



Advanced Webinar: Data Analysis Tools for High Resolution Air Quality Satellite Datasets

January 17, 19, & 22, 2018

Questions & Answers Sessions

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 Pawan Gupta (pawan.gupta@nasa.gov) or Melanie Follette-Cook (melanie.cook@nasa.gov) your question(s).

Question 1: How can I know the correct intercept and slope to calculate pm2.5 from AOD for my study region?

Answer 1: So this is a good question - there are many different ways. 1) I strongly recommend on the ARSET website we have conducted a specific webinar on how to get PM2.5 from AOD observations. It's an advanced webinar, we did it in 2015 (<https://arset.gsfc.nasa.gov/airquality/webinars/advanced-AOD-PM>). Go watch the recordings, go over those materials, and that will give you a lot of information on how to do this. 2) you perform the analysis if you have some ground measurements at your location/ROI and use those slope/intercept for that region. 3) search for literature/published papers - people have done this analysis for various global regions. You might be able to find that info in some of the published work.

Question 2: How we can run the code without select option 'y/n' each time?

Answer 2: This is simple - right now the codes are set up to take the input from the command line from the user so the user can make the decision. It's simple - you can go inside the code and change that. You can either just say whatever input variable they are reading, y/no comment that and give a y/n value there and the code won't ask and by default run. You can also do more advanced things so the code can run automatically for 100s of 1000s of files so it doesn't ask every time.

Question 3: Can I calculate co2, NO2 content or any other specific gas for regional scale?

Answer 3: Assuming the question is supposed to say SO2. This question also applies to aerosols. If you're calculating a regional mean or other kind of statistic, then you can use the vertical column values contained within the files to calculate various statistics you might be interested in. You can define lat/lon boundaries of a region either as a rectangle or a polygon shape (sometimes people also calculate statistics for



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a specific shape such as administrative boundaries, country/state boundaries, counties, etc.). To do that using the provided tools, you would have to really modify the codes more. You can search on the internet to see examples of these kinds of solutions, such as how to extract the data for certain boundaries.

If your goal is to grid the level 2 data and then average it, that's something that needs to be done very carefully. Coarser resolution, gridded products are available from the NASA Giovanni website (<https://giovanni.gsfc.nasa.gov/giovanni/>), but those are Level 3 products.

Question 4: how can we get the local slope and intercept value? - AOD-PM2.5

Answer 4: See above

Question 5: can I be able to download the recordings? Over here in Nigeria, we have issues of electrical power supply and I have not been able to attend the session fully.

Answer 5: The ARSET recordings are available on the website via streaming. If you have a PC, you may be able to download the recording through GoToWebinar.

Question 6: What can u say about OMI AOD data called as OMAERO?

Answer 6: OMAERO is an aerosol product from OMI sensors. It is a product that comes out from the KNMI, the Netherlands agency developed the OMI sensor. It's a multi-spectral channel-based aerosol algorithm that use 16-18 different channels to retrieve AOD and other aerosol-related parameters. I don't have much of an idea of the quality of the products - you might have to browse literature or their website. But the data is available to download from NASA Earthdata (where other OMI data is available). NASA has a similar product: OMARUV. The only difference is they use different types of algorithms to get the information (and that's true for other cases as well)

Question 7: Why NO2 is not also reported in Dobson Units??

Answer 7: Most column quantities are reported in molec/cm². SO2 is historically reported in DU because retrievals of SO2 began as an effort to remove an artifact from the total column ozone (TCO) retrievals. TCO is reported as DU, so SO2 was as well.

Question 8: Fabulous the informatic language python, I have the following question, it is possible to use the data of MODIS, for my country that is Guatemala, and what



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methods I advise to use for the adjustment of data, as they are more real, since I have the points geographies with spectrophotometry data for pm10 and pm 2.5.

Answer 8: Again - the answer is similar that all MODIS data is available globally. It should be available in your country as well. To calculate PM2.5 from AOD you need some kind of local AOD/PM2.5 relationships. Or you'll have to look for articles where people have already done it. You can also check the quality of MODIS data by going on one of the algorithm webpages from session 2 - darktarget.gsfc.nasa.gov and darkblue.gsfc.nasa.gov - those two websites provide some information on global validation results of their product.

