Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-290-RC2, 2018

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Climatology of mesopause region nocturnal temperature, zonal wind, and sodium density observed by sodium lidar over Hefei, China (32° N, 117° E)" *by* Tao Li et al.

Anonymous Referee #1

Received and published: 8 May 2018

"Climatology of mesopause region nocturnal temperature, zonal wind, and sodium density observed by sodium lidar over Hefei, China (32°âĂŃN, 117°âĂŃE)" by Li et al.

General comments;

This paper presents a new multi-year set of sodium wind-temperature lidar observations of the mesopause region from Heifei, China (32°N, 117°E). These observations over six years have yielded 237 nights (∼2200 hours) of mesospheric sodium, temperature, and zonal wind measurements that support the investigation of chemistry and

dynamics on time scales of hours over the night and months over the year. The observations are also compared with a contemporary coupled chemistry climate model and show reasonable agreement. The lidar system is a state-of-the-art wind-temperature system and the data set represents a significant experimental and observational effort.

Specific Comments;

The seasonal and tidal dynamics presented in the paper is in reasonable agreement with other mid-latiude studies. The paper presents yearly plots of monthly mean temperature, zonal wind and sodium density. The paper highlights the presence of the tropical mesospheric semi-annual oscillation where the temperature is in quadrature with the zonal winds. The paper presents nightly composite plots of hourly temperature, zonal wind and sodium density for each season. The paper highlights the presence of semidiurnal and diurnal tides in the winds and temperatures based on visual inspection of the composites. The tidal signatures are more pronounced in the zonal wind than the temperature. The diurnal tide appears to dominate at the equinoxes, while the semidiurnal tide dominates in winter. There is no clear tidal signature present in the summer composite. The authors note that these observations are consistent with meteor radar observations at Wuhan and sodium wind-temperature lidar observations Fort Collins. The authors may wish to compare their observations with those from Adelaide, Australia (35°S, 138°E).

The paper presents the correlation of sodium density and temperature perturbations. What was the time resolution of the data used in the correlation? The presence of a positive correlation below 95 km and a negative correlation above 95 km has been shown in steady state analysis of the chemistry of the sodium layer [e.g., Collins and Smith, JASTP, 2004]. The question of the time-scale of the correlations is important in assessing vertical fluxes in sodium density that are used to quantify meteoric input into the atmosphere [e.g., Gardner et al., JGR, 2014] and turbulent eddy fluxes in the mesosphere [e.g., Guo et al., GRL, 2017]. The authors might examine the correlation in different seasons and shed further light on the chemical dynamics that underlie the

correlation.

The paper presents momentum fluxes based on the coplanar beam technique [Vincent and Reid, JAS, 1984]. Again the authors show consistency with other mid-latitude observations showing an eastward flux in summer and a clearer westward flux in winter. The fluxes include fluctuations with periods from 10 min to 16 h. Studies have shown the that waves with high intrinsic frequencies are most effective at transporting momentum in the middle atmosphere [Fritts and Vincent, JAS, 1987]. The authors might consider calculating the fluxes by band-limiting the data to the higher frequencies (e.g., 10 min-4 h) and seeing if these periods dominate the fluxes. The seasonality of the fluxes might also be examined in terms of the semi-annual oscillation.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-290, 2018.