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Exploring interactions between hydrogeomorphological processes and riparian vegetation along the Fiume Tagliamento, Italy, using remotely sensed data

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This paper explores the potential of remotely sensed data to enhance understanding of the bi-directional interactions between hydrogeomorphological processes and riparian vegetation in fluvial systems. A combination of multispectral satellite imagery, aerial photographs and airborne LiDAR data are used to quantify spatiotemporal variation in vegetation coverage and channel morphology along the Fiume Tagliamento: a braided, gravel bed river in NE Italy that is largely unmanaged and has an intact riparian margin for most of its length. This information is then combined with continuous river stage data and ground measurements of vegetation height and growth rates and bed material size to elucidate the influence of flood disturbance and local growth and river energy conditions. The ecosystem engineering capabilities of riparian vegetation along the Fiume Tagliamento are highlighted by i) contrasts in the frequency distributions of LiDAR-derived bed elevation values in vegetated and non-vegetated reaches that relate to sediment accumulation by vegetation; and ii) the establishment, growth, coalescence, and resistance to floods of vegetated island features identified using multi-temporal Landsat TM data. Vegetation coverage is shown to reflect spatial variation in energy conditions along the river, with greater amounts of vegetation supported in reaches where stream power is low, while vegetation growth and expansion rates appear to relate to spatial variation in water availability. No simple relationship between vegetation removal and flood magnitude or frequency is evident. Instead, vegetation loss is shown to be controlled by complex channel planform adjustments that can occur over a range of competent flows, and in which spatially-variable form-process feedbacks are likely to play a crucial role.