Hydrol. Earth Syst. Sci. Discuss., 7, C65–C70, 2010
www.hydrol-earth-syst-sci-discuss.net/7/C65/2010/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Monitoring temporary ponds dynamics in arid areas with remote sensing and spatial modelling" *by* V. Soti et al.

Anonymous Referee #1

Received and published: 28 February 2010

In this paper, the ability of remote sensing information, to be used in the modelling of the spatio-temporal dynamics of ponds in Senegal is demonstrated. First, the hydraulics of the ponds are characterized in terms of water level-surface area relations. Then, two experiments are conducted consisting of a calibration attempt with in-situ rainfall and remotely sensed TRMM rainfall. This paper is interesting since its methodology opens up potential to further hydrological modelling in remote and data scarce areas. Below I first briefly give the evaluation criteria of HESS and then give detailed comments.

Scientific significance: Good

Scientific quality: Poor, there is potential for improvement, but this requires a lot of work from the authors.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

Presentation quality: Fair, also requires quite some work.

I have quite some comments which culminate to recommendation for an extensive revision and another review round before publication can be considered. Please find my comments below.

a) My first comment is that the hydrological behaviour of the in-stream pond and outside-stream ponds is significantly different (correctly observed by the authors) but that calibration is performed on the in-stream pond and then validation on the ouside-stream ponds which have a significantly different hydrological behaviour. This seems to be invalid and even if validation seems to give good results, this could be the right answer for the wrong reason (also related to my second comment). I would recommend to at least also perform a calibration on the direct rainfall dominated ponds and validate on a number of (you have 98 of them!!) similar ponds.

b) Another important issue is that the sensitivity of the parameters of the hydrological model is not tested. Therefore, I cannot judge whether the calibrated set of parameters is in any way meaningful. My suggestion is to perform a sensitivity analysis where the identifiability of parameters gets across (for instance a GLUE analysis, (see e.g. Beven 2006 and referred papers).

K.J. Beven (2006), A manifesto for the equifinality thesis, J. Hydrol., 320, 18-36.

c) The validation on 71 ponds (p.117). This does not have a lot of meaning to me if the temporal variability in extent of the ponds is unknown. For instance if the ponds would have the same size all over the year, then it is easy to get a RMSE, representing the spatial variability, of almost zero. The authors should find a way to validate the temporal behaviour.

d) The paper in general is in many places unclear. Please find detailed comments below.

Title: The main purpose of the paper to me seems the modelling (rather than monitor-

HESSD

7, C65–C70, 2010

ing) of temporary ponds dynamics. I would change the title accordingly.

Abstract: I have the feeling that the main message does not get across very well. In my opinion, the interesting new part about this paper is that 2 experiments are conducted: first calibration with in-situ rainfall, then calibration with remotely sensed rainfall to see what the capabilities of remote sensing rainfall in calibration are.

Furthermore, could you clarify whether the validation with quickbird imagery was done for both experiments or not? Does the 'pond map' contain water surfaces for all ponds at one moment in time?

p. 105, l. 7: "inventory" → "characterize"

p. 105, l. 10. I recommend a reference to the following interesting paper, that uses remotely sensed water surfaces to calibrate a hydrological model.

J. R. Liebe, N. van de Giesen, M. Andreini, M. T. Walter, and T. S. Steenhuis (2009), Determining watershed response in data poor environments with remotely sensed small reservoirs as runoff gauges, Water Resour. Res., 45, W07410, doi:10.1029/2008WR007369.

p. 105, l. 21 "was" → "is"

p. 106, l. 6, something is missing. . .

l. 7. "uses" → "use"

l. 9, these relations are purely mathematical.

l. 14. "Difficulty to generalize" → "difficulty generalizing"

l. 25. relatively simple. . .relative to what?

p. 107. l. 1. Why were extensive flood events omitted?

l. 13 "Ferlo River"