Question 9: The data of pm10 and pm2.5, we have them on an annual basis, and what role play the pm10 and pm2.5 that are data of the WHO?

Answer 9: There is PM2.5 data from WHO that comes out as a combination of model - satellite and ground data, but it's only available for 2014. Other data available on WHO website is either reported by individual countries, over specific stations, and you'll be able to find more info on the WHO website.

Question 10: There are many diseases associated with air quality, the smallest aerodynamic particles directly influence the alveoli of the human being, from the epidemiological point of view the causal agent can not be proven, however, advances in science such as the application of this online training contributes a lot, among other pollutants we can talk about Volatile Organic Pollutants and Persistent Organic Pollutants, in addition to obtaining data through Python, it will be possible to obtain this data at the level of shape for QGIS , ARCGis or any other free software?

Answer 10: To rephrase part of the question, "can we extract data using python or other software for a specific shapefile that can be used in GIS software?" We (ARSET) don't have any ready-made software that can do this job for you. If you search the internet, you can find examples of python scripts that will read a shapefile, read corresponding datasets, and extract the data for that particular file. You might have to modify the codes, but we don't have ready-made code to do that for Level 2 data. There are options for L3 (Giovanni: <https://giovanni.gsfc.nasa.gov/giovanni/>) that were mentioned earlier.

I think the second part of the question is asking about satellite observations of VOCs and their applicability to surface observations. Currently there are column satellite observations of formaldehyde (HCHO) and glyoxal (CHOCHO), which have been used



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as indicators of tropospheric VOC emissions. However, usually these products are most reliable on a monthly mean basis.

Question 11: how to process the averaging kernel variable from OMI NO₂

Answer 11: A lot of people, when comparing model output with OMI, post-process their output using what's called an averaging kernel for a more appropriate comparison. Satellite observations are inherently more sensitive to some altitudes of the atmosphere than others. Using an averaging kernel allows a user to see their model output as a satellite might actually view it.

For the OMI NO₂ data I think it's recommended to *not* use the averaging kernels to do this. In order to compute *vertical* column density, the OMI NO₂ algorithm retrieves tropospheric *slant* column density and divides this by what is called a tropospheric air mass factor (AMF). The tropospheric AMF is a function of atmospheric and surface properties and an a priori model NO₂ shape profile. The atmospheric surface properties are summarized in the OMI scattering weights, which are provided in the Level-2 files. From Krotkov et al. (2017), "The AMF [...] is computed as the vertical integral of the NO₂ profile shape-weighted average of [the scattering weight vector]. Also from Krotkov et al. (2017), averaging kernels can be calculated from the scattering weights and the AMF for tropospheric columns. Equations are included in the paper (section 3.2):

<https://www.atmos-meas-tech.net/10/3133/2017/amt-10-3133-2017.pdf>

And there is a discussion of this in Lamsal et al. (2014)

<https://www.atmos-chem-phys.net/14/11587/2014/acp-14-11587-2014.html>

Question 12: How can I resample swath OMI data to a grid Geotiff format?

Answer 12: We don't currently have a tool to convert Level 2 data to GeoTIFF format. But if you would like gridded level 3 OMI data, it is available from Giovanni (<https://giovanni.gsfc.nasa.gov/giovanni/>) for both NO₂ and SO₂ at coarser resolution than we've talked about here.

Question 13: When evaluating AOD, we saw reasonably strong correlations to surface PM_{2.5} concentrations using a simple linear model. Do any OMI parameters predict ground-level concentrations of gaseous pollutants in a similar way?



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Answer 13: For SO₂ the column SO₂ PBL product is meant to represent the column as if the SO₂ plume is nearest the surface. This product has actually been used to estimate SO₂ emissions (<https://so2.gsfc.nasa.gov/>).

For NO₂ as I stated earlier, NO₂ is relatively short lived - on the order of hours to days - so it tends to be most abundant in the lowest levels of the atmosphere and have very high spatial variability around its sources. So NO₂ is a good example of a quantity whose surface value can often be related to the column value. This is usually done using other information from an atmosphere model, for e.g. taking the modeled ratio of surface to column and applying it to your observed column value to calculate an estimated surface value. A group from Dalhousie has done this for OMI NO₂ to compute annual mean surface NO₂ from OMI:

http://fizz.phys.dal.ca/~atmos/martin/?page_id=232

Question 14: Is data loss valid for OMI AOD data? Do u have an idea?

