PHOTOGRAMMETRIC ANALYSES FOR HIGH RESOLUTION BATHYMETRY OF THE GEPATSCH RESERVOIR (TYROL, AUSTRIA)

Boschi Maximilian[(1)], Boschi Peter[(1)], Schletterer Martin[(2)]

[(1)] droneproject.at, Schneeburggasse 225, 6020 Innsbruck, Austria, Email: max@droneproject.at
[(2)] TIWAG-Tiroler Wasserkraft AG, Eduard-Wallnöfer-Platz 2, 6020 Innsbruck, Austria, Email: martin.schletterer@tiwag.at

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ABSTRACT:

The Structure from Motion (SfM) method [1, 2] became a powerful tool for photogrammetric analyzes of satellite and aerial imagery. Thus the generation of orthomosaics and digital elevation models (DEM) using SfM is becoming increasingly common.

The hydropower plant Kaunertal was built in 1961–1965 as high-pressure storage power plant with the annual reservoir Gepatsch, located in the Kaunertal valley. The dimensions of the reservoir are determined by a 600 m long dam crest, creating a length of about 6 km and a width up to 730 m, with a storage volume of about 138 Mio. m³.

In winter 2015/2016 a controlled drawdown of the Gepatsch reservoir took place [3], which was a unique chance to gain high resolution images and a topographical survey of the reservoir. To survey the bathymetry (between 14th and 23rd december 2015) of the Gepatsch reservoir an UAV (octocopter, Multirotor, service drone) was used. Beside the dataset of geotagged images, we measured 380 ground control points with a Leica Viva GS15 GNSS Rover to achieve a highly accurate, georeferenced model of the reservoir.

For optimal visual assessment a ground resolution of about 3 cm/pixel was selected. The camera-lens configuration (Lumix GH4, 14 mm fixed focal length) triggered a flight altitude of about 100 meters. Related to the confined flight time (capacity of the accumulator), the reservoir was divided into 20 sectors (Fig. 1). The blocks were surveyed with several autonomous flights (flight time 8 – 15 min each), which were performed if at least 6 GPS satellites were available. Flight planning was carried out with the software „Groundstation“. Due to lighting conditions in december, it was possible to fly between approx. 09:30 and 14:00, due to shading of the GPS signal.

The image processing (including georeferencing as well as removal of corrupt images) took place. The RAW-images that were selected for processing were optimized in Adobe Photoshop Lightroom. Subsequently the photogrammetric analysis was performed using the open source software MicMac/Apero [4].

We derived:

• orthophotos in 3 cm + 10 cm/pixel resolution
• point cloud
• digital elevation model (25cm) and contour lines

