

Review of “High frequency boundary layer profiling with reusable radiosondes” by Legain et al. (2013)

Recommendation: major revision

General comments:

The manuscript describes a radiosonde system to make high frequency boundary layer profiling with reusable radiosondes. It is achieved through a double-balloon system to make both ascending and descending profiles and recovering and reusing the radiosondes. Another advantage of the system is to make the descending soundings at pre-defined locations. I think that this cost-effective system has a lot of potential scientific applications. However, the manuscript falls short in several aspects (see my comments below). I think that the manuscript needs major revisions before it is ready for publication.

Major comments:

1. Overall I think that the manuscript is lack of technical details. Most of time it only contains qualitative descriptions of the systems. See below for a few specifics on this.
2. What are the advantages of this system comparing with a regular radiosonde with a parachute, which can be designed to have the balloon popped at preset pressure, and then use the parachute to make descending profiles?
3. Section 2.3: Accurate prediction of the balloon trajectory is important to achieve the desired pressure level, separation and landing point. More quantitative analysis on how sensitive the trajectory to the input parameters, such as wind speed and balloon rise rate. The balloon rise rate in still air is sensitive to the drag coefficient and other factors (see Wang et al. 2009, JTECH; Gallice et al. 2011, AMT). In addition, the vertical air motion affects the actual balloon rise rate. Such information is necessary for the researchers to decide whether it can achieve their scientific goals given the uncertainty in the desired pressure level and the location of the descending profile.
4. One of the advantages of this system is to obtain the descending profiles. The authors should specifically discuss the differences between ascending and descending profiles and the quality and value of the descending profiles. Vaisala RS92 is designed to make the ascending profile with a certain bending angle for the sensor module. How is the sensor module oriented during the descent? How does it affect the measurement? Is there enough ventilation? I think that during the descent, the heating cycle for RS92 twin humidity sensors would not work. How does it affect the measurement if the sonde goes through clouds with water/ice on the sensor?
5. Cost-effectiveness: Yes, it is great to reuse the recovered radiosondes to save the cost of the expendable. The question is what the cost is for separation device, protection system, extra balloons and other things, and the labor cost to recover the sondes. If you add all of them

together, is it still cost-effective? How easy is this to operate given extra gadgets added to the operational radiosondes?

6. What is the future plan for this development? I have seen many experiments with different developments. Very often they end up just a few testing to show the proof-of-concept. I think that it would be important to discuss the strength and weakness of the system and potential future improvement, which can be made by the authors or others. The ultimate goal would be to make the system more robust for more usage of the system either operationally or during field projects.

Specific comments:

1. P3342, L25: Does this protection system affect the air flow and then the measurements for both ascending and descending profiles?
2. P3343, L10-12: How do you decide whether the balloon reaches the required diameter? Do you weight the amount of helium put into the balloon or other ways?
3. P3343, L16: should “vertical wind profile” be “horizontal wind profile”?
4. P3343, Fig. 3: More explanations are needed for this software, such as which “wind profile” should be selected, what the impact is, and whether this is easily adapted by other researchers?
5. P3346, Fig. 6: It is hard to see the differences between ascending and descending profiles. What value does the descending profile add besides helping the recovery of the sondes?
6. P3346, L20: Why do 62 launches only give you 104 profiles rather than 124? What happened to missing 20 profiles?
7. P3346, Section 3.3: The statistics on the deviation of actual separation distance from desired one would be useful (see major comment #3), similar to Section 3.4 on the landing point.
8. P3349, Fig. 8: The figure caption incorrectly says that the thin line represents the ascending profile.