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Developing a data-driven ocean forecast system

Rachel Furner[1,2], Peter Haynes[1], Dan Jones[2], Dave Munday[2], Brooks Paige[3], and Emily Shuckburgh[1]

[1]University of Cambridge UK
[2]British Antarctic Survey UK
[3]University College London UK

The recent boom in machine learning and data science has led to a number of new opportunities in the environmental sciences. In particular, process-based weather and climate models (simulators) represent the best tools we have to predict, understand and potentially mitigate the impacts of climate change and extreme weather. However, these models are incredibly complex and require huge amounts of High Performance Computing resources. Machine learning offers opportunities to greatly improve the computational efficiency of these models by developing data-driven emulators.

Here I discuss recent work to develop a data-driven model of the ocean, an integral part of the weather and climate system. Much recent progress has been made with developing data-driven forecast systems of atmospheric weather, highlighting the promise of these systems. These techniques can also be applied to the ocean, however modelling of the ocean poses some fundamental differences and challenges in comparison to modelling the atmosphere, for example, oceanic flow is bathymetrically constrained across a wide range of spatial and temporal scales.

We train a neural network on the output from an expensive process-based simulator of an idealised channel configuration of oceanic flow. We show the model is able to learn well the complex dynamics of the system, replicating the mean flow and details within the flow over single prediction steps. We also see that when iterating the model, predictions remain stable, and continue to match the 'truth' over a short-term forecast period, here around a week.