Application of the INGV MUF nowcasting method for PECASUS to a relevant case for aviation

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As it is known, Space Weather (SWx) phenomena can have dramatic impact on satellite navigation and HF radio communication systems, being also responsible for increases on radiation levels at flight altitudes. For this reason, in recent years the International Civil Aviation Organization (ICAO) has been showing great interest in operational SWx services for aviation purposes in these three domains. Four global SWx centers have been then appointed by ICAO to provide real-time SWx advisories for aviation users, with two-week shifts in the responsibility of advisories validation and dissemination starting since November 2019, when the solar activity was at minimum, along with the probability for strong SWx events to occur.
The first advisories for degraded HF radio communication (HF COM) conditions as a consequence of ionospheric disturbances were issued on September 28th - October 1st 2020 by ACJF center, when moderate geomagnetic storm conditions were predicted. HF COM conditions are assessed by monitoring the F2-layer critical frequency f_oF2 or the MUF(3000) ionospheric characteristic (MUF = Maximum Usable Frequency), the latter representing the highest HF radio frequency that can be used for communications over a standard distance of 3000 km via F2-layer ionospheric reflection. Post-storm depressions in these parameters are then continuously monitored, being related to limitations in the working frequency band for communications crucial for aviation applications.
Nowcasting maps over Europe of MUF(3000) and its ratio with respect to a background level are developed by INGV as key operational 24/7 products for PECASUS (Partnership for Excellence in Civil Aviation Space weather User Services), as one of the global SWx centers designed by ICAO. In order to upgrade IRI-CCIR-based background maps over Europe, the mapping procedure makes use of the available real-time ionosonde measurements in different locations, and the Ordinary Kriging method for spatial interpolation. The MUF(3000) modeling performance was assessed comparing predicted values to measured ones over two test stations during strong geomagnetic storm periods, obtaining an overall *RMSE* < 2 MHz at both stations [1].
It is here presented the application of this MUF(3000) mapping method to the period September 28th - October 1st 2020, in order to study the ionospheric conditions provided by the model when HF COM advisories have been actually issued. MUF(3000) modeling performance are then assessed for this new case study in terms of *RMSE* over test stations data, comparing the results with those previously obtained.

References

[1] D. Sabbagh, P. Bagiacchi, and C. Scotto, "Accuracy assessment of the MUF(3000) nowcasting for PECASUS Space Weather services," *2020 XXXIIIrd General Assembly and Scientific Symposium of the International Union of Radio Science*, Rome, Italy, 2020, pp. 1-4, doi: 10.23919/URSIGASS49373.2020.9232437.