PECASUS service for monitoring the global distribution of foF2 and generating the warnings about its depression

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Pan-European Consortium for Aviation Space Weather User Services (PECASUS) has started 24/7 operations of the space weather services for civil aviation on November 7th 2019. Among the other space weather data, the information about the changes in conditions of HF radio communication, namely, warnings about a depression of critical frequencies foF2 or maximum usable frequencies (MUF) should be provided to users in near real time base. In frames of PECASUS the service for estimating the global distribution of HF communication condition was developed in Space Research Centre of Polish Academy of Sciences.

We decided to use foF2 as a main parameter describing the HF communication because it is scanned most accurate and confident from ionograms. As a result its databases are more complete in comparison with MUF(3000) ones. The techniques for building the global now-casting maps of foF2 as well as global maps of foF2 depression and warnings about the depression of more than 30% (moderate depression, HF COM MOD) and more than 50% (severe depression, HF COM SEV) were developed and implemented. We realized the next algorithm. All globe is divided on 6*24 polygons (6 – by latitudes and 24 by longitudes), so every polygon includes 30 degrees of latitude and 15 degrees of longitude. We check the foF2 numerical data from each available ionosonde and compare them with 30-days median value. If the number of numerical values of foF2 from the specified ionosonde is less than 20 for the last 30 days, the median value calculated within NeQuick ionospheric model [1]. In opposite case we use experimental median value. The information from the ionosonde is extended for the polygon where it located as well as on neighbor polygons if distance from ionosonde to them is lower than 10 angle degrees. If one ionosonde returns the warning for the specified polygon, but others not, the decision is negative: "NO WARNING". If at least two ionosondes return the warning, but others not, the decision is positive: "WARNING". For using the techniques for calculating the foF2 depression and warnings in near-real time for the PECASUS operative work all developed software were transferred to Python platform. The additional software for visualization of the maps of depression, warnings, and coverage of the globe with experimental data were developed. Now the maps in JSON and PNG formats are sent continuously to the PECASUS dashboard. The examples of the maps are shown at the Figure 1.
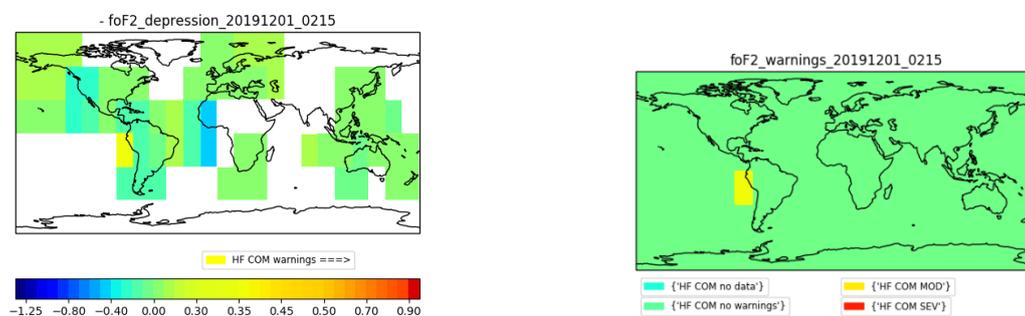

Figure 1. Global maps of foF2 depression (left), and foF2 depression warnings (right) for 02:15 UT, 1 December 2019

References

[1] B. Nava, P. Coisson, S.M. Radicella. "A new version of the NeQuick ionosphere electron density model." Journal of Atmospheric and Solar-Terrestrial Physics. **70** (2008), p. 1856–1862.