Part 2 Questions & Answers Session A

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: Are there plans to make the Landsat active fire product cover the entire globe?
Answer 1: The feasibility of expanding the current coverage of Landsat active fire detection data is being investigated by FIRMS in conjunction with partners. Factors to consider would include the participation and support of International Landsat Ground Stations, their willingness to make OLI imagery available at a low latency and the expansion of the current processing environment to accommodate the integration and processing of these additional data.

Question 2: The timestamps that Brad just displayed are UTC, correct?
Answer 2: Correct. The timestamps for the orbit tracks provided in FIRMS are UTC. If you have questions about UTC and how to convert it to your local time zone, please see the relevant FIRMS FAQ, *What is UTC?* (https://www.earthdata.nasa.gov/data/tools/firms/faq#heading-accordion-124369-18).

Question 3: Is the ACQUIRE_TIME when the data was observed, or when the data was published to FIRMS?
Answer 3: The ACQUIRE_TIME field that is returned when you click on a fire detection in the viewer indicates the date/time of satellite observation. Please note that by default, that date/time will be displayed in the time zone set on your computer. At the top of the window that displays the fire detection attribute information, you can toggle the date/time setting so the ACQUIRE_TIME will be displayed in UTC when you click on fire detections in the viewer.

Question 4: Are you able to export your drawing or measurements that you draw around the VIIRS or imagery data?
Answer 4: If you use the Measurement Tool to make a measurement, you can use the Capture button at the bottom of the screen to save an image of the current map you have compiled in FIRMS (png, jpeg). That image will contain the line/polygon feature(s)

you have drawn for your measurement, however, the measurement results are not displayed.

Question 5: Given my research, it appears that fire detection using remote sensors relies more heavily on visible spectrum bands than thermal bands. What are the primary reasons for this apparent preference or limitation?
Answer 5: Algorithms used to detect active fires are primarily designed to leverage the mid-wave infrared (MWIR) and long-wave infrared (LWIR) bands available on many satellites designed for meteorological or Earth observations. Other bands are used to support masking of features and to help reject false positives. Please see the FIRMS FAQ, *How are fires detected by satellite?* for more details and relevant references (https://www.earthdata.nasa.gov/data/tools/firms/faq#heading-accordion-124369-10).

Question 6: How can we calculate the burn severity of wildfire?
Answer 6: Burn severity is typically measured and assessed through the use of multispectral imagery. Pre and post-event imagery can be used to generate burn severity indices used in change detection methodologies to delineate the area burned and assess the magnitude of change to above ground vegetation (i.e., severity of the burn) that is detectable with the imagery.

You can find more information on burn severity indices in these ARSET trainings:
Spectral Indices for Land and Aquatic Applications
Calculating Spectral Indices for Land and Aquatic Applications Using QGIS

Question 7: Considering multispectral imagery (e.g., from Landsat or Sentinel-2), which false color composite is typically most effective for visually identifying wildfire smoke plumes? Beyond visual interpretation of false color composites, what other digital image processing techniques or indices could be employed to effectively mask or delineate smoke plumes in remotely sensed data?
Answer 7: To visualize smoke/aerosols, the use of a true color composite works well. True color composite band combinations for the satellite sensors used in FIRMS are as follows:
Landsat OLI: Band 4, 3, 2
Sentinel-2 MSI: Band 4, 3, 2
VIIRS: Band I1, M4, M3
MODIS: Band 1, 4, 3

Most satellite sensors include “coastal aerosol” or “deep blue” bands in the 0.4-0.45 µm range, slightly shorter than the visible bands in the electromagnetic spectrum. Reflected light in these bands is scattered by dust and smoke. Consequently, the use of these bands in false color composites involving the visible bands can be helpful in highlighting smoke/aerosols. For example, use of the red band with the available aerosol or deep blue band is cited as a useful false color composite (e.g., 4, 1, 1 for Landsat OLI). These coastal aerosol or deep blue bands and their spatial resolution are listed below by satellite sensor.
Landsat OLI: Band 1 (30m resolution)
Sentinel-2 MSI: Band 1 (60m resolution)
VIIRS: M1 and M2 (750m resolution)
MODIS: Bands 8 and 9 (1km resolution)

Question 8: Why or how does Maritime fog affect our satellite observation again?
Answer 8: Maritime fog can obscure the land, similarly to clouds, when using passive optical sensors, such as MODIS and VIIRS, to observe an area. These sensors are unable to penetrate through thick clouds or maritime fog.

