SENSITIVITY ANALYSIS AND PROBABILITY DENSITY OF BED MORPHODYNAMICS
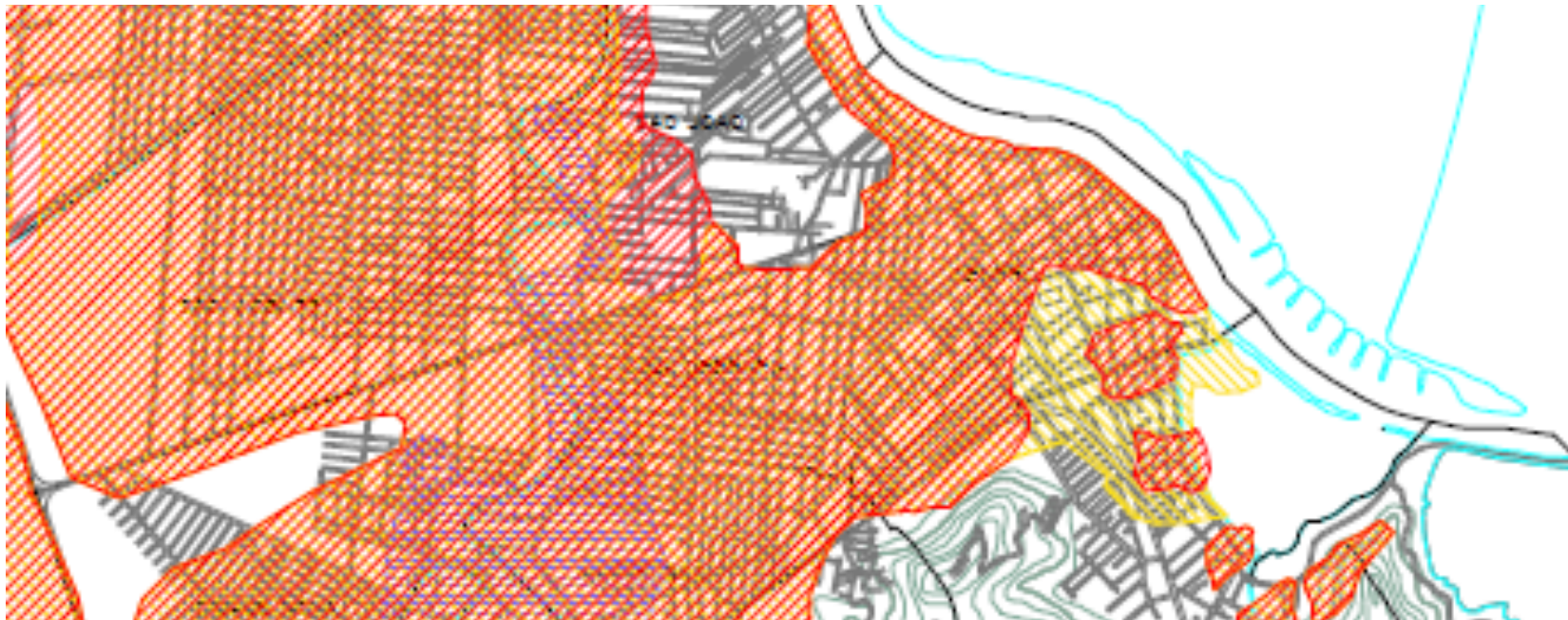
Bruno Oliveira
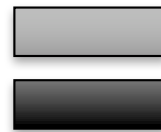
STOCHASTIC NUMERICAL MODELLING OF FLUVIAL MORPHODYNAMICS
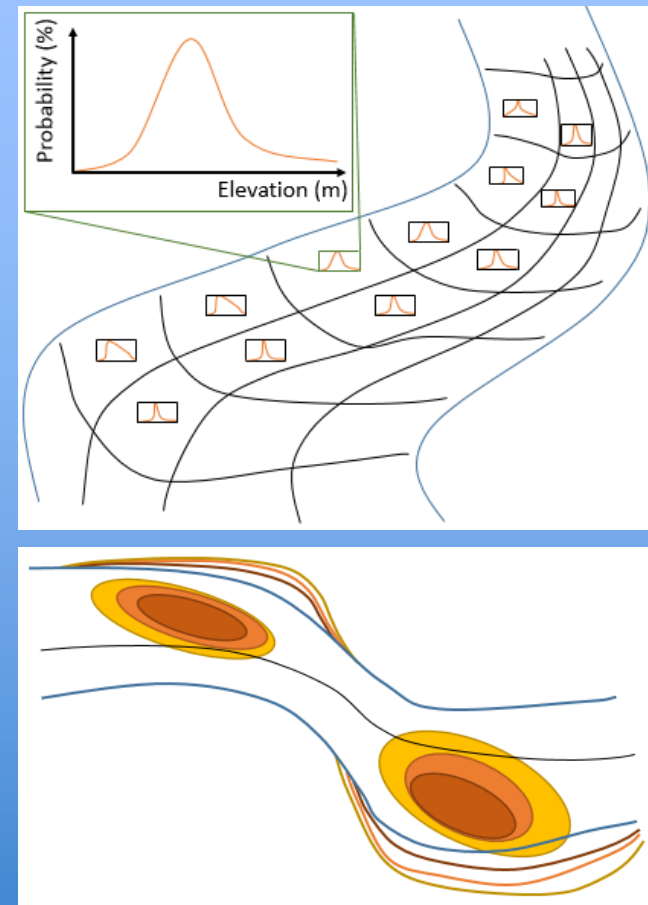
Main Objectives

