





TOPODRONE Post Processing is a professional tool for automatic processing of the raw GNSS measurements at any coordinate system.





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1. Preparation of the raw input data

• Download the dataset to a Workstation. (Images, Drone UBX files, GPS base station file, GCP coordinates list, files obtained during the LiDAR mission)

• Group all the data according to each executed flight. For example, Flight 1, Flight 2 and etc.

• Data obtained during the LiDAR mission is saved in an archive, which should be unpacked. It is necessary to have the 4 components in a LiDAR dataset: *.pcap file (LiDAR raw data), *.imr file (IMU data), *.ubx file (LiDARs GNSS receiver data). .log file should not be used during the data processing.

Name	Date modified	Туре	Size
2022-03-17_14-42-55	17.03.2022 14:55	Waypoint Raw IMU D	4 548 KB
2022-03-17_14-42-55.pcap	17.03.2022 14:55	File *PCAP*	448 111 KB
2022-03-17_14-42-55	17.03.2022 14:55	File "RAW"	7 488 KB
2022-03-17_14-42-55.ubx	17.03.2022 14:55	File "UBX"	8 396 KB
🗎 log	17.03.2022 14:55	Text Document	28 KB

Pic.1-1.

Attention!

DJI Drone filesystem is naming the images from 1 to 999 by default (for example, DJI_0001.jpg µ DJI_0999.jpg), it means that if there's more than 1000 images per flight, it is necessary to check the new image folder, which is created by default

Once the flight mission is finished - copy the ubx. file from GNSS receiver SD card to a separate folder on your PC (for example: Rover, Drone UBX, etc.)

Convert the Base station file to a RINEX format and copy to a separate folder on your PC (for example: Base, Base RINEX, etc.)



Pic. 1-2.





2. PPK Post Processing Module.

PPK module is aimed to process the GNSS data obtained from rover U-Blox chip. Run the Topodrone Post Processing software.

<u> </u>					PPK POST PROCESS	SING			– e ×
PPK Post Processing	RTK Post Processing	LIDAR Post Processing	LIDAR Cloud Generation	Static Post Processing	Precise Point Positioning	Tools		License	Settings
1. Drone files Images folder Drone GNSS file Output folder Batch processing		94 95 94	4. Coord nate	system WCS-84		Projection	Logs		
2: Drone offsets Drone model Antenna height Forward/backward offset Left/right offset	0.17 0 0	Pr mete mete mete	esets 15 15						
3. Base station Base station GNSS file Coordinate type Latitude Longtitude Altitude Antenna height	Decimal 0 0 0 Save coordinate	DMS degree degre	YandesSatel siss siss siss sis	iteMap 😢 Let		Colo Maters		-	
S. Processing ONSS data post processing Images matching & gecta	gong Slart	-		Ruber					
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Choose the folder containing images. Output folder will be created automatically. Path and/or folder may be changed if necessary.

<u>=</u>					PPK POST PROCES	SSING			– 8 ×
PPK Post Processing	RTK Post Processing	LIDAR Post Processing	LIDAR Cloud Generation	Static Post Processing	Precise Point Positioning	Tools		License	Settings
1. Drone files			4. Coordinate	e system			Logs		
images folder	D:\03_TopodroneWork\0	03_220309\Photo\1	select	WGS-84		Projection	Read traditation photos Read tags from 96 photos		
Drone GNSS file		S S	Select						
Output folder	D:\03_TopodroneWork\0	03_220309\Photo 1	Select						
Batch processing			dd (0)						
2. Drone offsets	_								
Drone model		* P	resets						
Antenna height	0.17	meti	ers						
Forward/backward offset	0	meti	ers						
Leronght onset	0	meta	ers						
3. Base station			YandexSate	lliteMap 💽 Lat S	5.7136077222 Lon: 37.6541	646667 Co To M	Markers: Cleat Fit		
Base station GNSS file		S	elect			100	Contraction of the second second	the state	1:2 2
Coordinate type	Decimal	DMS		66	· ···································	ATT IN TO	- Carlo de Carlo de Carlo de	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
Latitude	0	degr	ess		「日本」の	The second		Ad a second in	
Longtitude	0	degr	ees			Mary Will	THE SHARE BE AND	1 1 430	372
Altitude	0	mete	ars	2	Ser Hill			SEE E	2 2 4
Antenna height	0	mete	ers de la companya de	2	A Charles of the	Se for	THE NOW LINE		14 21
	Save coordinate	as to Rinex	44			2 1 81	the safe at a with the	A. D	
5. Processing						FA		ANG L	E week
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Images matching & geota	2ging				and we do	- T	C TRUDE LINE IN THE AV	Contraction of the	1000
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Choose the drone UBX file, this step will run an automatic .ubx to .obs conversion.





Interface Interface Like Hockers Like Hockers Interface	-					PERFOST PROCES.	110			~
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2 cons disks Meren radis Arren radis Arre	1 Drone files Images folder Drone GNSS file Output folder Batch processing	D\03_TopodroneWork	103_220309\Photol1 Se 50 103_220309\Photol1 Se Add	4 Coard inat	te system WGS-84		Projection	Logs Read metadata from photos. • Read lags from 36 photos • Convert drone raw data log to RINEX		
S Processing CNSS data gost processing images matching & gestagging Bart top	2. Drone offsets Drone model Anterna height Farwardhoukward offs Lutforght offset Base station CNGS frie Coordinate type Lutitude Latitude Aftrude Anterna height	annon an	Deta Sinex	C.1200004F.futfine C.1200004F.futfine C.1200004F.futfine C.1200004F.futfine C.1200004F.futfine C.1200004F.futfine C.12004F.futfine C.12004F	ening dati vtk9) (som bin en Topodrumesork (vš.) 22436 Topodrumesork (vš.) 22436 Topodrumesork (vš.) 22436 Topodrumesork (vš.) 22436 12:45:12 GR 0-5261 N-30 E=1 T=15	9)Photo\1\12-26-59.dbx. 9)Photo\1\12-26-59.dbx 9)Photo\1\12-26-59.nav	u-blox UBX)	- D X		
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Pic. 2-3.

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Select antenna offset for your drone from the dropdown list.

If necessary, it is possible to add your own "Preset", press the button and fill the form with offsets.







Pic. 2-5.

Select the base station file (*.ubx, *.obs, *.rnx, *.o). When *.rnx and *.ubx file formats are chosen, the software runs automatic conversion to *.obs format.

Attention!

The "Logs" window displays information about the actions that the software performs, you need to pay attention to the time the file from the rover and from the base station was recorded. The base station file must overlap the files from the rover.





The base station X,Y coordinates and the Height of the phase center will be loaded automatically from Rinex file, if it was filled during the measurements.





The WGS-84 Lat\Long\Ellipsoid height is used by default, in case if you need to choose another one, press the "Projection" button and use any coordinate system from the list, also you may use "Search" option.

4. Coordinate system										
	WGS-84	Projection								
Calibration	Not used									
Elevation	Ellipsoid WGS-84	·								
Projection Q	32637									
zone 355	s (m) EPSG 32735									
zone 36	N (m) EPSG 32636									
zone 365	5 (m) EPSG 32736									
zone 37N	N (m) EPSG 32637									
zone 375	6 (m) EPSG 32737									

Pic. 2-7.

If your coordinate system is not included in the list, you can add it in Topodrone Post Processing software manually. After choosing the optional coordinate system conversion from WGS-84 will be performed automatically. You may correct the precise base station coordinates, if necessary.

Attention!

The height of the antenna includes the height of the pole or tripod from a point with known coordinates to the bottom of the receiver mount and the height from the bottom of the receiver mount to the phase center.

3. Base station									
Base station GNSS file	D:\03_TopodroneWork\0	Select							
Coordinate type	Decimal	DMS							
North	6175008.998727652		meters						
East	415433.9370986667		meters						
Height	137.39		meters						
Antenna height	0.000		meters						
	Save coordinate	Save coordinates to Rinex							







The Topodrone Post Processing software is working with 3 types of height calculation, by default, H parameter conversion is performed automatically after choosing an option.

4. Coordinate system	n		
	WGS-84	Projection	
Calibration	Not used		-
Elevation	Ellipsoid WGS-84		*
Projection Q	Ellipsoid by projection Ellipsoid WGS-84		
zone 35S	GEOID (EGM2008)		
zone 36N	I (m) EPSG 32636		
zone 36S	(m) EPSG 32736		
zone 37N	I (m) EPSG 32637		
zone 37S	(m) EPSG 32737		

Pic. 2-9

The Topodrone Post Processing software allows to perform the batch processing within one observe session. To use batch processing algorithm, press the "Add (0)" button and in a popup window you can add the directories with other flights data, .ubx files and images and press "OK".





To run the processing just press the "Start" button. Data processing is being performed simultaneously Forward and Backward and solution type is shown marked with Q symbol:

- **Q1** Fix solution
- Q2 Float solution
- **Q5** Single solution/No solution







Pic. 2-11

As a result of data processing will be displayed a window in which you can see the rover's trajectory, the number of photos, the number of time marks, the number of alignments and the accuracy of the obtained photo centers, where the marks obtained with a fixed solution are highlighted in green, and the marks obtained with a float solution are yellow.









3. RTK Post Processing module.

That module is aimed to process DJI Phantom 4 RTK, DJI P1 RTK, Autel Evo II PRO RTK data.

×		RTK POST PROCESSING		– e ×
PPK Post Processing RTK Post Processing LIDAR Post Proce	issing LiDAR Cloud Generation Static Post Processing	Precise Point Positioning Tools		License Settings
L Drome Fries Drome NuX Hie Output folder Bitch processing 2 Base station Base station CNSS Frie Coordinate type Disormal DMS Listiculas Listiculas Coordinate type Disormal DMS	saket seket seket seket seket seket degress	Projection	Logs	
Altitude 0	meters YandexSatelliteMap	Lon: Co To Markers	Clear Fit	
Antenna height o Save coordinates to Rinex	meters		A. SP. A.	
4. Processing			A Carlo Maria	
CMS dua post procesing	Tink			
WAITING FOR ACTION				

Run the Topodrone Post Processing software and go to RTK Post Processing tab.

Pic. 3-1.

Choose the folder with obtained flight data. The folder should contain the following types of files: all of the images (not renamed and/or removed), * _EVENTLOG.bin, * _PPKRAW.bin, *_PPKRAW.sig, *.obs and * _PPKRAW.sig. Output folder will be created automatically. Path and/or folder may be changed if necessary.

PPK Pot Processing LDAR Pot Processing LDAR Pot Processing LDAR Pot Processing Pr	tings
Local Number Local Number Local Number Number Drow folder D/01_booktowsLupperf.2022.05/20307 Select Drow Nu/ Hole Select Drow Nu/ Hole Select Bitch processing Add (0)	
Drove folder D/s1_spondroveSupport\$202 015203007 Select W6584 Projection + Converting Lifts and BN Res. Drove half Converting Lifts and BN Res. + Converting Lifts and BN Res. + Converting Lifts and BN Res. Drove half Converting Lifts and BN Res. + Converting Lifts and BN Res. Drove half Select + Converting Lifts and BN Res. Output folds Select + Antiprocessing Setch processing - Antiprocessing	
Drone NAW File Images from FW/IND0_0001 abs. Output folder D/bl_Toppdron#Support2022 05220301 Select > APPROV FORTUN X = 2438053 1483 Output folder D/bl_Toppdron#Support2022 05220301 Select > AMTONIA DEL AN (EM = 0) Batch processing Add (b) > Mode = %07/022 9/202 > Mode	
Output folder Dist_StoppdransSupportSo22.0522.0502 Select > AATTENUL DELEX HER > 0 Batch processing Add (0) > TME OF 1457 005 * 900/2022 9502 > TME OF 1457 005 * 900/2022 9502	
Batch processing Add (9) >THME (5) LSG 1035 9/30720 9/39-4 > Number of photo events 59 >Number of photo events 59	
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Latitude D decreas	
Longitude D degrees	
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Arterna height 0 meters	
Size coordinates to Arres	177
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Images matching & geotagging	
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Start Stop	14
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Pic. 3-2.

