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Hydrology and Earth System Sciences Discussions

Interactive comment on "Water harvest- and storage- location assessment model using GIS and remote sensing" *by* H. Weerasinghe et al.

H. Weerasinghe et al.

harshi.weerasinghe@zmaw.de

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Revision Notes

Ref: hess-2011-84, Original Title: "Water harvest- and storage- location assessment model using GIS and remote sensing", Original Authors: H. Weerasinghe, U. A. Schneider, and A. Loew Article Type: Special Issue: Looking at catchments in colors: new ways of generating, combining and filtering information in hydrology

Response to referee #1 "I believe the methodological contribution is not novel"

Response: The novelty of this paper can be summarized as follows: 1. Existing papers in the literature use local or site-specific data sets to identify the rainwater harvesting

and storage potential. Thus, their approach may not be easily transferred to different regions because the employed data may not be available. Our model uses datasets, which are available at global scale.

2. Our Multi-Criteria Evaluation (MCE) is designed for a global analysis. Furthermore, in contrast to previous studies, we combine MCE with suitability assessment in crudely identified sites.

3. Previously applied MCE based methodologies are used to identify the suitability for either water harvesting or storage structures. We use a two-stage indexing to identify the combined overall suitability for both water harvesting and storage.

4. Our approach uses the non-process based SCS-CN method to estimate the potential runoff generation at 1kmx1km resolution.

5. We compute gross runoff potentials before evaporation. These potentials are useful for large-scale integrated land use decision models to better represent adaptations in water management. In these models, land use is endogenous and the net runoff after evaporation is internally calculated for each land use.

"The authors use standard global datasets on elevation, land cover, soil type and soil depth at spatial resolutions ranging from 1 degree to 5 minutes and low class resolution."

Response: The model uses several input datasets including i) a 90mx90m STRM DEM dataset (3 arc seconds), (NASA Shuttle Radar Topographic Mission (SRTM) provide digital elevation data (DEMs) for over 80% of the globe), ii) a 5-arc minute land use dataset, and iii) a 5-arc minute soil type dataset. To our knowledge, these are the currently available datasets with the highest resolution at global scale.

"These datasets are used to resolve for processes that depend on very local soil and terrain characteristics such as those involved in the determination of local runoff patterns critical for the enhancement of soil moisture or in the use of percolation pits at

the farm scale. I cannot see how the suitability of small scale water harvesting sites that are often located in small cultivated relatively deep soil patches of local converging topography, can be determined from the datasets used."

Response: We agree with the reviewer that higher resolved data would yield more accurate results. However, we try to find a compromise between integrating local characteristics and global applicability. We use the SCS-CN method to approximate the gross runoff potential. This method was initially developed for runoff estimation in small urban watersheds. The curve number parameter takes into account the soil moisture characteristics. Since our land use and soil data are resolved at 1kmx1km, we believe that the accuracy is reasonable for the envisioned purpose of our estimates. Particularly, our objective is to estimate the possible gross runoff volume over a relatively large area. As indicated above, these estimates are intended as input for large-scale integrated models of land use to better portray water adaptation strategies.

Determining high-resolution terrain features is especially difficult given that the elevation dataset used has been derived from 1-degree satellite images and inverse-distance interpolation. Also, what 1-degree satellite images have been used to "develop the DEM data"? Have the authors developed a new elevation dataset, and if so why, or have they downloaded it from the CGIAR server?

Response: As stated in the paper, we use the 3-arc second (90m) data from the CGIAR server. These published DEM data have been developed using auxiliary DEMs where the resolution ranges from 50m to 1km, for the whole globe. See also Jarvis, A., H.I. Reuter, A. Nelson, E. Guevara, 2008, Hole-filled SRTM for the globe Version 4, available from the CGIAR-CSI SRTM 90m Database: http://srtm.csi.cgiar.org.

I do not understand why the authors extract contour lines from the DEM data or why they need to calculate the contour density, which they define as "the magnitude (number?) of contour lines per grid cell". Isn't it this information contained in the slope layer?

Response: To assess the suitability for water runoff harvesting and storage, we are interested in knowing where the water can be best collected and stored. The most suitable places for water storage are valleys. Raster based contour density data can be used to identify valley locations for water reservoirs. Contour line data, however, are not in raster or grid format and thus are not directly compatible to our grid based assessment method.

The slope map contains only the average slope (in percent) in each grid cell. The average slope hides important slope differences within a grid cell. Thus, it also hides many locations of valleys and very steep slopes. Steep slopes are important for water harvesting. The objective of harvesting structures on steep slopes is to slow down the erosive fast flows, to increase the shallow ground aquifer recharge and to direct water to surface water storages.

Also, a major issue in water harvesting and management, especially in the areas where the authors are demonstrating the method, is that of salinity, which not a criterion is considered in their model. Some areas that may be indicated under their method as highly suitable for water harvesting techniques such as enhancing infiltration, terracing or percolation pits may be areas of high risk of salinization if the extra soil water resulting from these techniques leaves the soil through evapotranspiration.

Response: We agree with the reviewer and it is an important issue to be considered when considering the global scale applicability of the model. Therefore we have updated the scope of the MCE and included salinization as an additional factor in the compound weighted index.

More information on the ratio of precipitation to evapotranspiration (so far this information is mainly determined from the land use and landcover data, according to the authors) and the quality of soil drainage should be included to assess this risk if the method is to be appropriate for semiarid regions.

Response: The SCS-CN method provides an estimate of gross runoff potential be-

fore evaporation. As noted above, the water harvest and storage suitability maps are designed to improve global integrated land use models, for which land use and land management intensity is an endogenous decision. Evaporation depends on land use and land management intensity (i.e. higher biomass yields usually imply more evaporation). The global integrated land use models are linked to biophysical simulation models, which calculate specific evapotranspiration rates for each land use and land management intensity. Thus, the water harvesting and storage suitability estimate should reflect only the gross runoff potential. The actual runoff will be calculated in the integrated land use optimization model taking into account changes in land use decisions.

Also, related to dams, no criteria regarding inundation of high-value land, population that needs to be displaced or other important social factors are included in the evaluation criteria. These issues are critical to select a site.

Response: We exclude urban areas, roads, protected areas, and reservoirs.

In this section, the authors state that “only a few large scale irrigation systems exist in the catchment”. So far as I know, the Sao Francisco River Basin is home to the most productive, large scale irrigation districts for high-value produce for export in Brazil. Also, note the reservoir is Tres Marias, not Trees Matias.

Response: Yes we agree and have reworded this phrase (. . . “several large scale irrigation systems exist in the catchment”). The Sao Francisco basin contains irrigation systems linked to dams and reservoirs but not all dams are used for irrigation purposes. There are more potential locations for dams. Our intention is to identify the feasibility of additional locations.

Thank you for identifying the spelling mistake.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 3353, 2011.