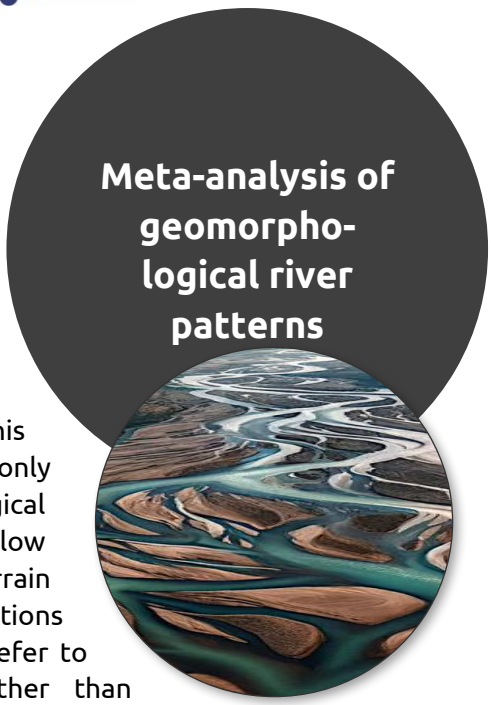
Universität Stuttgart

IWS Department of Hydraulic Engineering and Water Resources Management
Prof. Dr.-Ing. Silke Wieprecht

B.Sc / M.Sc. Topic

"Meta-analysis of geomorphological river patterns"



Background

Fluvial geomorphology is the study of how river systems shape the surrounding landscape and interact with sediment and water over time. It examines specific patterns of river channels, floodplains, and valley systems to understand processes such as erosion, sediment transport, and deposition. These processes interact and each involve a complex set of parameters, making it difficult to build deterministic models of rivers. Because of this complexity, morphological landforms have long been only conceptualized by experts. In the past decades, morphological descriptions have been substantiated with data on typical flow characteristics (e.g., water depth and flow velocity), terrain characteristics (e.g., slope), and other environmental conditions (e.g., humid or arid climates). Most of these descriptions refer to dimensional data, such as absolute flow velocity, rather than dimensionless parameters, such as Froude number and temporal variability. The objective of this thesis is to classify morphological landforms by means of purely dimensionless parameters and by their dynamics during morphologically relevant floods. Starting with dimensional analysis, a common tool in fluid dynamics, the student will enrich an existing database and perform consistent, systematic data analysis following best practices. Ultimately, the student will apply common data science tools to gain new insights in the field of fluvial geomorphology, which is also highly relevant for applications in flood protection and river restoration.

Thesis Overview

1. Familiarize with geomorphological concepts in river ecosystems.
2. Familiarize with the existing database and relevant Python libraries (numpy, sklearn).
3. Analyze the data for common statistics (normality, significant distributions, correlations, etc.).
4. Run dimensional analysis and extract morphological timescales.
5. Perform physics-informed statistical modeling (e.g., principal component analysis, PCA).

Required Skills

1. Basic understanding of hydraulic engineering and river hydraulics.
2. Interest in fluvial eco-geomorphology and data science.
3. Desired: Existing skills or willingness to learn and work with Python and QGIS.

Apply now!

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Examiner: Prof. Dr.-Ing. Silke Wieprecht

The thesis can be written in German or English