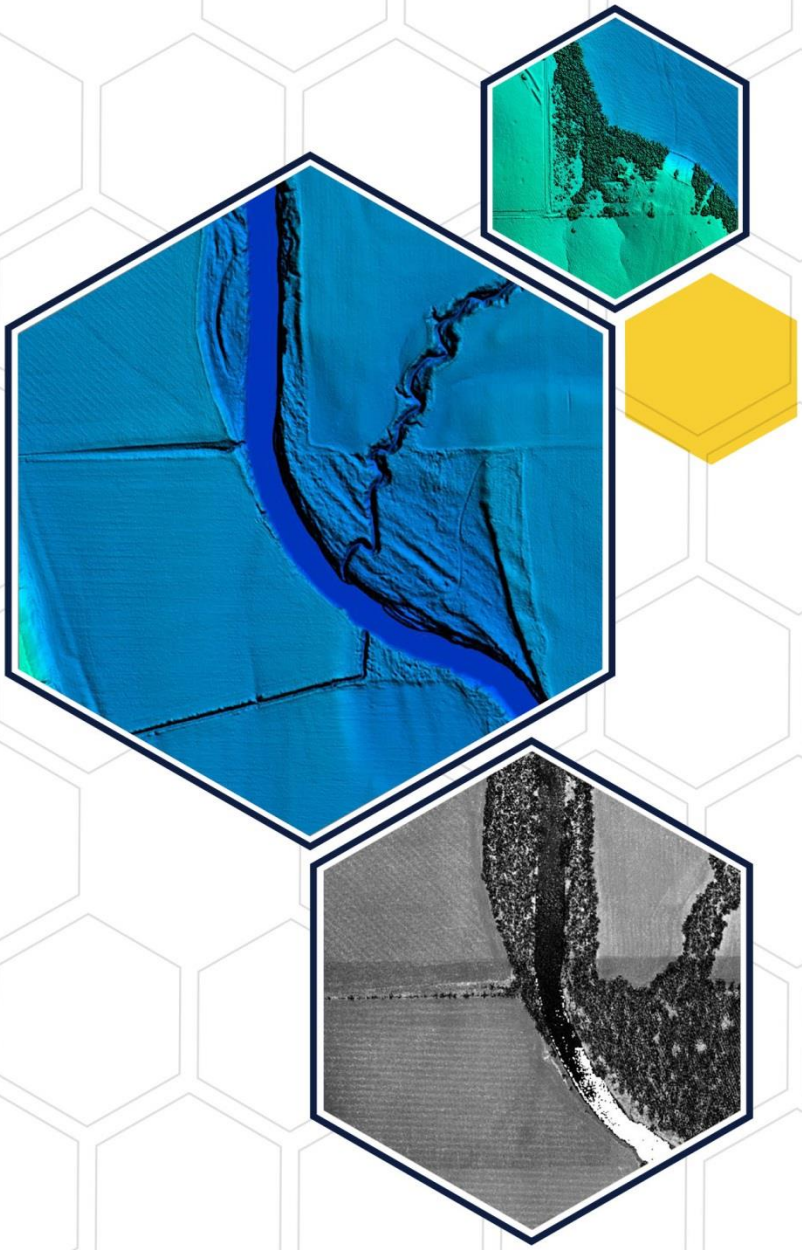


atlantic

NOAA Coastal Georgia Imagery

Project Report

August 2018

Table of Contents

Section I - Project Overview

I.1. Acquisition

The Atlantic Group, LLC (Atlantic) has successfully completed Aerial Triangulation (AT) of digital imagery acquired for the NOAA Coastal Georgia areas. Aerial Imagery acquisition for this project was completed in nine (9) flight lifts undertaken between the 25th of February and 13th of March 2018.

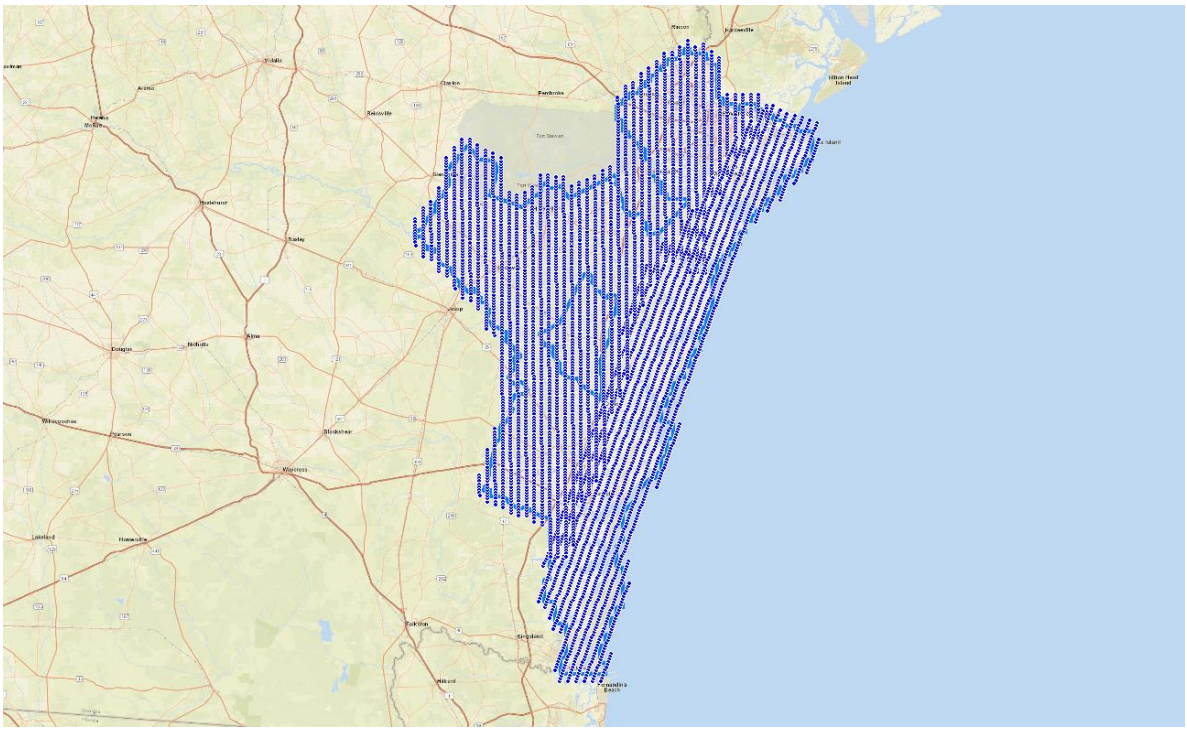
I.2. Datum Reference

Data produced for this project was developed in the following client specified reference system:

Horizontal Datum:	North American 1983	
Vertical Datum:	National Geodetic Vertical Datum of 1988	
Coordinate System:	State Plane Coordinate System 1983 (2011), Georgia East	
Units	**Horizontal Units:**	US Survey Feet
	Vertical Units:	US Survey Feet
GEOID Model:	Geoid 12B	

I.3. Acquisition Details

The following graphic represents the alignment of the project area of interest (AOI) and the individual exposure positions executed to provide AOI coverage.



Section II - Airborne GPS/INS Processing

Airborne-GPS data for this project was processed using POSPacTM (version 8.1) Mobile Mapping Suite; a GPS-IMU tightly coupled processing software which used Kalman Filtering techniques, On-The-Fly (OTF) ambiguity resolution techniques and multiple Continuously Operating and Reporting Stations (CORS) utilizing SmartBase trajectory processing.

