SUMMARY - DISCUSSION TOPIC 2: Hydrological and hydraulic models for urban pluvial flooding modelling and forecasting

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Participants: Eight (8) people took part in this discussion group, including academics, modelling consultants, local authorities and software developers. Given the number of participants, there was no need to split into subgroups.

Questionnaire circulated prior to the meeting: Prior to the meeting, a questionnaire had been circulated amongst participants covering different aspects of urban pluvial flood modelling. Before the discussion started, a summary of the replies to this questionnaire was provided, which served as basis for the subsequent discussion. This summary is available in a separate file, which can be downloaded from the RainGain project website (http://www.raingain.eu/en/raingain).

Discussion: Participants of the meeting were asked to reply the following question:

What do you see the major hydrological and hydraulic modelling challenges to overcome before we can have effective real-time pluvial flood forecasting and warning?

Consider the following issues: accuracy, constraints for model setup, runtimes, uncertainty, rainfall inputs, and organisational barriers, amongst others.

The main challenges/constraints for implementation of real-time pluvial flood forecasting and warning that were identified throughout the group discussion can be summarised as follows:

Accuracy constraints:

- Overall, the existing modelling tools and data (excluding rainfall data) currently available in the UK are enough for creating models which can represent urban pluvial flooding fairly accurately. However, there is room for improvement and attention must be paid to some points which are next described.
- Dual-drainage models are necessary: if pluvial flooding is to be modelled, mapped and understood properly, it is not enough to model only the surface or the sewer system. Both systems need to be modelled together and the interactions between them must be taken into account. UK regulations should be modified in such a way that dual-drainage models become mandatory.
- Detailed models are desirable for modelling urban pluvial flooding accurately. A balance must be found between detail and computational requirements (mainly runtime). Variable resolution should be used (higher resolution should be used in critical areas and lower resolution in non-critical ones).
- In some cases, flooding mechanisms are not fully understood, thus leading to inaccurate models. In order to understand flooding mechanisms and verify the models, these need to be shared and discussed with the local communities.
- Current 2D runoff models (i.e. runoff models for 2D models of the surface) are oversimplified and need to be further developed. They cannot yet capture the hydrological processes that take place in the real system.
- Most existing models were built in the past and were not built for forecasting purposes, but for planning purposes. Models must be updated if they are to be used for forecasting purposes; they should be setup in such a way that they provide the information needed for implementing real-time control measures, issuing warnings, etc.

Constraints for model setup:

- Lack and cost of data

- Lack of expertise of the modellers
- Difficulty and time required to process data and make it consistent (which is the starting point for model setup)
- Lack of use of appropriate methodology (Best Practices) for model setup and testing. This results in low quality/inaccurate models.

Runtime constraints:

- The group agreed in that the minimum allowed lead time for urban pluvial flood forecast is 30 min, time during which essential actions could be implemented. However, the longer the lead time, the better.
- Considering lead time and accuracy requirements, the group agreed in that current model runtimes are not fast enough for providing urban pluvial flood forecast.
- Options for reducing runtimes may include:
    - Pre-running a series of storms over the area of interest. Once the storm is approaching (when it is forecasted), a similar pre-ran storm can be identified and the previously obtained results could be used as forecast.
    - Hybridisation of different types: varying model resolution (using higher resolution for critical areas and lower for non-critical ones), combining 1D and 2D models of the urban surface (1D can be used in areas where the flow is channelled, 2D must be used in areas where the flow is multi-directional, in addition to critical areas). In any case, calibration of simplified models must be done using more detailed models.

Uncertainty:

- Uncertainty is not currently being estimated and dealt with appropriately. There are many sources of uncertainty in urban pluvial flood models, so a comprehensive uncertainty analysis is a challenging task.
- The different sources of uncertainty need to be identified and managed.
- Although this is a highly complex matter, uncertainty analyses must be kept simple and its results must be simplified in such a way that they can be used operationally and communicated to the public.
- The constraints imposed by current model runtimes must be kept in mind when developing methodologies for uncertainty analysis (multiple ensemble forecasts cannot be run because of the currently long runtimes).

Constraints imposed by rainfall inputs:

- Current rainfall forecasts are not accurate enough for generating reliable pluvial flood forecast.
- Currently available rainfall resolution is also not enough, but accuracy is considered more critical.
- Barriers for broader use of forecasted rainfall include not only accuracy, but also availability and price.
- Ideally, raingauge and radar estimates should be merged in order to improve accuracy of rainfall estimates.
- We cannot wait until rainfall estimates and forecasts are improved (this may take years); we should find a way of dealing with the uncertainty associated to the rainfall data that is currently available (possibly through simple ensemble forecast).

Organisational barriers/needs:

- Need to establish clear roles and responsibilities regarding maintenance of urban pluvial flood models.
- Need to establish procedures for updating urban pluvial flood models: how to update them in terms of urban creep, interventions that take place in the area, etc.?
- Need to improve data sharing with water companies in order to facilitate model update.
- Need to take into account interdependence between different types of infrastructure

Throughout the **RainGain** project many of the needs mentioned above will be addressed, especially the ones related to model accuracy, runtimes, uncertainty and improvement of rainfall inputs.