

3. New DSM Interaction - 3D DSM Editor

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1 Motivation

With the recent innovations and developments in software algorithms and processing hardware, data products like the DSM, orthophotos (projected on DSM or DTM) as well as 3D models became widely available and got well accepted. In parallel with the increased availability, expectations on the data quality grew and required sophisticated methods for efficient verification of the data and maintenance of the quality. The fact that hardly any automated processing produces 100% correct results led to the conclusion that a tool for manual interaction with the data was required and the DSM was identified as the key dataset for quality.

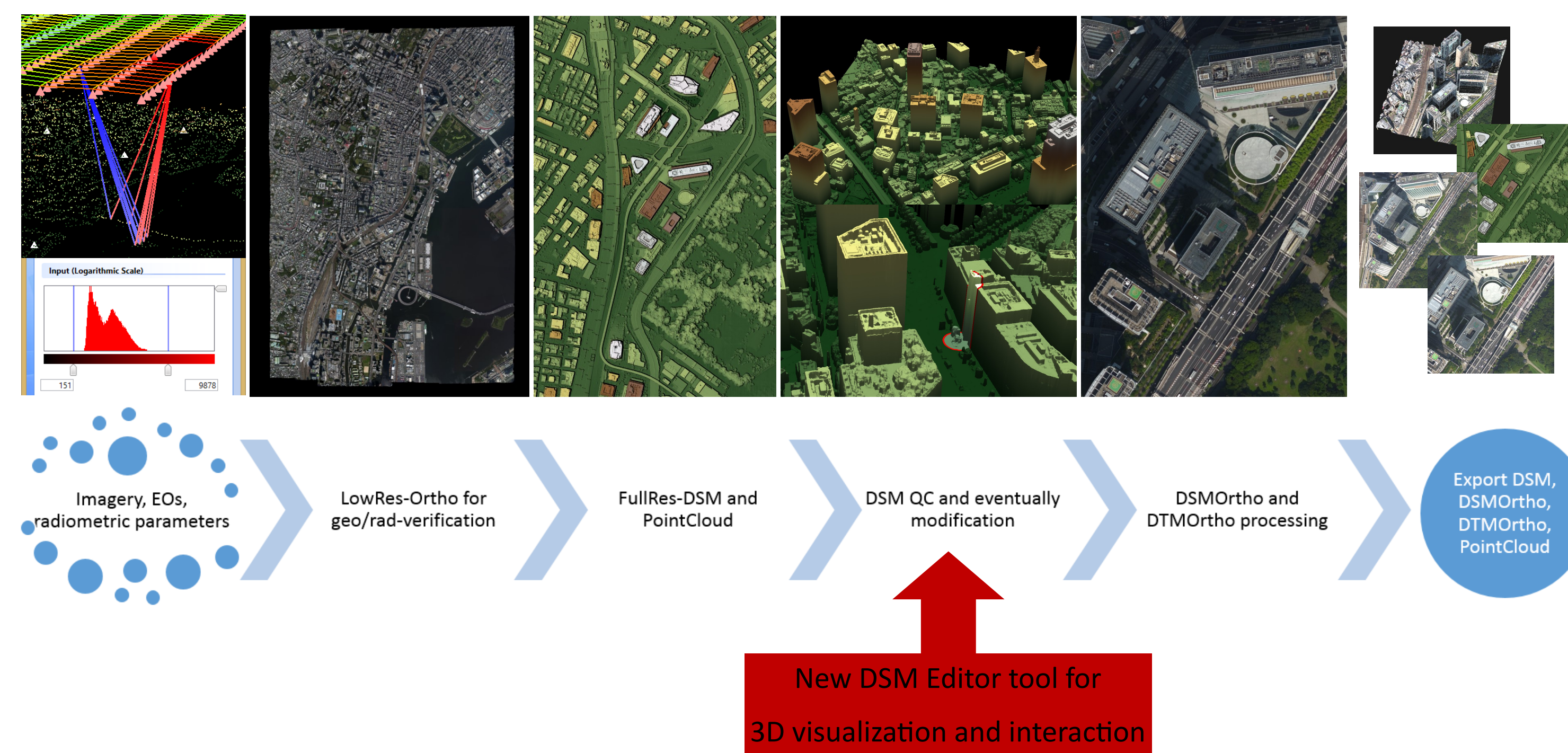
The experience from large scale data production for Bing Maps showed the typical situations where the operator sees the need for an in-depth inspection and eventually manual interaction with the data. The new DSM interaction tool, the 3D DSM Editor was developed accordingly.