Ξ			ţ	RTK POST PROCESSI	NG			- 8 >
PPK Post Processing	RTK Post Processing LIDAR Po	ist Processing LiDAR Clo	ud Ceneration Static Post Processing	Precise Point Positioning	Tools		License	Settings
1. Drone files			3. Coordinate system			Logs		
Drone folder	D\01_TopodroneSupport\2022 03\22	0302	WCS-84		Projection	 Converting MRK and BIN files Parse D\01_TopodroneSupport\2022 03\220302\Matej Leven\topodrone da 		
Drone NAV file	D-\01_TopodroneSupport\2022 03\22	10302/1 Select				Images from P4RTK(100_0001 obs. > APPROX POSITION X = 4291381.8943, Y= 1191081.3723, Z= 4551553.1483		
Output folder	D:\01_TopodroneSupport\2022 03\22	0302\I Select				ANTENNA: DELTA H/E/N = 0 TIME OF FIRST OBS = 9/02/2022 9/25/02		
Batch processing		Add (0)				 TIME OF LAST OBS = 9/02/2022 9:29:44 Number of photo events 99 		
2. Base station						Read metadata from photos. Read tags from 99 photos		
Base station GNSS file		Select						
Coordinate type	Decimal DMS							
Latitude	0	degress						
Longtitude	0	degrees						
Altitude	0	meters	OpenStreetMap	58683194 Long 15 5125386	189 Co To Markers	Clear		
Antenna height	0	meters		64 W				
	Save coordinates to Rinex		5 7 9 ¹⁰ 9 10 10					
4. Processing								
GNSS data post processin	9							//
Images matching & geota	agging						D546	
			A THE R W					
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			N					
	Start	Stop						
			& Openoteettivap - Map data 62022 OpenStreetMap		99			
WAITING FOR ACT								

Choose the * _PPKRAW.nav file from drone folder.

Pic. 3-3.

Choose the base station file (*.ubx, *.obs, *.rnx, *.o). When *.rnx and *.ubx file formats are chosen, the software runs automatic conversion to *.obs format.

Attention!

The "Logs" window displays information about the actions that the software performs, you need to pay attention to the time the file from the rover and from the base station was recorded. The base station file must overlap the files from the rover.



Pic. 3-4.





The base station X,Y coordinates and the Height of the phase center will be loaded automatically from Rinex file, if it was filled during the measurements.

The WGS-84 is used by default, in case if you need to choose another one, press the "Pojection" button and use any coordinate system from the list, also you may use "Search" option.

	WGS-84	Projection	
Calibration	Not used		
Elevation	Ellipsoid by projection		-
Projection C	Croatia		
HTRS96 C	roatia LCC (m) EPSG 3766		
HTRS96 C	roatia TM (m) EPSG 3765		
HTRS96 U	ITM zone 33N (m) EPSG 3767		
HTRS96 U	ITM zone 34N (m) EPSG 3768		
HVRS71 h	eight (m) EPSG 5610		

Pic. 3-5.

If your coordinate is not included in the list, you can add it in Topodrone Post Processing software manually. Если вашей системы координат нет в списке, то вы сами можете её добавить в программу Topodrone Post Processing. After choosing the optional coordinate system conversion from WGS-84 will be performed automatically. You may correct the precise base station coordinates, if necessary.

Attention!

The height of the antenna includes the height of the pole or tripod from a point with known coordinates to the bottom of the receiver mount and the height from the bottom of the receiver mount to the phase center.







Pic. 3-6.

The Topodrone Post Processing software allows to process 3 types of height parameters, by default, H parameter conversion is performed automatically after choosing an option.

3. Coordinate system	n	
	WGS-84	Projection
Calibration	Not used	·
Elevation	Ellipsoid by projection	·
Projection Q HTRS96 Cro	Ellipsoid by projection Ellipsoid WGS-84 GEOID (EGM2008)	
HTRS96 Cro	oatia TM (m) EPSC 3765	
HTRS96 UT	M zone 33N (m) EPSG 3767	
HTRS96 UT	M zone 34N (m) EPSG 3768	
HVRS71 hei	ght (m) EPSG 5610	



The Topodrone Post Processing software allows to perform the batch processing within one observe session. To use batch processing algorithm, press the "Add (0)" button and in a popup window you can add the directories with other flights data, .ubx files and images and press "OK".





To run the processing just press the "Start" button. Data processing is being performed simultaneously Forward and Backward and solution type is shown marked with Q symbol:

• Q1 - Fix solution





- Q2 Float solution
- **Q5** Single solution/No solution





As a result of data processing will be displayed a window in which you can see the rover's trajectory, the number of photos, the number of time marks, the number of alignments and the accuracy of the obtained photo centers, where the marks obtained with a fixed solution are highlighted in green, and the marks obtained with a float solution are yellow.









4. LiDAR Post Processing

That module is aimed to process the LiDAR trajectory jointly with IMU (Inertial Measurement Unit) data using the Topodrone developed Cloud solution, in order to avoid overloading the user's PC.



Run the Topodrone Post Processing software and go to Lidar Post Processing tab.



Choose the path to GNSS measurements data in "Drone GNSS file" field, IMU data will be loaded automatically in "IMU file" field. As an output folder will be used previously selected directory. Path and/or folder may be changed if necessary.

2				LIDAR POST	PROCESSING				- & ×
PPK Post Processing	RTK Post Processing	Post Processing LiDA	Cloud Generation	Static Post Processing	Precise Point Positioning	Tools		License	Settings
). Drone files Drone GNSS file IMU file Output folder Batch processing	ClusersldmitriDesktopiTOPODR ClusersldmitriDesktopiTOPODR ClusersldmitriDesktopiTOPODR	ONE\RAV Upload ONE\RAV Upload ONE\RAV Select Add (0)	Logs > Convert dro > C\Users\dra > APPROX PC > ANTENNA: I > TIME OF FIR > TIME OF FIR	ne file to RINEX Itr\Desktop\TOPODRONE\F rsdmitt\Desktop\TOPODR SITION X = 4351950.6878, v)ELTA H/E/N = 0 SIT OBS = 14/11/2020 12:49:21 SIT OBS = 14/11/2020 12:49:21	XAW, DATA/2020-11-14, 12, 28-31 abs OME/RAW, DATA/2020-11-14, 12-28- 522797-9034, Z= 4618729-8836				
2. Drone offsets Drone model Antenna height Forward/backward offset Left/right offset	0 0	Custom meters meters meters		Cooglet lybrid	Map 🔹 Lat Ö	Lon: 0	Co To Markers Clear	FR	
3. Base station Base station GNSS file Coordinate type Latitude	Decimal Dt	Upload 45 degress					Canada Ca		
Longtitude Altitude Antenna height	0 0	degrees meters meters			Versel Carea Carea				
Receiver type/format	Save coordinates to Pine	× •	_ /		100	Access Restored Balancian SamMiller	Websee	Anna	
	Start	Stop	Cooger M	es ans C 0022 Feb Mits. Housey C 0007		5			







NOTE: In the right part of interface, you can see the start and end time of the TOPODRONE receiver data recording.

Choose the model of your LiDAR sensor and a type of mount from the list.





Offsets will be loaded from library automatically.

2. Drone offsets		
Drone model	LiDAR 200 on DJI M300 RTK (quickre	Custom
Antenna height	0.305	meters
Forward/backward offset	0.157	meters
Left/right offset	0	meters

Pic. 4-4

Choose the base station file in the "Base station GNSS file" field.





PMR Notesting RUR Notesting RUR Notesting RUR Notesting Rule Note	×				LIDAR POST	PROCESSING			-	- 6 ×
Lower Rist Lower Constraints Lower Constraints <thlower constraints<="" th=""> Lower Con</thlower>	PPK Post Processing	RTK Post Processing	LIDAR Post Processing	LIDAR Cloud Generation	Static Post Processing	Precise Point Positioning	Tools		License	Settings
ind re	1. Drone files Drone GNSS file	C\Users\dmitr\Desktop\T	TOPODRONE\RAV Up	ood	RST OBS = 14/11/2020 12:28:51 ST OBS = 14/11/2020 12:49:21					
2. Done offices Done nodel Antenna height Susse Forwardbackwald Edwight offact Coordinate type Desimal Data Antenna height Data Data Susse Desimal Data Antenna height Data Data Antenna height Data Data Antenna height Data Data Antenna height Data Data Antenna height Data Data Antenna height Data Data Antenna height Data Dat	Output folder Batch processing	C:\Users\dmitr\Desktop\T	TOPODRONE\RAV	lect APPROX P ANTENNAC TIME OF FI TIME OF L	OSITION X = 4351962.7488, Y= DELTA H/E/N = 0 RST OBS = 14/11/2020 11:32:03 VST OBS = 14/11/2020 12:56:03	522798.5172, Z= 4618734.6229				
Drone model LDAR 100 on DJI MSDO DJI K (pulcice) Custom Arterna height 0.05 metris Formard/backward offset 0 metris Base station Masson CMS file In returs Coordinate type Demini Dasi Latitude 0.05020596 degress Arterna height 0.050 Anterna height 0.050 Latitude 0.05020596 Coordinate type Demini Dirgen Masson CMS file Coordinate type Demini Dirgen Masson CMS file Coordinate type Demini Anterna height 0.050 Anterna height 0.050 Anterna height 0.050 Donod metris Park Park Park Park Donod Park Discource Park <	2. Drone offsets				GoogleHybrid	Map Tat 46.6905620	6.8500800946	Go To Markers, Clear Fi		
J. Base station Base station CNSS file Users Franks Franks Foreisan Looming Lastitude 46:9005620881 degress Actor as hoight 0.000 meters Docodinates to Bines Base station State coordinates to Bines Receiver type/format BINEs	Drone model Antenna height Forward/backward offset Left/right offset	LIDAR 100 on DJI M300 0.305 0.146 0	RTK (quickrel - Cus meter meter meter	tom s s s	Mo Mezery près Donnelo Donneloye	londin (Champtauroz	Cheiry Villeneuve Her	Châtonnaye Villarzet Sédeilles niez La Folliaz	La Brillaz Chénens	Cotter
Base station CNSS file Coordinate type Listitude Anterna height Doco Receiver type/format Receiver type/	3. Base station			Ursins	Prahin	s, Clark	Praratoud	Rossens Chavanne	s sous Orsonnens	and the second sec
Longtrude 630030946 degrees Attrude 684504 meters Anterna height 0.000 meters Base coordinates to Binax Receiver type/format TaNEX	Base station GNSS file Coordinate type Latitude	Decimal 46.6905620681	DMS degree	oad Orzer n Or	Bioley-M s opens Add na	vigation data file?	I-sur-Eucens	Willaz Sant-Pier Fuyens	re Villorsonnens E	istavaye le
Attrade 684-504 meters Anterna height 0.000 meters Swe coordinates to Binx Busines Receiver type/format TalkDX	Longtitude	6.8500800946	degree	s Pailly	Yes	No No	Curtiles Vitror	nusée Romont,	Villar	siviriaux
Receiver type/format INIXX Preceiver type/format InixX	Altitude Antenna height	684.504 0.000 Save coordinates	meters meters s to Rinex		Bercher Saint-Cierge Boulens	S Bussy sur N	Anudon Angel Sarzens Angel	Romont Berlens		Le Gibloux
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Start Stop		Start	Stop	ttilliez: Póliczi Pi sthiar (Hundi	Gecko escalado: Jorar Menthue Peney le Jorat tet sp Nature D	Etdi Suisse Hermenches Villangeaux Vucherens	H ²⁹ Cr H ²⁰ Le Saulty Cr Esmonts Ursy Rue	Vuistemens üvennt-Romont avannes tes Forts 1 Romaner Sommenter	s	



While loading base station RINEX file, it is necessary to download the ephemeris, you can load it from Topodrone receiver which is built-in your LiDAR.

It is necessary to choose the reciever which is supported by TOPODRONE Post Processing

NOTE: TOPODRONE Post Processing software supports data from different types of receivers, if your GPS isn't shown in the list, you can convert static data to universal RINEX format.





Enter precise base station coordinates.





