Part 1 Questions & Answers Session

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 Brad Quayle (brad.quayle@usda.gov), Jenny Hewson (jennifer.h.hewson@nasa.gov), or Diane Davies (diane.k.davies@nasa.gov).

Question 1: I've noticed false detections at open pit mine sites in Arizona (high "reflectance"). Is this a known problem? Here is an example: https://firms.modaps.eosdis.nasa.gov/map/#d:2026-01-12;@-110.806,33.415,11.393z.

Answer 1: As you mentioned, the site you have noted is a large open pit mine, but also on that site is a large copper smelter facility. So, these detections are not false positives but are related to the thermal activity associated with that facility. This site is part of the FIRMS static thermal anomaly (STA) inventory and can be viewed at this FIRMS link:

https://firms.modaps.eosdis.nasa.gov/map/#m:advanced;d:2026-01-12;l:fires_landsat_landsat,fires_modis_aqua,fires_modis_terra,fires_viirs_noaa20,fires_viirs_noaa21,fires_viirs_snpp,sta_mask,countries,earth;@-110.826,33.417,12.393z.

For more context, this FIRMS link below shows the known industrial sources: https://firms.modaps.eosdis.nasa.gov/map/#m:advanced;d:2026-01-12,2026-01-12;l:fires_landsat_landsat,fires_modis_aqua,fires_modis_terra,fires_viirs_noaa20,fires_viirs_noaa21,fires_viirs_snpp,cement_plants,gas_flares=2023,gi_steel_plants,mineral_resources,nonferrous_metal,petro_chemical,sta_detections,sta_mask,steel_plants,country-outline,earth;@-110.806,33.415,11.393z.

Question 2: Do you have any recommendations for identifying and classifying different human-activity-related fires, like industrial fires and fires resulting from military activity (rocket launches, explosions, burnt tanks, etc.)?

Answer 2: There are spatial inventories of industrial facilities available (e.g., steel mills, power generation plants, etc.) which can be used to discern detected fire activity that may be related to human activity. These data can be used with satellite active fire detection data to characterize persistently detected activity at a particular geographic location. FIRMS has identified a number of these inventories and provide them for

users to access and view. Please see the individual descriptions for these layers under the Industrial Plants and Power Plants groups in the FIRMS legend to learn about the sources for these data. Potentially detecting all highly ephemeral incidents like explosions and rocket launches with polar orbiting Earth observation satellite data would be more challenging since the satellites can only potentially detect thermal activity at the time of overpass, and there are not enough of them in a satellite constellation to ensure persistent observation coverage of the entire surface of the Earth at all times. Additionally, the anomaly would need to be hot enough and/or large enough to be detected by a polar orbiting satellite. So, more than likely, you may potentially detect fire activity that may persist after an explosion depending on the size and intensity of the fire.

Question 3: Though not a fire application, is this "ensemble" imagery able to be used for fog detection (especially at night)?

Answer 3: Yes, true color composite imagery provided in FIRMS can be used to detect fog during the day. Here is a recent example of fog in India posted by NASA using Terra MODIS true color imagery: https://www.earthdata.nasa.gov/news/worldview-image-archive/dense-fog-over-northern-india. The VIIRS Black Marble image products, such as the Blue/Yellow composite imagery, can potentially be used to discern areas of fog during the night depending on the conditions. The following map displays the NOAA-20 VIIRS Blue/Yellow composite imagery for southern California which can be used to view not only clouds, but the nightly fog/marine layer that moves inland on a nightly basis (https://firms.modaps.eosdis.nasa.gov/map/#m:advanced;d:2025-05-21..2025-06-20,2025-06-20;l:sta_mask,countries,noaa20_bm_by,earth;@-116.2,33.3,9.0z).

Question 4: Do these datasets extend to as early as 1995? What is the temporal resolution for these datasets?

Answer 4: The MODIS data records start in November 2000 and VIIRS in January 2012. There are some active fire detection records from AVHRR extending back to the early 1990s but these are not available through FIRMS.

FYI:

MODIS C6.1 is available from November 2000 (for Terra) and from July 2002 (for Aqua) to the present.

- ■ VIIRS 375 m (S-NPP) data are currently available from 20 January 2012 to the present.

- VIIRS 375 m (NOAA-20) data are currently available from 01 April 2018 to the present.
- VIIRS 375 m (NOAA-21) data are currently available from 17 January 2024 to the present.
- LANDSAT 30 m OLI (8 / 9) data are currently available from 20 June 2022 to the present.

