Mean High Water Survey Methodology

Mississippi State University & Mississippi-Alabama Sea Grant Consortium Living Shoreline Program

Updated: March 28, 2023
MASGP-23-022

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This publication was prepared by the Mississippi-Alabama Sea Grant Consortium using federal funds under award NA22OAR4170090 from the National Sea Grant Office, NOAA, U.S. Department of Commerce. The statements, findings, conclusions and recommendations are those of the authors and do not necessarily reflect the views of the National Sea Grant Office, NOAA, U.S. Department of Commerce.

Document Overview

This document will describe, in detail, the exact methodology used by the Mississippi State University & Mississippi-Alabama Sea Grant Consortium Living Shoreline Program. This methodology is used when performing shoreline assessments and designing living shorelines for small-scale property owners and depends on high-resolution Real-Time Kinematic Global Positioning System (RTK GPS) technology.

Abbreviations

GPS	Global Positioning System
MASGC	Mississippi-Alabama Sea Grant Consortium
MS	Mississippi
MSU	Mississippi State University
RTK	Real Time Kinematic

Detailed Methods Description

The method that we use for determining where the Mean High Water (MHW) line lies on a particular property in Mississippi involves 5 steps:

1. Georeferenced Aerial Imagery
2. RTK GPS Survey
3. Overlay RTK Survey Points onto the Georeferenced Aerial Imagery
4. Find the Appropriate MHW Elevation
5. Align the MHW Line with RTK Survey Points

Detailed methodology for each step follows below. An overview of the methodology can also be found in the Mean High Water Survey Methodology Presentation on page 7.

1. Georeferenced Aerial Imagery

Easily accessible aerial imagery is often georeferenced. This means that each image is embedded with longitude and latitude coordinates that allow us to accurately align the RTK survey points that we obtain in step 2. Later, we use this imagery to create a living shoreline design that accurately depicts not only the state of the shoreline but also the exact location of the mean high water and mean low water lines. This allows us to create living shoreline designs that are fully customized for each private property owner, maximizing the chances of project success.

An example of a georeferenced aerial image can be seen on slide 2 of the Mean High Water Survey Methodology Presentation (page 7).

2. RTK GPS Survey

Technology Overview

Our team uses two brands of RTK GPS technology to obtain latitude, longitude, and elevation at private properties: Emlid and Trimble. Spec sheets are available for both brands on pages 21 and 23, respectively. Typically, we use the Emlid brand of RTK GPS units as they are more user-friendly and tend to have less error (less than 2cm). We collect elevation in the NAVD88 datum.

A description of how the RTK GPS uses satellites and local base stations to obtain accurate coordinates and elevations can be found on page 18 or at this website:

https://www.youtube.com/watch?v=ieearzWTCZw&embeds_euri=https%3A%2F%2Fdocs.emlid.com%2F&feature=emb_title.

Determining Where to Perform the Survey

Before we begin a RTK survey, we visually assess the shoreline to determine where to perform survey transects. The number and location of survey transects depends on the shape and slope of the shoreline. We take points along transects at each obvious change in direction along the shoreline (i.e., bend, curve, etc.) and at any section that has obvious depth or elevation changes. By doing this, we attempt to capture all changes in profile along the shoreline.

Performing the Survey

Before collecting RTK points, we check the accuracy on the unit to ensure that the error is below 2 cm. To begin our survey, we collect a single point at each bend along the shoreline. Then, we typically collect RTK points along at least 2 transects out to at least 30 feet from the perceived MHW line (i.e., perpendicular to the shoreline) when the shoreline is straight. When the shoreline has curves or bends, we also perform surveys along transects at each obvious bend. These transects extend into the water so that we can account for the base elevation of any breakwater or sill structures that may be needed in the living shoreline design. Points are collected every few steps (approximately every 3 to 6 feet into the water) or at any point in which there is an obvious change in elevation along each transect.

Outputs from the RTK Survey

The RTK GPS units automatically generate spreadsheets that include the longitude, latitude, elevation, and associated error for each point that we collected. An example of this can be found on slide 4 of the Mean High Water Survey Methodology presentation (page 19).

The spreadsheet also includes information for each point like date, time, and other items not useful to discuss here. However, an example output can be found on page 26.

3. Overlay RTK Survey Points onto the Georeferenced Aerial Imagery

Because both the RTK survey points and the georeferenced aerial imagery have longitude and latitude, we can align them.

By doing this, we can effectively design a living shoreline for the current state of the shoreline and accurately account for the location of the MHW lines. This, in turn, ensures that the living shoreline designs that we produce will be effective and fall within set guidelines for living shoreline permitting in Mississippi.

An example of this overlay can be found on slide 10 on the Mean High Water Survey Methodology presentation (page 15).

4. <u>Find the Appropriate MHW Elevation</u>

An integral part of the MHW survey is obtaining an accurate elevation for the MHW line at the approximate location of the property. To do this, we pull information from tidesandcurrents.noaa.gov. This NOAA website keeps updated environmental information at tidal stations around the country including temperature, water levels, tide predictions, and datum elevations. The datum elevations give relevant information like mean high water and mean low water relative to the datum zero elevation. We use NAVD88 datums for our work.

In Mississippi, there are two tide stations that we pull information from: Bay St. Louis and Pascagoula. We use the tide station nearest whichever property we are assessing. If a property falls near the middle of the two stations, we average the datum elevation information of the two stations.

An example of how we do this can be found on slides 6 through 9 of the Mean High Water Survey Methodology presentation (pages 11-14).

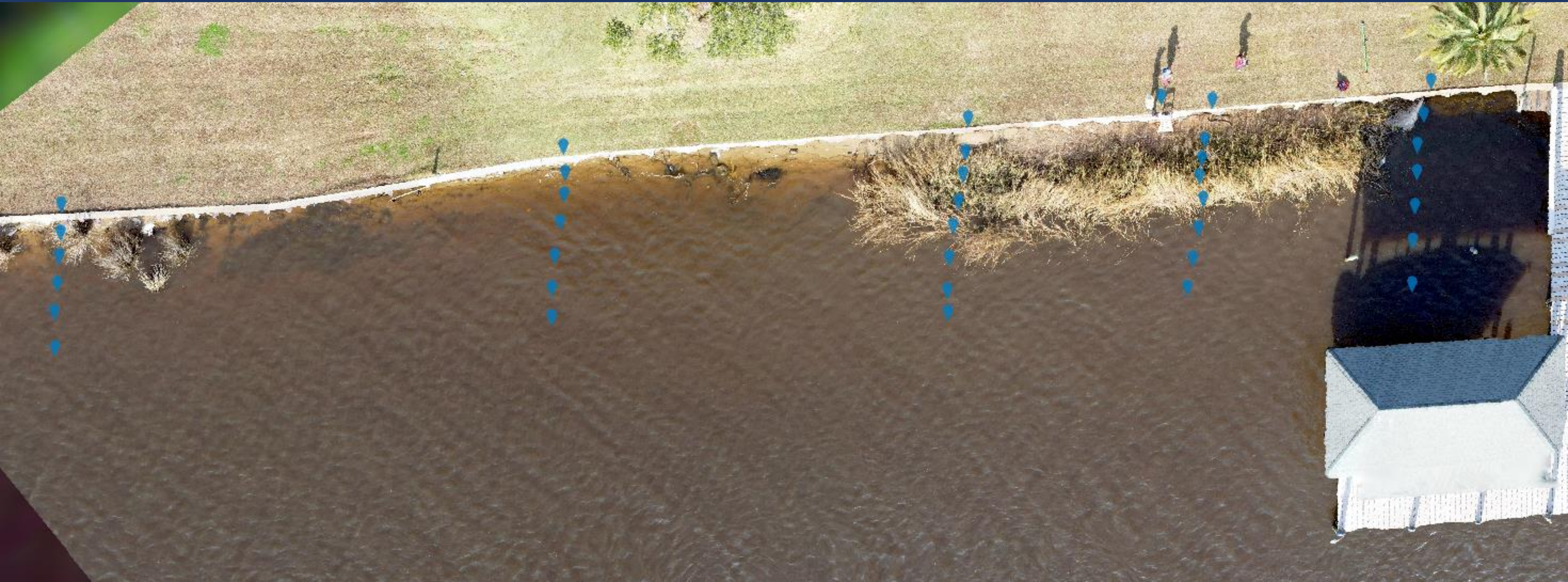
5. <u>Align the MHW Line with RTK Survey Points</u>

