ABSTRACT

In 1988, the Meteorological Research Institute (MRI) built a UHF (404.37MHz) wind profiler, which is a Doppler radar used to measure the winds in a clear and rainy atmosphere, at Tsukuba. Since then, the MRI has operated the wind profiler to examine its potential for measuring tropospheric and lower stratospheric winds and to study the wind field in the lower atmosphere.

The present report describes this wind profiler, including its principle, hardware system, data processing and the results of observations at Tsukuba.

In Chapter 1, a brief review of the wind profiler is presented. It observes the echo reflected from clear air turbulence and therefore is referred to as a clear-air radar. Early clear-air radar focused on upper atmosphere research. In the 1970's, the clear-air radar for the lower atmosphere was developed and examined from various points of view. Although, more effort is still necessary to improve the measured data, the wind profiler is now proved to be an importamt instrument for atmospheric researches, weather forecasting, etc.

In Chapter 2, the principle of wind profiler measurement is presented. Although the wind profiler is a fundamentally similar instrument to the conventional weather radar, the scattering process in the atmosphere of the transmitted signals is completely different from that of the weather radar : the weather radar uses reflection from rain drops but the wind profiler detects a weak signal from refractive index irregularities which is handled with the theory of Bragg reflection. The theoretical aspects of Bragg reflection are explained in detail.

In Chapter 3, the design of the wind profiler system in the MRI is described. The transmitter, receiver, antenna system and the data processing system are presented.

In Chapter 4, methods of processing the wind profiler signals are described. Besides what is common with the weather radar, the characteristic techniques of the wind profiler to handle very weak signals reflected from the atmosphere are presented.

The time sequential data of the received signals are first averaged over a time domain to reduce noise and then converted into a frequency spectrum using the Discrete Fourier Transform technique. After removing the DC component and windowing, the spectra are gathered. The ground clutter is then removed. Finally the Doppler (radial) velocity is obtained from the averaged spectrum by the moment method. The radial velocity measurements are made along three beams and are combined to calculate the horizontal wind

velocity.

Hourly averaged winds are produced by the wind profiler using a quality control algorithm. This method is also described.

In Chapter 5, the results of the observational study carried at the MRI are presented. Specific features of the wind profiler measurements are described. The vertical profile of wind when cold front and typhoon pass near the MRI are measured. A method to retrieve the size distribution of rain drops from the observed Doppler spectrum and the result of retrieval are presented.