Questions & Answers Part 2

Please type your questions in the Question Box. We will try our best to get to all your questions. If we don't, feel free to email Amy Huff (amy.huff@noaa.gov) and/or Pawan Gupta (pawan.gupta@nasa.gov)

Question 1: How do we "match'' different AOD retrieval algorithms from different satellites? Or are they "matched" by design/default? (''match'' I meant like, fuse the data)
Answer 1: I'm not sure what is meant by "matched". AOD algorithms are developed for each satellite sensor specifically, but they are based on the heritage of previous algorithms. For example, the GOES-R ABI AOD algorithms are based on the heritage of the MODIS AOD algorithms and the early VIIRS AOD algorithms (Tanre et al., 1997; Remer et al., 2005; Levy et al., 2007, Vermote et al., 2007).

Question 2: I am interested in gridded PM2.5 data at fine spatial resolution over South Asia and India. Can you please suggest any dataset available or going to be available in near future for this part of globe from NASA. If no similar dataset is present, can we consider MAIAC AOD as an indirect indicator?
Answer 2: You can access global monthly and annual PM2.5 datasets at 1km resolution from https://sites.wustl.edu/acag/datasets/surface-pm2-5/

Question 3: On slide 12: what is the "diagonal edge" inside the visible image on the right?
Answer 3: That is the discontinuity from one swath (observation) of the VIIRS sensor on the SNPP satellite overlapping with the next swath. SNPP is a polar-orbiting satellite, so every time it makes an orbit, VIIRS is observing a new area of the Earth's surface. Adjacent VIIRS swaths are about 90 minutes apart.

Please refer to the part 1 presentation for more information on orbits and coverage.

Question 4: What is the maximum of ABI AOD which can be retrieved in the algorithm? 5? Can you extend to a higher number?

Answer 4: Yes, 5 is the maximum ABI AOD value. The algorithm actually does retrieve higher values, but the uncertainty in values > 5 is very large, so 5 is the maximum value reported.

Question 5: Is it possible to use the GOES database and the AerosolWatch platform for retrieving and analyzing fog events (duration, intensity and spatial variability)? What would be the main limitation in using AOD observations from satellites to analyze fog variability?
Answer 5: I would not recommend using AOD for fog. There are RGB (composite imagery) products developed specifically for fog, such as https://rammb.cira.colostate.edu/training/visit/quick_guides/QuickGuide_DaySnowFogRGB_final_v2.pdf and Night time micro physics https://rammb.cira.colostate.edu/training/visit/quick_guides/QuickGuide_GOESR_NtMicroRGB_Final_20191206.pdf

Question 6: How do I get the AOD data in CSV format from AerosolWatch website?
Answer 6: The AerosolWatch website does not offer csv downloads, only imagery.

Question 7: Are AerosolWatch's downloadable animations georeferenced?
Answer 7: The downloads are static image files (.png) or animated .gif files. The downloads include international/state/local boundaries and place labels, if you include those layers under the “Labels Layer” tab.

Question 8: In AerosolWatch is the disk coverage only the one we are seeing or can we switch it to the whole globe?
Answer 8: You can switch between the CONUS (continental US) sector and the full (hemispheric) disk sector. The GOES-R satellites are geostationary satellites, so they do not have global coverage.

Please refer to the part 1 presentation for more information on orbits and coverage. Himawari-8/9 satellites cover Asia with similar capabilities as GOES-R.

Question 9: Does NOAA Geostationary data support HARP? (HARP is open source package for handling OMI and TROPOMI data)

Answer 9: NOAA Geostationary products do not appear to be on the list of ingested products for HARP currently:
https://stcorp.github.io/harp/doc/html/ingestions/index.html

Question 10: What are the limits (in %) of the different DQFlags?
Answer 10: They don't have limits in percent. They describe the confidence in the AOD data. The criteria used for assigning the quality flags are given in the Algorithm Theoretical Basis Document (ATBD), Table 3.9 (p. 32) for retrieval over water and Table 3.13 (p. 47) for retrieval over land (https://www.star.nesdis.noaa.gov/atmospheric-composition-training/documents/ABI_AOD_ATBD_V4.2_20180214.pdf)

The important thing to remember is the recommended quality flags for specific applications: use high quality AOD only for quantitative applications (like data assimilation in models), and use "top 2" qualities (high + medium) for qualitative applications, like operational forecasting. Avoid low quality AOD for most applications, as it has large uncertainty.

