The mission of the LIMNOLOGY Center is to provide socially-relevant and multi-disciplinary research to ensure the sustainable use and conservation of natural water resources, both on national and international levels.

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LIMNOLOGY Center

Ecole Polytechnique Fédérale de Lausanne

EDITORIAL

We had an exciting year behind us – for three reasons:

Firstly, end of October 2014, we had the great opportunity to host three international experts – Prof. Warwick Vincent, Dr. Eddy Carmack and Prof. Roland Psenner – for two days coresponding with the opening of the new François-Alphonse Forel section in the Musée du Léman at Nyon. The perspective discussion, development of upcoming new opportunities, and potential new projects in the north was very encouraging and stimulating.

Secondly, the engineering consortium (Sagrave, Kindlimann Naval Architecture and MABO Metallbau) finalized their study and we made a request to the Government of Vaud for a construction permit for our envisaged platform on Lake Geneva. We are now anxiously awaiting feedbacks but are confident on the outcome and look forward to the new workplace on the water.

Thirdly, the first expedition consisting of eight research groups from EPFL, UniGe, Eawag, INRA-Thonon and Observatoire Midi-Pyrenees will soon leave for Petrozavodsk. Although the original plan was to work on Lake Ladoga, the warm winter diverted us to Lake Onego, where the ice reaches at least up to 40 cm.

We thank the researchers, the support personnel and the sponsors, who all contributed to this constructive work.

Alfred Wüest, Director LIMNOLOGY Center

View on Lake Leman and Vevey

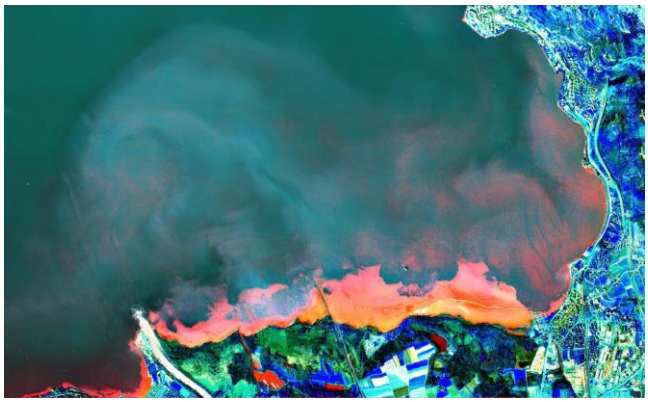
Leman-Baikal Project:

The Leman-Baikal project is an international Swiss-Russian collaboration that investigates lakes surface properties using ultralight aircrafts. The primary objective is to compare the water quality and the energy balance of Lakes Leman in Switzerland and Baikal in Russia. Remote sensing from ultralight aircrafts allows to map the spatial heterogeneity of water properties at a high resolution, which are particularly interesting for land-water interfaces in lakes.

After a testing phase in 2013, the remote sensing platform was improved and successfully collected hyperspectral observations above lake surfaces. In 2014, 17 flights took place above Lake Leman during 3 campaigns in February/March, April/May and September. The flights focussed on the mouths of Venoge and Rhone Rivers, where mixing of waters from different qualities showed interesting patterns. To obtain a global view, we also covered the entire Lake Leman in one day at an altitude of 4000 m.