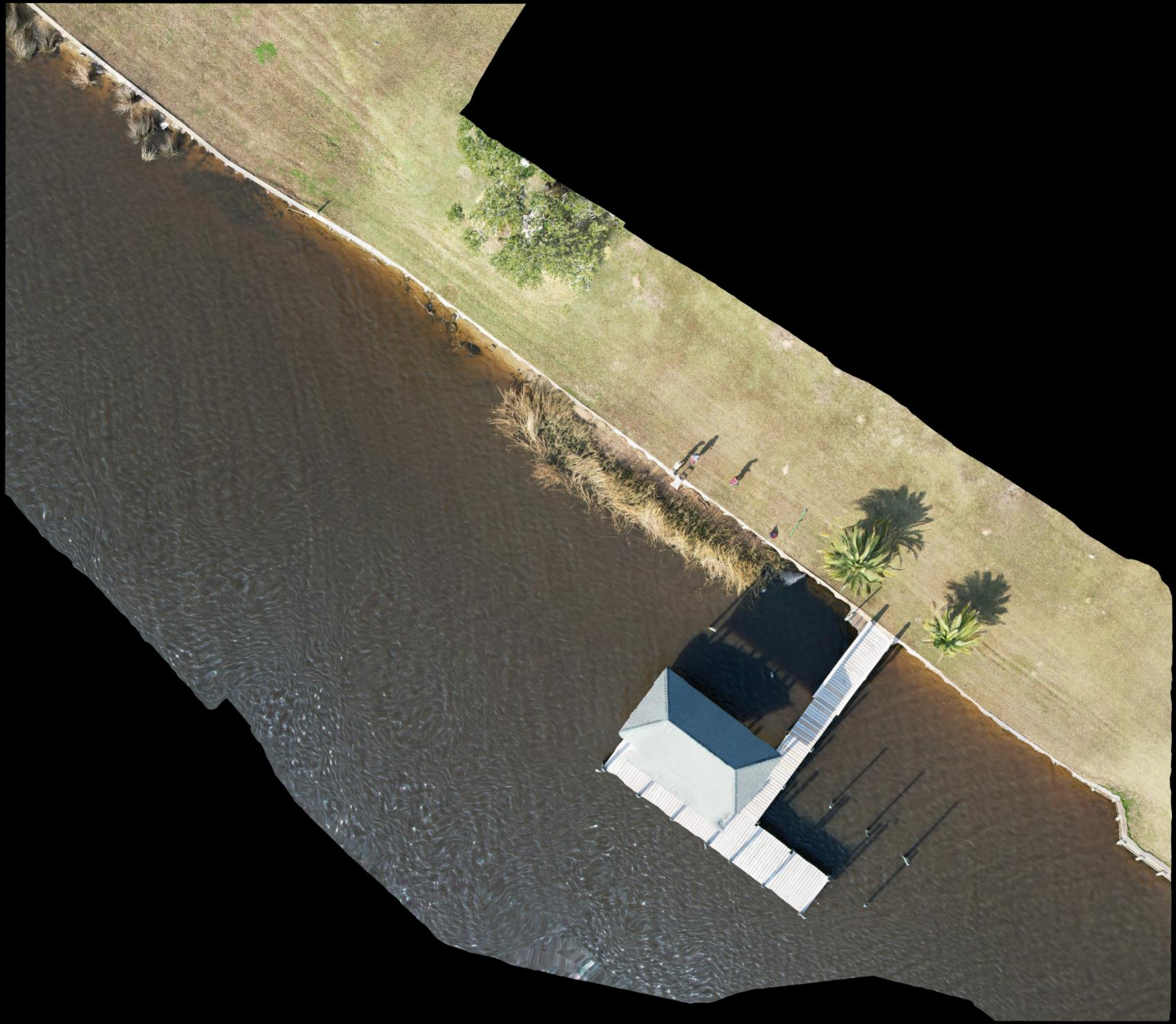
Once we find the appropriate MHW elevation, we go back to the RTK elevation points that we collected. We find the RTK point in each transect that is nearest to the elevation of the MHW line. Then, we draw the MHW line along those points (or between two nearest points) across the entire shoreline.

An example of this can be seen on slide 11 of the Mean High Water Survey Methodology (page 16).

Mean High Water Survey Methodology Presentation

Mean High Water Survey Methodology





Step 1: Georeferenced Aerial Imagery

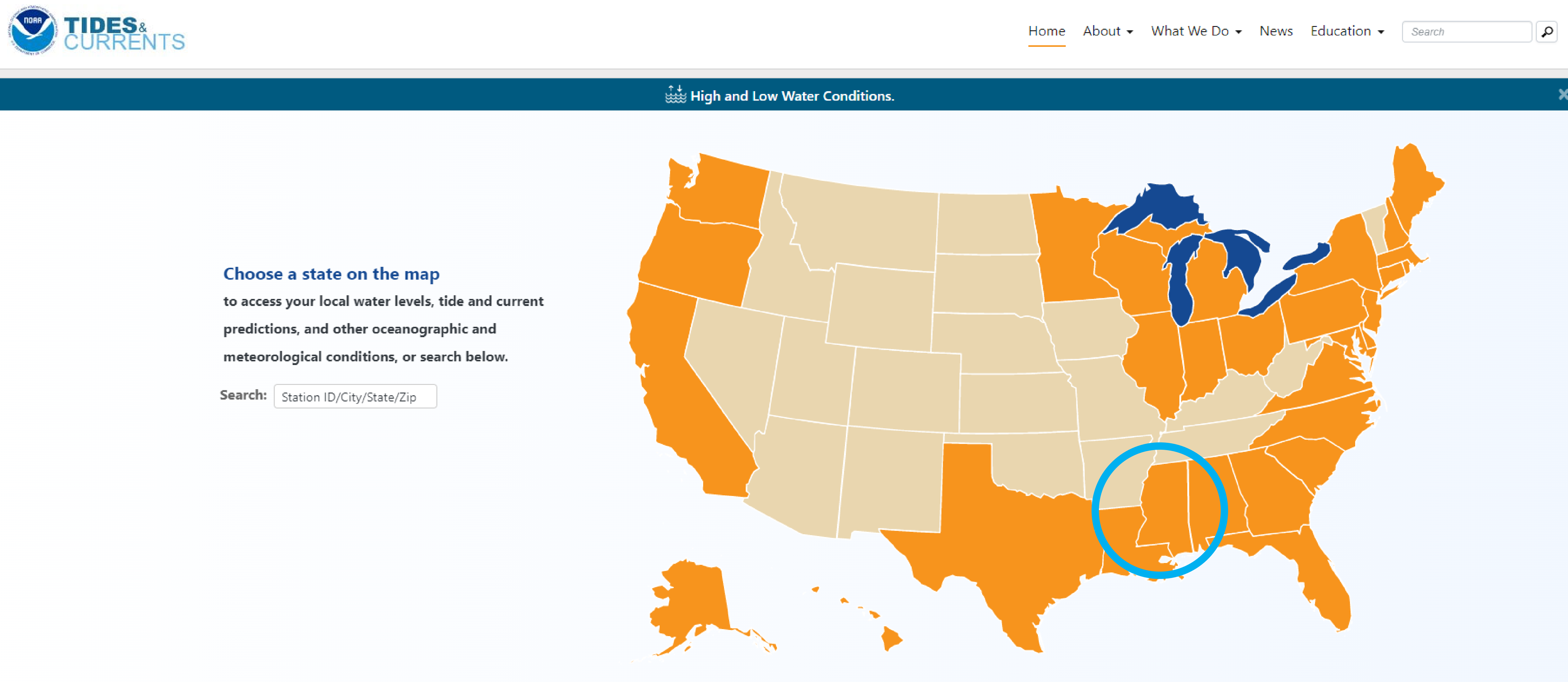
Step 2: RTK survey to gather elevation points

