LC-SPACE-04-EO-2019-2020 "Copernicus evolution – Research activities in support of cross-cutting applications between Copernicus services"

Action acronym: **G3P**
Full title: Global Gravity-based Groundwater Product
Grant Agreement No: 870353

User requirements of the Global Gravity-based Groundwater Product (G3P) – Survey results

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1. Change Record

Description	Author(s)	Date	File name
Submission 1	Ruz Vargas, Güntner , Haas, Contreras	24.03.2022	20220324 G3P_survey
Submission 2	Ruz Vargas, Güntner , Haas, Contreras	21.06.2022	G3P_survey_report

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3. Overview and summary

One of the Actions Items (AI) from the General Assembly of February 2021 was to collect user requirements on spatial and temporal resolution of G3P. To achieve this goal and compile answers in an organised way, a survey was produced.

It was identified that potential users of G3P belong, in general, to the following types of users: policy makers, commercial users, academic users, general public, scientific and data organisations, and other. Based on this, 132 individuals from organisations belonging to the previous categories were contacted directly via email. Table 1 (Annex) shows which organisations were contacted.

Other potential users of G3P were reached via the following channels:

- Request for participation in the survey via the project's website, which was shared via Twitter and IGRAC's website and its social media channels.
- Through networks such as: Space4Water[1], ICT4Water[2], GroundwatCH[3], GDI[4].

The survey consisted of sixteen (16) questions, and started on 18th May 2021. It was open during three (3) weeks, during which a total of eighty (80) answered forms were collected.

Later in 2021, a follow-up survey was produced to understand better the preferences of the previous participants regarding the accuracy of the product. The survey consisted of three (3) questions, and it was open for three (3) weeks starting on 31st January 2022. From this survey, a total of twenty-three (23) filled-in forms were collected.

Both surveys considered three (3) types of questions:

- Open field: the user can introduce text freely.
- Multiple choice, best answer: the user is allowed to choose only one of the answers provided. In the case that the answer "other" is selected, the user can introduce open text.
- Multiple choice, multiple answer: the user is allowed to select one or more of the answers provided. In the case that the answer "other" is selected, the user can introduce open text.

Both surveys were distributed via Microsoft Forms.

[1] https://www.space4water.org/
[2] www.ict4water.eu
[3] https://www.groundwatermaster.eu/
[4] https://piahs.copernicus.org/articles/383/297/2020/

4. Results per question

4.1 First user requirements survey

1. Name of your organisation (open field).

Answers (

Table 2, Annex) were collected and then distributed in nine (9) categories to facilitate the understanding of the data. These are:

A. Geological surveys and national institutes (32% of answers)
B. European commission (5% of answers)
C. Research institute/university/project (27% of answers)
D. UN Agency and affiliated centres (11% of answers)
E. Intergovernmental entity (4% of answers)
F. Charity/NGO/development agency (9% of answers)
G. Private company (4% of answers)
H. Individuals (5% of answers)
I. Empty (3% of answers)

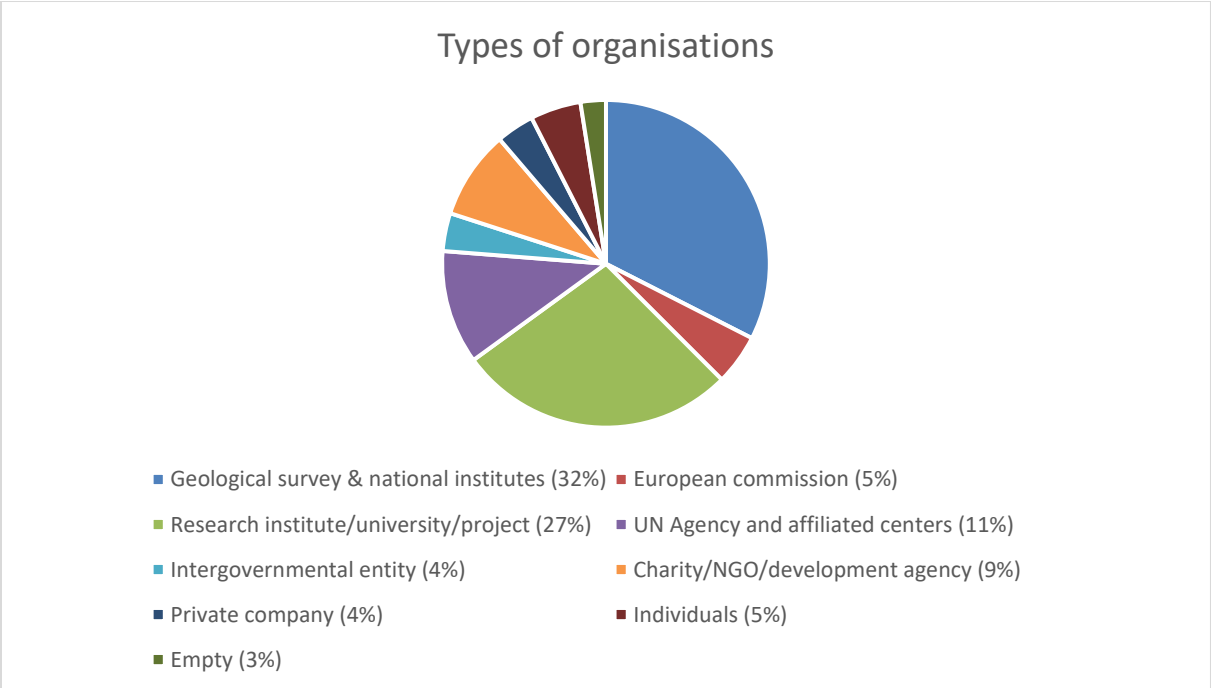

Figure 1: Type of organisations that answered the first survey (Q1)

2. Current job title (open field).

Answers were collected and then distributed in four categories to facilitate the understanding of the data (Table 3, Annex). These are:

A. Researcher/PhD/Postdoc/Professor/Lecturer/scientist (45% of answers)
B. Project leader/manager/engineer/programme specialist/officer/director/advisor (45% of answers)
C. Hydrogeologist (7% of answers)
D. Student (3% of answers)

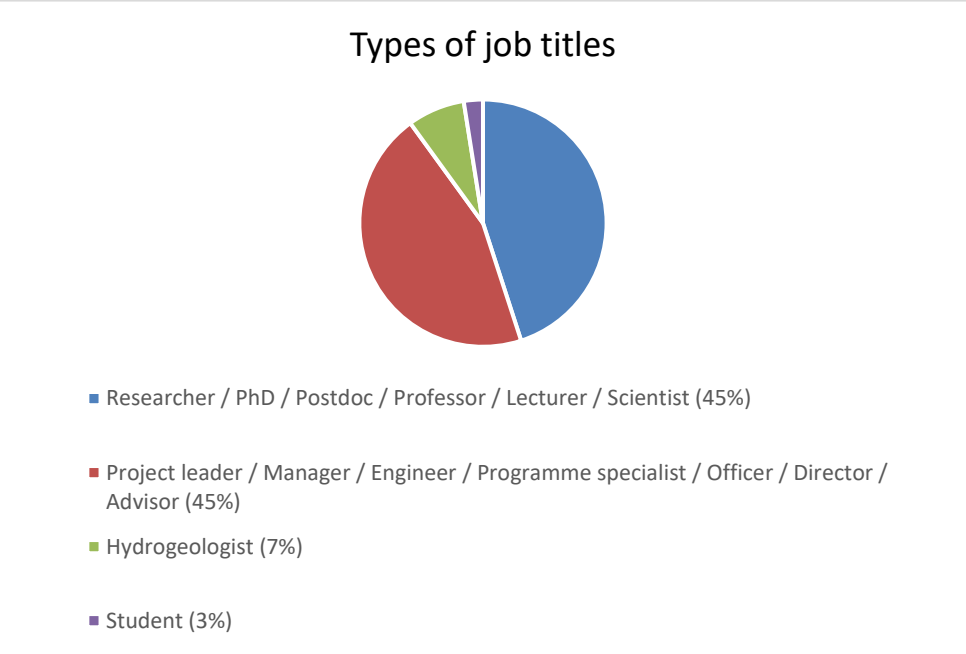

Figure 2: Distribution of current job titles among respondents (Q2)

3. To which of these groups would you say your organisation belongs to? (multiple choice, multiple answer).

Total answers:

- Policy makers – 19 answers
- Commercial users – 2 answers
- Academic users – 29 answers
- General public – 6 answers
- Scientific and data organisations – 37 answers
- Other – 13 answers
    - Inter-governmental river basin organization (1 answer)
    - NGO (4 answers)
    - Non-Governmental Organization provides water for community (1 answer)
    - Transboundary aquifers managers (1 answer)
    - UN (3 answers)
    - Development Partners (1 answer)
    - Policy Support (1 answer)
    - Public service (1 answer)

