

Reviewer 1

Thank you very much for your observations. You kindly spent time delving into our manuscript, and we are grateful. We have used a colour code to answer your questions. Please find your comments in grey, and the respective answers in black. The corresponding paragraph in the paper is in dark blue.

Comments

- Using one of the leading databases on scientific journal publications, the authors performed an assessment of articles published between 2008 and 2018 addressing the social and economic dimensions of vulnerability. From originally 235 articles, 21 were finally chosen for a detailed analysis. However, while the authors initially stated to undertake a systematic review for an application on an urban scale, the results and conclusions do not necessarily mirror this aim.

Thank you for your observation. A systematic review searches for, appraises and synthesises research evidence (Grant & Booth, 2009). We indicate the time period selected for the systematic review (2008-2018) as well as an indication of the terms selected for the query. As a decision of one of the authors, the complete list of search terms was not included in the manuscript; however, we can include it in a revised version. Please find the search terms used in Table 1.

Topic	(social vulnerability* OR societal vulnerability* OR socioeconomic vulnerability* OR socio-economic vulnerability* OR economic vulnerability*)
	AND
Topic	(area* OR distance* OR range* OR distance* OR direction* OR spatial geometries* OR patterns* OR spatial connectivity* OR isolation* OR diffusion* OR spatial association* OR scale* OR accessibility* OR network* OR cluster*)
	NOT
Topic	(climate change* OR ecological* OR drought* OR resilience* OR debris* OR epidemiological* OR substance* OR behavioral* OR evacuation* OR recovery* OR pollution* OR leptospirosis* OR violence* OR illness* OR disease* OR heat* OR crisis* OR Conflict* OR deaths* OR obesity* OR criminal* OR chemical* OR symptoms* OR syndrome* OR food insecurity* OR air pollution* OR stress* OR diabetes* OR depressive* OR alcohol* OR cancer* OR drugs* OR palm oil* OR tobacco* OR smoke* OR storm* OR psychometric* OR cocaine* OR toxic* OR palliative* OR therapy* OR HIV* OR dengue* OR ecosystem* OR rheumatoid arthritis* OR nutritional* OR malaria* OR resources* OR sexual activity* OR sexual health*).

Table 1. Search terms used in the systematic review.

- From their final choice of contributions, the main conclusion of the authors is that for assessing social vulnerability it is not sufficient to only compute a specific level of vulnerability, but also to include other spatial information available in order to avoid the modifiable areal unit problem (e.g., Unwin 1996).

Thanks for your comment. The main conclusion of our manuscript is as follows:

‘(...) we can conclude that it is not sufficient to only estimate the specific level of vulnerability per unit area; it is also necessary to determine the influence of the spatial component in this degree of socio-economic vulnerability(...)’.

Rather than the modifiable areal unit problem (MAUP), we wanted to make reference to 1) the influence of the elements and their configuration on a physical space that contributes to reducing or decreasing the degree of vulnerability of a specific area, such as the relationship between slums

and a low degree of wellness and health (Buzai & Villerías Alarcón, 2018)', 2) the Walk Score® index (Bereitschaft, 2017a) walkability (Bereitschaft, 2017b) and 3) the manipulation of snow and topography in Vorarlberg, Austria (Groß, 2017). With this approach, we wish to go beyond theory and demonstrate a more tangible relationship between socio-economic vulnerability and space in an urban environment.

- The overall choice of keywords and exclusion of other keywords results in the fact that many studies addressing social vulnerability and/or economic dimensions of vulnerability have not been considered by the authors, which in turn restricts the overall conclusions possible.

Thanks for your observation. The choice of keywords, as well as the exclusion of other keywords, was our decision as authors to focus mainly on the spatial dimension in the assessment of socio-economic vulnerability related to internal geo-dynamic processes such as earthquakes, tsunamis and volcanic eruptions. We will clarify this aspect in a revised version of the manuscript. The reason we did not consider climate change as a search term is that this topic is mainly addressed by the Centre for Climate and Resilience Research (CR)2 in Chile, and we did not want to step into its research field.

- The time period covered is not justified

Thank you for this observation. The reason for selecting the period 2008–2018 was to explore the state of the art on the topic of the spatial dimension in the assessment of socio-economic vulnerability related to internal geodynamic processes, which we believe has been covered in the past 10 years. We will include this clarification in a revised version of the manuscript. Of course, we are open to reviewing other references suggested by you, regardless of the publication period. Thank you for your suggestion.

- The overall aim to provide a structured overview on studies and indicators, which is not only promised in the title of the contribution but also in the introduction, is not mirrored by the main text body. Materials, methods and findings are rather compiled in a very unstructured way which makes a structured conclusion quite challenging.

