International Civil Aviation Organization

THE FOURTH MEETING OF IONOSPHERIC STUDIES TASK FORCE (ISTF/4)

New Delhi, India, 05 – 07 February, 2014

Agenda Item 4: Review of progress of tasks and related action items;

b) Task 2 - Data Analysis

METHODOLOGY OF SCINTILLATION DATA ANALYSIS

(Presented by Japan)

SUMMARY

This working paper presents one of the possible analysis methodologies of ionospheric scintillation data.

1. INTRODUCTION

1.1 Ionospheric scintillation and ionospheric delay gradient are the major effects of the ionosphere that have negative impact on the aviation use of GNSS. The threat models of the ionospheric delay gradients for GBAS and SBAS, which are the deliverables of the Ionospheric Studies Task Force (ISTF), have been well defined. However, the deliverables of ISTF for ionospheric scintillation has not been well defined.

1.2 To proceed to the data analysis and threat model development for the ionospheric scintillations, the way of analysis of ionospheric scintillation data should be determined.

2. DISCUSSION

2.1 The scintillation mapping as presented in IP11 presented in the last ISTF meeting (ISTF/3) is one of the possible representation of the ionosphere. The occurrence rates of ionospheric scintillations can be calculated in a certain size of latitude and longitude grid bins. Global model of ionospheric scintillations in this representation can also be found in (references). This way is more suitable for SBAS applications where the characteristics of the ionospheric scintillation in wide area is needed.

2.2 For GBAS, however, such a latitude-longitude map is not necessarily the best way, because the GBAS is a local augmentation system. In GBAS, the reference stations and airborne users share almost the same sky, the azimuth-elevation representation of the occurrence rate of ionospheric scintillations is a useful way. When the availability of the GBAS at a certain location is estimated, scintillation occurrence probability in a certain area of the sky is useful to determine the probability of losing satellites in the area (Figure 1).

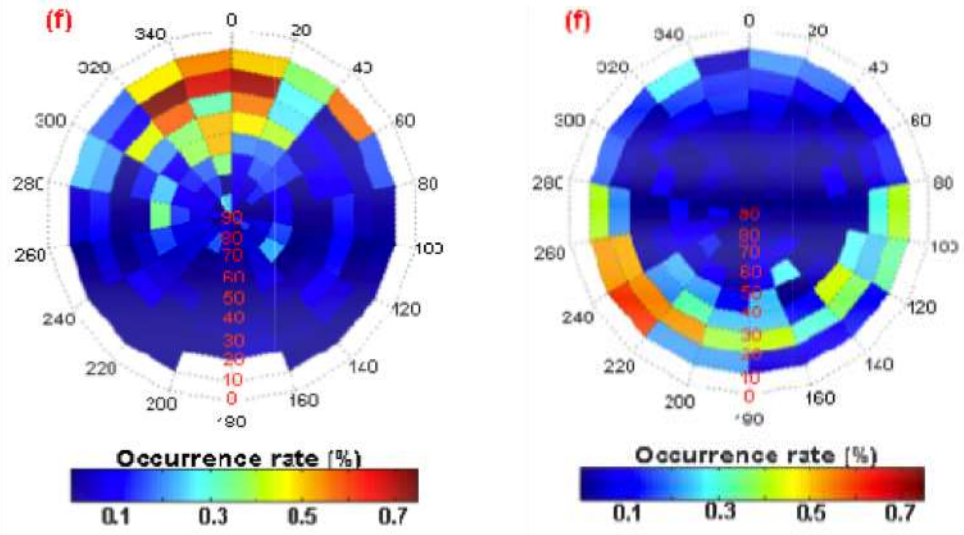

Figure 1. Occurrence rates of scintillations as a function of azimuth and elevation angles observed at Bandung (left) and Pontianak (right), indonesia in 2011 (Abadi et al., 2014).

2.3 In this context, Abadi et al. (2014) has analyzed ionospheric scintillation data at two sites in Indonesia, Bandung (107.6ºE, 6.9ºS; magnetic latitude 17.5ºS) and Pontianak (109.3ºE, 0.02ºS; magnetic latitude 8.9ºS). Bandung is located typically poleward of the Equatorial Ionization Anomaly (EIA) crest, while Pontianak is located equatorward of the EIA crest. Their main findings are:

1) ionospheric scintillation is more intense in the direction of EIA crest
2) ionospheric scintillaion enhances in the direction parallel to the magnetic field line
3) ionospheric scintillation is stronger in the west than east

More details of the way of analysis and the results are described in the attached paper published in Annales Geophysicae which is an open access journal.

2.4 Similar analysis with the ISTF data would provide useful information for GBAS in the low latitude regions. Thus, azimuth-elevation analysis of occurrence probability of ionospheric scintillation at a few selected magnetic latitudes is proposed to be an analysis methodology of ionospheric scintillation for GBAS for ISTF Tasks 4 and 5.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information presented in this paper;

b) consider the proposed method as a candidate for scintillation analysis of ISTF; and

c) discuss any relevant matters as appropriate.

4. ATTACHMENT

Abadi, P., S. Saito, and W. Srigutomo, Low-latitude scintillation occurrences around the equatorial anomaly crest over Indonesia, Ann. Geophys., 32, 7–17, 2014 www.ann-geophys.net/32/7/2014/doi:10.5194/angeo-32-7-2014, 2014.

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