EDITORIAL

Sediment challenges and opportunities due to climate change and sustainable development

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1 Introduction

We are glad to introduce the selection of topics presented at the 12th international SedNet conference organized in partnership with the Bureau de Recherches Géologiques et Minières (BRGM) and the Hauts-de-France Region, which was originally planned in Lille, France, but due to the COVID-19 restrictions, it was instead organized online from 28 June to 2 July 2021. The event was held in parallel with the 7th International Symposium on Sediment Management (I2SM) conference and was attended by 275 participants with access to both conferences. In addition to the classical SedNet sessions, such as sediment quality assessment, sediment management, and circular economy, the SedNet 2021 conference was dedicated to climate change and emerging pollutants such as per- and polyfluoroalkyl substances (PFASs) and microplastics, which are issues of global concerns. No less concerning is the global problem of sediment starvation due to dam constructions. The wider public and decision-makers are often unaware of the potential risk connected to sediment starvation such as coastal erosion, the sinking of deltas, salinization of groundwater, and changes in nutrient contribution. These issues were covered under the SedNet session “Impacts of Disturbed Sediment Continua and Mitigation Measures”. The session that probably brought together all issues related to sediments in the most positive way is “(Re)Using Sediment to Create, Keep or Restore Habitats.”

It should be emphasized that the SedNet conference is one of the rare conferences that gather together scientists, sediment practitioners, and decision-makers. For scientists and sediment practitioners the conference brings the opportunity to learn about real problems in the field, while decision-makers can be alerted to emerging problems and potential risks involved. Some of these issues are presented in 11 selected papers that are described below. There were many other very interesting studies presented at the SedNet conference which can be found following the links at https://sednet.org/events/sednet-conference-2021/sednet-conference-2021-presentations/ and https://sednet.org/wp-content/uploads/2021/07/SedNet-Lille-2021-closing-session-2-July-2021-FINAL.pdf. We hope you will enjoy the reading of this special issue and be motivated to further explore the studies presented at the SedNet-2021 conference.

2 Circular economy

The circular economy sessions offered insights on beneficial or more sustainable uses of dredged sediments, as opposed to disposal or relocation without benefits. They also hosted presentations on remediation or processing technologies aimed at facilitating beneficial uses.

Pellegrini (2022) presented the monitoring results of innovative technology, the ejector’s plant, tested for 15 months in the MARINAPLAN PLUS LIFE project for sustainable sediment dredging in harbors. The sediment–water mix is pumped with an open jet pump and then transferred through
a pipeline and discharged in an area where the sediment can be picked up again from the natural water current or is not an obstacle for navigation. Within the monitoring, the assessed parameters were water depth variation, energy consumption, maintenance costs, seabed features, species diversity, equivalent CO₂ emissions through LCA, and underwater noise impact. Results showed an improvement in the ecological status of the marine ecosystem in the area affected by the plant.

Garcia-Blas et al. (2022) presented the results on the usage of citric acid (CA) and ethylenediaminetetraacetic acid (EDTA) as surfactants that enhance the removal of Cr, Ni, Cu, Zn, As, Cd, Pb, and Hg by electrokinetic sediment remediation. Both CA and EDTA allow the desorption of contaminants from organic matter, enabling their removal from the solution.

Macci et al. (2022) presented the results of the AGRIPORT project, in which saline and brackish sediments were mixed with agronomic soil and underwent phytoamended. After 2 years, contaminants concentrations decreased, and the improvement of chemical and biological properties created a “functional soil” for further applications in projects CLEANSED (nursery plants growing) and HORTISED (horticultural plants growing). The landfarming process further reduced the organic contaminants in both sediments, while the yield was comparable to growing on conventional soils.

3 Sediment assessment and management – concepts and policies

One of the very active groups in developing advanced methods for improving port management comes from the Technische Universität Delft (TU Delft), Netherlands. They presented three studies conducted for the Hamburg and Rotterdam Port Authorities. Zander et al. (2022) presented the effects of microbial organic matter degradation on sediment rheological properties. After exposing sediments collected from Port of Hamburg, Germany, for 250 days in glass bottles to aerobic and anaerobic conditions in a laboratory environment, they found that degradation of organic matter significantly reduces the sediment strength, especially under anaerobic conditions. The reduced static and fluidic yield stress of sediments can enhance port maintenance dredging and navigability of ports and waterways. Shakeel et al. (2022) studied the impact of microbial degradation of organic matter on the rheological properties of mud samples by exposing fresh and degraded mud samples collected from three different locations in the Port of Hamburg to various stress tests (stress ramp-up tests, amplitude sweep tests, frequency sweep tests, time dependence tests, and structural recovery tests). They confirmed that degradation of organic matter indeed weakens the strength of mud and found that the strongest degradation occurs after 3 and 150 days. The authors also noted that phytoplankton can play a significant role in the settling of fine-grained sediment by facilitating the accumulation of organic matter. Buisman et al. (2022) presented a very novel distributed acoustic sensing (DAS) method developed for continuous bathymetry measurements. They identify standing waves along an optical fiber colled vertically, to measure the depth between mud–water and water–air interference. The standing wave can be obtained by applying an echo-sounder or by using ambient noise. This enables remote, fast, and on-demand monitoring of the waterways’ depths, e.g., after severe storms.

Harrington et al. (2022) tackled an important topic, which has not yet been dealt with often, on how to evaluate and compare the economic consequences of different sediment management options for specific sites. Based on information on the respective economic impact area, the site location, sediment characteristics, and unit costs, they propose a method to evaluate the logistical chain of project activities (from dredging the sediments to placement, use or disposal) with regard to the contribution to GDP and the resulting impact on jobs. With these analyses, the authors developed a method to inform stakeholders on the economic benefit of different sediment management options for specific sites as one criterion in the overall decision-making process.

4 Climate change and sediments: direct and indirect consequences and opportunities

Reduction of atmospheric carbon dioxide is one of the most important challenges nowadays. In this context, Vinković et al. (2022), in a paper with contributions from a high number of authors, explore the response of sediments to climate change and their capability to sequester C. They found that the recently increased sediment accumulation rate and increase in organic and inorganic C in the sediments of both Adriatic and the Black Sea, which have very different maritime characteristics, is correlated with the increase in atmospheric CO₂. This might be indicative of the C sea fertilization that calls for further investigation. The study highlighted the important role of sediments in regulating the Earth’s climate.

The spatial and temporal distribution of sediment particles from their source in the deposition area in a dammed reservoir was studied by Wilk et al. (2022). The results between the two analyzed hydrological units, catchment, and reservoir, in combination with modeling tools under climate change predictions, highlighted a possible negative impact in the future due to the increased mobility of clay particles in the reservoir.
5 How to deal with emerging substances

The important subject of assessing the toxicity of floodplain soils, for the case of barium, which can be toxic in high concentrations, is undertaken in the paper by Cappuyns (2022). She determined that only a small proportion of barium was available for uptake by living organisms or for leaching, concluding that the use of rapid screening of barium availability should be considered for environmental quality guideline purposes.

The ever-increasing accumulation of microplastic in the marine environment is receiving global attention, but gaps in addressing the problem remain due to insufficient knowledge of its impact on ecosystems and human health. Thus, it is important to study the distribution and typology of microplastics in relation to human activities and how it alters the quality of the aquatic ecosystem. Bošković et al. (2022) examined microplastics in the surface sea sediments of the Montenegrin coast.

The authors determined the abundance, distribution, shape type, colors, size, and polymer type of the microplastic as well as the most significant sources of microplastic pollution, providing interesting data for advancing research on this topic.

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