Part 4 Questions & Answers Session

Please type your questions in the Question Box. We will try our best to answer your questions. If we don't, feel free to email Amita Mehta (amita.v.mehta@nasa.gov) or Erika Podest (erika.podest@jpl.nasa.gov).

Question 1: Is there any indication when OpenET will be pushed out globally?
Answer 1: Great question. I am not on the OpenET team, so they would be best positioned to answer that question. I do know there are efforts to expand OpenET to specific international regions, such as Brazil, alongside regional partners. I do believe these types of efforts are driven by local researchers and will require ground-based validation/comparison studies, which will take time before anything may be made publicly available. You can also contact the OpenET team here: https://etdata.org/contact/.

Question 2: What skills or programming languages are essential for building a platform similar to Climate Engine?
Answer 2: The code used for creating Climate Engine I think is Python. I did not do any of the programming – that was with the Desert Research Institute team. As mentioned, Climate Engine is a user interface, or application, built off of Google Earth Engine. This is an extensive GEE course, and I would check out Module 5 on Earth Engine Apps: https://courses.spatialthoughts.com/end-to-end-gee.html.

Question 3: Is there a connection between drought and forest fires? Is it possible to prevent or estimate certain areas for controlled fire?
Answer 3: There is more fuel for fires during droughts. Please see this Drought.gov Wildfire Management page for more information.

Question 4: In Mozambique, the rainy season starts in October of one year and ends in March of the following year. How can it be defined in the script?
Answer 4: There is a place in the code to run the classification at different time frames.

Question 5: Is there any way to directly export the data from Google Earth Engine to an alternate location in place of Google Drive? How do I do that?
Answer 5: Google Drive is usually the easiest option. For details on alternatives, you can check out this doc: https://developers.google.com/earth-engine/guides/exporting.

Question 6: How are the classification categories set? Does it take into account crop rotation, crop type, etc.? What are the advantages of running land cover classification in Jupyter Notebooks rather than just using other satellite-derived, pre-produced products like Corine that have been validated?
Answer 6: Classification categories were set based on stakeholder requirements. They did not take into account crop rotation/types, etc. They were all based on an annual map of land cover classes. In Panama, for example, these are generated only every few years. Training your own classification models will allow you to do analysis for intermediate years, and specific things like seasonal studies which might not be reflected in annual products.

Question 7: Without the ground truth of our AOI, how would it work correctly? Is the provided ground truth data valid globally?
Answer 7: The provided ground truth data is valid for Panama. You would need the ground truth for any alternative region for which you want to train the model on. You can always use existing land cover products which have classifications as the ground truth. If this is not available on GEE already, you can upload raster files from other sources onto GEE.

Question 8: How can I define the appropriate spatial resolution when combining an optical Landsat 8/9 image with a DEM (radar) of different resolution for land cover classification in a Jupyter Notebook?
Answer 8: This is the GEE documentation on different spatial resolutions and changing between them: https://developers.google.com/earth-engine/guides/scale. The rule of thumb is to not deviate too much from the native resolutions of each individual dataset, and instead choose the resolution of the dataset you trust the most/are using the most information from.

Part 4 Questions & Answers Session B

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 Amita Mehta (amita.v.mehta@nasa.gov) or Erika Podest (erika.podest@jpl.nasa.gov).

Question 1: Is the GRACE data open/free access?
Answer 1: Yes, all NASA data are freely available. Here is a site with more information on the GRACE data access and visualization: https://grace.jpl.nasa.gov/data/get-data/. The GRACE(-FO) Data Analysis Tool allows you to visualize the data (https://grace.jpl.nasa.gov/data/data-analysis-tool/). You can also access the GRACE-based drought indicators for the US and the globe as presented from the Western LDAS project here: https://nasagrace.unl.edu/.

Question 2: Is the drought tool limited to the USA only?
Answer 2: The DSET tool was built as a spin-off of Climate Engine. All the data are available within Climate Engine globally. We just tailored some of the analyses and polygons specific to the Navajo Nation for how they needed to do their drought reporting. For global analyses, you can use the Climate Engine tool here: https://www.climateengine.org/.

