

## ***Interactive comment on “Equatorial Plasma Bubbles Developing Around Sunrise Observed by an All-Sky Imager and GNSS Network during the Storm Time” by Kun Wu et al.***

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This paper reports all-sky airglow and GNSS-TEC observations of plasma bubbles growing around sunrise terminator during a magnetic storm. This work could contribute to study of effects of magnetic storm on ionospheric disturbances. Therefore, this paper is worth publishing in this journal. However, the followings need to be addressed before its publication.

Specific comments: – "recombination": This reviewer recommends the authors to use a term "merging". "Recombination" is confusing because "recombination" is widely used to represent reaction of ions with electrons resulting in neutralization. "Merging"

C1

is used commonly compared to "recombination". See the following references:

Narayanan, V. L., S. Gurubaran, and K. Shiokawa (2016), Direct observational evidence for the merging of equatorial plasma bubbles, *J. Geophys. Res. Space Physics*, 121, 7923–7931, doi:10.1002/2016JA022861.

Huba, J. D., T.-W. Wu, and J. J. Makela (2015), Electrostatic reconnection in the ionosphere, *Geophys. Res. Lett.*, 42, 1626–1631, doi:10.1002/2015GL063187.

Huang, C.-S., J. M. Retterer, O. de La Beaujardiere, P. A. Roddy, D. E. Hunton, J. O. Ballenthin, and R. F. Pfaff (2012), Observations and simulations of formation of broad plasma depletions through merging process, *J. Geophys. Res.*, 117, A02314, doi:10.1029/2011JA017084.

– I. 55, "and the background ionospheric/thermosphere": Describe concretely which parameter the authors mean. Does the authors mean vertical gradient of plasma density at the bottomside of the F region or ion-neutral collision frequency?

– I. 96, "Hall electric field": It is better to add more detailed explanation of the Hall electric field.

– II. 110-111, Figure 1: Field-of-view (FOV) is shown by a circle in Figure 1. It would be better to describe the zenith angle corresponding to the circle shown as FOV.

– I. 122: Describe minimum and maximum frequency (or period) of the band-pass filter.

– II. 176-197: The authors describe that TEC depletion can be seen in Figures 4 and 5. However, TEC variations in these figures show positive and negative values rather than depletion. Spatial scale of the TEC variations seen in the figures is small. Therefore, the TEC variation corresponds to the plasma density irregularities existing within plasma bubbles. If the authors show ROTI (Rate of TEC change Index), structure of the plasma bubbles can be seen clearly as ROTI enhancements. See the following paper.

C2

Buhari, S. M., Abdullah, M., Hasbi, A. M., Otsuka, Y., Yokoyama, T., Nishioka, M., and Tsugawa, T. (2015), Continuous generation and two-dimensional structure of equatorial plasmabubbles observed by high-density GPS receivers in Southeast Asia, *J. Geophys. Res. Space Physics*, 119, pages 10,569– 10,580. doi:10.1002/2014JA020433.

– II. 229-232: Explain a reason why the eastern wall of EPB is unstable when the wind blows westward and equatorward. When the wind blow westward, and thus the wind-induced Pedersen current flows downward, gradient-drift instability can occur at the eastern wall of EPB, where the plasma density gradient is eastward. On the other hand, how does the equator ward wind work?

– II. 233-247, "This is because zonal drift value of EPBs ... EPBs should be influenced by ionospheric electric field.": The authors point out that the drift velocity of EPB is smaller than the wind, and argue the reason of this difference. However, this reviewer cannot understand what the authors are describing. If the F-region dynamo process completely works, the ExB drift velocity is equal to the wind velocity. Does the authors mean that electric field generation through the F-region dynamo is not completed and thus the ExB drift is smaller than the wind velocity? Otherwise, does the authors consider another electric field, which is different from the dynamo electric field induced by the wind?

– II. 255-256: The authors point out the EPBs kept developing after sunrise. Generally, it is considered that after sunrise, the photoionization due to the Solar EUV radiation produce the plasma in the ionosphere and fill the plasma depletion of EPB. In order to compare the time of sunrise, it would be worth showing local time variation of the absolute TEC, to compare the time of EPB existence with the time of rapid TEC increase at sunrise.

– I. 265, "during the development phase of storm": What is the development phase of storm? Is it "main phase of magnetic storm"? Why does the DDEF appear only during

C3

the development phase of storm?

Minor comments: – I. 127: "Digisond" → "Digisonde" – I. 308: "rise" may be "sunrise".  
– Figure 6: Legend of vertical axis in Figures 6c and 6e is "W-S distance". It should be "W-E distance". Furthermore, describe positive eastward.

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C4