Interactive comment on "Fractal analysis of INSAR and correlation with graph-cut based image registration for coastline deformation analysis: post seismic hazard assessment of the 2011 Tohoku earthquake region" *by* P. K. Dutta and O. P. Mishra

Anonymous Referee #2

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Dutta and Mishra: Fractal analysis of INSAR and correlation with graph-cut based image registration for coastline deformation analysis: post seismic hazard assessment of the 2011 Tohoku earthquake region

The paper is of general interest for the geoscience research community and within the scope of GI journal. However, the manuscript would benefit from a rather significant rework to improve the structure. Also, a thorough proof-reading should be performed

to clarify the language and to reduce the number of spelling errors. I would highly recommend using simpler and more direct language: science improves with legibility. In general, I think the paper could be shorter, too. These updates require a major revision round.

In my opinion, the authors should concentrate more on describing the analysis methods than describing tsunamis. There is great potential for the methodology to be used in other applications as well, so a user-friendly description of the actual method including validation (error estimates) would benefit a wider audience. Perhaps, the authors could consider sharing their Matlab code on their web site to encourage others to experiment with their method?

1. The title could be shortened. In fact, the authors mostly discuss damage rather than hazard (risk of possible damage) assessment.

2. The abstract should be clarified and rewritten. It is not obvious what the original problem setup is and how the authors contributed in solving the problem. And how the authors' method compares with other approaches.

3. The abbreviation INSAR is not defined anywhere, it's better to spell out the abbreviation in the abstract.

3. The introduction needs to be rewritten. First, the authors should describe the image registration problem with relevant references to related work and then they should list their contributions. A lengthy description of the tsunami is not relevant for the fractal analysis nor graph-cut-based registration.

4. The image registration surveys in the reference list are from 1992 and 2003. So, they are almost ten years old!! A brief literature search surely would reveal newer techniques for non-rigid image registration — especially in the medical image processing. Have you looked at stereo vision research or data fusion papers, where determing the point correspondence in two (or more) images is a critical task? What is the state-

of-art today? How does the graph-cut method compare with it, what are the advantages/disadvantages?

Some additional references which *may* contain useful links to other research:

Bhagalia et al., "Accelerated nonrigid intensity-based image registration using importance sampling", IEEE Tran. Medical Imaging, 2009, DOI: 10.1109/TMI.2009.2013136

Oldridge et al., "Mapping the problem space of image registration", 2011, DOI: 10.1109/CRV.2011.48

Crum et al., "Non-rigid image registration: theory and practice", 2004, DOI: 10.1259/bjr/25329214.

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5. The section 2 (Methodology of pre-process and data retrieval) is confusingly written. The idea and motivation of this text are difficult to determine. Perhaps, a graphical illustration would serve better to show the definitions and clarify the intent of authors? Please clarify the terminology, why are some parameters in quotes (e.g. vector "A" specifies the assignment of pixels "p" in "P")? The presentation of lists could be improved by using proper numerated lists (one task per one line).

6. "various transformations" (section 2, line 28): what are these various transformations? A computer algorithm has to be specific so that it can be programmed in the first place!!

7. It is unclear what the authors' contributions are in sections 2.1 (Image registration), 2.2 (Graph-cut based non-rigid...) and 2.3 (Fractal analysis...). Clearly identify what you have done and what others have done. Are the equations from others' works? What is new? If the algorithm (steps 1-16) is from a previous work and which you then implemented, please state so and provide specifics about differences and why you changed things. Could it be in an appendix, if duplicated from earlier work for the reader's convenience?

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8. In the graph cut method (steps 1-16), how do you perform the discrete labeling? What are the matched features, intensity and smoothness? What is the similarity measure? If you use intensity and smoothness as an aggregated feature, what sort of normalisation did you use if any?

9. I would prefer to collect most of the references to related work on image registration into a separate and more detailed discussion section. It would be interesting to hear the authors speculations and analyses about how well their method compares with others, too.

10. The method needs to be validated somehow. One solution is to extend the manual segmentation which then forms the "ground truth".

11. The Tohuku event should be in a separate case-study-like section (before the discussion section). This allows the reader to first concentrate on the methodology and then see it applied to a real case. As the coastline deformation can also be caused by other reasons (building harbours, floods etc.), the earthquake-initiated tsunami is just one possible cause for change of landscape. How does the method improve the post analysis? Could the devastation zone be determined by other methods?

12. Section 3 (Fractal analysis...) includes several claims that are not immediately obvious to the reader. E.g. line 27: why are active contour models preferred? How were the regions determined for Table 2 and Fig 5? How and why did you choose these ranges for region displacements? Would you obtain different results if some other ranges were used?

13. In section 4 (Conclusions), the authors use phrases like "comprehensive analysis of available INSAR images". On the other hand, in the introduction, the term ASAR is used. So, which is it, INSAR or ASAR? Details of the actual data used in this study should be provided in the case-study section that I suggested above. That section should also describe what the "diagnosed in the same visualization framework for change of pixel analysis" actually means (sec 1, 2nd paragraph, line 15).

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Tables and Figures ——————-

Table 1. How did you obtain these values? Why is this comparison not described in the text in more detail as this likely is a valuable contribution of this manuscript?

Table 2. Again, how did you obtain these values? How did you compute and normalise the joint intensity histograms? There are many algorithms in the literature. What are the uncertainties, as this analysis is apparently done after image registration process?

Table 3. Which entropy definition did you use (and why)? What is the size of the local neighbourhood in local entropy and why? In here, the reader is left alone to analyse the "disorder of the image". It is obvious that the scene looks different after the earthquake, isn't it? So, what do these numbers tell us?

Fig 1a and 1b: it would help the reader if you could show an "before and after" composite image. This could be two rectangle outlines illustrating the mutual alignment after image registering. Also, a simple intensity difference image would highlight changes to the human eye.

Fig 2a and 2b: I found the naming Static image and Moving image very confusing. Aren't both images static in the sense that they were captured at a certain time instant? (c.f. video images)

Fig 3 and Fig 6: The text in the plots is illegible. The authors should also extend the captions to help the reader understanding the reason for including these plots: what should we see in the curves? What are the solid lines and what are the dots?

Fig 4: would this figure not be easier to examine if it were 2D instead of a 3D meshplot?

In the pdf-file containing the manuscript, the plots appeared as if they were screen captures stored in JPG-format or some other lossy compression. Please use vector graphics (pdf, eps) to provide higher quality plots allowing better zooming.

Fig 5: How did you carry out the manual segmentation? What were the criteria for the

human operator who did the segmentation? Why?