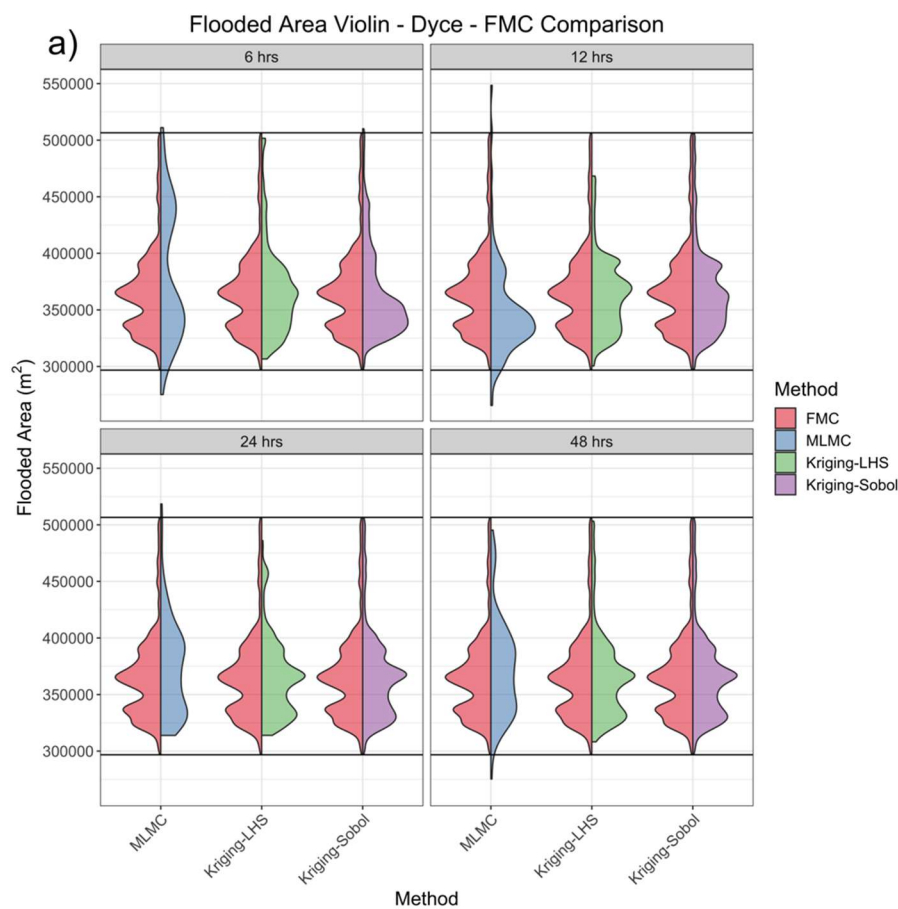# Advanced Uncertainty Quantification for Flood Inundation modelling: Supplementary Material

S1:Comparison of LHS and Sobol for Kriging

A comparison of Kriged model outputs using different sampling approaches has identified Kriging-Sobol as the preferable method. Proxy models created under different time constraints have been created using LHS and Sobol sampling. Output distributions are compared to FMC and MLMC results. It is clear that across each of the three case studies investigated that Kriging-Sobol matches the FMC extremes and distribution shape more efficiently than Kriging-LHS, Figure S1. Therefore, Sobol sequencing has been used for the Kriged models.
