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4.3.3 MESOSPHERIC WIND MEASUREMENTS USING A MEDIUM-FREQUENCY IMAGING DOPPLER INTERFEROMETER

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This paper presents some wind results from a medium-frequency radar operated as an imaging Doppler interferometer. We used ten independent antennas, together with the mesospheric wind motions, so that we could Doppler-sort and then echo-locate individual scattering points. We determined the three-dimensional location and radial velocity of each discrete scattering point. Mean winds were then determined by a least squares fit to the radial velocities of the ensemble of scatterers.

Figure 1 shows a two-dimensional map of the scattering surface at 85 km, with the radial velocity indicated for each scattering point (Δ's have phase-decreasing Doppler; +'s have phase-increasing Doppler). Notice that most of the points in the northern half of the sky are approaching the radar, while those in the southern half of the sky are going away, consistent with a southward-directed mean (and mainly horizontal) flow as indicated by the wind clock. Notice also that there is considerable structure in the radial-velocity display, particularly near the zenith. We show below that the vertical velocity shows a 6-minute period consistent with the local Brunt-Vaisala period.

Figures 2 and 3 show several altitude profiles of the direction and horizontal components of the wind, spaced approximately every 30 minutes. Notice the spiral behavior of the direction vector, indicating a vertical wavelength of 40 km (if we ignore the results below 65 km). The component profiles give results that seem physically plausible and seem to have sensible time histories.

The remaining figures show a variety of vertical velocities at 2-minute resolution (1 minute on; 1 minute off). Figure 4 shows a 28-minute time history of the 80-km vertical velocity. The vertical velocity is seen to be periodic, with a period of about 6 minutes. Notice also that the oscillation appears well-centered about zero, even though there is a 30 m/sec eastward wind and a 5 m/sec southward wind. This tends to support our analysis that the method used here is immune to many of the difficulties associated with beam-forming techniques, in particular, contamination of the vertical component by the combination of horizontal winds, finite beam widths, and off-vertical scattering.

Figures 5 and 6 show the time histories at 66 and 86 km, respectively. The vertical velocity at 66 km shows a 20-minute periodicity (less neatly sinusoidal than Figure 4), while the 86-km plot is less regular yet. Both the 66-km and the 86-km results appear, as did the 80-km curve, to be centered around zero, with no obvious upward or downward bias in the results, in spite of a 20 m/sec northward component at 66 km. (Both horizontal components are close to zero at 86 km.) These results are generally promising. Considerable improvement could be effected with more appropriate processing algorithms, which we hope to implement soon.

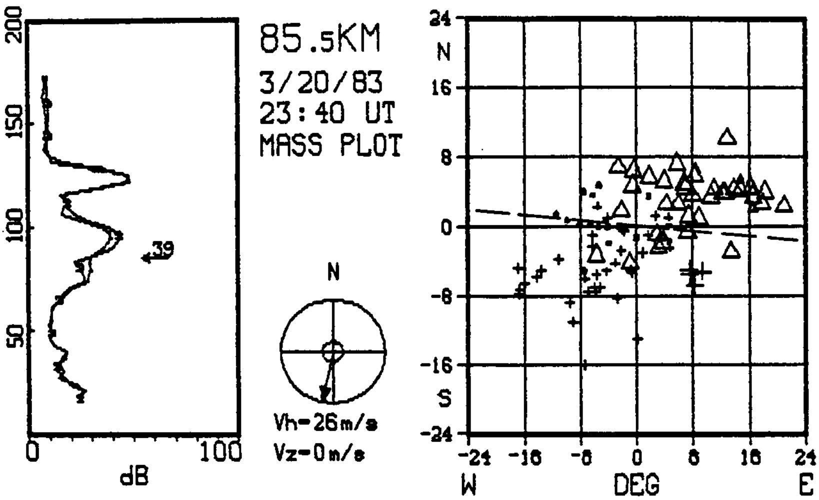

Figure 1.

