Dear Reviewer,

Thank you for your letter and for the reviewer's comments concerning our manuscript. We have addressed issues including further expansion and/or clarification on certain aspects of the paper. Those comments are all valuable and very helpful for revising and improving our paper, as well as the important guiding significance to our researches. We have studied comments carefully and have made correction which we hope meet with approval. The corrections have been marked red in the revised manuscript. Point by point responses to the reviewers' comments are listed below this letter.

Specific comments 1:

1. Some conclusions and statements are not supported by the results or are contradictory. For instance, according to the abstract and the discussion "there is no significant difference between the impacts of natural and anthropogenic factors" (Page 2940 Line 16-17; P 2952 L 20-23). However, according to the results and the conclusions, "natural factors have higher impact on KRD deterioration" (P2954 L23). Please clarify those points.

Response to comment No. 1

We compared PDs of natural and anthropogenic factors to evaluate their relative impact in the manuscript. As shown in the manuscript, the natural and anthropogenic factors have similar overall impact on KRD improvement and natural factors have a relatively greater impact on KRD deterioration than anthropogenic factors. The content is as follows:

Page 10 L14-16: "This implies that natural factors (with ranks of first, third, fifth, seventh, and eighth) and anthropogenic factors (with ranks of second, fourth, sixth, and ninth) have similar overall impact."

Page 12 L9-11: "It seems that natural factors (with ranks of first, second, fifth, sixth, and seventh) have a relatively greater impact on KRD deterioration than anthropogenic factors (ranked third, fourth, eighth, and ninth)."

Therefore, we state in the conclusion that: "Our results imply that there is no significant difference between natural and anthropogenic factors when it comes to influencing KRD improvement, but natural factors have a higher impact on KRD deterioration." However, as the comment, we just "there is no significant difference between the impacts of natural and anthropogenic factors" in the abstract and the discussion. And we do not explain the detailed difference of KRD improvement and deterioration.

To clarify our meaning and coordinate the content, we have refined these points as follows:

Abstract: "Interestingly, to our study at least, there is no significant difference between the impacts of natural and anthropogenic factors influencing KRD improvement, and even natural factors have a higher impact on KRD deterioration."

Discussion: "In our case study, there is no significant difference observed between the impacts of natural and anthropogenic factors influencing the KRD improvement based on the order of their PDs. Even natural factors have a higher impact on KRD deterioration."

Specific comments 2:

2. P2945 L5: In order to widen the applicability of the suggested method could you provide the soil taxonomy used to classify the soils.

Response to comment No. 2

The soil taxonomy used in the manuscript is the Genetic Soil Classification of China, which has been widely used in the soil survey in China. In our case study, there are 8 types of soil subgroup as follows: Calcareous soil, Rendzina, Purplish soil, Acidic lithosol, Skeletal soil, Paddy soil, Yellow soil, Terra rossa. As soil classification systems are not consistent among countries or organizations. We have provided the Genetic Soil Classification of China in the revised manuscript and added a reference with an overall introduction of this classification.

"Natural factors include soil type classified by the Genetic Soil Classification of China (Shi et al., 2004),"

"Shi, X.Z., Yu, D.S., Warner, E.D., Pan, X.Z., Petersen, G.W., Gong, Z.G, Weindorf, D.C., 2004. Soil Database of 1:1,000,000 Digital Soil Survey and Reference System of the Chinese Genetic Soil Classification System. Soil Survey Horizons 45, 129–136."

Specific comments 3:

3. Please clarify that the information on human activity farming (hilly lands, overgrazing, felling and restoration projects) was not directly evaluated but represented by proxies of distances to roads and settlements for it is difficult to measure it directly as you state in the conclusions P2945 L9-11).

Response to comment No. 3

We have clarified this statement in the conclusions as follows:

"We use GIS techniques to quantify the information on human activity farming (hilly lands, overgrazing, felling and restoration projects) by proxies of distances to roads and settlements for it is difficult to measure it directly."

Specific comments 4:

4. (P2945 L22-23) Could you provide any reference of other works using the same classification of the variables you used? If not, could you explain and support the classification selected?

