Annual Report 2020
January 2020 to December 2020

Margaretha Kamprad Chair
of Environmental Science and Limnology

Physics of Aquatic Systems Laboratory, APHYS at EPFL

Work on the LéXPLORE Platform in the Covid-year 2020.

1. OBJECTIVES

The aims of the *Physics of Aquatic Systems Laboratory (APHYS)* are to understand the physical processes in natural waters and the responses of aquatic systems to external forcing. The focus is on anthropogenic influences, such as nutrient inputs, hydropower production, heat and cold use from surface waters, climate change and human activities in the catchments. We study the effects on surface waters and their sensitivity to those drivers and outline consequences for water resources management. Besides *in-situ* measurements, we apply hydrodynamic modelling and use remote sensing information.

2. RESEARCH ACTIVITIES

2.1. Autonomous underwater robots of physical-ecological studies (SNF funded)

This Sinergia project "*A Flexible Underwater Distributed Robotic System for High-Resolution Sensing of Aquatic Ecosystems*", under the leadership of Prof Alcherio Martinoli (EPFL) in collaboration with Prof Bas Ibelings (UniGE) is an interdisciplinary project combining AUV robot technology and performing applied research. Prof Alexander Forrest (UC Davis, USA) spent the summer 2018 as a Visiting Professor with APHYS. This collaboration granted the opportunity to use the UC Davis Slocum glider.

The project came in 2019 to a closure and end-May 2020 Oscar Sepúlveda-Steiner passed his private PhD exam. He is currently revising the second manuscript on Lake Cadagno for Limnology & Oceanography and preparing a first manuscript on the lateral variability of various water parameters (temperature, algal pigments, etc) and small-scale turbulence in Lake Geneva. From the turbulence measurements in Lake Zürich, a first manuscript was submitted to Limnology & Oceanography and a second one is in preparation with a PhD student from the Kilchberg team. Oscar Sepúlveda-Steiner left in July 2020 for a post-doc at Eawag, Kastanienbaum.

2.2. Hydrodynamic modelling including data assimilation (CORESIM, ESA funded)

This research project is linked to Damien Bouffard, who is building up an Aquatic Physics group at Eawag. Despite this move, the PhD student of the project -Theo Baracchini - completed his PhD in APHYS at EPFL.

The aim of this project is to understand spatial variability of bio-geophysical processes in lakes. The approach is to couple all information sources of lake research (remote sensing data, field observations and numerical models) through adapted data assimilation algorithms. The coupling of those three data sources aims at providing a new, reliable, flexible, and global modelling framework for inland waters monitoring across Switzerland, Europe and possibly expanding to other lakes of the world. The framework is currently operated in real-time for the four Swiss Lakes Geneva, Biel, Zurich and Greifensee. The online platform can be viewed on www.meteolakes.ch.

In spring 2020, Theo Baracchini has migrated the framework to Eawag, where it will be supported long-term by the Aquatic Physics group. In 2020, two papers have been published on data assimilation as well as the overview of the platform in Water Research. The third publication (Env Mod & Softw) on calibration is currently in press.

2.3. Primary production in lakes under oligotrophication

This project focuses on short- and long-term developments of primary production (PP) in the large lakes of Switzerland, which are currently recovering from past eutrophication. Phosphorous levels have declined massively in most lakes. In this project, we couple physical, chemical and biological observations in an interdisciplinary framework to resolve the dynamics of PP and its drivers over various spatial and temporal scales. We obtain high-resolution in-situ measurements to assess PP at the diel scale and combine these observations in a modelling approach with data from several governmental long-term monitoring programs. In additions, we use satellite images and 3D-

hydrodynamic modelling to assess the variability in primary production at the basin-wide scale. More specifically, we:

(i) Employ the diel oxygen and carbon dioxide method to quantify primary production and metabolic balances by using in-situ measurements (data are shared among people within the CARBOGEN project by Marie Perga at UNIL, which aims at quantifying the carbon budget of Lake Geneva).

(ii) Operate an autonomous and high-resolution profiling system ("*Thetis*") to resolve water optical properties that serve as calibration for remote sensing data for spatial extrapolation (collaboration with Daniel Odermatt at Eawag).

