

# ON THE RELATIONSHIP BETWEEN MEDIUM FREQUENCY SCATTER AND POLAR MESOSPHERIC SUMMER ECHOES

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## ABSTRACT

Radar observations of the arctic mesopause region were conducted in Alaska during Summer 2001 at both the High Power Auroral Stimulation (HIPAS) Observatory and the High Frequency Active Auroral Research Program (HAARP) Facility for the purpose of creating a seasonal database of polar mesospheric summer echoes (PMSE). PMSE were seen for at least 50% of the observation period. We will describe the scientific program, discuss geophysical conditions during the observations, and present some of the preliminary results. We will also predict the signals expected by HIPAS and HAARP systems and signals expected by a typical MF (medium frequency) radar system.

## DISCUSSION

Preliminary observations of HF (high frequency) scattering have been made in the polar summer mesosphere. We have used two high power HF heaters called HIPAS (High Power Auroral Stimulation) and HAARP (High Frequency Active

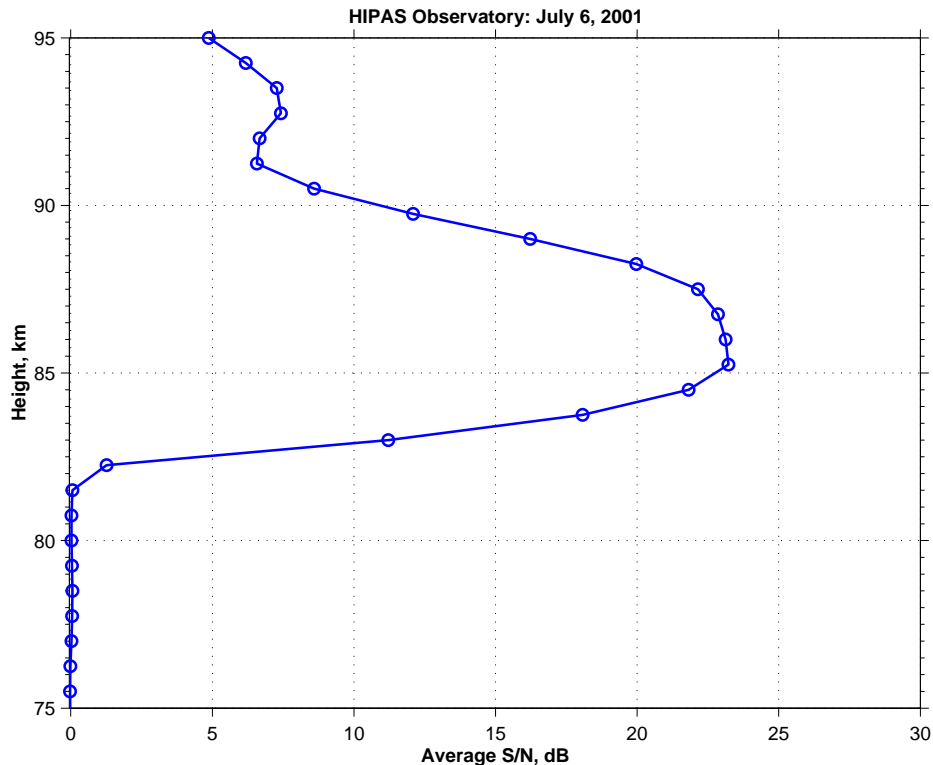


Fig. 1. Typical polar summer mesosphere HF scattering profile measured at the HIPAS Observatory in July 6, 2001.

Auroral Research Program), both located in Alaska, for these experiments. HIPAS is located at 64.8°N and HAARP at 62.4°N. The scattered signal was received with relatively broad beams, compared with the transmitted beam, using a nearby ionosonde antenna. As shown in Fig. 1, the scattering cross section profile shows a peak in a narrow height range near 85 km on average.

These echoes are similar to those seen with VHF (very high frequency) radars. The average profiles for the summer at HIPAS are compared in Fig. 2 to those published by Ecklund and Balsley at VHF. Our results are in good agreement with a similar study made at the heating facility in Russia [1].