II.1. SmartBase Processing Technique

Applanix SmartBase processing mode creates a virtual base station, which follows plane trajectory allowing faster and more accurate on the flight kinematic ambiguity resolution. In order to process trajectories in SmartBase processing mode, multiple CORS stations (usually from 6 to 11 CORS stations per mission) are imported into the project. The network of the CORS stations creates a closed polygon around the plane trajectory. Within the polygon atmospheric corrections are well modeled and applied to each photo center. One of the most reliable CORS stations is chosen as primary station. The SmartBase quality check is performed on all CORS stations involved in the network. Any CORS stations failing QAQC check are eliminated from processing. In the following step Applanix SmartBase CORS network adjustment is run to adjust all CORS stations to a common datum. The final step in Applanix SmartBase processing is 'GNSS-Inertial Processor' which combines GPS CORS data with inertial data in a tightly coupled process. SmartBase processing creates a virtual base station, which follows plane trajectory within the SmartBase region polygon. All CORS stations contribute to virtual base station accuracy.

The precise position of the camera lens node was interpolated from the trajectory of GPS positions utilizing polynomial fitting techniques. The time-tag for each event served as a basis for the interpolation.

The lever arm offset values are applied to this data resulting in a final AGPS file containing the coordinates of the camera lens node at each instance of exposure. Final Exterior Orientation parameters and positions are outputted using project assigned datum, projections and units.

II.2. Airborne GPS Ground Reference Stations

POSPac 8.1 SmartBase processing technique requires multiple GPS ground reference stations of at least 18 hours of data to process plane trajectory. The networks of CORS stations imported into PPAO project created 'SmartBase Region' polygons for each mission. The 'SmartBase Region' assists in virtual base station creation and atmospheric correction models that aid in solution processing.

Section III - Aerial Triangulation

The main objective of aerial triangulation is to produce from ground control points, airborne GPS data, and inertial measurement data sufficient points in photogrammetric models to ensure that each model can be oriented accurately as required for stereo compilation, ortho-imagery orientation or line mapping in digital or analogue form.

III.1. Processing Methodology

Aerial Triangulation for this project was completed utilizing the Aerial Triangulation module of SimActive Correlator3D, version 7.3.6. The first step is to extract tie points, which is performed automatically. A tie point is an image feature that is visible in two or more images. The second step requires the technician to decide whether to use ground control points (GCP). Although not required for relative accuracy, ground control points are necessary for absolute accuracy. The quality of the ground control points has a strong impact on the results. Ground control points have two benefits. First, they ensure that there is no global spatial offset (i.e. xyz translation) in the refined values. Second, they provide another means to validate the residual error of the refined values. The third step would be tie point editing where the technician reviews the quality of the automated tie point extraction process and adds manual tie points in necessary. The fourth step would be to perform the bundle adjustment. The bundle adjustment derives adjusted exterior orientation and camera data. Once the bundle adjustment is completed, the fifth and last step would be assessing the quality of the bundle adjustment.

III.2. Ground Control Point Listing

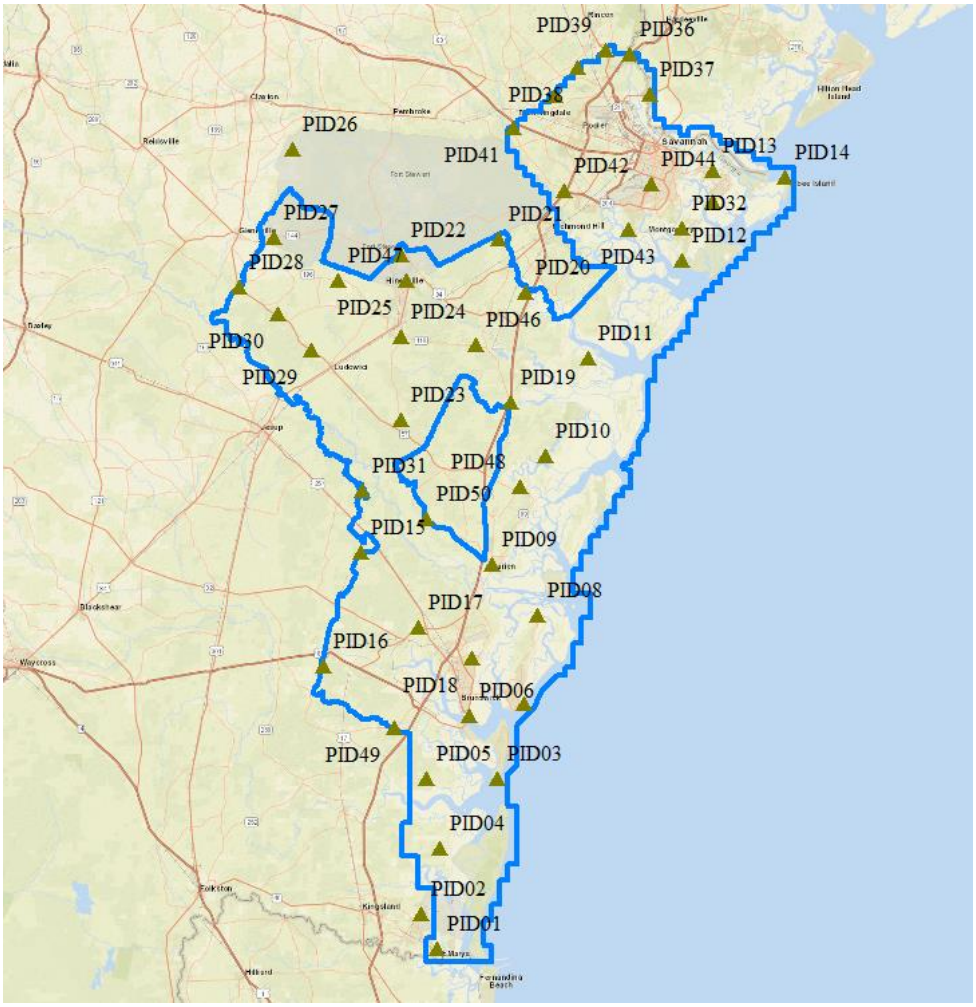
The following table represents a listing of the Ground Control Points (GCPs) collected for the defined project area of interest (AOI).

Point ID	Easting	Northing	Elevation
PID01	851347.3	267250.7	10.092
PID02	841407.7	288519.7	25.597
PID03	887915.8	370988.1	9.059
PID04	853079.1	328935.5	22.627
PID05	845041.1	371024.7	9.888
PID06	870674.4	410094.3	9.203
PID07	904461.5	417482.9	7.192
PID08	912669.4	471479.7	8.013
PID09	884553.3	502507.3	24.726
PID10	917200	568788.6	8.883
PID11	943862.3	628235.9	12.674
PID12	1000687	688058.7	8.157

PID13	1020112	742720.2	10.03
PID14	1063914	739021.6	10.984
PID15	804219.6	509632.6	53.282
PID16	781394.1	439931.6	64.774
PID17	839657.7	463660.2	12.065
PID18	872860.8	444742.8	14.825
PID19	896580.7	601492.5	9.082
PID20	905317.9	668338.5	8.435
PID21	888587.8	701376.9	16.531
PID22	829467.3	691574.1	78.953
PID23	828932.3	590305	69.189
PID24	829443.9	641240.1	53.784
PID25	832705.1	675709.4	85.968
PID26	763258.8	755763.7	130.511
PID27	751215.6	702264.8	168.505
PID28	730017	671759	73.366
PID29	774586.5	633287.7	70.169
PID30	753852.7	655345.4	82.298
PID31	805062.7	547342	39.022
PID32	1000672	707542.8	11.271
PID33	1019707	724174	10.749
PID36	969091.9	813648.4	36.29
PID37	981459.4	789292.6	8.122
PID38	937557.2	805713.5	43.36
PID39	954314.1	816799.9	19.881
PID40	923457.5	788368.4	37.542
PID41	897816.6	769211.5	33.599
PID42	929114.3	730256.4	12.071
PID43	968540.7	707146.5	14.485
PID44	982513.6	734268.1	24.276
PID46	874880	636298	24.553
PID47	790794.4	675772.5	85.46
PID48	902168.2	549254.2	39.191
PID49	825272.3	402528.6	21.487
PID50	844371.5	529639.5	16.896

III.3. Ground Control Point Distribution

The following graphic represents the distribution of Ground Control Points (GCPs) collected for the defined project area of interest (AOI).