Base station GNSS file	D:\Static PP\26 Test Lidar 200 SuperCam	Vpload
Coordinate type	Decimal DMS	
Latitude	55.7635219046	degress
Longtitude	37.6608992641	degrees
Altitude	220.875	meters
Antenna height	0.000	meters
	Save coordinates to Rinex	
Receiver type/format	RINEX	



NOTE: It is necessary to enter base station coordinates in following consequence: latitude, longitude and height on the ellipsoid of WGS84 system.

Start the processing by pressing the "Start" button.

X			LIDAR POST	PROCESSING		- 8 ×
PPK Post Processing	RTK Post Processing LiDAR Post Proc	essing LiDAR Cloud G	Generation Static Post Processing	Precise Point Positioning	Tools	License Settings
1. Drone files			Logs			
Drone GNSS file	C\Users\dmitr\Desktop\TOPODRONE\RAV	Upload 🌍 🍝	Establishing a connection to the server.			<u>^</u>
IMU file	C\Users\dmitr\Desktop\TOPODRONE\RAV	Upload >	 Uploading base file: CAUserstamitr/Desk Uploading navigation data file: CAUserst 			
Output folder	C\Users\dmitr\Desktop\TOPODRONE\RAv	Select >	 Passing parameters for calculation Uploading drone file 0: C\Users\dmit/\Di 			
Batch processing		Add (0)	> Uploading IMU file 0: C\Users\dmitr\Des > The data1 has been uploaded to the sen	ktop/TOPODRONE/RAW_DATA/2020-1 ver for calculation. Waiting for the corr	1-14_12-28-31.imr pletion of the calculation	v
2. Drone offsets			GopaleHybridM	lap 144 46,6905620681	Log: 6.8500800946 Co To: Markers	Clear
Drone model	LIDAR 100 on DJI M300 RTK (quickrei	Custom	Pomy Mole	ondin Champtauroz - 2	WILL ARTON	The Brilling
Antenna height	0.305	meters	AN AN	Statt 12 12	Ch	atonnaye Cotter
Forward/backward offset	0.146	meters	Mézery près Donnelo	e Fa ta	Villeneuve Villarzel Séd	eilles
Left/right offset	0	meters	Donneloye	aouna	Henniez	La Folliaz Chénens
3. Base station			Ursins Prahins Chanea	4 Vorder B	Praratoud	sens Chavannes sous Orsonnens
Base station GNSS file	C:\Users\dmitr\Desktop\TOPODRONE\RA\	Upload	Orzens	Denezy	eucens	Villaz-Saint-Pierre
Coordinate type	Decimal DMS		n Oppens Correvon	1 3 11-1	July in Marin	Fuyens Villorsonnens Estavayer le
Latitude	46.6905620681	degress	Ogens	Villars le Comte	Lucens Patinoire de Romor	to AC ROLLS
Longtitude	6.8500800946	degrees	Pailly Le Donjor	du a la l	Curtilles Vitromusée Romont	Villarsiviriaux
Altitude	684.504	meters	Bois des Briga Bercher	nds Neyruz-sur-Moudon	Musee suisse du vitrail.	Berlens
Antenna height	0.000	meters	Saint-Cierges	Bussy sur Moud	on yaub	Le Gibloux
	Save coordinates to Rinex		Boulens	M. Dayle	Sarzens	Lo Chátolard
Receiver type/format	RINEX		Fey	My We Della	Brenies	Sentier des Sculptures
			Montanaire	Lidl Suisse	Villaraboud	Estévenens
			Gecko escalade		Siviriez	1 hours
		8	Jorat-Menthue	W. A. C.	Chavannes-les-Forts	Bomanens
		1	AU 42 111	Drie alto	Charles On Star	X TOM DE
		1	ntilliez	termenches and a state of the s	Esinonis	Sálas
		1	Peney-le-Jorat	Villangeaux	Ursy Sommentier	14 Classics
	Start	Stop	PolieziPittet	Vucherens	e - Ne - Ar - Ar - P	
		3		der Trusy franzen honsen val de Diter		Vaulituz



NOTE: Once the processing is started the dataset will be uploaded to the Topodrone server for calculation the trajectory file from the GNSS and IMU data. For this processing step the internet connection should be stable, otherwise the calculation process will be interrupted and the procedure should be repeated.

As a result of the calculation the high precision trajectory file will be downloaded to your PC and in Map field of the software interface you will see the trajectory visual and its accuracy. Green color that trajectory calculated with Fix solution. means was Yellow color trajectory calculated with Float solution. that means was





Red color means that trajectory was calculated with Single solution. The trajectory file itself will be saved in Project default folder.



Pic. 4-9





5. LiDAR Cloud Generation

Run the Topodrone Post Processing software and go to LiDAR Cloud Generation tab.



Pic. 5-1

Choose the path to your dataset, *.pcap file "Lidar file" field, in the "Track file" field choose the path to a track_*.pos trajectory file, the output file will be saved to Output folder in the Project path by default. To change the default folder, please fill the "Output folder" field.





Press the "Trim Track" button if you want to choose the part of trajectory for Point cloud generation.







Pic. 5-3

Press the "ACCEPT" button to cut unselected trajectory data and press "OK" to confirm.



Pic. 5-4







To choose the correct coordinate system, press the "Projection" button and select your coordinate system from the proposed list or enter the name of the coordinate system in the search bar.

3. Coordinate syste	m	
	WGS-84	Projection
Calibration	Not used	
Elevation type	Ellipsoid by projection	
Projection	32637	
zone 34 zone 35 zone 35 zone 36 zone 36 zone 37	S (m) EPSG 32734 N (m) EPSG 32635 S (m) EPSG 32735 N (m) EPSG 32636 S (m) EPSG 32736 N (m) EPSG 32637	



The Topodrone Post Processing software is allows to process 3 types of height parameters, by default, H parameter conversion is performed automatically after choosing an option.

3. Coordinate system)	
	WGS-84	Projection
Calibration	Not used	
Elevation type	Ellipsoid WGS-84	
Projection Q	Ellipsoid by projection Ellipsoid WGS-84	
zone 34S	GEOID (EGM2008)	
zone 35N	(m) EPSG 32635	
zone 35S	(m) EPSG 32735	
zone 36N	l (m) EPSG 32636	
zone 36S	(m) EPSG 32736	
zone 37N	(m) EPSG 32637	



Press the "Start" button to run Point loud generation process.



















6. Static Post Processing

Static GNSS measurements data calculation module.

This module includes 2 parts:

- 1. One vector
- 2. Equalizing networks

One vector module calculates rover coordinates relatively to base station using one vector. To begin the calculation process we need load Base station file, Rover file and navigation file. Supported formats of the observation files are: *.ubx, *.obs, *.rnx and *.*O.

For the most accurate calculation it is high recommended to load the ephemeris file, own or downloaded from NASA server. Supported formats of the observation files are: *.nav, *.rnx, *.n, *.p, *.g, *.h, *.q, *.c and *.l.

The distance from the base station to the rover, when using accurate ephemeris and the NASA navigation file, is practically unlimited, daily RINEX files give an RMS of about 5 centimeters at a distance of 5 thousand km.

The module has the ability to perform a measurement immediately in the selected projection.

6.1. One vector

To run this module, you need to open the Topodrone Post Processing software, go to the Static Post Processing tab and click on the "One vector" button.





Loading Rover data files.









Loading the onboard ephemeris data files.

-							
PPK Post Processing	RTK Post Processing LiDAR Post	t Processing LiDAR Cloud Cenerati	on Static Post Processing Pre	cise Point Positioning Tools		License	Settings
1, Rover files		4 Coord	nate system		Logs		
Rover GN55 file	D\Static PP\reach_raw_20220426062	Oub: Select	WGS-84	Projection	Convert rover raw data log to RINEX. Convert rover raw data log to RINEX.		
RINEX NAV file		Select			Parse D\Static Preach raw_20220420020 005 Parse D\Static Preach raw_202204260520 0bs. ADDREW DOCTOOL > 2 DOCTOOL		
Ephemens/clock file		Download			 APPRIOR POSITION A 200204 / PCS, 15 3705544 0234, 25 4507546 3235 ANTENNA: DELTA H/E/N = 0 YUME OR EIDER DRE DRE 0 600/2002 620 / 3 		
Ephemerisklock file	C. Martine Science	Download			 TIME OF FIRST OBS = 26/04/2022 7:22:35 TIME OF LAST OBS = 26/04/2022 7:22:35 		
Output folder	D:\Static PP	Select					
2. Rover offsets	10						
Antenna height	0.000	meters					
3. Base station							
Base station GNSS file		Select					
Coordinate type	Decimal DMS						
Latitude	0	degress OpenSt	reetMap 💽 Lat	Lon: Co To	Markers: Cloar Fit		
Longtitude	0	degrees	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				
Altitude	0	meters	and the second			1	
Antenna height	0	meters			A CALL AND A CALL		
				the second	apply of young !!		
				12-11			
					A had the that		
					MAN STAR		
						× .	
						1	
	Charl	Char.					
	Start	Stop	22 OpenStreetMap				
WAITING FOR ACTI	ION						



Loading high precision ephemeris data files (if necessary).









Fill the Rover antenna height.

Attention!

The height of the antenna includes the height of the pole or tripod from a point with known coordinates to the bottom of the receiver mount and the height from the bottom of the receiver mount to the phase center.





Load base station measurements data files.









The base station X,Y coordinates and the Height of the phase center will be loaded automatically from Rinex file, if it was filled during the measurements.





The WGS-84 coordinate system is used by default, in case if you need to choose another one, press the "Projection" button and use any coordinate system from the list, also you may use "Search" option or add your own .prj file.





4. Coordinate sys	tem	
	WGS-84	Projection
Calibration	Not used	-
Elevation	Ellipsoid WGS-84	-
Projection (32645	
zone 4 zone 4 zone 4 zone 4 zone 4	41S (m) EPSG 32741 42N (m) EPSG 32642 42S (m) EPSG 32742 44N (m) EPSG 32644 44S (m) EPSG 32744	
zone	45N (m) EPSG 32645	

Pic. 6-1-8

При Selected coordinate system will be automatically converted from WGS-84 to user chosen projection. Adjust the base station coordinates if necessary.

Attention!

The height of the antenna includes the height of the pole or tripod from a point with known coordinates to the bottom of the receiver mount and the height from the bottom of the receiver mount to the phase center.

3. Base station		
Base station GNSS file	D:\Static PP\CHML_260422.0600_260422.	Select 🥥
Coordinate type	Decimal DMS	
North	5696506.926745112	meters
East	430318.657846235	meters
Height	399.041	meters
Antenna height	0.000	meters

Pic. 6-1-9

Press the "Start" button and software will begin calculation.







Pic. 6-1-10

After completion of the calculations, the program will display a window with the coordinates of the base station and the rover in the WGS-84 coordinate system and the local coordinate system and offer to save these data to observation files for further use. Also, a file with the results of the calculation will be saved in the output data folder.