HESSD

7, C65–C70, 2010

l. 26. Add the word “event”

p. 108, l. 17. Why was the 2001 data of Barkedji not used?

p. 109. l. 1. A lot of details are missing. The pond maps were not extracted is my guess. They were post-processed from the raw imagery. Please explain how this was done. I’m not sure how you can extract a pond catchment area from a visual image. This is usually done with a DEM. How was the maximum surface area derived??

p. 110. l. 1. Start by giving the water balance equation of the pond, for instance:

$$\frac{\mathrm{d}S}{\mathrm{d}t} = P(t)A(t) + K_r P_e(t) A_c - LA(t)) \tag{1}$$

It seems to me that a flux is missing. Outflow from the pond by the surface. In the riverine ponds, this may be very important.

The symbol ΔV for runoff is confusing as it is usually reserved for a change in Volume. Δ suggests a change in something. The symbol Q is more common for runoff. Eq. 1 is also not the equation for ‘the runoff value’ but an equation for the inflow. Please change accordingly. Also ER cannot be a symbol as it mathematically means ‘E*R’. You could use P_e (e as subscript) for effective rainfall.

eq. 1. I recommend writing the differential equation instead of its solution (Euler explicit). So please write (for instance)

$$\frac{\mathrm{d}V}{\mathrm{d}t} = P(t)A(t) + K_r P_e(t) A_c \tag{2}$$

eq. 3 Write with a max operator:

$$M(t) = \max\left[M\left(0\right) - I_{ap}(t), 0\right] \tag{3}$$

HESSD

7, C65–C70, 2010

Is this really correct, should it not be $\mathrm{d}M/\mathrm{d}t = I_{ap}(t)$?? Why not simply use a soil moisture state to cater for antecedent conditions??

p. 111, l. 6. "API has no regional meaning". But it does!! It is a measure for memory of the catchment which can vary considerably as a function of slope, soil moisture capacity, etc.

l. 9. "lower values for Sahelian regions" Explain why. My guess is there is a higher evaporation potential which causes dryer conditions and thus in general lower APIs.

p. 112 eq. 6. it is not clear with respect to what reference level ht should be given.

p. 113. l. 2-3. Omit "for one pond. . ..between A and h"

l. 17./p. 114, l. 5 Omit which software was used.

eq. 9, is incorrect. should be something like $1 - \sigma_{obs/cal}/\sigma_{obs}$

What data was used for V_{obs}? There were no observations available for this variable so how can it be used for calibration? Why not use h? In the figures, A is given. I'm confused. . .

l. 18. "realistic range base don scientific knowledge". What knowledge? This is not at all supported, at least a reference should be given to this knowledge or the evidence should be given here.

p. 115 eq. 10. Why was this radius calculated?? l. 3-6 are not clear to me. What is the 'negative buffer radius'.

l. 11. Nash and RMSE descibe in fact the same variability. The only difference is that Nash scales the errors over the variance of the observations. Please omit one of the two. If you refer here to eq.9, then please describe eq. 9 in general terms (not for volume specifically).

p. 116. I'm wondering: if the GPS survey is so detailed, why then do you need the

HESSD

7, C65–C70, 2010

power laws?

l. 13. How was calibration performed? Manually? As mentioned in my comments, I cannot judge the identifiability of any parameter value here. This needs additional work.

Table 1. mention the months as well as years of acquisition. replace 'extracted' by 'derived', the water level data is missing!!

Table 2. Units are not clear everywhere. Rainfall is a flux and thus effective rainfall cannot be a state variable and should have a unit L/T (e.g. mm/hr). The range of values (0<P<0.045) can therefore not be interpreted.

Fig. 1. Please indicate position of level gauges and rain gauges.

Fig. 2. A flux is missing. What about outflow from the pond? In the riverine ponds this is likely to be very important!

Fig. 3. The amount of significant numbers is far too large.

Fig. 5 and 6. Legends are different. The variables given on the y-axis are different from what is described in the caption.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 103, 2010.