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METEOR WIND RESULTS FROM ATLANTA, U.S.A., AND RAMEY, PUERTO RICO

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ABSTRACT

Results obtained using the French (CNET) Meteor Wind Radar at Ramey, Puerto Rico (18°N, 67°W), and the Georgia Tech Radio Meteor Wind Facility in Atlanta, U.S.A. (34°N, 84°W) are presented and compared. Prevailing wind, diurnal and semidiurnal wind amplitudes are considerably larger over Ramey than over Atlanta, but the mean zonal circulation over Atlanta is more characteristic of the equatorial circulation than winds measured by stations at higher mid-latitudes. The value of continuous observations, with a height resolution of ±2 km, is again emphasized, as is the need for the application of several techniques, groundbased, in-situ and satellite, if projects such as the MAP GLOBMET are to succeed in delineating the global meteorology of the mesopause.

INTRODUCTION

The Georgia Tech Radio Meteor Wind Facility is located in Atlanta (34°N, 84°W), and has been in operation since August, 1974. The system has been described by ROPER (1975), and results pertaining to both prevailing winds and tides using data from the four years 1974-1978 have been published by ROPER (1978 a,b), SALBY and ROPER (1980), DOLAS and ROPER (1981), and AHMED and ROPER (1983). No data is available for the period August 20, 1978 through July 14, 1980, when both transmitter and receiving sites were relocated (but still remained within a kilometer of their previous positions).

The French (CNET) Meteor Wind Radar, described by GLASS et al. (1978), was installed at a site near Aguadilla, Puerto Rico, during the summer of 1977. The site (18°N, 67°W, see Figure 1, from MATTHEWS et al., 1981) is located approximately 44 kilometers west-north-west of the 430 MHz Thomson scatter radar and other facilities at the National Astronomy and Ionosphere Center, Arecibo Observatory. The CNET radar has been described by various authors as the Aguadilla Radar, the Punta Borinquen Radar, and, as in this paper, the Ramey Radar. Only the zonal component of the wind at meteor heights is measured.

The Arecibo Thomson scatter radar has provided meteor zone wind measurements (MATTHEWS, 1976) prior to the installation of the Ramey meteor wind radar. However, Arecibo is a multi-use facility, and cannot be dedicated to any one task for more than a few days at most.

Other meteor radars have been operated in the tropics. In a pioneering effort, BABADZHANOV et al. (1970) reported meteor winds from Mogadishu (2°N, 45°E) for the period 22-29 September, 1968. The University of the West Indies has provided useful data from Jamaica (18°N, 77°W) as reported by ALLEYNE et al. (1974) and SCHOLEFIELD and ALLEYNE (1975).

Figure 2 (from MATTHEWS et al. 1981) is included to show the excellent agreement between the winds measured simultaneously at Ramey (M) and Arecibo (TS) between 0900 and 1600 hours, August, 1978.

EQUATORIAL WINDS

Before the Ramey radar was taken over by Georgia Tech in 1978, the Groupe Radar Meteorique of CNET had conducted several campaigns, each of which lasted

