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Investigation of the morphological and ecohydraulic evolution in the course of river restoration works in a transboundary section of the Thaya River

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Downstream of Bernhardsthal to its confluence with the Morava River, the Thaya River forms the border between Austria and the Czech Republic. Here, in the about 15 km long river section, the river was channelized in the 1970ies and 1980ies mainly by meander cut-offs and bank protection. In addition, this section is impacted by sediment retention in upstream reservoirs and by the effects of climate change, which has led to adverse morphological response of the river and a decline in habitat diversity. Since original habitats in the form of oxbows and riparian forests still exist in the immediate vicinity of the Thaya River, the potential for restoration is particularly high. This was exploited in two projects (Dyje 2020/Thaya 2020 and Thaya Wellendynamik/Dyje, rovnovážnádynamika odtokových poměrů, funded by the EU through INTERREG AT-CZ), where restoration measures such as the removal of bank protection and enhanced bank erosion by large woody debris structures, as well as the reconnection of meanders were implemented. Without monitoring of the morphodynamics before and after restoration, the effects of these efforts would remain unclear.

In the EU-funded project SEDECO (INTERREG AT-CZ), morphological changes and the current morphodynamics of the Thaya River in this section were investigated. The analysis is mainly based on cross-sectional measurements from 1996, which were resurveyed within the project. Furthermore, the current morphodynamics, occurring after the implementation of the restoration measures, are surveyed in detail. By comparing the different data sets, the development of the river was assessed and a sediment budget was calculated applying the newly developed sediment budgeting tool BudSed. Additionally, the suspended sediment transport is measured at a monitoring station in the upstream part of this section. These data were supplemented by orthophotos to determine the evolution of the active channel. Meso- and micro-scale habitat modeling, including climate change scenarios, will be conducted to evaluate habitat enhancement resulting from the meander reconnections. Besides numerical simulations, physical modeling of morphodynamics will be performed in the new hydraulic engineering laboratory, built as part of the project, allowing the performance of large-scale tests.

The project results show that the entire section is affected by erosion. This is most likely the result of the straightening and slope increase of the river, as well as the sediment deficit caused by the upstream reservoir. Sections without bank protection exhibited less incision and more lateral dynamics such as widening and migration of the river axis. The smaller width/depth ratio in reaches with protected banks indicates that impeded bank erosion is compensated by more bed incision. The sediment budget shows an imbalance as more sediment is transported out of the section. This imbalance will persist until the river has changed sufficiently to compensate for human impacts or new measures are taken to reduce their effect. In this respect, the recent reconnections of meanders seem promising by reducing the slope and thus sediment transport capacity. Furthermore, preliminary results of the habitat modeling indicate that the depth and width variations increased and habitat availability became larger even at low flow conditions.