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

Question 1: Could it be possible or reliable to retrieve soil moisture from SAR data with a high spatial resolution? Even though the SMAP soil moisture products are derived from the combination of passive and active microwave data, we have rarely seen the active only soil moisture products, right? What's the future of the soil moisture retrieval study from SAR observations?
Answer 1: It is possible to retrieve soil moisture from SAR data only. Getting to soil moisture with SAR data only is not straightforward. We recommend our previous SAR webinars. The radar signal interacts with different components of the land surface. SMAP products are derived from microwave data which do not function. Present SMAP products use Sentinel-1 data. NISAR is a joint mission between NASA and ISRO and has a L-band sensor, being an ideal frequency for soil moisture. The NISAR mission is looking at developing a soil moisture product.

Question 2: Can I perform wheat crop mapping using Sentinel-1?
Answer 2: Yes, there have been a number of research projects carried out using data from Sentinel-1 to monitor wheat. We are including some links below:

1. https://www.iamm.ciheam.org/ress_doc/opac_css/doc_num.php?explnum_id=18964
2. https://www.nass.usda.gov/Research_and_Science/Cropland/docs/IGARSS%202019_%20Early%20Crop%20ID%20using%20Sentinel%201%20SAR%20and%20Optical%20Data.pdf
3. https://www.mdpi.com/2072-4292/11/16/1887/htm

We also suggest referring to our previous SAR webinar on agriculture:
https://arset.gsfc.nasa.gov/disasters/webinars/2019-SAR

Question 3: What free computing tools are available for digital processing of satellite images by remote sensing, applied to surveying land cover?

Answer 3: There are a number of freely available image processing software. The list below is not comprehensive, but is a good place to start:
Google Earth Engine, SNAP, QGIS, Python, R

Question 4: If it's sun-synchronous, why do we need active sensors in SMAP?
Answer 4: I don't quite understand the question. When you are using SMAP products, the products are derived from the 6AM and 6PM passes. The temperatures and conditions will vary. Morning is more optimal.

Question 5: I am building a model for crop water requirements which gives daily outputs to farmers about their crop water requirements: soil moisture, ET, etc. Which free and commercial items do you suggest that give daily satellite images with appropriate resolutions?
Answer 5: Free data are available from SMAP (2-3 day return time) and LDAS (daily). We will have a session on ET data in Week-4. Satellites used for ET are MODIS, Landsat, and VIIRS. But high resolution Landsat-based ET available every 16 days.You may combine LDAS and satellite based data datasets for your work.

Question 6: What is the extension of the data of SMAP?
Answer 6: Below is a link for more information pertaining to SMAP data products: https://smap.jpl.nasa.gov/data/. The enhanced products are derived from the beginning of the mission. SMAP soil moisture data goes from April 2015-present.

Question 7: How will the Soil Moisture be applicable for the agricultural dominated Gangetic Plain of India?
Answer 7: Monitoring soil moisture changes over growing season helps assess water availability for crops.

Question 8: How is SMAP different from Wetness Index in Tasselled Cap Transformation?
Answer 8: I have not done a direct comparison. With microwave data, you can penetrate through vegetation as compared to optical data.

Question 9: Is there any open source code available for crop type mapping?
Answer 9: Yes, open source code is available from GitHub:
https://github.com/search?q=crop+type

Question 10: Over what period is the SMAP Soil Moisture Anomaly calculated?
Answer 10: There is no such thing as a SMAP soil moisture anomaly.

Question 11: How is RMSE calculated?
Answer 11: Basically comparing in situ data with model data and comparing differences. Any statistical package (e.g. in R) will have a procedure to calculate RMSE.

Question 12: Despite the spatial resolution of SMAP being approximately 9-40km, would it be viable to perform small-scale soil moisture analyses (10m-500m) by conducting calibrations using SMAP values as a reference?
Answer 12: You have to take into account soil differences/characteristics. Be mindful when conducting analysis.