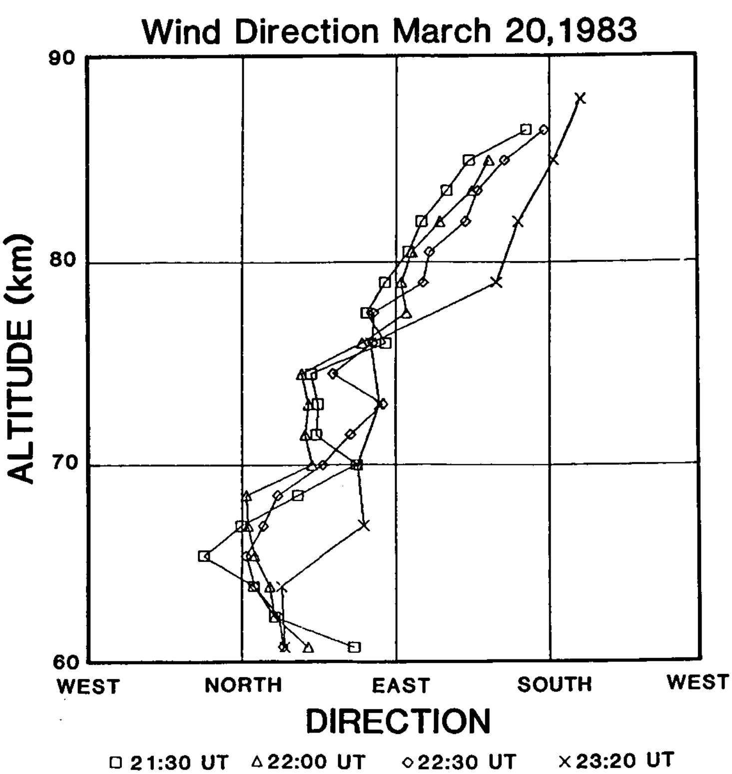

Figure 2.

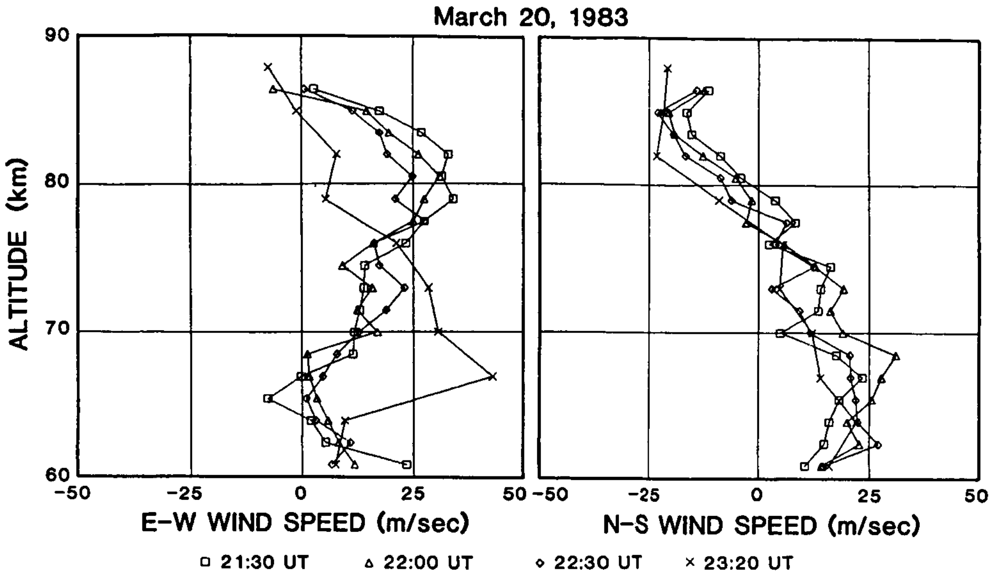

Figure 3.

