6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

Uncertainty quantification and ensemble forecast in coarse-grid or dimensionally-reduced computational fluid dynamics

Valentin Resseguier*[1], Etienne Memin[2], Bertrand Chapron[3]

[1] Scalian, Espace Nobel, 2 Alle de Becquerel, Rennes, France
valentin.resseguier@scalian.com,
http://www.irisa.fr/fluminance/team/Valentin.Resseguier.html
[2] Inria Rennes, Campus de Beaulieu, 263 Avenue General Leclerc, Rennes, France
[3] Ifremer Brest, 1625 Route de Sainte-Anne, 29280 Plouzan, France

Keywords: *Fluid Dynamics, Uncertainty Quantification, Reduced Order Model, , Ensemble forecast*

Turbulent flows spread other a wide range of temporal and spatial scales. Simulations and observations of these flows generally neglect the smallest scales and must involve subgrid corrections. These corrections are even more essential when only few modes of the dynamics are resolved (reduced order models). Besides, for ensemble forecasts and in term for data assimilation, an appropriate randomization of the dynamics is needed to quantify the model errors.

The models under location uncertainty define a new type of stochastic subgrid parametrization. By injecting a random time-uncorrelated velocity, the structure of the transport is modified. The new material derivative involves a heterogeneous and anisotropic diffusion, a drift correction and a multiplicative noise. As such, the ensuing transport equations remain conservative. This structure models instabilities, variabilities and energy transfers better than diffusive models. Furthermore, this specific randomization efficiently quantifies model errors, bifurcations and extreme events.

The talk will detail the general framework as well as numerical applications. In particular, simulations of a simplified geophysical model (SQG) and of a wake flow reduced order system will illustrate the presentation.