Study Area

Bad Vigaun is a municipality located in the district of Hallein, in the Austrian state of Salzburg at an elevation of 484 m above sea level.

Our study area is the Taugl river, which rises near the mountains Gennerhorn and Gruberhorn and flows to the state of Salzburg. The specific section of the river where we will be working is shown below.

(Source: Google Earth)

Goal

To prepare Digital Surface Model (DSM) and Orthophoto of river Taugl to be used in runoff simulation and high water risk analysis.

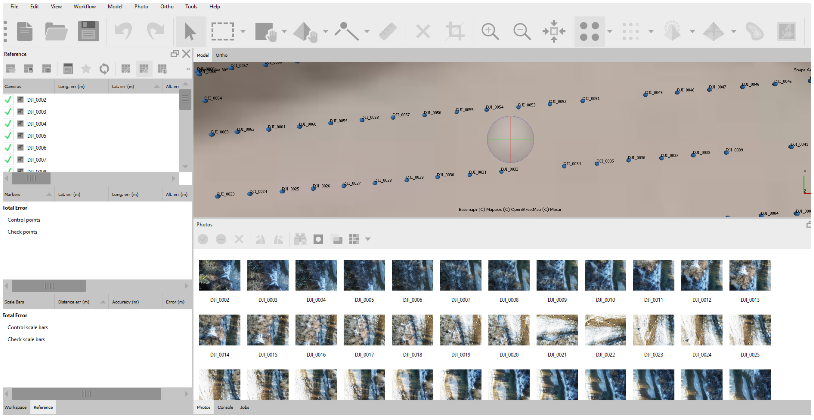
Data and Software Used

1. Drone captured images of the area.
2. Agisoft Metashape Version 1.7.5

Methodology

1. Loading images into Agisoft Metashape

A total of 81 images were loaded into the software by clicking on *Add Photos* command under *Workflow* menu in the main menu bar.



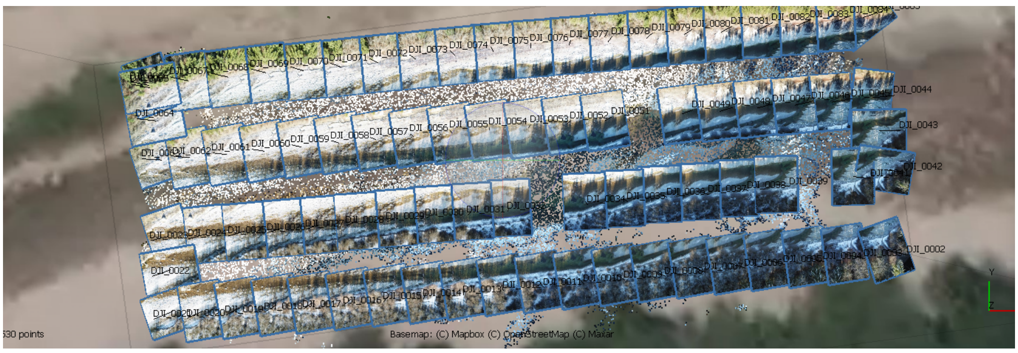
Screenshot of images added to the software

After adding the images to the software, the display looks more or less like this.

2. Aligning images

As we know that the camera position at the time of image capture is defined by two parameters: *interior* and *exterior orientation parameters*. *Interior orientation parameters* include focal length of lens, coordinates of image principal point and lens distortion coefficients. The *external orientation parameters* deal with position and heading of the camera in the real world coordinates. They are estimated during the image alignment process. After aligning the images, we will obtain point clouds with estimated orientation parameters.

Under the *Workflow* menu, there is the Align *Photos* command. I just used the default alignment parameters. *Accuracy* can be set to Highest, High, Medium, etc. depending on the required accuracy on camera position estimation. Of course, it corresponds with the time required for processing.

