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On The Development of a Real-Time Zenith Tropospheric Delay Estimation Model Using Triple GNSS Constellations

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Atmospheric sounding using global positioning system (GPS) has been extensively investigated in the last two decades to help a number of applications, including severe weather monitoring, nowcasting and numerical weather prediction (NWP). Recently, Galileo and BeiDou satellite navigation systems have been further developed, which provides an opportunity for real-time meteorological applications. In this paper, we develop a real-time zenith tropospheric delay (RT-ZTD) estimation model by combining the observations of three different global navigation satellite systems (GNSS) constellations, namely GPS, Galileo and BeiDou. Various RT-ZTD models are obtained from the GPS-only, the GPS/Galileo, the GPS/BeiDou, the Galileo/BeiDou and the triple GPS/Galileo/BeiDou observations based on the real-time precise point positioning (PPP) solution. Triple-constellation GNSS observations from a number of globally distributed reference stations are processed over a period of 7 days. The estimated RT-ZTDs from the aforementioned models are then compared with the international GNSS service (IGS) tropospheric products counterparts. The results demonstrate that our proposed RT-ZTDs models show millimeter level accuracy with respect to the IGS counterparts.