Predicting climate model response to changing emissions

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In order to make predictions on how the climate would respond to changes in global and regional emissions, we typically run simulations on Global Climate Models (GCMs) with perturbed emissions or concentration fields. These simulations are highly expensive and often require the availability of high-performance computers. Machine Learning (ML) can provide an alternative approach to estimating climate response to various emissions quickly and cheaply.

We will present a Gaussian process emulator capable of predicting the global map of temperature response to different types of emissions (both greenhouse gases and aerosol pollutants), trained on a carefully designed set of simulations from a GCM. This particular work involves making short-term predictions on 5 year timescales but can be linked to an emulator from previous work that predicts on decadal timescales. We can also examine uncertainties associated with predictions to find out where the method could benefit from increased training data. This is a particularly useful asset when constructing emulators for complex models, such as GCMs, where obtaining training runs is costly.