Measurement of neutral mesopause density at low latitudes using the Kunming meteor radar

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Abstract: In this study, the neutral atmosphere density at low latitudes in the mesopause region from April 2011 and December 2014 was derived by using data from the Kunming meteor radar in China (25.6°N, 103.8°E). The daily density near 90 km was estimated using the ambipolar diffusion coefficient and the temperature gradient method temperature, both of which were simultaneously measured from the Kunming meteor radar. The Kunming meteor radar density is consistent with the Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) density, and the mean values of the meteor radar and SABER density are 2.87×10^{-6} kg/m^3 and 2.88×10^{-6} kg/m^3, respectively. The annual variations of the Kunming meteor radar and SABER density mainly show an annual variation with a maximum during winter and a minimum during summer. The Mass Spectrometer and Incoherent Scatter (MSIS) model density shows similar annual variations with the Kunming meteor radar and SABER density but is approximately 20% larger than these measurements. In addition, we used a simple linear model to separate the effects of the neutral atmosphere density and meteor velocity on meteor peak height and found that a 1 km/s difference of the vertical meteor velocity yields a change of approximately 0.4 km in peak height. Moreover, the strong linear correlation between the Kunming meteor radar density and peak height after meteor velocity effects indicated that the Kunming meteor radar density can accurately reflect the neutral atmosphere density change; it also suggests that the peak height after meteor velocity effects are removed can serve as a readily available tool for measuring the variations of neutral atmosphere density in the mesopause region.