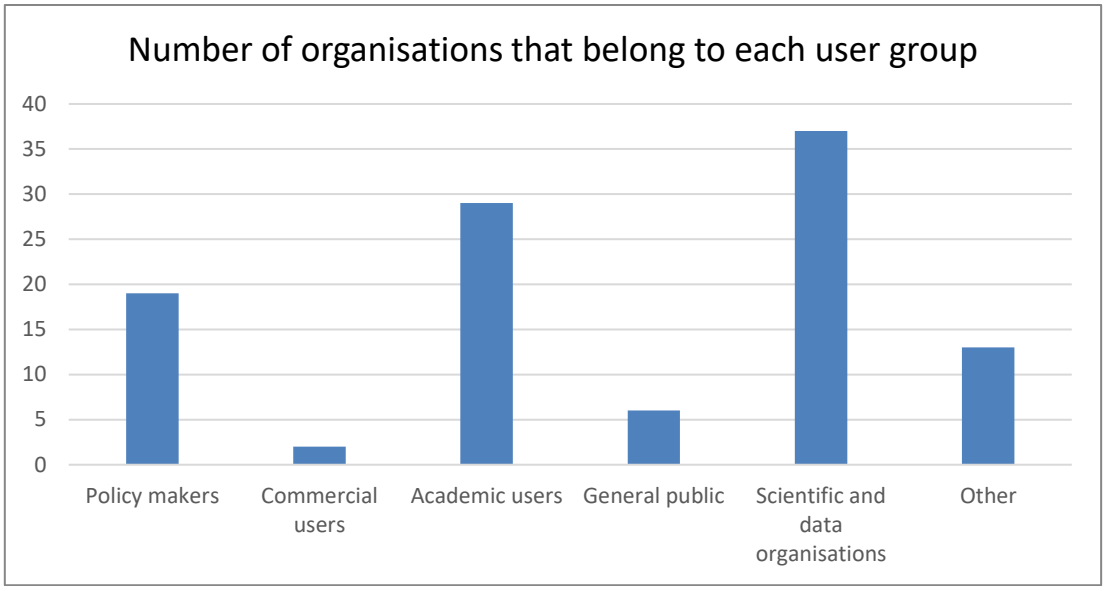

Figure 3: Number of organisations that belong each user group (Q3)

4. Is the groundwater product (data of groundwater storage variations with global coverage and monthly resolution from 2002 until present) something that might be useful for your organisation? (multiple choice, best answer)
    - Yes – 69 answers
    - No – 7 answers
    - Maybe – 4 answers

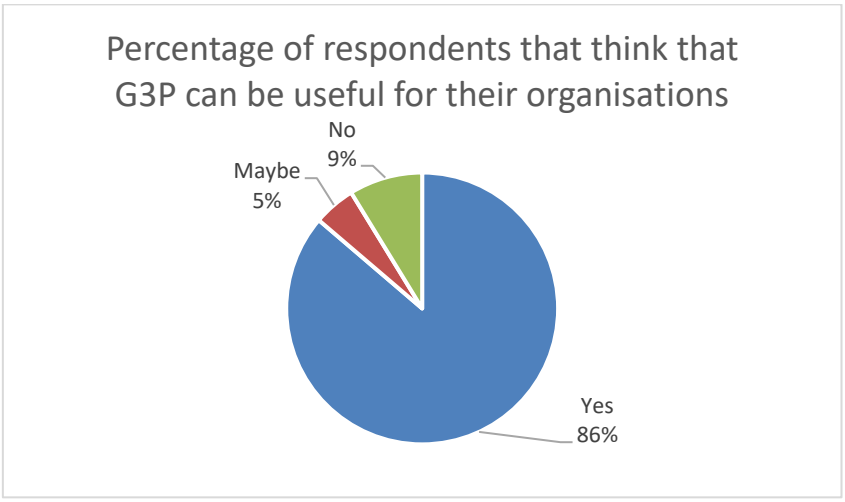

Figure 4: Percentage of respondents that think that G3P can be useful for their organisations (Q4)

5. G3P will be provided as global grids with 0.5 degree and 1.0 degree resolution, and as area-average time series for large aquifer systems. Is this spatial resolution appropriate for your requirements? If not, please indicate what you prefer in the field "Other" (multiple choice, best answer).
    - Yes – 39 answers
    - Other – 35 answers
    - Empty – 6 answers

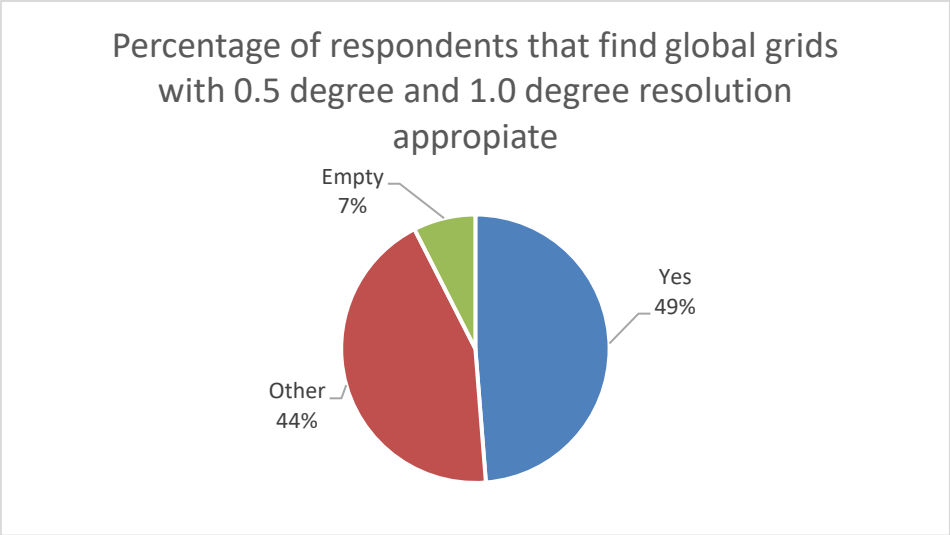

Figure 5: Percentage of respondents that find global grids with 0.5 degree and 1.0 degree resolution appropriate (Q5)

Individual "Other" answers are presented in

Table 4 (Annex). These answers can be ordered as follows:

- Higher resolution, without giving a specific number – 10 answers
- Flexibility preferred – 2 answers
- Higher resolution equal or below 0.5 degree – 1 answers
- Higher resolution equal or below 0.25 degree – 8 answers
- Higher resolution equal or below 0.1 degree – 9 answers
- Higher resolution equal or below 0.01 degree ~ 1 km – 1 answer
- Higher resolution equal or below 100 m – 1 answer
- No direct answer (N/A) – 3 answer

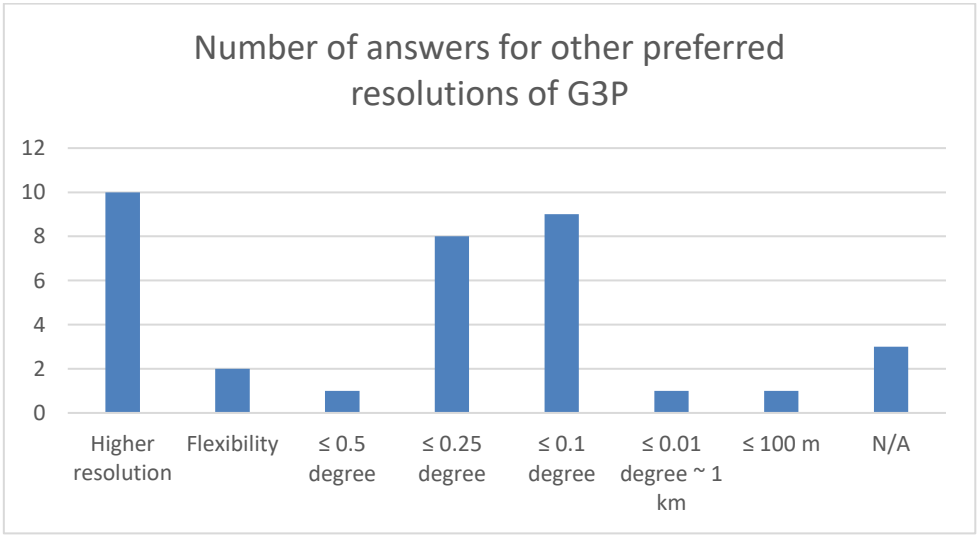

Figure 6: Number of answers for other preferred resolutions of G3P (Q5)

