

Interactive comment on “Tropospheric water vapour above Switzerland over the last 12 years” by J. Morland et al.

Anonymous Referee #2

Received and published: 3 April 2009

GENERAL COMMENTS

- The paper carefully analyses long-term observations of Integrated Water Vapour (IWV) obtained by ground-based microwave radiometry and puts them into relation with other sources of IWV climatologies (radiosondes, GPS, sun photometer, model analysis). The instrument specific problems are clearly described and the reader gets a good feeling for the difficulties involved to derive proper trends in water vapour. Since the number of sites continuously operating microwave radiometers and/or GPS is increasing the paper can be an important basis for future studies.

- The paper presents interesting results on the diurnal IWV cycle (and GPS problems in that), biases induced by instrument limitations and differences in IWV trends for

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

night/day and winter/summer. There are many interesting details which can distract the reader from the "larger picture". In this respect I encourage the authors to add a last paragraph to the conclusions relating their significant trends (and uncertainty - both preferable in %/decade) to literature results.

- I am rather puzzled by the slightly negative August IWV trend between the two significantly positive trends of July and September. The suggestion that this is due to surface drying does not sound too plausible for Switzerland - especially as September has a strong positive trend. In order to better understand this it could be helpful to look at the precipitation climatology. GPS might be used to check if this is a sampling problem.

- I am a bit surprised that the authors use the standard ECMWF analysis output and not a reanalysis product which should show higher consistency.

SPECIFIC COMMENTS

- An interesting aspect of the paper is the effect of bias introduced by the limitation of observing systems such as precipitating/non-precipitating (? %) and clear/cloudy (12 to 24 %). The results on this should also be mentioned in the abstract.

- The Introduction makes the point that microwave radiometer observations provide accurate water vapour observations. Therefore as a reader I would expect that section "2. Data Sources" provides error an assessment for each instrument. For example the cited GPS accuracy of 0.7 mm (page 7244, line 22) should be mentioned here. I know that such a one number error statement cannot be easily made for each instrument but for the reader it is always helpful to get more information on that. For example it might be worth to mention that noise is not the problem for the microwave method.

- Did you take into account the 85 m height difference between Payerne and Bern which can lead to about 0.5 mm systematic difference? It is mentioned in the caption of Fig. 2 & 3 but has it been applied everywhere?

- The introduction of the different periods (P1- P4) is a bit confusing since the periods

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

are already named in the beginning (page 7245, 1st line) and the explanation about their definition comes much later. A simple cure could be to just write "...evident from April 1995 to August 2000 (later defined as P1B)...". Why is Period 1 divided into A and B? I strongly suggest to create a table which provides period, start and end date, problem and correction. This would nicely summarize Section 3 and improve readability strongly.

- Page 7245, Line 28: Give a motivation why the weather stations and not the radiosondes were used for the homogenisation: continuity, consistency?

- Actually I find equations 1 and 2 not necessary as they are just linear corrections. The resulting bias values are of course important (something for the table). I am a bit puzzled why period 1b is treated before 1a?

- Page 7250, Line 10: Does this mean that in contrast to Fig. 2 here TROWARA is only from 2000 on? Why didn't you filter the GPS data according to non-precipitating conditions?

- Page 7253, Line 21: The phrase "around 2% annual IWV" is not straightforward. The diurnal amplitude is around 0.6 mm corresponding to 4% of the mean IWV of 14.4 mm... Ok, now I understand it is +/- 2%... Please write it simpler.

- Page 7255, line 9: Much simpler than dew measurements is the comparison it with water vapour flux observations from flux stations. However, evaporation/condensation is a rather local process with strong horizontal inhomogeneity while IWV is an integrated quantity. I suggest to eliminate this sentence and instead suggest to mention a possible separation of the diurnal cycle into seasons etc.

- Why do you stop the integration of the radiosonde at 200 hPa while TROWARA measures the full column? If the reason is the poor quality of RS humidity estimates then it might be better to assume a climatological value (3-5 ppm) above the tropopause. Anyhow the reason needs to be mentioned.

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

- The results of Fig. 6 might be better suited for presentation in a Table since in principal the different values shouldn't be connected by lines. Further it would be easier to compare the different values of the trend mentioned in the text - but this is more or less a question of taste.

- Page 7258, line 8. This is one of a few passages where the authors could make it easier for the reader to immediately get the message by saying: "The absolute values are larger than the LSA trends calculated for the full year because of compensating trends in winter and summer."

TECHNICAL CORRECTIONS 1) SPM is not explained in the abstract

2) Page 7242, line 17 say how on which instrument and threshold the decision on rain occurrence is made.

3) Page 7246, Line 18: It is not only true for a weather station but for all instruments brought to a different "climate". Therefore just say "..removal of the instrument to a different site."

4) Page 7251, Line 22: "..frequency of between.." remove OF

5) Page 7252, line 50: If you give such statements please give the supporting figure, e.g. (Fig. 2)

6) Fig. 1: Explain abbreviations MNT and SNHT in caption. You could also make vertical lines to distinguish the different periods.

7) Fig. 3. The Pdf is already rather noisy at least for the SPM. Maybe you should use larger IWV bins? Please provide the number of total observations for each instrument used here.

8) Fig. 4. It would be helpful to provide the shift values for sonde, ECMWF and GPS.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 7239, 2009.