



D6.3 Lessons learnt using AQUACROSS Information Platform

Deliverable 6.3



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Authors

Aaike De Wever, RBINS, Royal Belgian Institute of Natural Sciences, Belgium

Astrid Schmidt-Kloiber, BOKU Vienna, University of Natural Resources and Life Sciences, Austria

Juan Arevalo-Torres, IOC-UNESCO, Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization, France

Declan Dunne, UCC, University College Cork, National University of Ireland, Ireland

Vanessa Bremerich, IGB Berlin, Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Germany

Koen Martens, RBINS, Royal Belgian Institute of Natural Sciences, Belgium

Alejandro Iglesias-Campos, IOC-UNESCO, Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization, France

With contributions by:

Jeroen Vendrickx, RBINS, Royal Belgian Institute of Natural Sciences, Belgium

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List of abbreviations

| | |
|---------|--|
| CA | Consortium Agreement |
| CC | Consortium Committee |
| CKAN | Comprehensive Kerbal Archive Network |
| DCAT | Data Catalog Vocabulary |
| DOA | Description of Action |
| DOI | Digital Object Identifier |
| EML | Ecological Metadata Language |
| FIP | Freshwater Information Platform |
| GA | Grant Agreement |
| GEO BON | Group On Earth Observations Biodiversity Observation Network |
| GEOSS | Global Earth Observation System of Systems |
| IP | (AQUACROSS) Information Platform |
| IPT | Integrated Publishing Toolkit |
| INSPIRE | Infrastructure for Spatial Information in the European Community |
| OGC | Open Geospatial Consortium |
| PCG | Project Coordination Group |
| PO | Project Office |
| SPBTT | Science–Policy–Business Think Tank |
| WP | Workpackage |

About AQUACROSS

Knowledge, Assessment, and Management for AQUatic Biodiversity and Ecosystem Services aCROSS EU policies (AQUACROSS) aims to support EU efforts to protect aquatic biodiversity and ensure the provision of aquatic ecosystem services. Funded by Europe's Horizon 2020 research programme, AQUACROSS seeks to advance knowledge and application of ecosystem-based management for aquatic ecosystems to support the timely achievement of the EU 2020 Biodiversity Strategy targets.

Aquatic ecosystems are rich in biodiversity and home to a diverse array of species and habitats, providing numerous economic and societal benefits to Europe. Many of these valuable ecosystems are at risk of being irreversibly damaged by human activities and pressures, including pollution, contamination, invasive species, overfishing and climate change. These pressures threaten the sustainability of these ecosystems, their provision of ecosystem services and ultimately human well-being.

AQUACROSS responds to pressing societal and economic needs, tackling policy challenges from an integrated perspective and adding value to the use of available knowledge. Through advancing science and knowledge; connecting science, policy and business; and supporting the achievement of EU and international biodiversity targets, AQUACROSS aims to improve ecosystem-based management of aquatic ecosystems across Europe.

The project consortium is made up of sixteen partners from across Europe and led by Ecologic Institute in Berlin, Germany.

| | |
|---------------------|--|
| Contact | aquacross@ecologic.eu |
| Coordinator | Dr. Manuel Lago, Ecologic Institute |
| Duration | 1 June 2015 to 30 November 2018 |
| Website | http://aquacross.eu/ |
| Twitter | @AquaBiodiv |
| LinkedIn | www.linkedin.com/groups/AQUACROSS-8355424/about |
| ResearchGate | www.researchgate.net/profile/Aquacross_Project2 |

1 Introduction

This deliverable aims to identify lessons learnt throughout the AQUACROSS project with regards to the Information Platform development and usage. The idea is to report experiences gained and feedback accumulated in the course of the project. By sharing these lessons learnt, we aim to support future projects and initiatives to increase their efficiency and effectiveness in terms of data and information management and publishing by building on the experiences of AQUACROSS.

In addition, this report also represents a reflection and “wrapping up” of the activities undertaken in Work Package 6 (WP6): “Information Platform” and its tasks:

- ▶ Task 6.1 Data and information management
- ▶ Task 6.2 GIS guidelines and operational support
- ▶ Task 6.3 Development and maintenance of the information platform and tools
- ▶ Task 6.4 Wrapping up and lessons learnt

2 The AQUACROSS Information Platform

To facilitate the dissemination of research and innovation results in the AQUACROSS project, we aimed to establish a common and free of charge open-access information platform. This platform should act as a central access point for project partners and scientists for publishing data on different types of aquatic ecosystems, biodiversity and ecosystem-based management practices. It should provide open access to a wide range of resources related to aquatic (freshwater, coastal and marine) ecosystems and biodiversity management at the European level. The primary focus should be on data used in the various project Case Studies, resulting maps, model outputs and tools.

In terms of functionalities and objectives we envisaged to cover the following topics:

- ▶ Design, develop, build and test an INSPIRE/GEOSS compliant information platform.
- ▶ Build a software tool that would enable the cataloguing, interrogation, manipulation, and visualisation of diverse relevant datasets and their documentation on water and biodiversity.
- ▶ Provide project partners with a tool and data repository to support the implementation of the project including a user management module to administer user accounts, data access and processing rights.
- ▶ Provide the end-user community with a platform to search for and visualise geospatial data and documents:
 - overview of data and metadata (including links to data repositories)
 - indicators and tools (e.g., including research results from WP7 and WP8)
 - technical documentation and guidelines
 - geospatial exploration and visualisation of the collected data, e.g. case studies (with various levels of access to the stored data)

We envisaged to develop such a platform based on existing technology and adhering to common data and metadata standards including the OGC protocols and the ISO 19115/19139 metadata standards, conformant to the INSPIRE Directive.

In terms of content, we developed a Data Management Plan (as part of Task 6.1 *Data and information management*) for the project to document the data flow, detailing which data will be generated and how they will be made accessible, as well as future curation and preservation beyond the project duration. By doing so, we wanted to ensure compliance with all current data policies in Europe whilst also adhering to the GEOSS Data Sharing Principles and the European Commission's Open Access to Research Data policy. All data generated through the project will be available free of charge for discovery, visualisation and download. Any pre-existing spatial data brought to the project by partners will be available for discovery and viewing; download rights will be subject to the conditions pertaining to the specific datasets. Data accessed via web services will remain the property of the originators and users will be referred to their sites and metadata for full access and use conditions.

The Information Platform and its development are described in detail in Deliverable 6.2 *“Development of the Information Platform: atlas, data viewer, data catalogue and data toolkit including GIS guidelines”* (Arevalo–Torres et al. 2018, D6.2). This report covers the Information Platforms’ IT architecture and main elements including the data catalogue, data viewer and data toolkit, summarises the GIS guidelines and discusses the sustainability of the platform and the hosted data.

3 The AQUACROSS IP development process

3.1 WP6 activities relating to the AQUACROSS Information Platform development

3.1.1 Understanding the project requirements and distribution of tasks

The project proposal or “Description of Action” (DOA), and more particularly the description of work package 6 (WP6): “Information Platform” therein, clearly outlines the plans for an open-access INSPIRE/GEOSS compliant information platform and specifies functionalities/modules which should be envisaged. Although the Open Source SmartAtlas technology is mentioned as starting point for a data viewer, the DOA does not explicitly specify further technological choices, nor does it clearly lay down the responsibilities of the different partners in terms of development tasks (and available resources specific for development vs. other WP tasks). These two topics were therefore the subject of discussion over the first months of the project.

The project kick-off meeting (10–12 June 2015, Brussels) presented a first opportunity to bring WP6 partners around the table, to present existing initiatives including the SmartAtlas (<http://smartatlas.ucc.ie/>) based the Marine Irish Digital Atlas and the Freshwater Information Platform (www.freshwaterplatform.eu) as well as to consider options for the Information Platform development.

In the first months following this meeting, the distribution of responsibilities at task level was worked out in a “logical framework”, which was discussed over email and during regular teleconferences. This document represented an internal working document that aimed at clarifying tasks and their relationship to other activities in the project as well as providing contact details and responsible persons for each of the partners involved.

At that stage, the partners involved in the Freshwater Information Platform stressed the need for:

- (1) outlining a clear vision in terms of envisaged AQUACROSS Information Platform content, audience and links to existing initiatives,
- (2) thereby also considering the need for integrating non-spatial data in the Information Platform,
- (3) reserving a considerable amount of time and attention for active data mobilisation (based on their experience in the EU FP7 BioFresh project),
- (4) ensuring compatibility with existing components of the Freshwater Information Platform (FIP) and
- (5) developing a plan for long-term maintenance of the Information Platform after AQUACROSS.

The penultimate point includes adopting standards/fields used in the Freshwater Metadatabase (freshwatermetadata.eu), exchanging produced maps with the Global Freshwater Biodiversity Atlas (atlas.freshwaterbiodiversity.eu), using the Darwin Core standard for biodiversity occurrence data as adopted for the Freshwater Biodiversity Data Portal

(data.freshwaterbiodiversity.eu) and the need for implementing a harvesting mechanism of entries in the Freshwater Metadatabase.

This “logical framework” was further refined in the course of the first year to account for the organisational and technological choices made by all the partners involved.

3.1.2 Understanding the envisaged datasets

In parallel, in September 2015, a data survey was conducted among the project partners, which aimed to get an overview of the existing datasets produced/acquired by the partner institutions that were relevant for the pilot case studies, as well as possible new datasets generated during the project. This survey conducted in the framework of Task 6.1 *Data and information management* enabled us to account for the different types of datasets and data workflows in the Data Management Plan, gain a better understanding of the datasets to be integrated in the Information Platform and anticipate on the requirements in terms of operational support (Task 6.2) for integrating these data. Results of this survey, focussed on the different types of data expected, are integrated in the Data Management Plan (Arevalo–Torres et al. 2017, [D6.1](#)).

Complementary to the data survey among the project partners to identify datasets for integration in the Information Platform, WP6 partners were also involved in a review of existing information systems in marine, coastal and freshwater environments as contribution to Deliverable 2.2 *“Review and analysis of policy data, information requirements and lessons learnt in the context of aquatic ecosystems”* (O’Higgins et al. 2016, [D2.2](#)). This review also integrated the input received during the *H2020 AQUACROSS Policy, Data and Assessment Frameworks Orientation Workshop* (March 1st 2016, Berlin) which aimed to identify policy relevant information gaps and potential solutions for improving availability, interoperability and use of existing datasets. The final report can be found on the [project website](#).

3.1.3 Detailing technological choices

In October 2015 (20th–22nd, Berlin), WP6 partners met to discuss the technical and practical details of the Information Platform development (along with a range of other WP–related topics). At this occasion, we evaluated the possibility for building on or linking with existing systems including SmartAtlas, the Freshwater Information Platform (FIP), ARIES and MARXAN. During the presentation on the analysis of existing open source data platforms matching the project requirements and needs, executed by IOC–UNESCO, the CKAN system (ckan.org) was put forward as the most feasible option for building the AQUACROSS Information Platform. CKAN was considered to offer high flexibility and modularity, with a large number of available plug–ins thanks to the large community of developers supporting it.

