Professorship of Remote Sensing Applications
TUM School of Engineering and Design
Technische Universität München

Master Thesis

Network Analysis and Data Mining Techniques for Describing 2D River Changes and Enhancing Data Interoperability

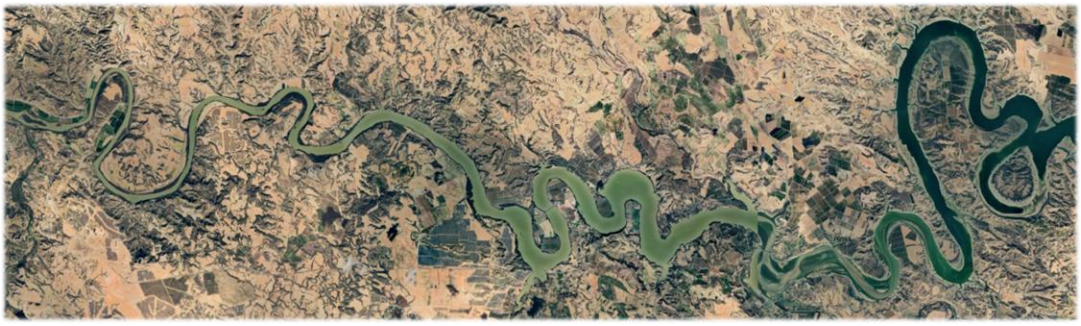

Figure 1. Google Earth View of a section of the Ebro river in the province of Zaragoza (Spain) as showcase for the proposed approach application (approximate image center's coordinates 41°16'44"N 0°08'21"W in World Geodetic System 1984 - WGS84).

Over the last years, there has been increasing recognition of the fact that river forms and processes are broadly impacted by sediment regime disturbances. The term "sediment regime" refers to the sediment budget of a river system as well as the way water and sediment interact to drive river conditions. To explore methods for describing the river's historical changes and creating a river memory record, a Master's thesis is proposed to investigate the application of network analysis and graph theory in detecting and describing river changes. The experimental approach focuses on a 50-km reach of the Ebro River in Spain (see Fig. 1).

The river section is represented by a connectivity matrix of a network with connected (water-water) and non-connected (land-water or land-land) pixels. By analyzing different timestamps, changes can be identified through algebraic operations on successive connectivity matrices over time. For each time interval, various indices can quantify (e.g., the number of new/depleted water links) and characterize (e.g., symmetry and direction of changes) morphological river variations at specific locations/pixels based on their neighbouring relations.

The main objectives are: a) To describe the history of the river section and classify time periods and spatial units based on past and current scenarios (e.g., floods, ephemeral/permanent changes), as well as the legacy of those changes. b) To translate this information into a text-structured river encyclopaedia, enhancing interoperability and enabling data mining tasks.

The student is expected to have basic experience with cloud computing (Google Earth Engine), basic programming skills (preferably Python or R), and basic knowledge of matrix algebra.

Location: TUM Professorship of Remote Sensing Applications

Supervision: Prof. Dr. Katharina Anders (TUM), Dr. Carmelo Juez (IPE), Dr. Miguel Vallejo (IPE)

Collaborators: Instituto Pirenaico de Ecología – Spanish National Research Council (IPE-CSIC)

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