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The Lunar Semidiurnal Tide in the Thermosphere

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Renewed interest in lunar tidal influences on the ionosphere-thermosphere (IT) system has emerged in connection with Fejer's discovery of a possible connection between stratospheric warmings and lunar tidal perturbations of the equatorial ionosphere. By virtue of its gravitational force on the solid earth, oceans and atmosphere, the moon produces perturbations in the temperature, density, pressure and wind fields of earth's atmosphere. Lunar tidal winds in the dynamo region (ca. 100-150 km) can furthermore generate electric fields that map into the F-region and redistribute ionospheric plasma. Direct penetration (propagation) of lunar tides to F-region heights can also transport ionospheric plasma. In this paper we examine the global structure of the main M2 (period = 12.42h) lunar tide through examination of temperatures measured by the TIMED SABER instrument between 90 and 110 km and densities inferred from accelerometers on the CHAMP and GRACE satellites in the 350-550 altitude range. Ten-year mean SABER temperature amplitudes are of order 5-10 K while the corresponding density perturbations approach amplitudes of order 5% at 360 km and 10% at 480 km. Evidence for significant longitude variability is also presented. Global-Scale Wave Model (GSWM) simulations agree in seasonal-latitudinal structure with the above results, and moreover provide estimates of E- and F-region winds. The observed amplitudes are large enough to impose non-negligible day-to-day variability on the IT system.