Observation of Tropical Pre-monsoon Thunderstorm by UHF wind profiler

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Introduction Thunderstorms are part of mesoscale convective systems and are interesting as well as important meteorological phenomenon in many aspects. Although they are short lived, they can be intense with strong updrafts and downdrafts and local heavy rain. Because of their large vertical extension they are hazardous to aviation also. Wind profilers are the only instrument that can provide virtually continuous observations of vertical motion though a column within convection and studies proved that wind profilers are efficient tools to diagnose thunderstorms (May and Rajopadhyaya 1999; Larsen and Rottger 1987). In this paper the ability of Pune wind profiler to directly measure vertical air motions and hydrometeor fall velocity through precipitating and non precipitating systems has been explored through an analysis of the pre-monsoon (March-May) thunderstorm which occurred in the late afternoon on 3 June 2008 over Pune, India. Using the high resolution UHF radar data the extent of enhancement in vertical velocities (updrafts and downdrafts), echo power, changes in spectral width, horizontal wind, vertical shear of horizontal wind and C_n^2 variation during thunderstorm event has been explored .

System Description

The 404 MHz Wind profiler at Pune, India has been in continuous operation since June 2003. The system consists of a dual polarized coaxial collinear antenna array where, the two arrays aligned along true N-S and E-W directions. The arrays produce three beams, two tilted beams; one along the east and the other along the south and the third beam looking at zenith. The profiler measures the radial velocities along these three beams by analyzing the observed Doppler shifted signals adopting Doppler Beam Swinging (DBS) technique. Such a configuration enables simultaneous measurement of all three components (zonal, meridional and vertical) of the wind field. The system has height coverage from 1.05 - 4.35 km in lower mode and 3.15-10.35 km in higher mode.

Wind Profiler at Pune

Antenna Array 13m X 13m

Radar Control Room

Operating frequency	404.37 MHz (λ = 76 cm)
No. of beams Off-zenith angle or Elevation	3 (NS, EW and Zenith) 16.3^0 or 73.7^0
Lowest range bin Highest range bin Range resolution (ΔR)	1.05 km 10.35 km 300 m
Transmitted Peak power	16 K Watts
Number of CI	76
Number of INC	10
Number of FFT points	256/512 (selectable)

Results

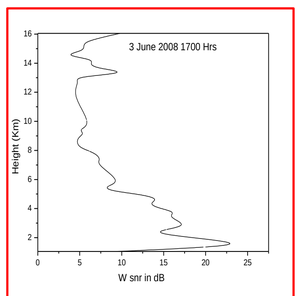

Figure 1: Vertical profile of hourly averaged vertical beam SNR at 1700 hrs. on 3rd June 2008.

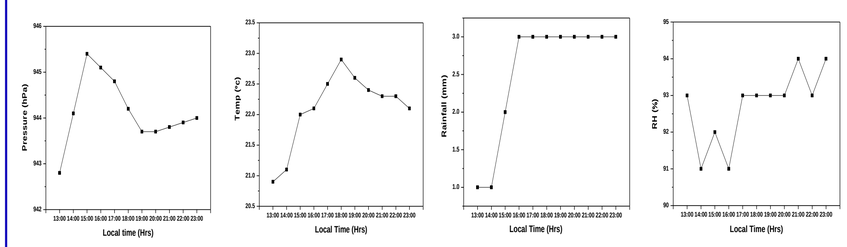

Figure 2: Temporal variations in surface observations of Pressure, Temperature, Rainfall, Relative Humidity for 3rd June 2008 during period 1300 hrs - 2300 hrs. LT (in sequence from left to right).

