Nat. Hazards Earth Syst. Sci. Discuss., 3, C2752–C2759, 2015
www.nat-hazards-earth-syst-sci-discuss.net/3/C2752/2015/

Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Review Article: Multi-criteria decision making for flood risk management: a survey of the current state-of-the-art" *by* M. M. de Brito and M. Evers

M. M. de Brito and M. Evers

mmdb@outlook.com

Received and published: 22 December 2015

Dear Referee, thanks for reviewing our manuscript. Your comments and observations are very informative and constructive. The manuscript will be revised according to the provided suggestions, which will help to improve the paper before final submission. Please find our response to each one of your comments and questions bellow.

1) Page 6693, Section 2: "I would suggest to extend the Section 2. This would help a lot the non-expert reader (including myself). Also, I understand that the Authors are trying to be as objective as possible, and I will not complain

if they will decide not to do it, but I would have found more intriguing/exciting to know what is their personal judgment on the methods."

We thank the Referee for having raised this issue. We think this is a good suggestion and that the discussion of the basic MCDM approaches will improve the quality of the paper. Therefore, we will add a more detailed description of MCDM methods, their classification and a discussion of the applicability of each approach in section 2.

The classification scheme proposed by Hajkowicz and Collins (2007) will be adopted, which includes the following approaches:

1. outranking approaches (ELECTRE and PROMETHEE);
2. multi-criteria value function (MAUT and MAVT);
3. distance to ideal point methods (CP and TOPSIS);
4. pairwise comparisons (AHP and ANP);
5. other methods (VIKOR, DEMATEL, fuzzy approaches).

2) Page 6694, line 24: "I do not understand the rationale for excluding few publications published before 1995."

The year 1995 was chosen as a starting date for this study for two reasons. First, we wanted to have a two decades review, which is considered to be long enough to arrive at consistent conclusions (Jato-Espino et al., 2014). Second, it is noticeable that since online database access point is limited, some papers published before 1995 could not be downloaded and were not available at our Library. In the same sense Macharis and Bernardini (2015) point out that the results of electronic searches for older periods do not have the same accuracy as newer ones. For these reasons, the six articles published between 1989 and 1994 were overlooked in this survey.

The text will be changed to clarify this issue.

3) Page 6697, line 10 and Figure 1: "reporting the polynomial model and R2 is meaningless to me."

We fully agree and we will eliminate it.

4) Page 6697, lines 12-18: "in order to correctly measure the increase of interest in MCDM, the n. of publications for this subject should be normalised by the overall number of publications in the same journals."

We completely agree. Totally, 72 journals indexed in 6 different databases were cited in the review. Several of these journals, including "Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis", "Advances in Information Sciences and Service Sciences", do not provide statistics regarding the number of papers published per year, making this comparison difficult.

Therefore, using the suggestion of Huang et al. (2011), a normalization was made according to the number of flood publications in the Web of Science and Science Direct databases, found through searches using only "flood" as the keyword. These databases were chosen because most of the reviewed papers were retrieved from them. As it is possible to see in Figure 1, the increase of MCDM publications is significantly greater than the increase of flood publications, especially after 2011. This observation confirms our hypothesis that the application of MCDM for flood risk management has been growing considerably over the past two decades.

5) Page 6699, line 4: "in Australia MCDM studies were rarely published. Is there an explanation for that? Do they call similar procedures differently? Do they publish MCDM reports in non-ISI journals?"

Thanks for raising this interesting question. Australia uses a similar terminology for flood risk management to the one used in Europe (Australian Government, 2015).

Regarding the MCDM terms, we used the name of the methods itself when searching for papers, which do not change from country to country. In addition, we used alternative terms for MCDM (e.g. MCA, MCDA). Therefore, we believe this is not a terminology issue.

It is worth noting that some MCDM tools are popular in Australia for other fields of study. For example, in a review of 217 PROMETHEE applications, Behzadian et al. (2010) found out that Australia was the second most popular country for this method. On the other hand, Behzadian et al. (2012) reviewed 266 TOPSIS applications of which only 1.96% were conducted in Australia. Similar rates were found in MCDM reviews made by Wallenius et al. (2008) and Mardani et al. (2015) for MAUT and fuzzy MCDM methods, respectively.

It could be that the existing studies are published in journals that are not indexed in the searched databases (Scopus, ProQuest, Science Direct, SpringerLink, Emerald Insight, and Web of Science). This is the case of several South American countries. For example, in Brazil the flood MCDM research is generally published in Portuguese, in regional journals or conferences.

We will address this important point in the results and discussion section.

6) Page 6701, lines 4-10: "is it possible that methods like DEMATEL, DRSA and ORESTE are published elsewhere, in non-ISI journals?"

We believe that DEMATEL, DRSA and ORESTE tools were not used because they are less popular when compared to classical MCDM methods. In order to illustrate this difference, we searched for these techniques in Google Scholar. While 6480 papers have mentioned TOPSIS in the title of the article, only 1120 have cited DEMATEL, 707 ORESTE, and 55 DRSA.

