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Hydrology and Earth System Sciences Discussions

Interactive comment on "Floods and wetlands: combining a water-balance model and remote-sensing techniques to characterize hydrological processes of ecological importance in the Tana River Delta (Kenya)" *by* C. Leauthaud et al.

Anonymous Referee #3

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General comments:

This manuscript details an effort of modeling floods in wetlands in the Tana River Delta (TRD) of which is an important ecological system in Kenya. Water resources management in the Tana system is of great importance given the fact that it is the main hydropower generating platform for Kenya accounting to close to 60% of all electrical

power supply in the country. The downstream delta and wetlands provides various ecosystem goods and services to human, animals and other species. It is a known fact that the TRD is prone to floods and this has often led to loss of life (both human & domestic animals) and livelihoods (e.g crops). Thus, the mapping exercise tested in this study is indeed a good research front and more effort is encouraged.

In summary, the paper has tried to address the issue of floods and wetlands in the Tana Delta with minimal success. The authors seem to have good intentions but the approach is not robust enough to support the desired analytical procedures in modeling floods through wetlands. Good progress in flood modeling in wetlands has been achieved in the recent past and I believe this need to be acknowledged and built upon. There is no need to going back and taking other routes that may not add more value to the effort. The labour of writing new source codes may not necessarily add much to science especially if we cannot clearly indicate the contribution of such an effort. Generally, in flood modeling, we need a flood generation model (hydrological) and a flood routing model (hydraulic). These two need to be coupled; with validation being done at all stages i.e hydrological and hydraulic. Thus, I challenge the authors to clearly indicate their contribution in science and literature on flood mapping/modeling in wetlands.

Technical comments:

Title & Abstract:

I don't agree with the authors that Tana Inundation Model (TIM) is the first hydrological model for Tana. There have been several efforts including by the Kenya Generating Company, local universities etc to use various hydrological tools e.g SWAT model, to understand the impact of land use changes on the hydrological regimes of the Tana. May be the authors need to clarify their understanding of hydraulic and hydrological modelling and how these two have been applied in this study. I tend to think that more of the efforts and relevancy in this study have been on hydraulic than hydrological mod-

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elling. Modelling floods is a hydraulic effort (flood routing) and hence the attributes that define the flood event e.g flood extent, duration, timing, frequency etc are important. I believe this was the primary focus of this paper including the validation approach using MODIS images and hence the inclusion of "Remote sensing. . .." in the title of the paper. Otherwise the relevancy of the title and abstract will not stand if we lose focus on flood modeling (routing) as presented in this paper. This needs to be made clear.

One of the tools for modeling floods in river systems is HEC-RAS, of which is in the public domain. Did the authors think of the possibility of constraining this tool to fit their challenge? RAS has been applied with great success in many countries including Tanzania. The main input is DEM (TIN form) of which can be created from contours e.g 1m interval. A high-res DEM is a pre-requisite for good results e.g flood extent, depth etc. At least ASTER 30m could be much better than validation with a 500m MODIS image. Any comment on this?

Introduction:

Page 11270, paragraph 5 The authors need to be explicit on their statement objective (i) construct a parsimonious hydrological model using satellite imagery. . ..". Were the MODIS images used as an input into the TIM model or used merely for validating flood extents? If the latter is true then this objective need to be revised. How is the satellite imagery reflected/factored in the TIM model structure?

Page 11271, paragraph 1 It would be nice if the authors could discuss the challenges of applying RS in hydrological studies while noting that RS and hydrological models are two different scientific platforms.

Page 11272, Paragraph 5 It would be nice to highlight the spatial & temporal resolution of the SAR images

Paragraph 15 Which of the spectral ranges are useful in mapping floods/water?

Page 11273 Paragraph 5 The authors need to justify the use of an 8-day, 500m res-

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olution MYDO9A product to map a flood. Can a 1m flood in the Tana be captured by such an image? Paragraph 20 It would be nice to write the formula for NDWI. Not all hydrologists understand remote sensing jargon.

Section 4 (page 11276) Paragraph 20 There are established ways of filling missing data. Any discussion about some of these methods?

Section 4.2 (page 11278) Paragraph 15 Any reason for using a 10-day moving average for the Garissa discharge? Is there a logical framework for choosing this time lag?

Page 11279 Paragraph 20 Was there an effort to seek local knowledge on flood dynamics in the area?

Section 5.1 (Page 11281) Paragraph 20 What were the assumptions in construction of the TIM model?

Section 5.3.2 Page 11285 It would be interesting to read more on the downscaling of monthly potential evapotranspiration to hourly time step. How was this achieved?

Are the equations mentioned in this section new or have been documented somewhere else? However, it is important to note that these equations define unique processes that have been documented over decades. How are these equations in this section related to the documented work in literature?

Section 6.1 Paragraph 1-5 Any possibility of groundthruthing this information with local knowledge?

Section 6.3 Paragraph 15-25 The authors are honest enough to explain the weaknesses of their model/approach. These weaknesses are expected in such a flood modeling framework where a high-res DEM is not used. Logically, it may be wrong to start something that one has a 100% assurance of failure. How can the authors defend their thesis in this paper - of their effort to model floods with “weak” tools, starting from the scratch, while there are available tools in the shelves that can do a much better job than their approach? Are the authors testing their model? Against what? If this is the

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case, then the paper could have taken the shape of an inter-comparative study.

The last sentence of paragraph 20 reads:" The model should therefore. . ...flooded areas". What is a large and small flood?

Section 7 Paragraph 25 (page 11294) I don't foresee any improvement of TIM or other sequel of models unless the concept of flood modeling is applied in the right way with the right tools. Flood routing need to be taken into consideration (a hydraulic approach).

In page 11295, paragraph 1, the authors are categorical that there is a need of using a DEM. Of course there is no doubt about this!

In page 11295, paragraph 15, the authors highlight the importance of being cautions when using results from this study. This is a self acknowledgement that what is presented in this study is not so good for "consumption". Now, what are the authors telling us? Do we discard the work and take a break from reading their work?

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 11267, 2012.