Due to the lapse in federal government funding, ARSET is unable to conduct Session 3 of this training series.

We sincerely regret this inconvenience.

A certificate of completion will be awarded to those who attend the 2 live sessions and complete the homework assignment before November 20th. The homework will be available on the training webpage before November 6th. You will receive an email when it is posted on the training webpage.

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 Savannah Cooley (savannah.cooley@nasa.gov), Stephanie Jiménez (sj0114@uah.edu), or Erika Podest (erika.podest@jpl.nasa.gov).

Question 1: How do you see the potential of GEDI data in the context of zoonoses (which are becoming a global problem)? GEDI could capture the vertical vegetation structure in tropical and subtropical regions, crucial for the habitats of bats, rodents, and other potential zoonotic hosts. RH metrics (RH25, RH50, RH100) could help classify habitat types that correlate with increased spillover risk. Deforestation, fragmentation, and urbanization are known drivers of zoonoses.

Answer 1: GEDI data has substantial potential in the context of zoonoses by quantifying the three-dimensional ecosystem structure in tropical and subtropical regions, which aligns with GEDI's coverage between ±51.6° latitude. Metrics derived from the full waveform, such as the suite of Relative Height (RH) metrics (e.g., RH25, RH50, RH100) from the Level 2A product, directly characterize the vertical distribution of vegetation. This structural information is essential for classifying wildlife habitats and assessing biodiversity, which can, in turn, be correlated with host species distribution and ecological conditions—like fragmentation or secondary regrowth — that are linked to changes in zoonotic spillover risk.

Question 2: Could GEDI data contribute to the characterization of vegetation structures that correlate with increased risk of zoonotic spillover events, particularly in tropical regions with high biodiversity?
Answer 2: Yes, GEDI data can substantially contribute to characterizing vegetation structures that correlate with zoonotic spillover risk, particularly in high-biodiversity tropical regions. GEDI's Level 2B products provide biophysical metrics like Canopy Cover Fraction (CCF), Plant Area Index (PAI), and the vertical Plant Area Volume Density (PAVD) profile. These metrics capture the vertical layering and complexity of the canopy, which is more informative for habitat analysis than simple horizontal measurements. For example, the ratio of RH50/RH95 can reveal structural layers that distinguish different forest stages, such as young regrowth from mature forest, allowing researchers to map areas of recent disturbance or regeneration that might present altered host-pathogen dynamics.

Question 3: Would it not be possible to improve hotspot models for spillover risks by combining GEDI with data on animal movements, climate variables, and human settlement?
Answer 3: It is not only possible but necessary to combine GEDI data with other datasets to improve spillover hotspot models and other models that are spatially-continuous in nature. GEDI is a sampling-based mission that provides discontinuous footprint-level data at a high resolution of ~25 m. To model continuous phenomena like spillover risk across large regions, you need wall-to-wall coverage. This is achieved by fusing GEDI's precise vertical metrics with complementary data from wall-to-wall mapping sensors like Landsat or TanDEM-X. Integrating these full-coverage forest structure maps with additional thematic layers—such as climate data, animal tracking data, and human settlement patterns—would create a

comprehensive model, allowing for more robust and spatially explicit identification of risk hotspots.

Question 4: Would a link to One Health approaches and platforms such as EcoHealth Alliance or Global Virome Project be conceivable?
Answer 4: The ARSET trainers are not familiar with these platforms. You may be able to connect with other remote sensing experts focused on public health who are familiar with these platforms in the Discussions, questions, and issues forum hosted by NASA EarthRISE here:
https://github.com/NASA-EarthRISE/training_Getting_started_with_GEDI_spaceborne_lidar/discussions

Question 5: Having experimented Exercise 1 later. However, the data are suppressed after downloading (the file and data are correctly processed). I mean that the algorithm skips the processing of data. I think, perhaps, this problem belongs to the high storage of the ONLY 5 datasets considered for tests.
Answer 5: Files that are “skipped” during processing in Exercise 1 is most likely due to the quality assurance (QA) filtering steps, not excessive data volume for a small test set. The Level 1B and Level 2 products are not analysis-ready, so quality filtering is critical. The most common reasons for GEDI shots to be filtered out include:

- Quality Flag: The primary quality_flag field in L2A/L2B is a summation of several quality assessment parameters, and a value of 1 indicates the shot meets criteria for energy, sensitivity, amplitude, and tracking quality. A conservative threshold (e.g., 0.9 sensitivity over land) is often used, filtering many shots.
- Geolocation Degradation: The degrade_flag indicates shots acquired during periods of degraded spacecraft attitude or trajectory. Non-zero values here signify degraded data that is often filtered out to ensure quality.
- Noise vs. Signal Ambiguity: Shots may be filtered if the six ground detection algorithms used in L2 processing disagree on the ground elevation by more than 2 m, which often happens over steep, heterogeneous terrain or in dense canopies where the laser signal is attenuated before reaching the ground.