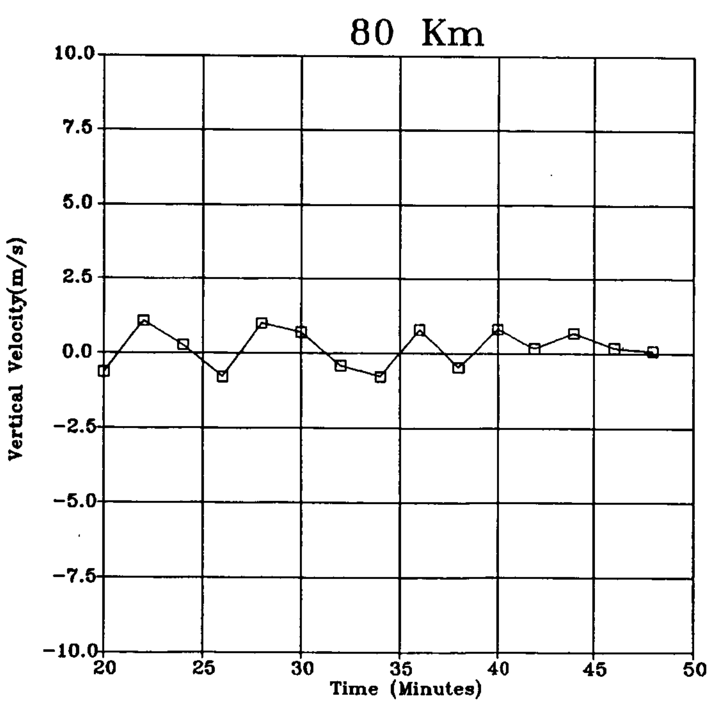

Figure 4.

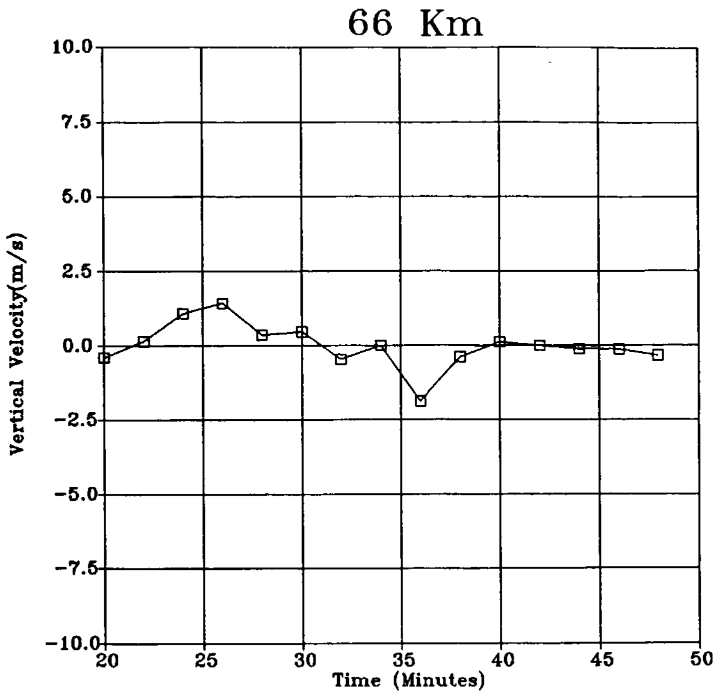

Figure 5.

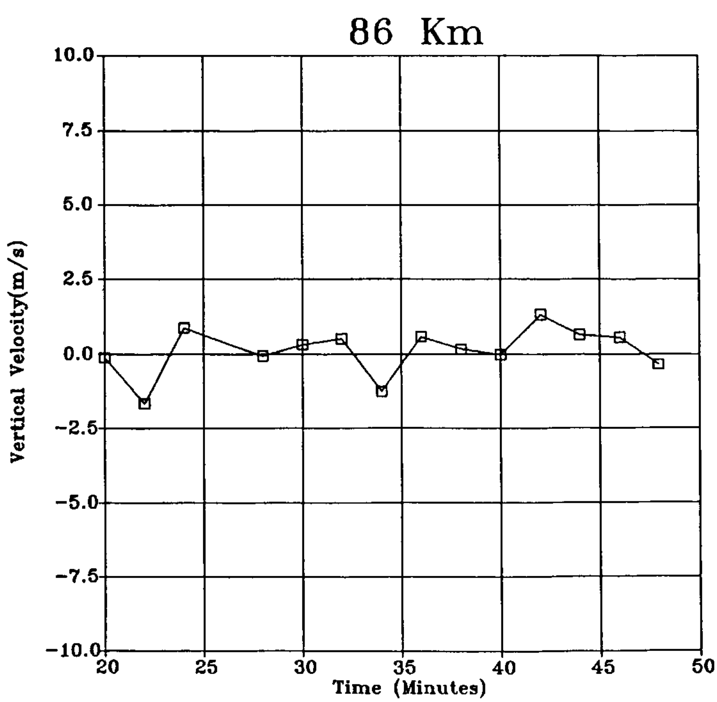

Figure 6.