1st priority:
Creation
Application
Validation

2nd priority:
Development
of Numerical
Models

Time Series Generation Technique

Output:

Multiple Streamflow Time Series

Initial Bathymetry

Hydro- and Morphodynamic Models

Output:

Multiple Sets of River Bathymetry

Statistical Code Module

Output:

Probability Distribution Function of River Evolution

Likely Estimate River Dynamics

3rd priority: Application and Validation of Numerical Models

4th priority: Sensitivity Analysis, Characterization of Bed Change and Application
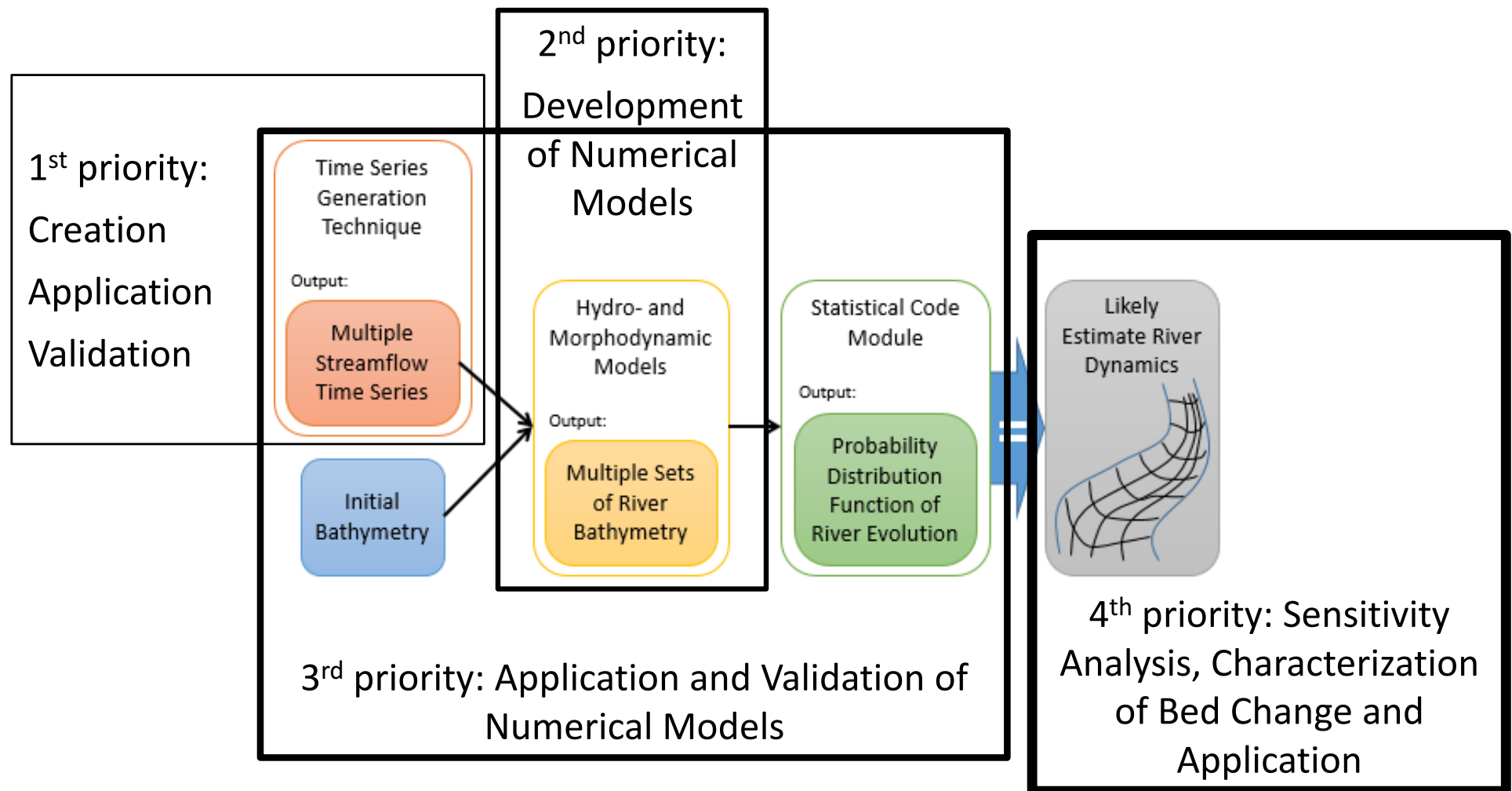
Work Plan

