Hydrology and Earth System Sciences Discussions

Interactive comment on "Application of quantitative composite fingerprinting technique to identify the main sediment sources in two small catchments of Iran" *by* A. Kouhpeima et al.

Anonymous Referee #2

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GENERAL COMMENTS

The paper by Kouhpeima et al. describes the application of the sediment fingerprinting approach to identify the main sediment sources in two catchment of Iran. This manuscript addresses a relevant scientific question (i.e. sediment sources identification) in a developing country, where, due to the limited resources available, this information is rather low.

Nevertheless, the authors neither present novel ideas or real advance in the methodology. Raw data is not presented, what makes it really difficult to assess the quality of the

results. Furthermore, I do not think that the presented results are enough to support the conclusions (at least, in the way they are presented). All the results are reported as mean values and, as a consequence, the reader has no idea of the spatial (and temporal) variability of source tracer values, mixing models results and the uncertainty involved with the procedure. I would encourage the authors to assess the uncertainty of their results since previous work has shown that uncertainty can be rather high (see Collins et al., 2010 and work cited therein).

I believe that an effort should be done to better present the status quo in the Introduction and to correctly reference (and update) previous relevant work. I would also suggest presenting the shortcomings of the approach (in the Introduction). A better map is needed, and it would be easier for the reader if some figures were used to present the results. I fully agree with the 'Anonymous Referee #1" in that discussion of the results should be extended.

SPECIFIC COMMENTS

Page 6680, lines 4-13: You provide some examples of different properties used to trace suspended sediment sources. I would suggest updating the referenced work here. Recent papers have been published that use new methodologies (e.g. spectral reflectance data, Poulenard et al., 2009; colour, Martínez-Carreras et al., 2010; and others) or that further develop the approach (Collins et al., 2010).

Page 6680, section 2.1. I suggest converting sub-section 2.1 in section 2. You should provide detailed information on the physiographical characteristics of the study site. A detailed map is necessary (catchment boundaries, stream, sampling points, delimitation of reservoirs, sizes, topography, etc). A geological map would be really helpful since one of the main aims of applying the sediment fingerprinting approach to discriminate geological types is to determine the spatial location of sediment provenance. I also suggest including some information about the hydrological behaviour and soils, of both catchments, in this section.

Page 6681, lines12-14. Could you provide more information about the sampling point locations (consider plotting these points in the map). Where the samples collected all around the catchment or only from locations close to the stream network?

Page 6681, line 12-14: when were collected these samples? Do you have any idea of temporal variability of source tracer values?

Page 6681, lines 17: it seem that you collected sediment deposed in the reservoir at 10 sites and only once. I am guessing that this are ephemeral reservoirs (could you further explain this) and that the material located next to the dams must be different than the material located in the inlet of the reservoir. Did you check the fingerprint's spatial variability inside the reservoir? Do the fingerprinting properties change also in time?? How representative are these samples? At which period of the year where they collected? Do you know when was this material transported?

Page 6681, section 2.5: Did you measure absolute particle size composition and organic matter content? Several research papers have demonstrated the need to use particle size correction factors and/or an organic matter content correction factors in order to compare the fingerprint concentration in soil and sediment samples (Horowitz, 1991; Motha et al., 2004; Collins et al., 2010). It seems that you have not used these correction factors. Could you explain the reason? It seems to me that potential sediment sources and sediment samples from reservoirs must have different particle sizes and organic matter contents. Could you further explain the possibility of tracer value transformation not only due to particle transport but also storage in the reservoir?

Page 6681, line 25: could you cite which previous source discrimination work has been done in the studied catchments before?

Page 6682, lines 23-24: I would suggest to provide more information about how did you performed the discriminant function analysis (e.g. you enter independent variables together or did you use the stepwise method? Were the number of samples correctly classified estimated using a leave-one-out cross-validation? Which programme did you

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used?)

Page 6683, section 2.5: This statistic was already used before the year 2000 (see Collins et al., 1996). I do not believe that the Mean Relative Error (MRE) statistic used to assess model performance is adequate. If I understood it well, you are comparing the fingerprint properties measured in sediment samples (from the reservoir) with the corresponding values predicted by the model. Moreover, you include in the mixing models the 'optimum combination of tracers' selected using the discriminate function analysis. Nevertheless, you use a mean value of each 'optimum' tracer and the variability of these tracers is not taken into account. I would suggest to evaluate the uncertainty associated with the results.

Page 6683, line 23: what does it mean "gully vales"?

Page 6684, line 12-16: Due to the high uncertainty associated with the results, I suggest to present (at least) averaged values with the associated standard deviation or to calculate the uncertainty ranges. The reader does not have any idea of the dispersion of the results. Page 6685, lines 1-6: Could you please reformulate this sentence. If I understood it well you are citing the work of Carter et al. (2003) and Collins (1997) as examples of accordance between source contribution and extension of each geology type. I think you should better explain this.

Page 6697, Table 6: I wonder if it would be easier to read this table if you order the rows in increasing catchment area or increasing contributions?

Page 6687, line 21-26: Indeed, it is less difficult to collect the material from a reservoir (ephemeral one). However, the authors do not seem to consider that sediment particles reached the reservoir after different rainfall-runoff events, and that different events might activate different sediment sources. Thus, there is the risk that material transported from several events (and coming from different sources) is mixed. Please, could you further explain how did you assess this problem? And/or give more details about the hydrological functioning of the catchments.

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Page 6688; 2-3: I think it is not correct to state that you have addressed the assumption of conservative behaviour of tracers by 'selecting fingerprinting properties that are known to be conservative'. I would better state that you have selected them because the values measured in the sediment were not higher than the ones measured in the sources. Eroded particles can suffer complex processes during erosion/transport, so I think it is maybe not adequate to talk about 'conservative behaviour'. Moreover, this sentence contradicts the following one, where you state that you should 'empirically verify the assumption of conservative behaviour. . .".

TECHNICAL COMMENTS

Page 6678, line 10: 'Differentiation Function Analysis (DFA)' should probably say 'Discriminant Function Analysis (DFA)'.

Page 6678, lines 18-20: this sentence should probably be written in past tense.

Page 6680, line 5: geochemical composition.

Page 6680, line 6 (+page 6682, line 7): 'organic' should not start with a capital letter.

Page 6680, line 14-17: I do not understand this sentence. Please reformulate it.

Page 6684, line 5-6: 'This composite fingerprint includes tracer properties from several different'. There shouldn't be a point after 'different' since the sentence continues on the following paragraph.

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