III.4. Aerial Triangulation Results

The following tables outline the settings and results of the Aerial Triangulation effort for the defined project area of interest (AOI).

III.4.a. Project Summary, Block 1

simactive QUALITY REPORT

1. PROJECT SUMMARY

PROJECT	
Project type	Aerial
Projection	State Plane Georgia East NAD 83 (2011)
Planar units	FEET
Elevation units	FEET
Camera 1	5530 images
Total images	5530

GROUND CONTROL POINTS		
Average GCP residual error	0.259	ft
Standard deviation	0.345	ft
Average GCP residual error	0.22	pixels
Standard deviation	0.17	pixels
Number of GCPs	50	

IMAGE TIE POINTS		
Quality assessment	EXCELLENT	
Average tie point residual error	0.36	pixels
Standard deviation	0.28	pixels
Average number of tie points per image	85	

CHECK POINTS	
Average check point residual error	-
Standard deviation	-
Average check point residual error	-
Standard deviation	-
Number of check points	0

1

III.4.b. Bundle Adjustment Parameters, Block 1

simactive QUALITY REPORT

2. BUNDLE ADJUSTMENT PARAMETERS

SENSOR CALIBRATION	
Type of sensor calibration	Unconstrained
Pixel size	Not calibrated
Xmm	Calibrated
Ymm	Calibrated
Focal length	Calibrated

EO ADJUSTMENT	
EO adjustment type	Unconstrained
Boresight calibration	Yes
X	Unconstrained
Y	Unconstrained
Z	Unconstrained
Omega	Unconstrained
Phi	Unconstrained
Kappa	Unconstrained

GROUND REFERENCE	
Ground reference type	GCP
Uncertainty X	0.50000
Uncertainty Y	0.50000
Uncertainty Z	Not adjusted
Sample radius	1.00000

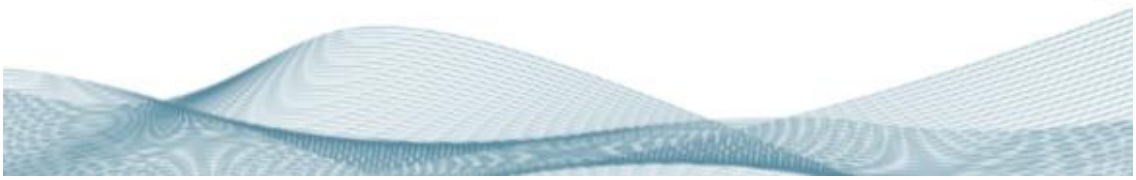
2

simactive QUALITY REPORT

3. AERIAL TRIANGULATION OVERVIEW

BEFORE ADJUSTMENT

AFTER ADJUSTMENT



III.4.c. Image Adjustment, Block 1

simactive QUALITY REPORT

4. IMAGE ADJUSTMENT

IMAGE ADJUSTMENT FOR CAMERA SYSTEM 0

	AVERAGE	MAXIMUM
X	1.879 ft	66.046 ft
Y	2.013 ft	109.953 ft
Z	4.866 ft	74.848 ft
Omega	0.015°	1.600°
Phi	0.012°	0.432°
Kappa	0.003°	0.577°

III.4.d. Sensor Calibration, Block 1

simactive QUALITY REPORT

5. SENSOR CALIBRATION

Camera 1

Camera ID: 1 (Part of group 1)

	INITIAL VALUE	ADJUSTED VALUE
Pixel size	5.20000	5.20000
Xmm	0.00000	0.00246
Ymm	0.00000	0.00273
Focal length	79.80000	79.80787

III.4.e. Control Point Analysis, Block 1

simactive QUALITY REPORT

6. CONTROL POINT ANALYSIS

PIXEL RESIDUAL ERROR

	GCP	Check Points
RMS pixel residual error	0.38	0.00
Average pixel residual error	0.22	0.00
Standard deviation	0.17	0.00
Min, Max pixel residual error	[0.00, 1.52]	[0.00, 0.00]

SPATIAL RESIDUAL ERROR

	GCP	Check Points
RMS XYZ residual error (ft)	0.431	0.000
Average XYZ residual error (ft)	0.259	0.000
Standard deviation (ft)	0.345	0.000
Min, Max XYZ residual error (ft)	[0.000, 1.407]	[0.000, 0.000]
Average correction / bias (ft)	(-0.010, 0.018, 0.000)	(0.000, 0.000, 0.000)

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simactive QUALITY REPORT

DETAILED RESIDUAL ERROR (1 / 4)

POINT ID	TYPE	X (ft)	Y (ft)	Z (ft)	XYZ (ft)	PIXELS
Coastal_G...	GCP	0.063	-0.011	0.058	0.086	0.144
Coastal_G...	GCP	0.089	0.059	0.404	0.418	0.136
Coastal_G...	GCP	0.091	-0.367	-1.355	1.407	0.446
Coastal_P...	GCP	-0.062	0.024	0.286	0.294	0.442
Coastal_P...	GCP	-0.087	-0.201	1.274	1.293	0.546
Coastal_P...	GCP	-0.000	-0.000	0.000	0.000	0.004
Coastal_P...	GCP	0.006	0.016	-0.021	0.027	0.243
Coastal_P...	GCP	-0.037	-0.036	0.173	0.181	0.155
Coastal_P...	GCP	0.066	0.132	0.773	0.787	0.263
Coastal_P...	GCP	0.075	-0.082	0.216	0.243	0.322
Coastal_P...	GCP	0.001	-0.022	-0.031	0.038	0.610
Coastal_P...	GCP	0.021	-0.040	0.149	0.156	0.131
Coastal_P...	GCP	0.047	-0.149	-0.005	0.156	0.411
Coastal_P...	GCP	-0.048	0.061	-0.102	0.128	0.169

simactive QUALITY REPORT

DETAILED RESIDUAL ERROR (2 / 4)

POINT ID	TYPE	X (ft)	Y (ft)	Z (ft)	XYZ (ft)	PIXELS
Coastal_P...	GCP	0.079	-0.098	0.149	0.195	0.234
Coastal_P...	GCP	-0.095	0.072	0.087	0.148	0.274
Coastal_P...	GCP	-0.066	-0.089	0.229	0.254	0.304
Coastal_P...	GCP	-0.046	0.021	-0.110	0.121	0.430
Coastal_P...	GCP	-0.055	0.076	-0.215	0.235	0.567
Coastal_P...	GCP	-0.002	-0.110	-0.335	0.353	0.180
Coastal_P...	GCP	-0.000	-0.000	-0.000	0.000	0.005
Coastal_P...	GCP	0.036	0.015	-0.000	0.039	0.082
Coastal_P...	GCP	0.216	-0.111	-0.476	0.534	0.303
Coastal_P...	GCP	0.064	-0.059	0.030	0.092	0.315
Coastal_P...	GCP	-0.129	0.240	-0.853	0.895	0.386
Coastal_P...	GCP	-0.018	0.001	-0.073	0.075	0.243
Coastal_P...	GCP	0.000	0.000	-0.000	0.000	0.003
Coastal_P...	GCP	-0.000	-0.000	-0.000	0.000	0.005

