



WORKING PAPER

WORLD AREA FORECAST SYSTEM OPERATIONS GROUP (WAFSOPSG)

SIXTH MEETING

Dakar, Senegal, 21 to 24 March 2011

Agenda Item 6: Development of the WAFS

6.1: Improved GRIB 2 forecasts for convective clouds, icing and turbulence

**GUIDANCE FOR THE USE OF WAFS GRIDDED ICING FORECASTS FOR
EXTENDED RANGE OPERATIONS BY TURBINE-ENGINEED AEROPLANES (ETOPS)**

(Presented by WAFC Provider States)

SUMMARY

This paper discusses WAFS gridded icing forecasts and their potential application and use for ETOPS.

1. INTRODUCTION

1.1 At the Fifth Meeting of the World Area Forecast System Operations Group (WAFSOPSG/5), the group reviewed the draft guidance presented for cumulonimbus (CB) clouds, icing and turbulence forecasts. The group concurred that the guidance presented was a good starting point and that further work by the world area forecast centre (WAFC) Provider States was needed. To achieve this, the group formulated the following conclusion:

**Conclusion 5/11 — Guidance on the intended use of gridded
WAFS forecasts for CB clouds, icing and
turbulence in flight documentation**

That, the WAFC Provider States update the guidance document proposals contained in Appendix D to this report, to reflect the expected changes in the visualization and to assist in the interpretation of the gridded forecasts, in time for the WAFSOPSG/6.

Note. — The Secretary will make the draft guidance available on the WAFSOPSG website prior to the WAFSOPSG/6 Meeting.

1.2 This paper only focuses on the icing forecast guidance produced in gridded format by the world area forecast system (WAFS) for use in flight planning for extended range operations by twin-engined aeroplanes (ETOPS)¹.

2. DISCUSSION

2.1 ETOPS

2.1.1 ETOPS is flight operations over flight routes where the time to reach a suitable diversion aerodrome with an engine failure is greater than 60 minutes or longer and is dependent on the type of aircraft. Many factors are involved in ETOPS, including the requirements for fuel supply. Under ETOPS, the aeroplane is required to carry sufficient fuel to fly to a diversion aerodrome assuming a rapid decompression at the most critical point followed by a descent to 10,000 feet (or a higher altitude if sufficient oxygen is provided).

2.1.2 Forecasts for icing are considered in ETOPS. Under the scenario described above (descent to 10,000 feet) additional fuel is required to compensate for the fuel used by the engine and wing anti-ice for the time during which icing is forecast.

2.1.3 Both European and US ETOPS regulations make special note to define alternatives for an icing forecast. If icing forecasts are not available, icing may be presumed to occur when the **outside air temperature is between 0°C and -20°C with a relative humidity of 55 per cent or greater**. ETOPS does not specify severity or type of icing, rather it is a yes/no icing forecast.

2.2 Icing Forecasts for Flight Planning: Regional and Global

2.2.1 There is one type of human-produced icing forecast, which is the Medium-Level Significant Weather (SIGWX) chart. These Medium-Level SIGWX are limited regional forecasts in chart form and cover Europe, North Atlantic, Middle East and South Asia. Icing forecasts from these charts must be used with caution since not all regions of the globe are covered and these charts only depict moderate and severe icing. They do not forecast or depict all icing (e.g., light).

2.2.2 In-flight icing on a global scale can be obtained or derived in two ways using WAFS computer-generated grids. The first is not an actual icing forecast, rather it is an inference of icing by using humidity and temperature forecasts while the second is the new WAFS gridded icing forecasts.

2.2.3 The WAFS Provider States produce upper-air temperature and humidity forecasts, on a global scale in grid point format, per Annex 3 — *Meteorological Service for International Air Navigation*, section 3.2.1a)2). These humidity and temperature forecasts can be used to infer icing for flight planning by using humidity and temperature ranges stated in the European and U.S regulations for ETOPS. Some airline meteorology departments and private weather data vendors produce icing forecasts for ETOPS based on these WAFS-provided humidity and temperature forecasts.

