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2022 GloFAS and GFM Annual Survey

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Executive summary

The 2022 Annual Survey was the first survey to include feedback for both the Global Flood Awareness System (GloFAS) and the Global Flood Monitoring (GFM). It provided valuable insight on the service and on the needs of the user community. The main findings are summarised below:

— *Survey outreach:* the area of work of most of the participants was in Hydrology and Climate Services. Few participants belonged to the Civil Protection and Humanitarian Aid Operations, Coordination of different sectors, Crisis management. This suggests to further promote the survey (and the uptake of GloFAS and GFM) within these sectors.

— *GloFAS Map Viewer functionalities:* survey participants expressed an overall good level of satisfaction. Two functionalities which survey participants were slightly unsatisfied with were the simultaneous visualization of several layers and the pop-out windows.

— *GloFAS layers information content:* survey participants expressed an overall good level of satisfaction, but suggested to add references to the detailed documentation in the legends.

— *GFM layers information content:* participants were generally satisfied/very satisfied with GFM layers although a few minor adjustments could help to improve the user experience (e.g., more detailed legends, shortcuts to GFM documentation, a more effective colour palette)

— *GloFAS products access:* GloFAS products are most commonly accessed through Web Map Services and Climate Data Store. Usage of other data access facilities (e.g. MARS) is comparably low. Regarding data download, about a third of survey participants did not know they could download data; about a third of those who did had issues during the process.

— *GFM products access:* at present GloFAS Map Viewer is largely the most popular way of accessing GFM data, whereas the [web portal](), though offering a wider portfolio of told for managing the data themselves, e.g., multiple download for the products, region-specific AOI definition etc., is ranked on the second place.

— *GloFAS documentation:* the 2021 survey highlighted the lack of awareness of the users about GloFAS documentation. In 2022, this lack of awareness reduced from 60% (2021) to 20%. More than 60% of the participants were satisfied or very satisfied with the documentation in terms of clearness, completeness, and consistency.

— *GFM documentation:* being a fairly new service in comparison to GloFAS, more than 30% of GFM users are not aware of the availability of a dedicated documentation for the monitoring products. Almost 60% of the participants were satisfied or very satisfied with the documentation in terms of clearness, completeness, and consistency.

— *GloFAS Users support:* the lack of awareness of the users about how to contact GloFAS User support decreased from 60% in 2021 to 20% in 2022. The 2022 survey showed that the q*uality of user support* is improving. The number of participants who were not satisfied with the users support reduced from over 60% in 2021 to 25% in 2022. The 2022 survey highlighted the lack of clarity/completeness/precision as the main weak points of the answers provided to the users.

— *GFM Users support:* 30% of the participants reached the GFM support service via personal contacts rather than the [contact form](). Roughly 20% of the participants did not know about the assistance service is offered on a regular basis.

— *GloFAS recent developments:* close to 80% of participants were satisfied about the recent developments.

— *GloFAS future developments:* the participants expressed high interest in improving the modelling of river routing, adding a flash-flood forecast layer and in improving the modelling of reservoirs.

— *GFM future developments:* the participants expressed high interest in the release of a product capable of estimating the water depth.

1   Introduction

The 2022 Annual Survey was the first survey to include feedback for both the Global Flood Awareness System (GloFAS) and the Global Flood Monitoring (GFM). The survey was conducted in February 2023 for the reference year 2022.

A total of 46 responses were received in the survey for 2022 of which 41 responses gave feedback to GloFAS only, while 31 responses gave feedback to GFM only.

A similar survey was carried out at the beginning of 2022 for the reference year 2021, but this one included feedback only to GloFAS (34 responses). The surveys for 2021 and 2022 have questions in common but the latest one has new questions which are expected to be repeated in upcoming years for evaluation of GloFAS and GFM through time. The responses of the survey are anonymous.

This report presents the results of the survey. The survey responses are divided according to the following categories:

— Users' background

— Web-service, products content, data

— Documentation

— Users support

— Recent and future developments and evolutions

2 Survey results and analysis

2.1 Users' background

The survey for 2022 started by asking which sector represents best the area of work of the participants. The area of work of most of the participants for 2022 was in Hydrology and Climate Services (**Figure 1**). Other two areas of work highly represented were Disasters Risk Reduction and Education, Academia, Research. Several sectors were represented by only one survey participant, less than 3% (e.g. Civil Protection and Humanitarian Aid Operations, Coordination of different sectors, Crisis management). One sector missing within the survey participants for 2022 was Banking, Finance, Insurance.

Figure 1. Participant's' responses about their area of work.
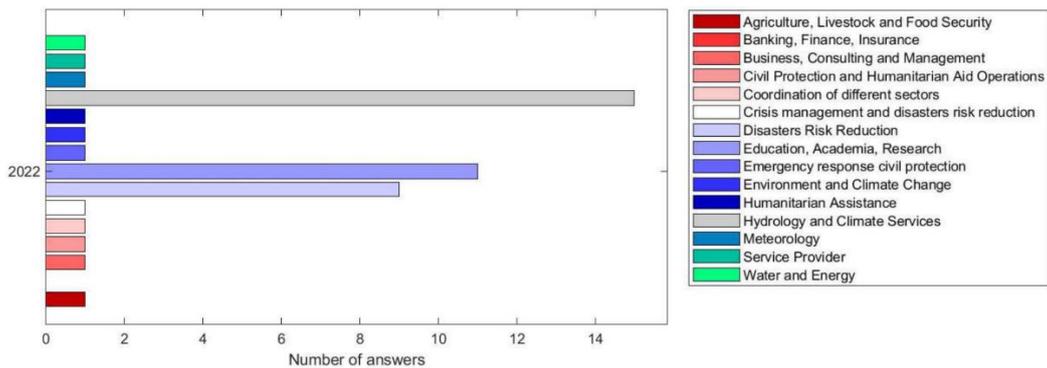
The survey for 2022 continued by asking the geographical domain for which GloFAS and GFM are used. The majority of the participants use GloFAS and GFM for the global domain (14 responses, more than 30%, **Figure 2**). At the continental level, the survey showed that GloFAS and GFM are mostly used for Africa and Asia.

