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9.4 VHF RADAR MEASUREMENTS OVER ANDOYA (NORTHERN NORWAY)

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The Mobile SOUSY Radar has been operated during the MAP/WINE, the MAC/SINE, and MAC/Epsilon campaigns at Andoya in Northern Norway. This paper presents a comparison between summer and winter results, in particular the generation and development of the scattering regions, the different power spectral densities and the aspect sensitivities which were derived from six different beam directions.

In summer 1983 the Mobile SOUSY VHF Radar was installed in Andenes on the island of Andoya in Northern Norway, with the aim of investigating backscattering structures and dynamics in the polar middle atmosphere. The object of this paper is to compare and summarize summer and winter results obtained during several campaigns within the last five years.

Typical summer echoes occur only during the three months from June to August. They are characterized by persistent, intense layers, centered around an altitude of 86 km, with echo powers of up to 60 dB above noise.

During the fall, winter and spring periods, echoes are observed predominantly at daytime within the height range from about 50 to 85 km. They often take the form of street-like structures separated by about 3 to 4 km. We have selected for this presentation some representative examples from the different campaigns.

Table 1. Summary of Echo Region Characteristics over Andoya.

Characteristics	Winter	Summer
Height interval of of echo occurrence	50 - 85 km	75 - 95 km
Typical signal to noise ratio	3 - 25 dB	30 - 60 dB
Height of echo power maximum	variable between 50 and 85 km	86 km on average
Echo occurrence	at daytime in connection with radio wave absorption	continuous during day and night, 15% diurnal variation
aspect sensitivity	intermittent; high at the top and bottom of the layers	continuous and high throughout the whole layer
dominating periods	gravity wave periods	tidal (12 h dominates) and long period gravity wave periods
spectral width	relatively constant in height	minimum near maximum power

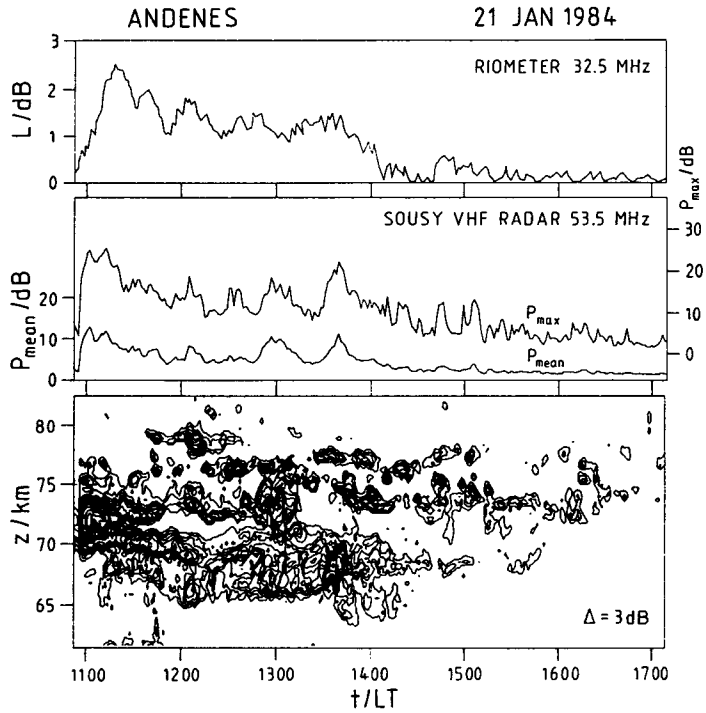

Figure 1. Absorption (L) as measured on 21 January 1984 with a 32.5 MHz riometer located at Andenes near the SOUSY radar facility (top), maximum echo power (P_{max}) and mean echo power (P_{mean}) measured in the 65 to 80 km height region as a function of time (center), and a contour plot of the echo power as a function of height and time (bottom).