- 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

Previous year

- Application of the methodology

- Sensitivity analysis

  - Analysis of Variable Relevance

  - Etc.

- Statistical characterization of morphodynamics

Present Stage

- Risk Analysis

Work completed so far

- Model optimization*

- Simulated **Simplified** Case Study

- Sensitivity Analysis of Morphodynamics (**Simplified** Case Study)*

- Simulated **Mondego** Case Study

- Sensitivity Analysis of Morphodynamics (**Mondego** Case Study)*

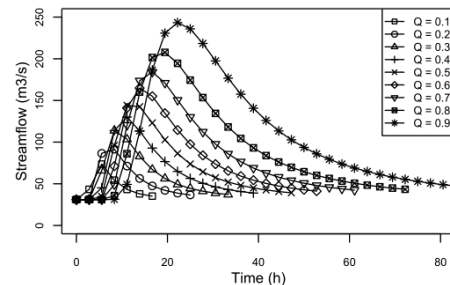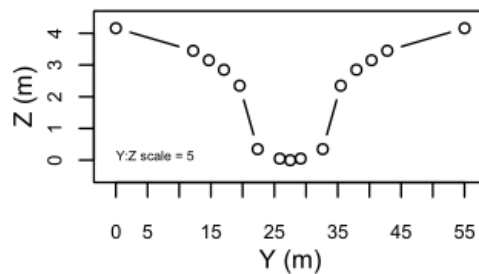- Statistical Characterization of Morphodynamics (**Mondego** Case Study)*

