RC3: 'Comment on essd-2024-266', Anonymous Referee #3, 12 Nov 2024

The availability of analysable large geodata is of great importance for lowering the inhibition threshold for potential users and thus enabling informed and comprehensible decisions and political action. Against this background, the work represents an important contribution that I recommend for publication, apart from minor suggestions for changes (see below). Against the background of Data-Fitness-For-Use/Data-Fitness-For-Purpose assessment approaches (Lacagnina et al., 2022; Pôças et al., 2014; Wentz & Shimizu, 2018; Yang et al., 2013) and the associated trustworthiness of geodata (products) (Lokers et al., 2016), however, I would ask the authors also to inform how metadata or additional information can help potential users to assess the suitability of the datasets for further use.

RE: We sincerely thank the reviewer for highlighting this important aspect. We have addressed this by discussing where to find the metadata and how it can assist users in assessing the dataset's fitness for their specific applications. A brief mention is included in the introduction on Page 5 Line 1-3 to raise user awareness, and the topic is elaborated upon in the Data Availability (Section 6) on Page 44. Additionally, detailed descriptions of the metadata are provided within the public storage location of the data cube at Zenodo landing page and central access catalog. The layers will also be updated in EcoDataCube, complete with metadata and a visualization.

Page 2, Line 28: Spelling error: Copernicus Data Spac Ecosystem ⇒Copernicus Data Space Ecosystem. Spelling error: Per-pixel count of available value ⇒Per-pixel count of available values

RE: Both spelling errors have been corrected.

Figure 2: To make the manuscript easier to read, I suggest placing the figure at the beginning of shapter 2.3 and briefly explaining the basic methodological process with reference to the corresponding subsections.

RE: We have revised the manuscript by placing Figure 1 at the beginning of Chapter 2.3 as recommended (see Figure 1 in Page 7). And we have included a brief explanation of the preparation flow with references to the corresponding subsections to enhance readability and clarity on Page 6 Line 2-7.

Page 4, Line 20: Could you elaborate on your perception/definition of the term (spatial) “plausibility” and differentiate it from “accuracy/uncertainty”?

RE: In the context of our study, “plausibility” refers to the process of demonstrating the validity of the biophysical index data cube by ensuring that the data aligns logically and statistically with known land surface processes or available reference data. This term is distinct from “accuracy” or “uncertainty,” as those imply direct, rigorous validation against ground-truth or survey data, which is not always feasible due to the limitations of available datasets.

As noted in the manuscript, the primary challenge lies in finding land survey data that match our data cube's temporal, spatial, and thematic coverage/focus for a true validation. Given these limitations, the "validation" in our study is performed through various methods:

- For BSF, NOS, and CDR, we conducted statistical analyses to assess their reliability.
- For BSF, we examined its correlation with a land survey dataset, though in a limited context—covering 2007–2016, requiring aggregation of our annual data to align with the survey, and with limited data points that do not ensure full continental EU coverage.
- For minimum NDTI, we compared it with EUROSTAT data, but only at a regional level, while our minimum NDTI layer is available at 30m resolution.

These mismatches between our high-resolution data layers and the available reference datasets make it challenging to perform a conventional "accuracy/uncertainty" analysis. Instead, we conducted a "plausibility check," which evaluates whether the data logically and statistically represent the processes they are intended to capture. This approach provides confidence in the data's usability despite the constraints of traditional validation methods. The clarification is added at the beginning of Section 2.4 Page 10 Line 9-14.

Page 11, Line 20: Could you add a reference for "typical CRC values for each tillage type"?

RE: The citations have been added to the manuscript on Page 12 Line 9-10. The "typical CRC values" used in our analysis were estimated based on CRC value ranges assigned according to Magdoff et al. (2000) and Zheng et al. (2022). These ranges provided a foundation for estimating the values by selecting those that maximize the correlation between WCRC and minNDTI within each NUTS2 region.

Page 12: Could you provide a kind of principle workflow for both modelling experiments?

