Cloud Observation Using 35GHz Cloud Radar In Chengdu Plain

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***Abstract*—A 35GHz cloud radar was deployed in Chengdu Plain for cloud observation from Sept. 2015 to Mar.2016. After the data is processed, the vertical properties of cloud in these months, such as the distribution of cloud intensity, cloud-top, cloud-bottom and cloud height, will be statically analyzed from the data of radar reflectivity.**

Keywords—Cloud observation; Chengdu Plain;

I. INTRODUCTION

Chengdu Plain is the largest plain in south west China. It's exact location is 103° to 104°42″ longitude east, 29°31″ to 31°50″ latitude north with altitude from 442 to 750 m . Fig.1 shows the terrain of Chengdu Plain where Longmen Mountain and Longquan Mountain separately blocked in the west and east, as a result it has formed a special climate condition with annual precipitation of 1000 mm and annual sunshine of 1100 hours[1].

Fig.1 Terrain of Chengdu Plain

A 35GHz cloud radar with vertical fixed point was deployed at 30°35″ latitude north and 103°59″ longitude east for cloud observation from Oct. 2015 to Mar. 2016. Radar products of reflectivity, vertical velocity and spectral width have been acquired which can be used to derive the information of cloud microphysics, such as the size and distribution of cloud particles, the motion of particles in clouds[2-4], etc. From the dataset of cloud observation, the microstructure of cloud properties in Chengdu Plain, such as cloud top, cloud bottom and cloud height, also can be statistically analyzed which is helpful for the climate study of the Chengdu Plain.

II. RADAR DATA

A. *Cloud radar system*

This 35GHz cloud radar is designed with a solid-state transmitter and with the signal type of linear frequency-modulated (LFM) pulses, which operates with a fixed vertical direction. It can easily implement the continued observation of cloud and weak precipitation.

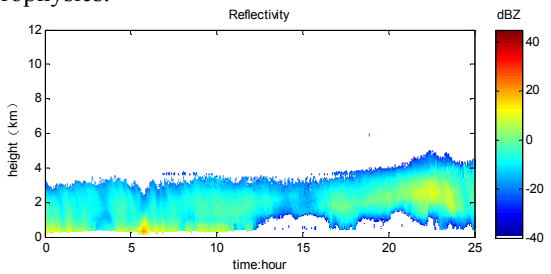
The key specifications of this cloud radar system is summarized in Table 1.

TABLE I CLOUD RADAR PARAMETERS

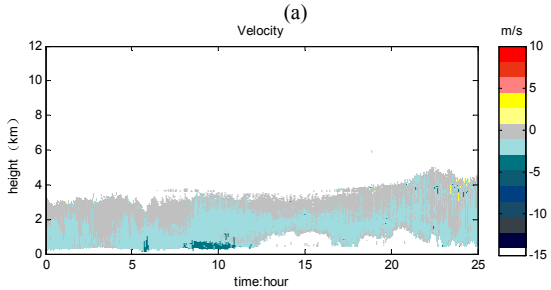
Frequency	35GHz	Dynamic range	80dB
Maxim range	15km	Noise figure	5.5dB
Polarization	horizontal	Peak power	10W
Antenna diameter	1.6m	Scan mode	Fixed vertical direction
Antenna gain	52dB	Pulse width	2us,5us,20us
Antenna sidelobe	-27dB	PRF	6000~20000Hz
Beam width	0.4°	A/D bits	16 bits
Vertical resolution	30m	Spectral estimation	PPP/FFT
Time resolution	1 min	Output	Z, V ,W

B. *Cloud observation*

The basic data of cloud radar includes reflectivity, velocity and spectral width which can indicate the microstructure and microphysics of cloud. Fig. 2 shows an observation example of a weak precipitation cloud acquired on Jan. 20th, 2016. From the data of reflectivity, the vertical structure of cloud is obviously exhibited and their microstructures as well as the microphysics can be retrieved. The cloud intensity shows the size and concentration of cloud particles. The change of cloud intensity in time shows the inner structure and evolution characteristics of cloud microphysics.



