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Atmospheric Measurement Techniques Discussions

# *Interactive comment on* "A Reel-Down Instrument System for Profile Measurements of Water Vapor, Temperature, Clouds and Aerosol Beneath Constant Altitude Scientific Balloons" *by* Lars E. Kalnajs et al.

**Masatomo Fujiwara (Referee)**

fuji@ees.hokudai.ac.jp

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This paper describes the technical details of the Reeldown Aerosol Cloud Humidity and Temperature Sensor (RACHuTS) instrument system used with the CNES's long-duration balloons under the Stratéole 2 mission, and presents some results from an engineering flight along the equator for 101 days. The RACHuTS instrument system is a very interesting and challenging one, but at the same time is a very promising one. The paper is well written, and the example of scientific measurements is very interesting. I think that the paper is within the scope of the Atmospheric Measurement



Techniques and will be acceptable for publication after considering my minor comments listed below.

Lines 74-76: There were several water vapor sounding campaigns in the tropical Pacific and in the tropical Indian Ocean including Indonesian maritime continent; some of the papers are listed below.

Fujiwara, M., H. Vömel, F. Hasebe, M. Shiotani, S.-Y. Ogino, S. Iwasaki, N. Nishi, T. Shibata, K. Shimizu, E. Nishimoto, J. M. Valverde-Canossa, H. B. Selkirk, and S. J. Oltmans (2010), Seasonal to decadal variations of water vapor in the tropical lower stratosphere observed with balloon-borne cryogenic frostpoint hygrometers, Journal of Geophysical Research, 115, D18304, doi: 10.1029/2010JD014179.

Hasebe, F., Y. Inai, M. Shiotani, M. Fujiwara, H. Vömel, N. Nishi, S.-Y. Ogino, T. Shibata, S. Iwasaki, N. Komala, T. Peter, and S. J. Oltmans (2013), Cold trap dehydration in the Tropical Tropopause Layer characterized by SOWER chilled-mirror hygrometer network data in the Tropical Pacific, Atmospheric Chemistry and Physics, 13, 4393-4411, doi: 10.5194/acp-13-4393-2013.

Inai, Y., F. Hasebe, M. Fujiwara, M. Shiotani, N. Nishi, S.-Y. Ogino, H. Vömel, S. Iwasaki, and T. Shibata (2013), Dehydration in the tropical tropopause layer estimated from the water vapor match, Atmospheric Chemistry and Physics, 13, 8623-8642, doi: 10.5194/acp-13-8623-2013.

Suzuki, J., M. Fujiwara, T. Nishizawa, R. Shirooka, K. Yoneyama, M. Katsumata, I. Matsui, and N. Sugimoto (2013), The occurrence of cirrus clouds associated with eastward propagating equatorial nâĂL'=âĂL'0 inertio-gravity and Kelvin waves in November 2011 during the CINDY2011/DYNAMO campaign, Journal of Geophysical Research, 118(23), 12941-12947, doi: 10.1002/2013JD019960.

Lines 166-: Regarding the docking connector, is there potential icing issue? If the answer is no, that's OK; there is a recent paper by Jorge et al. (2020) whose discussions,

I thought, might have some relevance.

Jorge, T., Brunamonti, S., Poltera, Y., Wienhold, F. G., Luo, B. P., Oelsner, P., Hanumanthu, S., Sing, B. B., Körner, S., Dirksen, R., Naja, M., Fadnavis, S., and Peter, T.: Understanding cryogenic frost point hygrometer measurements after contamination by mixed-phase clouds, Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2020-176, accepted, 2020.

Lines 177-: Does the Profiler have GPS position measurements? Or, the position information is taken by Zephyr? If the latter is true, please explain how to get the position information (in particular, the vertical position) at the measurement points. In Figures 5-8, in their captions, please specify which instrument is used to provide the vertical coordinate information.

Line 210: “to” should be “the”?

Lines 358-: In the near future, some close RS41 radiosonde sounding data at Singapore, at 1-second temporal resolution, may be available from the GRUAN data archive once the RS41 data product is certified (https://www.gruan.org/data/data-products). Also, again in the future, it would be interesting to make comparisons with GPS Radio Occultation temperature data.

Lines 382-: At the MLS 83 hPa level, we see that there is $\sim$0.5 ppmv difference on average between FLASH-B and MLS measurements, with MLS being lower. Are there any potential explanations for these differences? (Let me note that it seems that the results shown in the paper by Hurst et al. 2016 do not explain this.)

Hurst, D. F., Read, W. G., Vömel, H., Selkirk, H. B., Rosenlof, K. H., Davis, S. M., Hall, E. G., Jordan, A. F., and Oltmans, S. J.: Recent divergences in stratospheric water vapor measurements by frost point hygrometers and the Aura Microwave Limb Sounder, Atmos. Meas. Tech., 9, 4447–4457, https://doi.org/10.5194/amt-9-4447-2016, 2016.

Line 415: Is it really possible that cirrus cloud particles can exist above the cold-point



tropopause where the relative humidity is far less than 100% RHi (actually it is $\sim$50% RHi)?

Line 418: It may be actually surprising that the water vapor mixing ratio is low and constant at $\sim$3 ppmv between the cold-point tropopause and $\sim$1 km below. But, by looking at various profiles presented by Fujiwara et al. (2010), that might happen, although that may be rather rare.

Figure 1: Please explain (either in the caption or on the figure) which is Euros, which is Zephyr with the winch, and which is the Profiler with sensors. I happened to find the following presentation, and I found that the left-hand-side figure at Slide 4 was useful for me to understand the system: https://sites.google.com/umn.edu/2019-scientific-ballooning-tec/program (“Reeldown Instrument System Design for Atmospheric Profiling on Long-Duration Super Pressure Balloon Platforms” by St. Clair).

Figure 2: Could you add the explanation about how the line goes from (b)-(c) through (e) to (f)?

Figure 6: Is the vertical axis for radiosonde data geopotential height? Is the vertical axis for RACHuTS data also geopotential height (e.g., that has been converted from GPS geometric height)?

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