Part 2 Questions & Answers Session

Please type your questions in the Question Box. We will try our best to answer all your questions. If we don't, feel free to email Melanie Follette-Cook (melanie.cook@nasa.gov) or Andrew Thorpe (andrew.k.thorpe@jpl.nasa.gov).

Question 1: Is there an equivalent to the US Greenhouse Gas Center at a worldwide scale or for other countries other than the US?
Answer 1: The answer is no, or at least not yet. There are great international efforts to coordinate some types of information that we provide. For example, the United Nations Environment Programme (UNEP) maintains the Methane Alert and Response System (MARS), which includes a data portal that seeks to support alerts based on EMIT and other point source mapper satellites. This complements the work of the GHG Center, which provides the science basis for tracking emissions, but is not designed to provide enforcement. The World Meteorological Organization (WMO), through its Global Greenhouse Gas Watch (G3W), is working to deliver some international model-based estimates of sources and sinks like those that can be found on our data portal.

The U.S. Greenhouse Gas Center works to coordinate U.S. measurement and modeling activities and to provide our most mature information to these types of international initiatives and to establish best practices for data sharing to ensure interoperability. Other countries, including Japan, are also working toward similar coordination structures that are modeled, in part, on the U.S. initiative.

Question 2: Why are there more super emitter plumes from the Permian Basin compared to the other basins in the US or North American (Canada included) landmass? Is it because it's more density of wells and thus compressor stations and production equipment?
Answer 2: The Permian Basin is the largest producer of hydrocarbons (oil & gas) in North America and we believe that that is the primary reason for why we see more and larger methane emission events compared to other basins. If you look at the region, you can see a very high density of wells and infrastructure like compressor stations.

Question 3: Do large livestock feedlots (not wastewater lagoons from them), generate a detectable methane plume?
Answer 3: To date, we have only seen methane plumes from waste water lagoons from feedlots and dairies (mostly with airborne instruments like AVIRIS-NG, AVIRIS-3). We have not been able to see more diffuse emissions from individual feedlots.

Question 4: How thoroughly does this dataset capture super-emitting methane events? Does it include a specific concentration threshold?
Answer 4: Specific events that are captured are highly dependent on the brightness of the background surface (albedo), along with the wind speed conditions on the ground, which will control the concentration in the atmosphere. Recent work looks at quantifying the uncertainties, https://ieeexplore.ieee.org/abstract/document/10631736.

Question 5: In the first part of the presentation of the EMIT platform, the plumes were shown, but these look hand-drawn. Is this true, or is there an algorithm outlining the plumes?
Answer 5: This is true - right now, we use a process that requires a 3 person approval process for identifying any individual plume, and these are hand-drawn. The procedure is outlined here: https://lpdaac.usgs.gov/documents/1696/EMIT_GHG_ATBD_V1.pdf. We are continuing to work to develop automated tools for doing this, and as you might imagine, the hand-drawn dataset provides excellent training or evaluation data for such algorithmic developments.

Question 6: I am interested in using EMIT data to see if natural methane emissions from wetlands are detectable. Are there resources for generating new methane plumes from the raw data?
Answer 6: While we have observed methane from arctic permafrost using AVIRIS-NG (Elder et al., 2021, https://doi.org/10.1029/2020GB006922), to date we have not identified any high confidence examples of EMIT observed methane emissions from wetlands. That said, please feel free to take a look at EMIT methane results over wetlands! You can access these results using resources like Earth Data Search. These results are publicly available. All of the code used to process and visualize EMIT data for Greenhouse Gases is open source, and is available here: https://github.com/emit-sds/emit-ghg.

Question 7: Are methane plumes affected by precipitation? Do rainfall events diminish, enhance, or mask them?
Answer 7: Generally we do not see methane plumes *above* clouds - meaning that the cloudcover, more than the rain itself, limits our detection of methane. However, water that accumulates on surfaces will generally lower the surface albedo, temporarily making methane harder to detect in the absence of glint.

Question 8: Is it possible to download the methane plume data as a .csv file for future use? Can I download CO2 data?
Answer 8: Not as a .csv, but you can download vectors of the plumes as a .json, .kml, or .shp files. This can be done through the EMIT VISIONS portal (see "Methane Metadata" tab where you have the option to download these files).

Question 9: How do we get data for methane plumes and carbon dioxide? Is it possible to generate a time series profile and do analysis?
Answer 9: You can download vectors of the CH4 and CO2 plumes as a .json, .kml, or .shp file. There is a nice tutorial on the temporal variability of plumes available here: https://www.youtube.com/watch?v=CmSHuTGZ2W4&list=PLO2yB4LGNlWrC5NdxeHMxyAxdwQhSypXe&index=1

Question 10: Are you planning to collect data for Nigeria in the near future?
Answer 10: Yes - all terrestrial areas within +/- 52 degrees should see data acquired over the course of the next year. You can check the forecast layer to see when those data are likely to be collected.

