Hydrology and Earth System Sciences

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Discussions

Interactive comment on "Does discharge time source correspond to its geographic source in hydrograph separations? Toward identification of dominant runoff processes in a 300 square kilometer watershed" *by* Y. Yokoo

Anonymous Referee #3

Received and published: 6 November 2014

General Comments

The main aims of this study are to compare End Member Mixing Analysis (EMMA) and numerical filters in hydrograph separations in a large catchment. The chosen study site is the Abukuma River catchment in Japan, although the results are most likely applicable to other similar catchments worldwide. The paper is clearly written and generally well structured and deals with the subject matter in a logical order. The topic is of broad general interest to the hydrological community and falls well within the

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scope of HESS.

I am unsure whether the definitions of the various techniques are clear and meaningful. Both are based on time series data. To avoid confusion it would probably be better to refer to something more specific (e.g. filtered hydrograph data and chemical mass balance) such as is used in the text (e.g., in Section 2.3). The terminology also seems to subtly change at places within the manuscript and it is important to use the same terms throughout to not confuse the reader.

One main scientific concern is with the EMMA; firstly turbidity is not a good parameter as it is not conservative and secondly the derivation of end-members is done only by reference to data from the river with no independent verification. Despite statements to the contrary, some verification is required and should not be beyond the scope of the research.

The choice of the filtering technique also needs more justification. It is relatively easy to process hydrograph data with filters or other techniques and it would be not a difficult task and it would lend more weight to the conclusions.

There is also tendency to focus on the numeric aspects such that it is not always clear what the physical meaning of the 5 flow components or the lag is. It may be fine to get these results from processing of the data, but to be useful and convincing; you need to be clearer about how this relates to actual processes. The time lag in particular seems arbitrary and very long.

Overall, while this is potentially a valuable study, I think that it needs more work prior to publication.

Specific comments

There is some confusion as to the size of the catchment (I think that 3000 km2 as in text not 300 km2 as in the title is correct).

Abstract

The abstract is a good summary of the paper and conveys the main aims and results of the study without need to refer to the text.

Introduction

This is a good summary of the relevant literature; however, in places it lacks detail and doesn't convey what is really important.

âĂć Page 10933, lines 4-15. This would not be very clear to anyone who had not read the individual papers. Please explain how the several components may be distinguished.

âĂć Page 10933, lines 20-30. The significance of using geochemistry to do something other than calibrate the results of numerical techniques needs a bit more explanation. Basically it is because most techniques lump several water components into quick flow and slow flow (or baseflow) but do it differently; so delayed water such as bank return flows that is geochemically similar to surface water may be grouped with baseflow in a numerical filter but surface flow if chemical mass balance is used. This needs explaining a bit more fully as it may not be appreciated by all readers.

âĂć Pages 10933-10944. In places you are presenting a list of techniques or a historical perspective. It would be better to explain the important points of these techniques – what are their advantages and disadvantages? where do they "fail"? etc.

There are probably a few aspects that you need to discuss in the introduction to properly frame your paper. These could include

âĂć An explanation of the general situation that most techniques split river discharge into two components (quick flow and baseflow) but that those components may be made up of different waters (e.g. baseflow can be groundwater, bank return flows, drainage of floodplain pools etc).

âĂć The issue that the various techniques commonly give different answers and whether this is a problem or whether applying multiple techniques can give us com-

plementary information.

âĂć It would be good to start the introduction with a short statement of why we care about determining groundwater inflows or total baseflow to streams.

Data

The data for this project are from a public source, so details on their collection are probably not relevant, some minor points:

âĂć Are Temperature, pH, and DO used in this study, if not you can omit them here?

âĂć How were the record processed for data gaps (were the gaps ignored or did you try to estimate the data?)

âĂć I am not sure what the turbidity units are (deg?) I'm used to seeing these in Nephelometric Turbidity Units (NTU)

Study area (section 2.1)

This is very short and it is difficult to get a clear picture of what the catchment is actually like. Please provide some more details on the landscape, hydrology, rainfall, groundwater etc.

Filtering (Section 2.3).

There are several possible choices of filtering techniques; is there any specific reason why this one is chosen. It would be interesting to compare the results of this technique with other numerical filters or other techniques based on the hydrograph.

Results

Section 3.2.

I am not convinced that you have enough geochemistry data to do the EMMA in the way that you have. EC will likely work as a parameter, but to be convincing about this you need to say something about the major ions. For example if Cl is the major anion

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it is likely to be conservative and EC will probably not change in the river by any other process than addition from baseflow or evaporation. However if nitrate or bicarbonate are the major anions then EC values may not be conservative and may change due to in-river processes.

Turbidity is more of a problem and is certainly not a good choice of parameter. While Fig. 3 can be interpreted as a three component mixing plot, there is the assumption in doing this that mixing of water from the three sources is the only process. For EC that might be OK (see above) however as particulates settle out from streams, the turbidity is almost certainly modified during river flow; in which case, Fig. 3 cannot be so simply interpreted.

I am also concerned that there are no independent end-member data. For example do the supposed EC values of the groundwater and surface water match with observations in the catchment? This section needs far better justification as the EMMA results critically depend on it.

What is the justification for the 66 day lag? I can imagine that some smoothing of the geochemistry data to take into account the time taken for river transport from the distal part of the catchment might be necessary but this seems very long. It looks as if this was chosen for numerical convenience, is this the case or do you think that it has physical meaning? It may be that the lag relates to the delayed rise in the water table after rainfall, but if that is the case you would need to have some data to verify it.

Section 3.4.

This section compares the results, but I think that it needs to do more. Firstly, there needs to be some indication of the uncertainties and limitations of each technique (especially given the questions about whether turbidity is useful).

I also found it difficult to follow the discussion. Defining Q1 to Q5 is all very well but what do you think that these components actually are in terms of water stores. A study

like this is valuable if it can be related to physical processes. You do discuss this at the end of the section, but a clear explanation earlier (or in sections 3.2 and 3.3) would have helped.

Section 4.1

I can't help but think that there is a lot of circularity here. The EMMA has been adjusted by using a lag time so that it agrees with the filtering so it is not surprising that they agree (i.e. the agreement doesn't appear to be a very independent test). These latter sections are really only valid if the EMMA and filtering results are themselves valid. Given the questions raised above, I would have liked to have seen a more thorough justification of the results in these sections; as it is this section is very general and does not add a lot to the confidence of the study.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 10931, 2014.