Lab and Questions & Answers Session 1

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 Amita Mehta (amita.v.mehta@nasa.gov) or Sean McCartney (sean.mccartney@nasa.gov).

Question 1: How do geophysical parameters measure evaporation and transpiration?
Answer 1: Evaporation and transpiration are not observed directly but are derived from remote sensing based geophysical parameters such as land surface temperature, vegetation, and near-surface humidity and winds.

Question 2: Regarding slide 2, is it possible to change the spatial resolution to a higher resolution like 30 m for hydrology modeling?
Answer 2: One can interpolate data for the ease of calculations and to have some data at higher resolution points but that does not add any independent or accurate data/information.

Question 3: How can we estimate soil moisture from remote sensing using QGIS or other software rather than using SMAP data?
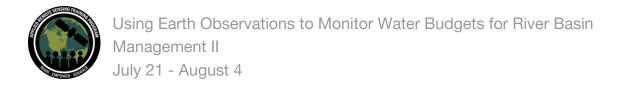Answer 3: In-situ soil moisture measurements. There is not a way in QGIS to get soil moisture information.

Question 4: Do GLDAS and GDAS refer to the same system? Some documentation cites GDAS which they translate as Global Data Assimilation System.
Answer 4: No, GLDAS is Land Data Assimilation System -- atmospheric data are used as forcing. GDAS is a Global Data Assimilation System that is primarily used for the NCEP atmospheric model.

Question 5: What is the smallest basin area you would recommend for working with this water budget data?
Answer 5: This is a very good question, we will see in the next two weeks! The lowest resolution data are from GRACE (~150,000 km^2 which is about 3x3 degree) so based on remote sensing alone one should not expect to get basins with a smaller area than

a GRACE footprint. The GRACE data we use are at 1x1 degree resolution, but each point is not independent from surrounding points. GLDAS resolution can be higher (~0.25 x 0.25 degree) and can resolve basins smaller than what GRACE would. However, models have their own uncertainties.

Question 6: How was the wet and dry period selected in the analysis?
Answer 6: Wet and dry seasons were picked based on long-term season precipitation for the Limpopo river basin. The wet season and dry season can be extended from Nov-April (wet) and May-Oct (dry), but for the purpose of this training we limited the study period to 3 months. For your own analysis you can follow the procedures outlined and extend the study period accordingly. We will show in the next session how the wet and dry seasons were decided.

Question 7: Is there any data available for south-east Asia regions?
Answer 7: Yes, all the data provided in this webinar can be accessed for south-east Asia regions.

Question 8: How accurate are these data and where can this analysis be used in the real world?
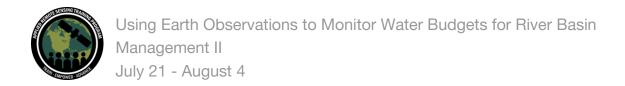Answer 8: These data can have uncertainties that vary from region to region (validation studies in published literature indicate 5 to >30% uncertainty compared to point measurements). However, monitoring the water budget components over time can give you an idea whether availability of water is increasing or decreasing in the region of your interest. Also, in the real world it is worthwhile to assess what else is used and how accurate the existing data/methodology are there for a given basin.

Question 9: Will QGIS read a NetCDF file?
Answer 9: Yes, newer versions of QGIS allow you to import NetCDF files without installing a plugin. You can do so using the Add Raster function. For raster calculations it is important to use tiff files.

Question 10: How do you get the approximate lat/long (bounding box) - need to use QGIS?
Answer 10: The extent of any file you download (i.e. bounding box) can be found by double-clicking (or right-clicking) on the layer you uploaded into the Layers panel and

select "Information". The extent of each dataset is provided in this window. In Giovanni and GES DISC you can also draw a box around the area of your interest, and that gives you lat/long in the coordinate window.

Question 11: Are datasets available for all the river basins across the globe?
Answer 11: No, datasets are not available for all river basins across the planet. There are limitations in resolution at the higher latitudes.
Refer to previous ARSET training provided in the opening slides for more information.

Question 12: I don't know if this is the proper time to ask this, but is calibration also necessary for these datasets, since they are RS-derived?
Answer 12: Yes, it is very important. One way to do it is to have good discharge/streamflow data that would confirm or validate the RS-based water amount variations. Surface based measurements should be used for calibration. These datasets are global--to apply in your area, look at the size of the basin to see if the data will work for you (spatial resolution) then use ground measurements to validate. RS and modeled data, once validated, are very useful when looking for _change in_ water storage.

Question 13: In GLDAS data, how do you remove the seasonal cycle from GRACE datasets?
Answer 13: We will address this in Part-3.

