Atmospheric Measurement Techniques Discussions

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Reply on RC1

Vicent Favà et al.

Author comment on "Thermodynamic model for a pilot balloon" by Vicent Favà et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-206-AC1, 2022

RC1: 'Comment on amt-2021-206', Anonymous Referee #1, 12 Nov 2021 reply

This paper presents a model of the ascent of a sounding balloon. The motivation is the retrieval of horizontal wind information from azimuth and elevation of pilot balloons reported at a time when position information was not directly measured. The topic is of interest to AMT and the paper is clearly written. However, in my opinion, it falls short of new results and more analyses are required before it can be accepted for publication. I detail below a few suggestions to the authors.

Main comments

1) Earlier studies, including those cited by the authors, have already examined the behavior of sounding balloons and it is not clear what is new in the analysis presented in this paper. This should be explicited. The development of the model equations is standard and could be shortened and partly moved to the appendix.

In this paper, we evaluated how the balloon's ascent rate determines the accuracy of wind calculations. Also, the sensitivity of the ascent rate to variations of some parameters of the model. The last, but not the less, our model, among others items, includes radiative balances. So, we consider it as one of the most complete one to understand the dynamics of a pilot balloon and represents a step forward in their study. Following the referee's suggestion, we have reduced the number of equations and moved them to the Appendix.

2) The lack of consideration of radiative fluxes is a severe shortcoming in my opinion. This point was also negelected in many previous studies and could be a novel interesting aspect of this paper if treated. Note that even during nighttime the infrared fluxes from the Earth surface might not be negligible compared to heat diffusion.

We have included a consideration of radiative fluxes in the model, for both IR and visible fluxes.

3) A validation of the numerical model is missing. Even though they do not have access to that information for Ebro launches, the authors could validate their model with ascent rates from present day radiosoundings. The sensitivity of the retrieved horizontal wind to the assumed lapse rate and model parameters should also be presented (currently only

this sentence on line 859 'correlations obtained between the ERA5 wind profile and the model hardly vary even when using the lapse rate for a standard atmosphere (6.5 K km -1)' hints that the authors have carried out such a sensitivity study but the results are not presented).

We have validated the model from radio soundings. We included a section (8.1) for the case of night-time radio soundings taking into account the radiative balance for IR, and another section (8.2) for daytime soundings which also take into account visible radiation.

We have included a table to show the sensitivity of the ascent rate to variations of some parameters of the model (Table II, part 6).

We have included a complete section (10) to analyze the impact of the assumed ascent rate on the accuracy of the horizontal wind calculation. We believe this question is of the utmost importance and had not previously received the attention it deserves.

Other comment :

p5 line 164 : 'ERA5 pressure levels': why not use model levels instead ? They have a higher resolution.

We have interpolated both the ERA5 data and the model data to be able to compare them at a resolution of 500 m. We believe this resolution is sufficient. The 30 g pilot balloon used in the observations has an ascent rate close to 200 m/min and, since the theodolite angles are measured every minute, we only have a little more than two measurements for every 500 m.