Figure 2. Geographical domain for which survey participants use GloFAS and GFM.
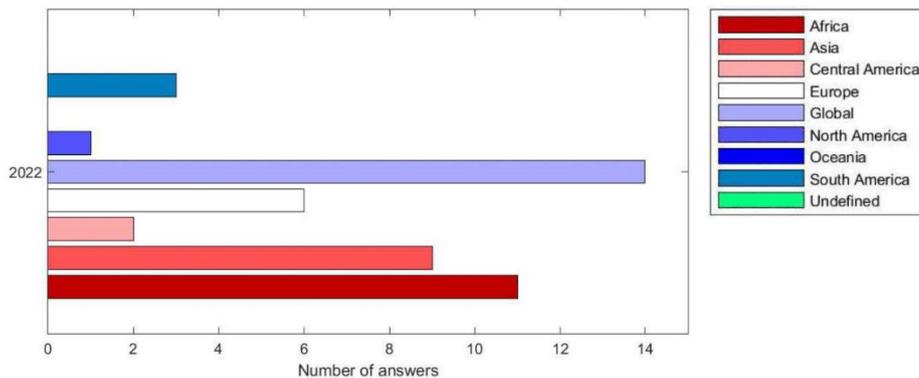
The last question within the Users' background section was to know how often the participants use GloFAS and GFM (**Figure 3**). The survey participants for 2022 responded that their use of the service is generally occasional (e.g. when a severe event occurs).

Figure 3. Frequency of usage of GloFAS and GFM.
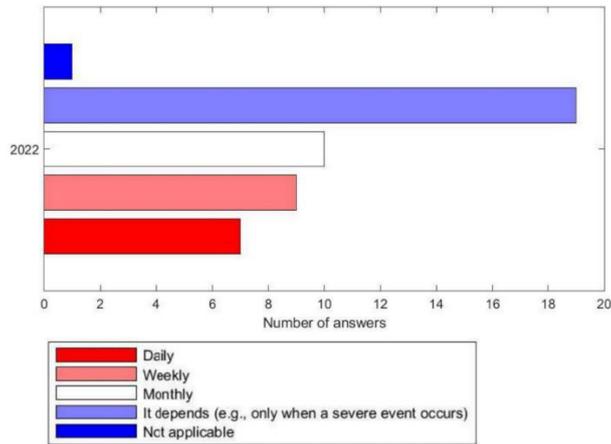

2.2   Web-service, products content, data

This section started by asking survey participants if they are satisfied with the functionalities of the GloFAS Map Viewer [https://www.globalfloods.eu]. In general, user responses indicate that they are mostly satisfied with all the functionalities of the GloFAS map viewer (**Figure 4**). For all the functionalities, the majority of the responses were 4 and 5 (i.e. satisfied and very satisfied, respectively). The general evaluation of the Map Viewer received the highest number of "very satisfied" responses; the Visualization of Several Layers and Pop-Out Windows had the lowest scores: these functionalities had a relatively larger number of negative responses (i.e. 1 and 2 votes, meaning very unsatisfied and unsatisfied, respectively).

Some suggestions or comments for improving the product/service with respect to the functionalities of the GloFAS map viewer were the following:

— Include a tool for changing the visibility of layers.
— Difficulties to move/navigate around (this was mentioned three times).
— Pop-out windows are difficult to find on small screens.
— Pop-out windows always show up on the top left corner hiding the main visualization tools.
— Layers are slow to load at times.
— It is challenging to look at multiple flood return periods.
— Country boundaries should be more visible.

Figure 4. Participants' responses about their satisfaction with the functionalities of the GloFAS Map Viewer.
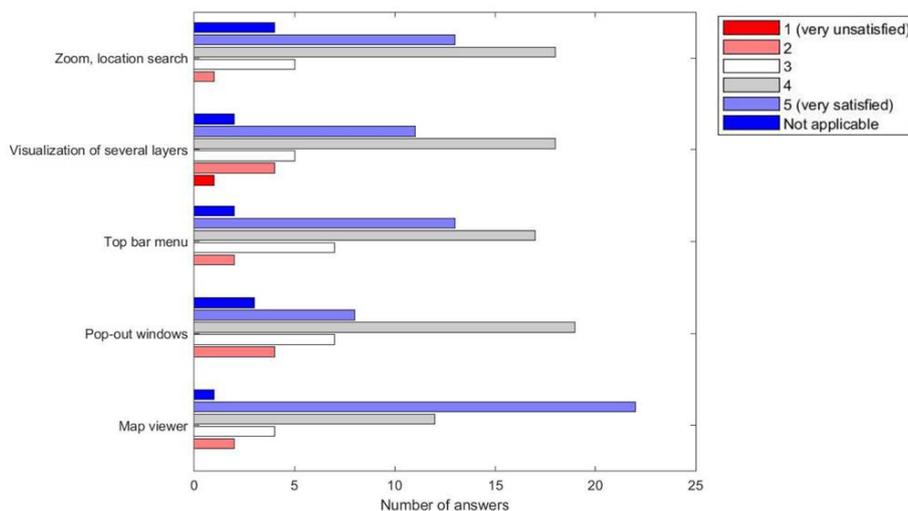
The survey participants were then asked if they considered that the GloFAS Map Viewer provided adequate information for them to understand the GloFAS layers (e.g. legends, colour scale). This question was also in the survey for 2021 but the response options were different than in the survey for 2022. In the latest survey, response options were from 1 to 5, where 1 means "very unsatisfied" and 5 "very satisfied". In the earlier survey, response options were Yes, No or Not Used. To make surveys comparable, the Yes responses for 2021 were considered as 5, the No responses as 1, and the Not Used responses as Not applicable. In general, survey participants for 2022 considered that the GloFAS Map Viewer provides adequate information to understand all the layers as most of the responses were 4 and 5 (i.e. very satisfied"), somewhat similar to the responses for 2021 where most of the responses were 5 (**Figure 5**). None of the survey participants for 2022 was "very unsatisfied" for any of the layers (i.e. zero 1 responses) and the layers with the most 2 responses, "unsatisfied", were the Meteorological, the Flood-Risk and the Evaluation layers (i.e. 2 votes each).

