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**Geoscientific
Model Development
Discussions**

Interactive comment on "PRACTISE – Photo Rectification And ClassificaTIon SoftwarE (V.1.0)" *by* S. Härer et al.

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We would like to thank the Anonymous Referee #1 for her/his careful reading of the manuscript and the very helpful comments. We agree that some aspects of the paper needed further improvement and extension in order to make it suitable for publication. We want to point out that all revised figures can be found in this response as we want to avoid duplications of figures in the responses to the other Referees. However, the revised Fig. 2 was also given as a supplement as the automatic rendering of the GMD Discussions creates a blurry image. Fig 9a-d was additionally split up in Fig 9a, b and Fig. 9c, d to fit the paper format. In the following we address all the general and specific comments made in detail:

Question 1: Figures need to be made larger, in particular the text. In the printed draft

copy, very little of the text is legible and I needed to go to the digital copy to resolve it.

Answer: We agree with the Referee's comment with respect to the size of certain figures and the used font size that they are indeed quite small in the discussions version, especially in the printed draft copy. However, we want to point out that the size of the figures, as well as the size of the fonts, has been created to fit the paper size (DIN A4) used in the GMD publication. Thus, the figure sizes and fonts should be appropriate when the figures are enlarged to a width of 170 mm. In any case, we will enlarge the sizes of the figures and fonts for the draft version where it is necessary. These are the figures 1, 2, 7, 8 and 9.

Question 2: I think there is a terminology issue in this manuscript. First, the authors use the term 'projected' in places where I think the term 'georeferenced' would be more appropriate (which they switch to later in the manuscript, i.e. figure 4).

Answer: We appreciate the careful reading of the Referee. We will change the word 'projected' to 'georeferenced' where the term was potentially misleading the reader, i.e. when the term was used to describe the complete transformation process between the coordinate systems of the DEM and the photograph. In the rest of the manuscript the terms are applied in accordance to geoinformation (Wade and Sommer, 2006) and computer animation (Watt and Watt, 1992).

Question 3: Second, I'm not sure about the phrase 'optimisation of GCPs'. That's not really what's happening here. You're using the GCPs to correct for errors in the initial camera parameters.

Answer: At page 172 in line 12-14 of the manuscript, we clearly point out that the optimisation routine is optimising the camera orientation using GCPs. We cannot find a statement in the manuscript where we write that we optimise the GCPs. We, however, change the word 'optimise' in some cases to 'improve' or 'enhance' to remove duplications with 'optimisation' whereas we want to avoid the word 'correct' as it indicates a 100% perfect fit after the optimisation which is not realistic. The DDS optimisation can

only minimise the positional inaccuracy of the georeferenced to the real location of the GCPs.

Question 4: Finally, I also think that the description of the methodology would be more clear to the reader if there was consistency in the terminology with that used in the literature. I recommend referring to a standard photogrammetry text like Wolf and Dewitt, (2000) for the nomenclature. I make more specific references below.

Answer: We will follow the Referee's suggestion with respect to the consistency in the terminology and change the 'viewpoint' to 'camera position', the 'focus length' to 'focal length', the 'inner and outer camera properties' to 'interior and exterior orientation parameters' and the 'rolling angle' to 'roll' using a phi in the formula. Further, we will add to the first sentence using 'camera target position' that in photogrammetry this is called the 'principle point'. Nevertheless, we will use the word 'camera target position' in this manuscript to avoid inconsistencies with the publications of Corripio (2004) and Corripio et al. (2004).

Question 5: The paper lacks a strong introduction and conclusion. For start, I'm not convinced that terrestrial photography has been used quantitatively very often, at least not for monitoring snow and ice, largely due to the difficulties the authors' discuss. I believe there is huge potential here which highlights the value of the presented software but I don't feel the authors have made a very strong case.

Answer: The Referee is right that studies using terrestrial photography for monitoring snow and ice are limited, i.e. in our comprehensive literature research we found 22 studies in about 40 years. 8 of these studies have been conducted in 2008 or later which has to be certainly attributed to the advancements in digital photography. Due to these facts we will clarify the statements by focusing on the increasing frequency. Further, we will follow the Referee's suggestion to emphasize the potential of our new software as studies using terrestrial photography to monitor snow and ice spatially and temporally distributed are rare.

Question 6: It is also not made sufficiently clear how the software improves on previous work (e.g. why is the viewshed approach preferable?).

Answer: Thanks for pointing this out. At first, we want to highlight that a viewshed is absolutely necessary for the georectification process. The generation of a viewshed within PRACTISE makes the processing more comfortable in comparison to the need for an external geoinformation software. Using our study as an example, this means that for the analysis of a single photograph without the implemented viewshed approach, the following processing steps have to be carried out: The camera orientation has to be optimised. Then, the visibility analysis of the geoinformation software is executed using the optimised camera location. After that, the produced viewshed is eventually used in the georectification and classification process of PRACTISE again. The increased workload becomes even more important considering that each new camera location needs a separate visibility analysis. Thus, the viewshed generation after each camera movement using an external geoinformation software will become tedious in the analysis of large time series. We will clarify this advantage of the implemented viewshed routine in the revised version.

Question 7: It is implied that PRACTISE is an advancement over Aschenwald et al. (2001)'s approach because it relied on GCPs. However, the reader later finds that PRACTISE does to some extent as well.

