

Crowdsourced bathymetry on the Great Barrier Reef

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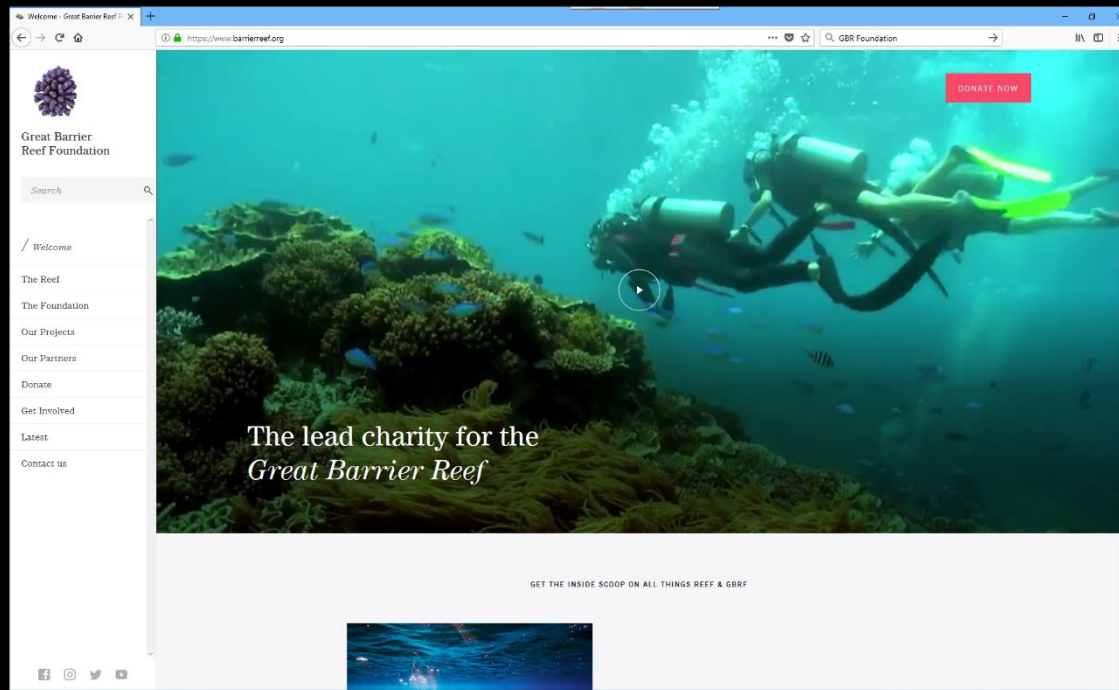


Aims

- Crowdsourced bathymetry (CSB) is collection of depth measurements from vessels, using standard navigation instruments engaged in routine operations.
- International Hydrographic Organisation (IHO) accepts CSB data into the Data Centre for Digital Bathymetry (DCDB) through a network of 'Trusted Nodes'.
- The 'Crowdsourced bathymetry on the GBR' project is a Trusted Node.
- Talk will focus on how CSB data are collected, processed and made public.