PR: WGS 84-UTM-zone 45N (m) EPSG 32645 Evention type: Ellipsoid WGS-84 Base:	TOPODE	RONE Post Proc	cessing		>
Base: WGS-84	?	PRJ: WGS 84 Elevation typ	UTM-zone 451 e: Ellipsoid W	N (m) EPSG 326 GS-84	45
WGS-84 Latitude: \$5,99797117 degrees Attitude: 399.041 meters Attitude: 399.041 meters PRJ North: \$5696506.9267 meters East: 430318.6578 meters Height: 399.041 meters Rover:	0	Base:			
Latitude: 51.4154901 degrees Longtitude: 85.99797117 degrees Altitude: 399.041 meters 		WGS-	84		
PRJ North: \$5696506.9267 meters East: 430318.6578 meters Height: 399.041 meters Rover:		Latitude: Longtitude: Altitude:	51.4154901 85.997971 399.041 met	degrees 17 degrees ers	
North: 5696506.9267 meters East: 430318.6578 meters Height: 399.041 meters Rover: WGS-84 Latitude: 51.95285239 degrees Longtitude: 85.92753598 degrees Altitude: 265.7635 meters Accuracy Accuracy Latitude 0.0011 meters Accuracy Latitude 0.0019 meters Accuracy Altitude: 0.0019 meters Accuracy Altitude: 0.0006 meters PRJ North: 5756337.5701 meters East: 426298.4687 meters Height: 265.7635 meters Update coordinates in rinex files of rover and base?		PRJ -			
Rover: WGS-84		North: East: Height:	5696506.926 430318.6578 399.041 me	57 meters meters ters	
WGS-84 Latitude: \$1.95285239 degrees Longtitude: 85.92753598 degrees Altitude: 265.7635 meters Accuracy Accuracy Latitude 0.0011 meters Accuracy Longtitude: 0.0019 meters Accuracy Altitude: 0.0006 meters PRJ North: \$756337.5701 meters East: 426298.4687 meters Height: 265.7635 meters Update coordinates in rinex files of rover and base? Yes No		Rover:			
Latitude: 51.95285239 degrees Longtitude: 85.92753598 degrees Altitude: 265.7635 meters Accuracy Accuracy Latitude 0.0011 meters Accuracy Longtitude: 0.0019 meters Accuracy Altitude: 0.0006 meters PRJ North: 5756337.5701 meters East: 426298.4687 meters Height: 265.7635 meters Update coordinates in rinex files of rover and base?		WGS-	84		
Accuracy Latitude 0.0011 meters Accuracy Longtitude: 0.0019 meters Accuracy Altitude: 0.0006 meters PRJ North: 5756337.5701 meters East: 426298.4687 meters Height: 265.7635 meters Update coordinates in rinex files of rover and base?		Latitude: Longtitude: Altitude:	51.9528523 85.927535 265.7635 m	9 degrees 598 degrees eters	
Accuracy Latitude 0.0011 meters Accuracy Latitude: 0.0019 meters Accuracy Altitude: 0.0006 meters PRJ North: 5756337.5701 meters East: 426298.4687 meters Height: 265.7635 meters Update coordinates in rinex files of rover and base?			Castorechargedeadare		
PRJ North: 5756337.5701 meters East: 426298.4687 meters Height: 265.7635 meters Update coordinates in rinex files of rover and base? Yes No		Accuracy Lati Accuracy Lon Accuracy Alti	tude 0.0011 gtitude: 0.001 tude: 0.0006	meters 9 meters meters	
North: 5756337.5701 meters East: 426298.4687 meters Height: 265.7635 meters Update coordinates in rinex files of rover and base? Yes No		PRJ -			
Update coordinates in rinex files of rover and base?		North: East: Height:	5756337.570 426298.4687 265.7635 m	01 meters meters eters	
Yes No		Update coo	r <mark>d</mark> inates in rin	ex files of rove	r and base?
				Yes	No





Pic. 6-1-11

6.2. Equalizing networks

To run this module, go to the Static Post Processing tab and click on the "Equalizing networks" button.

W1 R62 Researce LGAR R4 Researce LGAR R4 Researce Researce	2				N	IETWORK EQ	UALIZATION								- 8 ×
ELENDOC • Adjestimes • Adjestimes • • • • • • • • • • • • • • • • • • •	PPK Post Processing	RTK Post Processing	LIDAR Post Processing	LIDAR Cloud Ceneration	atic Post Processing	Precise Point Posi	tioning	Tools						License	Settings
	ELEVATION:	÷	Q				EVENTS LOG:								
	Afabaoistan					~									
	> Alaska														
	> Albania														
	 Algeria Morocco Tu 	unisia													
	> Algeria														
	 American Samoa 														
	 Annola (Cahinda) 					\sim									
		RNEE	COORDINATES	PROJECTION	PACY		COORDINATES	ITRF-14	4	ACCURACY	1	DI	STORTION OF CS		DENSITY
	NAME N		EAST HEIGI	HT NORTH EA	ST HEIGHT	NORTH	EAST	HEIGHT	NORTH	EAST	HEIGHT	NORTH	EAST	HEIGHT	WEIGHT
DIFEN NEW INITIAL TABLE: ADD ROW. MEASURED TABLE ADD ROW. DELETE ROW.	MEASURED R POINT I NAME N	RNEE IAPP NVHH NORTH	COORDINATES EAST HEIGI	PROJECTION ACCU	RACY ST I HEIGHT	NORTH	COORDINATES EAST	ITRF-14	NORTH	ACCURACY EAST	HEIGHT	NORTH I	STORTION OF CS BY SYGNS EAST	HEIGHT	
OPEN NEW INITIAL TABLE ADD ROW DELETE ROW MEASURED TABLE ADD ROW. DELETE ROW															
	OPEN NEW	INITIAL TABLE: ADD	DELETE ROW	MEASURED TABLE	ADD ROW D	ELETE ROW						STO	OP CALC	ULATE	Recalculate



For the visual displaying of observation points, it is necessary to have "Maps" window opened, while data files are being loaded to the software.









On the bottom panel, user can find some necessary tools:

Open or Create a new Project, Add or Remove the data files of the input points, Add or Remove the measured points, Start or Stop processing.

OPEN	NEW	INITIAL TABLE:	ADD ROW	DELETE ROW	MEASURED TABLE	ADD ROW	DELETE ROW	STOP	CALCULATE	Recalculate
WAI	TING FOR AC	TION								

Pic. 6-2-3

Pressing the "ADD ROW" button will initiate the loading of the input points.

2					NETWORK EQUALIZATION							- 8 ×
PPK Post Processing	RTK Post Processing	LIDAR Post Processing	LIDAR Cloud Generation	Static Post Processing	Precise Point Positioning	Tools					License	Settings
ELEVATION:	•	Q			EVENTS LOG							
 Afghanistan Alaska Albania Algeria Morocco TL Algeria Algeria Arrerican Samoa Anvela (Cahinda) 	inisia											
INITIAL R POINT I NAME N	NEE APP VHH NORTH	COORDINATES EAST HEIGH		CCURACY EAST I HEICHT		ITRF-14 HEIGHT NORTH	ACCURACY EAST	HEIGHT		STORTION OF CS BY SYGNS EAST	HEIGHT	DENSITY WEIGHT
MEASURED R POINT I NAME N		COORDINATES T EAST HEICH	Créss frie RINE NAV frie Ephenmenéolock frie Ephenmenéolock frie Arterna height Arterna height rr				x Select Select Doominaad exters OK	наснт	DIE NORTH	STORTION OF CS IPTSCHE 2007 1	неконт	
OPEN NEW		DELETE ROW	MEASURED TABLE	ADD ROW	DELETE ROW				នា	DP CALCULA	TE I	Recalculate
WAITING FOR AC	TION											

Pic. 6-2-4

GNSS file - measurements data from GNSS receiver, file formats: *.obs, *.rnx or *.*o.

RINEX NAV file – navigation measurements data, file formats: *.nav, *.rnx, *.n, *.p, *.g, *.h, *.q, *.c and *.l.

Ephemeris/clock file – final ephemeris file in *.sp3, *.eph format, you can also upload the accurate onboard clock *.clk file. When you click on the Download button, if there is data on the NASA server, the software will automatically download this data

Attention!

When processing Equalizing networks, the software uses the method of obtaining high-precision coordinates of the area (Precise Point Positioning - PPP) using global navigation satellite systems by obtaining corrections to the orbit ephemeris and on-board clocks of all visible spacecraft. For the best calculation, it is recommended to add daily measurements from the nearest reference base station or IGS.

Туре	Orbit and clock accuracy	Accessibility	Note					
Broadcast	~100 cm	Real time	GLONASS (.YYg) and GPS (.YYn)					
	~5 ns RMS		onboard ephemeris generalized in the					
	~2.5 ns σ		MCC per day in RINEX format					





			····
UltraRapid	~3 cm	3-9 hours later	Precise ephemeris and on-board clock
	~150 ps RMS		corrections
	~50 ps σ		
Rapid	~2.5 cm	17-41 hours	Ephemeris and on-board clock corrections
	~75 ps RMS	later	obtained on the interval of the last day
	~25 ps σ		
Final	~2.5 cm	12-18 days	Final ephemeris and on-board corrections
	~75 ps RMS	later	
	~20 ps σ		

Then it is necessary to enter the coordinates of the initial points and the accuracy of their determination. If you do not know with what accuracy they were determined, then you need to indicate the following recommended accuracy:

Fundamental astronomical geodetic network 20 mm north/east, 30 mm height

High-precision fundamental geodetic network 30 mm north/east, 40 mm height

Satellite geodetic network and astronomical geodetic network 40 mm north/east, 50 mm height

Government geodetic network 60 mm north/east, 110 mm height

INITIAL	RNEE	PROJECTION					
POINT	IAPP	COORDINATE	S		ACCURACY		
NAME	NVHH	NORTH EAST	HEIGHT	NORTH	EAST	HEIGHT	
batu120v00	D: D: D: D: 46110	092.565 224462.192	341.028	0.06	0.06	0.11	0
kobu120v00	D: D: D: D: 4635	472.569 232452.35	32.368	0.06	0.06	0.11	0
pot2120v00	D: D: D: D: 4671	068.231 225296.48	37.331	0.06	0.06	0.11	0
xulo120v00	D: D: D: D: 4613	968.662 276266.472	969.96	0.06	0.06	0.11	0

Pic. 6-2-5

To load data on measured points, you must use "ADD ROW" opposite the "MEASURED TABLE" item and, by analogy with the initial points, perform the download.





- A					NETWORK E	QUALIZATION	1							– e ×
PPK Post Processing	RTK Post Processing	UDAR Post Processing	LIDAR Cloud Generatio	Static Post Processin	g Precise Point Po	sitioning	Tools						License	Settings
ELEVATION: Afghanistan Albania Algeria Morocco Jalgeria Angola (Cabinda Angola (Cabinda	ELEVATION: C Adjamaintan Adjam													
INITIAL	RNEE	000000000000000000000000000000000000000	ROJECTION	10000400		000000000000000000000000000000000000000	ITR	-14	1000010101		D	ISTORTION OF CS	ç	DENSITY
NAME	N V H H NORTH	EAST HEIGH		EAST HEIGH	HT NORTH	EAST	HEIGHT	NORTH	EAST	HEIGHT	NORTH	EAST	HEIGHT	WEIGHT
batul20v00	D. D. D. D. 4611092.565	224462.192 341.028	0.06	0.06 0.11	0	0	0	0	0	0	0	o 0	<u> </u>	0
kobu120v00 pot2120v00	D D D D 4635472.569	232452.35 32.368	0.06	0.06 0.11	0	0	0	0	0	0	0	0 0		0
xulo120v00	D. D. D. D. 4613968.662	276266.472 969.96	0.06	0.06 0.11	ŏ	0	0	0	o.	ŏ	ŏ	o o	i i	o l
MEASURED POINT		COORDINATES	PROJECTION	ACCURACY		COORDINATES	ITR	=-14	ACCURACY		D	NSTORTION OF CS BY SYGNS		
NAME	N V H H NORTH	EAST HEIGH	IT NORTH	EAST HEIGH	HT NORTH	EAST	HEIGHT	NORTH	EAST	HEIGHT	NORTH	EAST	HEIGHT	
2120v00	D. D. D. D. 0	0 0	0.001	0.001 0.001	0	0	0	0	0	0	0	o o		
			MEASURED TA											Perairulate
NEW	AUD AUD	DELETE NOW	MEASURED TA	ADD NOW	CALLETE HOW							CALCO	1	- and consoliditer



Select the coordinate system and preferred height type.

X				
PPK Post Processing	RTK Post Processing	LiDAR Post Processing	LiDAR Cloud Generation	Static Post Processing
ELEVATION:	llipsoid WGS-84 ×	Q 32638		
zone 36S zone 37N zone 37S	(m) EPSG 32736 (m) EPSG 32637 (m) EPSG 32737			
zone 38N	(m) EPSG 32638			
zone 38S	(m) EPSG 32738			
zone 39N	(m) EPSG 32639			

Pic. 6-2-7

By pressing a "CALCULATE" button the software will run the calculation process. In the bottom left corner will be displayed which calculation is in progress and how many calculations need to be performed.





