Book of abstracts

Rivers in an uncertain future

NCR days 2021| Enschede, February 11-12

Jord J. Warmink, Anouk Bomers,
Vasileios Kitsikoudis, R. Pepijn van
Denderen & Fredrik Huthoff (eds.)

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NCR Days 2021

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Photo credits cover: IJssel river from Bureau Beeldtaal Filmmakers (2018)

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Program

Online Icebreaker Party. Wednesday February 10, 2021

15.45-16.00	Digital walk-in
16.00-18.00	Icebreaker party featuring: **The famous NCR-days pub quiz**

Block 1. Thursday-morning February 11, 2021

9.15-9.30	Digital walk-in	
9.30-9.40	Opening and announcements	
9.40-9.50	Welcome by Suzanne Hulscher (Chair MFS department, University of Twente)	
9.50-10.35	**Keynote** Koen Blanckaert (Vienna University of Technology) Title: Hydro- and morphodynamics of dense river inflows into lakes	
10.35-10.45	Introduction Young-NCR	
10.45-11.00	Break	
11:00-11:30	Social session 1 Speed dates	
11.30-11.45	Break	
	Parallel sessions (11:45-12:40)	
	1A: **Advances in river modelling** Session leader:Gertjan Geerling (Deltares)	1B: **Ecological sustainability in rivers and estuaries** Session leader: Rob Lenders (RU)
11:50-12:05	Burhan Yildiz (Deltares) A satellite-image-based method to overcome data scarcity for river morphodynamic modelling	Natasha Flores (RU) Upstream passability assessment of the LTD shore channel inflows by migratory fish species
12:05-12:20	Rutger Pasman, (TUD) Damping of ship-induced primary waves in groyne fields	Kshitiz Gautam (IHE, Deltares) Assessing morphological changes and impact on ecology in Koshi River using remote sensing and cloud computing
12:20-12:35	Daan Kampherbeek (UT) Modelling ship waves for the purpose of overtopping	Frank Collas (RU) Macro- and mesoplastic abundance and composition in the water column of the river Waal

Keynote Speakers

Koen Blanckaert (Professor of Hydraulic Engineering, TU Wien)
Hydro- and morphodynamics of dense river inflows in lakes

Koen has a degree in Civil Engineering from Ghent University and a PhD from EPFL. Before his appointment at TU Wien in 2017, he was a senior scientist at EPFL, Visiting Professor at the Research Center for Eco-Environmental Sciences of the Chinese Academy of Sciences and Associate Professor at the Hong Kong University of Science and Technology. In parallel, he has worked as consultant in Switzerland. His research has focussed on flow processes and their interactions with sediment transport and biota.

Koen will speak about dense (negatively buoyant) rivers flowing into lakes. These riverine inflows are sources of nutrients, organic matter, oxygen, contaminants (e.g., mercury, microplastics), heat and sediment particles. Koen will illustrate some hydro- and morphodynamic processes with field measurements from the inflow of the Rhône River into Lake Geneva (France/Switzerland), and discuss the broader relevance of these observations.

Matthijs Kok (Professor of Flood Risk, Delft University of Technology & HKV)
Probabilistic flood risk approaches along rivers

Matthijs Kok (1956) is professor of Flood Risk at the faculty of Civil Engineering at the Delft University of Technology and expert in Risk Management (flood protection and fresh water supply). He covers almost all areas in Uncertainty, Decision, Risk Analysis and Flood Risk assessment. In his approach, supporting decisions is the ultimate aim of his analytical research. He is one of the founders of HKV, and since 1995 this company has grown to an organisation with 70 employees which combines consultancy with scientific research on water and risk related issues. He is chairman of the Expertise Network for Flood Protection (ENW) working group on Flood Risk, which is the leading authority on the development of technical design and maintenance guidelines in the Netherlands, based on the risk approach.

His presentation focuses on flood risk issues along rivers. In the presentation, attention will be given to flooding probabilities and consequences of flooding. Much attention will be given to measures which will reduce flood risk in an efficient way, using a river system perspective.