Funding and support

- Great Barrier Reef Foundation



GBR Foundation at: <https://www.barrierreef.org/>

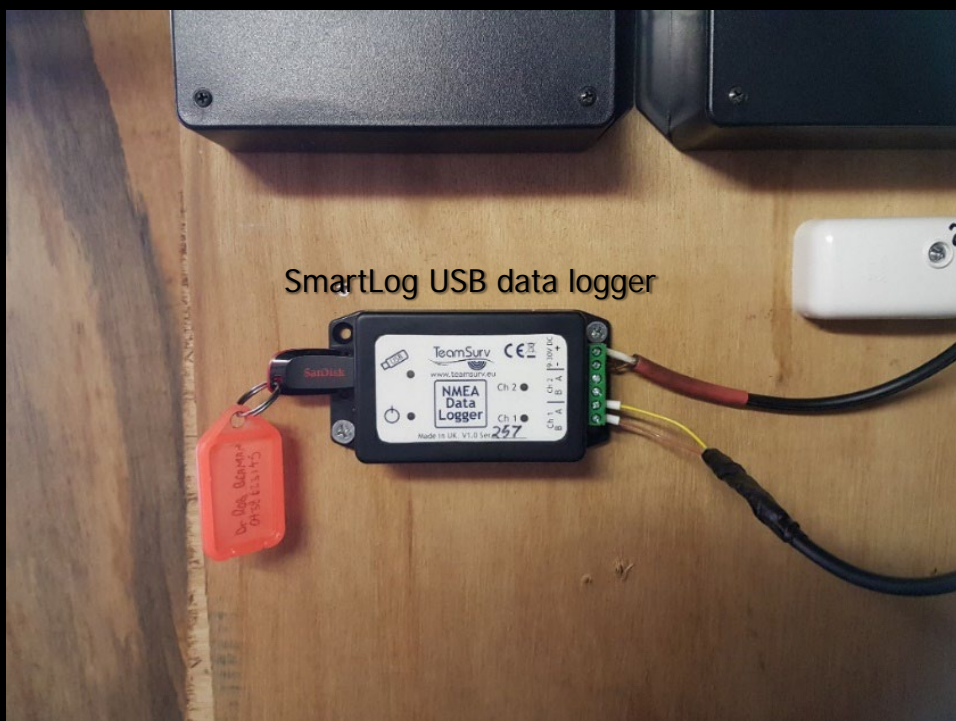
- Citizens of the Great Barrier Reef



Citizens of the GBR at: <https://citizensgbr.org/>

Technology

- TeamSurv SmartLog USB logger
- 12/24VDC plus NMEA channel 1
- reliable but sensitive to over-voltage



- stores raw NMEA 0183 data to USB

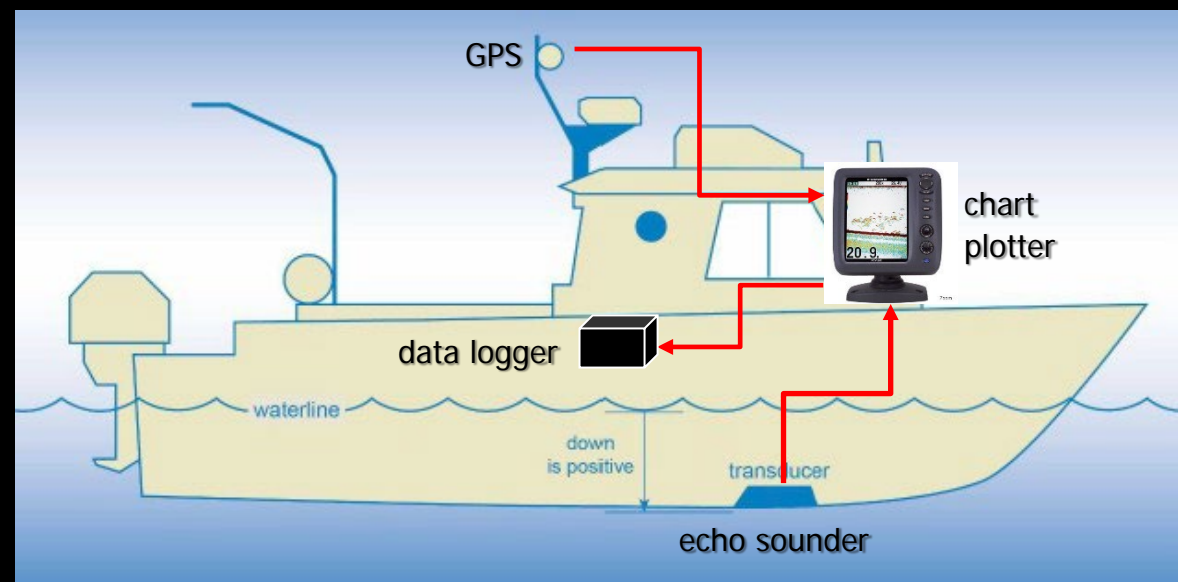
\$GPGGA,022018,1617.7499,S,14541.6567,E,1,11,0.84,-62.51,M,59.91,M,,*76

\$GPBWC,022020,1617.3701,S,14541.0190,E,301.8,T,295.0,M,0.721,N,End,A*37

\$SDDBT,3.74,f,1.14,M,0.62,F*36

.....

