ULF waves registered with the Ekaterinburg radar: Statistical analysis and case studies

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A midlatitude coherent decameter radar installed near Ekaterinburg, Russia (EKB radar) has been operating since 2012. It is aimed at monitoring dynamics of the ionosphere–magnetosphere system in Eastern Siberia. A special operation mode is used at the radar to study ULF wave activity: three adjacent beams oriented approximately along the magnetic meridian are surveyed with time resolution of 18 s each. A number of wave observation events registered with the radar was analyzed and discussed in several papers. An overview of the main results from these studies is presented here.

A statistical study of more than 30 waves observed in the nightside ionosphere revealed that in the majority of the cases their frequencies are considerably lower than those of field line resonance (FLR) for appropriate magnetic shells and longitudinal sectors (FLR fundamental frequencies for each case were estimated based on spacecraft data). Thus, these waves cannot be associated with the Alfvén mode. It was assumed that at least part of them should be identified with the drift compressional mode. Indeed, in individual cases oscillations exhibited signatures of this mode: in one of the events a linear dependence of frequency on azimuthal wave number $m$ at a fixed magnetic shell was found. Only the drift compressional mode can feature such dependence in the inner magnetosphere. For two other cases merging of drift compressional and Alfvén modes at some critical value of $m$ was shown. A case of simultaneous spacecraft and radar wave observation accompanied by increases in energetic particle fluxes was shown. A modulation with the frequency of this wave was found for flux intensity of those energetic protons, whose phase velocity is close to that of the wave. This implies that the source of the wave was a drift resonance with the substorm injected protons.