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Could the Beirut Explosion perturb the Ionosphere? Pre-results Using TEC-GNSS observations.

Mohamed Freeshah[1,4,7], Xiaohong Zhang[4,2,3], Erman Şentürk[5], Xiaodong Ren[2,3], Muhammad Arqim Adil[6], and Guozhen Xu[2]

[1]State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing, Wuhan University, 129 Luoyu Road, Wuhan 430079, China; (mohamedfreeshah@whu.edu.cn)
[2]School of Geodesy and Geomatics, Wuhan University, 129 Luoyu Road, Wuhan 430079, China; (xhzhang@sgg.whu.edu.cn ; xdren@whu.edu.cn ; 1471898145@qq.com)
[3]Key Laboratory of Geospace Environment and Geodesy, Ministry of Education, 129 Luoyu Road, Wuhan 430079, China
[4]Collaborative Innovation Center for Geospatial Technology, 129 Luoyu Road, Wuhan 430079, China
[5]Department of Surveying Engineering, Kocaeli University, Kocaeli, Turkey; (erman.senturk@kocaeli.edu.tr)
[6]Department of GNSS, Institute of Space Technology, Islamabad, Pakistan; (arqim07@mail.ist.edu.pk)
[7]Department of Surveying Engineering, Faculty of Engineering at Shoubra, Benha University, 108 Shoubra St., Cairo 11629, Egypt.

Natural hazards such as shallow earthquakes and volcanic explosions are known to generate acoustic and gravity waves at infrasonic velocity to propagate in the atmosphere layers. These waves could induce the layers of the ionosphere by change the electron density based on the neutral particles and free electrons coupling. Recently, some studies have dealt with some manmade hazards such as buried explosions and underground nuclear explosions which could cause a trigger to the ionosphere. The Global Navigation Satellite Systems (GNSS) provide a good way to measure ionospheric total electron content (TEC) through the line of sight (LOS) from satellite to receiver. The carrier-to-code leveling (CCL) technique is carried out for each continuous arc where CCL eliminates potential ambiguity influence and it degrades the pseudo-range noise. Meanwhile, the CCL retains high precision in the carrier-phase. In this study, we focus on the Beirut Explosion on August 4, 2020, to check slant TEC (STEC) variations that may be associated with the blast of Beirut Port. The TECs were analyzed through the Morlet wavelet to check the possible ionospheric response to the blast. An acoustic□gravity wave could be generated by the event which could disturb the ionosphere through coupling between solid earth-atmosphere-ionosphere during the explosion. To verify TEC disturbances are not associated with space weather, disturbance storm-time (Dst), and Kp indices were investigated before, during, and after the explosion. The steady-state of space weather before and during the event indicated that the observed variations of TEC sequences were caused by the ammonium nitrate explosion. There was a large initial explosion, followed by a series of smaller blasts, about ~30 seconds, a colossal explosion has happened, a supersonic blast wave radiating through Beirut City. As a result of the chemistry behind ammonium nitrate's explosive, a mushroom cloud was sent into the air. We suggest that these different explosions in strength and time could be the reason for different time

arrival of the detected ionospheric disturbances over GNSS ground-based stations.