Answer: We agree with the Referee's comment that PRACTISE needs some GCPs for the DDS optimisation if the exterior and interior camera orientations are not exactly known. This is the case in our study. By contrast, no additional GCPs are necessary if the precise camera orientation is known. This means that the focal length of the camera is determined in laboratory, the roll of the camera is identified after the mounting of the camera system, and the camera location and the principle point are measured using e.g. differential GPS. If camera movement is no problem even long time series can be analysed without the need to specify any additional GCPs. The photogrammetric approach of Aschenwald et al. (2001) needs on the contrary various GCPs irrespective

of whether the exterior and interior camera orientations are already known. Hence, we think that PRACTISE is an advancement over Aschenwald et al. (2001)'s approach because it does not rely solely on the availability of several GCPs. It works with both either the known camera orientation or the determined GCPs as input.

Question 8: While the 'DDS optimisation' is written up as an added feature, it appears to be a very necessary step in the procedure. If the mean RMSE after 'optimisation' is 5.3 pixels and this corresponds to 0.79 m in the DEM, then I assume that the pre-correction RMSE (as high as 93 pixels) would be equivalent to >10 m which is quite significant. I appreciate that the use of GCPs will only be required when one wishes to link changes to real ground space and possibly where camera movement is a problem. However, I think this needs to be made more clear in the introductory paragraphs of the paper.

Answer: We see the Referee's point about the necessity of the DDS optimisation in our study as we did not measure the precise focal length as well as the exterior camera orientation and further on, as the camera was moved several times during the observation period. We will clarify the importance of the DDS optimisation for cases like that in section 1, 2, 3.3 and 4 of the revised version. Nevertheless, the optimisation routine is not needed if the camera parameters are known. We want the user to be aware of that even though the DDS optimisation might be a valuable tool in many cases it is an optional routine.

Question 9: The conclusion mentions fast and easy processing but this is the first time this advantage of the software is explicitly stated.

Answer: We thank the Referee for this comment and we will incorporate the statement about PRACTISE being an 'easy and fast processing' software in the introduction chapter with respect to the decreasing workload in comparison to existing software packages utilizing the automatic optimisation of the camera parameters, the implemented viewshed algorithm and the bulk mode to analyse long time series.

Question 10: I'm also unsure the classification routine and results are that interesting. RGB image classification of snow is notoriously difficult (especially 8-bit) and the challenges are well known and reported in the literature.

Answer: The Referee's comment is certainly right that the deficiencies of different snow classification routines using 8-bit photographs have been discussed in several studies. However, we are interested in the spatial distribution of snow cover over time utilising RGB photographs. By using the classification routine of Salvatori et al. (2011) we present and discuss a promising approach that has not been linked quantitatively to real ground before. The algorithm that is based on the histogram distribution produces in most cases very good results with respect to different weather situations and snow cover patterns without the need for calibration (Hinkler et al., 2002) or the manual determination of thresholds in combination with additional masks of shadows and ground features (Schmidt, 2007). Thus, the classification routine of Salvatori et al. (2011) is an automatic approach that combines fast and easy processing with high quality results. Further on, the high flexibility of PRACTISE is highlighted. In the rare cases where classification problems arise, the problems can be determined in the visual investigation without much effort and the algorithms can be easily adapted or changed and the photographs reprocessed.

Question 11: What's interesting about this manuscript is that after running PRACTISE you have a georeferenced series of mono images (maybe even thermal IR which has interesting applications) that can then be used for any number of change detection routines and I think this should be more strongly emphasised.

Answer: We agree with the Referee that the application of PRACTISE can be extended to several other research disciplines. We address as an example the calculation of greenness indexes in phenology (at page 174, L14-18) whereas several other research topics might be possible, too. We also see a high potential in the Referee's suggestion of thermal IR images and thus the observation of the land surface temperature having in mind the observation of evaporation or the derivation of soil textures. Although our

main interest is restricted to snow we can emphasize the versatility of PRACTISE in the discussion chapter.

Question 12: I would almost rather see a short paragraph on each of the routines that have been developed rather than the example of snow monitoring.

Answer: The current objective of PRACTISE is to monitor the patterns of snow cover utilising RGB photographs, in particular with the additional option to comfortably analyse extensive time series. Hence, the snow classification and especially the automatic routine of Salvatori et al. (2011) is an essential part of the software package and might be of interest for other researchers in snow and ice. In addition to that, the classification routine of PRACTISE is also of importance for readers interested in extending the software to other research disciplines. They do not need the exact algorithms of the snow classification, but they can directly build for example the calculation of greenness indexes upon the existing modular framework by replacing some lines of code. Thus, the classification routine in PRACTISE forms a basic frame where adaptions and extensions can easily be implemented. However, we agree with the Referee that a short paragraph of the developed routines will be useful. We will add short descriptions to the mentioned snow classification routines in section 3.4 and clarify that routines, independently of the research discipline, can also be implemented with limited programming skills.

Question 13: Page 172, Line 2-3 – ". . .to derive the status of spatially distributed..." is an odd phrase. Consider, ". . . for measuring and monitoring spatially distributed. . .".

Answer: The reviewer is right, we will correct this within the revision.

Question 14: Page 172, L7-8 – It's not clear what is meant by a one-to-one analysis of projected model results to photographs.

Answer: Thanks for pointing this out. The sentence is confusing. We will change it to "However, the analysis of a photograph requires a preceding. . ."

Question 15: Page 172, L12 – is it for unknown viewing orientation or is it imprecise viewing orientation and position?

