



The space weather of the global ionosphere S4 scintillation

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In this paper, a method is introduced which converts S4 index observations by radio occultation of FORMOSAT-3/COSMIC (F3/C) to the scintillation on the ground. To carry out the conversion, three dimensional (3D) structures of S4max, the maximum value on each profile probed by F3/C, are constructed, which allows us to understand GPS scintillation variations at various local times, seasons, and solar activity conditions, as well as the geographical distribution from the space-based point of view. By applying the method to data of the 3D structure, maps of the worst case scenario on the ground as functions of geomagnetic local time and geographic coordinates are constructed and reported here. The converted S4max for the first time estimates the global distribution of ionospheric scintillations in the GPS L1 band C/A code signal on the ground. The results show that the worst-case scintillations appear within the low latitude region of $\pm 30^\circ\text{N}$, peaking around $\pm 20^\circ\text{N}$ magnetic latitude; they begin at 1900 MLT, reach their maximum at 2100 MLT, and vanish by about 0200-0300 MLT. The most pronounced low-latitude scintillation occurs over the South American and African sectors. Finally, based on the above the above data, an empirical model is constructed. For a given time, location, and solar activity, the model forecasts the ionospheric S4 scintillation in the L1 band signal on the ground.