Questions & Answers Session 3

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

Question 1: How can we identify different crops which are cultivated at the same time in a particular region from satellite images?
Answer 1: Understanding the crop calendar and when plants are normally planted in a region will help with stratifying, or distinguishing, between differing crop types based on their phenology. Some governmental ministries and international organizations provide access to crop masks which is a good place to start. Access to high resolution (spatial and/or temporal) imagery and in situ data will improve the accuracy of your crop type mask. If crops are intermixed and there are many crop types growing in the same pixel, this can lead to challenges, such as smallholder agriculture with intermixed crops in a small area (< 1.5 ha). Fine spatial resolution (< 5m) of freely available satellite data is one of the limitations of applying satellite imagery to crop identification.

Question 2: How do we use a crop mask without ground truthing?
Answer 2: Understanding your region's growing calendar for a specific crop can help, and many studies have used an analog from other regions of the world applied to major commodity crops such as wheat, soy, and corn. If you have access to high resolution data that can assist in differentiating crop types. If you only have access to coarse resolution data, studies have shown you can spatially aggregate crop growing areas to provide percentages of a crop growing consistently in the same area. This is assuming you have reliable statistics for areas planted over subsequent years.

Question 3: I am wondering about the Central Asian region. Do you think the products are more biased since there is less in-situ data available to verify it?
Answer 3: NDVI is the main product used for crop and rangeland monitoring. Nadir BRDF (bidirectional reflectance distribution function) adjusted reflectance is used to calculate NDVI for several NASA instruments, and these instruments have been calibrated and validated across the planet for objective and consistent results. NDVI-

derived products from MODIS, VIIRS, Landsat, Sentinel, and others should all be fine due to the validation process involved before, during, and after launch of the satellite.

Question 4: Can we get the local area (state wise) crop calendar?
Answer 4: USDA NASS has comprehensive data from crop planting through harvest. They are a good source in the United States for crop calendars.

Question 5: What is base temperature or Tbase? in GDD calculation?
Answer 5: It depends, for grasses, cereal and forage crops, 5C is the Tbase. For crops like corn, rice, soybeans, tomatoes, and grapes, 10 C is used as the Tbase.

Question 6: Agriculture extensively uses various fertilizers and even different practices. Does the difference affect the models?
Answer 6: Absolutely, there are many different parameters which go into modeling crop production and yield. Agricultural practices play a critical role in plant development, and it is difficult to assess all the varying agricultural practices using remote sensing. Ground truth data plays a big role in this regard, and in the United States, USDA NASS collects this information through surveys.

Question 7: Can you provide more details on degree day models for pest monitoring activities and control?
Answer 7: With insects, especially in mid-latitudes, GDD's can help us to estimate when the eggs of a particular pest are going to hatch (and subsequently when larvae or immatures are going to begin feeding) or approximately when vulnerable stages of certain insects will be present.
GDD's are a much more accurate method of estimating insect growth and development and the timing of insect life cycles than using the calendar method of estimating insect activity. The calendar method is based on historical records or past experience when a certain insect is present in the landscape. This can be very different year-to-year, as we know some springs are warmer or cooler than others are.
In the tropics, the timing of the rainy season(s) is a better estimate of when pests are going to hatch than GDD.
https://ag.umass.edu/landscape/fact-sheets/growing-degree-days-for-management-of-insect-pests-in-landscape

Question 8: I didn't understand FAPAR, can you please explain in layman's term please?
Answer 8: In layman's terms, the Fraction of Absorbed Photosynthetically Active Radiation (FAPAR) is the fraction of visible light absorbed by a plant canopy.

Question 9: How can we use application of satellite remote sensing data to allow information about the biophysical state of crops to identify Adoption of Sustainable Agriculture (like improved tillage practices, adoption of agroforestry system and increase of soil organic carbon)?
Answer 9: With respect to precision, or smart farming, remote sensing can provide: (i) information on pre-season risk factors for crop/livestock health and productivity, (ii) within-season observations of the current conditions of crops, livestock, soil and water, and (iii) information on the effect of treatments, interventions or other events–such as lodging—that take place during the season. All of these can help guide preventive or corrective actions for the current season as well as management decisions for the following seasons.

Question 10: Is there any site similar to USDA to get crop data globally? In India, is there an equivalent of CropScape and crop masking function for satellite data?
Answer 10: For India you can refer to Mahalanobis National Crop Forecast Centre (MNCFC), established under the Department of Agriculture:
http://www.ncfc.gov.in/index.html
For global crop data, we recommend FAO (http://www.fao.org/giews/en/) as well as USDA FAS (https://ipad.fas.usda.gov/)

Question 11: For the demo websites, do you need to register before use?
Answer 11: No, you do not need to register to use any of the monitoring systems demoed in today's webinar.

Question 12: Can data from the GADAS Geoportal be downloaded?
Answer 12: GADAS allows you to export images as .png, .tif, .jpg, and .gif

Question 13: How can we distinguish between rangelands and dry-farming areas, both having low NDVI values?
Answer 13: This can be challenging. You might be able to detect changes in dryland farming over consecutive years with alternating cropped and fallow years. Depending

on the size of the field and resolution of the sensor, you should be able to distinguish between the two, allowing you to contrast that with rangelands. Understanding the phenology of the species planted in dryland fields can also help distinguish between cultivated fields and rangeland.

