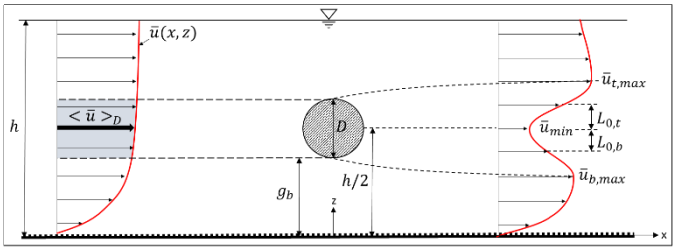
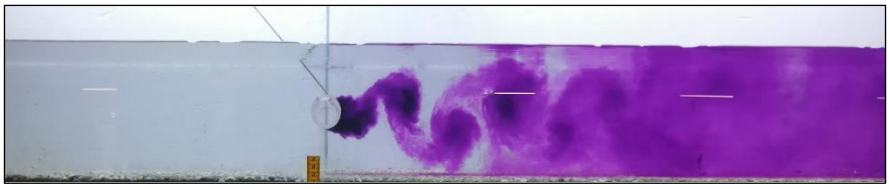
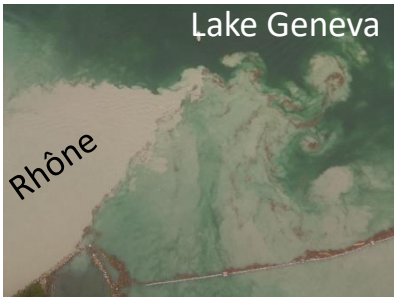
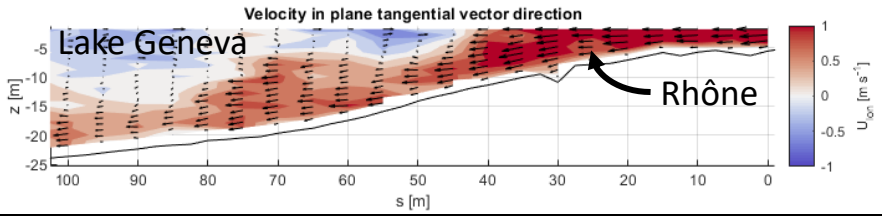
Opportunity for a research internship at TU Wien

Analyses of the perturbations induced by a horizontal cylinder in an open-channel flow

Where to?	TU Wien, Institute of hydraulic Engineering and Environmental Hydromechanics, Vienna, Austria
With whom?	Théo Fernandez, PhD., theo.fernandez@tuwien.ac.at Koen Blanckaert, Prof., koen.blanckaert@tuwien.ac.at
Keywords	Experimental, Data Analyses, Wake, Turbulence, Fluid Mechanics
Abstract	The flow past a circular cylinder has been widely investigated in the past, as cylindrical obstructions in a flow field can be found in a variety of configurations and engineering areas, such as pipeline near the sea bottom, marine and offshore structures, bridge piers or Large Wood in rivers. However, still little is known about hydrodynamic changes induced by them in the near-wake, in a confined environment. In the hydraulic lab of the TU Wien, we investigate the perturbations induced by a horizontal cylinder in an experimental flume study.  Scheme of the experiment  Dye visualization of the perturbations induced by a cylinder in a flume experiment
What we can offer	Working with us on this topic offers you the opportunity to work on an experimental project and deepen your skills in data analyses. During this internship, you will work and get to be familiar with measurement devices and techniques in order to run some experiments. You will then treat and analyse the data of your measurements and previous experiments. Just write an e-mail if you have more questions and would like to speak about the project in more details.
About us	Our group is lead by Prof. Blanckaert and works on two main topics; sediment transport and river inflows into lakes and ecohydraulics. We base our research on measurements in the field and physical experiments in the lab – both involve improving measurement techniques as a third part of our work. Currently, the group has 2 Post-Docs and 5 PhD students from Belgium, France, Germany, Austria and Indonesia.
Language	English (working language), with the occasional French, Dutch and German
Time	January 2023 – July 2023 (flexible)

Hydraulic Engineering and Environmental Hydromechanics
E222 Institute of Hydraulic Engineering and Water Resources Management

