The gravity tidal electric fields induced by Moon and Sun in the ionospheric layers

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The present work is based on simplifying assumptions. Let's consider a thin spherical isothermal plasma layer by thickness h on distance r from the center of the Earth $(h \ll r)$, with concentration of ions N_0.

A system of six equations including the continuity, proton motion and local electron equilibrium equations in two directions and equation of quasineutrality of spherical plasma layer under the homogeneous temperature of components is presented.

A periodical (semi-diurnal, diurnal and long) solution for perturbation induced by Moon (or Sun) taking into account both the gravitational and electric fields is examined.

Let Ω denote the angular speed of rotation of the Earth and let t denote the time; let e denote charge of electron and m denote mass of ion, let ψ denote the geographic longitude, θ the geographic co-latitude of this point and let δ - denote the geocentric declination of Moon (or Sun). For example, under action horizontal semi-diurnal constituent of tidal forces there are established oscillations of meridional electric field

$$E_\theta = 9\frac{kT}{er}G\frac{M}{R^3}\frac{\cos^2\delta\sin\theta\cos\theta\cos[2(\Omega t-\psi)+\varphi]}{\sqrt{(\omega_r^2-4\Omega^2)^2+\frac{64\nu^2 4\Omega^2}{r^4}}} \qquad (1)$$

and zonal electric field

$$E_\psi = 9\frac{kT}{er}G\frac{M}{R^3}\frac{\cos^2\delta_j\sin\theta\sin[2(\Omega t-\psi)+\varphi]}{\sqrt{(\omega_r^2-4\Omega^2)^2+\frac{64\nu^2 4\Omega^2}{r^4}}} \qquad (2)$$

where

$$\varphi = \arctan\frac{8\nu 2\Omega}{(4\Omega^2-\omega_r^2)r^2} \qquad (3)$$

$$\omega_r^2 = \frac{6kT(1+Z)}{mr^2} \qquad (4)$$

M - mass of Moon (or Sun), R - distance up to Moon (or Sun), Ze - positive charge of ion. G - gravitational constant, n - coefficient of kinematic viscosity gives

$$\nu = \frac{12\pi^{3/2}\varepsilon_0^2(kT)^{5/2}}{\ln\Lambda Z^4 e^4 N\sqrt{m}} \qquad (5)$$

where ε_0 - permittivity of free space, $\ln\Lambda$ - the Coulomb logarithm. Conditions of observation of the resonant phenomena in plasma ionospheric layers are determined.