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ANALYSIS OF GPS-BASED INTEGRATED WATER VAPOUR (IWV) OVER NIGERIA

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ABSTRACT

Water vapour is a highly dynamic component of the atmosphere thus, it greatly influences the atmospheric variability, especially in the tropics. This paper presents the analyses of GPS-derived Integrated Water Vapour (IWV) over Nigeria. Data from Nigerian Global Positioning System/Global Navigation Satellite System (GPS/GNSS) network (NIGNET) for the year 2011 was used for this study. In the absence of Surface meteorological data collocating with the GPS stations, surface temperature and Pressure were obtained from the Global Temperature and Pressure 2 wet (gpt2w) model and data from European Center for Medium-Range Weather Forecasts (ECMWF) reanalysis was used for validation. The GPS/ GNSS data was processed using Bernese (ver. 5.2) Scientific software for GPS/GNSS data analyses and hourly zenith path delay (ZPD) over the Nignet stations were estimated. Using the surface temperature and Pressure zenith hydrostatic delay (ZHD) were generated based on Saastamoinen tropospheric delay model. The ZPD and ZHD were used to compute zenith wet delay (ZWD) which was finally utilized to derive the Integrated Water Vapour (IWV) over seven (7) NIGNET stations across Nigeria (i.e., ABUZ (Zaria), BKFP (Birnin Kebbi), CGGT (Toro), FUTY (yola), RUST (Rivers), ULAG (Lagos) and UNEC (Enugu). The average yearly IWV value ranges from 21.178 kg/m² at CGGT to 47.260 kg/m² at RUST with minimum and maximum values of 0.210 kg/m² at CGGT and 64.509 kg/m² at RUST respectively. The validation results indicated RMS error of 2.879 kg/m², 1.380 kg/m², 3.490 kg/m², 3.394 kg/m², 3.257 kg/m², 3.860 kg/m², and 1.811 kg/m² respectively at ABUZ, BKFP, CGGT, FUTY, RUST, ULAG and UNEC. The correlation coefficient (R²) of 0.9157, 0.9965, 0.7751, 0.6305, 0.5644, 0.5403 and 0.8967 was obtained at each station respectively. The high correlation between the re-analysis (ECMWF) and GPS-based IWV underscores the significance of GPS-derived IWV for meteorological applications over Nigeria. It is recommended from the foregoing results that inter-agency collaboration between Office of Surveyor General of the Federation (OSGoF) and Nigerian Meteorological Agency (NiMet) should be created towards assimilation of geodetic products into forecast and nowcast systems for improved weather outlook over Nigeria.

Keywords: Integrated Water Vapour, Nignet CORS, GPT2w model, Global Navigation Satellite System, Zenith Wet Delay, European Center for Medium-Range Weather Forecasts (ECMWF).