Karlsruher Institut für Technologie

Seminar@IWU-WB

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Forcing the Flow, Shaping the Bed: New Insights into River Morphodynamic Control

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KIT, Bldg.10.81, Room 305
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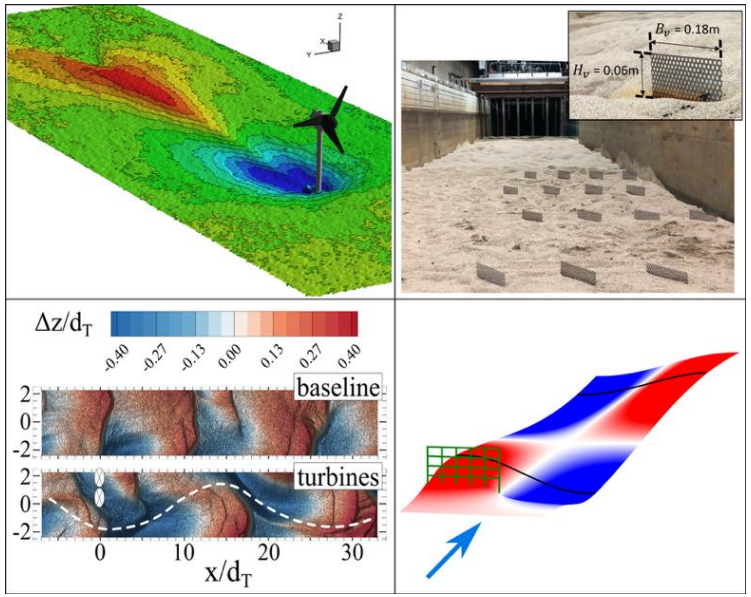

Abstract

Sediment transport and river morphodynamics remain among the most complex challenges in civil engineering and Earth sciences. While efforts to control them have driven advances in erosion mitigation, flood protection, and navigation, they have also led to interventions that often suppress natural river dynamics. Yet, in the face of climate change, understanding and managing sediment processes remains both a practical necessity and a scientific challenge. In this talk, I will present a series of non-conventional approaches to controlling sediment dynamics that shape my broader vision for sustainable river engineering. Experiments with hydrokinetic turbines and porous structures demonstrate how flow–sediment interactions can be manipulated to generate controlled scour and deposition, and steer sediment transport directionality. Beyond these local effects, the same experimental systems reveal large-scale morphodynamic instabilities in the form of bar-like bed deformations. These observations, coupled with a new analytical framework that incorporates forcing into morphodynamic theory, suggest that external forcing can actively influence river morphology. Together, these results highlight opportunities to work with, rather than against, natural river dynamics to support sustainable river engineering.

Biography

Mirko Musa is an Assistant Professor at EPFL, where he directs the Sustainable River Engineering, Energy, and Morphodynamics (STREEM) Lab. His research combines laboratory experiments, data analysis, and analytical modeling to study sustainable river engineering, morphodynamics, and river-based renewable energy. He focuses on the interactions between hydropower and hydrokinetic technologies and sediment-rich river environments, as well as fundamental processes in sediment transport and bedform dynamics. Before joining EPFL, he was a research scientist at Oak Ridge National Laboratory, supporting U.S. Department of Energy efforts in hydropower and marine energy. He holds a Ph.D. from the University of Minnesota, where he worked at the St. Anthony Falls Laboratory, and B.S. and M.S. degrees from the University of Trento.

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