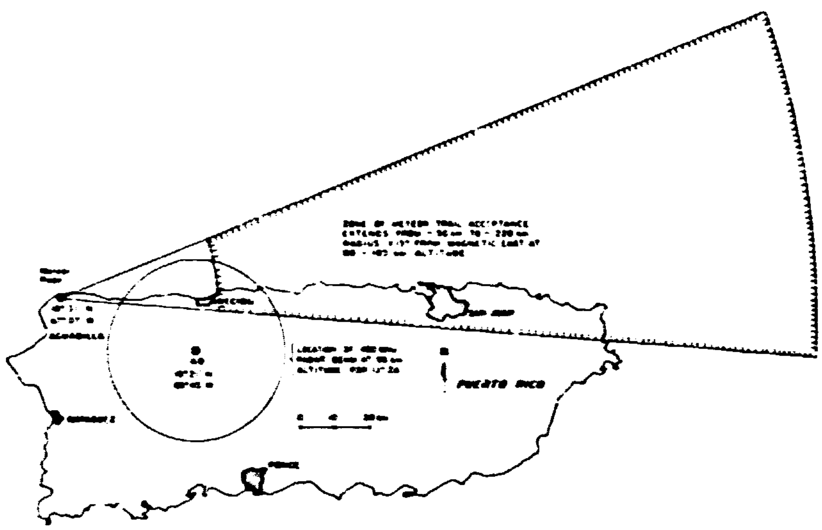

Figure 1.

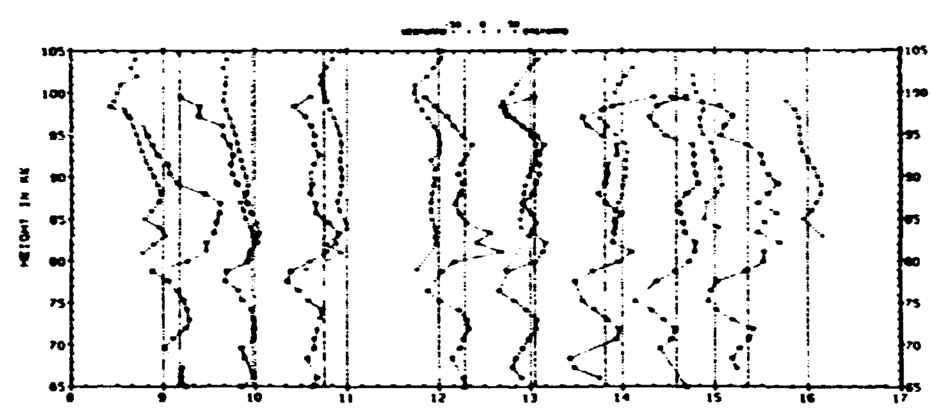

Figure 2.

approximately 10 days. Data from one of these campaigns (August 24 - September 2, 1977) is presented here to illustrate some of the features of the equatorial circulation. Figure 3 shows the results of lowpass filtering of the data, which eliminates the tidal and gravity wave components, leaving periods of greater than one day. The most obvious periodicity present has a period close to 2 days. This is the first recording in equatorial latitudes of the 2-day wave which has received considerable attention at middle latitudes in both the northern and southern hemispheres.

Figure 4 presents the results of a day-by-day analysis of the 24-hour component of the wind spectrum. The fact that the maximum amplitude of this component is 60 m sec^{-1} (considerably larger than is normally measured at mid-latitudes), strongly suggests this is a symmetric mode diurnal tidal wind.

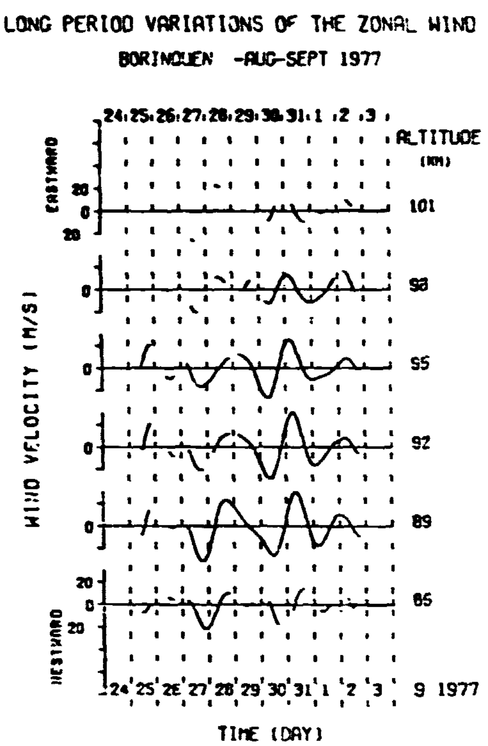

Figure 3.