Following this analysis, WP6 partners endorsed the choice for CKAN as a framework for developing the AQUACROSS Information Platform. Deciding factors in going with CKAN included:

- ▶ The possibility to handle both spatial and non–spatial information in different formats, which represents an added value compared to other solutions.
- ▶ Wide use in the Open Data community including the [EU Open Data Portal](#), [Open Data Portal in Greece](#), [JRC Data Catalogue](#), etc.
- ▶ Solid built–in options for user/contributor management.

Testing of the CKAN system by different partners was scheduled after the meeting, as well as the evaluation of the feasibility of integrating the presented tools/platforms (esp. ARIES and FIP). We also set out to further explore how we can take advantage of the existing developments and partners' know-how.

Additionally, this meeting also presented an opportunity to agree on details for server hosting and maintenance. ECOLOGIC reserved resources for renting and administrating server space, while IOC-UNESCO (Juan Arévalo-Torres) and UCC (Declan Dunne) took care of setting up the required services and their management.

Following this meeting, we set up regular (initially weekly) developer teleconferences to discuss and progress on technical issues. Once the server was available, we also set up the open source project management tool Redmine, which was used to define and assign tasks, track issues and progress and document procedures in a central wiki.

3.1.4 Implementing and filling the CKAN system

A hands-on hackathon in March 2016 (2nd–4th, Berlin) presented an excellent opportunity for developers to exchange experiences in working with CKAN, thereby improving the understanding of the CKAN IT architecture and learning to master the installation process and configuration steps for plug-ins. Potentially relevant plug-ins (e.g., GeoView, Spatial, FileStore, Datastore, Solr, DataPusher, Harvester, PublicaMundi) were identified and tested. A considerable amount of time was spent on configuring and modifying the harvester plug-in to import data from both the Freshwater Information Platform (FIP) Integrated Publishing Toolkit (IPT) and the Freshwater Metadatabase, which respectively rely on Data Catalog Vocabulary (DCAT) and Ecological Metadata Language (EML) parsing. These harvesting capabilities needed to be further developed following the meeting, while the correct settings for harvesting CSW Server Catalogue Services (from the European Environment Agency, EMODnet among others) were already identified at this stage.

The background documentation for assisting partners in their data management, the Data Management Plan (Arevalo-Torres et al. 2017, [D6.1](#)) and the GIS guidelines were made available in April 2016. The initial 'beta' version of the Information Platform and the user manual were available during the AQUACROSS Annual Meeting in June 2016 (Alcalá de Henares). At this occasion, the AQUACROSS Information Platform was presented and discussed both during the Forum, in the presence of project stakeholders and Science-Policy-Business Think Tank members, as well as during the consortium meeting. The demonstration for project partners focussed on user registration and data upload into the platform. During the WP6 discussion, responsibilities for operational support were distributed across partners, but active data requests were not issued at this stage in order to allow the Information Platform developers to finalise the main development work by the end of 2016.

At the end of February 2017, the largely finalised IP was shown at the WPs and CSs face-to-face meeting in Brussels. To reach all partners and provide dedicated training, a webinar "*Training and Guidance session on the AQUACROSS Information Platform*" was organised for project partners in April 2017, at which stage all project partners were actively encouraged to upload datasets.

Partners were requested again to upload datasets (spatial data, statistic data, maps, images, documents, metadata, etc.) in the build-up to the annual consortium meeting in Vienna in September 2017. In addition to the presentation of the WP6 activities and Information Platform at this meeting, we conducted a survey of all participants to get their feedback on the status of the platform and what could be improved. As WP6 partners started to engage in the quality assurance and quality control (QA/QC) of the uploaded datasets, the workflow for doing so was further improved in order to ensure that datasets are checked prior to public release. This procedure was fully implemented and documented in the updated manual by the time of the AQUACROSS Case Study Coordination Meeting in April 2018 (Málaga).

At this meeting, we organised a dedicated WP6 data workshop where we carried out a live survey, assisted during practical exercises in relation to the Information Platform, discussed the (meta)data upload process in depth, while responding to any questions and soliciting feedback for further improving the platform.

The feedback received at this meeting was implemented over the coming months, including the recommendation to clarify the (default) roles for data providers and data licenses, and to improve the links to and from the project website. Following a second request for uploading datasets, the AQUACROSS Information Platform was officially launched in July 2018 (see http://www.unesco.org/new/en/natural-sciences/ioc-oceans/single-view-oceans/news/new_portal_on_aquatic_ecosystem_services_launching_the_aqua/).

Partners were requested prior to the final conference of AQUACROSS in Brussels in October 2018 to upload datasets. At this stage (November 2018) the AQUACROSS Information Platform holds 655 datasets (which can include a variety of files) from 17 organisations.

Total number of Datasets

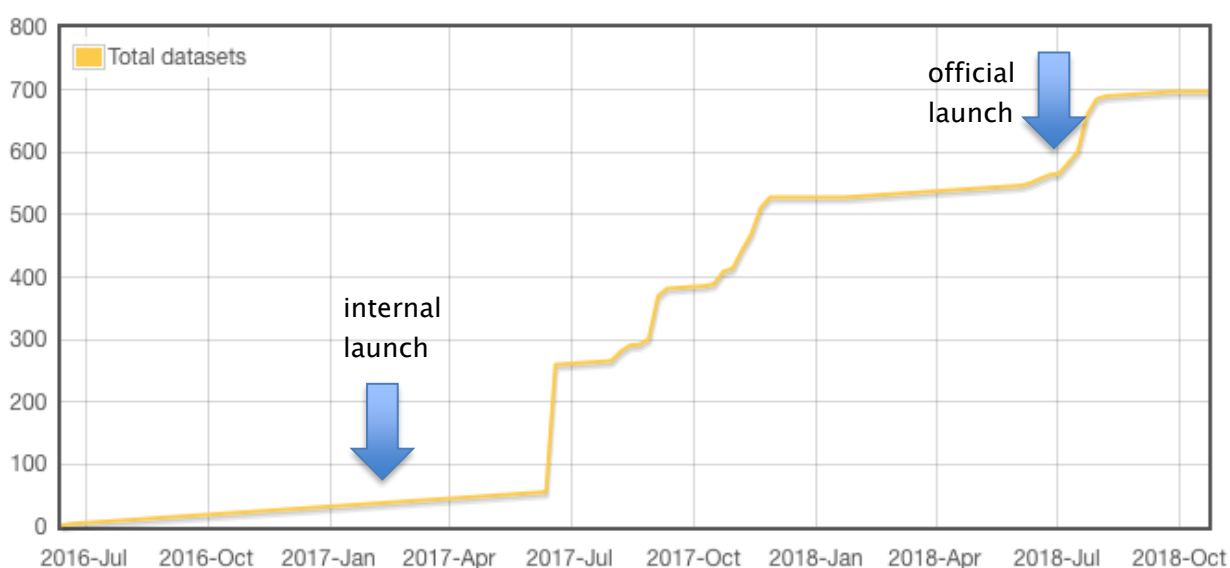


Figure 1. Number of datasets in the AQUACROSS Information Platform from its internal launch in February 2017 until October 2018.

3.2 Development of the AQUACROSS Information Platform

Although the SmartAtlas was mentioned in the “Description of Action” (DOA) as a starting point for the data viewer, we quickly realised this would not cover all the envisaged functionalities. Additionally, the technology behind the SmartAtlas was considered in need of updating which would have required a lot of work. Therefore, IOC–UNESCO performed a careful analysis of existing software systems watching the platform requirements. The CKAN system (ckan.org) was put forward as the most feasible option and adopted for the AQUACROSS Information Portal development.

Although most developers included in the AQUACROSS consortium had some experience with Python (the programming language used for the CKAN backend) and web GIS, none of the partners had worked with CKAN itself. This open source software is supported by a huge user and developer community, but has a complex architecture and steep learning curve. The installation and setup was quite tedious, especially as individual components needed to be compiled. In addition, it took us quite some time to figure out that some plug–ins from earlier CKAN versions did not work anymore on the version we used (see “MS8 Technical report on the implementation of the Spatial Data Infrastructure”).

The overall development work was coordinated by IOC–UNESCO. UCC was in charge of the back–end development and work on the metadata editor (ensuring its INSPIRE compliance), while both UCC and IOC–UNESCO focussed on interface development (using the Jinja2 templating language). BOKU, RBINS and IGB focussed on developments which ensured the integration of the Freshwater Information Platform (FIP) components with the AQUACROSS Information Platform, respectively working on ensuring metadatabase EML compatibility with the Information Platform, data availability through the Integrated Publishing Toolkit and DCAT harvesting, and setting up a bespoke FIP–metadatabase harvester.

4 Feedback from project partners and platform users

4.1 Collecting feedback from partners and users

Throughout the development process, we regularly interacted with project partners and invited feedback. In addition to add-hoc and informal feedback, we organised 3 surveys:

- ▶ Survey on paper and through Google Forms during the consortium meeting in Vienna in September 2017. At this occasion we actively ‘hunted’ for partners responses and could gather feedback from all meeting participants. In addition, a fair number of project partners not attending the meeting filled the survey online.
- ▶ Live survey and questions & answers session during the AQUACROSS Case Study Coordination Meeting in April 2018 in Málaga.
- ▶ Online survey for the AQUACROSS Information Platform visitors, partners and stakeholders which ran from July to September 2018.

As outlined in 3.1, the feedback received was considered throughout the development process.

4.2 Survey results

The questions for the September 2017 and the Summer 2018 surveys were very similar, but both the target audience (partners only vs. all potential Information Platform users) and the method (actively gathering responses during meeting vs. online only survey) were different. This obviously limits the comparability of the two surveys, but on the other hand, the earlier survey should primarily be seen as a method for soliciting feedback to improve the platform in the course of the development process. Nevertheless, the profile of the respondents is similar and there are some clear observations that can be made when comparing the two surveys.

First of all, it is clear (and logical) that partners gained more experience in using the platform by the time of the second survey. In 2017, of the 42 respondents (from all partner institutions), 13 already had some experience in uploading data. In 2018, we received 20 responses from partners on the questions about data upload, of which 17 indicated they had already uploaded data (Figure 2).

