

Total Electron Content Products From SIMuRG

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In the recent years, a significant amount of the measurements of the Earth's ionosphere has been made by medium- and high-orbit global navigation satellite systems (GNSS) such as GLONASS, GPS, Galileo, BeiDou, SBAS, etc. Currently, a number of services (such as IGS, UNAVCO, CHAIN, EUREF, etc.) provide GNSS data in open access in the RINEX format. The databases start from early 1990s. More than 6000 GNSS sites provide independent measurements. We have developed the System for Ionosphere Monitoring and Research from GNSS (SIMuRG) for organizing RINEX data and applying results in geophysical studies [1]. SIMuRG provides the total electron content (TEC) variations filtered within 2-10 min, 10-20 min, and 20-60 min, as well as calculates the Rate of the TEC Index (ROTI), the Along Arc TEC Rate (AATR) index, and the vertical TEC. SIMuRG is an on-line service at <http://simurg.iszf.irk.ru>. Figures 1 and 2 show examples of SIMuRG products which can be freely obtained. Figure 1 presents 2-10 min TEC variation during the Falcon Heavy launch on June 25, 2019. Significant TEC disturbance is observed along Falcon Heavy trace. The maximal disturbance is recorded 9 min (at ~6:39 UT) after the launch. Figure 2 shows dynamics of Global Electron Content (GEC) obtained based on global ionosphere maps. GEC is an index showing global ionosphere state and can be used to study ionosphere response to space weather events. During 23rd – 24th solar cycles, GEC changes from $\sim 0.4 \cdot 10^{32}$ to $\sim 3.2 \cdot 10^{32}$ electrons. There are significant annual, semiannual, 27-day and diurnal variations in GEC dynamics. The work is financially supported by the Russian Science Foundation (grant N 17-77-20005).

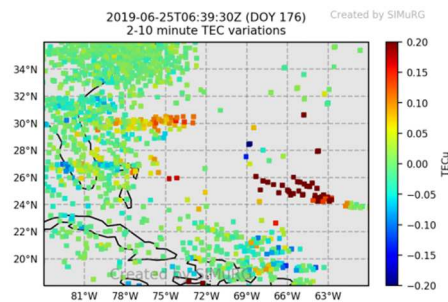


Figure 1. Map of 2-10 min TEC variations during Falcon Heavy launch on June 25, 2019.

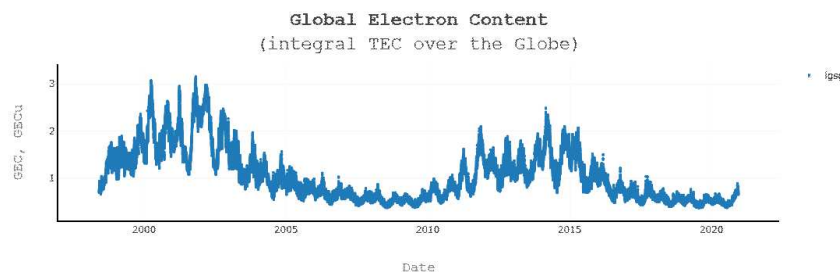


Figure 2. Global electron content during the 23rd and 24th solar cycles.

References

- [1] Y. V. Yasyukevich et al., “SIMuRG: System for Ionosphere Monitoring and Research from GNSS,” *GPS Solut*, 2020, **24**, 69, doi: 10.1007/s10291-020-00983-2.