¹ The acronym ETOPS is defined in Annex 6 as “Extended Range Operations by Turbine-Engine Aeroplanes” as well as “Extended Range Operations” (ETOPS), as well as “Extended Range Operations by Aeroplanes with Two Turbine Engines”. Other definitions of acronym include “Extended Operations” which is used by the U.S. when the provisions broadened to include aircraft with more than two engines.

2.2.4 The WAFS Provider States also produce icing forecasts, on a global scale in grid point format, per Annex 3, section 3.2.1a)7). These icing forecasts are derived from scientific algorithms that include more parameters than just temperature and humidity.

2.2.5 The WAFS gridded icing forecasts are currently distributed through the Internet-based services and are labelled as “trial forecasts”. These trial forecasts are the “first generation” of WAFS gridded icing forecasts and do not provide icing type or severity. However these first generation icing forecasts do provide icing potential. Icing potential demonstrates the confidence that any given atmospheric location, represented by a three-dimensional model grid box, will contain super-cooled liquid water that is likely to form ice on an aircraft. WAFS first generation gridded icing forecasts also provide a yes/no icing forecast which is in accordance with the regulations for ETOPS.

2.2.6 There are two types of “first generation” WAFS gridded icing forecasts. One is an average, or **mean**, icing potential over the grid (1.25 ° latitude by 1.25 ° longitude), while the other is the **maximum** potential within the grid. The **maximum** icing forecast provides the highest icing potential, in per cent units, for the 3 dimensional grid box which is 1.25 ° latitude by 1.25 ° longitude. Neither the **maximum** or **mean** icing potential have any relationship to severity or intensity. It is the opinion of the WAFCs that the **maximum** icing potential is a data set more appropriate for ETOPS flight planning as it provides a more conservative forecast.

2.2.7 Icing potential is not a true probability value. Icing potential points out differences in the likelihood of encountering icing at a given location. For example, a value of 70 does not indicate there is a 70 per cent chance of encountering icing. However, when comparing it to other higher or lower values will indicate if there is a greater or lesser likelihood of encountering icing.

2.2.8 The WAFS gridded forecasts of 1) temperature and humidity and 2) gridded icing are produced from the same Numerical Weather Prediction (NWP) model. This does not mean that the WAFCs use the same NWP as each other for these forecasts; rather it means that the US icing forecasts were derived from the same model that produced the US. humidity and temperature forecasts, and similarly for the London WAFS. The two WAFCs have looked at harmonized version of the two gridded icing forecasts (i.e. UK and US) output in order to provide global harmonization, which is an IATA requirement. Further explanation of how harmonization will be done is to be addressed in an Information Paper.

2.2.9 Based on data collected and evaluated for the WAFS Science Meeting in 2009, the WAFS gridded icing forecasts, maximum potential, indicated a smaller area of coverage, by a approximately a factor of 2, compared to the forecasts using the humidity/below freezing method (55 per cent or greater and below freezing temperatures), possibly resulting in less fuel carriage by aeroplanes leading to potential economic and environmental benefits. Further explanation of the verification will be addressed in an Information Paper.

3. CONCLUSION

3.1 For ETOPS, an aeroplane carries additional fuel over areas where at 10,000 feet the forecasts for humidity is 55% or greater and the temperature is between 0°C and -20°C. That same aeroplane possibly could carry less fuel if the WAFS gridded icing forecasts, in first generation form, were approved for use.

3.2 The group is invited to consider the following draft conclusion:

Conclusion 6/xx — WAFS Gridded Icing Forecasts

WAFS gridded icing forecasts

- a) of **maximum** icing, in the form of icing potential, are suitable as a valid icing forecast for ETOPS flight planning and fuel supply,
- b) ensure that the products provided by the WAFC are globally consistent, and
- c) these forecasts be made available on the WAFS Satellite broadcasts, and
- d) be considered as “operational products” for the use in ETOPS forecasting in the Annex 3 and the WAFS Internet-based services (i.e., WIFS and SADIS FTP).

4. **ACTION BY THE WAFSOPSG**

4.1 The WAFSOPSG is invited to:

- a) note the information contained in this working paper; and
- b) decide on the draft conclusion for the groups consideration.

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