										•	opourome		
Ξ						NETWORK EQUALIZ	ATION						– e ×
PPK Post Proces	sing RTK Post Pro	cessing LIDAR Post F	Processing UDAR Cli	oud Ceneration Sta	tic Post Processing	Precise Point Positioning	Tools					License	Settings
ELEVATION:	Ellipsoid WCS-84	· Q 32639	3			Start of Start of Parse D APPRO ANTEN	LOG network equalizati (Static Network)01 X POSITION X = 356 NA. DELTA H/E/N = E EIPST OBS = 30/0	on					
	CATOPODRONELPor processing : 2022	stProcessing\data\rtklib\rmx2rtk	kp.exe	and a first static and a state		-	□ × 152	022 20:59:30 atalogs (forward & backward)_					
			CI(10P00K0NE(P01P100	lessing (data ditab dini 210p	lete								
		pro	cessing : 2022/05/	01 07:05:30 Q=6					î		DISTORTION OF C		DENSITY
NAME									HEIGHT	NORTH	EAST	HEIGHT	
batu120v00									0	0	0)	0
pot2120v00									0	0	0	,)	0
xulo120v00									0	0	ō ()	0
MEASURED POINT NAME 1120v00 2120v00	-								HEICHT 0 0	NORTH 0 0	DISTORTION OF CO BY SYGNS EAST 0 0	HEIGHT	
									¥				
	INITIAL TABLE:	ADD ROW D	ELETE ROW	MEASURED TABLE	ADD ROW	DELETE ROW					TOP	ULATE	Recalculate
GNSS POS	ITIONING 1/79												



The calculation process uses the following algorithm:

1. Calculation of the coordinates of all points in the ITRF2014 coordinate system using the Precise Point Positioning - PPP method. After this step, in the ITRF-14 window you will see the calculated coordinates and the accuracy with which they were obtained.

ITRF-14										
	COORDINATES	5		ACCURACY						
NORTH	EAST	HEIGHT	NORTH	EAST	HEIGHT					
41.60400389	41.69360185	341.0316	0.0055	0.0042	0.0073					
41.82596701	41.77839375	32.397	0.0195	0.0066	0.0177					
42.14358073	41.67573877	37.3276	0.0044	0.0031	0.0078					
41.64607682	42.31343561	969.977	0.0046	0.0028	0.0086					
NORTH	EAST	HEIGHT	NORTH	EAST	HEIGHT					
41.7432263	41.76681853	341.0236	0.0242	0.0179	0.0285					
42.00570439	41.87580552	37.33	0.0224	0.0186	0.027					

Pic. 6-2-9

2. At the next stage, the software calculates the coordinates of the points using the Precise Point Positioning method and statically measures all possible vectors, calculates the coordinates of the points by accuracy using weighting method.





3. Then, using the coordinate system and coordinates of the original ones, taking into account the weighting accuracy of the points, the software calculates the total offset from the parameters of the selected projection and creates a grid of residual distortion correction.

In the DISTORTION OF CS BY SYGNS window, you can see the residual distortion of the coordinate system relative to the original points. In the DENSITY WEIGHT window - Dot Density, it is needed to increase / decrease the weight of distortion, a single point has more weight than a point that is next to others.

	DISTORTION OF CS BY SYGNS							
NORTH	EAST	HEIGHT	2					
-0.006	0.007	0.008	0.746					
0.006	-0.015	-0.017	0.725					
0.006	0.008	0.015	0.726					
-0.006	-0.001	-0.005	1.803					

Pic. 6-2-10

As a result of the calculations, you will receive a catalog of point coordinates in the coordinate system that was specified, the accuracy of determining these coordinates and a distortion grid for use in the Topodrone Post Processing program and open the CALIBRATION tab through the TOOLS module.

MEASURED	R	N	E	E		PROJECTION									
POINT	1	A	F	P		COORDINATES			ACCURACY						
NAME	N	V	H	ΙН	NORTH	EAST	HEIGHT	NORTH	EAST	HEIGHT					
1120v00	D:	D	D	: D	4626320.797	231145.1071	341.007	0.0842	0.0771	0.1453					
2120v00		D	D	D	4655132.4376	241270.8679	37.3174	0.0776	0.0727	0.1369					

Pic. 6-2-11





7. Precise Point Positioning

Precise Point Positioning (PPP) is a global navigation satellite system positioning method that calculates coordinates with an error of only a few centimeters under good conditions. PPP is a combination of several relatively sophisticated GNSS positioning techniques. Unlike the RTK method, which uses a base station, a rover and relatively small distances between them, the PPP method uses a single GNSS receiver.

Go to the Precise Point Position tab to and click on the "Select" button to download data from the GNSS receiver. Supported formats: *.ubx, *.obs, *.rnx and *.*o.



Pic. 7-1

Next, we need to load the rest of the data.



Pic. 7-2

RINEX NAV file – navigation measurement file, supported formats *.nav, *.rnx, *.n, *.p, *.g, *.h, *.q, *.c and *.l.

Ephemeris/clock file – final ephemeris file in *.sp3, *.eph format, you can also upload the exact onboard clock *.clk file. When you click on the "Download" button, if there is data on the NASA server, the software will automatically download this data.

Output folder – folder with output data, if necessary, it can be changed.

BIt is necessary to select the preferred coordinate system and height type in which we need to get the coordinates of the point.







Pic. 7-3

Then, if data is available, enter the coordinates of the base station and the height of the antenna, taking into account the phase center.





By pressing the "Start" button the software will run the calculation.



Pic. 7-5

As a result of the calculations, a window will appear indicating the coordinates of the point in the WGS-84 coordinate system, in the selected coordinate system and the accuracy of determining these coordinates. Also, by clicking the "Yes" button, the software will write the calculated coordinates to the header of the RINEX file.





TOPODRONE Post Processing

WGS	5-84						
Latitude:	56.06245439 degrees						
Longtitude	37.35495175 degrees						
Altitude:	Altitude: 241.4905 meters						
PR.	J						
North:	6214250.6927 meters						
East:	397572.745 meters						
Height:	241.4906 meters						
Accur	acy						
Accuracy La	titude: 0.0156 meters						
Accuracy Lo	ngtitude: 0.0051 meters						
Accuracy Al	titude: 0.0111 meters						
Update co	ordinates in rinex files of station						



8. Tools

8.1. GNSS Data Archive

This module allow to download rinex static data from open CORS networs. The module is divided into IGS - all available base stations, and RGS - base stations located on the territory of the Russian Federation. At the beginning of 2022, the database contains more than 500 base stations, while 56 base stations are located on the territory of the Russian Federation. Of all the base stations, more than half support several satellite constellations.

To launch the module, go to the Tools tab, then GNSS Data Archive and select the database you need.



Pic. 8-1-1





Then upload rinex/ubx data from your drone or GNSS receiver and software imports time of observation, or enter time interval manually. Specify the folder where you want to save the result.



Pic. 8-1-2

In the table or on the map, select the base station from which you want to download data and click the "Start" button, the data will be downloaded to the specified folder.





8.2. Maps

The Maps module is used to display loaded static observations and vectors during processing. To launch the module, go to the Tools tab and click the "MAPS" button. To display the points at which observations were made, it is necessary that the map window be open at the time the files are loaded. If this condition was not met, then the data must be loaded again.









8.3. Cloud viewer

This tool is designed to view the point cloud obtained during processing in the Topodrone Post Processing software product. To launch the module, go to the CLOUD VIEWER in the Tools tab and click the NEW button. In the tab that opens, select a point cloud in *.las or *.laz format. After loading, the point cloud will be displayed in the main window.





8.4. Trim

This tool is designed for trimming toolpath data. To run the tool, press the "Tools" button and select "Trim", then "Track". Then select the trajectory you want to trim.









In the bottom part of the window there are two sliders, by moving which you specify the trajectory interval that will remain and which will be cut off. On the trajectory you will see a visual display of two colors. Green indicates the area that will be saved after cropping, and red indicates the area that will be cropped.



Pic. 8-4-2

After selecting a section, trim the unwanted part by clicking on "TRIM" button. The trajectory will be saved to a file in its original format.

You can also trim Inertial Navigation System (IMU) data using the Trim tool.





NOTE: This tool is also useful if, after starting toolpath processing, the dataset contains an error message - The IMU file contains gaps in the measuring points! Use the "TRIM IMU" tool to remove the missed sampling time interval.

> Preparation of initial data for calculation
> Check the IMU file for missing measurement points
> The IMU file contains gaps in the measuring points! Use the "TRIM IMU" tool to remove the missed sampling time interval.

Pic. 8-4-3

To run the tool, you must click on the "Tools" button and select Trim, then IMU. Then select the *.imr file to be trimmed and the GNSS receiver file in *.ubx format.

File <u>n</u> ame:	2022-05-30_11-14-36.imr	 IMU file (*.imr) 	~
		<u>O</u> pen	Cancel
8-4-4			
File name:	2022-05-30_11-14-36.ubx	V Drone file (*.ubz	c) \
	ι	Open	Cancel

Pic. 8-4-5

Pi

The software will perform GNSS pre-processing and if there were gaps in the IMU data, you will see this on the screen in the form of vertical lines and the designation (GAP).





For further correct processing, it is required to exclude GAP from the data.

From the selected file, we will need to exclude 2 GAPs from processing, therefore the IMU file needs to be divided into 3 segments and further processed 3 parts. Cropping occurs only one segment, so in this case we will need to repeat this procedure 3 times.









After highlighting the desired segment using the sliders at the bottom of the screen, press "TRIM". After trimming, the IMU file will be saved to a file in its original format for the specified interval and will be saved to the original folder.

8.5. Coordinate convert

This utility allows you to convert data from one coordinate system to another using the *.prj coordinate system file that is loaded into the Topodrone Post Processing database. In order to convert one point from the WGS-84 coordinate system to any other, you need to pull out COORDINATE CONVERT in the TOOLS tab, then ONE COORDINATE.





Select coordinate format (decimal or degrees, minutes, seconds)





DEGREES	LATITUDE:	55.628671	DEGREES
D°M'S"	LONGTITUDE:	37.677768	DEGREES
	ALTITUDE:	144	METERS



Next, select the required type of height.

Ellipsoid by projection	۷
Ellipsoid by projection	
Ellipsoid WGS-84	
GEOID (EGM2008)	

Pic. 8-5-3

Select the desired coordinate system. The required *.prj file can be quickly found using the search bar. The origin point coordinates must be within the area covered by the *.prj file.





Then, click on the right arrow, which, when hovering over with the mouse, will change its color to green. Click on the arrow with the left mouse button.







Pic. 8-5-5

After that, the converted values of the coordinates of the starting point in meters will appear on the right side.





In order to convert a catalog of coordinates from one coordinate system to another, select COORDINATE CONVERT in the TOOLS tab, then COORDINATES FROM FILE.

2	COORDINATE CONVERTER FOR ALL COORDINATES IN FILE										
PPK Post Processing	RTK Post Processing	LIDAR Post Processing	LIDAR Cloud Ceneration	Static Post Processing	Precise Point Posit	ioning Tool	15			License	Settings
Source					Select						
Start row	3. Separator 🔲 Tab	Semicolon 🔤 Comma	Space Other:								
Coordinate system: Elevation type:	WCS-84 PRJ					Coordinate system: Elevation type:	WCS-84 PR3				
		•									
WAITING FOR AC	TION										



In the Source tab, you must select the file of the coordinate catalog that you want to convert, specify the line from which you want to import and the type of coordinate separator.





Source	D:\Topodre	one Post Process	ing\Coordir	ate converter\G	CP PPK WGS-8	34.txt		Se
Start row	1	3. Separator	Tab	Semicolon	Comma	Space	Other:	

Pic. 8-5-8

Then select the coordinate system and height type of the original coordinate catalog.