6. What levels of spatial aggregation would be useful for you? (multiple choice, multiple answer).
    - Pixel – 51 answers
    - Large river basins – 30 answers
    - Large aquifers – 38 answers
    - Specific irrigation regions – 27 answers
    - Other – 7 answers
        - As detailed as possible
        - Groundwater bodies
        - Countries, provinces
        - Catchment level
        - Flexibility of options preferred
        - Micro watersheds
        - Smaller river basins (sub-basins)

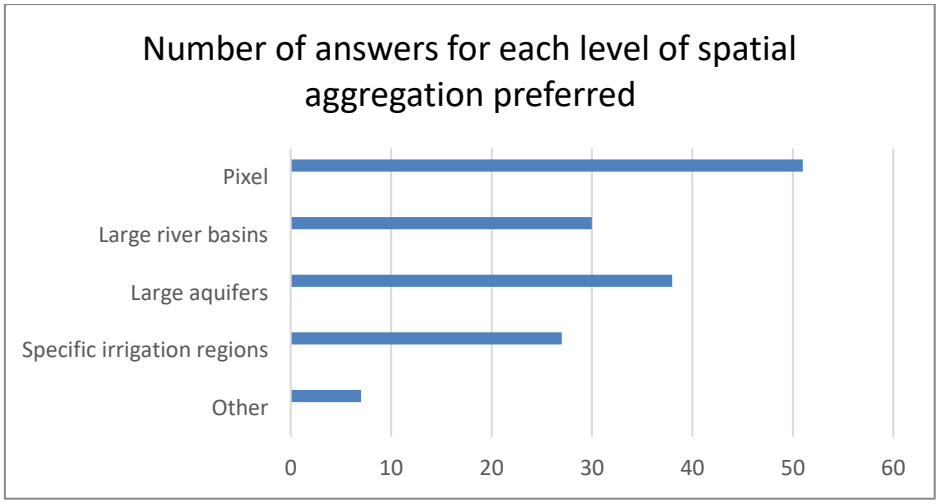

Figure 7: Number of answers for each level of spatial aggregation preferred (Q6)

7. G3P data will be provided monthly. Is this temporal resolution appropriate for your requirements? If not, please indicate what you prefer in the field "Other" (multiple choice, best answer).
    - Yes – 69 answers
    - Other – 7 answers
        - Bi-weekly (1 answer)
        - Weekly (3 answers)
        - Every 10 days (1 answer)
        - Daily (1 answer)
        - Shorter for selected areas (1 answer)
    - Empty – 4 answers

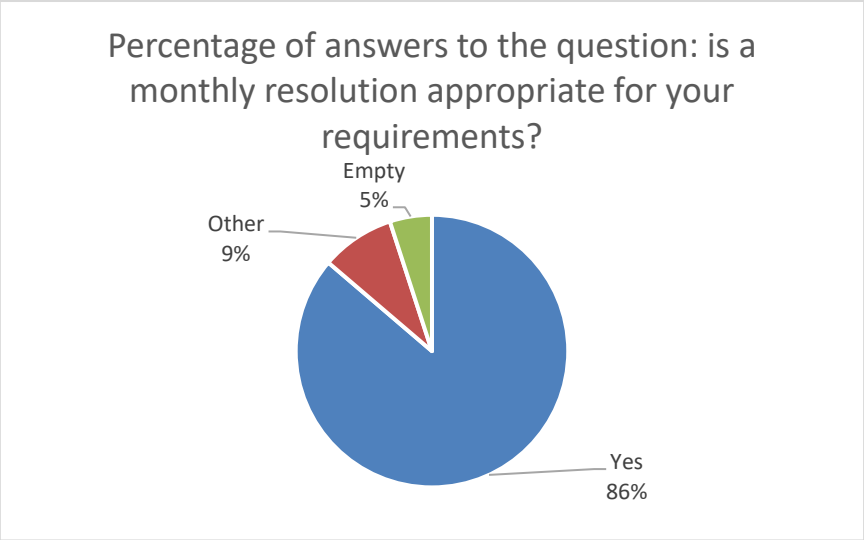

Figure 8: Percentage of answers to the question: is a monthly resolution appropriate for your requirements? (Q7)

8. What latency would be useful for you? (latency: time delay between the date at which an observation is taken and the date when the observation is provided to the end user) (multiple choice, multiple answer).
    - 1 week – 27 answers
    - 1 month – 43 answers
    - 2 to 3 months – 19 answers
    - 6 months – 17 answers
    - Other – 2 answers
        - Up to 15 days will be acceptable
        - As with other questions of temporal and spatial scale, the finer resolution/lowest latency is the most convenient and most useful - provided that uncertainty is communicated and managed. The data must be reliable.
    - Empty – 4 answers

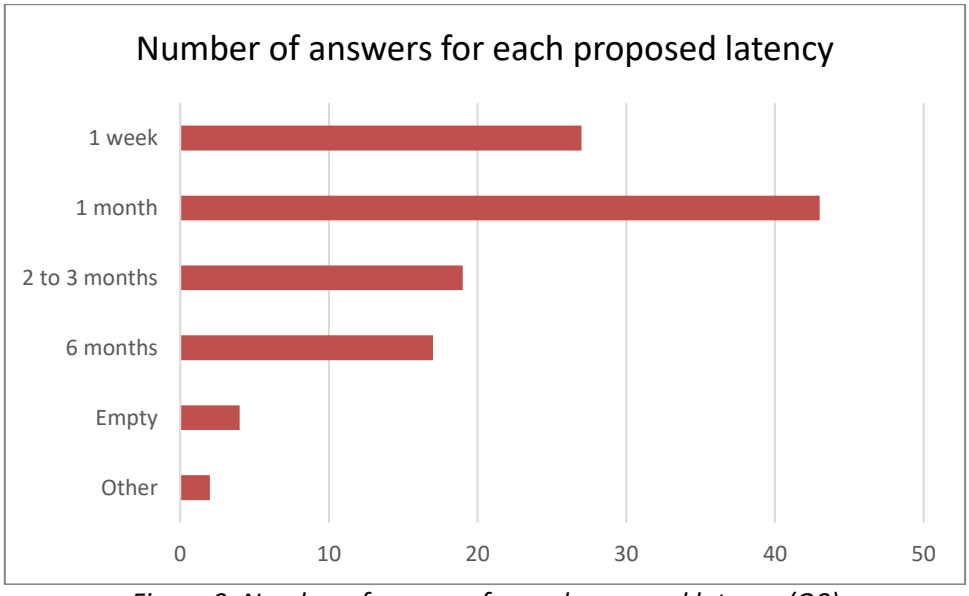

Figure 9: Number of answers for each proposal latency (Q8)

9. What way of showing uncertainties would be useful for you? (multiple choice, multiple answer).
    - Min-max – 37 answers
    - Percentiles – 29 answers
    - Confidence interval – 44 answers
    - Other – 3 answers
        - Any, if the uncertainty is explained
        - Options preferred
        - Variance
    - Empty – 4 answers

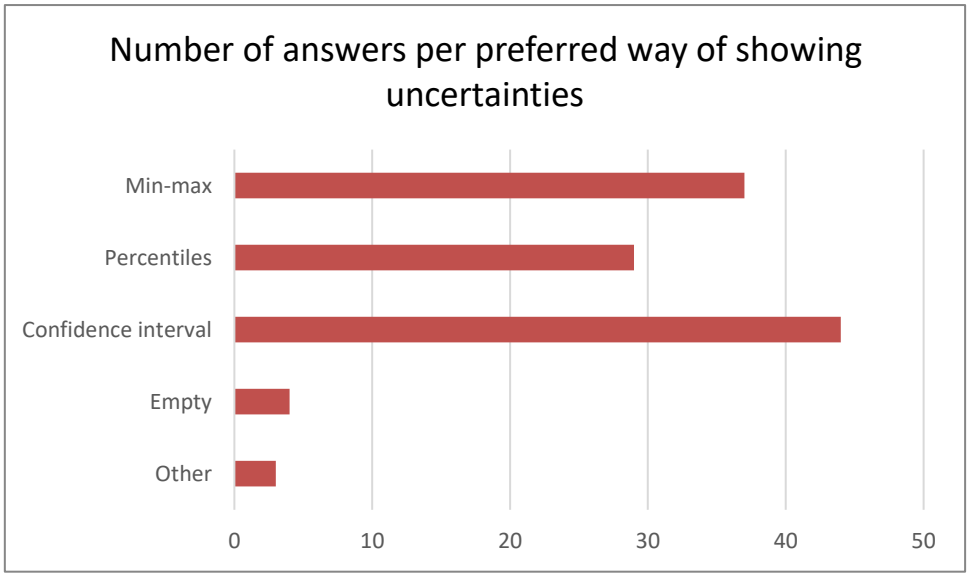

Figure 10: Number of answers per preferred way of showing uncertainties (Q9)

