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Atmospheric Measurement Techniques Discussions

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Interactive comment on "Intercomparison of in situ water vapor balloon-borne measurements from Pico-SDLA H₂O and FLASH-B in the tropical UTLS" *by* M. Ghysels et al.

M. Ghysels et al.

melanie.ghysels@nist.gov

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The authors wish to thank the anonymous referee 2 for his helpful comments. Below are our responses to the reviewer 2.

Specific comments:

General: Like suggested, we organized chronologically the sections 4.2 and 4.3. The section 4.2 becomes March 13, 2012 and the section 4.3 becomes February 10-11, 2013.

P 13698, l 22: Like we responded to the referee 3,onboard Pico-SDLA, we use a DFB

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laser diode having temperature and current control which are the two options to scan the water vapor line. However, the temperature tuning is much slower than a current modulation. Then, we prefer to modulate the current to scan the water vapor line and keep the temperature fixed. Then, you are right, we distinguish current tuning and TEC temperature tuning. In the text, we slightly modified the paragraph as: “This diode has temperature and current controls: then, we distinguish the current modulation from the TEC temperature tuning. The current modulation of the laser is the preferred method to scan the water vapor absorption line since the response time is much faster than for a TEC temperature modulation: the water vapor absorption line is scanned by tuning the laser current and fixing the TEC temperature.”

p 13700, l 23: The model of the Honeywell is a PPT0020AWN2VA Pressure transducer. We added this information in the text.

P 13708, l10: Thank you for this suggestion which has been taken into account.

P 13708, l 14: Thank you, we omitted to remove the part above 23 km. The figure has been updated and is now Fig. 6 (instead of Fig. 4 previously).

P 13708, l 25: About the “especially for water vapor” part, we removed this part to avoid redundancy. Like suggested, we restricted the CPT role description as following: “The CPT of each instrument is determined from the descent temperature profiles. This altitude corresponds to the level of the minimum temperature and has an important role in the troposphere-to-stratosphere coupling and exchange. The water vapor transport from the troposphere to the stratosphere is partially dependent on the thermal characteristics of the CPT (Holton et al, 1995, Mote et al, 1996, Kim and Son, 2012, Randel and Jensen, 2013). “ Now, since we reversed the Feb. 10 and March 13 sections, this sentence is in the March 13 section instead of the February 10.

p 13709, l 8: For this particular structure at 16.5 km that we see during the ascent of FLASH and the descent of Pico-SDLA, the pressure from Pico-SDLA and FLASH-B are the same or 100.8 hPa. Overall, it exist some differences if we compare the

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pressure vs altitude between Pico-SDLA and FLASH. These differences are of 1 hPa or less which is of the same order as the differences pointed out by the 8th WMO campaign. About the CPT altitudes different from Pico-SDLA and FLASH: the reviewer 1 pointed out this point too. To us this point is mostly related to 3 different factors: 1) The two sensors have flown 3 hrs aparts following slightly different trajectories: it is possible that small temporal temperature changes had occurred. 2) The determination of the CPT altitude also strongly depends on temperature and altitude measurements uncertainties and 3) on how the temperature structures are resolved. In both cases, we see that the CPT is not very well pronounced which makes its determination difficult. We notice, however, that the CPT altitudes are compatible and the temperature profiles structures are similar. Then, in the text, we added few sentences (section 4.3): "In the case of Pico-SDLA, the CPT is 16.63 km (P = 99.9 hPa, T = -74.15 °C) and for FLASH it is 16.98 km (P = 92.2 hPa, T = -75.2 °C). The difference between the CPT altitudes from Pico-SDLA and FLASH observed for the two flights can be attributed to three different factors: a natural temporal and spatial temperature variability in the TTL, the measurements uncertainties and how the temperature structures are resolved: for both flights the CPT is not well pronounced which makes its determination difficult. However, even though both CPT values are different by ∼300 m, the overall temperature profile is similar and the CPT altitudes are compatibles."

P 13709, l 11: Done.

