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Radar, radio and optical observations of long duration meteors over northern Germany

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Radar and optical long duration meteor trails, lasting more than a few seconds to minutes, although studied for many years, their physical understanding is still enigmatic. In part due to their differing composition, mass, and trajectory characteristics, but also to the different atmospheric conditions upon entering the Earth's atmosphere [1]. Moreover, recently it has been discovered that some long-duration meteor events can even be observed in radio, called Meteor Radio Afterglows (MRAs) [2]. Given that the radar cross section of these events can be very large [3], they can be observed with small radar systems. So far, such events have been observed either in radio and optics, radar and optics, but not simultaneously by radio and radar. To search for such simultaneous observations, we have recently conducted radio-radar campaign around the Perseids and Geminids 2022 meteor showers in northern Germany. The radio observations are pursued with five to six international LOFAR stations operating in the lower VHF band, specifically, three to four in Germany, one in Sweden and one in Poland. Each of the stations recorded four frequency bands with full Nyquist sampling, two around the radar frequency and two outside the radar frequency. In addition, local correlations were recorded with reduced resolution in a third non-radar band. These are used to search for MRAs, while the former to image the radar signatures. On the other hand, the radar observations are performed with the recently deployed multistatic specular meteor network called SIMONe-Germany using coherent and incoherent Multi-Input Multiple-Output radar approaches [4]. At the time of the experiments, more than 20 multistatic radar links were available, i.e., a long-duration meteor echo can be observed from up to 20 different viewing angles. Besides the main objective of simultaneously observed radio and radar long-duration events, the combined LOFAR-SIMONe events will be used to get precise wind profiles and turbulence associated to the long-duration events [1,3]. The LOFAR radar observations allow a more precise location of the events, given that up to 61 antenna elements were used on reception, while with SIMONe either 1 or 6 antennas were used on the receiving links. In this work, we will present our preliminary radar and radio observations from the two 2022 meteor shower campaigns.

References

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