2020

Technical Memo

WHYCHUS CREEK UAS MONITORING JULY 2020

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Summary of Work

The Aerial Information Systems (AIS) Laboratory at Oregon State University (OSU) conducted unmanned aircraft system (UAS) surveys from 7 July to 14 July 2020 across Camp Polk, Willow Springs, Reach 4, and Rimrock study areas throughout Whychus Creek in Sisters, Oregon (Figure 1). These aerial surveys were conducted to produce multispectral and thermal orthomosaics intended to monitor vegetation health, substrate size and distribution, and wood distribution. The aerial surveys coincided with ground surveys performed by the Upper Deschutes Watershed Council. Additionally, wetted and nonwetted evenly distributed photoplots were randomly generated, and high-resolution aerial images and videos were captured at these locations intended to measure fine sediment and flow direction and velocity.

Methods

Orthomosaic Flights

Spatial layers of reach boundaries were provided by the Upper Deschutes Watershed Council. These boundaries were used to plan automated flights in DJI Pilot software (DJI 2020). We installed a network of ground control points (GCPs) consisting of orange and white targets produced from plastic five-gallon bucket lids throughout the study area. GCP positions were recorded with a Trimble Geo XH GPS receiver equipped with a Tornado antenna mounted to a 2 m survey range pole. Locations were differentially corrected with GPS Pathfinder Office Software resulting in an approximate 0.1 m horizontal and 0.3 m vertical precision.

UAS orthomosaic flights were piloted by graduate student, Matthew Barker with Michael Wing, PhD assisting as a visual observer. The UAS platform consisted of a DJI Matrice 200 v2 equipped with a Micasense Altum combination multispectral/thermal sensor. Specifications of the Altum camera are available at: https://micasense.com/altum/ (Micasense 2020). Flights were flown at 120 m above ground level, and a NOTAM was filed to inform nearby manned aircraft of UAS operations.

Automatic flights were designed with DJI Pilot flight planning software. Flights were designed to capture imagery at a timed interval with 80% front and 80% side overlap. Images of a calibration panel with known albedo values were captured before and after each flight. The calibration panel imagery was used to radiometrically correct orthomosaics in photogrammetric software. All flights occurred within 2.5 hours of solar noon in accordance with manufacturer recommendations. Additionally, a downwelling light sensor was used in reflectance calibration for Reach 4 and Rimrock due to dynamic lighting conditions during the flights (partly cloudy and canyon walls casting shadows).

Resulting images were processed with Agisoft Metashape photogrammetric software (Agisoft 2019). Sparse point clouds were produced with the highest setting for accuracy alignment of aerial photos. Photos were then optimized using GCPs as markers. The gradual selection tool was used to remove points with > 0.5 pixel reprojection error. Additionally, points with reconstruction accuracy values >100 were removed. Dense clouds were produced with high quality and aggressive depth filtering settings. Coordinate system transformation was applied to convert photos and markers from WGS 1984 to NAD 1983 StatePlane Oregon South FIPS 3602 Feet Intl. Images were radiometrically corrected prior to

orthomosaic generation. DSMs and 6-band orthomosaics were exported as rasters (Tiff format). Orthomosaics were exported as raw digital number rasters (DNs and centikelvin) and converted rasters (reflectance = DN/32768; degrees Celsius = centikelvin/100 – 273.15). Image band order is: Blue, Green, Red, Red edge, Near infrared, and Long wave infrared (centikelvin). Table 1 summarizes data products. See figure 1 for map of study sites and resulting orthomosaics. Lastly, point clouds were exported in .las format.

Table 1: Data Product Specifications

Site	Camp Polk	Willow Springs	Reach 4	Rimrock
Approximate Survey Area (ac)	43	56	44	120
Orthomosaic Resolution (cm/pix)	5.46	5.25	5.31	5.31
Reprojection error (pix)	0.422	0.451	0.454	0.456
DSM Resolution (cm/pix)	10.9	10.5	10.6	10.6
Average Point Density (points/m^2)	83.9	90.6	88.6	88.7

Photoplot Flights

Photoplots were imaged with a DJI Phantom 4 Pro Version 2.0 equipped with an altimeter to measure precise altitude of the aircraft when images and videos were recorded. High-resolution images were collected from approximately 7 m AGL at wetted and nonwetted plots, and 30-second videos were recorded at wetted plots from approximately 20 m AGL. These flights were piloted by graduate students Matthew Barker and Katharine Nicolato. Waypoint locations from plot centers measured during ground surveys were visualized in DJI Pilot software. Pilots manually flew the UAS to each waypoint and adjusted altitude. Multiple photos were recorded at waypoints to capture ground markers installed by the survey crew.

