Australian Regional Ionospheric Disturbance Index Based on the Principal Component Analysis and GPS Data

Zahra BOUYA[1#+], Mike TERKILDSEN[2], Matthiew FRANCIS[2], David NEUDEGG[1], Richard MARSHALL[1]

[1]Australian Bureau of Meteorology, Australia, [2]IPS Radio and Space Services, Bureau of Meteorology, Australia

[#]Corresponding author: z.bouya@ips.gov.au [+]Presenter

In this paper, a new Australian Regional Ionospheric Disturbance Index (AusRDI) is introduced using Spherical Cap Harmonic Analysis (SCHA) and Principal Component Analysis (PCA) techniques. AusRDI is defined as the relative deviation of the vertical Total Electron Content. (TEC). The SCHA method was firstly used to estimate TEC at evenly distributed grid points from GPS data collected from the Australian Regional GPS Network (ARGN). The SCHA model is based on longitudinal expansion in Fourier series and fractional Legendre co-latitudinal functions over a spherical cap-like region including the Australian continent. This harmonic expansion requires fewer coefficients to represent the fine structure of regional ionospheric features and may be adapted to take advantage of regions of densely distributed observations in order to observe and model ionospheric dynamics over Australia on a range of spatial scales. PCA was then used to decompose the TEC dataset into a series of orthogonal Eigenfunctions (EOF base functions) and associated coefficients. The base function represents the variation in TEC with latitude and longitude. PCA is non parametric and as such does not utilize deviation from a previously described average to determine perturbations. It is used as a potentially useful method for detecting and describing the TEC disturbance during storm time. Specifications of the TEC variations are discussed and criteria for identifying TEC storm event are proposed. This approach will provide reliable ionospheric characterization during all possible ionospheric conditions for operational applications with high temporal and spatial resolution .

Keywords: PCA, Disturbance Index, Regional, SCHA, TEC, GPS, Australia .