GBAS Ionospheric Threat Model for APAC Region

1. Background

The Ionospheric Studies Task Force (ISTF) worked on the coordinated ionospheric data collection, analysis and sharing to facilitate ionospheric data collection and sharing in the Asia-Pacific (APAC) region since 2011. In 2016, ISTF delivered its final report to Communications, Navigation, and Surveillance Subgroup (CNS-SG). The report included a GBAS ionospheric threat model for APAC Region, and guidance documents on GBAS and SBAS safety assessments related to anomalous ionospheric conditions.

2. APANPIRG conclusion

The 27th meeting of APANPIRG made the following Conclusion to adopt the GBAS Ionospheric Threat Model for APAC region, based on a report of CNS-SG:

<table>
<tr><td colspan="2">Conclusion APANPIRG/27/40: Adoption of GBAS Ionospheric Threat Model for APAC Region and publication in Technical journal</td></tr>
<tr><td>That, the APAC GBAS Ionospheric Threat Model provided in Sections 2.1 to 2.4 of APANPIRG/27-WP/23 is adopted and remains the intellectual property of ICAO and be published in the public domain in selected technical journals with the list of author/contributors as per Appendix J to APANPIRG/27-WP/9.</td><td>Expected impact:
☐ Political / Global
☐ Inter-regional
☐ Economic
☐ Environmental
☒ Ops/Technical</td></tr>
<tr><td colspan="2">Why: To mitigate ionospheric threat to GBAS signal for States in the APAC low magnetic latitude region.</td></tr>
<tr><td>When: 31-Jan-17</td><td>Status: Adopted by PIRG</td></tr>
<tr><td colspan="2">Who: ☐ Sub groups ☒ APAC States ☒ ICAO APAC RO ☐ ICAO HQ ☐ Other:</td></tr>
</table>

3. Ionospheric Threat Model

In the APAC GBAS Ionospheric Threat Model (APAC GITM), the upper bound in the gradient magnitude is set to **600 mm/km irrespective of satellite elevation angle**. Figure 1 shows the gradients greater than 100 mm/km obtained by the analysis of ISTF. The upper bound is determined to bound the largest gradient (518 mm/km) observed in Japan, while gradients almost this large were also observed at Hong Kong and Singapore. The upper bound is determined to have no satellite elevation angle dependence, because there is no clear physical basis for having a linear decrease and data at high elevation angles remain insufficient. When more gradient samples are obtained in the future and more confidence gained in the statistics, the conservative margin that the model provides at higher elevation angles may be reduced.

Details of analysis leading to the model are described in a technical article which is under peer-review for publication in a technical journal.

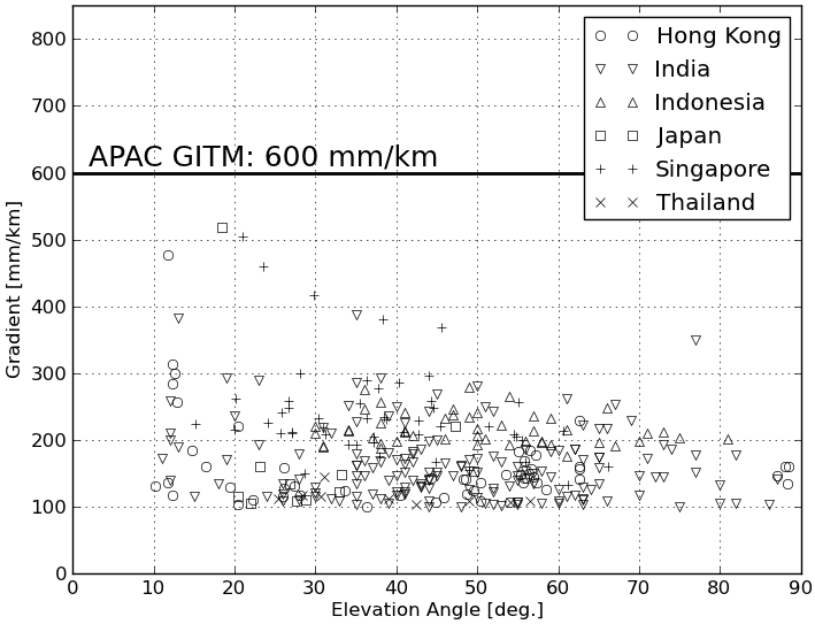

Figure 1. Ionospheric gradients (greater than 100 mm/km) observed in the APAC region and adopted upper bound of the gradient as a function of satellite elevation angle.

4. Guidance document

The guidance document on GBAS safety assessment related to anomalous ionospheric conditions is available at the ICAO APAC website:

http://www.icao.int/APAC/Documents/edocs/GBAS%20safety%20assessment%20guidance.pdf

5. Future actions

There may be a scope to reduce the threat space at higher elevation angles, if further analysis justifies this reduction. Other parameters of the ionospheric gradient (gradient depth, velocity, and width) have not been well assessed and are left for future analysis and validation. Therefore, the APAC-GITM as well as the GBAS safety assessment guidance documents will be maintained and updated as necessary in the future. States are encouraged to report to CNS-SG to share information obtained in their GBAS implementation activities, using the ISTF portal (https://portal.icao.int/ISTF/Pages/default.aspx, restricted access).
