ABSTRACT

This study is on the investigation of the simultaneous variations of total electron content (TEC) from the Global Positioning System (GPS) and the Ionospheric peak electron densities at the F2 region (NmF2) from the Digisonde Portable Sounder (DPS) over an African equatorial station, Ilorin (8.50^0N, 4.68^0E; dip lat. 2.95^0S) in 2010, a low solar active year (yearly average sunspot number, R_z =15.9). The monthly median values for the pre-sunrise magnitudes for TEC (MTEC) ranged between 0.5 TECU and 2.6 TECU while the corresponding values for monthly median of NmF2 (MNmF2) ranged between 6x10^{10} e/m^3 and 17x10^{10} e/m^3. After sunset, a considerable increased in the MNmF2 was observed around 2200 LT - 2300 LT, which lasts for about 2 - 3 hours in March, September, October and November. This significant post-sunset enhancement in MNmF2 was moderate in MTEC during February.The decay rates of MTEC and MNmF2 after the post sunset enhancement are greater than the build-up rates at the sunrise. The build-up rates of TEC ranged from 2.63 TEC/h to 4.65 TEC/h. The decay rates in TEC ranged from -2.98 TEC/h to -0.90 TEC/h. Regarding NmF2, maximum build-up rates occurred in April and has a value of 2.49 e/m^3h while the minimum value of 1.81 e/m^3h occurred in June. The maximum decay rates in NmF2 is -0.78 e/m^3h (June) while the minimum decay rate is -1.63 e/m^3h (March). It was observed that the build-up and decay rates of TEC are negatively correlated, likewise there is a negative correlation between the build-up and decay rate of NmF2. Also, one of the implications of the results of this is the possibility of modeling the topside and the bottomside of equatorial ionosphere with the usage of the coefficient parameters established from the build-up and decay rates of TEC and NmF2. The TEC and NmF2 diurnal variations have strong positive correlations. These correlation coefficients ranged from 0.86 in October to 0.96 in May. The significance of this is that the electrons in the F2 region, make the largest contributions to the TEC value, and therefore have a strong influence on TEC.

In this article, the results have also confirmed a quantitative linear relationship between TEC and NmF2 given as $TEC = \alpha_2 NmF2 + \beta_2$, where α_2 is the slope between TEC and NmF2 and β_2 is the intercept of the regression equation. Therefore, α_2 and β_2 are the coefficients of the variation between the TEC and NmF2. The coefficients of the variations obtained make it possible to predict TEC from NmF2 and vice versa. This approach could be used to model the equatorial region and to improve the prediction of existing ionospheric models.