(iii) Quantify the kinetic and potential energy budget and turbulent mixing at different scales of variability to resolve the pathways to energy dissipation and the implications for PP and gas exchange.

(iv) Simulate nutrients and phytoplankton dynamics using coupled physical-biogeochemical model systems, and statistical and model-based analyses of in-situ data. A first manuscript has been submitted on inter-annual variation of primary production.

The primary study site of this project is the LéXPLORE platform on Lake Geneva, where measurements are conducted since the installation of the protective circle in October 2018. Further study sites include Lakes Lugano and Constance, for which similar long-term monitoring data exist. These lakes are being studied through collaborative sub-projects with partner universities (SUPSI, University of Konstanz), and managed by the Limnology Center.

A FOEN (Federal Office for the Environment) proposal for PP estimates for practitioners, based on the usual routine monitoring data sets, was granted end of 2019. Since January 2020, Isabel Kiefer works on knowledge transfer on this project and published in 2020 a first article in Aqua & Gas on oxygen depletion in lakes. A follow-up publication specifically on Lake Geneva is planned for 2021.

3. MAJOR ACQUIRED EQUIPMENT

We had the opportunity to complete our field instrumentation with grants from the Kamprad Chair, EPFL and SNF. The acquisitions in 2020 comprised:

1.1. R500 Acoustic Transponding Releaser
The Benthos acoustic releaser R500, light, easy to manipulate, is used to deploy safely moorings at the bottom of the lake (left image)

1.2. PRO-Oceanus Mini CO_2 Datalogger
These mini probes are designed to measure dissolved CO_2 (central image). The sensor operates through rapid diffusion of gas from the liquid through an oil-resistant, advanced matrix interface to a non-dispersive infrared detector. The signal is compensated for both pressure and temperature.
The Mini CO_2 probes will be used in the project "*Primary production under oligotrophication in lakes*".

2. HUMAN RESOURCES

(alphabetic order)

Theo Baracchini	PhD concluded in 2019, was employed 2 months for Meteolakes migration in collaboration with Eawag
Emile Barbe	Master student of IIE/EPFL has been hired as scientific assistant for 4 months.
Hannah Chmiel	Post-doc since October 2016 (Primary Production Project)
Guillaume Cunillera	Technician at LIMNC since March 2020. Employed for technical work on LéXPLORE Platform
Lara du Bois	Secretary of APHYS and LIMNC, since February 2019
Bieito Fernández Castro	Post-doc, since February 2019 (Primary Production Project); He left end-August 2020 for University of Southampton
Isabel Kiefer	Scientific assistant since January 2020
Shubham Krishna	Post-doc since May 2018 (Primary Production Project)
Sébastien Lavanchy	Technician at APHYS and LIMNC since May 2015
Camille Minaudo	Post-doc since October 2018 (Primary Production Project)
Lucas Serra Moncadas	Civil servant from 01 September 2019 to 31 August 2020 He left for a PhD study at the University of Zürich
Sebastiano Piccolroaz	Post-doc from U of Bolzano, since April 2020 (Primary Production); follows Bieito Fernández who left in Aug 2020
Oscar Sepúlveda Steiner	PhD student since April 2016; ended in June 2020
Hugo N. Ulloa	Postdoc since February 2017 (former U de Chile and UC San Diego)
Guillaume Ulrich	Technical advisor from June 2019 to January 2020
Alfred Wüest	Professor, Margaretha Kamprad Chair since 2012 and Director of the Limnology Center since 2013.