Some suggestions or comments for improving the product/service with respect to the GloFAS Map Viewer information provided were the following:

— Two users commented that the description of the layers is sometimes limited and difficult to understand (e.g. rapid impact mapping layer).

— Two users considered that it might be useful to add a link where more details can be found.

— Option to click on any point to visualize data would be appreciated.

— Option to have the layer entries in the legend to the left as fully collapsible where only headlines are visible when collapsed.

— Weather-forecast animation could be improved.

— River names are normally lacking in the reporting points (this is a hydrological layer). When reporting points show potential flooding, one user said that he/she has to look for the river name in an external source and make a guess about which river is threatening for flooding based in the location of the points. It would be desirable if this information was already available in the reporting points;

— One user considers that it is challenging to look at multiple flood return-periods.

Figure 5. Participants responses about their satisfaction of the information provided in the map viewer: how understandable are the GloFAS layers?
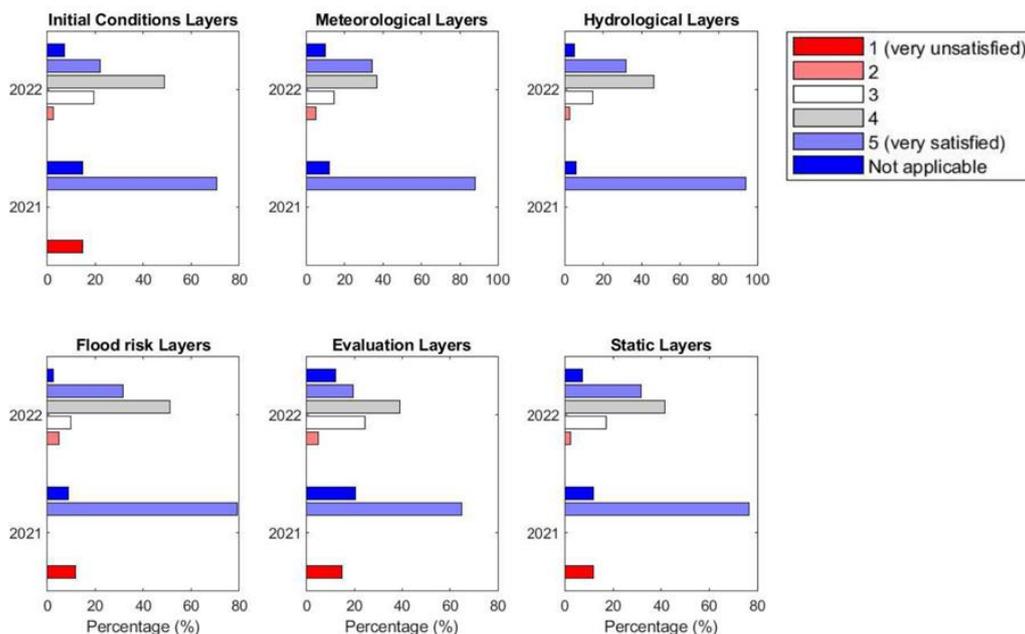
A specific question was related to the **Monitoring Layers** which is the menu listing the GFM product. The overall satisfaction is high since the "satisfied/very satisfied" options combined exceed the 60% of the sample. A few suggestions were also given to improve the user experience, namely:

— To change the colour coding for inundated areas (reference water, flood water, water-covered areas on aggregate).

— A clearer representation for the affected population layer, which is well known to be hard to spot given the very fine-scale of the GFM product output layers.

— To make GFM layers more responsive.

— To include more details in the description of the layers (add a link to the PUM and/or the PDD).

— To improve the pop-up legend to have the layer entries as fully collapsible headlines items (only headlines visible when collapsed).

The next question in the survey for 2022 was intended to know the users most preferred channel to access GloFAS data (https://confluence.ecmwf.int/display/CEMS/Data+Access). Two were highly chosen: Web Services and Climate Data Store (i.e. 14 and 13 responses, respectively; **Figure 6**).

Figure 6. Participants' responses about their preferred channel to access GloFAS data.
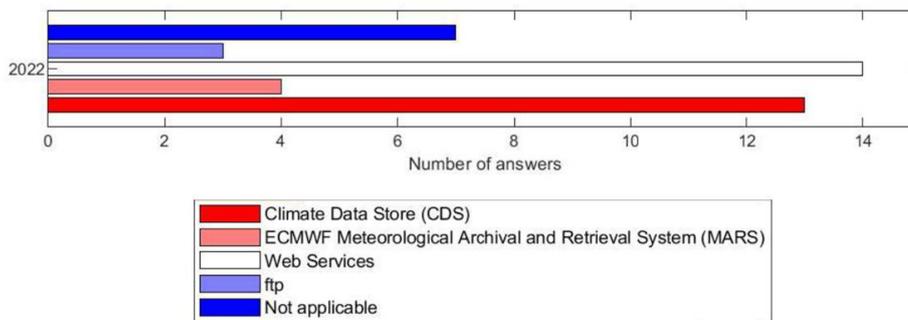
To close this section, survey participants were asked if they had difficulties or problems when downloading GloFAS data (**Figure 7**). Less than 50% of survey participants for 2022 had downloaded GloFAS data (i.e. 18 responses). About a 30% of those who downloaded data had issues during the process while the other 70% did not (i.e. 5 and 13 responses, respectively). Close to a third of all the participants did not know they could download GloFAS data (i.e. 11 responses).

Some comments by the survey participants regarding data downloading were the following:

— System was down at times (e.g. in September 2022 was down close to a month).

— One user commented that it would be useful to provide standardised formats and data availability.

— Datum of data is usually off by a day.

— Speed downloading of data is limited for local partners in Africa. One user commented that it would be desirable for them to have access to point data extraction and data downloading via ftp and/or to provide them ready-to-use codes for point data from CDS.

