

Platform LÉXPLORE

Annual report from July 2023 to June 2024



LÉXPLORE platform ©Natacha Tofield-Pasche, July 2023

Summary

The reporting period was dedicated to plan the future of LÉXPLORE beyond 2026. To steer in this direction, Damien Bouffard was nominated president of the Steering Committee (SC). The SC has produced a vision document for LÉXPLORE 2027-2037, that was submitted to the partner institutions end June 2024. In parallel, the Limnology Center has prepared the documents to officially start the procedures to renew the authorisation for another 10 years with the Canton of Vaud.

Twenty-four projects were active on LÉXPLORE during this period. Similar to the other years, the platform was used 51% of the working days. Seven interventions in the media took place in January to March 2024, concerning the impacts of climate change and the absence of complete mixing this year. Over 180 participants participated in the public visits.

1. Activities from the LÉXPLORE Steering Committee

The Steering Committee (SC) and the project manager held three meetings on 25th March 2023, 30th April 2024 and 25th May 2024. A special meeting was organized on 26th February 2024 together with the deans or directors of the five partner institutions. The institutions decided to nominate Damien Bouffard as president of the SC, and have agreed on a timeline to evaluate the potential 10-year extension of LÉXPLORE.

In June 2024, the SC has submitted a vision document for LÉXPLORE beyond 2026, highlighting its importance, hosting 197 researchers, and resulting in 27 peer-reviewed publications and 11 successful SNSF projects. The platform fosters interdisciplinary collaboration, and has developed the data pipeline Datalakes setting international standards. LÉXPLORE facilitates frequent and accurate

measurements in all weather conditions, enhancing our understanding of the lake's ecological processes. LÉXPLORE also enhances education and has become a successful tool for outreach. Looking ahead, the platform aims to expand its research capacities for precision sampling and continue to address environmental challenges.

2. Activities from the Limnology Center

For the extension of LÉXPLORE, Natacha Tofield-Pasche participated in the creation of the vision document. In parallel, she has prepared the official documentation for the public inquiry, to extend the concession for LÉXPLORE until December 2037. The Limnology Center (LIMNC) has continued to manage the day-to-day operations of LÉXPLORE as usual. Since 2024, Guillaume Cunillera has become the Chief Technical Officer (CTO), Jérémy Keller is the new technician, and Laurence Glass-Haller is the new administrative and scientific assistant.

The LIMNC team is also managing the reparations, when large damages occur. During the reporting period, the cables of buoys B1 and B9 broke in October 2023 and in January 2024, respectively. As a result, the wave buoy had to be moved between B3 and B4. The buoys B2, B3, B4, B6, B7 and B8 were inspected in January 2024. The LIMNC technicians completed all the reparations on the perimeter by April 2024. Since then, all buoys are secured with Dyneema cables, which facilitated the installation of heavy equipment for the LACTEL and CARBOLEX projects.

As the CTO, Guillaume Cunillera is leading the Technical Pool, who is composed of six technicians from the partner institutions. Given their larger working percentage, the LIMNC technicians are managing most technical activities and troubleshooting. They are also organising the monthly maintenances.

3. Activities from the LÉXPLORE Technical Pool

The six technicians from the Technical Pool meet once a month to perform 2 days of maintenance for the core dataset, with an additional day for the maintenance of the infrastructure every two months.

The Technical Pool has continued to improve the core dataset's quality by performing more frequent cleanings and calibrations. The maintenance and calibration procedures were updated and, include a cross-calibration of Thetis, both Sea and Sun sondes, and both Idronaut sondes every six months, as well as an annual factory calibration.

