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Guidance for the Usage of Data Linked Forecast and Current Wind Information in Air Traffic Management (ATM) Operations

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FOREWORD

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EXECUTIVE SUMMARY

Advances in aircraft equipment combined with satellite-based navigation and other supporting technologies provide the basis for more precise aircraft scheduling and spacing in Air Traffic Management (ATM) operations. Based on the opportunity for more precise aircraft scheduling and spacing, new and upgraded ATM concepts are being developed and implemented. The objective of these new concepts is to increase airspace capacity and lower energy consumption and emissions while maintaining and promoting aviation safety.

The degree of accuracy of a predicted aircraft flight path relative to its actual flight path is based on many factors including the impact of the forecast and current winds and temperatures. The dynamic nature of the atmosphere, however, causes inaccuracies and uncertainty in the quality of wind and temperature information (both forecast and current) used in support of ATM operations. Without quality forecasts and current wind information, the precision in predicting flight path scheduling and spacing will be reduced and the achievable throughput in capacity-constrained airspace will be less than what could be attained. Therefore, newly developed Next Generation Air Transportation System tools and procedures would be less effective or even not used during periods of congested air traffic.

This document examines the impact of wind information on three ATM operations: wake mitigation, Required Time of Arrival (RTA), and Interval Management (IM); and provides guidance in the form of findings and recommendations on the use of wind information and related airspace procedure impacts based on previously and newly completed studies. The guidance covers the reporting and recommended quality of wind information determined necessary to support the three ATM operations. The findings and recommendations provide initial considerations for trade-offs and compromises by industry and the Federal Aviation Administration (and potentially other Air Navigation Service Providers) when developing the concepts and procedures for implementing (or upgrading) wake mitigation, RTA, and IM operations.

This document also provides an overview of and findings related to the use of current sources of wind information used by the aircraft and ground systems in supporting the three ATM operations. In addition, recommendations for future work are included to cover additional factors impacting the quality of wind and temperature information used in supporting these ATM operations as well as other operations not covered such as Dynamic Required Navigation Performance and Traffic Aware Strategic Aircrew Requests.

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1 INTRODUCTION

1.1 Purpose

The purpose of this document is to provide guidance on the use of and quality requirements associated with data linked forecast and current wind information used in Air Traffic Management (ATM) operations.

1.2 Background

The Federal Aviation Administration (FAA) and associated RTCA Special Committees (SCs) are developing the concepts, standards, and procedures for improving the efficiency and safety of ATM operations. Advances in aircraft equipment combined with satellite-based navigation and other supporting technologies provide the basis for more precise aircraft scheduling and spacing. The degree of accuracy of a predicted aircraft flight path relative to its actual flight path is based on many factors including the impact of the forecast and current winds and temperatures. There are, however, inaccuracies and uncertainty in the quality of the wind and temperature information (both forecast and current) used in support of ATM operations. These inaccuracies and uncertainties are caused by limitations in modeling a complex atmosphere coupled with limitations in weather observing and communications systems and technology.

RTCA SC-206 was tasked to provide guidance on the use of data linked wind information in support of the ongoing and planned ATM improvements. Through SC and sub-group meetings as well as technical interface meetings, the scope and technical approach for developing this guidance document were agreed.

In addition, the committee used numerous reference documents from other RTCA SCs, government, industry, and other professional sources. The review of these documents provided valuable information regarding the history and background, as well as the current state of wind research and use of wind information in air traffic control (ATC) and flight deck operations.

For example, the RTCA Wake Vortex Tiger Team developed RTCA DO-360, *Standards Development Activities for Using Near Real-Time Aircraft-Derived Data in Future Applications*. That document identified information needs and made recommendations about providing aircraft-derived meteorological (MET) data not currently available (e.g., near real-time winds) to support safely increasing air transportation system capacity.

1.3 Use of this Document

It is envisioned that this document will be used by the FAA as well as standards organizations, such as RTCA and International Civil Aviation Organization (ICAO), in developing the procedures and methods for the use of forecast and current wind

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information in the generation and execution of clearances for wake mitigation, Required Time of Arrival (RTA), and Interval Management (IM) operations. In addition, it will be used by government and industry to minimize the impact of wind errors on the generation of trajectory predictions. Industry users include the manufacturers of avionics, the providers of MET information and data link services, and the Airline Operations Center (AOCs) or commercial Flight Planning Service Providers (FPSPs).

It is also envisioned that this document will be used to develop operational concepts and requirements as well as identify gaps and guide further wind information research.

1.4 Scope and Approach

The guidance in this document is based on three areas of interest: wake mitigation, the RTA aspect of four-dimensional (4D) Trajectory Based Operations (TBO), and IM. These operations were selected and prioritized through SC and sub-group meetings as well as technical interface meetings with other subject matter experts (SMEs). In addition to considering the need for and use of data linked wind information, it was recognized that wind is not an independent variable when analyzing aircraft performance in meeting the criteria for safe and efficient operations. Other factors, especially airspace procedures/constraints are variables that need to be considered in their relation to influencing the determination of wind requirements. The approach taken for each of these operations is described in the subsections below.

Note: *Forecast flight-level temperatures are routinely coupled with flight-level winds and both are provided to aircraft. The impact of the quality of forecast temperature information, however, was not included in the simulations and studies referenced in this document.*

The findings and recommendations included in this document are specific to each of the three operations and are made within the context of the assumptions for each operation.

1.4.1 Wake Turbulence Mitigation

Findings and recommendations for wake turbulence mitigation are based on the large quantity of previously published wake vortex research, more recent research on a specific wake mitigation solution (Paired Departures), and analyses performed to address questions during the development and review of this document. Relevant research is referenced in the descriptions of wake mitigation solutions, findings, and recommendations in Section 2.1, Section 4, and Appendix A. Previously published documents, such as RTCA DO-339, provide additional detail on the need for and potential use of improved wind information. The full range of wake mitigation solutions are presented herein for completeness, including solutions and supporting data published elsewhere necessary to provide context and ensure understanding.

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