Review for paper „ Observations of water vapor within a mid-tropospheric smoke plume using ground-based microwave radiometry"

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submitted to Atmospheric Measurement Techniques

General vote: Major revision

General comments:

The manuscript presents measurements from a microwave radiometer in the vicinity of forest fires in order to detect water vapor increases due to combustion reactions. The approach is interesting, however the number of cases and the lack of a statistical analysis makes the hypothesis that signals in the measurements are related to the smoke plume fairly vague.

I consider the paper to be published only after some major changes, such as:

- Checking whether the increase in water vapor on the case study days is significantly higher than on other days. A good way for that would be also checking the diurnal variation of PWV and WV profiles or typical diurnal cycles of water vapor and compare smoke-free with smoke days.

- Using backward trajectories to verify if the airmass considered stems in fact from the smoke region. This would also allow to answer the speculation of the smoke plume height for 2 of 3 case studies. You could use HYSPLIT for that.

- State more clearly that the vertical resolution of water vapor profiles by microwave radiometers is very coarse and that only 2 independent layers can be derived over the whole profile. Especially inversions in mid and high troposphere cannot be determined by MWR. Using the integrated water vapor might give more robust results, as the PWV retrieval has much less uncertainties than WV profiles retrieved from MWR.

- What did you do in case of rainy periods? Did you filter out these data? The measurements are not meaningful at all during rain due to scattering by (large) raindrops. Please mention that in section 2 or 3. See also Figure 1 for that!

- Consider to reduce the amount of figures, as some information is redundant.

Specific comments, Technical corrections:

- page 2, line 10: What causes the differences between 0.05 and 3 g kg^{-1} ? Please specify what causes this differences!

- page 2, line 22: What is “small percentage”? Do you have a number for that? Check if there is a number in the reference paper!

- page 3, line 9: The effective resolution is much coarser. There are only 2 independent vertical layers which can be detected. For more details check e.g. Caddedu, 2013 or Löhnert and Maier, 2012 or Güldner and Spänkuch, 2001. Note that the weighting functions for WV profiles do strongly overlap. Please state the uncertainty level for the profiles!

- page 3, line 12-13: “integrated precipitable water vapor profiles” > this expression is nonsense.
  For the integrated value write either “integrated water vapor” or “precipitable water”. “water vapor profiles” would correspond to vertically resolved retrievals.

- page 3, line 16: Please keep in mind that the vertical resolution is very coarse and that only 2 independent layers can be detected. The vertical information comes only due to the pressure broadening of the water vapor line, this signal is relatively small. Water vapor profiles from MWR are generally unable to capture inversions.

- page 3, line 18: write “brightness temperature” instead of “blackbody temperature”

- page 4, line 30: reference for CALIPSO! e.g. Winker et al., 2010 or Omar et al., 2009 for products

- page 5, line 16-18 / Figure 7: Did you look into the aerosol classification product from CALIPSO? This is also available online!

- page 5, line 19: SD means South Dakota?

- page 5, line 22: better “approximately 1830”. 1831 is too specific to be approximately…

- page 6, line 9: is that result significant? 7 % less water vapor with an uncertainty which is in my knowledge much higher than that

- page 6, line 28: what is the increase in PWV (integrated water vapor)? is there any large scale water vapor transport? check trajectories and weather charts for that!

- page 7, line 29: how do you know background levels? the increase of 250 % might also be caused by synoptic scale water vapor advection

- page 8, lines 20-23: for that, a thorough check of trajectories could give an answer

- page 8, line 25: MWR water vapor profiles are not really a “novel technique”, it’s just the first time to derive changes in

Comments to figures:

- Figure 1: What are the outliers on 8/9 and 8/13? Are the data filtered for rain?

- Figures 2, 3, and 4 could be put into one plot (maybe with subplots).
- Fig. 7: mention figure reference (CALIPSO website)
- In my opinion, it would be enough to show either 1 line per km (3,4,5,6 km) or PWV in the time series plots (Fig. 10, 13, 16). There is no additional information in the other lines!
- Fig. 11 does not show so much – you could skip that since you have Fig. 12 for the same day