



P815 Transitioning NCAR's Aviation Algorithms into NCEP's Operations

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EMC successfully implemented NCAR's Icing Algorithms in its Unified Modeling Suite to improve Global Aviation Safety

Introduction

Environmental Modeling Center (EMC) of NCEP has been collaborating with National Center for Atmospheric Research (NCAR) to transition their aviation algorithms into NCEP operations. The goal is to provide global aviation community better operational forecasts of in-flight icing, turbulence, and convection products for better flight planning and flight safety.

NCAR's aviation algorithms include Forecast Icing Potential, Current Icing Potential, and Graphic Turbulence Guidance. They have been coupled with Rapid Refresh Model to provide Aviation Weather Center (AWC) with valuable aviation forecast guidance over CONUS. Therefore, NOAA decided to collaborate with NCAR to expand and implement these algorithms globally to improve global aviation forecast.

The purpose of this presentation is to describe how EMC transitions NCAR's aviation algorithms into operations and to show results of objective and subject evaluations. In addition, the upcoming implementations to further improve EMC's operational aviation products will be outlined.

Methodology

- EMC's strategy to incorporate NCAR's aviation algorithms is to integrate these algorithms into EMC's Unified Post processor (UPP).
- UPP was developed to be used as the common post processor for all NCEP's operational models.
- There are several advantages to this strategy: 1) EMC can generate better aviation products for all its operational models (e.g., GFS, NAM, and GEFS) by including aviation algorithms into UPP; 2) more accurate aviation products can be generated by deriving on highest resolution horizontal and vertical grids in UPP; 3) faster product delivery can be achieved by using UPP's existing parallel framework.
- Global versions of FIP and GTG were more recently developed by NCAR in collaboration with AWC and EMC. More details on Global FIP and GTG can be found in McDonough et al. 2010 and Williams et al. 2009 respectively.
- Global FIP was simplified and retuned to work with simpler Zhao microphysics used by GFS.
- Global Current Icing Potential (CIP), which provides diagnosis of current icing environment, was developed to be used as verifying truth for Global FIP.
- Global CIP requires three data sets 1) GFS analysis or 3 hour forecast as initial guess, 2) global satellite mosaic data which is a combined products from 5 geostationary orbiting satellites (GOES-East, GOES-West, Meteosat at 0, Meteosat at 63E, and MTSAT), and 3) global METAR data. Optional PIREPs, radar, and lightning data are also used wherever they are available.

Acknowledgement

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References

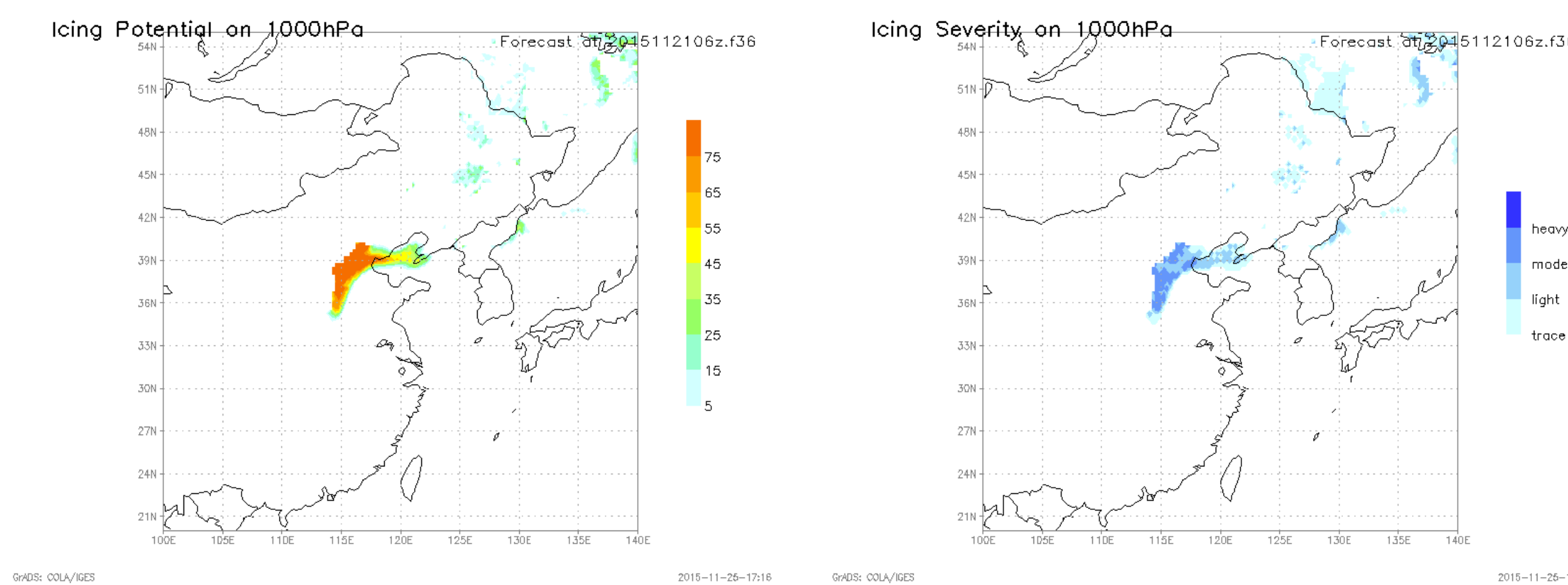
- McDonough, F., M. Politovich, and C. Wolff 2010: The Global Forecast Icing Product, Paper AIAA-2010-8111, *AIAA Atmospheric and Space Environments Conference*, Toronto, ON, August 2010
- Williams, J. K., R. Sharman, C. Kessinger, W. Feltz, A. Wimmers, and K. Bedka 2009: Developing a global atmospheric turbulence decision support system for aviation" Paper 2.4, *7th Conference on Artificial Intelligence and its Applications to Environmental Sciences, 88th Annual Meeting of the American Meteorology Society*, Phoenix, AZ, January 2009

