

Impact of the lower thermospheric winter-to-summer residual circulation on thermospheric composition

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Gravity wave forcing near the mesopause drives a summer-to-winter residual circulation in the mesosphere and a reversed, lower thermospheric winter-to-summer residual circulation. We conducted modeling studies to investigate how this lower thermospheric residual circulation impact thermospheric composition (O/N_2). We found that the upwelling associated with the residual circulation significantly decreases O/N_2 in winter and the downwelling in summer slightly increases O/N_2 . Consequently, the residual circulation reduces the summer-to-winter latitudinal gradient of O/N_2 , which causes the simulated latitudinal gradient of O/N_2 to be more consistent with observations. The smaller summer-to-winter latitudinal gradient of O/N_2 would decrease the ionosphere winter anomaly in model simulations, which would bring the simulated winter anomaly into better agreement with ionospheric observations. The lower thermospheric residual circulation may be a process that has been largely ignored but is very important to the summer-to-winter latitudinal gradients, as well as annual/semiannual variations in the thermosphere and ionosphere.

Keywords: Thermosphere Circulation, Thermosphere Composition, Ionosphere Winter Anomaly