Figure 7. Participants' responses when asked if they had problems when downloading GloFAS data.
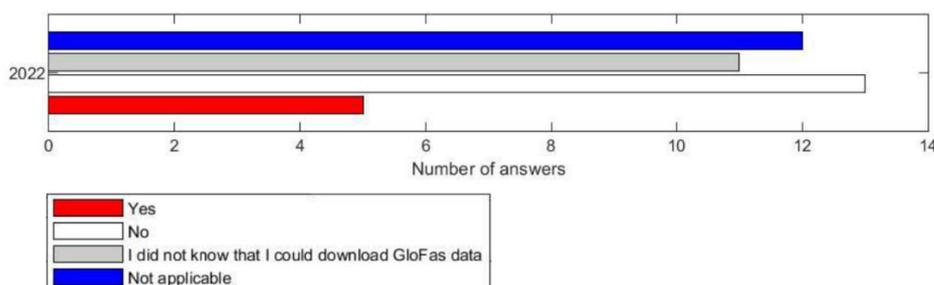
On the GFM side, GloFAS turned out to be by far the most preferred way to access the data (58% of the answers) whereas approximately 30% finds the portal a more suitable option. It has to be mentioned that at the time the survey was sent out, it was only a month since GFM data were released on EFAS therefore GloFAS was the only CEMS GUI user might rely upon to this end (**Figure 8**).

Figure 8. Participants' preferential way to access GFM data.
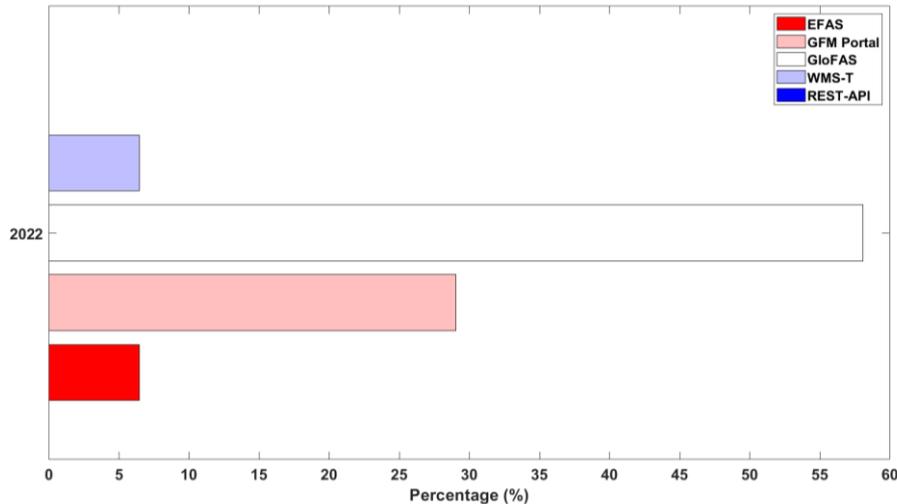
A part of the questionnaire was also devoted to investigate whether the informative level of each GFM product output layer was deemed valuable by the end users. It is worth noting that this aspect particularly relevant since the GFM v.2.0 had completed its first year of operations (GFM v.2.0 was fully released in January 2022). On that account, the performance of the service was rated as mostly satisfying with an average rating slightly below 4 on a scale of 5 (**Figure 9**).

Figure 9. Participants level of satisfaction for each GFM product output layer.
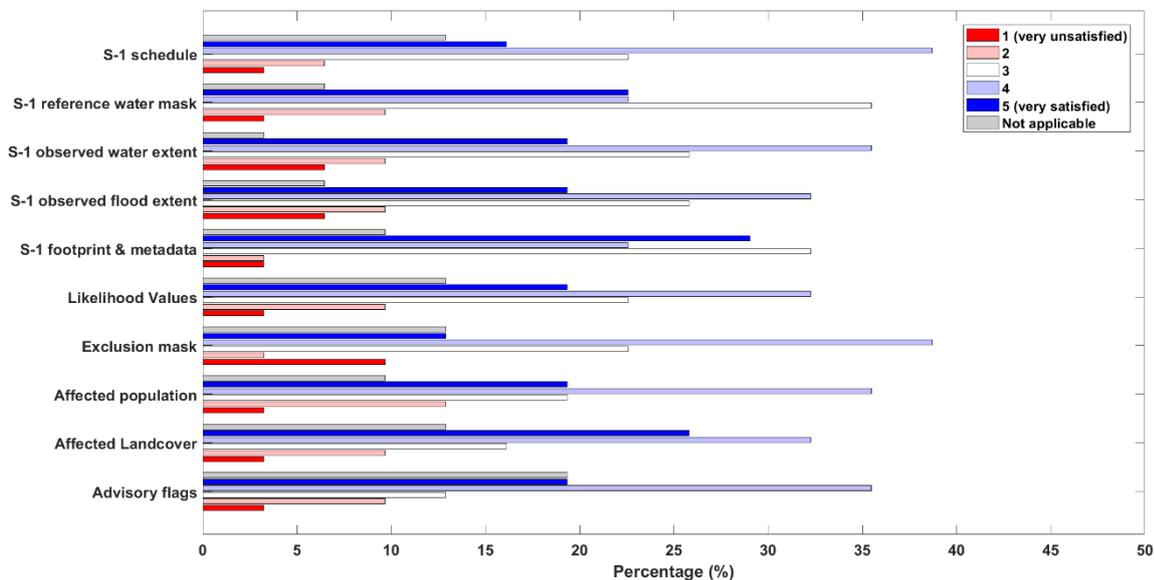
The core products (observed water extent, observed flood extent, and reference water) were all graded above 3.6 and the impacts-related layers (affected population and affected landcover) reached up to 4 on average. It is promising that, despite this high rating, the affected population has already undergone a major upgrade on March 22nd 2023 as the much-fine scale 100m resolution Global Human Settlement Layer (GHSL) was ingested instead of the coarser 250m-spaced gridded data that was operational throughout the 2022. It is moreover remarkable that all the ancillary layers that provide the estimate

of the uncertainties of water and flood detection meet the approval of end users as they reached 4 on average.