2 Typical Workflow

The UltraMap DSM+Ortho processing software module is using the following input:

- Directory with postprocessed UltraCam imagery
- Exterior Orientations from the UltraMap AT result file
- Radiometric adjustment parameters from the UltraMap radiometry module

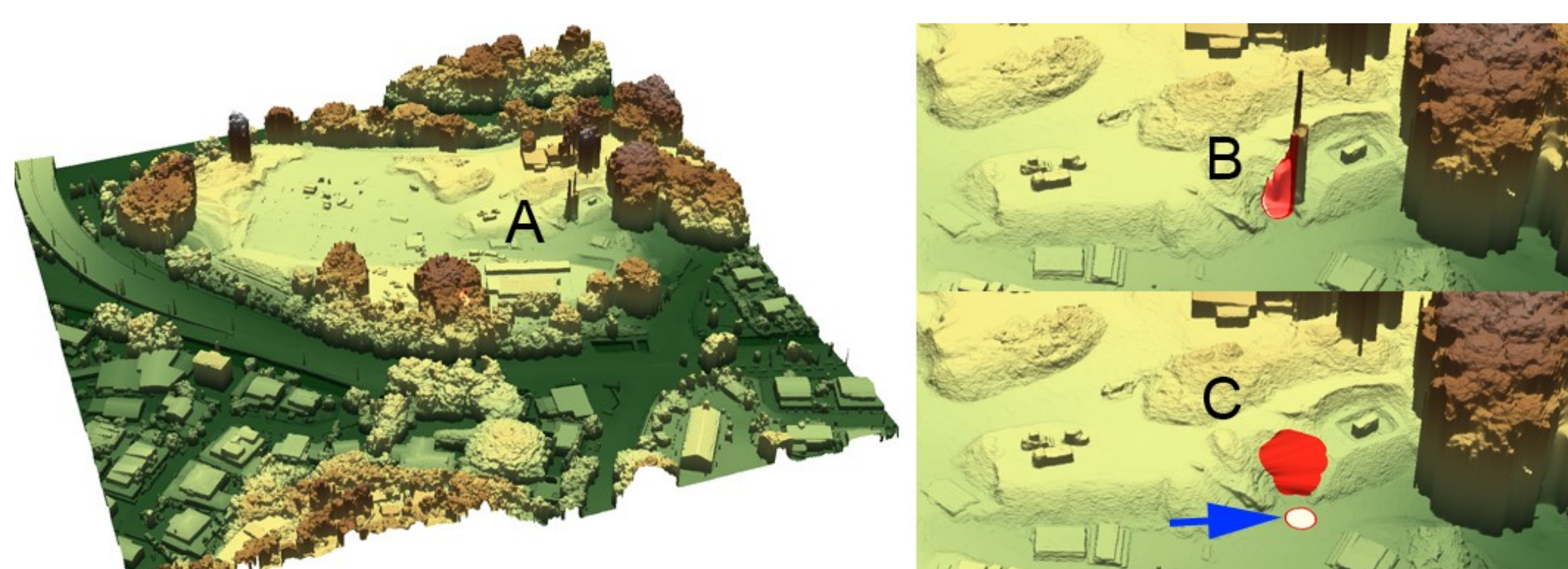
Based on these datasets, the software processes fully automatically a DSM which can be inspected in the new DSM Editor tool and be eventually modified. The QCed DSM is then the foundation for further processing of the DSMOrtho and the DTMOrtho (internal filtering from the DSM to the DTM). The software allows to switch from the fully automatically processed solution to the manually modified solution to see the effects of the human interaction with the data.



3 Real-Time 3D DSM Editing

The UltraMap DSM module uses image-based surface reconstruction algorithms. For many mapping and photogrammetry applications manual editing and refinement of raw DSM data is required. We are introducing the DSM Editor, a novel 3D interactive editing tool for digital surface models. Traditionally this was done using “drawing” tools (similar to image editing tools) to edit height-field (raster) data. For visualization different shading methods and image overlays or blending were used.

