ABSTRACT

The geomagnetic field shows regular variation during geomagnetic quiet conditions. However, during geomagnetic storms, it exhibits irregular fluctuations that can induce hazardous electric currents in ground based conductor systems. Total electron content (TEC) is an important ionospheric parameter capable of causing Global Positioning System (GPS) signal delays, scintillations and loss of lock resulting in inefficient operations of ground and space based satellite systems. The correlation between TEC and geomagnetic field still remains unclear, especially in East African region. The present study investigates the correlation between geomagnetic field variations and the dynamics of the equatorial ionosphere over East Africa using geomagnetic field data and GPS derived TEC and scintillation data sets within the period 2009 to 2014. The objectives of the study are to determine the annual variation of geomagnetic field from low solar activity year (2009) to high solar activity year (2014) during quiet and storm times within equatorial East Africa; investigate the annual morphology of TEC; investigate the correlation between geomagnetic field variations and TEC during quiet and storm times and investigate the possibility of inferring TEC from quiet time geomagnetic field variations. These objectives have been accomplished by use of the methods of scientific programming and statistical analyses. During quiet times, the correlation coefficients (corrcoef) were found to be strongest during the prenoon phase (0600-1200 LT), ranging from 0.69 to 0.98 at Addis Ababa and 0.61 to 0.97 at Nairobi. During the afternoon phase (1300-1800 LT), corrcoef range from -0.28 to 0.89 at Addis Ababa and -0.28 to 0.76 at Nairobi. The strong linear relationship is attributed to the independent increase of the eastward electric field and photo-ionization on TEC, while poor relationship is as a result of domination of photo-ionization over equatorial ionization anomaly (EIA) development. Further, the time instants of the impact of the storms on geomagnetic field and TEC exhibit a good correlation. It was observed that the global drivers of storms overwrite the local factors determining the variation of the geomagnetic field. Scintillation well correlated with depletions in TEC occurred in the post sunset sector during some months, with largest values being experienced in the March and April at Maseno. Inferring TEC from quiet time geomagnetic field variation has been found feasible. The results presented in the present thesis are useful for electric power industries, satellite-based communication and navigational systems as well as ionosphe