Question 9: How can small-scale agricultural litter burning be reliably distinguished from wildfires using FIRMS data? Are there specific strategies, thresholds (e.g., FRP), or filters within the FIRMS portal—especially when using MODIS or VIIRS products—that can support this differentiation?
Answer 9: It can be challenging to capture some small, cooler fires using satellite data. As the training today has illustrated, there are a number of factors that impact fire detection (including burn time, sensor overpass time, sensor resolution, view angle etc). FRP, or Fire Radiative Power, could be useful but it is not entirely foolproof. FRP is the rate of radiative energy emission per time unit from all fires within a pixel. FRP has been extensively used as a proxy of fire intensity to characterize fire types and is related to the rate of biomass combustion and rate of emissions. FRP estimates are provided for active fire data from MODIS, VIIRS and geostationary sensors used in FIRMS. Sensor spatial resolution, saturation temperature of thermal bands, satellite view zenith angle, time of satellite observation, etc. can affect the accuracy and variability of FRP estimates. Users should consider these factors when comparing FRP information from a specific sensor or multiple sensors.

Question 10: What are the limitations of FIRMS and how small fires can we detect using Landsat or Sentinel-2 data?
Answer 10: Below is a summary of the general detection performance of Landsat relative to fire size, fire intensity and observation conditions. Sentinel-2 active fire detection data is not available in FIRMS.

- Landsat OLI (30m)
  - ~10-20m^2 smoldering to flaming fires in good conditions (day)
  - ~4m^2 flaming fire in good conditions (day)
  - ~1m^2 flaming fire in good conditions (night)

Question 11: Does the FIRMS portal provide vegetation fuel map data, such as vegetation moisture content, that can be used to assess wildfire propagation and direction?
Answer 11: FIRMS does not currently include a vegetation fuel map (FIRMS Global), but the FIRMS team continually assess potential future layers and capabilities to include.

For the US only (FIRMS US/Canada) users can turn on the US Outlook Forecast. This product provides an estimate of today's risk for the occurrence of new large fires and the potential for significant growth of existing large fires in the United States. It is issued mid-morning on a daily basis by Predictive Services Program staff in each of the 10 Geographic Areas. The product integrates current fuel dryness levels as well as the potential critical weather factors and ignition triggers within eco-climatic units called Predictive Services Areas (PSAs). Each daily significant fire potential forecast update includes the current day and the subsequent six days.

Question 12: Do you have plans to add GOES terrain corrected data to FIRMS?
Answer 12: At this time we do not have plans to include GOES terrain corrected imagery.

Question 13: Is there a way to get the FIRMS data in format of netCDF or any other. A format that I can use to create a forecast model? (I am interested in creating my own forecasts.)
Answer 13: Active Fire detections data, (csv, hdf) you can order and download data. In Part 3, we will cover data download.

Question 14: How in cloudy times can smoke fumes be detected?
Answer 14: There are a few ways that smoke plumes can be detected during cloudy times. The S-NPP OMPS Aerosol Index (AI) layer in FIRMS can be helpful in identifying and tracking smoke plumes, even over clouds. This example shows the S-NPP OMPS AI layer over the United States and Canada in June 2023 resulting from several wildfires throughout these areas. While the OMPS AI imagery is 2km, the S-NPP OMPS resolution is 50km. However, OMPS AI layers from NOAA-20 and -21 are currently being incorporated into FIRMS and these layers will have higher resolution. Additionally, the true color imagery from MODIS, VIIRS, and Landsat can be helpful in separating cloud from smoke. This example shows smoke plumes from a fire near Jasper, Alberta, Canada in July 2024. The smoke plumes have a tan hue in the MODIS/Terra true color composite and the clouds appear white in comparison.