The DSM Editor is based on proprietary Vexcel Imaging 3D technology. With a circular 3D cursor, like with a magic wand, the user only provides hints to the software which then uses intelligent “3D brushes” to automatically and in real time fix the areas highlighted by the users. In case automation delivers imperfect results, the 3D cursor is used to provide additional guidance like highlighting an edge or a break-line. In the example below we show how the “flag pole” structure (marked up with the “A” on the left could be removed by guiding a 3D cursor over that area. On the right the starting point of the operation is marked up by “B” and the result is shown on the lower right (flagged by “C”). The interactive cursor is automatically guided in the vertical and interactively moved by the operator in x and y. The blue arrow on the lower right points to the circular cursor.



The new DSM Editor provides functionality to:

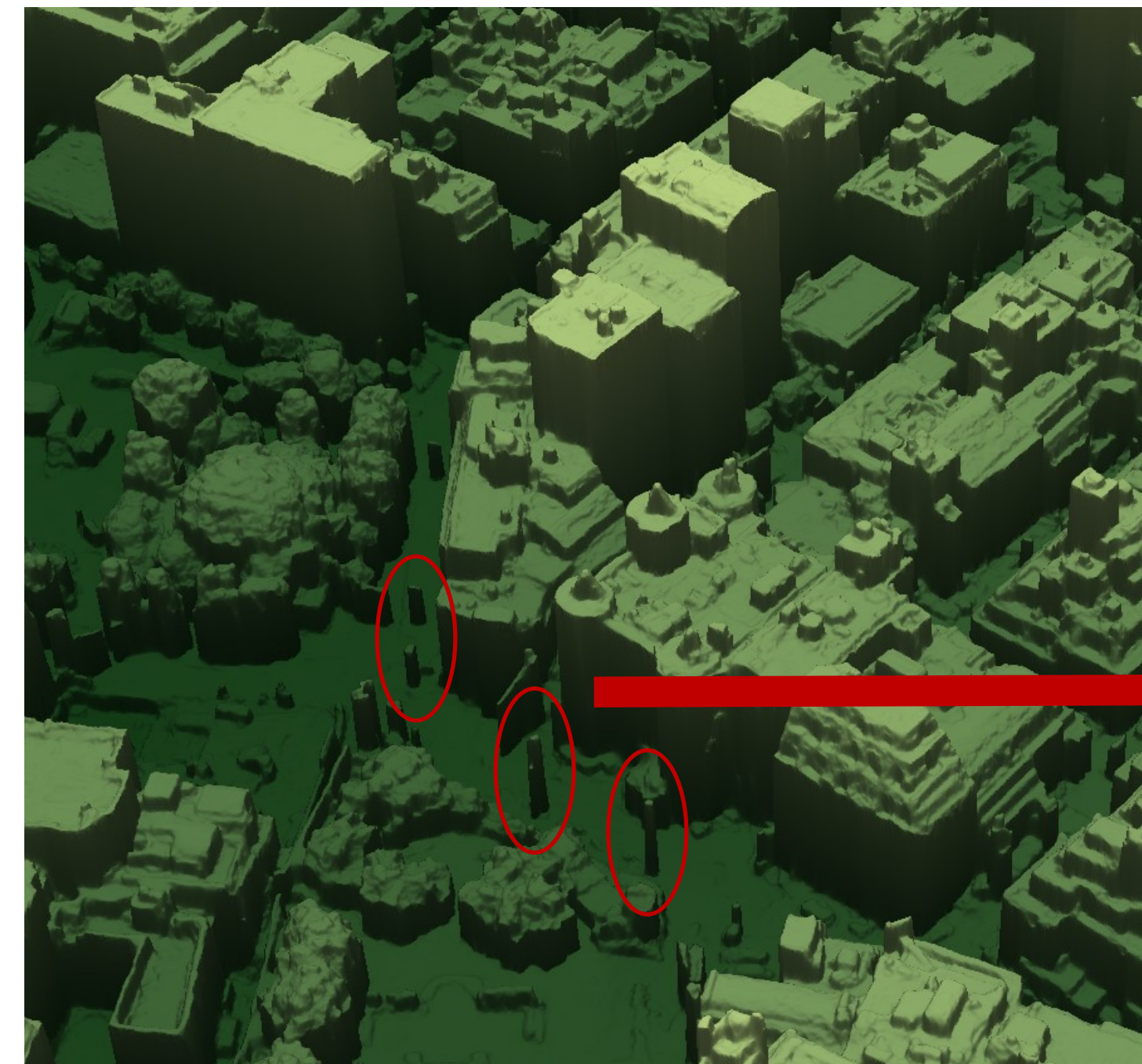
- ☒ Visualize data in 3D
- ☒ Color-code pixels based on elevation
- ☒ Texture the DSM with the DSMOrtho
- ☒ Remove objects and interpolate to Z of adjacent pixels
- ☒ Fill holes and interpolate to Z of adjacent pixels
- ☒ Read Z values and fine-tune DSM to given values

