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I: Random Forests Trained on a Large Ensembles of HADSM3 and HADCM3 Simulations

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With the need to constrain uncertain parameters in climate models, much work has been put into producing perturbed physics ensembles. However given the large parameter space that must be sampled we cannot realistically do this by running models alone, and so the concept of using statistical techniques to emulate the output of climate models has become popular over the past few years.

We present the random forests technique as a statistical emulator for the output of the HADSM3 and HADCM3 climate models when trained on large ensembles of simulations from climateprediction.net. In doing this we highlight how we may use this to help in efficiently sampling parameter space for future experiments. This is based on a method of importance sampling using the simulated future response of a model to anthropogenic forcing and it's relative likelihood when compared to observations. Having trained the emulator, candidate parameter combinations can then be run through the trained forest and we may select a subset based on subsequent predictions. We have recently distributed around 11,000 new perturbed physics models based on this technique for the HADSM3 model, using a continuous rather than discrete parameter sampling strategy.

Further analysis is conducted with the fully coupled HADCM3 model, where a larger subset of parameters is varied and fewer simulations are available. Initial results have shown encouraging results from our emulator in fitting the response of the ensemble to the input parameters. We hope to report further results on the performance of the emulator, along with implications that our results have on constraining climate predictions for the coming century.