Ellipsoidal Chapman Function for Atmosphere of Relevance to Ionospheres of Jupiter, Saturn, and Titan. Contribution to Models JIRA, SIRA, and TIRA

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As a continuation of our investigations of ellipsoidal Chapman (Che) function of the atmospheres of oblate planets (Velinov et al., 2004) we present new calculations for the giant planets Jupiter and Saturn, and its satellite Titan. In the above mentioned paper Che function only for the north and south pole regions is presented. There, some computations for Che function for the ionosphere of Saturn (only on latitudes 90 degree) at different altitudes and solar zenith angles: 45, 60, 75, 80, 83, 85, 87, 90, 93, 95, 97 and 100 degree, are made. This new paper presents the results of our work on the ellipsoidal Chapman function of oblate planetary bodies. Here the calculations for Che function in the oblate planet atmospheres of giant planets from Jovian group for middle and lower latitudes (including the equator) in Tables 1 - 3 are presented. Che function for a rotational ellipsoid depends on the oblateness and on the solar zenith angle, altitude, latitude and the solar declination. A comparison between Che function and classical Chapman function Ch for a spherical planet is made. The last function is applicable for the ionospheres of terrestrial planets (Venus, Earth and Mars). This comparison shows the necessity of introducing Che function in numerical analysis of ionospheres of Jupiter, Saturn and Titan. The function Che determines more precisely the optical depth parameter for solar XUV radiation and also the particle depth parameter for galactic and solar cosmic ray particles. The difference between evaluations of electron production rate profiles with Che and Ch functions are particularly significant at larger zenith angles (90 - 100 degree), i.e. in sunrise - sunset periods.