Answer 14: If this question is referring to the row anomaly, I believe any row anomaly feature is filtered out for all of the OMI data.

Question 15: Are there any freely available models to predict a much refined relation between PM_{2.5} and AOD data than a mere linear relation.

Answer 15: The answer is yes and no. Because it depends on where you are. There have been a lot of research done over the U.S. because there's a lot of ground measurements available. People have gone beyond the linear relationship models, and used non-linear, machine learning, combo of ground & satellite data. They are available on daily and annual scales, one from NOAA called - it's a joint NASA/NOAA/EPA project and data is created on a daily basis: the IDEA project. Search for IDEA NOAA and you'll be able to find it there. Other parts of the world - I would say still lack in these more sophisticated models and they aren't available. There's been a lot of work in china - a lot of people have used more complicated, sophisticated models.

Question 16: can I find the OMI data at LAADS DAAC?

Answer 16: No, LAADS only provides MODIS data. To get OMI data, you have to go to NASA Earthdata and use your same login. Instructions are on the PPT in the training website.

Question 17: Is VIIRS AOD data validated over Indian region?



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Answer 17: Yes - VIIRS data is processed by NOAA and they have validated over the global region, including India. The data quality looks good. I strongly recommend you read the papers - send Pawan an email and he can send you the specific validation paper for VIIRS over global regions and that will provide you more information.

Question 18: How to extract smoke mask from VIIRS data?

Answer 18: A product available through the [IDEA website](#) that I mentioned earlier. If you are looking for global, there's a [NOAA Class product](#) available. I don't remember the web address off the top of my head, but if you search for it, you'll find it. Or send us an email and we'll send you the proper link.

Question 19: Is it reasonable to assume that these codes can be easily modified to use the o3 returns from aqua?

Answer 19: Yes. You can modify easily to get ozone data as well.

Question 20: Where can we best access the VIIRS data?

Answer 20: VIIRS data is available from NOAA Class website let me find it real fast - the website is currently down, it's called [NOAA class](#) data download and you should be able to find it when the U.S. government reopens.

Question 21: Why doesn't the giovanni website have modis 3km product for aerosol optical depth?

Answer 21: The giovanni website is designed to handle L3 data only because if you go to L2 and high resolution data, the volume becomes very large and hard to handle in near real-time. That's why giovanni only hosts L3 data products. There have been other tools in development right now that will actually perform a similar task as giovanni with L2 data, but they're still in development.

Question 22: I have a question, if after these seminars, before adjusting some superficial data with the data of MODIS, we can consult you for any doubt that may arise, since the only way to learn your application is to exercise on the subject, and if that were the case, we could contact them by mail

Answer 22: Yes, please contact us by email if you have more questions. We'll be happy to respond.



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Question 23: When OMI loses 50 % of the data, I think more data is lost near the tropical zone? In that case how can we assure the quality of the product.? How can we assure that data quality is good?

Answer 23: The row anomaly causing data loss for OMI is already filtered in the NO₂ and SO₂ column values and that will be indicated by the fill values that are very, very large negative values. The exact numbers are on the slides you can download. To ensure you're using the best data, please refer to the tables included in the powerpoint, those are what the developers advise users to use as far as filtering the data using parameters such as radiative cloud fraction, terrain reflectivity, and solar zenith angle.

Question 24:Wavelength sensitive to NO₂ and SO₂

Answer 24: NO₂ is measured in visible and near UV from 400-565 nm. SO₂ is measured in the region about 310-340 nm.

Question 25: Is there an algorithm for AOD that does not discard the image due to cloudiness?

Answer 25: The short answer is no. But there are algorithms to detect aerosols above the clouds. If there is a cloud underneath - if there's an aerosol layer underneath the clouds, it's really not possible to see from the imager. But if you look at the data from active sensors like CALIPSO that has a laser, it can provide you the vertical profile. If the cloud isn't very thick, it can see the aerosol layer underneath the cloud and provide you the AOD from that. Not possible from the passive sensors.

Question 26: TROPOMI could be used to find concentrations of PM_{2.5} ?.

If so, where could I find information?

Answer 26: At this point, TROPOMI data has not been released. Once they release the data, we'll know more about the data and what we can and cannot do with that.