Answer: PRACTISE needs at least an estimate of the viewing orientation although this doesn't need to be very accurate. Hence, we will follow the Referee's suggestion and use 'imprecise'.

Question 16: Page 172, L15-16 – I'm not sure I agree with the terminology here. In my mind the DEM points are not projected onto the image plane and classified but rather the image georeferenced using the DEM and then the image is classified.

Answer: The Referee is right, we will rewrite the sentence in the revised version clarifying that the image is georeferenced using the DEM.

Question 17: Page 172, L16 – The resulting georeferenced and classified image?

Answer: Yes, it will be replaced.

Question 18: Page 172, L17 – georeferenced images rather than projected data?

Answer: We will replace 'projected' by 'georeferenced' here, too.

Question 19: Page 173, L9-12 – the link made here is pretty tenuous. I'd suggest removing this or provide a more robust argument.

Answer: The Referee is right, we will skip these lines.

Question 20: Page 173, L18-19 – all photography is centrally projected and there is nothing inherent about horizontal angles (or more correctly phrased, high oblique) in terrestrial photography. A camera can be pointed in any direction dependent only on what you want to observe.

Answer: We can see the Referee's point and will skip these lines.

Question 21: Page 173, L25 – in photogrammetry, you would call the camera target position the principle point. Perhaps include this?

Answer: We have already replied to this comment in question 4 and will follow the advice of the Referee and add a sentence that in photogrammetry the word 'principle point' is used instead of the 'camera target position'.

Question 22: Page 175, L2-3 – I think you mean unaffected by weather conditions

Answer: The Referee is right, we will adopt 'unaffected by'.

Question 23: Page 175, L4-5 – these terms need to be more clearly defined. The viewpoint? Is that the coordinates of the camera itself? If so, why not simply describe this as the camera position? What is the rolling angle? I have no idea what this is. Typically, camera attitude is described using three angles, either pitch, roll and heading or omega, phi and kappa. I suggest adopting the standard terms to make your meaning clear. For example, outer camera properties are typically called exterior orientation parameters (and similarly interior orientation parameters).

Answer: We have replied to this comment in question 4 and we will change the addressed nomenclature in the revised version according to the Referee's suggestion.

Question 24: Page 175, L6 – 'determined using latitude and longitude.' This does not make sense. Do you mean you derived the coordinates of C and T using the DEM?

Answer: The Referee is right, this sentence is confusing. We explain how the coordinates are derived at page 175, L21-24. What we try to say is that PRACTISE needs as input solely the coordinates of latitude and longitude, while the altitude is taken from the corresponding DEM pixel during the computing process. We will clarify this in the revised version.

Question 25: Page 175, L9 – focus length should be called focal length. I think you should also acknowledge here that lens distortions (which can be very significant) are not taken into account.

Answer: Thanks for pointing this out. We will replace 'focus length' with 'focal length' and we will add a sentence that the software does not account for lens distortions even

though they can be significant depending on the used camera. Further, we will add a comment to the description of the camera setup that we have chosen an objective lens that is known to have almost no distortion.

Question 26: Page 175, L11-12 – delete 'display different recording situations, i.e'. and just say to show different weather conditions and snow cover extents.

Answer: We will shorten the sentence in the revised version in the proposed way.

Question 27: Page 175, L18 – here you refer to georectification which is think is more correct.

Answer: In accordance to the reply to question 2, we have changed the misleading word 'projected' in the manuscript where it has been necessary.

Question 28: Page 175, L22 – there must be huge errors here if these coordinates were extracted visually from an orthophoto (what is an official orthophoto?). Especially, T which presumably is in the middle of a snow field? Couldn't the former be provided independently?

Answer: Obviously, there are uncertainties in deriving the coordinates of C and T visually from an orthophoto. Therefore, we need the DDS optimisation in our study. As stated at page 175, line 21 to 24, we used 'an orthophoto with a spatial resolution of 0.2m'. It is an official orthophoto as it is "provided by the Bavarian State Office for Survey and Geoinformation" and georeferenced with an accuracy below 0.5m. The image was recorded in digital form on 1st September 2009, hence, the camera position C as well as the camera target position T are not located in a snow field. The comparison of a photograph of our time series in September to the orthophoto allows a good estimate of T. C is quite easy to derive as the edge of the UFS building where the camera is located is clearly visible. The DDS optimisation identifies subsequently the coordinates of C and T. With respect to today's resolution of Google Earth images at the Zugspitze area, we think the derivation of the coordinates of C and T using Google Earth will

also be adequate when the upper and lower boundaries of the DDS optimisation are enlarged. In-situ measurements using GPS are obviously also a possibility to derive a good estimate. We will clarify how we determined the coordinates and add a comment that C and T can also be obtained using other methods, e.g. with a standard GPS device.

Question 29: Page 176, L3-4 – this sentence is unclear

Answer: Thanks for pointing this out, we will rephrase it. What we are trying to say with "the modular structure facilitates to switch routines on and off or even to exchange single modules" is that we programmed PRACTISE in a way that the routines for the viewshed or the DDS optimisation can be activated and deactivated without great effort. The user can also choose which classification routine should be applied. And if a user is interested in e.g. another research topic like e.g. greenness indexes, changing some lines of code in PRACTISE allows implementing a self-programmed routine instead of the available classification algorithms in the processing.

Question 30: Page 176, L4-11 – The flow of steps is a bit confusing here too. The way the authors have listed the steps here suggests that viewshed happens first, followed by the georectification and then the classification. When does the accuracy assessment happen in this work flow? The section numbers suggest this happens after the rectification but before the classification. However, you discuss this after the other three steps but it says that this happens first. Not clear.

