Review of
"A comparison of Loon balloon observations and stratospheric reanalysis products"
by Leon S. Friedrich *et al.*

This paper is a revised submission of the article by Friedrich et al. that deals with comparisons between reanalyzed winds and wind observations gathered during Google Loon long-duration balloon flights. The paper also compares balloon trajectories with those computed with reanalyzed winds. I re-iterate my initial statement on the previous version that this study uses an unique dataset to provide very helpful information on reanalysis accuracies, which are widely used to study transport in the atmosphere. I have furthermore found that the authors have thoughtfully addressed most of my comments on the previous version, as well as those of the other reviewer. I therefore recommend publication of this article. I have nevertheless listed a few minor points that the authors may want to address before publication.

Minor points

- p7, l146 (end of introduction): I still find that the transition between the end of the introduction, which discusses previous studies, and Section 2 is a somewhat abrupt. I would encourage the authors to either include a short outline of their studies, or a transition sentence.
- p7, l160: remove comma after "while"
- p11,l272 to p12, l283: One likely reason that could explain the differences between this study and Podglajen et al. (2014) regarding reanalysis accuracies in the tropics is that Podglajen et al. (2014) deal with deep tropical balloon flights (within 10° of the equator), while this study considers observations mostly southward of 15°S. It is expected from simple balance argument that mass information provided by spaceborne instruments provides less and less constraints on the wind field as one gets closer to the equator. This is for instance illustrated in Baker et al. (2014) (their Figure 2 notably), which shows that the largest wind errors between models are actually located in the deep tropics (and above oceans).
- p13, l317-324: Another possible reason to explain this difference in trajectory separation is that the balloon flights considered in Hertzog et al. (2004) took place in the stratospheric polar vortex. The separation between the real and simulated balloons in this study was therefore somehow limited by the polar vortex size.
- p16, l388: I agree with the authors' statements on my previous comment. Yet, I find that some of the words used around here are inducing some confusion. For instance, the authors use "SZA bias" while they are referring to differences between the temperature of the lifting gas (i.e. in the balloon envelop) and that of the ambient air. On the next sentence, they carry on with "the solar heating on the lift gas temperature is much more significant than the usual solar bias", i.e. the one which takes place when one is measuring the ambient air temperature. I would suggest to make a distinction between:

  1. a real measurement bias associated with the daytime radiative heating of temperature sensors (used either to measure ambient air or lift gas temperatures). This bias is mostly dependent on the sensor size, coating and ventilation, and is quite unlikely to explain the 30-K difference between the lift gas temperature measurement and the real ambient air temperature,
  2. a physical issue, which is that the daytime lift gas temperature is indeed warmer (by a few tens of degrees) than the ambient air temperature. This issue arises as the balloon envelop absorbs in the UV-visible, and thus conductively heats the lift gas.

  My impression is therefore that using Google Loon temperature measurements to infer air temperature is mostly spoiled by this second item than by the sensor bias itself, which was what was corrected for in the previous studies mentioned in the article. I would thus rather use "temperature difference" or anything that clearly identify this contrast. I furthermore notice that this second item likely also explains the nighttime lift-gas temperature that are sometimes significantly colder than the ambient air. Here, it is the envelop absorption in the infrared which plays a role: if the balloon flies over high, optically-thick clouds the envelop cools and cools down the lift gas with respect to the ambient air.

Bibliography

Baker, W. E., et al., 2014: Lidar-measured wind profiles: the missing link in the Global Oserving System. *Bull. Am. Meteorol. Soc.*, **95**, doi:10.1175/BAMS-D-12-00164.1.