Part 2 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), Dylan Mendes (dylan.m.mendes@nasa.gov), Jenny Hewson (jennifer.h.hewson@nasa.gov), or Diane Davies (diane.k.davies@nasa.gov).

Question 1: Hello! For FIRMS-based industrial monitoring, how can users account for cloud obscuration and other retrieval gaps when interpreting periods with no fire detections? Are per-overpass observation logs or quality-layer products available that allow users to differentiate "no fire observed" from "no observation possible" and build complete time series including both detections and valid non-detections?

Answer 1: Good question! To assess potential impacts of cloud cover on fire detection, please refer to the associated reflectance imagery acquired at the time of overpass. True color and false color composite imagery is available for each MODIS and VIIRS daytime observation. You can also use the Black Marble image products available for SNPP and NOAA-20 VIIRS for nighttime observations. These image layers are available in the FIRMS legend under the Dynamic Imagery group and cloud cover is visible in these imagery sources. Additionally, for the western hemisphere, you can also use the GOES East/West Geocolor imagery. These geostationary sources of imagery are acquired at a high temporal frequency (every 15 minutes) day and night and are also an excellent source for discerning where cloud cover is present. Please also see this relevant NASA EarthData blog post *The Impact of Cloud Cover on Active Fire Detections* at:

https://www.earthdata.nasa.gov/news/blog/impact-cloud-cover-active-fire-detections.

For information about any anticipated or ongoing technical issues affecting observations by any of the satellite missions used in FIRMS, please see **Announcements -> Technical Issues** in the upper right corner of any page on the FIRMS website. The Technical Issues page will provide information on any current or anticipated interruptions to data availability or issues affecting the operational acquisition of imagery by any of the satellite missions used in FIRMS. Information will

also be provided on when data or operational capability of the satellite will be restored, if known.

Question 2: If I want to do analysis, will I need to create a new code or can I use this one?
Answer 2: Depending on the type of analysis that you want, you may need to change the code provided. Feel free to modify the code to your needs, that is why we are using Github and Google Colaboratory!nYou just need a google account.
Also feel free to keep the code as is if that suits your needs.

Question 3: What is the main work of the Static Thermal Layer and what is its importance? What is its purpose and methodology?
Answer 3: The purpose of the static thermal anomalies layer (STA) is to help users separate industrial and natural heat sources from vegetation fires. Industrial heat sources include activities such as concrete manufacturing, gas flares, petroleum processing, etc., and natural heat sources include, for example, volcanoes. The STA layer is important as it informs users about the source of an active fire detection and whether this could be a wildfire start and, therefore, requires alerting and monitoring, or whether the detection is from a planned manufacturing activity, for example. The methodology used to generate the layer is available [here](#) and essentially includes generating a gridded layer of cumulative SNPP VIIRS and Terra/Aqua MODIS 2023 active fire detections based on the centroids, and then generating a mask for any grid cells containing 5 or more detections over the year. This mask is then filtered using multiple datasets (of industrial/power plant locations) to constrain the mask to areas not associated with vegetation fires (i.e., persistent thermal anomalies). An updated layer will be released soon.

Question 4: What is the recommended confidence level in the active fire product that I should use to ensure good data quality for my research?
Answer 4: This is copied from the [FIRMS FAQs](#): The confidence value was added to help users gauge the quality of individual fire pixels included in the Level 2 fire product. The confidence field should be used with caution as it is likely that it will vary in terms of meaning in different parts of the world. Nevertheless, some of our end users have found such a field to be useful in excluding false positive occurrences of fire. The confidence values are attributed differently for MODIS and VIIRS.

For MODIS, the confidence value ranges from 0% to 100% and can be used to assign one of the three fire classes (low-confidence fire, nominal-confidence fire, or high-confidence fire) to all fire pixels. For some uses or applications, errors of commission (or false alarms) are particularly undesirable, and for these applications a user may consider trading a lower detection rate to gain a lower false alarm rate.

Conversely, for other applications missing any fire might be especially undesirable, and a user may be willing to tolerate a higher false alarm rate to ensure that fewer true fires are missed. Users requiring fewer false alarms may wish to retain only nominal- and high-confidence fire pixels and treat low-confidence fire pixels as non-fire, land pixels. Users requiring maximum fire detectability who are able to tolerate a higher incidence of false alarms should consider all three classes of fire pixels.

For VIIRS, the confidence values are set to low, nominal, and high; they are based on a collection of intermediate algorithm quantities used in the detection process and are intended to help users gauge the quality of individual hotspot/fire pixels. Low-confidence daytime fire pixels are typically associated with areas of Sun glint and lower relative temperature anomaly (<15 K) in the mid-infrared channel I4. Nominal-confidence pixels are those that are free of potential Sun glint contamination during the day and marked by strong (>15 K) temperature anomaly in either day or nighttime data. High-confidence fire pixels are associated with day or nighttime saturated pixels.