Response to comment No. 4

As the soil, lithology and vegetation data are discrete data, we just classify them as the origin data source. For other continuous variables, we majorly used the method of natural breaks coupled with the professional knowledge and rounded the intervals as the integer format. The 15 and 25 degree for the classifications of slope are the critical intervals which are related to the soil erosion and widely used in China. The other variables exhibiting local characteristics should discretize them as significantly different classes based on the numerical characteristics of variables. This is similar to other studies in the application of the geographic detector model (Hu, et al., 2011; Wang et al., 2010). Natural breaks method is executed in the Arcgis and seeks to minimize each interval' s average deviation from the interval mean, while maximizing each interval' s deviation from the means of the other groups . In other words, the method seeks to reduce the variance within intervals and maximize the variance between intervals.

We provide above information in the revised manuscript as follows:

"Based on the distribution and prior knowledge of data, we majorly used the method of natural breaks coupled with the professional knowledge and rounded the intervals as the integer format (Figure 2). As continuous variables are with local characteristics, natural breaks can seek to minimize each interval' s average deviation from the interval mean, while maximizing each interval' s deviation from the means of the other groups . In other words, the method seeks to reduce the variance within intervals and maximize the variance between intervals."

Hu, Y., Wang, J. F., Li, X. H., Ren, D., and Zhu, J.: Geographical detector-based risk assessment of the under-five mortality in the 2008 Wenchuan Earthquake, China, PloS one, 6, e21427, doi:10.1371/journal.pone.0021427, 2011.

Wang, J. F., Li, X. H., Christakos, G., Liao, Y. L., Zhang, T., Gu, X., and Zheng, X. Y.: Geographical detectors-based health risk assessment and its application in the neural tube defects study of the Heshun Region, China, Int. J. Geogr. Inf. Sci., 24, 107–127, 2010.

Specific comments 5:

5. As an innovative spatial analysis technique, the geographic detector model and the index used should be explained in detail (P2946). For instance, how do you calculated the mean values for the KRD evolution indexes for various levels of driving factors? How those values are interpreted?

Response to comment No. 5

We have explained how the model calculate mean values for the KRD evolution indexes for various levels of driving factors in the revised manuscript. The geographical detector model overlays the distribution of K (e.g., E-KRD in our study) over several strata of driving factors of D (i.e., one of driving data) and the mean value and the dispersion variance of K. It can be demonstrated in the Figure 1 by Wang et al., 2010 (K was presented by H in Wang's paper).

Wang, J. F., Li, X. H., Christakos, G., Liao, Y. L., Zhang, T., Gu, X., and Zheng, X. Y.: Geographical detectors-based health risk assessment and its application in the neural tube defects study of the Heshun Region, China, Int. J. Geogr. Inf. Sci., 24, 107–127, 2010.

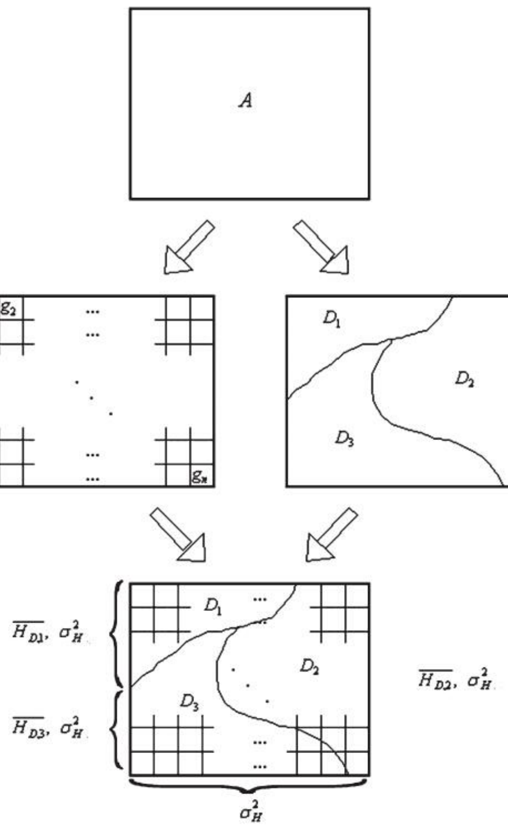

Figure 1

The added content is as follows:

"The geographical detector model overlays the distribution of K (e.g., E-KRD in our study) over several strata of driving factors of D (i.e., one of driving data). D_i (where i=1, 2,… n, and *n* is the number of categorical types of D) are the discrete attributes associated with a stratum of driving factors of D, which is denoted as D={D_i} (Li et al., 2013; Wang et al., 2010b), then the study regions were divided to sub-regions (D_1, D_2, … D_n). The mean value and the dispersion variance of K (denoted as $\sigma^2_{K_{D,i}}$) can be calculated by the model."