Question 5: Do LANDSAT or SENTINEL have a burned area product as well?

Answer 5: There isn't currently a NASA LANDSAT or SENTINEL-2 burned area product available through FIRMS. However, there are the NASA 500m MODIS and VIIRS burned area products which are provided in FIRMS map viewer under the MODIS and VIIRS Burned Area groups. Please see these recent NASA EarthData blogs about use of the MODIS and VIIRS burned area products in FIRMS (https://www.earthdata.nasa.gov/news/blog/enhanced-tools-interannual-monthly-comparisons-burned-area and https://www.earthdata.nasa.gov/news/blog/viirs-global-burned-area-product-added-firms).Plus, for example, the HLS normalized burned ratio (NBR) product and the HLS false color composite (FCC) imagery – both accessible in the Harmonized Landsat Sentinel-2 Imagery group of FIRMS legend – and these can be explored to see if they are useful for your application.

Question 6: What is the spatial resolution of the sensors? Also what are the smallest emissions that can be detected? For example, is it possible to detect emissions from small commercial generators?

Answer 6: The spatial resolution of the sensors as well as the data products varies. For example the Harmonized Landsat Sentinel (HLS) imagery and Landsat active fire (AF) detections have a spatial resolution of 30m, and is currently the finest spatial resolution product available in FIRMS; MODIS AF detections (1km); VIIRS AF detections (375m); the geostationary AF detections have a spatial resolution between 2-3km. As far as whether it is possible to detect emissions from small commercial generators, the active fire products do not detect emissions.

Question 7: Why aren't OMPS and PyroCB indices merged into a single aggregate index? The selection of when to use each seems from a first glance quite algorithmic.

Answer 7: The OMPS Aerosol index signal remains below 5.0 for most smoke and dust events, and so the OMPS AI product with an AI range of 0.0 to 5.0 satisfies the needs of

most LANCE users. But to provide better near real-time imagery for these high AI events, the OMPS and LANCE teams designed a new pyroCb product with an upper AI limit of 50.0. The design team also removed flags that screened out unusually high AI values. The resulting OMPS PyroCumuloNimbus AI product more accurately captures high AI events and makes it easier to track the spread of high aerosol concentrations in the atmosphere. Please see the following two NASA EarthData blogs for more information about use of the OMPS aerosol indices in FIRMS and application of the PyroCB aerosol index for recent wildfire events.

- https://www.earthdata.nasa.gov/news/blog/viewing-smoke-firms

Question 8: Are solar power arrays also in the static thermal anomaly files?
Answer 8: The MODIS and VIIRS algorithms are designed to minimize the occurrence of false positives due to sun glint from solar panels and other specular surfaces. However, they can still potentially still be present in active fire data. The FIRMS team used active fire detection data to identify features that were routinely detected. So, yes, it is possible that some STA features may be false positives from glint from solar panel arrays; but their prevalence in the STA dataset is significantly reduced due to the robust design of the MODIS and VIIRS active fire detection algorithms.

Question 9: What is the spatial resolution of the sensors used in the case of the Canadian Fires?
Answer 9: All the current satellite sensors used in FIRMS can be leveraged to detect past and current fire activity in Canada. Detected historical fire activity occurring within the temporal extent of the data record of each satellite sensor can be mapped for Canada and elsewhere in the world, with the exception of the Landsat active fire data which is only available for most of North America. The spatial resolution of the fire detection data derived from polar-orbiting sensors and the extent of their data records are provided below:
- Terra MODIS - 1km (November 2000 to present)
- Aqua MODIS - 1km (July 2002 to present)
- SNPP VIIRS - 375m (January 2012 to present)
- NOAA-20 VIIRS - 375m (January 2020 to present)
- NOAA-21 VIIRS - 375m (January 2024 to present)
- Landsat OLI - 30m (June 2022 to present)

Question 10: Can we use this satellite or your tools to monitor high-risk areas for fire potential and use that information for fire prevention?

Answer 10: Yes. Each VIIRS sensor onboard SNPP, NOAA-20 and NOAA-21 provide <u>complete</u> coverage of the globe on a daily and nightly basis. Terra and Aqua MODIS respectively provide <u>near</u> global coverage on a daily and nightly basis. Collectively, these five sensors provide 8-10 daily observations of any location in the equatorial to mid-latitudes, increasing to 15-20 collective observations in the polar latitudes. As a result, these polar orbiting observations combined with much higher temporal frequency geostationary observations can be used to observe high-risk areas for new wildfire ignitions to help inform initial response activities and/or monitor the rapid growth of existing fire activity.

