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3.2.6 SIMULTANEOUS FINE STRUCTURE OBSERVATION OF WIND AND TEMPERATURE PROFILES BY THE ARECIBO 430-MHz RADAR AND IN SITU MEASUREMENTS

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INTRODUCTION

The study of the interaction between waves and turbulence in the troposphere and lower stratosphere requires continuous fine structure observation of both wind and temperature profiles. The radar technics (ST radars) allow a continuous observation of wind profiles with a vertical resolution of at least 150 m, while balloon-borne measurements of temperature and wind are potentially able to provide a spatial resolution as short as 0.1 m along the balloon trajectory. The use of balloon-borne technics, concurrently with radar observations, is necessary to understand the generation mechanisms of turbulence and to improve our knowledge about the radar measurement physics FRITTS et al., 1984; THOMAS et al., 1985).

EXPERIMENT

A simultaneous campaign of balloon and radar measurements took place on March 14-16th, 1984, above the Arecibo 430-MHz radar. This radar was operating with a vertical resolution of 150 m following two antenna beam directions: 15° from the zenith, respectively, in the N-S and E-W directions (WOODMAN, 1980). The balloons (5-m diameter) were equipped with sonic anemometers (accuracy of 0.05 m/s) and temperature sensors (accuracy of 0.1 K). The vertical velocity of the balloons was of about 4 m/s. One of the three balloons, launched during this campaign, flew only 3 km apart the radar beam in the altitude range 14-15 km (Figure 1).

RESULTS

We analyse here the main results concerning the comparison between the flight and simultaneous radar measurements obtained on March 15, 1984.

1) The radar return power profile (S/N ratio in dB) exhibits maxima which are generally well correlated with step-like structures in the potential temperature profile (Figure 2). These structures are generally considered as the consequence of the mixing processes induced by the turbulence.

2) A good correlation appears in the altitude range 12.5 - 19 km between wind shears induced by a wave structure observed in the meridional wind and the radar echo power maxima. This wave structure is characterized by a vertical wavelength of about 2.5 km, and a period in the range 30-40 hours. These characteristics are deduced from the twice daily rawinsonde data launched from the San Juan Airport by the National Weather Service (ROE, 1981).

CONCLUSION

These results have pointed out an example of the interaction between wave and turbulence in the upper troposphere and lower stratosphere. Turbulent layers are observed at locations where wind shears related to an internal inertia-gravity wave are maxima. Wind and turbulence radar measurements will allow to obtain the temporal variation of this interaction and to estimate the amount of kinetic energy dissipated by this wave. A comparison between the

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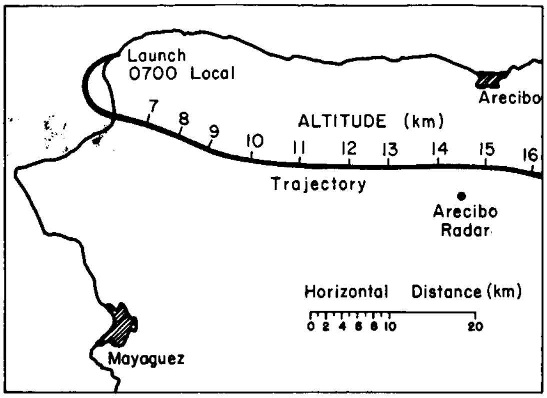

Figure 1. Balloon trajectory.

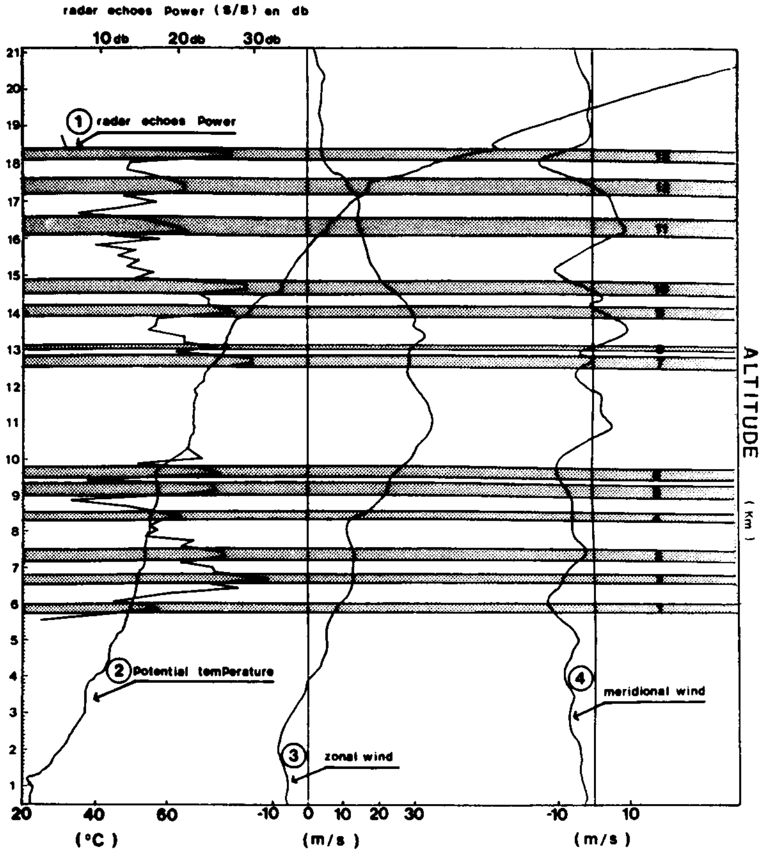

Figure 2. Radar echo power (1) ; Potential temperature profile deduced from balloon experiment (2) ; Zonal wind (3) and meridional wind (4) profiles measured with the Arecibo radar. Dotted area, numbered from 1 to 13, correspond to maximum echo power and are interpreted in terms of turbulent layers.

energy dissipation rate deduced from the velocity variance and the spectral width of the radar echoes is now in progress.

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