Keynote papers

Hydro- and morphodynamics of dense river inflows into lakes

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Keywords — Turbidity current, density current, field measurements

Introduction

Dense inflows plunge under the lighter surface waters of the receiving water body (Fig. 1) (Fisher et al., 1979). This plunging process is accompanied by intense mixing, and conditions the pathway of the subsequent underflow along the bottom of the receiving water body. The density of the underflow changes during its propagation due to mixing with the ambient water and exchanges of sediment with the bottom.

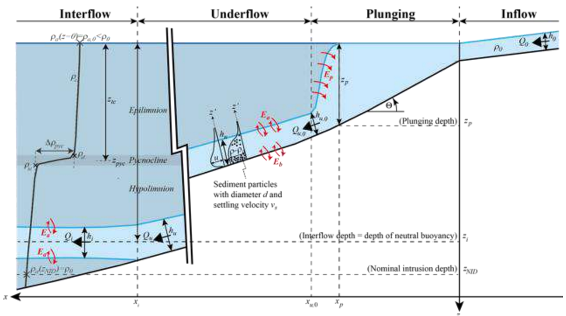

Figure 1. Conceptual representation of the flow processes of dense river inflow into a lake.

Open-channel inflows into lakes are vectors of momentum, sediments and contaminants. The inflow of sediments leads to reservoir sedimentation and can generate turbidity currents (underwater avalanches) that threaten infrastructure. The spreading and mixing of the introduced quantities control the water quality.

Knowledge on the relevant hydro-and morphodynamic processes is still largely based on laboratory experiments in simplified configurations (Alavian et al. 1992). The main simplifications are typically a constrained narrow-width geometry, a lack of sediment, a lack of stratification, and a smooth bottom.

A field investigation on the geometrically unconstrained inflow of the sediment-laden Rhône River into the stratified Lake Geneva (France/Switzerland) is reported. The principal research questions are: (i) what are the hydro- and morphodynamic processes in the plunging region; (ii) how can the mixing in the plunging region be parameterized; (iii) what are the hydro-and morphodynamic processes related to the turbidity currents; can the observations be explained with commonly used models ?

Methods

A unique feature of the investigated configuration is that the properties of the riverine inflow, the lake stratification and the lake bathymetry are all known from publicly available data (Fig. 2).

An intricate morphological feature is the delta-canyon-fan system that is cut by the inflowing Rhône River into the bottom of Lake Geneva (Fig. 2) (Forel, 1892).

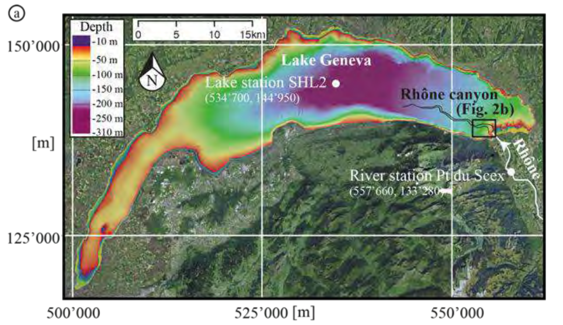

Figure 2. Lake Geneva, the Rhône River inflow, the Rhône River submarine canyon and the measuring stations on the river and in the lake.

Continuous flow measurements were performed with ADCP's moored at three locations in the canyon, where the depths are 130m, 150m and 190 m, resp. The ADCPs provide the vertical profiles of the velocity. Continuous monitoring of the surface patterns in the plunging area was performed with an autonomous remote sensing system, equipped with RGB and IR cameras, installed on a viewpoint overlooking the river mouth.

Additional event-wise measurements were made in the plunging region. A balloon equipped with RGB and IR cameras observed the surface patterns with higher spatial and temporal resolution, and the 3-D velocity pattern were measured with a boat-towed ADCP. This ADCP provided in addition the elevation of the lake bottom.

