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Interactive comment on "Photospheric vortex flows close to the polarity inversion line of a fully emerged active region" *by* Jean C. Santos and Cristiano M. Wrasse

Anonymous Referee #3

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1 General comments

This article deals with the topic of vorticity computed on velocity field in the solar photosphere. The chosen topic is quite relevant, since this magnitude can have different applications in solar physics (as the stated for flares) among others (see in Specific comments). The idea of linking vorticity to fractal dimension is interesting. I suggest to perform some other comparisons on another magnetic regions, in order to show whether this fractal dimension is really dependent on the region taken (PIL) or it would be similar/different to other solar magnetic regions. It would be important to clarify how the fractal dimension would be/would not be dependent of the local correlation tracking

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(LCT) parameters (spatial and temporal).

This paper is clearly written, with good potential, which can be improved with some of the extra analyses suggested below. However, I have a number of questions and concerns, that hopefully can be clarified.

2 Specific comments

a. Page 2, line 7: In Bonet et al., 2008, it is said that "how that the vortexes are indeed associated to the occurrence of bright points". It is actually the other way round, the bright points are indeed used as vortex tracers.

b. Page 2, line 7: However, strong flares (M- or X-class) are usually associated to rapid (abnormal) sunspot rotation. I think it is more precise "However, strong flares (M- or X-class) are **sometimes** associated to rapid (abnormal) sunspot rotation", since the focus is on rotation but the main mechanism may be shear motions. Vorticity is very important, not only in the context for flares, but in different solar scenarios (e.g., the authors can check the relationship of vorticity and internal waves in Vigeesh et al., 2017).

c. Fig 2. In this figure, the polarity N1 looks more like deforming, while the polarity P1 looks like protruding into N1. For some description on polarity protrusion and their role in flares, please refer to Kusano et al. (2012); Toriumi et al. (2013).

d. In page 5, line 1, please mention why FLCT is preferred over LCT, and over other more appropriate methods for magnetograms like LCT with induction equation (i.e., DAVE-4VM, Schuck, 2008).

e. The chosen cadence (192 min) probably will lead to very small values on the surface velocity field (which it seems the case), which makes the vortices detection

more complicated (meaning “vortices” on typical granulation times, as minutes, and then allowing the long-lasting vortices to be detected). The cadence for LCT usually is adjusted to the structures one desires to track. How is this considered in this work?

f. *Importantly, the method described in Section 2.1 is similar to that developed in Kato & Wedemeyer (2017) (see references therein for their basis, as Chong et al. 1990). Please cite also this work, and it can be used for comparison. Also another very recent method is explained in Giagkiozis et al. (2018) and some references therein.*

g. Page 6, line 20: some percentages on false positives and missing events would improve the quality of the work.

h. Since LCT is very dependent on cadence and spatial sampling, one wonders how the result on fractal dimension would be with HMI data (0.6” pixel^{-1}), different cadence (shorter than 192 min), and around PIL/around a one-polarity region. This work would really improve by adding these extra analyses and re-computing the *D* dimension.

i. Page 9, line 2. Are these vortices percentage dependent on the solar hemisphere? May they be dependent on the PIL? The extra analyses (as inside/outside the PIL) can contribute also to this particular point and moreover, to the whole work relevance.

3 Technical comments

1. In the abstract (page 1, line 4), it is said “eigenvalues of the Jacobian matrix of the linear transformation”. Of which magnitude? One guesses that it is the surface velocity field.

2. Page 1, line 22: “In the quiet Sun convective flows concentrate magnetic fields in the downdraft region”. Please change to plural, regions.
3. Please mention the cadence and spatial sampling of MDI in the data description paragraph (starting in page 2, line 29). The spatial sampling and cadence only appears when explaining Fig.1. Please mention also that they are full disk MDI data, since potential readers may be not fully familiar with solar imaging datasets.
4. Please add units in Figure 1. Are these arcsecs?
5. Equations: A hyphen over the letter is a bit misleading, since it reminds to a vector. Probably other symbol would be a better choice.
6. Page 6, line 18: “The solid (dashed) contour line indicate the regions where BLOS assumes the value of +100 G (-100 G). Probably is better explained as “The solid (dashed) contour line indicate the regions where BLOS equals the value of +100 G (-100 G)”
7. Page 6, line 22: “The the identification of the critical points (LIC)” probably can be rephrased as: hereafter, LICs. What “LIC” does stand for in this work? Is it ‘line integral convolution’, as in Kato & Wedemeyer (2017)?
8. Please add maximum and minimum values for the units in Figure 3.
9. Page 7, line 9, section Results: please detail how the fractal dimension is computed in this case.
10. Page 7, line 16: Please explain how is resampled (what was the original size of the image which is resampled to 128x128?
11. Please add units in Figure 4.
12. Please detail in the text the content of Figure 7. Are these counts non-cumulative? Are they computed every time step?

References

Giagkiozis, I., Fedun, V., Scullion, E., Jess, D. B., & Verth, G. 2018, ApJ., 869, 169 DOI: https://doi.org/10.3847/1538-4357/aaf797

Kato, Y., & Wedemeyer, S. 2017, A&A, 601, A135, DOI: https://doi.org/10.1051/0004-6361/201630082

Kusano, K., Bamba, Y., Yamamoto, T. T., et al. 2012, ApJ., 760, 31, DOI: https://doi.org/10.1088/0004-637X/760/1/31

Vigeesh, G., Steiner, O., Calvo, F., & Roth, M. 2017, Mem. S.A. It., 88, 54

Schuck, P. W. 2008, ApJ., 683, 1134

Toriumi, S., Iida, Y., Bamba, Y., et al. 2013, ApJ., 773, 128 , DOI:https://doi.org/10.1088/0004-637X/773/2/128

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