Additionally, FIRMS provides the ability for users to set up alerts for defined areas of interest. These alerts can be configured for users to receive timely notifications about newly detected fire activity identified by MODIS or VIIRS.

Question 11: I am already using NASA FIRMS data to visualize 'live fire hotspots'. Are there any related open source repos? Any best practices or standards for visualizing the various data as 'layers'?

Answer 11: In addition to using NASA FIRMS to visualize the active fire (AF) detections, the detections are available for download from the *Active Fire Download* dropdown. You can also sign up for a fire alert for a particular area of interest and receive an email notification when active fires are detected in that area. As far as best practices for visualizing the data layers, some considerations include:

- The role of cloud cover and thick smoke which can impact the detection of active fires and affects both polar-orbiting and geostationary AF detections. Users can review the MODIS or VIIRS or geostationary imagery that is available through FIRMS to assess the presence of clouds or smoke for a particular area of interest. Please see [this blog](#) for more information.
- The geostationary AF detections change as observations increase from the sub-satellite point towards the edge of the disk due to the systematic pixel growth away from the sub-satellite point. Geostationary active fire detections also have a coarser spatial resolution and are less sensitive to small fires. Please see [this blog](#) for more information about the Geostationary active fire data.
- Additional tips and more information is available in the FIRMS blog (https://www.earthdata.nasa.gov/news/blog).
- The FIRMS FAQ (https://www.earthdata.nasa.gov/data/tools/firms/faq) is also a great resource.

Question 12: Is it possible to track the GHGs concentration in the smoke direction?

Answer 12: Active fire detections and smoke don't directly detect GhG but can be used in the calculation of diff GhG estimates. It can't be done using the tools from FIRMS.

Question 13: What are your views on utilizing SAR and hyperspectral data for the same task? What benefits can it potentially bring?

Answer 13: There has been some research and applications on the Synthetic Aperture Radar (SAR) for mapping active fires. As an active sensor, it can penetrate clouds and thick smoke. Additionally, SAR is used to map burned areas, particularly in areas where persistent cloud cover is an issue. The FIRMS team looks forward to possibly leveraging soon to be available SAR data and products derived from the NISAR mission (https://science.nasa.gov/mission/nisar/). Hyperspectral imagery has been used for post-fire mapping and assessment of burn severity. Hyperspectral data cubes are large datasets and require time and resources to process, which historically has made their availability to support near real-time needs relatively difficult.

Question 14: How would you suggest using the aerosol/smoke identification with the presented tools to further analyze air quality?

Answer 14: Aerosol index in FIRMS is best used for smoke and dust events. Since it detects aerosols within a column of the atmosphere, it may not be representative of conditions at ground levels (for assessing health implications). Its strength is looking at smoke and large dust clouds and their propagation over long distances.

Question 15: Apart from MODIS fire points data for validation, is there any other higher resolution dataset from FIRMS?

Answer 15: Active fire detection data from Landsat 8/9 OLI (30m) and SNPP, NOAA-20 and NOAA-21 VIIRS (375m) are available in FIRMS. Each source has relatively higher resolution compared to the MODIS 1km active fire detection data. Landsat and VIIRS data would offer opportunities to use as validation data, but the daily orbits and overpass times would need to be evaluated and considered to determine if it would be appropriate to use for validation of MODIS active fire data on given days.

Question 16: What do you advise for fine-scale post fire detection and analysis. It looks like the highest spatial resolution yet is the HLS at 30meter resolution. Do you think downscaling would be a viable option?

Answer 16: The Landsat and Sentinel-2 imagery provided at 30m spatial resolution in the HLS dataset are ideal for use in mapping the extent of burned areas and characterizing fire impacts at a landscape scale. These are the highest resolution image datasets available in FIRMS. Other sources of imagery potentially available for post-fire mapping and assessment include commercial high-resolution satellite imagery (Maxar, Planet, etc.), which have spatial resolution ranging from 1 to 4 meters, and aerial imagery commonly available at spatial resolutions less than 1m. Downscaling of moderate resolution imagery is a viable option is higher resolution imagery and other sources of ancillary data and the application of reliable methods/techniques.

Question 17: How can these algorithms be finetuned, as in with machine learning?