Also we explain what a higher PD means in the revised manuscript as follows:

"When the $\sigma^2_{K_{D,i}}$ of each subregion is small, the variances between sub-regions is large and the PD is large (which means that such a division explains most or even all of the spatial K variation). Therefore, a higher PD indicates that the driving factor (D) has a larger impact on K."

Specific comments 6:

6. A table including the PDs of the driving factors for both improvement and deterioration would be helpful.

Response to comment No. 6

We have added the Table 8 to show PDs of driving data and their order for both of the KRD evolution in the revised manuscript when we compare the difference of driving data influencing KRD improvement and deterioration.

Table. 8 PDs of driving data and their order for both the KRD improvement and deterioration

	KRD improvement		KRD deterioration	
	PD	Order	PD	Order
Soil type	0.120	3	0.194	1
Lithology	0.154	1	0.151	2
Vegetable type	0.088	5	0.099	6
Elevation	0.062	7	0.138	5
Slope	0.029	8	0.056	7
Road influence	0.135	2	0.143	3
Settlement influence	0.073	6	0.140	4
GDP density	0.013	9	0.022	8
Population	0.105	4	0.014	9

Specific comments 7:

7. According to the results of the factors considered is 0.779 for improvement and 0.957 for KRD deterioration (P2948 L21-23 and P2949 L15-17). Does it mean that there are complementary factors not included in this study with PDs of 0.221 and 0.043 respectively affecting the KRD evolution?

If so, please consider to include a sentence stating this and explaining the difference observed between improvement and deterioration.

Response to comment No. 7

Indeed, there are complementary factors not included in this study as we could not include all the driving data in the study. The model overlays the distribution of K (e.g., E-KRD in our study) over several strata of driving factors of D (i.e., one of driving data) to calculate each PD of driving data separately. Then PD of each driving data solely reflects the impact of itself. If the driving factor D completely controls the total K, then PD = 1 in theory. Therefore, there is not a restriction that the sum of all driving data's PD is 1.

As the above comment, we could sum PDs of driving data (0.779 for improvement and 0.957 for KRD deterioration) to compare the difference between improvement and deterioration. It indicates that our selected driving data have a relatively larger impact on KRD deterioration than improvement. Then we added this statement in the revised manuscript as follows:

"Moreover, summing PDs of driving data (0.779 for improvement and 0.957 for KRD deterioration), it indicates that our selected driving data have a relatively larger impact on KRD deterioration than improvement. Indeed, we could not include all the driving data in the study. For example, meteorological factors are relatively similar at the county scale and were neglected in this study."

Specific comments 8:

8. P2950 L8-10: sorry but in my opinion the results confirm that soil type influences KRD transformation, likely due to their different hydrological proper ties and susceptibility to erosion, but not that "soil types are associated with water retention capacity and soil conservation".

Response to comment No. 8

As the above comment, we have revised this sentence as follows:

"This confirms that soil types are associated with their different hydrological proper ties and susceptibility to erosion, which influence KRD transformation."

Specific comments 9:

9. I do not understand the interpretation of the results included in tables 5 and 7 and the related discussion and conclusion. I understand that if C>A+B there is an enhancement of the impact of those factors. However, if C<=A+B, how could it be that there is an enhancement of the impact of those factors?

Response to comment No. 9

We show the explanation of model in the website (http://www.sssampling.org/Excel-GeoDetector/) with the Figure 2.

