

# **Quasi-biannual oscillations (QBO) seen in GPS/CHAMP tropospheric and ionospheric data**

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In this paper we analyze small-scale fluctuations of the 50-Hz GPS/CHAMP SNR and phase data acquired in the lower stratosphere and the E-region ionosphere. Both stratospheric and ionospheric variances of the SNR and phase fluctuations exhibit a clear quasi-biannual oscillation (QBO) on top of annual variations. In the E-region ionosphere, the variances are dominated by summertime variability associated with mid-latitude ( $\sim 40^\circ$ ) sporadic-E near 100 km. The QBO modulation is more prominent in the northern summers than in the southern ones during 2002-2006, showing larger variances in 2003 and 2005 northern summers. Compared to the northern results, the southern summer variances are generally weaker and show slightly stronger variances in 2002/2003 and 2004/2005 summers. In the lower stratosphere (e.g., 25 km), the variances are confined mostly in the tropics and subtropics. However, their latitudinal distributions exhibit two distinct types: one with a single peak centered at the equator (hereafter referred as to Kelvin mode); another with two peaks centered at  $\pm 25^\circ$  (Rossby mode). Both modes tend to maximize in January-March but the Kelvin mode dominates in 2002 and 2004 while the Rossby mode dominates in 2003 and 2005. The presence of QBO signatures in the stratosphere and in the ionosphere suggests a strong dynamical coupling between the lower and upper atmospheric tropics. A possible coupling through propagating gravity waves will be discussed.