Long	Lat	Elevation
-88.98178812	30.42988056	2.03375
-88.98177211	30.4298668	0.28871
-88.98178444	30.42985561	0.23867
-88.98178999	30.42985027	0.09466
-88.98179518	30.42984504	-0.09036
-88.98179965	30.42983671	-0.23339
-88.9818085	30.42982829	-0.37241
-88.98181795	30.42981969	-0.50844
-88.98182692	30.42981141	-0.59947
-88.98169544	30.42981867	0.0226
-88.9817062	30.42980955	-0.07743
-88.98171583	30.42980115	-0.18346
-88.98172276	30.42979228	-0.28649
-88.98173182	30.42978168	-0.39552
-88.98174107	30.42977085	-0.52956
-88.98175211	30.42975674	-0.7136
-88.98185696	30.42992156	0.32584

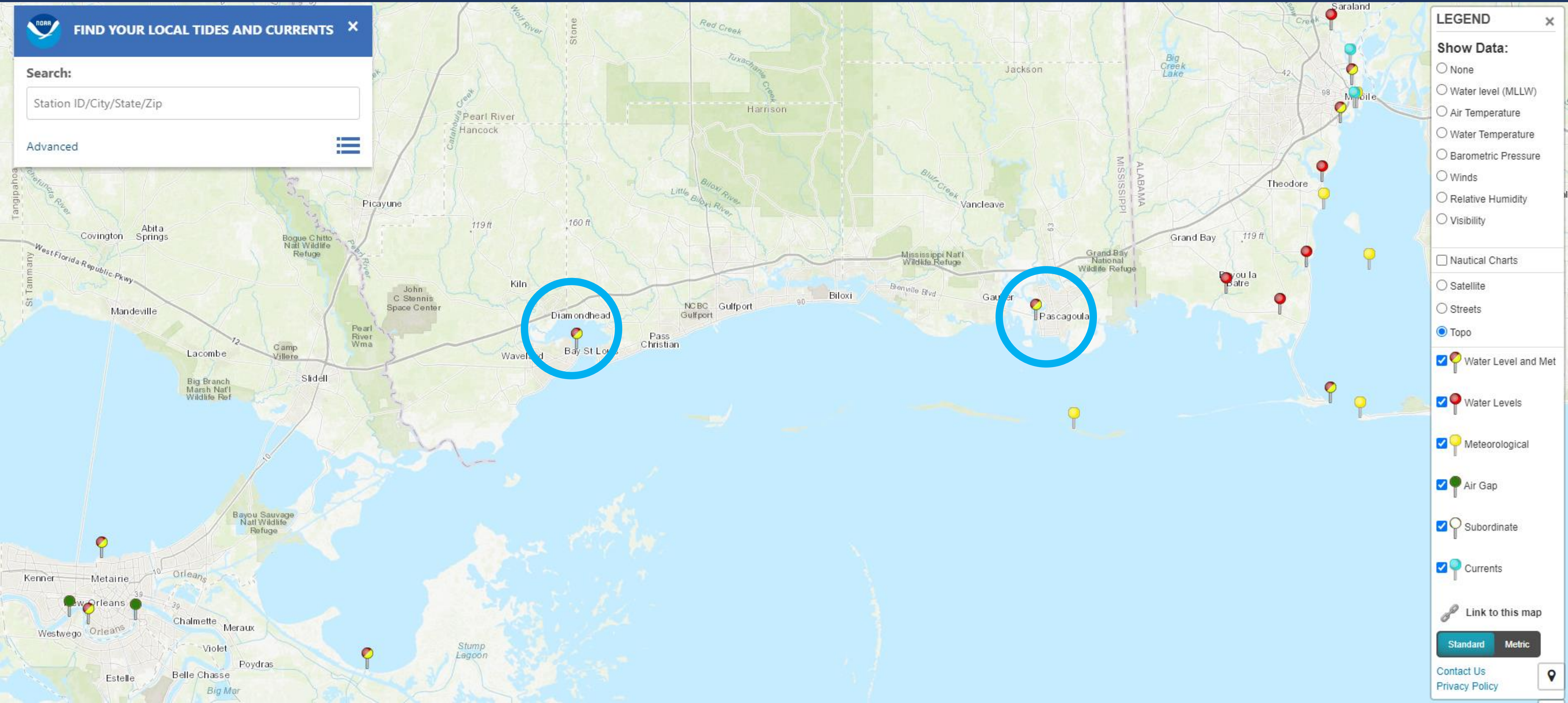
Step 2: RTK survey to gather elevation points

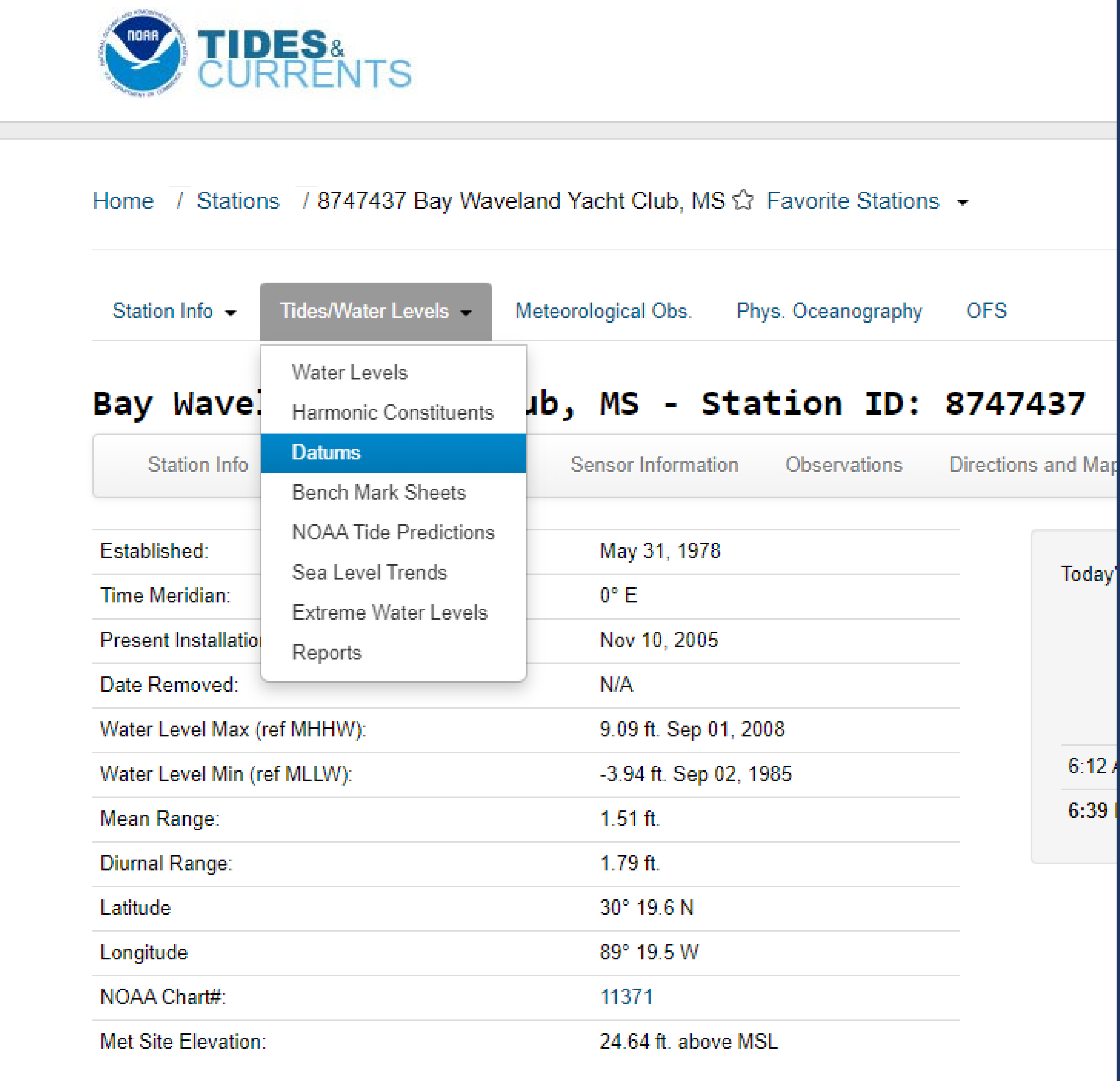
Step 3: Overlay RTK elevation points on georeferenced aerial images

