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A flexible Open Data Assimilation framework

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Accurate and reliable real-time hydrological forecasts are essential for protection against water-related hazards, operation of infrastructure, and water resources management. Recent advances in radar rainfall estimation and forecasting, numerical weather predictions, satellite and in-situ monitoring, and faster computing facilities are opening up new opportunities in real-time hydrological forecasting. More effective use of the different information sources via data assimilation will provide the basis for producing more accurate and more reliable forecasts. In this regard, development and implementation of robust and computationally efficient data assimilation algorithms that are feasible for real-time applications remains one of the key challenges.

The implementation of data assimilation techniques is traditionally in a model specific form. The disadvantage of this approach is the need to have in-depth knowledge of the numerical core computations and it does not allow to freely experiment with data assimilation algorithms and measurement sources without the need of additional programming.

We present a more flexible approach to setup a forecasting system. The OpenDA data assimilation framework contains many state of the art data assimilation algorithms to easily set up a forecasting system. The setup of the framework allows users to select and experiment with various algorithms. OpenDA defines an interface between model and data assimilation algorithms. This interface only needs to be implemented once for a particular model. The OpenDA model interface is already implemented for various models. Besides these models it is very easy to couple models that are already implementing the Open Model Interface (OpenMI) to OpenDA using the generic OpenMI-OpenDA coupler.

Using a synthetic test case we demonstrate the capabilities of the proposed approach using OpenMI and OpenDA. We use the MIKE SHE distributed and integrated hydrological modeling system to demonstrate how various ensemble based algorithms can be used to improve the forecasted groundwater level and river discharges. Biases in the measurements are detected and corrected by the generic bias correction module of OpenDA and spurious correlations are handled using both heuristic as automatic localization strategies.