Questions & Answers Session Part 4

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 trainers Pawan Gupta (pawan.gupta@nasa.gov), Melanie Follette-Cook (melanie.cook@nasa.gov) or Ana Prados (ana.i.prados@nasa.gov).

Question 1: Is it possible to detect active fires through SAR imagery (Sentinel-1 for example)?
Answer 1: I believe SAR imagery can be used to detect burned area, but not thermal anomalies associated with active fires. Active fires can be detected in near real time. I am not sure if Sentinel-1 can detect thermal anomalies. For more details refer to this article- https://doi.org/10.1038/s41598-019-56967-x

Question 2: On slide 8, you mention burned area not available in near real time, though at a 2K resolution. It would seem GOES 16/17 ABI Band 7 would provide an estimate of burned area. Thoughts?
Answer 2: The GOES 4 um band (Band 7) is used for detection of thermal anomalies associated with active fires at ~2 km spatial resolution. Burned area can be calculated using GEOS observations, but I don't believe this is available in NRT. Other GOES bands can be used. The high resolution VIIRS data have been used to calculate burned area.

Question 3: Is FRP only for the 4um channel or any channel?
Answer 3: FRP is typically calculated using the 4 um channel (smoldering and flaming type fires), which is the primary channel used in detection of an active fire.

Question 4: What studies have shown that burning dry vegetation yields the same amount of energy regardless of vegetation type? Can you please provide references?
Answer 4: Sure, Kaufman et al., 1998 (FRP)
https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/98JD01644
Ichoku et al., 2005 (energy emitted)
https://ieeexplore.ieee.org/document/1522624

Question 5: Is there a definition for dry vegetation? What is the criteria to be classified as dry vegetation?
Answer 5: Dry vegetation is vegetation without moisture. Dry vegetation such as debris on the forest floor is used to calculate emission factors.

Question 6: THE GFED DATA captures prescribed fire actions, and can gather prescribed fire data? Areas, emissions, etc.?
Answer 6: The GFED data will include information about the burned area and emissions from fires that have been detected by satellite. If a prescribed fire is large enough to be detected, it will be included. This information will be reported on a 0.25x0.25 deg grid, not on an individual fire basis.

Question 7: How are large burned areas acquired by MODIS and VIIRs respectively?
Answer 7: The MODIS burned area product is available at 500m spatial resolution. Session 6 will cover more in depth but land burned by fire will have different spectral reflectance and changes in reflectance are used to calculate burned area.

Question 8: In the case of peatland fires, is burned peat part of the emission and smoke calculations in the presented methods and tools or are these limited to burned above ground vegetation?
Answer 8: That's a great question. GFED and GFAS fire emissions include emissions from peat fires. QFED does not. In other words, a fire detected in a region where peat fires are likely will be assigned an emission factor or biome associated with the vegetation type. I don't think FINN includes peat emissions.

Question 9: Thanks Dr. Melanie, for a wonderful presentation. I am wondering if there is a possibility in GFED to find out what types of plants were burning? So that one can correlate PM2.5 emissions from grasses or trees etc.
Answer 9: The GFED emission files include an estimate of how much carbon was emitted by different vegetation types:

1. Savanna, grassland, and shrubland fires
2. Boreal forest fires
3. Temperate forest fires
4. Deforestation and degradation
5. Peatland fires
6. agricultural waste burning

Anything finer than that is not available through GFED. If you have finer resolution land cover data and emission factors, you can use carbon emissions from GFED.

Question 10: FRP is radiation from a very narrow wavelength (e.g. 4um channel only receive a radiation if the wavelength 3.75 - 4.25 um). How could FRP be used to calculate emission? I meant do we not need the radiation information from different wavelength?
Answer 10: Studies like those of Ichoku et al. 2005 (https://ieeexplore.ieee.org/document/1522624) show a direct relationship between FRP and aerosol emission rate. The FEER emission database uses a derived coefficient of emission (Ce) to convert FRP to emissions.
FEER reference: https://acp.copernicus.org/articles/14/6643/2014/

Question 11: Why does FRP use T4 (4um brightness temperature) and not the other channel?
Answer 11: The 4um wavelength is sensitive to both flaming and smoldering fires. The FRP is therefore less sensitive to the ratio between the different types of fire. This is also the primary channel used in detection of an active fire.

Question 12: How did the GWIS classify the fire season in case of California during the demo?
Answer 12: I am not sure what this question is referring to.

