**Responses to reviewer's comment (amtd-6-C3065-2013)**

**General comments**

This paper describes an interesting method to retrieve vertical air motions by a dropsonde, that it is well in AMTD field. This work is based on the method proposed by Wang (2008) and improved by using a hardball as parachute. The method used is well described. However, the presented technic has a lack of validation with other means. The comparison of vertical motions estimated by a radar and radiosondes are limited to one case, that is not enough to evaluate the accuracy of the technic. In the goal to an operational uses of this technic, some technical details about the separation device and the sphere are needed, and some limitations can be discussed. I suggest that this paper can be published after major revision including some precisions about the following points :

1)Comparisons with VW measured by radar must be more consistent. The authors can present all VW soundings made with radar UHF.

**Response:** More studies are conducted by us, which are specified as follows.

Fig. S1 shows the orientation and distance from the launch site for the radiosondes losing signal during descent at Baochang in 2012. The distances are generally less than 50 km; meanwhile, they are very close for the radiosondes launched on the same day.

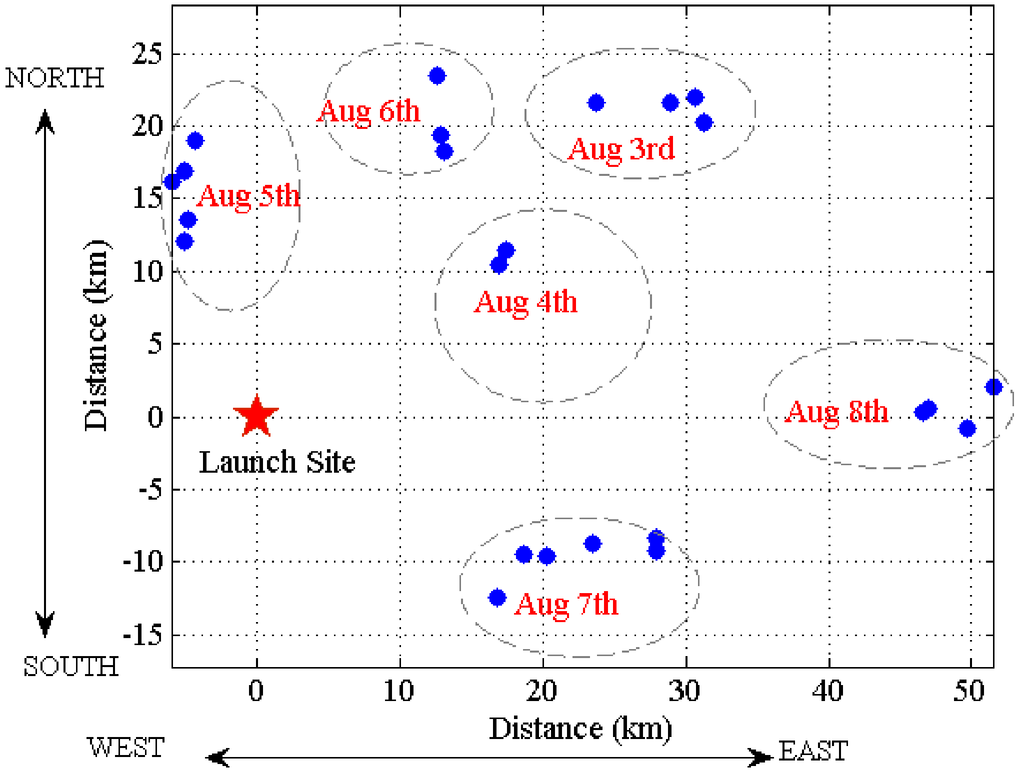


**Fig. S1.** The orientation and distance from the launch site for the radiosondes losing signal during descent at Baochang in 2012.

The radar used in this study can provide vertical air motion profiles at a temporal resolution of 5 minutes from the surface upwards to 4.5 km above ground level (a.g.l.). One radiosonde launch generally takes less than 5 minutes to fall down from 4.5 km to ~0.5 km a.g.l where the receiver usually misses the data signal due to blocking by the terrain. The radar samples with the observational time closest to the radiosonde measurements, including horizontal wind and vertical wind (VW), are selected to compare with the radiosonde results.

