Impacts of ULF wave power on the Ionosphere

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Abstract: The impact of the ULF wave power, which is excited by long-lived high solar wind speed streams, in the magnetosphere has been well understood. For example, it has been reported that ULF pulsations may be the likely acceleration mechanism for generating storm-time MeV "killer" electrons in the magnetosphere. However, the impact of this energetic ULF wave power onto the ionosphere is not yet explored very well. In this paper we unequivocally demonstrated that during intense global ULF wave activity period, distinct pulsations with the same periodicity were found in the TEC data observed by GPS receivers located at different latitudes. The GPS-TEC has been used as a powerful tool to study the propagation pattern of transient ionospheric disturbances generated by seismic or internal gravity waves. Since then the small-scale variations (undulation) of GPS TEC has been associated with either gravity wave or TIDs. However, these small scale undulations of TECs turned out to be sensitive enough to the intense global ULF waves as well. The wavelet analysis of GPS TEC small scale undulations shows a peak value at the frequency of 2-10mHz which is a typical frequency range of Pc5 ULF wave. The typical internal gravity wave frequency is less than 1.6 or 2 mHz, therefore the small scale TEC undulations are likely due to ULF waves. At the same time, we detect the ULF activity on the ground using a chain of ground-based magnetometer data, depicting the ULF wave penetration from high latitude to low latitude region. All these observations demonstrate that Pc5 waves with a likely driver in the solar wind can penetrate to the ionosphere and cause small scale undulation on the ionospheric density structures.