

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

## **Anonymous Referee #2**

Received and published: 2 December 2015

### General Comments:

This manuscript examines the relationship between upper tropospheric humidity (UTH), as defined by weighted mean over a relative humidity profile in the upper troposphere, and relative humidity for the condition that relative humidity remains constant and temperature increases. This condition has been observed and predicted in observations and models, so the question presented here is whether UTH can vary for those conditions. The results presented here indicate a small decrease in UTH (-0.2%) but generally not more than 1% as determined from a set of radiosonde data from Lindenberg. Therefore, changes in the water vapor profile in warming environment which impact the vertical structure of water vapor seem to have minimal impact on UTH. A final comment notes that observational evidence of increasing UTH for a northern

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mid-latitude data set shown in a previous study suggests that relative humidity may be increasing as well in the upper troposphere.

The manuscript is well written. I could find no significant problems with the grammar, the organization, or the technical aspects of the paper. I believe the approach used to compute the changes in scale height and peak emission altitude are sound. The values used to determine the impacts on the kernel function are reasonable. The introduction provided a thorough background on water vapor's contribution global warming and appropriate references were used for this study.

One concern comes from the application of real profiles from one geographic location. While the 1564 radiosondes do sample profiles through one annual cycle at a mid-latitude location, this is a small sample of environmental conditions globally. Presumably the impacts on UTH sensitivity are less in the tropics and greater for polar conditions, but I think the application of changes to the kernel function to a more geographically diverse set of radiosondes would strengthen the argument that UTH remains invariant or at least show its sensitivity from tropical to polar conditions. The discussion in the last paragraph in section 3.2 acknowledges this issue and says it is beyond the scope of the paper to examine profiles from other locations. However, I don't think it is beyond the scope of this paper and application of the kernel function to set of diverse radiosondes such as the Thermodynamic Initial Guess Retrieval (TIGR) profiles (or similar set) would strengthen the paper.

The discussion regarding trends in UTHi from the previous HIRS data study (Gierens et al., 2014) should also note that temperature in the upper troposphere also increased for that latitude band which would then lead to the expectation that relative humidity increased (based on the arguments put forth in this paper). Observations of changing UTH in some regions on earth may not necessarily lead one to believe there is a corresponding relative humidity change without knowledge of the temperature trend.

Minor Corrections and Comments:

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Line 70: I would remove the word “therefore” and have the sentence read “. . .and that convection must be taken . . .”

Line 93: I would remove the word “there” and have the sentence read “. . . and exceed a factor of two . . .”

Line 185: I would substitute the word “correspondingly” to “allowed”

Line 352: I would remove the word “in” and have the sentence read “It is particularly noteworthy . . .”

Line 502: Remove word “thus” and have the sentence read “. . . we may conclude that . . .”

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

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