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A reduced-complexity model of fluvial inundation with a sub-grid representation of floodplain topography evaluated for England, United Kingdom

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Timely predictions of fluvial flooding are important for national and regional planning and real-time flood response. Several new computational techniques have emerged in the past decade for making rapid fluvial flood inundation predictions at time and space scales relevant to early warning, although their efficient use is often constrained by the trade-off between model complexity, topographic fidelity and scale. Here we apply a simplified approach to large-area fluvial flood inundation modelling which combines a solution to the inertial form of the shallow water equations at 1 km horizontal resolution, with two alternative, simplified representations of sub-grid floodplain topography. One of these uses a fitted sub-grid probability distribution, the other a quantile-based representation of the floodplain. We evaluate the model's steady-state performance when used with flood depth estimates corresponding to the 0.01 Annual Exceedance Probability (AEP; '100-year') flood and compare the results with published benchmark data for England. The quantile-based method accurately predicts flood inundation in 86% of locations, with a domain-wide hit rate of 95% and false alarm rate of 10%. These performance measures compare with a hit rate of 71%, and false alarm rate of 9% for the simpler, distribution-based method. We suggest that these approaches are suitable for rapid, wide-area flood forecasting and climate change impact assessment.