Thank you for your observation. We are afraid that we do not have a materials section. The methods, as well as the data sources, spatial variables, indicators, indexes and tools, which we believe you named 'findings', are listed in the following tables:

Table 2. Data sources for the spatial assessment of socio-economic vulnerability.

Table 3. Methods applied to the spatial assessment of socio-economic vulnerability.

Table 4. Spatial variables for socio-economic vulnerability assessments.

Table 5. Spatial indicators for socio-economic vulnerability assessments.

Table 6. Spatial indexes for socio-economic vulnerability assessments.

Table 7. Tools used for spatial socio-economic vulnerability assessments.

Tables 2, 3, 4, 5 and 6 are structured mainly in two columns: the first column lists data sources, methods, spatial variables, spatial indicators, and spatial indexes, respectively; the second column contains the authors and the year of their publications, in which the mentioned topics are addressed. Moreover, the references are listed from the most recent publication to the oldest ones in the period from 2008 to 2018. Table 7 about tools includes three columns, namely, method, software and authors, and the structure and the time period covered are the same as the previous tables. Please find below each of the tables mentioned:

	DATA SOURCES	AUTHORS	
Census data	REDATAM	Buzai, G., & Villerías Alarcón, I. (2018)	
	Statistics of Sleman Regency https://slemankab.bps.go.id/	Maharani, Y. N., Lee, S., & Ki, S. J. (2016)	
	Xishan and Huishan Statistical Yearbook 2008	Chen, Y. (2016)	
	Population and Housing Census 2010	Lin, W.-Y., & Hung, C.-T. (2016).	
		Toké, N. A., Boone, C. G., & Arrowsmith, J. R. (2014)	
	2000 U.S. Census Bureau	Poudyal, N. C., Johnson-Gaither, C., Goodrick, S., Bowker, J. M., & Gan, J. (2012)	
	Statistical Office of Baden-Wuerttemberg	Khazai, B., Merz, M., Schulz, C., & Borst, D. (2013)	
	GENESIS-online Datenbank Federal Statistical Office in Germany (BBR, 2007; Destatis, 2006a)	Fekete, A. (2009)	
	INE (2002)	Müller, A., Reiter, J., & Weiland, U. (2011)	
	Armaş, I., Toma-Danila, D., Ionescu, R., & Gavriş, A. (2017)		
	Renard, F. (2017)		
	Walker, B. B., Taylor-Noonan, C., Tabbernor, A., McKinnon, T. B., Bal, H., Bradley, D., . . . Clague, J. J. (2014)		
	Pandey, A. C., Singh, S. K., & Nathawat, M. S. (2010)		
	Satellite images	SRTM	Buzai, G., & Villerías Alarcón, I. (2018)
		ASTERGDEM	Buzai, G., & Villerías Alarcón, I. (2018)
CORINE land cover		Fekete, A. (2012)	
Quickbird (December 2006)		Müller, A., Reiter, J., & Weiland, U. (2011)	
Quickbird		Ebert, A., Kerle, N., & Stein, A. (2009)	
ASTER (February 2005)		Müller, A., Reiter, J., & Weiland, U. (2011)	
IRS-AWIFS (2008) LANDSAT-ETM+ (2001) LANDSAT-MSS (1975)		Pandey, A. C., Singh, S. K., & Nathawat, M. S. (2010)	
LANDSAT		Toké, N. A., Boone, C. G., & Arrowsmith, J. R. (2014)	
SPOT		Zeng, J., Zhu, Z. Y., Zhang, J. L., Ouyang, T. P., Qiu, S. F., Zou, Y., & Zeng, T. (2012)	
RecourseSat-1 (IRS-P6) Digital Terrain Model DTM (based on point data)		Ebert, A., Kerle, N., & Stein, A. (2009)	
Lang, S., Kienberger, S., Tiede, D., Hagenlocher, M., & Pernkopf, L. (2014)			
Surveys		Photographs/HD video	Bereitschaft, Bradley (2017)