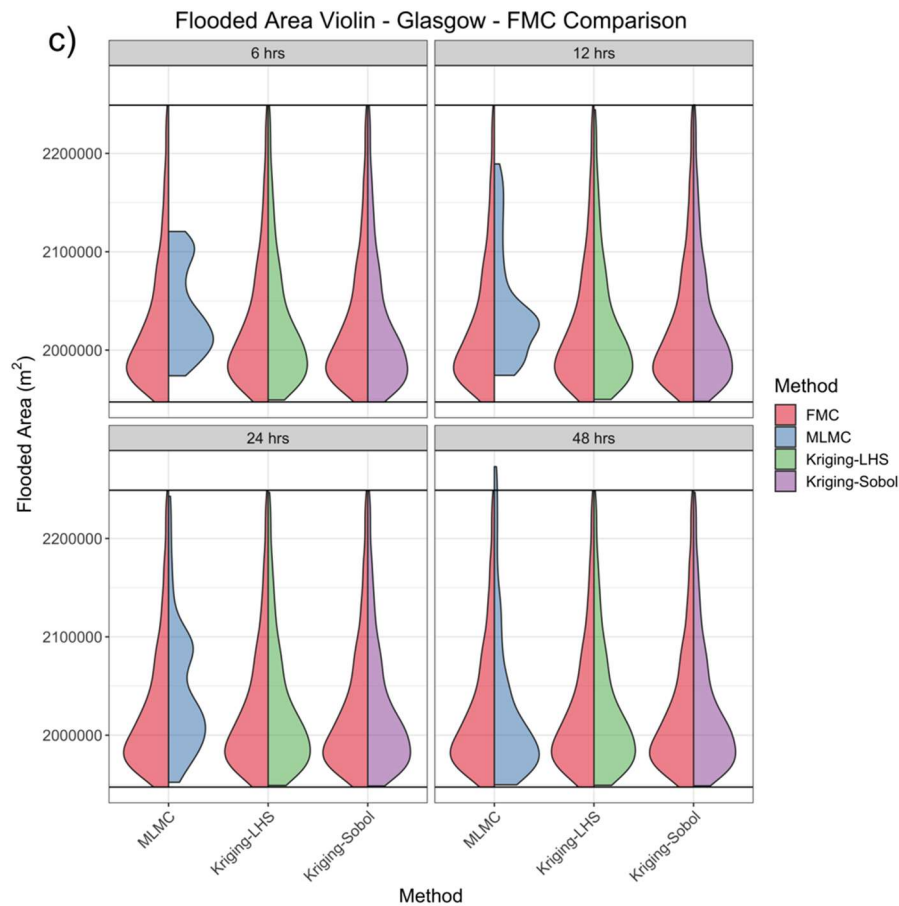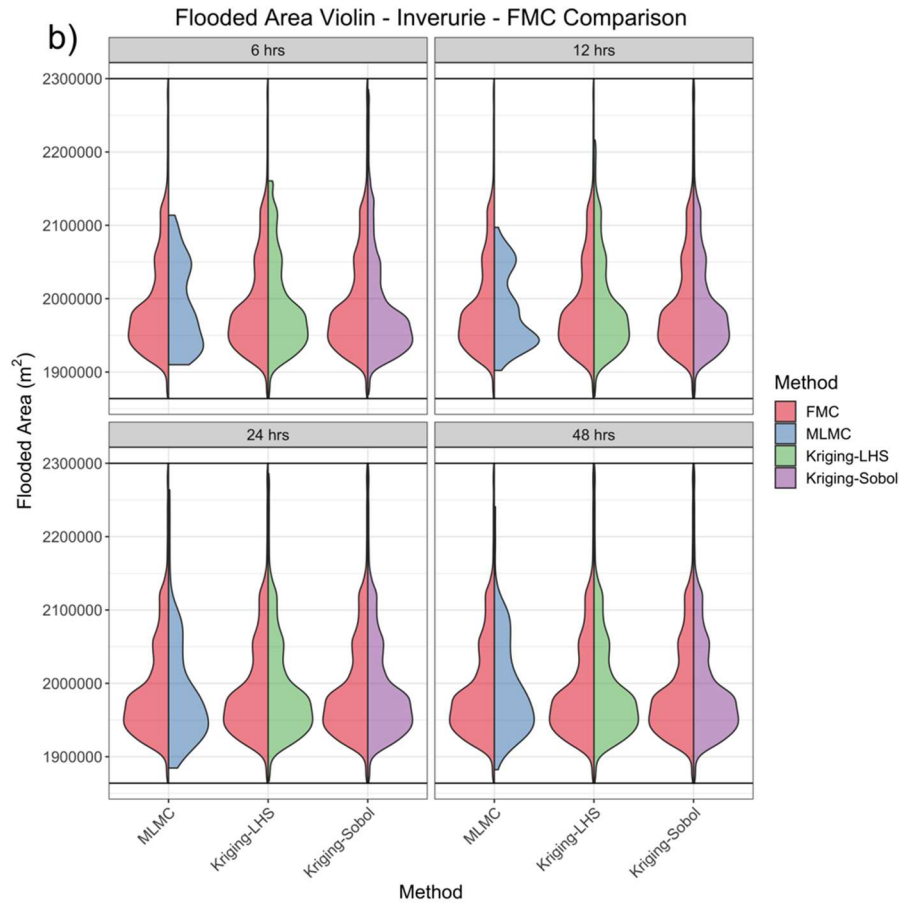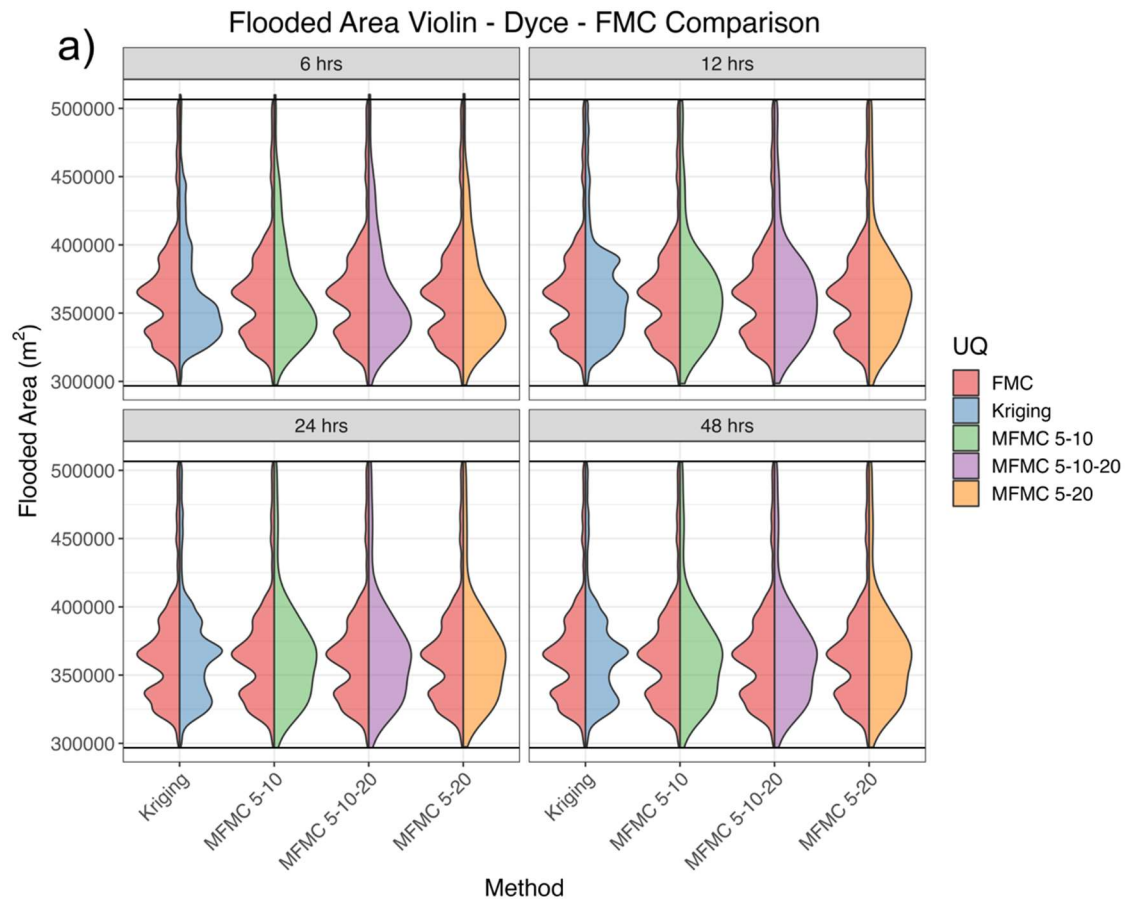
Figure S1: Output PDF's for varying Kriging sampling approaches at different locations a) Dyce b) Inverurie and c) Glasgow and time constraints compared to FMC results. Horizontal black lines correspond to the minimum and maximum flooded area of the FMC distribution.

S2: MFMC Combination Analysis

Three MFMC models have been examined to identify the most effective way to merge proxy models in a multi-level framework with the triple combination (5-10-20m) model identified as the most efficient approach. MFMC modelling with three resolutions was seen to slightly outperform the other two approaches particularly for small time constraints, Figure S2. As such the MFMC 5-10-20m model will be used for the full analysis of MFMC.