Q
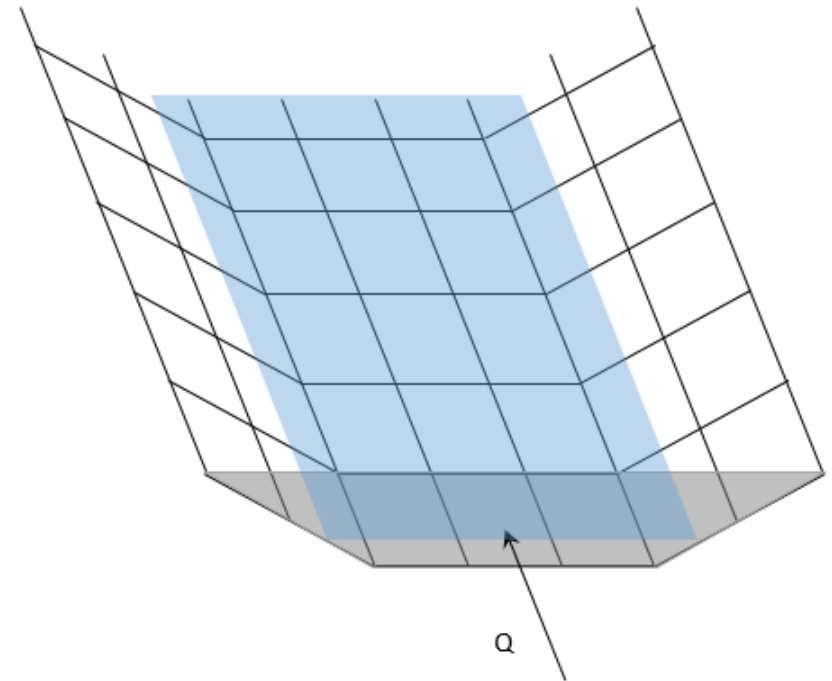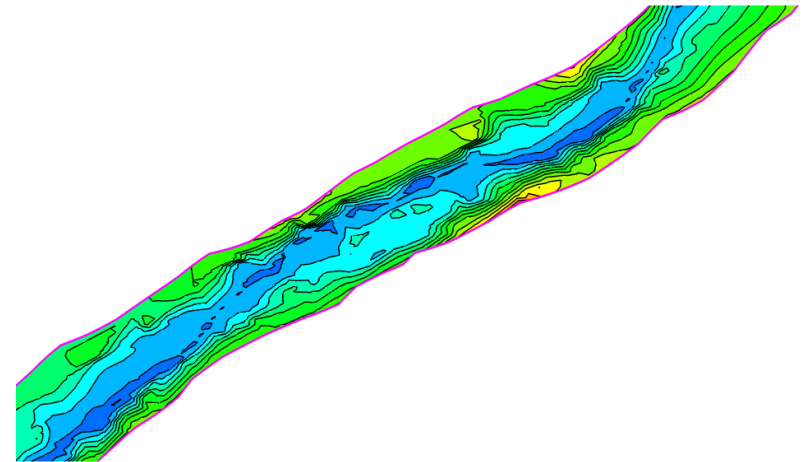
Simulation of Case Studies

Simplified Case Study

Stylized straight channel with:

- Set (stylized), symmetrical cross section
- Longitudinal Slope = 0.5%

- Term of Comparison/Validation

- 6 stylized flow hydrographs
- 6 roughness values
- 6 D50

Mondego Case Study

Real case study based on data:

- Geometry of the Mondego river
- In-situ granulometric measurements
- Upstream reservoir discharges
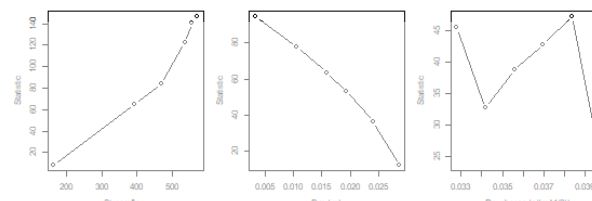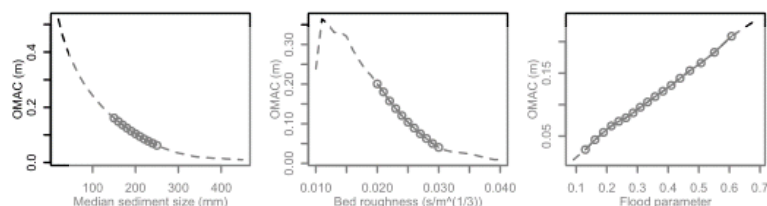- Observed terrain occupation

