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Cascading uncertainties in flood inundation models to uncertain estimates of damage and loss

Timothy Fewtrell (1), Gero Michel (2), Alexandros Ntelekos (3), and Paul Bates (4)

(1) Willis Research Network, University of Bristol, School of Geographical Sciences, United Kingdom (t.fewtrell@bristol.ac.uk), (2) Endurance Specialty Insurance Ltd., Wellesley House, 90 Pitts Bay Road, Pembroke HM08, Bermuda, (3) Willis Research Network, Willis Analytics, Willis Building, 51 Lime Street, London, EC3M 7DQ, UK , (4) School of Geographical Sciences, University of Bristol, BS8 1SS, UK

The complexity of flood processes, particularly in urban environments, and the difficulties of collecting data during flood events, presents significant and particular challenges to modellers, especially when considering large geographic areas. As a result, the modelling process incorporates a number of areas of uncertainty during model conceptualisation, construction and evaluation. There is a wealth of literature detailing the relative magnitudes of uncertainties in numerical flood input data (e.g. boundary conditions, model resolution and friction specification) for a wide variety of flood inundation scenarios (e.g. fluvial inundation and surface water flooding). Indeed, recent UK funded projects (e.g. FREE) have explicitly examined the effect of cascading uncertainties in ensembles of GCM output through rainfall-runoff models to hydraulic flood inundation models. However, there has been little work examining the effect of cascading uncertainties in flood hazard ensembles to estimates of damage and loss, the quantity of interest when assessing flood risk. Furthermore, vulnerability is possibly the largest area of uncertainty for (re-)insurers as in-depth and reliable of knowledge of portfolios is difficult to obtain. Insurance industry CAT models attempt to represent a credible range of flood events over large geographic areas and as such examining all sources of uncertainty is not computationally tractable. However, the insurance industry is also marked by a trend towards an increasing need to understand the variability in flood loss estimates derived from these CAT models.

In order to assess the relative importance of uncertainties in flood inundation models and depth/damage curves, hypothetical 1-in-100 and 1-in-200 year return period flood events are propagated through the Greenwich embayment in London, UK. Errors resulting from topographic smoothing, friction specification and inflow boundary conditions are cascaded to form an ensemble of flood levels and extents. Perturbations to characteristic depth/damage curves for residential, industrial and commercial structures are used to assess the variability in vulnerability information of insurance portfolios. As a result, it is possible to assess the relative magnitudes and consequently, determine whether reducing the uncertainties in inundation modeling or gaining a better understanding of portfolio vulnerability is more necessary for understanding flood risk.