

An IDL-based weather forecast system for aviation using real-time data from remote sensing instruments, nowcasting tools and numerical models

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ABSTRACT:

A novel integrated weather forecast system named WxFUSION ("Weather Forecast User Oriented System Including Object Nowcasting") aims at combining real-time remote sensing data with satellite and radar-based nowcasting tools and numerical model simulations and outputs information on weather hazards especially tailored to the needs of aviation. In contrast to forecasts from numerical models, which can only estimate the occurrence of thunderstorms, WxFUSION provides the exact location and time of the thunderstorms including their development within the near future. Weather hazards like turbulence, icing or thunderstorms are represented as objects indicating areas where it is dangerous to fly. The system's core element "FUSION" combines available data from the various tools accordingly in order to detect, nowcast (0-1 hrs), and forecast (1-12 hrs) these objects including their attributes like moving speed, moving direction, intensity, and trend. The fusion process is based on fuzzy logic, which allows accounting for imprecise observations and forecasts and also to deal with parameter ranges instead of fixed thresholds. Furthermore, conceptual models and expert knowledge can be incorporated in this way. The forecast quality of individual members of ensemble weather forecasts is estimated, thereby allowing the selection of the best member for the data combination.

For integration of the data from different sources into WxFUSION, the programming language IDL has been chosen because it provides a means to easily and efficiently describe the weather objects by their geometrical properties as well as by their attributes. Furthermore, IDL provides an ideal platform during the development of WxFUSION, where algorithms are changed frequently and the effect of the changes has to be analyzed quickly. A graphical user interface has been developed in IDL in cooperation with Exelis VIS for the overlay of the different data sources, as well as for visualizing the result of the data fusion process.