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Global river flood hazard maps: hydraulic modelling methods and appropriate uses

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Flood hazard is not well understood or documented in many parts of the world. Consequently, the (re-)insurance sector now needs to better understand where the potential for considerable river flooding aligns with significant exposure. For example, international manufacturing companies are often attracted to countries with emerging economies, meaning that events such as the 2011 Thailand floods have resulted in many multinational businesses with assets in these regions incurring large, unexpected losses. This contribution addresses and critically evaluates the hydraulic methods employed to develop a consistent global scale set of river flood hazard maps, used to fill the knowledge gap outlined above.

The basis of the modelling approach is an innovative, bespoke 1D/2D hydraulic model (RFlow) which has been used to model a global river network of over 5.3 million kilometres. Estimated flood peaks at each of these model nodes are determined using an empirically based rainfall-runoff approach linking design rainfall to design river flood magnitudes. The hydraulic model is used to determine extents and depths of floodplain inundation following river bank overflow. From this, deterministic flood hazard maps are calculated for several design return periods between 20-years and 1,500-years.

Firstly, we will discuss the rationale behind the appropriate hydraulic modelling methods and inputs chosen to produce a consistent global scaled river flood hazard map. This will highlight how a model designed to work with global datasets can be more favourable for hydraulic modelling at the global scale and why using innovative techniques customised for broad scale use are preferable to modifying existing hydraulic models.

Similarly, the advantages and disadvantages of both 1D and 2D modelling will be explored and balanced against the time, computer and human resources available, particularly when using a Digital Surface Model at 30m resolution.

Finally, we will suggest some appropriate uses of global scale hazard maps and explore how this new approach can be invaluable in areas of the world where flood hazard and risk have not previously been assessed.