# Questions & Answers Sessions Part 1

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 our training team. For general inquiries, email us at nasa.arset@gmail.com.

Question 1: What are the assumptions in the future prediction models of climate temperature?

Answer 1: There are several climate models and there is a systematic program (Coupled Model Intercomparison Project 6 is the latest). Information about these models can be found here: https://www.wcrp-climate.org/wgcm-cmip/wgcm-cmip6

Also, projections (assumptions) scenarios used by these models are described in this paper:

https://esd.copernicus.org/articles/12/253/2021/

Question 2: I am wondering if it is possible to have a Python script to download MERRA-2 data?

Answer 2: To download MERRA-2 data using a Python script, please refer to the instructions on NASA's GES DISC webpage: https://disc.gsfc.nasa.gov/data-access#python

Question 3: Does Giovanni have API access?

Answer 3: NASA's Precipitation Measurement Missions (PMM) have API services, but not Giovanni. If you're interested in using a NASA API for dataset searches, please refer to the following links:

1. https://disc.gsfc.nasa.gov/information/howto?keywords=API&title=How%20to%20Use%20the%20Web%20Services%20API%20for%20Dataset%20Searching
2. https://api.nasa.gov/

Question 4: How can we get fire count data of a particular place for a particular time?

Answer 4: Fire detection will be covered in Session 3. Stay tuned!

Question 5: What is meant by the area average when temperature and precipitation was shown? Is it for a particular county or for northern California?

Answer 5: The seasonal area-averaged time series were for California, the weather time series were averaged in the northern California region where fires were observed in August 2020.

Question 6: How can we know the precise number of fires prior to the satellite era? Could it be that population growth is somehow associated with the increase in detected fires?
Answer 6: Before the satellite era, local fire departments kept fire records on hand. On the west coast of the United States (California, Oregon, etc.) population growth is associated with increased fires.

Question 7: What is the spatial resolution of the precipitation map from IMERG?
Answer 7: The spatial resolution of IMERG data is 0.1 x 0.1 degrees (or roughly 10 x 10 km).

Question 8: How is anomaly calculated for 2020? Is it a deviation from decadal temperature, precipitation trend, or just previous year?
Answer 8: The anomalies are departures from 2001-2020 means.

Question 9: How did you produce the graphs and maps for the California case study?
Answer 9: The graphs used data downloaded from Giovanni, then used Excel for generating seasonal time series. Maps were created using QGIS after downloading data from Giovanni. The weather time series were downloaded from Giovanni (png option).

Question 10: Can you explain how the IMERG data indicates lightning potential?
Answer 10: We can not confirm that there was lightning associated with the IMERG rain event we saw -- but ground observations showed that this particular fire complex started with a lightning spark. When we looked at the IMERG data it coincided with the start of the fire activities. NOAA and the ISS have lightning detectors which are accessible to the public. Please see the links below to learn more:
1. https://lightning.nsstc.nasa.gov/isslisib/isslisnrt.html
2. https://worldview.earthdata.nasa.gov/?v=-173.1045458054729,3.6311626495395046,-66.56364949347292,69.0821184880981&l=LIS_ISS_Flash_Count,Reference_Labels_15m,Reference_Features_15m(hidden),Coastlines_15m,VIIRS_NOAA20_Co

rrectedReflectance_TrueColor(hidden),VIIRS_SNPP_CorrectedReflectance_True
Color(hidden),MODIS_Aqua_CorrectedReflectance_TrueColor(hidden),MODIS_T
erra_CorrectedReflectance_TrueColor&lg=false&t=2020-08-16-
T15%3A07%3A14Z

Question 11: Thanks for the useful case explanation in California. In the case of a spike of precipitation before the fire event, does the moisture anomaly from SMAP detect some positive moisture anomalies?

Answer 11: We checked GLDAS 3-hour soil moisture between August 1st to 31st. Soil moisture (0-10 cm) increased from 10.2 kg/m$^2$ to 12 kg/m$^2$ between August 16-18 -- we will try to include this time series along with the precipitation time series in the presentation (TBD). We have not checked SMAP soil moisture but you may want to download data from AppEEARS and check.

Question 12: Can remote sensing techniques be used to detect smoke from charcoal burning? In Malawi, there is a lot of deforestation due to charcoal production. I was wondering if NASA products could be used to identify areas where charcoal production is common but are hard to reach.

Answer 12: This depends on how big the area is and how intense fires are? We will discuss more in session 3 when we cover air quality pertaining to fires.

Question 13: Is there anything other than the spike in 30 min precipitation to suggest lightning was the cause?

Answer 13: Not really, this was showing a coincidence between the one IMERG event we saw.

Question 14: How big should the fire be to be detected by the satellites?

