



Questions & Answers Session 3

Question 1: Is it possible to access the data before any Earthquake happens in Afghanistan?

Answer 1: Not for an earthquake - earthquakes happen very quickly and are very unpredictable. You won't be able to have any data before the earthquake. There might be imagery, before an event, to set the baseline on how conditions were before an earthquake occurred. That would be something you would have to specifically search for.

Question 2: How does one model landslides from dnsar and rainfall data?

Answer 2: What you're looking for with interferometric SAR are small movements in the hillside. You want to ID areas susceptible to landslides. When you ID areas at risk and couple them with large precipitation events, you can allocate a larger risk for a landslide to that specific area.

Question 3: Only with interferometry can we monitor dimensions of damage caused by an earthquake?

Answer 3: Correct. If you're using radar, the only way to assess the deformation of the surface is through interferometry.

Question 4: How do you choose the temporal interval between imagery to derive interferograms?

Answer 4: You want to select before and after imagery, but they should not be that far apart temporally. In fact, if the images are too far apart in time, they tend to decorrelate depending on the characteristics of the land surface. Ultimately, it will depend on the imagery that's available,.

Question 5: Radar sensors are side-looking, how do you translate the number of fringes to centimeters?

Answer 5: That has to do with the wavelength that's used by the radar sensor. I suggest you visit the SAR webinar trainings that we've done. We've done two - an introduction to SAR and advanced SAR training. Both of these series have had a component on interferometric SAR, specifically looking at earthquakes. We'll do another SAR training sometime later this year, probably focusing on interferometric



SAR for a specific application - most probably landslides. We'll be announcing this training in the next month and a half.

Question 6: In the volcano events, can surface temperature or surface temperature differences be correlated with the deformations? If so, how close to "real-time" can those data be collected and accessed?

Answer 6: I'm not sure about that - I'm not a volcano expert. However, you cannot measure temperature differences with radar. You need to use something else such as thermal IR.

Question 7: Can we use SAR images for gully erosion since the depth of them are very high like 15 meters?

Answer 7: Again - this would be the same technique if I understand this question correctly. If you want to look at erosion through time, with interferometric SAR you can detect changes in the land surface on the order of cm.

Question 8: Is there a routinely updated InSAR product available for most of the Earth's surface (like there is for precipitation in IMERG)?

Answer 8: Unfortunately there isn't. However, the ARIA platform is looking at producing InSAR products for certain disaster-related events. The NISAR mission, a joint satellite mission between NASA & ISRO, which will be launched in 2021/2022 timeframe, will produce routine InSAR products.

Question 9: Can you point to the NASA products on deriving the earthquake induced landslides?

Answer 9: Not sure about earthquake-induced landslides. Otherwise we'll update this answer later on. (AMITA) also not 100% sure. But when the NASA disaster portal reports a landslide, it reports the cause. If it's an earthquake-induced landslide, it'll be on the disaster portal Dr. Podest just showed: <https://maps.disasters.nasa.gov/>

Question 10: Is there any remote sensing product that routinely measures the distance between fixed triangulation points on the earth's surface, so as to highlight strain vectors?

Answer 10: Not that I'm aware of. This is not something that is being routinely done.

Question 11: Are the products related to damages after earthquakes provided by UNITAR in vector or raster format?



Answer 11: The products provided by UNITAR are PDF files depicting damages represented in vector format. Underlying high resolution imagery (raster) is from different commercial providers and varies depending on the disaster. Open Street Map (vector) is used to provide the roads layer:

<https://disasterscharter.org/web/guest/charter-activations>

Question 12: Will you please tell me how to differentiate between landslides triggered by rainfall or earthquake if an event of earthquake is followed by heavy rainfall such as happened during Sikkim 2011 earthquake and landslides?

Is there any methodology or algorithms?

Answer 12: You may want to see this site

<https://pmm.nasa.gov/applications/global-landslide-model> - there is a reference that talks about a global landslide model, looking at rainfall-triggered landslides. I believe that has a terrain component and moisture component.

Question 13: What is the accuracy of differential interferometry over a pair of Sentinel-1 SAR images (IW wide swath? or What is the minimum deformation detectable with a pair of Sentinel-1 SAR images (IW wide swath)?

Answer 13: I'm not sure I quite understand this. So, these are two different methods. One is interferometric SAR and that allows you to detect deformation on the surface on the order of cm. That would be related to the length of the wavelength - the frequency the radar sensor uses. In order to do differential interferometry you use the phase of the signal. Then there are SAR images that are the amplitude images and have a range of values from very high (white) to very dark (black). And you cannot do measurements on the surface on the order of cm with the amplitude-based images. You cannot do deformation measurements with amplitude based measurements.

Question 14: Is there any model which describes the relation between rainfall and landslide intensity in any hill land area?

Answer 14: If you visit the pmm site, it has a reference to a landslide model that addresses this question. It's a landslide because of heavy rain but is in a hilly area and takes into account how moist the surface is from soil moisture:

<https://pmm.nasa.gov/applications/landslides>

Question 15: What is the vertical accuracy of differential interferometry over a pair of Sentinel-1 SAR images (IW wide swath? or What is the minimum VERTICAL deformation detectable with a pair of Sentinel-1 SAR images (IW wide swath)?



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Answer 15: With a pair of sentinel-1 SAR images that are amplitude based, you cannot measure surface deformation. You need the phase to measure surface deformation. If you have something like an L-band sensor you can measure surface deformation on the order of cm. With Sentinel-1 it's on the order of 6 cm.

Question 16: What is the update interval for the global landslide susceptibility map?

Answer 16: The model that uses GPM-IMERG would be daily. The data are available at sub-daily scales, but that's so the model is run at every few hours or every hour. It uses 7-day accumulated precipitation every day, then runs the model:

<https://pmm.nasa.gov/applications/global-landslide-model>

Reference: Kirschbaum, D. and Stanley, T. (2018), Satellite-Based Assessment of Rainfall-Triggered Landslide Hazard for Situational Awareness. Earth's Future. .
doi:10.1002/2017EF000715.

Question 17: What is the best model for landslide modelling?

Answer 17: If landslides are occurring because of rainfall, we talked about a model earlier. If it's occurring because of earthquake or volcano, I'm not sure what the best model to use is.

<https://pmm.nasa.gov/applications/global-landslide-model>

Question 18: I'm looking for a high-resolution DEM to accurately measure the terrain for estimating landslide susceptibility.

Answer 18: A high-resolution DEM is very important. In terms of a global DEM, there's SRTM which is almost global (60 deg north/south) and then there's ASTER. There are some regional DEMs that are higher resolution than SRTM and ASTER which are about 30 m/1 arc-second.