.....



Vessels



Chart plotters

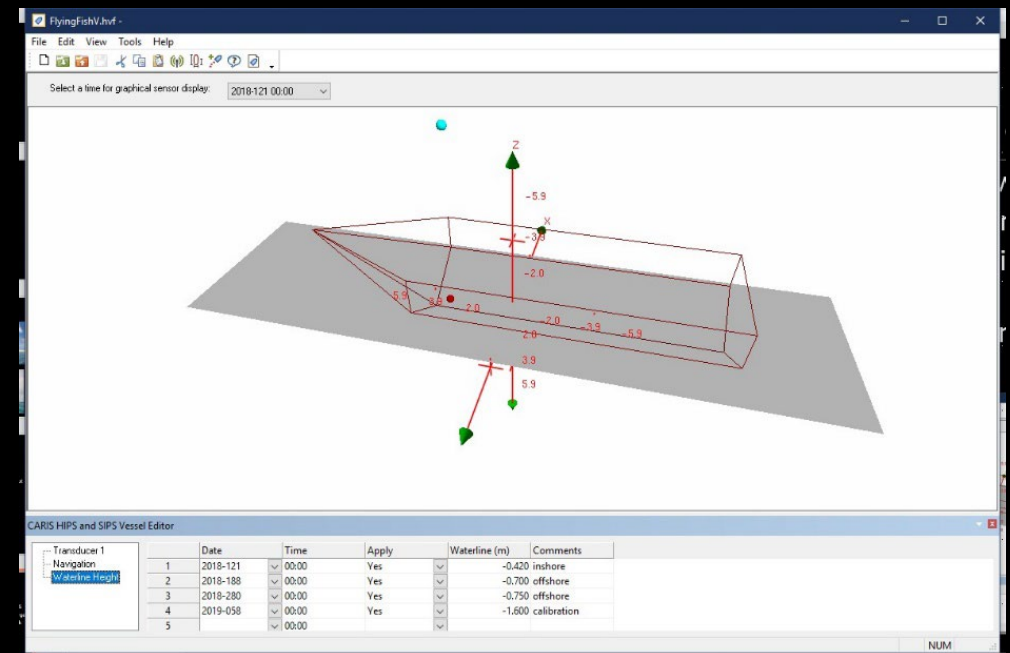


Installation

- marine technician to install
- mount in dry sheltered place
- ideally one NMEA channel feed
- switch or fuse helps to kill power



- use 30 m tape to measure offsets
- reference point (RP) is the sounder
- GPS aerial is measured to sounder
- measure depth with leadline for waterline height to RP



Python processing

- data logger stores .TSV files
- raw data are NMEA 0183 strings
- can have wrong dates, missing value
- i/p GGA, RMC, ZDA, DBT strings
- o/p lat,long,date,time,course,speed,depth
- report of errors, valid data points, % pass

The image shows a Python script processing NMEA 0183 data. The script reads a .TSV file containing NMEA strings and outputs a processed .TSV file with columns: latitude, longitude, date, time, speed, course, depth. A summary window shows 43175 valid data points, 94 processing errors, and 99.783% pass rate.