Fig. S2 presents the comparisons of horizontal wind for U and V components derived from radiosonde and wind profiler radar at Baochang in 2011 and 2012. Overall, the agreement between horizontal wind retrievals from two approaches is reasonable. The correlation coefficient and root mean square are 0.90 and 2.0 m/s for the U component, which are 0.93 and 2.0 m/s for the U component.

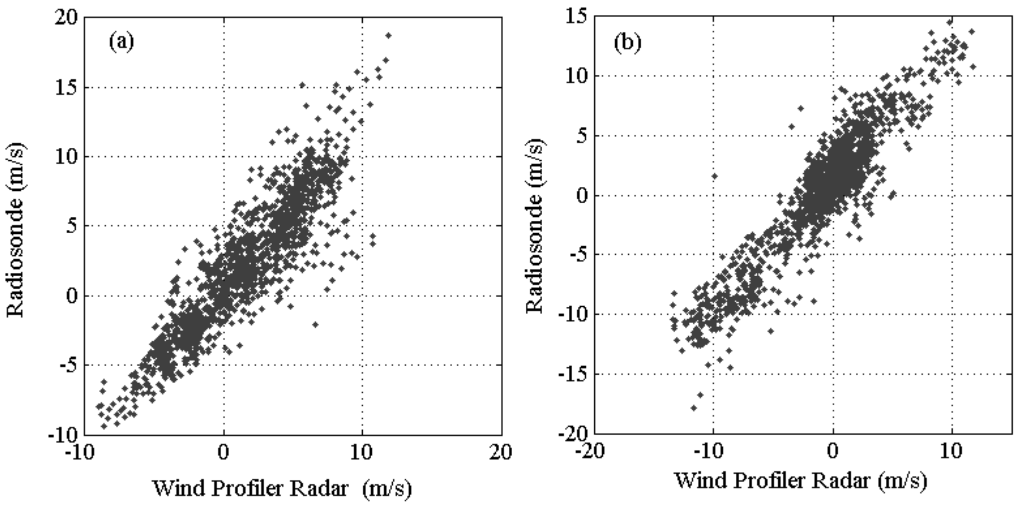


**Fig. S2.** The comparisons of horizontal wind for U component (a) and V component (b) derived from radiosonde and wind profiler radar.

Fig. S3 shows the comparisons of VW derived from two methods; their correlation coefficient, variance, and covariance are -0.13, 0.85, and -0.04, respectively. Overall, the agreement of VW from two approaches is not good, which should be associated with different objects detected by two instruments caused by a drifting radiosonde and the fixed radar. So, it seems to be difficult to obtain point-to-point data of the vertical wind measurements for comparisons.

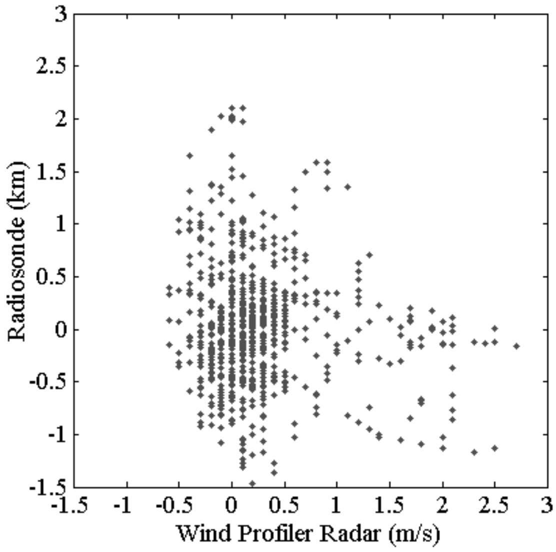


**Fig. S3.** Comparisons of VW derived from radiosonde data and wind profiler radar.

Fig. S4 illustrates the average difference of radiosonde- and radar-retrieved VW and their standard deviations. The larger value of VW is obtained by radar than that by radiosonde at most levels; the maximum difference is ~0.7 m/s located around 2 km. The standard deviations are generally less than 2 m/s.