Step 4: Find high water elevation (tidesandcurrents.noaa.gov)



Step 4: Find high water elevation (tidesandcurrents.noaa.gov)





Step 4: Find high water elevation (tidesandcurrents.noaa.gov)

Elevations on NAVD88

Station: 8747437, Bay Waveland Yacht Club, MS
T.M.: 0
Status: Accepted (Aug 4 2021)
Epoch: 1983-2001
Units: Meters
Datum: NAVD88
Control Station: 8741533 Pascagoula NOAA Lab, MS

Datum	Value	Description
MHHW	0.298	Mean Higher-High Water
MHW	0.257	Mean High Water
MTL	0.026	Mean Tide Level
MSL	0.027	Mean Sea Level
DTL	0.025	Mean Diurnal Tide Level
MLW		
MLLW		
NAVD88		

Elevations on NAVD88

Station: 8741533, Pascagoula NOAA Lab, MS
T.M.: 0
Status: Accepted (Sep 14 2020)
Epoch: 1983-2001
Units: Meters
Datum: NAVD88
Control Station: 8729840 Pensacola, FL

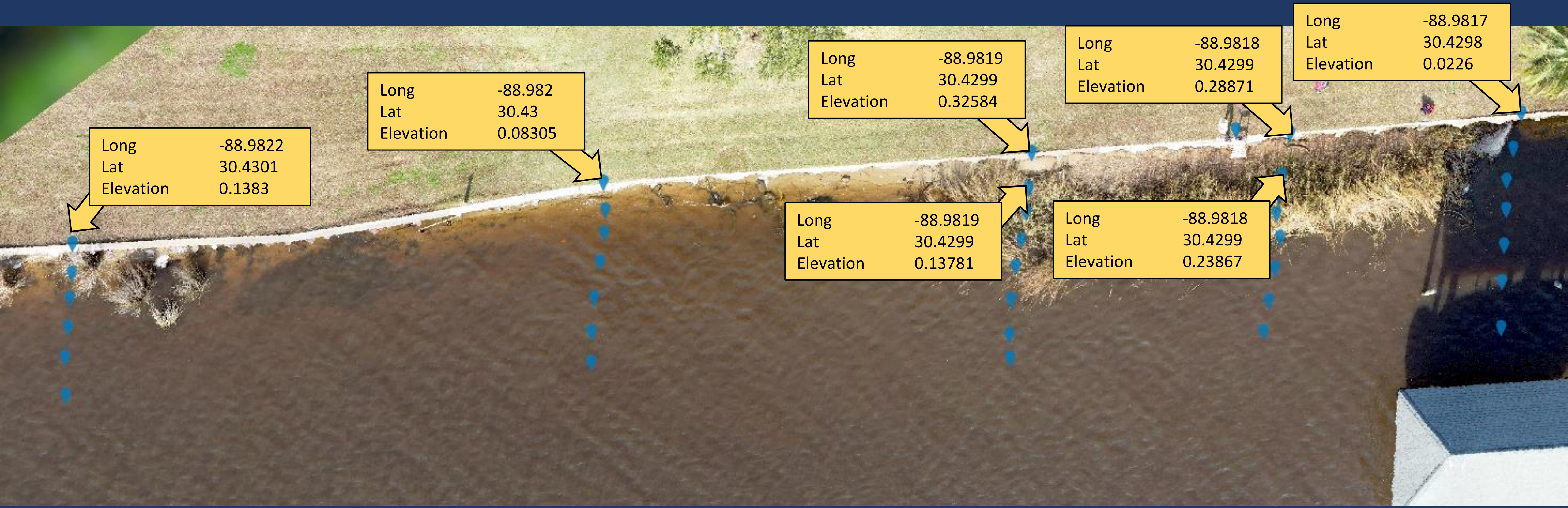
Datum	Value	Description
MHHW	0.267	Mean Higher-High Water
MHW	0.239	Mean High Water
MTL	0.033	Mean Tide Level
MSL	0.031	Mean Sea Level
DTL	0.034	
MLW	-0.174	
MLLW	-0.200	Mean Lower-Low Water
NAVD88	0.000	North American Vertical Datum of 1988

Mean High Water = 0.248

Step 4: Find mean high water elevation

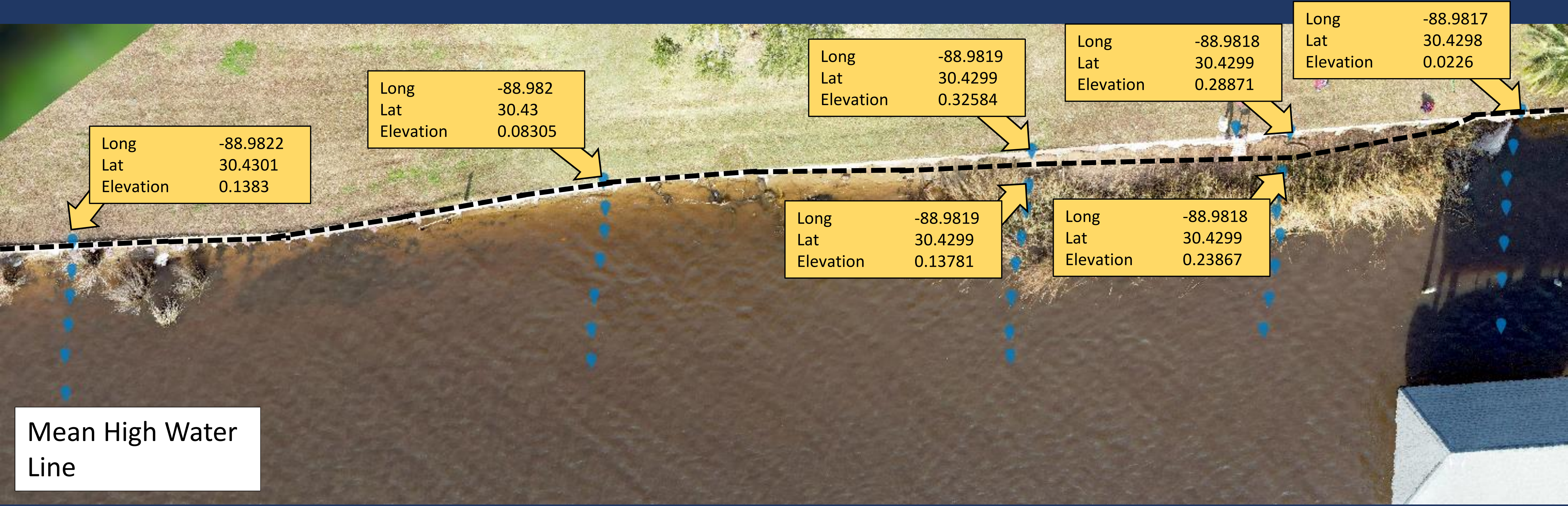
Tidesandcurrents.noaa.gov

Step 5: Match the mean high water elevation to the nearest RTK elevation points in each transect



Mean High Water = 0.248

Step 5: Match the mean high water elevation to the nearest RTK elevation points in each transect



