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Earth's Exosphere Variability Linked to Surface by Thermal Tides

J.M. Forbes (1), S.L. Bruinsma (2), X. Zhang (1), and J. Oberheide (3)

(1) Department of Aerospace Engineering Sciences, University of Colorado, Boulder, CO 80309-0429, United States (forbes@colorado.edu, +1 303 492-7881), (2) Department of Terrestrial and Planetary Geodesy, CNES, Toulouse 31401, France (sean.bruinsma@cnes.fr, +33-561253098), (3) Physics Department, University of Wuppertal, 42097 Wuppertal, Germany (joberh@uni-wuppertal.de, +49-202-439-2680)

Exosphere temperatures are derived from inter-calibrated densities measured by accelerometers on the CHAMP and GRACE satellites, and are used to elucidate the longitude structure of the upper thermosphere (ca. 400-500 km) under quiet (Kp < 3) geomagnetic conditions. The near-polar orbits of CHAMP and GRACE precess in local time at different rates, thus enabling complete local time sampling as a function of longitude within 72-day windows moving forward daily from Aug 2005 to Aug 2006, and from Oct 2003 to Oct 2004; thus 72-day running vector-mean nonmigrating tides are revealed during these periods. Wave-4 longitude structures are often seen, suggesting connection with deep convective activity and latent heat release in the tropical troposphere. Many individual tidal components, e.g., DE3, DE2, SE2, etc., reveal the same seasonal-latitudinal variabilities as those in temperatures at 110 km measured by TIMED/SABER. Our results demonstrate that the variability of Earth's exosphere is determined in part by near-surface processes; similar effects can be expected at Mars.