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The uptake of emerging remote sensing technologies into river survey practices

Simone Bizzi (1), Barbara Belletti (1), Patrice Carbonneau (2), Andrea Castelletti (1), and Hervé Piégay (3)

(1) Department of Electronics, Information, and Bioengineering, Politecnico di Milano, Piazza Leonardo da Vinci, Milano, Italy, (2) Department of Geography, Durham University, Durham, UK, (3) University of Lyon, UMR 5600 CNRS EVS, ISIG platform, Site ENS de Lyon, 15 Parvis René Descartes, F-69362 Lyon, France

In the last decades, river management is facing unprecedented challenges due to the increased human pressures affecting our river systems almost worldwide. To design effective management measures, we need a proper understanding of how riverscape processes operate at the basin scale: characterize where sediments are produced, how they are stored and re-worked within the catchment over time, how hydrology, climate, and more recently human pressures affect these processes, and how the emerging connectivity pattern shape river channel forms and processes and support ecological processes. River surveys (e.g., River Styles and MQI) allow such understanding of fluvial processes and effective support river management. However, they require substantial resources and, so far, generated mostly a qualitative type of understanding without considering so far driving factors in a multi-scale perspective.

Meantime, in recent years, emerging remote sensing technologies are significantly transforming river science. Applications to geomorphology are huge and they contribute to advance all kinds of traditional fluvial monitoring practices. They allow to provide indicators in an objective, comparable and consistent way, they can rely on low cost, high resolution, small scale technologies, as well as generate large scale (e.g. global) lower resolution datasets (e.g. from satellites). The accuracy and the cost of these technologies are changing fast and opportunities for the near future are unprecedented.

Despite that, existing river survey practices have not yet formally and conceptually assimilated these emerging technologies and associated layers of information. We have failed so far to provide a proper conceptual framework to integrate fluvial remote sensing into traditional river surveys. In concrete this means: i) to incorporate in the river survey the design of appropriate monitoring networks and acquisition campaigns based on available state of art technology; ii) to propose new indicators based on spatial and temporal resolutions of these newly generated datasets; iii) to provide suitable analysis tools to process big data generated by remote sensing technologies; iv) to delineate the limits of current technologies and integrate these gaps with traditional approaches.

The Italian Research and development Initiative for Spaceborne river monitoring (IRIS) project (funded by ISPRA, the National Institute for Environmental Protection and Research) aims at developing tools for monitoring medium-large river systems from remote sensing. Drones and traditional field techniques (e.g. RTK-GPS) are used to survey local river features, e.g. topography, sediment size, vegetation, morphological habitats. These datasets are then used as ground truth to test what can be detected at large scale from the recent Sentinel satellites from the Copernicus program. The objective is to provide prototypal tools and guidelines for an integrated, multi-scale framework for monitoring medium-large river systems fusing most recent advances in remote sensing. In this paper, we use preliminary results from this project to review river survey practices in the light of emerging technologies in fluvial science, and provide conceptual frameworks to properly place the huge amount of new generation remote sensing information into river surveys state of art practices.