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Abstracts

Radioactivity soundings at Sodankylä, Finland – past and present activities

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Radiation detectors have been lifted to the upper atmosphere with hydrogen or helium balloons for over a century. The FMI acquired radioactivity sounding systems to its three sounding stations in the 1990s. The still operational system consists of a radioactivity sonde, a radiosonde (PTU sonde) and the ground equipment. With the system it is therefore possible to measure the vertical distribution of atmospheric radiation dose rate together with meteorological parameters from ground-level up to a pressure level of a few hPa. At Sodankylä over 30 radioactivity soundings have been performed since 1995.

The development of a new radioactivity sounding system became necessary recently. The measurement module of the system is a commercially available dose rate meter. It communicates to the radiosonde through a compact microcontroller board, that acts as an interface module. The radiosonde reads the messages and transmits them to the ground station along with the meteorological and technical (e.g. GPS performance) data using its 400 MHz telemetry link. The lifespan of the system is expected to last to the early 2040s.

Solar activity dependence of TID amplitudes using a rapid-run Sodankylä ionosonde

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We investigated the amplitude of medium scale traveling ionospheric disturbances (MSTIDs, with periods 25–100 min) and their dependence on the solar activity using 16 years data of the rapid run- ionosonde operating at high latitudes (67°N, Sodankylä, Finland). A deep learning neural network was applied to ionograms to extract critical frequency of the F2 region (foF2) with a 1 min time resolution. Then, we analyzed the relative amplitude of MSTIDs (i.e., 2δfoF2/foF2), which corresponds to the amplitude of atmospheric gravity waves (AGWs) causing MSTIDs. The amplitude of AGWs propagating upward increases with height due to the decreasing density of the air, and hmF2 varies depending on local time, seasonal and solar activity conditions. To account for this effect, we calculated a corrected MSTID amplitude by normalizing the relative amplitude for the air density at the hmF2. The corrected amplitudes show no clear dependence on F10.7 during winter (0–12 UT), equinox (20-01 UT) and summer (19-01 UT), while a positive dependence of corrected amplitudes on F10.7 was observed during winter and equinox, in 14–22 UT and 15–19 UT, respectively. Corresponding to the dependence behaviors of corrected and relative amplitudes, two likely mechanisms of MSTIDs, AGWs from the lower atmosphere and auroral sources, are inferred. Their subsequent roles in the solar activity dependence of MSTID amplitudes were separately discussed, although in reality, the observed dependence is complex and often involves several mechanisms together.