Climatology of Quasi-two day Oscillations from GPS-derived total electron content during 1999-2015

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Abstract

The paper presents the climatology of eastward- and westward-propagating quasi-2-day oscillations (QTDOs) with zonal wave numbers 1-4 using the global ionospheric total electron content (TEC) derived at the International GNSS Service (IGS) from the network of ground Global Positioning System (GPS) receivers. The climatologies of space-time spectra and amplitudes of QTDOs in TEC during 16 years from December to February (DJF) (1998/99-2014/15) and 17 years from June to August (JJA) (1999-2015) were investigated. The space-time spectra (spectral signature) and the mean amplitude of all wave modes (1-4) of QTDOs exhibit strong latitudinal, hemispheric, inter-annual and solar-cycle variations. Latitudinaly, strengths of the spectral signature and amplitude values diminish gradually from maxima at EIA crest towards high latitude regions. The spectral signature amplify (weaken) in the solar maximum (minimum) periods. Likewise, the amplitudes of both the eastward- and westward-propagating QTDOs attain peak values during the maximum solar activity phases of the solar cycle. Seasonally, the spectral signature and amplitude values reveal summer amplification in both hemispheres as opposed to winter suppression. However, the spectral signatures (amplitudes) in the Southern Hemisphere summer are stronger (larger) than that in the Northern Hemisphere summer. Moreover, the spectral signatures and amplitudes associated with the westward-propagating oscillations are dominant over those propagating eastward. The hemispheric and latitudinal mean differences in the long-term mean daily values of amplitude of E1 (W1) QTDOs exhibit high values in the southern (northern) hemisphere near the December (June) solstices that follow the solar declination. The global spatial mean amplitudes of E1 and W1 QTDOs are significantly higher during DJF than in JJA throughout the period of study with a few exceptions revealing the annual anomaly phenomenon in TEC which is more notable during solar maxima. Moreover winter anomaly is distinctly captured in the northern hemisphere as reflected by higher amplitudes of E1 and W1 QTDOs in summer solstice (JJA) than in winter solstice (DJF) consistent with the antecedent understanding.

Keywords: Quasi-2-day Oscillations, vertical total electron content (vTEC), Global ionospheric maps (GIMs), ionosphere