G36 – Research Fellows Meeting

Presenter's Abstract

3 April 2019

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Deep Compositional Spatial Models

Nonstationary, anisotropic spatial processes are often used when modelling, analysing and predicting complex environmental phenomena. One such class of processes considers a stationary, isotropic process on a warped spatial domain. The warping function is generally difficult to fit and not constrained to be bijective, often resulting in `space-folding.' Here, we propose modelling a bijective warping function through a composition of multiple elemental bijective functions in a deep-learning framework. We consider two cases; first, when these functions are known up to some weights that need to be estimated, and, second, when the weights in each layer are random. Inspired by recent methodological and technological advances in deep learning and deep Gaussian processes, we employ approximate Bayesian methods to make inference with these models using graphical processing units. Through simulation studies in one and two dimensions we show that the deep compositional spatial models are quick to fit, and are able to provide better predictions and uncertainty quantification than other deep stochastic models of similar complexity. We also show their remarkable capacity to model highly nonstationary, anisotropic spatial data using radiances from the MODIS instrument aboard the Aqua satellite.