DATA SOURCES		AUTHORS
	Structured Questionnaires'/Interview	Sarkar, R., & Vogt, J. (2015) Müller, A., Reiter, J., & Weiland, U. (2011)
Maps	Land use – Land cover maps	Müller, A., Reiter, J., & Weiland, U. (2011)
	Flood hazard maps	Fekete, A. (2012) Pandey, A. C., Singh, S. K., & Nathawat, M. S. (2010)
	Thematic city maps	Ebert, A., Kerle, N., & Stein, A. (2009)
Disaster Databases	Indonesian Disaster Data Information (DIBI) http://dibi.bnpb.go.id/dibi/	Maharani, Y. N., Lee, S., & Ki, S. J. (2016)
	Risk Atlas of the Municipality of Mexicali 2011	Ley-García, J., Denegri de Dios, F. M., & Ortega Villa, L. M. (2015)
	Federal Office of Civil Protection and Disaster Assistance (BBK)	Khazai, B., Merz, M., Schulz, C., & Borst, D. (2013) Fekete, A. (2012)
Air photos	Toké, N. A., Boone, C. G., & Arrowsmith, J. R. (2014)	
Orthophoto	Armaş, I., Toma-Danila, D., Ionescu, R., & Gavriş, A. (2017)	
Gridded Lidar DSM	Ebert, A., Kerle, N., & Stein, A. (2009)	
Multi-source data	Gu, H., Du, S., Liao, B., Wen, J., Wang, C., Chen, R., & Chen, B. (2018)	

Table 2. Data sources for the spatial assessment of socio-economic vulnerability.

METHODS	AUTHORS
SoVI®	Gu, H., Du, S., Liao, B., Wen, J., Wang, C., Chen, R., & Chen, B. (2018)
	Maharani, Y. N., Lee, S., & Ki, S. J. (2016).
LA-SoVIC	Toké, N. A., Boone, C. G., & Arrowsmith, J. R. (2014)
SVI	Ebert, A., Kerle, N., & Stein, A. (2009)
	Fekete, A. (2009)
SOVUL	Poudyal, N. C., Johnson-Gaither, C., Goodrick, S., Bowker, J. M., & Gan, J. (2012)
FA	Gu, H., Du, S., Liao, B., Wen, J., Wang, C., Chen, R., & Chen, B. (2018)
	Maharani, Y. N., Lee, S., & Ki, S. J. (2016)
	Zhou, Y., Li, N., Wu, W., Wu, J., & Shi, P. (2014)
	Fekete, A. (2012)
	Fekete, A. (2009)
PCA	Armaş, I., Toma-Danila, D., Ionescu, R., & Gavriş, A. (2017)
	Maharani, Y. N., Lee, S., & Ki, S. J. (2016)
	Sarkar, R., & Vogt, J. (2015)
	Toké, N. A., Boone, C. G., & Arrowsmith, J. R. (2014)
	Fekete, A. (2009).
Logistic Regression	Fekete, A. (2012)
	Fekete, A. (2009)
Stepwise regression	Ebert, A., Kerle, N., & Stein, A. (2009)

METHODS	AUTHORS
model	
SMCE	Armaş, I., Toma-Danila, D., Ionescu, R., & Gavriş, A. (2017)
MCE	Walker, B. B., Taylor-Noonan, C., Tabbernor, A., McKinnon, T. B., Bal, H., Bradley, D., . . . Clague, J. J. (2014)
MCA	Müller, A., Reiter, J., & Weiland, U. (2011)
DEMATEL - MCDA	Khazai, B., Merz, M., Schulz, C., & Borst, D. (2013)
AHP	Armaş, I., Toma-Danila, D., Ionescu, R., & Gavriş, A. (2017). Renard, F. (2017) Lin, W.-Y., & Hung, C.-T. (2016) Walker, B. B., Taylor-Noonan, C., Tabbernor, A., McKinnon, T. B., Bal, H., Bradley, D., . . . Clague, J. J. (2014)
Global Moran's I	Gu, H., Du, S., Liao, B., Wen, J., Wang, C., Chen, R., & Chen, B. (2018). Buzai, G., & Villerías Alarcón, I. (2018) Renard, F. (2017) Lin, W.-Y., & Hung, C.-T. (2016) Ley-García, J., Denegri de Dios, F. M., & Ortega Villa, L. M. (2015) Zhou, Y., Li, N., Wu, W., Wu, J., & Shi, P. (2014)
Gi* de Getis-Ord	Gu, H., Du, S., Liao, B., Wen, J., Wang, C., Chen, R., & Chen, B. (2018) Renard, F. (2017) Lin, W.-Y., & Hung, C.-T. (2016)
<i>geon</i>	Lang, S., Kienberger, S., Tiede, D., Hagenlocher, M., & Pernkopf, L. (2014)
SOM	Maharani, Y. N., Lee, S., & Ki, S. J. (2016)
OLS model	Poudyal, N. C., Johnson-Gaither, C., Goodrick, S., Bowker, J. M., & Gan, J. (2012)
GWR	Poudyal, N. C., Johnson-Gaither, C., Goodrick, S., Bowker, J. M., & Gan, J. (2012)
ANN	Alizadeh, M., Alizadeh, E., Kotenace, S. A., Shahabi, H., Pour, A. B., Panahi, M., . . . Saro, L. (2018)
Distance-based network analysis	Walker, B. B., Taylor-Noonan, C., Tabbernor, A., McKinnon, T. B., Bal, H., Bradley, D., . . . Clague, J. J. (2014)
Participant observation approach	Bereitschaft, B. (2017)
Logical analysis method	Chen, Y. (2016)
Fuzzy Delphi method	Lin, W.-Y., & Hung, C.-T. (2016)
Overlay analysis	Toké, N. A., Boone, C. G., & Arrowsmith, J. R. (2014) Pandey, A. C., Singh, S. K., & Nathawat, M. S. (2010)
ESDA	Zhou, Y., Li, N., Wu, W., Wu, J., & Shi, P. (2014)
OBIA	Lang, S., Kienberger, S., Tiede, D., Hagenlocher, M., & Pernkopf, L. (2014)
OOA	Ebert, A., Kerle, N., & Stein, A. (2009).