Answer: The Referee is right that concerning the accuracy assessment and the DDS optimisation (section 3.3) we do not follow the chronological order of the processing in PRACTISE. There is a single reason why we put the optimisation section after the georectification section: The georectification process is necessary to determine the positional inaccuracy of the georeferenced to the real location of the GCPs. If we start with the DDS optimisation, the reader would be left in uncertainty how the GCPs in a 2-D photograph and in a 3-D DEM can be compared with each other. We will clarify

this in section 3.

Question 31: Page 176, L15 – it should be highlighted. . . not considered.

Answer: Yes, we will use the suggested word 'highlighted' in the revised version.

Question 32: Page 176, L17 – what is the external data that replaces the need for the viewshed?

Answer: A viewshed is absolutely necessary. The choice of each user is that the viewshed is either generated in PRACTISE or externally e.g. in a geoinformation software. We will clarify this by changing the formula to "... if a viewshed is externally provided from e.g. a geoinformation software".

Question 33: Page 176, L21- 22 - I think the way this is stated is unnecessarily complicated. Do you simply mean that the photograph is divided into 8 sectors based on the compass directions N, NE, E, SE, S, SW, W and NW? The Figure caption (Page 194) similarly needs to be clarified.

Answer: The Referee is right, we will adopt "divided into 8 sectors based on the compass directions N, NE, E, SE, S, SW, W and NW" in the manuscript.

Question 34: Page 177, L2-11 (and Fig 2) – The methodology here is hard to follow. First, the term si,j in Fig 2a has not yet been defined in the main text at this point which makes the figure difficult to understand. Is this the DEM or the photo space we are looking at? I initially assumed that i,j was referring to the image space since this these variables are often used this way. Also, are each of the rings mentioned in Fig 2 one pixel wide? But think I see now that both i,j and m,n refer to row/columns in the DEM space? Based on Fig 2b, I would think that the point r's position relative to dm,n should be rm,n-1 and rm-1,n-1.but I may be missing something. Maybe just that m and n need to be defined.

Answer: Thanks for pointing this out. We revise this paragraph and will define the variables i and j, as well as m and n, as row and column positions before they are used

in the figure. Then, it should become clear that the viewshed is generated in the DEM space and that the distance between the rings is indeed one pixel wide. The positions rm,n+1 and rm+1,n+1 are correct as the origin of the DEM raster is at the upper left (NW) corner of the grid which will also be mentioned when i, j, m and n are defined.

Question 35: Page 177, L2 – Has Co been raised before?

Answer: Yes, it is defined for the first time at page 175, L4-8 and used again at page 176, L19.

Question 36: Page 181, L14 – to correct instead of to optimise?

Answer: We have replied to this comment in question 3, we do not think replacing 'optimise' with 'correct' is the best choice here whereas we will avoid the duplication with the word 'optimisation' and change it to 'enhance'.

Question 37: Page 181, L24 – produces good results

Answer: We adopted the suggestion of the Referee. However, the sentence was rephrased due to the reply to question 11 of M. Spencer.

Question 38: Page 182, L3 – You cannot use the term latter with more than two items. Rephrase.

Answer: We will replace 'the latter' with the focal length 'f'.

Question 39: Page 182, L4 – If these are truly guesses, I find it hard to imagine the utility of PRACTISE without the DDS optimisation. This needs to be made clear in the introductory paragraphs and discussion.

Answer: The Referee is right that the initial camera parameters are not measured, they are estimated (page 175, L18-27 and e.g. question 28). Therefore, we will replace "guesses" with "estimates" here. Additionally, we will clearly state in the revised manuscript that in our study the DDS optimisation of the exterior and interior orientation parameters is absolutely necessary. We have already agreed to this point in the

reply to question 8. We will highlight it in this chapter, as well as in the introductory and the discussion chapter of the manuscript.

Question 40: Page 182, L8 – exemplary isn't really the right word. Say. . . 6 GCPs are used in this DDS optimisation example.

Answer: We will change the sentence according to the Referee's suggestion.

Question 41: Page 182, L21-22 – what other land surface variables are possible? Do these routines exist and are they available? I think it's worth mentioning these somewhere.

Answer: As an example, we will once again refer to the greenness indexes in phenology here (see also question 11 and 12). The papers of Richardson et al. (2007), Ahrends et al. (2008), Crimmins and Crimmins (2008) and Migliavacca et al. (2011) that we mention at page 174, L14-18 describe thoroughly how each of these indexes are calculated. The framework of PRACTISE can be easily adapted by replacing some lines of code in the snow classification routine with the respective formula and as mentioned in question 12, no specific programming skills are needed for that. We will add this at the end of section 3.4. As stated in the reply to question 11, we will also add the example of thermal infrared images in the discussion chapter.

Question 42: Page 183, L3-6 – This sentence is awkward. What about saying on L5 that you use images captured under different lighting conditions?

Answer: The Referee is right. We will restructure and clarify this sentence in the revised version.

Question 43: Page 183, L21-23 – a short description of these routines would be useful to the reader.

Answer: We will follow the Referee's suggestion and add a short description of the addressed snow classifications to this paragraph.

Question 44: Page 184, L3-12 – this paragraph here demonstrates to me that the DDS routine which is dependent on GCPs is critical for acquiring quantitative information from the imagery. For example the error of 93 pixels is some 2

Answer: The necessity of the DDS routine in our study has already been discussed in the questions 7, 8, 28 and 39. As we stated before, we will highlight this in the respective sections of the revised manuscript.

