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Interactive Comment

Interactive comment on "Height of convective layer in planetary atmospheres with condensable and non-condensable greenhouse substances" *by* A. M. Makarieva et al.

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In this commentary we return to the comments of Referee No. 2 pertaining atmospheric water vapour.

In both first and second comments the referee questioned the validity of Clausius-Clapeyron equation for determination of the atmospheric water content, noting that surface temperature does not necessarily determine the atmospheric water content. The referee also noted that amospheric water content is highly variable and, for this reason, questioned the relationship (unambiguously derived from Clausius-Clapeyron equation):

$$\frac{p_L}{p_{sL}} \approx \left(\frac{p}{p_s}\right)^{\beta_s}, \tag{1}$$

between water vapour and atmospheric pressure.

In our previous responses we indicated that, as far as atmospheric water is not in hydrostatic equilibrium, but in dynamic equilibrium, its spatial distribution is highly variable, so that Eq. (1) is written for the **mean** values of the related variables, not for their variances.

Here we would like to present observational support for the validity of the Clausius-Clapeyron equation for the determination of atmospheric water content. Wentz and Schabel (2000) analysed the recently available satellite zonally-averaged data sets on atmospheric water content over large oceanic regions. They found **"a strong association between sea surface temperature, lower-atmospheric air temperature and total column water-vapour content"** on interannual and decadal time scale. They observed that calculating atmospheric water content with use of the Clausius-Clapeyron equation displays a very good agreement with observations, with calculations and observations indistinguishable withtin the accuracy of the experiment.

Furthermore, in accordance with our statement about the relevance of Clausius-Clapeyron relationship for the mean values of atmospheric water vapour content W, Wentz and Schabel (2000) noted that previous *regional* studies of atmospheric water content (Gaffen et al., 1992) "show a relatively weak W versus T_A [lower tropospheric air temperartue] correlation on interannual timescales." Wentz and Schabel (2000) attributed this weak correlation to "regional variability in atmospheric stratification and convection", which was also mentioned by Referee No. 2 in his first comment. However, as shown by the analysis of Wentz and Schabel (2000) and expected from physics, **"it appears that zonal averaging effectively cancels the regional variability"** (Wentz and Schabel, 2000) and produces a pronounced dependence between temperature and atmospheric water content, which is accurately described by Clausius-Clapeyron equation.

We conclude that the high spatial variability of atmospheric water vapour content does

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not in any way prohibit quantitative descriptions of its spatially averaged values and related quantities on the basis of well-established physical laws like the Clausius-Clapeyron equation.

References

Gaffen, D.-J., Elliott, W. P. and Robock, A.: Relationships between tropospheric water vapor and surface temperature as observed by radiosondes, Geophys. Res. Lett., 19/18, 1839–1842, 1992.

Wentz, F. J. and Schabel, M.: Precise climate monitoring using complementary satellite data sets, Nature, 403, 414–416, 2000.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 6701, 2003.

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