Dear David Tanner,

Thank you for taking the time to review our submission and provide us with constructive feedback.

Please see below how we have implemented and addressed your suggestions. Specified line numbers refer to the original document.

Best regards,

Peter Betlem on behalf of all authors.

1. **The title is a bit misleading. It's not just a DOM of faults and fractures, but also stratigraphic units. Please adjust accordingly.**

Agreed. We have changed the title to *High resolution digital outcrop model of faults, fractures, and the stratigraphy of the Agardhfjellet Formation caprock shales at Konusdalen West, central Spitsbergen*.

2. **It is tantalising to see a small portion of the orthomosaic and the fractures within. There should be a figure of just faults/and fractures, without stratigraphic units.**

We have revised Figure 7B to include a larger section of the DOM, and have removed stratigraphic unit boundaries and other markers. Fractures have only been mapped locally for data-usage illustration purposes, and no full-outcrop fracture data set exists. Nonetheless, Figure 7C has been revised to include a "raw" section (now Figure 7D), with the locally annotated fractures shown in the new subfigure 7E.

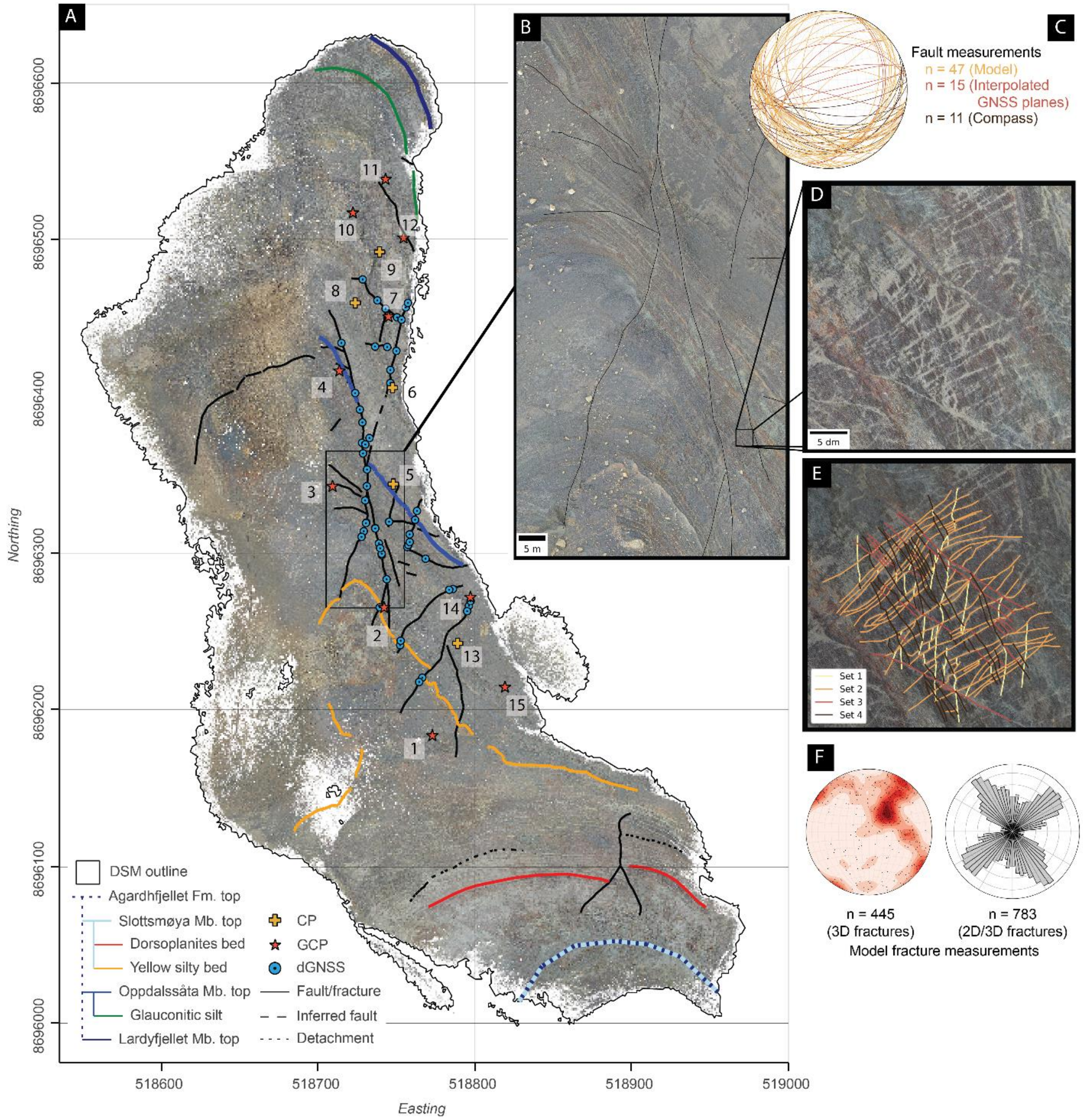

Figure 7: High resolution orthomosaics, stratigraphic units and structural measurements. A) Top-down view orthomosaic of the outcrop including control point locations and basic interpretations. Control points are subdivided into dGNSS points, ground control points, and check points. B) The 50-by-100 m zoom-in shows the lower part of the Slottsmøya member, including major structural elements. C) Stereonet of field and model structural measurements of the faults. Compass measurements are supplemented by GNSS point-grouping measurements and model measurements. D) The orthomosaic is of high enough resolution to identify and delineate sub-cm scale features, as the annotated fracture sets show in E). F) Fracture stereonet and rose diagram for the model-picked fracture data in E). Only 3D/multi-segment fractures were included in the stereonet. Maps use the WGS 84/UTM zone 33N (EPSG:32633) projection.

3. **Some handmade strike and dip of fractures are given in Table C1. Why not produce a stereonet figure, with measurements made in the field and measurements made in the DOM?**

Table C1 only includes strike and dip measurements for faults. We have updated the table caption to better clarify this. The new caption reads:

> *Table C1: Structural measurements and ground truthing of selected faults, acquired summer 2021. Easting and Northing given in the WGS 84/UTM zone 33N (EPSG:32633) projection. The calculated orthogonal heights use the Earth Gravitational Model 2008 (Pavlis et al., 2008). Interpolation point set indicates point groupings used for the calculation of GNSS-based fault measurements.*

Field and DOM-measurements have also been visualized in stereonets and rose diagram in Figure 7 C (faults) and F (fractures). Fracture sets have been annotated as part of the new subfigure 7 D. The following section has been added below line 174 in the original manuscript to clarify the methodology:

> Fracture sets were analysed and classified through use of the NetworkGT software (Nyberg et al., 2018). Dip angles were calculated from the interpolated planes through line traces with at least 3 points, i.e., 3D data. The same methodology was applied to along-fault groupings of dGNSS field measurements (Table C1) to obtain interpolated fault planes and structural information.

