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Modelling riverscape evolution in the Danube Floodplain National Park (Austria) - Effects of flooding and side-arm reconnections on lateral connectivity and geomorphic change

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The Danube's discharge in the National Park is highly variable, influenced by Alpine snow and glacier melt as well as regional rainfall. Average flow typically ranges between 1,500 and 1,900 m³/s. Low flow levels can drop to 600–900 m³/s, while 100-year flood events can reach 8,500 – 11,000 m³/s. Due to climate change, there is an overall decreasing trend in growing season (April–September) streamflow, while winter volumes are slightly increasing due to changing precipitation patterns. Snowmelt-driven spring floods are occurring earlier, and often more pronounced, in the year due to reduced mountain snow storage. While major floods are rare due to regulation, extreme precipitation (like the 2002, 2013 or 2024 events) can cause rapid regional flooding with significant geomorphic effects.

The National Park contains the last major “free-flowing” stretch of the Danube in Austria (36 km), yet it faces significant structural and ecological challenges. A major deficit in bedload sediment from upstream dams causes the riverbed to deepen progressively. Management combats this by dumping gravel to stabilize the bed. Paradoxically, while the main bed level sinks, the floodplains (incl. present side arms) are rising due to overbank sedimentation, fragmenting vital floodplain habitats and increasing terrestrialization trends. Projects like "Dynamic Life Lines Danube" aim to foster complete side-arm reconnections to reactivate “natural” erosion and the renewal of aquatic habitats in the adjacent floodplains.

Within the EU-funded “DANube SEdiment Restoration (DANSER): Towards deployment and upscaling of sustainable sediment management across the Danube River basin” project, the Danube Floodplain National Park section comprises an important pilot site in the “Upper Danube DEMO” region. One essential project task is to model the long-term hydro-geomorphic effects of different types of river(scape) management and restoration efforts, such as the reconnection of side-arms. In this presentation, we will highlight the results of different scenario runs using the 2D landscape evolution model CAESAR-Lisflood. We will focus on complex hydro-geomorphic responses to various external (incl. management) and internal perturbations, with a particular focus on the effects of flooding and side-arm reconnections and related long-term consequences for lateral connectivity and riverscape evolution.

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