Question 11: It looks like the example plume in Jordan is spreading outside of the observed area. Is this a common phenomenon that a plume is detected but EMIT does not actually capture its full area and volume?
Answer 11: It's not uncommon - the EMIT swath is large, but finite - so frequently plumes will go off the edge. From an emissions quantification perspective, the area closest to the plume is the most important, but plenty of examples have some level of truncation.

Question 12: Is there any way to detect smog with EMIT data?
Answer 12: Both water vapor and aerosols are independently measured with EMIT data. These are available as part of the L2A product, in the 'masks' file. At present, we

don't have an explicit 'smog' detection, and I suspect that the water vapor will largely obscure the aerosol signal - but this would be a great research question. We have not seen any specific retrieval of smog.

Question 13: Hello,
(A) Is it possible to download a subset of EMIT data?
Answer 13A: Yes - the best way to do this is to utilize the AppEEARS tool from nasa, https://appeears.earthdatacloud.nasa.gov/. This resource allows you to subset and convert file formats based on different inputs. EMIT L1B and L2A data are available on AppEEARS.

(B) Have you noticed a lower quality of the reflectance/ radiance data in the pixels located at the edges of the products?
Answer 13B: There are multiple effects that occur as you go close to the edge - the viewing geometry and path length change, and there can be some instrument calibration effects at the extreme boundaries. Generally, the products are quite robust up to the last few pixels, which may have some small challenges, depending on the application.

Question 14: What are some ways that generally technical individuals can use EMIT data to engage in the mitigation effort either locally or globally?
Answer 14: Our goal is to make these EMIT results open to the public to empower individuals and organizations to use these results as they see fit. EMIT and airborne results from AVIRIS-NG and AVIRIS-3 have led to direct mitigation. We hope that by sharing these results this can lead to more examples of direct mitigation as well as the opportunity to inform broader mitigation strategies.

Question 15: How do we derive methane concentrations from raw EMIT data? I might be looking for something more subtle than an industrial methane plume.
Answer 15: The retrieval algorithms are publicly available here: https://github.com/emit-sds/emit-ghg. You can also look at full scene EMIT methane results though LP DAAC, NASA Earth Data Search.

Question 16: Can you please comment on the strength of CH4 from agriculture vs landfills?

Answer 16: We have seen many landfill plumes with EMIT while emissions from agriculture are more challenging to see (i.e. they are weaker sources that are typically more diffuse). Airborne surveys with AVIRIS-NG and AVIRIS-3 have routinely seen methane emissions from dairy waste lagoons.

Question 17: Do CH4 point sources contribute to local temperature increases that we feel? If yes, can you please say by how much? Can we estimate this on our own?
Answer 17: This is a great question. For methane point sources, the impact on local temperature will be quite small. For methane enhancements over larger areas (i.e. basin scale), we would expect some impact on temperature.

Question 18: Does the data from the NASA observations of methane contribute to Climate Trace global emissions measurements?
Answer 18: I am not aware of EMIT or AVIRIS methane or carbon dioxide results that are currently being incorporated into Climate Trace products.

Question 19: Are there other compounds that can interfere with the detection of methane in refinery or petrochemical Industries>
Answer 19: Water vapor has absorption features in the shortwave infrared that in some places do overlap with methane absorption features.

Question 20: How would you define a data product? Where would you limit the definition? As algorithms can filter the data color map, differentiate the lightmap or/and the interpretation of the specified data product for the type of data and frequency.
Answer 20: I am not sure if I completely follow the question. EMIT and AVIRIS-3 data products and associated documentation are made publicly available here:
https://search.earthdata.nasa.gov/search?q=emit%20L2B%20ch4%20co2
https://daac.ornl.gov/cgi-bin/dsviewer.pl?ds_id=2358
The retrieval algorithms are publicly available here:
https://github.com/emit-sds/emit-ghg.

Question 21: I am currently measuring methane in the near surface ocean at 2 meters depth in the up welling system of central Chile. In the system chlorophyll values are extremely high, is it possible to measure methane near the surface, to

understand the flux of methane between the near-surface and the low atmosphere?

Answer 21: We have used sunglint to observe methane point sources from anthropogenic sources like offshore platforms (Ayasse et al., 2022, 10.1088/1748-9326/ac8566). Detecting the small methane enhancements near surface that you describe will be very challenging with existing remote sensing technologies. I suspect that you would need in situ gas sampling to estimate these types of fluxes.