Table 3. Methods applied to the spatial assessment of socio-economic vulnerability.

SPATIAL VARIABLES	AUTHORS
Location	Buzai, G., & Villerías Alarcón, I. (2018)
Distribution	Buzai, G., & Villerías Alarcón, I. (2018)

SPATIAL VARIABLES	AUTHORS
Number of primary schools and kindergarten	Gu, H., Du, S., Liao, B., Wen, J., Wang, C., Chen, R., & Chen, B. (2018).
School	Zeng, J., Zhu, Z. Y., Zhang, J. L., Ouyang, T. P., Qiu, S. F., Zou, Y., & Zeng, T. (2012)
Industry land	Zeng, J., Zhu, Z. Y., Zhang, J. L., Ouyang, T. P., Qiu, S. F., Zou, Y., & Zeng, T. (2012)
Office land	Zeng, J., Zhu, Z. Y., Zhang, J. L., Ouyang, T. P., Qiu, S. F., Zou, Y., & Zeng, T. (2012)
Commercial and residential land	Zeng, J., Zhu, Z. Y., Zhang, J. L., Ouyang, T. P., Qiu, S. F., Zou, Y., & Zeng, T. (2012)
Hospital	Zeng, J., Zhu, Z. Y., Zhang, J. L., Ouyang, T. P., Qiu, S. F., Zou, Y., & Zeng, T. (2012)
Critical facilities	Zeng, J., Zhu, Z. Y., Zhang, J. L., Ouyang, T. P., Qiu, S. F., Zou, Y., & Zeng, T. (2012)
Road-network	Zeng, J., Zhu, Z. Y., Zhang, J. L., Ouyang, T. P., Qiu, S. F., Zou, Y., & Zeng, T. (2012)
Park space	Toké, N. A., Boone, C. G., & Arrowsmith, J. R. (2014)
Distribution of urban greenspace	Toké, N. A., Boone, C. G., & Arrowsmith, J. R. (2014)
Total area of occupied space in the residences	Armaş, I., Toma-Danila, D., Ionescu, R., & Gavriş, A. (2017)
Spatially varied potable ground water availability	Sarkar, R., & Vogt, J. (2015)
Distant to collect water	Sarkar, R., & Vogt, J. (2015)
Travel distance to trauma centres	Walker, B. B., Taylor-Noonan, C., Tabbernor, A., McKinnon, T. B., Bal, H., Bradley, D., . . . Clague, J. J. (2014)
Distance to hospital	Zeng, J., Zhu, Z. Y., Zhang, J. L., Ouyang, T. P., Qiu, S. F., Zou, Y., & Zeng, T. (2012)
Demand dependency	Khazai, B., Merz, M., Schulz, C., & Borst, D. (2013)
Travel barriers to the trauma centres	Walker, B. B., Taylor-Noonan, C., Tabbernor, A., McKinnon, T. B., Bal, H., Bradley, D., . . . Clague, J. J. (2014)
Land use	Müller, A., Reiter, J., & Weiland, U. (2011)
Land cover	Müller, A., Reiter, J., & Weiland, U. (2011)

Table 4. Spatial variables for socio-economic vulnerability assessments.