Visitors in 2020

➢ No visitors in 2020 due to Covid-19 pandemic

4. NETWORKING

4.1. Oxygen depletion in lakes

➢ Beat Müller, Damien Bouffard, Thomas Steinsberger, Eawag
➢ Robert Schwefel, University of California, Santa Barbara

4.2. Primary production project

➢ Miguel Gil Coto, Instituto de Investigacións Mariñas (IIM-CSIC, Vigo, Spain)
➢ Biel Obrador, University of Barcelona
➢ Serena Rasconi, UMR CARRTEL, Université Savoie Mont-Blanc
➢ Massimiliano Cannata, Camillia Capelli, and Fabio Lepori. University of Applied Sciences and Arts of Southern Switzerland (SUPSI)

4.3. Lago Cadagno Project (SNF fund for Prof Tonolla)

➢ Mauro Tonolla, Andreas Bruder and Nicola Storelli, University of Applied Sciences and Arts of Southern Switzerland (SUPSI)
➢ Anupam Sengupta and Francesco Danza Physics of Living Matter Group, University of Luxemburg, Luxemburg
➢ Damien Bouffard, Eawag
➢ George Constantinescu, University of Iowa.

4.4. AUV applications in Lakes Zurich and Geneva (Sinergia project)

➢ Anwar Quraishi, Alexander Bahr and Alcherio Martinoli, DISAL, EPFL
➢ Felix Schill, HYDROMEA SA
➢ Alex Forrest and Jasmin McInerney (UC Davis, USA)
➢ Bas Ibelings, Ena Suarez Bolanos, Roxane Fillion and Evanthia Mantzouki, U of Geneva
➢ Deborah Knapp, Jakob Pernthaler and Thomas Posch, University of Zurich
➢ Damien Bouffard, Eawag

4.5. Remote sensing

➢ Daniel Odermatt and Damien Bouffard, Eawag
➢ Alexander Damm, Andreas Hueni and Michael Schaepman; RSL University of Zürich
➢ Stefan Wunderle, University of Bern
➢ Tiit Kutser, Estonia

4.6. DATALAKES - Heterogeneous data platform for operational modeling and forecasting of Swiss lakes

➢ Artur Safin, Jonas Sukys, James Runnals and Damien Bouffard, Eawag
➢ Fotis Georgatos, Swiss Data Science Center.

5. CONCLUSION AND FUTURE DIRECTIONS

Within the next three years, we envisage to pursue the following new projects:

5.1. LéXPLORE research platform on Lake Geneva

The aim of this research platform is to acquire continuous records of physical and biogeochemical properties, as well as phytoplankton and zooplankton. This platform should also promote international collaboration with other research groups interested in this facility. Major equipment was funded by R'Equip FNS. Since 2017, we were first four partners (UniGE, UniL and Eawag besides EPFL), which committed to finance the platform construction. The platform was mounted off Pully on 19 February 2019 and inaugurated on 24 June 2019. Since mid-2019 we operate the platform with five partners (INRA Thonon-les-Bains joined the consortium in 2019). LéXPLORE is open to any scientists.

5.2. Primary productivity in large lakes

This research project started in August 2018. The goals are to explain the dependency of primary production (PP) on different levels of phosphorus forcing. Beside the reconstruction of primary production over the past decades, this project includes various goals related to new observation technologies and new methods of PP estimates over short time intervals (days). We plan to cooperate with partners and other research institutions such as Eawag on Lakes Geneva, Lugano-NB, Lugano-SB (SUPSI), Constance (IGKB and SFI Langenargen).

A Federal Office for the Environment (FOEN) proposal for PP estimates for practitioners, based on the usual routine monitoring data sets, was granted end of 2019, and started in 2020.

6. CONFERENCES IN 2020

Bouffard D., Runnalls J., Bouillet E., Fernández-Castro, B., Georgatos F., Minaudo C., Ozdemir F., Odermatt D. Datalakes, a data platform for Swiss lakes. **18th Swiss Geoscience Meeting,** Zurich, 6-7 November 2020. Online Meeting.

Broullón, E, Crespo, E., Chouciño, P., Comesaña, A., Fernandez-Castro, B., Fernández, E., Fuentes Lema, A., Gilcoto, M., Nogueira, E., Pérez, M., Reboreda, R., Reguera, B., Souto., C., Velasco,

E., Villamaña, Villar, S., Mouriño. Formation of thin layers of phytoplankton in the upwelling region off NW Iberia: biological growth versus physical accumulation. **Ocean Sciences Meeting.** 16-21 February 2020. San Diego, USA.

