









Platform LéXPLORE

Annual report July 2021 to June 2022



LéXPLORE platform ©Nathalie Racheter, 2021

Summary

During the reporting period, the exploitation of the LéXPLORE platform was further optimized, and a total of 41 scientific projects was reached. This period was disturbed by important damages of the safety perimeter, however only a small fraction of the projects and of the core dataset were affected. Results from projects were presented within the Swiss Geoscience Meeting, and during the 2nd LéXPLORE workshop. Six peered-reviewed papers were also published. The data quality within DATALAKES platform was improved, and higher level products are now available. The communication around LéXPLORE was productive with several articles in the media, and the first public visits took place in June 2022.

1. Administration

The LéXPLORE Steering Committee (SC) held 3 meetings on the following dates: 3rd November 2021, 24th February 2022, 17th March 2022. During these meetings, the SC discussed the diverse technical and scientific activities on LéXPLORE, as well as the preparation of the workshop. The results from three scientific projects were also presented to the SC. In addition, the SC validated 13 project applications.

As five of the nine principal buoys broke in winter 2021/2022, the meeting in February was held in urgency to agree on the strategy to repair the damaged safety perimeter. The SC agreed to participate











in the funding of a study, to understand the causes of the damages and to propose a more durable solution for the entire perimeter.

2. Exploitation

The reported period was still disturbed by the COVID-19 sanitary crisis, but to a lesser extent. The full capacity was only reduced to 10 persons from 20th December 2021, until all the restrictions were removed from the OFSP on 31st March 2022.

As the previous year, the Limnology Center managed the day-to-day exploitation of LéXPLORE. This year, the damaged safety perimeter required an intense workload. Between October 2021 and February 2022, five principal buoys broke one after the other each month. Thus, the EPFL team took multiple urgent measures: several meetings to assess the current situation and the way forward, a call for offer to repair 2 buoys, a call for offer to repair 3 buoys with an improved method, mandate Orlatti company to reinforce the structure at the surface, and negotiate with the insurance for indemnities. After two calls for offer and the evaluation of 7 offers, the study to secure the entire perimeter was attributed to Vincent Becker Ingénieurs SA with the French company ICTP on 10th March 2022. Their final report is expected by mid-July 2022.

The Technical Pool worked in emergency to secure the safety perimeter and the different scientific instruments as the individual buoys broke, and inspected the remaining lines with our ROV. On 28th to 30th April 2022, Sébastien Lavanchy and Guillaume Cunillera managed to attach a dynema line to each of the 5 clamp weights using the ROV. By 4th May 2021, the technical team had re-installed all the surface buoys and managed to repair the whole perimeter. Congratulations!

The technical team also improved the LéXPLORE infrastructure and performed several maintenances of LéXPLORE. The power consumption was optimised, the power supply is now automated and can be operated remotely. A technical office with a computer and several displays directly connected to LéXPLORE was created at EPFL.

The black waters and the diesel are managed entirely by the technical team, which significantly reduced the costs. The overall safety was improved, and a safety training took place with the technical team on 16th November 2021.

Concerning the core dataset, the Thetis profiler was deployed on 3^{rd} March 2022, after a 5 month gap due to the lack of perimeter. Thanks to the pairs of O₂ and PAR sensors, the OxyPAR mooring successfully collected data continuously, except from 2 small gaps in October and November 2021. The O₂ and PAR sensors installed near the surface (0.5 m) had to be repaired at multiple occasions. The Idronaut profiler worked well until 22nd August 2021, when the cable broke and the profiler felt to the bottom. After its successful recovery, reparation and calibration, the Idronaut was reinstalled on 3rd March 2022. On 16th June, a smaller accident with the winch broke the trilux sensor. Thanks to the EPFL-ENAC in 2022, an additional Idronaut will be purchased and will allow more flexibility to provide a continuous dataset. Finally, the wave buoy, purchased through the EPFL-ENAC call 2021, was installed on 7th April 2022 and took continuous records ever since.











For the data management, DATALAKES (<u>www.datalakes-eawag.ch</u>) was further improved with the project REPRODUCE. This project implemented a method to ensure a good quality check for environmental data and added higher level products. Currently, there are 39 datasets available, which include the wave buoy, skin temperature, many new parameters from the Thetis autonomous profiler, and products from satellite images.