View of the Rhone delta from the ULM

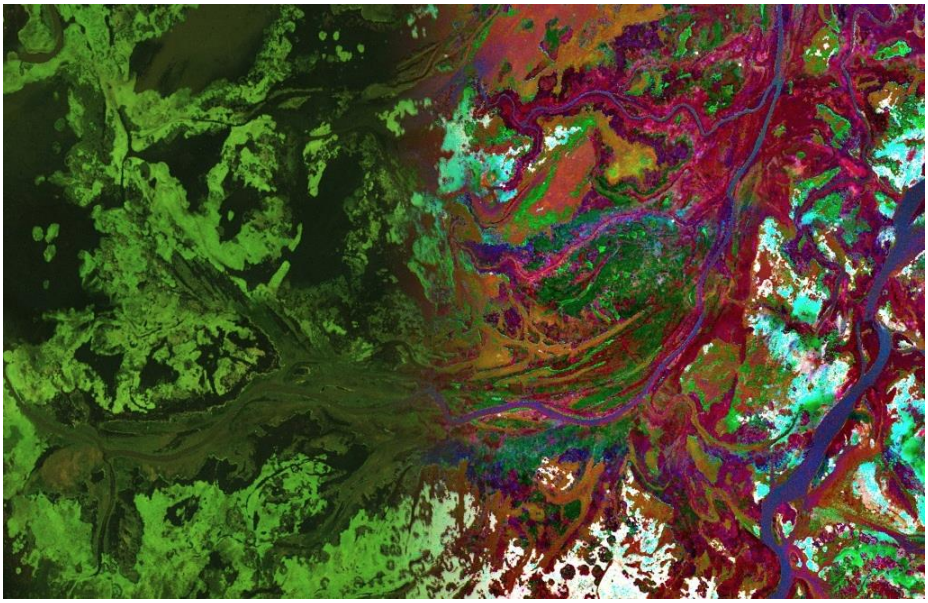
Data processing of the massive dataset will soon deliver the first maps of water qualities. The remote sensing and the ground truthing teams are working together on the last step of a long processing chain. However, iterative steps are still needed to ensure a high data quality of the results.



Principal component analyse (PCA) of Rhone delta showing high discrimination between static waters and dynamic sediments

RESEARCH PROJECT

Leman-Baikal Project



RGB to PCA transition of a hyperspectral image of Selenga Delta

From 27th July to 21st August 2014, Swiss and Russian scientists carried out a field campaign over the entire Selenga Delta. The campaign was conducted in close collaboration with the Geography Faculty of Moscow State University (MSU) and the Baikal Institute of Nature Management (BINM) in Ulan Ude. The airborne observations were complemented by extensive ground truthing data. The ground truthing team analysed water samples, and recorded the spectral reflectance signatures on the corresponding water surface, in order to calibrate the images.

Galina Shinkareva and Michael Tarasov, two Russian students from MSU, started a 4-month internship at EPFL to process the collected data.

We would like to warmly thank our sponsors:

FERRING PHARMACEUTICALS

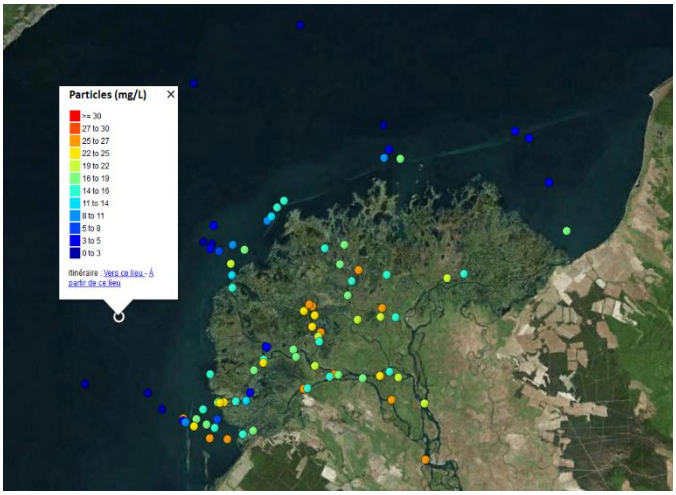
Lake BAIKAL Protection FUND

elemo exploration des eaux lémaniques

METROPOL GROUP OF COMPANIES

and coordination:

Consulat honoraire de la Fédération de Russie à Lausanne

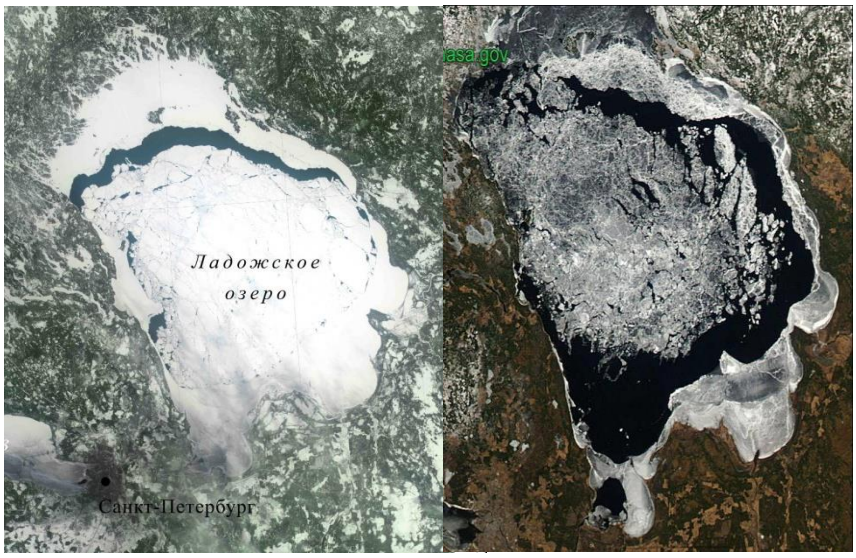


Particles concentrations (mg/L) in the Selenga Delta measured in 2013 and 2014. Courtesy from Vincent Nouchi.

RESEARCH PROJECT

Lake Ladoga: life under the ice.

Interplay of under-ice processes by global warming, 2014-2017



Images of ice-covered Lake Ladoga on 21st March 2012 (left) and 25th March 2007 (right)

This project was developed in collaboration with the Northern Water Problem Institute in Petrozavodsk Russia, and will bring together several research institutions from Switzerland, France and Russia.

The research program aims at investigating life under ice and the relevant processes using a multidisciplinary approach. Four subprojects will work together to understand the implication of under-ice convections for ecosystem development. As new technology, automatic underwater vehicles will allow to horizontally map the convection structures, and remote sensing from drones will identify spatial heterogeneity of the ice cover.

The functioning of the ecosystem will be further studied by analysing phytoplankton, zooplankton, microorganisms, as well as carbon transfer throughout the trophic system. Carbon dioxide accumulation and carbon cycling throughout the winter period will be assessed. The reconstruction of land use history in the catchment area will be explained using short sediment cores.

The research program was officially launched in June 2014 and the first fieldwork is planned for mid-March 2015.

We would like to warmly thank our sponsors:

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FERRING PHARMACEUTICALS

and coordination:

Consulat honoraire de la Fédération de Russie à Lausanne

HUMAN RESOURCES

Director: Prof. Alfred Wüest, **Deputy Director**: Dr. Natacha Pasche,

and **Secretary** (10%): Tania Gonin

Teams involved within Leman-Baikal Project

TOPO/LASIG: Dr. Yosef Akhtman, Dragos Constantin, Prof. Bertrand Merminod, Prof. François Golay, Dr. Devis Tuia, Kevin Barbieux

ECOL: Prof. David Andrew Barry, Abofazel Irani Rahaghi

APHYS-Margaretha Kamprad Chair: Dr. Damien Bouffard, Vincent Maurice Nouchi, and Prof. Alfred Wüest

WIRE: Dr. Valerio Iungo Giacomo, Nicolas Bocherens, Fernando Carbajo Fuertes, Dr. Corey Dean Markfort, and Prof. Fernando Porté-Agel

EFLUM/CRYOS/Princeton: Prof. Mark Hultmark, Dr. Hendrik Huwald, Gilad Arwatz and Prof. Marc Parlange

Teams involved within Lake Ladoga Project

In Russia:

Northern Water Problems Institute, KRC RAS, Petrozavodsk: Prof. Nikolay Filatov, Dr. Arkady Terzhevik, Prof. Dmitry Subetto, Dr. Natalja Kalinkina, Dr. Petr Lozovic, and Dr. Natalja Belkina

Institute of Limnology RAS, St-Petersburg: Dr. Irina Iofina

Arctic and Antarctic Research Institute: Dr. Boris Ivanov

Nansen International Environments and Remote Sensing Center: Dr. Anton Korosov

In France:

UMR CARRTEL, INRA-Thonon-les-Bains: Dr. Emilie Lyautey, Dr. Marie-Elodie Perga, and Dr. Victor Frossard

OMP-LEGOS: Dr. Alexei V. Kouraev

In Switzerland:

University of Geneva: Prof. Daniel Ariztegui, Prof. Bastiaan W. Ibelings, Prof Christel Hassler, Marie-Caroline Tiffay and Evanthia Mantzouki