Chmiel H.E., Fernández-Castro, B., Minaudo C., Krishna S., Perolo P., Rasconi, S., Wüest A. Summer primary and ecosystem production in Lake Geneva diagnosed from high-resolution in situ oxygen measurements. **18th Swiss Geoscience Meeting,** Zurich, 6-7 November 2020. Online Meeting

Doda T., Ramón C.L, Ulloa H.N., Brennwald, M., Kipfer, R., Schubert, C., Wüest A., and Bouffard D. Lateral transport of dissolved gases by cooling-driven density currents in a small temperate lake. **18th Swiss Geoscience Meeting,** Zurich, 6-7 November 2020. Online Meeting.

Doda T., Ramón C., Ulloa H.N., Wüest A., Bouffard D. Density currents induced by differential cooling in a small temperate lake: seasonality in their occurrence and magnitude. **23rd Workshop on Physical Processes in Natural Waters**, On-line, June 2020.

Fernández-Castro B., Bouffard D., Troy C., Piccolroaz S., Lavanchy S., Chmiel H.E., Ulloa H.N., Sepúlveda Steiner O., Wüest A. Seasonality of the mechanical energy budget in a large lake: Lake Geneva (Switzerland-France). **18th Swiss Geoscience Meeting,** Zurich, 6-7 November 2020. Online Meeting.

Fernández-Castro B., Troy C., Doda T., Chmiel H., Minaudo, C., Ulloa, H. N., Serra L., Sepúlveda-Steiner O., Bouffard D., Wüest, A. Seasonality of the mechanical energy budget in a large lake, Lake Geneva (Switzerland-France). **Workshop on Physical Processes in Natural Waters 2020**. 15-18 June 2020. Online meeting.

Krishna S, H.N. Ulloa, O. Kerimoglu, C. Minaudo, O. Anneville, and A. Wüest, A tale of two years: Changes in dynamics of physical and biogeochemical processes in an oligotrophic lake, **Ocean Science Meeting 2020**, San Diego, USA, February 2020. Abstract ID: OM24A-3103.

Minaudo C., Odermatt D., Bouffard D., Rahaghi A.I., Lavanchy S., and Wüest A. Diel patterns in inherent optical properties of Lake Geneva water and their physical and biogeochemical drivers. **18th Swiss Geoscience Meeting,** Zurich, 6-7 November 2020. Online Meeting.

Minaudo C., Odermatt D., Fernandez Castro B., Chmiel H.E., Lavanchy S., Bouffard D., Wüest A. High-resolution spatiotemporal heterogeneities of water optical properties in a large lake to infer physical and biogeochemical drivers of primary production. **EGU General Assembly 2020**, Geophysical Research Abstracts, Vol. 21, EGU2020-15063, 2020.

Minaudo C., Odermatt D., Fernandez Castro B., Chmiel H.E., Lavanchy S., Bouffard D., and Wüest A. Measuring high-resolution spatiotemporal heterogeneities of water optical properties in a large lake to infer physical and biogeochemical drivers of primary production. **ASLO Meeting 2020,** Madison. Online Meeting.

Odermatt D., Minaudo C., Kesselring J., Runnalls J and Wüest A. Satellite Earth observation products for lake research. **18th Swiss Geoscience Meeting,** Zurich, 6-7 November 2020. Online Meeting.

Pasche N., Bouffard D., Guillard J., Ibelings B., Lavanchy S., Perga M-E., and Wüest A. LéXPLORE – the new Léman exploration platform. **18th Swiss Geoscience Meeting,** Zurich, 6-7 November 2020. Online Meeting.

Pasche N., Hofmann H., Sobek S., Bouffard D. and Chmiel H. Implications of river intrusion and convective mixing on the spatial and temporal variability of under-ice CO_2 in Lake Onego, Russia. **ASLO Meeting 2020,** Madison. Online Meeting.

Piccolroaz S., Fernández Castro B., Chmiel H.E., Wüest A. Lake-atmosphere CO_2 fluxes in Lake Geneva: disentangling the role of physical and biological processes in affecting diel and seasonal patterns. **18th Swiss Geoscience Meeting,** Zurich, 6-7 November 2020. Online Meeting

Ramón C., Ulloa H.N., Doda T., Winters K., Bouffard D. Differential heating and Earth rotation modify lake warming under ice. **AGU Fall meeting**, On-line, 1-17 December 2020.