A few suggestions aimed to the improvement of the service has also been provided by the end users as listed below:

— To double-check S-1 overpass schedule as sometimes they were found as inaccurate.

— To better highlight the S-1 tiles that define GFM product output layers.

— To enhance the reference water mask as it currently does not account for low tides (yet this might be out of scope with regard the very nature of the layer).

— To add uncertainty (likelihood) and exclusion values also for the "reference water".

— To refine the flood imagery on user-defined AOI rather than leaving it to the user.

— To improve the visibility of flood-detected areas (e.g., the current colour coding).

2.3 Documentation

The first question of this section in the survey for 2022 was intended to know how satisfied are the users with the Forecast Wiki (GloFAS documentation) and the CEMS Flood data user guide, for what concerns clearness, completeness, and consistency.

More than two-third of the survey participants in 2022 were between mostly and very satisfied with the documentation (i.e. 30 responses; **Figure 10**). None of the survey participants was unsatisfied with the documentation but there were some which were barely satisfied with it (i.e. 3 responses). Close to one-fifth of survey participants were not aware of the GloFAS documentation (i.e. 8 responses). In the survey for 2021, a question asked whether the survey participants were aware of the GloFAS documentation. About 60% of participants in the survey for that year were not aware of the GloFAS documentation (this number reduced to about 20%, a considerable improvement from 2021 to 2022).

The only comment about this topic from the 2022 survey was from one participant who considered that GloFAS documentation could be more user-friendly.

Figure 10. Participants' responses when asked if they were satisfied with the GloFAS documentation (Forecast Wiki) and the CEMS Flood data user guide, in terms of clearness, completeness, and consistency.
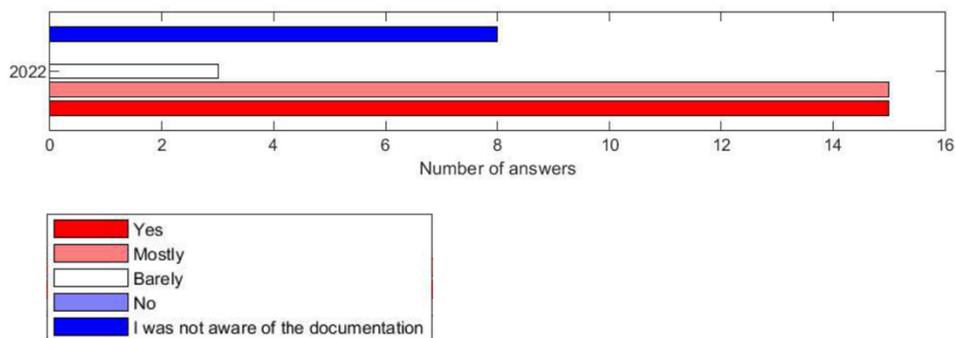
The second question of this section concerned the GFM documentation (**Figure 11**). More than a third of the sample was not aware of the existence of any documentation for the service, even though a dedicated Monitoring Wiki link was on GloFAS landing page. Narrowing the analysis to interviewees that actually were aware of the documentation (20 out 31 people that have taken this part of the survey), 90% of the users is "mostly" or fully satisfied with the documentation made available in the GFM wiki. Suggestions have been submitted to enhance the API section to be more of help to people who are not familiar with the approach and to make the quick-start guide more adaptive when displayed on a laptop. For the latter topic, the current version released through Rise360 allow for users to select a full screen mode which is supposed to meet the requirement.

Figure 11. Participants' responses when asked if they were satisfied with the GFM documentation (Monitoring Wiki) in terms of clearness, completeness, and consistency.
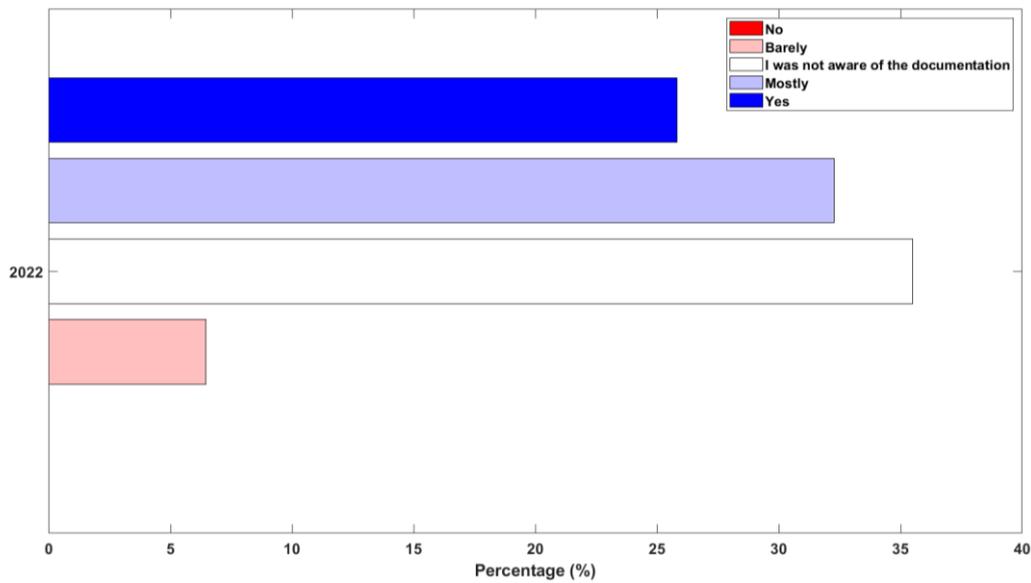
The survey for 2022 continued by asking the survey participants if they were satisfied with the GloFAS webinars. Overall, survey participants were satisfied with the webinars (**Figure 12**): more than two-third of the responses were positive (i.e. 31 responses), only one response was negative and about one-fifth of the participants were not aware of the webinars. The only comment received from the survey participants about this topic was that it would be desirable that the webinars were shorter but with deeper explanations.

