

Influence of Tides on the Ionospheric Annual Anomalies



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Abstract Through respectively adding June tides and December tides at the low boundary of GCITEM-IGGCAS model (Global Coupled Ionosphere-Thermosphere-Electrodynamics Model, Institute of Geology and Geophysics, Chinese Academy of Sciences), we simulate the influence of tides on the annual anomalies of the ionospheric electron density. The tides' influence on the annual anomalies of the ionospheric electron density varies with latitude, altitude and solar activity level. Compared with the density driven by December tides, the June tides mainly increases the lower ionospheric electron density, and mainly decreases the electron density at higher ionosphere. In the low-latitude ionosphere, tide drives an additional equatorial ionization anomaly structure (EIA) at higher ionosphere in the relative difference of electron density, which suggests that tide affect the equatorial vertical $E \times B$ plasma drifts. Although the lower ionospheric annual anomalies driven by tides mainly increases with the increase of solar activity, the annual anomalies at higher ionosphere mainly decreases with solar activity.

Model: GCITEM-IGGCAS is a three-dimensional (3-D) code with 5° latitude by 7.5° longitude cells in a spherical geographical coordinate system, which bases on an altitude grid. This model self-consistently calculates the time-dependent 3-D structures of the main thermospheric and ionospheric parameters in the height range from 90 to 600 km, including neutral number density of major species O_2 , N_2 , and O and minor species $N(^2D)$, $N(^4S)$, NO , He and H ; ion number densities of O^+ , O_2^+ , N_2^+ , NO^+ , N^+ and electrons; neutral, electron and ion temperature; neutral wind vectors; and ionospheric electric field. GCITEM-IGGCAS can reproduce the main features of the thermosphere and ionosphere. The details of GCITEM-IGGCAS are given in Ren *et al.* (2009).

Simulation

Case 1: December condition with December tide

Case 2: December condition with June tide

Case 3: December condition with June tide, which switched the tides from north to south

