



Polar mesospheric VHF radar echoes and their connection to neutral dynamics

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Since more than 40 years mesospheric radar echoes are observed in the VHF range, e.g. around 50 MHz radar frequency. Generally, two different radar phenomena exist in the mesosphere, which are the mesospheric summer echoes and the so-called winter echoes (MSE and MWE, and PMSE, PMWE for polar locations, respectively). While the summer echoes are related to reduced electron diffusivity due the presence of charged ice between 78 and 90 km altitude. The generally much fainter winter echoes, however, typically occur between 50 and 85km height. Specifically in the last two decades PMWE gained interest and case studies as well as statistical analysis of their occurrence have been published, e.g. [1].

Winter echoes are most frequently observed around the equinoxes given enhanced electron densities due to particle precipitation events. Furthermore they show a clear diurnal pattern, which again is strongly related to the available electron density. Based the still open questions on the cause, their formation and propagation dedicated sounding rocket campaigns have been performed to improve the understanding of this phenomenon.

The dependence of the PMWE visibility with the VHF radar MAARSY on the ambient electron density has been investigated in depth with the co-located partial reflection radar Saura for the solar minimum conditions [2].

Besides a minimum required electron density neutral dynamics are assumed to play a crucial role for the formation, i.e. creation of turbulent structures of suitable scales and their transport.

In this study we will analyze radar observations of PMWE in northern Norway using MAARSY multibeam experiments and connect them to background dynamics using the Saura partial reflection radar as well as ECMWF reanalysis data.

1. R. Latteck, T. Renkwitz and J. L. Chau, Two decades of long-term observations of polar mesospheric echoes at 69°N, *J. Atmos. Solar-Terr. Phys.*, 216, 105576, [doi:10.1016/j.jastp.2021.105576](https://doi.org/10.1016/j.jastp.2021.105576), 2021.
2. T. Renkwitz, R. Latteck, I. Strelnikova, M. G. Johnsen and J. L. Chau, Characterization of polar mesospheric VHF radar echoes during solar minimum winter 2019/2020. part I: Ionisation, *J. Atmos. Solar-Terr. Phys.*, 105684, [doi:10.1016/j.jastp.2021.105684](https://doi.org/10.1016/j.jastp.2021.105684), 2021.