Eawag: Dr. Nathalie Dubois and Alois Zwyssig

Within EPFL:

APHYS-Margaretha Kamprad Chair: Dr. Damien Bouffard, and Prof. Alfred Wüest

DISAL: Dr. Felix Schill, Dr. Alexander Bahr, and Prof. Alcherio Martinoli

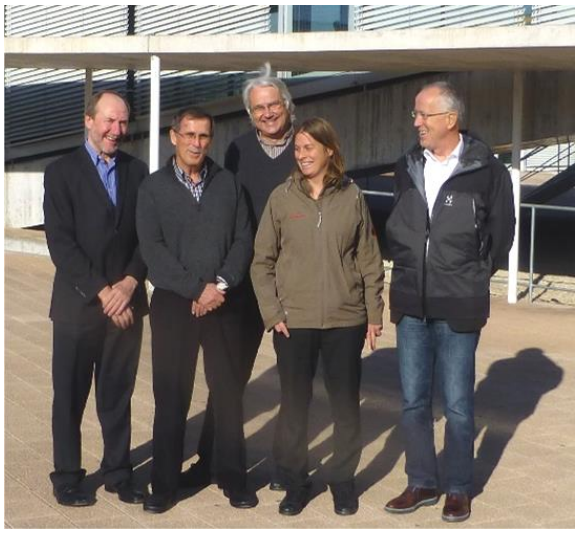
TOPO: Dr. Yosef Akhtman, and Prof. Bertrand Merminod

LIMNC: Dr. Natacha Pasche

REVIEW MEETING OF THE INTERNATIONAL ADVISORY PANEL

From 23rd to 26th October 2014, the Limnology Center was reviewed by three well-recognized scientists :

- Dr. Eddy Carmack, Institute of Ocean Sciences, Sidney, BC, Canada
- Prof. Warwick F Vincent, Université Laval, Québec, Canada
- Prof. Roland Psenner, Vice Rector from University of Innsbruck, Innsbruck, Austria



From left to right: Prof. Vincent, Prof. Carmack, Prof Wüest, Dr. Pasche, Prof. Psenner

After three days of extensive discussions, the international panel expressed their recommendations in a detailed report. The executive summary is presented below :

The Limnology Center has excellent leadership and expertise, and enormous opportunities given the technological strengths of EPFL.

– *A set of world class research projects are already underway at Lake Geneva and abroad, with many collaborators nationally and internationally.*

– *The Limnology Center needs to grow in capacity to be recognized as an international center of excellence in freshwater system science and technology.*

– *One approach to expand the expertise, reach and impact of the Limnology Center would be to offer membership to active partners, both within and outside EPFL.*

– *The vision of the Center needs to be clearly articulated on the website in such a way that it attracts EPFL colleagues, national and international partners.*

PUBLICATIONS

SCIENTIFIC PUBLICATIONS

Up to now, the Leman-Baikal project generated the following publicationss:

Arwatz G, Bahri C, Smits AJ and Hultmark M. (2013): Dynamic calibration and modeling of a cold wire for temperature measurement. Measurement Science and Technology (24): 125301. doi:10.1088/0957-0233/24/12/125301

Arwatz G, Fan Y, Bahri C and Hultmark M. (Under review): Development and characterization of a nano-scale temperature probe (T-NSTAP) for turbulent temperature measurement, Measurement Science and Technology.

Carbajo Fuertes F, Iungo GV and Porté-Agel F. (2014): 3D Turbulence Measurements Using Three Synchronous Wind Lidars: Validation against Sonic Anemometry, in Journal of Atmospheric and Oceanic Technology, 31(7):1549-1556.

Markfort CD, Porté-Agel F and Stefan HG. (2014): Canopy-wake dynamics and wind sheltering effects on Earth surface fluxes. Environmental Fluid Mechanics. 14(3):663-697. doi:10.1007/s10652-013-9313-4.

Akhtman Y, Constantin D, Rehak M, Nouchi V, Shinkareva G, Bouffard D, Pasche N, Chalov S, Lemmin U, and Merminod B (2014): Télédétection multi-échelle des lacs depuis un aéronef ultraléger motorisé. Géomatique Suisse, vol. 9, num. 395-398.