- (6 of each variable)
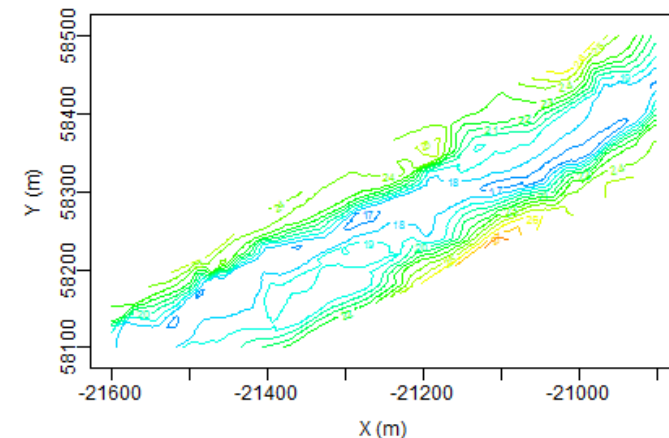
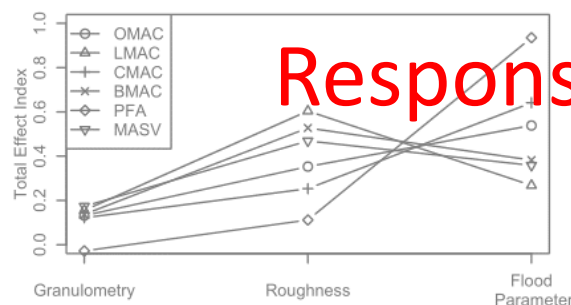# Sensitivity Analysis of Morphodynamics

Simplified Case Study   **Mondego** Case Study

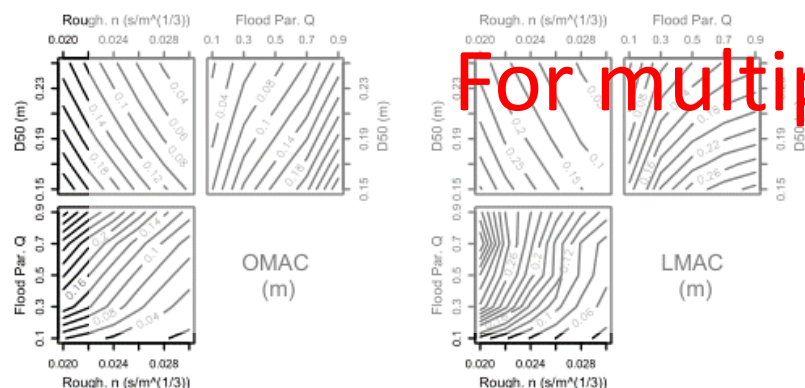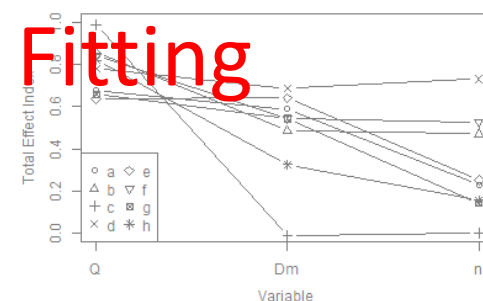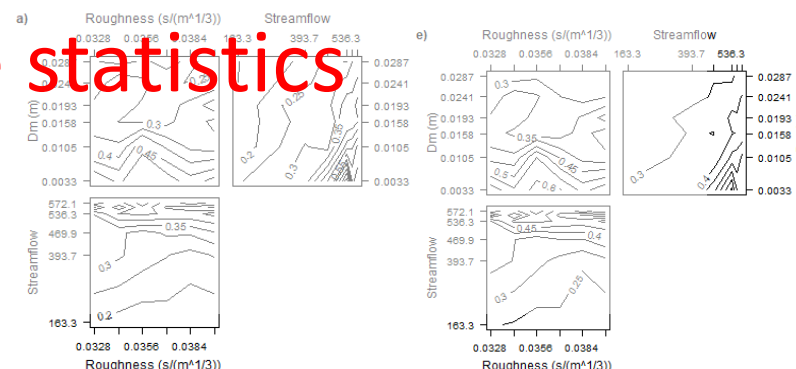Independent
Sensitivity
Analysis

