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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Upper-tropospheric humidity changes under constant relative humidity" *by* K. Gierens and K. Eleftheratos

**Anonymous Referee #3**

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I find the paper very interesting and useful for future discussions of UTH trends. My comments and questions are listed below.

1. p29500, where UTH is introduced: Please make it clearer already here that UTH is a radiance based quantity. This does become clearer later on, but not clear enough in my view.

2. p29501ff, a very general question: Should not the temperature lapse rate also be somehow part of your analysis? As a thought experiment, if the atmosphere were isothermal, Rh would not make any difference to observed radiance. I think this is why a downlooking instrument has no sensitivity to humidity around the tropopause. I think that a changing temperature lapse rate under constant relative humidity would also give a UTH signal. (Additionally, it would also change the water vapor scale height, but in a



different way compared to the constant temperature offsets that you have investigated.)

3. Figure 2: I'm puzzled by the "spikes" in the right plot, where peak altitude jumps by several hundred meters. Especially given that the left plot shows that the initial peak altitude there is quite ordinary. I think it would be good to better understand this behaviour, is it real or some numerical artefact?

4. p29508, my main scientific comment: You treat the weighing function and the RH profile as quantities that can be changed independently. (You take a "standard" weighting function and apply it to all RH profiles, then you do the same for a modified weighting function.) However, in reality the weighting function for the actual radiance measurement will be a function of the RH and temperature profile. For each radiosonde measurement, there is exactly one corresponding weighting function that determines the radiance that reaches the satellite.

RH changes imply weighting function changes, that is basically also your starting argument for the article. (Due to the implied lapse-rate and peak altitude changes.) I am unsure if treating the two as separable items really captures the essence of what the real radiance based UTH will do. I would be happy to let myself be convinced on this point, but I think you need some additional arguments to justify the approach taken.

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Interactive comment on Atmos. Chem. Phys. Discuss., 15, 29497, 2015.