P 13709, l 12: Thank you, this mistake has been pointed out by the other reviewers too. Therefore, we corrected the text as: “During the descent, the structure at 17.2 km was captured by FLASH-B shifted upward by 50 m. The ascent profile of FLASH-B also shows the structure at the same altitude but the noise amplitude is larger rendering the structure much harder to distinguish.”

P13710, L12: We removed this sentence to avoid any confusion. The outgassing becomes an issue at 70 hPa only during the ascent. Nevertheless, since it could be a source of confusion, we modified the sentence section 2 as: " The contamination effect is observed as a quasi-exponential growth of water vapour readings above about 70 hPa level during the ascent. "

P 13712, l 1: Thank you, we refer to a poster giving the trajectory analysis details: (Khaykin et al, 2013b) S., M. Khaykin, J., -P. Pommereau, E., Riviere, M., Ghysels, N., Amarouche, F., Ploegner, J., -P. Vernier, F., G. Wienhold, G., Held: Vertical and horizontal transport of water vapour and aerosol in the tropical stratosphere from high-resolution balloon-borne observations, Poster session presented at the EGU general assembly 2013, 7-12 April 2013, Vienna, Austria, EGU2013-4813.

P 13712, l 11: To the best of our knowledge, the slope of the fitting equation does not represent the correlation coefficient which comes from the R^2: the Pearson's r coefficient for each flight has been discussed previously. To us, this coefficient was the most important. The instrumental bias (b) is the mean of the difference between both sensor measurements expressed as:

$$b = \sum_{i=1}^{n} \frac{mix.ratio(P - SDLA)_i - mix.ratio(FLASH)_i}{n} \quad (1)$$

This value changes from one flight to another so we concluded that there was no systematic bias. On February 10-11, 2013, the bias has been calculated to +0.12 ppmv and on March 13, 2012, it has been estimated to be -0.06 ppmv. To the best of our knowledge, this information was not accessible using the fitting equations, it is the reason why we did not include the equations initially. Since the reviewer suggested that the reader could be interested in the equations, we nevertheless added the fit equations in Fig. 7. Therefore, in the text, we added few sentences:

"A linear fit of the Pico-SDLA versus FLASH data is shown as a solid line and the equations of the fits are given. The bias (b) has been calculated using the following

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equation:

$$b = \sum_{i=1}^{n} \frac{mix.ratio(P-SDLA)_i - mix.ratio(FLASH)_i}{n} \quad (2)$$

Here n represents the number of measurements. For these two flights, between the CPT to the maximum altitude usable, the maximum bias visible is of 0.12 ppmv (February 10-11, 2013 flight). For the March 13, 2012 flight, this bias is of -0.06 ppmv. Both bias are of the same amplitude of those in (Weinstock et al, 2009), obtained from coincident flights. Since the bias varies from one flight to the other, no systematic bias has been demonstrated between Pico-SDLA and FLASH."

P 13713, l 23: Done, we added the absolute values.

Figure 4/6: The temperature variability can be surprising. Then, the two sensors have flown 3 hrs aparts following slightly different trajectories: it is conceivable that small temporal temperature changes had occurred. Then, the temperature and altitude measurements error have most probably played a role. Since these two flights occurred during nighttime, we agree that a solar heating is probably not the source of these differences.

The figures 3, 5 and 7 have been updated.

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 13693, 2015.