Joint
Sensitivity
Analysis
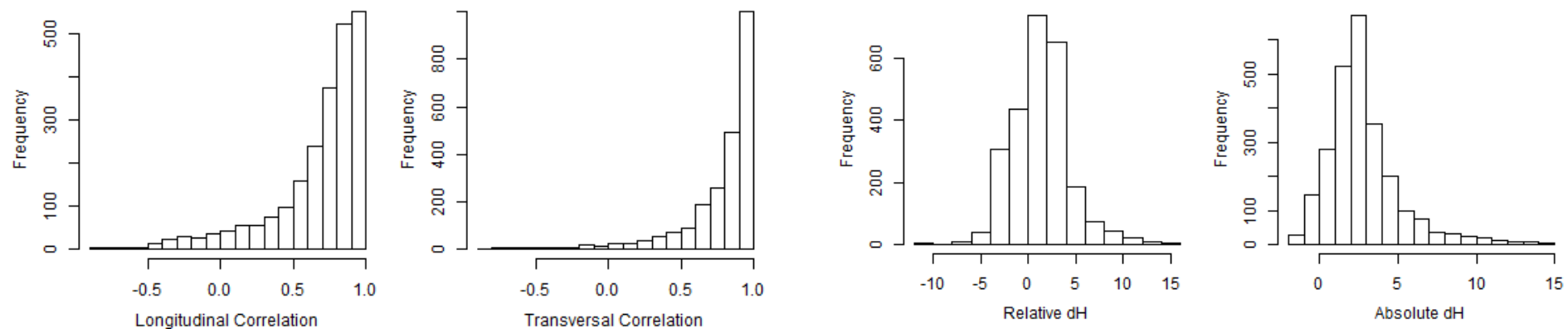
JSA+Mean
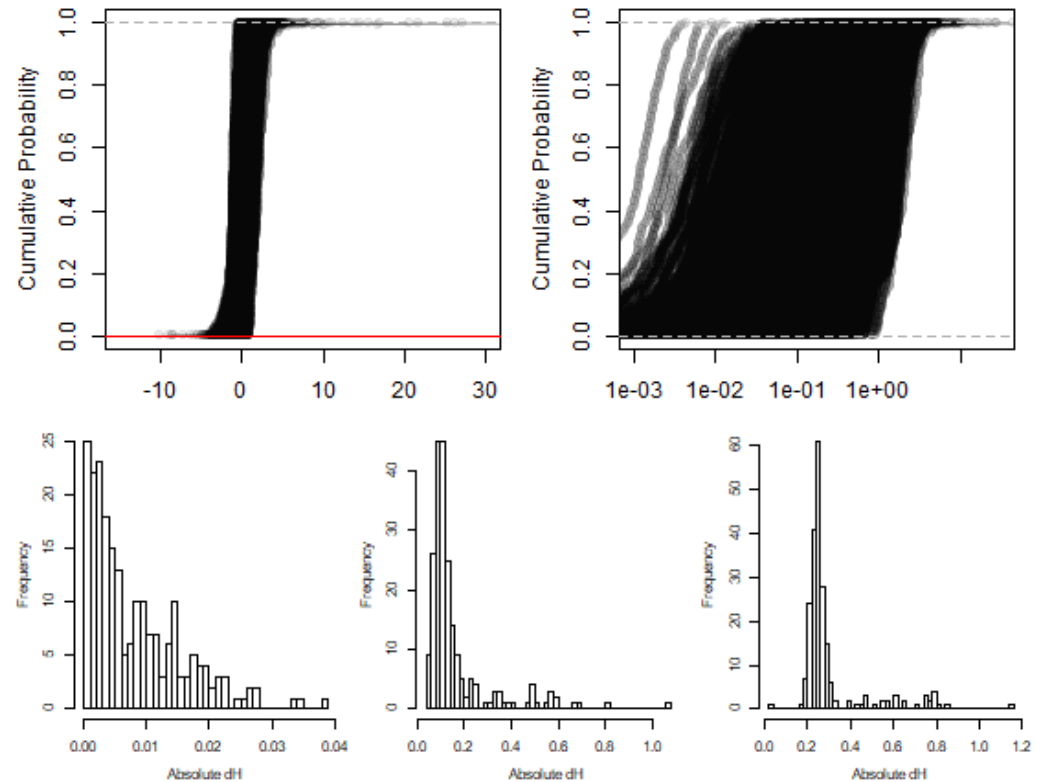Response Surface Fitting
Etc.