RE: We have added a workflow chart (Figure 3) in the Modeling Experiments section (Section 2.6) to provide a clear overview of the processes involved in the modeling experiments on Page 13.

Section 2.4.4: You may consider deleting section 2.4.4 or integrating elements into the results section. For example, the explanation seems somewhat contrived "These visual representations complement the statistical analysis by highlighting spatial patterns that may". In addition, the paragrapgh on page 12 and line 5 can be used as an introduction to the results section.

RE: We thank the reviewer for this constructive feedback. We have made modifications to enhance the clarity and coherence of the manuscript accordingly. Specifically, we have merged key elements of original Section 2.4.4 into other relevant sections and revised the paragraph, incorporating it into the introduction of the Results section. Please see the Result section (Section 3, starting from Page 15).

Page 13, lines 13–26: Although in my view there is no need to list the formulas of the validation metrics (F1-score, CCC), references should at least be mentioned.

RE: References for the validation metrics have been added as suggested on Page 10 Line 20 and Page 15 Line 6.

Page 36, lines 22–34: It is not entirely clear to me why emphasis is placed on the supposed limitations of the Bare Soil Composite (BSC). In principle, BSC represent a filtered view of the Landsat and Sentinel-2 time series with a focus on agricultural areas in order to identify stable soil patterns. The "accusation" of regional applicability also does not reflect the complexity of digital soil mapping (DSM), as the transferability of DSM approaches depends on many factors such as the representativeness of soil samples, suitable explanatory variables, or DSM models that take into account the spatial variability of soil landscapes (e.g., Broeg et al., 2024). In this respect, BSF products face the same challenge. More relevant would be a discussion of differences in the generation of BSC and BSF products. This concerns, for example, approaches to temporal-dynamic filtering taking phenology into account (Zepp et al., 2023), which would be a nice feature of your products in the future.

RE: We sincerely thank the reviewer for their insightful comments on this matter. Our intention was not to overemphasize the limitations of the Bare Soil Composite (BSC), which we also find as highly valuable for DSM practices. Instead, our aim was to highlight the need of developing BSF products and to distinguish them from BSC. In response to the reviewer's suggestion, we have revised this section to focus on the differences in the generation and perspectives of BSC and BSF products (see from Page 38 Line 13-28).

Page 38, lines 20-21: This result is in line with Zepp et al., 2023.

RE: We have added the reference as suggested in Page 40 Line 33.

Page38, section 4.3: Both use cases represent current topics. I would therefore welcome it if the discussion referred to a few relevant works.

RE: We sincerely thank the reviewer for this valuable suggestion. We have incorporated references to several relevant works in Section 4.3 on Page 40 - Page 41.

Page 39, lines 6ff Could you support your conclusions on the feature importance and selection together with scientific references?

RE: In response, we have added scientific references to support our conclusions on feature importance and selection on Page 41 Line 15-23.

References mentioned:

- Broeg, T., Don, A., Gocht, A., Scholten, T., Taghizadeh-Mehrjardi, R., & Erasmi, S. (2024). Using local ensemble models and Landsat bare soil composites for large-scale soil organic carbon maps in cropland. Geoderma, 444, 116850. https://doi.org/10.1016/j.geoderma.2024.116850

- Lacagnina, C., David, R., Nikiforova, A., Kuusniemi, M.-E., Cappiello, C., Biehlmaier, O., Wright, L., Schubert, C., Bertino, A., Thiemann, H., & Dennis, R. (2022). Towards a data quality framework for EOSC authorship community (tech. rep.). EOSC Association. https://doi.org/10.5281/zenodo.7515816
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- Yang, X., Blower, J. D., Bastin, L., Lush, V., Zabala, A., Masó, J., Cornford, D., Díaz, P., & Lumsden, J. (2013). An integrated view of data quality in Earth observation. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 371(1983), 20120072. https://doi.org/10.1098/rsta.2012.0072
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