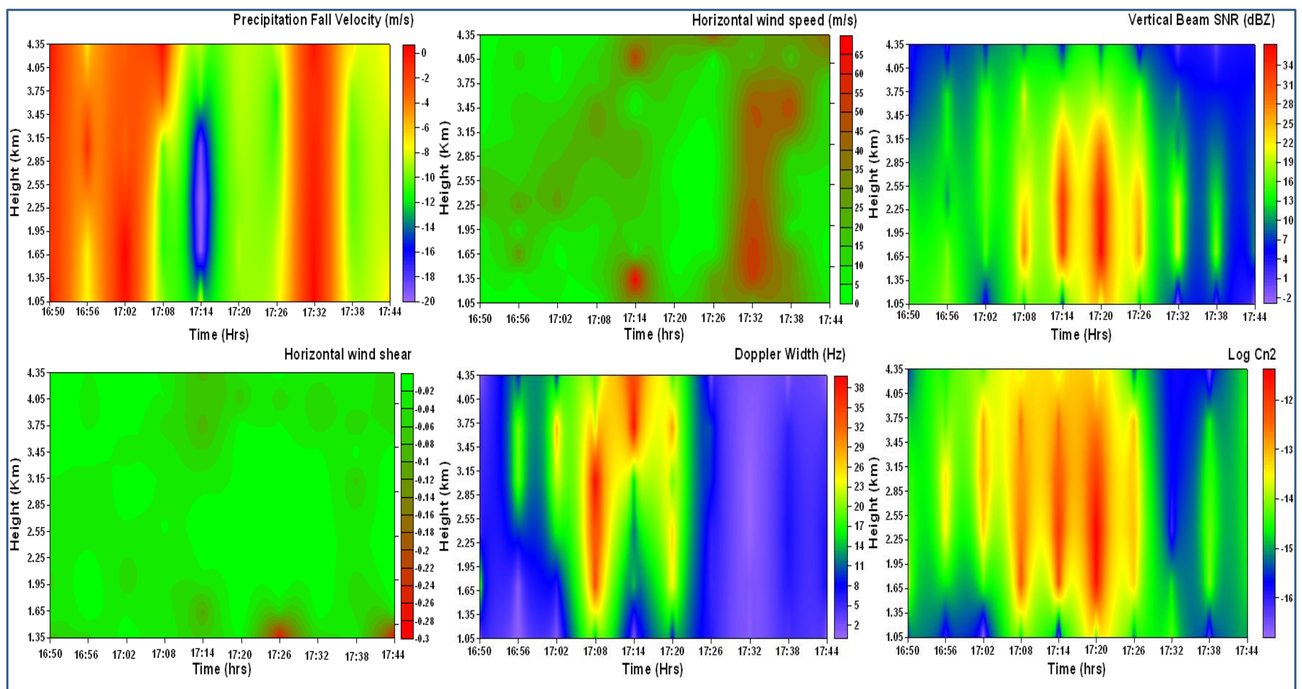

Figure 3: Time Height variations of wind profiler derived Vertical velocity, Horizontal wind speed, Vertical beam SNR, Vertical shear of horizontal wind, Spectral width and Refractive index structure parameter (in sequence from Top left to Bottom right).

Discussion of Results

❖ This paper illustrates an investigation of a pre-monsoon thunderstorm that occurred over Pune (18 32'N, 73 51'E), India from observations made using a 404 MHz wind profiler (UHF radar).

❖**From hourly averaged vertical profile of vertical beam SNR, it can be observed that the peak values are observed up to the height of 4 km with a sharp fall above this, indicating the presence of radar bright band (Figure 1).**

❖**Temporal variations of surface meteorological parameters shows a significant change during the course of the thunderstorm event (Figure 2).**

❖ High resolution profiler data collected has been used to investigate the time-height variations in vertical velocities, Doppler width, reflectivity, Refractive index structure parameter C_n^2, horizontal winds and wind shears in the height range 1.05 km to 4.35 km on 03 June 2008 during the period 1650 - 1744 hrs local time. Rapidly varying vertical velocities (updrafts and downdrafts), large values of vertical Doppler width and large C_n^2 variations from 10^{-16} to 10^{-13} $m^{-2/3}$ under clear air to heavy precipitation conditions have been observed

❖UHF wind profiler thus provide valuable information at high temporal and spatial resolution which is useful to study events of intense convection in detail.

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