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Comment on egusphere-2022-246

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Referee comment on "Accuracy of regional-to-global soil maps for on-farm decision-making: are soil maps “good enough”?" by Jonathan J. Maynard et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-246-RC1, 2022

Review of “Accuracy of regional-to-global soil maps for on-farm decision making: Are soil maps “good enough”? Maynard et al. 2022

General Comments:

Information about select soil properties is necessary for agricultural productivity decisions. Digital soil mapping is a rapidly maturing discipline that attempts to provide this type of information. I applaud the authors research. The promise of DSM has always been to provide an efficient method to produce accurate soil information. While the accuracy of DSM maps is often assessed, little research has been done on how accurate such maps are at providing the necessary information for specific land management.

Specifically, this research addresses the accuracy of four soil maps to provide site-specific soil information for small, rain-fed maize farms in Ghana. This is done by comparing point- and farm-scale soil measurements (i.e., validation observations) to the soil map predictions. The validation observations are from a large dataset collected by local individuals. Overall, the results indicate that the soil maps tested do not have the accuracy necessary to reflect on-farm soil properties.

Specific Comments:

I have two concerns with this analysis. My main concern with the research regards the (im)precision of the validation data. The methodology that was used to evaluate the soil map accuracy assumes that there is no uncertainty in the labels of the validation observations (e.g., soil texture or rock fragment classes), even though the authors recognized the error/uncertainty in field collected observation in section “4.2.1 Sources of field sampling error”. I am uncomfortable with this because I feel that not accounting for measurement error in the validation data has the potential to obfuscate the ‘true’ accuracy of the soil maps (either higher or lower than is presented).

The authors do attempt to account for the accuracy of the validation observation class labels using the results of several authors (Line 479) to argue that since sandy soils are often the most accurately identified and since most of the soils in the study are sandy then the validation observations are probably okay. The generalization of soil classes into soil suitability classes also helps address this issue; however, using the numbers provided by the authors may suggest that this is not an entirely robust assumption. For example, Salley et al., indicates that field technicians (and I assume that field technicians, not trained soil scientists collected the validation observations) are only able to correctly identify the true textural class 41% of the time (a rather dismal number), but that this improves to 78% if the adjacent textural class is accounted for. This suggests that the accuracy of the validation observations might be expected to be between 41% and 78%. A more in-depth, if rather crude, analysis* however suggests that the true accuracy of the class labels for the validation dataset is between 64% and 82%. Thus, if the true accuracy of the validation observations is 82% then even if the soil maps were 100% accurate (which they are not) then the maximum accuracy that the soil maps could achieve would be 82%. This suggests that the reported accuracy metrics are not robust making a clear accuracy assessment difficult. Because the uncertainty of class labels in the validation data is not accounted for in the analysis I feel that the methods are not appropriate for this type of analysis.

There are several methods that might be employed to address the imprecision of the validation observations such as: 1) selecting a subset of the validation observations and running these through a lab (e.g., hydrometer) to verify class labels or 2) Use a method that accounts for measurement uncertainty (though I will admit to not knowing of a method to do such a comparison without retreating to a statistics textbook).

I am also uncomfortable with the conclusions. The authors state “results from this study highlight the need for on-site verification technologies… that can constrain the… site-based soil map predictions”. I generally agree with this, but feel that this conclusion focuses too much on such technologies. What about improving the soil maps? If soil maps were 100% accurate then they would be a very useful source of soil information and we wouldn’t need on-site verification technologies. I realize that no soil map (or any map) will every be 100% accurate, but the authors should consider this in their conclusions. Also, what about training more soil scientists? A broader cadre of local professional soil scientists could provide such site-specific information and might be more familiar with local soils and issues.

Technical Corrections:

- Figure 5 and 5. A-d. I believe this would be much more helpful if these were to show the resampled depths instead of the original depths. Also, do i-n show M2F observations at the pedon scale or farm scale?

- iSDAsoil soil maps are generated from a suite of ensemble models. My own application of ensemble modeling techniques suggests that they can miss the extreme values (although this observation was likely a result of the specific ensemble method that I tested). It might be more informative to use the predictions from Hengl et al 2015. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0125814 If the authors want to test ALL available maps for Ghana, then this would be good to include, but I leave this to the authors discression.
- Please explain the balanced error rate in more detail. Is this (UA + PA)/2 or some other equation? What does this mean? Please also clarify that the error rate seems to be an error metric with the users and producer's accuracy rates are accuracy metrics.
- The paragraphs from lines 255-265 seem duplicated. Please revise.
- Please put the discussion of SQ ratings and associated equations in their own paragraph as it is confusing as currently written.
- Line 339: How do you know the delineation procedure captured 48% of the fields area if you do not have farm field maps? (the lack of such maps was stated earlier as the justification for the delineation proceedure).
- Line 509: ... of the point soil data...
- Line 525: scale does not really translate well to discussing gridded variables. I think that the neighborhood size, or distance-over, is a more accurate description. Also, maybe a salient point to this discussion: the source of the geospatial source data (DEM's in particular) is important. A 30m DEM from contours will be much different than a 30m DEM derived from upscaled LiDAR.
- Please check the following sentences for grammatical errors: 48, 89, 91, 308, 331, 369, 370, 591
- Line 153 should be grouped with the preceding paragraph.
- Please check references. Lines 169 and 172 are missing, also Ritchie and Roser does not seem complete.
- Line 230, what about user's accuracy?

*There are 19,542 soil layers, of these 71% are either sandy loams, loamy sands, or sands. Line 479 states that the sand class is correctly identified 80% (+-7%) of the time and that the clay class is correctly classified 56% of the time. Assuming that sandy loams, loamy sands, and sands in the validation observations were correctly classified 80% (+-7%) of the time and that the remaining soils were correctly classified 56% (+- 15%) of the time results in the following numbers:

	number of observations
Total soil layers	**19572**
71% of the soil layers that were sandy	*13,875*

80% accuracy of the correct field id	11100
73% of the sandy soils (80%-7%)	10129
87% of the sandy soils (80%+7%)	12071
29% of the soil layers that were not sandy	*5676*
56% accuracy of the correct field id	3178
41% of the non-sandy soils (56%-15%)	2327
71% of the non-sandy soils (56%+15%)	4030

	Lower accuracy estimate	Moderate estimate	High accuracy estimate
number of sandy soils	10129	11100	12071

number of non-sandy soils	2327	3178	4030
percentage of total	**64**	**73**	**82**