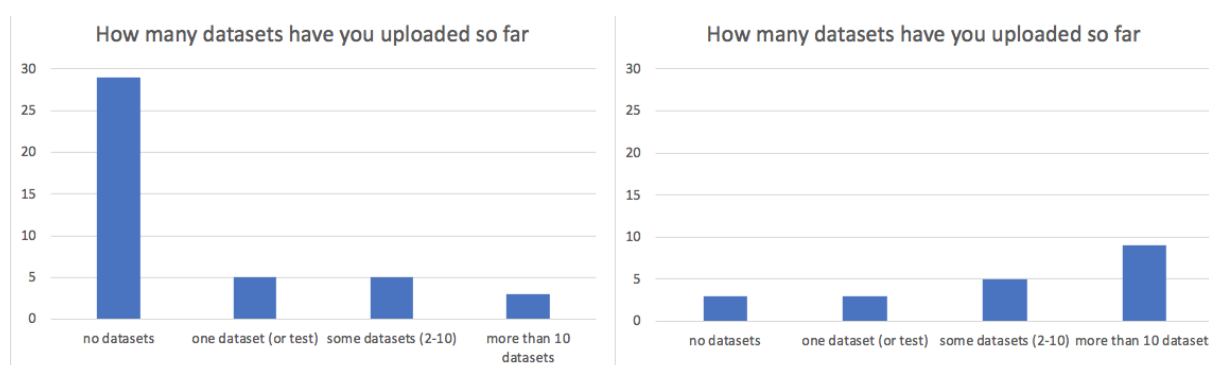


Figure 2. Experiences with uploading datasets within the AQUACROSS consortium compared between 2017 (left) and 2018 (right)

Secondly, in both surveys the use of the Information Platform from the data provider perspective was evaluated positively. All respondents found the upload process and the

instructions ‘easier’ or ‘as expected’. The question about finding the instructions and the person(s) to ask for assistance also scored high. Only 2 persons (in 13 and 15 respondents respectively) found this harder than expected in 2017 and only 1 person (in 18 respondents) did so in 2018 (Figure 3).

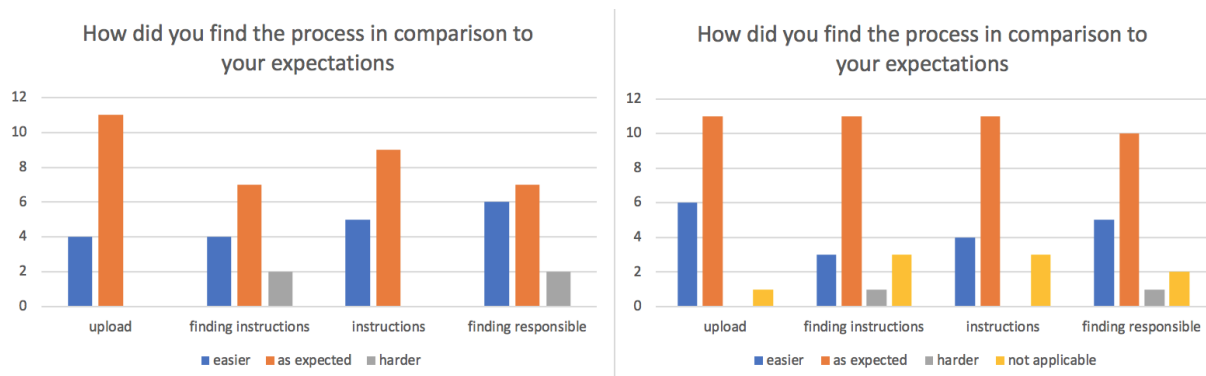


Figure 3. Experiences with the uploading process within the AQUACROSS consortium compared between 2017 (left) and 2018 (right)

We also asked about the overall appreciation of the Information Platform through an open question. This was only filled by a fraction of the respondents; therefore this aspect is hard to evaluate based on the current surveys. Looking at the 2017 responses it is clear however that a lot more recommendations for improvements were made at that stage (see Annex for details). As a general observation, the ease of use of the Information Platform was clearly appreciated, while some concerns were raised about the long-term sustainability of the platform.

Based on our experiences and observations during the surveys, we can recommend to actively solicit feedback during the development process. The September 2017 survey clearly alerted partners about the Information Platform, helped us to pinpoint some points for improvement and gave us an opportunity to further encourage partners to upload data. The live survey in April 2018 provided an excellent tool to engage with the Case Study representatives, trigger their interest and understand the (potential) bottlenecks for uploading additional data and resources.

All survey results are shown in the Annex.

4.3 Visitor statistics

In addition to the surveys conducted, we also evaluated the visitor statistics of the AQUACROSS Information Platform provided by Google Analytics.

The beta version of the AQUACROSS Information Platform went online at the beginning of 2016. At this stage it was mainly used by WP6 partners and also by some other AQUACROSS members. The internal launch took place in February 2017. Extensive “data hunting” started in September 2017. The IP was finally officially launched on July 10th 2018. At this stage the IP was advertised through various communication channels of the project as well as of individual partners (e.g. a blog feature on the FIP Freshwater Blog, the Global Environmental Facility – International Waters, UNESCO websites and social networks, etc). In Figure 4, the internal use is clearly indicated by up to 40 users a week maximum, while after the official launch we reached up to over 100 visitors a week.

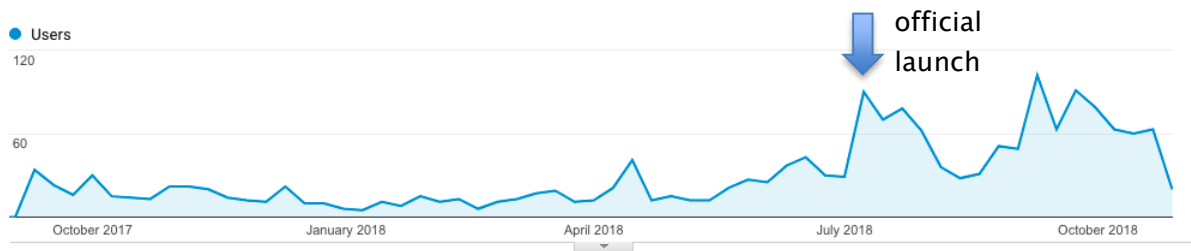


Figure 4. Number of AQUACROSS IP users per week from September 2017 until end of October 2018.

Considering only the official period from July 2018 until end of October 2018, the number of visitors reached up to 50 a day, revealing a large proportion of new users (see Figure 5). Most of the users were from France (about 15.1 %), Germany (10.8 %) and Portugal (8.5 %). Additional user peaks can be seen on July 27th, when the blog post was published as well as on September 12th and 28th.

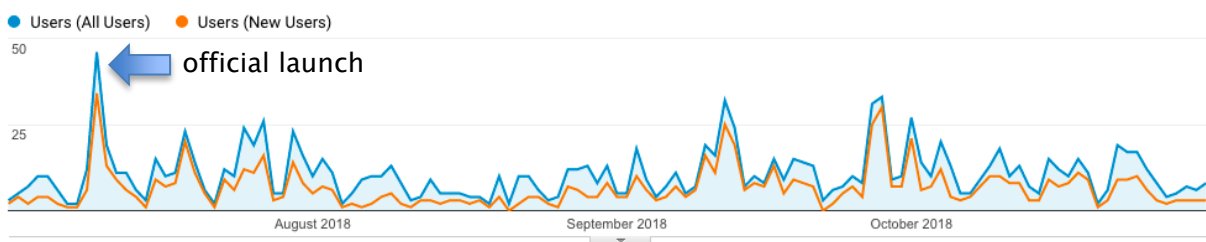


Figure 5. Number of AQUACROSS IP users per day from July 2018 until end of October 2018.

As to the acquisition of users, most visitors directly approached the AQUACROSS IP (56.2 %). 25 % of the users found the IP through a dedicated search, while 12.9 % followed a link to it. About 6 % of the users became aware of the platform through social media, where Twitter clearly took the lead.

Top Channels

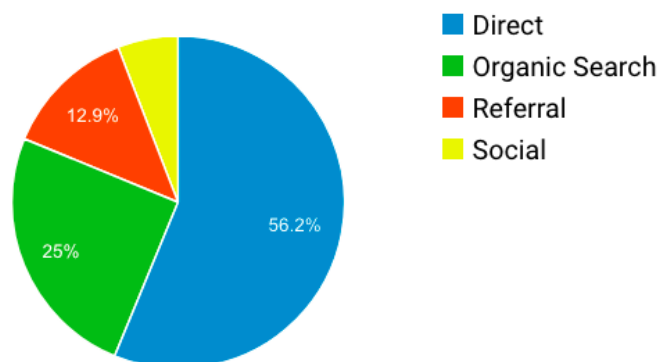


Figure 6. Percentage of user acquisition from different channels.

4.4 Other input

In addition to the surveys conducted and the visitor statistics, we also used one important additional information source for compiling this report: developer interviews of WP6 partners.

A series of interviews was conducted by Aaike De Wever (RBINS) with developers and key WP6 partners, particularly Declan Dune (UCC; 02/08/2018), Juan Arevalo (IOC-UNESCO; 08/08/2018), Michel Kapel (RBINS; 08/08/2018) and Astrid Schmidt-Kloiber (BOKU; 21/08/2018). Their feedback is integrated in the “5.1 Developers’ and WP6 partners’ perspective” section of the Lessons learnt.

5 Lessons learnt

5.1 Developers' and WP6 partners' perspective

5.1.1 Evaluating the project requirements

The first step of setting up the AQUACROSS Information Platform was going back to the “Description of Action” (DOA) to identify the key requirements and functionalities and reconsider the technical and organisational choices. As it can easily take more than one year between project writing and initiation, especially when considering a typical lead-in phase during which project staff is hired and need to familiarise themselves with the project, it is important to recognise that suggested candidate technologies might no longer represent the best option and technological developments/choices may have to be reconsidered. Ideally a good proposal strikes a good balance between being specific enough and allowing sufficient flexibility in terms of technological choices and proposed functionalities.

In the AQUACROSS project, we abandoned the idea to build the data viewer based on the SmartAtlas system in favour of the all-encompassing CKAN system. This choice was embraced by all partners involved in the development work. This change in technology choice could obviously have had a serious impact on the work distribution among partners depending on their familiarity with the technology chosen, but was actually very minimal. Setting up a “logical framework” of the WP6 tasks proved very useful to clarify responsibilities and tasks among different partners.

One minor shortcoming we identified in the DOA is the fact that server hosting (for both development and production machines) was not assigned to a specific partner, nor foreseen in the budget. This has a fairly minimal impact on resources and was easily resolved within the project, but this oversight seems an easy one to avoid in future applications. This also is relevant for continuation of the infrastructure after the project's term, which is not foreseen to be included in any application (see section “Sustainability of IT developments”).

Other points that are up for improvement include carefully considering the timing of availability of results, data products and the role of technological tools and developments in the project workflow. If an information platform is for example also considered as data exchange platform for partners, its availability and training on its use needs to be ensured early on in the project while allowing for a realistic development time. At the same time, the implementation of any dissemination tools that require a lot of development time, e.g. the use of storytelling tools that also need good example data to start the development work, need to be well planned in the DOA schedule and could be hampered by late data availability. In this respect we believe that working out the data workflow for Case Studies more in detail in the DOA or early on in the project would have been helpful. This includes the assignment of responsibilities amongst experts involved in the Case Studies and the specific PM clearly reflected in the DOA.

