

Interactive comment on “Sensitivity of the West African hydrological cycle in ORCHIDEE to infiltration processes” by T. d’Orgeval et al.

Anonymous Referee #1

Received and published: 17 October 2008

This is an interesting and well-written paper reporting on new parameterizations in the ORCHIDEE land surface model for surface infiltration, deep-soil infiltration and root-zone infiltration, sensitivity experiments in West Africa, the introduction of new modules to simulate river re-infiltration in floodplains and ponds and validations against river discharges in West Africa, Central Africa and East Africa. The paper is well-structured with clear figures and tables. I recommend that the paper be accepted for publication in HESS, following attention to the questions and minor comments provided below.

Questions

• Why are the 13 different vegetation types with parameters given in Table 1 if

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they are not used as such but are grouped into three ensembles for use in the simulations. Why not give representative parameter values for the three ensembles?(p.2255, lines 16-22)

• What is the size of the “gridbox” as used in line 22, p. 2255? Do the three tiles make up one gridbox? What is the difference between grid box and grid point? How does the 0.5o x0.5o base map mentioned in line 17 (p. 2257) correspond with the 1o x 10 scale forcing data mentioned in line 18 (p.2259).

• Provide more explanation on “Parameters have been fixed in accordance with validations against Hapex-Sahel observations “(line 25, p. 2255). Calibration of ORCHIDEE is not very well described in this paper.

• What is meant with (line 9, p. 2257) “the fraction of vegetation type v on the tile”?

• Are the sub-basins referred to in line 15 (p. 2257) the same as the basins B, B’, B’’ of Figure 1?

• Is ORCHIDEE as used in Section 3.2 in its original form, i.e.without the new infiltration parameterizations?

• I wonder whether the authors can explain what is meant with “structural resistance” and how it is due to the vertical structure of leaves. How is this different from the canopy resistance? (p. 2260, line 25).

• The fact that the catchment size as estimated by the ORCHIDEE procedure can be in error by as much as 20% (see p.2263, line 21) makes me wonder about the accuracy of the location/size of the floodplains and ponds and the appropriate vegetation patterns (see Section 4.3). This clearly also has a bearing on the uncertainty associated with the soil map.

• The last four lines of the Conclusions (p. 2273, lines 4-7) refer to the structuration (??) of the AMMA project and the need for improved insight into the link between

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various scales and the means to validate regional parameterization of small scale processes. I did not see much evidence in this paper of linking various scales and any validation was done at very large scale indeed.

Minor comments

p.2252 4: resulting version;. Resulting from what? 9, 10: why distinguish here between basins and regions? 14: could be recalibrated;. Replace with was calibrated; or has been calibrated; 18,19:; denser monitoring;at different scales; What is meant with this? 19: calibration of the infiltration parameterizations;

p2253 1: though? 18: replace corresponding to; with which relate to; 19: in the vertical part;? 28: seems so determinant;. Do you mean appears to be of such significance;? 29: in the horizontal part;?

p2254 2: in an original routing scheme;? You mean a new routing scheme;? 3: the world's 10 largest river basins 8: across the globe 9: At a smaller scale.. 15: Should processes; be replaced with pathways;. (A pond is not a process) 18: large-scale 22: delete introduced; 24: sub-regions in West Africa 25: in river basins across Africa 26: and ways to improve;

p2255 9: The vertical diffusion of water.. 11: maximum upward hydrological flux 13: Water extraction from roots; 23, 24: New parameterizations have been introduced to represent three infiltration processes (surface infiltration, deep-soil infiltration and rootzone infiltration) that are considered to be important to;

p2256 2: on the slope of the land surface; 5: with the reinfiltreated fraction (s) given by;. 7: Integration of s over the grid box gives; 9: with depth (z) 17: where $z_s=0.5m$ 18: inconsistency 19-21: This is

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unclear and needs rephrasing.

p2257 8: Carsel and Parrish (1988). Is it Carsel or Carsell? 8: above-mentioned? 9: is tile equivalent to grid box (0.5 x0.50) 16,17: explain with a different time constant;

p2258 2: swamps 12: mainly? 13: a hypothesis is made about the shape 17: where SB is the;

p2259 3: first-order 20: spin-up or spin up 20: three consecutive years (not y!) of spin up 23-25: and compared to;??

p2260 2: surprised to see that W.Africa goes all the way to 30oE! 7: drier than what? 9: is the beginning of the desert; You mean on the edge of; or at the margin of;? 22: is far less than the ET estimated with the other models 27: leaves

p2261 13: significant source of.. 27: resulting? 28: consists of a

p2262 14:On the opposite? 16: Those two features..

p2263: 7: consists of; 18: errors in 20 error in

p2264 10: Then? You mean Next;? 11: What is meant with different sources of sensitivity;? Sensitivity is a measure of the response to changes. Perhaps you mean the sensitivity to (changes in) forcing, different parameters and parameterizations; 16: Before describing? conducting? the sensitivity tests for the infiltration processes; 21: was available for two pairs of years;. 26: consists of;

p2265 19: ..improved with currently available data; 24: However, this sensitivity test is somewhat limited because both maps come;

p2266 18: first-order

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5, S1500–S1504, 2008

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p2267 3: experiments 17/18: for a much smaller catchment size. 22/23: An example of the annual cycle;

p2268 2: is the orography of these basins.

p2269 4: drainage below the rootzone. 7: bare soil evaporation+runoff represents respectively.. 8/9: (transpiration+drainage represents respectively);

p2270 3/4: ..no analysis..was carried out; 10/11: by a canopy structural resistance that is too high, resulting in a decrease in transpiration;. 12: ; by reducing the canopy structural resistance;. 13:.. It would also cause ORCHIDEE to yield results which are closer to those obtained with the other LSMs in GSWP2. 23/24: rephrase: ;.there is no element that leads to;. Element?

p2271 5: first-order 9: ..major part of the error; In what? 21: One assesses or investigates the sensitivity; or performs a sensitivity analysis. 24: Next, ORCHIDEE simulations of;

p2272 4: .. the uncertainties associated with the vegetation map, the soil map and;. 13/14: Indeed, if parameterizations were changed or new parameterizations added, it;. 25: may also be addressed;

p2273 4: what is meant with structuration? 6: by offering a means;

p2275 14: I think that it is likely that V. Charles should be replaced by C. Vorosmarty?

Table 1: How are root coefficient c and structural resistance r_s defined? Figure 1 Line 4: surface area Line 7: water flows out of each reservoir

Figure 2 Add Hydrology and Routing to the Figure as in Fig. 1 Line 3: surface areas Line 5: ;receive a fraction f of the runoff..

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 2251, 2008.