Contribution to congress: National Colloquium on Data Assimilation, Rennes France, 26-28 September 2018

Poster's title: Interaction between ensemble filter/smoother and model dynamics for stiff ODEs

Authors: ARGAUD Jean-Philippe[a], GRATTON Serge[b], MOTTET Dimitri[ab], SIMON Ehouarn[b]

Keywords: Ensemble data assimilation, stiff ODE, errors propagation

Stiff systems can be commonly found in the description of physical processes. The implicit methods commonly used for the numerical integration are often of the multi-step category, the number of steps used being called the order of the method. One source of stiffness are variables within the physical process described with time constants of strongly differing orders of magnitude. This leads to numerical integrators based on time-step refinement strategies and variable order implicit multi-step integration methods. Time-step refinement and order variation strategies are based on local error indicators, determined using the current iterate for one integration step.

In a data assimilation context, current iterate at one particular step often represents the system's state. Thus, the assimilation stage will interact with the integration by updating the state with observations exterior to the model, and this results in model's and filter's dynamics that are closely intertwined. Therefore, our interest is to have better knowledge about this interaction and its impact on each dynamics, so as to improve the data assimilation process' quality for stiff systems and heterogeneous data availability.

For this, emblematic or simplified scenarios, where observations and/or integration could be problematic are described to illustrate these issues and highlight the difficulties. The performances of ensemble-based Kalman filters and smoothers are assessed with twin experiments in stiff problems. Several experimental configurations involving observations' availability, frequency, error and model's characteristics (dynamics, non-linearities…) are investigated. A simplified industrial model of Xenon's dynamic for nuclear cores is used for application. This makes us able to provide realistic insight on the data assimilation behaviour in various observation and model configurations for ensemble algorithms. It opens way in the future to better quantify this interaction by introducing new useful indicators.

29/05/2018

[a] EDF R&D Paris-Saclay, Palaiseau, France
[b] Université de Toulouse, INP, IRIT, Toulouse, France