SPATIAL INDICATORS	AUTHORS
Population density	Gu, H., Du, S., Liao, B., Wen, J., Wang, C., Chen, R., & Chen, B. (2018)
	Armaş, I., Toma-Danila, D., Ionescu, R., & Gavriş, A. (2017)
	Maharani, Y. N., Lee, S., & Ki, S. J. (2016)
	Chen, Y. (2016)
	Sarkar, R., & Vogt, J. (2015)
	Zeng, J., Zhu, Z. Y., Zhang, J. L., Ouyang, T. P., Qiu, S. F., Zou, Y., & Zeng, T. (2012)
	Pandey, A. C., Singh, S. K., & Nathawat, M. S. (2010)
Fekete, A. (2009)	
Population per square mile	Toké, N. A., Boone, C. G., & Arrowsmith, J. R. (2014)
Housing density	Armaş, I., Toma-Danila, D., Ionescu, R., & Gavriş, A. (2017)
Proportion of households with more	Müller, A., Reiter, J., & Weiland, U. (2011)

SPATIAL INDICATORS	AUTHORS
than 2.5 people per bedroom per building block	
Living space pp	Fekete, A. (2009)
Global Moran's I	Gu, H., Du, S., Liao, B., Wen, J., Wang, C., Chen, R., & Chen, B. (2018). Buzai, G., & Villerías Alarcón, I. (2018) Renard, F. (2017) Lin, W.-Y., & Hung, C.-T. (2016) Ley-García, J., Denegri de Dios, F. M., & Ortega Villa, L. M. (2015) Zhou, Y., Li, N., Wu, W., Wu, J., & Shi, P. (2014).
Local Indicators of Spatial Association (LISA)	Buzai, G., & Villerías Alarcón, I. (2018). Lin, W.-Y., & Hung, C.-T. (2016) Ley-García, J., Denegri de Dios, F. M., & Ortega Villa, L. M. (2015) Zhou, Y., Li, N., Wu, W., Wu, J., & Shi, P. (2014).
Degree of clustering	Renard, F. (2017) Lin, W.-Y., & Hung, C.-T. (2016) Poudyal, N. C., Johnson-Gaither, C., Goodrick, S., Bowker, J. M., & Gan, J. (2012)
GDP density	Chen, Y. (2016)
Density of industrial production	Chen, Y. (2016)
Density of agricultural production	Chen, Y. (2016)
Investment density of fixed assets	Chen, Y. (2016)
Access to medical facilities	Walker, B. B., Taylor-Noonan, C., Tabernor, A., McKinnon, T. B., Bal, H., Bradley, D., . . . Clague, J. J. (2014)
Walkability	Toké, N. A., Boone, C. G., & Arrowsmith, J. R. (2014)
Transport dependency	Khazai, B., Merz, M., Schulz, C., & Borst, D. (2013)
Proportion of green spaces per building block	Müller, A., Reiter, J., & Weiland, U. (2011)
Proportion of people without employment per building block	Müller, A., Reiter, J., & Weiland, U. (2011)
Proportion of people without permanent income per building block	Müller, A., Reiter, J., & Weiland, U. (2011)

Table 5. Spatial indicators for socio-economic vulnerability assessments.

SPATIAL INDEXES	AUTHORS
WalkScore®	Bereitschaft, B. (2017)
Normalized Difference Vegetation Index (NDVI)	Toké, N. A., Boone, C. G., & Arrowsmith, J. R. (2014)
SV index	Ebert, A., Kerle, N., & Stein, A. (2009)
Spatial Vulnerability Units (SVU)	Kienberger, S., Lang, S., & Zeil, P. (2009).

Table 6. Spatial indexes for socio-economic vulnerability assessments.

METHOD	SOFTWARE	AUTHORS
GIS	ArcGIS	Lang, S., Kienberger, S., Tiede, D., Hagenlocher, M., &

METHOD	SOFTWARE	AUTHORS
		Pernkopf, L. (2014)
	GeoDa (version 1.8.16)	Gu, H., Du, S., Liao, B., Wen, J., Wang, C., Chen, R., & Chen, B. (2018)
	GeoDa (version 16.6)	Ley-García, J., Denegri de Dios, F. M., & Ortega Villa, L. M. (2015)
	GeoDa™ 0.9.5-i	Zhou, Y., Li, N., Wu, W., Wu, J., & Shi, P. (2014)
	GeoDa	Cutter, S. L., & Finch, C. (2008)
	ILWIS	Armaş, I., Toma-Danila, D., Ionescu, R., & Gavriş, A. (2017)
	TerrSet (IDRISI)	Alizadeh, M., Alizadeh, E., Kotenaee, S. A., Shahabi, H., Pour, A. B., Panahi, M., . . . Saro, L. (2018)
	Others	Renard, F. (2017)
		Toké, N. A., Boone, C. G., & Arrowsmith, J. R. (2014)
		Müller, A., Reiter, J., & Weiland, U. (2011)
		Pandey, A. C., Singh, S. K., & Nathawat, M. S. (2010)
		Fekete, A. (2009)
RS	eCognition Trimble	Lang, S., Kienberger, S., Tiede, D., Hagenlocher, M., & Pernkopf, L. (2014)
		Ebert, A., Kerle, N., & Stein, A. (2009)
	Others	Zeng, J., Zhu, Z. Y., Zhang, J. L., Ouyang, T. P., Qiu, S. F., Zou, Y., & Zeng, T. (2012)
		Müller, A., Reiter, J., & Weiland, U. (2011)
Statistical Analysis	SPSS 19.0	Gu, H., Du, S., Liao, B., Wen, J., Wang, C., Chen, R., & Chen, B. (2018)
		Maharani, Y. N., Lee, S., & Ki, S. J. (2016)
		Sarkar, R., & Vogt, J. (2015).
	SPSS 14.0	Fekete, A. (2012)
Programming language	MATLAB (SOM)	Maharani, Y. N., Lee, S., & Ki, S. J. (2016).

