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The impact of turbulence processes on ionospheric plasma density irregularities

Paola De Michelis[(1)], Igino Coco [(1)], Giuseppe Consolini [(2)], Fabio Giannattasio[(1)], Giulia Lovati [(3)(1)], Michael Pezzopane [(1)], Alessio Pignalberi [(1)] and Roberta Tozzi [(1)]
(1) Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy
(2) INAF-Istituto di Astrofisica e Planetologia Spaziali, Rome, Italy
(3) Università di Roma Sapienza, Dipartimento di Fisica, Rome, Italy

The ionospheric plasma density irregularities are known to play a role in the propagation of electromagnetic signals, and to be one of the most important sources of disturbance for the Global Navigation Satellite System (GNSS). Nowadays, many critical infrastructures and our economy depend significantly on positioning, navigation, and timing services of GNSS, so that, our society is vulnerable to damages due to malfunction of these systems. For this reason, one of the research priorities of the Space Weather community is to investigate the occurrence of ionospheric plasma irregularities, and understand their features and generation mechanisms. An interesting aspect of these irregularities is their possible turbulent nature. The long dataset recorded by Swarm satellites, the first constellation launched by ESA for Earth observation, gave the chance to investigate this topic from a new point of view. The analysis we have done focused on a better understanding of features of plasma density irregularities. Specifically, we have deeply analyzed one of their interesting aspect, that is, their possible turbulent nature. This was done with the purpose of assessing the origin of one of the large Space Weather effects on GNSS, which is the occurrence of loss of lock (LoL) events. In detail, the study investigates the possible dependence of global positioning system (GPS) LoL events on the presence of a specific kind of ionospheric irregularities. The obtained results pave the way to the realization of effective models able to mitigate the risk due to LoL and/or degradation of GPS signals, for which for the first time turbulence processes are taken into account.