Geophysical Research Abstracts
Vol. 21, EGU2019-9311, 2019
EGU General Assembly 2019

Validation of broad-scale hydrodynamic flood models, using both extent and discharge

Fergus McClean, Richard Dawson, and Chris Kilsby
School of Engineering, Newcastle University, United Kingdom

Broad-scale flood modelling is a growing research area with applications in insurance, adaption and response. This has been fuelled by increasing availability of continental-global scale gridded datasets providing inputs to a mounting array of models. However, outputs often differ greatly and conventional validation methods are inadequate to allow objective assessment of model performance.

This research developed a novel, consistent methodology for assigning performance scores to models using a range of gridded input datasets and an accurate numerical 2D hydrodynamic flood model (CityCAT). Validation using both extent and discharge was conducted for Storm Desmond across Northern England. Both satellite observations and higher resolution Environment Agency flood zone maps were used to check extents and 15 minute flow gauge data from the event was the benchmark for discharge. To meet the high computational demands of the model, a cloud computing framework was implemented using a PostgreSQL database. This allowed automated calculation of performance metrics and rapid evaluation of simulations, removing the often time-consuming task of manual analysis. Visualisation was achieved using a newly designed web interface which further enabled assessment of results. Roads and buildings from OpenStreetMap were overlaid to demonstrate the sensitivity of impact estimates to flood model inputs.

The main findings are that relative importance of precipitation and topographic data changes depending on the metrics used for validation. More variability in peak discharge error was found between rainfall inputs (22-63%) than DEMs (10-41%). In contrast, flood extent critical success index against EA maps was more sensitive to the choice of topography (25-32%) than rainfall (27-30%). This was echoed in the impacts analysis with higher sensitivity of feature inundation to topography than rainfall. Importantly, there was far more overall variability in discharge accuracy than extent which indicates that reproduction of peak discharge is a more powerful measure for assessing model performance. All global-continental precipitation products underestimated peaks more than Met Office rain gauges, though improvement was demonstrated from ERA-Interim to ERA5. Remotely sensed observations of extent from Sentinel 1 were also used to calculate extent metrics, however this was limited by the low frequency of satellite overpasses and an absence of imagery during the peak of the event.

The research has highlighted a growing need for more robust multi-source validation of broad scale flood simulations, and the difficulties this presents. The strong influence of dataset choice on infrastructure inundation also has consequences for insurance premiums, development planning and adaptation to climate change risks which should not be ignored.