Table 7. Tools used for socio-economic vulnerability assessments.

- The authors further argue that the economic dimension of vulnerability is the predisposition for the loss of economic value (page 2, lines 15/16), which according to my experience is exactly the contrary relationship – also here we do have scholarly articles which did not make it to the current overview. One reason is again the choice of keywords (see below).

Thanks for this comment. We respect your opinion; however, based on the previous work of one of the authors, we prefer to stick with the definition of economic dimension of vulnerability formulated by Birkmann et al. (2013): ‘Economic dimension: propensity for loss of economic value from damage to physical assets and/or disruption of productive capacity’. We consider that the opposite concept will be more related to economic resilience than vulnerability.

- In the introduction it becomes not clear which specific research question should be answered and where the niche and the gap for the contribution is to be found.

Thank you for your observation and question. The research question was, ‘Which spatial variables/indicators/indexes are useful to characterise the socio-economic vulnerability to natural

hazards in urban environments?’ In a revised version of the manuscript, we will include a rephrased version of the research question as follows: ‘Which spatial variables/indicators/indexes are useful to characterise the socio-economic vulnerability to internal geodynamic processes in urban environments?’

- Paragraphs addressing common sense are somehow not connected to those showing specific issues; to give an example it remains unclear why paragraph 3 immediately starts with the SoVI as one of the indices available to assess social vulnerability.

Thanks for this observation. After checking carefully, we found the first reference to SoVI® in the manuscript in line 20 on the second page. The reason for including this reference to the index for the assessment of social vulnerability (SV), developed by Cutter, Boruff and Shirley (2003), is that in previous lines (17 to 19), we described the object of the assessment of SV: (...) ‘The assessment of SV is orientated to cast the light on the most susceptible groups of a population to be impacted by a disaster, in the spatial and temporal dimensions (Zhou et al., 2014)’. Then, we decided that the next paragraph should start with the first index developed to assess SV, which, to our best knowledge, is the SoVI®.

- On page 3, line 18 the authors even conclude (or state) that only a few authors have elaborated on the spatial dimension of social vulnerability, which is wrong if proper literature research would have been undertaken. There are lots of studies around on this topic, some of them in the target journal NHESS.

Thanks for your opinion. We do agree that there are several studies related to the spatial dimension of socio-economic vulnerability, but not specifically related to internal geodynamic processes. Regarding references from the NHESS journal, we are happy to highlight that one of the references from the present journal is already considered in the manuscript (Lines 21 -21, page 11): ‘(...) The *geon* approach also identifies clusters using semi-automated regionalisation in multispectral image data to represent a socioeconomic vulnerability in the form of spatial vulnerability units (SVU) (Kienberger, Lang, & Zeil, 2009) (...)’.

Reference:

Kienberger, S., Lang, S., & Zeil, P. (2009). Spatial vulnerability units – expert-based spatial modelling of socio-economic vulnerability in the Salzach catchment, Austria. *Nat. Hazards Earth Syst. Sci.*, 9(3), 767-778. doi:10.5194/nhess-9-767-2009

This reference is not among the 21 references finally selected, because a more recent paper from the same authors is already included in this list.

Reference:

Lang, S., Kienberger, S., Tiede, D., Hagenlocher, M., & Pernkopf, L. (2014). Geons – domain-specific regionalization of space. *Cartography and Geographic Information Science*, 41(3), 214-226. doi:10.1080/15230406.2014.902755

- On page 3, line 18 the authors even conclude (or state) that only few authors have elaborated on the spatial dimension of social vulnerability, which is wrong if a proper literature research would have been undertaken. There are lots of studies around on this topic, some of them even in the target journal NHESS.