5.1.2 Fostering good collaboration and communication among workpackage members

Executing development work through distributed teams, while having to reconcile differences in expectations and perspectives, is obviously challenging and requires good communication among partners.

To complement the regular teleconferences and email exchanges, all participants especially appreciated the hackathon organised in March 2016 as an excellent opportunity to gain a common understanding of the technology and project requirements, jointly resolve technological issues as well as testing and advancing the development of modules. Some also stressed the importance of this event from a “teambuilding” perspective, leaving the participants energised and enthusiastic to remotely continue their joint development work.

Meeting with other developers at the CKAN development conference (Madrid, October 2016) proved very useful for advancing the development work and learning the ins and outs of the system. It was very helpful to get to know other developers and projects using CKAN, but also to find out more about latest developments and interesting extensions in the context of the AQUACROSS project. We had the opportunity to discuss the roadmap for the CKAN project and give advice on interesting features to be developed. Thanks to our participation we were able to get technical support from the core developers of CKAN.

Having dedicated “developer calls” (organised weekly during periods of intense development work) with the persons actively involved in the programming work in addition to the more general “coordination calls” provided a good opportunity to follow up on the progress of the work, resolve issues, refine requirements and perform tests. Minutes of these meetings were circulated to all participants and posted on the AQUACROSS intranet page for reference. In parallel, tracking progress through the Redmine tool, which included issue tracking and the possibility for documenting procedures, was considered a very useful addition to the toolbox for managing the development work, though setting up the notification system for specifically receiving (only) relevant updates proved tricky in the beginning. Code sharing and version tracking was done through GitHub (github.com/aquacross).

Overall communication and collaboration among the technical partners were evaluated as very positive, but turnover and unavailability of staff (e.g. due to issues with contracts) made it challenging to ensure continuity.

5.1.3 CKAN as technology of choice

Despite the learning curve for the CKAN system being steep and the need to rely on forums and user experiences in the absence of extensive documentation, the experience of the developers was overall very positive.

We are convinced that we will use the system again for similar purposes as it has a very good metadata catalogue, powerful searching options, basic visualisation capabilities and forms an excellent starting point for a lightweight platform (or even an advanced one, depending on the number of modules and level of customisation required). We recommended the system to colleagues, among others at the GEO BON all hands meeting in July 2016 (“Lessons learned from the freshwater biodiversity data mobilisation activities for the Freshwater Information Platform”), at the International Conference on Ecological Informatics in September 2018

(“Integration and dissemination of aquatic biodiversity and ecosystem service data for case studies focusing on ecosystem-based management”) and at the 9th International Waters Conference in November 2018 (“Analysis of transboundary Water Ecosystems and Green-Blue Infrastructures: A bottom-up approach”).

We also appreciated the fact that there is a very active and growing community supporting CKAN, with patches and security updates being released regularly. There is a widely used CKAN(-dev) email list on which questions for improvements of the CKAN platform are discussed.

5.1.4 CKAN implementation

Overall, we believe that the CKAN implementation for the AQUACROSS Information Platform strikes a fairly good balance between specialist vs. generalist portal and served the need of project partners and the wider audience.

Project partners and stakeholders (e.g. tests done within the CS2 Andalusia-Morocco) uploading data to the platform seemed to appreciate the easy use of the platform, but some of the terminology used was not always clear and required further explanations and guidance (see section “User guidance, operational support and quality control”).

In terms of the Information Platform being a tool for dissemination, we believe the functionalities to fulfil this role are available, but could be exploited more intensely. Obviously, this largely relies on input from partners, the presence of important/major datasets that draw attention to the platform, and the “advertisement” of key datasets and types of data that can be found (see also next section). Also the number of initiatives/platforms to which the Information Platform links and integrates with could be enlarged.

The plug-ins used within AQUACROSS were based on existing ones and tailored to the needs for the project. Developing such modules from scratch would have been hard, but many plug-ins exist (see extensions.ckan.org). The INSPIRE compliant metadata editor plug-in as adopted for the AQUACROSS Information Platform is available on our GitHub page (github.com/aquacross) for re-use in other contexts. As this metadata editor was specifically tailored for the needs of the project, i.e. adopting a fairly minimal set of fields and having Case Study specific details hard coded in it, this plug-in will most probably require further modifications if reused. In terms of the chosen metadata profile, adopting two complementary profiles for spatial and non-spatial data respectively, rather than implementing a hybrid profile, could have been a better option. This could avoid possible confusion about which fields to complete under which conditions.

Another implementation detail that would be up for improvement is the harvesting process from the Freshwater Metadatabase. Initially, the idea was that the CKAN system would harvest this database on a regular basis, but this was not implemented in the end due to time constraints.

5.2 Mobilising data from project partners and external parties

5.2.1 User guidance, operational support and quality control

The usefulness of an information platform depends for a very large extent on the data that are integrated. Within WP6 we reserved considerable attention to “operational support” for assisting partners, but the DOA also assumed a pro-active role of the partners in uploading data. Though the uploading of data to the platform seems rather straightforward, we prepared an extensive manual, including specific terminology and further explanations.

Responsibilities for the operational support as well as quality control of uploaded datasets were distributed among WP6 partners based on the respective work package, Case Study and thematic datasets. This division of work seemed fine, and we do not think that a single person acting as a central data contact person would necessarily have done a better job.

5.2.2 Uploading of datasets

During the first round of data mobilisation among partners, responses remained fairly low and requests for uploading of datasets had to be repeated several times. Reasons for this low response varied from lack of time/interest, over the unavailability of data, to misinterpretations of what could be provided and was considered relevant.

Generally, many scientists consider documenting and releasing (publishing) data online still as a very low priority (as opposed to scientific publishing) and do not consider this an essential part of the scientific (data) life cycle. Based on prior experiences in other projects, WP6 partners were very well aware of the challenges data mobilisation may pose. At the first face-to-face WP6 meeting (October 2015) we already discussed this, acknowledging the need for actively requesting data and sending out frequent reminders and exploring ideas for reward mechanisms for partners to share their datasets such as assigning Digital Object Identifiers (DOIs) to datasets.

Largely we feel that this is an issue of educating and training scientists in data management and publication, which is not unique to the AQUACROSS project. Nevertheless, we wondered how we could address the ‘intrinsic motivation’ of collaborators rather than having to ‘force’ them to upload data through endless reminders and referring to contractual obligations.

From a developer’s point of view, implementing a tool that users are happy to apply in their data exchange workflow (e.g. instead of cloud services such as Google Drive or Dropbox) would ensure that the data are already in the system and reduce the reluctance to make them available. This would require that this tool would be available already at a very early stage of the project. The beta version of the IP was already available in the first year of the project at the beginning of 2016, but we did not advertise its additional functionality as data exchange tool actively enough within the consortium. Partners did not use the IP in the early phase of the project, which resulted in the fact that we had to actively hunt for data as soon as the IP was fully operative.

Creating additional visibility and recognition for existing datasets could also make it more attractive for partners to share their data. We tried to do so by grouping data by Case Study, but feel that it might also be interesting to highlight key datasets. Though datasets can be searched for with a full-text search in the CKAN system, the consistency of included datasets

could have been improved by adhering to harmonised naming and/or tagging of datasets. This is typically something to be proposed at an early stage of the project and to be included in the guidelines for users.

The Information Platform additionally includes tools for specifically advertising datasets using social media links, but this requires active utilisation of partners. Dedicated training workshops for using these specific dissemination tools could improve their uptake and we recommend considering such aspects at the stage of proposal writing.

5.3 Sustainability of IT developments

For information systems like the AQUACROSS Information Platform it is essential to envisage long-term maintenance, also, and especially, after the end of the project and the stated term after it through project regulations. Although the future responsibility to ensure the sustainability of the IP was not explicitly mentioned in the AQUACROSS DOA, the coordinator has agreed to maintain the IP for three years after the project's end. We also do believe that there is an interest from several partners for a longer-term maintenance as they have already invested considerable efforts to integrate their data. The maintenance work would – after modification of the QA/QC workflow in the absence of operational support – be limited to financing the server hosting and reserve 1 to 2 days a month of IT work for server maintenance and applying security patches as required. As a back-up solution, datasets not published elsewhere should also be made available through Zenodo. For future proposals we encourage that they already specify the roles and commitments for post-project sustainability in the DOA.

Additionally, we think it is highly necessary to create sustainable solution options for the development and maintenance of infrastructures like the AQUACROSS IP from the side of the funding body. Currently European research schemes do not foresee funding for the maintenance and further development of IT tools after the project ends and their continuation still relies on other (sometimes unrelated) sources of funding. Therefore, very often there is a risk that these developments disappear from the infrastructure landscape and considerable time and development knowledge becomes lost if alternative sources of funding are not found. AQUACROSS therefore encourages the European Union to create dedicated post-project funding schemes that allow sustainably maintaining IT infrastructures and software research tools in order to avoid duplication of work and re-inventing the wheel after each project.

6 Conclusions

The decision to use CKAN as technology for the AQUACROSS IP turned out to be a good and practicable solution as it is an excellent tool for making data and information visible and disseminating results. Technology-wise it makes datasets available for harvesting through and integration in other CKAN installations, which multiplies the potential visibility of project research results. The AQUACROSS IP has been registered as one of the CKAN instances publishing open biodiversity data around the world (<https://ckan.org/about/instances/>). Regarding the development process, we experienced that communication among developers is key if working with distributed teams.

An information platform like the one we developed can only fulfil its purpose, if it presents a critical mass of relevant data. Successful data mobilisation needs extensive operational support to actively hunt for data. Sufficient resources (personnel- and money-wise) need to be foreseen for data delivery as well as data processing. The process of publishing (uploading) data needs to be embedded in the entire project workflow, meaning that the timing of development work is well aligned with the other project work. These steps should be described in the proposal and in the Data Management Plan. Most importantly, the reluctance to upload/publish data needs to be reduced with scientists. This can be done by outlining its advantages (visibility, recognition, possibility of new research collaborations, etc.) as well as by making the process as easy and clear as possible by providing good default options and clear guidance.

Finally, we want to encourage the EU Commission to create post-project funding schemes that allow sustainably maintaining IT infrastructures and software tools in order to avoid duplication of work and re-inventing the wheel.

