



ASSEMBLY — 42ND SESSION

TECHNICAL COMMISSION

Agenda Item 24: Aviation Safety and Air Navigation Priority Initiatives

DEVELOPMENT OF STUDIES TO PROMOTE THE DEPLOYMENT OF THE GROUND-BASED AUGMENTATION SYSTEM (GBAS) IN PLACES WHERE SUCH DEPLOYMENT IS LIMITED

(Presented by Argentina and supported by Belize, Bolivia (Plurinational State of), Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Jamaica, Mexico, Nicaragua, Paraguay, Peru and Uruguay)

EXECUTIVE SUMMARY

This working paper highlights the need for more studies on the performance of the ground-based augmentation system (GBAS) in order to lay down criteria and develop analytical tools that will enable the further deployment of GBAS. The findings of such studies will provide better access to the technical benefits of GBAS systems and promote their use in places that are determined to be suitable.

Action: The Assembly is invited to:

- note the content of this working paper; and
- instruct the Council, together with the Secretariat, to consider the convenience of requesting the Navigation Systems Panel to press ahead with specific studies to determine the characteristics of the analysis and the historical background necessary to identify significant ionospheric events in areas lacking ideal infrastructure for the deployment of GBAS.

<i>Strategic Goals:</i>	This working paper relates to <i>Every Flight is Safe and Secure, Aviation is Environmentally Sustainable</i> and <i>The Economic Development of Air Transport Assures the Delivery of Economic Prosperity and Societal Well-Being for All</i> .
<i>Financial implications:</i>	This proposal involves a potential benefit in the use of safer and more efficient flight procedures at airports with limited ability to deploy landing aids.
<i>References:</i>	Annex 10 – <i>Aeronautical Telecommunications</i> , Volume I – <i>Radio Navigation Aids</i> Doc 9750, <i>Global Air Navigation Plan (GANP)</i> Guide for Ground Based Augmentation System Implementation, (SAM Regional Office – ICAO) GBAS safety assessment guidance related to anomalous ionospheric conditions (edition 1.0 – September 2016, adopted by APANPIRG/27)

¹ Spanish version provided by Argentina.

1. INTRODUCTION

1.1 The ground-based augmentation system (GBAS) provides corrected position information, approach path details and integrity data to the aircraft via VHF transmission from the ground. Two multi-mode receivers (MMRs) on board the aircraft translate uplinked data that are used to calculate the position of the aircraft and provide lateral and vertical trajectory deviations.

1.2 The GBAS provides an alternative to the instrument landing system (ILS). The term "GBAS Landing System (GLS)" is used for GBAS-based instrument approach procedures, with "GLS" appearing on the approach charts.

1.3 GBAS monitors and corrects errors created by the Global Navigation Satellite System (GNSS) and provides accurate navigation and approach data via VHF frequencies and transmitters to all airports and runways located within 23 NM of the GBAS reference point.

1.4 The use of this system is contemplated in the APTA and NAVS modules of the Global Air Navigation Plan (GANP). At the regional level, guides and specific projects have been implemented within the framework of the CAR/SAM Regional Planning and Implementation Group (GREPECAS).

1.5 In Argentina, the company INVAP S.E. has been implementing its SINAL project since 2014 that includes the design and manufacture of a GBAS model currently deployed at Teniente Luis Candelaria International Airport in Bariloche (SAZS). Research and development work has shed light on the need to pursue studies aimed at correcting errors caused by ionospheric effects, with a view to developing tools and criteria that will make it possible to deploy this technology at airports where infrastructure cannot accommodate a full GBAS system.

2. DISCUSSION

2.1 The system has a margin of error of less than one metre (1 m) in the horizontal and vertical planes, which translates into a very high level of accuracy and integration. Sudden changes in ionospheric delay pose a threat that can generate an error of several metres in the position of the aircraft. This error must be corrected in real time for a precise approximation. GBAS augmentation systems have been installed to overcome this threat, based on parameters derived from the ionospheric characteristics of the location where the system has been installed, and dual-frequency multi-constellation alternatives have been suggested.

2.2 When GBAS is GPS-based using L1, a significant limitation is posed by the ionospheric threat for several reasons. In this case, use of the augmentation system to overcome the threat is based on parameters derived from the historical ionospheric characteristics of the location where the system is installed and its immediate surroundings.

2.3 According to the document prepared by the ICAO SAM Regional Office, "Guide for Ground Based Augmentation System Implementation", a State wishing to validate the Stanford threat model for a specific region should set up a structure that enables the collection of data from GPS satellites to identify and measure the ionospheric gradients and their speeds. This document provides no detailed characteristics of the data collection structure.

2.4 Validation of the Stanford model involves as yet undetermined costs relating to equipment, software and research. Substantial effort and investment may be deployed to end up finding that performance, and availability in particular, are unacceptable.

2.5 Where the aim is to ascertain the performance of GBAS at a given airport, it is feasible to determine what characteristics the Stanford wedge model needs for that location. Accordingly, if there is evidence of a significant ionospheric event that leads to an unacceptable wedge model, that site should be ruled out as a potential location for GBAS.

2.6 In addition, although it is known that the Navigation Systems Panel (NSP) GBAS Working Group (GWG) is reviewing studies and tests on the characteristics of the ionosphere conducted in the APAC Region and that build on those detailed in the document "GBAS safety assessment guidance related to anomalous ionospheric conditions", it is proposed that the ICAO technical expert groups should be encouraged to widen the scope of studies into ionospheric behaviour being conducted by the NSP to identify the best analytical approach to find significant ionospheric events in areas that lack ideal infrastructure, i.e., where installation of the necessary number of sensors is not possible or their distribution is inadequate, or where no sensors can be installed. In addition, the scope of such a study should include specifying the necessary measurement history for a given circumstance and at what stage of the solar cycle the measurements should ideally be conducted.

2.7 Conducting additional studies to those currently being carried out by the NSP will save resources and time, by focusing on a determination of the worst case and thereby avoiding regional generalizations and concentrating on a specific airport and the approach paths to that airport.

2.8 The results of these studies would, *inter alia*, help determine criteria and methods to address the following system location issues:

- a) For a given airport and the approach paths to that airport, what is the minimum required distribution of sensors and measurement history to identify significant ionospheric events with a Stanford wedge that is unacceptable to the performance goals of that location.
- b) Given a certain distribution of sensors with an appropriate measurement history, for which nearby airports is it possible to compute Stanford wedge parameters that determine the performance of a possible GBAS on the site.

3. CONCLUSION

3.1 To ensure the availability of analytical tools and criteria to identify configurations where deployment of the ideal infrastructure for a GBAS system is not possible, specific studies need to be carried out to detect significant ionospheric events in areas where the ideal infrastructure cannot be deployed.

3.2 Accordingly, the objective of this working paper is to encourage ICAO's technical expert groups to widen the scope of study with a view to identifying the analytical approach and measurement history required to detect significant ionospheric events in areas lacking ideal infrastructure; i.e., where installation of the necessary number of sensors is not possible or their distribution is inadequate, or where no sensors can be installed.