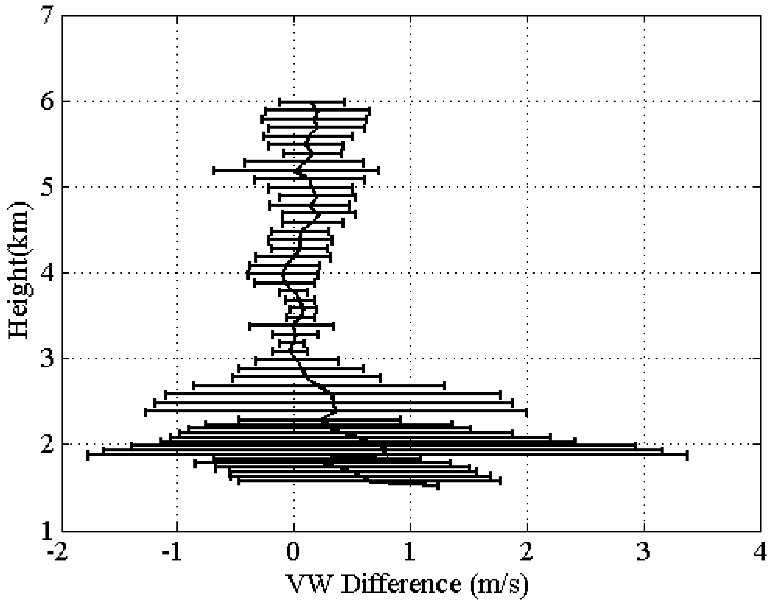


**Fig. S4.** Average VW difference between wind profiler radar and radiosonde retrievals (radar-radiosonde) and their standard deviations.

2) Error estimates on the measured vertical velocities with this technic and radar are needed. Spatial resolution of the VW radar must be discussed.

**Response:**

Error analysis was carried out based on the formula to derive the air vertical wind (VW) which is given by

$$VW = -(V_d - W_d) \qquad \text{(i)}$$

where Vd is the observed descent velocity and Wd is the calculated descent velocity in the still air. Note that both Vd and Wd are positive toward the surface. The error in Vd is related to the radiosonde pendulum motion and mainly to the truncation of GPS-given height value. The pendulum motion is very small during the radiosonde descent, so it causes small error in Vd which can be ignored. While the value of height given by the differential surface and radiosonde GPS data has ~±0.5m of uncertainty. So, the maximum uncertainty in $V_d$ at one height could be 1m/s. This random error is observed in the $V_d$ profile and can be reduced through smoothness. The error in $V_d$ is estimated to be ±0.35m/s if 10-point moving average is applied.

The calculated $W_d$ is a function of $m_s$, $C_d$, $A_b$ and ρ:

$$W_d = W_d(m_s,\ C_d,\ A_b,\ \rho) \qquad \text{(ii)}$$

The error in $W_d$ is a composite of the contributions of the individual accuracies or uncertainties of different parameters listed above. The uncertainties for these parameters are given in Table 1. Some of the error contributions depend on air pressure, such that the overall uncertainty of the $W_d$ calculation will be a function of pressure i.e. altitude. The uncertainties are assumed to be random and following Gaussian statistics thus Gaussian law of error propagation [e.g. Bevington and Robinson, 1992] is applied to Eq.(ii). The overall relative uncertainty of $W_d$ is expressed as:

$$\frac{\Delta W_d}{W_d} = \sqrt{(\frac{\Delta m_s}{m_s})^2 + (\frac{\Delta C_d}{C_d})^2 + (\frac{\Delta A_b}{A_b})^2 + (\frac{\Delta \rho}{\rho})^2} \qquad \text{(iii)}$$

The cross-section area of radiosonde box and the string is about 5% in comparison with that of the hard ball. For the purpose of simplicity in calculating Cd, the drag effects of radiosonde box and the string on the $W_d$ calculation are not taken into account due to its complexity. This neglect will result in some uncertainty in Wd calculation. Analysis shows that another main error in calculating Wd comes from the uncertainty of the drag coefficient estimation. The maximum relative error in Wd, obtained by employing the maximum relative uncertainty for all parameters, is estimated in the order of ~8.3%, leading to an absolute error of about 1-2 m/s. However, some of these errors can be mutually cancelled or significantly reduced by means of smoothness. So, it is estimated that the calculated Wd has an error of about ±1 m/s.

