

IDENTIFICATION AND LOCALIZATION OF LAYERS AND WAVE ACTIVITY IN THE ATMOSPHERE AND IONOSPHERE USING THE EIKONAL AND AMPLITUDE OF RADIO OCCULTATION SIGNALS

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Conditions for remote sensing of the ionosphere and atmosphere by using the high-stability navigational signals of Global Positioning System (GPS) depend strongly on the ionospheric impact on the radio wave propagation. An analytical model is introduced for the description of the radio waves propagation in a stratified medium consisting of sectors having the spherically symmetric distributions of refractivity. Model presents analytical expressions for the phase path, bending angle, and refractive attenuation of radio waves. Model is applied for analysis of the radio occultation (RO) signal propagation effects along an extended path including the atmosphere and two parts of the ionosphere and taking into account the horizontal gradients. Model explains influence of the inclined ionospheric layers on the amplitude and phase variations at the altitudes 50-90 km of the RO ray perigee where there is essentially almost no atmosphere to refract the RO signals. By use of the CHALLENGE Minisatellite Payload (CHAMP) and the Formosa Satellite-3 and Constellation Observing System for the Meteorology, Ionosphere, and Climate (FORMOSAT-3/COSMIC) RO data a description of different types of the ionospheric contributions to the RO signals at the altitudes 50-90 km of the RO ray perigee is introduced and compared with results of measurements obtained earlier in the communication link satellite-to-Earth at frequency 1.5415 GHz. An innovative eikonal acceleration technique is described and applied for the identification and location of the inclined ionospheric layers and measurements of their parameters. The eikonal acceleration/intensity technique can be applied to separate the influence of layered structures from contributions of turbulence and irregularities in the atmosphere and ionosphere. Eikonal variations may be converted into the refractive attenuation variations, which allows the integral absorption to be determined with the refraction effect on the radio-wave intensity cancelled out. This is necessary for measurements of the water-vapor density and gas minorities during multi-frequency RO sounding along the satellite-to-satellite paths. In many cases the layered structures in the atmosphere and ionosphere indicate quasi-periodical altitude dependence that reveals their wave origin. The altitude profile of the vertical gradient of refractivity in layered structures can be used to find the main characteristics of the in-

ternal wave activity with a global coverage. When the types of internal waves are not known, the height dependence of the vertical gradient of refractivity can be applied for monitoring the temporal and spatial distributions of wave activity at different levels in the atmosphere. In the case of the internal gravity waves one can measure by use of the vertical profile of the refractivity under some assumptions the intrinsic phase speed, the horizontal wind perturbations, intrinsic frequency, potential and kinetic energy, and other important parameters as functions of height in the atmosphere. The obtained results can be of common value for other remote-sounding paths, as well.