10. How important would it be to have a quality assessment of the outputs generated at the pixel level? (multiple choice, best answer)
    - High – 43 answers
    - Moderate – 29 answers
    - Low – 3 answers
    - Not relevant at all – 0 answers
    - Empty – 5 answers

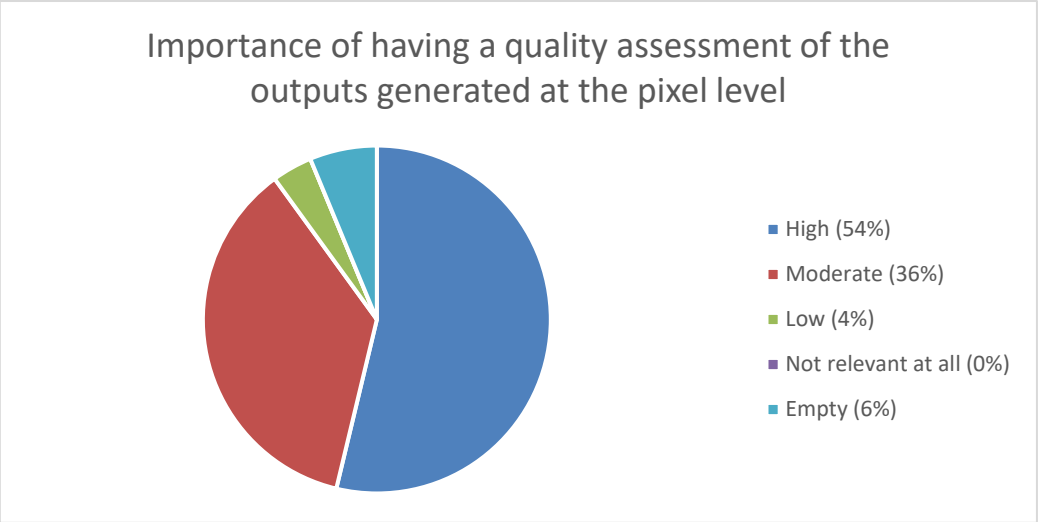

Figure 11: Importance of having a quality assessment of the outputs generated at the pixel level (Q10)

11. How quality assurance (QA) of G3P products should be reported? (multiple choice, multiple answer).
    - Through a QA layer with a reliability qualitative index (Highest quality, Good data, Marginal or Lowest quality, Filled/No data) – 50 answers
    - Through a QA layer with detailed QA flags about the "overall usefulness" and reliability values for each G3P subcomponent (TWS, glaciar, snow, soil moisture, river and lakes) – 37 answers
    - Other – 1 answer
        - Providing some means of allowing the user to access detailed information regarding source data and processing methods would be very useful.
    - Empty – 10 answers

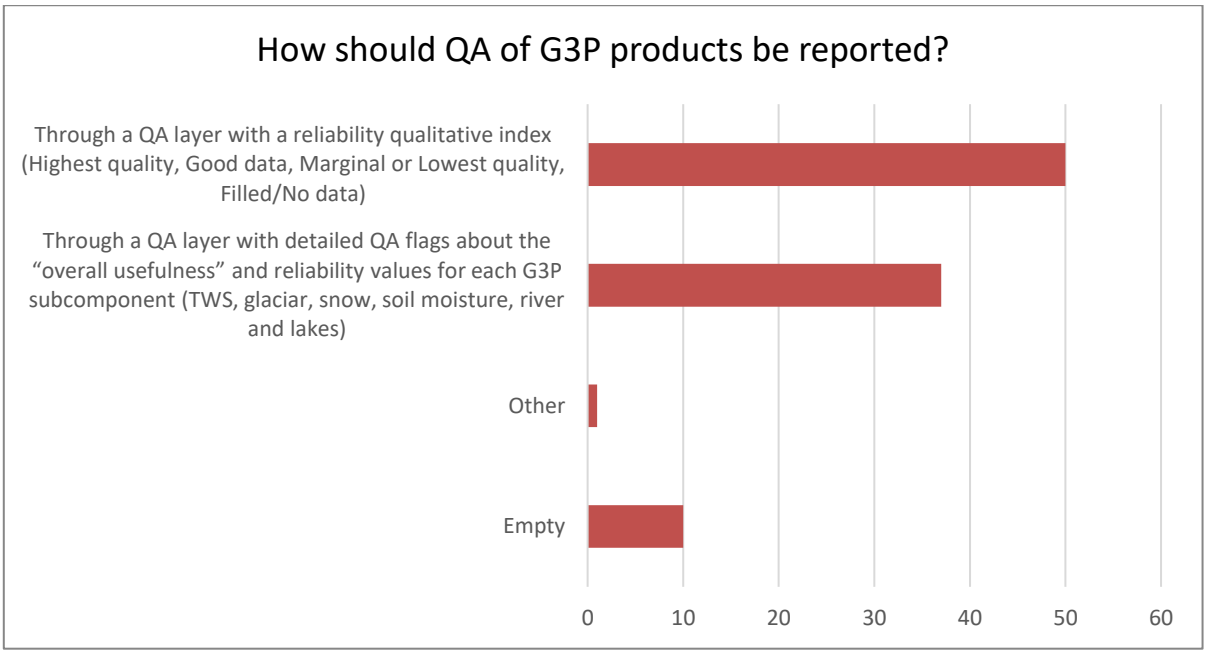

Figure 12: How should QA of G3P products be reported? (Q11)

12. The groundwater product (G3P) on long-term monthly groundwater storage variations will be made available for visualization, analysis and download through two service portals: Global Groundwater Monitoring Network (GGMN, https://ggmn.un-igrac.org) and the Gravity Information Service (GravIS, http://gravis.gfz-potsdam.de/home). Is there another way of accessing to the data that we should consider? (multiple choice, multiple answer).
    - FTP – 15 answers
    - Cloud repositories/catalogues (eg. Earth Engine, S3 bucket of Amazon Web Services,…) – 26 answers
    - There is no need to consider another way of accessing the data – 30 answers
    - Other – 8 answers
        - C3S Climate Data Store
        - Google Earth Engine would be the best
        - API to trigger the development of applications
        - API to download the product (if not already available)
        - Copernicus CDS
        - Bulk download of some sort is important to use data in other apps. WMS layer might be also good.
        - Copernicus Open Access Hub?
        - Allowing the user to access the files would be very valuable
    - Empty – 11 answers

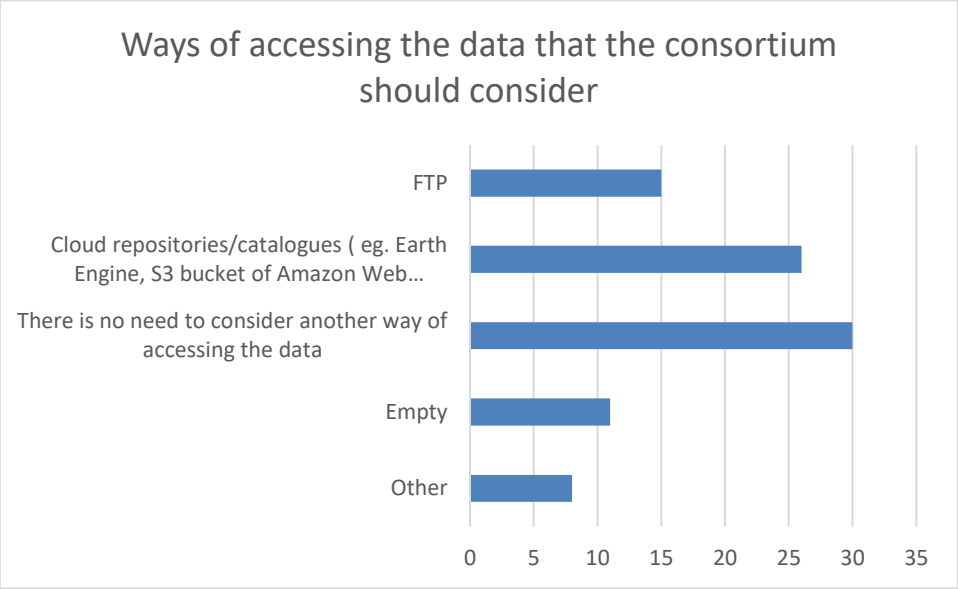

Figure 13: Ways of accessing the data that the consortium should consider (Q12)

13. For which of the following activities do you think the groundwater product (G3P) has a direct use? (multiple choice, multiple answer).
    - Support of water resources management activities – 71 answers
    - Risk assessment for water security – 63 answers
    - Food security – 39 answers
    - Drought monitoring – 61 answers
    - Global hydrological models – 54 answers
    - Awareness raising – 44 answers