To monitor the use of LéXPLORE, each team leader recorded the visits on the logbook. From 1st July 2021 to 30th June 2022, the platform was used at 309 occasions: 175 for the projects, 112 by the technical team, and 23 to fulfil special requests. The special requests comprised: 8 for the media, 9 visits, 4 teaching activities, and 3 others occasions. The technical team worked for 39% on the infrastructure, 30% on the core dataset, 19% on the safety perimeter, and 12% on the safety. Similar to last year, the platform was used during 145 days in total, which represents 56% of the working days. Only one team worked during 38% of these days, while multiple teams (from 2 up to 8 per day) worked in parallel during 61% of the days. The number of visits per project were distributed as shown in the following graph.



3. Scientific Projects

By end June 2022, we had a total of 41 projects: 20 running projects, 6 upcoming projects and 15 completed projects. In addition, two projects are in the validation phase. As next year, a separate scientific report describes the results from all the projects. The list below presents the collaborators and the project title, together with their link to the LéXPLORE website.









Current running projects:

- 1. Perga Marie-Elodie, Perolo Pascal, Lambert Thibault, Escoffier Nicolas, Chmiel Hannah, Fernandez Castro Bieito, Bouffard Damien: <u>CARBOGEN: carbon cycling in Lake Geneva</u>
- 2. Breider Florian, Hanahan Jonathan, Vernez Karine, Coudret Sylvain, Loizeau Jean-Luc: <u>Deposition</u> <u>and Accumulation of Microplastics in Lake Sediments (Microsed)</u>
- 3. Bouffard Damien, Sebastiano Piccolroaz, , Gil Coto Miguel, Lavanchy Sébastien, Cunillera Guillaume, Dinkel Christian, Fernandez Castro Bieito: <u>LéWalk: autonomous turbulence profiling</u>
- 4. Jézéquel Didier, Moiron Marthe, Perga Marie-Elodie, Escoffier Nicolas: <u>DynaMeth Dynamics</u> <u>and origin of methane in the water column of Lake Geneva</u>
- 5. Ibelings Bastiaan, Thomas Mridul, Fillion Roxane, Mesman Jorrit, Devanthery Matthieu, de Loes Sebastien, MUSE-Master students, Müller Beat: **POETICS PlanktOn vErTICal Structure**
- 6. Guillard Jean, Rautureau Clément, Tran-Khac Viet, Goulon Chloé: <u>LéXfish: monitoring fish</u> <u>presence below LéXPLORE</u>
- 7. Bouffard Damien, Bieito Fernandez Castro, Piccolroaz Sebastiano, Michäel Plüss, Sebastien Lavanchy, Wüest Alfred: <u>Skin2Bulk: investigating the surface boundary layer</u>
- 8. Maxime Hedou, Jeremy Luterbacher, Lorenz Manker: **<u>Biodegradability assessment of PBX, a</u>** <u>sustainable bio-polyester developed at EPFL</u>
- 9. Mridul Thomas, Pomati Francesco, Suarez Ena, Fillion Roxane, Ibelings Bastiaan: <u>Plankton in Lake</u> <u>Geneva : you can't have it both ways</u>
- Maner Jenny, Drieschner Carolin, Ebi Christian, Schönenberger René, Angst Levin, Bloem Simon, Solsona Miguel, Renaud Philippe, Schirmer Kristin: <u>Rainbow_{flow} chip_{online}: Fishcell biosensor for</u> <u>automated water quality testing</u>
- 11. Adam Nicolas, Selz Jonathan, Lecine Sofian, Hirt Timothée, Deloose Christophe, Bernier-Latmani Rizlan, Maerkl Sebastian: <u>GenoRobotics CoWaS - Continuous Water Sampling</u>
- 12. Estoppey Nicolas, Pfeiffer Fabienne, Glanzmann Vick, Reymond Naomi, Huismann Sofie, and Weyermann Céline: <u>Aqua-Gabs/MONET in Lake Leman</u>
- 13. Bouffard Damien, Perga Marie-Elodie, Runnalls James, Russo Stefania: <u>REPRODUCE léxploRE</u> <u>PRODUct ACcESs</u>
- 14. Perga Marie-Elodie, Frech Benoit, Vittoz Jérôme, Gravey Mathieu: the sounds of LéXPLORE
- 15. Larivé Odile, Wynn Htet Kyi, Li Chaojie and Tamar Kohn: <u>Effect of lake exposure on Enterovirus</u> <u>population</u>
- 16. Tercier-Waeber Mary-Lou, Ibelings Bastiaan, Layglon Nicolas, Gressard Tanguy: <u>Synergic</u> <u>interaction between arsenic species and microorganisms in freshwater contrasting dynamic</u> <u>conditions (SyBAM)</u>
- 17. Mariethoz Gregoire, Koch Erwan, Berne Alexis: Installation of a drip-based rain gauge on LéXPLORE
- 18. Dubois Nathalie, Mittelbach Benedict, Eglinton Timothy, White Margot, Rhyner Timo: <u>Radiocarbon Inventories of Switzerland (RICH)</u>
- 19. Natacha Tofield-Pasche, Guillaume Cunillera, Nathalie Dubois, David Janssen: <u>Temporal and</u> <u>spatial variations of the settling particles fluxes in Lake Geneva (SEDTRAP)</u>
- 20. Carratalà Anna, Ibelings Bastiaan, Odermatt Daniel, Janssen Elisabeth: <u>Remote sensing and risk</u> <u>assessment of toxic Cyanobacteria in Lake Geneva (CYANOSENSE).</u>











