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## **Comment on angeo-2021-27**

Anonymous Referee #2

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Referee comment on "Seasonal features of geomagnetic activity: a study on the solar activity dependence" by Adriane Marques de Souza Franco et al., Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2021-27-RC2>, 2021

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### **Revision of:**

Title: Seasonal features of geomagnetic activity: evidence for solar activity dependence?

Author(s): Adriane Marques de Souza Franco et al.

MS No.: angeo-2021-27

MS type: Regular paper

### **Summarization:**

The work intends to study the Earth's geomagnetic seasonal features produced by solar influences. Concerning the main geomagnetic activities, the authors consider the Sun-Earth electrodynamics coupling modulation captured by (1) geomagnetic indices: the low-latitude equatorial effects (Dst), planetary effects ap, auroral effects AE, and Akasouf Epsilon parameter, and (2) the solar influences defined by some significant parameters: the solar flux (the F10.7), Interplanetary magnetic field Magnitude Bo, the South-North oriented component (supposed to be in GSM) Bs, the solar wind speed Vsw, the D500 (percentage of the days with the Vsw peak equal or higher than 500 km/s). Although

several periods have been obtained by signal analysis from the Lomb-Scargle periodograms, the investigation focus is short cycles, less or equal to an annual variation.

The data interval involves the solar cycles 20 to 24.

### **General comments:**

The work is interesting. The text is well written using clear ideas. The contents are well chained. The statistical technique is simple. Nevertheless, the current work needs some improvements. Beyond the simple statistical interpretation, some physical discussions are expected to be included.

### **Suggestions (major remarks):**

In the introduction, the authors can describe the supposed sources of the Earth Geomagnetic activity modulations more clearly.

On the one hand: the solar cycle activity (11year), the solar rotation (27 days), the solar activity features (in general lines): the electromagnetic radiation, the corpuscular radiation, plasmas emission phenomena, the heliospheric current region occurrence. On the other hand: The Earth's translational movement (solstices), the inter-hemispheric symmetry (equinoxes), and the effect of the Coordination reference systems (GSE x GSM, for instance)

### **Discussion problems not adequately addressed:**

**Line 115:** "...Thus the AE index shows an annual variation...". There are several geomagnetic stations located only in the North Hemisphere to calculate AE

(<http://wdc.kugi.kyoto-u.ac.jp/aedir/ae2/AETABLE1.html>). The asymmetric pole exposition to the Sun during the Earth translation could contribute to this annual variation.

**Line 121:** "...VBs exhibits a semi-annual variation...". It was not declared at work; however, the GSM seems the choice (from the OMNI web service option), which creates a (statistical) artefact. The Bs calculated is affected by a diary cycle (magnetic dipole attitude spinning around the rotation axis) and by a 6-month interval, i.e., this latter concerns the attitude of the Earth rotation-axis during the translation.

**Line 136:** "...HILDCAAs, on the other hand, exhibit a ~4.1-year periodicity...". Could it be related to the 11-year solar activity cycle (concerning the ascending and descending phases)?

**Line 151:** "...On the other hand, the ~1-year periodicity in Vsw/D500 can be a source of the annual variation in the AE index...". Beyond the Line 121 remark, could the Earth's slightly elliptical orbit also contribute to it?

**Lines 229-270:** The Conclusion section will be affected by the earlier remarks. Please, pay attention to other parts of the text. Some written contents in Results Section will require an update of interpretation or discussion.

**Minor remarks:**

**Line 86-87:** Please, justify the solar cycles to be grouped into the even and odd ones.

**Figure 3:** The bottom panel presents colour (VBs and D500) confusingly.

Line 146: write "...in the southern hemisphere..."