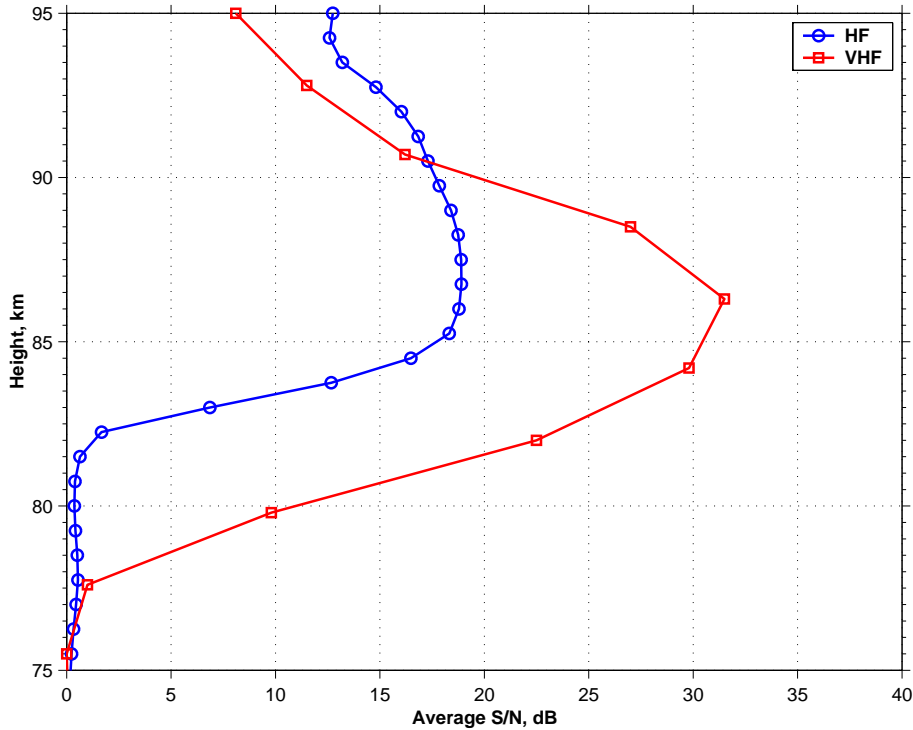


Fig. 2. Comparison of VHF [2] and HF PMSE profiles measured in HIPAS during Summer 2001.

A question which arises immediately is the extent to which the scattering mechanism differs from MF (medium frequency) radar scattering. We believe that it does differ, since extracting PMSE (polar mesospheric summer echoes) from MF radar data taken in the polar mesosphere (Mercedes Huaman, personal communication, 2001) has proven to be difficult. Yet in these data the narrow layers seem to stand out quite nicely.

Our hypothesis is that MF radars use relatively broad beams and are more sensitive to volume-filling scatter than narrow beam systems, which respond better to specular reflection from a single Fresnel zone. To test this idea we will calculate and present the two predicted scattering cross-sections using data from two rocket flights: one in polar summer and one in equinox conditions. In the former case we will use a wavelet technique to extract the specular component responsible for edge scatter at the HF wavelength by using the profile plotted in Fig. 3a, as supplied by Jim Ulwick. This profile was obtained during a strong VHF (PMSE) scattering event in Norway. For the volume-filled scatter case we will use the profile plotted in Fig. 3b, as supplied by Tom Blix.

To be specific, we will predict the signals expected by the HIPAS and HAARP systems as well as signals expected by a typical MF radar system.

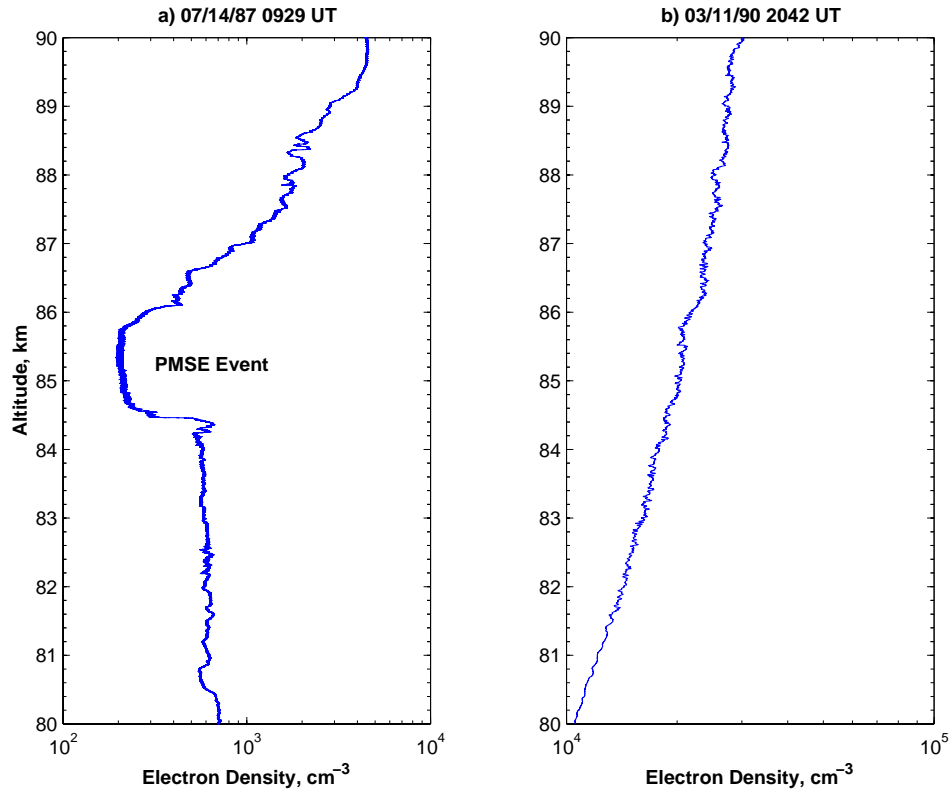


Fig. 3. a) Rocket profile during a PMSE event [3]. b) An equinoctial electron density profile.

## ACKNOWLEDGEMENTS

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