Referee Report on MS angeo-2020-1 "An Early Low Latitude Aurora Observed by Rozier (Beziers, 1780)" by Bertolin *et al.*

General Comments

This is an interesting case report for the mid-latitude aurora on 1780 August 15 likely at Beauséjour near Béziers. The mid-latitude auroral report in 1780 is especially important, as this will be a footprint of solar eruption and a hint for contemporary solar activity where we do not have enough coverage of sunspot observations. Overall, I think this manuscript will be an interesting contribution, while further clarifications and explanations are needed both on its background and discussions. I have listed my comments below and wish the authors to address them. Their language needs to be improved as well, preferably with professional grammatical proofreading.

Specific Comments

1. Introduction

The scientific background of this article should be improved. Rather than associating "Incursions of high-energy particles from space, mainly solar wind, strongly interact with the Earth's magnetosphere" with the cause of auroral display, I would explicitly mention the coronal mass ejection with southward interplanetary magnetic field as a cause of auroral displays in low to mid magnetic latitude. I advice the authors to cite Gonzalez *et al*. (1994) and Daglis *et al*. (1999) for its references, rather than Vazquez *et al*. (2014).

The space weather hazards are not only geomagnetically induced currents, but also satellite drags (Oliveira and Zesta, 2019) or atmospheric radiations (Dyer *et al*., 2018). These details should be cited with actual cases reports/predictions (Nakamura *et al*., 2018; Love *et al*., 2018; Boteler, 2019) and reviews (Pulkkinen *et al*., 2017; Ngwira and Pulkkinen, 2018; Riley *et al*., 2018; Oliveira *et al*., 2018).

Given the magnetic latitude of Béziers (50.2° MLAT), I would consider this aurora not as "low-latitude aurora" but as "mid-latitude aurora". In comparison with auroral ovals during the extreme storms like the Carrington event (~30° MLAT), I consider that this extent is confined in mid magnetic latitude.

The references on the Carrington event should be updated. The reference of Green et al. (2014) is probably Green et al. (2006), as long as checking the NASA ADS database. Three benchmark articles for this event should be cited in this context (Tsurutani et al., 2003; Cliver and Dietrich, 2013; Hayakawa *et al*., 2019a). Moreover, recent studies have located at least three rivaling storms with extremely low-latitude auroral visibility: 1872 Feb (Silverman, 2008; Hayakawa *et al*., 2018) and 1921 May (Silverman and Cliver, 2001; Hapgood, 2019; Love *et al*., 2019). These cases should be documented as well.

The usage of LLA as historical solar activity is another story. I would rephrase this as "Being footprints of solar eruptions, the mid-latitude aurorae (or low-latitude aurorae) are considered as proxies for the long-term solar variability", citing several relevant articles such as Silverman (1992), Lockwood and Barnard (2015), Lockwood et al. (2016), Vázquez et al. (2016), and Hayakawa et al. (2017). Caveats must be noted here, however. Even when the solar activity is low, several great magnetic storms with significant auroral displays are reported as well (Garcia and Dryer, 1987; Hayakawa *et al*., 2020). This caveat should be clarified too.

2. Methodology

It is nice to cite Rozier's portrait and personal detail in this article. However, citing them from wikisource or other online resources is not the best scientific practice. Please specify their original references in the publications and cite them accordingly. The reference clarifications are especially important as most of P2 of this manuscript is devoted to its explanation and the readers may wish to know more about him with appropriate references.

3. Analyses of the Observations

The analyses seem sound but some improvements seem advised. The description of ""a flash started from the end of the lower area…". This is a frequent structure of the aurorae (Vaquero & Vasquez, 2009)" may be flaming of auroral display (Störmer, 1955). If the description of "a main structure of two bands oriented east to west" means westward auroral motion, this sounds consistent to the westward traveling surge

(Ebihara and Tanaka, 2015).

The whitish auroral colour are explained with "the enhancement of the 630,0 nm [OI] emission caused by soft electrons (<100 eV) precipitating from the plasmasphere" in this manuscript. However, I suspect the whitish colour may be explained to the enhancement of the 557.7 nm of Oxygen with weak brightness or its mixture with other emissions as well (*e.g.*, Ebihara *et al*., 2017; Stephenson *et al*., 2019). Rather than citing Abott and Juhl's statistics, it would be more straightforward to cite actual observational cases of whitish aurorae (See Section 6 of Stephenson *et al*., 2019).

For the sunspot number analyses, the authors need to cite the data source "WDC SILSO" appropriately. I would strongly recommend the authors to cite Clette et al. (2014) and Clette and Lefevre, 2016) for this dataset. Likewise, the authirs need to mention the WDC SILSO in the acknowledgment. I suspect that the cause of this storm is probably better explained with the coronal mass ejections (see Gonzalez *et al*., 1994; Daglis *et al*., 1999) rather than the high-speed solar wind from the corona hole.

Conclusion

The conclusion needs to be more developped to be an independent original article.

Supplement

It may be helpful to reproduce the French text here, as the authors stated "complete original French version is reported in the Supplementary Materials".

Minor Comments

P1L12: The authors need to be consistent for the usage of Béziers or Bezier. By the ways, isn't the observational site Beauséjour? If this is the case, the coordinate should be N43°19′, E3°13′.

P1L20: disturbs => disturbances

P1L22: Babylonians (Stephenson *et al*., 2004) => Assyrians and Babylonians (Stephenson *et al*., 2004; Hayakawa *et al*., 2016, 2019b)

P1L30: "require an accurate analysis to avoid possible misinterpretations" => Cite Kawamura *et al*. (2016), Usoskin *et al*. (2017), and Stephenson *et al*. (2019) here.

P2: Please italicise the journal titles.

P2L48: Béziers (Beauséjour) => Beauséjour in the suburb of Béziers

P3L68: “reported below in English” => “reported below in our English translation”

P3L95: “proved” => “proven”

P3L104: “the measure of time of the French Hours that lasted until the French Revolution in 1789” => Please cite a reference for this statement.

P3L104: “These times correspond” => “Given its longitude, these time stamps correspond”

P3L105: “nautical twilight” => “astronomical twilight”

P4L122-123: For auroral audibility, cite the review of Silverman and Tuan (1973).

P5L124-128: For bright aurorae visible during night with the full moon, it would be advised to reinforce the existing discussions with actual observational cases cited in Stephenson *et al*. (2019) and Hattori *et al*. (2019).

P5L137: “15th august 1780” => “15 August 1780”.

P5L143: “is” => “it is”

P6L157: “decrease phase” => “declining phase”

P6L158: “2-years delayed respect the peak of the highest solar activity” => “2-years after the maximum”

P6L160: Cite Lefevre *et al*. (2016) here.

P6L160: “few solar observation” => “few sunspot observations”

P6L162: “very welcomed” => “useful” or “informative”

P6L164: “this solar observation” => maybe “the nearest solar observation”?

P6L166: “This is 48 days without sunspot information” => “It means this event occurred in an interval without sunspot data for 48 days”.

Figure 1: The two figures are overlapped. They should be separated at least. The data source of the photograph should be addressed not with the URL but with shelf mark in the Library of Congress Prints and Photographs Division Washington.

Figure 3: Cite Clette *et al*. (2014) and Clette and Lefevre (2016) here.

Figure 4: Cite Dominguez-Castro *et al*. (2016) and Vaquero *et al*. (2016) here.

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