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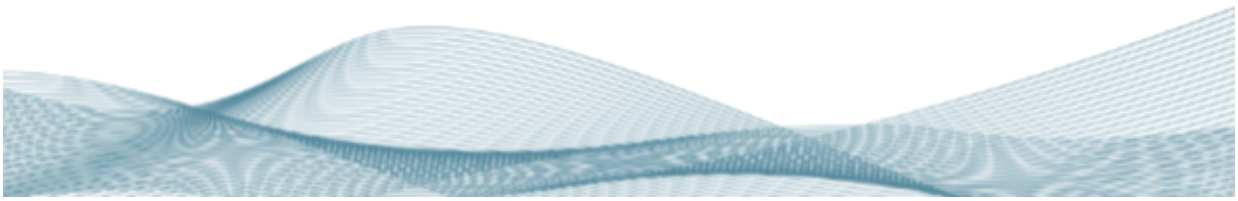


simactive

QUALITY REPORT

DETAILED RESIDUAL ERROR (3 / 4)

POINT ID	TYPE	X (ft)	Y (ft)	Z (ft)	XYZ (ft)	PIXELS
Coastal_P...	GCP	-0.000	0.000	-0.000	0.000	0.003
Coastal_P...	GCP	0.039	-0.019	0.150	0.156	0.196
Coastal_P...	GCP	-0.169	0.078	-0.308	0.360	0.410
Coastal_P...	GCP	0.118	0.215	1.021	1.050	0.367
Coastal_P...	GCP	0.072	-0.002	-0.110	0.131	0.077
Coastal_P...	GCP	0.110	0.020	-0.303	0.323	0.170
Coastal_P...	GCP	-0.068	0.043	-0.176	0.194	0.193
Coastal_P...	GCP	0.019	-0.024	0.185	0.188	0.279
Coastal_P...	GCP	0.000	0.000	-0.000	0.000	0.004
Coastal_P...	GCP	-0.000	0.000	0.000	0.000	0.003
Coastal_P...	GCP	0.029	0.003	0.047	0.055	0.053
Coastal_P...	GCP	-0.000	0.000	0.000	0.000	0.002
Coastal_P...	GCP	-0.095	0.009	0.151	0.179	0.123
Coastal_P...	GCP	-0.006	-0.023	0.087	0.090	0.225

simactive QUALITY REPORT

DETAILED RESIDUAL ERROR (4 / 4)

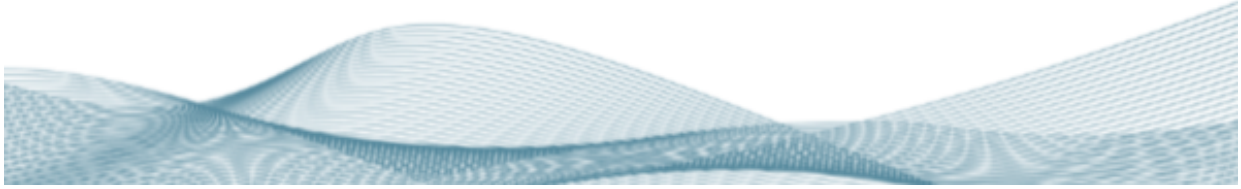
POINT ID	TYPE	X (ft)	Y (ft)	Z (ft)	XYZ (ft)	PIXELS
Coastal_P...	GCP	0.016	-0.024	0.043	0.052	0.237
Coastal_P...	GCP	-0.000	0.000	-0.000	0.000	0.004
Coastal_P...	GCP	-0.000	0.000	-0.001	0.001	0.004
Coastal_P...	GCP	-0.317	-0.015	-1.192	1.234	0.549
Coastal_P...	GCP	-0.062	0.018	-0.176	0.187	0.109
Coastal_P...	GCP	0.019	-0.040	0.041	0.060	0.102
Coastal_P...	GCP	0.112	0.004	-0.202	0.231	0.204
Coastal_P...	GCP	-0.121	0.061	0.245	0.280	0.372

III.4.f. System Information, Block 1

simactive QUALITY REPORT

7. SYSTEM INFORMATION

Software version	Correlator3D 7.3.3
Correlator3D license	547632637690136130 - 465094583
Operating system	Windows 8, 64-bit, build 9200
OpenGL GPU	NVIDIA Quadro P1000, 4095MB RAM
OpenGL GPU driver version	23.21.13.9077 (2018-01-23)
OpenCL GPU	Quadro P1000, 4096MB RAM
OpenCL GPU driver version	390.77, OpenCL 1.2 CUDA, OpenCL C 1.2
OpenCL CPU	No OpenCL-enabled CPU found
OpenCL CPU driver version	N/A



Section IV - Camera Calibration

VEXCEL
IMAGING

ULTRACAM

Calibration Report

ULTRACAM

ULTRACAM

Geometric Calibration

Camera:	**UltraCam Eagle**
Serial:	**UC-E-1-50617043-f80**
Panchromatic Camera:	**ck = 79.800 mm**
Multispectral Camera:	**ck = 79.800 mm**
PPA Information:	**X: 0.000 mm** **Y: 0.000 mm**
Calibration Date:	**Nov-14-2017**
Date of Report:	**Nov-20-2017**
Camera Revision:	**Rev09.00**
Version of Report:	**V01**

Panchromatic Camera

Large Format Panchromatic Output Image

Image Format	long track cross track	68.016mm 104.052mm	13080pixel 20010pixel
Image Extent		(-34.008, -52.026)mm	(34.008, 52.026)mm
Pixel Size		5.200µm*5.200µm	
Focal Length	ck	79.800mm	± 0.002mm
Principal Point (Level 2)	X_ppa	0.000mm	± 0.002mm
	Y_ppa	0.000mm	± 0.002mm
Lens Distortion	Remaining Distortion less than 0.002mm		

