Co-UDlabs

Press release

Acoustic monitoring of suspended solids in natural and engineered systems

Co-UDlabs Webinar. 16/05/2023

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CO-UDLABS WEBINAR EXPLORES THE ADVANTAGES OF ACOUSTIC TURBIDITY SENSORS IN OVERCOMING CHALLENGES OF TRADITIONAL OPTICAL PROBES

16.05.2023

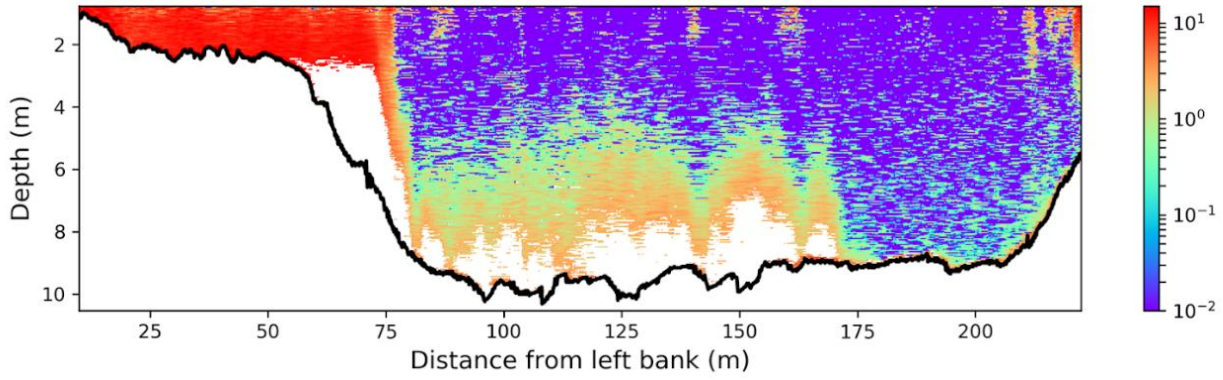
Co-UDlabs, an EU project funded by the INFRAIA H2020 program, organized a groundbreaking training event on acoustic monitoring of suspended solids in natural and engineered systems. The webinar, held on May 16, 2023, brought together particle experts, sensor manufacturers, and practitioners experienced in monitoring campaigns. The goal was to bridge the knowledge gap surrounding the limitations of traditional optical turbidity probes and highlight the recent advancements and potential solutions offered by acoustic turbidity sensors.

Traditional optical methods for monitoring total suspended solids (TSS) in water face challenges and require extensive calibration and maintenance. Acoustic turbidity monitoring, on the other hand, presents a modern approach utilizing acoustic profilers.

During the webinar, renowned experts discussed the principles of acoustic turbidity and its application in urban and wastewater systems. Prof. Peter Vanrolleghem highlighted the importance of continuous particle monitoring in urban drainage systems as a pollution level indicator and stressed the need for high-frequency monitoring and modeling to effectively manage urban pollution.

Stéphane Fischer, from the Ubertone Company, explained the fundamentals of acoustic turbidity and its advantages over optical turbidity for measuring suspended sediment concentration. He showcased practical applications of Ubertone's scientific instruments in wastewater treatment plants, rivers, sewers, and beaches, demonstrating the versatility and potential of acoustic scattering. The new hyperband Acoustic Backscattering System (ABS), the UB-SediFlow, shows its potential for continuous suspended sediment concentration monitoring.

Céline Berni presented recent progress on inversion techniques for acoustic turbidity measurement, focusing on evaluating hydroacoustic models and inversion methods for rivers. She reported on laboratory experiments and field measurements in the Rhone River, highlighting challenges and potential solutions for accurately modeling sediment response and additional scatterers in rivers.