Question 13: As the pest problem is increasing with the change in moisture therefore the food security has a great threat from the pests under climate change. Please can you explain the types of models which can be used in smart pest management techniques with those models. If possible please also email me the details of those models which can be used with the NASA data set or SAP data products.
Answer 13: Not aware of any pest management models. However, analysis of soil moisture, temperature, and vegetation along with pest outbreak observations may be used to develop statistical models (e.g. DOI:10.1016/j.compag.2019.104943).

Question 14: Can a radiometer resolution be brought down under 5km? Any insights into future missions providing improved resolution with a passive microwave sounder?
Answer 14: You can enhance the resolution up to certain points (25 km gridded to 9km for SMAP). The GPM Microwave Imager (GMI) has a resolution of 5-10 km at certain frequencies.

Question 15: Was the SMAP 9km data downscaled from the 36km product? What are the potential errors associated with the interpolation?
Answer 15: Yes, the SMAP 9km was downscaled from an interpolation technique. Email Dr. Podest with your inquiry: erika.podest@jpl.nasa.gov
Here is reference to the SMAP enhanced radiometer resolution methodology https://ieeexplore.ieee.org/document/7729065

Question 16: Which SMAP data is used by USDA for crop forecasting activities?
Answer 16: https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20190001615.pdf. USDA uses SMAP level-3 data.

Question 17: Would it be possible/useful to merge the SMAP with the AMSR-2 soil moisture?
Answer 17: Yes, it is possible. Merging both can help to fill any gaps.

Question 18: How does the algorithm work in urban areas? Does it use any proxy or just shows pixels with no values?
Answer 18: For SMAP, the algorithm does not work with urban areas, since it was made for more natural areas.

Question 19: Is brightness temperature different from LST?
Answer 19: Yes, LST is land surface temperature. Brightness temperature is usually derived from top-of-atmosphere radiance measurements.

Question 20: Can we use the kml file to sort the boundaries of the data which is to be downloaded?
Answer 20: If you are referring to GES DISC or Giovanni, you can use a .kml file after you download global or regional data.

Question 21: Does NSIDC require a separate account than NASA EarthData?
Answer 21: NSIDC is part of NASA'S Distributed Active Archive Center (DAAC). You can use the same EarthData account to access data from all DAACs.

Question 22: Are any of the SMAP products delivered as geotiffs?
Answer 22: Yes. Through the Earth Data website you can download data as geotiffs.

Question 23: Can we use the softwares given on the site to read the hdf files for reading other hdf files rather than using it for only SMAP products?
Answer 23: Yes, the software will read any hdf file.

Question 24: Is it possible to access the SMAP datasets using an API?
Answer 24: Yes, below is a link explaining how to access SMAP data using an API. It requires EarthData login credentials to do so:

https://nsidc.org/support/how/how-do-i-programmatically-access-data-spatial-temporal

Question 25: Can we use SMAP for delineation of groundwater?
Answer 25: SMAP looks at the top 5cm of soil. GRACE focuses on groundwater change.

Question 26: Can extract values to points be generated on the NetCDF format of the SMAP dataset? Can the points extracted be taken as soil moisture values?
Answer 26: I believe you can.

Question 27: What size of a farming operation would benefit from using these satellite data? And how are they using it? It seems to us the resolution and capability is to cover very large areas and probably used for more regional analysis. What are the panelists' thoughts on this?
Answer 27: SMAP has a 9km resolution. Smaller farms would have a harder time taking advantage of it due to resolution. You can use SMAP or LDAS data as forcing crop models.

Question 28 How does the accuracy of LDAS vary over different land covers? Is it easier to quantify over grassland?”
Answer 28: Yes, it does vary with land cover.

Question 29: How accurate is the SMAP time series for one pixel or a group of pixels? Would the accuracy/inaccuracy be relatively stable for each location?
Answer 29: SMAP is very consistent and each pixel has an accuracy associated with it, but does not necessarily match with the mission requirements.

Question 30: How does the instrument differentiate the depth of surface and root-zone?
Answer 30: Root-zone uses a model that takes moisture from the surface and determines what the moisture is at root-zone level.

Question 31: In a future Webinar are you going to have a practical session? Like a Workshop using the different products from all the sensors, it will be great.
Answer 31: This is a good suggestion - and we will definitely consider it in future.