- Other – 4 answers
    - Global groundwater models, research in general (1 answer)
    - Water accounting (2 answers)
    - Basically all applies (1 answer)
- None – 0 answers
- Empty – 4 answers

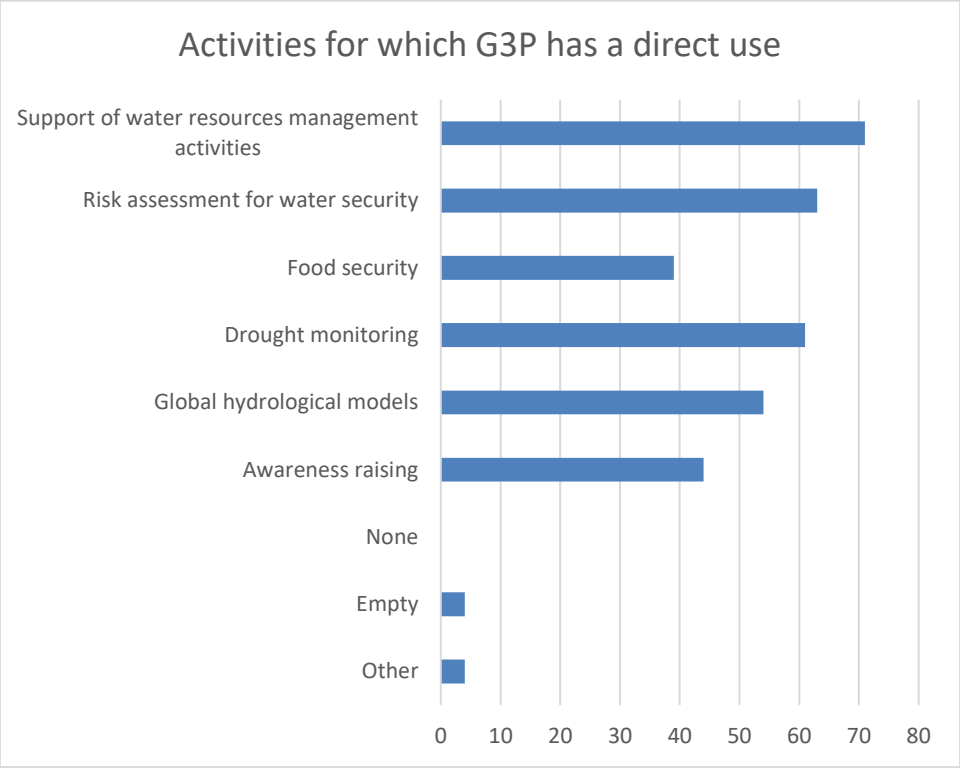

Figure 14: Activities for which G3P has a direct use (Q13)

14. Do you think that you would be able to use the groundwater product in your current position? (multiple choice, best answer).
    - Yes – 66 answers
    - No – 4 answers
    - I don't know – 6 answers
    - Empty – 4 answers

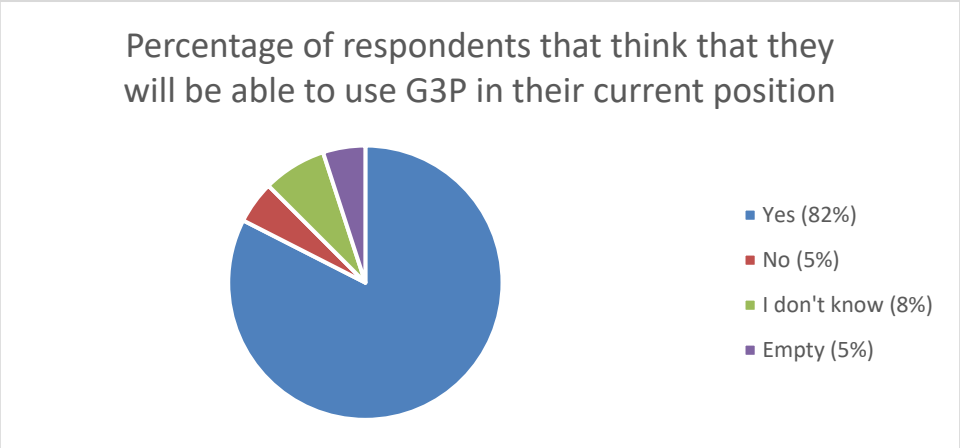

Figure 15: Percentage of respondents that think that they will be able to use G3P in their current position (Q14)

15. If you answer "Yes" to the previous questions, please indicate how would you use the groundwater product. If you answer "No", please let us know why, or if we can do something to make it more useful to you (open field).

The answers of this question have been grouped into eight (8) categories to facilitate a quick overview. The categories have been ordered in a decreasing way by the amount of corresponding answers.

i. **For advocacy/awareness raising; science-policy interface; management (17 answers)**

- for science - policy interface related actions
- The database would be useful to identify high risk areas and to advocate for water security
- Since we are an NGO so these data will be very much useful for the local community and society. We will use our scientific knowledge to decipher the condition and will provide support to the marginal people
- For developing decision support systems for water management.
- We would be using the G3P product for knowledge and policy decision-making tools, regarding transboundary aquifers management.
- '- Advise decision makers and developers, Applications in research programs and trainings
- Development of Water Resource Management Strategies buildt on remote sensing data. This is especially relevant for countries where data availability on water resources is bad. Further the data would help to estimate the potential for sustainable water abstraction and in consequence the potential for the expansion of irrigated agriculture.
- Planification des ressources hydroagricoles. Optimisation des coûts d'énergie.
- This product will help to better manage the groundwater resources.
- Help in my project related to groundwater governance
- Water availability is crucial for healthy ecosystems, so we should protect the specific ground water resources for critical ecosystems. The product can be used to prioritize our conservation actions.
- It gives an indication of area possible to be irrigated
- I intend to demontrate to my government (Malaysia), on the importance & relevance of groundwater monitoring, to ensure sustainable water resources.

- We conduct researches on GW droughts, and also are involved on researches dealing with EU water policy such a River basin management plans. This would contribute.
- We consult for the national water resources authority and regional governments hence this product will help us develop a regional understanding of groundwater storage and its related impacts
- to be able to help farmers to adopt with the water shortage
- The groundwater product would be very useful for my current job to analyze the situation of groundwater availability and groundwater use in the Lower Mekong River Basin.

ii. In combination with models (13 answers)

- constraint for water management tools and groundwater recharge model.
- Evaluate global modelling efforts.
- In hydrological models
- Validation and intercomparison to large scale hydrological models and remote sensing estimates
- combined with groundwater numerical models
- For water accounting
- We have a tool on Water budgeting that gives seasonal water requirements for crops and other usages in rural areas/ water scare areas, we would like to integrate this dataset also into that
- Data assimilation with in-house global hydrological model
- Integrations in regional and local groundwater vulnerability models. Comparison to ongoing isotope sampling projects. Monitoring of groundwater abstraction for agricultural use as well as domestic supply in and around the city of Cape Town, where groundwater development for water stress relief has recently been commission.
- For comparison to the outputs of our global hydrological model
- Feasibility study to assimilate the data into the hydrological model for GloFAS
- To validate and assimilate into our large scale hydrological and water resources models
- drought monitoring as part of EDO/GDO
- GW BALANCE AND RECHARGE ESTIMATION

iii. For monitoring/forecasting (10 answers)

- To monitor groundwater level changes.
- In Remote sensing monitoring of groundwater
- It would be used for groundwater drought monitoring in some big aquifers.
- The groundwater product will be of great use in monitoring the state of aquifers that suffer from overexploitation. It can be used to supplement the measurements carried out in the field and the research in this subject.
- Monitoring trends on Mediterranean groundwater resources for governance purposes and support provided to countries in the region (planning)
- Yes, we drill water wells on average 150 shallow wells per year. This will help to forecast the service of the wells. Some of the wells have been dry out after serving two and three years etc.
- Cela va être utilisée comme une base de donné pour toutes les études en relation avec la gestion des ressources en eau et surtout souterraine, car actuellement il y a un manque dans les mesures de niveau piézométrique sur terrain (mauvaise couverture

et fréquence faible des compagnes) cela est conjuguée aussi à une autre difficulté pour le suivi des ressources souterraines à savoir la prolifération des forages illicites.
- Drought monitoring and forecasting, impacts on socio-economic sectors
- Look at it in relation to conventional monitoring of GW in UK and other countries where I (e.g. India, Vietnam, Philippines). 2. Use in looking at climate resilience of rural gw supplies in Africa (e.g. Ethiopia)
- such product could have some application in the larger Pacific islands (Fiji, Vanuatu, Solomons) if its resolution could be increased to at least 0.1 x 0.1 degrees. It could assist in monitoring of aquifer impacts from the mineral bottling industry.