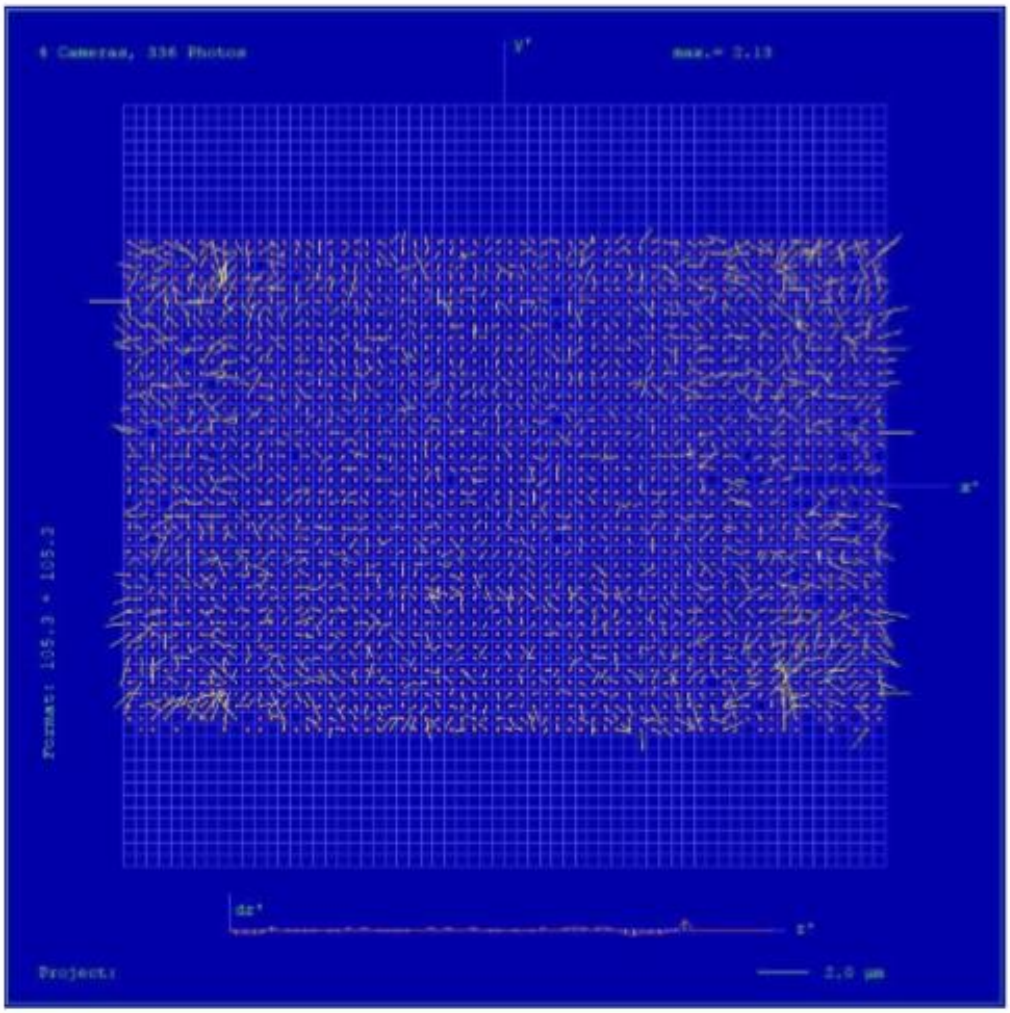
Multispectral Camera

Medium Format Multispectral Output Image
(Upscaled to panchromatic image format)

Image Format	long track cross track	68.016mm 104.052mm	4360pixel 6670pixel
Image Extent		(-34.008, -52.026)mm	(34.008, 52.026)mm
Pixel Size		15.600µm*15.600µm	
Focal Length	ck	79.800mm	± 0.002mm
Principal Point (Level 2)	X_ppa	0.000mm	± 0.002mm
	Y_ppa	0.000mm	± 0.002mm
Lens Distortion	Remaining Distortion less than 0.002mm		

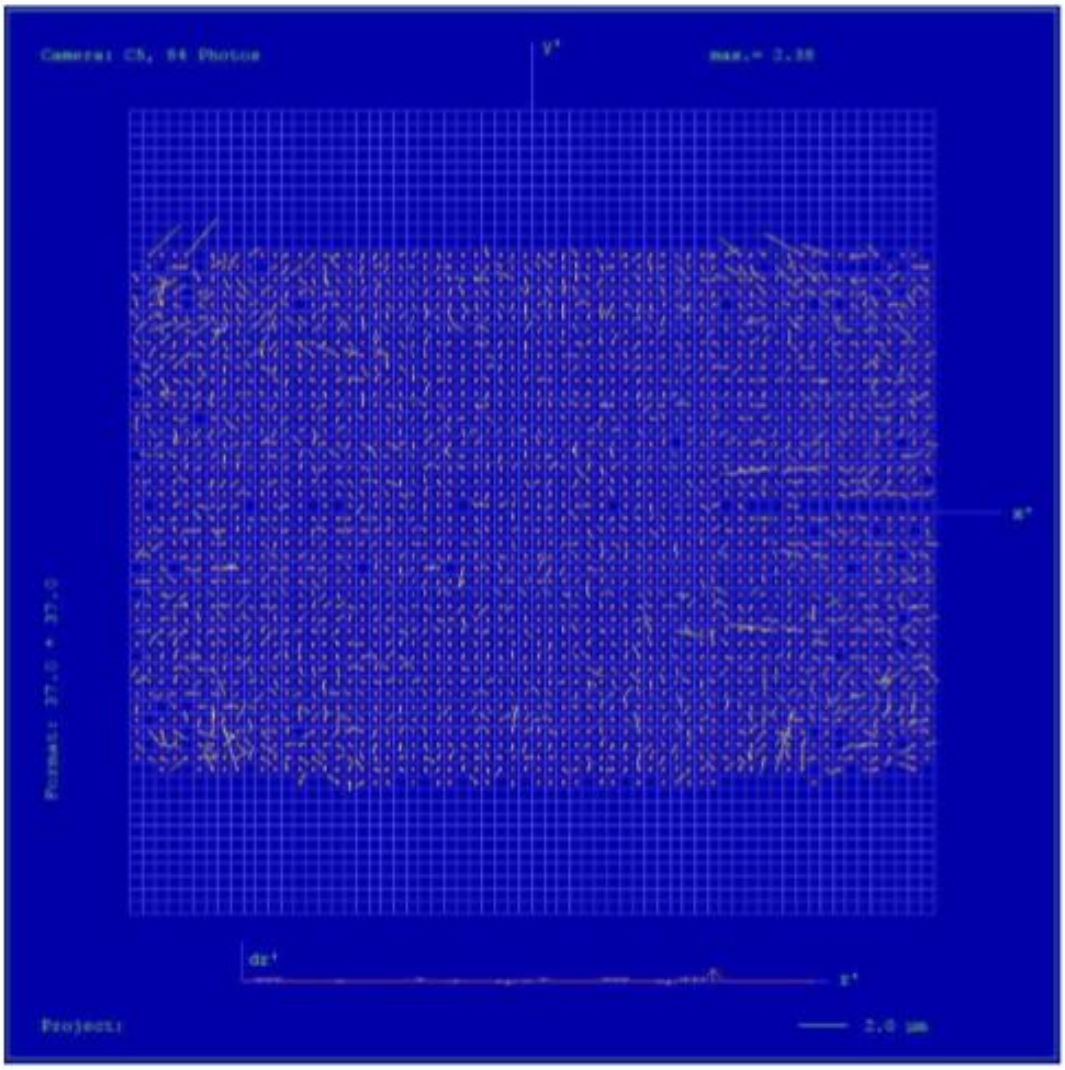
ULTRACAM

Full Panchromatic Image, Residual Error Diagram



Residual Error (RMS): **1.11 µm**

Green Cone (Cone 5), Residual Error Diagram



Residual Error (RMS): 0.95 µm

ULTRACAM

Explanations

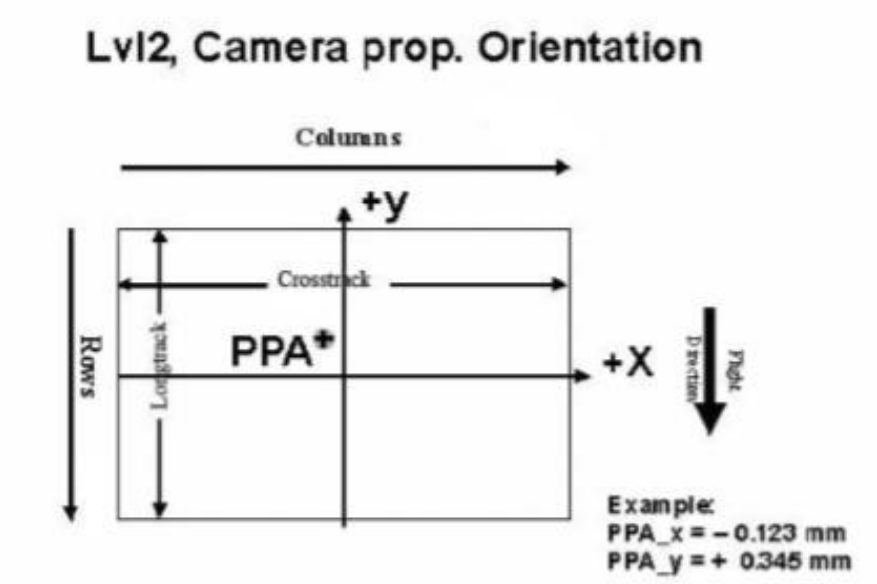
Calibration Method:

The geometric calibration is based on a set of 84 images of a defined geometry target with 394 GCPs.

