



Questions & Answers Part 2

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 Jamon Van Den Hoek (vandenhj@oregonstate.edu), Hannah Friedrich (hfriedrich@email.arizona.edu), or Sean McCartney (sean.mccartney@nasa.gov).

Question 1: Does the refugee settlement analysis include those refugees displaced due to climate change or disasters?

Answer 1: Good question! Refugees are technically only populations displaced by violence or the threat of persecution. "Climate refugees" or those displaced by disasters over international borders are technically a different population of concern. This part of the training only focuses on refugees under the protection of the UNHCR who have been affected by violence. Please see this UNHCR page on "what is a refugee?": <https://www.unhcr.org/en-us/what-is-a-refugee.html>

For those interested in learning about differences between conflict and climate or disaster induced displacement for Internally Displaced Persons (IDPs), check out the Internal Displacement Monitoring Centre's data which breaks down internal displacements by type and country. IDPs are not refugees as IDPs remain within their home country, and are not provided the legal status that is granted to those who become refugees.

<https://www.internal-displacement.org/database/displacement-data>

Question 2: Is this data (satellite remote sensing data for monitoring humanitarian conditions) available for the public? I may have missed you saying this, what is the resolution of this data and its temporal resolution too?

Answer 2: All of the data we'll be using in this training is available to the public through NASA and ESA. We are using a handful of different imagery sources so the spatial, temporal and spectral resolution will vary by dataset. In this training, we are using Landsat 8, which is 30-meter optical imagery and is available every 16 days, approximately. To learn more about Landsat 8, check out the Google Earth Engine data catalog entry for Landsat 8 here:

https://developers.google.com/earth-engine/datasets/catalog/LANDSAT_LC08_C02_T1_L2



Question 3: Is the calculus about NDVI Disturbance (pag. 37) made for all pixels in the image's area of interest or a sample or a mean value?

Answer 3: We measure NDVI across the entire image and run BFAST across all pixels to give pixel-level results on disturbance timing and magnitude. The figure on slide/page 37 is an illustration of running the BFAST model across the time series at the pixel-level.

Question 4: What happens if the environment in which we calculate the NDVI is more like a desert? Does it affect the quality of the results?

Answer 4: This is a good question. NDVI is mainly designed for detecting vegetation condition/quality, and so in a barren or sparsely vegetated landscape, NDVI will not work well. In the case of settlement establishment and growth in a non-vegetated landscape, you'd choose a metric that is sensitive to differences between the background landscape and the settlement itself. In the case of settlements established in a desert, Normalized Difference Built-Up Index (NDBI) or Normalized Burn Ratio (NBR) may be well suited for demonstrating this change. The Artificial Surface Index (ASI; [Zhao et al., 2022](#)) was shown to be more effective at discriminating artificial surface from bare lands compared to seven other leading built-up area spectral metrics, and so also might be helpful.

Question 5: Has there been any application of BFAST on other types of Earth Observing Systems (EOS) data i.e. SAR?

Answer 5: Yes, there have been many studies applying time series disturbance detection techniques (such as [CCDC](#)) to SAR time series data, usually for forest cover change detection, i.e., [Hethcoat et al. \(2019\)](#), [Bullock et al. \(2022\)](#), and [Shimizu et al. \(2019\)](#). There are other examples of using time series disturbance detection techniques on nighttime lights data, i.e., [Zhao et al. \(2020\)](#) and [Zheng et al. \(2019\)](#).

Question 6: Is there any available BFAST script in GEE?

Answer 6: Yes, but the code is currently under development and is not being actively maintained. We will provide links to the BFAST tool showcased in the presentation.

<https://www.mdpi.com/2072-4292/12/18/2953>

<https://github.com/bfast2/geeBfastMonitor>



Question 7: Is it possible to use BFAST for time series analysis of (a) forest change, degradation, (b) disaster impact assessment, (c) Tree Phenology mapping, (d) Urban growth mapping?