iv. Groundwater assessment (6 answers)
- Analysis of the vulnerability of aquifers, droughts, climate change adaptation
- For regional scale groundwater assessments
- regional scale water resource assessment
- GW stocks assessment
- In the analysis of flooding for specific regions, the condition of groundwater must be taken into account.
- analysis of groundwater droughts (especially previous), supporting resource assessment, particularly in often data-scarce developing countries

v. General answer (e.g. "I will use it for research") (6 answers)
- supporting various projects at IWMI
- i hope we can use this data in our work
- Water management, groundwater modelling, ‹ater accounting, ...
- In most of the studies which i am doing (for example water according) i need this information
- For my research
- I am current a postdoc working on a specific project. I will use it in future research.

vi. To compare with/complete other datasets (5 answers)
- comparison with my calculations derived from ground-water-monitoring plus porosity
- I shall compare the data with those of Geological Institute of Romania and if it is the case I shall fill in the gaps where necessary.
- We give int'l MSc education in EO for water cycle and water resources studies, and also have several PhD researchers and staff working in this. So, a welcome data set, completing our EO water cycle.
- My current research involves quantifying groundwater dynamics and controls at the regional scale - the G3P could possibly be correlated/compared with the results of my work. Rigorously applying the G3P would require having knowledge of the source data, processing methods, and uncertainty. An accompanying academic paper/supplementary paper would be welcome.
- Support hydrological data collection and analysis of Land and Water Division projects.

vii. Not applicable/other (4 answers)
- Fixed-term position finishing soon
- This project aims to develop the Global Gravity-based Groundwater Product, the G3P, which monitor groundwater storage changes with global coverage and monthly resolution from 2002 until present by a cross-cutting combination of GRACE and

GRACE-FO satellite data with water storage data that are based on the existing portfolio of the Copernicus services.
- i will use time series of groundwater level for my study area
- I would like to see a number of showcases/ usecases to get a better idea on current and potential uses of the product. Would you be able to share them? Our project have a special focus on developing sustainable agricultural solutions, whereby IWRM is integrated and setup to ensure the long-term availability of (ground)water.

viii. In Managed Aquifer Recharge (MAR) projects (2 answers)
- Research of potable and thermal water aquifers; MAR applications.
- In my research work as to experiment managed aquifer recharge techniques in area of water scarcity.

16. Do you have any additional feedback? (open field).

The answers of this question have been grouped into four (4) categories to facilitate a quick overview. The categories have been ordered in a decreasing way by the amount of corresponding answers.

i. Cautious about accuracy/uncertainty of the product (7 answers)
- I am curious about the accuracy of the monitored data.
- I don't expect any accuracy of a single moment-raster, but maybe there is some useful information on changes and comparisons of droughts in different years; do you clean your data from effects of the moon-gravity ?
- Considering a lower spatial resolution it would be a very interesting product.
- I am just concerned about the grid size, If the grid size will be at a very minimum scale then it will impart a better picture to the farm level
- Any output for the quality? what is your source data? (how can I check the accuracy of the output)? Thanks
- Good initiative. But, please give good information to users as GRACE data present very complex signals, influenced by many earth gravimetric field processes.
- As my interest is academic and research orientated, I will emphasize that finer resolutions and reduced latency is most welcome provided uncertainty and error is managed and quantified. I look forward to seeing the results of your work!

ii. Positive comments (5 answers)
- Glad to see that new groundwater resources products will be available and could be the first preliminary approach for future more detailed assessment
- This product would be very useful
- It is very important data source for developing countries that have no alternative data sources.
- Thank you
- This is a great initiative - looking forward to seeing the outputs of it and I am sure this will be very welcomed by the scientific community

iii. Extra requests/wishes (3 answers)

- For research purposes it would be good to have access to all the input layers as well for checking
- If I have a chance, I would like to join your team and learn more about this product and apply to the Mekong River Basin.
- The program could explore how privately monitored wells can be incorporated to increase data density while maintaining quality?

iv. Other (1 answer)

- Recently, the G3P project has become a member of the ICT4Water cluster, which is a hub for EU-funded research and innovation projects on ICT applied to water management. By joining the cluster, G3P is now united with 40 other projects that have digitalisation at their core as a mean to address several research and innovation topics.

4.2 Follow up user requirements survey

1. What is the accuracy of groundwater storage change that G3P needs to meet to be useful for your applications? (multiple choice, multiple answers).

   a) For the long-term trend of groundwater storage change (in mm water equivalent):
      - 100 mm/year – 2 answers
      - 50 mm/year – 3 answers
      - 10 mm/year – 11 answers
      - 5 mm/year – 3 answers
      - 1 mm/year – 2 answers
      - No preference – 2 answers
      - Other – 5 answers
        - perhaps good to express in % not in absolute term given very different climate regions
        - or as accurate as technology permits
        - As accurate as possible
        - Estimates of uncertainty and list of limitations
        - this really depends on the specific project, but (despite loving high resolutions) in general, I presume the range of 10 mm/year would be ideal, though 50mm/year would be OK. 100mm/year would likely be too course, particularly for more arid regions

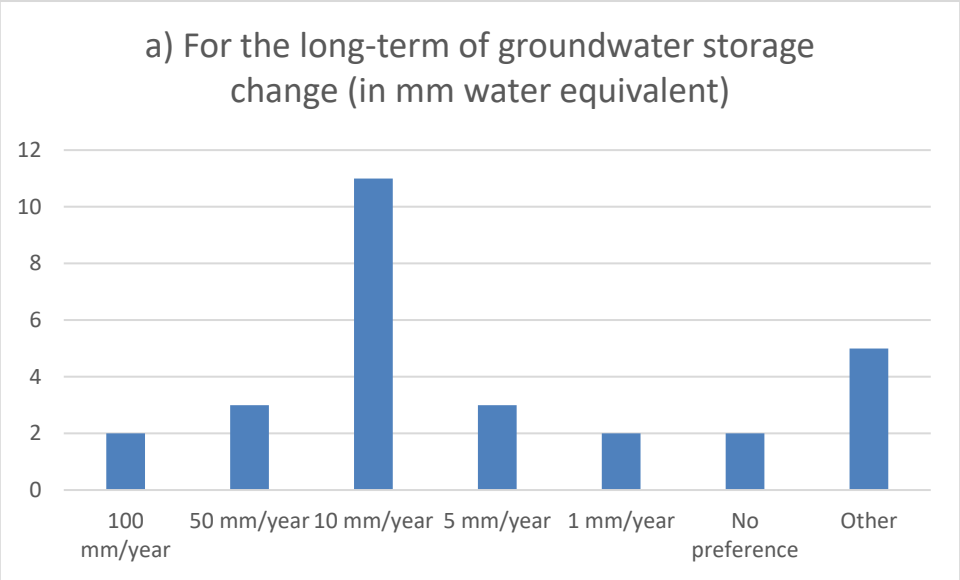

Figure 16: Accuracy of groundwater storage change that G3P needs to meet to be useful for user's applications (For the long-term trend of groundwater storage change)

b) For the change of groundwater storage from one month to another (in mm water equivalent):
   - 100 mm/year[5] – 1 answer
   - 50 mm/year – 0 answers
   - 10 mm/year – 5 answers
   - 5 mm/year – 8 answers
   - 1 mm/year – 4 answers
   - No preference – 2 answers
   - Other – 4 answers
     - same as above (perhaps good to express in % not in absolute term given very different climate regions)
     - The unit mm/yr is confusing. I would say 1-3 mm for the change from month to month
     - As accurate as possible
     - Estimates of uncertainty and list of limitations

[5] This was a typo, the correct unit is "mm/month". Since only one person commented on this, it is assumed that the participants understood that the correct unit was mm/month and answered accordingly.