Finally, Betlem (2022c) will be updated with the relevant scripts and Jupyter Lab workflow to document the structural analysis in detail.

4. **Line 72-75. Please revise the last line of this paragraph, as it is it doesn't make sense. Make it in to two sentences.**

We have revised 72-75 to the following:

> *Geological constraints and inputs are needed to ascertain what may happen following injection. The Konusdalen West outcrop, covering the lower part of the caprock, is ideally suited for this and forms an important analog to assess the impact of faults and fractures on fluid flow in mudstone-dominated sequences (e.g., Ogata et al., 2012).*

Dear Niklas Schaaf,

Thank you firstly for your interest in our manuscript, secondly for providing us with constructive community feedback.

Please see below how we have implemented and addressed your recommendations and comments.

Specified line numbers refer to the original document.

Best regards,

Peter Betlem on behalf of all authors.

The article provides a thorough description of the acquisition, processing, and relevant metrics of a high-quality digital outcrop model. It places the dataset in the geological context on a regional scale, illustrates its suitability to assess the caprock integrity of the Agardhfjellet Fm. in the context of local CO2 sequestration, and suggests further use cases.

Adding to the previous comment minor suggestions are:

- In addition to the detailed Data availability section, it would be nice to see how the data set can be accessed in the introduction, for example, right after stating the issue of data availability for DOMs in lines 48-53.
- We agree and have added a brief statement right after line 53 on the integration of the digital data assets into the Svalbox Digital Model database, and visualization through SketchFab and V3Geo.
- Future studies could implement a cross validation approach with respect to the ground control and control points to further increase the accuracy.
- Agreed. Though this would at present be difficult to implement efficiently in the Agisoft Metashape workflow, we are looking into this as part of follow-up studies in Svalbard and elsewhere.

Niklas Schaaf

Dear Anonymous Reviewer,

Thank you for your interest and taking the time to review our submission. The constructive suggestions and feedback have improved the original manuscript.

Please see the comments below as to how we have implemented and addressed your recommendations and comments. Please also note that the ESSD LaTeX template has moved most figures to the end of the manuscript, even though they are placed near their corresponding texts in the raw text.

Specified line numbers refer to the original document.

Best regards,

Peter Betlem on behalf of all authors.

The manuscript describes an original regional data set consisting of digital elevation and image data derived from drone flight images using Structure-from-motion photogrammetry. The authors discuss their workflow in great detail and integrate independent geologic data to validate and complement the digital database. The field area is well suited for such a demonstration as it has a rich inventory of rocks, structures and geomorphic features. I enjoyed reading it.

The described method is widely used and of general interest. The careful implementation into a customized workflow resulting in precise terrain models seems a highly valuable contribution. Given that (input) drone image quality increases steadily this suggests a great perspective for this young branch of geological mapping.