Question 32: Is LIS publicly available for free?
Answer 32: Yes, the LIS software is available freely.

Question 33: Do you know of a higher resolution model that is located in the tropics?
Answer 33: The models highlighted are the same models available in the tropics.

Question 34: Could SMAP data as well as the LDAS products be used for irrigation scheduling, or groundwater recharge of a specific area?
Answer 34: It should be possible for a large region with LDAS being 25km and SMAP being 9-40km in resolution. High-resolution, satellite-based ET is used for monitoring irrigation scheduling (https://ecocast.arc.nasa.gov/simsi/about/).

Question 35: Does Giovanni allow you to download large amounts of data through scripts?
Answer 35: For downloading large amounts of data, GES DISC is better. However, in Giovanni you can go to 'Lineage' link just below the 'Download' link where links to all data files included in the Giovanni analysis are provided and can be downloaded by clicking on them.

Question 36: Are all these products also available in Google Earth Engine? If so, wouldn't it make more sense to work directly in Earth Engine?
Answer 36: Not all of the products are available. A version of SMAP is available on GEE. If you want the original product, refer to the referenced sites.

Question 37: What Python libraries are generally recommended for use by consumers of data in NetCDF or HDF5 formats?
Answer 37: Python/numpy interface to the netCDF C library: netcdf4-python

Question 38: How can we use FLDAS for food security?
Answer 38: See for example Famine Early Warning Network (https://fews.net/).

Question 39: What does units of soil moisture units of Kg/m2 mean?
Answer 39: For every unit area (m2) how much mass of soil moisture there is (in Kg).

Question 40: Will you cover shallow groundwater from the Land Data Assimilation System (LDAS)?
Answer 40: Not in this webinar, but we will in the near future when we cover the water budget.

Question 41: How can we compare the RS soil moisture data and in situ observed data?
Answer 41: You have to extract RS soil moisture by latitude-longitude corresponding to in situ data locations -- ideally from a time series of both these data and then can compare using any software.

Question 42: How are humidity measurements corrected from the ground to remove the effects of vegetation, surface roughness, and temperature?
Answer 42: Referring to SMAP, it uses ancillary data files to inform the algorithm and correct for potential bias.

Question 43: What is the recommended spatial resolution for a soil moisture sensor?
Answer 43: For field level, 9 km may not be very useful. It depends on the type of study.

Question 44: Are SMOS and ASCAT data freely available like SMAP and Sentinel1?
Answer 44: Yes. In accordance with ESA Earth Observation Data Policy, SMOS Level 1 and Level 2 Science data products are accessible on-line to all users, free of charge: https://smos-diss.eo.esa.int/oads/access/
ASCAT data can be freely accessed at the link below: https://search.earthdata.nasa.gov/search?q=ascat%20soil%20moisture

Question 45: Can SMAP soil moisture product be downscaled to a higher resolution? What additional information is needed?
Answer 45: The enhanced radiometer resolution can be downscaled to higher resolution, with validation, on the ground measurements, ancillary data layers to account for differences in landcover, slope, etc.

Question 46: Can it be combined with Sentinel-1 data for high resolution soil moisture?
Answer 46: Yes. There is a beta version of Sentinel-1 data at 3km.

Question 47: Is the top 5 cm of soil moisture measurement sufficient for crop moisture requirement assessment or for crop yield predictions? Crops root zone extends more than the top 5 cm.
Answer 47: Excellent point. You want to get down to root-level soil moisture.
SMAP can only penetrate so much into the soil. There is a level 4 data product that is modeled that can show deeper into the root zone (1 meter).

Question 48: Where can I get a historical soil moisture product for the past 3-4 decades?
Answer 48: Reanalysis data such as MERRA goes from 1979-present. (https://gmao.gsfc.nasa.gov/reanalysis/MERRA/).

Question 49: Are there any limitations on the SMAP data since it now uses C band from Sentinel instead of L band?
Answer 49: There are limitations. C band does not penetrate as much as L band and there is some variation between SAR and SMAP data.

