

Climate model development and the role of machine learning

Daniel Williamson, Wenzhe Xu, Bertrand Nortier

Machine learning and AI, thanks to a number of high-profile successes, are often touted as potentially holding the keys to solutions to some of science's greatest challenges. Indeed Google's DeepMind, having achieved some of the aforementioned successes, turned their attention to weather and climate prediction. But what is machine learning and can it replace climate modelling (my view is no)? In this talk I will introduce some key ideas in machine learning, and argue how it can assist in climate model development, for example through tuning and falsification of parameterisations.

In the last half of my talk I will focus on recent innovations with Gaussian processes and their implications for tuning. In particular I will introduce 2 ideas: Kernel History Matching (KHM) and Integrating Gaussian Processes (IGPs). KHM is a new tuning method capable of searching parameter space for climate models with important emergent features without requiring that these features occur in exactly the same place or at the same times as they do in reference data sets (knowing that in general they can't due to limited resolution). IGPs use (deep) Gaussian processes to couple components of a network (e.g. a climate model). I will demonstrate the technology and look ahead to its implications for tuning.