Question 11: I am confused about the AOD Unsigned integer * scaling to Float... the max scaled value is ~5. I thought the standard range of AOD values is 0 to 1... What is the significance of an AOD value of 5?
Answer 11: In the NetCDF file, the AOD is stored as an unsigned integer with the bounds that you saw in the example. Multiplying those integers by the scaling factor and adding the offset is necessary to convert from the integer to the AOD value as a floating point number (with a range of -0.05 to 5). The "standard range" of 0 to 1 refers to AOD values we would "typically" see in the atmosphere; it is not the full range of ABI AOD. An AOD value of 5 corresponds to a very high Aerosol Optical Depth; this might represent very thick smoke.

Question 12: Is there a way to download AOD time-series for certain locations/points from AWS database without downloading the respective set of GOES images? This would be useful for users who need just the values at certain locations.
Answer 12: The data on the AWS archive are all netcdf4 files - there are no imagery files available. The AWS archive contains the satellite data files, which are in netcdf4 (.nc) format. You can download image files from the AerosolWatch website.

You can download a time series of files from the AWS archive. ABI data are available for the ABI scan sector - full disk, conus, or mesoscale. You cannot subset the netcdf4 data files to only download the data for a specific region (subset) of the entire sector. You would need to download the netcdf4 file for the sector, and then extract the data for the specific area of interest - similar to what we did in the Python example: we downloaded AOD full disk sector files and plotted only the AOD in central South America.

Question 13: Do libraries such as xarray in python also automatically apply scaling and offset?
Answer 13: I believe this is done automatically by xarray when you use the correct netCDF4 decoder, but you should verify this yourself before using it: read the AOD variable into an array and then print out the array. Are the AOD values floating point numbers, or are they unsigned integers? If they are floats, then xarray converted the stored AOD values for you.

It may be helpful to refer to the documentation for the specific library to verify what options are available.

Question 14: For some reason my files do not contain the AOD variable. They do have the DQF information though. Any thoughts on how I can fix this?
Answer 14: Look at the name of the file you downloaded (the long name that begins with “OR_ABI”); does the file name start with “OR_ABI-L2-AODF”? If it does, you downloaded the correct file. If it doesn’t, then try downloading again, and be sure to select “Aerosol Optical Depth” from the “Product” pull-down menu in Block 6.

Question 15: On AerosolWatch, the available data seems to span UTC 13:32 - 14:47 (@6 steps). Should full daylight hours be available? I am looking at April 12, 2018.
Answer 15: The most recent ~1 hour of data load automatically when you open AerosolWatch, and that range is retained when you change dates. To change the animation times, go to the top of the page, where you see the little blue buttons. Click on the button with the clock, which will allow you to select the animation range.

Question 16: Can you explain what is angstrom exponent vs AOD?

Answer 16: The Angstrom exponent is the slope of the logarithm of AOD vs the logarithm of wavelength at which AOD is measured. It provides basic information about the aerosol size distribution: Angstrom exponent is inversely proportional to the average aerosol particle size, so the larger the Angstrom exponent, the smaller the average size of the particles.

Question 17: Can you explain more about bands versus wavelength for the measurements?
Answer 17: Spectral bands (also called channels) are the wavelength ranges of the electromagnetic spectrum which are measured by a satellite sensor. For example, ABI has 16 spectral bands.

Question 18: In the beginning of the webinar in some slide it was given the range of the AOD varies from -0.05 to 5, but we know that AOD is thickness so how can it be negative?
Answer 18: This is explained on Slide 6. Small negative values of AOD in the ABI AOD retrieval represents the uncertainty in the AOD retrieval. You can think of the negative AOD values as representing very small positive AODs, which are made slightly negative due to the uncertainty.

Question 19: Is there any work being done to develop better imagery or products of the areas that are currently difficult to map, such as the caribbean due to glint, and coastal areas
Answer 19: Sun glint is not a permanent feature and it varies during the course of the day. Amy has a twitter feed @AerosolWatch that shows imagery over the Caribbean, see for example https://twitter.com/AerosolWatch/status/1554119247051333633

Jun Wang's group at the University of Iowa has developed a method to retrieve AOD over shallow and turbid water, such as coastlines, see for example: https://arroma.uiowa.edu/docs/publication/paper_pdf/2021/Yi_GRL_grl62897.pdf

Question 20: How do we cite or acknowledge who provided the code if we use it?
Answer 20: Please acknowledge the "NOAA/NESDIS/STAR Aerosols and Atmospheric Composition Science Team" if you use the code.

Question 21: As shown in a graph, the AOD retrieval error is different for different acquisition time slots for the same day. Could you comment on this?

Answer 21: I think you are referring to Figure B on Slide 9 - there is a slightly larger difference between ABI AOD (red line) and AERONET AOD (blue line) in the early morning and the late afternoon. This is due to the relatively large solar zenith angle at these times, which causes larger uncertainty in the ABI AOD retrieval.