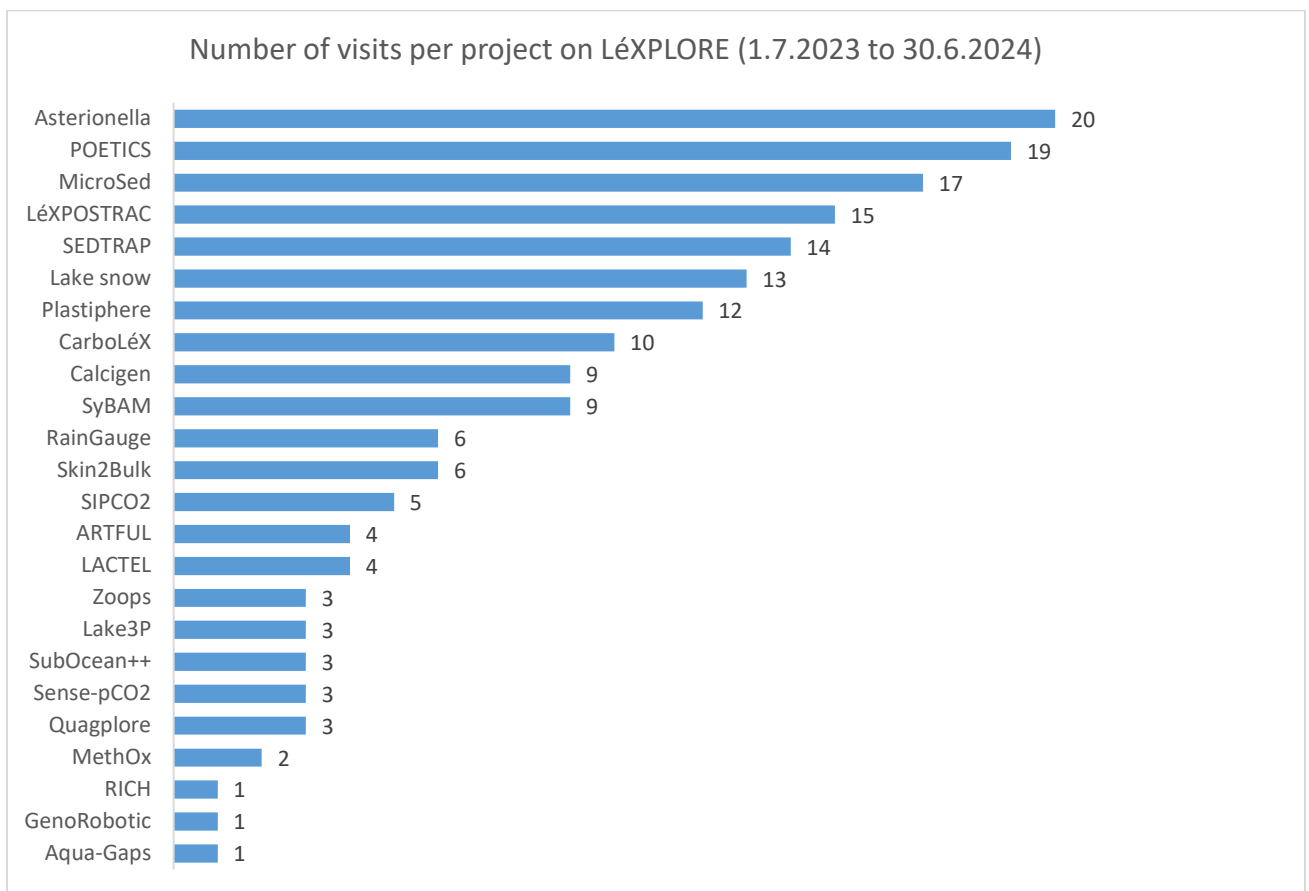
The duplications of the multiparameter probes (Sea and Sun & Idronaut) allow for a rotation during calibrations, when one instrument is sent for calibration, the other remains in use. One of the Idronaut probes was sent for calibration in April 2024. For the Thetis profiler, the ECO triplets and HOCR sensors underwent calibrations between October and November 2023. These sensors were reinstalled and became operational in January 2024. The Thetis profiler was operating with a single battery instead of two, reducing its profiling capacity from four to two profiles per day. A new Turner Designs C-Fluor sensor was acquired, so that both Idronaut probes are now equipped with a sensor to measure chlorophyll-a concentrations.

In addition, a second meteorological station was installed between February and March 2024, allowing the original station to be sent for factory calibration without disrupting data collection. The technical

team is now using detailed metadata from the core dataset to identify significant events directly on the DATALAKES website. In conclusion, all instruments in the core dataset have been calibrated this year, leading to an improved data quality.

