«A holistic view of the catchment area is needed»

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Topics: Ecosystems

On 15 September, after a two-year hiatus due to the pandemic, an Eawag Info Day will be held once again, dedicated to new technologies for monitoring surface waters. Physicist Damien Bouffard, Head of the Aquatic Physics Group at Eawag, was involved in its conception and explains in an interview what new opportunities and challenges these technologies bring.

Mr Bouffard, you were instrumental in the conception of the Info Day “Dynamic Waters: New Tools, New Opportunities” at Eawag. Why is this symposium necessary?

The technologies and tools for recording and analysing water bodies are constantly evolving, and in some cases very rapidly. They enable specialists from different fields, whether from research or the private sector, to study the dynamics of surface waters and find solutions for the conservation of water resources – one of the major challenges facing society. One of the objectives of the Info Day is to bring these specialists together to discuss the current state of the developments and exchange experiences. At the Info Day, we also want to discuss how these new tools can be used in lakes and rivers as well as in urban areas to support a holistic approach at the level of the water catchment area.

You worked together for a long time with Alfred Johny Wüest. Prof. Dr Wüest, who worked in the Eawag Directorate until his retirement, created this Info Day together with you. What have you taken away from this collaboration?

Previous generations have already addressed similar research questions, and we often pursue the same objectives as they did. We are continuing their research, but now have new technologies and tools to help us better understand the complexity of environmental systems. It is important to understand the achievements of the past and build on them to make progress and not to “reinvent the

wheel". I am mainly occupied with lakes. Today, thanks to new technologies, I can easily collaborate with specialists in urban waters, rivers, glaciers, etc., in order to understand certain developments in lakes. Lakes are not isolated, but are nodes in water catchment areas, and they are, to a certain extent, collectors of information. New technologies now enable us to quickly propose innovative solutions to socially important problems. Tracking viruses in wastewater during the Covid-19 pandemic is an example of what new technologies can do.

The catchment area of lakes is often many times larger than the water surface. The image shows the catchment area of Lake Geneva.
(Image: www.bgbphenology.com)

The Info Day focuses on methods for monitoring and managing surface waters at the level of the catchment area. Where are the greatest challenges for research and practice?

A holistic view of the catchment area is needed to understand its development and assess the consequences of local changes. However, this management at the level of the catchment area is complicated. This is because data from different disciplines such as hydrology, glaciology, biology, chemistry or physics must be linked, evaluated and interpreted. And different measurement methods are needed, such as remote sensing, drones, analytical methods and on-site observations. It is therefore crucial to have specialists from the various disciplines who collect and analyse the important data. It is equally crucial that these specialists communicate and interact with each other to get the whole picture and, where possible, propose sustainable solutions that take into account the complexity of the system. The results must therefore be exchanged, and this requires free access to data and models. Only in this way can water catchment areas be studied as a whole. For this reason, open science projects like "Datalakes" are important.

Such open science projects are relatively new in research. Can you describe how the "Datalakes" platform works?

The objective of the platform is to enable the exchange and use of data. "Datalakes" is based on the visualisation of data and works well because numerous researchers feed in their data and use it freely. As a user, I first look at the data I need for my research. For example, if I am a lake researcher interested in the chlorophyll content of a particular lake, I can download the relevant data and use it freely. I also have access to other data such as weather or current data and can thus try to put my observations into context. The big advantage is that I don't have to collect and prepare all the data myself. The raw data is processed by small programs and converted into so-called products that can be used directly by every user. The programs

are also freely available and are continuously reviewed and developed by the community. The users thus benefit from each other's knowledge and results, and this in many different disciplines.

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The variety of methods and techniques available to research is remarkable. How do you assess their development over the past ten years?

Most of the methods were still in their infancy ten years ago and could not yet be applied as standard. Looking back, it is impressive to see how quickly they have developed in this relatively short time. Take satellite data for example: satellite imagery has been around for a long time, but its spatial and temporal resolution was low until a few years ago. We used to be able to take a measurement about every fortnight, buy now we take measurements every day and evaluate the images almost in real time. Today, for example, it is possible to follow in real time how blue-green algae blooms in Lake Geneva develop within just a few days. We can then link these images to the water parameters that we measure hourly on the "LéXPLORE" research platform.

You have described many new opportunities that have arisen as a result of technical developments. Isn't there a danger of not being able to see the wood for the trees?

There is a real danger of losing sight of the objective when discussing the new tools and technologies. Collecting and analysing data should not be an end in itself, but should help us answer scientific questions and solve socially relevant problems. After all, our objective is to improve the understanding of systems and processes of surface waters in order to improve water management in the water catchment areas. For this reason, our common questions and objectives will be the focus of the Info Day

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What are the important questions for you in terms of system and process understanding or the management of surface waters?

We only have poor insight into processes that take place downstream of a catchment area – i.e. from glaciers to flowing water to lakes, groundwater and urban bodies of water. This makes it difficult to understand how changes in the catchment area affect the various subsystems, for example lakes or groundwater. I see a second gap at the temporal level. For monitoring surface waters at the level of the catchment area, we need on the one hand to carry out long-term observations in order to record long-term developments. On the other hand, we need to follow and understand short-term developments. For individual subsystems, we already have better possibilities today, as the example of blue-green algae shows. However, this does not apply to all systems in a catchment area. So what we need are long-term measurements with a very high temporal resolution, which is very costly and challenging.

What challenges do you face as a researcher?

On the one hand, we need to be able to capture, analyse and secure very large amounts of data. On the “LéXPLORE” research platform on Lake Geneva, we have succeeded in technically solving this problem with the “Datalakes” project. What still need to be solved is the question of how to maintain cooperation between experts from different disciplines over long periods of time. Our research is typically based on projects that are ongoing for over three to four years. However, developing interdisciplinary cooperation is time-consuming and only effective over a longer period of time. The ten-year research platform “LéXPLORE” enables us to go one step further here and create new synergies. Without the broad financial support of the universities and research institutes involved in “LéXPLORE”, it would have been impossible to plan the studies on the platform over a period of ten years.

Would you venture a look into the future? Which questions and problems can be answered or solved based on the expected methodological developments in the next five to ten years?

Of course, I cannot look into the future, but I hope that in the next few years it will be possible to obtain an integrated overall view of water dynamics in water catchment areas. Because – to put it bluntly – the boundaries between subsystems such as lakes, rivers or groundwater hardly matter for environmental systems. In addition, biological, chemical and physical processes, which influence each other, run simultaneously. For this reason, the boundaries between disciplines are meaningless for understanding the whole water catchment area. My second hope is that we succeed in integrating the social dimension and the “human factor” into our analyses and understanding of the processes. This social science perspective is necessary to better understand how humans influence systems and which solutions work and are sustainable in the long term. This is an urgent but particularly demanding challenge.

Cover picture: Damien Bouffard (Photo: Christian Dinkel)

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Eawag’s Info Day

Eawag's Info Day is devoted once a year to a current research topic. The event is aimed at anyone who is interested in the subject, and particularly experts working in the field in focus. The topic of this year's Info Day on 15 September is «Dynamic Waters: New Tools, New Opportunities».
More information and registration

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