Question 3: Are SPI values standardized across the globe, or normalized locally in some way?
Answer 3: The SPI quantifies observed precipitation as a standardized departure from a selected probability distribution function that models the raw precipitation data. So it is specific to the precipitation from the region being analyzed. In a simplified way, it is calculated by evaluating the long-term climatological average of precipitation over the same time period of interest compared to the current or featured time period of interest. Therefore, the benefit is that the SPI can be compared across regions with markedly different climates and for different timescales of interest from 1-to-36 months. There are limitations, as it only uses precipitation as a marker for drought, whereas other indices may include things like evapotranspiration. Here is a bit more information

about the SPI:
https://climatedataguide.ucar.edu/climate-data/standardized-precipitation-index-spi.

Question 4: Is the DSET tool available for any country in the world?
Answer 4: Same answer as Q2. The DSET tool was built as a spin-off of Climate Engine. All the data are available within Climate Engine globally. We just tailored some of the analyses and polygons specific to the Navajo Nation for how they needed to do their drought reporting. For global analyses, you can use the Climate Engine tool here: https://www.climateengine.org/.

Question 5: Does GEE_exports have to be loaded in Google Colab? I have done the GEE authentication, connected the project 'sfmis-347819', and authenticated Google Drive, but for the data import I have an error: EEException: Earth Engine client library not initialized. Run `ee.Initialize(). Is there a step that I missed?
Answer 5: You probably missed the ee.initialize() step after authentication. If that ran properly you should not have any errors afterwards.

Question 6: Is it possible to import the GEE map and view the results directly in Google Colab?
Answer 6: Yes! It's just sometimes a bit finicky displaying it and dragging the map around depending on what browser you are using but it's straightforward to view them within the Jupyter notebook itself.

Question 7: Can you briefly discuss connecting to Colab?
Answer 7: You just need to go to https://colab.research.google.com/ while either being logged into your Google account on your browser, or click the sign-in option on the top right of the page and sign in. You should be good to go after that.

Question 8: When I select Tasks in GEE and run L8_Cls_Me_2019_20a_3c, it shows: ImageCollection.load: LANDSAT/LC08/C01/T1_SR is deprecated. See https://developers.google.com/earth-engine/landsat_c1_to_c2 for how to migrate to Collection 2 Landsat.
Answer 8: The updated version of the code that is currently on GitHub is actually using C02/T1_L2, i.e., the new dataset. GEE deleted the deprecated dataset between

recording the demo and last week. You should not run into any errors with the version that is made available as part of the training.

Question 9: How many samples are needed for each class? May we use Sentinel images? Are there options we could include in our data?
Answer 9: It would work with Sentinel-2, yes, if you switch out the dataset names and replace them with the correct S2 (surface reflectance, ideally) datasets. However, the S2 dataset does not go back as far in time as L8 does, which is why this demo uses L8. We have roughly 10^6 training points (within ~100 or so polygons) but it might work with much fewer training samples.

Question 10: On the Navajo Nation case study (precipitation graph superimposed with SPI graph), how can you explain the lag on the SPI with respect to the precipitation (this lag was mentioned during the lecture)?
Answer 10: Yes, because the 6-month SPI shown here is including the precipitation from the last 6 months in the calculation. The SPI maps can be interpreted at various time scales. This in turn indicates that the SPI is useful in both short-term and long-term applications. These time scales reflect the impact of drought on the availability of the different water resources. For instance, soil moisture conditions respond to precipitation anomalies on a relatively short scale. Groundwater, streamflow, and reservoir storage reflect the longer-term precipitation anomalies.

Question 11: If in my study area I have specific and historical precipitation data from meteorological stations, how do you recommend integrating them into a drought analysis?
Answer 11: You can calculate with SPI. You can calculate with a specific station or a variety.

Question 12: Can the GRACE/FO data also be used to monitor deep groundwater depletions in addition to shallow storages for hydrological drought?
Answer 12: We will review and update before we post. The GRACE data is a translation of gravitational anomalies that translates into groundwater. There is no underground resolution of where the water is.

Question 13: How do I select a suitable ML Model for prediction if I use different Landsat data (e.g., a different country)? Do I have to modify the parameters?
Answer 13: You will need ground truth data for the country of interest. Next, you will also need to play around with the optical bands. You want to validate your results for the year that you have the ground truth. You can still use random forests.

Question 14: So, for GRACE-FO, the groundwater storage content changes are most easily assessed in arid areas (where surface water and snow is unlikely to exist)?
Answer 14: GRACE-FO will give you total terrestrial water and groundwater.

Question 15: Is it possible that from SPI we can define or identify a specific drought year if we do SPI time series?
Answer 15: We believe yes. This will be drought factors based solely on precipitation.