The independent data were chosen to validate (geological maps) and ground truth (outcrops, GPS) the newly acquired data are very adequate. One may wish to have the link between field observations and digital data as described in the integration chapter 4 a bit clearer. For example: How well visible are the structures shown in field images (Fig. 8) in the digital model? Down to which scale fault data (orientation, thickness, length, dip) can be mapped from the digital model (you say sub-centimetre scale) and how do fault data from the field vs. digital model compare more quantitatively (e.g. using analysis and visualization tools in FracPaQ as anticipated by the authors)? However, I am unsure to which extent this is already beyond the scope of such a data paper and/or if this is already a work in progress for a more interpretation-focused paper.

Agreed. We have revised various paragraphs for clarity and added additional descriptions as to how well the structures shown in Fig 8 are of use to better understand the digital data assets. We also clarified down to which scale (and how) structural data can be mapped from the presented digital data assets. As you also mention, we think the comparison of the field data with analysis and visualization tools in e.g. FracPaQ is beyond the scope of this data paper and fits better with the follow-up work. We have included a brief statement on follow-up work that has since been published and/or is currently in review in the relevant sections.

The **text** is generally very well written and structured. Only the abstract appears a bit lengthy and could potentially be shortened. Some comments on the text:

The abstract has been shortened.

Line 14: “stata” -> “strata”

Fixed

Line 34: “…developments >by/of< the petroleum industry…”

Fixed

Line 38: I am not sure what you mean with “discontinuous structures” and if this is the adequate term here (for folds, faults, fractures) or if should be simply “structures”?

Removed discontinuous.

Line 47: FYI: …and even in analogue (laboratory scale) models (e.g. https://doi.org/10.1016/S0377-0273(03)00034-9

Implemented additional references and rewritten paragraph the corresponding paragraph.

Line 51-52: “….data must be … “: maybe add “standardized, inter-operable” if applicable.

Revised paragraph, added in additional references to FAIR and recent developments in DOM publishing portals.

Line 96: Maybe repeat what WSFTB stands for.

Repeated the WSFTB acronym in full.

Line 99-101: This paragraph seems to better fit in the flow if replaced one up (before “Considerable lateral variation…”)

Replaced one up.

Line 106 (and other instances eg. Lines 199-200): 35.2 m: I suggest indicating standard deviations along with such numbers.

Value has been updated and script has been added to the suppl. repository on Zenodo. Standard deviations were also added where provided/available (e.g., mean confidence of dense cloud, table 1, C1), but not for values taken from the processing report (e.g., multiplicity) or provided as-is by PDAL/Agisoft Metashape (e.g., point spacing/point-to-point distance).

Line 116: “+” -> “+/-“

The GNSS reference manual specifies + as the error increases with distance, so this should remain + as far as we are aware.

Line 212: “vertical features condensed…” – this seems to be sensitive to the slope, could you specify the latter for your study area?

The paragraph was revised to clarify the observed point density variations and specified where in the study area these irregularities were observed.

Tables especially those in the main body of text (Figs. 1 and 2) are barely readable in the current layout. Increase font size, and decrease empty column space.

Agreed. When submitting we followed the manuscript guidelines for authors and implemented the latex template, which specifies table font sizes. We share your concern that the tables shown as in the preprint are not optimal for printing, and hope/trust that the final proofs will use correct font sizes/layouts.

Figures are generally well done and suited to illustrate the content, some suggestions:

The background orthophoto in figures 2-6 might work well when viewed on a computer screen but appear blurry and not very attractive when printed. Maybe choosing a simpler map, e.g. with contour lines could be considered?

Background for figure 3-6 has been replaced with elevation contour lines (10 m spacing) extracted from the reference DEM data set from NPI. We decided, given the scale of Figure 2, to keep the orthophoto background in place, though re-generated the figure with 600 dpi resolution to improve quality.

Figure 7: The background is difficult to interpret. Is it an image or a point cloud? Full page display might help.

The figure has been enlarged, and additional subfigures have been inserted following suggestions from RC1. The image is a high-resolution orthophoto/mosaic. Individual pixels are ~ 1 cm in resolution, with gaps of no-data giving the resemblance of a point cloud. Detailed features are best appreciated in the 3D viewers linked to in Table 2.

In Figure 8 a bit of fine line drawing may guide the reader better. And maybe a side-by-side comparison to the digital “twin”? Scale missing in A. Orientation missing.

We have revised part of the text to clarify that the Figure 8 images are taken along excavated transects, which are not observed in the model itself. Thus, a side-by-side comparison to the digital twin is difficult. These images were included to aid geomodelling exercises with further details on the core architecture.

Figure 8 has been revised to include scales and orientations, where missing.

In Figure 9 the borehole data display is too small, maybe the whole figure could be rotated 90 degrees and displayed full page?

Figure has been rotated and displayed full page.

Thanks