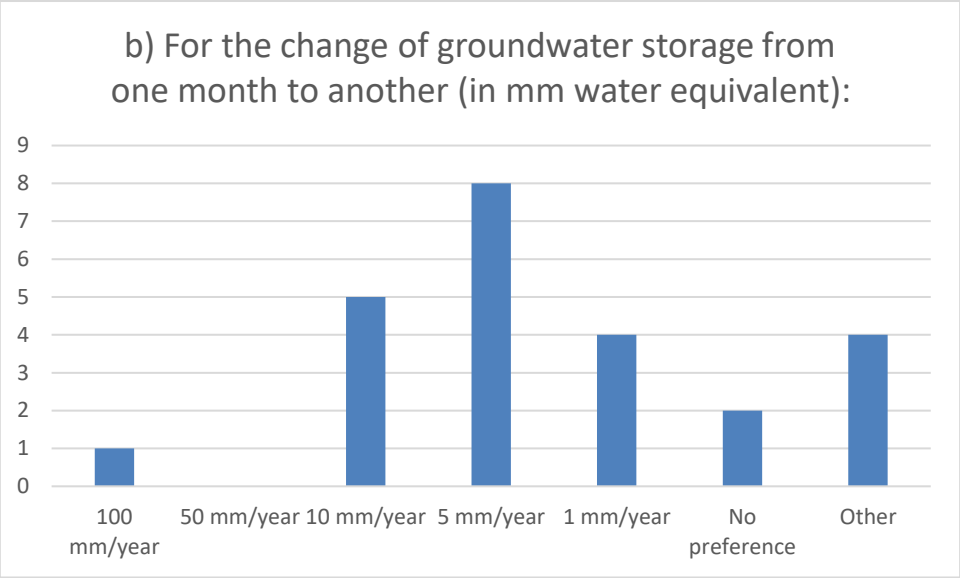

Figure 17: Accuracy of groundwater storage change that G3P needs to meet to be useful for user's applications (For the long-term trend of groundwater storage change)

2. Does this required accuracy scale with the size of the target region of your applications? (multiple choice, multiple answers).
    a. Yes, the required accuracy needs to be higher for larger regions/aquifers – 3 answers
    b. Yes, the required accuracy can be lower for larger regions/aquifers – 7 answers
    c. No, the required accuracy is more or less independent of the size of the region/aquifer – 7 answers
    d. Other
        i. We are not very much engaged in Groundwater interventions at the current moment, but our interest would be to link observations with climate variance/data.
        ii. Depends on the applications given spatial scales
        iii. /our target region is global
        iv. No, the required accuracy is more or less independent of the size of the region/aquifer.
        v. Size and climatic zone both matter
        vi. Estimates of uncertainty and list of limitations
        vii. the accuracy indicated above is considering continental and global scale applications

3. Name of your organisation (open field).

- Geological survey of Slovenia
- International Water Management Institute, IWMI
- Cyprus Geological Survey
- iwmi
- Mekong River Commission Secretariat
- World Food Programme
- IIASA
- Texas Water Resources Institute. Texas A&M University

- BRGM
- Ghent University
- European Centre Medium Range Weather Forecast
- Goethe University
- International Water Management Institute (IWMI)
- University Potsdam
- JRC
- Professional Hydrologist
- Deltares
- SPC
- Utrecht University, Department of Physical Geography
- School of Environment and Sustainability
- Geological Institute of Romania
- Swiss Federal Office for the Environment FOEN
- British Geological Survey

5. Conclusions

First survey

The survey was well received by most target groups, with commercial users and the general public being the groups with least respondents (2 and 6 respectively – Q3). One explanation to this could be that a reduced number of such organisations and individuals were contacted to answer the survey.

It appears that G3P is a product that will be useful for most organisations enquired, as shown by Q4 and Q14, and that there is interest in G3P among the defined target user groups. Q13 and Q15 provide clear examples of how the product could be used. At the same time, the respondents are interested in having a clearer understanding of the uncertainties associated to G3P and its accuracy (Q16), which is something that the consortium will be taking into account when presenting the final product to the community. In this regards, it was indicated that the most useful way to show uncertainty would be as confidence interval (Q9). Moreover, the participants indicated that it would be important/moderately important to have a quality assessment of the outputs generated at pixel level. The survey results also show that quality assurance should be reported through a QA layer with a reliability qualitative index (Q11).

Around half of the people surveyed would be satisfied with the current resolution of G3P (Q5), but a similar amount of potential users would like to have a higher resolution (below 0.1 or 0.25 degree). Also, it appears that the most preferred level of spatial aggregation is pixel, although large aquifers and large river basins where also chosen (Q6). Regarding G3P's temporal resolution, most of the respondents would be satisfied with what has been offered, i.e. monthly (Q7). The most useful latency would be 1 month (Q8).

Regarding the dissemination of G3P data, it is appreciated to have available other ways of accessing it, but not necessary (Q12).

Follow up survey

The preferred accuracy of groundwater storage change that G3P needs to meet to be useful for the participants' applications is 10 mm for the long-term trend of groundwater storage change (in mm water equivalent) (Q1a), and 5 mm for the change of groundwater storage from one month to another (in mm water equivalent) (Q1b). However, mixed answers were received when enquiring if the required accuracy scale with the size of the target region of the users' applications (Q2).

6. Annex – Tables

Table 1 – Organisations contacted to answer the survey, previously classified in groups and subgroups

Group	***Subgroup***	***Organisation***
Policy makers	European union & agencies	ESA (European Space Agency)
		EGS (EuroGeoSurveys)
		EIB (European Investment Bank)
		EEA (European Environment Agency)
		European Centre for Medium-Range Weather Forecasts (ECMWF)
		Copernicus Climate Change Service (C3S)
		JRC (Joint Research Centre)
	UN organisations and programmes	UNESCO IHP (Intergovernmental Hydrological Programme)
		IWMI (International Water Management Institute)
		FAO (Food and Agriculture Organization)
		UNDP (United Nations Development Programme)
		UN Women
		WFP (World Food Programme)
		WHO (World Health Organization)
		WMO (World Meteorological Organization)
		World Bank Group
	Provincial agencies and governments	National Groundwater Institute of Thailand
		Director General, Geologisches Landesamt Hamburg
		Institut Cartogràfic i Geològic de Catalunya
	International organisations at a regional scale (e.g. River Basin Organisations)	Mekong River Commission (MRC)
		ORASECOM
		Nile Basin Initiative
		ZAMCOM (Zambezi Watercourse Commission)
	Water resources managers	Geological Survey, Albania
		Geological Survey, Austria
		Geological Survey, Belgium
		Geological Survey, Bosnia & Herzegovina
		Geological Survey, Bosnia & Herzegovina
		Geological Survey, Croatia
		Geological Survey, Cyprus
		Geological Survey, Czech Republic

Group	*Subgroup*	*Organisation*
		Geological Survey, Denmark
		Geological Survey, Estonia
		Geological Survey, Finland
		Geological Survey, France
		Geological Survey, North Macedonia
		Geological Survey, Germany
		Geological Survey, Greece
		Geological Survey, Hungary
		Geological Survey, Ireland
		Geological Survey, Italy
		Geological Survey, Kosovo
		Geological Survey, Latvia
		Geological Survey, Lithuania
		Geological Survey, Luxembourg
		Geological Survey, Malta
		Geological Survey, Montenegro
		Geological Survey, The Netherlands
		Geological Survey, Norway
		Geological Survey, Poland
		Geological Survey, Portugal
		Geological Survey, Portugal
		Geological Survey, Romania
		Geological Survey, Russia
		Geological Survey, Serbia
		Geological Survey, Slovakia
		Geological Survey, Slovenia
		Geological Survey, Spain
		Geological Survey, Sweden
		Geological Survey, Switzerland
		Geological Survey, UK
		Geological Survey, Ukraine
		Geological Survey, Ukraine
Commercial users	Hydrogeology	OPV
		Wellfield Consulting Services
		CONSULTEC - Consultores Associados, Mozambique
		Van Essen Instruments
	Agricultural sector	IFAD (International Fund for Agricultural Development)
		Woord en Daad
		Texas A&M Agrilife Research Center
		International Center for Biosaline Agriculture

Group	*Subgroup*	*Organisation*
	Mining companies	Lhoist, Belgium
Academic users	Hydro(geo)logists	BRGM
		Stellenbosch uni
		BGS
		SPC (The Pacific Community), Fiji
		Deltares
		GESDEC, Switzerland
		BGS
		GroundwatCH (alumni)
		Iowa State Uni.
	Climatologists	Drought mitigation center
		Caribbean Institute for Meteorology & Hydrology
		Climatology MSc
		IUCN, NL
	Ecologists	Wetlands International
		Acacia Water
		Witteveen & Bos
		WSP, Canada
		DHI
	Modellers	Dar Al-Handasah, Lebanon
		CEST, Philippines
		Goethe University Frankfurt
		The University of Texas at Austin
		Hydro-JULES
	Research programmes/groups	Department of Physical Geography of Utrecht University
		IASA
		GDI
		GDI
		Water Accounting Group IHE Delft
General Public	(Potential) students	Individuals (6)
Scientific and data organisations	Scientific and data organisations	International Association of Geodesy
		European Geosciences Union
		Global Climate Observing System
		Intergovernmental Panel on Climate Change
	Scientific networks	ICT4Water
		Space4Water

