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Empirical Data Fusion for Convective Weather Hazard Nowcasting

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This paper describes a statistical analysis approach to developing an automated convective weather hazard nowcast system suitable for use by aviation users in strategic route planning and air traffic management. The analysis makes use of numerical weather prediction model fields and radar, satellite, and lightning observations and derived features along with observed thunderstorm evolution data, which are aligned using radar-derived motion vectors. Using a dataset collected during the summers of 2007 and 2008 over the eastern U.S., the predictive contributions of the various potential predictor fields are analyzed for various spatial scales, lead-times and scenarios using a technique called random forests (RFs). A minimal, skillful set of predictors is selected for each scenario requiring distinct forecast logic, and RFs are used to construct an empirical probabilistic model for each. The resulting data fusion system, which ran in real-time at the National Center for Atmospheric Research during the summer of 2009, produces probabilistic and deterministic nowcasts of the convective weather hazard and assessments of the prediction uncertainty. The nowcasts' performance and results for several case studies are presented to demonstrate the value of this approach. This research has been funded by the U.S. Federal Aviation Administration to support the development of the Consolidated Storm Prediction for Aviation (CoSPA) system, which is intended to provide convective hazard nowcasts and forecasts for the U.S. Next Generation Air Transportation System (NextGen).