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REAL-TIME HAZARD IMPACT MODELLING OF SURFACE WATER FLOODING: SOME UK DEVELOPMENTS

Steven J. Cole[1,*], Robert J. Moore[1], Timothy Aldridge[2], Andy Lane[3,4], Stefan Laeger[3]

[1] Centre for Ecology & Hydrology, UK; [2] Health and Safety Laboratory, UK; [3] Environment Agency, UK; [4] Flood Forecasting Centre, UK.
[*] *Centre for Ecology & Hydrology, Wallingford, Oxon, OX10 8BB, UK; Tel: +44 (0)1491 692263*
E-mail: scole@ceh.ac.uk

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EXTENDED SUMMARY

1. INTRODUCTION

Following the UK floods in summer 2007 and those in Cornwall in 2010, forecasting and warning of surface water flooding has received much attention. Good progress has already been made in response to the government Pitt Review of the summer 2007 floods. For example, the Extreme Rainfall Alert (ERA) methodology was introduced as a pilot and is now embedded within the current Flood Guidance Statement (FGS) services for England & Wales, delivered by the Flood Forecasting Centre (FFC) since April 2009 (FFC, 2010). However, both professional partners and the public now have raised expectations. There is a growing demand for more robust, accurate and timely forecast and alert information on surface water flooding to facilitate effective mitigation actions. In addition to forecasts of the “hazard footprint” (e.g. location and severity) there is also an increasing desire for information on “impacts” of surface water flooding at local, regional and national scales. Providing an improved countrywide alerting service for surface water flooding is a challenging goal requiring a step-change in current capability to come closer to meeting user expectations.

A major drive for the recent developments reported in this paper has come through the Natural Hazards Partnership (NHP). The partnership aims to provide co-ordinated information on natural hazards from across UK government departments, agencies, trading funds and public sector research establishments (including the authors’ organisations). In order to deliver more targeted risk assessments to government and Civil Contingency Act Category 1 and 2 responders, a cross-agency Hazard Impact Model (HIM) framework initiative is developing impact models for specific hazards.

2. PROTOTYPE SURFACE WATER FLOODING HAZARD IMPACT MODEL

Currently the FFC uses a Surface Water Decision Support Tool (Halcrow, 2011) along with expert judgement and feedback from local Environment Agency flood teams, public weather service civil contingency advisers and the Met Office chief forecaster to produce the surface water flooding element of the FGS. The tool calculates an empirical flood-impact weighted score for 109 county and unitary authority areas. Since April 2013, each area score uses the maximum probability of high resolution forecast rainfall exceeding ERA thresholds for durations of 1, 3 and 6 hours and return periods of 10 and 30 years, the average soil moisture deficit and some assessment of rainfall type. Previously only the 30 year return period ERA thresholds of 3 and 6 hour duration along with rainfall type were used. The overall risk category is determined by assessing the susceptibility of an area to surface water flooding using the 1 in 200 year Flood Map for Surface Water (FMfSW) and 1km cluster maps of minimum numbers of people, commercial properties and critical infrastructure.

The current decision-support tool approach has proved useful but is only intended for “first guess” guidance. Known limitations include use of static vulnerability/exposure data, the likelihood is controlled by rainfall alone, only one depth threshold from FMfSW is used and no assessment of flood velocity is made. The NHP is addressing some of these limitations through prototype use of the Grid-to-Grid (G2G) distributed hydrological model developed by CEH (Moore *et al.*, 2006) to characterise the surface water flooding hazard footprint in terms of location and severity. G2G is already used operationally for countrywide forecasting of fluvial flooding across England, Wales and Scotland by the FFC (Price *et al.*, 2012) and Scottish Flood Forecasting Service (SFFS, Cranston *et al.* (2012)). The use of dynamic gridded surface runoff estimates from G2G marks a potentially significant step forward beyond methods based on rainfall depth. This is because runoff production in the model is shaped by spatial datasets on landscape properties - land-cover (e.g. urban/sub-urban), terrain, soil and geology - along with dynamically and spatially changing antecedent soil moisture, calculated through continuous water accounting within G2G. Collaboration with the Health & Safety Laboratory (HSL) has produced novel dynamic maps of the possible impact of surface water flooding. These combine the dynamic hazard footprint with time-varying national impact datasets on population, infrastructure, property and transport (e.g. the EA flood risk maps and the National Population Database from HSL (2008)). Illustrative examples using historical case studies will be presented - such as that shown in Fig. 1 - along with a perspective on future developments.

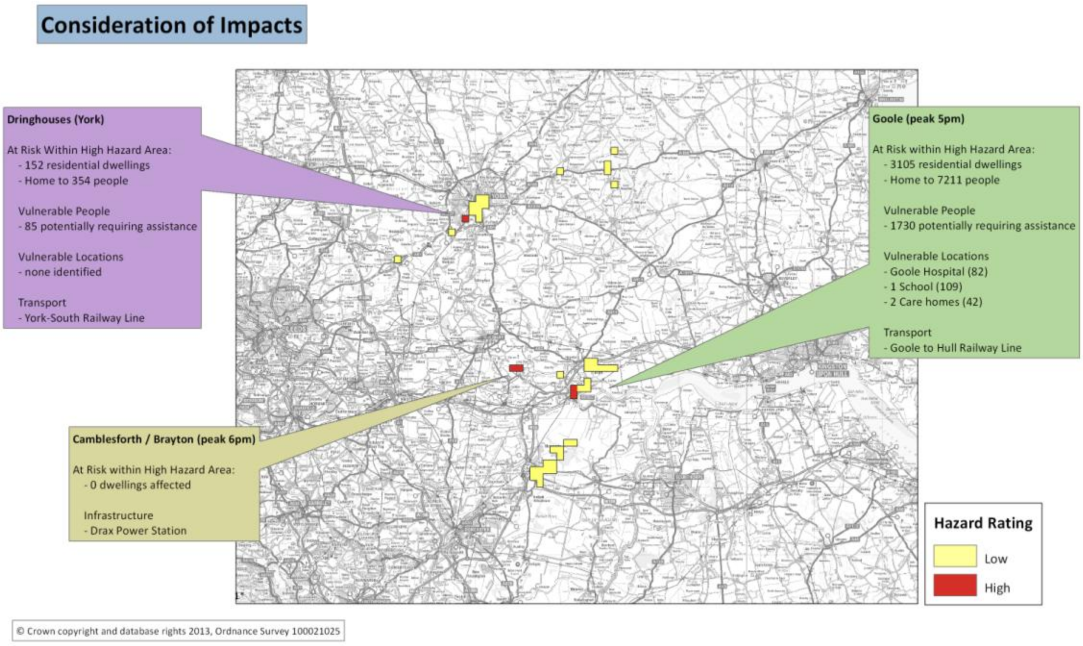

Figure 1. A case study surface water hazard impact map: Goole and York, 3 August 2011

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