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# *Interactive comment on* "Continuous and consistent land use/cover change estimates using socio-ecological data" *by* Michael Marshall et al.

**Michael Marshall et al.**

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We would like to thank the reviewer for her/his constructive and comprehensive comments. We have made changes to the manuscript accordingly, which are summarized below. We believe the manuscript is much stronger, but welcome additional suggestions if the reviewer feels it necessary.

1) We agree with the reviewers that the methods section needed a strong introduction. We have inserted the following at the beginning of Section 2.2: "The development of the functional relationships from the sample area frames involved four major steps illustrated in Figure 2. Non-remote sensing and remote sensing predictors were selected after an exhaustive online search that are available freely and seamlessly across SSA, so that the relationships can be used in future studies across the continent for ret-



rospective or prospective analyses. Given the large number of predictors collected, machine learning was used to identify a subset of the most powerful predictors before constructing the functional relationships. The functional relationships were then evaluated against remote sensing predictors with hold-out samples and finally, to demonstrate how these relationships can be used to reconstruct LULCC estimates continuously through time." We have also inserted a workflow outlining major milestones as Figure 2.

2) We have inserted the following after defining the two levels of classification in the methods: "These two levels of specificity allowed us through model-building to understand the level of detail that can be captured by coarse resolution geospatial data." It is expected that coarse resolution data will not be able to capture the same level of classification detail as higher resolution data. Since we had the data to explore this hypothesis, we performed the analysis. For the most part, coarse resolution data is inappropriate for detailed classification. This is important, because regional to global scale analyses often run with detailed classification descriptors and it is clear from our analysis that coarse resolution data is good for understanding, for example, the impact of the transition of natural vegetation to agriculture, but perhaps not for forest to crops. We have added the following as a major finding to the discussion: "3) coarse resolution data was able to capture general classification descriptors, but was unable to capture more detailed descriptors." and expounded on this finding in the final paragraph.

3) Per a previous reviewer's comments, we have inserted the following into the discussion: "The proposed methodology when applied to other regions of the world will undoubtedly result in a different combination of socio-ecological predictors and functional relationships, because access to land varies between agrarian and non-agrarian societies, so further study is required with observed data to develop region-specific models. Kumar et al., 2013, for example, showed that in the United States pre-1900 when the country was largely agrarian and transportation networks were weak, population density and crop area were highly correlated, because crops needed to be

grown close to markets. However, as the country became more industrialized and transportation networks improved, farmers moved to more biophysically suitable areas away from city centers, making biophysical determinants of crop area more important than population density in the latter half of the 20th century. Whether the analyses are performed in agrarian or non-agrarian regions, extensive preparation of observed data will be required, because the observed data used in this study, namely consistent sample area frames at a spatial resolution appropriate for land surface modeling and spanning multiple climatic zones through time, is quite unique."

4) We have removed reference to pre-1981, but have simply stated that the models can be used for retrospective analysis. Per a previous reviewer's comments, we reiterated that the time series analysis was purely for demonstrative purposes and that population and climate (main drivers) are projectable and could be used with AFRICLIM, for example, to project LULCC into the future. To address the uncertainty with projections, we added to the discussion on the population data used: "In addition, the extrapolation method used is efficient and can be projected indefinitely, but does not capture complex demographics that other methods do and can lead to 'runaway' growth/decline and unrealistic mid- to late- 21st century projections for scenario-building (Baker et al., 2008)." In reference to using other biophysical and socio-economic data in the discussion, we added "Many biophysical predictors are available mid- and late-21st century and are therefore widely used for prospective analyses, so methods should be explored to project soils and socio-economic data into the future to improve LULCC estimates."

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