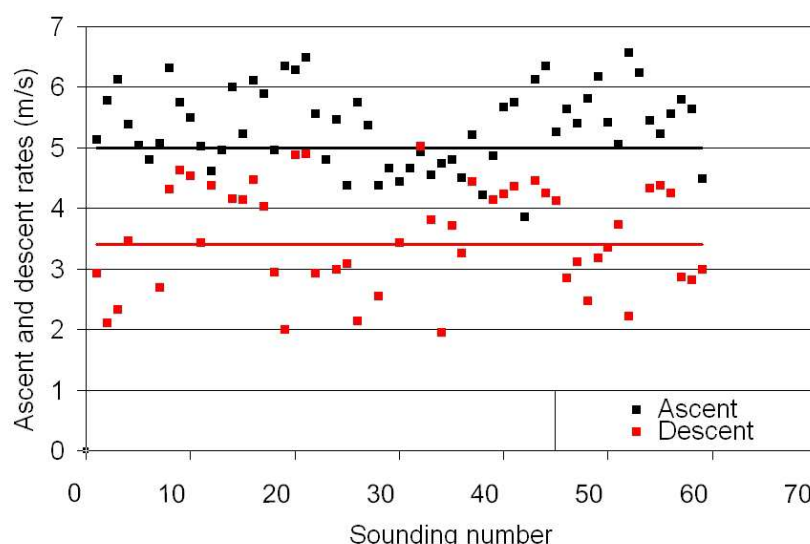


Responses to Reviewer 1

We thank you for the thoughtful comments and changes suggested in your careful review of our manuscript. Our point-to-point responses are developed hereafter.

“It would be interesting to quantify the difference between the expected vertical speeds of the balloons and the observed ones. How close are they to the nominal values of 5 m/s and 3.4 m/s used in the simulations?”

This information was lacking in the original version of the manuscript. Thank you for pointing it out. The figure below shows the differences between expected and observed mean vertical speeds for all radiosondes recovered during BLLAST. The actual mean descent speed computed from 49 soundings is 3.55 m/s (STD 0.86 m/s), while the mean ascent speed is 5.35 m/s (STD 0.65 m/s). These values are now given in Section 3.4 of the revised version of the paper.

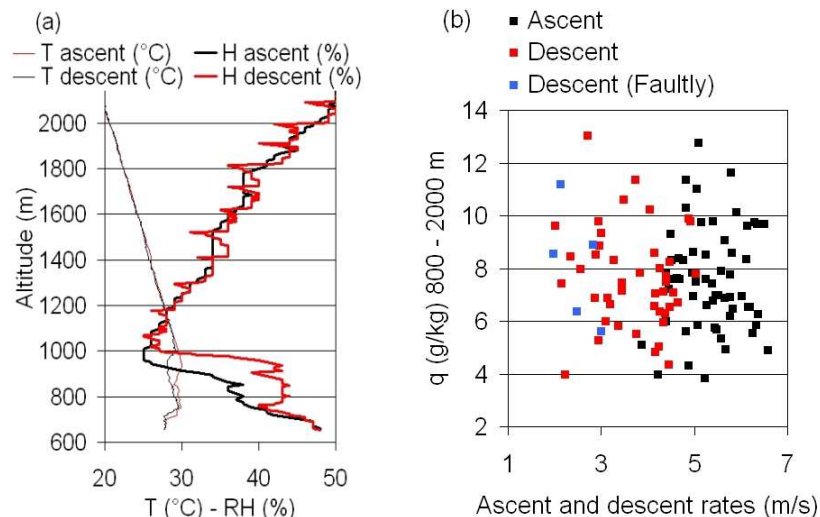


Mean ascent (black) and descent (red) rates for all radiosondes recovered during BLLAST. The black and red lines respectively indicate the ascent (5 m/s) and descent (3.4 m/s) rates used to estimate the location of the landing point.

“How is the measurement accuracy affected by the difference in vertical speed at ascent and descent? I think namely about the influence of ventilation on temperature and humidity measurement.”

Inadequate ventilation of the radiosonde can indeed have an impact on the accuracy of the measurement. This is more likely to occur at descent due to the slowest relative speed of the system. No significant effect was seen on temperature measurements between the ascent and descent phases, but we did notice a few descending soundings for which humidity measurements became unstable. For instance, the figure below shows the presence of unrealistic peaks in humidity measurements collected at descent on 6 June 2011 at ~20 UTC (left panel). All suspicious humidity peaks are separated from a time period of 55 seconds, which suggests that the heating cycle of the twin humidity sensors is not functioning properly - the RS92 uses twin humidity sensors that alternatively measure humidity over a cycle of 110 seconds.

