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INVESTIGATION OF THE TEMPORAL CHARACTERISTICS OF TEC AND L-BAND SCINTILLATION AT THE EQUATORIAL STATIONS OF LAGOS AND ILORIN IN NIGERIA DURING SOLAR MINIMUM

L. L. N. Amaeshi⋆, C. S. Carrano†, C. E. Valladares†, C.T. Bridgwood†, E.Y.Yizengaw†, R. Sheehan†, P. H. Doherty†, J. O. Adeniyi°, K. M. Groves*, T. R. Pedersen*, P. A. Roddy* and R. G. Caton*

⋆Department of Physics
University of Lagos
Akoka, Yaba, Lagos Nigeria

†Instittute for Scientific Research
Boston College
Boston, MA, USA

°Department of Physics
University of Ilorin
Ilorin, Kwara State, Nigeria

*Air Force Research Laboratory
Hanscom AFB, MA, USA

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Abstract. Ionospheric irregularities and plasma turbulence, which are manifestations of space weather, can cause scintillation in the amplitude and phase of trans-ionospheric radio waves employed by satellite navigation and communication systems, leading to a degradation of system performance, with the attendant adverse consequences. In order to mitigate these adverse effects it is imperative to have a realistic model of the ionosphere and/or, be in a position to predict the causative events and processes. These require knowledge of both the climatology and morphology of ionospheric irregularities, thus, permanent monitoring of the state of the ionosphere, on regional and global scales, since many applications of these navigation and communication systems have global relevance and imperativeness. Unfortunately, due to the relatively sparse distribution of ground-based ionospheric monitoring instruments in Africa, the climatology and morphology of iono spheric irregularities over Africa have not been adequately characterized. Yet, there

is no region where this exercise is more pertinent than the African Region, for, in this region the equatorial ionization anomaly, the region of the greatest variability of the ionosphere, traverses the longest meridonal range over a regional land mass.

Boston College, American Air Force Research Laboratory, and the Universities of Lagos and Ilorin in Nigeria, have collaborated to operate two high-rate GPS receivers capable of monitoring both Total Electron Content (TEC) and GPS scintillation intensity. We use GPS measurements collected from 2008-2009, a period of minimum solar activity to: (i) identify ionospheric irregularities and quantify their seasonal morphology, (ii) estimate the zonal drift velocity by cross-correlating TEC measurements between pairs of GPS receivers, (iii) relate ionospheric irregularities to occurrence of weak scintillation at the GPS L1 frequency, (iv) characterize the strength of amplitude and phase scintillations in terms of their power spectral densities, and (v) use phase screen theory to predict the intensity of scintillation that would be observed by communications systems operating at lower frequencies. Measurements of plasma density from the C/NOFS satellite during passes over Nigeria are used to corroborate and complement these ground-based observations.