Question 13: In slide 36, comparing the TOC emissions from Fire 2008, which one is likely the correct estimate?
Answer 13: That's a great question, and really depends on your application. For example, GFED is available over the longest time period, but is known to generally underestimate emissions from fire. This can be compensated for by scaling the emissions up. Typically for GFED, scaling is in the order of 3 or 4. FINN is available at the highest resolution and in NRT.

Question 14: Do we have correction factors to cater for uncertainty in fire emissions using burnt area and thermal techniques?
Answer 14: Emissions from burned area techniques can be scaled to agree with other observations (such as AOD). These can vary depending on region and datasets used.

Question 15: How can the uncertainty of carbon emissions be calculated, and which product is the most accurate among the others? Which product has been identified as being the most accurate for tropics fire? Or, is each product discovered to be site-specific?
Answer 15: This depends on your application and the metric which you evaluate it against. If you want to evaluate against AOD, QFED and FEER would be the most accurate. If you want to evaluate against surface concentrations of pollutants, accuracy and which dataset is more accurate will vary.

Question 16: When you said the satellite only views one location twice a day. Does it mean the satellite could view the Earth's entire surface in 12 hours?
Answer 16: Yes, depending on the orbit and FOV of the satellite it can view the entire earth or part of earth. VIIRS views the entire earth every 12 hours, whereas MODIS has some gaps in tropics. When referring to variables like AOD you only get data for the sunlit portions (so one observation per day) and under cloud/snow/ice free conditions.

Question 17: Thank you Dr. Melanie for sharing this exciting tool. I especially loved the peroxy radicals in the GEOS-CF model. I am wondering if it is possible to download this data as a csv file from individual fires? e.g if I would like to know peroxides in Northern California from 2020 fires.
Answer 17: The GEOS-CF model uses QFED fire emissions. For the model forecast, you can download CF output. I am not sure about how detailed the output is. Refer to the Fluid website (https://portal.nccs.nasa.gov/datashare/gmao/geos-cf/v1/forecast/) in the presentation. No fire emissions dataset has fire emissions from individual fires, they are all grid based. They represent emissions within the grid cells.

Question 18: What are the most detailed spatial resolution datasets for emissions?
Answer 18: FINN has the highest resolution of the **global** datasets.

Question 19: Can GEOS detect sulphur hexafluoride (SF6)?
Answer 19: If referring to the GOES satellite, no, it cannot detect SF6. If referring to the GEOS-CF forecast, it's unfortunately still no, that species is not included in the output.

Question 20: During transport of smoke and other particles, are corresponding lifetimes of each particle taken into account? For example, if NOx has a shorter lifetime, how is it taken into account in models?
Answer 20: It is taken into account. Chemical transformation in smoke is an active area of research. Aerosolization of particles, smoke aging, deposition, etc. is taken into account.

Question 21: Is MODIS's FRP information available since 2000 (Terra) and 2002 (Aqua) by thermal anomaly detection? Or is it more recent information only (e.g., 2014)?
Answer 21: MODIS FRP is available for the entire MODIS period.

Question 22: Can you separate prescribed fire data from Wildfires? Or do you treat them equally? The different types of fires are gathered in the total data?
Answer 22: The most we can distinguish is by the type of vegetation burned (e.g. using land cover type). For example, if we see a fire where crops are grown, we can be pretty sure it was a prescribed agricultural fire. But we can't distinguish a prescribed fire in a forest from a forest fire from a satellite.

Question 23: Is there any link with the IPPC approach for fire emission and GFES? Moreover, how can we get information in regards to other African countries like Sudan for fire emissions in forests?
Answer 23: I am not sure what the first question is referring to. The datasets covered today include global information, so sub-Saharan Africa is included.

Question 24: How do we estimate the emission factors and how do we verify their correctness?
Answer 24: Emission factors are calculated in a laboratory setting or by field measurements. How that is done we are not sure about. Each emissions database I covered will include information about the emission factors they used in the references I included on slide 18.

Question 25: What is the minimum pixel size that can be taken into consideration for forecasting fire emissions?
Answer 25: FINN fire emissions have the highest spatial resolution at 1 km. So even if you ran a forecasting model at a higher resolution, the fire emissions would still be on that resolution.

Question 26: Where can I find the information on spatial and temporal resolution of MODIS and VIIRS?
Answer 26: Part 3 has information on the spatial resolutions of many products from both MODIS and VIIRS. You can also review a previous webinar we gave on air quality relevant products from MODIS and VIIRS:
https://appliedsciences.nasa.gov/join-mission/training/english/arset-modis-viirs-transition-air-quality-applications