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Case study of observations and sensitive region of heavy rainfall in Beijing area Based on Ensemble Transform Sensitivity

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For High-Impact Weather (HIW) events, such as the heavy rainfall in northeast China, adaptive mobile observation instruments or vehicles can be deployed to improve analysis quality and forecast accuracy. A major challenge is to identify sensitive areas for deploying the adaptive observations in the hours or days ahead of HIW events. Ensemble Transformation (ET) method has been shown to be a useful approach to provide guidance for adaptive observation deployment. In order to improve the efficiency of ET method, an ET-based sensitivity (ETS) method, which calculates the gradient of forecast error variance reduction in terms of analysis error variance reduction, is proposed to specify regions for possible adaptive observations. ETS is a first order approximation of the ET, but only needs one single calculation of transformation matrix, and increases computation efficiency. In this study, the ETS method is applied to identify the sensitive region of a heavy rainfall case in Beijing China. And the targeting observation strategy, such as the chosen of energy norm/state variables and the form of sensitive region, are designed to fulfill the suddenness of convective meso-scale phenomenon. Additionally, a set of Observation System Simulation Experiments (OSSE) are setup to evaluate the impact of the synthetic observation data over the sensitive regions. The result shows that the sensitive region near the cyclonic vortex in the 500hPa, three experiments are designed to verify the sensitive region, Ctrl simulates the conventional observation, Sen simulates the conventional observation and the artificial observation in sensitive area, Ran simulates the conventional observation and the artificial observation in random area, the TS shows that both Ran and Sen improve the precipitation of the heavy rainfall case in the verify area, and Sen performs best. The work can improve the knowledge of the sensitive region study for the meso-scale HIW events, improve the numerical forecasts of the heavy rainfall in Beijing and provide a reference for the intensive observation.