3. LÉXPLORE usage

To monitor the use of LÉXPLORE, each team leader recorded their visits in the logbook. From 1st July 2023 to 30th June 2024, the platform was visited 307 times: 183 times for the projects, 87 times for technical operations, and 37 times to fulfil special requests. The special requests comprised: 6 for the media, 15 visits, 7 teaching activities, and 9 others occasions (equipment test, punctual sampling, and a citizen project). The technical team worked 51% on the core dataset, 31% on the infrastructure, and 18% on the safety perimeter. Similar to the previous year, the platform was used during 127 days in total, which represents 51% of the working days. The number of visits per project were distributed as shown in the following graph.



3. Scientific Projects

During the reporting period, a total of 24 projects have been active on LÉXPLORE. A [detailed scientific report](#) outlines the results of the projects every year. The list of active projects are presented below with their titles, collaborators, and funding source.

1. Florybeth La Valle, Aaron Strong, Julian Jacobs: **Quantification of Lake Geneva biological metabolism and validation of novel pCO₂ sensor system (SIPCO₂)**. Lab internal funding.

2. Jérôme Chappellaz, Sébastien Lavanchy: **Tests and improvements of the SubOcean probe (SubOcean++)**. Lab internal funding.
3. Alexandre Tellier, Sébastien Lavanchy, Jérôme Chappellaz: **Design and construction of a probe for continuous monitoring of dissolved CO₂ in seawater from a sailboat or a small ship (Sense-pCO₂)**. Lab internal funding.
4. Pierre Rossi, Emmy Oppliger: **Quantification of Quagga mussels within the EPFL water cooling system (Quagplore)**. EPFL-VPO.
5. Lisa Morales, Matteo Gios, Bastiaan Ibelings: **Asterionella chytrids (Asterionella)**. SNSF.
6. Helmut Bürgmann, Damien Bouffard, Sasikaladevi Rathinavelu: **Antimicrobial Resistance Tracking and Fate modeling in the Urban flows – Lake interface (ARTFUL)**. SNSF.
7. Santona Khatun, Jasmin Berg, Marie-Elodie Perga: **Measurement of methane oxidation rate to understand the greenhouse gas emission from Lake Geneva (MethOx)**. Lab internal funding.
8. Nicolas Escoffier, Jérémy Keller, Santona Khatun, Isabel Herr, Marie-Elodie Perga: **Calcite precipitation dynamics in Lake Geneva (Calcigen)**. Lab internal funding.
9. Natacha Tofield-Pasche, Marc-Antoine Courtois, Louise Noël du Payrat, Guillaume Cunillera: **Dynamics of the settling particulate matter in Lake Geneva (Lake Snow)**. ENAC call for equipment and Lab internal funding.
10. Neronov Andrii, Kneib Jean-Paul, Shutska Lesya, Bernard Florian, Lesrel Jean, Haefeli Guido: **LAC TELEscope (LACTEL)**. Lab internal funding.
11. Didier Jézéquel, Paris Jean-Daniel, Lozano Mathis, Ruffine Livio, Fandino-Torres Olivia, Grilli Roberto, Chappellaz Jérôme, Mettra François, Perga Marie-Elodie, Berg Jasmine, Khatun Santona: **High-frequency monitoring of CO₂ and CH₄ fluxes at LÉXPLORE station by combining different methods (CarboLÉX)**. PEPR Carbonium.
12. Breider Florian, Hanahan Jonathan, Vernez Karine, Coudret Sylvain, Loizeau Jean-Luc: **Deposition and Accumulation of Microplastics in Lake Sediments (Microsed)**. Limnology Center then Lab internal funding.
13. Ibelings Bastiaan, Thomas Mridul, Fillion Roxane, Matteo Gios, MUSE-Master students: **Plankton vErTICal Structure (POETICS)**. Lab internal funding.
14. Bouffard Damien, Bieito Fernandez Castro, Piccolroaz Sebastiano, Michäel Plüss, Sebastien Lavanchy, Wüest Alfred: **Investigating the surface boundary layer (Skin2Bulk)**. Lab internal funding.
15. Adam Nicolas, Selz Jonathan, Lecine Sofian, Hirt Timothée, Deloose Christophe, Bernier-Latmani Rizlan, Maerkl Sebastian: **An automated instrument for water sampling and DNA extraction (GenoRobotics)**. Limnology Center then the EPFL Make Project.
16. Weyermann Céline, Estoppey Nicolas, Pfeiffer Fabienne, Glanzmann Vick, Reymond Naomi, Huisman Sofie: **Aqua-Gabs/MONET in Lake Lemman (Aqua-Gabs)**.
17. Mariethoz Gregoire, Koch Erwan, Berne Alexis: **Installation of a drip-based rain gauge on LÉXPLORE (RainGauge)**. Lab internal funding.
18. Natacha Tofield-Pasche, Guillaume Cunillera, Nathalie Dubois, David Janssen: **Temporal and spatial variations of the settling particles fluxes in Lake Geneva (SEDTRAP)**. Lab internal funding.
19. Odermatt Daniel, Werther Mortimer, Wydler Jonas, Irani Rahaghi Abolfazl, Damm Alexander, Pasche Natacha, Alikas Krista, Soomets Tuuli, Spyrakos Evangelos: **Monitoring Lake Primary Production using the PACE satellite (Lake3P)**. SNSF.