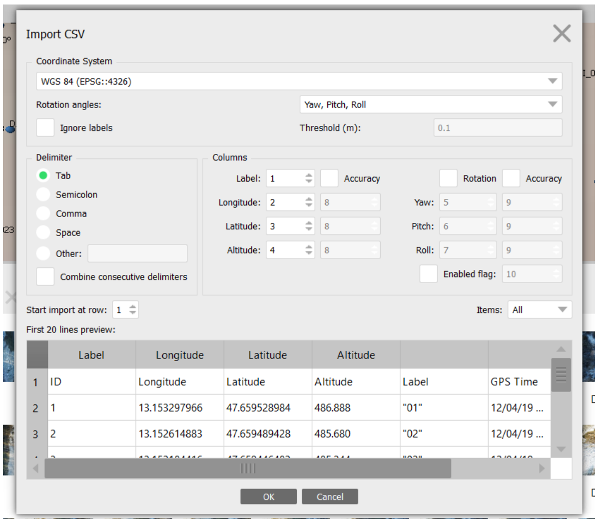


Point clouds after image alignment

3. Assigning real world coordinates to the data

After aligning the photos, I imported Ground Control Points (GCPs) to assign the real world coordinates to my data. On the Reference tab, there is *Import Reference* command to import the GCPs to the software. It accepts CSV files, XML files and other several file types.

I added my CSV file which contained the information about all the GCPs used during the survey. After adding the file, we need to place markers for all the points in our images. We need to identify the control points in the images and place markers for each of them.



"Import Reference" Dialogue Box

4. Optimizing camera alignment

The next step is to update the sparse point cloud by clicking on the *Optimize Cameras* command on the *Reference* tab. This process performs adjustment procedures on the aligned photogrammetric block, refining both exterior and interior orientation parameters.

Markers	Long. err (m)	Lat. err (m)	Alt. err (m)	Accuracy (m)	Error (m)	Projections	Error (pix)
1	-1.399069	-3.090762	-48.489355	0.005000	48.607899	8	831.918
2				0.005000		0	0.000
3	13.110551	-3.214639	-47.470055	0.005000	49.352068	9	783.657
4				0.005000		0	0.000
5	-0.011655	1.435235	-55.874323	0.005000	55.892755	16	539.620
6	0.155629	-0.639299	-51.944516	0.005000	51.948683	12	651.910
7	-3.529371	-1.276684	-51.317586	0.005000	51.454650	10	735.559
ID				0.005000		0	0.000
Total Error							
Control points	6.104503	2.190216	51.104385		51.514272		690.627
Check points							

Before "Camera optimization"

Markers	Long. err (m)	Lat. err (m)	Alt. err (m)	Accuracy (m)	Error (m)	Projections	Error (pix)
1	-0.055345	0.989501	0.125323	0.005000	0.998940	8	23.216
2				0.005000		0	0.000
3	5.136436	-1.924137	0.575544	0.005000	5.515118	9	101.370
4				0.005000		0	0.000
5	-1.716310	-0.531884	0.010419	0.005000	1.796866	16	17.622
6	-2.929895	1.025213	-0.169444	0.005000	3.108707	12	41.983
7	-0.446074	0.292525	-0.045290	0.005000	0.535354	10	13.286
ID				0.005000		0	0.000
Total Error							
Control points	2.760979	1.104622	0.274892		2.986429		47.612
Check points							

After "Camera optimization"

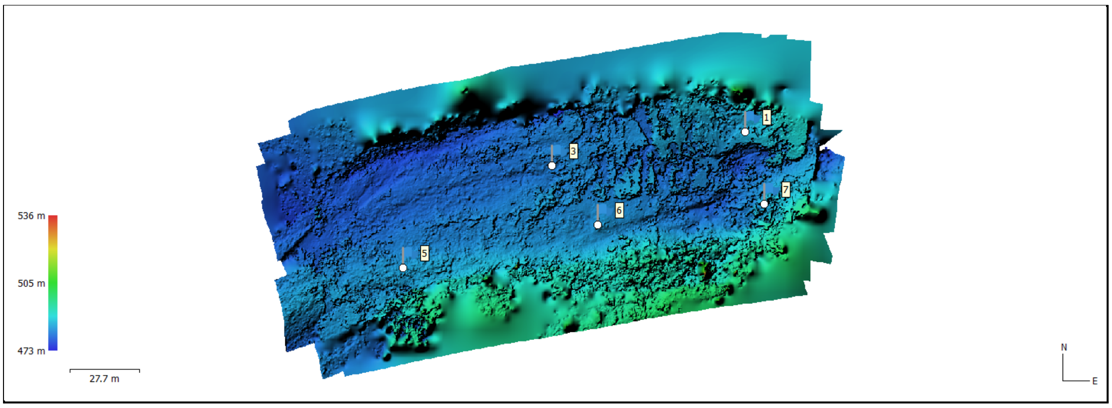
5. Building Dense Cloud

After camera optimization, the point dense cloud was generated. The *Build Dense Cloud* option is available under the Workflow menu. The processing was done with default settings of “Medium” quality and “Moderate” depth filtering. These settings always depend on the amount of details in the scene and the quality of maps to be generated.

