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Comparison of IGS Network GPS Receiver DCBs Provided by CODE and a Single Station Estimation Method

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The Global Positioning System (GPS) is a valuable tool in the measurement and monitoring of ionospheric total electron content (TEC). To obtain accurate GPS-derived TEC, satellite and receiver hardware biases, known as differential code biases (DCBs), must be removed. A number of sources calculate and provide GPS satellite DCBs, one such source is the Centre for Orbit Determination in Europe (CODE). CODE also provides monthly averages of receiver DCBs for a number of stations within the International GNSS Service (IGS) network. However, utilization of these DCBs can create discontinuities and inaccuracies in the unbiased TEC.

A comparison of the monthly receiver DCBs provided by CODE with DCBs estimated using the Minimization of Standard Deviations (MSD) method [1], on both daily and monthly time scales, is presented. The comparison is performed using eight collocated station sets within the IGS network. Regardless of receiver hardware, TEC calculated from collocated receivers should provide identical results if the biases are correctly removed. Therefore, the difference between the respective unbiased receiver-derived TEC is calculated and compared. MSD derived DCBs, for both monthly and daily time scales, result in consistently lower differences between collocated TEC measurements than differences obtained using CODE-derived DCBs. Differenced TEC, unbiased using CODE-derived DCBs, are typically on the order of 2 TEC units (TECU) larger than their MSD counterparts.

Daily MSD-derived DCBs also show fluctuations within the monthly intervals, with standard deviation values typically on the order of 2 - 5 TECU. These fluctuations allude to a time dependence in receiver DCB and introduces a possible need for bias estimation over smaller time intervals. These fluctuations are very well correlated between collocated receivers regardless of receiver make and model. This suggests that the receiver DCBs are affected by more than just the receiver hardware.

[1] Ma, X. F., T. Maruyama, G. Ma, and T. Takeda (2005), Determination of GPS receiver differential biases by neural network parameter estimation method, Radio Sci., 40, RS1002, doi:10.1029/2004RS003072.

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