Figure 12. Participants' responses when asked if they were satisfied with the GloFAS webinars.
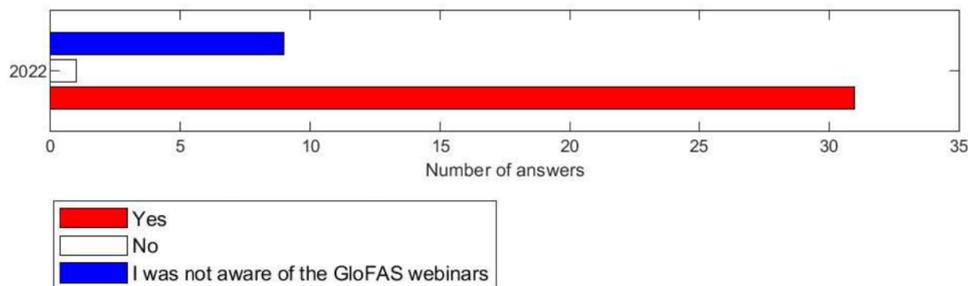
In its first year of operations, GFM has held one webinar that was attended by 200+ people and so far this has been the only standalone meeting that took place whereas dedicated sessions was hosted during CEMS and EFAS annual meetings. Though only slightly more than half of the participants had notice of GFM webinar, all of them declared to be satisfied with the meeting.

To close this section, survey participants for 2022 were asked if they were satisfied with the information on the GloFAS home page (e.g. news items). The intention of this question was to know if the GloFAS users find this information useful. Survey participants were generally very positive about the information on the GloFAS home page (i.e. 31 responses; **Figure 13**). None of the survey participants was unsatisfied, but there were three barely satisfied. 7 out of 41 responded that they do not pay attention to the GloFAS home page. The comments regarding this topic recommended to increase the visibility and accessibility of the Map Viewer.

Figure 13. Participants' responses when asked if they were satisfied with the information on the GloFAS home page.
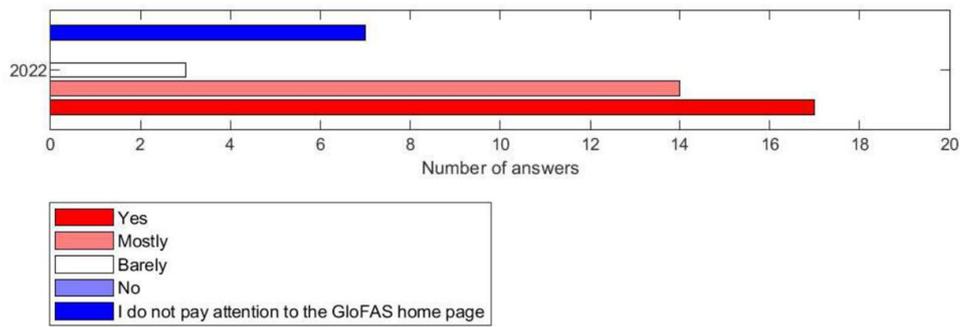
2.4   Users support

The first question of this section in the survey for 2022 was intended to know how users contact GloFAS User Support. A relatively large number of participants asked for support by using their personal connections rather than the official contact form (**Figure 14**). About one-fifth of the participants did not contact GloFAS User support while another fifth did not know how to contact them (i.e. 9 responses each). In the survey for 2021, there was a question where survey participants were asked if they knew how to contact GloFAS User Support. About 60% of participants in the survey for that year did not know (this number reduced to about 20%, a considerable improvement from 2021 to 2022).

Figure 14. Participants responses about how do they contact GloFAS User Support.
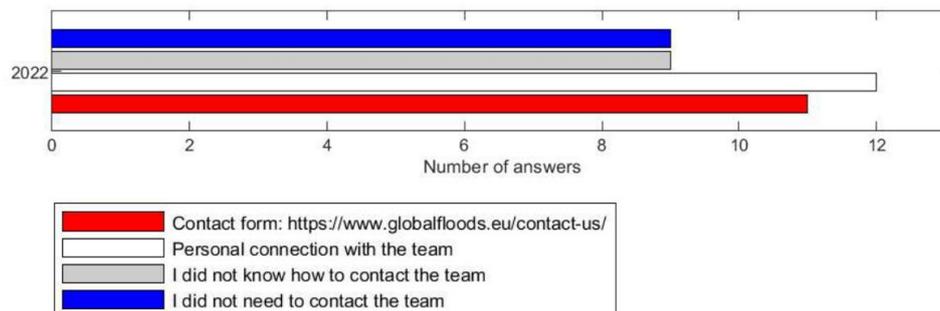
GFM User Support was activated in October 2021 in parallel with the pre-operational release of the service on GloFAS. To this end, an item of the drop-down menu of the Contact Us was specifically devoted to engage the GFM support team. Apparently, most of the issues and requests came in to the support service via personal contacts (30%, 10 people) rather than the proper reporting channel (accounting for 7 tickets managed though the first-level helpdesk). Though another 24% did not feel the need to inquire with the user support on any specific topic, another 22% (6 people) did not know about the assistance service is offered on a regular basis.

The survey continued by asking to the survey participants how helpful the GloFAS User Support was with regard to their questions or concerns. About 60% of the survey participants for 2022 has requested help to the User Support (i.e. 25 out of 41; **Figure 15**). Half of the participants who requested help to User Support considered that the help provided was very helpful (i.e. 13 responses), about a quarter of them thought it was somewhat helpful (i.e. 6 responses), while the remaining quarter considered it was either not so helpful or not at all helpful (i.e. 4 and 2 responses respectively). In the survey for 2021, there was a question where survey participants were asked if they received help from GloFAS User Support with regards to their request. Almost two-third of those who reached out for help did not receive a satisfying support (this number reduced to about 25%, a considerable improvement from 2021 to 2022).

