Hydrol. Earth Syst. Sci. Discuss., 9, C6528–C6535, 2013
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Hydrology and Earth System Sciences Discussions

Interactive comment on "A critical assessment of the JULES land surface model hydrology for humid tropical environments" *by* Z. Zulkafli et al.

Z. Zulkafli et al.

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Many thanks to the reviewers for your helpful comments. Please find our response following each comment.

1. Toby Marthews, received and published: 26 November 2012

Comment: p.12526 line 26: "most are not field based". Im not disagreeing, but this is a sweeping statement and in any case many pedotransfer functions are based on a lot of field-work (e.g. Cosbys across I think 23 US states). I presume youre meaning that in the absence of tropical field data there is a tendency to apply temperate pedotransfer functions in environments arguably outside their domain of validity. Also, it would be nice if you could mention Beto Quesadas work: he has done a lot of soil sampling in the upper Amazon (see http://www.rainfor.org/en/project/field-campaigns/2010-perusoils).

Response: By ”most are not field based”, we were referring to the soil parameters applied that were not directly field-measured, rather than to the pedotransfer functions not being based on field measurements. Our intended argument was that ideally, parameters in physics-based models, in this specific case that describe the soil water retention curve, should be informed by field measurements. However, this may not be feasible in large domains. We do agree with the reviewer's comment that the functions are sometimes applied ”outside of their domain of validity”, which we will incorporate in the manuscript revision,including a reference to the work by Quesada et al. [2009].

Comment: p12535 line 6: ”This may highlight that the underestimation of precipitation by global precipitation products is most problematic at small scale and over mountainous regions”. (i) Id prefer ”uncertainty in” rather than ”underestimation of” because we cant be sure its always off in the same direction. (ii) This is also a bit of a loose statement: there have been many studies into the uncertainties of GCM predictions. Most of these talk about high uncertainties because of scale issues, mountainous terrain and/or proximity to oceanic gridcells. These are not unrelated, however: uncertain predictions in the Andes could be because the topography changes over smaller spatial scales than the resolution of the prediction (i.e. its a scale issue and could perhaps be solved by moving over to an RCM) but may also be because of barrier effects (i.e. an RCM wouldnt help). I think you need to fill out this sentence a little and be specific as to what aspect you believe is causing the uncertainty in precipitation here. (iii) You used version 6 TRMM data, which some believe has much reduced uncertainty (e.g. http://shadow.eas.gatech.edu/vvt/Shige2006-TRMM-validation.pdf). Are you contending that the uncertainty is still too high in general or that they are generally good enough but dont work in particular areas? These points are also relevant to the interesting discussion about TRMM and NCEP that follows p.12535.

Response: We update the commented statement to: ”This may highlight that the un-

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certainty of precipitation by global precipitation products in the study area is the most problematic when applied at small scale and over the mountainous regions particularly in south-east Ecuador. This has been previously demonstrated in studies of rain gauge data by Buytaert et al. [2006] and radar data by Rollenbeck and Bendix [2011]. Both attribute the difficulties of capturing precipitation to the highly variable topography. According to Buytaert et al. [2006], due to relief-induced micro-climates, the extent of precipitation events may be as small as 4 km. Rollenbeck and Bendix [2011] revealed multiple interactive processes such as convective and orographic rainfall at local and regional scales. These are unlikely to be fully resolved even using the highest resolution that most regional climate models are currently capable of.

The TRMM version 6 precipitation time series, on the basis of the model performance, provide a reasonable starting point for estimates of precipitation and are superior to precipitation data from NCEP reanalysis data. Pinpointing to the exact weakness of the TRMM data is a challenging task, as the TRMM 3B42 precipitation is derived from multiple observational datasets, converted from measurements of infra-red temperatures, passive microwave radiation, and radar reflectivities from multiple sources of satellites that work at different temporal and spatial scales and domains [Huffman et al. 2007]. Dinku et al. [2010] attributes the tendency of TRMM to underpredict precipitation in mountain areas to several reasons. Firstly, the temperature measured above orographic clouds greatly exceeds the temperature threshold above which the clouds are considered precipitating. The warm clouds also tend not to contain ice particles, which would provide more accurate estimates of rainfall from passive microwave observations. The recent release of version 7 [Huffman and Bolvin, 2012] of the product may bring some improvements, but a full analysis is outside the intended scope of this paper."