Question 45: Page 184, L8-9 – I don't think this is at all surprising. Guessing the initial camera orientation values were never going produce good results. I'm more surprised that the improvement wasn't greater.

Answer: The differences in the accuracy of the georectification using the initial and the optimised camera parameters is clearly not that surprising for a reader familiar with the topic. A geoscientific user that is inexperienced in photogrammetry might, on the contrary, underestimate the need for a high accuracy in the exterior and interior camera orientations. Thus, the presented numbers give a spread for these users.

Question 46: Page 184, L13 – the reader cannot take part in the visual investigation because of the quality of the figures. They need to be much larger.

Answer: The Referee is right, the figures, as well as the font sizes of the figures, will be enlarged in accordance to the reply to question 1.

Question 47: Page 184, L16 – not clear what you mean by this being 'valid'. This sentence doesn't make sense.

Answer: We rephrase the sentence to: "The high quality of the classification applies to both clear sky conditions in the May image (Fig. 9a) and cloudy conditions in the February image (Fig. 9b)."

Question 48: Page 184, L19 – not sure what you mean by, ". . . very strong effect of the erroneous classification. . ."

Answer: Thanks for pointing this out. We will skip "... and a very strong effect of the erroneous classification had been identified" in the revised version and clarify that in the small test area where visually no snow could be detected ". . ., the automatic classification routine mistakenly classifies 477m^2 of limestone as snow which corresponded to a relative error of 4.1%".

Question 49: Page 185, L12 – I'm not sure the software has a large number of features!

Answer: We do have several additional features in comparison to the already existing software packages. A 'large number of features' is admittedly not the right expression here wherefore we will change it to 'different features'.

Question 50: Page 190 – Delete except noted otherwise since they are all in meters?

Answer: As noted in the column of the parameter name in Table 1, the roll (phi) is given in degree and the numbers of rows and columns (Nv and Nh) are defined in pixels.

Question 51: Page 190 – Why don't C and T have a z component seeing as you're getting them from the DEM? Is this UTM? If so, what is the zone?

Answer: Table 1 shows the needed input data so that PRACTISE can start the georectification process. At page 175 in the lines 5-7 which will be clarified in the revised version according to question 24, we state that the latitude and longitude positions of C and T need to be derived. The z component is automatically derived from the DEM in the computation process of PRACTISE and thus, it is not needed as input before. Further, we describe at page 175 in line 21-24 that "the latitude and longitude positions of C and T were visually derived from an official orthophoto. . ." in our study. The Referee is right that we did not describe the used projection. We will add a sentence to the section 2 that the coordinates are referenced to the European Terrestrial Reference System 1989 (ETRS89) and UTM Zone 32T.

Question 52: Page 193 – Legends, and scales are very small. Is the inset of the camera necessary? It's not really providing much information to the reader? The reader also

doesn't know what UFS is at this point. Is it necessary to point this out in the figure and the DEM? Isn't it better to specify that the camera station is within the limits of the DEM?

Answer: Thanks for these useful suggestions. We will enlarge the size of the legends, scales and fonts, remove the inset of the camera and replace "UFS" with "Camera". We will also follow the Referee's suggestion to some extent and trim the displayed extent of the DEM. We remove the upper part of the figure (around the Zugspitze) but keep the camera location in the revised figure as we want to show where the camera is located and how it is oriented.

Question 53: Page 194 – Simplify as suggested above.

Answer: We will simplify the confusing sector description in the revised version in accordance to the reply to question 33.

Question 54: Page 194 – As I've stated in the text, the relationship between i,j and m,n is not clear.

Answer: Thanks for pointing this out. The parameters i, j, m and n will be defined as described in the reply to question 34 in section 3.1 before Fig. 2 is mentioned.

Question 55: Page 195 – Wouldn't it be more appropriate to show the camera location here rather than labeling it UFS?

Answer: In accordance to the reply to question 52, we will replace "UFS" with "Camera".

Question 56: Page 196 and 197 – Black and grey is hard to differentiate in the printed copy. Since this paper would need to be printed in colour anyway. . . why not use colour to differentiate?

Answer: The Referee is right, we will revise this figure and use colours to simplify the differentiation.

Question 57: Page 198 – Is this figure necessary?

Answer: We see the Referee's point here. However, the essential part of the software package PRACTISE is to create a link between the real ground and the photograph which is established in this chapter for the first time. The figure showing the visible DEM pixels superimposed on the complete photograph will become even more important as Fig. 9a-d only show an enlarged view of the photographs and the superimposed DEM pixels (similar to Fig. 7).

Question 58: Page 199 – I think this figure is important and should be larger.

Answer: The Referee is right, we will ensure that this figure is enlarged to the full width of 17cm in the publication process which corresponds to a zoom of about 170%.

Question 59: Page 201 – Figure is totally unusable due to its size. Font size of the axes are ridiculous. . . this shouldn't have made it through the initial editorial.

Answer: We agree with the Referee here and will enlarge the size of the figures and fonts. Further, we will zoom in to the study site, the northeastern slope of Schneefernerkopf because this will allow the reader to take part in the visual investigation of the quality of the classification. The revised figures (9a-d) have been split up in Fig 9a, b and Fig. 9c, d to fit the paper format of the GMD Discussions.

Question 60: Page 201 – Purpose of black box, which cannot be seen in the printed copy, should be added to the caption.