ULTRAMAP
Workflow Software System

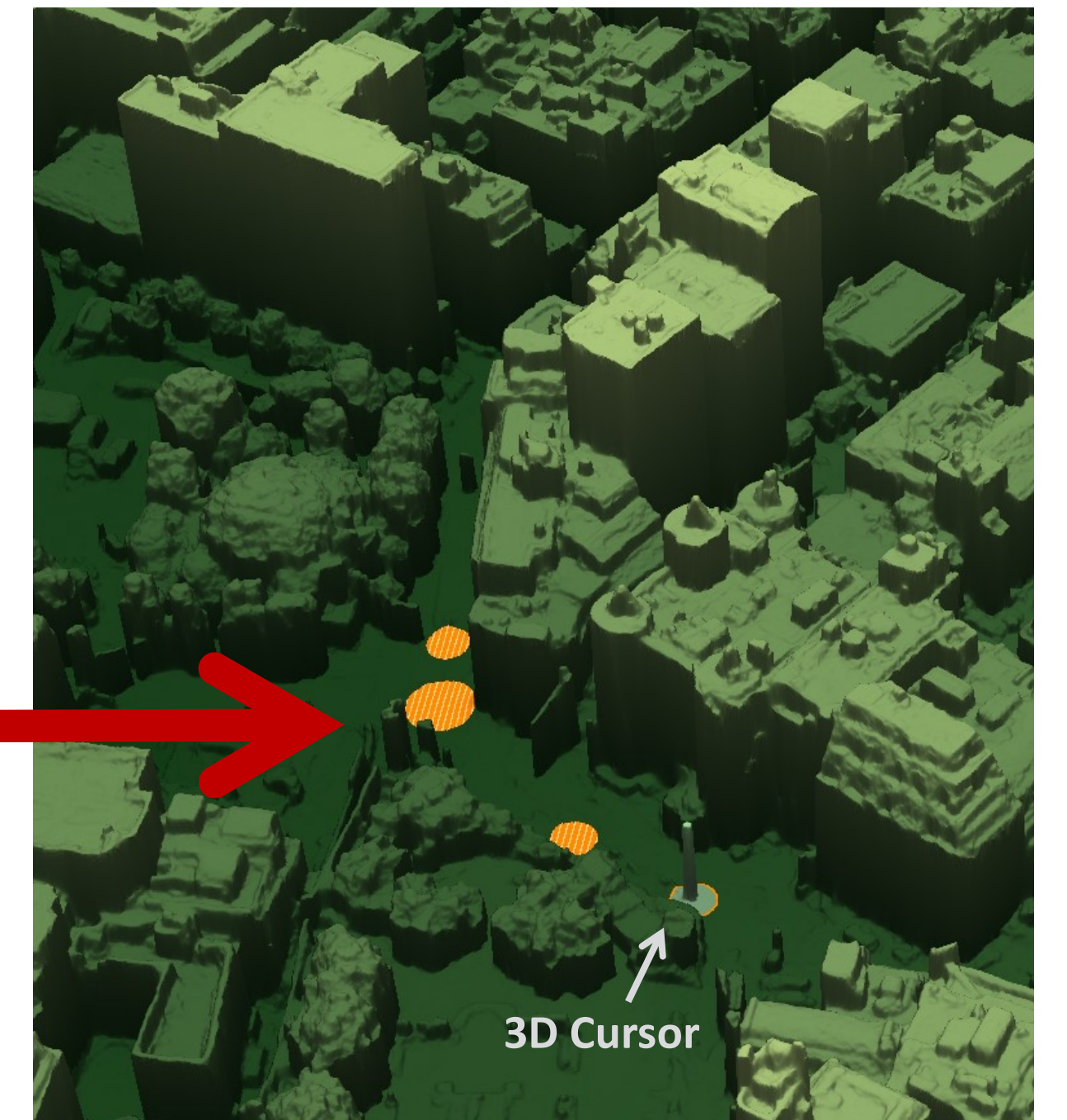
4 Samples

The following visualizations demonstrate some of the functionality of the new DSM Editor tool:

Street lamps should be removed:

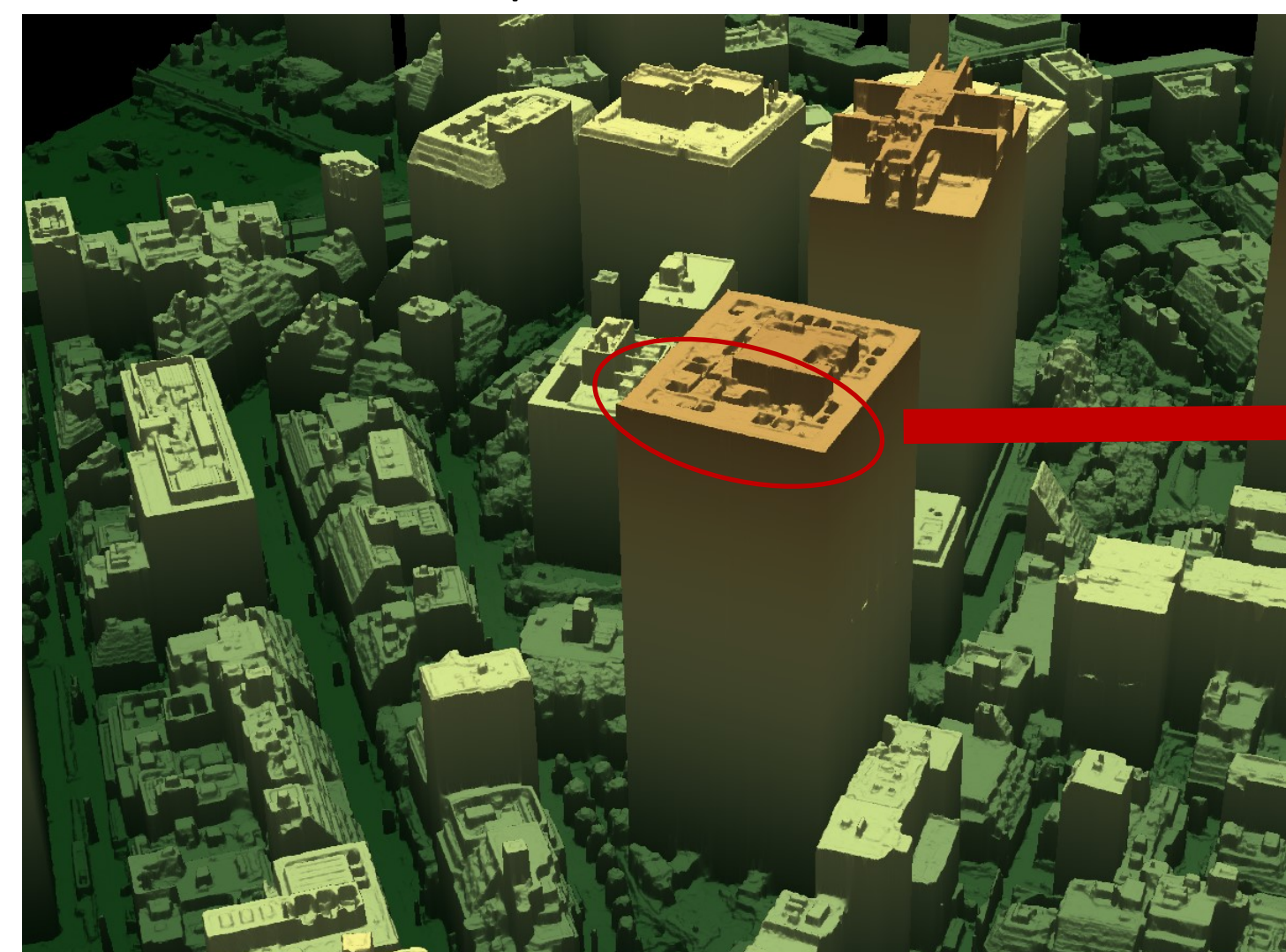


Objects for removal = red ellipses