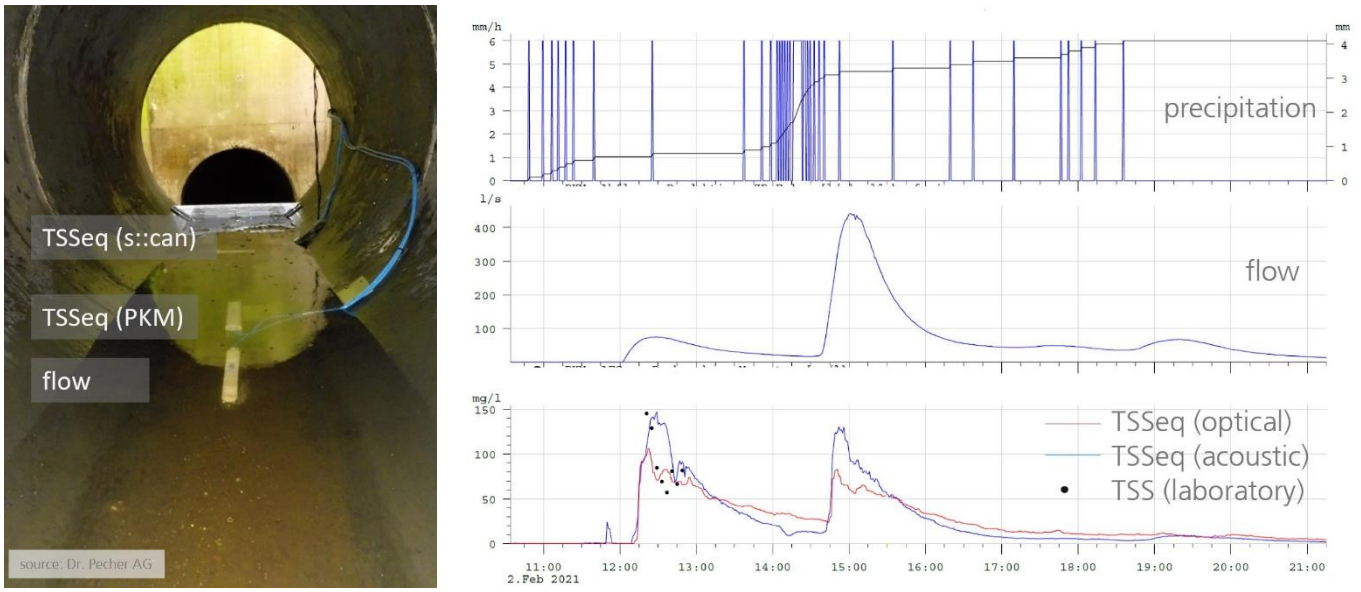


Inverse fine SSC outputs [g/L] from acoustic backscatter profiles in the confluence of Rhône and Isère rivers. Source: Vergne et al. (2020)

Asmorom Kibrom unveiled NIVUS's groundbreaking research and development work on their new sensor, the Particle Concentration Measurement (PKM). The PKM sensor addresses the limitations of existing optical spectrometer probes, specifically designed to measure particle concentration and mass flow in sewer networks. Dr. Kibrom emphasized the sensor's practical advantages and preliminary results showcasing its effectiveness in capturing concentration variations over time.

Manuel Regueiro discussed the use of acoustic sensors for monitoring suspended particle concentrations and sizes in water systems, focusing on research conducted in collaboration with Eawag. The findings demonstrated the correlation between acoustic turbidity profiles and particle sizes, while addressing challenges related to accurately measuring particles, including bubbles.

Daniela Böckmann shared insights from a pilot project in Emsdetten that utilized the PKM sensor alongside an optical sensor to survey storm sewers. The data collected during the project informed the planning of a stormwater treatment concept tailored to the catchment's pollution characteristics. The acoustic sensor demonstrated advantages in terms of lower disturbance and reduced maintenance requirements.



Measurement campaign in a storm sewer (left) and data from rain intensities, flow rates and TSS concentrations comparing acoustic, optical and laboratory measurements (right). Source: Daniela Böckmann (Dr. Pecher AG).

Anne Pallarès presented her team's pioneering work on Time Resolved Optical Turbidity (TROT), a novel technique combining optical and velocity measurements for real-time turbidity data. The experiments showcased TROT's capabilities in differentiating particle concentrations and its potential for biofouling resistance in wastewater monitoring. Anne Pallarès emphasized the complementary nature of optical and acoustic techniques, advocating for their integration to advance sediment transport monitoring.

TAKE HOME MESSAGES

Acoustic turbidity monitoring presents important advantages over traditional optical turbidity methods for measuring suspended sediment concentration. In practical application, it is less affected by biofouling. The effectiveness of acoustic scattering has been demonstrated in various applications, such as rivers, beaches,

hydropower facilities, as well as wastewater treatment plants and sewers. The various scientific sensors that are commercially available do not come with built-in inversion methods to compute levels of solid concentrations or turbidity. In contrast, the newly available heavy-duty industrial sensors require (strong) assumptions on the scattering properties of the solids, which can differ from the conditions in the field.

Continuous TSS monitoring, enabled by high-frequency monitoring and modeling, not only acknowledges the important role of particles in pollution assessment, but also opens opportunities for effective solutions. In practical applications, for example, real-time control to improve the effectiveness for stormwater pollution, the virtually maintenance-free operation of acoustic sensors can outweigh the lack in precise measurements.

Optical turbidity sensors are effective for monitoring small particles and perform poorly at high concentrations, while acoustic turbidity sensors are more sensitive for large particles and perform poorly at low concentrations. Therefore, the complementary nature of optical and acoustic techniques was highlighted, with many participants advocating for their integration to advance suspended solids monitoring. This integration, as showcased with the work on Time Resolved Optical Turbidity (TROT), can provide real-time turbidity data, differentiate particle concentrations, and offer potential resistance to biofouling in wastewater monitoring. Also, gathering and re-analysing available datasets with novel inversion methods seems very promising.

The Co-UDlabs webinar provided a valuable platform for knowledge sharing and collaboration among experts and industry professionals. Endorsed by the International Water Association (IWA) and the International Association for Hydro-Environment Engineering and Research (IAHR), the event highlighted its significance in the water quality management domain. The recorded presentations are available on the Co-UDlabs youtube channel.

Co-UDlabs is dedicated to advancing research, innovation, and practical applications in the urban water sector. For this purpose, the partners provide free-of-charge access to 17 facilities of relevant scientific and technical excellence. The access to the facilities is open to the international community through Transnational Access (TA) projects. The next TA call will open at the NOVATECH conference on July 3.