Review by Pascal Marquet of the revised paper "acp_2020_361"

entitled: *Reappraising the appropriate calculation of a common meteorological quantity: Potential Temperature.*

by Manuel Baumgartner, Ralf Weigel, Ulrich Achatz, Allan H. Harvey, and Peter Spichtinger.

1 General Comments / Recommendation

I still disagree with the use of too extreme and unrealistic values of C_p. Indeed, the values $C_p = 1010$ in the new cited papers Chang et al (2010) and Tiwary Williams (2019) are only indicative (it is a mere scale value for computing the LMO for the latter). The authors deliberately blacken the picture by retaining values that should obviously be discarded outside the relevant interval between 1003.5 and 1006.5 (namely 1005 ± 1.5).

Moreover, I am still not convinced by the possible applications in NWP and climate models of the quantity θ_{ref} defined by the authors. I wouldn't recommend them for our GCM and NWP models in any case. And section 7.1 is a bit caricatural, although interesting in fact, since it now only shows that one should not apply the usual and inaccurate formula (2) with θ_{ref}, namely $N^2 = (g/\theta_{ref})\,\partial\theta_{ref}/\partial z$, and thus simply apply formulations of DK82 or MG13.

However, I appreciate the consideration of the criticisms and comments made about the first version of the paper. **Accordingly, my opinion is that the revised version of the article deserves to be published.**

I would suggest one last modification, because on rereading the paper it seems to me that it is difficult on first reading (and even on subsequent readings) to know how θ_{ref} is calculated. I would suggest in between present Eqs. (23)-(24), and by possibly replacing some words in lines 386-395, to add:

$$F(\theta_{ref}) \;=\; \int_{\theta_{ref}}^{T} \frac{c_p^0(T')}{T'}\,dT' \;-\; R_a\,\ln\left(\frac{p}{p_0}\right) \;=\; 0$$

or even the more simple versions:

$$\int_{\theta_{ref}}^{T} \frac{c_p^0(T')}{T'}\,dT' \;-\; R_a\,\ln\left(\frac{p}{p_0}\right) \;=\; 0$$

or:

$$\int_{\theta_{ref}}^{T} \frac{c_p^0(T')}{T'}\,dT' \;=\; R_a\,\ln\left(\frac{p}{p_0}\right)$$