# Announcement of a Study Project

with the topic

# Comparative analysis of official determination of flood hazards and real flood impacts in the municipality of Asakura City, Fukuoka Prefecture, in Japan

Supervisors: Prof. Mário J. Franca, Prof. Sameh Kantoush (Kyoto University, Japan)

Contact: Prof. Mário J. Franca, mario.franca@kit.edu

*in collaboration with the Disaster Prevention Research Institute, Kyoto University*

## Motivation

Climate-related extremes cost the EU about EUR 650 billion from 1980 to 2022. Nearly 43% of this total is attributed to floods (https://www.eea.europa.eu/en/analysis/indicators/economic-losses-from-climate-related). Additionally, the growth of urban areas has increased flood-related losses (Bevere & Remond, 2022). Urban floods often transport large-scale debris, including tree branches, vehicles, and construction materials (Bayón et al. 2024 and Valero et al. 2024), worsening flood damage and obstructing waterways (Mohr et al. 2022). As commonly observed in urban floods, flow-driven debris accumulates at hydraulic infrastructures like bridge spans and within the urban grid, significantly exacerbating flood risk by provoking structural failures and higher flood levels. For instance, Germany's 2021 Ahr River floods caused various bridge collapses (Fekete & Sandholz, 2021). With global warming and population growth, effective strategies to address urban flood risk enhancement due to large-scale debris are urgent. This requires understanding the interactions between flood flow, debris, and urban infrastructure. A new paradigm in flood management has emerged, focusing on integrating debris transport in flood simulations. However, this task is complex due to an epistemic deadlock caused by a lack of an adequate and generalized analytical framework to simulate debris transport. A first step to bridge this gap is to understand the real implications of not considering the transport of large-scale debris in the official definition of flood maps commonly done by local authorities. For this, a study case of Northern Kyushu in Japan, where past impacting extreme floods events were documented, will be investigated.

## Research objective

With this Study Project we intend the student to:

1. Describe and discuss common risk management practices in the Northern Kyushu area and comparison with the guidelines in Baden-Württemberg.

2. Analysis of the official flood hazard maps and identify possible bottlenecks and dangerous situations.

3. Compare the hazard quantification in the official hazard maps with field data, identifying and discussing where these diverge and where large-scale debris may have had a role.

4. Discuss practice improvements towards a better evaluation of the flood hazard.

**Methods**

The work is mainly desk work, including critical reading of state-of-the-art publications and consultation of available data. The student should also identify the correct networks for discussing the topic nationally and internationally. The student will use a combination of historical and modeling data as a reference. WB-IWU and DPRI-Kyoto have been developing work on flood risk management for decades, which provides an excellent context for this work. Other data may include online and freely available publications and resources (satellite images, media coverage, etc). The student should understand how a combination of historical data with numerical model results can be used to identify where flood hazard determination needs to improve to integrate the role of large-scale debris better. In this context, the student is expected to provide a critical assessment of the current practices in flood risk management and to be able to discuss the possible improvements.

The final report should contain a concise state of the art on flood mapping practices, a quantitative comparison of the differences between the official hazard determination and the real consequences, a critical analysis of these differences, the identification of the main steps towards improving the determination of the official flood hazard considering large-scale debris, the identification of needs in terms of research and development in the topic. The final document will be redacted in English, and the discussions and presentations will also be presented in English. Collaboration with Kyoto University will be made online.

**References**

Bevere L. & Remond D.F., “Natural catastrophes in 2021: the floodgates are open,” Swiss Re Inst., no. 1, 2022.

Bayón, A., Valero, D., & Franca, M. J. (2024). Urban flood drifters (UFD): Identification, classification and characterisation. Journal of Flood Risk Management, e13002.

Valero, D., Bayón, A., & Franca, M. J. (2024). Urban Flood Drifters (UFDs): Onset of movement. Science of the Total Environment, 927, 171568.

Mohr, S., Ehret, U., Kunz, M., Ludwig, P., Caldas-Alvarez, A., Daniell, J. E., ... & Wisotzky, C. (2022). A multi-disciplinary analysis of the exceptional flood event of July 2021 in central Europe. Part 1: Event description and analysis. Natural Hazards and Earth System Sciences Discussions, 2022, 1-44.

Fekete, A., & Sandholz, S. (2021). Here comes the flood, but not failure? Lessons to learn after the heavy rain and pluvial floods in Germany 2021. Water, 13(21), 3016.