For multiple statistics

Statistical Characterization of Morphodynamics

Case study reach

Described in terms of:

- Bed change C/PDFs
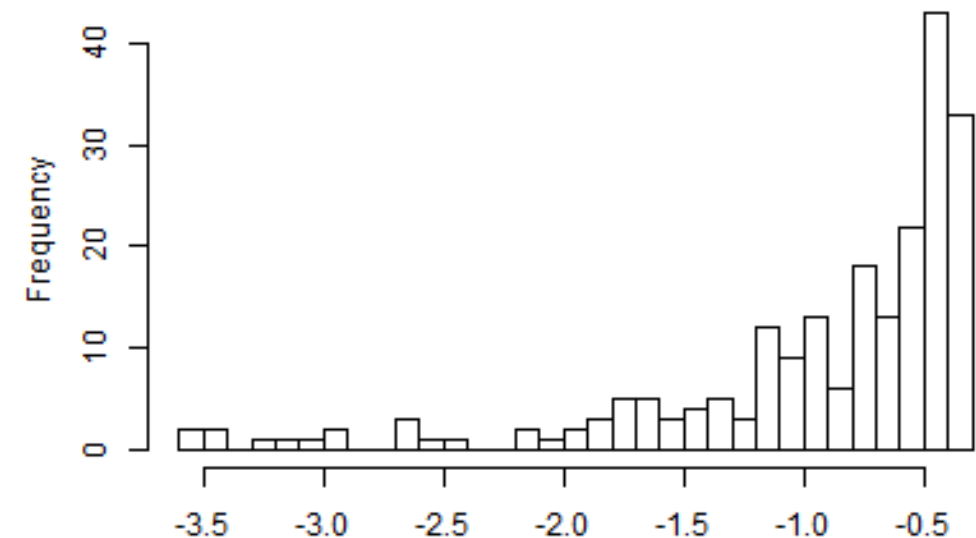- Symmetricity of peaks
- Kurtosis/peakedness
- Etc.

Statistical Characterization of Morphodynamics
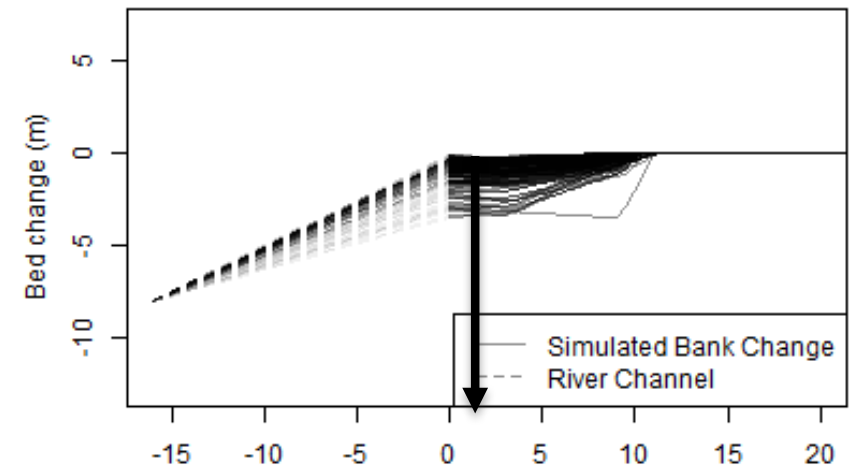
Case study reach