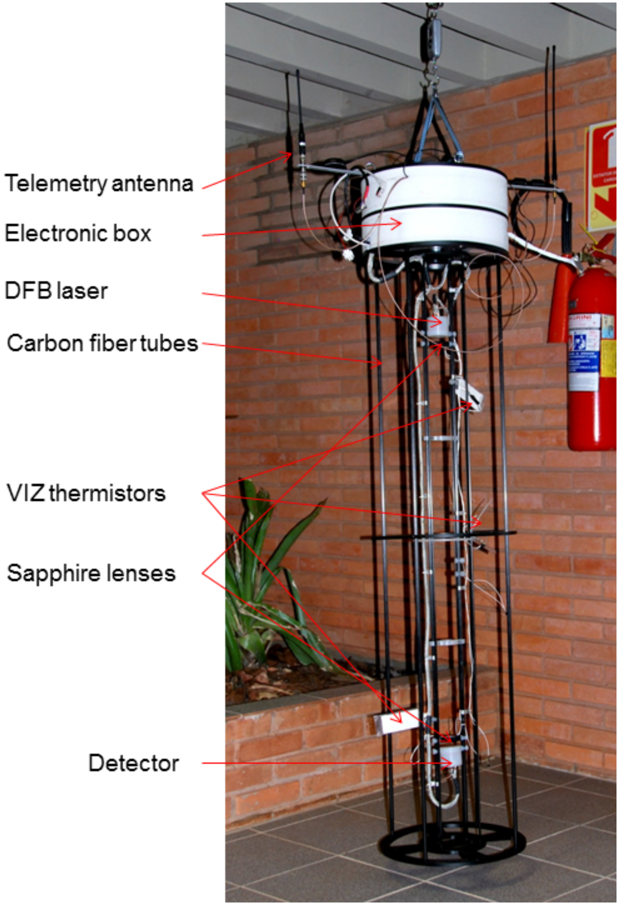

Fig. 1.

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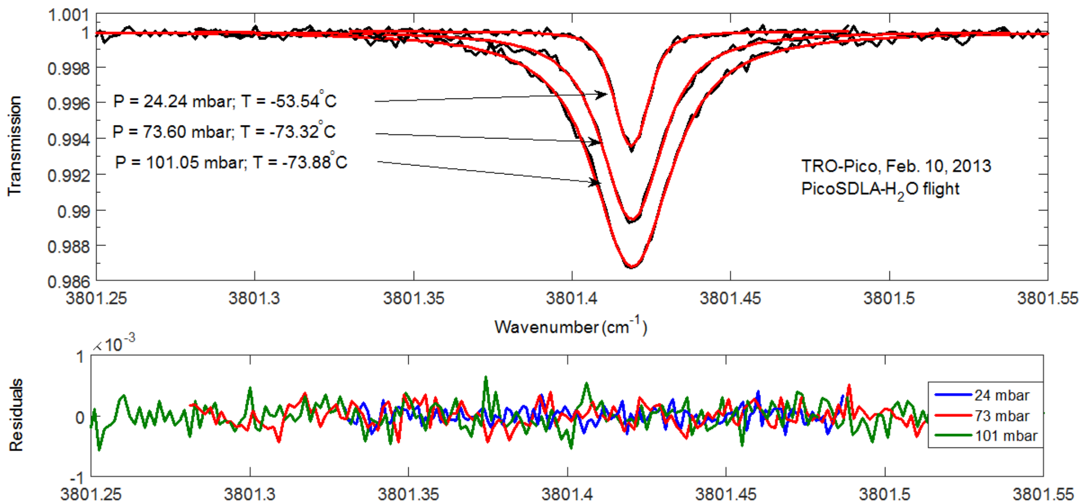

Fig. 2.

