

## Supplementary material

### 1. Materials and Methods

#### 1.1. Drone data

The spatial analysis was completed with high-resolution images recorded by a low weight Drone Phantom 4 Advanced DJI. This is a quadricopter with a GPS normally used in agriculture and photogrammetric applications. The drone had a FC 6310 digital 4K/20MP (RGB) camera that recorded image width with 5472 pixels (focal length: 8.8 mm and sensor width: 12.8 mm). This camera recorded high spatial resolution (2.6 cm) images of the study area, calculated using the following equation 1:

$$(1) GSD = (Sw * H * 100) / (Fr * imH),$$

where,  $GSD$  = Ground Sampling Distance (centimeters/pixel),  $Sw$  = sensor width of the camera (millimeters),  $H$  = the flight height (meters),  $Fr$  = the focal length of the camera (millimeters) and  $imH$  = the image width (pixels). Considering that the images were acquired at 100 m altitude, the  $GSD$  for the orthoimages was of 2.6 cm/pixel (PIX4D, 2013).

The predefined missions were implemented autonomously with 90° camera angle, 90% frontal, and 70% lateral overlay and 100 m altitude. A total of six (2632 images), nineteen (8941 images) and six (2330 images) missions were flown in Oct/2017, March/2018, and Nov/2018, with each mission covering ~48 ha (15-18 minutes) to allow scanning 270, 937, and 270 ha, respectively.

#### 1.2. Ground control points

Planialtimetric data were acquired during field trips in Oct/2017 (fall), March/2018 (spring), Nov/2018 (fall), and Nov/2019. A smartphone, linked to an Antenna Trimble Catalyst with a differential Global Navigation Satellite System (GNSS), was used for the acquisition of these data. The GNSS system enhances

the basic information received by GNSS satellites to increase the accuracy of the positions being calculated by the receiver. A decimeter correction, supplied by the Trimble website upon payment of a subscription, was used to the GNSS data. The planialtimetric accuracy of the GCPs were in the order of  $\pm 10$  cm, with the Real-Time Kinematic correction, confirmed by comparison the data acquired by the Antenna Catalyst with the geodetic benchmark (National Geodetic Survey, 2018) from Golden Meadow, Louisiana ( $29^{\circ} 24' 08.14601''\text{N}$  /  $90^{\circ} 16' 21.50643''\text{W}$ ) at the end of each topographic survey. Considering the altimetry, this geodetic benchmark has an orthometric height of 0.15 m, while the Catalyst indicates an orthometric height of  $\sim 0.077$  m for the geodetic benchmark site, a difference of -7.3 cm. The Antenna Catalyst was used to measure coordinates and terrain surface elevations. Considering the long period ( $>30$  minutes) necessary to reduce the oscillations of planialtimertic data obtained by the Antenna Catalyst, such data (absolute data) were used as reference points for the topographic survey developed with an electronic Self Leveling Horizontal Rotary Laser (model Topcon RL-H5B). Once an absolute planialtimetric point based on the Catalyst was established, the Self Leveling Horizontal Rotary Laser was fixed on that point to define the relative topography of others Ground Control Points (GCPs) using a Laser Sensor (model LS-80L) fixed on a 5-meter aluminum scale. Then, the planimetric ( $\pm 10$  cm) and altimetric ( $\pm 10$ ) data obtained for that GCPs were based on the Catalyst and Self Leveling Horizontal Rotary Laser, respectively. These data were used as GCPs (61 points) to evaluate and calibrate the DEM obtained by photogrammetry. (Table S1, supplementary material).

Table S1 – Coordinates, orthometric heights, as well as saltmarsh and mangrove heights obtained by the Antenna Catalyst, electronic Self Leveling Horizontal Rotary Laser and a ruler. Also shown are orthometric and vegetation heights, obtained by the digital elevation model and digital terrain model.