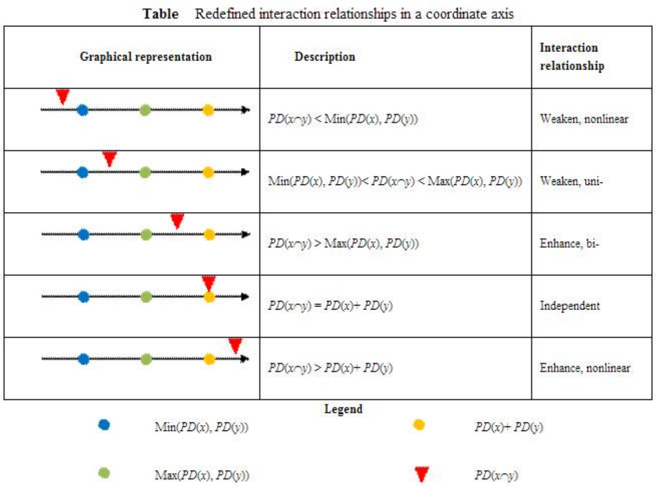

Table Redefined interaction relationships in a coordinate axis

Graphical representation	Description	Interaction relationship
	$PD(x \cap y) < Min(PD(x), PD(y))$	Weaken, nonlinear
	$Min(PD(x), PD(y)) < PD(x \cap y) < Max(PD(x), PD(y))$	Weaken, uni-
	$PD(x \cap y) > Max(PD(x), PD(y))$	Enhance, bi-
	$PD(x \cap y) = PD(x) + PD(y)$	Independent
	$PD(x \cap y) > PD(x) + PD(y)$	Enhance, nonlinear

Figure 2

Although C<=A+B, C >A or B. At this situation, A and B enhance each other and do not weak each. If they reflect a weaken interaction, PD(A∩B) would be not only smaller than PD(A)+PD(B) but also smaller at least A or B.

Specific comments 10:

10. Could you include the scale of the geographic information in table 3 please?

Response to comment No. 10

We have included the scale of the geographic information in table 3 as follows:

Table 3. Driving data sources and processing

Input dataset	Data source	Format	Processing	Variable	Scale
Soil	Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences	Polygon	Format transformation	Discrete	1: 500000
Lithology	Local map of Changshun county	Polygon	Digitization and format transformation	Discrete	1: 500000
Vegetable	Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences	Polygon	Format transformation	Discrete	1: 500000
Elevation	International Scientific Data Service Platform, Computer Network Information Center, and Chinese Academy of Sciences	Raster	Resampling	Continuous	1:50000
Slope	International Scientific Data Service Platform, Computer Network Information Center, and Chinese Academy of Sciences	Raster	Generated from the elevation map	Continuous	1:50000
Buffer of roads	Local map of Changshun county in 2000	Polyline	Digitization and buffer analysis	Continuous	1:50000
Buffer of settlements	Local map of Changshun county in 2000	Point	Digitization and buffer analysis	Continuous	1:50000
Gross Domestic Product density	Data Center for Resources and Environmental Sciences, Chinese Academy of Sciences	Raster	Resampling	Continuous	1:500000
Population density	Data Center for Resources and Environmental Sciences, Chinese Academy of Sciences	Raster	Resampling	Continuous	1:500000

Technical corrections 1:

1. P2946 L14: delete the “(“ before D.

Response to comment No. 1

We have deleted the “(“ before D in the revised manuscript.

Technical corrections 2:

2. P2952 L28: I miss a space between “factors” and “Febles-González et al. 2012)”.

Response to comment No. 2

We have added the space in the revised manuscript.

Technical corrections 3:

3. P2953 L21: should it be (A \B) < PD (A)+PD (B)?

Response to comment No. 3

We have changed the mistake as “PD (A∩B) < PD (A) + PD (B)”.

Technical corrections 4:

4. Table 4 footnotes: Level 3 is not different from level 4.

Response to comment No. 4

We have corrected that “Level 3 is not different from level 4”.

5. Table 5 and 7: should it be “vegetation” instead of “vegetable”?

Response to comment No. 5

The “vegetation” was instead of “vegetable” in the revised manuscript.

Special thanks to you for your good comments.

We tried our best to improve the manuscript and made some changes in the manuscript. We appreciate for Editors/Reviewers’ warm work earnestly, and hope that the correction will meet with approval.

Once again, thank you very much for your comments and suggestions.