Coordinate system:	WGS-84 PRJ
Elevation type:	Ellipsoid WGS-84

Pic. 8-5-9

Then it is necessary to specify which column belongs to which coordinate.

v	Longitude/East ~	Latitude/North ~	H-EII/H v
P3	85.9625224	51.49032709	392.66
P5	85.95642994	51.49033207	427.862
P4	85.9577886	51.48947973	429.369
P6	85.94639449	51.49107792	445.855
P7	85.94200696	51.49158162	447.035
P8	85.94416609	51.4941664	429.238
P9	85.94912985	51.48694646	469.084
T26	85.90946928	51.48816517	484.667
T27	85.91545609	51.49013224	460.869
T28	85.9225729	51.49361702	437.739

Pic. 8-5-10

Specify the coordinate system and type of height of the catalog of coordinates that we want to get.





				topourone.com	
Coordinate system:	WGS-84	PRJ			
Elevation type:	Ellipsoid WGS-84				
Use calibration?	NO	Q 3264			
	,				^
zone 42N (m	n) EPSG 32642				
zone 43N (m	n) EPSG 32643				
20ne 44N (m	D EPSC 32645				
2008 46N (m) EPSC 32646				
20110 4014 (11	17-21-30-320-40				~

Pic. 8-5-11

By pressing the "Start" button in the right window, the catalog will be displayed in the coordinate system that was selected in the previous step.

Ξ					COORDINATE CC	NVERTER FO	OR ALL CO	ORDINATES IN FIL	E			– 8 ×
РРК Р	ost Processing	RTK Post Processir	ng LiDAR Post Processing	LiDAR Cloud Generation	Static Post Processing	Precise Point Posi	itioning	Tools			License	Settings
Sou	D.\Topodron	e Post Processing\Coo	rdinate converter\GCP PPK WGS-	B4.bit		Select						
Sta	t row 1	3. Separator 🔲 Ti	ab 🔲 Semicolon 🔛 Comma	Space Other:	į.							
Coc	rdinate system:	WGS-84 Pr	ນ				Coordinat	e system: WCS-84	PRI			
Elev	ation type:	Ellipsoid WGS-84					Elevation	ype: Ellipsoid WGS-	-84			
							Use calibra	ition? NO	Q 3264			
								ne 42N (m) EDSO 32642				~
							-	ne 43N (m) EPSC 32643				
								ne 44N (m) EPSG 32644				
								ne 45N (m) EPSG 32645				
								ne 46N (m) EPSG 32646				
~	Longitude/East	Latitude/North ~	H-EII/H ~									
P3	85.9625224	51.49032709	392.66									
PS	85.95642994	51.49033207	427.862									
P4	85.9577886	51.48947973	429.369									
P6	85.94639449	51,49107792	445.855									
P7	85.94200696	51,49158162	44/035									
P9	85.94912985	51,48694646	469.084									
T26	85.90946928	51.48816517	484.667									
T27	85.91545609	51.49013224	460.869									
T28	85.9225729	51.49361702	437.739									
						Start						
	WAITING FOR ACT	ION										



If necessary, click on the "Save" button and save the new file.





										topodrone.com	
<u>≍</u>				COORDINATE C	CONVERTER FOR	ALL COORDIN	ATES IN FILE	ίί.			– 8 ×
PPK Post Processing	RTK Post Processing	g LIDAR Post	Processing LiDAR CI	oud Generation Static Post Processing	Precise Point Position	ning Tool	5			License	Settings
Source DATopodron	e Post Processing\Coord	dinate converter\G0	CP PPK WGS-84.txt		Select						Save
Start row 1	3. Separator Tab	b Semicolon	Comma 🔝 Space	Other:							
Coordinate system:	WGS-84 PR					Coordinate system:	WCS-84	PRJ			
Elevation type:	Ellipsoid WGS-84		🔛 Save As					×			
			← → - ↑ □>	This PC > Data 2 (Dt) > Topodrone Post Proc	essing > Coordinate converte	er v	ð ,≏ Searc	h Coordinate converter			
			Organize + New fr	older				80 - 🕜			
			3D Objects	Name	Date modified	Type	Size				
			Desktop	GCP PPK UTM 45N.txt	16.05.2022 17:39	TXT File	2 KB				
			Documents	GCP PPK WGS-84.txt	19.04.2022 10:17	TXT File	1 KB				-
			Downloads Music								
			Pictures								×
 Longitude/East 	 Latitude/North ~ 	H-EII/H ~	Videos						East	Height	
P3 85.9625224	51,49032709	392.66	🏪 Local Disk (C:)					197531		392.66	
P5 85.95642994	51.49033207	427.862						58093		427.862	
P4 85.9577886	51.48947973	429.369	TOPODRONE 211					92868		429.369	
P6 85.94639449	51.49107792	445.855	TOPODRONE 2Th					483042		445.855	
P7 85.94200696	51,49158162	447.035	@eaDir	~				593723		447.035	
P8 85.94416609	51.4941664	429.238	File name: G	CP PPK UTM 45N.txt				000372		429.238	
P9 85.94912985	51,48694646	469.084	Save as type: De	stination file (*.*)				~ 39599		469.084	
T26 85.90946928	51,48816517	484.667						811392		484.667	
127 85 91545609	5149013724	460 869	 Hide Folders 				Save	Cancel 502756		460.869	
T28 85.9225729	51.49361702	437.739			5	705269.653572415		425203.3723487730		437.739	
					Start						
WAITING FOR AC											



8.6. Calibration

The calibration approximates the distortions of the calibrated SC on WGS-84 or ITRF, and the height distortions are also approximated. Unlike localization or calibration of 7 datum parameters, this calibration corrects distortions that cannot be described mathematically and corrects distortions without residual errors. Unlike NTv2, it corrects heights and approximates distortions not from four points, but from one point to an infinitely large number. To perform calibration, at least one point is required, for which coordinates are known in WGS-84 and in the coordinate, system being calibrated.

Select the Tools tab in the main menu, then select CALIBRATION in the pop-up window Enter the coordinates of the points in the calibrated CS.





×.			CALI	BRATION		1		- 🗆 X
PPK Post Processing	RTK Post Processing	LIDAR Post Processing	LIDAR Cloud Generation	Static Post Processing	Precise Point Positioning	Tools	License	Settings
CALIBRATIONS:				ELEVATION:	v			
EFT MSK01 zone2 EFT MSK02 zone1 EFT MSK13 zone1 EFT MSK16 zone1 EFT MSK16 zone2				Projection Q Afghanistan Alaska Albania Albania Algeria Morocc	o Tunisia			
EVENTS LOC:				 Algería American Sam Angola (Cabino Angola Angola Anguilla Antarctica 	oa Jia)			
IcqAQCqAQBYM1 AP #1 27 AP #2 186 AP #3 711 AP #4 390	IORTH EAST HE 568.37 4231.25 122. 126.4 26 5691.34 851 2.63 14022.21 112: 8755 10007.83 123.	IGHT NORTH EAST 54 0 0 53 0 0 66 0 0 25 0 0	HEIGHT NORTH 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	EAST HEIGHT NC 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	DRTH EAST HEIGHT 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NORTH EAST 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	HEIGHT 0 0 0 0 0 0 0 0 0 0 0	
NEW	ADD ROW	DELETE ROW	CALCULATE			SAVE		
WAITING FOR ACTI	ON							



Maintain the accuracy with which the coordinates were determined. If you do not know with what accuracy they were determined, then you need to indicate the following recommended accuracy:

Fundamental astronomical geodetic network 20 mm north/east, 30 mm height

High-precision fundamental geodetic network 30 mm north/east, 40 mm height

Satellite geodetic network and astronomical geodetic network 40 mm north/east, 50 mm height

Government geodetic network 60 mm north/east, 110 mm height





X							CAI	LIBRA	TION	ų.								– 🗆 🗙
PPK Post Processing	RTK Po	st Processi	ng Lil	DAR Post Pr	ocessing	LiDAR Clou	ud Generatior	n Sta	atic Post	t Process	sing Pre	cise Point P	Positioning	т	ools	Lice	ense	Settings
CALIBRATIONS:									ELEVAT	ION:			×					
EFT MSK01 zone2								^	Project	ion	Q							
EFT MSK02 zone1									> Af	fghanista	an							_
EFT MSK13 zone1									> Al	laska								
EFT MSK16 zone1									> AI	Ibania								
EFT MSK16 zone2								~	> AI	lgeria Mo	orocco Tunis	ia						
EVENTS LOG:									> AI	lgeria								
									> AI	merican	Samoa							
									> AI	ngola (C	abinda)							
									> AI	ngola								
									> Ai	nguilla								
									> Ai	ntarctica	3							<u>~</u>
	NORTH	EAST	HEIGHT	NORTH	EAST	HEIGHT	NORTH	EAST	г	EIGHT	NORTH	EAST	HEIGHT	NORTH	EAST	HEIGHT	<u> </u>	
AP #1 2/	/868.37 4	-231.25 -681.341	85153	0.06	0.06	0.11	0	0	0		0	0	0	0	0	0	0	
AP #3 71	112.63 1	4022.21	112.366	0.06	0.06	0.11	ŏ	0	ŏ		ŏ	0	0	o o	0	0	õ	
AP #4 39	987.55 1	0007.83	123.25	0.06	0.06	0.11	0	0	0		0	0	0	0	0	0	Ö	
NEW		ADD RC	w	DELETE ROV		CALCULAT	E							SAVE				
WAITING FOR ACT	TION																	



Enter measured WGS-84 or ITRF coordinates (recommended). Tectonic shifts on the territory of Russia are approximately 30 mm per year, therefore, when choosing ITRF coordinates, it is necessary that they be obtained for an epoch of one year. In future versions, the correction of coordinates for the speed of tectonic plates will be added.

À						CA	LIBRA	ALIC	N								- 🗆 ×
PPK Post Processing	RTK Post Proces	sing LiE	DAR Post Proc	cessing	LiDAR Cloud	d Generatior	n St	atic P	ost Proces	sing Pr	ecise Point P	ositioning	Te	ools	Lice	ense	Settings
CALIBRATIONS:								ELEV	ATION:			×					
EFT MSK01 zone2							^	Proje	ection	Q							
EFT MSK02 zone1									Afghanist	an							~
EFT MSK13 zone1								>	Alaska								
EFT MSK16 zone1									Albania								
EFT MSK16 zone2									Albania								
							~	>	Algeria M	orocco Tuni	sia						
EVENTS LOG:									Algeria								
									American	Samoa							
									Angola (C	abinda)							
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								,	Anguilla								
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lo au declude de d									Antarctica	1							
CCACCCACBYW	/4																
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AP #1	2/868.57 4231.25	122.64	0.06	0.06	0.11	48.584055	135.05	/888	44.0773	0	0	0	0	0 Ö	0	0	
	10004.020 3001.341	05.155	0.06	0.06	0.11	40.495090	135.050	J340 1	7/1/25	0	0	0	0	0	0	2	
AP #3	7112.63 14022.21	112.366	0.06	0.06	0.11	48.3972614	135.189	1896	34.1425	0	0	0	0	0	0	2	
AP #4	3987.55 10007.83	123.25	0.06	0.06	0.11	48.369234	135.135	610611	45.0597	0	0	0	0	0	0	p	
NEW	ADD F	ROW	ELETE ROW		CALCULATE								SAVE				
WAITING FOR A	CTION																

Pic. 8-6-3





Maintain the accuracy with which the coordinates were determined.