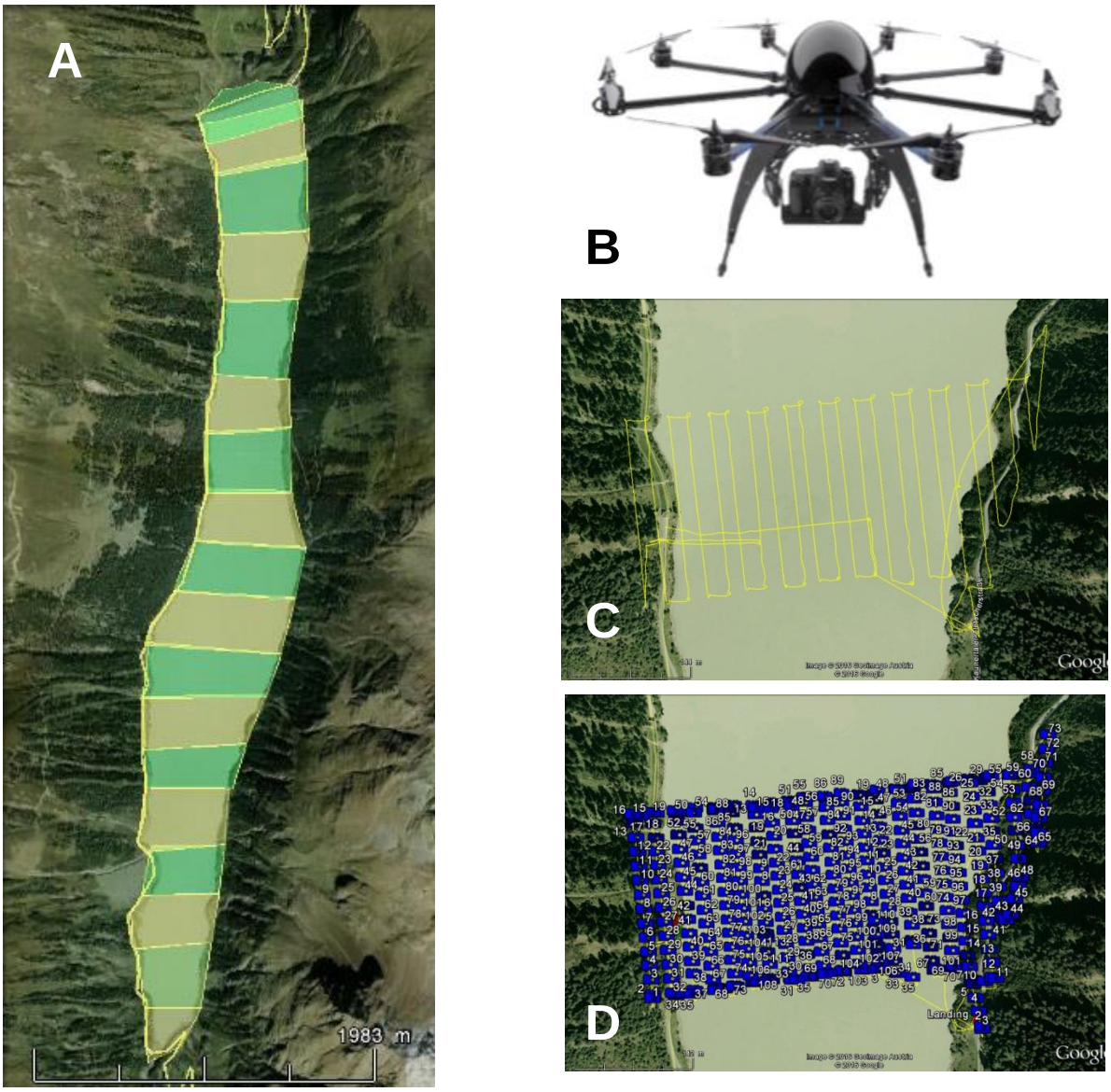

Figure 1. Gepatsch reservoir, A – overview on the 20 flight sectors (uppermost = 20), B – UAV MULTIROTOR service-drone, C – example for flight planning in sector 8 and D – corresponding camera positions

This case study underlines, that unmanned aerial vehicles (UAVs) can support remote sensing observations and enable the creation of a high resolution map. The procedure was supported by favourable weather conditions (late snow fall), i.e. despite winter period the assessment was possible without snow cover when the lowermost reservoir level was reached. We achieved an orthomosaic as well as a Digital Elevation Model (DEM) comprising high resolution bathymetric data of the Gepatsch reservoir (Fig. 2).

Possible applications range from archaeology, geography, mining, as well as civil engineering to ecology. In aquatic sciences, photogrammetric models became an important tool for detailed assessments of river segments [5], i.e. the generation of surface models as a basis for 2D hydraulic modelling and subsequent habitat modelling. But beside the step “from an image to coordinates”, additional application of spectral imagery from UAVs can support e.g. the Normalized Differenced Vegetation Index (NDVI) or the assessment of bark-beetles in forestry can be analysed using near infrared (NIR) imagery gathered by a multi camera system. Thus UAV generated datasets can provide an essential contribution to environmental intelligence gathering.

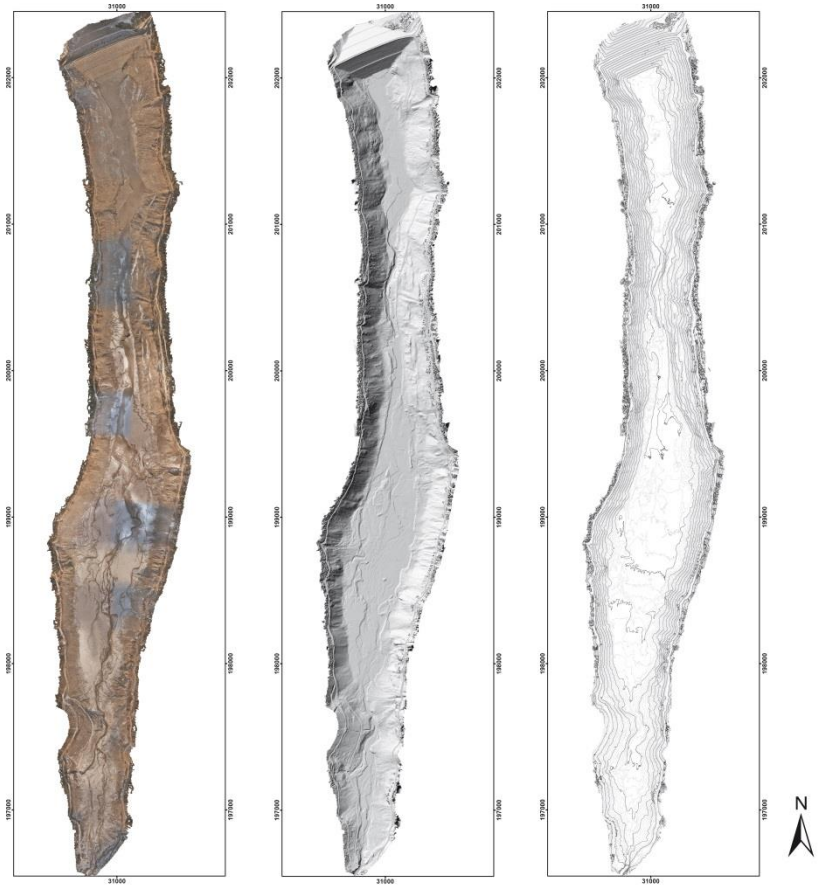

Figure 2. Orthophoto and DEM of the Gepatsch reservoir (December 2015)

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