



## Questions & Answers Session

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 contact Amita Mehta ([amita.v.mehta@nasa.gov](mailto:amita.v.mehta@nasa.gov)) or Sean McCartney ([sean.mccartney@nasa.gov](mailto:sean.mccartney@nasa.gov)).

Question 1: Do GRACE and GRACE FO provide only TWS anomaly data, not TWS data?

Answer 1: That is correct. You only see anomalies.

Question 2: Why is base mean taken from 2004 to 2009 data for computing TWS anomaly?

Answer 2:

Question 3: Can GRACE be used for oil exploration?

Answer 3: It may require a lot of processing. Not certain.

Question 4: Why are the estimated annual groundwater extraction data so old? Is it difficult to obtain such data?

Answer 4:

Question 5: What is the difference between RL05 and RL06 versions of GRACE?

Answer 5: We will post this link. This is described in the CSR site.

Question 6: Is it possible to convert GRACE point data of 1\*1 degree spatial resolution into 0.25\*0.25 spatial resolution using Inverse distance weighting (IDW) interpolation? What are error chances?

Answer 6: GLDAS downscales it to 0.25 degree. In the slide deck, there is a reference to the error estimation. Downscaling aside, it is still coming from the original data.

Question 7: What is the difference between the water budget as Total water budget or Surface-water budget or groundwater budget?



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Answer 7: Total is easy because you are looking at water in all forms (on land, in the atmosphere). Surface is just top several meters on the Earth. Groundwater is how it is renewed and how it is withdrawn.

Question 8: Is there any reference (benchmark) for the anomaly of terrestrial water storage change?

Answer 8: That is 2004-2009. It is gravity anomalies are used and that is translated into TWS.

Question 9: Does the terrestrial water storage in GLDAS data come from GRACE data?

Answer 9: Yes, but all the other hydro components are also added to GLDAS. GRACE data acts as a constraint to TWS in GLDAS

Question 10: What is the spatial resolution GLDAS v2.2?

Answer 10: 0.25 degree

Question 11: Can GRACE be used for monitoring of the flood hit area?

Answer 11:

Question 12: What is the baseline to calculate the GW anomaly?

Answer 12: The same years have been used. We are sharing the contact information for an expert on GLDAS groundwater in the Chat Box.

Question 13: GRACE data being monthly, how is this data being used in weekly drought or flood monitoring that you mentioned in PPT Nos. 27-28?

Answer 13: If you see it is really the GLDAS based groundwater that is used. You have daily data of other hydro components and they are used.

Question 14: Can we use Grace data for drought detection?

Answer 14: You will need more data, however. That would be short term hydro drought that may not show in groundwater storage.

Question 15: Could anyone please tell how to remove seasonal signal from GRACE data?



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Answer 15: Take each long term mean from each month, then subtract that from anomalies to remove seasonal cycle.

Question 16: Is there any accuracy issue using different data access sources like JPL, GFZ, CSR?

Answer 16: There is a link in the slide deck with that information. All are validated and published. Ensemble Mena is the most accurate.

Question 17: How does the cm of equivalent water thickness translate to depth to groundwater?

Answer 17: Unit area of land and the column of water in that is shown in cm. If you subtract depth of SM and SW, what remains is gW thickness.

Question 18: Does GRACE report the fresh water usable for drinking and agriculture or report the total GW including high salinity water?

Answer 18: It is total water. Saline water would be included.

Question 19: How to choose GRACE TWSA product for basin water balance? JPL is standard GRACE product, does it mean it is the best choice?

Answer 19: Product choice: Try each and see how it works in your basin. The size has to be kept in mind. This is coarse data. Discharge data, ET, PPT, you can do an error analysis. Ensemble mean is recommended.

Question 20: Do we have research examples that utilize GRACE data for flood and drought monitoring?

Answer 20: We do. GRACE JPL site has publications listed.

Question 21: How can GRACE and GRACE-FO be adapted for watershed studies? Also, could groundwater have any link with flooding and erosion?