Answer 14: Satellites take a 'snapshot' of events as they pass over the earth. Each hotspot/active fire detection represents the center of a pixel flagged as containing one or more fires, or other thermal anomalies (such as volcanoes). For MODIS the pixel is approximately **1km** and for VIIRS the pixel is approximately **375m**. The "location" is the center point of the pixel (not necessarily the coordinates of the actual fire). The actual pixel size varies with the scan and track. The fire is often less than the size of the pixel. **We are not able to determine the exact fire size, what we do know is that at least one fire is located within the flagged pixel**.

Question 15: Does the data collection cover the globe? For instance, if I was interested in Iraq, will I be able to find data?
Answer 15: Yes, the data we discussed in today's webinar has global coverage and you will be able to explore and download the data for Iraq.

Question 16: I may have missed it, but how is BAI used to assess pre-fire conditions? What does BAI indicate?
Answer 16: The Burned Area Index (BAI) is not used to assess pre-fire conditions--we included it in today's webinar so attendees can see the full functionality of Climate Engine.
The BAI indicates burned land in the red to near-infrared spectrum, by emphasizing the charcoal signal in post-fire images. The index is computed from the spectral distance from each pixel to a reference spectral point, where recently burned areas converge. Brighter pixels indicate burned areas.

Question 17: Are any live monitoring fire websites available?
Answer 17: Yes, NASA provides the Fire Information for Resource Management System (FIRMS) systems for Near Real-Time (NRT) active fire data within 3 hours of satellite observation from MODIS aboard the Aqua and Terra satellites, and VIIRS aboard Suomi-NPP and NOAA 20. We will be discussing FIRMS much more in the following parts of this webinar series along with a demo in Session 3.
https://firms.modaps.eosdis.nasa.gov/

Question 18: The chart you show for NFDRS is outdated. See NFDRS 2016 for a new update.
Answer 18: Good suggestion, thanks. The 1978/88 NFDRS has been replaced by NFDRS 2016, more information for which can be found here:
https://www.nwcg.gov/committees/fire-danger-subcommittee/nfdrs

Question 19: How is the Fire Weather Index calibrated for different regions?
Answer 19: Good question. The Fire Weather Index or the sub-indices are calibrated using a combination of historical analyses, field studies, laboratory experiments, and expert judgement. A representative set of examples can be found on the second table here:
https://data.giss.nasa.gov/impacts/gfwed/

Question 20: What are the nuances of the difference between BI and FWI. One tracks the other, but does FWI, say, do better for heavy fuels in terms of lining up with the large fire events?

Answer 20: They're pretty close in both tracking moisture content and the effects of wind. The BI will also depend on fuel type, so would in theory be better for the NFDRS2016 Slash or Timber types. But I'm not aware of any thorough comparison between the BI and FWI.

Question 21: Just wondering how one can calculate these fire indices? Is there a formula to plug in T, RH, and wind speed, etc.?

Answer 21: Yes, the equations are described in several publications, two of which can be found here:

https://cfs.nrcan.gc.ca/publications?id=19927

and in Appendix A here:

https://www.bushfirecrc.com/publications/citation/bf-3549

There is FWI code in FORTRAN 95, C, C++, Python, Java and SAS/IML available here:
https://cfs.nrcan.gc.ca/publications?id=36461

Question 22: How can I get all this weather data into WMS or WMTS service?

Answer 22: All of the data is provided in NetCDF file formats. Getting into a WMS depends on how the site handles NetCDF data.

Question 23: Slide no 87 is wonderful. Just wondering how one can make such maps and graphs?

Answer 23: These types of maps can be made using the NASA GISS Panoply software:
https://www.giss.nasa.gov/tools/panoply/

and by downloading the monthly mean and long-term monthly mean files from the GFWED website. You can make simple difference maps in Panoply. These maps were made using these two files:

May means over 2001-2019
https://portal.nccs.nasa.gov/datashare/GlobalFWI/v2.0/fwiCalcs.MERRA2/Default/IMERG.FINAL.v6/FWI.IMERG.FINAL.v6.LongTermMean.Default.2001.2019.05.nc

May 2019:

https://portal.nccs.nasa.gov/datashare/GlobalFWI/v2.0/fwiCalcs.MERRA2/Default/IMERG.FINAL.v6/2019/FWI.IMERG.FINAL.v6.Monthly.Default.201905.nc

Question 24: Can we use FWI data instead of using individual pre-fire weather variables data?
Answer 24: Both are worth considering. Relative humidity or antecedent precipitation can be useful on their own as a starting point for fire danger. Indices from other danger rating systems such as the NFDRS, NFDRS2016, or the McArthur indices are also worth considering.

