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Inventory of natural processes with nautical charts, real-time kinematic global navigation satellite systems (RTK-GNSS) and unmanned aerial vehicle (UAV), Trindade Island, Brazil
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Supplementary material of "Inventory of natural process with nautical charts, real-time kinematic global navigation satellite systems (RTK-GNSS) and unmanned aerial vehicle (UAV), Trindade Island, Brazil"

1. Survey data: Unmanned Aerial Vehicle (UAV) Photogrammetry

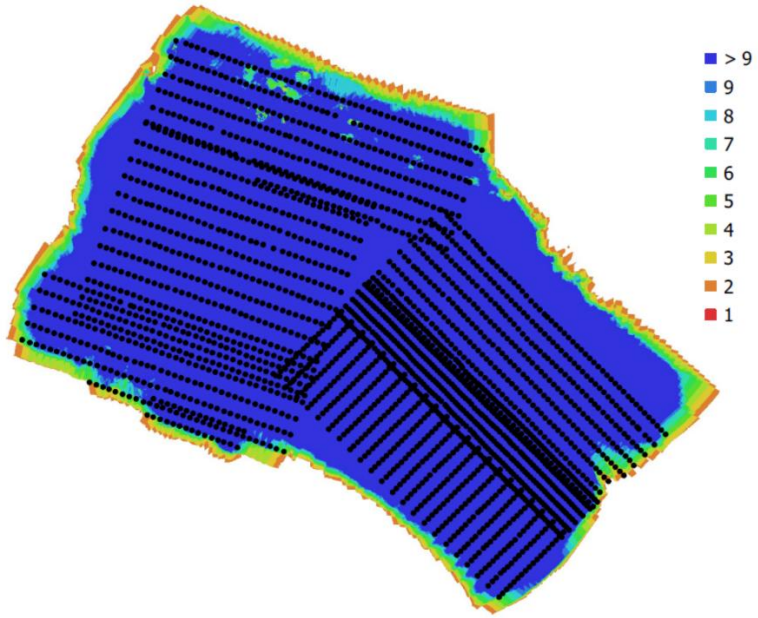

Figure 1. Survey data: camera locations and image overlap.

Table 1. Details of UAV survey.

Number of images	2.328
Flying altitude (x m)	45.3
Ground resolution (x cm/pix)	1.79
Coverage area (km²)	0.195
Camera stations	2.328
Tie points	1,297,378
Projections	9,908,314
Reprojection error (x pix)	1.19

Table 2. Cameras of UAV survey.

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
FC300S (3.61 mm)	4000 x 3000	3.61 mm	1.56 x 1.56 µm	No

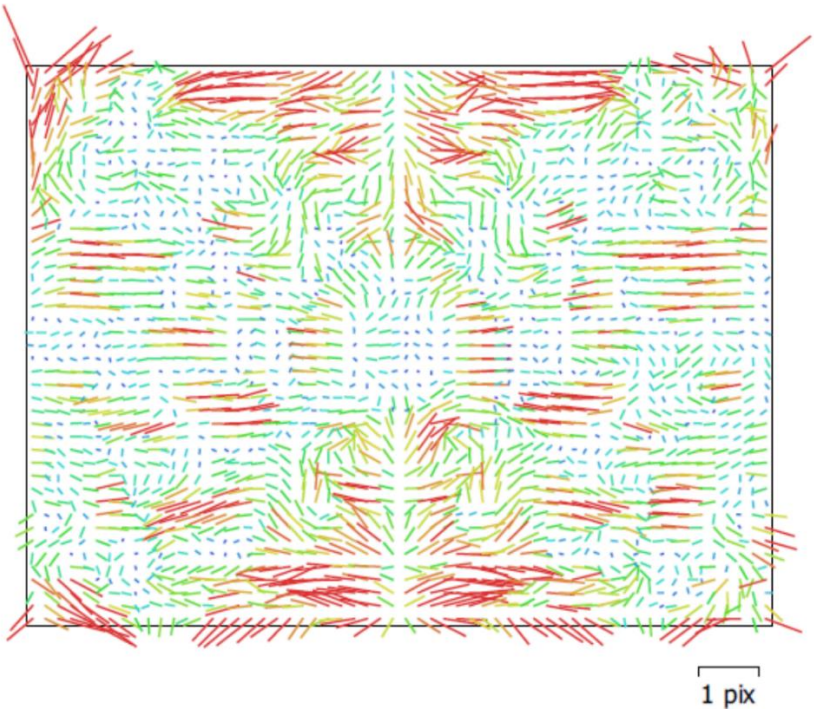

Figure 2. Camera calibration: image residuals for FC300S (3.61 mm).