Mean High Water = 0.248

How RTK GPS Works

How RTK works

Overview

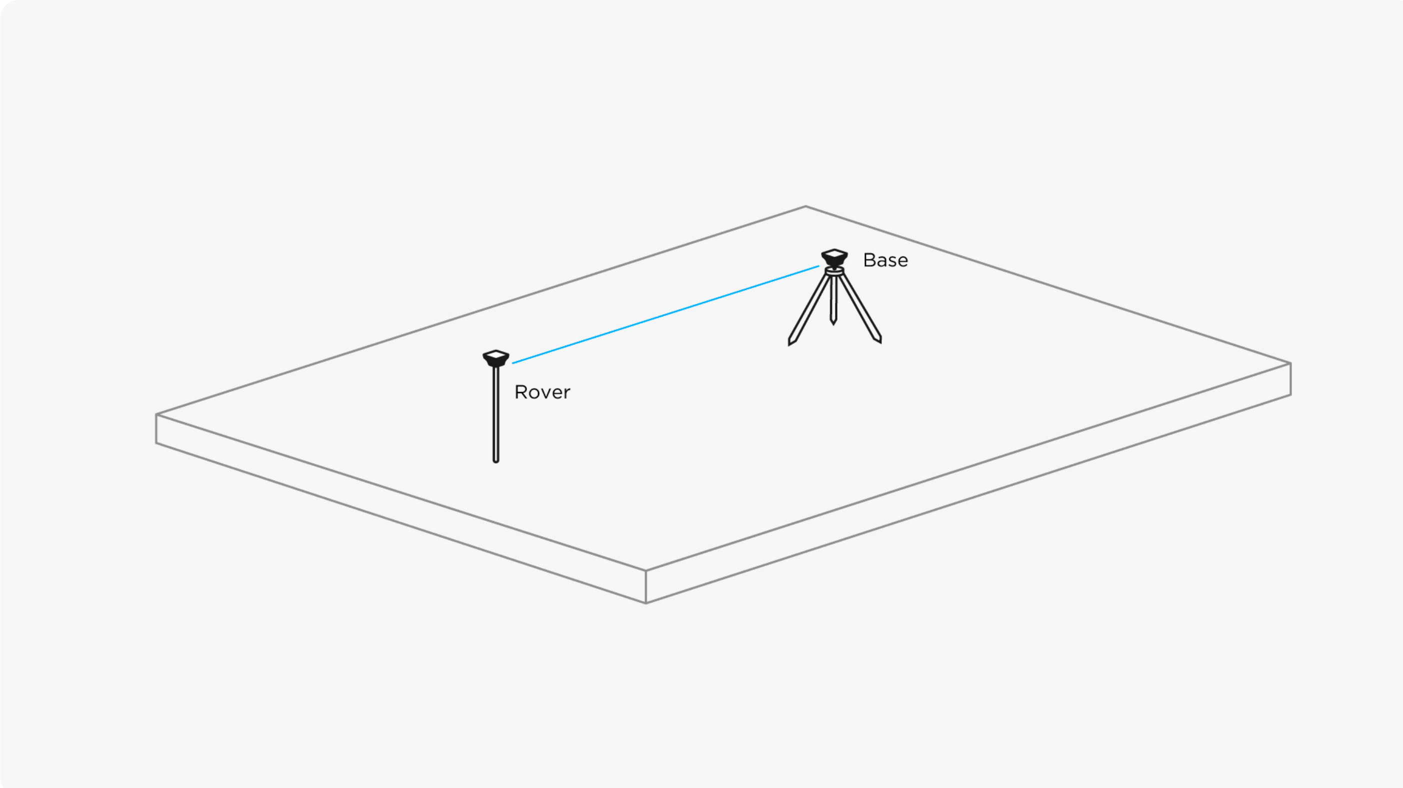
RTK is a technique used to improve the accuracy of a standalone GNSS receiver. Traditional GNSS receivers, like the one in a smartphone, could only determine the position with 2-4 meters (7-13 feet) accuracy. RTK can give you centimeter accuracy.

GNSS receivers measure how long it takes for a signal to travel from a satellite to the receiver. Transmitted signals travel through the ionosphere and atmosphere and are slowed down and perturbed on the way. For example, travel time on a cloudy day and in clear sky conditions would be di erent. That is why it is di cult for a standalone receiver to precisely determine its position. RTK is a technology that solves this issue.

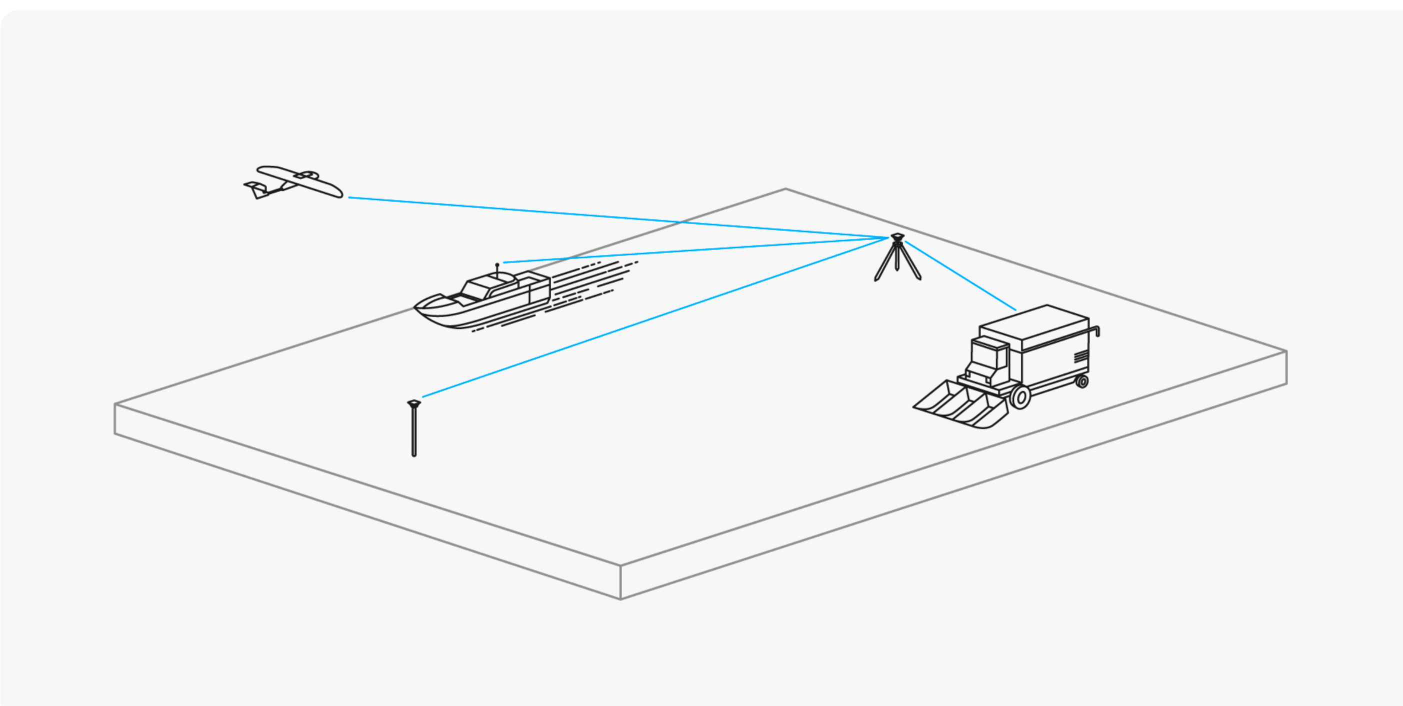
This video will show you how RTK technology works.

High real-time precision

Two receivers are used in RTK. One of them is stationary, another moves freely. They are called **base station** and **rover**.



The base's mission is to stay in one place and send corrections to a moving receiver. Rover uses that data to achieve centimeter precise position. Any number of rovers can connect to one base if their input settings match the base's output.

