Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-1040-RC2, 2019

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Climatology of the mesopause density using a global distribution of meteor radars" *by* Wen Yi et al.

Anonymous Referee #2

Received and published: 28 January 2019

GENERAL COMMENTS

The mesosphere and lower thermosphere (MLT) is the boundary between the middle atmosphere and the upper atmosphere. Physical processes in the MLT determine the fluxes of waves and tides that propagate into the thermosphere and so act to influence the coupling of these atmospheric regions. There is thus a need for measurements able to characterise the properties of the MLT. Measurements of winds and temperatures in the MLT have been made for many years by radars, lidars and satellites. However, it is very difficult to measure densities at these heights and such measurements are particularly valuable.

This paper presents observations of MLT densities made by combining radar measurements of ambipolar diffusion coefficient with satellite measurements of temperature. A

total of nine radars are used, giving coverage over all latitudinal regimes apart from mid-latitudes in the SH.

The key results of the paper are determinations of the seasonal cycle in MLT density over the different radars, which also reveals interesting inter-hemispheric differences and suggestions of MLT perturbations associated with the MJO. Comparisons are made with models which highlight deficiencies in the models.

The paper is exceptionally well written and was a pleasure to read. The analysis is persuasive and is presented in a logical manner. The figures are appropriate, easy to understand and nicely produced. The references are adequate and up to date. The abstract is clear and accessible.

Overall, this is scientific work of a high standard which presents interesting and significant results. It merits publication in ACP subject to a few minor clarifications as detailed below.

SPECIFIC COMMENTS

1. The authors determine ambipolar diffusion coefficient at each height from the radar data. Is there any sorting of data by elevation angle? Meteors recorded at low elevation angle will be at long ranges and so even a small error in elevation angle may thus correspond to a significant error in height. Conversely, errors in elevation angle will produce smaller errors in height near the zenith. The authors should explain if they used any sorting and comment on this possibility.

2. The authors use MLS temperatures in combination with the ambipolar diffusion to estimate density. However, at these heights the vertical resolution of MLS is poor, e.g., at z = 81 km the vertical resolution is $\sim$ 14 km. Given that the atmosphere at these height can have sharp temperature gradients associated with the mesospause, how does this impact the analysis? Is this not a major source of uncertainty in the determination of density given that the actual atmospheric temperature at a particular

height may be rather different from the one derived from MLS measurements of low resolution?

TECHNICAL CORRECTIONS

1. Please check all references are present – e.g., Dowdy et al. (2001) is mentioned on p3 but missing from the references.

2. The manuscript refers to “densities”, but the measurements are actually “relative densities”. This should be corrected throughout to avoid confusion.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-1040, 2018.