After a careful review of all soundings performed during BLLAST, we found that this problem had occurred 5 times, always at descent. This is also illustrated in the figure below (right panel) where blue dots correspond to the 5 soundings associated with unrealistic humidity peaks. According to this figure, the problem only occurs at descent, when the mean descending speed of the radiosonde is lower than 3 m/s. In order to mitigate this issue, one could use a lighter slowing balloon to increase the descent speed of the system. Using a balloon with a weight of 50 g would for instance increase the descending speed of about 20% with respect to the 100g weight balloons used in BLLAST and HYMEX. Both this figure (now Fig. 8) and the discussion have been included in a new dedicated subsection (3.5 “accuracy of measurements”).



Effect of insufficient ventilation on radiosonde measurements. (a) Example of disturbed descending sounding made during BLLAST on June 26 2011 at 20:08 TU. (b) Ascent and descent rates vs. mean specific humidity between 800 m and 2000 m for ascending soundings (black), descending soundings (red) and disturbed descending soundings (blue).

“It seems to me that a 22% error in the simulated position of the landing point is quite large (P3347) and may prevent recovery of the sondes in most practical applications. For example 22% of a 40 km distance represents 8.8 km. The results from BLLAST experiment contradict this interpretation since 80% recovery was achieved. I thus guess that the flights in this experiment were made over short distances. This should be stated (or even better quantified in km) by the authors.”

It is correct that BLLAST soundings were always made over short distances. This is now more clearly specified in the text (Section 3.3). Figure 7 has also been modified so as to indicate the distance travelled by the radiosondes.

“It is shown that the horizontal wind is critical for performing a good simulation of the landing point. Could it be attempted that the measured wind from the sonde is used for updating the simulations in real-time?”

This is indeed possible, but this would not add much extra information with respect to real-time information already provided by the GPS. Also keep in mind that the main objective of trajectory simulations is to make sure, to the extent possible, that radiosondes do not fall in hardly accessible regions such as forests, urbanized area or water. As such, the release pressure/altitude of the carrier balloon is currently set from trajectory simulations performed before the launch. Updating simulations in real-time may nevertheless be interesting if one

can remotely trigger the separation of the carrier balloon. This possible improvement is briefly discussed in the last section of the paper.

“Would a 3D wind field from a model forecast provide more accurate results instead of a single vertical profile?”

This should be true, especially for long flying distances, but one must also take into account the weather conditions. Errors on modeled vertical speeds in stormy environments could actually have an opposite effect and degrade the accuracy of the results.

“P3340/L16: indicate that the 80% recovery is for BLLAST campaign”

Corrected as follows: “Seventy-two soundings were performed during BLLAST (62) and HyMeX (10) with a recovery rate of more than 80% during the BLLAST field campaign”.

“P3341/L18: explain what is meant by “passive” and “active” recovery”

This sentence was rewritten as follow: “Other systems for the recovery of meteorological sensors have been proposed later by Tennermann et al. (2004), using a tethered balloon, and Douglas (2008), using a light weight, motorized, glider programmed to return at the launching site.

Reference to Mastenbrook (1966) is actually not relevant and has been deleted.

“P3341/L19: as long as the quoted systems are not described or their cost is given, it cannot be understood what is challenging and what is inconvenient.”

This comment is no longer relevant according to the above change.

“P3344/L12: from figure 3 it seems that the flight is valid on 21 Oct 2012 at 15:00”

Corrected! Thank you for pointing this out.

“P3344/L23: “the landing point is extrapolated from the last wind measurement” add “provided by the sonde.” ”

Done thanks!

“P3347/L12: how is the vertical wind speed derived from the in-situ measurements of the sonde and how accurate is this retrieval?”

We actually refer to the mean ascent speed of the balloon, not to the vertical wind speed. This has been clarified in the new version of the manuscript.

P3347/L15: how much does the 22% error represent in km?

This corresponds to a distance of roughly 1.4 km. This has been specified in the text (section 3.4)

“P3348/L19: “About a dozen” give the exact number.”

The correct number is 12. This has been clearly specified in the text.

“P3349 – 3350 and Figure 8 and 9: the plots related to radar in these figures are hardly readable and I am not sure that they are actually necessary, unless the impact of the precipitation detected with the radar on the trajectory of the balloons or on the measurements of the radiosondes is explained.”

The radar plots have been improved. We believe that it is important to provide the reader with information about weather conditions during the flight.

“P3340/L19-20: could the increase of humidity in the low levels and decrease at midlevels be interpreted as convergence and divergence, respectively, due to the overturning circulation associated with convection? The mid-level decrease in humidity can also be due to condensation/precipitation.”

Although it is not possible to figure out precisely what factors are responsible for the observed changes, the latter are indeed likely related to both precipitation and convection processes. This has been indicated in the text.

“Figure 4: explain why the ground receiver is not operated at the launch site.”

