Questions & Answers Session Part 1

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 Erika Podest (erika.podest@jpl.nasa.gov), Amita Mehta (amita.v.mehta@nasa.gov) or Sean McCartney (sean.mccartney@nasa.gov).

Question 1: Does satellite data over-estimate sea level rise?
Answer 1: I don't believe satellite data over-estimates current global sea level. Rather it is a very accurate measurement of global sea level, down to the millimeter level. From changes in global sea level, we can derive the rate of sea level rise.

Question 2: For the GEE script presented by Amita, in the link provided in the lecture notes, I can only see one of the codes. Is it possible to share the other two codes? (animation and time series). Many thanks!
Answer 2: The GEE scripts are in the PDF of the presentation on the website. In addition, we are also posting them here:
Total precipitation from Hurricane Maria:
https://code.earthengine.google.com/3376a412623fee73bd0be6275b97f87c
Time Series Code:
https://code.earthengine.google.com/f0885054cbd03886f204f189473d5ea5
Animation Code:
https://code.earthengine.google.com/1d8ff136c8c7a0093cc51fc771519e5a
Flood extent and impact:
https://code.earthengine.google.com/6d7b34248dc7631ec1fdb063fee7c6ad

Question 3: How does the new ICEYE SAR compare to Sentinel-1 SAR?
Answer 3: I am not familiar with ICEYE SAR data. I do know however, that it is X-Band and Sentinel-1 is C-Band. X-Band has a smaller wavelength than C-Band therefore C-Band will have greater penetration through vegetation, soil or snow.

Question 4: Question to Mr. Englander: The Indonesian capital, Jakarta, is in danger of sinking in the next 10 years. This has become a hot topic of discussion

in Indonesia. There are those who argue that it is not only sea level rise that makes Jakarta sink, but excessive groundwater extraction is making Jakarta sink quickly. What do you think about this?
Answer 4: I would word it differently. SLR (sea level rise) is not actually making Jakarta sink. The relative SLR is a combination of global SLR plus the local land subsidence. Jakarta has one of the highest levels of subsidence in the world, several meters in the last few decades. As you note correctly, the biggest factor in the subsidence is groundwater extraction.

Question 5: What is the advantage of projecting geospatial and remote sensing visualizations and images in GEE as compared to visualizations in R or R Shiny?
Answer 5: I don't have experience with visualizations in R or R Shiny. In GEE, there are databases you can recall and it is relatively straightforward to integrate within your analysis.

Question 6: As for flooding in a city, there is a practical question: how much are we going to lose due to anthropic influence? What is the natural risk we can't influence? What are the immigration or relocation measures that should be compulsory? How is it going to affect logistics (we have a life example with COVID-19), urbanization, food, energy, water, industries, services? All these elements could be factored into the sea level rise mitigation/adaptation cost benefit analysis.
Answer 6: This can be misleading. While global mean sea level (GMSL) is being forced by the increase in CO_2 and other greenhouse gases, there is a long lag time for the giant ice sheets and glaciers to melt. Even if we could reduce greenhouse gas (GHG) emissions to zero immediately, the ice on land will continue to melt for centuries due to the excess heat already stored in the sea from the past century, plus warming. So it can be misleading to correlate cost/benefit analysis. In other words, the cost of increasing SLR for the next century plus is due to the burning of fossil fuels until the present. The sooner we stop adding to GHG, the sooner that the melting will slow and that SLR will slow. But considerable SLR is already committed, or locked in, probably well more than a meter, and possibly 2-3 meters, if not more.

Question 7: When comparing SAR data pre- and post-event, do you need to have the same viewing geometry?

Answer 7: Yes and for this you need to use images that are from either all ascending or all descending paths. Do not use a combination of descending and ascending images in your analysis.

Question 8: Considering that some small islands are of very small scale (e.g. Lakshadweep islands in India), aren't they particularly complex for remote sensing considering the poor spatial resolution?
Answer 8: Yes they are particularly challenging for many remote sensing sensors, but in the case of Sentinel-1 and Sentinel-2 , which have 10-20 meter spatial resolution, they can reasonably resolve features on the surface. However, sensors with lower spatial resolutions help locate large scale features and can help guide where to focus in situ measurements. Also, satellite measurements have the advantage of providing continuous spatial and temporal coverage of islands.