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Results

Plunging

The images form the remote-sensing cameras revealed beautiful and quite surprising surface patterns in the plunging region (Fig. 3). The riverine inflow converges when entering the lake, and vortical stabilities at multiple spatial scales occur at the interface between the river and lake waters. The triangular plunge line and vortical instabilities do not occur in laterally constrained geometries, such as found in typical laboratory flumes.

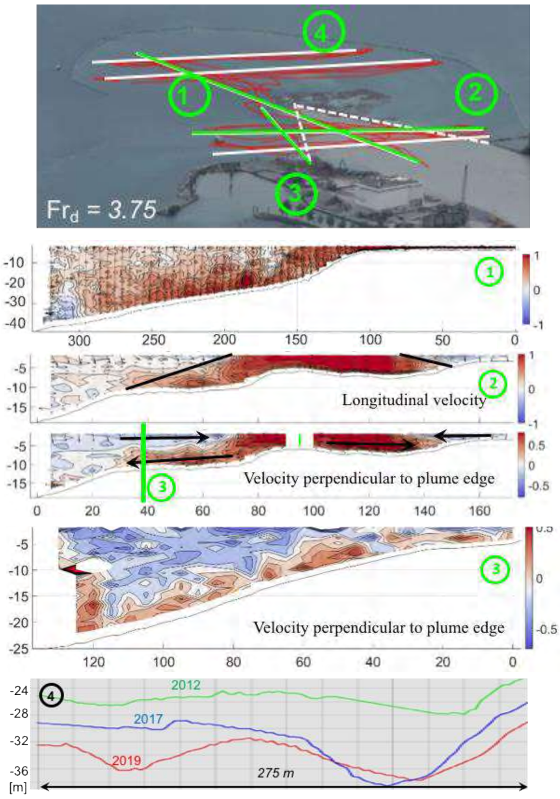

Figure 3. From top to bottom. Surface pattern revealed by remote sensing and boat trajectories; Velocity along longitudinal transect 1; longitudinal velocity across cross-section 2; Velocity perpendicular to the plume edge in cross-section 2; Velocity perpendicular to the plume edge along transect 3.; Bathymetric changes along cross-section 4.

The boat-towed ADCP measurements clearly reveal the corresponding 3-D flow structure (Fig. 3). A "classical" plunging flow structure is visible in the longitudinal-vertical transect no 1 along the axis of the riverine inflow. The measurements in the cross-section no 2 and transect no 3 reveal that the riverine inflow collapses laterally. This is different from the plunging in laterally constrained geometries, where the lateral collapse is suppressed, leading to significant amplification of plunging mixing.

Surprisingly large bathymetric changes of the order of 10 m per year were observed in the plunging area.

Turbidity currents

In general, the Rhône inflow is captured in the thermocline of the lake. Storm-events in the Rhône watershed, however, temporarily lead to high suspended sediment concentrations in the Rhône and an increased density excess that induces turbidity currents in the lake that break through the thermocline and reach the fan of system at a depth of 280 m.

The maximum velocity in these turbidity currents is about 5 m s^{-1}, which is significantly higher than the velocity of the river inflow (Fig. 4).

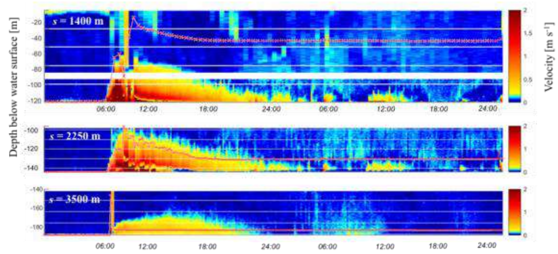

Figure 4. ADCP measurements of a turbidity current on July 3th,2018 at locations in the canyon where the lake depth is 130m, 150m, and 190 m, resp.

The peak discharge in the turbidity current is about 15'000 m^3 s^{-1}, which is about 30 times higher than the peak discharge in the river. A tentative explanation is that the turbidity current is fuelled by massively picking up sediment from the bottom in the plunging area, which increases its excess density. This pronounced interaction with the bottom is confirmed by a 6m thick layer of deposited sediment after the passage of the event.

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