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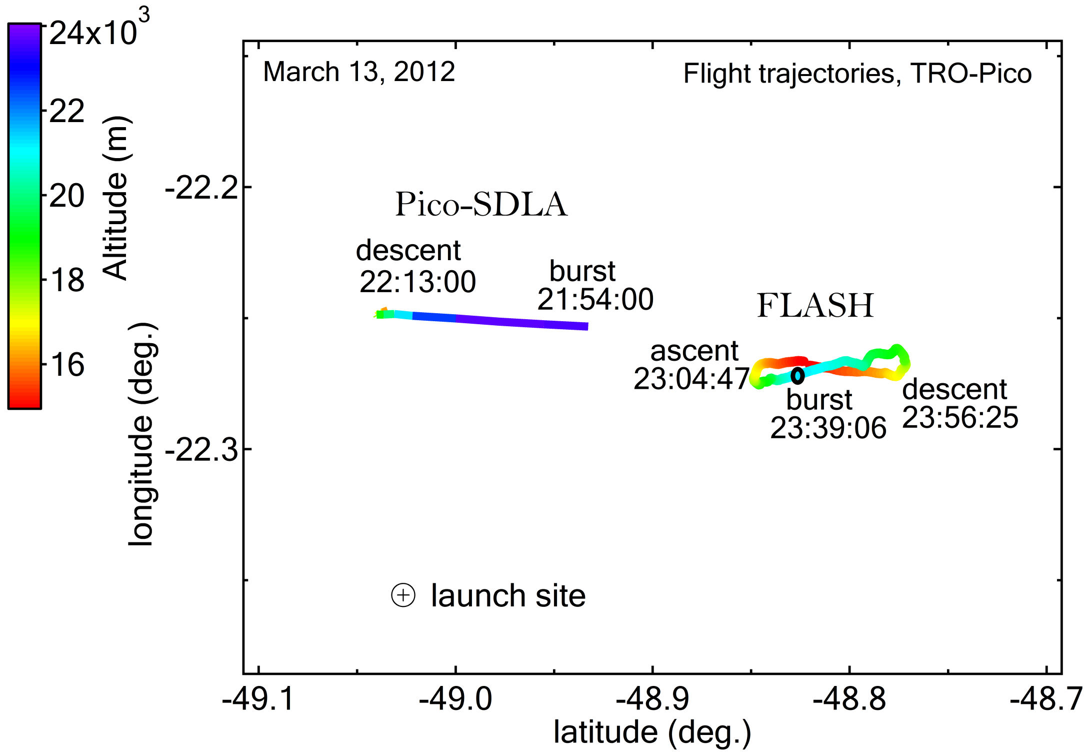

Fig. 3.

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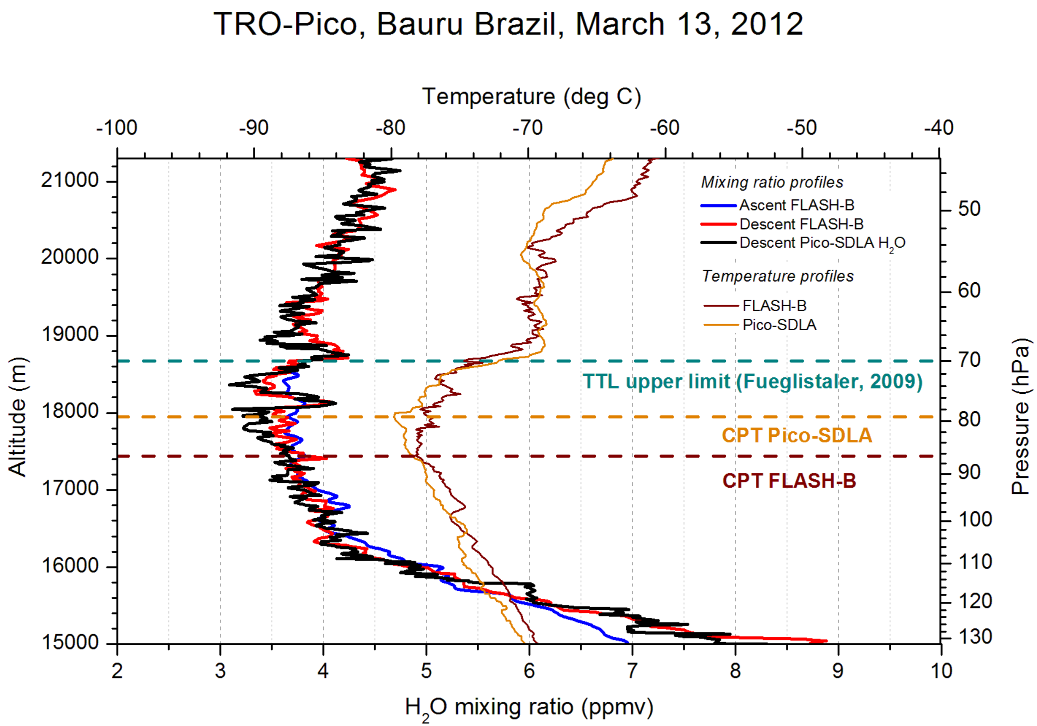

Fig. 4.