Answer 21: Flooding, there is a link. Erosion, not certain. Spatial resolution is the issue with watersheds.



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Question 22: Is there any pre-processing required for TWS analysis using the RL06 version of GRACE?

Answer 22: There is a scale factor. You can download the TWS data and use it as is.

Question 23: <http://thegraceplotter.com/> Do we have a continuation for graceplotter website?

Answer 23: We are not familiar with that site.

Question 24: What is the difference between levels of data?

Answer 24: Please refer to the Fundamentals of RS course, it will explain. The basics is that Level 0 to 1, to 2, to 3, to 4, involve going from raw measurements to gridded, to modeled.

Question 25: As you described that GRACE cannot distinguish between the state of water. Would like to know which one is best to know the state of moisture?

Answer 25: Other observations (MODIS, VIIRS, etc) that can tell you that is liquid or frozen water. GLDAS incorporates those into consideration.

Question 26: Can we download this data from GOOGLE EARTH ENGINE?

Answer 26: GRACE Monthly Mass Grids over land can be accessed through GEE

[https://developers.google.com/earth-engine/datasets/catalog/NASA\\_GRACE\\_MASS\\_GRIDS\\_LAND](https://developers.google.com/earth-engine/datasets/catalog/NASA_GRACE_MASS_GRIDS_LAND)

Question 27: What type of wells (active pumping wells, monitoring wells, etc.) are used when validating the GRACE Data?

Answer 27: Not certain they kind of well. The Li et al paper has the information of the data they used.

Question 28: What time-period of observations are the TWS anomalies defined with respect to?

Answer 28: 2004-2009.

Question 29: How is the TWSA time-series filled for the gap between GRACE and GRACE-FO periods (2016-2018)?

Answer 29: JPL portal: it is not filled (2017-2018). GLDAS data will be continuous.



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Question 30: How can uncertainty in GRACE estimates be calculated?

Answer 30: The paper we referenced. It is based on the algorithm will tell you what to expect. True Uncertainty can only be found if you have all the components measured and their uncertainties. You have to work in your own basin's data and there is no clear answer, in general.

Question 31: Can we map aquifers on the basis of density?

Answer 31: TWS anomalies will help in mapping aquifer change.

Question 32: Can we use these data for ground water analysis of small countries like Nepal, Bhutan, etc.?

Answer 32: Using GLDAS is the better choice due to spatial resolution.

Question 33: Is the JPL and Giovanni data available for commercial use?

Answer 33: Any NASA data you can use. There are companies that have been using NASA data.

Question 34: Can GRACE satellites track human earthworks or natural earth-moving events?

Answer 34: Any change in gravity will be noted. How it is interpreted...

Question 35: Can we generate temporal water storage data for a specified location?

Answer 35: JPL's interactive tool will show you the data by pixel but it is the GRACE footprint for that area.

Question 36: Hi, I have a question, in the time average map you just showed, the unit is mm, how to interpret it?

Answer 36: It refers to depth of water in mm over that grid.

Question 37: Is it possible to convert the TWS data to water level data?

Answer 37: No, it is not as straightforward. You would need additional data.



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Question 38: What is the baseline of the TWS anomaly values? Does it refer to the gw level of the pixel at a certain time point? Or does it refer to a certain absolute value?

Answer 38: 2004-2009. Change in water storage at that pixel over that month. It is not absolute data.

Question 39: Hi, what is the physical meaning of a groundwater storage equal to 500 mm?. My question is: the numbers in mm are only useful in a relative sense but not in an absolute sense. Am I right?

Answer 39: mm of gw is useful. If you consider water density and take the unit area, you can have it as a column of water in that area. GLDAS mm is absolute data. GRACE gives you anomaly data.

Question 40: Is GRACE suitable to estimate TWSA for small catchments (for example <math><1000\text{km}^2</math>)?

