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Comparing TID Simulations Using 3D Raytracing and Mirror Reflection

Abstract:
Measurements of Doppler frequencies and angles of arrival (AoAs) of ionospherically reflected HF waves are a means of detecting the occurrence of traveling ionospheric disturbances (TIDs), using the time variations of these measurements. Simulations are made using the Huang and Reinisch [2007] ray tracing technique and the IRI electron density model in an effort to reproduce measured (or simulated) signatures. The TID is represented by a wavelike perturbation of the 3D electron density with an amplitude that varies sinusoidally with time and travels horizontally in the ionosphere in a given direction. By judiciously selecting the TID parameters the raytracing simulation can reproduce observed Doppler frequencies and AoAs. The raytracing is, however, excessively time consuming because of the involved homing procedures. To simplify the procedure we simulated the results for a mirror reflection model [Paznukhov et al., 2012]. The height and tilt of the undisturbed reflection surface are adjusted to agree with assumed AoAs. This undisturbed reflection surface is then deformed into a wavelike moving surface. The ray reflected from the deformed surface is varying and the Doppler frequencies and the AoAs are determined. The simulation results from the ray tracing and the mirror model are compared to assess the applicability of the mirror model.

Paznukhov et al., Digisonde observations of AGWs/TIDs with Frequency and Angular Sounding Technique, Adv. Space. Res., 49(4), 700-710, doi:10.1016/j.asr.2011.11.012, 2012.

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