20. Laureen Mori-Bazzano, Bastiaan Willem Ibelings: **Characterization of biofilm formation on different types of plastic substrate (Plastisphere)**. Lab internal funding.
21. Tercier-Waeber Mary-Lou, Ibelings Bastiaan, Layglon Nicolas, Gressard Tanguy: **Synergic interaction between arsenic species and microorganisms in freshwater contrasting dynamic conditions (SyBAM)**. Limnology Center. Completed project.
22. Beauvais Rébecca, Ferrari Benoît, Casado-Martinez Carmen, Rohrbach Emmanuelle: **Tracking ecotoxicological effects of lake suspended particulate matter on the ostracod *Heterocypris incongruens* (LÉXPOSTRAC)**. Limnology Center. Completed project.
23. Jeremy Keller, Jake Vander Zander, Marie-Elodie Perga: **Temporal dynamics of zooplankton (ZOOPS)**. Lab internal funding. Completed project.
24. Dubois Nathalie, Mittelbach Benedict, Eglinton Timothy, White Margot, Rhyner Timo: **Radiocarbon Inventories of Switzerland (RICH)**. SNSF. Completed project.

4. Communication and events

On 24th May 2024, a special event was organised on the platform with members of ASHPA (Association pour la Sauvegarde du Hameau du Port et de ses Abords) and the Club Nautic of Pully. We invited them to present our achievements on LÉXPLORE and to inform about the potential extension of LÉXPLORE for another ten years. The members of the Steering Committee, EPFL ENAC vice-dean joined this event, to emphasize the platform important role in advancing scientific research and in raising awareness to protect Lake Geneva.

The following communication, events and outreach activities took place during the report period:

- 11th March 2024: RTS Couleurs locales, video on LÉXPLORE
- 8th March 2024: Euronews, Lake Geneva is warming at an alarming rate and its delicate ecosystem is under threat
- 3rd March 2024: RFI radio, Réchauffement climatique: le lac Léman se réchauffe 4 à 5 fois plus vite que les océans
- 7th March 2024: on TV France 2, Réchauffement climatique : le lac Léman menacé par des températures élevées
- 21st February 2024: Article on 24heures, Le Léman va mieux que dans les années 80 mais...
- 12th February 2024: RTS, L'analyse de Marie-Elodie Perga, professeure de limnologie à l'UNIL, sur les risques du réchauffement rapide du Léman
- 14th January 2024: Vidéo on RTS news, La météo glaciaire actuelle favorise le brassage des eaux du lac Léman
- 13th November 2023: the **3rd LÉXPLORE workshop** gathered 44 scientists and was an excellent opportunity for networking. As an inspiring keynote speech, Paul Hanson presented the lessons learnt from 18 years of the Global Lake Ecological Observatory Network (GLEON). Four research projects were presented in the plenum, as well as 12 pitches followed by a poster session.
- 12th July 2023: Tamar Kohn portrait on FNS, The insatiable virus hunter
- the LIMNC team also performed seven days of public visits for a total of 186 visitors

In addition, the following educational activities took place:

- 19th March 2024: Visits of 18 Bachelor students from UNIGE

- 14th May 2024: Visits of 12 master students from EPFL
- 16th May 2024: Visits of 11 master students from UNIL
- 17th May 2024: Visits of 11 master students from UNIL

5. Scientific Publications

During the reported period, five publications and three PhD theses were completed.