*							CA	LIBRA		N								- 🗆 ×
PPK Post Processing	RTK P	Post Processi	ng Lii	DAR Post Pr	ocessing	LIDAR Clou	d Generatio	n Sta	atic Pc	st Proces	sing Pr	ecise Point P	ositioning	1	Fools	Lice	ense	Settings
CALIBRATIONS:									ELEV/	TION:			v					
EFT MSK01 zone2								^	Proje	tion	Q							_
EET MSK13 zonel										Afghanist	an							
EFT MSKI5 zonol										Alaska								
										Albania								
EFT MSK16 zone2								~		Algeria M	orocco Tun	isia						
EVENTS LOG:										Algeria								
										American	Samoa							
										Angola (C	abinda)							
									>	Angola								
										Anguilla								
									1	engunia								
la eu de el uter de de el									· ·	Antarctica	3							
CCACCACBYWI	(
	NORTH	EAST	HEIGHT	NORTH	EAST	HEIGHT	NORTH	EAS	T	HEIGHT	NORTH	EAST	HEIGHT	NORTH	EAST	HEIGHT		
AP #1 2	7868.57	4231.25	122.64	0.06	0.06	0.11	48.584055	135.057	888 14	4.0773	0.015	0.027	0.037	0	0	0	0	
AP #2 14	0004.020	14022.21	112 366	0.06	0.06	0.11	40.495090	135.050	896 17	4 14 25	0.016	0.028	0.036	0	0	0	0	
ΔP #4 3	98755	1000783	123.25	0.00	0.06	0.11	48 369234	135.135	5106 14	5 0597	0.015	0.027	0.037	0	0	0	n n n n n n n n n n n n n n n n n n n	
[/1 #/1	507.55	10007.03	12.3.2.3	10.00	10.00	0.0	10.000204	155,1550	JIOC	13.0337	0.015	0.027	0.037	- P	P	<u>P</u>	P	
NEW		ADD R	ow (DELETE ROV	v	CALCULATE								SAVE	k			
WAITING FOR AC	TION																	

Pic. 8-6-4

Then, select the required coordinate system (if the wrong .prj is selected, the calibration module will calculate the distortions for corrections, but the distortions will be very large, the calibration is sensitive to the wrong zero meridian).





X							CAI	LIBR	RATIO	ON								
PPK Post Processing	RTK F	ost Processi	ing LiC	AR Post Pro	ocessing	LiDAR Clou	d Generatior		Static	Post Proces	sing Pr	ecise Point P	Positioning	Т	ools	Lice	ense S	Settings
CALIBRATIONS:									ELE	VATION:			~					
EFT MSK01 zone2 EFT MSK02 zone1 EFT MSK13 zone1 EFT MSK16 zone1								*	Pro	ijection Afghanista Alaska Albania	¤							
EFT MSK16 zone2								~		Algeria Mo	rocco Tunis	ia						
EVENTS LOG:									> > > > > >	Algeria American S Angola (Ca Angola Anguilla Antarctica	Samoa Ibinda)							
	vi				• • • • • • • • • • • • • • • • • • • •					•								
AD #1	NORTH	EAST	HEIGHT	NORTH	EAST	HEIGHT	NORTH	EA	ST	HEIGHT	NORTH	EAST	HEIGHT	NORTH	EAST	HEIGHT	0	
AP #1	18064.826	3681341	85153	0.06	0.06	0.11	48.384033	135.0	50346	106 6863	0.015	0.027	0.037	0	0	0	0	
AP #3	7112.63	14022.21	112.366	0.06	0.06	0.11	48.3972614	135.18	39896	134,1425	0.015	0.027	0.037	0	0	0	0	
AP #4	3987.55	10007.83	123.25	0.06	0.06	0.11	48.369234	135.13	56106	145.0597	0.015	0.027	0.037	0	0	0	0	
NEW	NEW ADD ROW DELETE ROW CALCULATE																	
WAITING FOR A	CTION	10																
D' 0 6 5																		

Pic. 8-6-5

Select the height system, if the height system is above sea level, then we select EGM2008

×				and and a work			CA	IBRA	TION								Succession of	- 🗆 ×
PPK Post Processing	RTK P	ost Process	ing Lil	DAR Post Pro	ocessing	LIDAR Clou	d Generation	n Stat	tic Post P	rocessing	g Pre	cise Point P	ositioning	т	ools	Lice	nse	Settings
CALIBRATIONS:								E		N:	GEOI	D (EGM2008	3) *					
								^ r	Projection	, C	2							
EFT MSK01 zone2									x 46	ha nieta r			-1					~
EFT MSK02 zone1									× ^/-	rianistan								
EFT MSK13 zonel									× 411									
EET MCK/16 zonel									> Alt	ania								
EFT MSKIG Zoner								~	> Alg	jeria Mor	occo Tun	isia						
EVENTS LOG:									> Alg	leria								
									> An	nerican S	amoa							
									> An	gola (Cat	oinda)							
									> An	gola								
									> An	ouilla								
									 Arr 	tarctica								
									- All	carctica								
	ĺ .																	
	NORTH	EAST	HEIGHT	NORTH	EAST	HEIGHT	NORTH	EAST	HEI	CHT I	NORTH	EAST	HEIGHT	NORTH	EAST	HEIGHT		
AP #1 2	7868.37	4231.25	122.64	0.06	0.06	0.11	48.584055	135.0578	88 144.0	773 0.	015	0.027	0.037	0	0	0	0	
AP #2 10	0004.020	14022.21	112 766	0.06	0.06	0.11	40.495090	135.0503	06 174 1/	005 0.	016	0.028	0.038	0	0	0	0	
AP #4 3	987.55	10007.83	123 25	0.06	0.06	0.11	48 369234	135,13561	OF 145 0	597 01	015	0.027	0.037	0	0	0	o o	
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WAITING FOR AC	TION																	



Press the "Calculate" button.





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PPK Post Processing	RTK F	ost Processi	ing Li[DAR Post Pro	ocessing	LIDAR Clou	d Generatior	n Static	Post Process	sing Pre	cise Point F	Positioning	Т	ools	Lice	nse	Settings
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1								^ Pr	ojection	Q							
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Geoid)								;	Angola (0	Cabinda)							
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AP #1	27868.37	4231.25	122.64	0.06	0.06	0.11	48.584055	135.05788	144.0773	0.015	0.027	0.037	0.05	-0.031	-0.016	0.876	
AP #2	18064.826	3681.341	85.153	0.06	0.06	0.11	48.495898	135.05034	106.6863	0.016	0.028	0.038	-0.007	0.054	-0.008	0.936	
AP #3	7112.63	14022.21	112.366	0.06	0.06	0.11	48.3972614	135.189896	134.1425	0.015	0.027	0.037	-0.011	-0.008	0.029	1.312	
AP #4	3987.55	10007.83	123.25	0.06	0.06	0.11	48.369234	135.135610	145.0597	0.015	0.027	0.037	-0.032	-0.016	-0.005	0.876	
NEW		ADD RO	ow C	ELETE ROV	/	CALCULATE							SAVE				
WAITING FOR A	CTION																



The "distortions" column shows the distortions that the calibration will correct (if there is much more distortion at any point than at other points, then exclude this point from the calibration, the "density weight" column shows how many points are evenly distributed on the ground. The software will correct the uneven distribution, but it is still desirable to distribute the points more or less evenly.

Then, click "save", as a result we get a file, which later will be used instead of .prj file for aerial photography calculations.

→ · ↑ 🎴	> Windows (C:) > TOPODRONE > PostPr	ocessing > data > tpc	~ C	,O Search: tpc
				≣ •
Windows (C:)	АМИ	Дата изменения	Тип	Размер
Topodrone (D:)	1.tpc	06.05.2022 18:22	Файл "ТРС"	9 КБ
Topodrone1(E:)	EFT MSK01 zone2.tpc	16.03.2022 2:14	Файл "ТРС"	3 КБ
Topodrope (Dt)	EFT MSK02 zone1.tpc	16.03.2022 2:14	Файл "ТРС"	5 КБ
	EFT MSK13 zone1.tpc	16.03.2022 2:14	Файл "ТРС"	8 КБ
9 17 02 2021	EFT MSK16 zone1.tpc	16.03.2022 2:14	Файл "ТРС"	5 КБ
17 Base EFT+Ri	EFT MSK16 zone2.tpc	16.03.2022 2:14	Файл "ТРС"	14 КБ
43 Test Fantom	EFT MSK23 zone1.tpc	16.03.2022 2:14	Файл "ТРС"	30 КБ
20200101_Kpac	EFT MSK23 zone2.tpc	16.03.2022 2:14	Файл "ТРС"	14 КБ
Arhiv	EFT MSK50 zone1.tpc	16.03.2022 2:14	Файл "ТРС"	10 КБ
Name: TEST	CALIBRATION			
Туре: Торос	drone calibration file			





Pic. 8-6-8

* WGS-84 navigation coordinates cannot be used when performing calibration. We recommend to use ITRF.

** the accuracy of known or measured coordinates is very important, the program distributes confidence weights according to accuracy, if you do not know what accuracy, then put the same on all points.

8.7. Merge Rinex file

This function is designed to combine measurement files from different GNSS receivers and is suitable for cases where the provider of the reference base station divides the file into time intervals when downloading data.

Select the Tools tab in the main menu of the program, then select Merge Rinex file in the pop-up window.



Pic. 8-7-1

Click the "ADD" button to add measurement files and select the required files. The following formats are supported: *.rnx, *.**o and *.obs.







The "RINEX FILES" window will display the downloaded files, and the "EVENTS LOG" window will display information about the recording time, antenna type and receiver coordinates that the software reads from your files.





Specify the path to the folder where to save the associations file.





Ξ					MERGE RINEX FI	LES				· · ·		- 8 ×
PPK Post Processing	RTK Post Processing	LIDAR Post Processing	LIDAR Cloud Ceneration	Static Post Processing	Precise Point Positioning	Tools					License	Settings
RINEX FILES:												400
D\Topodrone Post Proce	ssing\Merge Rinex file\BRST_1	1002221100_1002221200_82	0075220									
D. Topodrone Post Proce	ssing\Merge Rinex file\BRST_1	1002221000_1002221100_65	3216.220									DELETE
D-Topodrone Post Proce	ssing\Merge Rinex file\BRST_1	100222.0900_100222.1000_5	3311.220									
D\Topodrone Post Proce	ssing\Merge Rinex file\BRST_1	00222.0800_100222.0900_3	202222222									
D\Topodrone Post Proce	ssing\Merge Rinex file\BRST_1	Select Fol	lder						×			
		$\leftarrow \rightarrow -$	1 This PC > Data 2 (D:) > Topodrone Post Process	ing > Merge Rinex file	~ Ö	,P Sea	rch Merge Rinex file				
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> ANTENNA: DELTA H/E/N = > ANTENNA: DELTA H/E/N =												
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> TIME OF FIRST OBS = 10/0	2/2022 9:00:00											
TIME OF FIRST OBS = 10/0 TIME OF FIRST OBS = 10/0	2/2022 8:00:00 2/2022 10:00:00											
> TIME OF LAST OBS = 10/02	2/2022 8:00:00											
 TIME OF LAST OBS = 10/02 TIME OF LAST OBS = 10/02 	2/2022 9:00:00											
TIME OF LAST OBS = 10/02												~
											1	START



When you click on the "START" button, the program will merge all the files and save to the previously specified folder.









9. Settings

9.1. General

Select the Settings tab then General. This menu is for general settings.

<u>GEOIDS:</u>	ADD
EGM2008	
geoid_MSK77	DELETE

Pic. 9-1-1

In the "GEOIDS" window, you can add or remove the type of geoid used in post-processing. Some geoid models are already preloaded. If necessary, you can import another geoid in *.gtx format. To do this, click the "ADD" button and select the desired file.

🗮 Open				×
← → ~ ↑ 📙	« TOPODRONE > PostProcessing > data > geoid	5 v	🔎 Search geoid	
Organize 👻 Nev	v folder		<pre>EEE</pre>	• 🔳 🕜
 3D Objects Desktop Documents Downloads Music 	Name	Date modified 10.01.2020 14:04	Type GTX File	Size 145 834 KB
	File <u>n</u> ame:		Geoid file (*.gtx)	✓ Cancel

Pic. 9-1-2

If necessary, you can remove the geoid model from the list by clicking on the "DELETE" button. It is impossible to delete EGM2008 geoid.

The "PRJ" menu displays a list of available coordinate systems that will be available for selection in post-processing.





PRJ:	ADD
Afghanistan-Herat North (degree) EPSG 4255	
Alaska-WGS 84-UTM-zone 59N (m) EPSG 32659	DELETE
Albania-Albanian 1987-(degree) EPSG 4191	
Albania-Albanian 1987-zone 4 (m) EPSG 2199 DEPRECATED	
Albania-Albanian 1987-zone 4 (m) EPSG 2462	
Albania-Durres height (m) EPSG 5777	
Albania-ETRS89-LCC 2010 (m) EPSG 6962	
Albania-ETRS89-TM 2010 (m) EPSG 6870	
Albania-Pulkovo 1942(58)-3 degree-zone 6 (m) EPSG 3330 🔍	

Pic. 9-1-3

The "PRJ" menu displays a list of available coordinate systems that will be available for selection. You can add or remove the required coordinate system from the list. In order to add a coordinate system, press the "ADD" button and select the desired file. Files in *.prj formats are supported, other formats of coordinate systems are not supported in post-processing.