Limitations

Three circular areas of overexposure are present in the northern portion of Rimrock orthomosaic. Additionally, there is a flight line artifact in Rimrock orthomosaic.

Some photoplot waypoints were inaccessible due to vegetation or signal interference.

Data Location

All data (DSMs, orthomosaics, point clouds, ground control points, photoplots, and raw photos) are available at the following BOX folder: whychus_july2020.

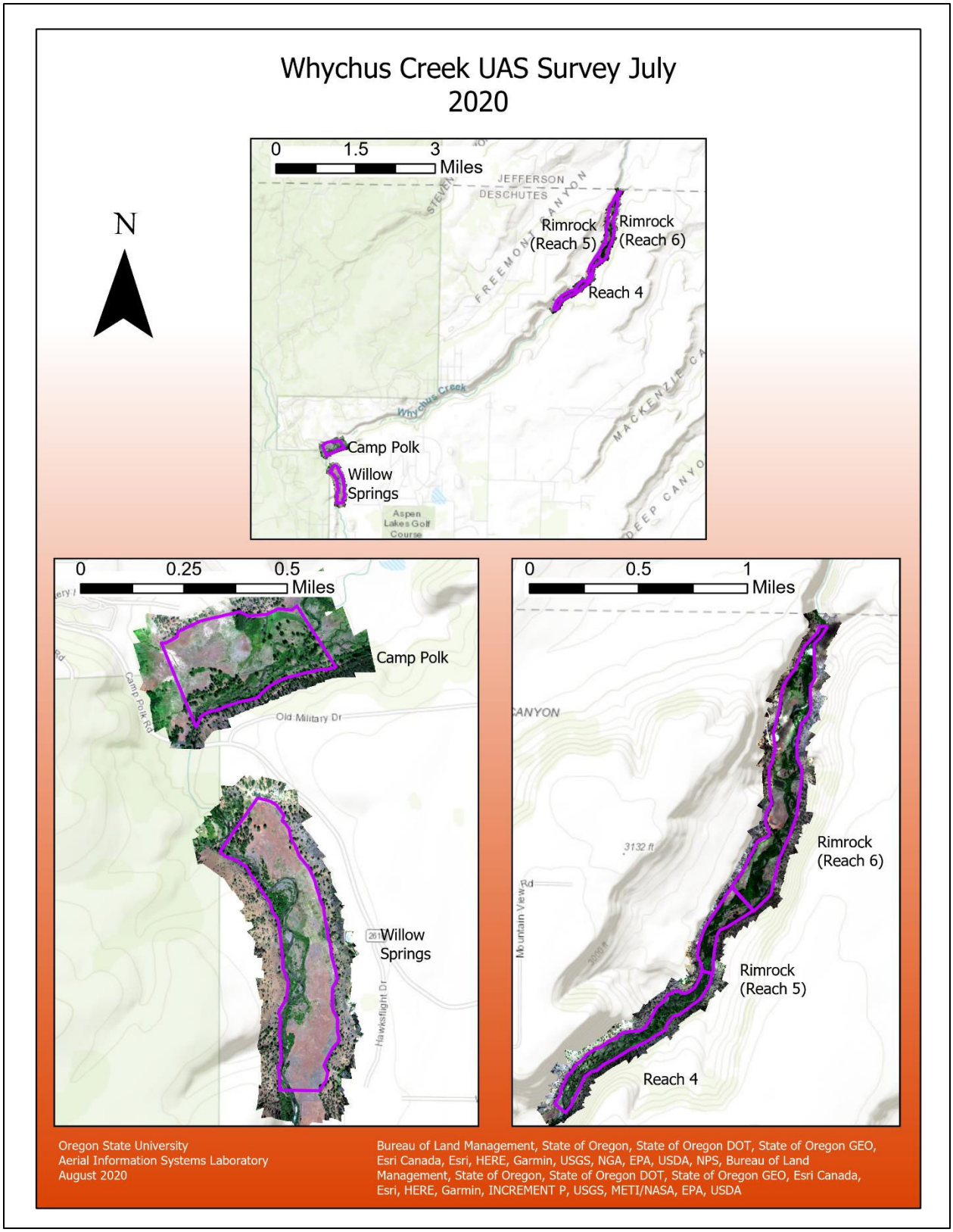

Figure 1: Whychus Creek RGB Orthomosaics

References

Agisoft. 2019. Agisoft Metashape. Available from https://www.agisoft.com/.
DJI. 2020. DJI Pilot - DJI Download Center - DJI. Available from https://www.dji.com/downloads/djiapp/dji-pilot.
Micasense. 2020. Altum - Micasense. Available from https://micasense.com/altum/.