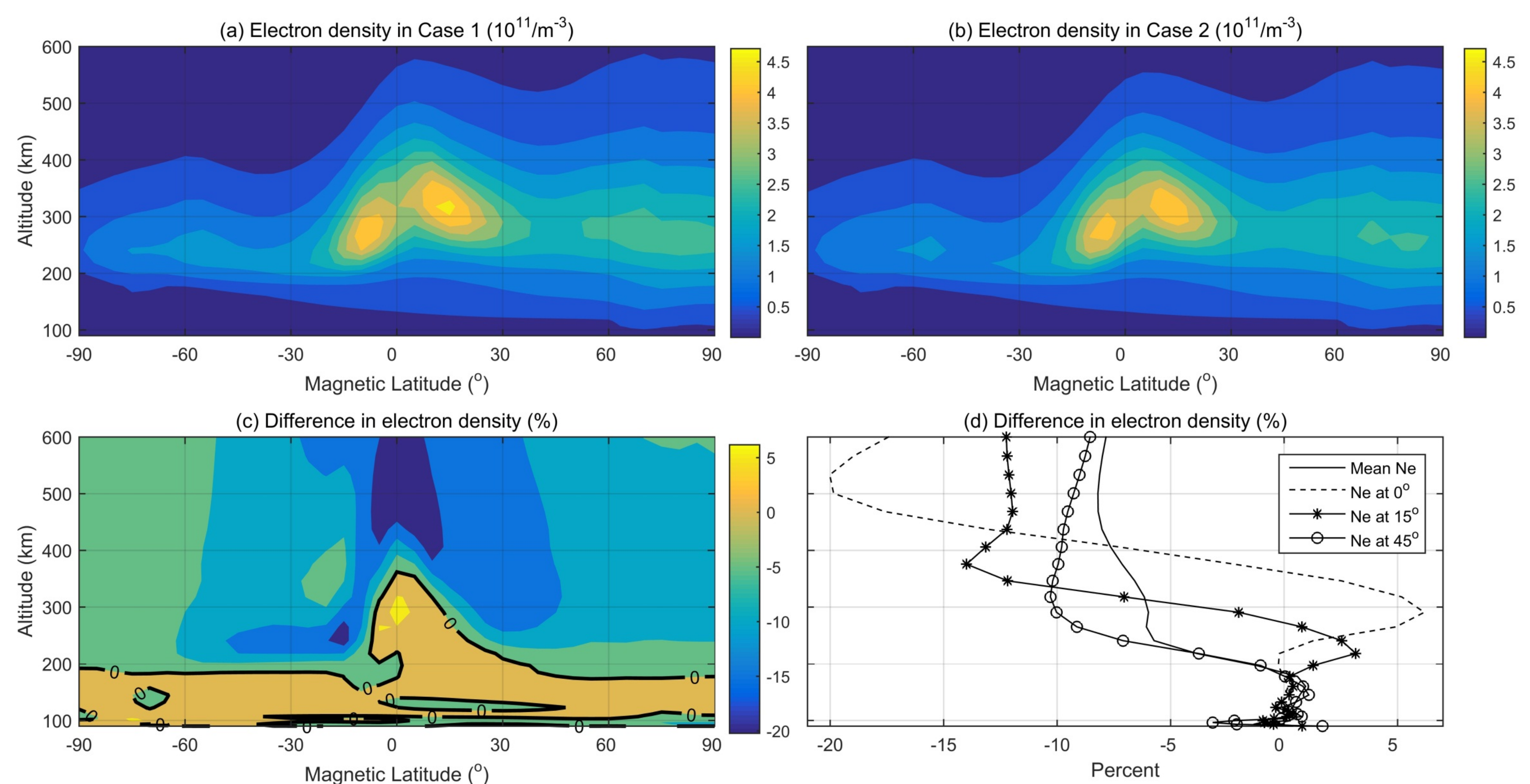


Figure 1 The altitudinal and latitudinal variations of the zonal mean electron densities. The altitudinal and latitudinal variations of the simulated zonal mean electron densities in (a) Case 1 (in a unit of $10^{11}/m^3$) and (b) Case 2 (in a unit of $10^{11}/m^3$); the relative difference of the zonal mean electron densities between (c) two simulations (δNe) (in a unit of %) and the (d) altitudinal profiles of δNe (in a unit of %). The solid lines in (c) represent the zero lines.

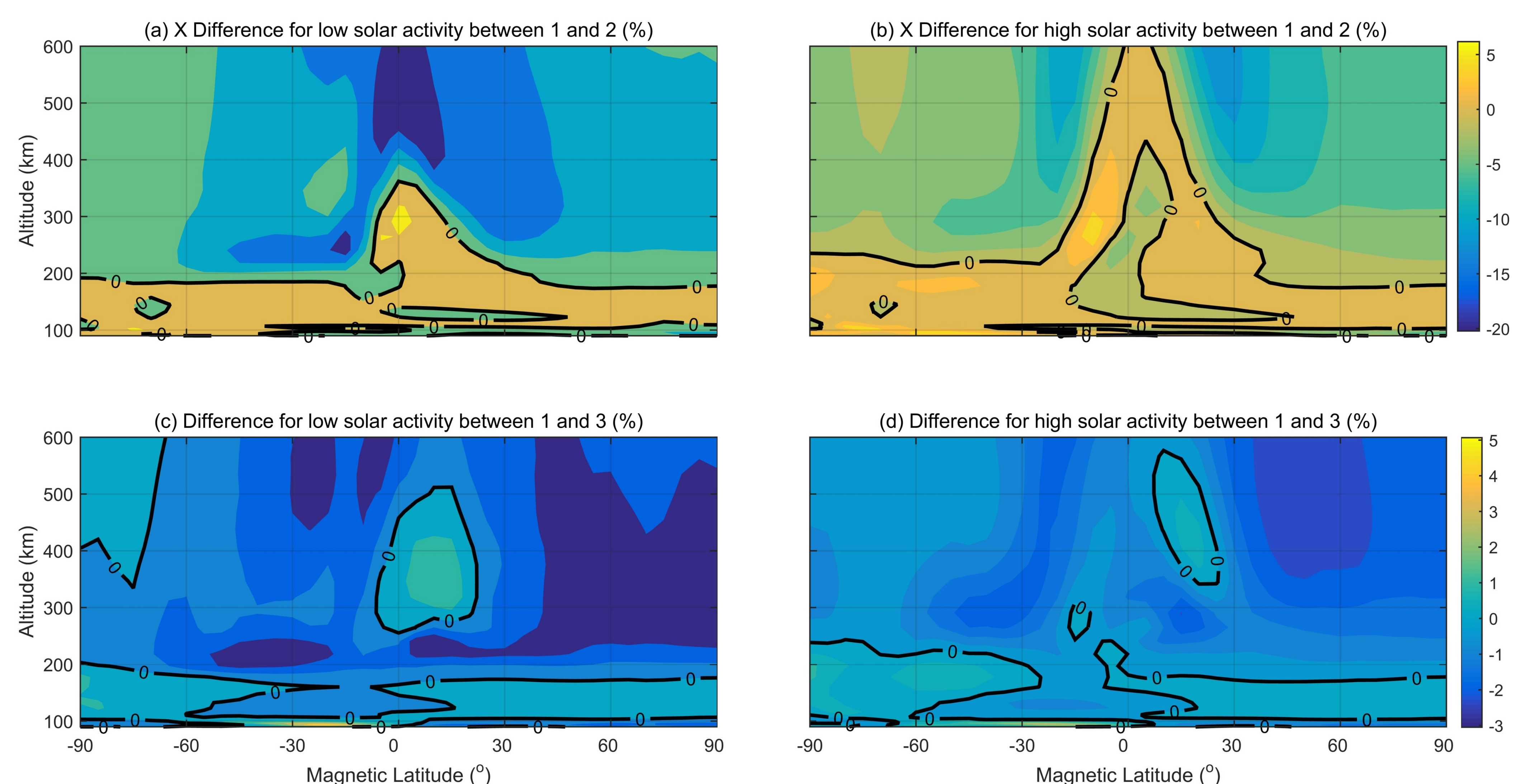


Figure 2 The relative difference for different solar activity level and tide condition.