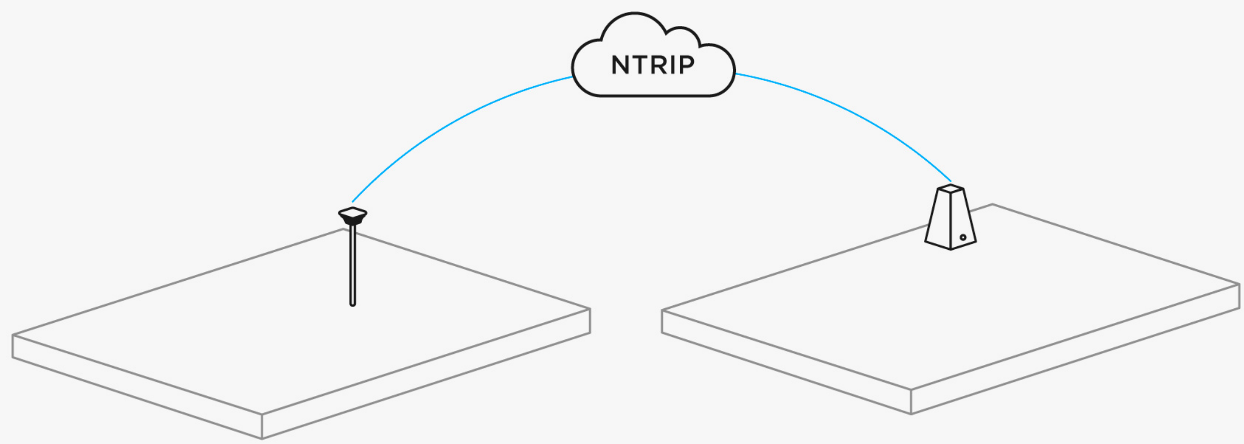


Corrections over NTRIP

You do not necessarily need a second unit for RTK all the time. Usually, there are local services that share base corrections over the Internet. This technology is called NTRIP.

NTRIP is a good option for areas with strong 3G/LTE coverage and a vast network of NTRIP bases nearby. In other cases, using the second receiver as a local base station has two advantages:

- autonomy in remote areas as there's no need in the Internet connection
- independency from local providers, no additional fees by NTRIP service



Single-band and multi-band receivers

Roughly speaking, there are two types of receivers: single-band (L1) and multi-band (L1/L2 or more). Their di erences come from how much data they can receive from satellites.

For example, it helps to increase the maximum distance between base and rover, which is also called **baseline**:

	Single-band maximum baseline	Multi-band maximum baseline
RTK	10 km (6 miles)	60 km (36 miles)

	Single-band maximum baseline	Multi-band maximum baseline
PPK	30 km (18 miles)	100 km (60 miles)

Multi-band receiver is also way more robust when it comes to sky view. It can maintain centimeter precision even if you survey in challenging conditions: forest, city, mining sights, quarries, etc.

Further reading

- How PPK works
- Placing the base
- Working with NTRIP service

Emlid RTK Spec Sheet

EMLID

REACH RS2

Datasheet

Key features

- Tracks GPS/QZSS L1C/A, L2C GLONASS L1OF, L2OF BeiDou B1I, B2I Galileo E1-B/C, E5b
- Fast RTK convergence
- Multi-feed antenna with multipath rejection
- 868/915 MHz LoRa modem for up to 8 km connectivity
- Global 3.5G modem
- 22 hours on 1 charge
- NTRIP and VRS support, works with RTCM3
- Logs RINEX at update rate up to 10 Hz
- 16 GB of internal storage
- IP67, water- and dustproof

REACH RS2

Technical specifications

POSITIONING

Precision	Static	H: 4 mm+0.5 ppm V: 8mm+1 ppm
	PPK	H: 5 mm+0.5 ppm V: 10 mm+1 ppm
	RTK	H: 7 mm+1 ppm V: 14 mm+1 ppm
Convergence time		~5 s typically
Signal tracked		GPS/QZSS L1C/A, L2C, GLONASS L1OF, L2OF, BeiDou B1I, B2I, Galileo E1-B/C, E5b
Number of channels		184
Update rates		10 Hz GPS / 5 Hz GNSS
IMU		9DOF

CONNECTIVITY

UHF LoRa radio	Frequency range	868/915 MHz
	Power	0.1 W
	Distance	Up to 8 km
3.5G modem	Regions	Global
	Bands	Quad-band, 850/1900, 900/1800 MHz
	SIM card	Nano-SIM
Wi -Fi		802.11 b/g/n
Bluetooth		4.0/2.1 EDR
Ports		RS-232, USB Type-C
Data Protocols		NTRIP, VRS, RTCM3, position output in NMEA, LLH/XYZ
Data logging		RINEX at update rate up to 10 Hz
Internal storage		16 GB

MECHANICAL

Dimensions	126x126x142 mm
Weight	950 g
Temperature	-20...+65 °C
Ingress protection	IP67 water- and dustproof

ELECTRICAL

Autonomy	16 hrs as 3.5G RTK rover, 22 hrs logging
Battery	LiFePO4 6400 mAh, 6.4 V
External power input	6–40 V
Charging	USB-C 5V 2A

COMMUNICATIONS AND DATA STORAGE

- 9PIN port: RS-232, PPS, Event
- USB OTG
- Internal Radio Modem:
  LoRa technology
  Reliable link on up to 8 km baseline
  Transmit power up to 100 mW
  Configurable 862–1020 MHz carrier
- Internal 3.5G modem
  Global
  Quad-band, 850/1900, 900/1800 MHz
- Built-in short-range Wi-Fi 802.11 b/g/n, WEP, WPA, WPA2 encryption
- Built-in short-range Bluetooth 4.0/2.1 EDR
- Data storage 16 GB internal memory
- Raw logs in RINEX, UBX
- External Radio Modem connectivity over RS-232/USB OTG
- RTCM 3.x input and output over Wi-Fi, Bluetooth, LoRa, USB, RS-232, NTRIP
- NMEA 0183, ERB output over Wi-Fi, Bluetooth, USB, RS-232
- ReachView app for iOS and Android for configuration and surveying

YOUR LOCAL DEALER

Trimble RTK Spec Sheet

Trimble TDC150

HANDHELD

KEY FEATURES

- Integrated high-accuracy GNSS receiver
- Scalable positioning accuracy from meter to centimeters
- Android™ 6.0 operating system
- 5.3-inch sunlight readable multi-touch capacitive screen
- Google Mobile™ services certified to run Google core applications and services
- Compatible with Trimble or third-party software applications
- High speed 4G LTE cellular data connectivity
- Ultra-rugged design with MIL-STD-810 certification and rated IP67
- Removable, all day battery
- Fast Qualcomm® processor with 2 GB RAM and 16 GB internal storage
- Ergonomic form factor
- Front- and rear-facing cameras

Learn more:
geospatial.trimble.com/tdc150

GNSS CHARACTERISTICS

- 240 GNSS channels
  - GPS L1C/A, L1P(Y), L2P(Y), L2C
  - GLONASS L1C/A, L2C/A
  - BeiDou B1 (phase 2), B2
  - Galileo E1, E5b
  - QZSS L1C/A, L2C, L1SAIF
  - SBAS L1C/A
  - L-band
- Scalable accuracy from meter to centimeter (meter, sub meter (30/30), decimeter (7/2), centimeter)
- Patented Z-Blade technology for optimal GNSS performance
  - Full utilization of signals from all 6 GNSS systems (GPS, GLONASS, BeiDou, Galileo, QZSS and SBAS)
  - Enhanced GNSS-centric algorithm: fully-independent GNSS signal tracking and optimal data processing, including GPS-only, GLONASS-only or BeiDou-only solution (autonomous to full RTK)
  - Fast Search engine for quick acquisition and re-acquisition of GNSS signals
- Patented SBAS ranging for using SBAS code & carrier observations and orbits in RTK Processing
- Patented Strobe™ Correlator for reduced GNSS multi-path
- Supported data formats: ATOM, CMR, CMR+, RTCM 2.1, 2.3, 3.0, 3.1 and 3.2 (including MSM), CMRx and sCMRx

REAL-TIME ACCURACY (RMS)[1,2]

SBAS (WAAS/EGNOS/MSAS/GAGAN)

Horizontal .... < 50 cm
Vertical .... < 85 cm

Real-Time DGPS position

Horizontal .... 25 cm + 1 ppm
Vertical .... 50 cm + 1 ppm

Real-Time Kinematic Position (RTK)[3]

Horizontal .... 10 mm + 1 ppm
Vertical .... 15 mm + 1 ppm

REAL-TIME PERFORMANCE

Instant-RTK® Initialization .... Typically 2 sec for baselines < 20 km
Up to 99.9% reliability
RTK initialization range .... over 40 km