Table 2 – Individual answers to question 1, in alphabetic order

A. Geological surveys and national institutes
B. European commission
C. Research institute/university/project
D. UN Agency and affiliated centers
E. Intergovernmental entity
F. Charity/NGO/development agency
G. Private company
H. Individuals
I. Empty

#	Organisation	A	B	C	D	E	F	G	H	I
1	-									x
2	-									x
3	Agriculture, water resources and fishing ministry; Agricultural development regional office of Ariana CRDA Ariana	x								
4	Austrian hydrographic survey	x								
5	British Geological Survey	x								
6	British Geological Survey	x								
7	Chaolei zheng								x	
8	Croatian Geological Survey	x								
9	CYPRUS GEOLOGICAL SURVEY	x								
10	Dan Odero								x	
11	EIAR			x						
12	Ethiopian Institute of Agricultural Research	x								
13	Ethiopian Institute of Agricultural Research	x								
14	European Commission - DG Joint Research Centre		x							
15	European Commission Joint Research Center		x							
16	European Commission Joint Research Centre		x							
17	European Commission JRC - EDO/GDO drought team		x							
18	FAO				x					
19	FAO				x					
20	FAO Land and Water Division				x					
21	Federal Office for the Environment FOEN, Hydrology division, Hydrogeological Basics Section	x								
22	Florida State University			x						
23	General Directorate of Water Resources (Tunisia)	x								
24	Geological Institute of Romania	x								
25	Geological Survey of Austria	x								
26	Geological Survey of Denmark and Greenland	x								
27	Geological Survey of Slovenia	x								
28	Geological Survey of Sweden	x								
29	GIZ						x			
30	Global Institute for Water Security, University of Saskatchewan			x						
31	Human rights& environment development society						x			
32	IHE Delft			x						
33	IIASA				x					

34	Institut Agronomique et Vétérinaire Hassan II			x						
35	Institut Agronomique et vétérinaire Hassan II - Morocco			x						
36	IRIMO							x		
37	ITC UTwente			x						
38	IUCN NL				x					
39	IWMI				x					
40	IWMI				x					
41	IWMI				x					
42	Khaled Haider								x	
43	Krieter Water & Environment Sdn Bhd							x		
44	Luxembourg Water Administration	x								
45	Mekong River Commission					x				
46	Mersin University			x						
47	Ministere Agriculture	x								
48	Ministère d'agriculture	x								
49	Ministry of Agriculture	x								
50	Ministry of Agriculture	x								
51	Ministry of Agriculture	x								
52	MOHAMED OUESSAR								x	
53	National Agrarian University La Molina			x						
54	National Agricultural Research Center (NARC)	x								
55	National University of Lesotho			x						
56	Pacific Community					x				
57	Palestinian Water Authority	x								
58	Sahara and Sahel Observatory (OSS)					x				
59	SEMIDE			x						
60	Spanish Geological Survey	x								
61	Spanish Geological Survey	x								
62	Stellenbosch University			x						
63	Stellenbosch University			x						
64	Tarbiat Modares University			x						
65	Texas A&M University			x						
66	UNESCO				x					
67	Université d'Abomey-Calavi			x						
68	University of Aberdeen			x						
69	University of Latvia			x						
70	University of Tehran			x						
71	University Potsdam			x						
72	USGS EROS Center	x								
73	US-PCAS Water, MUET, Jamshoro			x						
74	Water Bridge Myanmar							x		
75	Water Witness International						x			
76	Watershed Organisation Trust						x			
77	Watershed Organization Trust (WOTR)						x			
78	Woord en Daad						x			
79	Working Group Hydrology, Goethe University Frankfurt			x						

80	World Vision Ethiopia						x			

Table 3 – Individual answers to question 2, in alphabetic order

A. Researcher/PhD/Postdoc/Professor/Lecturer/scientist
B. Project leader/manager/engineer/programme specialist/officer/director/advisor
C. Hydrogeologist
D. Student

#	**Organisation**	A	B	C	D
1	Academician	x			
2	Advisor		x		
3	Agriculture and Irrigation Specialist		x		
4	Associate Professor	x			
5	Chairman Department of Water Resources (Faculty ITC)		x		
6	Chief Technical Advisor		x		
7	Coordinateur National de Projet		x		
8	Deputy Director, Technical Services Branch, Department of Agriculture		x		
9	Director		x		
10	Director		x		
11	Director of Climate Change and Drought Monitoring Dept.		x		
12	Director Water, Food and Ecosystems		x		
13	Drought Expert		x		
14	employee, specialized on ground- and soilwater-calculations		x		
15	Engineer		x		
16	Environment development coordinator		x		
17	Expert Innovative Monitoring		x		
18	Geosciences engineer		x		
19	Graduate research assistant	x			
20	Head of Departmant Hydrogeology and Geothermal Energy			x	
21	Head of Hydrogeological Basics Section		x		
22	Head of Irrigation Management Research Department		x		
23	Hydrogeologist			x	
24	Hydrogeologist			x	
25	Hyrdogeologist			x	
26	Hyrogeologist			x	
27	Ingénieur de planification des ressources en eau		x		
28	International Programme Officer		x		
29	Land and Water Officer		x		
30	Lecturer	x			
31	Lecturer-researcher	x			
32	MSc Student				x
33	PhD	x			
34	PhD candidate	x			
35	PhD Student	x			
36	Platform lead, Sustainable Asian Cities		x		
37	Postdoc	x			
38	Postdoctoral Research Fellow	x			

39	Postdoctoral researcher	x			
40	Postdoctoral Researcher	x			
41	Postdoctoral Researcher	x			
42	Principal HydroGeologist			x	
43	Principal Irrigation Engineer		x		
44	Principal Researcher	x			
45	Professor	x			
46	Professor	x			
47	Professor of Hydrology	x			
48	Professor-Researcher	x			
49	Program Director		x		
50	Programme Specialist		x		
51	Project Engineer		x		
52	Project Expert Sustainable Water		x		
53	project leader		x		
54	projectleader Water-Energy-Food-Ecosystems		x		
55	Research Associate	x			
56	Research Scholar	x			
57	Researcher	x			
58	Researcher	x			
59	Researcher	x			
60	Researcher	x			
61	RESEARCHER	x			
62	Researcher	x			
63	Researcher	x			
64	Researcher	x			
65	Researcher	x			
66	Researcher	x			
67	Scientific Officer		x		
68	Scientific Project Manager		x		
69	Scientist	x			
70	Scientist	x			
71	SENIOR GEOLOGICAL OFFICER		x		
72	Senior Researcher	x			
73	Senior Researcher	x			
74	Senior Researcher	x			
75	SENIOR RESEARCHER	x			
76	sous directeur		x		
77	student				x
78	Water Exepert		x		
79	Water Quality and GIS Officer		x		
80	Water resources engineer		x		

Table 4 – Other answers for question 5

ID	Answer
1	10x10 km maximum
2	Most of the Spanish groundwater bodies (more than 95%) extend over a surface smaller than the area of a pixel. Therefore, a higher resolution will help to perform an appropriate analyses of their resources.
3	Yes, but only if the data is actually meaningfull at that scale. How can your project provide such a resolution, when the original Grace products are limited to 300-400 km resolution?
4	higher resolution below 0.5 degree: 0.1 - 0.3 degree
5	we would prefer 0.1 degree resolution
9	0.25 degree more appropriate
10	Most of the groundwater bodies of Spain would requiere a higher spatial resolution.
11	smaller grids if possible
14	AT LEAST 0.25 DEGREE
15	0.1 degree would be preferred for local systems, as South Africa's fractured rock aquifers are heterogenous in nature.
18	finer resolution would be more useful
20	least 0.1 degree
21	Flexibility preferred
22	'0.25
27	Less than 0.1 degree would be great
31	0.25 degree or lesser
33	What could me the minimum grid size?
34	'0.1
43	0.25 is better for our work. It looks like low resolution in our context
45	Less than 0.1 degree
48	From GRACE data obtaining Higher resolutions is not evident??
50	Higher resolution if possible
52	in first this are interessting, but after the resolution may be specified by country focal point or technical service government especialy in pilot area
53	Already useful! However the higher the resolution the more useful applications can be developed for the use in development countries.
59	I need 1 km resolution in my study
60	Finer resolutions would be also beneficial for regional assessments.
64	I would prefer a bit higher spatial resolution of 0.1 or even 0.05 degree
65	preferably 0.2 degrees or better
66	0.25 degree would be preferable
67	'0.25
70	0.1 degree
71	30 m × 30 m or 90 m x 90 m
73	My study area is 129 000 kilo meter squared
77	Higher spatial resolution would be great, but understand the technical limits
79	Ideally, a higher resolution grid will be more useful in order to measure/ monitor groundwater storage variations within project areas which are about the same size of the current grid.