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Special Project

Status of Inflight Icing Forecasting Products and Plans for Future Development

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Abstract

The three papers in this Special Project Report were presented at the AIAA Atmospheric and Space Environments Conference in August 2010. They provide the current status of automated inflight icing diagnosis and forecast algorithms, and describe steps for improvement: new data inputs, improved logic, development of human-over-the-loop production methods, and expansion of the domain to cover the globe.

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Foreword

Inflight icing has been a strong component of the Atmospheric and Space Environment Technical Committee of AIAA. For the most part, inflight icing studies presented at AIAA conferences tend to focus on the effects of the atmospheric environment on the performance of aircraft. However, descriptions of the icing environment, and of forecasting or diagnosing icing conditions, have also had a place in the presentations. This intermingling of related disciplines with a common goal—reducing icing-related accidents—has stimulated discussions and encouraged collaborations that otherwise would not likely have come to pass.

Three papers were presented at the 2010 Atmospheric and Space Environments Conference, held in Toronto, Ontario, Canada describing state-of-the-art automated forecasts and paths to future versions. At the time of the 2010 Conference, products available for inflight icing forecasting included the following:

- Airmen's Meteorological Bulletin (AIRMET): An advisory for widespread moderate or greater structural icing covering a 6-h forecast period, which may be amended.

- Significant Meteorological Information (SIGMET): A weather advisory for severe icing over a 3000-mi^2 or 7800 km^2 area.

- Current Icing Product (CIP): An hourly diagnosis of inflight icing environmental conditions over the continental United States (CONUS). The product includes probability of encountering icing in any of the 20-km/1000-ft grid boxes, expected severity, and likelihood of supercooled large drop (SLD; drops with diameters exceeding 50 microns, which is outside of the certification conditions). The CIP algorithm combines numerical weather prediction (NWP) model output with observations such as geostationary satellite imagery, NexRad radar reflectivity, surface weather observations, and the national lightning network.

- Forecast Icing Product (FIP): An output updated hourly for each hour up to 12 hours forward in time. FIP is similar to CIP but it uses NWP model surrogates for the observations ingested by CIP.

The automated CIP and FIP do very well at what they are called to do: provide a medium-scale resolution product with a broad-brushed icing severity estimation over the CONUS. The intended user is an aviation meteorologist, dispatcher, or pilot looking for strategic information for flight planning. Graphical depiction, both format and content, is extremely important to these users.

Consider a future air transportation system where aviation weather products are fully integrated into a seamless weather-to-aircraft process. The products will incorporate various components including weather observations, NWP models, algorithms to interpret and combine information, human-over-the-loop methods, communications protocols, and flight planning and control systems. User needs for displays will be taken into account, but for the most part the forecaster, dispatcher, or pilot is not the end-user so much as automated aircraft and ground-based systems that plan for and monitor the many aircraft in the air.

This publication, which comprises three presented papers, offers ideas for extending the existing suite of inflight icing products into new geographic domains, with richer information content and opportunities for forecasters to add additional skill and insight gained from experience and knowledge of the atmosphere. This research, which is underway, forms a solid basis for automated aircraft icing diagnosis and forecasting, which offers the reader a glimpse into future products.