CERIS : Civil Engineering Research and Innovation for Sustainability

RiverCure – Curating and Assimilating Crowdsourced and Authoritative Data to Reduce Uncertainty in River Flow Modelling

Summary

We address the issue of reducing uncertainty and improving forecasting capabilities of hydrodynamic and morphodynamic mathematical models suitable for flood simulation, water resources management and habitat protection. We emphasise that morphodynamics is not a minor issue in river modelling as it directly affects water levels.

In particular, we address parameter and data uncertainty through a combination of calibration of model parameters and Data Assimilation (DA) techniques, for which historical and real-time data are necessary.

We have been highly motivated by recent advances in collecting and processing crowdsourced information produced by riverine communities and shared in internet sites and social media (Figure 1). The ubiquity of such information is potentially a game-changer for DA, due to the increased spatial and temporal coverage of flow events. However, this potential has not been fulfilled? there is not yet a systematic approach to improve reliability of river mathematical models.

This is the key drive of the project, which shapes its main objective: to improve the forecasting capabilities of mathematical models of rivers by making an efficient and systematic use of curated crowdsourced and authoritative data through assimilation and calibration. The "efficient and systematic use" will result from employing a careful and conservative methodology that include i) laboratory investigation under controlled conditions (Task 5), ii) selection of authoritative data from APA's SNIRH system and data mining in social media (Task 6) and iii) formation of a citizen observatory in Montemor-o-Novo municipality to collect crowdsourced data, supplementary to authoritative data (Task 7). All data undergoes a careful curation process, to ensure standardization and interoperability, for efficient communication, and classification and storage for future use (Task 4). On the modelling front, an in-house hydrodynamic and morphodynamic mathematical model was adapted for high-performance computing including DA (Task 1). The actual DA strategy was decided and validated in Task 2 and a systematic parameter calibration strategy was devised in Task 3.

The key outputs of the project are:

- A new-generation hydrodynamic and morphodynamic model with embedded DA algorithms and continuous calibration features; will be maintained by IST-ID (Figure 2).
- A web portal to articulate data and model forecasts and to manage data fluxes; will be maintained by APA and INESC-ID (Figure 3).
- Curated databases combining authoritative and crowdsourced data; will be owned by APA.

Nine (9) papers in international journals and 18 conference papers were submitted. The impact of the project transcends its alignment with Portuguese ENEI and Lisbon EREI: the improved mathematical tools will directly benefit water governance entities, such as APA, in what concerns water management and risk mapping. Additionally, 2 doctoral and 6 master students were trained in this project.

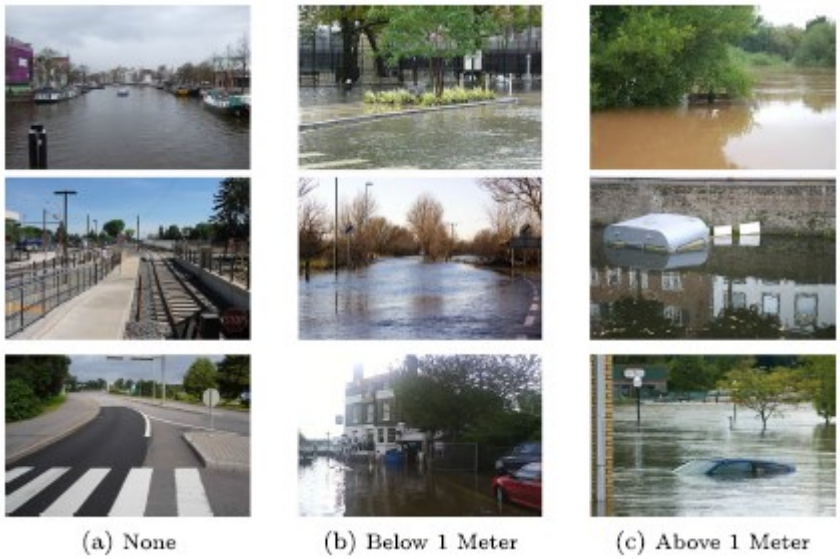

Figure 1. Sample of training images of AI algorithms for determining flood levels.

Project Reference

PTDC/CTA-OHR/29360/2017 / LISBOA-01-0145-FEDER-029360

Leading Institution

IST-ID – Associação do Instituto Superior Técnico para a Investigação e Desenvolvimento (Portugal)

Partners

UMinho – University of Minho (Portugal), INESC-ID – Instituto de Engenharia de Sistemas e Computadores: Investigação e Desenvolvimento (Portugal), APA – Agência Portuguesa do Ambiente (Portugal)

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Period

2018-2022

Total

235 577.45€

CERIS

180 774.50€

Project Website

rivercure.inesc-id.pt:8080

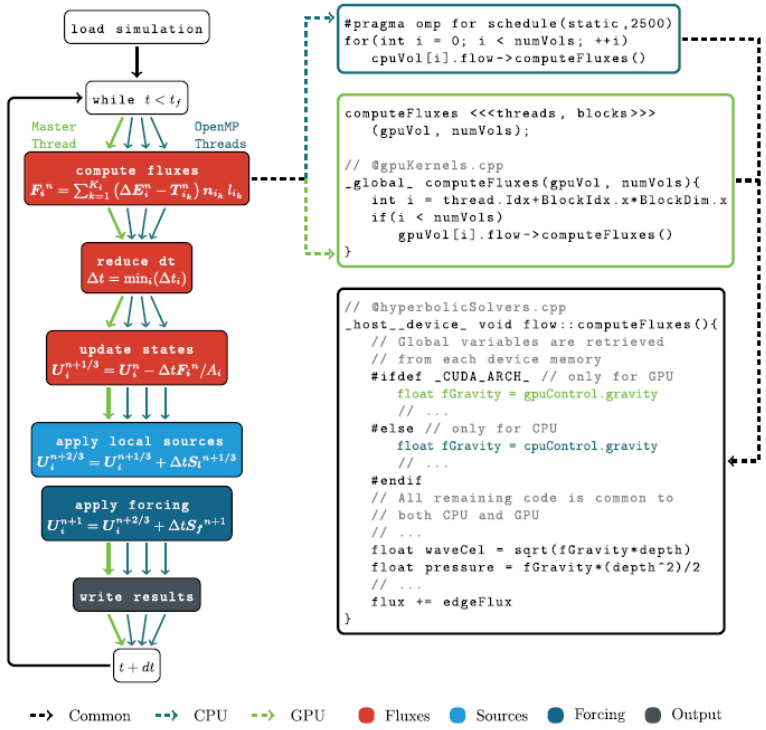

Figure 2. General flux diagram of computation of model HiSTAV.

Figure 3. Computed flood in River Águeda.