Review of "*Multi-level qualification of parafluvial exchange*..." by Meghdadi and Eyvazi

This manuscript examines hyporheic exchange in an alluvial river in Iran using environmental tracer techniques. The general scope of the work was to qualitatively assess the scale of exchange under different conditions. This topic is well within the scope for HESS and the authors clearly put a lot of efforts into the collection of a large database. However, the manuscript is not acceptable for publication because no clear hypothesis was outlined and tested, the interpretation is largely qualitative whilst this field seeks to be quantitative nowadays, and the manuscript would require significant editing to meet publication standards. I would encourage the authors to resubmit the manuscript but it will certainly require a major revision.

The context of the work needs to be better explained. I am suspecting the motivation for the work is to characterise groundwater – surface water interactions in an irrigated agriculture setting to constrain the water and nutrient balance for the river. Thus, the scope of the manuscript would need to be broaden to include groundwater – surface water interactions at the scale of the whole floodplain (or 'alluvial plain'), with less emphasis on parafluvial and hyporheic exchange. Broadening the scope would also help to evaluate whether some processes now labelled as 'parafluvial' really are.

Whilst definitions vary, 'hyporheic exchange' generally describes groundwater – surface water exchange within the river channel because of flow over an uneven riverbed ('bedform-induced' exchange) or due to elevation differences between pools and riffles ('gravity-induced' exchange). Parafluvial exchange is essentially gravity-induced exchange due to water level differences between meander bends. However, in alluvial plains other processes can trigger groundwater – surface water exchange without being 'parafluvial' or 'hyporheic'. What is the regional context for groundwater flow? As a whole, is the alluvial plain gaining or losing relative to regional hydrogeological systems? How does this change over time? For example, in large alluvial plains it is common for the lowest point in the water table during dry periods to be in the floodplain rather than the river itself because of high transpiration rates by phreatophytes. This results in the focus for regional groundwater discharge to be in the floodplain and for the river to be 'losing' relative to the floodplain. This is not parafluvial exchange (when the infiltrated water largely comes back to the river) but 'river recharge' (where the river water largely does not return to the river). However, in an irrigated agriculture setting, the reverse could happen in dry periods if irrigation with surface water results in a groundwater mound in the floodplain. The tendency would then be for the river to be gaining via 'irrigation return'. If irrigation is via groundwater pumping, the water table will tend to drop and the river will be losing via 'induced bank recharge'.

The variations over time also include processes occurring at larger scales. Less transpiration during colder periods can result in the water table rising in the floodplain and for the river to be gaining instead of losing relative to the floodplain. Flow pulses can induce cycles of 'bank recharge and discharge', where some of the recharged water will remain in the floodplain but much returned to the river once the flood-pulse passes. If flows overtop the banks, flood recharge can take place. In large alluvial plains and in more arid settings, this is often by far the main recharge mechanism for alluvial aquifers.

This does not mean that parafluvial and hyporheic exchange are not important, but in order to understand their significance the broader picture at the scale of the alluvial plain must be understood.

In summary, if the paper is to remain largely qualitative, it must cover all scales of groundwater – surface water exchange in the system. Whilst similar studies have been done elsewhere, the topic is still worth investigating here because of the different climatic and geographical setting. Indeed, I am quite sure that HESS readers would be interested in the general hydrology for this particular system. If the paper is to remain focussed on hyporheic exchange, it must be quantitative to be consistent with the state of the literature for this field. This would involve, for example, modelling the temperature and radon profiles collected in the riverbed to determine the direction of groundwater flow and the magnitude of the hyporheic exchange.

Some suggestions are provided below for studies done at the floodplain scale that might be useful in reformulating the scope for the manuscript.

References

Burt et al. 2002. Water table fluctuations in the riparian zone: comparative results from a pan-European experiment. Journal of Hydrology 265: 129-148.

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