Question 15: Has RADAR data been effectively employed for the detection or identification of wildfire risk factors or active fires? If so, what specific RADAR sensor types, data products, and methodologies have proven most useful in this context?
Answer 15: There have been some studies and evaluations of the use of synthetic aperture radar (SAR) data for identifying fire activity, smoke, etc. Radar data is used to map burned area extent in areas that are prone to persistent cloud cover. NISAR and other types of SAR data with requisite band(s) can potentially be used to map and characterize post-fire conditions, assess fuel structure and conditions, etc.

Question 16: Active project fires utilize NIROPS airborne imagery – will there be an ability to incorporate that data?
Answer 16: At this time, incorporation of daily airborne infrared imagery acquired by the Forest Service National Infrared Operations (NIROPS) unit is not planned. Those image data are not currently published and made available for public access.

Question 17: How confident are you with the geostationary data at the moment? It's currently in BETA.
Answer 17: The geostationary active fire detection products are labeled Beta for a few reasons including the relatively new application of these sensors for active fire detections (and associated ongoing algorithm refinement), the inherent sensor design characteristics, spatial resolution, etc. Additionally, in FIRMS, the data are filtered to reduce the number of false detections. Several FAQs address this question including:

Question 18: When will GOES-16 data be available for the NASA FIRMS email alerts system?

Answer 18: GOES-16 active fire data in the interactive Fire Map were replaced by GOES-19 active fire data in early April. These can be displayed through the Advanced Mode in the interactive Fire Map. Currently, the sources for geostationary active fire detection data provided in FIRMS are considered to be “beta”. This is due to these data being more subject to significant commission and omission errors compared to polar-orbiting satellite data sources. Additionally, these data are subject to significant geolocational accuracy issues as a result of high view angles, etc. Consequently, due to these factors, we currently do not integrate these data into email alerts in order to avoid any confusion or unintentional misuse. Please see the FIRMS FAQ, *Why are the geostationary fire data filtered in FIRMS?,* for additional information (https://www.earthdata.nasa.gov/data/tools/firms/faq#heading-accordion-124520-7).

Question 19: Are there any GIS/geodatabases for wildfires that provide risk outputs for example to indicate areas too difficult to access for ground crews? Or where the risk is too extreme?

Answer 19: Yes. The USDA Forest Service has developed a Suppression Difficulty Index (SDI) which considers topography, accessibility, fuel types, anticipated fire behavior, etc. to identify where it may be more difficult to conduct fire control and suppression operations. Please see this publication provided by the Forest Service (https://research.fs.usda.gov/treesearch/60002).

Question 20: Can FIRMS data be exported/linked with other types of data, perhaps with Giovanni data, to see the probable causes of fire (correlations)?

Answer 20: FIRMS active fire data from MODIS, VIIRS, and Landsat (where available) for the last 24, 48 hours and 7 days can be downloaded (in Shapefile, CSV, and KML format) and integrated into a range of desktop and online GIS for further analysis. Users can also sign up for an ‘email alert’ (for MODIS & VIIRS) for a particular area of interest (AOI). When active fire detections occur within this AOI, users receive an email

that contains the active fire locations, including in CSV format. These, too, can be imported into a GIS. Users can access the archive of active fire detections from Landsat (where available), MODIS, and VIIRS, and integrate these into other systems for further analysis. Session three of this webinar series will also cover setting up an email alert, using active fire detection data in a GIS, as well as WFS/WMS.

Question 21: Another question is how FIRMS can distinguish fire detection over water bodies? Or sometimes overlaps pixels over water bodies?
Answer 21: MODIS and VIIRS data are processed for oceans and other large water bodies to detect offshore gas flaring. Please see the MODIS C6/6.1 Active Fire User's Guide (https://modis-fire.umd.edu/files/MODIS_C6_C6.1_Fire_User_Guide_1.0.pdf) and the VIIRS Active Fire Product User's Guide (https://ladsweb.modaps.eosdis.nasa.gov/archive/Document%20Archive/Science%20Data%20Product%20Documentation/VIIRS_C2_AF-375m_User_Guide_1.0.pdf) for more details on the applied methodology.