While the confidence value may not be very helpful for all users or applications, there is no way to establish an optimal cutoff a priori. Users have to adopt an empirical approach—what threshold works best for what I'm trying to do?

Question 5: What type of AI Large Language Mode/MCP integration activities are happening with FIRMS?
Answer 5: Stay tuned we have been discussing what options are possible and their prioritization.
If you have any suggestions that may be helpful to your use cases of active fire detection data, imagery and other NASA FIRMS products, please feel free to reach out to Dylan (dylan.m.mendes@nasa.gov) or the 'Feedback' module in the very top right of the FIRMS websites.

Question 6: With FIRMS and fire imagery, what can the potential warnings be for indigenous communities to be effectively evacuated?

Answer 6: We **do not** recommend you use FIRMS for evacuation purposes but rather stay connected to local agencies that can provide "on the ground" updates. FIRMS is updated as soon as data are available – but with data from polar-orbiting satellites – there are a limited number of observations per day and in a dynamic situation that requires communities to evacuate, on the ground information needs to be taken into account.

Question 7: Have you seen real-world cases where NASA Earth observation data directly informed the development of physical products or operational systems, not just research?

Answer 7: NASA Earth observations and other technical capabilities have been instrumental in the development and support of many operational products and systems. For example, in the realm of active fire detection and monitoring, there are private partnerships that support the development and implementation of new, enhanced satellite missions, such as FireSat. These missions are intended to provide new capabilities and services and leverage knowledge and capabilities developed by NASA science teams and missions. Another example is the use of NASA satellite observations by government agencies to map the extent and severity of wildland fires. These data are compiled through change detection analyses conducted at multiple stages after wildfires are suppressed. Burn severity mapping products and other derivatives are used to inform decisions on the stabilization of soils and mitigation of hazards in the immediate aftermath of a fire. Longer-term post-fire assessments using NASA satellite imagery are used to prioritize reforestation activities and monitor the recovery and regeneration of vegetation. Observations conducted by NASA satellite assets are also instrumental in mapping fuel types, monitoring fuel moisture/drought stress, etc., which inform fire danger/fire risk applications.

Question 8: Can STA data be used to analyze fire persistence or intensity over time, and how would you recommend integrating this into a time-series analysis?

Answer 8: The STA data layer identifies nonvegetation fire persistence over time (not persistence of a wildfire). This nonvegetation fire persistence results from industrial and natural heat sources such as volcanoes, cement plants, gas flares, iron plants, mineral resource processing, etc. So you would not use STA layers to monitor and analyze the persistence or intensity of vegetation fires.

Question 9: Satellites detect emitted infrared radiation (heat) from the Earth's surface. Active fires emit much more heat, creating detectable "hotspots." Is the satellite capable of differentiating between active fire and atmospheric heat as many regions have above 50 degree Celsius temperature?

Answer 9: Yes, satellite sensor capabilities and the design of active fire detection algorithms allow you to discern fire activity from high surface temperatures. Please see the Intro to FIRMS training in April 2025 (https://www.earthdata.nasa.gov/learn/trainings/introduction-nasa-earth-observations-tools-wildfire-monitoring-management) for an overview on satellite sensors and active fire detection algorithms. The following FIRMS FAQs provide additional information, including references to relevant guides and other documentation.

- *How are fires detected by satellite? -* https://www.earthdata.nasa.gov/data/tools/firms/faq#heading-accordion-124369-10
- *Where can I get more information on the MODIS Fire Products -* https://www.earthdata.nasa.gov/data/tools/firms/faq#heading-accordion-124479-8
- *Where can I find the MODIS and VIIRS active Fire User Guides? -* https://www.earthdata.nasa.gov/data/tools/firms/faq#heading-accordion-124369-2

It should be noted, however, that super heated plumes can result in false positive VIIRS detections in some cases. Please see the following FIRMS FAQ for more information about when that may occur.

- *Are there ever false fire detection or data artifacts? -* https://www.earthdata.nasa.gov/data/tools/firms/faq#heading-accordion-124439-1

Question 10: As a follow-up, for automated analysis using VIIRS Active Fire data accessed via the LAADS DAAC API, can the cloud information in the VIIRS fire mask be used to distinguish cloud-obscured observations from true absence of fire, or is it recommended to rely on the cloud confidence from VIIRS cloud products despite their lower spatial resolution?

