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Comment

## ***Interactive comment on “The development of mountain risk governance: challenges for application” by S. Link and J. Stötter***

**Anonymous Referee #1**

Received and published: 19 January 2015

This manuscript is a nice work on the development of (mountain) hazard risk management and is showing the governance paradigm from its roots to present-day discussions. The topic addressed lies totally within the scope of the target journal, and given the suggested expansions I would like to recommend an acceptance.

Above all a more proper introduction in the overall topic as well as a clear statement that the examples given are focusing on the European Alps (in individual chapters, examples from France, Austria, Switzerland and Italy are provided, but not every example is discussed with the same depth). Moreover, the authors are kindly asked to (a) better define the technical terms used such as risk, hazard and vulnerability since throughout the paper I detected some changes in the respective meanings, and (b) refer to the works of colleagues that have already been published on this topic. The overall aim

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of this manuscript is challenging, and lies in the connection between theoretical concepts of risk management and governance and practical implementation in the alpine countries.

Some specific remarks (lots of them are related to published works from the same Innsbruck school as the authors... - I am wondering why so few are used so far to underpin some of the arguments):

p. 430, lines 20f.:

“Risk governance has been discussed in broad terms as a new paradigm that will succeed risk management, but risk governance has not yet been applied to the context of mountain risks.” -> Citation? Who is stating that governance is discussed, and how is this new paradigm being introduced. Is it embedded in an institutional context by e.g. legislation? A bit too many assumptions from my point of view. “first, it seeks to trace back the succession of four distinct paradigms for the dealing with mountain risk in the Alps, with special attention focused on the role of communication. . .” -> ...which can be nicely followed in Holub and Fuchs (2009) already, and in the broader context of resilience also in Fuchs (2009). Could you give details? By whom this is stated?

p. 431, line 3:

“...mountain risks...” -> what is mountain risks? - Following a proper definition of hazard and risk, it should be mountain hazard risk -> needs clarification, see also your page 1 (same: mountain risks...)

p. 431, line 12:

“Risk...”...and is therefore following the engineering definition of risk... (e.g., Varnes 1984, etc.).

p. 431, line 18:

...which are... common framework according to scientific principles (e.g. the concept

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of risk management)? OR in the context of common laws (e.g., the Austrian Forest law mentioned later?)

p. 431, line 21:

which is not necessarily different: technical and natural hazards do have a certain probability of occurrence; this information is usually needed to subsequently compute risk. So both approaches rely on the same risk concept.

p. 431, line 23:

intensified and mitigated cannot be used as a synonym. Either intensified or decreasing, or mitigated (as a neutral term: mitigation just means "try to do something that reduces the effects of something" > mitigation can be technical, planning, temporal,... but should under no circumstances intensify the hazard potential or the potential for loss. This is even stated in the underlying Austrian regulations. For a discussion which is centred around such issues you may wish to refer to the editorial by Fuchs et al. (2001): Fuchs, S.; Kuhlicke, C. & V. Meyer (2011): Vulnerability to natural hazards – the challenge of integration. *Natural Hazards* 58 (2). p. 609-619

p. 431, line 25:

short-term and long-term is valid for both, mitigation but also the dynamics of the hazard potential, for a discussion on elements at risk see e.g. Fuchs et al. (2013): Fuchs, S.; Keiler, M.; Sokratov, S. & A. Shnyparkov (2013): Spatiotemporal dynamics: the need for an innovative approach in mountain hazard risk management. *Natural Hazards* 68 (3). p. 1217-1241

p. 431, line 26:

long-term and short-term as well as different mitigation concepts do not necessarily produce discrepancies in spatial scales (again, you may wish to refer to Fuchs et al. (2013))

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p. 432, line 4:

which seems to be valid for all mountain hazards despite river flooding. The complexity and non-linearity has been discussed extensively e.g. by Keiler et al. (2010) focusing on climate change in European mountain regions, Kappes et al. (2012a, b) with respect to multi-hazards in mountain environments and Mazzorana et al. (2012) with respect to torrential flooding:

Kappes M, Keiler M, von Elverfeldt K, Glade T (2012a) Challenges of analyzing multi-hazard risk: a review. *Natural Hazards* 64 (2):1925-1958

Kappes M, Papathoma-Köhle M, Keiler M (2012b) Assessing physical vulnerability for multi-hazards using an indicator-based methodology. *Applied Geography* 32 (2):577-590

Keiler M, Knight J, Harrison S (2010) Climate change and geomorphological hazards in the eastern European Alps. *Philosophical Transactions of the Royal Society of London Series A: Mathematical, Physical and Engineering Sciences* 368:2461-2479

Mazzorana B, Comiti F, Scherer C, Fuchs S (2012) Developing consistent scenarios to assess flood hazards in mountain streams. *Journal of Environmental Management* 94 (1):112-124

p. 432, line 16:

“enhanced communication... risk management” -> see also Fuchs et al. (2009) and Meyer et al. (2012) for the example of hazard maps in Austria.

