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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "A noniteratiave approach to modelling moist thermodynamics" *by* Nadya Moisseeva and Roland Stull

**Anonymous Referee #1**

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Review of 'A non-iterative approach to modelling moist thermodynamics' by Nadya Moisseeva and Roland Stull

The article presents an interpolation function to compute wet-bulb potential temperature as a function of pressure and temperature and its inverse, i.e. temperature as a function of pressure and wet-bulb potential temperature. The direct computation of wet-bulb potential temperature involves solving a nonlinear differential equation and therefore it can only be solved by iterative numerical methods. From this point of view, having a ready-made interpolant can be a valuable contribution within the scope of ACP for researchers and modellers. However, the manuscript can be improved by adding references and being more specific in the language used to present the mathematical description of the method. Perhaps more important is the definition of a set of 'true'



adiabats that serve as reference to develop the interpolant. How accurate is this 'truth' itself? I think this deserves further discussion. I elaborate on these recommendations in the comments below.

Specific comments

Table 1: How sensitive are the 'truth' adiabats to the values of the constants in Table 1? Also, what is the source of the constants' values? They do not always correspond to the values in e.g. Bolton (1980). Please, provide references.

P1L20: Include reference to Bolton (1980)

P2L21-L22: I don't see how normalizing the curves removes any inherent nonlinearity at all. Please explain further. Also give mathematical expressions for the operations you are doing here. I'm interpreting your division by a reference moist adiabat as $T(P, \theta_w)/T_{ref}(P)$, where $T_{ref}(P) = T(P, \theta_{ref})$ and $\theta_{ref} = -70°$C is a constant. Is this interpretation correct?

P2L24: What does 'the resulting transformed adiabats shift around the $\theta_{ref}$ unity line' mean? $\theta_{ref}$ is not unity and is not even close to it.

P2L27: In what sense are polynomials are well-behaved and why is this behaviour convenient?

P2L29: Chaotic behaviour is a property of dynamical systems and polynomials per se are not dynamical systems. So can you clarify what chaotic behaviour of high-degree polynomials are you referring to here? Please include references.

P3L7: Discuss further the results that you get with bi-exponential and arctan to explain what the accuracy is insufficient. How different is this accuracy to that achieved by your chosen method?

Section 4: The notation in very confusing. For instance, step 2 of Section 4.1, in which the computation of $T(P, \theta_w)$ is described, requires the computation of $\theta_{ref}(P)$.

However, $\theta_{ref}$ was assumed constant in Section 2.2!! I believe what you actually need to compute is $T_{ref}(P) = T(P, \theta_{ref})$, where $\theta_{ref}$ is a constant. A similar notation problem is present in Section 4.2.

Technical corrections

Title: It should read 'noniterative'

P1L20: It should read to 'To improve'

P2L17: It should say $\theta_w(P, T)$.

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