2024 (3)

Irani Rahaghi A, Odermatt D, Anneville O, Sepúlveda Steiner O, Reiss RS, Amadori M,... & Bouffard, D. (2024). **Combined Earth observations reveal the sequence of conditions leading to a large algal bloom in Lake Geneva.** Communications Earth & Environment, 5(1), 229. doi.org/10.1038/s43247-024-01351-5

Khatun S, Berg JS, Jézéquel D, Moiron M, Escoffier N, Schubert CJ, Bouffard D, Perga M-E, **Long-range transport of littoral methane explains the metalimnetic methane peak in a large lake.** Limnology and Oceanography. doi.org/10.1002/lno.12652

Zhou L, Masset T, Breider F 2024. **Adsorption of copper by naturally and artificially aged polystyrene microplastics and subsequent release in simulated gastrointestinal fluid.** Environ. Sci.: Processes Impacts, 26, 411-420. doi.org/10.1039/D3EM00354J

2023 (2)

Carratalà A, Chappelier C, Selmoni O, Guillaume AS, Chmiel HE, Pasche N, Weil C, Kohn T, Joost S, 2023. **Vertical distribution and seasonal dynamics of planktonic cyanobacteria communities in a water column of deep mesotrophic Lake Geneva.** Front. Microbiol. 14:1295193. <https://doi.org/10.3389/fmicb.2023.1295193>

Zhang H, Haltiner L, Kaeser S, Dennis SR, Rothhaupt K-O, Kraemer BM, Spaak P, 2023. **Veliger density and environmental conditions control quagga mussel colonization rates in two perialpine lakes.** Journal of Great Lakes Research 49:809–820. doi.org/10.1016/j.jglr.2023.05.001

6. Doctoral theses

Dos Santos Correia F, 2023. **Re-oligotrophication and its impacts on phytoplankton and zooplankton of Lake Geneva: an ecological analysis.** PhD Thesis, University of Geneva.

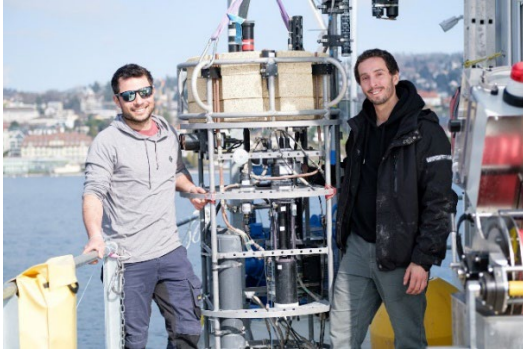
Gupana RS, 2023. **Remote Sensing of Sun-induced Chlorophyll-a Fluorescence in Optically Complex Waters.** PhD Thesis, University of Zurich. www.zora.uzh.ch/id/eprint/253492/

Hamze Ziabari M, 2023. **Quantifying Systematic Lateral Variability of Dissolved Oxygen Induced by Complex (Sub)mesoscale Circulation Interplay in a Large Lake.** In Unraveling submesoscale processes associated with meso- and basin-scale gyres in Lake Geneva. PhD Thesis (Chap 7). EPFL no 10293. www.doi.org/10.5075/epfl-thesis-10293

7. Way Forward

The next steps for LÉXPLORE are the following:

- Optimize the exploitation of LÉXPLORE and its infrastructure.
- Improve the data quality of the core dataset within the DATALAKES Platform
- Present the results on LÉXPLORE in national and international conferences.
- Encourage interdisciplinary exchanges during the LÉXPLORE workshop.
- Promote international scientific collaborations and collaborative projects around LÉXPLORE.
- Encourage the use of LÉXPLORE for summer schools



Images of scientists at work on LèXPLORE



Images of visits on LèXPLORE (up) and the participants of the workshop (down)

