Flood Hazard Mapping in Dynamic Rivers

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The incidence of river floods has shown a substantial increase within the past few decades (Blöschl et al., 2020). Owing to the pervasive influence of climate change and the increase of exposure and vulnerability in many countries, it is expected that floods will exert an ever-expanding influence on global populations in the near future. Mitigation of floods effects requires acting on several aspects (i.e., hazard, exposure, vulnerability) and improving our capability in assessing and mapping flood hazard remains a crucial aspect.

Flood hazard consists of a combination of hazards caused by inundation and river channel dynamics. While for low-energy or highly-controlled rivers the evaluation of inundation probability may be sufficient for a first order assessment of the overall flood hazard, in more dynamic rivers the assessment of hazard related to geomorphological dynamics assumes crucial importance. Hazards related to geomorphological processes in fluvial contexts have historically been poorly considered for management and planning purposes. Only recently there has been a development of geomorphological approaches and methods aimed to specifically assess channel dynamics or instabilities in response to hydrological events (e.g., Biron et al., 2014, Rinaldi et al., 2015).

The aim of this project is to test and further develop the "River Morphodynamic Corridors" approach proposed by Rinaldi et al. (2015). The effectiveness of such corridors for flood hazard mapping was recently confirmed by Brenna et al. (2024) (Figure 1). Despite its significant implications for flood hazard mapping and river management in general the idea of mapping "River Morphodynamic Corridors" has been applied in few rivers worldwide and mostly for research purpose. In parallel, at present satellite imagery offers novel opportunities to assess very accurately direction and rate of bank erosion and, overall, morphological changes (Bozzolan et al., 2023, Carbonneau and Bizzi, 2024). Such approaches for medium and large rivers (wider than 50 m) can be applied semi-automatically and globally. For instance, Sentinel 2 data are freely available worldwide with a reacquisition time of 5 days and a spatial resolution of 10 m in VIS and NIR.

The aim of this PhD project is to build on these new capacities to use satellite datasets to delineate river corridors and to extract their planimetric dynamics automatically over the years. Making the "River Morphodynamic Corridors" approach satellites based has the potential to make it applicable with little efforts widely and it opens to the possibility to test the effectiveness of the methodology on recent flood events worldwide. This research aims to make river geomorphic flood mapping applicable widely proving its utility and relevance in hazard assessment.

Possible collaborations: Prof. James Brasington (University of Canterbury, New Zealand)
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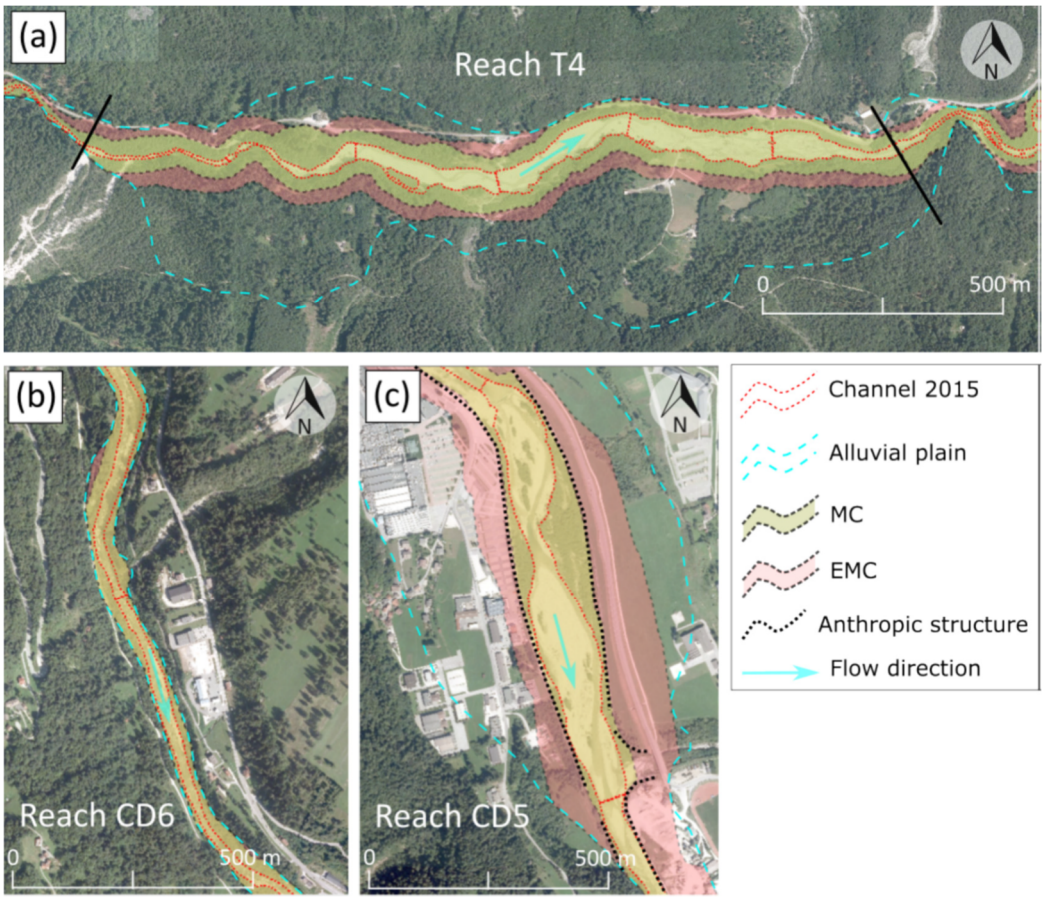

Figure 1. Comparison of Morphodynamic Corridors (MC) and Event Morphodynamic Corridors (EMC) in the Tegnas Torrent (a) and Cordevole River (b and c) in the Dolomites, Italy (from: Brenna et al., 2024)