

Desktop review of 2D hydraulic modelling packages Science Summary SC080035/SS

Greater availability of two-dimensional (2D) inundation prediction models to simulate flood flows on floodplains has provided the Environment Agency with a set of powerful tools to help decision-making in flood risk assessment and management. The Environment Agency would not be able to fulfil many of its responsibilities in this area without the use of such computer models.

A number of software packages for 2D inundation modelling are available and the appropriate use of each modelling package depends upon:

1. the physical processes simulated by the models mathematical formulation;
2. the approximate numerical method used to solve the mathematical formulation within the modelling package;
3. the representation of the problem geometry on the numerical grid upon which the numerical method is applied;
4. the representation of boundary conditions (inflows to and outflows from) the modelled domain;
5. the manner in which the 2D inundation model interfaces with other models of the flood system, which can include river and sewer models.

There is now a significant body of literature on the above issues but little of it evaluates how the choice of model type will impact on practical decision making at the level required by the Environment Agency.

This report sets out the theoretical background to the 2D inundation modelling packages used on Environment Agency projects, evaluates these packages against key performance indicators and recommends benchmark test cases that will provide practical guidance on choosing 2D inundation modelling packages for future projects.

The report summarises the physics, mathematical formulation, numerical scheme, numerical grid type and method of linking with other models for all 2D inundation modelling packages currently used on Environment Agency projects. While theoretical aspects of model development are appropriate in all cases, better practical understanding of the range of package applicability can be achieved by benchmarking package performance.

Using a questionnaire survey, the 2D inundation models most commonly used on Environment Agency problems were identified: the four most popular 2D hydraulic modelling packages were TUFLOW, InfoWorks, Mike 21 and JFLOW. The questionnaire also captured information on the performance of these against the following key performance indicators:

1. User manual and technical reference
2. Technical support (including training)
3. Data compatibility
4. Flexibility of data input
5. Model setup
6. Adding structures
7. Run time
8. Stability
9. Presentation of depth and velocity predictions
10. Visualisation tools
11. File management
12. Sensitivity testing
13. Uncertainty analysis

In broad terms, all packages in common use perform satisfactorily against these measures.

Evaluation of the theoretical aspects of packages and the results of the questionnaire analysis highlighted a number of areas of model performance where practical understanding would be boosted by benchmarking. This benchmarking should be undertaken using case study examples appropriate to the type of decisions required by the Environment Agency.

To address this, the report outlines eight practical benchmark test cases that with further development could be used by Environment Agency staff to determine the best use of 2D inundation modelling packages for flood risk and management decision making.

Finally, the report recommends that the Environment Agency complete the second phase of benchmarking described in this report prior to deciding which 2D inundation modelling package to adopt for in-house use. However, if business needs dictate an early decision, the range of application and popularity of the TUFLOW software suggests that the purchase of a multi-user licence for this package would be a relatively safe investment in the short to medium term.

This summary relates to information from Science Project SC080035, reported in detail in the following output:

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