Question 9: I find the NDVI difference approach quite dangerous. Even an exact 365 day time difference might not really mean that one will have fixed NDVI in a specific region, or that non-flooded factors might also change them. What are the suggestions for the operational use of NDVI difference for flood extent estimation?
Answer 9: This is a good point. We showed the NDVI difference as a demo post-hurricane Maria. The focus was less on flooding and more with damage to vegetation resulting from the hurricane. There could certainly be other factors impacting vegetation health outside of hurricane damage (e.g., drought, landslides, etc). Regarding an operational use of NDVI difference for flood extent estimation, that is something we'll have to look into. The preferred methodology for flood extent is to use SAR data or optical data (outside of vegetation indices) for flood extent estimation.

Question 10: If you change the polarization from VV to VH, there may be changes in the areas that are displayed as flooded. For a complete map of flooded areas, should one combine the results of both polarizations?
Answer 10: The demo was just to show the basics of what can be done. VV polarization can penetrate further into the canopy and is better at detecting inundated vegetation. VH polarization is better at detecting open water. For a more comprehensive map of flooding conditions, which includes inundated vegetation and

open water (there is no standing vegetation over it) then a combination of VV and VH will provide more accurate results.

Question 11: Can Sentinel data be applied to calculate the surface temperature?
Answer 11: Sentinel-1 cannot. Sentinel-3 data can be used for calculating surface temperatures as it has a thermal band.

Question 12: What are the applications of InSAR during flood events? How does an InSAR work to monitor the water level changes during flood events?
Answer 12: InSAR is a bit more advanced. It measures change in phase and relates them to changes in water level. If you are interested in learning about InSAR, ARSET has had several trainings (though none on water level changes), which you can access here:
Introduction to InSAR
https://www.youtube.com/watch?v=9T1lBnta9P0
InSAR for Earthquake Studies
https://www.youtube.com/watch?v=P8lQ7pjkRIw&feature=emb_logo
InSAR for Landslide Observations
https://www.youtube.com/watch?v=biqoDH9VsiA

Question 13: Are there any good resources that break down the uses of different bands? I am very interested in multiband multitemporal research.
Answer 13: Relative to radar - ARSET has conducted a number of trainings on SAR, which include the use of multiple polarizations. Here are the links:
https://appliedsciences.nasa.gov/join-mission/training?title=sar&program_area=All&languages=All&source=All
Below is a reference of band combinations for Landsat 8:
https://www.esri.com/arcgis-blog/products/product/imagery/band-combinations-for-landsat-8/
The Flood Observatory uses multiband (optical - including commercial satellite data, passive microwave, and SAR) for flood detection and monitoring, and river discharge modeling (https://floodobservatory.colorado.edu/).

Question 14: Given the global coverage of 6-12 days of Sentinel, when would be the earliest after a disaster that one can conduct an assessment such as the one demonstrated in this webinar?
Answer 14: You may have an image taken during an event or a few days after an event. It's all about performing a thorough search for your study area. In the case of Sentinel-1 SAR data, you will want to search for both descending and ascending passes.

Question 15: In Saint Lucia we have rapid terrain change in small areas. You mentioned that the 10m resolution is gridded but not the actual resolution. I know SAR resolution is not straight forward, but what is the smallest resolution you can safely quote, as it makes a difference in much smaller islands.
Answer 15: SAR is characterized by speckle. You can apply a speckle filter on a single image to remove that effect, which also reduces spatial resolution. The size of the filter window will determine how much the spatial resolution is degraded. However, you can also do a time series average if you have a multi-temporal series, which will maintain the true 10 m spatial resolution of the data.

Question 16: Why does inundation show as "light" in radar images?
Answer 16: Inundated vegetation appears bright because the scattering mechanism is dominated by double bounce. Open water appears black because the scattering mechanism is specular. Refer to our Intro to SAR webinar for further information about scattering mechanisms:
https://appliedsciences.nasa.gov/join-mission/training/english/arset-introduction-synthetic-aperture-radar

Question 17: Sometimes water is not detected with Sentinel-1 imagery near urban areas. Any suggestions?
Answer 17: It is not clear why water would not be obvious near urban areas. It might be that the open water area might be too small compared to the resolution of the sensor.

Question 18: Do cross-polarized data provide more information on an inundation area?
Answer 18: It is easier to detect open water with cross-polarization (VH or HV) data and inundated vegetation with co-polarization (VV or HH) data.