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EMPIRE and pyenda: Two ensemble-based data assimilation systems written in Fortran and Python

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We present and compare the features of two ensemble-based data assimilation frameworks, EMPIRE and pyenda. Both frameworks allow to couple models to the assimilation codes using the Message Passing Interface (MPI), leading to extremely efficient and fast coupling between models and the data-assimilation codes.

The Fortran-based system EMPIRE (Employing Message Passing Interface for Researching Ensembles) is optimized for parallel, high-performance computing. It currently includes a suite of data assimilation algorithms including variants of the ensemble Kalman and several the particle filters. EMPIRE is targeted at models of all kinds of complexity and has been coupled to several geoscience models, eg. the Lorenz-63 model, a barotropic vorticity model, the general circulation model HadCM3, the ocean model NEMO, and the land-surface model JULES.

The Python-based system pyenda (Python Ensemble Data Assimilation) allows Fortran- and Python-based models to be used for data assimilation. Models can be coupled either using MPI or by using a Python interface. Using Python allows quick prototyping and pyenda is aimed at small to medium scale models. pyenda currently includes variants of the ensemble Kalman filter and has been coupled to the Lorenz-63 model, an advection-based precipitation nowcasting scheme, and the dynamic global vegetation model JSBACH.