The DEMATEL method needs to be coupled with other MCDM approaches, such as ANP or AHP in order to generate weights, which makes it harder to apply. Therefore,

we believe these approaches were not used due to their great complexity. In addition, there are not many software packages that implement DEMATEL, DRSA and ORESTE available.

7) Page 6708, line 25: "it would be interesting to have a discussion on how do the Authors define "susceptibility, hazard and risk assessment somewhere in the introductory part of the paper."

The definitions used by the authors can be found in Section 3.2, page 6696, line 1 to 15. The terminology proposed by United Nations International Strategy for Disaster Reduction (UNISDR, 2009) was adopted because it is widely disseminated and accepted in the literature. Considering that we are trying to be as objective as possible, and that susceptibility, hazard and risk assessment are not the main focus of the paper, we prefer not to add a discussion of this terms in the introduction. However, we will extend the descriptions provided in Section 3.2 to make it clearer for readers.

References

Australian Government: Flood Terms, [online] Available from: http://www.ga.gov.au/scientific-topics/hazards/flood/australian-flood-risk-and-information-portal/about-the-portal/flood-terms, 2015.

Behzadian, M., Kazemzadeh, R. B., Albadvi, A. and Aghdasi, M.: PROMETHEE: a comprehensive literature review on methodologies and applications, Eur. J. Oper. Res., 200(1), 198–215, doi:10.1016/j.ejor.2009.01.021, 2010.

Behzadian, M., Otaghsara, S. K., Yazdani, M. and Ignatius, J.: A state-of the-art survey of TOPSIS applications, Expert Syst. Appl., 39(17), 13051–13069, doi:10.1016/j.eswa.2012.05.056, 2012.

Hajkowicz, S. and Collins, K.: A review of multiple criteria analysis for water resource planning and management, Water Resour. Manag., 21(9), 1553–1566, doi:10.1007/s11269-006-9112-5, 2007.

Huang, I. B., Keisler, J. and Linkov, I.: Multi-criteria decision analysis in environmental sciences: ten years of applications and trends., Sci. Total Environ., 409(19), 3578–94, doi:10.1016/j.scitotenv.2011.06.022, 2011.

Jato-Espino, D., Castillo-Lopez, E., Rodriguez-Hernandez, J. and Canteras-Jordana, J. C.: A review of application of multi-criteria decision making methods in construction, Autom. Constr., 45, 151–162, doi:10.1016/j.autcon.2014.05.013, 2014.

Macharis, C., Bernardini, A.: Reviewing the use of multi-criteria decision analysis for the evaluation of transport projects: time for a multi-actor approach, Transport Policy, 37, 177-186 doi: doi:10.1016/j.tranpol.2014.11.002, 2015.

Mardani, A., Jusoh, A. and Zavadskas, E. K.: Fuzzy multiple criteria decision-making techniques and applications – Two decades review from 1994 to 2014, Expert Syst. Appl., 42(8), 4126–4148, doi:10.1016/j.eswa.2015.01.003, 2015.

UNISDR: Terminology on disaster risk reduction, UNISDR, Geneva., 2009.

Wallenius, J., Dyer, J. S., Fishburn, P. C., Steuer, R. E., Zionts, S. and Deb, K.: Multiple Criteria Decision Making, Multiattribute Utility Theory: Recent Accomplishments and What Lies Ahead, Manage. Sci., 54(7), 1336–1349, doi:10.1287/mnsc.1070.0838, 2008.

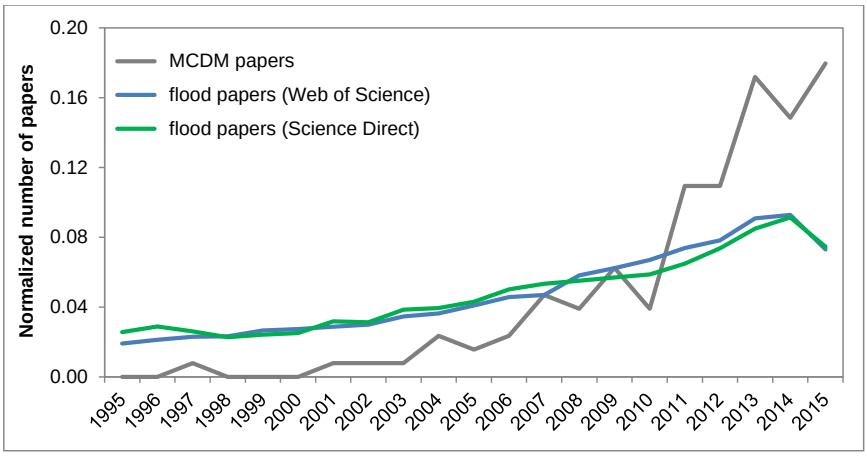

Fig. 1. Normalized number of MCDM and flood papers published between 1995-June 2015, based on Web of Science and Science Direct data.