Modelling the impact of climate change and human pressures on the evolution of the anastomosing river network.

Anastomosing rivers constitute a rare example of rivers with multiple, interconnected channels that enclose flood basins. They were historically common in temperate zones before extensive agricultural and industrial development in river valleys, however, currently few of them remain in temperate zones, and their protection is an international conservation priority. There is continual debate among hydromorphologists on key factors controlling the creation, functioning and response to pressure of anastomosing rivers. They occur in different geological and climatic conditions and are considered as an example of equifinality, i.e., different combinations of processes or causes produce a similar geomorphic form. Consequently, it is hard to define one universal hypothesis for all anastomosing rivers worldwide, explaining their origin, evolution and response to land use/climate changes and river engineering/management, and hence, site-specific studies across the globe are highly required to increase the knowledge on this type of rivers.

The overall objective of the proposed project is to increase the understanding of the evolution of lowland, vegetated anastomosing river under multiple, environmental and human pressures, with special focus on the fundamental processes such as erosion, transport and deposition of sediments. To be specific, environmental pressures refer to climate change, whereas human pressures to engineering interventions conducted at reach and catchment scale. The study will be conducted in one of the last, well preserved examples of anastomosing type of river in Europe - the upper River Narew. Narew at the studied reach (within the borders of the Narew National Park) is regarded as a typical anastomosing fluvial system of temperate climate, with dominating impact of vegetation on its development and functioning. The project will explore geomorphological drivers and processes at two different spatial scales (i.e. Upper Narew catchment and river floodplain enclosing anastomosing river section in the national park) and link them together. To address the scientific problems, the research design consists of two major pillars: (1) extensive fieldwork including channel bed and bank sediment sampling, hydraulic/hydrologic measurements and vegetation mapping and (2) coupled catchment-scale hydrological and floodplain hydrodynamic 2-dimensional modelling.

The main goal of the pillar 1 is to address the basic research question on the historical sedimentation and the human impact on this process. The main goal of the pillar 2 is to derive quantitative (model-based) impact of multiple environmental and human pressures on the processes of erosion, transport and deposition of sediments, and consequently the evolution of the anastomosing fluvial system. To address previously mentioned research questions and problems coupled hydrological and hydrodynamic model will be used. At first, dynamic hydrological model will be calibrated and validated based on historical data against water discharge and sediment concentrations to reflect current conditions (covering at least two decades back). Results from catchment scale will be used as an input for hydrodynamic modelling capable of simulating morphological and vegetation changes at reach and floodplain scale. Hydrodynamic model will also be calibrated based on in-situ field measurements. In the second step climate change projections consisting of an ensemble of Regional Climate Models will be applied in the catchment model to “transfer” the signal from basin into the river reach and again implemented in the model as the upper boundary condition. Additionally, to test the impact of both catchment and reach scale human interventions on the anastomosing river functioning, multiple scenarios will be defined and implemented in the modelling scheme.

It is believed that the results obtained in this project could potentially contribute to understanding the channel evolution and controlling factors in similar lowland, vegetated anastomosing systems across the world. Given the fact that most studies concerning anastomosing rivers are conducted in Australian catchments and for European continent little records can be found, it is of great importance to fill not only the topical but also the geographical gap in the anastomosing rivers investigation.