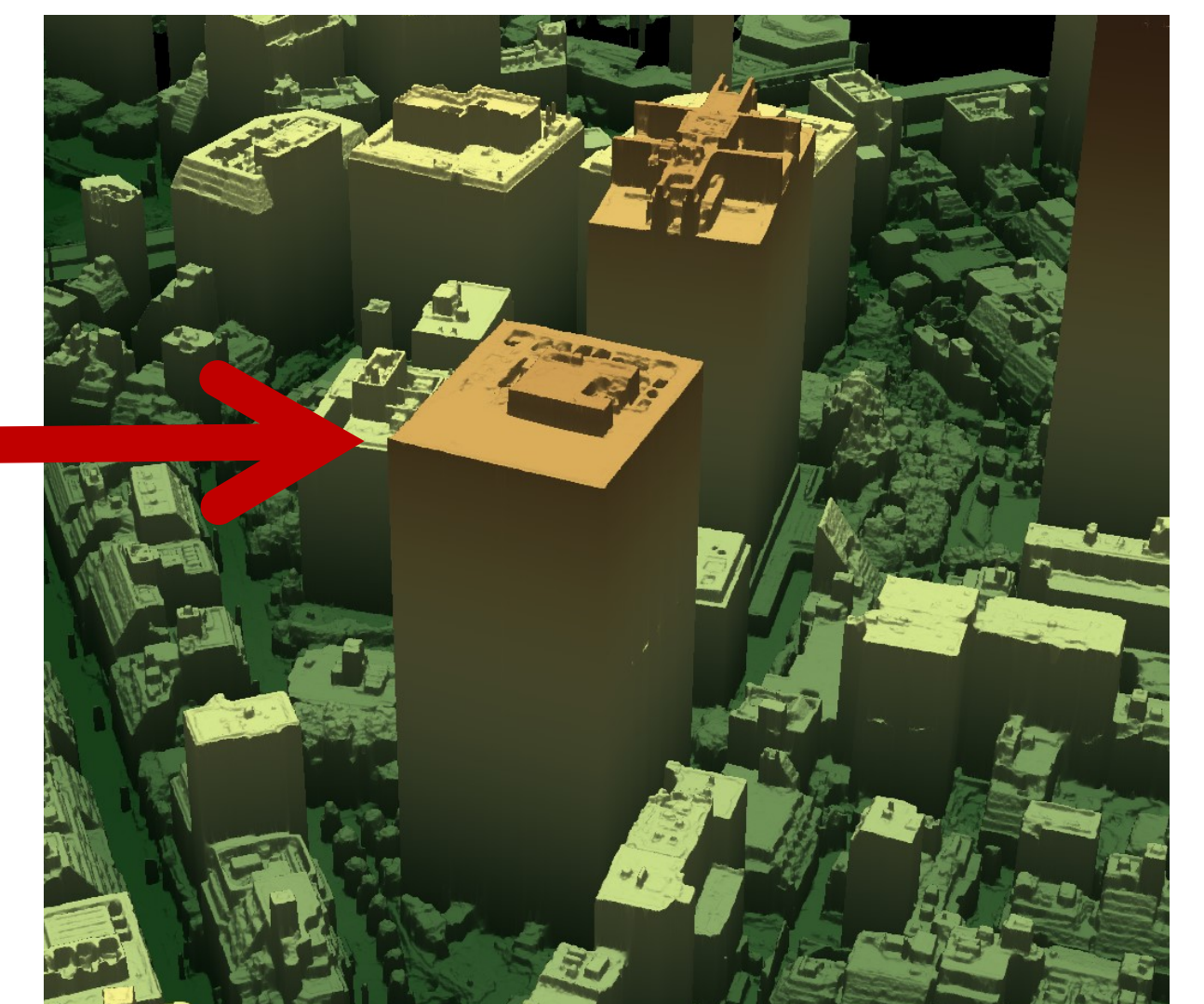


Removed objects, highlighted edit = orange

Fill holes on roof top:

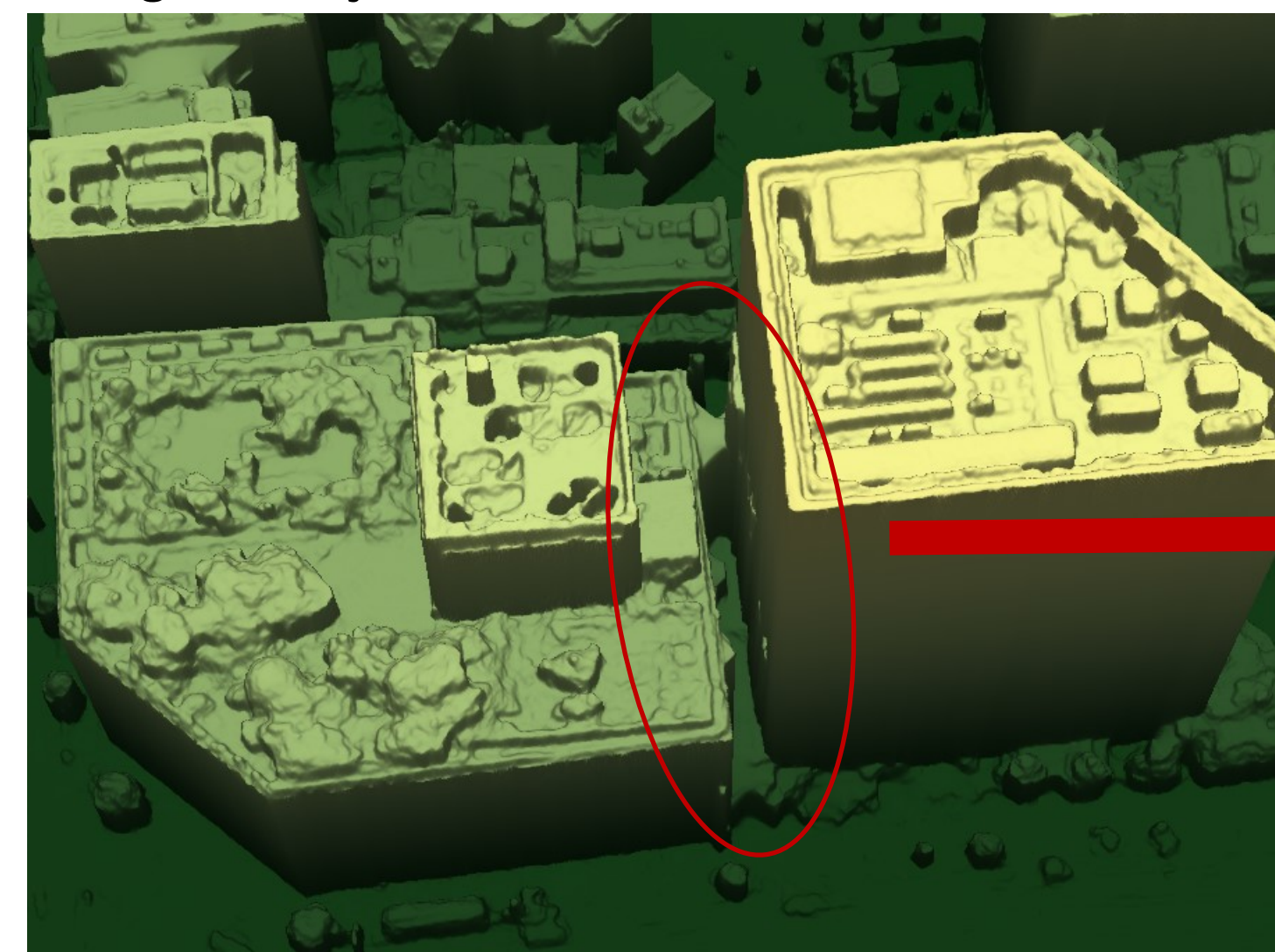


Area to be filled to consistent level = red ellipse



Roof top flattened (air conditioning etc.)

Straighten façades :



Narrow street and façade distorted = red ellipse
(because of occlusion in input imagery)



Façade straightened and street flattened

5 Future Developments

Further development is going on at the software side. New versions will add functionality for using both nadir and oblique images in the DSM processing. This will allow automated accurate modelling of building façades (e.g. structured façades, roof lines) and situations with objects with information underneath (e.g. bridges, trees) as far as the field of view permits. Additional tools will enable automated color balancing of the oblique images by matching tie points across all images.

6 Conclusion

The new innovative tools to the UltraMap photogrammetric processing chain open a door towards efficient production and interactive quality assessment and quality control for large photogrammetric projects. Based on an intuitive user interface interactive investigations are well supported and the user is enabled to focus on his control task even if a huge number of up to 50.000 images and their parameters have to be inspected. In the same way, based on a 3D user experience we have designed the DSM editing tool. It significantly increases operator efficiency when creating high quality 3D description of the object surface.

Further Information

For further information and a live demonstration of our products, please visit us at booth #308.