Given the high variability of the raw data, the algorithm is likely doing its job by removing low-quality observations, making it appear that data processing is skipped. Try relaxing the filter thresholds in the Python notebook to see if more shots are retained.

Question 6: How could GEDI be used to analyze habitat changes following zoonotic outbreaks such as Nipah or SARS-CoV-2 in order to identify ecological risk patterns and strengthen early warning systems in line with the One Health approach? Are there any future projects planned?
Answer 6: GEDI can be used to analyze habitat degradation and fragmentation that often precede zoonotic outbreaks. By fusing GEDI's precise ~25 m structural metrics (like Canopy Height, PAVD, and PAI) with wall-to-wall sensors like Landsat, researchers can create continuous, large-area maps of forest structure and biomass. Comparing these maps over time allows for the quantification of structural loss or secondary regrowth in areas near human and animal interfaces—like palm oil plantations or logged forests—that can push host species (e.g., bats, as with Nipah and SARS-related coronaviruses) into closer contact with humans. Identifying these ecological risk patterns provides an evidence base to strengthen early warning and land management policies. The trainers of this training are not aware of any specific future GEDI-only projects for zoonoses.

Question 7: For application in mangrove forests that are affected by frequent tidal inundation, is the GEDI data affected by it? Or can it work fine in a submerged area?
Answer 7: GEDI is a full waveform LiDAR, meaning it records energy returns from all intercepted surfaces. In an inundated mangrove forest, the final ground return will be the measurement of the water surface elevation at the time of the shot, which is dictated by the tide.

Question 8: Can we use GEDI to estimate below-ground biomass?
Answer 8: No, GEDI's standard data products are designed to estimate Above-Ground Biomass Density (AGBD). As a spaceborne LiDAR (Light Detection and Ranging) instrument, GEDI operates by sending a laser pulse that reflects off of and penetrates through the vegetation canopy until it hits the ground. The resulting waveform captures the three-dimensional structure of the vegetation above the ground. It cannot directly measure or sense the biomass contained within the roots, which constitutes Belowground Biomass (BGB). BGB estimation is typically done via allometric equations that relate measured AGB to BGB.

Question 9: You say in this session that GEDI can detect water level, so can we find out damage to forests due to flood?

Answer 9: Yes, GEDI's ability to measure both canopy height (Level 2A) and water surface level makes it useful for analyzing the impacts of flooding on forests.

- Water Level Monitoring: GEDI can determine the elevation of water surfaces, even in heavily vegetated areas. This is valuable for modeling and validating large-scale flood inundation maps.
- Damage Assessment: By comparing pre-flood and post-flood canopy height and structural metrics (like CCF or PAVD) over the same area, GEDI can reveal structural damage, canopy loss, or tree mortality caused by prolonged inundation or physical damage from moving water/debris. However, GEDI has limited temporal resolution (weeks to months) for any single point, meaning it can't capture the entire flood event, but it can provide valuable "snapshots" of long-term structural change.

Question 10: If I want to use L2A data, is there any difference in the data when downloading using Earthdataaccess API, SlideRule, or GEE?
Answer 10: The core data values of the format of the raw l2 data are the same as those on the LP DAAC. ED API allows for downloading the footprint data. No clipping or subsetting is applied. This will require post processing. Slide rule applied spatial subsetting and basic filtering before downloading. GEE is preprocessed into vector feature collections. It is analysis ready.

Question 12: What opportunities do you see for integrating GEDI data into previously underrepresented areas such as urban resilience, pollination ecology, or mental health, and how could ARSET training promote such interdisciplinary applications in the future?
Answer 12:

Question 13: What is the link to the training that was mentioned about the PAIz profile?
Answer 13: Here is the link to the guided tutorials that were mentioned:
https://github.com/NASA-EarthRISE/training_Getting_started_with_GEDI_spaceborne_lidar

Question 14: Is it possible to compare SRTM data and GEDI data to study differences in elevation over time?