Answer 10: The active fire detection algorithms for MODIS and VIIRS include the generation of a cloud mask that is used during the detection process. This mask is not published in FIRMS but it is available as a part of the MODIS and VIIRS active fire detection products, provided in Hierarchical Data Format (HDF) format from NASA

EarthData. Fires in areas with thick cloud cover will likely not be detected and will be indicated as "cloud" in the fire mask products. Fires occurring in areas under thinner, high cirrus clouds, and not indicated as "cloud" in the fire mask products, likely will be detected if they are of sufficient size and/or intensity. The confidence value is also a useful resource. Fire detections with relatively lower confidence values may be located near detected cloud pixels. These adjacent pixels may be at risk of being "cloud contaminated" due to proximity to the edges of clouds. The edges of clouds may not be clearly detectable due to the spatial resolution of the imagery.

The standard VIIRS and MODIS cloud products are not provided in FIRMS. The FIRMS team has not conducted a thorough comparison and evaluation between the cloud mask generated in the respective active fire algorithms and the cloud science products.

Question 11: Good day. May I kindly ask, in Question 3, the mask generated uses detections of 5 fires at the same point. Is there a reason for 5 fires specifically? Or is it a general rule of thumb? Thank you.
Answer 11: It is 5 active fire detections within a 400m grid cell (VIIRS) and 1km grid (MODIS) over the course of the year (the current mask uses MODIS and VIIRS active fire detections from 2023). While 5 detections reflect a rule of thumb, this was empirically derived and generally reflects the persistence of nonvegetation active fire detections based on the 2023 data and multiple industrial location datasets. Most STA features are associated with active fire detection counts that greatly exceed this threshold and are persistent for extended periods of time over the entire year.

Question 12: My other question is, what is the work of the Power Plant Layer?
Answer 12: The power plant location dataset is a set of reference provided to users in the FIRMS map viewer. These power plant layers, and other relevant layers from authoritative sources, were leveraged with cumulative active fire detection data to generate the STA layer. Its use helps identify nonvegetation active fire detections and explain some static thermal anomalies. ther layers found within the collection include cement plants, mineral resource processing centers, etc.

Question 13: Aloha from Hawai'i. Question on STA related to Industrial Hydrocarbon by-product residue in ground where active Volcanic Rift Zone and recent lava flows; witnessed possible hydrocarbon lightening over flow where Hydrocarbons exist; Need to Assess danger of heat related combustion, risk level

based on thermal readings of Multiple Industrial STA and natural heat underground by rift zone?

Answer 13: I am not clear what the question is here and would need some clarification. Could you please email the FIRMS team using the Feedback link and provide additional information?

Question 14: Can FIRMS data analysis be used as an early warning system for buffer village communities to prevent crop loss from forest-adjacent fires?

Answer 14: It is possible to create an email alert to be notified of fires in your area of interest. See https://firms.modaps.eosdis.nasa.gov/alerts/ to initiate and configure an alert. Various sources of satellite active fire detection data can be used to set up the alert, including all the polar orbiting satellites used in FIRMS.

Question 15: Does the processing of Northern hemisphere fires differ from Southern hemisphere fires? Or are there certain parameters that need changing for fire detections in the different hemispheres? Might be a random question, but in many models I find that the results differ for different hemispheres and require parameter changes to gain the same accuracy results. I hope this makes sense.

Answer 15: The same algorithm is applied to the raw satellite data for the globe in the polar orbiting satellites. Geostationary satellites that cover certain parts of the world have different algorithms for each instrument/satellite but the algorithm does not vary between northern and southern hemispheres. Some organizations may develop "regional" algorithms for polar and geostationary satellites developed and calibrated for improved performance within local biomes or to meet particular use case requirements. These algorithms are typically developed by organizations that operate ground stations to collect satellite direct readout imagery in near real-time for their areas of interest.

Question 16: Which indicators or datasets would you recommend for measuring environmental impact before and after implementing a design intervention?

Answer 16: Polar-orbiting satellite observations provide imagery that is used to conduct change detection analyses and assess the impact or severity of fires on above ground biomass. These derived severity data are commonly used with other data and field observations in the immediate aftermath of a fire to develop additional products (e.g., soil burn severity products, etc.). These data are used to inform decisions about the type and location of particular prescriptions to stabilize the landscape and mitigate potential hazards. Examples of such prescriptions include seeding of annual grasses to

stabilize soils, installation of erosion control measures, development of catchment basins for potential debris flows, etc. Change detection activities conducted using satellite observations collected over longer time periods after a fire can also help land managers monitor the recovery of vegetation within the previously burned area, identify areas of concern and inform decisions about methods that can be implemented to support restoration.

Question 17: Can post-fire data be used to anticipate future environmental behavior, or is it strictly retrospective analysis and where is the boundary?
Answer 17: Yes, post-fire satellite imagery and derived data are valuable for assessing the immediate impacts of a given fire and inform decisions to help mitigate potential post-fire hazards which may persist for several years after the fire. These data, which capture the effects of fire activity in general biophysical settings under different fuel, climate and weather scenarios, can be aggregated for many fires in a given area, along with field data and other ancillary data/information, and used looking forward. For example, these data can potentially develop and train AI/ML workflows to accurately, efficiently and consistently map the extent of burned areas and burn severity within the burn scar.