Opportunity for a research internship at TU Wien
Plunging rivers in lakes

Where to?	TU Wien, Institute of hydraulic Engineering and Environmental Hydromechanics, Vienna, Austria
With whom?	Stan Thorez, stan.thorez@tuwien.ac.at Gauthier Rousseau, gauthier.rousseau@tuwien.ac.at Prof. Koen Blanckaert, koen.blanckaert@tuwien.ac.at
Keywords	Rivers, Lakes, Plunging, Turbulence, Sediment transport, Turbidity currents
Abstract	Low temperatures and high sediment concentrations can lead river water to become highly dense. When such a dense river meets a lake, it can **plunge** (dive down) into the lake and form a gravity-driven flow at the bottom of the lake. Such flows are called **turbidity currents** and can carry oxygen, nutrients and sediment to the deepest layers of the lake, influencing the **lake water quality**. Understanding the processes related to plunging is essential to estimate how deep turbidity currents will intrude into the water column. To this end, the plunging inflow of the **Rhône River into Lake Geneva** was studied in the field by our group and efforts were made to model it **computationally** and **in the lab** in collaboration with our partners at LEGI, Grenoble. We will be continuing this research to find an answer to many remaining open questions.   
What we can offer	Working with us on plunging rivers in lakes offers you the opportunity to work on a topic that has a large impact on the lake ecosystem. You will investigate the possibilities, differences and limitations of field, lab and/or computational experiments. Your work will help us improve and expand existing conceptual models with newly gathered data. You will learn how to treat this data and how to analyse it. One-on-one supervision will be provided in combination with scientific meetings in groups.
About us	Our group is led by Prof. Blanckaert and works on two main topics; sediment transport and river inflows into lakes and ecohydraulics. We base our research on measurements in the field and physical experiments in the lab – both involve improving measurement techniques as a third part of our work. Currently, the group has 2 Post-Docs and 5 PhD students from Belgium, France, Germany, Austria and Indonesia.
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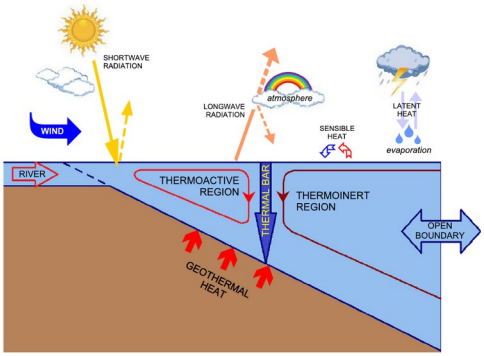
Hydraulic Engineering and Environmental Hydromechanics
E222 Institute of Hydraulic Engineering and Water Resources Management

Opportunity for a research internship at TU Wien
Density currents and thermal mixing processes in lakes

Where?	TU Wien, Institute of Hydraulic Engineering and Environmental Hydromechanics, Vienna, Austria
Supervision	Gauthier Rousseau, Dr., gauthier.rousseau@tuwien.at.ac Koen Blanckaert, Pr., koen.blanckaert@tuwien.ac.at
Keywords	Thermal bars, cabelling, differential cooling, mixing processes in lakes, heat, temperature
Context	Mixing processes in lakes are multiple and their comprehension is essential to develop predictive tools for related environmental issues (e.g. oxygen transport, biogeochemical reactions, water quality, habitat response, reservoir sedimentation). Understanding thermal (temperature-induced) mixing processes is all the more critical in the current context of global warming. *Cabbeling*[1], for example, is a surprising mixing process in lakes: when a river at 2°C flows into a lake at 6°C, the river and lake waters mix and lead to water at 4°C. Compared to other liquids, water has a density anomaly: its density reaches a maximum at 4°C and decreases with decreasing temperature, until it freezes. This causes the water at 4°C to sink to the bottom of the lake forming a so-called thermal bar. Field and laboratory measurements of cabbeling are scarce and of rather low accuracy[2,3,4]. *Differential cooling* is another intriguing mixing process. When temperature drops (p. ex. in the evening), shallow nearshore waters cool faster than deep offshore waters. This leads to a density difference that drives a density current along the bottom. Laboratory experiments would complement field observations and numerical modelling results[5,6]. The research on mixing processes in lakes is done in collaboration with the Aquatic Physics group at EAWAG (Switzerland).
Objectives	Depending on applicant's aspirations and expertise, the focus can be on numerical modelling (*openFoam*), laboratory experiments (*image velocimetry for simultaneous measurements of temperature and velocity*) or the development of innovative experimental techniques using thermographic phosphors[7] .
Requirements	• A curiosity for understanding and investigating natural processes in lakes • A background in fluid mechanics and/or physics • Knowledge in scientific programming languages (python/matlab/cpp) are a plus
About us	The supervisors have a background in physics and fluid mechanics, resp. with expertise in optical (PIV) and acoustic (ADCP) techniques for velocity measurements using python or matlab programming. More information on our group can be found on kw.tuwien.ac.at.
Language	English (main working language), German or French
Time	January 2023 – July 2023 (flexible)