Comment: p.12529 line 11: Perhaps you mean ”spin up” not ”warming up”?

Response: We acknowledge that the term ”spin-up” is more commonly used by climate modellers although ”warming up” in hydrological modelling essentially describes the

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same phase of the simulation during which the model state variables are initialized, for example, as is used by Huard and Mailhot [2008].

Comment: p.12531 line 10: ”are considered the best available pedotransfer function for tropical soil”. Firstly, I think neither Hodnett nor Tomasella would claim this: they would claim at most that it was suitable for South American tropical soils. Secondly, I think H&T have updated their opinion since 1998: see Tomasella & Hodnett (2004). Tomasella J & Hodnett M (2004). Pedotransfer functions for tropical soils. Developments in Soil Science 30:415-429.

Response: The quoted claim will be removed from the sentence. We note the opinion of Tomasella and Hodnett [2004] that PTFs that provide estimates of the water content at various heads provides a superior description of the hydraulics of tropical soils than do PTFs that provide estimates of the parameters of established soil water retention curve formulations, e.g. the PTFs of Tomasella and Hodnett [1998] that is being implemented in this work.

2. Anonymous Referee, received and published: 4 January 2013

General comment: The uncertainty analysis consider 2 important aspects for the hydrological performance (precipitation forcing and runoff parameterization) and I find a pity that a 3 major uncertainty is not represented (that of the ancillary dataset, i.e. soil texture map). While there is a description of the FAO-HWSD dataset there is no attempt to quantify the uncertainty coming from the choice of texture. A set of simulations could include the choice of a uniform vertical texture profile, vs a vertically stratified texture (as in the simulation realized) to enable depicting and quantifying this 3rd important source of uncertainty. I leave this as suggestion to the Authors, and in case it is considered the discussion could be extended consequently.

Response: We include a sensitivity analysis performed on the soil data that provides some insight into the model responses to the input parameters. Figure 1 shows that there is barely discernible difference between the simulations using four soil parameter sets calculated using temperate PTFs of Cosby et al. [1984] (1) applied vertically uniform and (2) stratified, and calculated using tropical PTFs (3) applied vertically uniform and (4) stratified. We observed that despite the large differences in the values of parameters between the two estimation methods (Figure 2), the difference in the model response i.e. streamflow are limited. This could be due to the large modelling domain, in which the local effects from the parameter perturbations offset each other at the regional basin scale. However, we suspect that the models may be more sensitive to other parameters that are not perturbed, e.g. saturated hydraulic conductivity and soil depth, and by the model forcing. A similar analysis could be performed on different textural maps, but we can expect a similar outcome to the one presented.

Minor errors: P12534 L12: can be significant is repeated twice. P12536 L23: paramos and jalcas need capital letter. P12530 L13: JJF is to be corrected to JJA

Response: All suggested minor revisions will be incorporated in the revised manuscript.

