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## Morphological response to climatic and anthropic pressures of the Vjosa river, a reference system for river management and restoration

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Besides their environmental values, near-natural rivers offer the opportunity to observe and investigate riverine processes as they would occur under limited anthropic pressures, representing fundamental references for river management and restoration. Even so, few large near-natural rivers can still be found in Europe and worldwide, and their knowledge is often scarce due to a lack of hydromorphological monitoring and baseline studies. Among them, the Vjosa/Aoos River (GR, AL) has been recently recognized as a key large fluvial corridor and a significant model ecosystem. We investigate the catchment-scale recent morphological trajectories of the Vjosa river and its tributaries, coupling the reconstruction of channel adjustments over the past 50 years from remote sensing images with the analysis of possible drivers of change at the catchment and reach scale. We considered eight reaches in the main course of the Vjosa river as well as in some major tributaries (Sarandaporo, Drinos, Shushica) with different morphologies and confinement degrees. Our results underline the sensitivity of the Vjosa system to both hydrological alterations and human pressures. Specifically, it is possible to observe a response of the system passing from an intense period of high magnitude, frequency, and duration of flood events in the 1960s to a drier period in the following decades. To study the morphological response, three time periods are considered: 1968-1985, 1985-2000 and 2005-2020. In the first examined decades, river trajectories highlight the narrowing of the active channel as a primary response to the hydrological change in the majority of selected reaches, with a 20-50% active width reduction with respect to 1968. In the following time periods, the narrowing rate decreases at the catchment scale, while in the last phase the effect of human pressures in some reaches can be observed. Indeed, from the late 1980s, human pressures at different spatial and temporal scales can be identified, locally altering the natural trajectory of the affected reaches. Such pressures include sediment mining and extensive bank protection of the lowland reaches, together with flow regime alteration occurring in one headwater sub-catchment. However, our analysis reveals primarily a high sensitivity of the Vjosa system to recent climatic variations, suggesting the importance of accounting for future projected changes in rainfall regime in shaping morphological trajectories. The baseline knowledge on the morphological sensitivity and recovery

time developed in this work provides an important reference for the management of highly dynamic river corridors in temperate and Mediterranean climates.