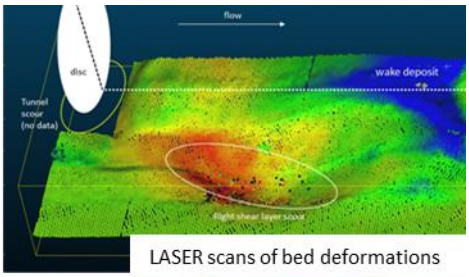
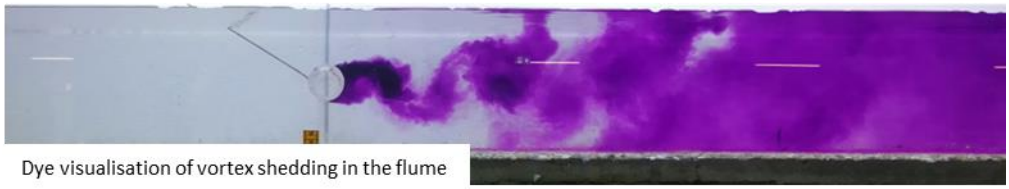


Schematic representation of the thermal bar process at a river mouth and external forcings according to Tsydenov (2019)[3]

[1] Witte, E. (1902). "Zur Theorie der Stromkabbelungen". Gaea, Köln.
[2] Carmack, Eddy C. "Combined influence of inflow and lake temperatures on spring circulation in a riverine lake." Journal of Physical Oceanography 9.2 (1979): 422-434.
[3] Ivey, G. N., and P. F. Hamblin. "Convection near the temperature of maximum density for high Rayleigh number, low aspect ratio, rectangular cavities." (1989): 100-105.
[4] Tsydenov, Bair O. "A numerical study of the thermal bar in shallow water during the autumn cooling." Journal of Great Lakes Research 45.4 (2019): 715-725.
[5] Doda, T., Ramón, C. L., Ulloa, H. N., Wüest, A., & Bouffard, D. (2022). Seasonality of density currents induced by differential cooling. Hydrology and Earth System Sciences, 26(2), 331-353.
[6] Ulloa, H. N., Ramón, C. L., Doda, T., Wüest, A., & Bouffard, D. (2022). Development of overturning circulation in sloping waterbodies due to surface cooling. Journal of Fluid Mechanics, 930.
[7] Abram, C., Panjikkaran, I. W., Ogugua, S. N., & Fond, B. (2020). ScVO 4: Bi 3+ thermographic phosphor particles for fluid temperature imaging with sub-° C precision. *Optics Letters*, *45*(14), 3893-3896.

Opportunity for a research internship at TU Wien

Wood in Rivers: Flume Experiments on Flow and Morphodynamics

Where to?	TU Wien, Institute of hydraulic Engineering and Environmental Hydromechanics, Vienna, Austria
With whom?	Ingo Schnauder, Dr.-Ing., ingo.schnauder@tuwien.ac.at Théo Fernandez, PhD, theo.fernandez@tuwien.ac.at Prof. Koen Blanckaert, koen.blanckaert@tuwien.ac.at
Keywords	Experimental Study, Rivers, Hydraulics, Wood, Flow, Turbulence, Morphodynamics
Abstract	Wood is an essential component of river ecosystems. Wood locally modifies flow patterns, turbulence and bed topography and provides habitat diversity, retention and mixing. In the **hydraulics lab of TU Wien**, we investigate the local effects of wood in **experimental flume studies** – and offer opportunities for visiting students from France to conduct a Master thesis with own **experiments, flow measurements and data analyses.**  Wood in Rivers  LASER scans of bed deformations  Dye visualisation of vortex shedding in the flume
What we can offer	Working with us on the wood topic offers you the opportunity to work on practically and ecologically relevant flow configurations in rivers. You will be able to analyse and find analogies / differences to the idealised configurations known from literature. To get there, we will show and train you to master measurement devices and techniques – so you can run your own experiments. We will help you and provide supervision on a daily level in the lab, and a weekly level with the full group. Just write an e-mail if you got more questions. Our PhD student, Théo Fernandez, has participated in the exchange programme before and is also available for questions (incl. life in Vienna if you love real mountains :)
About us	Our group is lead by Prof. Blanckaert and works on two main topics; sediment transport and river inflows into lakes and ecohydraulics. We base our research on measurements in the field and physical experiments in the lab – both involve improving measurement techniques as a third part of our work. Currently, the group has 2 Post-Docs and 5 PhD students from Belgium, France, Germany, Austria and Indonesia.
Language	English (working language), with the occasional French, Dutch and German :)
Time	January 2023 – July 2023 (flexible)