Fieldwork				Photogrammetry	Planialtimetric differences = Model – GCPs data		
Site	Latitude	Longitude	Soil orthometric height (m)	Soil orthometric height (m) - DTM	Long. Error (m)	Lat. Error (m)	Elev. Error (m)
1	29.11536351	-90.19069677	0.80	0.88	0.34	0.55	0.08
2	29.11431639	-90.19016652	0.82	0.9	-0.24	-0.45	0.08
3	29.40220097	-90.27262901	0.08	0.15	0.44	0.30	0.07
4	29.15725036	-90.17542554	2.09	2.18	-0.26	-0.41	0.09
5	29.11241007	-90.18374607	0.20	0.3	0.64	0.23	0.1
6	29.11229771	-90.18330629	0.31	0.37	-0.22	-0.42	0.06
7	29.11217180	-90.18279381	0.31	0.37	-0.36	-0.54	0.06
8	29.11196535	-90.18282984	0.46	0.5	0.44	0.53	0.04
9	29.11183377	-90.1834419	0.30	0.4	0.39	0.59	0.1
10	29.11122964	-90.18342126	0.42	0.40	0.17	0.33	-0.02
11	29.11149069	-90.18442454	0.41	0.37	0.10	0.45	-0.04
12	29.11275833	-90.18511817	0.22	0.3	-0.22	-0.47	0.08
13	29.11592754	-90.18360577	0.19	0.27	0.31	0.54	0.08
14	29.11581338	-90.18249316	0.19	0.18	0.10	0.33	-0.01
15	29.11597191	-90.18229348	0.2	0.25	-0.13	-0.71	0.05
16	29.11750025	-90.18256824	0.19	0.23	-0.22	-0.52	0.04
17	29.11767480	-90.18092084	0.40	0.4	-0.21	-0.33	0
18	29.11726114	-90.18065388	0.30	0.4	0.41	0.38	0.1
19	29.11778024	-90.18029993	0.38	0.4	-0.20	-0.23	0.02
20	29.11834611	-90.18157424	0.20	0.35	0.20	0.39	0.15
21	29.11950689	-90.17979119	0.19	0.25	0.52	0.65	0.06
22	29.11907442	-90.17871277	0.26	0.4	-0.55	-0.58	0.14
23	29.12028496	-90.18069169	0.13	0.1	-0.27	-0.36	-0.03
24	29.12046102	-90.18066797	1.11	1.19	0.34	0.21	0.08
25	29.12074042	-90.18044134	0.30	0.33	0.43	0.39	0.03
26	29.12066791	-90.1779868	0.30	0.45	-0.41	-0.55	0.15
27	29.1216794	-90.17629609	0.30	0.34	0.54	0.32	0.04
28	29.12269903	-90.17247803	0.44	0.37	-0.10	-0.43	-0.07
29	29.12483293	-90.17396613	0.22	0.29	-0.63	-0.36	0.07
30	29.12708151	-90.17380542	0.7	0.8	-0.01	-0.21	0.1
31	29.12730165	-90.17325054	0.35	0.38	0.32	0.42	0.03

32	29.13295352	-90.1752577	0.06	0.08	0.31	0.23	0.02
33	29.13297452	-90.17067997	0.05	0.1	0.20	0.42	0.05
34	29.13579115	-90.17382294	0.10	0.05	0.43	0.21	-0.05
35	29.13560896	-90.17399032	0.03	0.14	-0.42	-0.32	0.11
36	29.13816305	-90.17123578	0.12	0.1	-0.51	-0.45	-0.02
37	29.12313720	-90.17055395	0.30	0.29	0.51	0.61	-0.01
38	29.12393073	-90.16858257	0.8	0.8	-0.60	-0.40	0
39	29.12416421	-90.16787752	0.69	0.59	-0.44	-0.51	-0.1
40	29.12455065	-90.16700951	0.39	0.45	0.22	0.31	0.06
41	29.12573747	-90.16418490	0.45	0.46	-0.65	-0.45	0.01
42	29.12696577	-90.16211471	0.38	0.31	0.47	0.57	-0.07
43	29.12575242	-90.1625257	0.42	0.7	0.34	0.44	0.28
44	29.12530798	-90.16321299	1.29	1.34	0.33	0.57	0.05
45	29.12516513	-90.16347944	0.46	0.47	0.45	0.39	0.01
46	29.1238981	-90.16686088	0.42	0.5	0.44	0.41	0.08
47	29.12113039	-90.16940172	0.21	0.2	-0.40	-0.57	-0.01
48	29.12049661	-90.16904086	0.45	0.4	-0.23	-0.27	-0.05
49	29.12001534	-90.17279388	0.26	0.27	-0.31	-0.43	0.01
50	29.12021927	-90.17526493	0.30	0.4	-0.51	-0.60	0.1
51	29.11550258	-90.18179969	0.22	0.1	-0.40	-0.52	-0.12
52	29.11311032	-90.18260242	0.3	0.30	-0.64	-0.43	0
53	29.11266021	-90.17533740	2.48	2.41	0.12	0.26	-0.07
54	29.11004821	-90.17839682	0.48	0.47	-0.25	-0.21	-0.01
55	29.10827198	-90.18038176	0.41	0.49	0.17	0.29	0.08
56	29.10976091	-90.17922851	3.00	2.95	0.30	0.35	-0.05
57	29.11434558	-90.17604789	0.13	0.13	-0.13	-0.17	0
58	29.11423217	-90.17408004	1.00	1.05	0.25	0.31	0.05
59	29.11382752	-90.17318434	1.10	1.08	-0.24	-0.22	-0.02
60	29.11478320	-90.17147257	0.82	0.78	-0.10	-0.16	-0.04
61	29.11586115	-90.17020811	1.59	1.64	-0.13	-0.27	0.05