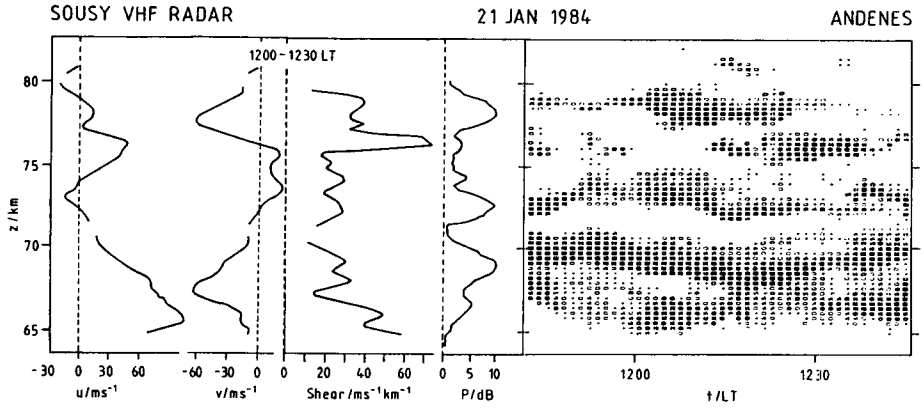

Figure 2. Height profiles of the mean zonal (u) and meridional (v) wind velocities for 1200 - 1230 LT on 21 January 1984 (left), and the corresponding mean echo intensity (P), and mean shear (center). A section of the bottom panel of Figure 1 is shown as a height time intensity plot (right).

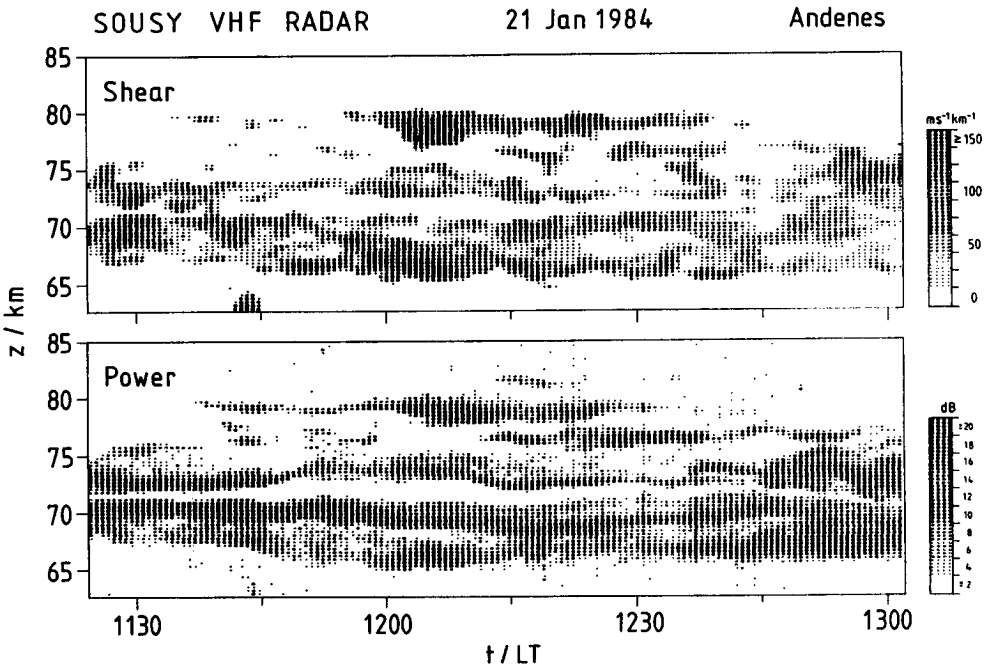

Figure 3. Height-time intensity plots of shear (top) and echo power (bottom) for 1118 - 1305 LT on 21 January 1984.