Number of point measurements for the panchromatic camera : >16000
Number of point measurements for the multispectral camera : >60000

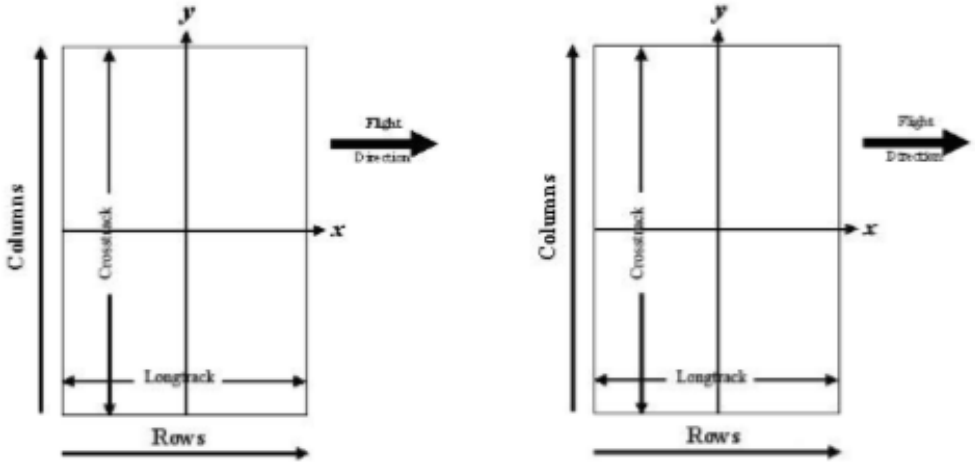
Determination of the image parameters by Least Squares Adjustment.
Software used for the adjustment: BINGO (GIP Eng. Aalen, Germany)

Level 2 Image Coordinate System:



The image coordinate system of the Level 2 images is shown in the above figure. The basic image format and coordinate of the principal point in the level 2 image is given on page 4 of this report. The above figure shows the position of an example principal point at the coordinate (-0.123 / 0.345).

Level 3 Image Coordinate System:
(after rotation of 270° CW)



Panchromatic Image Format

Multispectral Image Format

Position of Principal Point in Level 3 Image

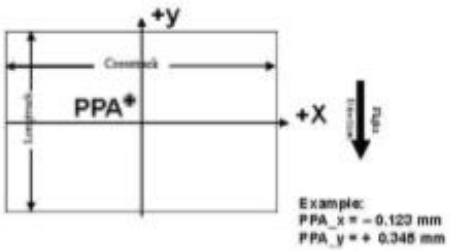
The position of the principal point in the level 3 image depends on the "rotation" setting used in UltraMap during the pan-sharpening step. The exact position relative to the image center is given in the table below as a function of the rotation setting used in UltraMap. The coordinates are specified for clockwise (CW) rotation in steps of 90 degrees, according to the principal point coordinate given on page 4 for high- and low resolution images.

Image Format	Clockwise Rotation (Degree)	PPA	
		X	Y
Level 2	-	0.000	0.000
Level 3	0	0.000	0.000
Level 3	90	0.000	0.000
Level 3	180	0.000	0.000
Level 3	270	0.000	0.000

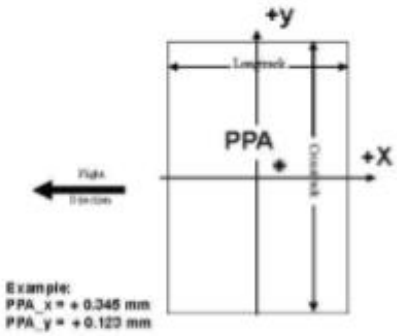
ULTRACAM

The coordinates in the figure below are only example values to illustrate the effect of image rotation on the principal point position, and do **not** correspond to the camera described in this report.

