

Effects of Equatorial Plasma Bubbles on RTK Positioning in Bangkok, Thailand

P.C. Thu, J. Budtho, L.M.M. Myint and P. Supnithi

School of Engineering, King Mongkut's Institute of Technology, Bangkok 10520, Thailand; e-mail: 64601010@kmitl.ac.th, 60601161@kmitl.ac.th, pornchai.su@kmitl.ac.th,

Equatorial Plasma Bubbles (EPB) [1] refers the area of electron density depletion during post-sunset to pre-morning periods. They typically originate at the bottom side of the ionosphere before extending longitudinally along the magnetic field line to high latitudes. The EPB causes abnormal variation of total electron content (TEC) which then affects the GNSS signals and, as a result, degrades the positioning errors. Since the real-time kinematic (RTK) positioning [2] is a widespread cm-level positioning technology, in this work, we aim to study the effects of EPB at low-latitude stations in Thailand.

The base station is on KMITL campus, while the rover station is the DPT station located about 21 kilometers away. Below is an example of RTK performances on DOY267, 2021, in UTC time. The GNSS data are analyzed using RTKLIB software [3]. On this days, strong ionospheric disturbance as seen on the rate of TEC change index (ROT) is apparent between 13UT to 19 UT (or 20 LT to 02 LT). During the disturbed hours, the number of satellites are still above 4. During quiet period without ionospheric irregularity, the horizontal and vertical errors are in the cm levels, but during the disturbed period, the maximum horizontal and vertical errors reach 4 meters and 6 meters, respectively, well exceeding the cm level service requirements. In addition, we analyze the positioning errors at various baseline length in this work.

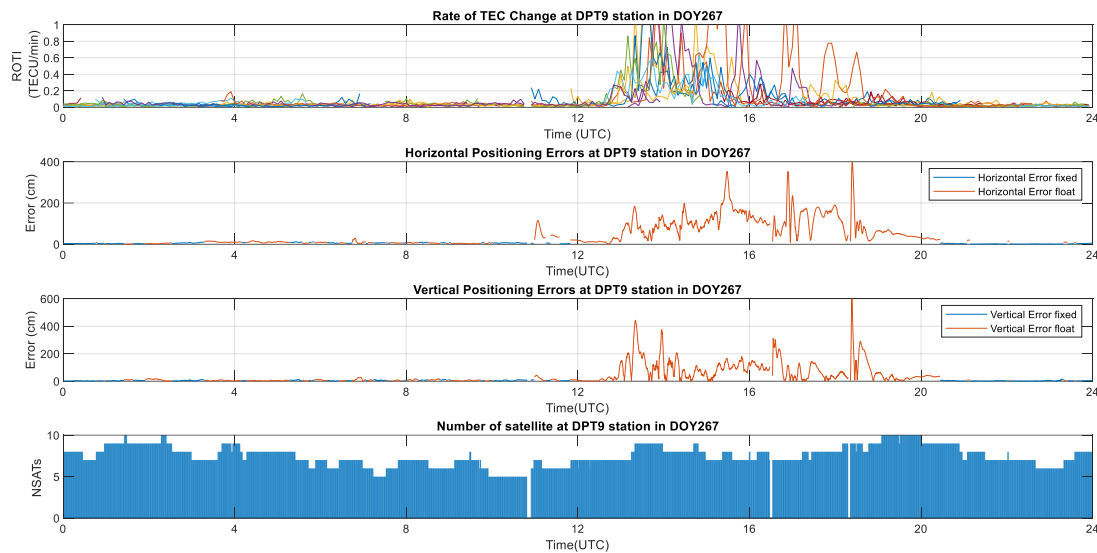


Figure 1. Example of RTK positioning performances on DOY267, 2021.

References

- [1] M.C. Kelley, “*The Earth’s Ionosphere: Equatorial Plasma Instabilities*,” 2nd Ed., Academic press, San Diego.
- [2] H. He, J. Li, Y. Yang, J. Xu, H. Guo and A. Wang, “Performance assessment of single- and dual-frequency BeiDou/GPS single-epoch kinematic positioning,” *GPS Solutions*, **18**, 3, March 2014. <https://doi.org/10.1007/s10291-013-0339-3>
- [3] T.Takasu, “RTKLIB: Open Source Program Package for RTK-GPS, *FOSS4G 2009*, Tokyo, Japan, Nov. 2, 2009.