Response to the interactive comment from Reviewer #2, an anonymous reviewer

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MINOR COMMENTS

1) I find the presentation of the technique somewhat unbalanced: while most of the concepts presented in detail in section 2 can be found in a number of books and are, in general, well-known (it could be moved to an Appendix), almost no detail is provided about the method used to impose the local anisotropy (based on the Generalized Scale Invariance model; Niemi et al., 2014). I would strongly suggest to add a brief description (if necessary, in an Appendix, as well).

Thank you for raising this point. Our intention was to provide the reader with the necessary basic definitions that are relevant to understand the transition from a classical approach to the Short-Space Fourier transform. By subdividing the theoretical sections into clear subjects, we give the reader the option to skip those parts he or she is already familiar with.

It is important to mention that we only used a non-parametric stochastic generator, i.e. we filter the white noise field using the actual local Fourier transform of the rainfall field. The fitting of a GSI model as in Niemi et al. (2014) is not employed in our study. We only implemented a GSI model and defined arbitrary parameters to test the SSFT approach with synthetic data. For these reasons, we decided not to dedicate a section for a detailed explanation of the GSI model, but we tried to better specify how we employed it.

> *Page 13:* **As next step, ~~anisotropy was introduced in the simulation of synthetic data~~the method was tested in its capacity to reproduce the locally varying anisotropy of a synthetic target image. This target image was ~~done~~ produced by means of the Generalized Scale Invariance (GSI) model as presented by Niemi et al. (2014). […].**
> **In a similar way as in Fig. 4, the set of arbitrary parameters of the GSI model ~~were~~ was spatially varied in order to ~~introduce~~ produce a target image ~~a~~with changing anisotropy ~~into a field of correlated Gaussian noise~~.**

2) The figures should be sequentially cited in the text. Currently, Figs. 8 and 9 are cited in page 7 (before first citation of Fig. 2), and Fig. 11 is cited in page 14 before Fig. 7.

For the sake of consistency, we removed the whole reference to Figs. 8 and 9 in page 7 and replaced the reference to Fig.11 in page 14 with a single reference to Section 5.3.

3) Figs. 8 and 9. It is unclear to me why the authors have chosen to rotate the 3D power spectra by 90 degrees and use a decreasing y axis to display the 2-D autocorrelation functions. Why is it better to use these configurations?

The rotation of the 2D power spectra by 90 degrees in Figs. 8 and 9 is motivated by the wish to improve the interpretability of the anisotropy observed in the power spectra. In fact, the rotation allows a direct comparison to the original radar fields and to the spatial autocorrelation function. Thus, the idea is to help the reader to more easily connect the structures observable in the geographical space with the representation in the Fourier space. We modified the figures' caption in order to motivate our choice:

Caption of Fig. 8: **Radar rainfall fields (top row), 2D Fourier spectra zoomed on ~~frequencies~~wavelengths > 13 km and rotated by 90° (centre row) and corresponding 2D autocorrelation functions (bottom row) […]. The 90° rotation is performed in order to align the anisotropies of the 2D spectra and spatial autocorrelation functions.**

Conversely, the inverted y-axis in the 2D autocorrelation function appears to be a simple mistake in our codes: the orientation of the figures is correct, but the axis labels were inverted. We corrected the error in all concerned figures.

4) I miss the color palette in Figs. 3 – 5 and 10. It is clear that the simulated fields have arbitrary units, but this could be explicitly stated in the text.

Yes, these are arbitrary units. Specifically, the values belong to the standard normal distribution. As suggested, we both included colorbars in the concerned figures and a short explanation in the captions:

Captions of Figs. 3-5 and 10: **All noise fields have been drawn from the standard normal distribution and share the same random seed.**

SPECIFIC COMMENTS

1) Page 1, line 11. "Differences" could be replaced by "variability".

We changed the term as suggested.

2) Page 4, line 17. To my knowledge, Ciach et al. (2007) did not propose the use of any stochastic noise generator. The sentence "A major limitation and concern of all the cited stochastic generators is that they assume spatial stationarity: : :" (page 4, lines 26-30) might be misleading because some of the references provided in section 1.1 (e.g. Germann et al., 2009; Villarini et al. 2009) did not assume spatial stationarity of the rainfall field.

Thanks for this remark. We moved the citation of Ciach et al. (2007) to the previous sentence where we mention the residual radar measurement uncertainty.
We also agree that our original statement was somehow misleading, considering that not all cited references include the assumption of spatial stationarity, as correctly pointed out by the reviewer. We changed it as follows:

Page 4: **~~A major limitation and concern of all the cited stochastic generators is that they assume spatial stationarity~~ Apart from few exceptions, the stochastic generators presented above assume spatial stationarity, i.e. uniformity of the generator across space.**

3) Page 6, lines 27 – 34 and elsewhere. The term "spectrum" is used indistinctively to refer to the Fourier spectrum, X(f), and to the power spectral density, S(f). For clarity, it could be better to use it for S(f).

Following the reviewer's suggestion, we kept using the term power spectrum as a synonym for power spectral density. The complex Fourier amplitude-phase spectrum is now referred to as complex Fourier representation.

4) Page 9, lines 26-30. At first, I found this paragraph a little misleading: although the title of the section is "Short-space Fourier transform", this first paragraph (and up to Page 10, line 4) focuses on the time-frequency signal analysis.

We included an introductory sentence to Section 3.1 in order to limit any possible confusion.

> *Page 9:* **The concept of Short-Space Fourier Transform is introduced through its more intuitive 1D temporal equivalent and then extended to the 2D spatial case.**

References

Ciach, G. J., Krajewski, W. F., and Villarini, G.: Product-error-driven uncertainty model for probabilistic quantitative precipitation estimation with NEXRAD data, J. Hydrometeorol., 8(6), 1325–1347, 2007.

Niemi, T. J., Kokkonen, T., and Seed, A. W.: A simple and effective method for quantifying spatial anisotropy of time series of precipitation fields, Water Resour. Res., 50, 5906–5925, doi:10.1002/2013WR015190, 2014.

Germann, U., Berenguer, M., Sempere-Torres, D., and Zappa, M.: REAL—Ensemble radar precipitation estimation for hydrology in a mountainous region, Q. J. Roy. Meteor. Soc., 135, 445–456, 2009.

Villarini, G., Krajewski, W. F., Ciach, G. J., and Zimmerman, D. L.: Product-error-driven generator of probable rainfall conditioned on WSR-88D precipitation estimates, Water Resour. Res., 45, W01404, doi:10.1029/2008WR006946, 2009.