**Satellite AQPG Annual Advisory Group Workshop**

**September 9, 2015**

**Case Study Worksheet**

**Goals:** The goals of this breakout session are to 1) give you the opportunity to view VIIRS aerosol products in detail, 2) anticipate how they will enhance air quality forecasting and/or analysis, and 3) provide feedback to NOAA on data visualization and format options.

**Instructions:** Please pick a range of days when your state/forecast area was impacted by smoke or dust this past summer. Some options include:

* June 8-12, 2015 (transported smoke in northern Plains, Ohio River Valley, Mid-Atlantic)
* August 20-29 (local and transported smoke in Washington, Oregon, and Idaho)
* August 30-September 4 (transported smoke in Great Lakes, Ohio River Valley, Mid-Atlantic, and New England)

Go to the **NOAA IDEA website** (<http://www.star.nesdis.noaa.gov/smcd/spb/aq/>) and look at all of the available VIIRS aerosol products for the days you selected. Use the steps below to guide your analysis. This breakout session will allow you to familiarize yourself with the VIIRS products available from IDEA, especially the newest updates.

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

1. **VIIRS AOT/RGB CONUS Imagery and quick comparisons to MODIS AOD/RGB and GASP**

From the **IDEA home page** (click on the light bulb in the upper left corner anywhere in IDEA to return to the home page), click on the **VIIRS CONUS tab** in the horizontal menu of tabs near the top of the page.

Then click on the image at the lower left, **Plots of VIIRS RGB and aerosol optical depth (AOD)**. You should see VIIRS RGB imagery overlaid with AOD for yesterday for the CONUS.

* Use the **calendar** near the top of the page to select the day of interest.
* Toggle through the various aerosol imagery available using the **Choose plot type** buttons:
  + MODIS (Terra)
  + MODIS (Aqua)
  + GASP animated and fixed frame
  + GASP west animated and fixed frame
  + VIIRS EDR
  + VIIRS IP
* Use the **AOD opacity slider bar** (located below the **Chose plot type** buttons) to remove the overlay of AOD so just the RGB imagery is visible.
* Use the Previous Day and Next Day arrows to the left of the calendar to follow the transport/evolution of the smoke plume for your days of interest.
* Hover your cursor over the CONUS imagery to see EPA region subsets; click on a region to see the AOD image(s) zoomed in for that region.
* Note the **Images download links** at the bottom of the page; try downloading one or more images to your computer.

1. **VIIRS CONUS RGB and AOD Zoom-In Interactive Tool**

From the **IDEA home page** (click on the light bulb in the upper left corner anywhere in IDEA to return to the home page), click on the **VIIRS CONUS tab** in the horizontal menu of tabs near the top of the page.

Then click on the image at the top left, **VIIRS CONUS RGB, EDR and IP AOD Images (with quality, zoom, etc)**. You should see a Google maps-based visualization tool with VIIRS RGB imagery overlaid with AOD for yesterday for the CONUS.

A reminder about the VIIRS products:

* The VIIRS **RGB** imagery has **750 m** **resolution**.
* There are two VIIRS **AOD** products:
  + The **Intermediate Product (IP)** has **750 m resolution** (pixel level).
  + The **Environmental Data Record (EDR)** is an aggregation of IP and has **6 km resolution**.

A reminder about the VIIRS quality flags:

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

Analyze the days of interest (when smoke was impacting your region) using the interactive visualization tool. Note that the default is **EDR High** AOT overlaid on RGB imagery.

* Use the **select date/calendar** feature to select the day of interest and click the **Go** button.
* Use the **zoom slider** or **double click on the imagery** to zoom in to your region of interest as far as you can go.
* Click back and forth between the **EDR High** and **EDR High & Medium** AOD to see the differences in coverage between the two qualities of EDR AOD data.
* Click back and forth between the **IP High** and **EDR High** AOD 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** AOD to see the differences in coverage between the various qualities of IP AOD data.
* Use the **RGB Opacity** slider to completely hide the RGB imagery (drag the slider bar completely to the left). You should see the AOD imagery on a black background. Slowly move the **RGB Opacity** slider all the way to the right to see the RGB imagery underneath the AOD imagery.
* Use the **AOD Opacity** slider to completely hide the AOD 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 (you may need to zoom out to the CONUS view if you are looking at a case of transported smoke). *Note that the fire hotspots are only available for IP AOD.*
* While zoomed in on the smoke, click the **Toggle County** button to turn county boundary lines on and off and click the **Toggle Dust/Smoke Mask** to see the areas of smoke (pink) and/or dust (orange) identified by VIIRS. *Note that the dust/smoke mask is only available for IP AOD.*
* 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.
* Download some (or all) of the image files using the **Save Image** link under the Toggle County button.

1. **Aerosol trajectories based on VIIRS, MODIS, and GASP AOD**

From the **IDEA home page** (click on the light bulb in the upper left corner anywhere in IDEA to return to the home page), click on the **VIIRS CONUS tab** in the horizontal menu of tabs near the top of the page.

Then click on the image at the top right, **48-hour aerosol trajectory forecast, with model winds and precipitation**. You should see an animation loop of winds vectors, precipitation (yellow shading), AOD, and trajectories (magenta, pink, and white streaming lines).

Read the [product description](http://www.star.nesdis.noaa.gov/smcd/spb/aq/traj_fx_desc.php) for more information on the aerosol trajectories. The trajectories are initialized at 50 mb, 100 mb, 150 mb, and 200 mb above surface level (in most cases) in locations with high AOD (>0.4). The air parcel trajectories are run using 12Z NAM forecast output. The pressure levels of the trajectories are plotted in mb and colored to a magenta-white scale. As the forecast trajectories progress in time, darker magenta color trajectories indicate a flow of air towards the surface, with a potential similar movement of the aerosols. White color trajectories indicate upward movement in the air flow, away from the surface. 850 mb wind field vectors (white) are plotted to show wind direction and speed. Areas where forecasted 3-hour accumulated precipitation is greater than 2kg/m2 are shaded yellow and represent the potential for wet deposition in areas of high aerosol loading.

Analyze the days of interest (when smoke was impacting your region) using the aerosol trajectories. The trajectories should give you an idea of the transport of aerosol-rich air into your region, and the potential for mixing into the boundary layer.

* Use the **calendar** near the top of the page to select the day of interest.
* Begin with the **VIIRS-based trajectories** for the day(s) of interest. Look for the transport of aerosol-rich air into your region and see if the trajectories are magenta (transport near surface) or white (transport away from surface) when they get to your region.
* Use the tabs near the top of the page to toggle between the trajectories initialized with **MODIS Terra AOD, MODIS Aqua and OMI AOD, and GASP or GASP West**.
  + Each of the AOD products has a slightly different AOD algorithm and/or observation time, so there will be some variations in the identified high AOD locations.
  + Note that for early afternoon forecast deadlines, the GASP-based trajectories may be the only ones available for the current day (forecast for “tomorrow”).
* You can **save the trajectories** by right-clicking on the figure and selecting “Save picture as…”