Figure 15. Participants responses about how helpful has the User Support been to their questions or concerns about the GloFAS products.
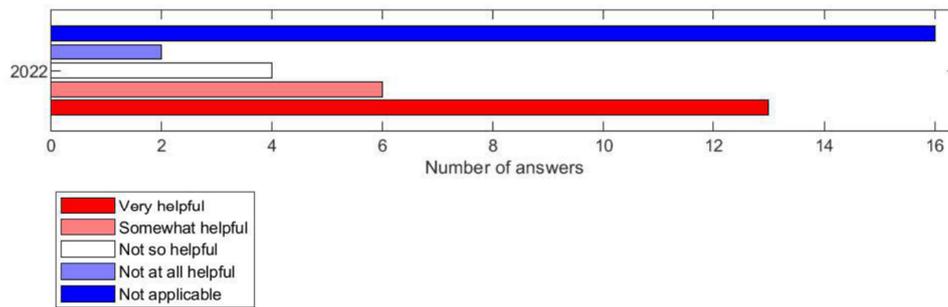
As a follow-up question, survey participants in the survey for 2022 were asked to explain their main reason for not being satisfied with the GloFAS User Support. The survey format provided some pre-compiled answers: the most chosen was "not clear/not complete answer" (**Figure 16**). Users were also given the opportunity to choose "Other" and explain in more detail their reasons but none of the survey participants added a comment.

Figure 16. Participants' responses about their main reasons for being unsatisfied with the help provided by the GloFAS User Support.
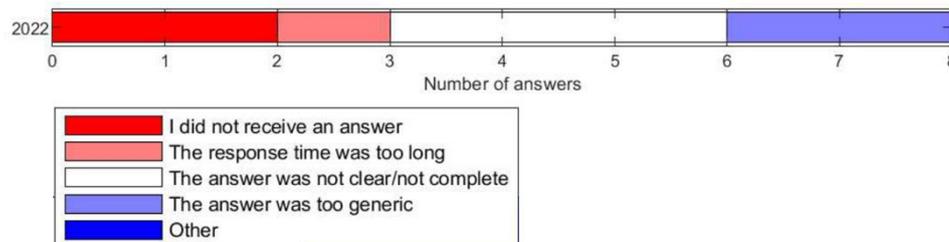
2.5 Recent and future developments and evolutions

The first question in this section was about recent developments of GloFAS. This question was intended to know if the users were satisfied with the improvements introduced with GloFAS v3.4 (i.e. improved reporting points algorithm and visualization, new flood probability persistency layer, multi-tab feature). Close to 80% of the survey participants were satisfied about the recent developments of GloFAS (**Figure 17**): 17 participants were "very satisfied" and another 15 were "mostly satisfied". Despite the small number of negative responses (i.e. only one participant was "barely" satisfied), it must be noted that close to one-fourth of the survey participants were not aware of GloFAS recent developments (i.e. 8 responses).

In the survey for 2021, there was a question where survey participants were asked if they were aware of the GloFAS developments. About two-third of participants in the survey for that year were not aware of the recent developments back then (this number reduced to about 25%, a considerable improvement from 2021 to 2022).

Participants who were "barely" satisfied with the recent GloFAS developments in the survey for 2022 highlighted the need to improve the users' experience (make the system more user-friendly).

Figure 17. Participants' responses when asked if they were satisfied with the recent developments introduced with GloFAS v3.4.
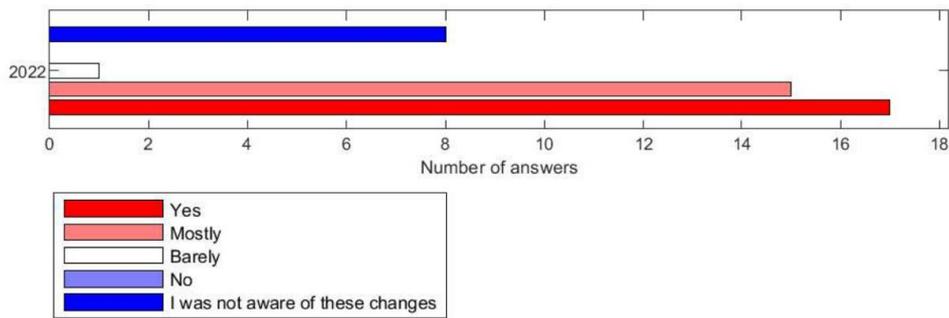
The last two questions of the survey for 2022 aimed to know how survey participants rank a number of proposed developments and evolutions to GloFAS and to GFM. They were allowed to select only 3 proposals and rank them according to their perceived priority (1 = highest priority).

For GloFAS, the proposal voted with the highest priority ranking was the one regarding improving the modelling of river routing (i.e. 15 rank-1 votes, more than 30% of survey participants; **Figure 18**). The second and third proposals voted with the highest priority ranking were adding a flash flood forecast layer and improving the modelling of the reservoirs (i.e. 8 and 6 rank-1 votes respectively). The three proposals voted with the highest priority ranking were the most voted among the three rankings as well (i.e. 25 votes in total for improving the modelling of river routing, 24 votes in total for adding a flash-flood forecast layer, and 16 votes in total for improving modelling of reservoirs).

Other proposals of interest by the survey participants but at a lesser extent than the previous were: improving modelling of snow processes (i.e. 11 votes in total), and the one about optimising the forecasts according to the lead time (i.e. 9 votes in total).

Other proposals suggested by the survey participants were:

— To improve initial conditions.

— Possibility to download layers of interest clipped according to selected areas of interest.

— Access to real-time data via Web Map Service Time (WMS-T) with possibilities for data downloading.

— To further improve the temporal and spatial resolution of GloFAS.

— To improve user experience (e.g. provide immediate visual feedback when clicking report points in order avoid multiple clicks; change z-index of tab menus as they currently appear behind the layers panel – survey participant considers it should be in front).