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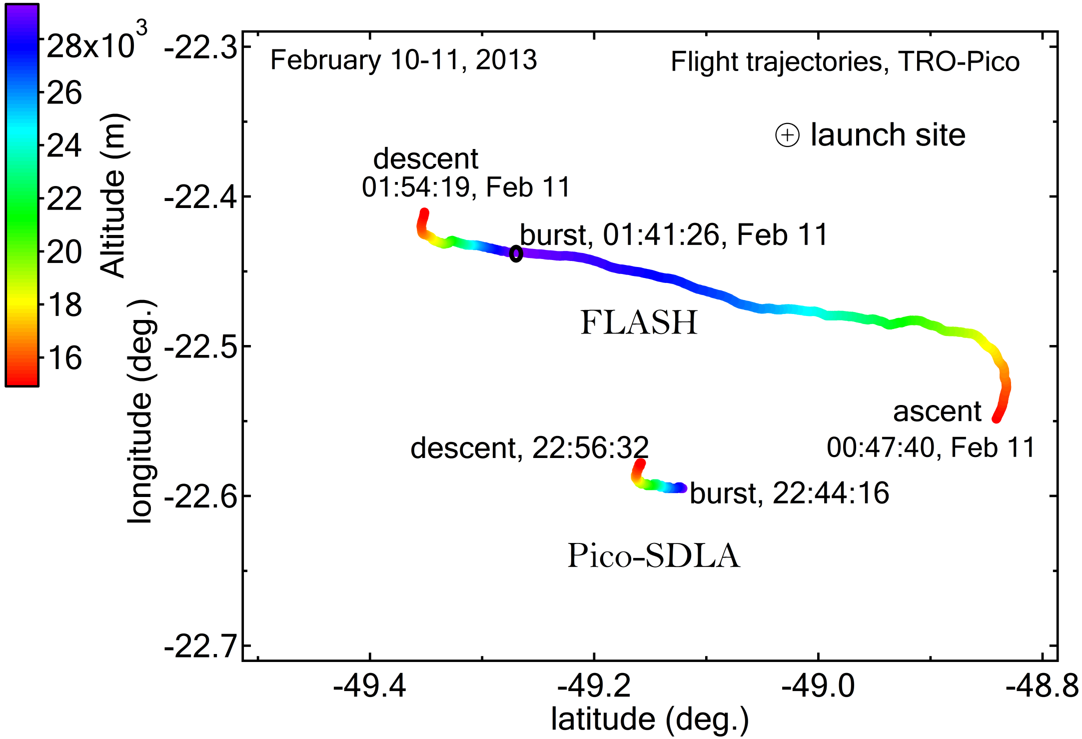

Fig. 5.