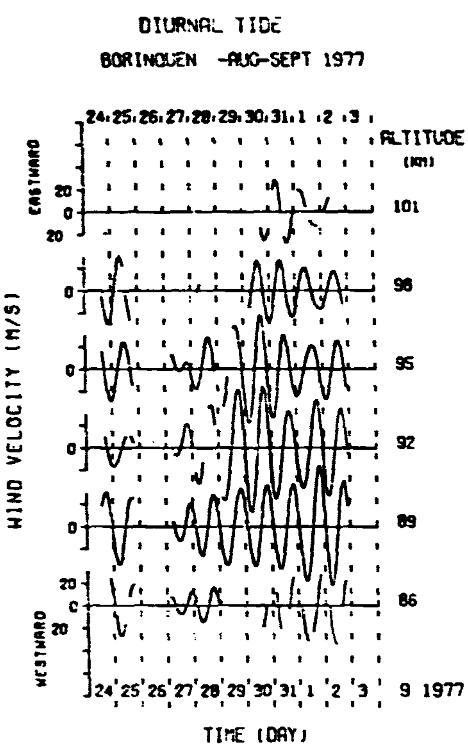

Figure 4.

Figure 5 illustrates the variation with time of the 12-hour zonal component, with an apparent modulation of the 12-hour periodicity at approximately 7 days.

Figure 6 presents the zonal prevailing, 24- and 12-hour component amplitudes for the period March 17-24, 1979. These results, the first produced under Georgia Tech operation of the system, are somewhat controversial, in that the large amplitudes in all three components on March 21 (which accompany a zonal wind reversal from easterly to westerly above 90 km) appear anomalous.

RAMEY AND ATLANTA WINDS: FEBRUARY - JUNE, 1981

Figure 7 details the monthly mean winds determined for the period February through June 1981, the only period for which long term means are available simultaneously from both sites. Some problems were encountered at both sites during the period because of F region backscatter folding back into the meteor region (range ambiguity). This phenomenon is a problem only at times of high sunspot activity, and is not present for most of the sunspot cycle.

While winds are weaker over the "midlatitude" station (Atlanta is 34°N), strong winds and shears in both height and time are characteristic of the equatorial (Ramey, 18°N) winds. However, as has been noted previously in Atlanta data, if one simply chracterizes the zonal mean wind in terms of "easterly" or "westerly" circulation, it would appear that Atlanta is on the fringe of the equatorial circulation, since its "spring reversal" appears much later than is normally the case for midlatitude stations.

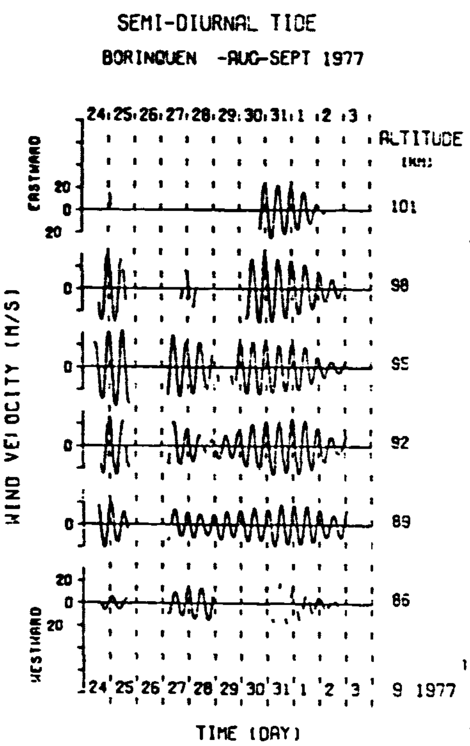

Figure 5.

