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Natural Hazards and Earth System Sciences
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Interactive comment on "Hazard interaction analysis for multi-hazard risk assessment: a systematic classification based on hazard-forming environment" *by* B. Liu et al.

B. Liu et al.

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We thank Dr Martin Mergili for his useful and helpful comments. In the following, we provide our reply to the comments:

1. The article is well written in general, some final polishing of language will be necessary.

Re: We have made every effort to check and edit our English to provide the revised version.

2. Even though Figs. 1 and 2 are informative, they should be designed in a more

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appealing way (e.g. by using colours).

Re: In the revised version, we have re-designed these two figures to make them more attractive, including using different shapes and colours as suggested.

3. Section 3 takes up a lot of space, even though it does not contain any new information, but only compiles well-known issues. I acknowledge that this information is important within the scope of the article, but in my opinion it should be provided in a condensed way e.g., as a table, instead of an entire section.

Re: Thanks for the useful suggestion. In the revised version, we have added a new table - Table 1 - to replace Section 3 in the previous version. This table gives the definition, stable factors and trigger factors to some major natural hazards.

4. On p7215, l20 the authors mention that drought and slow riverine flood cannot happen at the same time. Even though I acknowledge that such a coincidence is not very likely, the authors should be careful with this statement as flooding may be caused by the meteorological conditions far away from the impact area.

Re: To avoid misunderstanding, we have taken out this example in the revised version.

5. My major concern: the proposed concept is expressed in an extremely general way, making it impossible to assess its validity and applicability. However, the authors mention the application of the scheme to the Yangtze River Delta. In my opinion, this case study has to be laid out in detail in the paper in order to show a practical application of the methodology, and to demonstrate how to make it an integral part of a multi-hazard risk assessment. I would like to emphasize that for me, this point is highly critical with regard to the possibility to accept a revised version of the manuscript.

Re: Thank you for the constructive comment. To address the reviewer's concern, we have added a new section entitled "A case study in China's Yangtze River Delta" after the section "Application in multi-hazard risk assessment". This new section depicts the use of the classification scheme within a multi-hazard risk assessment model to esti-

NHESSD
3, C3037–C3040, 2016

mate potential loss caused by multiple hazards in China's Yangtze River Delta (YRD). There are three sub-sections in this section and they are:

1) Hazard identification: it is used to identify which kinds of natural hazards occur in the YRD and summarise the spatial distribution of these hazards based on the stable factors. The YRD is mainly influenced by typhoon, flood (slow riverine flood, fast riverine flood, coastal flood and pluvial flood) and landslide. According to the types of hazards in each assessment unit, the whole YRD area is divided into four zones.

2) Hazard interaction analysis: according to the trigger factors for various hazards in the YRD, the relationships among multiple hazards in the YRD were discussed in each zone. Then the exceedance probabilities of multiple hazards occurring with different magnitudes were calculated based on the mathematical statistics approach with the change of trigger factors.

3) Multi-hazard risk assessment: Here, the YRD being struck by two consecutive typhoons (the most common multi-hazard scenario in the YRD) is taken as an example of this risk assessment. The first and second typhoons have an independent relationship. These two typhoons could induce various kinds of floods and landslides. Maximum daily rainfall and maximum daily wind speed in each typhoon were selected as trigger factors to construct the set of hazard-related indicators which represent the magnitudes of multiple hazards. With respect to losses, this case study takes the economic loss as an example, with Gross Domestic Product (GDP) in 2013 selected as the exposure indicator. The vulnerability-related indicators selected were: the number of mobile phone users per 10,000 people, doctors per 10,000 people, population density, GDP per km2, number of medical institutions per km2, percentage of population age >15 and < 65, percentage of male residents, and percentage employed. Based on the historical loss data form 1980 to 2012, the loss distribution influenced by multiple hazards with different exceedance probabilities was calculated.

By adding this new section and its sub-sections in the revised version, we hope that

NHESSD

3, C3037–C3040, 2016

the reviewer's concern is clarified and answered.

The revised version was uploaded in the form of a supplement.

Please also note the supplement to this comment:
http://www.nat-hazards-earth-syst-sci-discuss.net/3/C3037/2016/nhessd-3-C3037-2016-supplement.pdf

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Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 3, 7203, 2015.