Upcoming (or delayed) projects

- 21. Bellouard Yves, Rey Samuel, Ayer Baptiste, Sala Federico, Ibelings Bastiaan, Pomati Francesco: <u>PhytoWaveTaxa: all glass sensors for algae population monitoring</u>
- 22. Piccolroaz Sebastiano, Cunillera Guillaume, Chmiel Hannah, Perolo Pascal, Lavanchy Sébastien: <u>caGAStrophic: designing a low-cost, automated, floating chamber for gas flux measurements at</u> <u>the air-water interface of water bodies</u>
- 23. Bahr Alexander, Schill Felix, Lavanchy Sébastien and Cunillera Guillaume: <u>SUBMULE easy access</u> to submerged data
- 24. Schuback Nina, Oxborough Kevin, Moore Mark, Ibelings Bastiaan, Odermatt Daniel, Lavanchy Sébastien: <u>Single Turnover Active Fluorescence of Enclosed Samples for Aquatic Primary</u> <u>Productivity (STAFES-APP)</u>
- 25. Odermatt Daniel, Damm Alexander, Pasche Natacha, Alikas Krista, Soomets Tuuli, Spyrakos Evangelos: Monitoring Lake Primary Production using the PACE satellite (Lake3P)
- 26. Bakker Eric, Forrest Tara, Zdrachek Elena, Damala Polyxeni, Cherubini Thomas: <u>Submersible</u> <u>Probe with In-line Calibration and Symmetrical Reference Element for Long-term Continuous</u> <u>Measurement of Environmentally Relevant Ions (Multiple ion)</u>.

Completed projects:

- 27. Joost Stéphane, Carratalà Anna, Charlotte Weil, Vajana Elia, Guillaume Annie, Kohn Tamar: <u>Local</u> <u>adaptation of bacteria communities to environmental conditions (LAC)</u>
- 28. Barry Andrew, Foroughan Mehrshad, Porté-Agel Fernando: <u>Spatio-temporal analysis of wind</u> <u>field characteristics over Lake Geneva</u>
- 29. Müller Beat and Kathriner Patrick: In-situ pursuit of whitening events applying on-site analysis and profiling
- 30. Doda Tomy, Bieito Fernández Castro, Ulloa Hugo, Ramon Casanas Cintia, Damien Bouffard: <u>Buoyancy driven nearshore flows in lakes (HYPOTHESYS, experiments on LéXPLORE)</u>
- 31. Vennemann Torsten, and Cotte Gabriel, Mixing of Rhône River in Lake Geneva
- 32. Piccolroaz Sebastiano, Fernandez Castro Bieito, Alfred Wüest, Chmiel Hannah, Minaudo Camille, Pascal Perolo, Troy Cary: <u>Surface Turbulence and CO₂ Lake Exchange Experiment (CO₂LEX)</u>
- 33. Haltiner Linda, Piet Spaak, Dennis Stuart: Life in the deep: colonisation by Dreissena along a <u>depth gradient</u>
- 34. Lattaud Julie: <u>Variability in stable isotopic composition of long-chain diols as a proxy for</u> <u>environmental conditions in lakes</u>
- 35. Violaine Piton, Wynn Htet Kyi, Barry Andrew, Reiss Rafael: <u>Test measurements for Long-Range</u> <u>ADCP parametrization</u>
- 36. Wüest Johny, Fernandez Castro Bieito, Ulloa Hugo, Minaudo Camille, Lavanchy Sébastien, Shubham Krishna, Piccolroaz Sebastiano, Chmiel Hannah: <u>Primary production under</u> <u>oligotrophication in lakes</u>
- 37. Bouffard Damien, Fotis Georgatos, Bouillet Eric, Perez Cruz Fernando, Minaudo Camille, Lavanchy Sébastien, Sukys Jonas, Safin Artur, Tran-Khac Viet, Runnalls James: <u>DATALAKES Heterogeneous</u> <u>data platform for operational modelling and forecasting of Swiss lakes</u>
- 38. Odermatt Daniel, Runnalls James, Abolfazl Irani Rahaghi, Remika Gupana, Anita Schlatter, Camille Minaudo: <u>Whitening detection and optical characterization (W-DOC)</u>
- 39. Gallorini Andrea, Arpagaus Philippe, Loizeau Jean-Luc: <u>MetOxiC : Methylmercury in Oxic water</u> <u>Column</u>







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- 40. Carratalà Anna, Chmiel Hannah, Joost Stéphane, Janssen Elisabeth, Kohn Tamar: <u>Unravelling the</u> <u>diversity, functioning and toxin production of cyanobacteria populations in lake Geneva</u> (<u>CYANOFUN</u>)
- 41. Beauvais Rébecca, Casado-Martinez Carmen, Lüthi Christina, Ferrari Benoît: <u>LéXPOCHIRO: Effects</u> of lake suspended matter quality on growth, emergence and molecular endpoints in <u>Chironomus riparius</u>

During this period, only one 36 h campaign was organized on 12-13th April 2022 for the SyBAM project.









4. Communication and events

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

- 9th June 2021 : Rockland news, <u>Swiss Limnologists Benefit from Swift Support & Loaner</u> <u>MicroCTD</u>
- 9th August 2021: 24 heures, <u>Avec le réchauffement, notre poumon bleu risque de manquer</u> <u>d'air</u>
- 10th August 2021: Tribune de Genève: <u>Le lac Léman, notre poumon bleu, risque de manquer</u> <u>d'oxygène</u>
- 21st August 2021, Eawag: <u>LéXPLORE brings together researchers from different disciplines –</u> <u>that's fantastic</u>
- August 2021: photo reportage on La plateforme in Nathalie Racheter's ocean newsletter
- 31st October 2021: Public presentations « *La plateforme LéXPLORE: un outil de pointe pour comprendre les changements environnementaux dans le Léman* » by Natacha Tofield-Pasche during Scientastic, the EPFL Science Festival
- 12th October 2021: Science Daily, Science news, <u>Seasonal variability in lakes' environmental</u> processes reveal susceptibility to climate change
- 4th November 2021 : <u>EPFL</u> and <u>Eawag news</u>, First full-year study of turbulent mixing in Lake Geneva
- 19th and 20th November 2021: during the online Swiss Geoscience Meeting, the session <u>Limnology in Switzerland</u> was co-organized with the Swiss Society for Hydrology and Limnology. Researches on LéXPLORE were presented in 4 of the 12 talks and 4 of the 10 posters
- 3rd March 2022: Revue Horizons, <u>Pêche aux données high-tech</u>
- 22th March 2022: video from Geneva Water Hub for the <u>World Water Day 2021: valuing water</u> for peace
- 24th March 2022: the 2nd <u>LéXPLORE workshop</u> gathered 54 scientists and was a great opportunity for networking. Five research projects were presented in the plenum, as well as 14 pitches followed by a poster session
- 15th June 2022: Damien Bouffard presented « *LéXPLORE: un laboratoire flottant sur le Léman* » during the confercence <u>Cercl'Eau 2022</u>
- 23th June 2022: the Department of Surface Water Research & Management had a retreat with an excursion on LéXPLORE platform
- 24th June 2022: the new concept for the public visit was launched with 5 planned visits of 45 min for 5 visitors (our boat capacity). Unfortunately, only two public visits could take place due to a thunderstorm. However, the 8 participants were delighted by the experience
- The website <u>www.lexplore.info</u> was regularly updated.