Figure 18. Participants' responses about their rankings on proposed developments and evolutions to GloFAS.
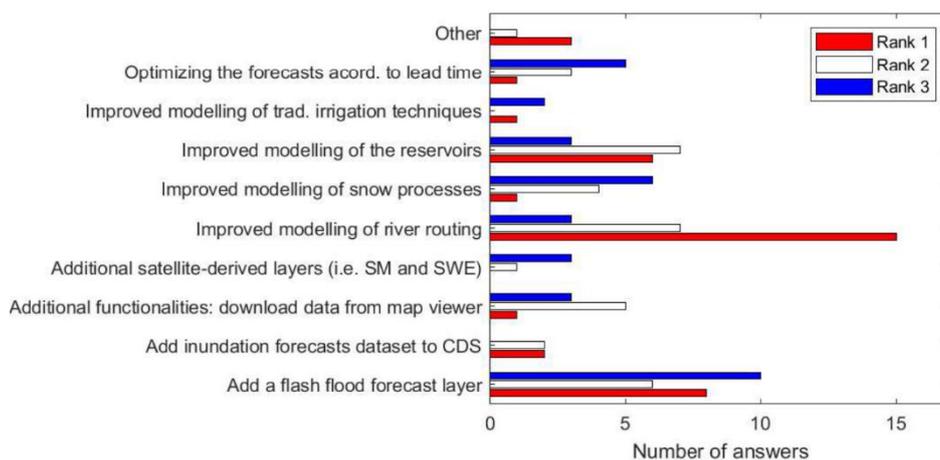
Along the same lines, the questionnaire asked the participants to indicate which developments amongst a list of possible enhancements they would like to see prioritised for GFM (**Figure 19**). Three items resulted the most popular: machine learning to analyse SAR data got 18 votes, water depth products 18, and improved flood detection in urban 22, respectively. Among these three possible evolutions, the development of a GFM product devoted to estimate the water depth was ranked the highest (1.41) followed by the implementation of a machine learning pipeline to analyse SAR data ranked highest (1.89), and the improved of flood detection in urban areas (2.27). It is worth mentioning that other options (namely, tutorials and improved flood impact layers) were appointed with a comparatively higher priority (1.33 and 1.88, respectively) than the latter yet they were selected by less than the half of the voters with respect to the former. Additionally two further potential lines of development have been outlined by users that suggested to allow users to download the layers of interest clipped according to the selected AOI and to merge S-1 data with other local-scale information provide by national agencies to refine both the reference water and the exclusion layers.

Figure 19. Participants' responses about their rankings on proposed developments and evolutions to GFM.
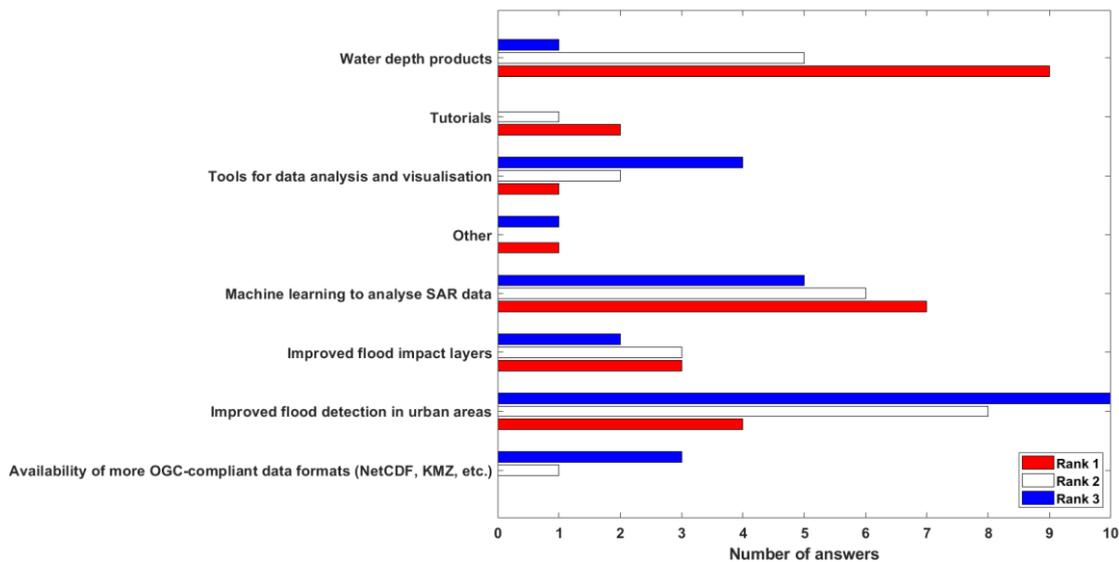
3   Conclusions

The 2022 Annual Survey was the first survey to include feedback for both GloFAS and GFM.

Survey participants were generally satisfied with the GloFAS and GFM products, which they could adequately explore via the GloFAS Map Viewer. Minor adjustments could help to further improve the user experience (e.g., more detailed legends, improved default location of the pop-up windows). For the GloFAS layers, the 2022 survey confirmed the positive response of the previous survey. The level of satisfaction for the GFM layers was generally high.

GloFAS and GFM documentation content have been rated as satisfactory. Users' awareness of GloFAS resources (documentation, webinars) increased in 2022 thus encouraging a continued communication effort, which must now include the recently published GFM documentation. Communication efforts about products and services should focus on GloFAS data download opportunities and protocols.

Regarding future developments, GloFAS users showed high interest in improving the modelling of river routing. For GFM, the users expressed interest in the release of a product capable of estimating the water depth in flooded areas.

The list below enumerates some of the actions that have been planned to acknowledge our users' feedback:

— Improve legend descriptions in the Map Viewer, for both GloFAS and GFM products.

— Continued improvements of the GloFAS web page to ameliorate the communication of opportunities (with specific attention to GloFAS data download opportunities and modalities) and developments.

— Review of the FAQ section of the CEMS GloFAS User Guide to provide answers to many of the questions raised by the participants of this survey.

— Continued improvement of the internal protocol to respond to the requests submitted via the GloFAS and GFM Contact Form.

— Make the GFM quick-start guide more adaptive when displayed on a laptop: *!improvement in place!* the new version released through Rise360 allows for users to select a full screen mode.

— GloFAS long term development: improved modelling of river routing.

— GFM long term development: estimation of the water depth in flooded areas.

List of figures