Thank you for your observation. We offer to rephrase the following statement: ‘(...) only a few authors in the period between 2008 to 2018 have elaborated on the spatial dimension of socio-economic vulnerability related to internal geodynamic processes (...)’. This could be a conclusion

as well as the basis for a recommendation to conduct further research into the mentioned aspect. In addition, we are willing to redo the systematic search of relevant literature references that we could have missed, including but not limited to the NHESS journal.

- Moreover, the statement that spatial vulnerability assessments only became prominent after the 2004 Indian Ocean Tsunami is neither proven by references, nor true according to my own knowledge.

Thank you for this observation. We acknowledge that we drafted this sentence incorrectly. Citing Fekete (2012), we wanted to state that events such as the Indian Ocean tsunami in 2004 and Hurricane Katrina in 2005, with an explicit spatial component, sparked again the research community's interest in those social groups that are more affected by this type of phenomena. We will rephrase the sentence accordingly:

'(...) the Indian Ocean tsunami in 2004, as a result of its large impact area, sparked again the research community's interest in spatial vulnerability analyses and an interdisciplinary approach, which illuminated the problems faced by low-income populations after disasters (...)'.

- Further, the use of GIS is not only very suitable for assessing spatially the issues of social and economic vulnerability, but it is also a tool to exactly do this.

Thank you for this observation. While we agree with your claim, after carefully going through the manuscript, we found that the exact statement in the manuscript is (line 4, page 4): '(...) The use of geographic information systems (GIS) to collect and process data related to hazards and vulnerability was found very suitable (Fekete, 2012) (...)'. The reason for including this statement is that, in the past, hazard and vulnerability data collection processes were performed manually, making the assessment highly time-consuming. Now, these hazard and vulnerability assessments are speeded up with the integration of GIS into the process. However, the potential of GIS is sometimes untapped and limited to the mapping of the socio-economic characteristics of a case study area, without taking into account the influence of the spatial component that can be integrated to take advantage of the GIS capabilities.

- Finally, the statement that vulnerability is dynamic and subject to spatial and temporal dynamics across scales is not very innovative, there are even specific research papers on this topic from the period 2008-2018.

Thank you for this comment. We agree with the reviewer. Nevertheless, the objective of this manuscript is to determine the spatial variables, indicators and indexes used to characterise socio-economic vulnerability to internal geodynamic processes in the period between 2008 and 2018 in urban environments; the manuscript will be a guide for scientists who wish to perform a spatial assessment.

- Methods: it remains totally open how the amount of 235 papers initially identified was reduced to the final set of 21 contributions.

Thanks for your observation. The initial number of papers selected through the systematic review was reduced based on the relevance to the topic of spatial assessment of socio-economic vulnerability related to mainly internal geodynamic processes. However, in the final set of papers, we also included those related to hydrometeorological hazards, epidemics and anthropogenic hazards that contain spatial (Gu et al., 2018) variables, indicators or indexes that could be applied to the spatial assessment of socio-economic vulnerability related to internal geodynamic

processes. Therefore, following your observation, we will include this explanation in the manuscript.

- Moreover, searching only for combinations of “social vulnerability” excludes the amount of (valuable) papers around addressing multiple dimensions of vulnerability – and some of these contributions again can be found in NHESS.

Thank you for reminding us that, apart from the social and economic dimensions, other dimensions of vulnerability also exist physical, cultural, environmental and institutional (Birkmann et al., 2013). Nevertheless, we prefer to focus on the social and economic dimensions for this specific research.

- Further, the authors state in the text that they excluded terms such as “climate change”, “health” and “crime analysis”, whereas in Figure 1, much more terms have been excluded. BTW: Why has the term “debris” been excluded? Just to give an example, many studies on (social and economic) vulnerability are related to dynamic flooding such as flash floods and debris flows/torrential hazards (even the mentioned EU-funded project MOVE), these are completely ignored by the authors due to their choice of key words.

Thank you for your suggestion; however, we are afraid that the term ‘debris’ suggested by you is not a spatial variable, indicator or index that is useful for the assessment of socio-economic vulnerability. The area where the debris appears distributed after a flash flood will be more useful for damage and exposure estimation and/or hazard zonation because of floods than for a complete socio-economic vulnerability assessment related to internal geodynamic processes.

- In contrast, some of these hazard types are then mentioned in the results section (page 7, second paragraph).

Thanks for your observation. In this manuscript, we already stated that we are focused on the topic of the spatial assessment of socio-economic vulnerability related to mainly internal geodynamic processes; however, in the final set of selected papers, we also included those related to hydrometeorological hazards, epidemics and anthropogenic hazards that contain variables, indicators or indexes that could be applied to the spatial assessment of socio-economic vulnerability related to internal geodynamic processes.