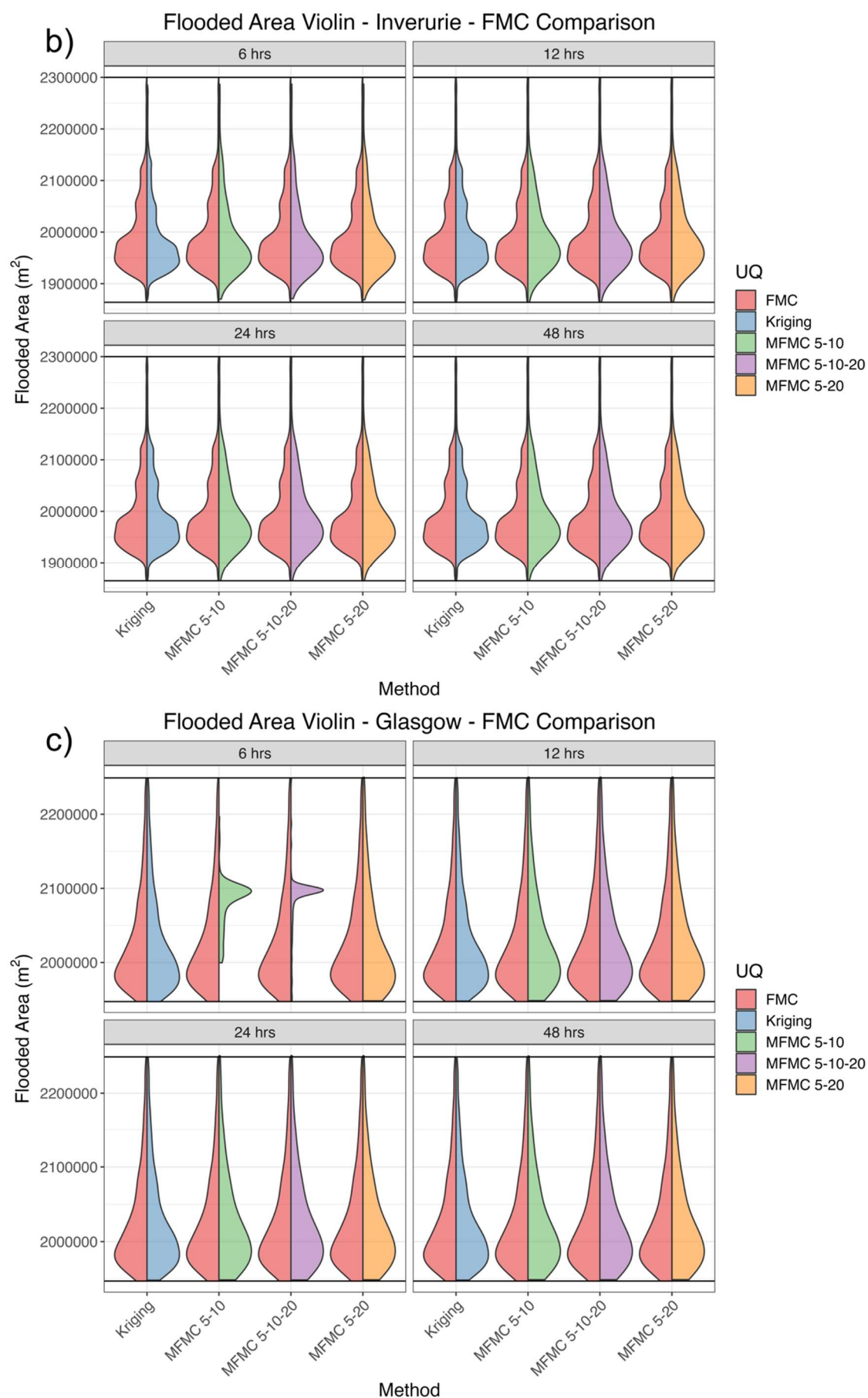
Figure S2: Output PDF's for varying MFMC combinations at different locations a) Dyce b) Inverurie and c) Glasgow and time constraints compared to FMC results. Horizontal black lines correspond to the minimum and maximum flooded area of the FMC distribution.