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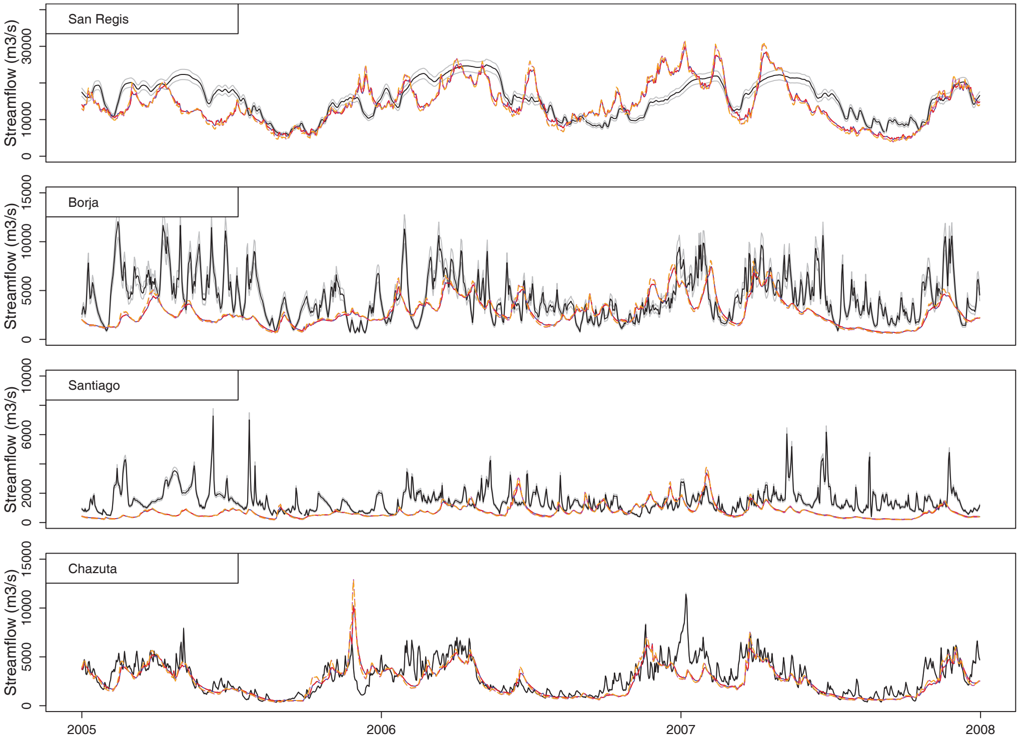

Fig. 1. The model (TRMM-JULES BASE) sensitivity to variations in the soil parameters. Blue:tropical PTF-stratified,magenta:tropical PTF-uniform,red:temperate PTF- stratified,orange: temperate PTF-uniform

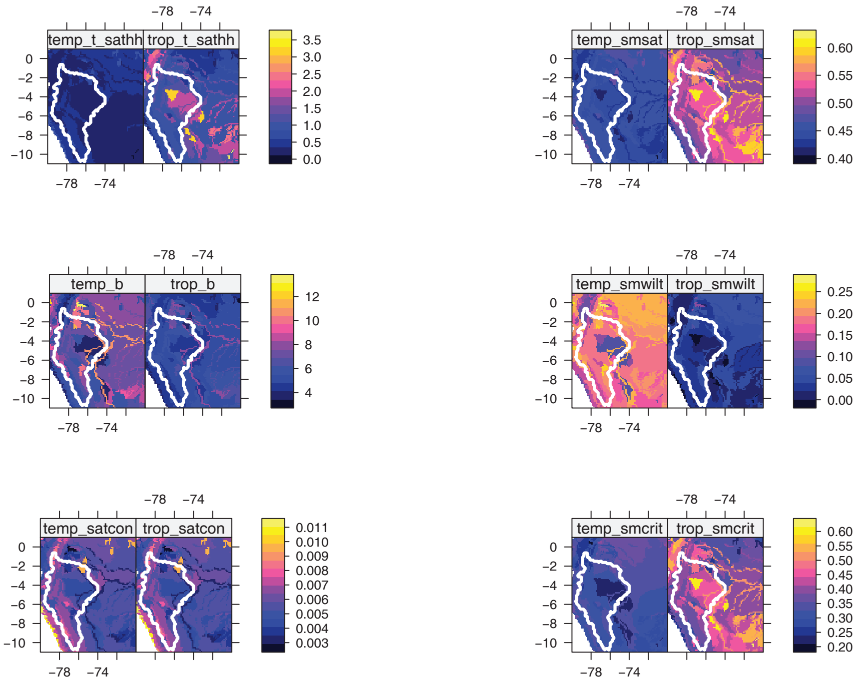

Fig. 2. Parameter variations generated using temperate (left panel) and tropical (right panel) pedotransfer functions in the topsoil (top 35cm). The hydraulic conductivity (mm/s) are unchanged

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