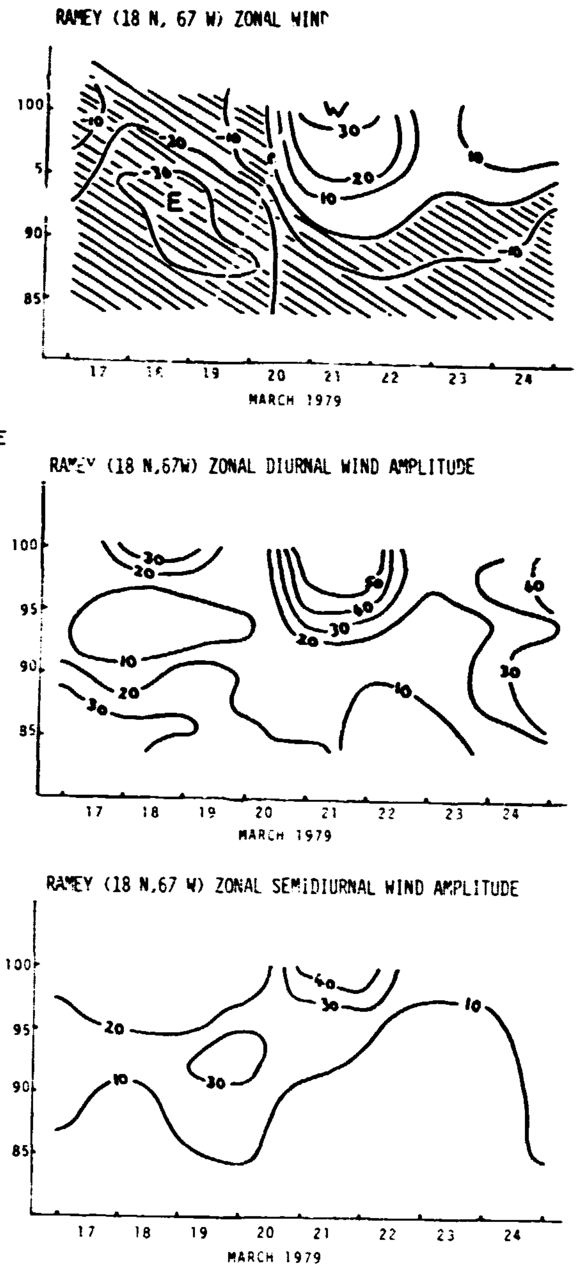

Figure 6.

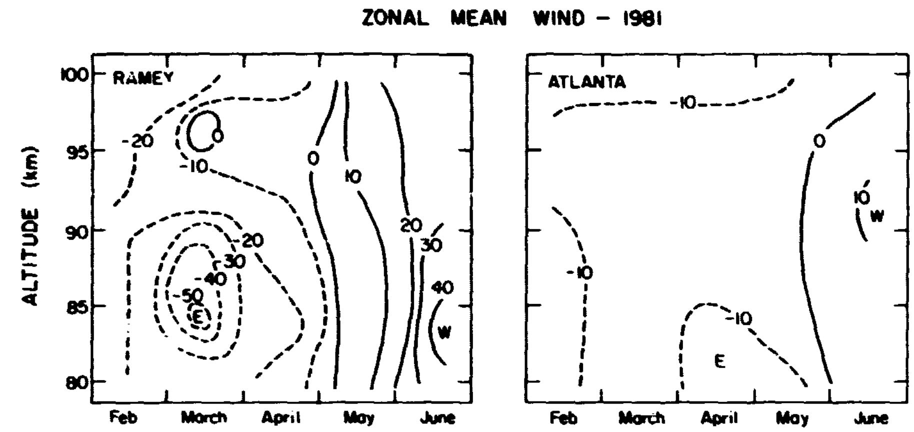

Figure 7.

Figures 8 and 9 of the diurnal and semidiurnal amplitudes, respectively, have not been analyzed in detail but are included to emphasize the much larger tidal amplitudes observed at Ramey compared to Atlanta.