DATA LOGGING CHARACTERISTICS

Recording interval .... 1–999 seconds

PROCESSOR

- Qualcomm Snapdragon™ 410
- Quad-core
- Clock frequency: 1.2 GHz

OPERATING SYSTEM

- Android 6.0 (Google certified)
- Languages available: Afrikaans, German, English, Spanish, French, Italian, Portuguese (Portugal and Brazil), Japanese, Korean, Simplified Chinese, Greek, Russian, Azebaijani, Czech, Danish, Lithuanian, Hungarian, Dutch, Norwegian (Bokmal), Romanian, Finnish, Swedish, Turkish, Bulgarian, Serbian (Cyrillic), Hindi, Polish
- Software package includes: Google Mobile Services

MEMORY

- 2 GB SDRAM
- Storage: 16 GB (non volatile).
- MicroSDHC™ memory card (up to 64 GB, SanDisk®, Kingston® recommended)

INTERFACE

- USB 2.0 (micro)
- External antenna connector (TNC)
- Audio jack 2.5 plug (CTIA/AHJ standards)

COMMUNICATIONS

- Cellular: GSM (850,900,1800,1900), GPRS, EDGE, UMTS, WCDMA (B1, B2, B5, B8), HSPA, TDSCDMA (B34, B39), LTE-FDD(B1, B3, B4, B5, B7, B8, B20), LTE-TDD (B38/B39/B40/B41)
- Wi-Fi (IEEE) 802.11 b/g/n
- Bluetooth® 4.0 dual mode
- USB (micro B USB connector)
- NFC

ENVIRONMENTAL CHARACTERISTICS

Operating temperature .... –20 °C to +60 °C (–4 °F to 140 °F)
Storage temperature .... –30 °C to +70 °C without battery (–22 °F to 158 °F)[5]
Humidity .... 95% non condensing
Water & dust proof IP67
Free drop .... 1.2 m on concrete
Shocks .... MIL STD 810 (fig 516.5-10) (01/2000)
Vibration .... MIL-STD-810F (fig 514.5C-17) (01/2000)

POWER CHARACTERISTICS

Battery .... Li-Ion, 6400mAh
Battery life .... > 8 hrs @ 20 °C with GNSS on
Charging time .... 4 hours
Removable battery

PHYSICAL CHARACTERISTICS

Size .... 29.5 x 12 x 4.5 cm (11.6 x 4.7 x 1.8 in)
Weigh .... 850 g (1.87 lb)
User interface .... 2 volume keys, on/off/reset key, 2 programmable keys, standard Android touch panel buttons

On screen keyboard display
- Size .... 5.3" capacitive multi touch
- Resolution .... 1280x720 pixels
- Brightness .... 450 Cd/m²
- Gorilla Glass damage-resistant
- Auto rotate .... between Portrait and Landscape

MULTIMEDIA & SENSORS

- Rear camera 13 MP pixels with flash light
- Front camera 2 MP pixels
- E-Compass
- G-sensor
- Speaker
- Microphone
- Light sensor

STANDARD ACCESSORIES

- Handstrap
- Screen protectors (x2)
- A/C charger
- USB cable
- Pouch
- Battery door opener
- Monopole adaptor

OPTIONAL ACCESSORIES

- External GNSS antenna
- Pole bracket
- Monopole

OPERATING MODES

- RTK rover: Direct IP, NTRIP (VRS, FKP, MAC networks)
- Post-processing (if supported by the field application)

FIELD SOFTWARE

- Trimble TerraFlex™
- Trimble Penmap® for Android
- Third-party Android applications

1 Accuracy and TTFF specifications may be affected by atmospheric conditions, signal multipath, satellite geometry and corrections availability and quality.
2 Performance values assume minimum of five satellites, following the procedures recommended in the product manual. High multipath areas, high PDOP values and periods of severe atmospheric conditions may degrade performance. Real time accuracies depend on TDC150 accuracy option.
3 TDC150 centimeter used with Monopole accessory.
4 Long baselines, long occupations, precise ephemeris used.
5 Batteries can be stored up to +70 °C.
6 Receiver convergence time varies based on GNSS constellation health, level of multipath, and proximity to obstructions such as large trees and buildings. Convergence can be improved in RAM enabled regions.

Specifications are subject to change without notice.

Contact your local Trimble Authorized Distribution Partner for more information

NORTH AMERICA
Trimble Inc.
10368 Westmoor Dr
Westminster CO 80021
USA

EUROPE
Trimble Germany GmbH
Am Prime Parc 11
65479 Raunheim
GERMANY

ASIA-PACIFIC
Trimble Navigation
Singapore PTE Limited
3 HarbourFront Place
#13-02 HarbourFront Tower Two
Singapore 099254
SINGAPORE

Example RTK Output

Name	Code	Easting	Northing	Elevation	Descriptior	Longitude	Latitude	Ellipsoidal l
51		285739	103083.2	2.03375		-88.9818	30.42988	-26.14
52		285740.5	103081.7	0.28871		-88.9818	30.42987	-27.885
53		285739.3	103080.4	0.23867		-88.9818	30.42986	-27.935
54		285738.8	103079.8	0.09466		-88.9818	30.42985	-28.079
55		285738.3	103079.3	-0.09036		-88.9818	30.42985	-28.264
56		285737.9	103078.3	-0.23339		-88.9818	30.42984	-28.407
57		285737	103077.4	-0.37241		-88.9818	30.42983	-28.546
58		285736.1	103076.5	-0.50844		-88.9818	30.42982	-28.682
59		285735.3	103075.5	-0.59947		-88.9818	30.42981	-28.773
60		285747.9	103076.3	0.0226		-88.9817	30.42982	-28.151
61		285746.9	103075.3	-0.07743		-88.9817	30.42981	-28.251
62		285745.9	103074.4	-0.18346		-88.9817	30.4298	-28.357
63		285745.3	103073.4	-0.28649		-88.9817	30.42979	-28.46
64		285744.4	103072.2	-0.39552		-88.9817	30.42978	-28.569
65		285743.5	103071	-0.52956		-88.9817	30.42977	-28.703
66		285742.4	103069.5	-0.7136		-88.9818	30.42976	-28.887
67		285732.4	103087.8	0.32584		-88.9819	30.42992	-27.848
68		285731.5	103086.6	0.13781		-88.9819	30.42991	-28.036
69		285730.9	103085.9	0.01478		-88.9819	30.4299	-28.159
70		285730.1	103085	-0.10924		-88.9819	30.4299	-28.283
71		285729.3	103084.3	-0.24826		-88.9819	30.42989	-28.422
72		285728.5	103083.2	-0.35129		-88.9819	30.42988	-28.525
73		285727.6	103082.1	-0.50433		-88.9819	30.42987	-28.678
74		285727.1	103081.2	-0.59935		-88.9819	30.42986	-28.773
75		285718.9	103097.9	0.08305		-88.982	30.43001	-28.091
76		285718.4	103096.9	-0.06797		-88.982	30.43	-28.242
77		285717.8	103096.1	-0.168		-88.982	30.43	-28.342
78		285717	103095.3	-0.27202		-88.982	30.42999	-28.446
79		285716.1	103094.2	-0.36805		-88.982	30.42998	-28.542
80		285715.2	103093.1	-0.45009		-88.982	30.42997	-28.624
81		285714.5	103092	-0.56012		-88.982	30.42996	-28.734
82		285701.7	103109.7	0.1383		-88.9822	30.43012	-28.036
83		285701	103108.7	-0.00973		-88.9822	30.43011	-28.184
84		285700.4	103107.9	-0.12876		-88.9822	30.4301	-28.303
85		285699.7	103106.9	-0.23378		-88.9822	30.43009	-28.408
86		285698.9	103105.9	-0.35081		-88.9822	30.43009	-28.525
87		285698.1	103104.6	-0.51885		-88.9822	30.43007	-28.693
88		285683.5	103124.1	0.4016		-88.9824	30.43025	-27.773
89		285683	103123.3	0.18558		-88.9824	30.43024	-27.989
90		285682.4	103122.6	0.07456		-88.9824	30.43024	-28.1
91		285682	103122	-0.08146		-88.9824	30.43023	-28.256
92		285681.1	103121.3	-0.18748		-88.9824	30.43022	-28.362
93		285680.4	103120.4	-0.3005		-88.9824	30.43022	-28.475
94		285679.7	103119.5	-0.40953		-88.9824	30.43021	-28.584
95		285679	103118.4	-0.50456		-88.9824	30.4302	-28.679