Answer: Thanks for pointing this out. We will add a description of the purpose of the black box in the figure caption. The enlarged view of the photographs will additionally help to clearly identify the black box as test area for the misclassification and ease the change detection between the automatic and the manual classification approach in the August image.

Question 61: Page 201 – Reference to panel (d) needs to be added to the caption.

Answer: We thank the Referee for the careful reading and we will add the reference to panel (d) in the figure caption.

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Please also note the supplement to this comment:
http://www.geosci-model-dev-discuss.net/6/C205/2013/gmdd-6-C205-2013-supplement.zip

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Interactive comment on Geosci. Model Dev. Discuss., 6, 171, 2013.

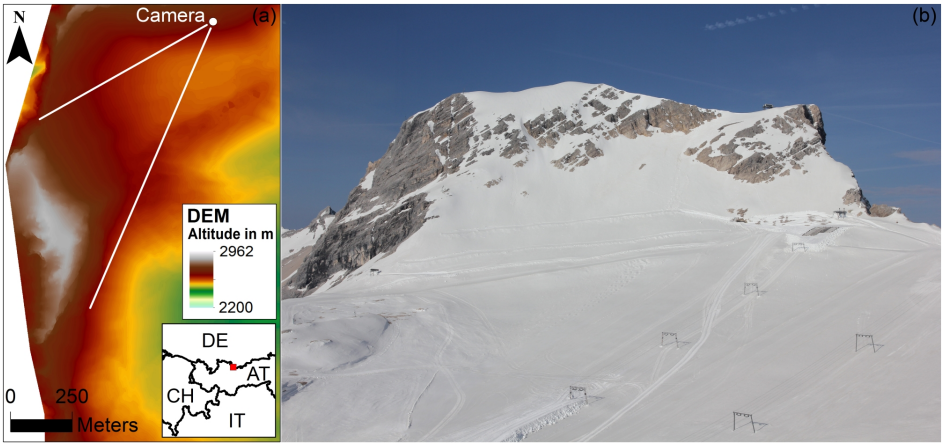


Fig. 1. Revised Figure 1

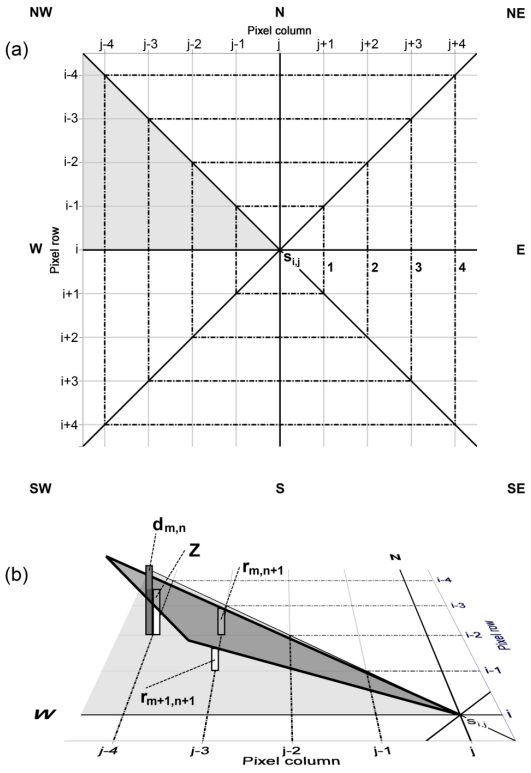


Fig. 2. Revised Figure 2

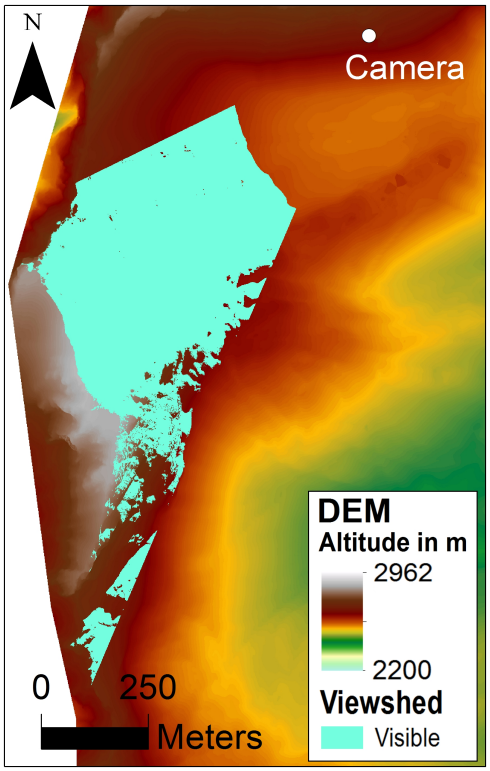


Fig. 3. Revised Figure 3

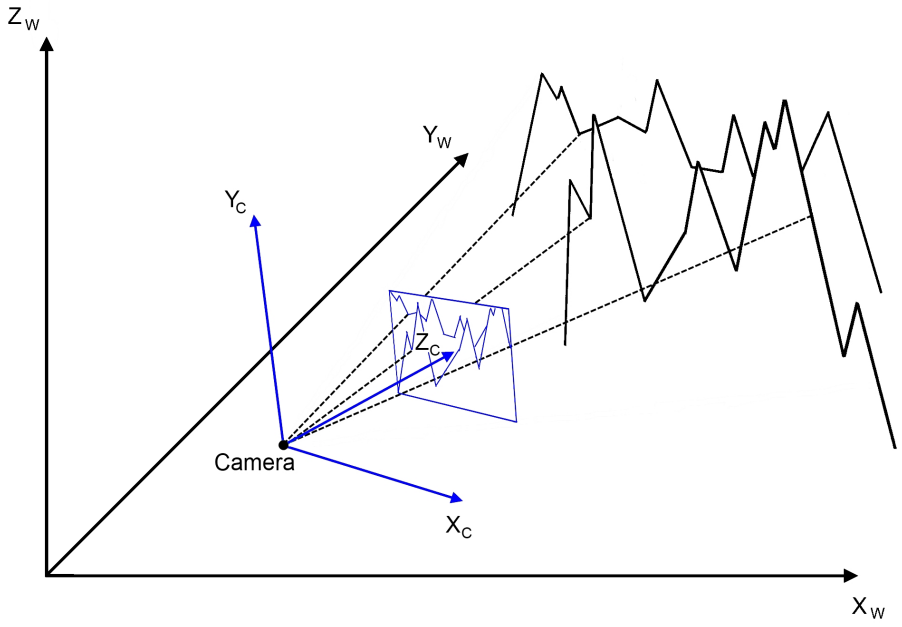
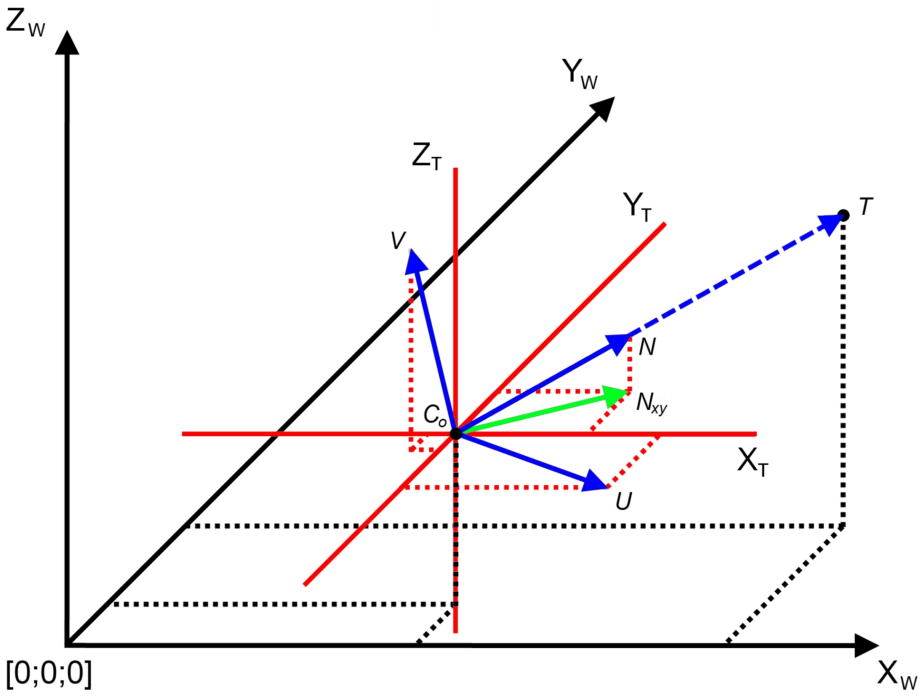


Fig. 4. Revised Figure 4



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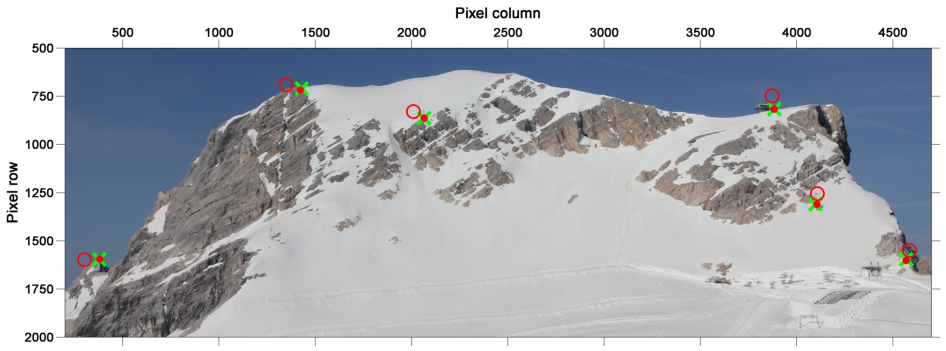
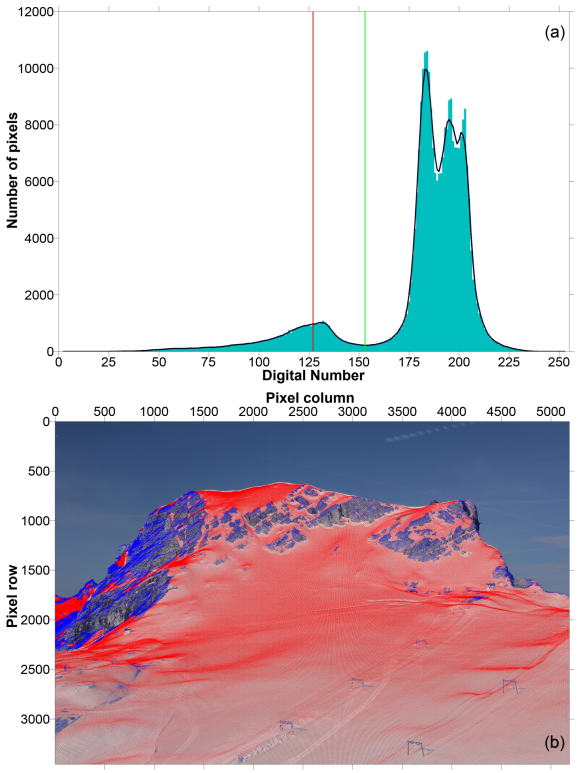