MESOPAUSE CIRCULATION VARIABILITY

Figure 10, which demonstrates the correlation between wind reversals over Atlanta and midwinter polar stratospheric warmings (discussed in detail in DOLAS and ROPER, 1980) is included to emphasize the need for continuous monitoring of the variation of the wind with height, which is required for a full understanding of the circulation at mesopause altitudes. This region does exhibit characteristics of a synoptic meteorology.

Obviously, the results produced by one or two stations are not of much use in determining the global nature of this synoptic meteorology. In order to further this aim, a cooperative program has been set up under the auspices of the Middle Atmosphere Program to further the cooperation which has been carried out since 1970 in the IAGA Global Radio Meteor Wind Studies Project, and the URSI/IAGA Coordinated Tidal Observations Program, which included incoherent

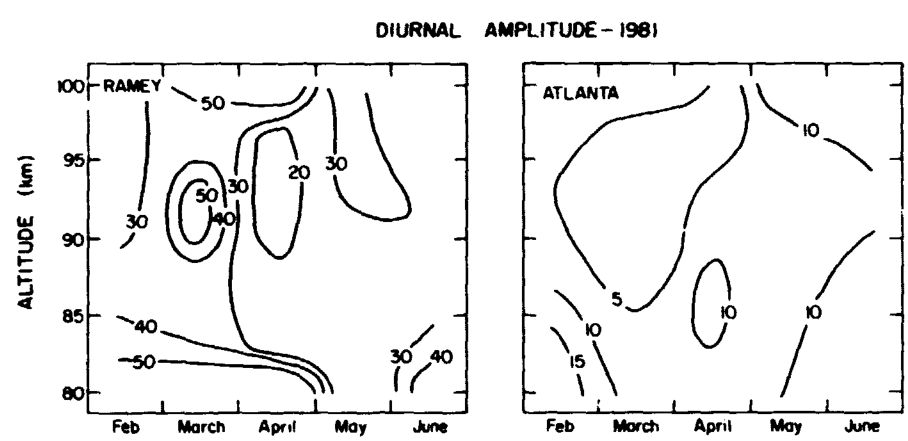

Figure 8.

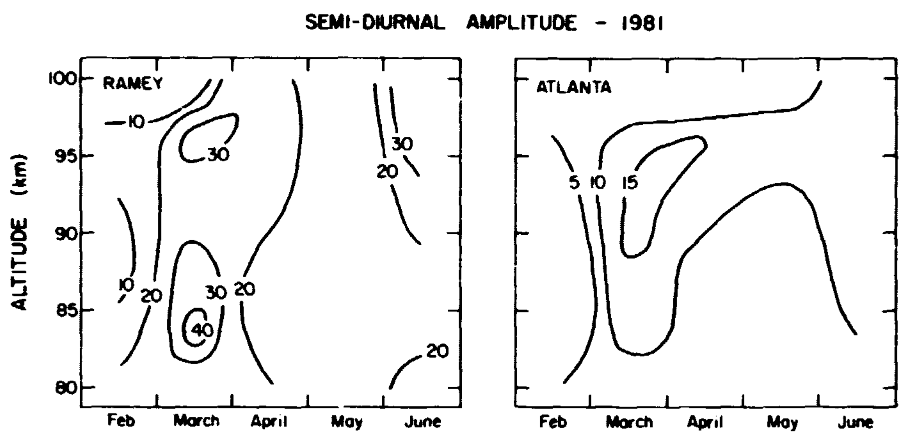

Figure 9.