Easting RM	Northing R	Elevation R	Lateral RM	Antenna he	Antenna he	Solution st	Averaging s	Averaging e
0.011	0.012	2.03375	0.016	2.134	m	FIX	2023-01-11	2023-01-11
0.011	0.01	0.28871	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.011	0.011	0.23867	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.01	0.011	0.09466	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.011	0.011	-0.09036	0.016	2.134	m	FIX	2023-01-11	2023-01-11
0.014	0.012	-0.23339	0.018	2.134	m	FIX	2023-01-11	2023-01-11
0.012	0.011	-0.37241	0.016	2.134	m	FIX	2023-01-11	2023-01-11
0.012	0.011	-0.50844	0.016	2.134	m	FIX	2023-01-11	2023-01-11
0.013	0.012	-0.59947	0.018	2.134	m	FIX	2023-01-11	2023-01-11
0.011	0.01	0.0226	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.01	0.01	-0.07743	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.011	0.011	-0.18346	0.016	2.134	m	FIX	2023-01-11	2023-01-11
0.01	0.01	-0.28649	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.011	0.01	-0.39552	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.013	0.012	-0.52956	0.018	2.134	m	FIX	2023-01-11	2023-01-11
0.015	0.011	-0.7136	0.018	2.134	m	FIX	2023-01-11	2023-01-11
0.01	0.012	0.32584	0.016	2.134	m	FIX	2023-01-11	2023-01-11
0.01	0.01	0.13781	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.011	0.011	0.01478	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.011	0.011	-0.10924	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.078	0.054	-0.24826	0.095	2.134	m	FIX	2023-01-11	2023-01-11
0.01	0.011	-0.35129	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.011	0.012	-0.50433	0.016	2.134	m	FIX	2023-01-11	2023-01-11
0.012	0.012	-0.59935	0.017	2.134	m	FIX	2023-01-11	2023-01-11
0.01	0.01	0.08305	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.01	0.011	-0.06797	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.011	0.011	-0.168	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.011	0.011	-0.27202	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.015	0.012	-0.36805	0.019	2.134	m	FIX	2023-01-11	2023-01-11
0.011	0.011	-0.45009	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.011	0.011	-0.56012	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.012	0.012	0.1383	0.017	2.134	m	FIX	2023-01-11	2023-01-11
0.01	0.012	-0.00973	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.011	0.011	-0.12876	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.011	0.01	-0.23378	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.01	0.01	-0.35081	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.011	0.011	-0.51885	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.011	0.011	0.4016	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.01	0.011	0.18558	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.012	0.01	0.07456	0.016	2.134	m	FIX	2023-01-11	2023-01-11
0.012	0.01	-0.08146	0.016	2.134	m	FIX	2023-01-11	2023-01-11
0.01	0.011	-0.18748	0.015	2.134	m	FIX	2023-01-11	2023-01-11
0.012	0.011	-0.3005	0.016	2.134	m	FIX	2023-01-11	2023-01-11
0.01	0.012	-0.40953	0.016	2.134	m	FIX	2023-01-11	2023-01-11
0.011	0.014	-0.50456	0.018	2.134	m	FIX	2023-01-11	2023-01-11

Samples	PDOP	Base eastin	Base north	Base elevat	Base longit	Base latitu	Base ellips	Baseline
26	2.3	285744	103083.5	2.03375	-88.9817	30.42988	2.03375	5.057
26	2.2	285744	103083.5	0.28871	-88.9817	30.42988	0.28871	4.389
26	2.2	285744	103083.5	0.23867	-88.9817	30.42988	0.23867	5.938
26	2.2	285744	103083.5	0.09466	-88.9817	30.42988	0.09466	6.713
26	2.3	285744	103083.5	-0.09036	-88.9817	30.42988	-0.09036	7.476
26	2.3	285744	103083.5	-0.23339	-88.9817	30.42988	-0.23339	8.391
26	2.3	285744	103083.5	-0.37241	-88.9817	30.42988	-0.37241	9.646
26	2.3	285744	103083.5	-0.50844	-88.9817	30.42988	-0.50844	10.943
26	2.5	285744	103083.5	-0.59947	-88.9817	30.42988	-0.59947	12.179
26	2.3	285744	103083.5	0.0226	-88.9817	30.42988	0.0226	8.436
26	2.4	285744	103083.5	-0.07743	-88.9817	30.42988	-0.07743	8.964
26	2.5	285744	103083.5	-0.18346	-88.9817	30.42988	-0.18346	9.62
26	2.5	285744	103083.5	-0.28649	-88.9817	30.42988	-0.28649	10.479
26	2.5	285744	103083.5	-0.39552	-88.9817	30.42988	-0.39552	11.587
26	2.6	285744	103083.5	-0.52956	-88.9817	30.42988	-0.52956	12.801
26	2.3	285744	103083.5	-0.7136	-88.9817	30.42988	-0.7136	14.443
26	2.3	285744	103083.5	0.32584	-88.9817	30.42988	0.32584	12.522
26	2.3	285744	103083.5	0.13781	-88.9817	30.42988	0.13781	13.07
26	2.3	285744	103083.5	0.01478	-88.9817	30.42988	0.01478	13.522
26	2.3	285744	103083.5	-0.10924	-88.9817	30.42988	-0.10924	14.191
26	2.3	285744	103083.5	-0.24826	-88.9817	30.42988	-0.24826	14.905
26	2.2	285744	103083.5	-0.35129	-88.9817	30.42988	-0.35129	15.777
26	2.2	285744	103083.5	-0.50433	-88.9817	30.42988	-0.50433	16.692
26	2.2	285744	103083.5	-0.59935	-88.9817	30.42988	-0.59935	17.289
26	2.4	285744	103083.5	0.08305	-88.9817	30.42988	0.08305	28.997
26	2.4	285744	103083.5	-0.06797	-88.9817	30.42988	-0.06797	29.028
26	2.4	285744	103083.5	-0.168	-88.9817	30.42988	-0.168	29.179
26	2.2	285744	103083.5	-0.27202	-88.9817	30.42988	-0.27202	29.539
26	2.2	285744	103083.5	-0.36805	-88.9817	30.42988	-0.36805	30.038
26	2.2	285744	103083.5	-0.45009	-88.9817	30.42988	-0.45009	30.483
26	2.2	285744	103083.5	-0.56012	-88.9817	30.42988	-0.56012	30.853
26	2.2	285744	103083.5	0.1383	-88.9817	30.42988	0.1383	49.783
26	2.2	285744	103083.5	-0.00973	-88.9817	30.42988	-0.00973	49.866
26	2.2	285744	103083.5	-0.12876	-88.9817	30.42988	-0.12876	49.996
26	2.2	285744	103083.5	-0.23378	-88.9817	30.42988	-0.23378	50.181
26	2.2	285744	103083.5	-0.35081	-88.9817	30.42988	-0.35081	50.438
26	2.2	285744	103083.5	-0.51885	-88.9817	30.42988	-0.51885	50.64
26	2.2	285744	103083.5	0.4016	-88.9817	30.42988	0.4016	72.903
26	2.2	285744	103083.5	0.18558	-88.9817	30.42988	0.18558	72.937
26	2.3	285744	103083.5	0.07456	-88.9817	30.42988	0.07456	73.041
26	2.2	285744	103083.5	-0.08146	-88.9817	30.42988	-0.08146	73.059
26	2.2	285744	103083.5	-0.18748	-88.9817	30.42988	-0.18748	73.44
26	2.2	285744	103083.5	-0.3005	-88.9817	30.42988	-0.3005	73.555
26	2.2	285744	103083.5	-0.40953	-88.9817	30.42988	-0.40953	73.751
26	2.2	285744	103083.5	-0.50456	-88.9817	30.42988	-0.50456	73.849

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