Ulloa H.N., Ramón C., Winters K., Doda T., Wüest A., Bouffard D. Buoyancy driven modes of motion in radiatively heated rotating ice-covered waterbodies. **23nd Workshop on Physical Processes in Natural Waters**, On-line, June 2020.

7. PUBLICATIONS IN 2020

7.1. Published peer-reviewed papers in 2020

Baracchini, T., A. Wüest, and D. Bouffard (2020). Meteolakes: An operational online three-dimensional forecasting platform for lake hydrodynamics. *Water Research, 172*: 115529. https://doi.org/10.1016/j.watres.2020.115529.

Baracchini, T., P.Y. Chu, J. Šukys, G. Lieberherr, S. Wunderle, A. Wüest, and D. Bouffard, (2020). Data assimilation of in situ and satellite remote sensing data to 3D hydrodynamic lake models: a case study using Delft3D-FLOW v4.03 and OpenDA v2.4. *Geoscientific Model Development* **13**(3): 1267–1284, https://doi.org/10.5194/gmd-13-1267-2020

Baracchini, T., Hummel, S., Verlaan, M., Cimatoribus, A., Wüest, A., and Bouffard, D., 2020. An automated calibration framework and open source tools for 3D lake hydrodynamic models. *Environmental Modelling & Software.* https://doi.org/10.1016/j.envsoft.2020.104787

Chmiel, H.E., Hoffmann, H., Sobek, S., Efremova, T., and N. Pasche (2020). Where does the river end? Drivers of spatiotemporal variability in CO_2 concentration and flux in the inflow area of a large boreal lake*. Limnology and Oceanography,* **65**: 1161–1174. https://doi.org/10.1002/lno.11378.

Dubois, N., L. Råman Vinnå, M. Rabold, M. Hilbe, F.S Anselmetti, A. Wüest, L. Meuriot, A. Jeannet and S. Girardclos (2020). Subaquatic slope instabilities: The aftermath of river correction and artificial dumps in Lake Biel (Switzerland). *Sedimentology, 67*(2): 971–990. doi: 10.1111/sed.12669.

Fernández-Castro, B., D. G. Evans, E. Frajka-Williams, C. Vic, and A. C. Naveira-Garabato (2020). Breaking of internal waves and turbulent dissipation in an anticyclonic mode water eddy. *J. Phys. Oceanogr.,* 50, 1893–1914, https://doi.org/10.1175/JPO-D-19-0168.1.

Flaim, G., Andreis, D., Piccolroaz, S., & Obertegger, U. (2020). Ice cover and extreme events determine dissolved oxygen in a placid mountain lake. *Water Resources Research*, *56*, e2020WR027321. https://doi.org/10.1029/2020WR027321.

Fernández-Castro, B., D. G. Evans, E. Frajka-Williams, C. Vic, and A. C. Naveira-Garabato, 2020: Breaking of Internal Waves and Turbulent Dissipation in an Anticyclonic Mode Water Eddy. *J. Phys. Oceanogr.*, 50, 1893–1914, https://doi.org/10.1175/JPO-D-19-0168.1.

Man, X., K.A. Bierlein, C. Lei, L.D. Bryant, A. Wüest, and J.C Little (2020). Improved modeling of sediment oxygen kinetics and fluxes in lakes and reservoirs. *Environmental Science & Technology*, **54**(5): 2658−2666, https://doi.org/10.1021/acs.est.9b04831

Moatar, F., M. Floury, A.J. Gold, M. Meybeck, B. Renard, M. Ferréol, A. Chandesris, C. Minaudo, K. Addy, J. Piffady and G. Pinay (2020). Stream solutes and particulates export regimes: A new framework to optimize their monitoring. *Frontiers in Ecology and Evolution*, **7**: 516 (19 pages); doi: 10.3389/fevo.2019.00516.