In combination of all errors in $V_d$ and $W_d$, the vertical wind is derived with an error of about 1.5m/s.

**Table 1 Technical specification of the descending radiosonde**

| | Value | Uncertainty | Maximum relative uncertainty |
|---|---|---|---|
| $m_s$ | 675-710g | 0-3g | 0.0044 |
| $C_d$ | 0.3229- 0.3326 | 0.0074- 0.0206 | 0.0621 |
| $A_b$ | 0.1960 $m^2$ | 0.0100 $m^2$ | 0.0500 |
| P | 0.2582- 1.0035 $kg/m^3$ | 0.0005-0.0078 $kg/m^3$ | 0.0221 |

**Reference:**

Bevington, P. R. and D. K. Robinson (1992), Data reduction and error analysis for the physical sciences, MacGraw-Hill Inc, New York.

3) Authors must indicates some technical details about the cutter (way to separation, weigth, cost, failure rates, if any), weight and materials for the ball.

**Response:** A cutter triggered by a timer is placed above the hard ball. The radiosonde hangs under the hard ball using a string of 40 m in length. The string linking the balloon and ball is cut when the instrument package is elevated to the upper troposphere by a balloon. After that, the radiosonde and hard ball start to fall down, while the balloon and cutter continue rising until the balloon bursts. The time for the cutter trigger is set to 45 minutes during the experiments. The weight and cost for the cutter is ~ 200 g and ~25 dollars. The cutter always works well during the entire campaign. The weight for the ball made of plastic foam is ~320 g.

4) The effects of icing about estimates VW, in convective layer, must be discussed.

**Response:** At present, we have no idea how to discuss the effects of icing on VW estimation.

**Minors comments**

Page 8108/L8 : This sentence seems to say that it is the string linking the ball and radiosonde that is cut. Please rephrase more clearly.

**Response:** The string linking the balloon and ball is cut. After that, the radiosonde and hard ball start to fall down, while the balloon and cutter continue rising until the balloon bursts.

Page 8111/L8 : See previous comment, same thing.

**Response:** Please see the previous response.

Page 8111/L19 and L20: Write "descent rate"

**Response:** They are corrected.

Page 8111/L21. "Up to eigth: : : channel receiver". What is the interest of this sentence? Did you made simultaneous launches ?

**Response:** Yes, we made simultaneously multiple launches on occasion and got 2-4 profiles during ~90 minutes. Up to 8 radiosondes can be released simultaneously and their data can be received and processed by the ground system.

Page 8112/L1 : Indicate radiosonde and hardball weights.

**Response:** The weights of radiosonde and hardball are ~240 g and ~320 g, respectively.

Page 8112/L8 : Give the exact number of sondes released.

**Response:** There are 56 radiosonde launches in total.

Page 8112/L14 to L19: It is usefull to indicate the number of radiosondes launched when the radar is working.

**Response:** The numbers of radiosondes launched when the radar is working are 13 at Chuangchun in 2010, 6 and 21 at Baochang in 2011 and 2012, respectively. There is no radar deployed in Lhasa.

Page 8113/L3: Information on the horizontal distances traveled by the radiosondes would be useful.
**Response:** The horizontal distance traveled by the radiosonde is 20.8 km.

Page 8114/L27: What was the horizontal distance travelled by the sonde in this case?
**Response:** The horizontal distance traveled by the radiosonde is 7.3 km.

Page 8115/L21: See first comment, same things.
**Response:** Please see the response to the first comment.

Figure 3 and 6: Write launches in the legend.
**Response:** They are corrected.

All information mentioned above will be added into the revised manuscript.