

Development of a software framework for sequential data assimilation and its applications in Japan

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Abstract

Data assimilation techniques have received growing attention due to their capability to improve prediction in various areas. Despite of their potentials, applicable software frameworks to probabilistic approaches and data assimilation are still limited because the most of hydrologic modelling software are based on a deterministic approach.

In this study, we developed a hydrological modelling framework for sequential data assimilation, namely MPI-OHyMoS. MPI-OHyMoS allows user to develop his/her own element models and to easily build a total simulation system model for hydrological simulations. Unlike process-based modelling framework, this software framework benefits from its object-oriented feature to flexibly represent hydrological processes without any change of the main library. In this software framework, sequential data assimilation based on the particle filters is available for any hydrologic models considering various sources of uncertainty originated from input forcing, parameters and observations. The particle filters are a Bayesian learning process in which the propagation of all uncertainties is carried out by a suitable selection of randomly generated particles without any assumptions about the nature of the distributions. In MPI-OHyMoS, ensemble simulations are parallelized, which can take advantage of high performance computing (HPC) system.

We applied this software framework for several catchments in Japan using a distributed hydrologic model. Uncertainty of model parameters and radar rainfall estimates is assessed simultaneously in sequential data assimilation.

Keywords : Data assimilation, MPI-OHyMoS, Particle filters, Uncertainty assessment

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