7 References

- Arevalo-Torres, J., Barbosa, A., Iglesias-Campos, A., Barbière, J., Ouellette, W., O'Higgins, T., Dunne, D., Schmidt-Kloiber, A., Pletterbauer, F., De Wever, A., Daam, M., Nogueira, A., Lillebø, A., Bremerich, V., Lago, M., Abhold, K. 2017. AQUACROSS Data Management Plan V 2. Deliverable 6.1, European Union's Horizon 2020 Framework Programme for Research and Innovation Grant Agreement No. 642317.
- Arevalo-Torres, J., Barbosa, A., Iglesias-Campos, A., Barbière, J., Dunne, D., Schmidt-Kloiber, A., De Wever, A., 2018. Development of the Information Platform: atlas, data viewer, data catalogue and data toolkits including GIS guidelines-Deliverable 6.2, European Union's Horizon 2020 Framework Programme for Research and Innovation Grant Agreement No. 642317.

8 Annex

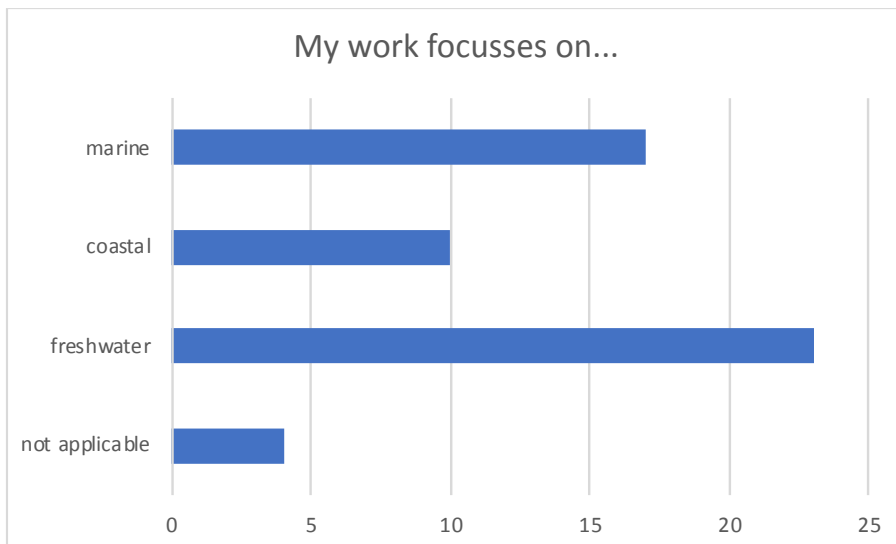
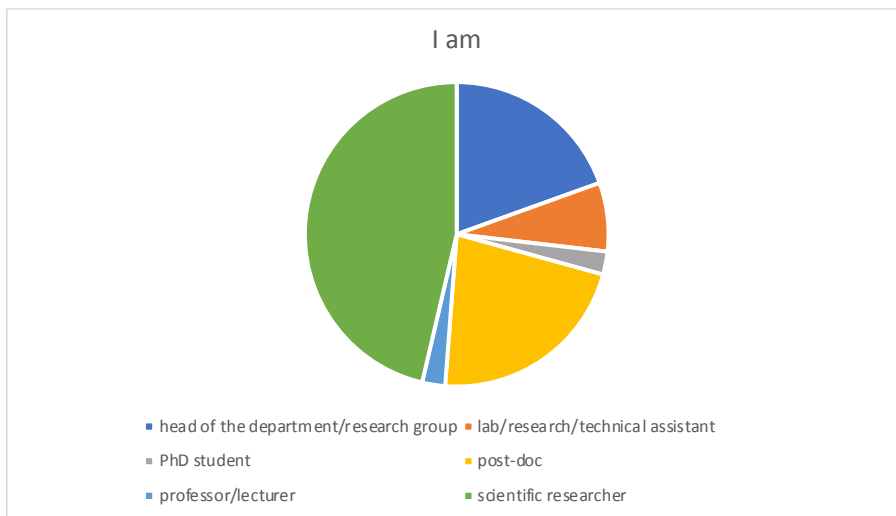
8.1 Annex A: Summary of AQUACROSS IP user survey results

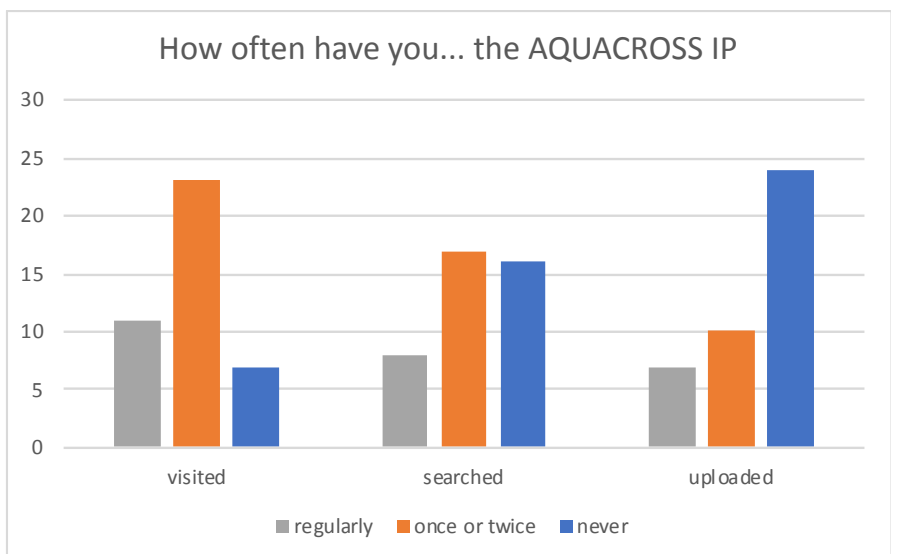
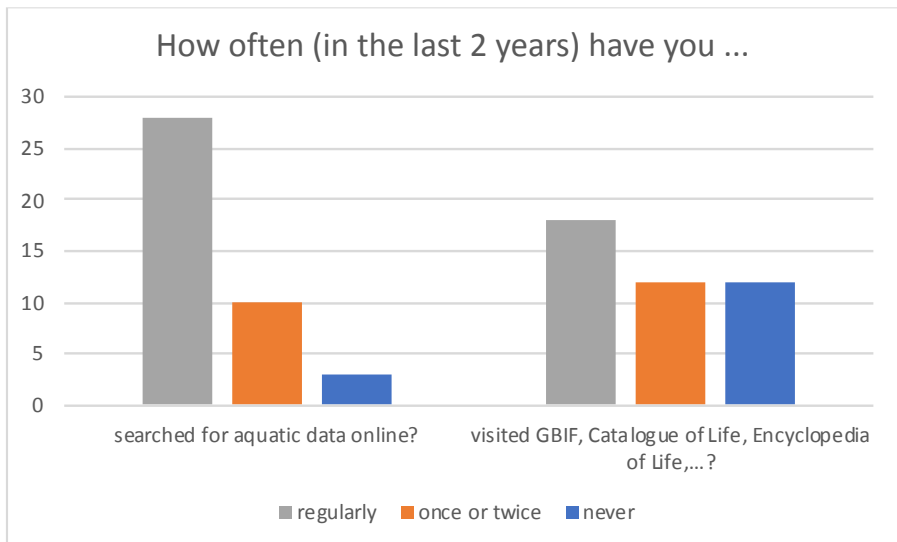
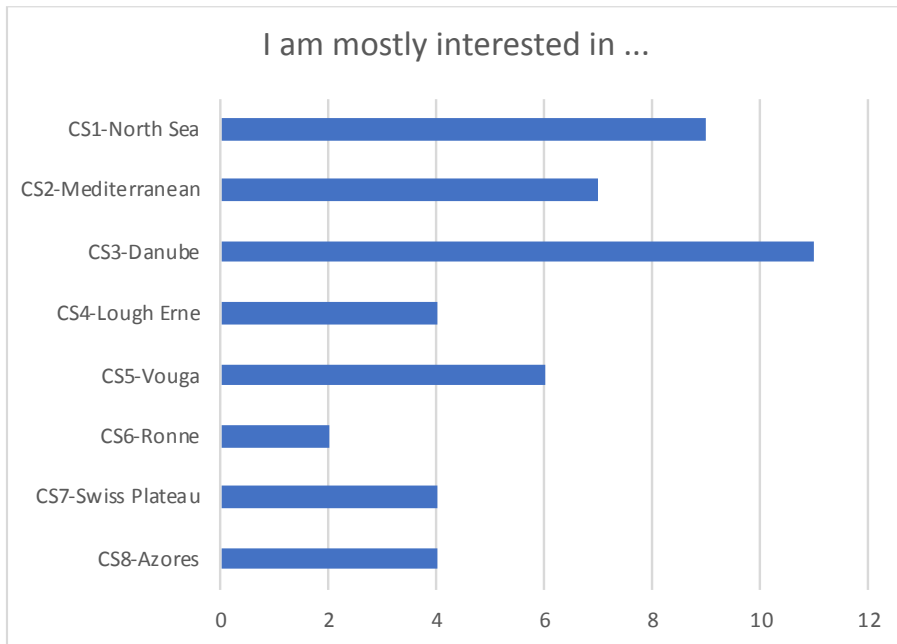
Survey conducted during partner meeting in Vienna, September 2017

8.1.1 Respondents

Responses received: 42

Distribution over partners (deduced from respondent names): ACTeon (2); BC3 (1); BOKU (5); DDNI (3); EAWAG (4); ECOLOGIC (5); IGB (2); IMDEA (2); IUCN (1); RBINS (2); SRC (1); UAVR (4); UCC (2); ULIV (1); UNESCO (3); unknown (1); WUR (3).





8.1.2 What would make you visit such a web portal (e.g. news, attractiveness, pictures, data, maps,...)?

Categorisation of responses in order of popularity:

- data (28)
- maps (13)
- attractiveness (5)
- statistics/graphs (3)
- pictures (3)
- ease of use (3)
- up-to-dateness (3)
- metadata (2)
- news (2)
- useful data formats (2)
- search functionality (2)
- species info/data
- occurrences
- environmental variables
- tools
- download options (e.g. bulk)

Selected answers:

- Has "everything" I need in one place.
- data & analysis

8.1.3 What would make visiting the AQUACROSS Information Platform worthwhile (in comparison to those other portals)?

Categorisation of responses in order of popularity:

- containing relevant data/info (e.g. for case study work) (19)
- ease of use (7)
- clear mission/niche (4)
- storytelling (2)
- structure/organisation (2)
- download options (e.g. bulk) (2)
- data to repeat analyses
- active platform
- ready-to use products (e.g. maps)

Selected answers:

- Not too much, because it contains information about very specific regions spread across Europe. Information should better be provided in more complete information platforms (at the country or European level). In my view, this platform is only useful for collaboration among case studies in AQUACROSS.
- raw data
- the multidisciplinary content/perspective

- A single entry point for data relevant for EBM application and the management of aquatic biodiversity.
- If it was easier to use and if it compiled everything available for the area I'd be interested in.
- social-ecological aspects, information about management

8.1.4 What did you expect to find on the AQUACROSS Information Platform?

Categorisation of responses in order of popularity:

- project/case study data (23)
- biological & environmental data (6)
- metadata (3)
- articles
- scripts

Selected answers:

- more "real" data to work with
- some initial "statement" or presentation of main goal and purpose of the platform on the intro "page"
- more narrative
- a linkage between data uploaded and the CS
- CS specific data, linkages to ALL relevant databases
- The purpose of the platform itself.

