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Interactive comment on "Investigation of dominant hydrological processes in a tropical catchment in a monsoonal climate via the downward approach" *by* L. Montanari et al.

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Dear authors,

A third review has arrived after the deadline for the open discussion. As it contains useful comments I would like you to take these comments into consideration as well. Especially the comment about the lack of described motivation for a 4-bucket model is something that should be addressed.

Could you reply to the second reviewer as well? If your replies have arrived, I will give some final editing comments. Regards.

Investigation of dominant hydrological processes in a tropical catchment in a monsoon climate via the downward approach. L. Montanari, M,. Sivapalan, and A. Montanari

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Interactive Comment

Anonymous referee #

General comments

In the manuscript a relatively simple procedure is described to investigate the relation between model complexity and model performance for a tropical catchment (619 km2) in Australia with relatively short observation time series of runoff and meteorologic forcing.

In the manuscript a simple lumped conceptual model structure is systematically developed and optimised following the downward approach to simulate runoff production by means of Saturation overland flow, delayed runoff and groundwater flow through groundwater-river mass exchanges. At the onset of model structure development a single bucket approach is proposed and based on model performance analysis, additional buckets and complexity has been added to finally to end up with the B4DGETh model structure that allows for explicit simulation of runoff production by the identified runoff processes. The approach is mass conservative and catchment response modes are directly related to meteorologic forcing. Additionally to natural forcing also time series of synthetic rainfall have been utilised to better understand and to evaluate the effect the start of the monsoon period has on catchment runoff production where real world evaporation time series constrain simulation results. Finally a sensitivity analysis has been executed for specific, but lumped, catchment properties.

As stated above, the proposed procedure is a very simple one but also the optimised and developed model structure is a very simple one. In literature ,the effectiveness of lumped conceptual model structures that are based on sequential and/or parallel storages (in the manuscript called buckets) is undisputed and as such development of such structure nowadays has become common practise and could be termed “an every days” activity for a good runoff modeller. In this respect the procedure of model structure development is not regarded very innovative, particularly due to the simplicity of the parsimonious bucket approaches. The fact that the downward approach now

is applied to better understand the monsoon climatic forcing in a tropical environment also is not regarded highly innovative since runoff production over space and time in basically any system of regional scale primarily is a function of such forcing where specific system characteristics such as depth, slopes and topography govern catchment responses and catchment runoff distributions over time. The overall outcome of the proposed research however is relevant in a sense that research is well structured and results match with our understanding and perception of real world rainfall-runoff behaviour. As claimed in the manuscript, broad scale features are nicely represented and the approach could be applied to regionalization studies. Particularly simulation results as obtained for the monthly and annual time scale support the claim. It is a pity that, repeatedly and implicitly, averaging effects across such large time scales are used as a validation argument of the approach. Daily simulation results reveal the limitations of the selected approach but issues of small system dynamics and nonlinearity are hardly identified and addressed as possible cause of poor model performance. These aspects should not be ignored in the manuscript but require much more elaboration in the various Sections.

Some detailed comments

Page 166: line 5-10. The optimal structure is subjective and, as stated in the Introduction, “the model structure possibly only is able to represent broad scale hydrologic features”. The applicability and usefulness of the approach should be constrained.

Page 169. The development and testing of the single bucket model is not very relevant since such approach intrinsically already could be denied. The paragraph should be removed.

Page 170. It is unclear / not argued why for a four bucket model is opted. It is described that this structure is obtained through manual (trial and error) calibration over large time scales but there is hardly any bearing to the choices made.

Page 170. The criteria to differentiate between delayed runoff and groundwater flow is

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arbitrary and should be relaxed since flux parameterisation only is indirect.

Page 171: line 10. Daily simulation results are not very explicitly shown and only and exceedance distribution is shown. Such distributions however carry no information of model performance over time and as such figure 11 does not support the statement of line 10.

Page 171: line 13. Reasoning is suggestive and not in line with previous comments on catchments slopes and available information on aquifers.

Page 172: line 12. This line should be reformulated: temporal resolution is not dependant on hydraulic geometry and surface roughness but simple defined by the simulation time step.

Page 172: line 27-28. The statement is too weak. The model structure simply is too incomplete to simulate extreme catchment response modes as triggered by extreme forcing conditions. The argument of poor rainfall observation is valid. Model limitations however should be clearly described and be manifestly formulated. The comments on effectiveness of automated calibration to prove model performance (see page 173 lines 3-9) are not relevant and out of scope.

Page 26: line 26. Analysis are not shown nor described. Also given the relatively small scale of the catchment and relative quick responses it is somehow trivial that catchment responses primarily are governed by recent forcing. This is also shown in Figure 4.

Page 175: line 3-8. The statement cannot be made since results are not shown. The statement now is tendentious and also pretentious moreover since results in figures 12, 13, 14, 15 and 16 do not provide substantiation.

Page 176. Conclusions on saturation overland flow generation must be reconsidered since explicit proof is not provided in the research. Particularly the fact that simulation of saturation overland flow, that is a highly dynamic ,non-linear and basically a local

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phenomenon, by means of a very simplified lumped model approach causes that conclusions must be formulated with care. Also detailed simulation results at the daily time scale are ignored and conclusions are based on bulk performance indicators such as exceedance probability distributions and cumulative curves.

Page 177: line 3. The statement is applicable to any shallow system with significant rainfall inputs/intensities. The comment on the “tropical region” in this respect is not pertinent but more circumstantial.

Page 177: line 23-25. In the manuscript prove is not provided for the conclusion on extrapolation. Conclusion is suggestive and pretentious moreover since this research also has proven that specific catchment characteristics such as depth, slope and topography have significant effect on runoff production.

Page 188. In Fig 4 the time period should be added.

Page 194. It is not clear why mean monthly discharges are divided by mean annual precipitation. This should be explained in the manuscript. Such procedure again masks and filters relevant (model) signals.

Page 195 and 196: A percentage normally ranges from 0 to 100%.

Page 196 and 197: Legend text: Groundflow should be groundwater flow. The manuscript requires further detailing and limitations of the optimised model structured and effects of the applied time-averaging procedures should be clearly described. Also conclusion should be formulated accordingly. The manuscript requires major revision.

Interactive comment on Hydrology and Earth System Sciences Discussions, 3, 159, 2006.