Answer 14: Yes, comparing SRTM (Shuttle Radar Topography Mission) and GEDI data for elevation study is possible, and the comparison is actually facilitated by the GEDI data products themselves. The GEDI Level 2A and Level 2B products include the elevation from the SRTM digital elevation model for comparison. SRTM data generally represents the ground elevation over non-vegetated areas and a canopy surface model over forests, while GEDI provides highly accurate ground elevation even beneath dense canopies (it's elev_lowestmode). While GEDI's mission length is limited (2019-2023, resumed 2024), comparing GEDI's accurate ground and canopy top elevations to the older SRTM elevations can help researchers identify significant changes in topography (like subsidence) or in canopy height over the time gap between the two missions.

Question 15: Is the beam sensitivity metric a unique feature of GEDI or is that information available within any waveform lidar data?
Answer 15: The concept of "sensitivity" is a key characteristic of waveform lidar systems in general, particularly those used for vegetation profiling. It is a fundamental metric used to describe the signal quality and the capability of the laser pulse to penetrate the canopy and detect the ground return above the noise floor. For GEDI specifically, the sensitivity metric is included in the Level 2A and L2B data products and is a critical component used in calculating the recommended quality_flag for filtering erroneous and lower-quality returns. While the specific calculation and naming convention for "beam sensitivity" may vary by sensor (such as LVIS or ICESat-2), the underlying need to quantify the usable dynamic range of the returned waveform is common to all full-waveform lidar systems.

Question 16: Can we use GEDI in agricultural areas?
Answer 16: Yes, GEDI can be used in agricultural areas, though GEDI is generally better suited to examine tree crops rather than low biomass crop types such as vegetable crops, whose aboveground biomass returns are often so close to the ground that they are not differentiated from the ground return.
Part 1 of this training showed an example in Ucayali, Peru, where GEDI's ability to measure canopy height and vertical structure allowed researchers to characterize different tree crop types and management practices. For example, the Relative Height (RH) metrics clearly distinguish between agroforestry cacao plantations (which show more canopy height variation), monocrop cacao plantations, and oil palm plantations (which show low canopy height and low variation).

Question 17: How can we filter the dataset for multipolygons? For example, if I have a map with many forest areas that burned in a year. If I upload a multipolygon as my AOI, how could I make it work?
Answer 17: The ability to filter a GEDI dataset using a multipolygon (an AOI composed of many disconnected forest areas, for example) depends entirely on the access tool or platform you use.

- Coding Platforms (Google Earth Engine, Harmony API, earthaccess): These are the best methods. Platforms like Google Earth Engine (GEE) inherently handle multipolygons for spatial queries and clipping of the GEDI data. Using the Harmony API or the earthaccess Python library also allows you to define complex spatial filters (WKT or GeoJSON) to download data only for shots falling within your multipolygon boundaries.
- GUI Tools (EarthData Search, TESVIS, SlideRule): Graphical user interfaces (GUIs) are typically limited to single bounding boxes or simple drawn polygons. For a complex multipolygon, you would likely need to subset the data yourself after downloading the granules, or run separate queries for each polygon within your AOI.

Question 18: Since the final training will no longer be held, could you share any slides and video of the 3rd part on the webpage?
Answer 18: We will not be sharing the material for Part 3 at this time due to the lapse in federal funding. However, we may host this Session at a later date. This will be announced after the government shutdown ends.

Question 19: Can you provide guidance on geocalibration issues with GEDI? Is it off by ~10m? I think I was running into issues where the GEDI shot over my study site (1 acre) and was actually over the nearby forest, not my study site.
Answer 19: You are correct; GEDI has a geolocation uncertainty that can be significant at the scale of a small study plot. The improved horizontal geolocation accuracy in Version 2 of the Level 2 data is still approximately 10 m (1-sigma). This positional uncertainty is a major limitation, especially in heterogeneous terrain or with small 25 m footprints.
For a small 1 acre study site (about 63 m×63 m), a ~10 m error means the recorded coordinates could easily be offset, causing the footprint to sample an adjacent land cover (like a nearby forest) instead of your intended plot, which is likely the issue you encountered.

Guidance for geolocation issue mitigation:

- **Filtering:** Use the **quality_flag** and **degrade_flag** to filter out shots with poor geolocation performance.

- **Buffering (Best Practice):** The recommended best practice is to restrict GEDI observations to areas where the surrounding land cover is homogeneous within a ~45 m diameter (the 25 m footprint plus a ~10 m buffer to account for the error). This ensures the measured data corresponds only to your desired feature type, mitigating the risk of boundary contamination.