Fuchs, S.; Spachinger, K.; Dorner, W.; Rochman, J. & K. Serrhini (2009): Evaluating cartographic design in flood risk mapping. *Environmental Hazards* 8 (1). p. 52-70

Meyer, V.; Kuhlicke, C.; Luther, J.; Fuchs, S.; Priest, S.; Dorner, W.; Serrhini, K.; Pardoe, J.; McCarthy, S.; Seidel, J.; Scheuer, S.; Palka, G.; Unnerstall, H. & C. Viavatenne (2012): Recommendations for the user-specific enhancement of flood maps. *Natural*

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Hazards and Earth System Sciences 12 (5). p. 1701-1716

p. 432, line 18:

“European Floods Directive” -> discussed extensively in Meyer et al. (2012)

p. 433, line 13:

see also the alpS-report on stakeholder communication (2005) - risk communication framework for the Austrian Torrent and Avalanche Control Service, and there the chapter by Peter Wiedemann.

p. 433, line 17:

you may wish to refer to David Alexander’s monograph "Confronting catastrophe" here: Alexander D (2000) Confronting catastrophe. Oxford University Press, Oxford

p. 433, line 20:

which is discussed focusing on Austria in Stötter and Fuchs (2006)

p. 434, line 5:

not entirely correct; as you already have the Stötter and Fuchs (2006) article, have a quick look there. More information is also provided in Holub and Fuchs (2009). You may wish to consult Eugen Länger’s thesis which has been reported in a very short version also by Länger (2005): Länger E (2005) Geschichtliche Entwicklung der Gefahrenzonenplanung in Österreich. Wildbach- und Lawinenverbau 152:13-24

p. 434, line 12:

...and Kappes et al. (2012a)

p. 434, line 16:

I am not entirely sure about that. Edmund Penning-Rowsell has recently published a nice and critical review on this issue.

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p. 435, lines 7-10 (bullet points):

but this chronological steps need a proper explanation why they can be distinguished. In the current wording, you are just stating that there is a distinction, but with no prove(s). These issues are explained later on (3.1-3.x), but it needs a reference already here.

p. 436, line 3:

But complexity also means that we have an increase in emergence - see Keiler (2011) - and emergent structures may not be found in the institutionalized dealing with natural hazards in Austria... so it may be worth to properly define your understanding of complexity in the introductory section.

Keiler M (2011) Geomorphology and complexity – inseparable connected? Zeitschrift für Geomorphologie 55 (Suppl. 3):233-257

p. 436, line 24:

very nice reference which is rarely found in articles... :-)

p. 436, line 23 (3.2 Hazard mgmt.):

also the severe floodings in the 1966s or 1967s in Carinthia.

p. 438, line 11:

Swiss Federal Institute. . .

p. 438, line 19:

please change 1991 a with b

p. 439, line 15:

already but slightly different cited in section 3.1

p. 439, line 15:

but in the Austrian Forest law of 1975 and/or the Degree on Hazard Mapping of 1976, public participation is already foreseen (Holub and Fuchs (2009) as well as both legal regulations)

p. 439, line 18:

any citation for this statement? - the elements at risk developed quite diverse, if we compare the different countries in the Alpine arc. It was the agglomerations which increased in values, compare the recent publication bei Steinicke et al. in the Mitteilungen der Österr. Geographischen Gesellschaft (2014)

p. 439, line 22:

Difficult statement: I believe that the shift to a kind of risk management was driven by the cost-effectiveness of measures (Fuchs et al. 2007, Fuchs & McAlpin 2005):

Fuchs, S.; Thöni, M.; McAlpin, M.C.; Gruber, U. & M. Bründl (2007): Avalanche hazard mitigation strategies assessed by cost effectiveness analysis and cost benefit analysis – Evidence from Davos, Switzerland. *Natural Hazards* 41 (1). p. 113-129

Fuchs, S. & M.C. McAlpin (2005): The net benefit of public expenditures on avalanche defence structures in the municipality of Davos, Switzerland. *Natural Hazards and Earth System Sciences* 5 (3). p. 319-330.

