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A deep learning based approach for inferring the distribution of potential extreme events from coarse resolution climate model output

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Frequency based climate change attribution of extreme weather events requires thousands of years worth of model output in order to obtain a statistically sound result. Additionally, extreme precipitation events in particular require a high resolution model as they can occur over a relatively small area. Unfortunately due storage and computational restrictions it is not feasible to run traditional models at a sufficiently high spatial resolution for the complete duration of these simulations. Instead, we suggest that deep learning could be used to emulate a proportion of a high resolution model, at a fraction of the computational cost. More specifically, we use a U-Net, a type of convolutional neural network. The U-Net takes as input, several fields from coarse resolution model output and is trained to predict corresponding high resolution precipitation fields. Because there are many potential precipitation fields associated with the coarse resolution model output, stochasticity is added to the U-Net and a generative adversarial network is employed in order to help create a realistic distribution of events. By sampling the U-Net many times, an estimate of the probability of a heavy precipitation event occurring on the sub-grid scale can be derived.