8.1.5 How did the Information Platform compare to your expectations? What would you improve? And, would it make you visit the Information Platform more often?

Appreciation in free-form responses:

- Positive (10)
- Room for improvement (18)

Selected suggestions:

- organise datasets according to workpackages
- internally within project – mail alert when new data is uploaded
- externally – we need some tweets probably to announce it; and a newsletter explaining it
- better structuring where to find what; i.e. data compared to background info
- clearer search functionality
- datasets need to be associated to more institutes if they were produced by more than one institute
- clear mission statement on the first site
- linking from AQUACROSS webpage
- Raw data was limited, surprised to see links to very common and public websites like fishbase.org. I would not go to the AQUACROSS platform to look for links to those types of websites.

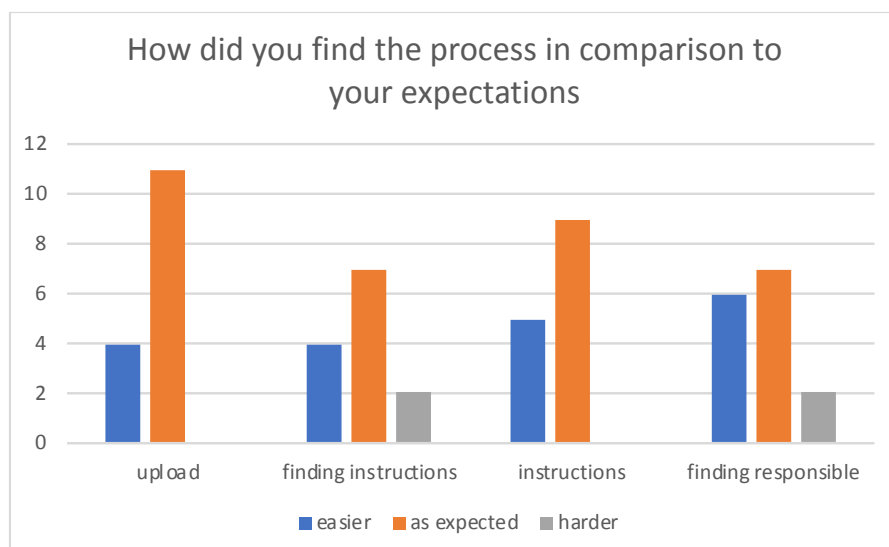
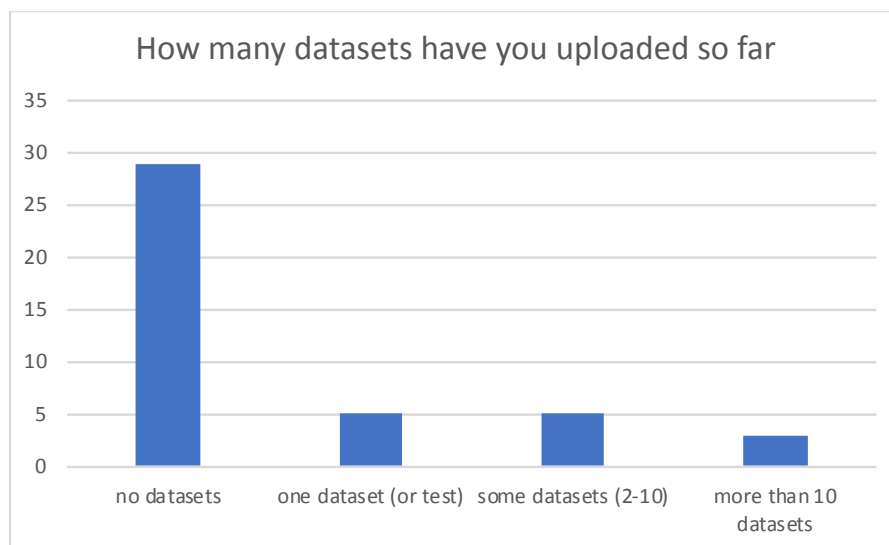
8.1.6 Which data, results and/or documents could you contribute to improve the Information Platform?

All answers:

- novel information, clear messages
- pdfs, data
- result plots of species distribution models (maps) as appendix to publications
- Possibly more useful would be AQUACROSS Case Study results: publications, successful application of the EBM principle etc.
- As I am not the data owner, I am not allowed to contribute the raw data, but "only" the results (i.e. maps).
- we provide the links to the data used in our case study + pictures etc.
- both data, publications, pictures of invertebrates etc.
- generic data used for ecosystem services
- mainly data from the case study – Mediterranean
- We try to provide our data, but are in most cases constrained by the access limitations of our data providers. We thus can only provide the links to these data sources. We will, however, provide our results.
- aggregated fish and benthic (raw data is publicly available), fisheries (raw data protected by privacy laws) data for the North Sea
- data on species distribution, documents with environment-related information
- spatial datasets, policy documents, reports, scripts for data processing, tools and models
- Azores data will be added soon!
- organize type of outputs/data on the platform per type or broader categories in first "page" highlighting AQ delivered products (probably more meaningful once the results (models; papers; databases; linkages etc. start to be realised in this last year of project).
- Mostly papers
- Policy docs?
- maps; news; pictures
- story maps?
- "links to Swedish data sources (but not sure how much this is worth to others due to Swedish metadata)
- stakeholder workshop material (planned exercise)
- Perhaps some WP8 information once it is more advanced.
- data, results from WP & CS work
- maps involving the CS displaying spatial information on policies applicable realms etc.
- I am expected to make some uploads in relation with WP2 and drivers and economic activities at the EU level.
- IOC's publications and databases related to biodiversity, global ocean observation system et al.

8.1.7 Data upload to the Information Platform

Number of respondents that uploaded data: 13



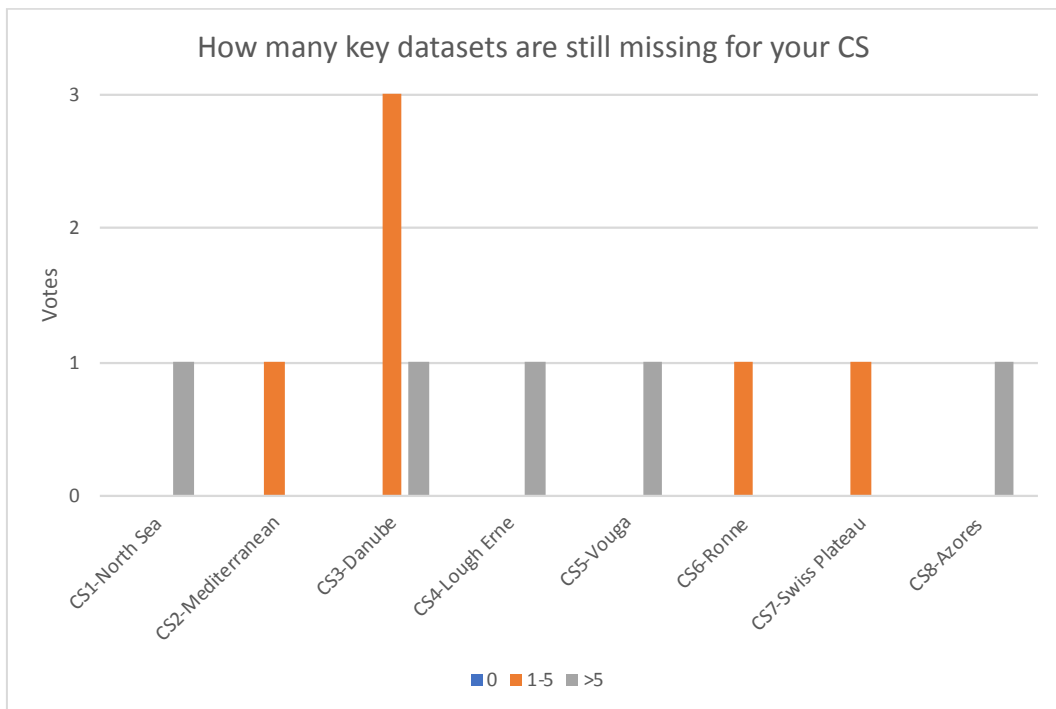
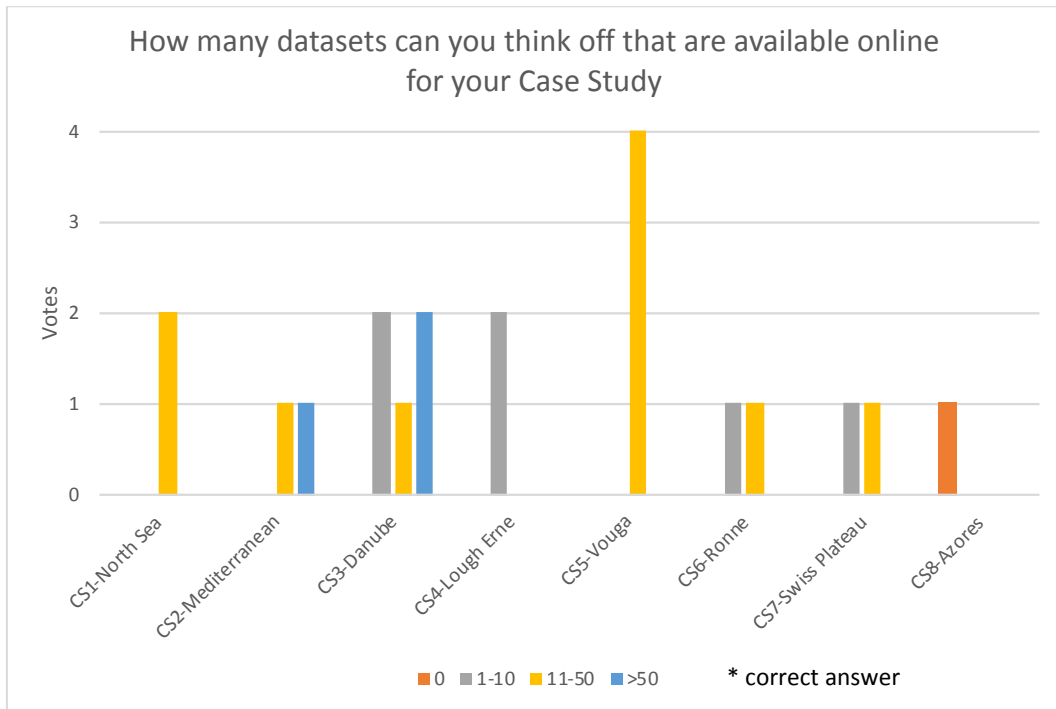
8.1.8 What could be improved to facilitate the upload of data? What support would seem useful to you?