Question 14: If we would like to do the analysis for a long period of time (i.e. 2008 to 2020) is the procedure to do it month by month?
Answer 14: Yes, if you are interested in monthly or seasonal water components. But the analysis can also be done at annual time scale. If you refer to slides 23 & 28, you will see MODIS ET data can be downloaded annually. For other datasets you will need to download the monthly data and aggregate to the study period of your interest.

Question 15: How do we test the accuracy of GRACE data?
Answer 15: If you have monitoring wells in the area of your interest you may be able to get some indication of accuracy when comparing GRACE data to these point data. You may want to review the GRACE webinar offered by ARSET. Based on the algorithm validation it is suggested that GRACE anomalies have 2-3 cm errors in them.

Question 16: If I download a NetCDF file, can I extract the individual files from it to use or do I have to use them combined all the time?
Answer 16: Yes, you are able to extract individual files for further analysis from any NetCDF file you download. Below is a link to learn more on how to do so:
https://gis.stackexchange.com/questions/357159/cannot-open-netcdf-file-in-qgis

Question 17: Instead of downloading precipitation data separately for Dec to Feb and then Jun to Aug/Sep, what will happen if I download continuous data for Dec to Sep? And why not for a complete calendar year?
Answer 17: This all depends on the level of analysis you are conducting. If you are interested in specific seasons you can download data as demonstrated in this training. If your study period is annual or at a different time step, you can always change the date range to accommodate your research interests. We chose just the wet and dry seasons for this area for demonstration purposes.

Question 18: How do geophysical parameters measure the evaporation and transpiration? (slides 17/18)
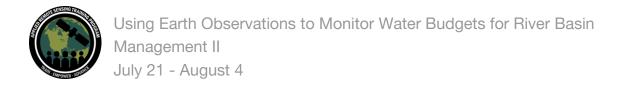Answer 18: Refer to Q1.

Question 19: Is this method valid for arid and semi-arid regions?
Answer 19: Yes, the method is valid. The datasets we are using can vary by accuracy depending on your region of interest (arid vs humid regions). You will still need to validate with ground data.

Question 20: Why is GRACE data downloaded for September while for other datasets it is only through August?
Answer 20: We need to download GRACE data for September because the *change in terrestrial water storage (DTWS)* is calculated as the difference from one month to the next. We can not determine August DTWS without having access to September monthly data.

Question 21: When I click on Plot data, I received this message "giovanni.app.Result: Initiate service request failed"

Answer 21: Be sure you are entering all parameters carefully. Go back and double-check everything you entered, if you are still receiving issues close out of Giovanni and log back in.

Question 22: Would it be possible to give us a list of software or tools and their uses in different exercises? It would really help to follow and practice the exercises, and also be useful for utilities the learning/knowledge of these exercises in the real world.
Answer 22: This is a good point. A list of software and tools are provided in the Objectives slide of Exercise #1 (slide 3). We will consider changing future exercises.

Question 23: While downloading the GLDAS data for this case, the number of links are only 11 so it's not a difficult thing to download one by one, but in case of longer period we will have to use wget, so can you please demonstrate the process of downloading using wget or suggest a source from where it can be learned.
Answer 23: Refer to the following link to learn more about using wget for bulk data download :
https://disc.gsfc.nasa.gov/data-access

Question 24: Are we going to see any way to obtain data using Python, JavaScript, or any other language?
Answer 24: For this training we will not be using programming languages to obtain data. We are increasingly showing data in Google Earth Engine that uses code to do that.
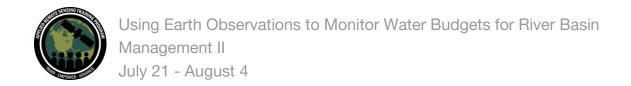
Question 25: Can we use GFS data as precipitation in the model during floods?
Answer 25: GFS has a 72-hour forecast.

Question 26: Can you suggest any source from where I can learn how to download multiple links using wget? It may be required if I need to download GLDAS data for a longer period.
Answer 26: https://disc.gsfc.nasa.gov/data-access

Question 27: Can we separate evaporation and crop transpiration data using satellite data products?
Answer 27: The data we are using is ET. In models you can get both.

Question 28: Many people talk about errors in the EMCWF model, so how do we justify the validity of our results while using GRACE? How do we get the error bar for EMCWF?

Answer 28: The answer is that unless you have in situ data in your region, you cannot get error bars.

Question 29: What does the initials "DS" mean in the water budget equation?

Answer 29: DS = Change in water storage

DS in the watershed can include surface (snow, soil moisture), sub-surface (root zone moisture), and groundwater components.

Question 30: Isn't SMAP now C-band since the active sensor failed and it's now using Sentinel-1 data?

Answer 30: SMAP has an L-band radiometer. Currently C-band SAR from Sentinel-1 is used along with the SMAP passive radiometer.

