

Advanced Modelling of Flooding in Urban Areas Integrated 1D/1D and 1D/2D Models



Submitted by

Jorge Eduardo Teixeira Leandro

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To my family:

Marlene Maria Teixeira Vieira Leandro

Eduardo Manuel Vieira Leandro

Robert Edward Teixeira Leandro

To my girlfriend:

Maike Rimmel

Abstract

The research presented in this Thesis aims at defining the strengths and weaknesses of an Improved 1D/1D model when compared with a more accurate 1D/2D model. Although both coupled-models (sewer/surface) solve the St. Venant equations in both layers, the latter uses a higher approximation (2D two-dimensional) on the surface layer. Consequently, the 1D/1D model is computationally more efficient when compared to the 1D/2D model, however there is some compromise with the overall accuracy.

The hypothesis is that "The inundation extent of urban flooding can be reproduced by 1D/1D models in good agreement with the 1D/2D models if the results are kept within certain limits of resolution and under certain conditions".

The Thesis starts by investigating ways of improving an existing 1D/1D model to rival the more accurate 1D/2D model. Parts of the 1D/1D model code are changed and new algorithms and routines implemented. An innovative GIS tool translates the 1D output-results into 2D flood-inundation-maps enabling a thorough comparison between the two models. The methodology assures the set-up of two equivalent models, which includes a novel algorithm for calibrating the 1D/1D model vs. the 1D/2D model results.

Developments are tested in two distinctly different case studies of areas prone to flooding. The conclusion is that the 1D/1D model is able to simulate flooding in good agreement with the 1D/2D model; however, it is found that features such as topography, density of the urbanised areas and rainfall distribution may affect the agreement between both models.

The work presented herein is a step forward in understanding the modelling capabilities of the analysed coupled-models, and to some extent may be extrapolated to other models. Research is growing in urban flooding and this work may well prove to be a strong foundation basis for future research.

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