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Interactive comment on "Distributive rainfall/runoff modelling to determine runoff to baseflow proportioning and its impact on the determination of the ecological reserve" *by* Andrew Watson et al.

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Dear Anonymous reviewer (#1)

We would like to thank the reviewer of our paper for their comments and feel that these will help in improving our paper. The aim of this paper is to provide the hydrological data or hydrological components required for ecological determination, and the paper has scientific contributions in that it deals with both distributive surface water and groundwater modelling as well as improving rainfall/runoff model baseflow separation

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ability. The long time series data estimated for this sub-catchment is the first in this WMA and can be used for future water management as gauging structures and measurements are presently unavailable. While the reviewer has raised some issues that need to be addressed in the paper, there are some points that are not correct and some that are to do with the way in which the paper is written and not actually related to the results. We accept that parts of the manuscript can be written better, although the results themselves are sound and are vital for management of water resources in this water stressed region.

Regarding the references, we accept that these might be slightly out of date, although the catchment lacks site specific references which is part of the problem which compounds the need for research such as the one presented here. We have considered the uncertainty that limited data could have on hydrological models that are constructed for WMA such as Olifants/Doorn, although this has obviously not been brought through clearly enough in the introduction and we will update this accordingly. With regards to the Verlorenvlei system, this is classified as an estuarine-lake (e.g. Meadows et al., 1996 amongst many others) and we feel that this is clear in our manuscript. The sandbar limits the connection between the sea and freshwater. Water levels measured at G3T001 are significantly far away from the sandbar and therefore not impacted by coastal tides. Regarding the lake receiving direct inputs from groundwater, the daily evaporation rates in the sub-catchment are very high in which case groundwater contributions could be significant, although these volumes are not enough to counteract the daily evaporation potentials. While we do not consider this in the model setup, groundwater inflows into the lake could potentially be an important component of the water balance. While the focus of this contribution is quantifying stream and baseflow inputs into the lake using distributive modelling, in future we would like to be able to simulate the water levels in the lake as well as groundwater and surface water abstractions, although this will only be included in future studies.

The reviewer is correct that if you look at current Google Earth imagery of the catch-

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ment, there is clearly extensive agricultural development with many centre pivots which would impact streamflow. However, the model was calibrated between 1987 to 1993 (Fig. 7), when agricultural withdrawals from the catchment are far less intense (see Google Earth). Moreover, the model was calibrated for the Kruismans tributary (Fig 1), which has a far lower water footprint as the number of centre pivots are far less than the rest of the sub-catchment even today. Therefore, the calibration was conducted when river flow regimes where relatively unaltered and parameters estimated are valid for this sub-catchment. During the periods where there was no observed data (2007-2018), the data was set as missing values as presumed by the reviewer. An EMD protocol was applied to the water level data in the lake (2008-2018) to filter runoff data that resulted in a water level change at the sub-catchment outlet for further comparison, although further improvement can still be made to this approach.

Regarding Fig 4, streamflow exceeds the cut-off threshold of 3.675 m.3.s-1 for the station more frequently during the calibration, as this is during a wet cycle, with average rainfall of 413 mm/year as opposed to the dry cycle, which has an average of 330 mm/year (Fig. 4). We accept that a probability could be used to ascertain how often the cut-off threshold was exceeded, which would be more beneficial to the reader and can clarify this in the revised version. Reviewer 1 is correct that equation 1 refers to the overall water balance used, and it is not immediately clear how groundwater is part of the model presented, although equation 2 and 3 explain how recharge and interflow is determined, while equation 4 and 5 outline how slow and fast groundwater flow is calculated in the model. We accept that a flow diagram can be added to aid in this description and it will be included in the revised paper. Regarding the slope factor, this is a component of the J2000 model (Krause et al., 2005) and is a calibration factor used to determine the proportion of percolation to interflow (http://jams.uni-jena.de/ilmswiki/index.php/Hydrological_Model_J2000). It essentially represents the forces in the triangle of gravitation, normal force and frictional force. The latvertdist parameter is a representation of anisotropy, which modifies the forces triangle.

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We agree that the MODFLOW estimates and the J2000 should not be calibrated to one another and that they should rather be in broad agreement with one another. Due to the J2000 lumping percolation rates (hydraulic conductivity), in this paper we have distributed the percolation rate for different geological formations by considering aquifer hydraulic and net recharge values that we used for a groundwater model calibrated for a sub-tributary. We believe this is just a wording issue and can be dealt with in the revised version. Whilst a reservoir model could be used to include the lake water level data thereby accounting for evaporation losses, further developments on the model structure still need to be made, which will be covered in future work. With regard to the catchment that the Verlorenvlei system sits in, it is quite clear that Verlorenvlei makes up the southern portion of the Olifants/Doorn Water Management Area (WMA). This is on a wide variety of published material, from Dept of Water Affairs maps to peer-reviewed journal articles and numerous consultancy reports. It is not clear to us why the reviewer thinks otherwise. Regarding the comments on page C4, these are minor and will be dealt with in the revised paper.

While this contribution uses a simplistic estimate for the ecological reserve, it provides the necessary data required for more comprehensive estimates and hence the need to make it open sourced. We accept that there might be some disparity as to how the paper conveys ecological reserve estimates which are quite out of date now, where Building Block Methodology (BBM) has become the standard for ecological reserve determination in South Africa. Therefore, this paper would require some minor restructuring to make this clearer. The distributive surface water modelling was covered in a previous paper published in Journal of Hydrology and therefore only a summary is included in this contribution. This is standard journal practice as most journals don't provide space for lengthy summaries of prior components of the same work. We will however, fine-tune the information presented to ensure that the most critical components are covered.

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