(a)



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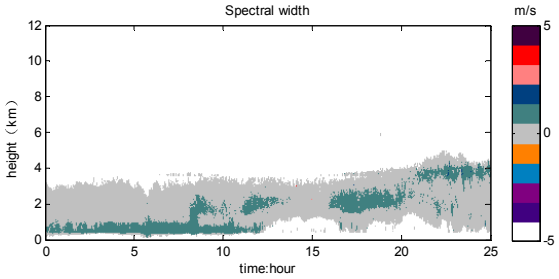


(c)

Fig.2 One observation case of weak precipitation cloud

C. *Data processed*

Fig.3 shows a flow of cloud radar data processing which is mainly based on the data of reflectivity and velocity. Firstly, to decrease effects of data fluctuation, data average along vertical direction within adjacent four range bins was processed which resulted in the range resolution of 120m. Secondly, the clutter near ground were directly removed, in addition to the exceptional data. Finally, the range bins of cloud top and cloud bottom were searched along the vertical cloud profile, as a result cloud properties of each cloud profile can be received. After that, a averaging process has been done among all the cloud-property values for the one day so that each value of cloud properties was acquired.

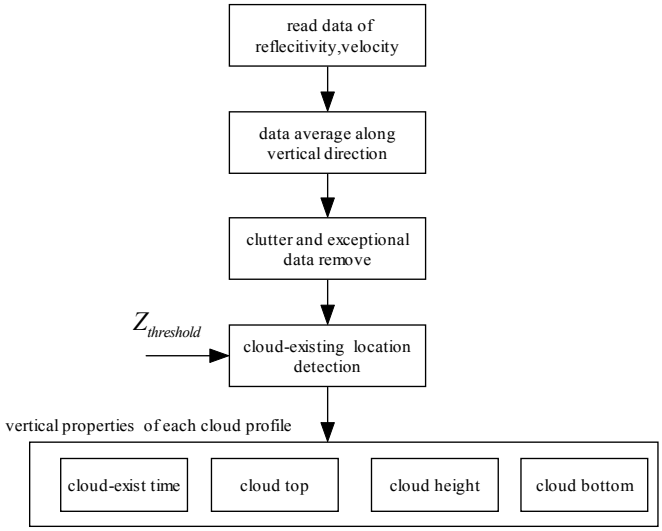
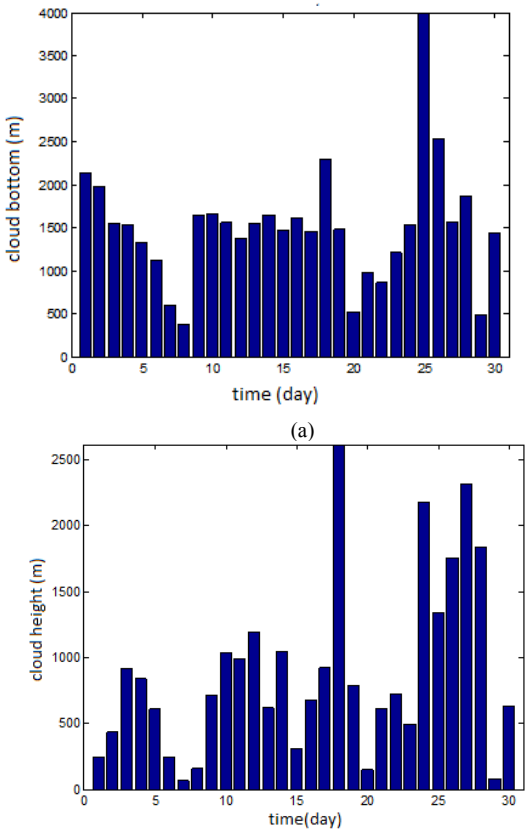


Fig.3 The flow of cloud observation data processing

III. RESULTS

Fig.4 shows a processed example of cloud bottom and cloud height from the cloud observation in the month of November 2015. It shows that the weather in the Chengdu Plain is always cloudy in this whole month, and most of values of the cloud bottom are from 1000 to 1500m except for that of Nov. 25th, and most of the values of their cloud height are more than 500m. However, it only shows one of the results in that month, the entire results and detail analysis under different months are in work.



(a)

(b)

Fig.4 Cloud bottom and cloud height of the month of November in 2015

IV. CONCLUSION

The cloud radar observation from a 35GHz cloud radar in Chengdu Plain is presented in this paper. The cloud radar system and its cloud observation data were introduced. After data processing, an example result of cloud properties in one month, such as cloud bottom and cloud height, were shown. Notice that the results are preliminary and further work is in process.

Acknowledgment

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