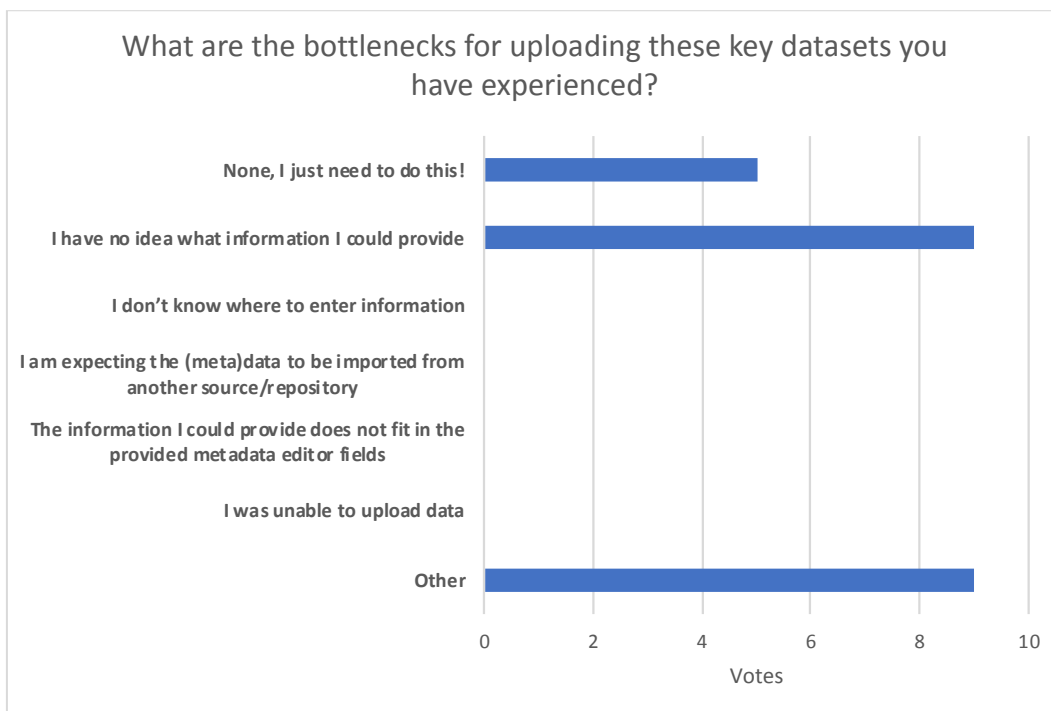
All answers:

- More information on the different open-access policies (to avoid any potential issues later on).
- short guides (as in the manuals) directly displayed after logging in; or more visible
- Maybe online tutorials with demo video.
- It is ok. I just had a problem associating our data with the case study due to a restriction in my user rights. But this was very kindly resolved.
- Well described reasoning for uploading data and for what purpose the data will be used.
- the organisation of webinars or dedicated sessions for training users

- 1) If datasets are similar there could be a button to duplicate metadata as a template, the user could edit duplicate, instead of writing full metadata again.
- 2) support 2 metadata profiles: spatial and non-spatial
- 3) Metadata according to ISO19115 & INSPIRE is extensible. AQUACROSS metadata editor is a simple editor. (e.g. at moment only one organisation may be documented as, for example, owning the dataset. In reality, a number of organisations may own or be the origin of data. In this example the metadata editor would need to support multiple organisation fields for metadata entry).
- 4) Multi lingual support.
- 5) Clean strategy concerning data duplication issues, encourage harvesting metadata where possible & enable to better harvest results.
- Instructions should be clearer/more visible on how to link a document to a workpackage.
- Our experience has been mostly positive.
- Pop up boxes of instructions and examples for each field. And a more detailed guide document.
- The process cannot be more simple, we would need to find the way to encourage partners and stakeholders to upload data and information.

8.2 Annex B: Survey results from CS meeting





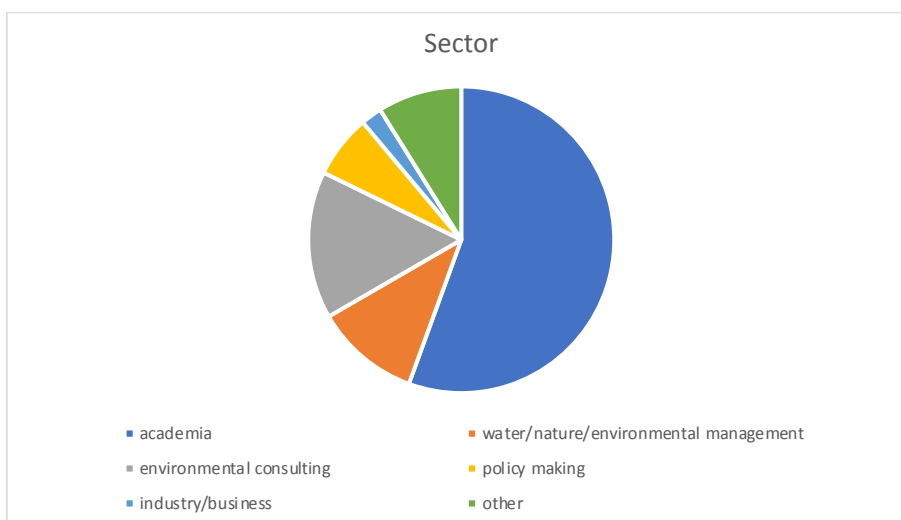
8.3 Annex C: Summary of online AQUACROSS IP survey results

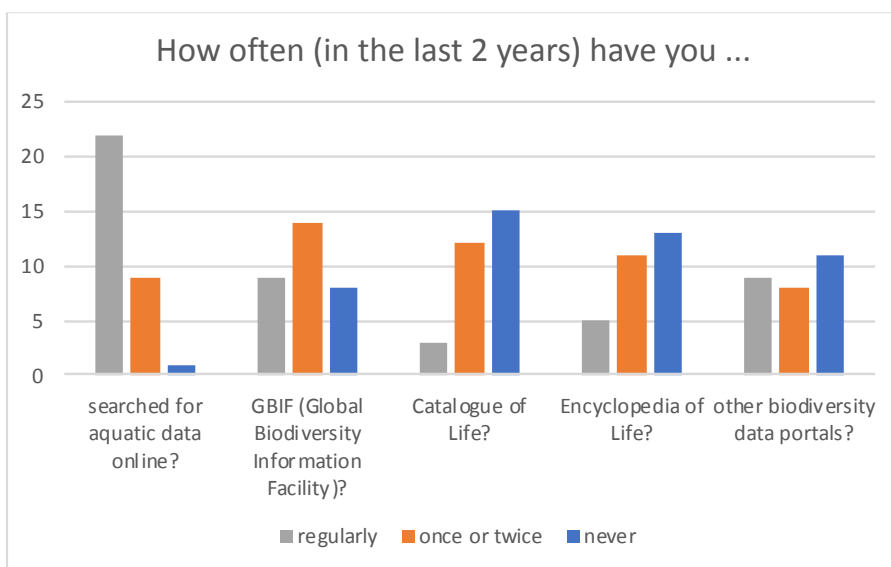
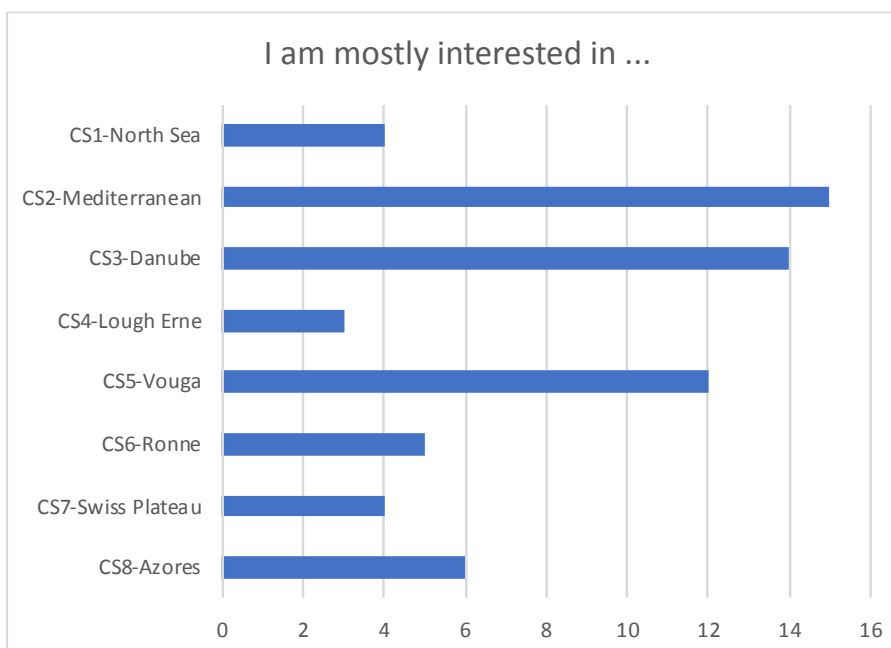
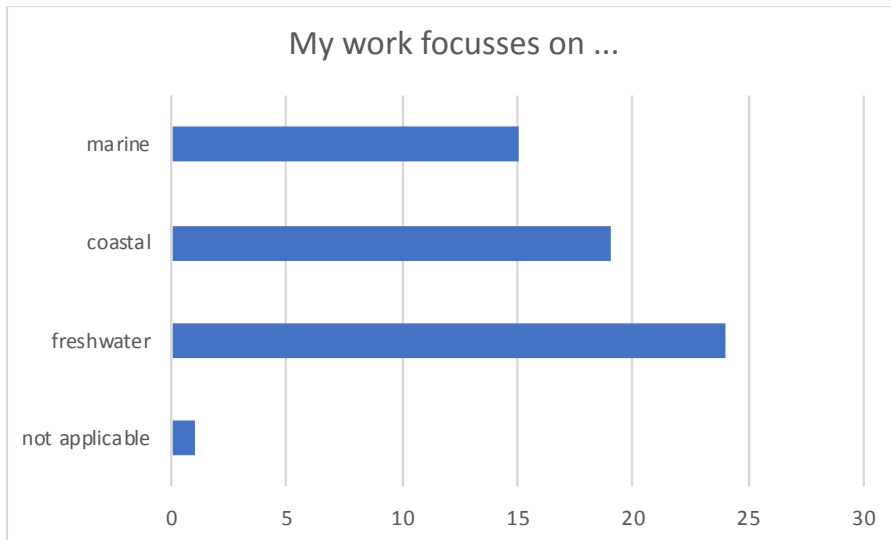
Survey conducted online in July–September 2018