In addition, the following educational activities took place:

- 9th September 2021: presentation « *LéXPLORE: the novel platform for Leman exploration»* to 15 international Master students from the UNESCO IHE Delft
- 16th September 2021: Visit of 14 Master students from the French University of Tours
- 3rd May 2022: visit of UNIL students (70 students)
- 10th May 2022: visit of 11 EPFL students for the limnology course









5. Scientific Publications

Fernández Castro B., Bouffard D., Troy C., Ulloa H.N., Piccolroaz S., Sepúlveda Steiner O., Chmiel H.E., Moncadas L.S., Lavanchy S., and Wüest A. (2021): **Seasonality modulates wind-driven mixing pathways in a large lake.** Communications Earth & Environment 2: 215, 1-11. <u>doi.org/10.1038/s43247-021-00288-3</u>

Minaudo C., Odermatt D., Bouffard D., Rahaghi A.I., Lavanchy S. and Wüest A. (2021): **The Imprint of Primary Production on High-Frequency Profiles of Lake Optical Properties.** Environmental Science & Technology 55: 14234-14244. <u>doi.org/10.1021/acs.est.1c02585</u>

Perolo P., Fernández Castro B., Escoffier N., Lambert T., Bouffard D., and Perga M.-E.: (2021): **Accounting for surface waves improves gas flux estimation at high wind speed in a large lake**, Earth *Syst. Dynam. Discuss*. 12: 1169-1189. <u>doi.org/10.5194/esd-12-1169-2021</u>

Steinsberger T., Wüest A., and Müller B. (2021). **Net ecosystem production of lakes estimated from hypolimnetic organic carbon sinks.** *Water Resources Research* 57(5): e2020WR029473. doi.org/10.1029/2020WR029473

Serafy E. G. Y. H., Schaeffer B. A., Neely M., Spinosa A., Odermatt D., Weathers K. C., Baracchini T., Bouffard D., Carvalho L., Conmy R. N., Keukelaere L. De, Hunter P. D., Jamet C., Joehnk K. D., Johnston J. M., Knudby A., Minaudo C., Pahlevan N., Reusen I., Rose K. C., Schalles J. and Tzortziou M. (2021): **Integrating Inland and Coastal Water Quality Data for Actionable Knowledge**. *Remote Sens*. 13(15): 2899, <u>doi.org/10.3390/rs13152899</u>

Gallorini A. (2022): **Hypoxic and anoxic micro-environments in the water column of a peri-alpine lake: the potential role of lake snow in Hg methylation.** in Role of Lake Snow in the Methylmercury cycle of a Deep Lake. PhD Thesis (Chap 3): Uni. Geneva, 2022, no. Sc. 5658. <u>doi: 10.13097/archive-</u> <u>ouverte/unige:162094</u>

6. Way Forward

The next steps for LéXPLORE are the following:

- Ensure an optimal exploitation of LéXPLORE and continue to improve the infrastructure.
- Continue to improve the data quality of the core dataset within the DATALAKES Platform, and explore the possibilities to upload the data collected for the different projects.
- Present the results on LéXPLORE in national and international conferences.
- Encourage interdisciplinary exchanges during the 3rd LéXPLORE workshop in 2023.
- Promote international scientific collaborations and collaborative projects around LéXPLORE.
- Develop the possibilities to use LéXPLORE for summer schools
- Prepare an AGORA call for a citizen science project in collaboration with the Association pour la Sauvegarde du Léman (ASL).
- Organize the <u>public visits</u> planned on LéXPLORE, and explain key concepts with experiments.













Images from persons at work on LéXPLORE platform, and during the workshop in March 2022