuse haze in the MRV. If you are having trouble seeing the smoke plume or the haze in the true color image, look at the AOD image (slide 7). Areas of high AOD values (red, orange, and yellow colors) in CA correspond to high concentrations of PM2.5 from smoke, while the turquoise color in the MRV and Great Lakes region corresponds to haze.

1. **Open the link to the special section of the NOAA IDEA website where the VIIRS case study data are available:**

<http://www.star.nesdis.noaa.gov/smcd/spb/aq/viirs_workshop_2013/>.

Be sure you are on the **VIIRS CONUS** tab (not VIIRS Global).

**2a.** **Understand** the available AOT and RGB data products.

The VIIRS **RGB** imagery has **750 m** **resolution**.

There are two VIIRS **AOT** products:

* The **Intermediate Product (IP)**, which has **750 m resolution** (pixel level).
* The **Environmental Data Record (EDR)**, which is an aggregation of IP and has **6 km resolution**.

Note that the VIIRS AOT products are **provisional**, which means:

* Product quality may not be optimal
  + Product accuracy is determined for a broader (but still limited) set of conditions
  + No requirement to demonstrate compliance with specifications
* Incremental product improvements are still occurring
* The general research community is encouraged to participate in the QA and validation of the product, but users need to be aware that product validation and QA are ongoing
* Users are urged to consult the EDR product status document prior to use of the data in publications
* The data are ready for operational evaluation.

There are several levels of **quality flags** for the IP and EDR AOT, indicated by the **Select AOT & Quality** buttons on the right side of the imagery. Quality flags indicate whether AOT data are degraded for any reason, such as contamination by clouds. In general, users want to view **high quality data**.

* **IP High:** cloud-free IP AOT of the highest quality (use for quantitative applications).
* **IP High\*:** IP High AOT plus degraded AOT due to cirrus clouds or soil-dominated surfaces (use for qualitative applications – comparable to MODIS Aqua AOD).
* **IP High & Degraded:** IP High AOT plus all degraded AOT (see Table 2 in the Product Description for a list of degraded conditions).
* **EDR** AOT has 3 levels of quality flags: **High**, **Medium**, and **Low**, based on the number of IP AOT pixels with a particular quality flag falling inside or outside a threshold number (e.g., **EDR High** AOT are comprised of >16 IP pixels [out of a possible 64] and all of the IP pixels are **IP High** quality).

**2b.** Use the **select date/calendar** feature to select **September 9, 2013** and click the **Go** button.

**2c.** Use the **zoom slider** or **double click on the imagery** to zoom into the **Rim Fire** in CA.

**2d.** **Explore** the AOT and RGB data. Note that the default is **EDR High** AOT overlaid on RGB imagery.

* Use the **AOT Opacity** slider to completely hide the AOT data (drag the slider bar completely to the left). You should see the **dark grey smoke** from the fire in the RGB imagery in the vicinity of Yosemite National Park. Slowly move the **AOT Opacity** slider all the way to the right to see the EDR High AOT pixels that correspond to smoke from the fire.
* Click back and forth between the **EDR High** and **EDR High & Medium** AOT to see the differences in coverage between the two qualities of EDR AOT data.
* Click back and forth between the **IP High** and **EDR High** AOT to see the differences in coverage and pixel size between the IP and EDR AOT data.
* Click back and forth between the **IP High**, **IP High\***, and **IP High & Degraded** AOT to see the differences in coverage between the various qualities of IP AOT data.
* Use the **RGB Opacity** slider to completely hide the RGB imagery (drag the slider bar completely to the left). You should see the AOT imagery on a black background. Slowly move the **RGB Opacity** slider all the way to the right to see the RGB imagery underneath the AOT imagery.

**2e.** **Explore** the additional features and data visualization options.

* Use the **AOT Opacity** slider to completely hide the AOT data (drag the slider bar completely to the left). Click the **Toggle Fire Hotspots** button to turn the satellite-identified fire hotspots (red circles) on and off. These hotspots are burning fires identified by VIIRS. If you can’t see any hotpots, zoom out a little bit.
* While zoomed in on the fire, click the **Toggle County** button to turn county boundary lines on and off.
* Download some (or all) of the image files using the **Image Files Download** links at the bottom right, under the Toggle County button.
* Use the **Previous Forecast Day** and **Next Forecast Day** arrows (to the left of the **select date/calendar**) to quickly move back and forth between consecutive days. This is useful for a multi-day event, such as the Rim Fire, which burned for several weeks.
* The **Toggle Dusk Mask** button turns the VIIRS dust mask on and off. See the **Product Description** (link on upper right above the **Select AOT & Quality** buttons) for more information on the dust mask. There wasn’t any blowing dust on Sept 9, 2013 in the CONUS, so you won’t see any difference in the CONUS VIIRS imagery with the dust mask on. Use the **select date/calendar** to go to **Sept 4** and zoom in on NV/CA. Click the **Toggle Dust Mask** button to see isolated areas of blowing dust across NV and southern CA.

To get the full experience of the dust mask feature, click on the **VIIRS Global** tab and go to **September 15** using the **select date/calendar** feature. Click on the **Toggle Dust Mask** button and zoom in to northern Africa and the Arabian Peninsula to see widespread blowing dust.

**July 2, 2013 Case Study**

**Case Study Event Summary:**  Wildfires burned for several weeks during the early summer in Quebec province in southeastern Canada. On July 2, smoke from these fires advected south and mixed down to the surface, resulting in localized Code Yellow (Moderate), Code Orange (Unhealthy for Sensitive Groups) and Code Red (Unhealthy) PM2.5 conditions in northern New York State, northern New England, and southern Quebec. There were also widespread Code Yellow (Moderate) PM2.5 conditions across the MRV, Plains states, and TX due to haze and smoke from agricultural fires, as well as in northern CA and southern OR due to remnant smoke from wildfires.

1. **Open the accompanying “July 2 2013\_AQI\_Met” Power Point file and activate it in “slide show” mode*.*** The file can be downloaded from the VIIRS workshop website (<http://alg.umbc.edu/aqpg/viirs_workshop/>).

Review the air quality and meteorological information in the Power Point file, as for the Sept 9 case study (Step 1).

1. **Return to the special section of the NOAA IDEA website where the VIIRS case study data are available:**

<http://www.star.nesdis.noaa.gov/smcd/spb/aq/viirs_workshop_2013/>.

Be sure you are on the **VIIRS CONUS** tab (not VIIRS Global).

**4a.** Use the **select date/calendar** feature to select **July 2, 2013** and click the **Go** button.

**4b.** Use the **zoom slider** or **double click on the imagery** to zoom into the fires in **Quebec**.

**4d.** **Repeat** **steps 2d and 2e** to analyze the VIIRS AOT and RGB imagery for the Canadian fires. Note that this case study is a little trickier than the Rim Fire analysis, since clouds associated with a frontal boundary running from New England to the Gulf Coast are blocking satellite observation of the smoke advecting south to northern New York State and New England. But the smoke plumes from the source fires themselves are clearly visible in the AOT and RGB imagery.

1. Answer questions 1-5 on the **Case Study Questionnaire** about the VIIRS AOT and RGB products, visualization options, and data delivery.