Ann. Geophys. Discuss.,
https://doi.org/10.5194/angeo-2018-24-RC2, 2018

Annales Geophysicae Discussions

Interactive comment on "Ionospheric and thermospheric response to the 27–28 February 2014 geomagnetic storm" *by* Khalifa Malki et al.

Anonymous Referee #2

Received and published: 2 May 2018

Title: Ionospheric and thermospheric response to the 27–28 February 2014 geomagnetic storm

This paper reports the response of F-region thermosphere and ionosphere over north Africa to the 27-28 Feb 2014 geomagnetic storm using observations based on an all sky imager, FPI, and GPS data. The all sky imager and FPI are collocated at the Oukaimeden Observatory (31.206N, 7.866W), while the GPS station is in Rabat (33.998N; 6.853W). This is the first case study of a geomagnetic storm from Africa using a co-located all sky imager and FPI. The strong departure of neutral winds from climatological winds reported in this study clearly demonstrates the control of geomagnetic activity on the low-latitude neutral winds. This study also reports the formation of an EPB that occurred at nighttime on 27 Feb and associated changes in ionosphere-

thermosphere electrodynamics. Overall, this is a very straightforward study based on observations. The manuscript is well written and logically organized. On the whole this is a useful contribution to understand the local-scale ionosphere and thermosphere coupling dynamics under disturbed conditions.

I have few major and minor comments/suggestions. I would strongly recommend the authours to consider the following points and questions before publication:

The authour has shown neutral winds from 24 Feb to 1 March 2014 with primary focus on the storm day (27 Feb). The neutral winds on 27 Feb significantly differ from the non-storm day. The authour relates the variations in meridional winds on storm day to TADs and variations in zonal winds to EPB. Thus, an interplay of three different factors (geomagnetic storm, TADs, and EPB) affecting ion-neutral dynamics differently at the same time occurred on this day. They might not be independent of each other, but one can find days when geomagnetic activity was high and no TAD or EPB occurred or vice-versa. So, I would recommend the authour to include another case study when there was a geomagnetic storm, but no TAD or EPB appeared. That would eliminate the effect of change in electrodynamics associated with TADs or EPBs on the thermospheric winds above the observation region. This would isolate the pure effect of geomagnetic activity on neutral winds over the station from other factors.

I think the authour should include a location descriptor in the title (like - . . .. geomagnetic storm over north Africa) as this is a study of localized events.

Line 9 page 1: I think replace ". . .. . 22 LT, when the zonal. . ..." with ". . .. . 22 LT, after the zonal. . ..."

L32, page 2: Please include citation with "reversal in the background ionospheric electric field was evident through the dynamics of the plasma bubbles that occurred that night."

L33, page 2: Define EPB first and then start using this acronym.

L35, page 2: Replace DWM with DWM07 or stay consistent with the naming style.

L32, page 4: Figure 3 shows zonal and meridional winds measured with the FPI. As discussed in the section 3, this FPI measure LOS winds in four cardinal directions. So, you have 2 measurements in zonal and 2 in meridional direction. Did you average those LOS wind measurements in each direction to calculate zonal and meridional winds? If yes then please describe it either in section 3 or here.

Are they geographic or geomagnetic winds? Please state this too.

L33, page 4: The FPI measurements are binned into half hour bins. I am wondering why the FPI measurements are binned. The data could be shown at its original temporal resolution.

L1, page 5: The authour started using "quiet time" before defining it. It is defined in line 4, page 5.

L1, page 5: replace "The average quiet time derived from" to "The average quiet time wind components derived from".

L7, page 5: Instead of "sharply at 21 UT", it should be "sharply after 21 UT".

L9, page 5: replace "quiet time climatology and reverse" with "quiet time climatology and turn".

L11-12, page 5: Are these TADs associated with or caused by the geomagnetic storm? Please discuss.

L$\sim$15, page 5: Could these strong changes in zonal and meridional winds be related with the sharp changes in the background 630 nm airglow intensity as shown in Figure 8. The sharp intensity gradients in airglow in a small region in the FPI field of view may introduce errors in the recovered spectrum and those errors can propagate into the wind estimation procedure. Please discuss or cite.

L10-20, page 6: Please reorganize the sentences to make it more legible.

L20, page 5: Please add some details regarding DWM07 that it is a climatological model. TADs do not occur periodically or are predictable. Therefore, their effects are washed out in climatology.

L28, page 6: Your definition of quiet-time has changed here - Kp<3. Earlier it was Kp<4.

L7-9, page 7: Please remove redundancy.

L10, page 7: I think you are trying to say here that "when meridional winds are more equatorward, ..."

L12, page 7: "reduced density" - I think you mean "reduced plasma density".

L25-26, page 7: I could not extract this information from Figure 8. For example, 27 Feb at 22 UT - this time period is not shown in Figure 8. An extended temporal sequence of EPB motion in Figure 8 is desirable to assist what you have described here.

L3, page 8: slices of keogram in zonal or meridional direction?

L3-10, page 8: I would suggest to elaborate this technique more in this paragraph.

L5-6, page 8: It would be nice to know how this uncertainty of +-1 m/s was calculated.

L17-19, page 8: This information is redundant.

L29, page 8: until 01 UT of 29 Feb.

Figure 3: Figure show zonal and meridional winds, but are they geographic or geomagnetic? Please describe. Also, their titles "Meridional wind vs Quiet time" and "Zonal wind vs Quiet time" are not appropriate. Please change them.

Figure 4: I think Figure 4 is redundant as Figure 7 includes all the information displayed in Figure 4. So, you can remove Figure 4 (if you want).

Figure 9: I assume the winds shown earlier are geographic. How did you calculate magnetic zonal winds from the LOS winds? Is the instrument aligned with magnetic

axis? Although this is not the focus of this paper, but it should be stated or discussed in the data and methodology section.

Also, what are MOR winds (in the title of Figure 9)?

Interactive comment on Ann. Geophys. Discuss., https://doi.org/10.5194/angeo-2018-24, 2018.