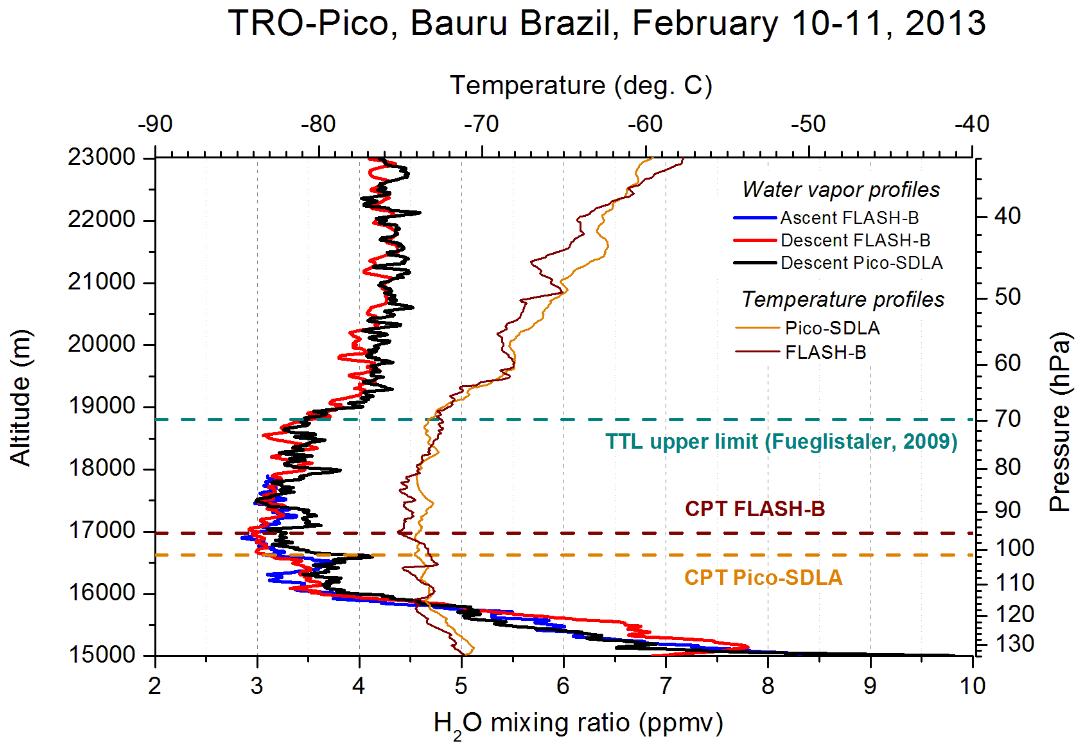

Fig. 6.

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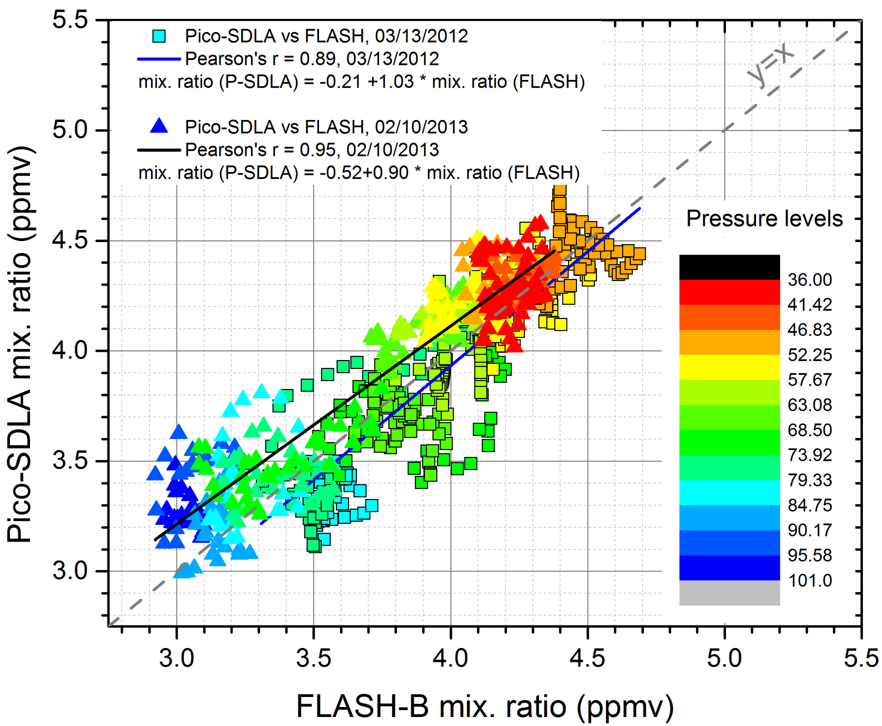

Fig. 7.

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