

## ***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) This is essentially a methods manuscript. We are demonstrating a new approach that overcomes the challenges of non-remote sensing and remote sensing approaches, so the manuscript can appear technical at times. In upcoming studies, the approach will be applied to important questions in earth system science as now highlighted in the manuscript. That said, and without more specific remarks from the reviewer, we have edited the manuscript by eliminating technical jargon and more clearly describing

C1

statistical approaches. The manuscript is already long and we reveal adding any more detail will make it too cumbersome.

2) Per another reviewer's suggestion, we have added the following to the discussion: "The proposed methodology when applied to other regions of the world will undoubtedly result in different socio-ecological predictors, because access to land varies, so further study is required with observed data to develop region-specific functional relationships. 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." In short, the method will remain the same for other regions of the world, but the functional relationships and important predictors, as in the example of the United States, will change.

Further, it would be very difficult to conduct this analysis outside of Kenya at this time, because the observed data assembled does exist to our knowledge anywhere else in the world. The sample area frames as indicated in the methods do span multiple climatic zones and a standard split sample approach with cross-validation was used to assess the model. That said, we have added to the discussion: "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 frames at a spatial resolution appropriate for land surface modeling and spanning multiple climatic zones through time, is quite unique."

3) The primary purpose of the manuscript was to introduce new geospatial data and a new methodology using a unique observed dataset. The retrospective analysis performed, as stipulated, was for illustrative purposes only. To add a prospective analysis to the manuscript would make the manuscript, which is already long, too cumbersome.

C2

We are however using newly acquired observed data to project the models into the future across SSA. We added to the conclusion: “In an upcoming study, the same approach will be used with a newly acquired sample frame dataset to estimate baseline LULCC and project land suitability across SSA mid-21st century with AFRICLIM and other geospatial data used here.”

4) We have rephrased page 4, lines 18-21 to merely reflect the difficulty in applying integrated models, as opposed to their frequent use. We did not give an exhaustive review of models, but simply gave two examples which illustrate the primary categories. The introduction is targeting regional (more than global) land surface modeling, because of the deficiency of current LULCC models in capturing land-atmosphere feedbacks. That said, we have added appropriate sentences in the introduction that current integrated models run at a very coarse resolution. The IMAGE model, which you elude to runs at 50 km spatial resolution, which is much too coarse to capture land-atmosphere interaction and feedbacks. The model we propose runs at 5 km resolution, which is more appropriate. Remote sensing-based models run at even higher spatial resolution (30 m – 500 m), but have their own deficiencies. In this manuscript, we are essentially striking a balance between integrated and remote sensing-based models.

5) We have explained the BIOCLIM term and why it is more useful than other climatic variables for LULCC estimation.

6) The “.d.” extension was used to indicate dynamic, as opposed to static or slowly-changing predictors. We have changed the caption for Table 2 and throughout the main body of the manuscript to reflect this.

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