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Interactive comment on "Constraining on the Stationarity of Signal with Time-Frequency Surrogates to Enhance the Reliability of Singularity Spectrum Attributes of Random Seismic Noise Wavefield" *by* Amir Ali Hamed et al.

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EC: Unfortunately the English is not fluent and the clarity of the sentences and concepts is not always achieved. Even the abstract, which in principle has to outline clearly and synthetically the main findings of the study, seems quite obscure and does not convey clearly the information on what is the outcome of the presented research.

AC: Many thanks for the comment. The abstract contents were thoroughly revised as follows:

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Discussion paper

Extended Abstract. The diffusivity of incoming seismic noise is certainly a critical precondition for executing seismic interferometry. But higher than the narrow ~ (0.05 -0.3) Hz microseismic bandwidth, this diffusivity stems mostly from the heterogeneity of local site characteristics, therefore the heterogeneity level of sites should be assessed beforehand in order to make an accurate assessment of a Green's response. As evidenced by recent studies (e.g. Padhy 2016), it has become evident that seismic signals show a self-afïňĄne long-range persistence in their coherent parts (e.g. P or S body waves) which is slowly disappeared with the emergence of the incoherent diffused incoming wavefield (i.e. Coda waves). Pilz and Parolai (2014) showed that the rate of this evolving transition is closely linked to the heterogeneity level of a medium in such a way that for a strong heterogonous medium less time will be needed for falling signal into the diffuse state. Therefore learning the fractality of a seismic noise will indirectly provide the basis for a decision on the potential place for executing this method. But this conclusion rests on this pillar that input incoming noise wavefield is always stationary, but there is obviously a degree of ambiguity surrounding such assumption. There may be circumstances under which signals include: a) Intrinsic Non-Stationary Direct Waves (as indicated by Hillers and Ben-Zion, 2011, the interaction of wind and topography, by near-surface microcracks or micro earthquakes may repetitively generate a reproducible source of energy. Because of this repetitive reproducibility, they do not necessarily equivalent to temporary superposed perturbations. So depending on the generating source type and distance from the receiver, they might cause large variability in the characteristics of seismic noise signals.). b) Intrinsic Non-Stationary Scattered Waves (see, for instance Meng, et al., 2015 who showed that the incoherent coda waves induced by multiple scattering is a non-stationary signal, or Margerin et al., 2016 where they showed that stronger emphases need to be placed on the active scattering in an unstable perturbed medium), Intrinsic Stationary/ Non-Stationary Direct Waves). c) External non-Stationary signals (e.g. segments with different properties, random outliers or spikes with different amplitudes, etc.). In executing the fractal analysis, it is essential that the method chosen be consistently reliable to ensure that the correct Hurst coefficient is being used for the interpretation. There is broad agreement on the appropriateness of MFDFA in studying multifractal scaling behavior of non-stationary time series, but it fails to comply with the intrinsic non-stationarity of signals (please take a look at the responses given to the RC1 comments, to find complete explanations in this regard.). In this paper, we used the method introduced by Borgnat et al., (2010) to recognize the inherent characteristics of signal in the pre-processing step, before the feeding data into the cycle of Fractal analysis. Based on this revised method we try to define the degree of heterogeneity of different sites, located at the North-Western of Iran.

References:

Borgnat, P., Flandrin, P., Honeine, P., Richard, C., and Xiao, J.: Testing stationarity with surrogates: A time-frequency approach, IEEE Transactions on Signal Processing, 58, 3459-3470, 2010.

Hillers, G., and Ben-Zion, Y.: Seasonal variations of observed noise amplitudes at 2–18 Hz in southern California, Geophysical Journal International, 184, 860-868, 2011.

Margerin, L., Planès, T., Mayor, J., and Calvet, M.: Sensitivity kernels for coda-wave interferometry and scattering tomography: theory and numerical evaluation in two-dimensional anisotropically scattering media, Geophysical Journal International, 204, 650-666, 2015.

Padhy, S.: The Multi-fractal Scaling Behavior of Seismograms Based on the Detrended Fluctuation Analysis, in: Fractal Solutions for Understanding Complex Systems in Earth Sciences, Springer, 99-115, 2016.

Pilz, M., and Parolai, S.: Statistical properties of the seismic noise field: influence of soil heterogeneities, Geophysical Journal International, 199, 430-440, 2014.

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