Comments on the paper "Dependence of the critical Richardson number on the temperature gradient in the mesosphere" by Michael N. Vlasov and Michael C. Kelley submitted for publication in ANGEO (2016JD025811)

In the paper authors described their simulations of dependence of the critical Richardson number on temperature gradient in the mesosphere.

I mainly concerned with the question: What is importance (or application) of this work?

From theoretical studies and laboratory experiments, the critical Richardson number (Ri_c) has been determined to be approximately, **but not precisely** equal to 0.25 [e.g., *Grachev et al.*, 2012, and references therein]. For example, *Haack et al.* [2014] observed large variation of energy dissipation rate for wide range of Ri-values, i.e. also for $Ri > 1$. In regions where Ri was > 1 and far beyond, turbulent layers have been detected. Thus, the increase of Ri_c from 0.25 to 0.38 found in this work is by no means crucial, especially if we take into account very limited altitude range (within mesosphere-lower thermosphere region) used by authors for simulations.

List of references contains only 14 items (with 2 from the same authors). That is, a proper overview of previous results regarding Ri_c is not present. Quick look in 50 years old overview articles [e.g., *Reiter and Lester*, 1967; *Obukhov*, 1971] reveals that different values of Ri_c with different approaches were obtained, which is not mentioned in this manuscript. In the manuscript authors refer to papers of *Miles* and *Howard* from 1961 (i.e., 57 years back). Does it mean, that in the last half century nobody considered this problem? Also some reference to the statement "*However, the eddy turbulence peak is observed in the mesosphere or the lower thermosphere where the large negative and positive gradients of the temperature occur.*" (lines 47-49) is needed.

Authors concluded, that *Ri_c value depends on the temperature gradient. The Ri_c value increases with the negative mesospheric temperature gradient increase.* (for example, lines 226-227). These statements were supported by different figures that only show an altitude range above 90 km where temperature gradient is already positive. This is confusing. Is it possible to use altitude range below mesopause for simultions?

References

Grachev, A., E. L Andreas, C. Fairall, P. Guest, and O. Persson, The critical richardson number and limits of applicability of local similarity theory in the stable boundary layer, *147*, 2012.

Haack, A., M. Gerding, and F.-J. Lübken, Characteristics of stratospheric turbulent layers measured by LITOS and their relation to the Richardson number, *J. Geophys. Res.*, pp. 10,605–10,618, doi:10.1002/2013JD021008, 2014.

Obukhov, A. M., Turbulence in an atmosphere with a non-uniform temperature, *Boundary-Layer Meteorology*, *2*, 7–29, doi:10.1007/BF00718085, 1971.

Reiter, E. R., and P. F. Lester, The Dependence of Richardson Number on Scale Length, *Colorado State University, Atmospheric Science*, *111*, 39, 1967.