Fig. 6. Revised Figure 7



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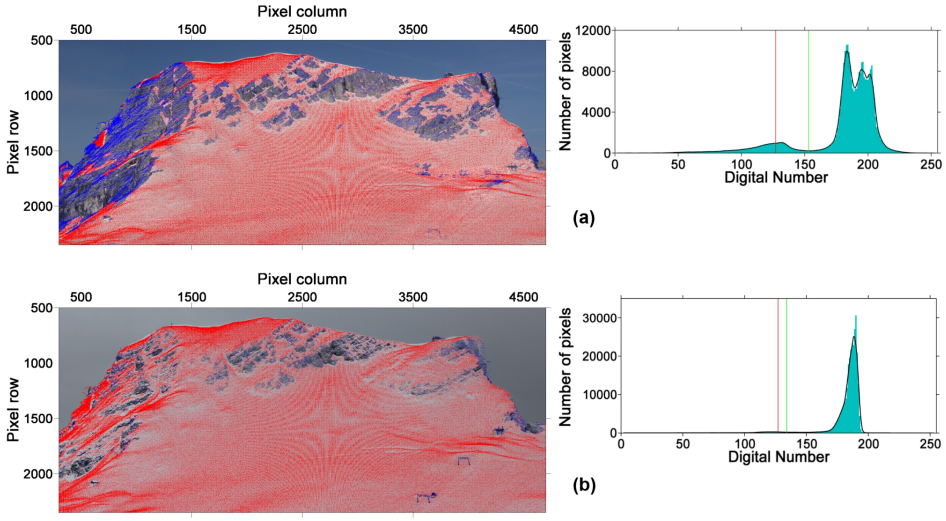

Fig. 8. Revised Figure 9a, b

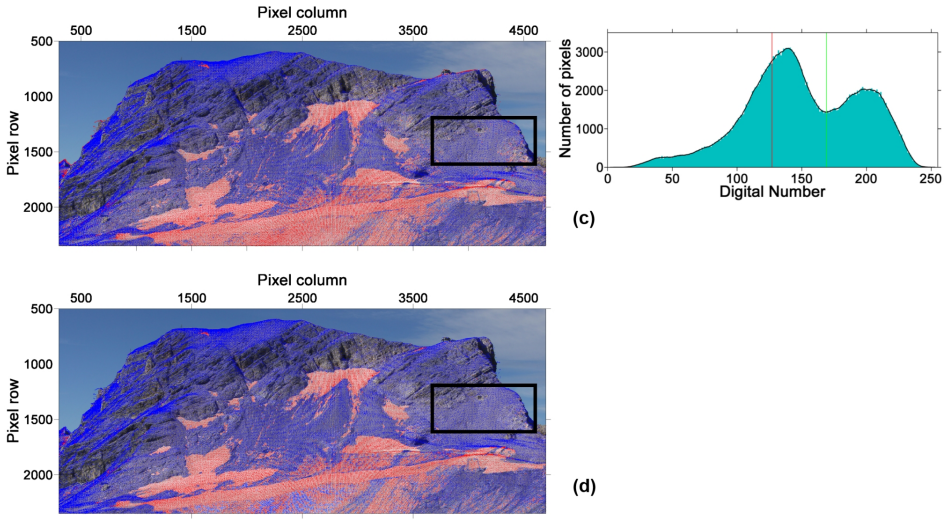

Fig. 9. Revised Figure 9c, d

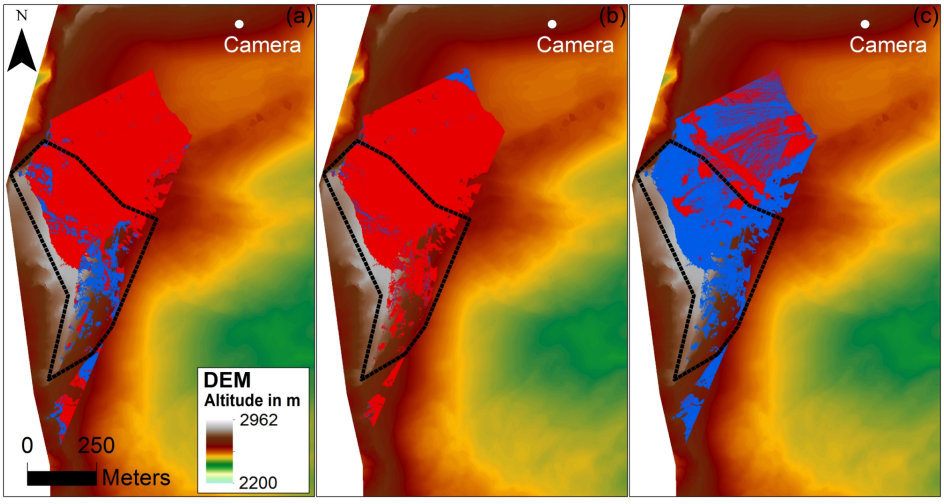

Fig. 10. Revised Figure 10