↓

Specific section(s):
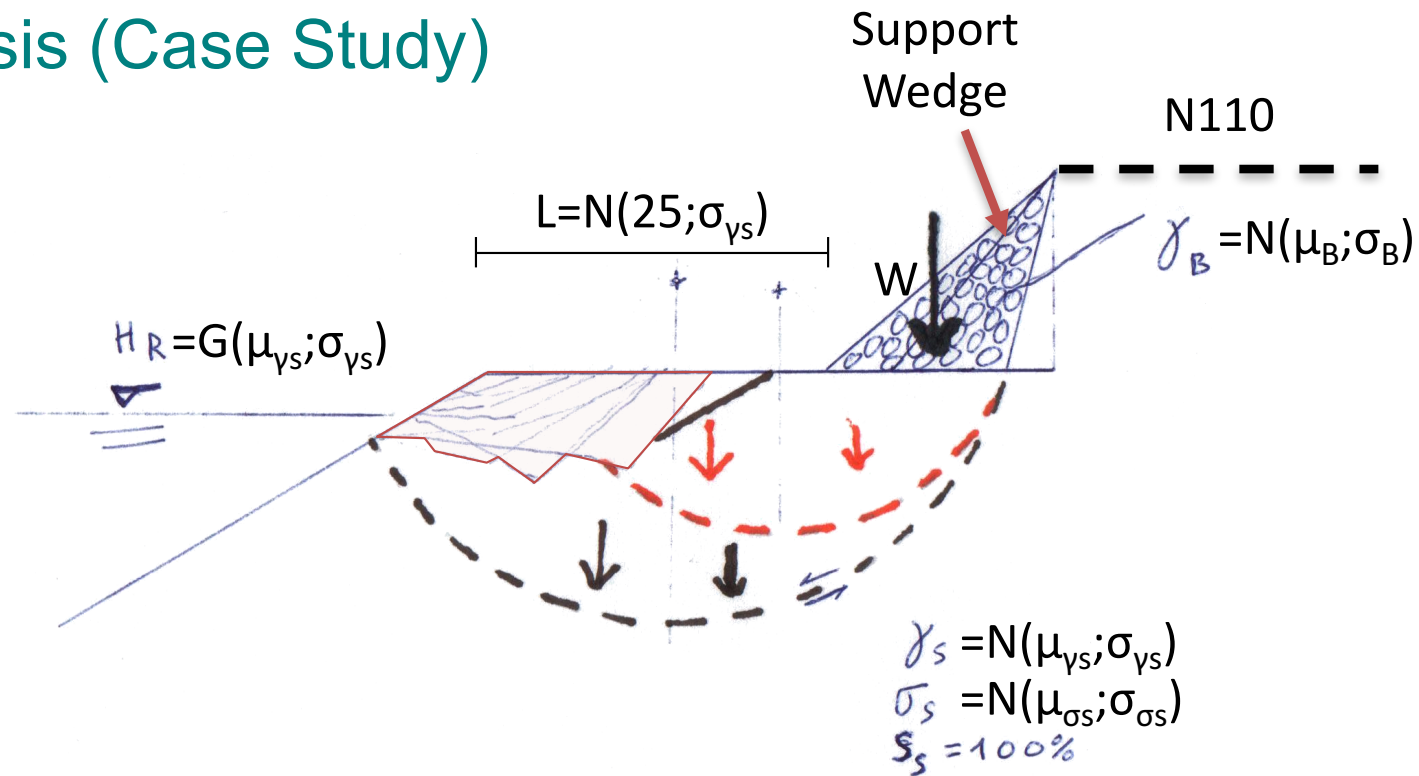
- Erosion magnitude
- Erosion profiles

FLOW

Risk Analysis

Risk Analysis (Case Study)

Support Wedge

N110

$L = N(25; \sigma_{\gamma s})$

$\gamma_B = N(\mu_B; \sigma_B)$

W

$H_R = G(\mu_{\gamma s}; \sigma_{\gamma s})$

$\gamma_S = N(\mu_{\gamma s}; \sigma_{\gamma s})$
$\sigma_S = N(\mu_{\sigma s}; \sigma_{\sigma s})$
$S_S = 100\%$

Estimating P(x), where x is:
- Rotational failure
- Block failure
- Slide failure

Failure costs/scenarios:
- Complete bank rehabilitation
- Full bank protection
- Active monitoring/rehabilitation

$$P(\%) \times C\ (€) = RISK$$

Future Work

- Definition of Case Study in Risk Analysis

- Simulation of relevant Case Study variables (incl/ river morphodynamics)

- Writing of the Thesis

Thank you for your attention!

The End