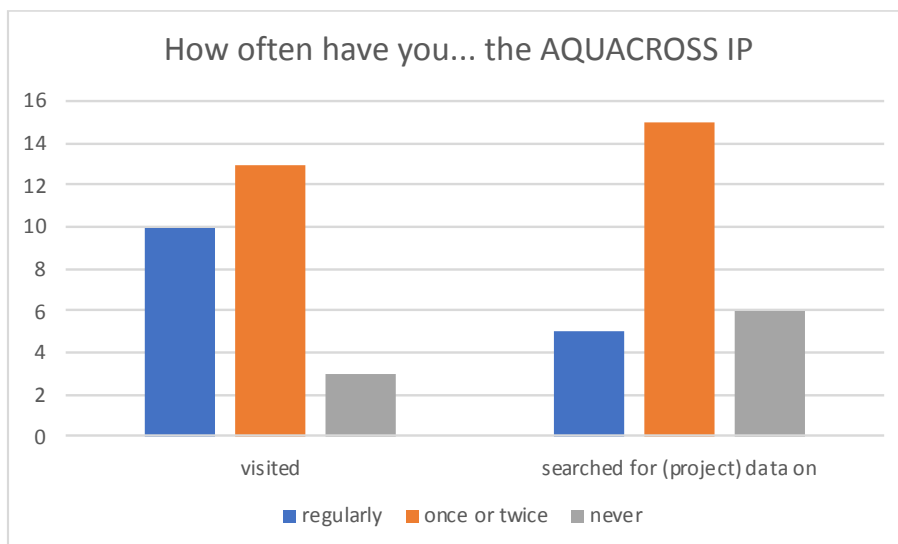
8.3.1 Respondents

Responses received: 42; 23 project partners, 19 external (stakeholder, project advisor, other)

Distribution over partners (deduced from respondent names): BC3 (1); BOKU (2); EAWAG (2); ECOLOGIC (3); IGB (1); IMDEA (3); IOC–UNESCO (3); SRC (1); UAveiro (3); UCC (1); unknown (3).







8.3.2 What would make you visit such a web portal (e.g. news, attractiveness, pictures, data, maps,...)?

Categorisation of responses in order of popularity:

- data/information (general) (24)
- maps (11)
- pictures/media (6)
- news (6)
- attractiveness (3)
- structured information (3)
- download options (e.g. bulk) (3)
- metadata (2)
- species info/data (2)
- scientific papers (2)
- ease of use (2)
- statistics/graphs (1)
- interactiveness (1)
- methodology (1)
- visualisation (of data) (1)

Selected answers:

- Interactivity of the portal and cross-information on different areas (from scientific data to scientific papers and media information).
- relevance to work; regularly updated data; ease of use (e.g. bulk downloads); attractiveness
- The quality and the format of the data and information provided.
- Accessible data (not only metadata) and the related output (figure) linked to from scientific publications.

8.3.3 What would make visiting the AQUACROSS Information Platform worthwhile (in comparison to those other portals)?

Categorisation of responses in order of popularity:

- containing relevant data/info (e.g. for case study work) (4)
- ease of use (4)
- focus on aquatic data/specificity (2)
- GIS data
- methodology
- models
- publications
- download options
- presentation/synthesis of data

Selected answers:

- New information, (new methodologies to analyze the information), models, etc.
- datasets not available anywhere else
- The publication of data and resources, additional information as the related publications, and the option to choose the file preferred formats.
- The fact that it is specifically focused on aquatic ecosystems and has a good amount of processed and raw data available on this topic specifically.

8.3.4 What did you expect to find on the AQUACROSS Information Platform?

Categorisation of responses in order of popularity:

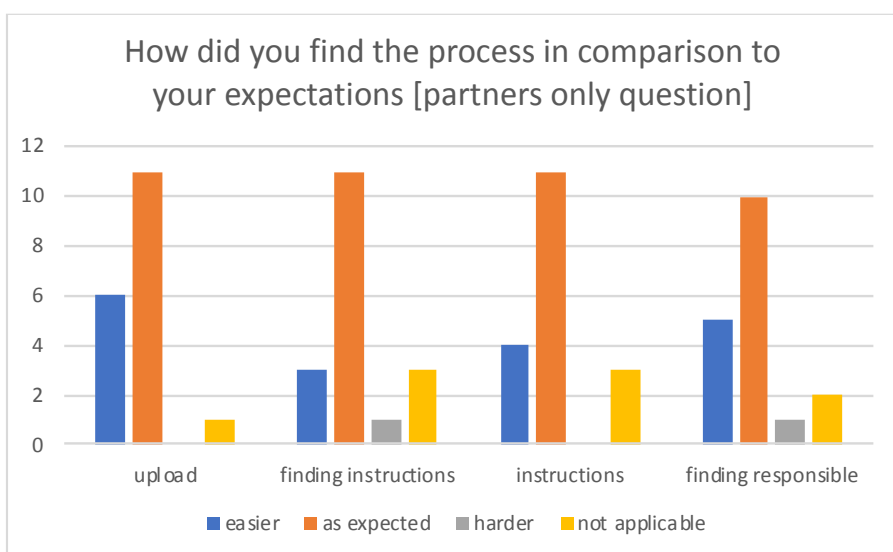
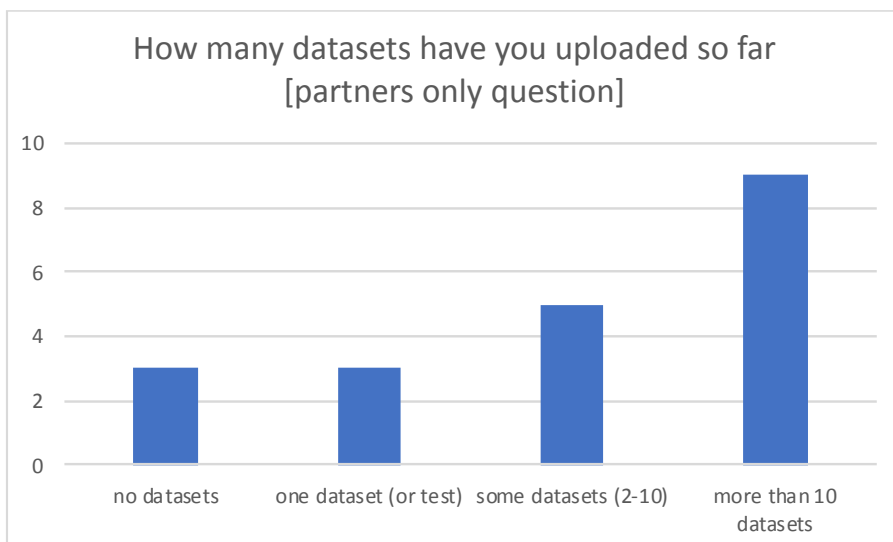
- project/case study data (11)
- results/conclusions/synthesis/applications (4)
- maps
- articles
- GIS-search

Selected answers:

- Conclusions referred to the case studies; application to similar areas
- [online data monitoring]
- Educational and informative materials and updates on the topics covered on the AQUACROSS Information Platform
- Results of the project: namely spatial and non-spatial data, technical reports and reference bibliography used in the Case Studies;

8.3.5 Data upload to the Information Platform

Number of respondents that uploaded data: 17



8.3.6 How did the Information Platform compare to your expectations? What would you improve? And, would it make you visit the Information Platform more often?

All answers:

- Having a news service that will notify of new contents.
- It is good. I improve Geographical information, viewers.
- I did not check in detail.
- Not entirely sure how many of these data portals we will need. Wouldn't it be a strategy to join forces?
- information on habitat conservation status
- It is very easy to use and a very attractive portal.
- It mostly met my expectations. An interactive map with placed datasets would improve the user experience.
- I would expect more data or links to reference data repositories; In our case we are currently uploading the CS's data together with the STOTEN manuscript

publication; therefore I believe that the IP will be enriched with the Cs data once the manuscripts are published.

- I will not visit the platform any more after termination of the project, as we have better access to data directly from the national authorities or international organizations or project partners.
- It would be good to have a more dynamic spatial data viewer.
- The Information Platform reached the expectation in a positive way. For me it's fine as it is.
- The setup looks and the usability seems quite professional so far, however, in our case study we are not used to and do not have the goal to interact more with data platforms.
- The fact that the data is limited to 8 case studies will probably limit the interest in visiting the platform. However, I do not see how this can be mended.
- the possibility of uploading georeferenced rasters/vectors and visualize them
- Que hubiera algún caso de estudio para el continente americano específicamente en México, aunque se que esta acotado a la Unión Europea

Further comments (all answers)

- In general, the platform integrates the contents that one expects to find as results of a Project. Perhaps it would include (I may not have seen it), more information on how to contact the experts involved in the project.
- If it will be continued as a separate platform, it needs to be clear how new information / data sets will be added. Otherwise there is the danger that it will soon be "aged".
- Star for later
- Data should be provided by long-term, national or international organizations as otherwise spatial and contextual coverage, coherency, maintenance, etc. cannot be guaranteed. The AQUACROSS Information Platform is nicely made, but in my view not very useful for these reasons (poor spatial coverage [artificial regions in Europe], no long-term maintenance possible, incoherent data sets, a lot of missing data due to missing rights to publish the data, etc.).
- It's a useful platform and a good way to be updated of all cases of study.
- Great job done with the IP for those who need it!
- Could the platform serve as a data repository for the articles published in the STOTEN special issue? This may help get some visitors through that channel.
- Expandir el estudio a América

AQUACROSS PARTNERS

| | |
|--|---|
| Ecologic Institute (ECOLOGIC) Germany | University of Liverpool (ULIV) United Kingdom |
| Leibniz Institute of Freshwater Ecology and Inland Fisheries (FVB-IGB) Germany | University College Cork, National University of Ireland (UCC) Ireland |
| Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (IOC-UNESCO) France | Royal Belgian Institute of Natural Sciences (RBINS) Belgium |
| Wageningen Marine Research (WMR) Netherlands | Stockholm University, Stockholm Resilience Centre (SU-SRC) Sweden |
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| Universidade de Aveiro (UAVR) Portugal | International Union for Conservation of Nature (IUCN) Belgium |
| ACTeon – Innovation, Policy, Environment (ACTeon) France | BC3 Basque Centre for Climate Change (BC3) Spain |

| | |
|--------------|--|
| Contact | aquacross@ecologic.eu |
| Coordinator | Dr. Manuel Lago, Ecologic Institute |
| Duration | 1 June 2015 to 30 November 2018 |
| Website | http://aquacross.eu/ |
| Twitter | @AquaBiodiv |
| LinkedIn | www.linkedin.com/groups/AQUACROSS-8355424/about |
| ResearchGate | https://goo.gl/lcdtZC |