SIAM MPE Community Meetings: Colloquium

Prof. Dan Crisan

Professor of Mathematics, Faculty of Natural Sciences, Department of Mathematics
Imperial College London, UK

Noise Calibration for Geophysical Fluid Dynamics Models

Abstract: Stochastic partial differential equations have been used in a variety of contexts to model the evolution of uncertain dynamical systems. In recent years, their applications to geophysical fluid dynamics has increased massively. For a judicious usage in modelling fluid evolution, one needs to calibrate the amplitude of the noise to data. In this paper we address this requirement for the stochastic rotating shallow water (SRSW) model. This work is a continuation of [1], where a data assimilation methodology has been introduced for the SRSW model. The noise used in [1] was introduced as an arbitrary random phase shift in the Fourier space. This is not necessarily consistent with the uncertainty induced by a model reduction procedure. In this paper, we introduce a new method of noise calibration of the SRSW model which is compatible with the model reduction technique. The method is generic and can be applied to arbitrary stochastic parametrizations. It is also agnostic as to the source of data (real or synthetic). It is based on a principal component analysis technique to generate the eigenvectors and the eigenvalues of the covariance matrix of the stochastic parametrization. For SRSW model covered in this paper, we calibrate the noise by using the elevation variable of the model, as this is an observable easily obtainable in practical application, and use synthetic data as input for the calibration procedure. This is joint work with Alexander Lobbe, Oana Lang, Peter Jan van Leeuwen, and Roland Potthast.

[1] Lang, O., P.J. van Leeuwen, D. Crisan, and R. Potthast, 2022. *Bayesian Inference for Fluid Dynamics: A Case Study for the Stochastic Rotating Shallow Water Model*. Frontiers in Applied Mathematics and Statistics 8. doi:10.3389/fams.2022.949354

Biography: Dan Crisan is a Professor of Mathematics at the Department of Mathematics of Imperial College London and Director of the EPSRC Centre for Doctoral Training in the Mathematics of Planet Earth. His long-term research interests lie broadly in Stochastic Analysis, a branch of Mathematics that looks at understanding and modelling systems that behave randomly. He is one of the four PIs of the project Stochastic Transport in Upper Ocean Dynamics. This project has received a six-year Synergy ERC award.

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11:00 AM EST

Zoom link: siam.zoom.us/j/81561821731

Host:
Pierre Lermusiaux
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