Question 14: You mentioned neural networks could be used for analyzing with FAPAK. Is there another analysis for agriculture where machine learning is used?
Answer 14: Yes. Decision Trees, Random Forest, and Support-Vector Machines are being used for crop type masking. Refer to our previous SAR for Landcover training that goes into detail about Random Forest analysis.

Question 15: Is it possible to assess nutrients of soils?
Answer 15: Hyperspectral imagery and precision farming allow one to assess nutrients of soils. With space-based observations this is challenging, and requires access to ground truth data.

Question 16: What is the basic difference between FAPAR & NDVI?
Answer 16: FAPAR is the fraction of visible wavelengths of light absorbed by a plant canopy. NDVI is the normalized difference between NIR and red wavelengths. They deal with different parts of the spectrum but are both indicative of plant health.
https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1506&context=natrespapers

Question 17: Can Digital Elevation Models be used to detect the land cover change?
Answer 17: Digital Elevation Models provide information on the relief of the planet's surface. Land cover change deals with quantifying the location, extent, and variability of ecological and human-built changes, the causes or forcing factors of change, and the responses and consequences of change.

Question 18: What about other countries? How does one acquire data on agricultural statistics or cropland data for countries other than the US?
Answer 18: For other countries you can refer to agricultural monitoring systems which we provided links for in the slides. The FAO (http://www.fao.org/giews/en/), USDA FAS (https://ipad.fas.usda.gov/), and others provide information and data you can acquire for your respective countries. We recommend you explore the links provided the presentation for more information outside of the US.

Question 19: For USDA IPAD, can you get the crop production map as a geospatial file?
Answer 19: For GADAS and Crop Explorer, you can export the data as .png or .pdf files, but not as geospatial files.

Question 20: My focus is on crops that are grown two times per year. If I'm going to use the Crop Explorer, are the areas there also consider the one seasonal (within a year) variability? or are they already averaged?
Answer 20: For the Crop Explorer tool, the anomalies are determined for a period of time over the average for that period of time. They reflect short-term and seasonal conditions and do not average over the entire year. The tool can be used within each growing season to assess the variability for that specific growing season, and can be used to assess each growing season separately.

Question 21: Can a ML (machine learning) algorithm be used to determine a phenological map of an area from the vegetation indices data?
Answer 21: Yes, there has been a number of research projects using machine learning methods to determine a phenological map of an area from the vegetation indices. The two most common are Random Forest (RF) and Support Vector Machines (SVM).

Question 22: How would you approach crop masks, crop types if you are looking at historical data? I was trying to determine crop type in the Aral Sea in 1980-2000, and found it difficult. Any suggestions would you have for the next time.
Answer 22: If you can find reliable ground truth data for that region (gov't data) it would help. Finding an analog of the area and determining the methods used for a different area can also help.

Question 23: Kindly provide the web link for the GADAS webtool.
Answer 23: https://geo.fas.usda.gov/GADAS/

Question 24: In the case of the Andes region of South America, have the NDVI products been topographically corrected?
Answer 24: NDVI has been corrected for angular variations in observation and sun-target-sensor variations, but not due to topography using a DEM.

Question 25: Can I use these datasets and tools to study Environmental Degradation?

Answer 25: Yes. An example is deforestation in the Amazon region using comparable methods such as those mentioned in the presentation.

Question 26: How is the base temperature calculated?
Answer 26: It depends, for grasses, cereal and forage crops, 5C is the Tbase. For crops like corn, rice, soybeans, tomatoes, and grapes, 10 C is the Tbase.

Question 27: For the international production assessment, how is the crop information validated?
Answer 27: FEWS NET, for example, has analysts and specialists in 19 field offices that work with US government science agencies, national government ministries, international agencies, and NGOs. The "NET" in their name represents the vast network of partners, ranging from collaborators in data collection and analysis to consumers of their reporting.

Question 28: Is NDVI the same for plants containing chlorophyll- a & chlorophyll-b?
Answer 28: Yes, NDVI will be the same for both.

Question 29: Could you explain why NASA AgMERRA (https://data.giss.nasa.gov/impacts/agmipcf/agmerra/) has not been discussed? What other sources might you suggest for temperature, precipitation, etc. measures instead?
Answer 29: Other similar NASA datasets include MERRA-2 and GLDAS. We did not discuss AgMERRA as the spatial resolution is not appropriate for operational agricultural monitoring.

Question 30: For all of the applications shown today--geospatial imagery portals and tools, which are available for download?
Answer 30: The Cropland Data Layer (for the US); GADAS data can be exported but not as a raster.

Question 31: What is the difference between NDVI driven from Landsat OLI and driven from Terra MODIS? And are any available in Google Earth Engine (GEE)?
Answer 31: NDVI from OLI and MODIS are both calculated from red and NIR bands. The difference being the spectral resolution of the sensors from each instrument are different.
NDVI for both products are available in GEE.

Question 32: I am working on creating a crop mask in my work area. The CropScape crop mask eliminates many areas of irrigated rangeland in my area. I would like to follow your suggestion of comparing NDVI over 3 months. Can you recommend an online tool for doing this easily?
Answer 32: There are several online tools. Below is a short list:
GEE, TimeSat, R, Python, QGIS - QPhenoMetrics