Global Validation of Ionospheric Bottomside Profile Parameters (B0 & B1) from FORMOSAT-7/COSMIC-2 Radio Occultation Profiles with Digisonde and IRI-2020 Model

Iswariya S [1], Sampad Kumar Panda [2]

[1,2] Department of Electronics and Communication Engineering, Koneru Lakshmaiah Education Foundation, Green Fields, Vaddeswaram, Andhra Pradesh 522302, India

Abstract

We present a comprehensive validation of bottomside electron density profile thickness (B0) and shape (B1) parameters derived through least-square fitting from FORMOSAT-7/COSMIC-2 occultations with the coincident ground-based Digisonde observations at 24 globally distributed locations spanning equatorial, low-, and mid-latitude regions and the default bottomside modeling option in the latest edition of the International Reference Ionosphere model (IRI-2020) [1]. These parameters are the essential descriptors of the ionospheric bottomside morphology, which are critical for characterizing the vertical structure of the ionosphere but are influenced by solar flux, geomagnetic activity, and space weather dynamics [2, 3]. Leveraging a large dataset from the COSMIC-2 profile, we employed rigorous quality constraints through systematic visual inspections and defined exclusion criteria to identify the most representative profiles for investigating the diurnal, seasonal, and longitudinal variations of the aforementioned parameters as functions of local time during the period from 2020 to 2022, referring to the ascending phase of 25th solar cycle. The results demonstrate that COSMIC-2 derived B0 and B1 parameters have better agreement with Digisonde observations than those predicted by IRI-2020, thereby emphasizing the consideration of COSMIC-2 profile parameters towards improvements in the empirical ionosphere models.

Keywords: Ionosphere; Bottomside thickness and shape (B0 and B1); FORMOSAT-7/COSMIC-2 ; Digisonde; International Reference Ionosphere model

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