Question 25: Fire can have a serious impact on power transmission when too close to this facility. Any approach on how the FWI index can be used to infer an impact on power transmission lines?
Answer 25: The FWI System components on their own are used, after local calibration, to capture fuel dryness and potential fire behavior. These can be combined with power transmission line information (in a wildfire threat sense) to identify power lines in regions of high fire danger.

Question 26: How does the (low/high) humidity affect the fire, given low precipitation conditions?
Answer 26: Humidity is a critical control on fuel flammability, especially for fine fuels such as leaf and needle litter and dead grass.

Question 27: I think FWI is derived from reanalysis data? If so, how different are ERA-5 and MERRA-2 FWI products?
Answer 27: That is a good question - the ERA-5 based and MERRA2-based FWI products have not been compared directly. The NRT 'analysis' versions of both can be compared on the Global Wildfire Information System 'Fire Danger Forecast':
https://gwis.jrc.ec.europa.eu/apps/gwis_current_situation/index.html

The MERRA2-based FWI have been compared to FWI from weather station data in the Field (2020) paper listed on slide #78.

Question 28: Which decisions can be taken by using a daily fire hazard index?
Answer 28: Examples how fire danger rating systems are used in decision making are provided in this paper:

de Groot, W. J., Wotton, B. M., and Flannigan, M. D.: Wildland Fire Danger Rating and Early Warning Systems, in: Wildfire Hazards, Risks and Disasters, edited by: Shroder, J. F., and Paton, D., Elsevier, Oxford, 207-228, (2015) https://doi.org/10.1016/B978-0-12-410434-1.00011-7

Question 29: Is active remote sensing data used for assessing fire danger? Do you value data from Synthetic Aperture Radars? Will that be discussed in next sessions?
Answer 29: SAR can help to monitor vegetation so it can be used for that application. Below is a paper that used SAR for fire monitoring. Also refer to slide 78 in the presentation for a link to another publication.
https://www.nature.com/articles/s41598-019-56967-x

Question 30: How would you process the canadian FWI index in a program such as ArcGIS using interpolation techniques for the variables? Would you recommend using ArcGIS or would you rather use a different program?
Answer 30: It is common to take raw weather station data and make maps in ArcGIS for gridded data using interpolation techniques. Presumably, NetCDF, GRIB or other gridded data can also be read into ArcGIS.

Question 31: Do FWI System Moisture Codes differ for every region or country?
Answer 31: The underlying equations for countries where the FWI system is used are usually unchanged. The outputs are interpreted differently for different fire environments. Examples of how this is done can be found in the second table here:
https://data.giss.nasa.gov/impacts/gfwed/

Question 32: Are ignition source parameters going to be covered in more detail in future sessions?
Answer 32:

Question 33: Question for Robert: You demonstrated that FWI works effectively to predict fires days before the fire occurs. What are some ways we can use FWI for fires a year/a fire season before the fires occur?
Answer 33: That is very much an active area of research, and depends on the skill of the underlying seasonal forecast. Here is one example of seasonal FWI forecast evaluation for Europe:
https://www.sciencedirect.com/science/article/pii/S2405880716300826

Here is a case-study for Indonesia:
https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2017GL073660

Question 34: What are your thoughts/recommendations about using MERRA-2, IMERG, and GLDAS data as explanatory variables in spatial statistical models for wildfire risk?

Answer 34: These data can certainly be **tested** and used in statistical models. One issue is their different spatial resolutions that should be managed (MERRA-2 weather data can be interpolated).

Question 36: Which satellite data would you recommend to map forest fires with dense canopy cover in the tropics?

Answer 36: The Visible Infrared Imaging Radiometer Suite (VIIRS) instrument is an accurate source of data to map forest fires with dense canopy cover in the tropics. We will be discussing much more about VIIRS in subsequent parts of the webinar series. Below are some references to learn more:
1. https://www.nature.com/articles/s43247-020-00069-4
2. https://www.sciencedirect.com/science/article/pii/S003442571500019X

Question 37: Other than NDVI which index can be used to measure the plant or vegetation stress?

Answer 37: **Solar Induced Fluorescence** can be used as an indicator of vegetation stress. ARSET has a training on this we will refer you to:
https://appliedsciences.nasa.gov/join-mission/training/english/arset-use-solar-induced-fluorescence-and-lidar-assess-vegetation

Question 38: Is there a correlation between FWI and the climate conditions due to the fires? What is the overall prediction confidence?

Answer 38: The relationship between the FWI and actual fire activity or burned area varies by region. As a starting point, this paper shows where there are strong and weak relationships between the two:
Abatzoglou, J. T., Williams, A. P., Boschetti, L., Zubkova, M., and Kolden, C. A.: Global patterns of interannual climate-fire relationships, Global Change Biology, 24, 5164-5175, 10.1111/gcb.14405, 2018.
https://onlinelibrary.wiley.com/doi/full/10.1111/gcb.14405

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