Question 22: Hello, I wonder if it is possible to use Landsat's 8/9 TIRS instrument to complement this thematic acquisition by calculating temperatures on land.
Answer 22: Landsat TIRS imagery/products are not provided in FIRMS. The TIRS sensor collects two infrared bands centered at approximately 11µm and 12µm in the long-wave infrared (LWIR) portion of the spectrum. These data can be used to provide estimates of land surface temperature.

Question 23: How can we filter fire radiative power during night from artificial light by cities? Yellow pixels can be confused by cities', etc. artificial light irradiance?
Answer 23: The VIIRS Black Marble products (At Sensor Radiance and the Blue/Yellow Composite) can be used to visualize the light and emitted energy from city lights and wildfires. Although their response in the imagery may look quite similar, fires will have a stronger response/emitted energy and a blooming or halo effect will typically be discernible around fires. Additionally, the Human Built-up and Settlement Extent layer and available high resolution imagery provided with the Blue Marble static background layer and current HLS imagery can also provide context to identify urbanized or other built up areas.

Fire detection algorithms are not affected by the ambient light produced by urban areas. Consequently, active fire detections identified within urban areas are indicative of significant emission of thermal activity and the strong response in the infrared

portion of the spectrum associated with locations of fire or other sources of combustion (industrial activity, etc.).

Question 24: What data goes into the elevation/slope/res of cover type data for FIRMS? Are dead-end roads and/or nearby water sources included in outputs?
Answer 24: Please forgive us if we are misinterpreting your question, but here are a few responses.
The HLS imagery in FIRMS will have the most detail in terms of the types of features (such as cover types, water sources, dead-end roads, etc) that will be visible. There are also some additional layers that could be of interest under the Overlays tab including a Borders/Roads – DETAILED layer. The Topographic layer under the Static Backgrounds menu could also be useful. In terms of the algorithms used to generate the active fire detections, the algorithms are designed to detect active fires vs. the potential for fire based on access, cover type, etc.

If the question is in the context of whether these types of data layers are directly integrated into the active fire detection algorithm, yes, to a certain degree. The MODIS and VIIRS algorithms include thresholds/tests applied to thermal data being analyzed to identify and mask clouds. A predefined, global land/water mask is also used by these algorithms to exclude areas from analysis that are classified as water. Please see the FIRMS FAQ, *How are fires detected by satellite?* (https://www.earthdata.nasa.gov/data/tools/firms/faq#heading-accordion-124369-10), for more information.

If the question is asking whether the land cover type, elevation, slope, etc is provided with each detected fire, no, that associated information is not provided.

Question 25: What is the proper way to cite and reference data from FIRMS?
Answer 25: Please use the following acknowledgement:
We acknowledge the use of data and/or imagery from NASA's Fire Information for Resource Management System (FIRMS) (https://www.earthdata.nasa.gov/data/tools/firms), part of NASA's Earth Science Data and Information Systems (ESDIS).

Question 26: How can FIRMS help detect when a wildfire becomes extreme, and how could this improve early warning systems?

Answer 26: There are fire danger/significant fire potential forecast products that are provided to help with early warning systems. These products may provide fire danger forecasts/outlooks for short-term and longer-term periods (days vs. month). FIRMS US/Canada includes daily updates of fire danger forecasts for Canada provided by the Canada Wildfire Information System (https://cwfis.cfs.nrcan.gc.ca/maps/fw) and significant fire potential forecast for the United States from the National Predictive Services Program at the National Interagency Coordination Center (https://www.nifc.gov/nicc/predictive-services/outlooks).

Question 27: Has the Difficulty Index ever been harmonized with the Landsat/Sentinel?

Answer 27: No. Imagery data are not directly used in computing the Suppression Difficulty Index. However, products derived from Landsat/Sentinel-2 imagery are used (i.e., land cover/fuels, previously burned areas and burn severity, etc.).