Answer 40: No. That is a major limitation of GRACE data. But before GRACE there was no other way to look at global water like this. You can downscale using modeling.

Question 41: Are higher res products coming?

Answer 41: No, not from the GRACE and GRACE-FO missions.

Question 42: As the GRACE and GRACE-FO, can't focus on small watersheds, how can we get the data and complete the analysis on those areas? Are there any alternatives?

Answer 42: Small watersheds, if you look at ppt, et and surface water, you can come up with total water change. But GRACE GW data would not be very useful for the smaller watersheds.

Question 43: Can we validate the missing data between GRACE and GRACE-FO using groundwater data of a specific location?

Answer 43:

Question 44: From which Land Surface Models should we provide soil moisture, surface water, and snow water equivalent? Noah, CLM, or Mosaic?



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Answer 44: Ensemble mean is used in many cases. We have used Noah, but GLADS 2.2 is based on CLM too. LIS uses many different models to come up with water budget.

Question 45: Is the contribution from oil and gas extraction also accounted for in the algorithm?

Answer 45: We don't believe so but we will check and post this doc on our webpage.

Question 46: Thank you very much, But can you explain how come the last two animations look like they have much smaller grids - smoother?

Answer 46: The animation is smoothing that data.

Question 47: Is the GLDAS GWS an anomaly? If yes, what is the baseline?

Answer 47: No, it is actually GW. Change in TWS from GRACE is used as a constraint to the model.

Question 48: You mentioned GRACE is not applicable for small watersheds. This means that it is not applicable for countries as small as Chile?

Answer 48:

Question 49: Can the technology distinguish between fresh and saline groundwater using the relative specific gravity? If not, are there any plans in this direction?

Answer 49: We are not aware of EO distinguishing between saline and fresh water.

Question 50: Does the Giovanni website give details on how the soil moisture, snow water, etc. corrections were made to get the groundwater GLDAS product?

Answer 50:

Question 51: How can GRACE TWS be validated?

Answer 51: There is not a direct validation of TWS. You can measure different components to see how accurate it is.

Question 52: Are these processing algorithms available?

Answer 52:



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Question 53: Any of the data on groundwater storage available in shapefile format?

Answer 53: From JPL's interactive browser, no. You may need to derive a shapefile in a GIS.

Question 54: What other analysis is needed to use GRACE data in regions with large lakes or large wetlands (such as the Pantanal, in Brazil)? Which corrections should I make while working with GRACE data on these regions?

Answer 54: You will need to be able to desegregate the water in the lake from the TWS.

Question 55: Is there any ideal size of the study area or watershed that GRACE could work best?

Answer 55:

Question 56: Does the anomaly baseline calculation of 2004 to 2009 still apply to both GRACE GWS and TWS within the GLDAS v2.2?

Answer 56: It is the same period used in both.

Question 57: Can we transfer the Grace data on ANY GIS software for further detail processing?

Answer 57: NetCDF or Tiff file will be able to be imported into a GIS.

Question 58: Which data should I use to get an annual summary of change in groundwater storage? And what portal to use?

Answer 58: JPL's portal, all 3 datasets are there. Links are available there. Download all 3 datasets and get the mean.

Question 59: Can we compare INSAR based subsidence rate with GIOVANNI and Grace Groundwater data? What are the limitations?

Answer 59: This would be widely different comparisons in spatial resolution. Here is a nice reference that discusses the advantages and limitations of both methods:

[https://www.researchgate.net/publication/307476419\\_Assessing\\_Groundwater\\_Depletion\\_and\\_Dynamics\\_Using\\_GRACE\\_and\\_InSAR\\_Potential\\_and\\_Limitations](https://www.researchgate.net/publication/307476419_Assessing_Groundwater_Depletion_and_Dynamics_Using_GRACE_and_InSAR_Potential_and_Limitations)





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Question 60: Are the tools required for analysis pertaining to removal/filtering of errors available online?

Answer 60: Not online that we know of. Please contact the researchers who are developing these for more information.