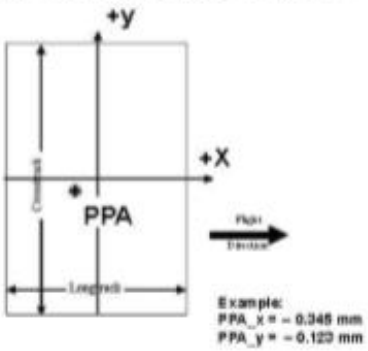
Lvl3, Rotation 0 deg clockwise



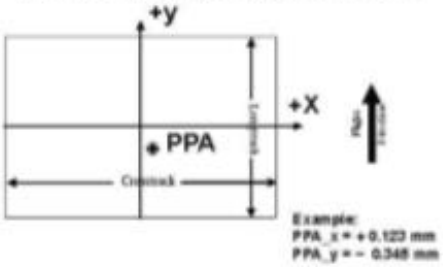
Lvl3, Rotation 90 deg clockwise



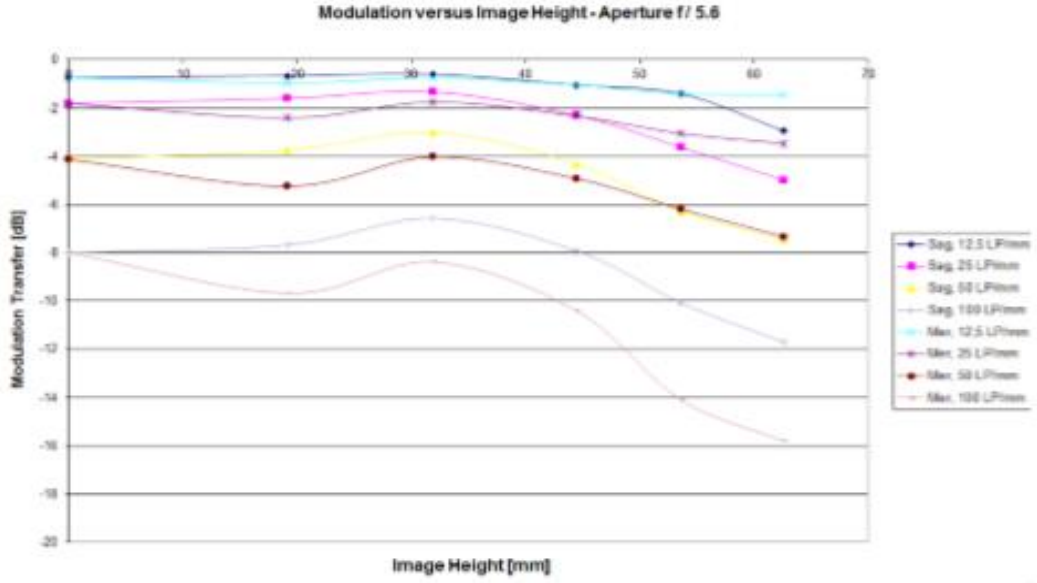
Lvl3, Rotation 270 deg clockwise

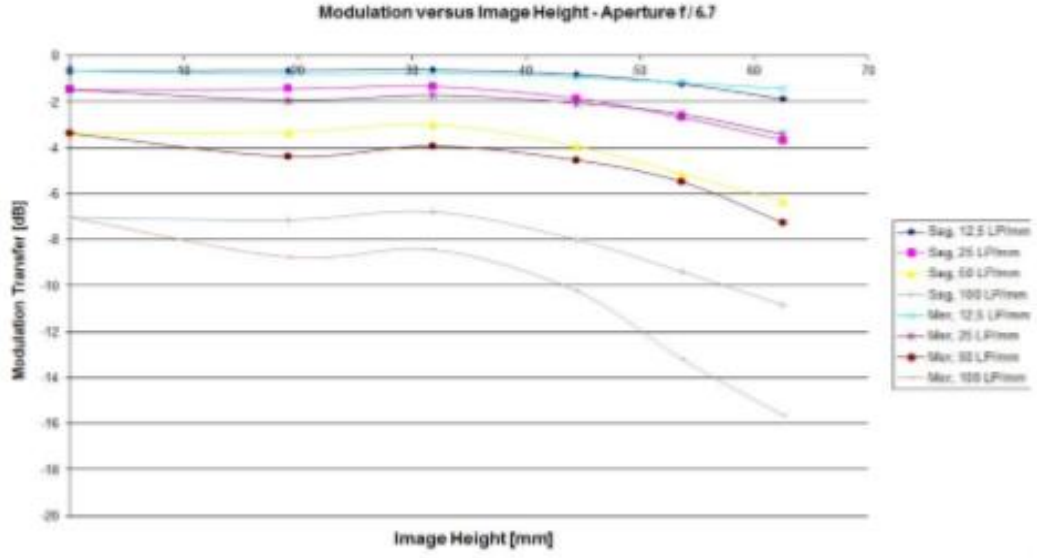


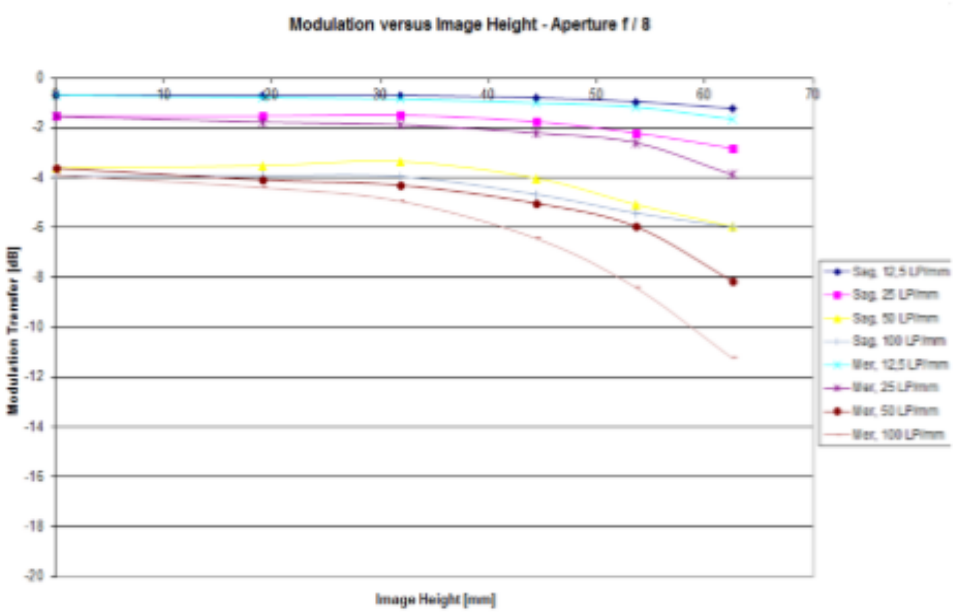
Lvl3, Rotation 180 deg clockwise

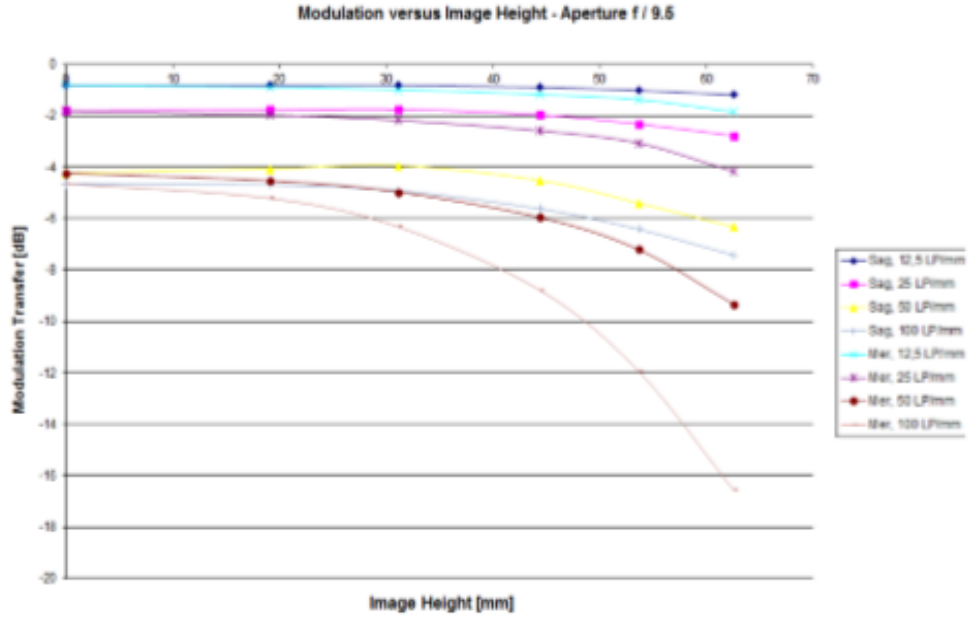


ULTRACAM


Modulation versus Image Height - Aperture f / 5.6
Modulation Transfer [dB]
Image Height [mm]

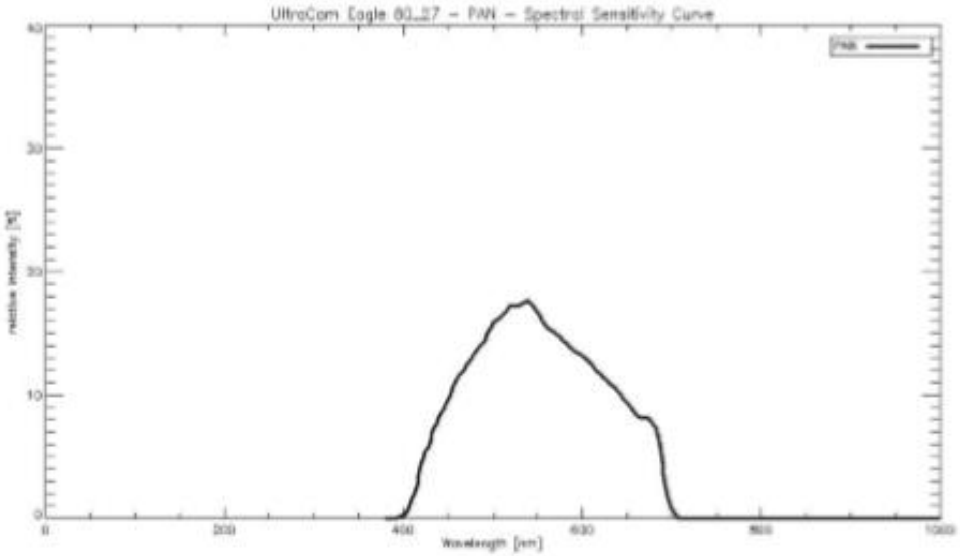

Modulation versus Image Height - Aperture f / 6.7
Modulation Transfer [dB]
Image Height [mm]

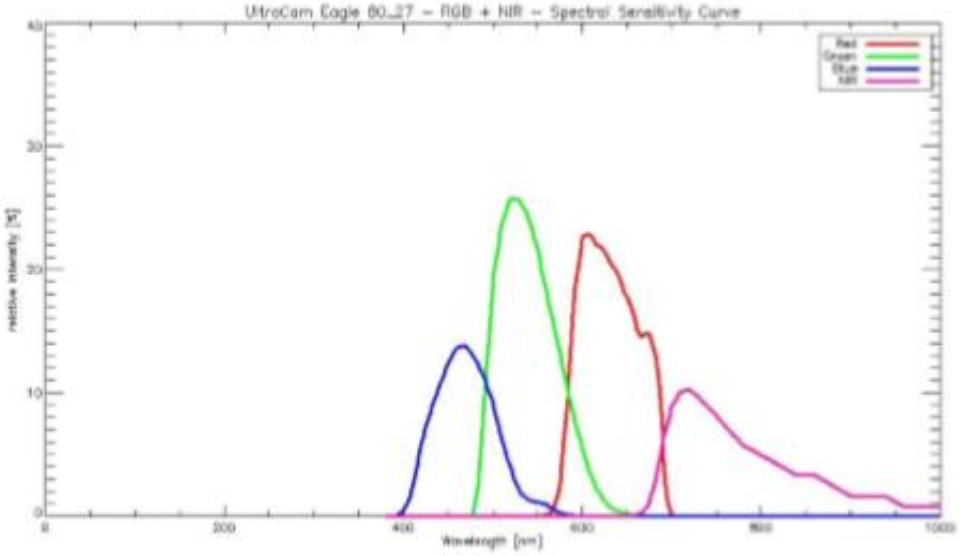

Modulation versus Image Height - Aperture f / 8
Modulation Transfer [dB]
Image Height [mm]
Sag, 12.5 LP/mm
Sag, 25 LP/mm
Sag, 50 LP/mm
Sag, 100 LP/mm
Mer, 12.5 LP/mm
Mer, 25 LP/mm
Mer, 50 LP/mm
Mer, 100 LP/mm