Answer 17: AI/ML is being tested and evaluated with the algorithms for some satellite data algorithms/products, including active fire detection algorithms. At this time, the active fire detection data FIRMS are based on the traditional heritage approach algorithms used for fire detection for multiple decades, which are very reliable and accurate. The same applies to the OMPS aerosol indices. ML could be used to speed up processing but for the AI the algorithm is simple and already processes quickly, There is perhaps work currently being done with Aerosol Optical Depth (AOD) algorithms to speed up the processing.

Question 18: Could you revisit the navigation to get to the Blue/Yellow color scheme (related to the fog question).

Answer 18: To access the SNPP and NOAA-20 VIIRS Black Marble imagery products in FIRMS, which includes the Blue/Yellow composite imagery, while in the ADVANCED MODE please see the "Dynamic Imagery" group in the legend. These image sources are available in the lower portion of the list of imagery layers.

Question 19: Can we understand the intensity of the thermal anomaly coming from the VIIRS data?
Answer 19: The AF detection attributes include the Fire Radiative Power (FRP) of the detection which reflects the intensity or energy release of the detected fire. FRP, measured in megawatts, is estimated for each active fire detection at the time of satellite observation. Please see this FAQ for more information regarding the FRP: https://www.earthdata.nasa.gov/data/tools/firms/faq#heading-accordion-124439-9.

Question 20: Do the FIRMS products available in Google Earth Engine have the same temporal accuracy as they appear in FIRMS platform?
Answer 20: Google Earth Engine ingests MODIS and VIIRS active fire detection data provided by NASA, including FIRMS near real-time data. However, users should closely examine the data in Google Earth Engine to verify the version of the data and also be aware of latency in the availability of the data in that platform if attempting to use it for low latency applications.

Question 21: Could you explain a bit more about Pyro CB, I live in an region prone to intense bush fires but haven't heard about this Phenomenon,
Answer 21: PyroCb is an intense fire event where the fire is large and hot enough where you get a huge uplift to higher layers of the atmosphere (tropo/strato). The smoke can travel very long distances. This NASA EarthData article provides an excellent overview of the OMPS PyroCB aerosol index product https://www.earthdata.nasa.gov/news/feature-articles/new-omps-product-provides-better-view-high-aerosol-events.

Question 22: Is it possible to determine the extent of a fire perimeter, if it's much less than 30m resolution of the FIRMS product?
Answer 22: A 30m pixel equates to approximately ⅕ of an acre or 1/10 of a hectare. If a single pixel at this spatial resolution was at least partially affected by fire, it would have effects on the spectral response from that pixel and possibly would be detected as "burned" in a given algorithm. However, it would not be possible to visually interpret a perimeter for a fire approximating ⅕ of an acre in size within a pixel and delineate a vector boundary around it. Higher spatial resolution imagery would be needed.

Question 23: Are FIRMS data products downloadable as raster types? If yes, at what spatial resolution is it delivered.

Answer 23: All the downloadable active fire detection data in FIRMS are available in vector (point) format. These points represent the centroids of an active fire detection pixel from their respective sensor sources. MODIS and VIIRS active fire detection products are available from NASA (see NASA EarthData) as raster data in Hierarchical Data Format (HDF) format.

Question 24: Is it possible to use FIRMS application to detect both active crop field burning (near realtime as 3 hrs) and identify areas that have already been burned (burn scars), especially the start of combustion?
Answer 24: Detection of field burning would depend on the spatial extent, intensity and timing of the burning.
For field areas that have already burned, detection would depend on the residence ash and other discernable first order fire effect as well as land use practices. Users can explore the false color imagery or NBR products available in the HLS imagery dropdown menu to explore agricultural burning detected by MODIS, VIIRS or Landsat active fire detection products as well as geostationary active fire detection. The latter has very high temporal resolution (every 10-15 minutes); however, it is relatively coarse spatial resolution (2-3km).

Question 25: Is it possible to use NBR and dNBR (Delta NBR) to differentiate between low-intensity grass fires (often set by poachers to stimulate new grass growth for deer) and high-intensity canopy fires that destroy our reforestation sites?
Answer 25: Yes, the burned area is mostly discernable using a post-fire NBR image alone. However, a dNBR image, created by subtracting the post-fire NBR image from the pre-fire NBR image, provides the ability to better discriminate burned from unburned areas as well as characterize the magnitude of fire impacts on vegetation within the burned area. The detectable post-fire burn signal wanes faster in herbaceous settings and typically is not detectable by the peak of greenness in the following growing season. However, the ability to detect areas burned in forests and other high biomass settings persist much longer and may be discernable for years after the fire, particularly in colder/dryer climates that do not support rapid vegetation growth/regeneration.