Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2019-101-RC2, 2019

Hydrology and Earth System Sciences
Open Access
Discussions

Interactive comment on "Technical note: Water table mapping accounting for river-aquifer connectivity and human pressure" *by* Mathias Maillot et al.

Anonymous Referee #2

Received and published: 24 June 2019

This manuscript evaluates the connection status of an urban river through the statistical generation of a water table map. Determining groundwater - surface water interactions at the larger scale for rivers is a current research topic and thus the manuscript is well suited for the journal. In general, I have found the paper interesting and potential quite useful with some adjustments. However, I cannot comment on the methodology used for generating the water table map because I have no expertise in the methods used. The manuscript will require some English editing but this is a minor concern.

My main comment is that the authors could have also used simpler alternative approaches to evaluate connectivity to compare with their methodology. Likewise, some

of the hydrogeological assumptions used to derive the map are probably incorrect. I will explain these concerns below.

1) Connectivity state. The authors are probably aware but have failed to mention that there are three hypothesised connectivity states for a river - alluvial aquifer system: Connected (gaining or losing), disconnected, and transitional. The transitional state was not described here and needs to be mentioned in the context of the system (transitional conditions can occur when the capillary zone intersects the riverbed. The concept of the riverbed clogging layer and the necessity of its presence to generate disconnected conditions under most field conditions in a temperate climate needs to be described.

2) Hydrogeology in an urbanised area: I was uncomfortable with some of the assumptions used in the generation of the water table map, in particular that there is no recharge in urban areas due to the presence of 'impervious' structures. This is not consistent with findings elsewhere, which have shown that 'impervious' structures like road networks are never completely so. Moreover, most large old cities have large old and leaky water distribution and sewerage networks. Whether this is the case for the study area I do not know but evidence must be provided to satisfy that no recharge occurs there. In addition and of consideration for the generation of the water table map, sewerage networks can also act as drains and thus impart an upper limit for the position of the water table.

3) Hydrogeological interpretation: It is probably necessary to compare the assessment made using a water table map with a more hydrogeologically-based interpretation. For example, Lamontagne et al. (Hydrological Processes 28: 1561-1572) provide a methodology where assessments of connectivity for rivers can be made using pairs of surface and groundwater level measurements for different hydrogeological properties of riverbeds and aquifers. Even though the authors may not have all the information required (e.g. riverbed hydraulic conductivity) the Lamontagne et al. approach can still be used in a sensitivity analysis context. Indeed, a sensitivity analysis should also be

applied to the water table approach as well if possible - what is the potential error in the map?

The empirical approach used by the authors to evaluate connectivity (Fig. 3) could be flawed based on hydrogeological principles. The lack of response of a water table to variations in surface water level could be due to a number of factors other than a river being disconnected. Indeed, even when disconnected, the specific recharge rate and flux below a river will increase at higher water levels (due to a greater head and wetted area), thus a response of the water table is still possible. On the other hand, a river could be connected but the alluvial aquifer have a very low transmissivity, which could result in a subdued variation in the water table especially if bores are at some distance from the river or the variation in river stage only for a short period of time. At a very low transmissivity, the response will only be notable when very close to the river. For a given change in river level, there will be a certain distance where the water table response can be practically measured considering other sources of variation.

Minor comments:

P2, Line 1:'Embankments' should probably be 'levees' if they raise the water level at which water would spill into a floodplain. P4. Use of unsaturated zone thickness: I did not understand why this was better than using the water table elevation. It would also be preferable to use the term 'vadose zone' instead of 'unsaturated zone' considering capillary effects are of interest. P.20. Basis for the 10 m threshold. Some additional justification is required for using this threshold to identify disconnected conditions. Drawdown cones can be much deeper, especially when transmissivity in the aquifer is low. P.6, line 11. This is only correct if the river level is constant. If the river level increases, the specific recharge rate and overall recharge flux below the river will increase because of a higher hydraulic head and a larger wetted area (i.e. wider river). Figures: Could in general all be improved - very faint lines and symbols in particular. Figure 6a was interesting and should be complemented with similar 2D cross-sections when feasible to get an idea of the shape of the water table near the river.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2019-101, 2019.