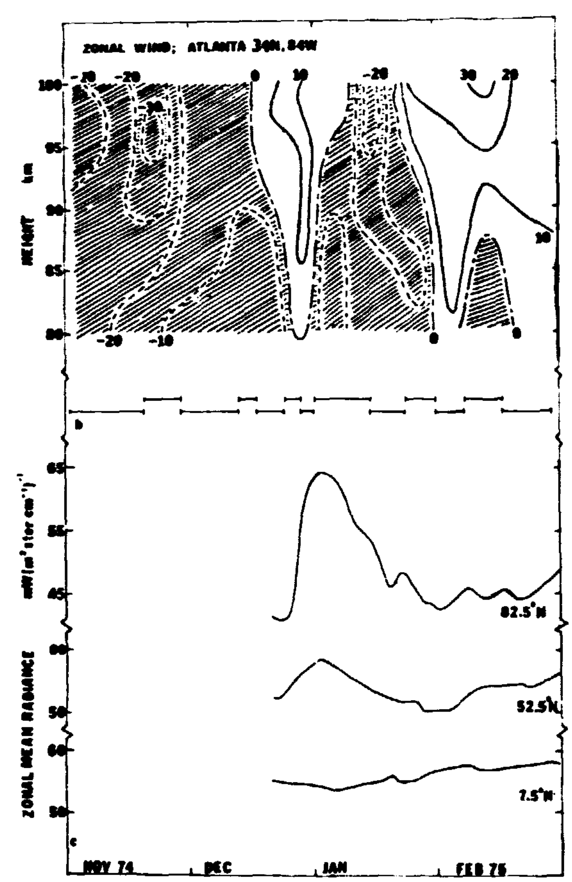

Figure 10.

scatter radar results. This MAP project, GLOBMET (Global Meteor Observations System; for details see MAP Handbook No. 7, p. 20), while oriented towards meteor research, is seeking the cooperation of experimenters using many different techniques (partial reflection drifts, mesospheric scatter radars, lidar, rockets, satellites, etc.) to contribute to the atmospheric dynamics portion of the program, since all available data will be needed if a truly global picture of upper mesosphere/lower thermosphere circulation is to be realized.

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REFERENCES

Ahmed, M. I. and R. G. Roper (1983), The diurnal and semidiurnal oscillations in meteor winds over Atlanta, J. Atmos. Terr. Phys., (in press).

Alleyne, H., W. Keenliside, G. S. Kent, J. W. MacDougall and A. J. Scholefield (1974), Observations of atmospheric tides over Jamaica using three different techniques, J. Atmos. Terr. Phys., 36, 171.

Babadzhanov, P. B., B. V. Kalchenko and V. V. Fedynsky (1970), Meteor winds over the equator, Izv. Akad. Nauk SSSR., 9, 33.

Dolas, P. M. and R. G. Roper (1981), Prevailing wind in the meteor zone (80-100 km) over Atlanta and its association with midwinter stratospheric warming, J. Atmos. Sci., 38, 182-188.

Glass, M., R. Bernard, J.-L. Fellous and M. Massebeuf (1978), The French meteor radar facility, J. Atmos. Terr. Phys., 40, 923-931.

Matthews, J. D., M. P. Sulzer, C. A. Tepley, R. Bernard, J.-L. Fellous, M. Glass, M. Massebeuf, S. Ganguly, R. Harper, R. A. Behnke and J. C. G. Walker (1981), A comparison between Thomson scatter and meteor radar wind measurements in the 65-105 km altitude region at Arecibo, Planet, Space Sci., 29, 341-348.

Matthews, J. D. (1976), Measurements of the diurnal tides in the 80 to 100 km altitude range at Arecibo, J. Geophys. Res., 83, 505.

Roper, R. G. (1975), The measurement of meteor winds over Atlanta, Radio Sci., 10, 363-369.

Roper, R. G. (1978a), Winds from the Atlanta (34°N, 84°W) radio meteor facility, J. Atmos. Terr. Phys., 40, 891-893.

Roper, R. G. (1978b), Radio meteor winds over Atlanta (34°N, 84°W) August 1974 - December 1977, Final Report on Contract E-16-688, NSF Grant No. ATM75-14414, July.

Salby, M. L. and R. G. Roper (1980), Long period oscillations in the meteor region, J. Atmos. Sci., 37, 237-244.

Scholefield, A. J. and H. Alleyne (1975), Low latitude meteor wind observations, J. Atmos. Terr. Phys., 37, 273.