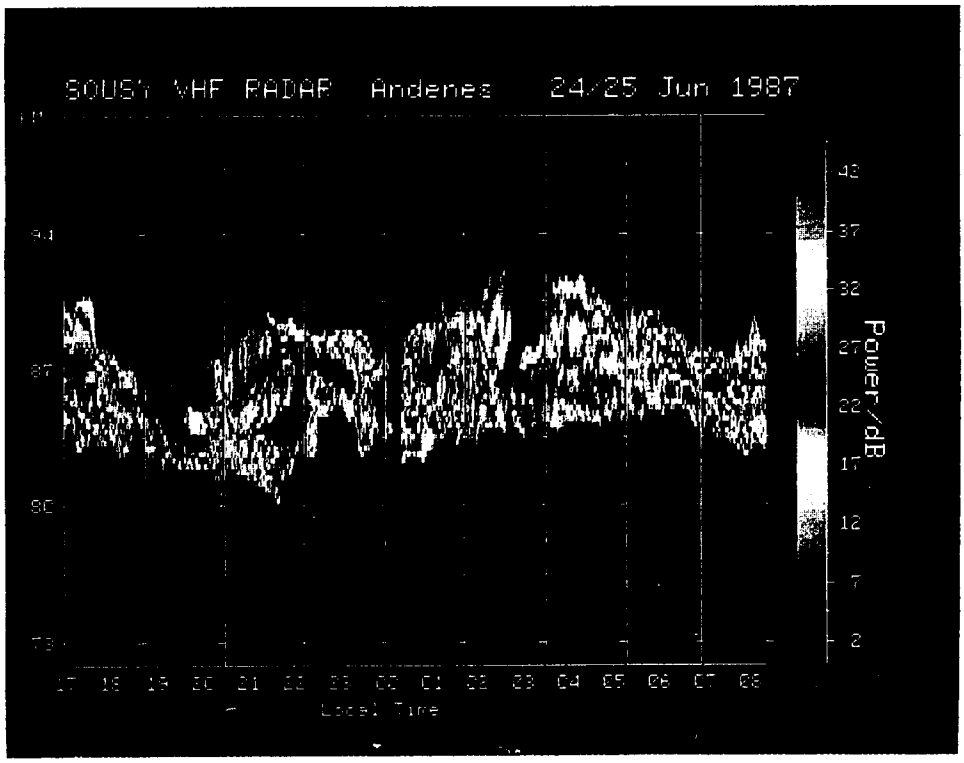

Figure 4. Height-time plot of the variation of the echo power for a period of about 15 h which is typical for the MAC/SINE campaign 1987. The characteristic double peak structures with vertical separations of around 5 to 10 km are often observed to move downwards with apparent velocities between 0.1 and 2.5 m/s and tend to oscillate in height with a period of about 12 h.

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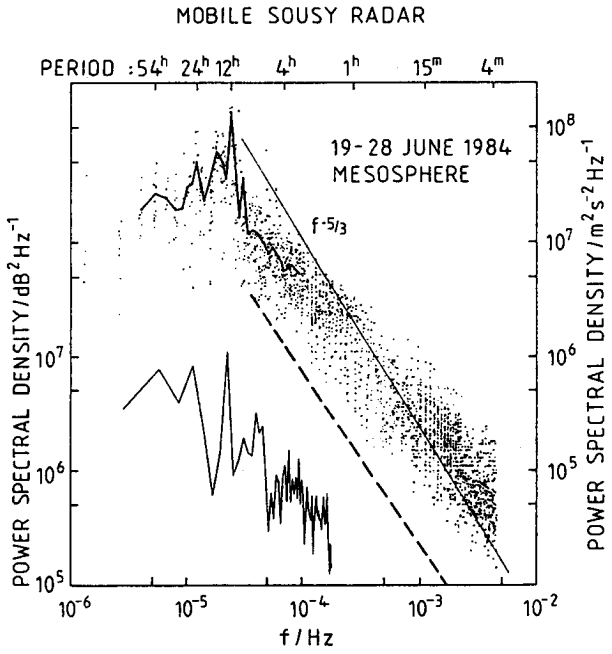

Figure 5. Power spectral density of zonal velocity for the entire summer campaign 1984 (scale on left). The lower curve shows the power spectral density of echo power (scale right). Spectral peaks are evident in both curves at 54, 24, 12, and 8 h. The straight line represents summer results from Poker Flat for a height of 87.3 km [Balsley and Garello, 1985].

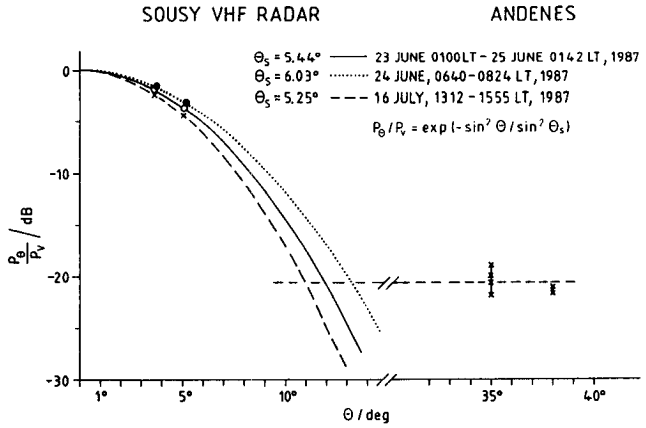

Figure 6. Backscattered power relative to that received in the vertical beam (crosses, dots and circles) plotted as a function of zenith angle, for three different periods. The powers measured at $\theta = 35°$ and $\theta = 38°$ (crosses) are observed in the two grating lobes of the antenna. The fall-off in power up to $\theta \approx 15°$ represents the equation:

$$P_\theta/P_{vert} = \exp(-\sin^2\theta/\sin^2\theta_s)$$

θ_s = half width of the backscatter angular polar diagram.