The difference in DEM generation directly from the point cloud or the mesh is the way interpolation of points takes place. When we build DEM from dense clouds, the Inverse Distance Weighting (IDW) interpolation takes place to generate points with unknown values. But in case of using mesh, the points get interpolated as “Triangulated Irregular Network” TIN. IDW technique generates less noise around buildings or any structural edges. It is also recommended to calculate DEM based on dense cloud as this option allows the point classification and surface generation based on certain classes only.

6. Building Digital Surface Model (DSM)

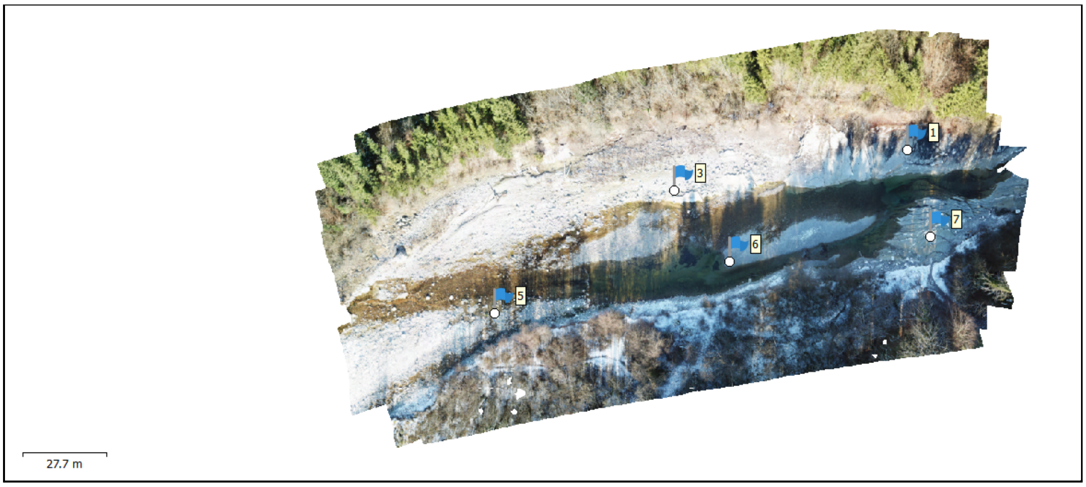
We then generate DEM from the dense point cloud obtained from previous steps by clicking on *Build DEM* under the *Workflow* menu. The product of the Build *DEM* option will depend on the input used .Here, in this survey, the surface height is captured including the top of the tree canopy or any other features, not the bare ground elevation. So, this would be the Digital Surface Model (DSM).



DSM of the study area

7. Building Orthomosaic

Orthomosaic is an image product obtained after the correction applied to geometric distortion(s) to the image and transformed to the selected projection. Either existing DEM or mesh can be used to build orthomosaic in Metashape. We used the previously created DEM to do so. Both the DSM and Orthomosaic were exported as TIFF file for further analysis.



Orthophoto of the study area

Conclusion

The outputs were also matched with other base imagery using ArcGIS Pro and it was aligned perfectly conforming to the correctness of our methodology. But in some of the images captured, there is more shadow and sunlight. It is generally advised to collect data when illumination is relatively consistent over all areas, particularly during the time close to solar noon. It is said that shadow and other factors are generally consistent during that period (not true in all areas).

UAV techniques are quite useful to survey small areas with high spatial and temporal resolution. Both the DEM and orthomosaic obtained are of very high quality which will in turn produce high quality results from subsequent analysis.

References

1. Agisoft User Manual
2. Location, location, location: considerations when using lightweight drones in challenging environments
3. Wikipedia