Qualitative Validation of GFS Forecast Icing Products

Two case studies are shown below to demonstrate good performance of global FIP coupled with GFS forecast.

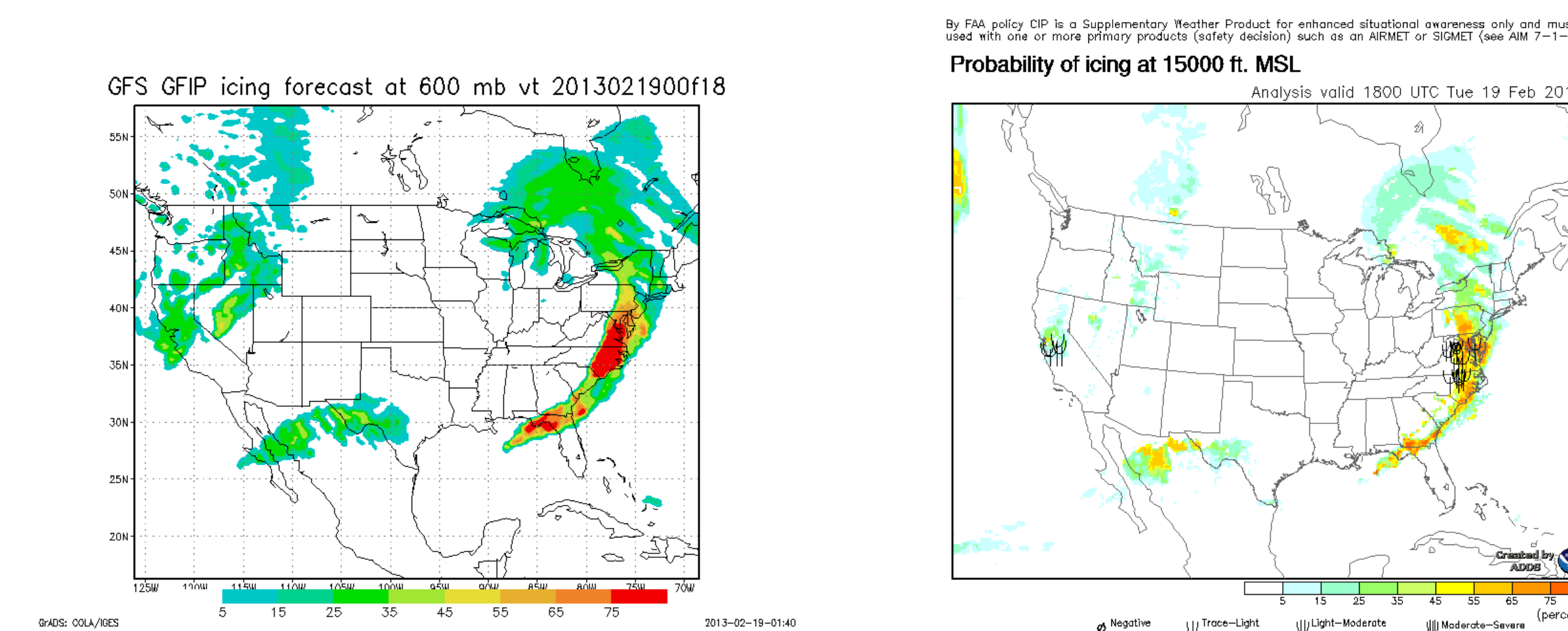
Case one involved a recent event of heavy surface icing at Beijing Airport which, when combined with insufficient de-icing equipment, caused flight cancelation and delay for the following two days. This event was predicted by EMC's operational FIP products with thirty-six hours lead time, as shown in Fig. 1 below. The eighteen hour GFS FIP forecast (not shown) also consistently predicted severe icing in Beijing.

