OPTIMIZATION OF NUMERICAL MODELLING IN THE CONTEXT OF SENSITIVITY ANALYSIS

Bruno Oliveira
STOCHASTIC NUMERICAL MODELLING OF FLUVIAL MORPHODYNAMICS

METHODOLOGY FOR STOCHASTICALLY GENERATING MODEL INPUT

EXISTING NUMERICAL HYDRODYNAMIC AND MORPHODYNAMIC MODELS

GOAL
Main Objectives

1st priority: Creation
Application
Validation

2nd priority: Development of Numerical Models
- Time Series Generation Technique
- Output: Multiple Streamflow Time Series
- Initial Bathymetry

3rd priority: Application and Validation of Numerical Models
- Hydro- and Morphodynamic Models
- Output: Multiple Sets of River Bathymetry

4th priority: Sensitivity Analysis of the Output
(Methodology Changes, Analysis of Variable Relevance, etc.)
Work Plan

- Collection of in-situ information from case study(ies)
- Collection of historical records

Stochastic Series Generation

- Development of the hydro- and morphodynamic models
  - Model Selection and Integration
- Application of the methodology
  - Calibration, Application and Analysis
- Sensitivity analysis
  - Analysis of Variable Relevance
  - Etc.
- Structural Safety Analysis

Present Stage
Work completed so far

- Data collection on case study
  - Appended simplified example case study

- Finalized Stochastic Series Generation Methodology (paper presently under review)

- Selected numerical model for PhD (CCHE2D)

- Methodology for numerical model optimization
Case Studies

Mondego River

Data from two stretches in the Mondego river

• Available bathymetry and topography data
• Point measurements of granulometry
• Well-defined boundaries
• Large hourly records of streamflow values
Numerical Model Optimization

5 VARIABLES, 4000 CELLS, 5-10 YEAR LONG SIMULATIONS

Objective: Reducing model uncertainty

Focus: Bathymetry and Topography data
Numerical Model Optimization

Pre-modelling

Fluvial morphodynamics forcings include:

- River flow
- Vegetation
- Anthropogenic effects
Numerical Model Optimization

Reduced model uncertainty implies:

• Better quality results (more accurate)
• Faster simulations
• Clearer comparison of different solutions (more precision)
• Clearer sensitivity analysis

Histogram

<table>
<thead>
<tr>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.45</td>
</tr>
<tr>
<td>0.40</td>
</tr>
<tr>
<td>0.35</td>
</tr>
<tr>
<td>0.30</td>
</tr>
<tr>
<td>0.25</td>
</tr>
<tr>
<td>0.20</td>
</tr>
<tr>
<td>0.15</td>
</tr>
<tr>
<td>0.10</td>
</tr>
<tr>
<td>0.05</td>
</tr>
<tr>
<td>0.00</td>
</tr>
</tbody>
</table>

Streamflow (m³/s)

Bruno Oliveira / Optimization of Numerical Modelling in the Context of Sensitivity Analysis
Future Work

• Journal paper “Pre-modelling as a tool for the optimization of morphodynamical numerical simulations”

• Completion of numerical modelling process

• Sensitivity Analysis (& preparation for publication)
Thank you for your attention!