Question 50: Which of these products is best to detect non-permanent wetlands?
Answer 50: SMAP detects the amount of water in the soil. SAR is a better alternative to look at and detect wetlands. Refer to our previous SAR webinars.

Question 51: Where can I get the historical Soil Moisture product for 3-4 decades?
Answer 51: See Question 7.

Question 52: What about other factors like density of plants in the field, health of plants, and variety of crops that affect crop yield? Should they be included in the estimation of crop yield?
Answer 52: Yes, biophysical parameters such as Leaf Area Index (LAI), Fraction of Absorbed Photosynthetically Active Radiation (FAPAR), and crop health are all important and should be considered when estimating crop yield.

Question 53: Can you explain what is surface soil moisture and what is the root soil moisture?
Answer 53: We are referring to the top 5cm for surface soil moisture and 1m for root zone soil moisture.

Question 54: Can SMAP products be used for field-scale applications?
Answer 54: It depends on the “field scale”. Optimally, it should be used for larger fields.

Question 55: Is it possible to map irrigated areas with the help of soil moisture data?
Answer 55: It may be difficult to map irrigated areas at small field levels as SMAP pixel is 9 km and LDAS is ~25 km. So regional patterns in irrigation can be observed.

Question 56: Can GrADS be used to extract SMAP data products?
Answer 56: Correct, GrADS can read SMAP files.

Question 57: Can SMAP data provide any information about soil salinity?
Answer 57: The data provided is very minimal. SMAP is more so used in the analysis of sea salinity.

Question 58: Is it possible to get a manual for downloading SMAP data?
Answer 58: erika.podest@jpl.nasa.gov
https://smap.jpl.nasa.gov/data/
https://nsidc.org/data/smap/smap-data.html

Question 59: Which are the most common and complete softwares to use for detecting changes in vegetation production and greenness?
Answer 59: There are many different softwares for detecting changes in vegetation production and greenness. The following are just a few examples:
Google Earth Engine, Climate Engine, QGIS, ASAP, GIMMS

Question 60: Can we say that soil moisture analysis is a must in studies that deal with land suitability analysis for various crops?
Answer 60: Yes. Different crops have different types of water consumption and soil moisture information is important for that.

Question 61: Is it possible to use this data for land surface temperature (LST)?
Answer 61: Though LST is influenced by the amount of soil moisture I am not sure whether SMAP data have been used for LST. Brightness temperature (K)...

Question 62: Are soil moisture retrieval algorithms and the parameters that influence the soil moisture included in SMAP?

Answer 62: Yes. ATBD is openly available on NSIDC website and describes sources of datasets.

Question 63: If we want to use other products for soil moisture retrieval, which software do you suggest? And what parameters do you see being critical for assessing?
Answer 63: I am not sure I understand the question (Amita).
SMOS is an ESA L-band radiometer being a global product (Erika).

Question 64: Can we use LDAS to trace the previous drought periods (years) of a given country?
Answer 64: Yes, LDAS data have been available since 2000 (LDAS 2.1) with consistent forcing data, so can be used to study past doughnuts during this period.

Question 65: Will SMAP end up using NISAR data instead of Sentinel-1?
Answer 65: If they are flying at the same time then maybe (NISAR launches in 2022). It will depend on how far apart the time of acquisitions are between the two satellites. Keep in mind that the NISAR mission has an effort in place to generate soil moisture from just NISAR data, which will be at a higher spatial resolution than SMAP (but lower temporal repeat).

Question 66: Using Giovanni, how does one show only dry or wet seasons?
Answer 66: You can calculate long term mean and then calculate annual mean for precipitation and soil moisture. By visually comparing long-term maps with individual annual maps you can indicate dry and wet periods. To do this visually it is recommended that color range should be the same for all maps in Giovanni. For more quantitative analysis of dry and wet periods, you have to download the mean as well as individual annual data and use QGIS or other software to calculate anomalies (e.g. https://arset.gsfc.nasa.gov/water/webinars/IMERG-2020).

