

# **Impact of famous CEDAR, GEM and ISTP geomagnetic Storms on HF Radio Propagation**

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The mighty geomagnetic storms due to the extraordinary Sun's activity cause as a rule some impacts in these areas: radiation effects on human and satellites, commercial airlines outages, electric power and other geomagnetic effects, navigation and communication: GPS effects, ionospheric disturbances, HF communication effects. Therefore, our scientific understanding of this activity is very important. Joint efforts, for example within the framework of the CAWSES, enable progress in our ability to: (i) identify critical inputs to specify the geospace environment at a level needed to minimize impacts on technology, human society and life and (ii) support the development of robust models that predict conditions in geospace based on understanding of the Sun-Earth system and all of its interacting components. In this study, influence of 14 geomagnetic storms from a list of CEDAR, GEM and ISTP storms within 1997-99 on radio propagation conditions have been investigated. These conditions were estimated through variations of the MOF and LOF (the maximum and lowest operation frequencies) on each path from three high-latitude HF radio paths of North-west Russia before, during and after a storm. It was shown that the storm impact on the ionosphere and radio propagation for each storm has an individual character. Nevertheless, the common character of the certain manifestations during storm-time was revealed. For example, the frequency range MOF - LOF is getting wider several hours before a storm, then it is sharply narrow during a storm-time and further it is expanded again several hours after storm ending. This regularity may be useful for organizing and planning the HF network operation at high-latitudes with airplanes, ships, geophysical stations during crucial states of the Space Weather. On the radio path with a reflection point inside the auroral oval, the full time interval  $T_{des}$  when the path is destroyed throughout a storm depends on a local time LT. For the day-time storms an average value  $T_{des}$  is 30%, for the night storm  $T_{des}$  is only 20%. The fact is established that the ionization increase in the F2 layer several hours (4 hours during the day-time and 2 hours during the night) before the storm expansion phase onset may be considered as a reliable forerunner of the storm expansion phase development. By present experimental data, it was revealed that at the high latitudes not only the traditional mechanism of the solar energy transfer into the upper atmosphere through the magnetosphere tail, plasma sheet and auroral ionosphere operates but a quite another mechanism also exists - through the diurnal cusp and enter sheet of the magnetosphere. Similar investigation is important for the problems being solved by the Space Weather program.