Question 31: How would you consider fusing ESA Sentinel and NASA data?

Answer 31: Yes, data fusion of Sentinel-1 and SMAP is already going on (https://elib.dlr.de/129013/). In addition, Landsat and Sentinel-2 MSI data are harmonized for land applications (https://hls.gsfc.nasa.gov/) and water quality applications (https://landsat.usgs.gov/sites/default/files/documents/landsat_science_team/2018-02_Day2_Pahlevan_SSAI.pdf).
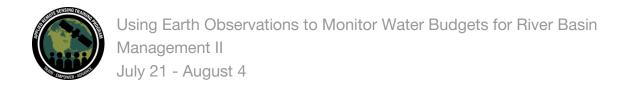
Question 32: Are these datasets in Google Earth Engine?

Answer 32: Yes, all the datasets are available in GEE except for GLDAS CLSM.

Question 33: Can we seasonally calculate the amount of water for river basins from remote sensing?

Answer 33: That is the focus of session 2 of the webinar series. Stay tuned for next week.

Question 34: For next week's exercise, which software are we going to use?

Answer 34: We will use the latest version of QGIS along with spreadsheet software (Excel or Open Office) in next week's session.

Question 35: In GIOVANNI, how does one add their own area of interest shapefile?
Answer 35: You cannot add any shapefile for your own area of interest. Buy you can create a bounding box around your area of interest. You may also select from Giovanni's database of shapes.

Question 36: What is the difference between IMERG and IMERG Final run data?
Answer 36: There are three IMERG products: Early, Late, and Final.
IMERG Early Run provides the lowest latency available (4 hours), suitable for near real-time applications.
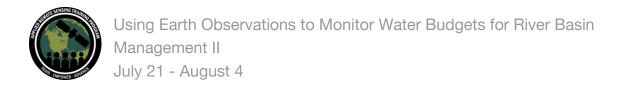The Late Run has a longer latency than Early Run (10 hours) but is a higher quality product.
The main difference between the IMERG Early and Late Run is that Early only has forward propagation (which basically amounts to extrapolation forward in time), while the Late has both forward and backward propagation (allowing interpolation). As well, the additional 10 hours of latency allows lagging data transmissions to make it into the Late run, even if they were not available for the Early.
We always advise people to use the Final Run for research. The vast majority of grid boxes have fairly similar Late and Final values, so it makes sense to stick to metrics that are more resistant to occasional data disturbances. The Final version has ~2-3 months latency because this product includes calibration with rain gauge data on land.

Question 37: Can I download the IMERG PNG option? The geotiff gives me an error.
Answer 37: To perform the analysis in sessions 2 & 3 you will need to download the GeoTiff files. The error you are experiencing can be caused by a number of different issues. Try closing out of Giovanni and attempt to login and download the data at a different time. If you continue to experience issues with your download, email the instructor: Sean McCartney (sean.mccartney@nasa.gov).

Question 38: When we download IMERG precipitation data on Giovanni as monthly does it download to the end of the month? If we do so for MODIS ET should we then specify the last day of the month?

Answer 38: Yes, IMERG data is aggregated hourly → daily → monthly. It is accurate for the date range specified (i.e. end of month). Since MODIS ET is an 8-day product it does not always fall on the end of the month (except for Dec 31). By specifying the last day of the month, you will ensure the 8-day product will include this date in the download. This will be expanded upon more in the coming sessions.

Question 39: Could you explain why the units of ET are given in (kg m^{-2} s^{-1}) and not mm?
Answer 39: We will convert units next week.

Question 40: It's not possible to download files from AppEEARS from 21st to 22nd July because of maintenance? Does it mean that the Part 2 Exercise cannot be done before 23rd July?
Answer 40: Unfortunately, the website is being serviced from 21st to 22nd July. You have until the 28th to obtain the data so please be patient. We will also be posting the data on the ARSET website in the coming week.

Question 41: What is the exact data name of GRACE and GRACE FO products we are using?
Answer 41: JPL TELLUS GRACE-FO Level-3 Monthly Land Water-Equivalent-Thickness Surface Mass Anomaly Release 6.0 version 03 in netCDF/ASCII/GeoTIFF Formats

Question 42: Is there any homework this week?
Answer 42: Homework #1 will be due on August 11. Answers must be submitted via Google Forms. The URL for the assignment can be found in the Chat window and on the training webpage:
https://arset.gsfc.nasa.gov/water/webinars/water-budgets-river-basin

Question 43: I have downloaded IMERG monthly data from Dec15-Feb16. Should I download IMERG precipitation date from Jun16-Aug16?
Answer 43: Yes, please follow the instructions as they are provided in Exercise 1.