Table 3. Calibration coefficients and correlation matrix.

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	P1	P2
K3	0.0633677										
K4	-0.0262106										
F	2326.65	0.14	1	-0.09	-0.9	0.33	0.11	-0.3	0.72	0.02	-0.03
Cx	5.3555	0.012		1	0.1	0	0.36	0.03	-0.06	0.51	0.01
Cy	-7.66326	0.028			1	-0.4	-0.1	0.23	-0.65	0	0.14
B1	-2.22677	0.0029				1	0.06	-0.2	0.25	-0.02	-0.19
B2	0.543851	0.0027					1	-0	0.08	0.28	0.02
K1	0.00411679	6.20E-06						1	-0.6	0.05	-0.23
K2	-0.0357335	5.90E-06							1	0.02	-0.08
P1	0.00015061	1.30E-06								1	-0.02
P2	7.74E-06	1.10E-06									1

2. Accuracy assessment

Table 4. Location of checkpoints measured by RTK-GNSS technique.

CP	Longitude	Latitude	Altitude
P1	7730437.0933	258627.1765	53.72
P2	7730594.3947	258794.7058	10.82
P3	7730536.0932	258681.1023	28.53
P4	7730589.1225	258593.0589	24.87
P5	7730668.9002	258641.7224	13.71
P6	7730404.4133	258916.6156	38.84
P7	7730360.6022	258784.1054	63.31
P8	7730303.5238	258859.6175	77.97
P9	7730509.3438	258886.2869	10.26
P10	7730435.1185	258970.9043	12.29
P11	7730417.5280	258725.3904	42.93
P12	7730450.0106	258827.5376	22.72
P13	7730508.7325	258768.4183	20.82
P14	7730242.8341	258944.0780	74.50
P15	7730498.0319	258528.4042	51.40
P16	7730451.0985	258496.9786	60.92
P17	7730576.3261	258871.7575	3.30
P18	7730376.3513	259030.9013	40.77
P19	7730652.2101	258730.8157	14.95
P20	7730305.2054	258969.0962	47.93

3. RTK-GNSS: spatial interpolation algorithm

Table 5. Checkpoints (CP) in altitude (m) and differences between respective DSMs and checkpoints in meters (m) are listed by different spatial interpolation algorithms enable in the ArcGis software. MAE = Mean Absolute Error; RMSE = Root Mean Square Error.

CP	Altitude	TIN	IDW	Kriging	Spline	Topo to Raster	Natural Neighbor
P1	53.72	-0.98	-0.38	-0.62	-0.18	-0.77	-0.3
P2	10.82	-2.82	-3.19	-2.5	-0.14	-2.47	-2.44
P3	28.53	-0.53	0.08	0.01	0	0.09	-0.02
P4	24.87	-0.85	0.08	0.1	0	-0.1	0.1
P5	13.71	2.57	3.79	3.81	0.11	2.17	1.11
P6	38.84	-0.66	0.09	0.08	0.11	0.13	0.07
P7	63.31	-1.09	-0.55	-0.41	-0.31	-0.88	-0.51
P8	77.97	0.03	0.68	0.63	0.37	0.7	0.65
P9	10.26	-5.86	-3.99	-7.16	0.02	-5.55	2.99
P10	12.29	-0.26	6.04	4.65	0.12	0.29	0.49
P11	42.93	-0.13	-0.06	0.12	0.02	0.15	0.15
P12	22.72	0.98	1.78	1.47	2.07	0.64	1.61
P13	20.82	-0.82	0.02	0.01	0.01	-0.01	0.01
P14	74.50	-0.5	-0.03	-0.01	0	-0.03	0.06
P15	51.40	-0.87	-0.09	-0.1	-0.02	0.07	-0.15
P16	60.92	-0.32	0.04	0.03	0.02	-0.12	0.05
P17	3.30	-0.3	-0.06	-0.03	0	0.05	0.04
P18	40.77	-0.37	0.1	0.01	0	-0.04	0.05
P19	14.95	-0.95	-0.05	-0.1	-0.05	-6.83	-6.24
P20	47.93	-0.4	-0.1	0.05	0.02	-0.12	0.04
	MAE	1.06	1.06	1.1	0.18	1.06	0.85
	RMSE	1.68	2.01	2.2	0.48	2.13	1.71
	RMSE/MAE	1.58	1.89	2	2.66	2.00	2.01