Geometric enhancement for scintillation modeling

D. Vasylyev[1], Y. Bèniguel [2] , M. Kriegel [1] , V. Wilken [1] and J. Berdermann[1]
1) German Aerospace Center, Neustrelitz, Germany, 17235
2) IEEA, Courbevoie, 92400, France
Corresponding Author e-mail: Dmytro.Vasylyev@dlr.de

Continuous improvement of scintillation models is an important task required for adequate analysis and prediction of scintillation events caused by ionospheric irregularities. Some improvement can be achieved by an improved geometric description of small-scale perturbations in the ionosphere. Recently we revise the classical results of Ref. [1] obtained in the flat-earth approximation and generalized them for the case when the finite curvature of the earth has to be considered. Assuming that the earth is spherical, we obtained the analytic expressions for phase and intensity scintillation indices [2] in the approximation of a single thin phase changing screen. Figure 1 illustrates the difference between to mentioned geometries that becomes especially apparent at large zenith angles of the ground-based observer. The obtained results for spherical-earth geometry are divergence-free and represent the appropriate position of the enhancement maximum as a function of the dip angle for field-aligned ionospheric irregularities. Thus, the spherical-earth model is suitable for scintillation modeling and forecasting in such user cases as limb sounding, reflectometry, positioning at small elevation angles. Implementation of the proposed geometric considerations in the Global Ionospheric Scintillation Model is also briefly discussed.

1 C. L. Rino, "A power law phase screen model for ionospheric scintillation: 1. Weak scatter," Radio Sci., **14**, 1135 (1979)

2 D.V. Vasylyev, Y. Bèniguel, M. Kriegel, V. Wilken, J. Berdermann, "Modeling ionospheric scintillation," **12**, 22, (2022)

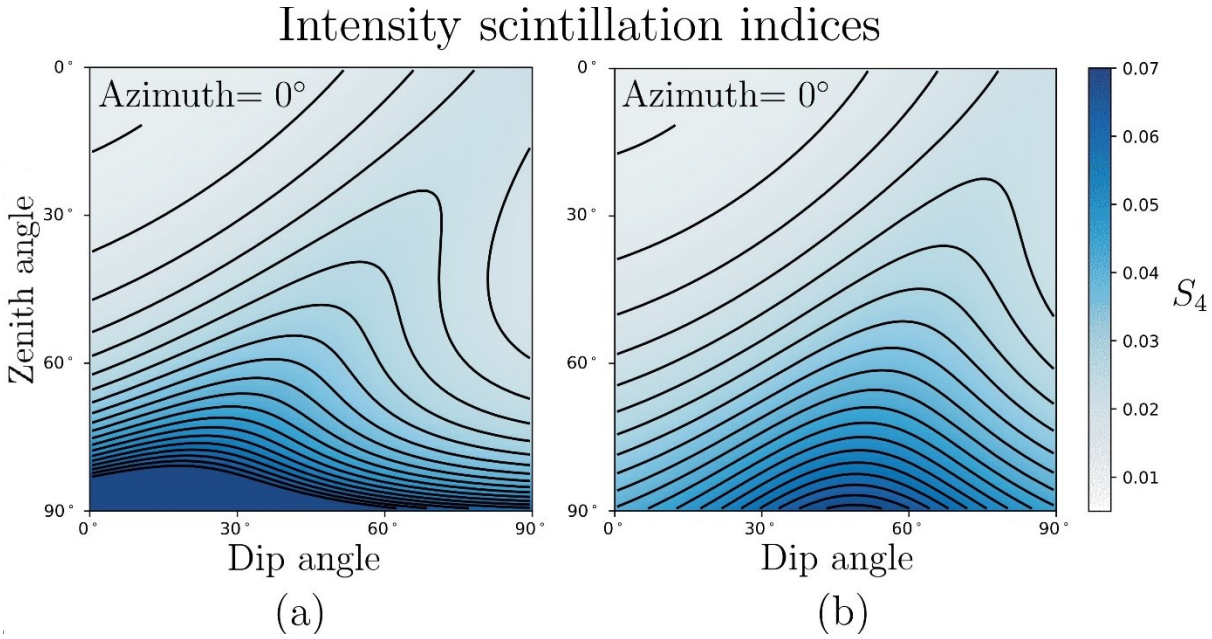

Figure 1. Example of the intensity scintillation index calculated using the approximations of: (a) flat-earth and (b) spherical-earth geometries. Both approximations yield similar results for near-vertical propagation but geometric enhancement of scintillation results into different dependence on magnetic dip angle as the propagation link is near horizontal.