The receiver is not operated at the launch site in order to have a good radio reception on each side of the town (case A) or of the mountain (case B). In case C, the “ground” receiver can be operated either on the boat or at the ground. These precisions have been included in the caption.

“Figure 5: The text in the captions is not easy to follow: I suggest you introduce first the case of 21 October at 15h for which the trajectories are plotted with the yellow markers and for which the wind profile is displayed in Figure 3. Then mention the other markers corresponding to other flights. If different wind profiles are used on the same day (e.g. 21 Oct 10:50 and 14:50), mention this also in the caption.”

We agree. The caption has been modified following your recommendations and now reads:

Flight trajectory simulations valid 21 October 2012 at 15:00UTC, according to the wind profile and sounding settings displayed in Fig. 3. The launch site is located in Candillargues, along the Mediterranean coast. Blue, green and red trajectories correspond to flight simulations made from mean ascent rates of 3, 4, and 5 ms⁻¹, respectively. The yellow circle (resp. square) indicates the actual landing point (resp. separation point) of the radiosonde. Other circles/squares show the actual landing (resp. separation point) of soundings performed at 10:50 UTC, 21 October 2012 (black), 9:03 UTC, 17 October 2012 (white) and 11:55 UTC, 17 October 2012 (pink). The foothills of the Massif Central Mountains are indicated by the dashed black line.

“Figure 7: I guess it would be more instructive for the reader to have the error given in km, or at least to give the mean distance so that the percent error can be converted in km.”

The mean distance travelled by the balloon is now indicated on each panel of Fig. 7. See below.

“Figure 7a: in the header, replace “estimated” with “expected” or something like that because estimated suggests that the vertical speed is calculated in some way.”

Agreed and corrected!

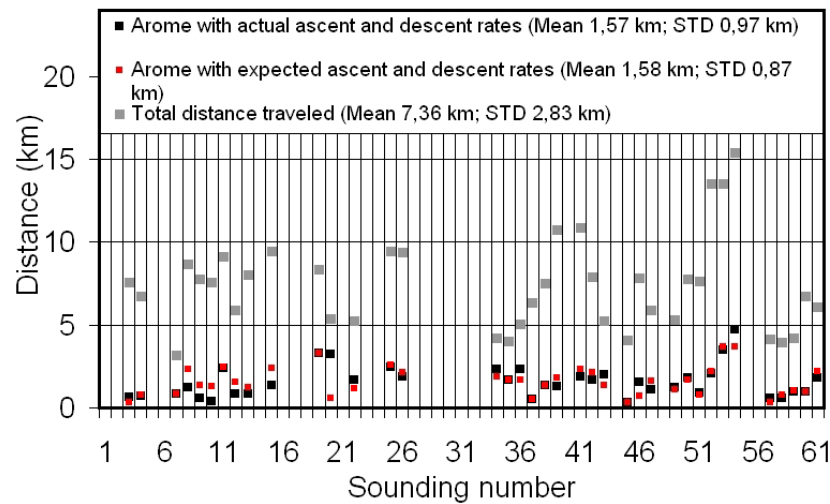


Figure 7a

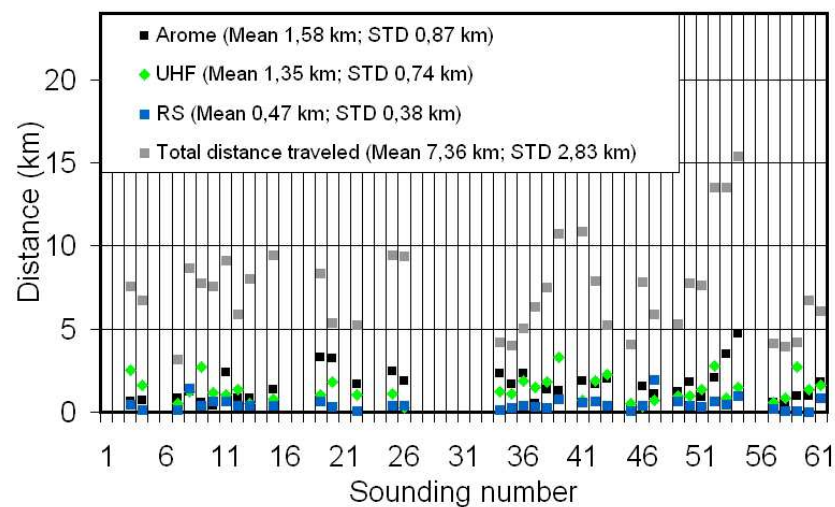


Figure 7b

Figure 8: the red vectors and white and red squares mentioned in the captions are undistinguishable in the radar figure. The labels of the color scale are also not readable. It is also hard to see the descent profiles in plots (a) and (b).

Figure 9: similar remarks as for Figure 8.

Figure 10: is it hard to see the light colors.

Figure 8 to 10 have all been modified to improve readability.