Topside ionosphere and plasmasphere modelling by NEDM and its potential use to improve the IRI model

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Neustrelitz Electron Density Model (NEDM2020) [1] is developed for supporting space weather services and mitigation of propagation errors for trans-ionospheric signals. NEDM2020 is composed of a dedicated plasmasphere model called Neustrelitz Plasmasphere Model (NPSM) [2] and separate Chapman layer functions for ionospheric F and E-layer distributions and provide 3D electron density distribution up to about 20,000 km altitude. We will present comparisons of mean electron density variations derived from NEDM2020, NeQuick2 and IRI-2016 (or IRI-2020) models with respect to reference electron density datasets from ICON's Ion Velocity Meter (IVM), DMSP's Faraday scintillation cup, Swarm's Langmuir Probes (LP) and Van Allen Probes's Radiation Belt Storm Probes (RBSP) instruments. Our limited investigation shows that NEDM2020 performs better than NeQuick2 and IRI when compared with the in-situ datasets from IVM and RBSP instruments (see Figure 1 below). When compared with Swarm's LP datasets all three models perform very similarly.

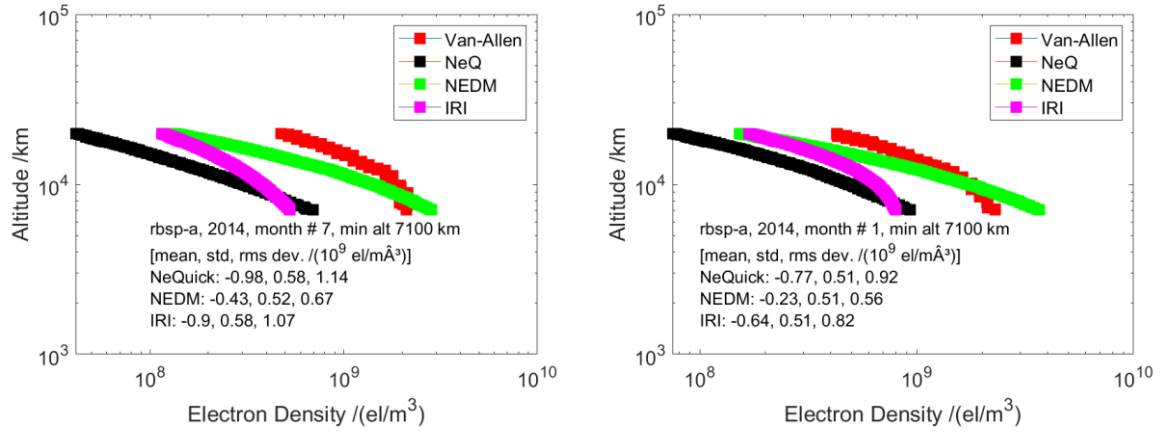

Figure 1. Comparisons of NEDM2020, NeQuick2 and IRI-Plas results with reference in-situ data from Van Allen Probes's RBSP-A instrument during January and July 2014 periods.

Due to flying at a very low inclination orbit of about 10° the Van Allen data only covers low latitude regions on both side of the equator. The data covers a large altitude range approximately 600 – 30,500 km for electron density specification. Our investigation shows that NEDM2020 provides a better topside ionosphere and plasmasphere description compared to the NeQuick2 and IRI-Plas. Therefore, the topside part of the NEDM2020 has the potential to improve the IRI model up to 20,000 km altitude.

References

[1] M. M. Hoque, N. Jakowski, and F. S. Prol"A new climatological electron density model for supporting space weather services," *J. Space Weather Space Clim.*, **12**, 1., 2022, https://doi.org/10.1051/swsc/2021044

[2] N. Jakowski, and M. M. Hoque, "A new electron density model of the plasmasphere for operational applications and services," *J. Space Weather Space Clim.*, **8**, A16, 2018, doi: 10.1051/swsc/2018002