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Flood Forecasting as a tool for Flood Management

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Introduction

- Urban flooding causes enormous economic and social loss.
- The contribution of flood risk to the average annual loss on a global level is estimated at US$104 billion (United Nations, 2015).
- Hydroinformatics tools such as flood models are valuable assets for an integrated flood management approach, and ultimately reducing the risks faced in urban areas (Henonin et al., 2013).

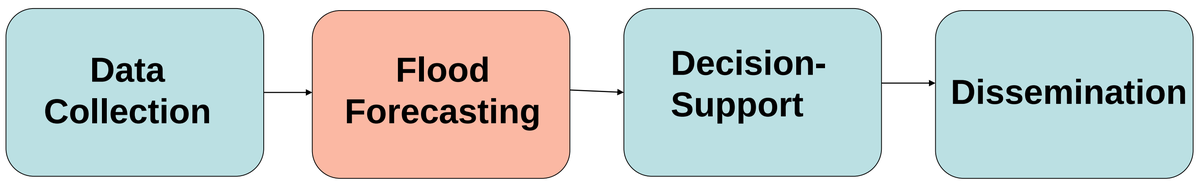

Figure 1-A typical urban flood forecasting system (adapted from Henonin et al, 2013)

Methodology

The following steps will be carried out for the initial 6-9 months of the project:

- Identify flood simulation models suitable for this study.
  For example, DHI MIKE Suite, CADDIES.
- Identify and study details of flood forecasting tools
- Identify potential areas for improvement of the above tools
- Familiarize with the previously identified models, by using data from previous studies to run models.
- Explore ongoing related projects and investigate any possible opportunities.
  Potential projects include: CHANSE, PEARL, GII etc.

- As an original piece of work, identify an initial case study to use, and carry out the following steps:
  - Collect and analyse data
  - Calibrate model and validate model, subject to data availability
  - Analyse model output
  - Identify how model can be improved or be adapted for further uses
  - Compare output from different models

- Drawing on the findings and results, identify a focus and methodology to further develop and investigate.

Methods used for simulating floods in urban areas

- Hydrological model - used to simulate surface runoff, used as input for hydrodynamic model
- Hydrodynamic models - simulates flow in pipes, streets and storage of water on surface. Characterised by dimensionality. For example:
  - 1D- pipes in a sewer or surface channel
  - 2D- surface flow model
  - Coupled 1D-1D, or 1D-2D- combination of the above

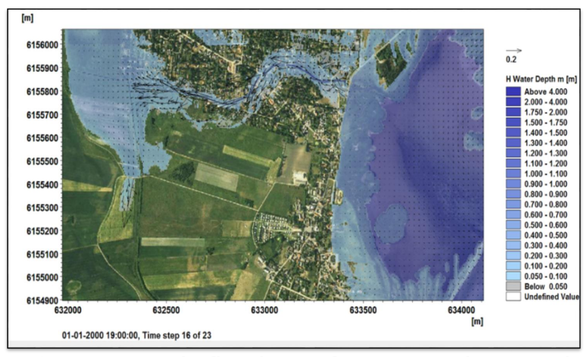

Figure 2- An example flood map for a coastal area using 2D surface flow modelling (PEARL, 2017).

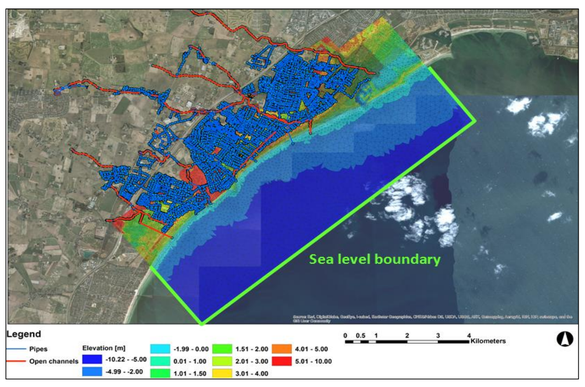

Figure 3- A map showing the 1D-2D coastal flood forecast model for Greve. A 1D model of streams on the surface (red lines) and the drainage system (blue lines), linked to a 2D mesh model of the coastal area shown in colour. (PEARL, 2017).

Real-time flood forecasting methods

- Empirical scenarios-based system
  -use a rainfall forecast as an input for empirical scenario selections
  -based on historical events
  -no hydraulic model
  -can be relatively simple, for example based around a rain gauge record with the warning levels based on previous experience
- Pre-simulated scenarios-based system
  -rainfall forecast as input
  -selects from pre-determined scenarios which are based on hydraulic simulations
- Real-time simulations-based system
  -Uses a real-time flood forecast with online hydraulic models

References:

Henonin, J., Russo, B., Mark, O. and Gourbesville, P. (2013) 'Real-time urban flood forecasting and modelling – a state of the art', *Journal of Hydroinformatics*, 15(3), p. 717. doi: 10.2166/hydro.2013.132.

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