Multi-instrumental observations of non-underdense meteor trails

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Meteor trails are often identified in the ionosonde data at the Sodankylä Geophysical Observatory (SGO, 67° 22' N, 26° 38' E, Finland). The ionosonde performs ionospheric sounding once per minute with frequency rising from 0.5 to 16 MHz. Typically, these ionosonde reflections are obtained from heights around 90 km. In a number of cases such trails coincided with the optical meteors detected be the meteor camera nearly co-located with the ionosonde. It was found that the electron line densities of such trails exceeded 10^{14} el/m, which characterize the trails as non-underdense (i.e., transitional or over-dense).

The ionosonde reflections were observed for a few minutes, with decreasing maximal frequency of the return. During the first 250 s, for the trails with initial line density about $(2\text{-}3)\cdot10^{15}$ el/m the return frequency decreased with time corresponding to the diffusional expansion of cylindrical meteor trails, whereas less dense trails decayed slower and more dense trails decayed faster. In many cases the meteor events were accompanied by non-specular long-lived detections using a co-located all-sky interferometric meteor radar (SKiYMET) with operating frequency 36.9 MHz. The meteor radar echoes were often detected at heights about 100 km and higher (i.e., higher than the ionosonde detections), the echo durations were longer than expected from diffusional expansion of cylindrical meteor trails, and their amplitudes were highly variable. We suggest that the slower frequency decrease of the ionosonde echoes and the non-specular long-lived meteor radar echoes might be associated with the presence of meteoric dust.