Modulation versus Image Height - Aperture f / 9.5
Modulation Transfer [dB]
Image Height [mm]
Sag, 12.5 LP/mm
Sag, 25 LP/mm
Sag, 50 LP/mm
Sag, 100 LP/mm
Mer, 12.5 LP/mm
Mer, 25 LP/mm
Mer, 50 LP/mm
Mer, 100 LP/mm

ULTRACAM

Spectral Sensitivity





Section V - Orthophoto Production

The main objective of orthophotography is to take aerial photography and geometrically correct or rectify it so that the scale is uniform, and the photo has the same lack of distortion as a map. Unlike an uncorrected aerial photograph, an orthophotograph has been adjusted for topographic relief, lens distortion, and camera tilt.

V.1. Processing Methodology

The project area was completed as one (1) digital orthophoto project. Initial processing begins with extraction and refinement of an appropriate terrain model surface. Once an appropriate surface has been obtained, information from the aerial triangulation is combined with the surface data to facilitate image rectifications, and mosaics. Once mosaics are completed, any necessary edits are applied, and a final QC of the data is performed.

V.2. Horizontal Accuracy Assessment

The following table represents a listing of the Ground Control Check Points (GCPs) measured for the defined project area of interest (AOI).

HORIZONTAL ACCURACY COMPUTATIONS [RMSEx <> RMSEy]

References: FGDC's Geospatial Positioning Accuracy Standards, NSSDA, FGDC-STD-007.3-1998

APSRS Positional Accuracy Standards for Digital Geospatial Data, Edition1, Version 1.0 - November 2014

POINT	SURVEY		ORTHO		Δ (ORTHO - SURVEY)		^{2} [Δ (ORTHO - SURVEY)]	
NUMBER	X (EAS)	Y (NOR)	X (EAS)	Y (NOR)	Δ X (EAS)	Δ Y (NOR)	2 [Δ X (EAS)]	2 [Δ Y (NOR)]
Coastal_GCP01	957495.017	817230.325	957494.965	817230.464	-0.052	0.139	0.003	0.019
Coastal_GCP02	898581.828	766754.720	898582.266	766754.313	0.438	-0.407	0.192	0.165
Coastal_GCP03	1066000.470	737934.843	1065999.900	737934.561	-0.570	-0.282	0.324	0.080
Coastal_GCP04	740053.669	683666.662	740053.625	683666.491	-0.044	-0.171	0.002	0.029
Coastal_GCP05	935044.681	619214.275	935044.966	619213.510	0.285	-0.765	0.081	0.585
Coastal_GCP06	829877.765	659994.495	829877.284	659994.641	-0.481	0.146	0.232	0.021
Coastal_GCP07	791622.612	477182.386	791622.403	477182.589	-0.209	0.203	0.044	0.041
Coastal_GCP08	914635.658	469777.892	914635.083	469778.418	-0.575	0.526	0.331	0.277
Coastal_GCP09	886147.151	371522.829	886146.904	371522.703	-0.247	-0.126	0.061	0.016
Coastal_GCP10	860597.870	275548.945	860597.541	275549.309	-0.329	0.364	0.108	0.133
Coastal_PID26X3	761466.868	732858.446	761466.968	732858.646	0.100	0.200	0.010	0.040
SECP_BRANT_UA59	782699.253	448129.616	782699.072	448129.631	-0.181	0.015	0.033	0.000
SECP_CAMDEN_UA64	824755.242	402799.187	824754.780	402799.167	-0.462	-0.020	0.214	0.000
SECP_CAMDEN_UA65	849810.776	262551.909	849811.092	262551.677	0.316	-0.232	0.100	0.054
SECP_CHAT_UA153	955972.648	799652.622	955971.157	799652.272	-1.492	-0.350	2.225	0.123
SECP_CHAT_UA154	938457.493	741537.913	938457.780	741538.143	0.287	0.230	0.082	0.053
SECP_GLYNN_UA136	893422.834	383773.208	893423.082	383774.461	0.248	1.253	0.062	1.571
SECP_GLYNN_UA34	804923.190	470093.654	804922.975	470094.002	-0.215	0.348	0.046	0.121
SECP_GLYNN_UA35	837610.785	415807.166	837610.310	415806.584	-0.475	-0.582	0.226	0.338
SECP_LIBER_UA22	793802.497	676704.277	793803.507	676703.734	1.010	-0.543	1.020	0.294
SECP_LIBER_UA24	904795.468	647619.027	904796.762	647619.295	1.294	0.268	1.675	0.072
SECP_LONG_UA143	753852.673	655345.498	753852.528	655345.642	-0.145	0.144	0.021	0.021
SECP_LONG_UA29	787720.659	623927.510	787719.420	623927.670	-1.239	0.160	1.535	0.026
SECP_LONG_UA30	821625.642	588443.977	821625.120	588444.215	-0.522	0.238	0.273	0.057
SECP_WAYNE_UA37	807974.301	522169.088	807974.464	522168.970	0.163	-0.118	0.026	0.014

ACCURACY STANDARDS (FT)	
CLASS GSD (CM)	15.0
RMSE [(X) (Y)]*	0.984
$RMSE_r$	1.392
$ACCURACY_r$	2.409

TESTED ACCURACIES (FT)		
SUM OF Δ^2 (X), (Y)	8.926	4.150
AVERAGE [Σ OF Δ^2 (X), (Y)]	0.357	0.166
RMSE [(X) (Y)]	0.598	0.407
$RMSE_r$		0.723
$RMSE_{min}$ / $RMSE_{max}$		0.682
$ACCURACY_r$		1.230

Section VI - Certified Photogrammetrist Statement

To Whom It May Concern:

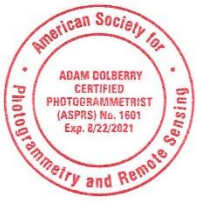
The 15CM data set was produced and tested to meet ASPRS Positional Accuracy Standards for Digital Geospatial Data (2014) for a 15CM Accuracy Class which equates to Positional Horizontal Accuracy = +/- 15CM in RMSEx and RMSEy and a Positional Vertical Accuracy = +/- 30CM RMSEz at a 95% confidence level. Actual positional accuracy was found to be RMSEx = 0.598 (ft) and RMSEy = 0.407 (ft) which equates to Positional Horizontal Accuracy = +/- 1.230 (ft) at the 95% confidence level.

The calibration and Aerial Triangulation procedures used to arrive at the results outlined in this report are in full compliance with the recommendations for in-situ calibration from Zeiss/Intergraph Imaging and established industry standards.

I, Adam Dolberry, certify that the Digital Aerial Photography and Analytical Aerial Triangulation were performed under my supervision and the results conform to the project specifications and to ASPRS accuracy standards. To the extent of my knowledge, that the statements and statistics represented in this document are true and factual.

Should you require any additional information or clarification, please contact me directly at 256-971-9991 (office).

Sincerely,



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Adam Dolberry, ASPRS Certified Photogrammetrist #1601