NEWSPAPER ARTICLES

Swiss

10.07.2014: Projet Baïkal – Comprendre les phénomènes météorologiques. Le Courrier-Lavaux-Oron

ULM flight over Lake Baikal

CONFERENCES AND WORKSHOPS

Abolfazl Irani, Ulrich Lemmin, Damien Bouffard, Michael Riffler, Stephane Wunderle and Andrew Barry: **Surface heat flux variability of a large lake: Lake Geneva, Switzerland**. Abstract H11E-0906 presented at AGU Fall Meeting, San Francisco, California. 15 to 19 December 2014.

Markfort Corey, Carbajo Fuertes Fernando, Iungo Valerio, Stefan Heinz, Porté-Agel Fernando: **Canopy wake measurements using multiple scanning wind LiDARs.** Abstract A43B-3268 presented at AGU Fall Meeting, San Francisco, California. 15 to 19 December 2014.

Markfort Corey, Carbajo Fuertes Fernando, Iungo Valerio, Stefan Heinz, Porté-Agel Fernando: **Canopy wake measurements using multiple scanning wind LiDARs.** Abstract EGU2014-9401 presented at General Assembly of the European Geosciences Union, Vienna, Austria. 27 April to 2 May 2014.

Akthman Yosef: **Leman-Baikal 2014: Science, Technology, Environment and Politics**, Environmental Engineering Seminar Series, EPFL, Lausanne. 23 September 2014

Akhtman Yosef, Constantin Dragos, Rehak Martin, Nouchi Vincent, Bouffard Damien, Pasche Natacha, Shinkareva Galina, Chalov Sergei, Lemmin Ulrich, Merminod Bertrand: **Leman-Baikal: Remote sensing of lakes using an ultralight plane.** 6th Workshop on Hyperspectral Image and Signal Processing, Lausanne, Switzerland. 24 to 27 June 2014.

Akthman Yosef, Constantin Dragos and Merminod Bertrand: **Leman-Baikal: Remote Sensing of Lakes Using an Ultralight Plane.** Presented in the conference Bringing Together Selenga-Baikal Research 2014, Helmholtz Centre for Environmental Research, Leipzig, Germany. 1 to 3 October 2014.

Natacha Pasche, Vincent Nouchi, Damien Bouffard, Alfred Wüest, Yosef Akhtman, Dragos Constantin and Bertrand Merminod: **High-Resolution Mapping of Water Quality in the Selenga Delta from Remote Sensing.** Presented in the conference Bringing Together Selenga-Baikal Research 2014, Helmholtz Centre for Environmental Research, Leipzig, Germany. 1 to 3 October 2014.

OUTLOOK

In 2015, the Limnology Center would like to promote the following projects:

Research Platform on Lake Leman

The aim of this research platform is to acquire continuous records of physical properties, biogeochemical processes, as well as phytoplankton and zooplankton on Lake Leman. This platform should also promote international and regional collaboration with other research groups. The scientific equipment will be financed through a successful R'Equip proposal to FNS.

After several meetings with the main lake users, we managed to agree on a localisation near Pully at a depth of 110m. To design the platform and its anchorage system, the Center also hired the consortium Sagrave SA, Kindlimann Naval Architecture, MABO Metallbau GmbH. The official request for authorisation will be deposited to Canton Vaud in March 2015.

Underwater Automatic Vehicles to investigate ecological niches

This interdisciplinary project is a collaboration with Prof. Bas Ibelings from UNIGE and Prof. Alcherio Martinoli from DISAL laboratory at EPFL. The goal is to use underwater automatic vehicles to investigate the spatial heterogeneity of physico-biological processes in lakes. The proposal submitted on 15 January 2014 was rejected, but was resubmitted in January 2015.

Lakes on the West Coasts (to Arctic)

The goal of this project is to investigate very old water masses from last ice-age. These masses experience double diffusion and contains high concentrations of gases and old organic matter. The idea was discussed with potential interested parties (EPFL, ETHZ, Eawag, University of British Columbia, Institute of Ocean Sciences).

Lakes in Antarctica

This project aims at studying double diffusion in ice-covered lakes in Antarctica.
Potential interested parties are EPFL, ETHZ, WSL and Eawag.