Råman Vinnå, L., D. Bouffard, A. Wüest, S. Girardclos, and N., Dubois (2020). Assessing subaquatic mass movement hazards: An integrated observational and hydrodynamic modelling approach. *Water Resources Management.*

Roubeix, V., C. Minaudo, J. Prats, N. Reynaud, Q. Zhang, F. Moatar, P-A. Danis (2020). Adapting the dynamic LakeMab model to simulate seasonal variations of phosphorus concentration in reservoirs: a case study of Lake Bultière (France), *Limnology* 21: 233–244; https://doi.org/10.1007/s10201-019-00606-x.

Steinsberger, T., R. Schwefel, A. Wüest, and B. Müller (2020). Hypolimnetic oxygen depletion rates in deep lakes: effects of trophic state and organic matter accumulation. *Limnology and Oceanography*. https://doi.org/10.1002/lno.11578.

Strohmenger, L., Fovet, O., Akkal-Corfini, N., Dupas, R., Durand, P., Faucheux, M., Gruau, G., Hamon, Y., Jaffrezic A., Minaudo, C., Petitjean,P., Gascuel-Odoux C. (2020). Multitemporal relationships between the hydroclimate and exports of carbon, nitrogen, and phosphorus in a small agricultural watershed. *Water Resources Research*, 56, e2019WR026323. doi.org/10.1029/2019WR026323.

Ulloa, H.N., G. Constantinescu, K. Chang, D. Horna-Munoz, O. Hames, and A. Wüest (2020). Horizontal transport under wind-induced resonance in stratified waterbodies. *Physical Review Fluids* **5**(5): 054503, 1-20; DOI: 10.1103/PhysRevFluids.5.054503.

7.2. Published non-peer-reviewed papers in 2020

Kiefer, I., T. Steinsberger, A. Wüest und B. Müller (2020). Sauerstoffzehrung in Seen. *Aqua & Gas - Fachzeitschrift für Gas, Wasser und Abwasser* **100**(7/8): 62 - 70.

7.3. Submitted manuscripts to peer-reviewed Journals in 2020

Amadori M., L. Giovannini, M. Toffolon, S. Piccolroaz, D. Zardi, M. Bresciani, C. Giardino, G. Luciani, M. Kliphuis, H. van Haren, and, H.A. Dijkstra (2020). Multi-scale evaluation of a 3D lake model forced by an atmospheric model against standard monitoring data. *Environmental Modelling & Software*. In revision

Fernández-Castro, B., O. Sepúlveda Steiner, D. Knapp, T. Posch, D. Bouffard, and A. Wüest (2020). Inhibited vertical mixing and the seasonal persistence of a cyanobacterial thin layer in a stratified lake. *Limnology & Oceanography.* In revision

Guillemot, S., Fovet, O., Gascuel-Odoux, C., Gruau, G., Casquin, A., Curie, F., Minaudo, C., Strohmenger, L., and Moatar, F.: Spatio-temporal controls of C-N-P dynamics across headwater catchments of a temperate agricultural region from public data analysis, *Hydrol. Earth Syst. Sci. Discuss.*, https://doi.org/10.5194/hess-2020-257, in review, 2020.

Krishna S., H.N. Ulloa, O. Kerimoglu, C. Minaudo, O. Anneville, and A. Wüest (2021). Model-based data analysis of the effect of winter mixing on primary production in a lake under oligotrophication. *Ecological Modelling.* In revision

Piccolroaz S., S. Zhu, M. Ptak, X. Du, and M. Sojka (2020). Warming of lowland Polish lakes under future climate change scenarios and consequences for ice cover and mixing dynamics. *Journal of Hydrology: Regional Studies.* In revision

Sepúlveda Steiner, O., D. Bouffard and A. Wüest (2021). Persistence of bioconvection-induced mixed layers in a stratified lake. *Limnology & Oceanography.* In revision

Swann, G.E.A., V.N. Panizzo, S. Piccolroaz, V. Pashley, M.S.A Horstwood, S. Roberts, E. Vologina, N. Piotrowska, M. Sturm, A. Zhdanov, N. Granin, C. Norman, S. McGowan, A.W. Mackay (2020). Changing nutrient cycling in Lake Baikal: the world's oldest lake. *Proceedings of the National Academy of Sciences*. In revision.

