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The daytime thermospheric mass density minimum near the equator: A model study using the Upper Atmosphere Model (UAM)

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Global distribution of the thermospheric total mass density derived from the CHAMP satellite at 400 km altitude shows maxima at about 20–25 deg geomagnetic latitude on both sides of the equator between 10 and 20 magnetic local time whereas the MSISE90 model misses these peaks. The theoretical Upper Atmosphere Model (UAM) predicts for a selected interval in the second half of April 2002 the global thermospheric total mass density distribution similar to that obtained by CHAMP with the daytime density minimum near the equator. However, the density peaks are located at middle latitudes being larger in the Northern hemisphere under geomagnetically quiet conditions and in the Southern hemisphere under geomagnetically disturbed conditions. The last feature also agrees with the CHAMP results. We investigated the role of the low and high latitude electric fields and magnetospheric electron precipitations for the formation of the equatorial density minimum by successive switching off the low and high latitude electric fields and the magnetospheric electron precipitations within the UAM calculations. We found that the neutral density distribution did not change principally after switching off the electric fields at magnetic latitudes below 30 degrees whereas the equatorial anomaly of the electron density disappeared. Therefore, the equatorial neutral density minimum is apparently not related to the equatorial anomaly. Another pattern takes place after switching off the high latitude electric fields and magnetospheric electron precipitations: the equatorial neutral density minimum disappeared and only one daytime density maximum persists, being displaced into the Northern hemisphere. We conclude that the high latitude magnetospheric heating is the likely reason of the daytime thermospheric density minimum near the equator.

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