Integrating machine learning into data assimilation

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Abstract:

Data assimilation, the process of combining model forecasts with observations to estimate the state of the atmosphere and other Earth systems, underpins weather and climate prediction. Posed probabilistically, it is a high-dimensional Bayesian inference problem. Machine learning (ML) is increasingly being integrated into data assimilation, from correcting model error, to replacing physics-based forecast models with ML emulators, to learning the assimilation process itself. I will give an overview of these approaches and present a mathematical framework for integrating them in a principled way, drawing on a forthcoming Cambridge University Press book with Andrew Stuart, Ricardo Baptista, and Daniel Sanz-Alonso.