VideosNameDate modifiedTypeSizeLocal Disk (C:)Angola-Cabinda-Mhast 1951 (degree) EPSG 4703.prj20.05.2022 13:34PRJ File1 KBData 2 (D:)Angola-Cabinda-Mhast UTM zone 32S (m) EPSG 26432 DEPRECA20.05.2022 13:34PRJ File1 KBTOPODRONE 2TbAngola-Camacupa-1948 (degree) EPSG 4220.prj20.05.2022 13:34PRJ File1 KBAngola-Camacupa-1948 TM 12 SE (m) EPSG 22092.prj20.05.2022 13:34PRJ File1 KBAngola-Camacupa-1948 TM 12 SE (m) EPSG 22091.prj20.05.2022 13:34PRJ File1 KBAngola-Camacupa-1948 TM 1130 SE (m) EPSG 22091.prj20.05.2022 13:34PRJ File1 KBAngola-Camacupa-1948 TM 1130 SE (m) EPSG 22032.prj20.05.2022 13:34PRJ File1 KBAngola-Camacupa-1948 UTM zone 32S (m) EPSG 22032.prj20.05.2022 13:34PRJ File1 KBAngola-Camacupa-1948 UTM zone 33S (m) EPSG 22033.prj20.05.2022 13:34PRJ File1 KBAngola-Camacupa-1948 UTM zone 33S (m) EPSG 22032.prj20.05.2022 13:34PRJ File1 KBAngola-Camacupa-1948 UTM zone 33S (m) EPSG 2203.prj20.05.2022 13:34PRJ File1 KBAngola-Camacupa-1948 UTM zone 33S (m) EPSG 2000.prj20.05.2022 13:34PRJ File1 KBAngola-Camacupa-1948 UTM zone 33S (m) EPSG 2000.prj20.05.2022 13:34PRJ File1 KBAnguilla-Anguilla 1957 (degree) EPSG 4600.prj20.05.2022 13:34PRJ File1 KBAnguilla-Anguilla 1957 Ritish West Indies Grid (m) EPSG 2000.prj20.05.2022 13:34PRJ File1 KBAntarctica-Adelie La	ganize 🔻 🛛 New folde	r			EE 👻 🛄 🧕
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		🕍 Antarctica-Australian sector-Australian AntArctic-(degree) EPSG	20.05.2022 13:34	PRJ File	1 KB

Pic. 9-1-4

If you need to remove the coordinate system from the list, press the "DELETE" button. Complete removal of imported SCs is possible only after restarting the software.

The "Calibrations" menu displays the available calibration parameters that are used to change from one coordinate system to another.





CALIBRATIONS:	ADD
EFT MSK01 zone2	
EFT MSK02 zonel	DELETE
EFT MSK13 zone1	
EFT MSK16 zone1	
EFT MSK16 zone2	
EFT MSK23 zonel	
EFT MSK23 zone2	
EFT MSK50 zonel	
EFT MSK50 zone2	
ЕЕТ Москва МГГТ	
Habarovsk-ITRF	

Pic. 9-1-5

By default, several calibration files are added for some zones. In order to add a calibration parameter, press the "ADD" button and select the desired file. Files in *.tpc format are supported, other formats of coordinate systems are not supported. To create a calibration file, see paragraph 8.6.

🖾 Open							×
← → • ↑ 📙	<< TOP	ODRONE > PostProcessing > data > tpc	v	<u>ن</u>	,	h tpc	
Organize 👻 Ne	w folder					H •	0
3D Objects	^	Name	Date modified	Туре		Size	^
E Desktop		batu120v00-xulo120v00World-WGS 84-U	01.06.2022 13:05	TPC	File	12 KB	
Documents		CHML_240422.0700_240422.0830_814940	20.05.2022 16:42	TPC	File	4 KB	
		CHML_260422.0600_260422.1600_463819	06.05.2022 18:32	TPC	File	3 KB	
👌 Music	~	CHML_260422.0600_260422.1600_463819	17.05.2022 18:20	TPC	File	4 KB	~
	File <u>n</u> ar	ne:		~	Topodrone	calibration file (*.t	p(~
					<u>O</u> pen	Cance	1
							al

Pic. 9-1-6

9.2. Point cloud generation

Select the Settings tab then POINT CLOUD GENERATION. In the pop-up window, select the type of shooting.





	AERIAL LIDAR TERRASTRIAL LIDAR				
EXCLUDE POINTS WITH DIS	STANCE:				
	SHORTER:	10	METERS		
	LONGER:	200	METERS		
CUTOFF ANGLE:	START:	37	DEGREE		
	END:	143	DEGREE		
DRONE ANTENNA:	HEIGHT:	0	METERS		
OFFSET FORWAR	RD/BACKWARD:	q	METERS		
OFFS	SET LEFT/RIGHT:	0	METERS		
LIDAR ANGLE O	F ACQUISITION:	FORWARD			
POINT CLOUD FILE FORMAT: O LAZ O LAS					
INCLUDE RETURN TYPES: 🔲 FIRST 🔲 SECOND 🔲 THIRD					
SPLIT BY LASER ID					
PREVIEW CLOUD GENERATION					
USE NMEA GPRMC MESSAGES					
HDL-32E					

Pic. 9-2-1

AERIAL LIDAR-aerial shooting (LIDAR is mounted on the UAV)

TERRASTRIAL-ground shooting (LIDAR is mounted on the ground carrier)

Specify the limits for shooting.







Pic. 9-2-2

EXECLUDE POINTS DISTANCE - Specify the data recording distance along the length of the laser.

SHORTER - distance from Lidar

LONGER - max distance

CUTOFF ANGLE - specify the scan angle for Lidar

START - starting angle

END - end angle

LIDAR ANGLE OF ACQUISITION - specify the type of LIDAR mount

FORWARD - default setting when the sensor is facing forward

BACKWARD - sensor looks back

POINT CLOUD FILE FORMAT – select the format in which the LAS/LAZ point cloud will be generated

INCLUDE RETURN TYPES – select reflection types

- FIRST first reflection
- SECOND second reflection
- THIRD third reflection

SPLIT BY LASER ID – generation of separate point clouds by beam number

PREVIEW CLOUD GENERATION – view point cloud generation in real time

USE NMEA GPRMC MESSAGES – HDL-32E - this checkbox must be used when using the HDL-32 sensor

9.3. Geotagging and post processing

Select the Settings tab, then Geotagging and Post processing. This window is used to configure the processing of the PPK Post Processing and RTK Post Processing modules.





<u>ع</u>				GEOTAGG	ING & POST PROCES	SSING SETTINGS	*		– 8 ×
PPK Post Processing	RTK Post Processing	LIDAR Post Processing	LiDAR Cloud Generation	Static Post Processing	Precise Point Positioning	Tools		License	Settings
SATELLITES									
GLONASS GA	LILEO 🔤 QZSS 💼 SBA	IS 🔲 IRNSS 💼 BEIDOU							
	MASK ANGLE:	10 DEGRE	EE						
	FREQUENCIES	L1+L2 ×							
	- 0000 - 1075								
SAVE FILE	PIALD O META	SHAPE SUSURVEY							
			N						
EXIF COORDINATE TYPE									
INCREASE TIME WE	IGHT 🔲 INCREASE WEI	SHT OF COORDINATES							
DIMER									
	TIME CORRECTION:	0 SECON	NDS						
	HEIGHT ADUSTMENT:	0 METER	75						
									SAVE



In the SATELLITES window, you can enable or disable certain satellite constellations from processing, specify the required elevation mask and select the frequencies for which you want to perform processing.

SATELLITES:					
GLONASS		QZSS	SBAS		
	a.	MASK ANGLE	÷ [10	DEGREE
	F	REQUENCIES	: L1+L2		Ŷ

Pic. 9-3-2

In the COORDINATE CATALOG window, check the SAVE FILE checkbox to save the catalog of photography centers and select the file format for the program you are using.

COORDINATE CATA	LOG:			
SAVE FILE	PIX4D	O METASHAPE	3DSURVEY	

Pic. 9-3-3

In the PHOTO window, you can save the coordinates of the photo centers in the EXIF file of the photo, assign a unique name to the photos depending on the time of creation, it is recommended to check the box for manually comparing photos and marks, the checkbox "Shutter correction" is responsible for shifting the mark by half the exposure time.





PHOTO:

Pic. 9-3-4

If you ticked the box "BURN EXIF" in the previous window, then you need to select the format for storing coordinates (LBH - geographic coordinates, XYZ - rectangular coordinates)

EXIF COORDINATE TYPE:	🔲 LBH	XYZ
-----------------------	-------	-----

Pic. 9-	3-5
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The GEOTAGGING ALGORITM tab contains settings that help the program match photos and tags in case of quantity mismatch.

INCREASE TIME WEIGHT – coincidence by time;

INCREASE WEIGHT OF COORDINATES – coincidence by coordinates.

GEOTAGGING ALGORITHM:	
INCREASE TIME WEIGHT	INCREASE WEIGHT OF COORDINATES

Pic. 9-3-6

Attention!

For routes in which some photos are superimposed on others, the alignment algorithm by coordinates may not work correctly. Example: route on one battery when shooting a small object for 3D reconstruction. In the case of shooting when the camera is pointed to nadir, and then immediately shooting when the aircraft is shooting perspective.

If your GNSS receiver does not record time or altitude correctly, you can correct this in the OTHER window.

OTHER:			
	TIME CORRECTION:	0	SECONDS
	HEIGHT ADUSTMENT:	0	METERS



9.4. Track file structure

Select the Settings tab, then Track file structure. In the window that opens, select the trajectory file that you received as a result of post-processing. If you performed processing in





TOPODRONE Post Processing software, specify the order of the columns as in the picture below.

~	Latitude / X	Longitude / Y 👻	H-EII/H ×	Roll ¥	Pitch *	Heading *	70Time Y	~
13:50:22.010000	55.713305187566846	37.653742918151913	140.265	1.754441161922826	0.609907908637038	-156.918356047957047	1648216222.0100	
13:50:22.020000	55.713305187496708	37.653742918075203	140.265	1.754527433449306	0.609561051282546	-156.918139876672001	1648216222.0200	
13:50:22.030000	55.713305187364519	37.653742917937471	140.265	1.753875093227311	0.610733034526325	-156.918200255128937	1648216222.0300	
13:50:22.040000	55.713305187173852	37.653742917730426	140.265	1.753594148013014	0.612892057854831	-156.917718795997075	1648216222.0400	
13:50:22.050000	55.713305186922177	37.653742917474027	140.265	1.753431270190594	0.615294740836477	-156.918230871528010	1648216222.0500	
13:50:22.060000	55.713305186614150	37.653742917161530	140.265	1.753250350659146	0.617223684084248	-156.918945648057360	1648216222.0600	
13:50:22.070000	55.713305186251773	37.653742916799864	140.265	1.753613699414706	0.618255287913219	-156.920189918960943	1648216222.0700	

Pic. 9-4-1

After you fill in all the fields, click save (Save).

NOTE: This procedure needs to be done once, if you continue processing in the TOPODRONE Post Processing software, then you will no longer need to specify the file structure. If you have processed in any other software then the structure will be different and you will need to specify the appropriate field order for your toolpath file.

9.5. Lidar calibration

Select the Settings tab, then Lidar calibration. In the window that opens, you can select your Lidar and turn off unnecessary beams.

Attention!

Sensors that are equipped with TOPODRONE Lidar are calibrated at the manufacturer's factory and do not require further calibration during the entire period of operation.

Topodrone SA



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Pic. 9-5-1 Use – beam number

Tilt (deg) – beam tilt angle in degrees угол наклона луча в градусах

Offset (mm) – beam offset relative to the sensor in mm.

NOTE: Depending on your Lidar, you will have your own number of beams.