- Instead of showing which contributions used which methods or indicator groups for assessment, the authors could have shown the challenge of indicator interdependencies, one of the main points of criticism for the SoVI. Simply applying the SoVI does not necessarily result in an overview on social and economic dimensions of vulnerability because of the inherent dependencies between indicators.

Thank you very much for this comment. We agree with you. Therefore, in addition to the information that is currently in the manuscript, we will include your comment as a conclusion. Moreover, as a recommendation, we will suggest using the stepwise regression analysis to avoid collinearity between variables and/or indicators, removing the weakest correlated variables and spatial indicators and identifying those that best explain the socio-economic vulnerability of a particular area to take actions to reduce it.

- In the discussion section the authors have raised some issues that remain questionable, such as the fact that most of the articles related to flood hazard and social vulnerability have been written by geographers because they may be interested in environmental vulnerability.

Thanks for this observation. It was a statement based on the evidence collected during the systematic review, but as we are mainly focused on the spatial assessment of socio-economic vulnerability related to mainly internal geodynamic, we can delete that sentence.

- These issues are just examples underpinning the overall judgement that this contribution is so far not up to international standards. Although the authors have some interesting arguments, I believe that the manuscript needs further improvement to bring it up to an acceptable level before it can be accepted for publication.

Thanks for the assessment of our manuscript. We expect that based on your comments, we will be able to produce a revised version that meets international standards and can, therefore, be published.

- To summarise, it is not clear why the authors chose specific keywords and excluded others, it is not clear why the authors chose the distinct time period between 2008 and 2018 (the discussion on multiple dimensions of vulnerability and the spatiality of vulnerability is much older). The results are not presented in a logical and organised manner, and the conclusions are not underpinned by the results, some of them seem rather driven by speculation than by evidence.

The criteria to select the search terms were those spatial variables, indicators and indexes useful for assessing socioeconomic vulnerability mainly related to internal geodynamic processes. The reason for selecting the period 2008–2018 was to examine the state of the art on the topic of the spatial dimension in the assessment of socio-economic vulnerability related to internal geodynamic processes, which we considered to have been covered in the past 10 years. The results regarding more frequent methods, as well as the data sources, spatial variables, indicators, indexes and tools used for the assessment of socio-economic vulnerability related to internal geodynamic processes, are listed in tables. These findings support most of the conclusions.

References

- Bereitschaft, B. (2017a). Equity in Microscale Urban Design and Walkability: A Photographic Survey of Six Pittsburgh Streetscapes. *Sustainability*, 9(7), 1233.
- Bereitschaft, B. (2017b). Equity in neighbourhood walkability? A comparative analysis of three large U.S. cities. *Local Environment*, 22(7), 859-879. doi:10.1080/13549839.2017.1297390
- Birkmann, J., Cardona, O. D., Carreño, M. L., Barbat, A. H., Pelling, M., Schneiderbauer, S., . . . Welle, T. (2013). Framing vulnerability, risk and societal responses: the MOVE framework. *Natural Hazards*, 67(2), 193-211. doi:10.1007/s11069-013-0558-5
- Cutter, S. L., Boruff, B. J., & Shirley, W. L. (2003). Social vulnerability to environmental hazards. *Social Science Quarterly*, 84(2), 242-261.
- Fekete, A. (2012). Spatial disaster vulnerability and risk assessments: challenges in their quality and acceptance. *Natural Hazards*, 61(3), 1161-1178. doi:10.1007/s11069-011-9973-7
- Grant, M. J., & Booth, A. (2009). A typology of reviews: an analysis of 14 review types and associated methodologies. *Health Info Libr J*, 26(2), 91-108. doi:10.1111/j.1471-1842.2009.00848.x
- Groß, R. (2017). Uphill and Downhill Histories. How Winter Tourism Transformed Alpine Regions in Vorarlberg, Austria – 1930 to 1970 *Zeitschrift für Tourismuswissenschaft* (Vol. 9, pp. 115).

- Gu, H., Du, S., Liao, B., Wen, J., Wang, C., Chen, R., & Chen, B. (2018). A hierarchical pattern of urban social vulnerability in Shanghai, China and its implications for risk management. *Sustainable Cities and Society*, *41*, 170-179. doi:<https://doi.org/10.1016/j.scs.2018.05.047>
- Kienberger, S., Lang, S., & Zeil, P. (2009). Spatial vulnerability units – expert-based spatial modelling of socio-economic vulnerability in the Salzach catchment, Austria. *Nat. Hazards Earth Syst. Sci.*, *9*(3), 767-778. doi:10.5194/nhess-9-767-2009