Question 67: Are these products available on Google Earth Engine?
Answer 67: Some SMAP data is (.25 degree soil moisture product).

Question 68: Is it correct to average the soil moisture values that are at different depths?

Answer 68: Referring to LDAS layers, depends on your analysis. For monitoring soil moisture conditions it is ok to average soil moisture across the layer, but for water budget analysis soil moisture values from all the layers have to be added.

Question 69: Using SMAP data, can we do urban heat island mapping?
Answer 69: SMAP data does not work with analysis of urban areas.

Question 70: Can one use Giovanni to see the seasonal pattern and correlation between soil moisture, sun induced fluorescence, and gross primary production (GPP)?
Answer 70: You can map the data seasonally, but have to use other software to get correlation between the parameters.

Question 71: Is there an API to automate SMAP data collection rather than using a web portal?
Answer 71: Yes. https://nsidc.org/support/how/how-do-i-programmatically-access-data-spatial-temporal

Question 72: Can one compare between SMAP soil moisture and drought index from other satellites (e.g., S2, L5 and L8)?
Answer 72: Yes. If you are looking at drought, soil moisture can be an indicator.

Question 73: How do I install the soil moisture toolbox in SNAP? Why does it not appear?
Answer 73: The latest version of SNAP will have the soil moisture toolbox. It will be released soon.

Question 74: Can soil moisture using satellite images be used to locate groundwater?
Answer 74: No. Soil moisture just looks at surface moisture. The GRACE mission can detect groundwater.

Question 75: Which soil moisture product is suitable for rice yield estimation in Thailand?
Answer 75: Looking at surface and root-zone moisture is necessary for any crop. Try different products (SMAP, LDAS) and analyse along with rice yield data to determine which soil moisture product is most suitable for your region.

Question 76: What is the most important impact to the accuracy of soil moisture from satellites?
Answer 76: With SMAP, roughness, land cover, topography, texture, vegetation, and water content all play a role with determining accuracy.

Question 77: Can we compare SMAP data for soil moisture and GRACE satellite data? Can they be used together to get a better assessment of soil moisture?
Answer 77: GRACE gives you total column water and you can discern the amount of water on the top to determine the amount of water at the bottom. You can use both for determining water column.

Question 78: Why do we use a radar in accordance with the Radiometer in SMAP irrespective of its less accuracy?
Answer 78: I'm not sure I understand. Radar does help to provide higher resolution.

Question 79: It is possible to obtain water quality information with these data?
Answer 79: Not with SMAP. With microwave, it cannot determine the chemical properties of a surface. Runoff data from LDAS can be used in statistical/empircal techniques in estimating sediments, nitrogen, and phosphorus.

Question 80: For a daily-scale satellite image, I wonder if it's possible to get its exact obtained time? E.g.: all the time stamp of GLEAM daily ET or soil moisture data is Year-Month-Day-0(Hour)-0(Min). Is there any method to figure out its exact collection time like 3:00 or 14:00?
Answer 80: Yes. With level 1 data it can be. It is included in SMAP metadata and can be a bit overwhelming. SMAP is in a sun synchronous orbit and is specified.

Question 81: is there some platform where we can download SMAP, LDAS, GPM, and MODIS data?
Answer 81: You can download most of the information using NASA EarthData (https://earthdata.nasa.gov/). This site will provide links to appropriate locations to get all these data sets. GES DISC has LDAS, GPM, and some MODIS data.

Question 82: What are the different sources of uncertainty which could affect our measurement at one location? What could you do to reduce these uncertainties?

Answer 82: With SMAP, it depends. Soil texture is an example and SMAP uses a soil texture map for analysis. It's hard to exactly pinpoint uncertainty, but there are many factors that can increase uncertainty.

Question 83: Are Community Land Model (CLM) and Common Land Model (CLM) V2.0 (GLDAS Version 1) different? If yes, what kind of fundamental differences do they have?
Answer 83: Please see the article about GLDAS: (https://journals.ametsoc.org/doi/pdf/10.1175/BAMS-85-3-381). The CLM used in GLDAS combines some Community Land Model (CLM) features with components from other LSMs.