3rd URSI AT-AP-RASC, Gran Canaria, 29 May – 3 June 2022

Using Van Allen Probes and Arase Observations to Build a New Empirical Plasma Density Model in the Inner Zone

D. P. Hartley*[(1)], G. Cunningham [(2)], J. F. Ripoll [(3)], D. Malaspina [(4)], F. Tsuchiya [(5)], A. Kumamoto [(5)], S. Matsuda [(6)], Y. Kasahara [(7)], Y. Miyoshi [(8)], A. Matsuoka [(9)], and S. Nakamura [(8)]

(1) University of Iowa, Iowa City, IA, USA; e-mail: david-hartley@uiowa.edu
(2) Los Alamos National Laboratory, Los Alamos, NM, USA
(3) CEA, DAM, DIF, Arpajon, France
(4) University of Colorado Boulder, Boulder, CO, USA
(5) Tohoku University, Sendai, Japan
(6) JAXA, Sagamihara, Japan
(7) Kanazawa University, Kanazawa, Japan
(8) Nagoya University, Nagoya, Japan
(9) Kyoto University, Kyoto, Japan

Existing cold plasma density models have been identified as a major source of uncertainty that must be improved upon in order to explain the behavior of relativistic electrons in the inner belt. The primary cause of this uncertainty is due to the extrapolation of existing density models beyond their regions of validity. It has recently been shown that the plasma density can be inferred from Van Allen Probes observations of the electric and magnetic wavefield associated with plasmaspheric hiss, a wave which is prevalent in the inner zone. This method, referred to as the "hiss method" hereafter, is particularly useful for time periods when the upper hybrid resonance (UHR) frequency, which is typically used to infer the plasma density, exceeds the 400 kHz upper frequency limit of the Van Allen Probes instrumentation. This is a relatively common occurrence in the inner zone, particularly inside $L < 2.5$.

The hiss method has been statistically calibrated against the UHR inferred plasma density for Van Allen Probes data up to ~2,500 cm^{-3}, however no calibration has been performed beyond this limit. To test and calibrate above this limit, we compare plasma density values determined via the hiss method for Van Allen Probes against plasma density values determined from the upper hybrid line on the Arase satellite, which can observe the upper hybrid resonance frequency up to 10 MHz, and therefore infer densities up to ~10, 000 cm^{-3}. Plasma density values are compared during close conjunction events, as well as statistically, with a view to calibrating the hiss method in the inner zone. The MLT, L, and latitudinal dependence of the plasma density is investigated. The ultimate goal is to develop a new plasma density model that specifically targets the inner radiation belt region, thus removing the need to extrapolate existing models.