See also:

BMLFUW (2006) Technische Richtlinie für die Wildbach- und Lawinerverbauung gemäß §3 Abs 1 Z 1 und Abs 2 des WBFG 1985 i. d. F. BGBl. Nr. 82/2003 vom 29.8.2003. BMLFUW, Wien

p. 439, line 25:

The risk cycle was developed independently (firstly as far as I know by Carter (1991)): Carter W (1991) The disaster management cycle. In: Carter W (ed) Disaster management: A disaster manager's handbook. Asian Development Bank, Manila, pp 51-59

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and later by Alexander (2000), and finally modified (but not cited) in the final version by e.g. Kienholz et al. (2004): Kienholz H, Krummenacher B, Kipfer A, Perret S (2004) Aspects of integral risk management in practice – considerations with respect to mountain hazards in Switzerland. *Österreichische Wasser- und Abfallwirtschaft* 56 (3-4):43-50

Elements at risk were only considered quite recently; for details please refer to Holub and Fuchs (2009).

Vulnerability was only very recently explicitly addressed, see e.g. Fuchs et al. (2007) and Totschnig and Fuchs (2013) for an overview:

Fuchs, S.; Heiss, K. & J. Hübl (2007): Towards an empirical vulnerability function for use in debris flow risk assessment. *Natural Hazards and Earth System Sciences* 7 (5). p. 495-506

Totschnig, R. & S. Fuchs (2013): Mountain torrents: quantifying vulnerability and assessing uncertainties. *Engineering Geology* 155. p. 31-44

p. 440, line 13:

But: legally not prescribed in Austria. So argumentation should be changed.

p. 440, line 22:

What do you define by residual risk? - should be clarified with respect to your definition of risk. From my point of view, this term should be residual hazard.

p. 440, line 23:

see my remarks above.

p. 440, line 25:

but only from a scientific level, not in practice.

p. 440, line 27:

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self-responsibility is not yet a paradigm. See e.g. discussion in Holub and Fuchs (2009)

p. 441, line 1:

“are deepened have been elaborated” -> either one or the other. - see also Toschnig and Fuchs (2013) or Papathoma-Köhle et al. (2011):

Papathoma-Köhle M, Kappes M, Keiler M, Glade T (2011) Physical vulnerability assessment for alpine hazards: state of the art and future needs. *Natural Hazards* 58 (2):645-680

p. 441, line 6:

Citation needed.

p. 441, line 9:

only since the implementation of the EU Flood Directive. This is not yet stated in many national laws.

p. 441, line 14:

please search for scientific evidence, Start-IT-up is no such source.

p. 441, line 16:

Citations needed (publications or final reports).

p. 441, line 19:

“second stage. . . achieved” -> difficult statement. needs clarification and scientific evidence.

p. 441, line 20 f:

“Under this paradigm, the second stage of participation (consultation) has been achieved with key local individuals in affected regions being consulted for their views on risk assessment (Bründl et al., 2009) -> just in Switzerland???”

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p. 442, line 2:

“Borter...” -> well, Patricio Borter was the author, but it was a quite large initiative behind. So developed may not be the right term here.

p. 442, line 7:

where is the difference between EconoMe and the Austrian guidelines on cost-efficiency?

p. 442, line 14:

“Fuchs and Zischg 2014)” -> This work is focusing on exposure. I recommend to refer to Totschnig and Fuchs (2013) and Totschnig et al. (2011):

Totschnig, R.; Sedlacek, W. & S. Fuchs (2011): A quantitative vulnerability function for fluvial sediment transport. *Natural Hazards* 58 (2). p. 681-703

p. 442, line 16:

I also recommend Meyer et al. (2012) and Fuchs et al. (2009) with practical examples from the alpine region.

p. 443, line 2 ff.:

see also the works of Mazzorana et al.

p. 443, line 7:

I am not entirely sure about that. It is only since the implementation of the EU floods directive that administrations start to talk about risk, before it was (and according to many national regulations still is) a hazard paradigm. In contrast, some regional legislation related to "risk" exists (e.g., in Austria), see the recent works by Kanonier. Probably some more information necessary.

In general I kindly would like to suggest that the authors include these suggestions in order to broaden up the manuscript, and to improve the readability. At the moment,

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the manuscript reads rather hard in terms of absolute statements made without taking into account some of the recent studies of the research community, which seems indispensable if it should address both scientists and practitioners in mountain hazard risk management. Therefore I suggest a major revision of this manuscript.

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Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 3, 429, 2015.

# NHESSD

3, C1–C11, 2015

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