Hydrol. Earth Syst. Sci. Discuss., 12, C1227–C1232, 2015
www.hydrol-earth-syst-sci-discuss.net/12/C1227/2015/

Hydrology and Earth System Sciences
Open Access
Discussions

Interactive comment on "Nonstationarity of low flows and their timing in the eastern United States" *by* S. Sadri et al.

Anonymous Referee #3

Received and published: 23 April 2015

This work deals with the analysis of trends and step changes in low flow statistics at stations over the eastern part of the US, and attempts to relate findings to qualitative USGS flags. Although of scientific and operational interest, this study has some weaknesses that prevent its publication in HESS in the present form. My comments had been mainly drawn before the publication of other comments in the online discussion, but I can see that many of my points overlap with previously made ones.

In summary, I would suggest to investigate in much more detail the qualitative flags used and check the meaning of "no flag" for each station, all of this necessarily in close cooperation with USGS database managers. This would contribute to improve the conclusions in terms of relations between statistical findings and human disturbances. My two main comments are detailed below, followed by a list of more specific comments.

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

General comments

Understanding of the hydrometric database

The manuscript shows many examples of misunderstanding of the database flags, the most noticeable being the “change in gauge datum”. This seems to reflect a lack of investigation on the meaning of these flags. More generally, such a study should be done in close cooperation with the database managers and field hydrologists. In that sense, the hard work made to identify reference hydrometric networks should be recognized, and more critically, used.

Below are some related comments on specific parts of the manuscript:

1. P2770 L3-6: The big question here is: What is the default in the database? Indeed, what is the meaning of a station with no flag? Is it actually a station with minor anthropogenic influence or change, or may it be a station that has not been documented (yet)? I know that other hydrometric databases include stations that are not flagged (by lack of time for a comprehensive overview) but should be. This is an issue that is not even mentioned in the manuscript, while it may have serious consequences on the interpretation of results.

2. P2770 L9-11: “The sites in the mid-Atlantic states are generally more affected by [. . .] change of gauge datum”: This sentence implies that a change of gauge datum can be interpreted as a change in the catchment hydrological behaviour. Well, this is simply a change in the reference level for measuring water levels at the station. Besides, the list of flag you mention does not include dates of changes in the rating curve, which may have consequences in computed stream-flow values, mainly for stations with unstable riverbed.

3. P2773 L21-26 “this is mostly associated with a change in gauge datum” (and

HESSD
12, C1227–C1232, 2015

similar quotes): Again this serious issue of interpreting the “change in gauge datum” flag.

Relating human disturbance and trends or step changes

There are several assumptions in the interpretation of trends and step changes in terms of potential causes that are clearly debatable and that undermine the overall conclusions. Indeed, gradual changes may for example come from either the climate or gradual changes in water abstractions and water management. A step back should be taken to consider all possible causes (climate, water abstraction, water management) to statistical findings.

Below are some related comments on specific parts of the manuscript:

1. P2767 L14-16 “We therefore assume that step changes in the time series are indicative of an anthropogenic effect, and that gradual trends reflect a climate effect”: This is a very strong assumption, and if climate change may indeed mainly cause gradual changes, this is also the case for different anthropogenic actions on the catchment. Examples of such actions can be found in the manuscript itself, for example P2768 L6-16, where you list a number of land cover / land use changes that gradually change the catchment hydrological behaviour. Similar comments may also be applied to gradual increase in water withdrawals, be they for drinking water following urbanization and population growth or for irrigation.
2. P2772 L16-17: “Is a statistically significant step change is not identified, we assume that the autocorrelation is a reflection of management effects”. Well, this is again a very string assumption. Indeed, autocorrelation may come from natural long-term memory from e.g. aquifers.
3. P2776 L22: “regulation” What do you precisely mean by regulation? Regulation may for example aim at sustaining low flows above a given absolute level (for

HESSD
12, C1227–C1232, 2015

e.g., environmental flows), and this would have in this case a strong effect on Q1day or Q7days, but a limited effect on more temporally integrated indices like Q90days.

4. P2777 L4: “rather than a direct anthropogenic impact on the low flows” Again it is not clear what you mean by “direct”. I could understand “indirect” through the consequences of anthropogenic climate change. But “direct” in my opinion applies to all human disturbances on the natural catchment hydrological behaviour, whether on land cover/ land use change, water management change, or combination of both.

Specific comments

1. P2764 L4-6: I don’t understand why the two facts should be conflicting. Please rephrase.
2. P2764 L16: I’m not sure that the reference used here is the most relevant one to support your statements.
3. P2768 L21: Could you elaborate on the “lake-effect snow”? I’m not sure any reader is familiar with it (I am not).
4. P2769 L8: “(EPA, 2008)”: Could you provide any primary and recent literature on this?
5. P2770 L23: Is it the day with the minimum low flow? Please confirm.
6. P2771 L1: I assume you wanted to write “A sequence of realizations of a random variable”
7. P2771 L7-9: Please define “i”.

HESSD
12, C1227–C1232, 2015

8. P2771 L14-16: Well, this may be true if you have a long enough series, which is rarely the case in hydroclimatology where the quest for understanding natural variability is still ongoing. Plus, I would strongly suggest using hydrological text-books or papers rather than finance ones as reference works in order to better capture the specificities of the field.

9. P2773 L9-11: "therefore a large number of sites appear stationary": why should there be a causal relationship here? 90 days is only one season and there may be trends/changes occurring on one season only. Please rephrase.

10. Fig. 4: Does it show results from the first step of the algorithm? (I assume it does)

11. P2776 L1-2: "Q1 may be the most appropriate for identifying a change since they are based on the original time series data": I personally disagree. Indeed, Q1 are more prone to measurement errors at so low water levels than more temporally integrated indices. Q7, or MAM(7) as described by WMO (2008), is much more widely used and in my sense more suitable here.

12. P2776 L23: There is no grey point in Fig. 7.

13. Fig. 7: There is some inconsistency between (b) and (c). Plus, did you apply here some MK test taking account of autocorrelation?

14. P2777 L 11-12: "If the onset time of the low flow season for a site occurs 70 to 100

15. Section 5.1: I would recommend changing the section title, as there is no formal attribution performed here, only observations of qualitative correlation.

16. Section 4.3: So If I understand well, you remove from the analysis all sites that have two low flow seasons. This means that you are removing all sites that could

HESSD
12, C1227–C1232, 2015

see a shift in absolute minimum flow from one season to the other, and which are the most interesting ones, from a process point of view, but also from a water management point of view. This would completely change the pattern shown in Fig. 9.

17. Fig. 10 (a): What is the "warm season"? Plus, what sites are exactly plotted here? I would assume that only unregulated ones (or at least the ones not flagged as regulated) should be presented here.

Technical corrections

1. Figures: they are all very difficult to read (most notably Fig. 5 and 6, but all others). However, there is redundant information that could be removed to make them bigger: axes across subplots, legends across subplots, etc.

References

- WMO (2008) Manual on low-flow estimation and prediction. Operational Hydrology Report 30, WMO-N° 1029. Geneva, Switzerland.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 2761, 2015.