Answer 7: Yes, a) is probably the most common application, b) and (before/after analysis may be a better application for this) c), less so. (time series decomposition may be better for phenological analysis) d) is also a somewhat common application.

Question 8: While coding the image collection, Hannah had filtered out cloud cover images but we could still see them in the output gif, why is that?

Answer 8: Yes, we are filtering based on the image level cloud cover property so because we are filtered images less than or equal to 40% cloud cover, that is not specifically to the parts of the imagery that falls over Pagirinya as Pagirinya just takes up some portion of the total Landsat 8 image. So, that's why we still have some clouds represented in the time series.

Question 9: What is the accuracy of global population data in urban areas? Which population data is more accurate?

Answer 9: Some of the leading geospatial products are WorldPop, GHSL, and Landscan, but all of these depend on national census data when/where available. Inconsistencies in census data can also affect the accuracy of the data itself due to a variety of factors.

Question 10: Where do we have to input/select the indices when calculating BFAST in GEE?

Answer 10: Choose appropriate metric for variable called "dependent" in following script:

<https://code.earthengine.google.com/e74a2fa1b9f030414da080626cf69b73>

Question 11: What basic libraries are used to run BFAST in R with raster data?

Answer 11: If you want to run BFAST in R, here's a great tutorial to get you started which includes an overview of the libraries needed.

<http://www.loicdutriveau.net/bfastSpatial/>

Question 12: Is it possible to use the Planet NICFI data to do the same process for settlement refugees analysis?

Answer 12: Yes, the Planet data should be helpful for monitoring settlement establishment and expansion. The NICFI data are monthly composites so would capture the trends at the monthly scale. Daily PlanetScope data would offer a higher



frequency of observations but these data can sometimes suffer from imprecise georeferencing – pixels jumping from one image to the next – potentially leading to “false positives” in an automated analysis of change like we show in this part of the training.

Also, good to be aware of the temporal extent of the NICFI which begins at the end of 2015. So if a settlement was established before then, you would not be able to track the establishment of that settlement using the NICFI dataset hosted on EE. The NICFI imagery is also spatially constrained to tropical regions so you’re limited to using the dataset in those regions.

Question 13: Why do different types of settlement layouts happen?

Answer 13: Usually this has to do with the rapidity of the displacement and the ability to prepare and plan a new settlement at the destination. With ample time, UNHCR and the host country will seek to establish a planned settlement (usually with a grid layout of streets) but some displacements occur too quickly for this to happen, and refugees end up self-settling at a location that develops into a longer-term settlement.

Question 14: GHSL is from 2015, as it was mentioned the refugee camp was established in 2016. So how could it show the refugee population?

Answer 14: We do not see any estimated GHSL population at Pagirinya (settled in 2016) because the GHSL product was produced using 2015 data. At Kiryandongo (settled in 2014), we do see a GHSL estimate of population since the settlement was established before GHSL data collection.

Question 15: Are there rules of thumb for correcting for underestimation, based on aggregating known underestimation amounts from several such examples?

Answer 15: This is an interesting question. Off the top of my head, there is no one tried and true method to correct for this underestimation. One idea is to essentially model the variability in underestimation to understand patterns in underestimation and assess what settlement level characteristics result in greater or lesser estimation of population compared to the UNHCR provided population counts.

Question 16: When using BFAST, would you consider accounting for spatial autocorrelation? Do you think that is important? How could spatial autocorrelation complicate the analysis? Conversely, how could it perhaps help, i.e., could there actually be an advantage to be had if one could properly account



for/take advantage of spatial autocorrelation (e.g., results of near-by pixels could corroborate each other)?

Answer 16: With BFAST, we don't account for spatial autocorrelation since we are looking for pixel level change and we expect autocorrelation. We do hope to see a pattern with autocorrelation and if it is not present then we assume something went wrong with the analysis. Another concern is change within the pixel itself. Refer to the upcoming part of the training next week.