7.4. Reports and expert services in 2020

Müller B. und A. Wüest (2020). Sanierung der Mittellandseen: Bewertung möglicher seeinterner Massnahmen (Beantwortung Postulat P343, R. Zurbriggen). Eawag Kastanienbaum, August 2020, 10 p.

8. TEACHING

8.1. Courses
- **Limnology**, Master course, spring term 2020, ENV-425, Env. Engineering, EPFL
- **Design project:** none due to Covid-19 pandemic.
- **Master thesis:** Emile Barbe "*Long-term changes in phytoplankton functional groups and primary production in Lake Geneva: A Modelling Approa*ch".

8.2. PhD Student supervised 2020
- Oscar Sepúlveda Steiner. Resolving horizontal structures in lakes; exam May 2020
- Tomy Doda. Convective flows; since February 2018.

8.3 PhD Student exams in 2020
- Oscar Sepúlveda Steiner. Resolving horizontal structures in lakes; exam May 2020
- One first-year Candidacy exam (Li Chaojie)

8.4 Master students in 2019
- Emile Barbe (September 2019 to February 2020). "*Long-term changes in phytoplankton functional groups and primary production in Lake Geneva: A Modelling Approach*"

9. CURRENT EXPERT AND CONSULTING ACTIVITIES
- Member of the Eawag Directorate (since 2014)
- Member of Doctoral Program in Civil and Environmental Engineering (since 2014)
- Member of Advisory Board to the Swiss Competence Centre for Energy Research
- Member of Advisory Board to Forschungsstelle Nachhaltige Energie- und Wasserversorgung, University of Basel
- ContourGlobal, Methane extraction in Lake Kivu, external advisor
- Co-editor of Aquatic Sciences
- Member of the Scientific/Technical Board for Lake Restoration on the Swiss Plateau, ASSAN
- Member of Group of Expert for IGKB (Lake Constance International Commission (Sachverständiger).

10. PROPOSALS

Submitted
- **SNF Hyperstrata (Hyperspectral retrieval of stratification in aquatic systems)**, Daniel Odermatt (Eawag), Alexander Damm (University of Zürich), Camille Minaudo (EPFL)

Recent on-going funding
- **FOEN**, Swiss Federal Office for the Environment, Bern, Project: "***Primärproduktion in Seen unter Oligotrophierung: Verfahren zur Erhebung des Produktionsstatus basierend auf Routineuntersuchungen und öffentlich zugänglichen Daten*** *(Trophie Status)*". Dossier No: 17978. Total amount: 387,500 CHF. Active 2019 to 2021

- ➢ **Primary production under oligotrophication in lakes**. Alfred Wüest (responsible). SNF grant 200021_179123, 1. August 2018 to 31 July 2021. Internal EPFL number 514 254. Total amount: 547'560 CHF.
- ➢ **Heterogeneous data platform for operational modeling and forecasting of Swiss lakes (DATALAKES)**, Sykus and Bouffard (Eawag), Wüest (EPFL) and Siddhartha Mishra, ETH Zurich. Swiss Data Science Center
- ➢ NCCS Hydro-CH2018 – Research Project: **Evolution of stream and lake water temperatures under climate change.** Hendrik Huwald and Alfred Wüest (EPFL) and Damien Bouffard and Martin Schmid (Eawag), FOEN, Swiss Federal Office for the Environment.
- ➢ **Kivu Monitoring project,** Hydrodynamic modelling of Lake Kivu (EDMC/LKMP, Rwanda); PI: Deltares, NL, Damien Bouffard (EPFL, now Eawag), started in 2016.

Recently finished

- ➢ **CORESIM**, **CO**upling **RE**mote **S**ensing, **I**n situ and **M**odelling data for inland waters, Bouffard D. (EPFL), Odermatt D (Odermatt and Brockmann GmbH), Anneville O (UMR CARRTEL) and A. Wüest (EPFL), ESA, 2016 - 2018. Final report issued in 2020.