Fig. 1 – Severe icing event at Beijing Airport – 36 hour GFS icing potential (L) and severity (R) forecast valid at 18 UTC Nov. 22 2015



Case two showed an icing event in the East Coast associated with the passage of a front. The GFS FIP forecast predicted high probability of icing along the East Coast from southern Maryland to North Carolina at FL 150, as shown in the top left plot below. Both CIP in the top right plot and Pilot report in the bottom plot valid at the same time confirmed heavy icing occurrences at the same locations. Note that although pilots report did not indicate icing in Northern Florida, it may simply mean there were no flights there at that time.

Fig. 2 – Icing event in East Coast - (TL) 18 hour GFS icing forecast valid at 18 UTC Feb. 19 2013, (TR) Current Icing Potential, (B) Pilot report



Objective Validation of GFS Forecast Icing Products

EMC generated experimental Global FIP products and performed objective validation of these and previous operational icing products from 2013 to 2015.

Figure 3 showed that Global FIP outperformed previous operational US icing products in terms of both scores during Spring 2014. Figure 4 also showed better performance from Global FIP during Winter 2014-2015, especially at 400 hPa where previous operational US icing products did not have any skills.

Fig. 3 – Objective verification of Global FIP and other Global Icing products during Spring 2014

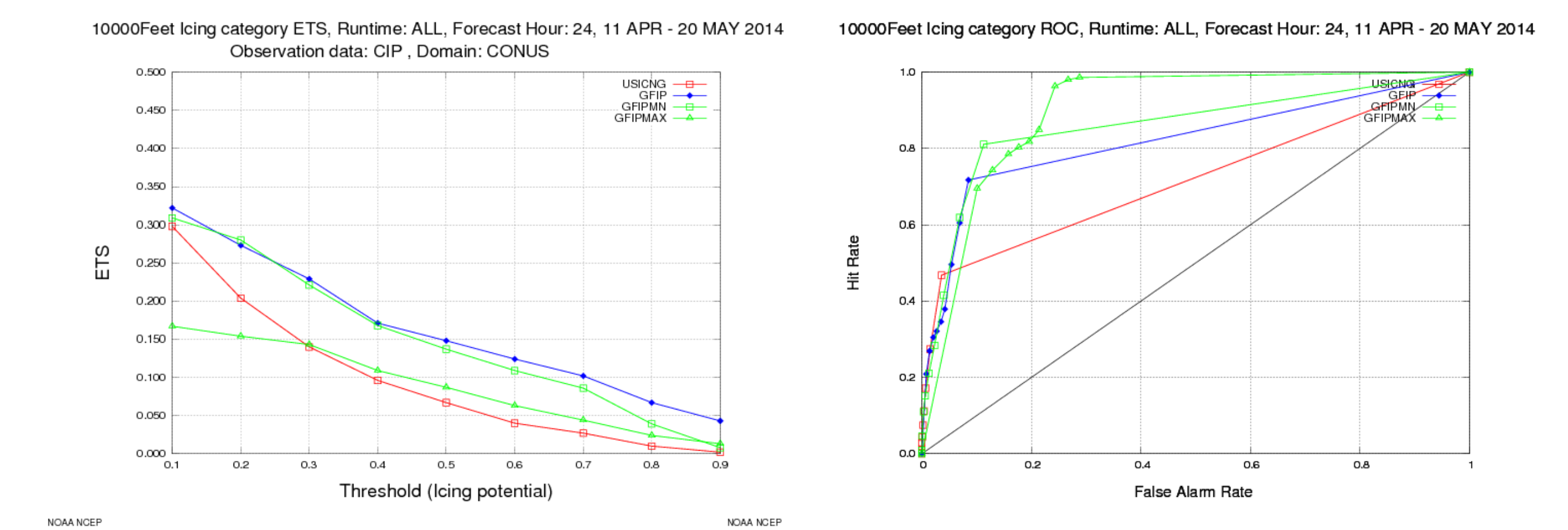
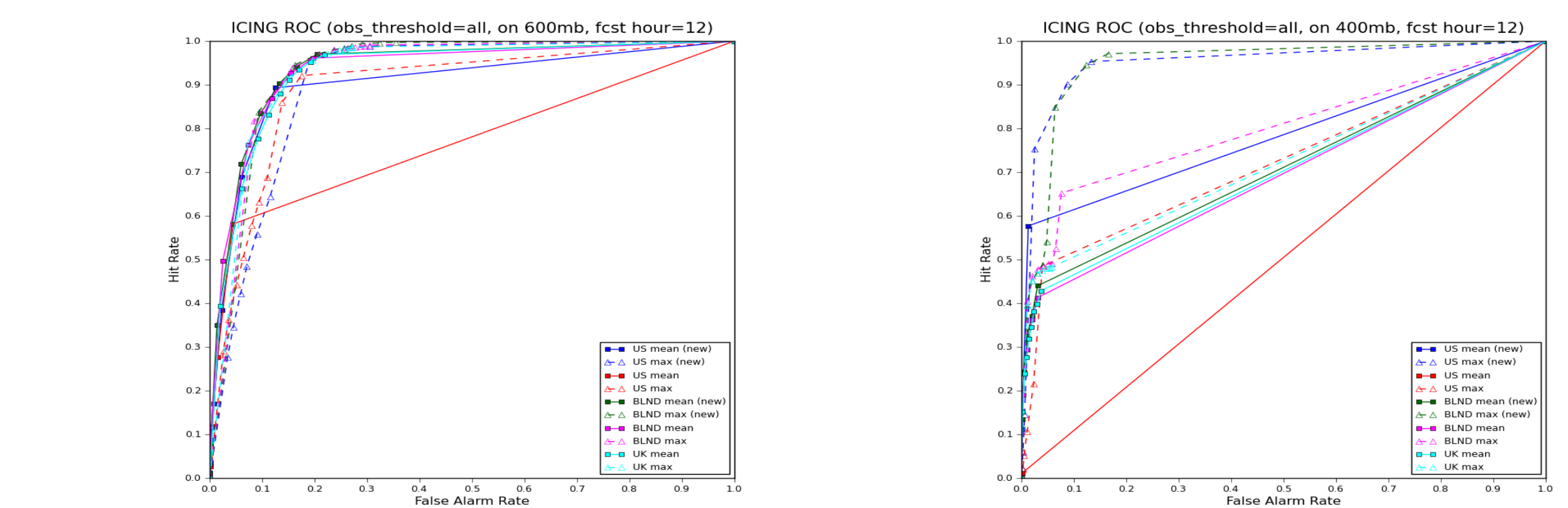


Fig. 4 – Objective verification of Global FIP and other Global Icing products during Winter 2014-2015



Summary and Implementation Status

- EMC has been collaborating with NCAR to transition their in-flight forecast icing potential and severity, current icing potential, and turbulence algorithms into NCEP's operations.
- Two years of objective and qualitative evaluations indicated NCAR's icing algorithm outperformed previous US icing product. Select results are shown in this poster.
- Global version of NCAR's forecast icing product was implemented operationally in Jan. 2015.
- Current icing potential is soon to be implemented in Q2 FY16.

Future Plan and Upcoming Implementations

- EMC has been working on incorporating NCAR's Turbulence Algorithm into EMC's Unified Post.
- Global GTG is scheduled to be implemented operationally in 2017.
- GEFS has started to output NCAR's forecast icing products. AWC is working with EMC to generate probabilistic icing products.