Note on Mesospheric Winds Above White Sands Missile Range

MARVIN DIAMOND

U. S. Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.

18 December 1964

1. Introduction

Two high-altitude explosions above the White Sands Missile Range (WSMR), New Mexico, provided information on winds above altitudes usually attained by meteorological rockets. This note concerns the evaluation of winds from the sounds of these explosions as they were detected at the earth's surface.

2. Data

Explosive charges (about 2 pounds TNT) were detonated over the WSMR at the following times and altitudes:

19 May 1964, 2332:25 MST at 315,360 ft msl

26 May 1964, 2232:19 MST at 309,850 ft msl.

Wind and temperature data between the surface and 65 km on 19 May and the surface and 62 km on 26 May were the available observations taken at the times listed below:

Date	Time	
19 May	2030 MST	Radiosonde
19 May	0800 MST	Meteorological rocket
20 May	0900 MST	Meteorological rocket
26 May	2130 MST	Radiosonde
25 May	0800 MST	Meteorological rocket
27 May	0945 MST	Meteorological rocket

The temperature and wind data above radiosonde levels were interpolated from the meteorological rocket observations approximately 12 hours prior to and after the time of the explosion. Temperatures above the

TABLE 1. Cross-wind calculations.

Date	Geographical position of explosion from microphone array: Elevation angle	Geographical position of explosion from microphone array: Azimuth*	Computed azimuth (from microphone data)	Cross-wind effect** between surface and 62 km	Cros-wind** effect between 62 and 100 km
19 May 2332 MST	78°45′	318°45′	311°06′	−3°22′	−4°17′
26 May 2232 MST	69°55′	360°00′	360°00′	−3°36′	+3°36′

* From true north.
** Positive effect is drift from west to east; negative effect is drift from east to west.

altitudes of current data were taken from the *U. S. Standard Atmosphere, 1962.*

The sounds from the explosions were detected by a microphone array located on the surface. The position of the explosions with reference to the array is listed in Table 1. The capacitor type microphones were located 1500 ft apart in a square array which permitted a determination of the azimuth along which the sound wave was moving as it crossed the array. The accuracy of these azimuth determinations is about ±2.0 degrees.

3. Results

The wind component normal to the plane of propagation between the source and receiver appears to act as a translating mechanism and results in the observed azimuth of a sound wave not usually in agreement with the geographical azimuth (Diamond, 1964). Ray tracing computations provide values of the cross-wind effect on a sound wave propagating through the atmospheric layers for which meteorological data are available. From the computed cross-wind effect between the surface and about 62 km and the geographical azimuth of the explosion, it was possible to determine the cross-wind effect between 62 km and the explosion height. The results as summarized in Table 1 show that on 19 May the mean wind direction in this layer was easterly while on 26 May the mean wind direction was westerly. The mean wind speed for each case was determined to be about 2 m sec^{-1}. Estimates of the general circulation pattern between 60 and 100 km during the summer over the WSMR indicate that easterly winds prevail to an altitude of about 72 km with westerly above that altitude (Batten, 1961). The mean wind speed for the layer between 60 and 100 km is estimated at 2 m sec^{-1} from the west (Batten, 1961). The low values of mean wind speed for the layer between 60 and 100 km as estimated from general circulation patterns and computed as above are in agreement and indicate that the mean wind speed in this layer is about zero.

REFERENCES

Batten, E. S., 1961: Wind systems in the mesosphere and lower ionosphere. *J. Meteor.*, **18**, 283–291.

Diamond, Marvin, 1964: Cross-wind effect on sound propagation. *J. Appl. Meteor.*, **3**, 208–210.

U. S. Committee on Extension to the Standard Atmosphere, 1962: *U. S. Standard Atmosphere, 1962.* Washington, D. C. Government Printing Office.