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Augmenting WRF with PDAF for an Online Localized Ensemble Data Assimilation

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Data assimilation is a widely used method for estimating the state and associated uncertainties in numerical models. While ensemble-based approaches are common, their computational expense arises from necessary ensemble integrations. This study improves the Weather Research and Forecasting–Advanced Research WRF (WRF-ARW) model by integrating it with the Parallel Data Assimilation Framework (PDAF) in a fully online mode. Through minimal modifications to the WRF-ARW code, an efficient data assimilation system is developed, leveraging parallelization and in-memory data transfers to minimize file I/O and model restarts during assimilation. The clear separation of concerns between method development and model application, facilitated by PDAF's model-agnostic structure, is an advantage. Evaluating the assimilation system through a twin experiment simulating a tropical cyclone reveals improved accuracy in temperature, U and V fields. The assimilation process incurs minimal overhead in run time compared to the model without data assimilation, demonstrating excellent parallel performance. Consequently, the online WRF-PDAF system proves to be an efficient framework for high-resolution mesoscale forecasting and reanalysis.