Question 18: What is the key difference between datasets suitable for academic research versus those reliable enough for real-world design implementation?
Answer 18: NASA active fire detection products are generated both as (1) a NRT product (rapidly generated within 3 hours of satellite overpass and may rely on some predicted criteria) – this can support time-sensitive applications such as wildfire monitoring as well as (2) a NASA standard product which is a science quality product (that is internally consistent and well calibrated) and may be more appropriate for particular types of research.
It is worth noting that the same algorithm is used for both NRT and science quality. See the ADVANCED MODE and click on the information icon (ℹ️) for the NRT and Standard (for research) group as well as the information icon (ℹ️) for the respective layers listed in that group for more information on the differences.

Question 19: How can post-fire data influence material selection or manufacturing strategies for products designed for harsh environments?

Answer 19: I am not sure I am fully understanding the question. Please email the FIRMS team with more information by clicking on the Feedback link.

Question 20: What is the biggest gap today between satellite data capabilities and real-world design needs?
Answer 20: Specifically for fires – we find users generally would like reliable higher spatial and temporal resolution active fire detection data and more timely data (lowest latency possible).

Question 21: Question on Geothermal Power Plant use of Pentane in non-closed loop system; creating Hydrocarbons in ground. Need to process data for Public Health & Safety Risk related to STA and Volcanic Rift Zone (Heat Level Risks); how to use data to monitor changes and increases in Fire Threat and underground heat from Rift Zone heat? What is the best way for a multi-layered data set for Puna, Hawai'i?
Answer 21: Please contact the FIRMS team via the Feedback link with additional information describing your anticipated application/question of FIRMS data for your use case. We will be happy to further examine this information and discuss it with you.

Question 22: (Worst Case Scenario) for critical threshold for any Industrial Chemicals affecting ground integrity, cumulative chemical effects and fire risk in Active Volcanic Rift Zones. Where Pentane is used in any Open Loop System; there is a risk of Hydrocarbon related fire risk which can generate fumes from the ground and can cause Bone Marrow Cancer, Coma, and other scientifically-known health risks. Early detection is critical; how to apply rating of fire risk?
Answer 22: Please contact the FIRMS team via the Feedback link with additional information describing your anticipated application/question of FIRMS data for your use case. We will be happy to further examine this information and discuss it with you.

Question 23: I used the MapKey, but the transaction limit is coming. I did it twice but still it's not showing anything. What should I do?
Answer 23: Have you used the MapKey to gather data? If not then the transaction limit will not go up. If you have further questions I suggest reaching out via the 'Feedback' module in the top right of the FIRMS web sites and we can help directly with your use case.

Question 24: When reconstructing fire events from VIIRS active-fire detections, are there recommended spatial and temporal clustering thresholds (e.g., distance in km and time gaps in days) commonly used in wildfire studies, particularly for Mediterranean or small-country contexts?

Answer 24: Constructing this information in real-time can be very challenging. Additionally, certain biophysical conditions (fuel types, temperature, humidity and particularly wind conditions) combined with intermittent observations by polar-orbiting satellites can increase the complexity. For example, wind driven events in finer fuels will likely have large gaps in active fire detection data,not fully capture the extent of the fire and make it difficult to identify the full extent of individual fire events.

If conducting this type of work retrospectively, it is advisable to use the active fire detection data in the context of MODIS and/or VIIRS burned area products. These data are generated as monthly datasets at 500m spatial resolution via a time series analysis of daily active fire detection data and a vegetation index derived from daily multispectral imagery. Each pixel is coded with the Julian date of burning estimated by the algorithm. Additionally, other ancillary data sources, such as spatially enabled fire reporting information, can be helpful in identifying or validating burned areas associated with particular events when conducting this type of activity retrospectively.

These comments highlight just a few considerations, however, there are many recent references in the literature highlighting different methods for spatio-temporal clustering of active fire detection data for event identification. In fact, FIRMS host the VIIRS Modelled Fire Perimeter Product in the EXPERIMENTAL MODE of the FIRMS map viewer. This product is the result of an iterative spatio-temporal clustering approach based on Chen et al., 2022 using SNPP and NOAA-20 VIIRS active fire detection data to provide updated estimates of the perimeter and characteristics of fire events on a semi-daily basis.

Question 25: In contexts where burned area products under-detect small fires, is it methodologically acceptable to use VIIRS fire counts or fire events as a complementary proxy for fire activity when evaluating Early Warning Systems?

Answer 25: Given that Early Warning Systems would likely operate in near real-time, it would be acceptable as long as the limitations and caveats associated with active fire

detection algorithms and data, and the satellite sensors from which they are derived, are considered and the results are used with the appropriate caution.