Input File (00000007.TSV):

```
NMEA Data logger version 3.00
$ECGGA,044137.83,1656.294,S,14546.891,E,1,08,1.0,12.80,M,0.0,M,0.00,*4B
$ECGLL,1656.294,S,14546.891,E,044137.83,A,*62
$ECRMC,044137.83,A,1656.294,S,14546.891,E,3.4,010.0,051219,0.0,A,0.0,0.0,0.0
$ECVTG,010.0,T,003.0,M,3.4,N,6.3,K,A*32
$ECZDA,044137.83,05,12,2019,*,*75
$VWMTW,87.78,C*22
$VWVLW,0.0,N,0.00,N*7C
$ECGGA,044139.93,1656.292,S,14546.891,E,1,08,1.0,12.80,M,0.0,M,0.00,*4B
$ECGLL,1656.292,S,14546.891,E,044139.93,A,*6B
$ECRMC,044139.93,A,1656.292,S,14546.891,E,3.4,010.0,051219,0.0,A,0.0,0.0,0.0
$ECVTG,010.0,T,003.0,M,3.4,N,6.3,K,A*32
$ECZDA,044140.04,05,12,2019,*,*7A
$VWMTW,87.78,C*22
$VWVLW,0.0,N,0.00,N*7C
$ECGGA,044142.00,1656.290,S,14546.892,E,1,08,1.0,12.80,M,0.0,M,0.00,*4B
$ECGLL,1656.290,S,14546.892,E,044142.00,A,*6C
$ECRMC,044142.00,A,1656.290,S,14546.892,E,3.4,010.0,051219,0.0,A,0.0,0.0,0.0
$ECVTG,010.0,T,003.0,M,3.4,N,6.3,K,A*32
$ECZDA,044142.25,05,12,2019,*,*7B
$SDBT,47.4,f,14.4,M,7.9,F*0E
$SDDPT,14.4,0.0*66
$VWMTW,87.89,C*2C
$VWVLW,0.0,N,0.00,N*7C
$GPGGA,044144.01,1656.288,S,14546.892,E,1,08,1.0,12.80,M,0.0,M,0.00,*4B
$GPGLL,1656.288,S,14546.892,E,044144.01,A,*73
$GPRMC,044144.01,A,1656.288,S,14546.892,E,3.5,010.0,051219,007.0,E,A*21
```

Output File (00000001.TSV):

```
latitude,longitude,date,time,speed,course,depth
-16.8013717,145.7184117,20200306,203053.00,0.98,326.33,0.56
-16.8013633,145.7184017,20200306,203055.00,0.78,324.90,0.57
.7183933,20200306,203057.00,0.78,322.28,0.57
.7183833,20200306,203059.00,0.79,319.91,0.59
.7183783,20200306,203101.00,0.74,318.39,0.60
.7183700,20200306,203103.00,0.59,318.39,0.62
.7183633,20200306,203105.00,0.43,318.23,0.61
.7183617,20200306,203107.00,0.38,317.21,0.60
.7183567,20200306,203109.00,0.33,316.43,0.61
.7183533,20200306,203111.00,0.27,315.71,0.60
.7183517,20200306,203113.00,0.00,314.43,0.60
.7183483,20200306,203115.00,0.00,314.29,0.60
.7183450,20200306,203117.00,0.00,314.29,0.61
.7183433,20200306,203119.00,0.00,314.29,0.60
.7183400,20200306,203121.00,0.00,314.29,0.60
.7183367,20200306,203123.00,0.00,314.29,0.61
.7183350,20200306,203125.00,0.00,314.29,0.61
.7183400,20200306,203127.00,0.00,315.22,0.61
.7183450,20200306,203129.00,0.00,328.47,0.61
.7183517,20200306,203131.00,0.00,341.55,0.61
.7183567,20200306,203133.00,0.00,344.20,0.61
.7183583,20200306,203135.00,0.00,344.20,0.61
.7183617,20200306,203137.00,0.00,344.20,0.61
.7183600,20200306,203139.00,0.00,344.20,0.62
.7183617,20200306,203141.00,0.00,344.20,0.60
.7183633,20200306,203143.00,0.00,344.20,0.61
-16.8013100,145.7183600,20200306,203145.00,0.00,344.20,0.61
-16.8013100,145.7183583,20200306,203147.00,0.00,344.20,0.61
-16.8013100,145.7183567,20200306,203149.00,0.00,344.20,0.61
```

Summary Window:

```
Completed
All files completed processing
OK
```

NMEA converter window:

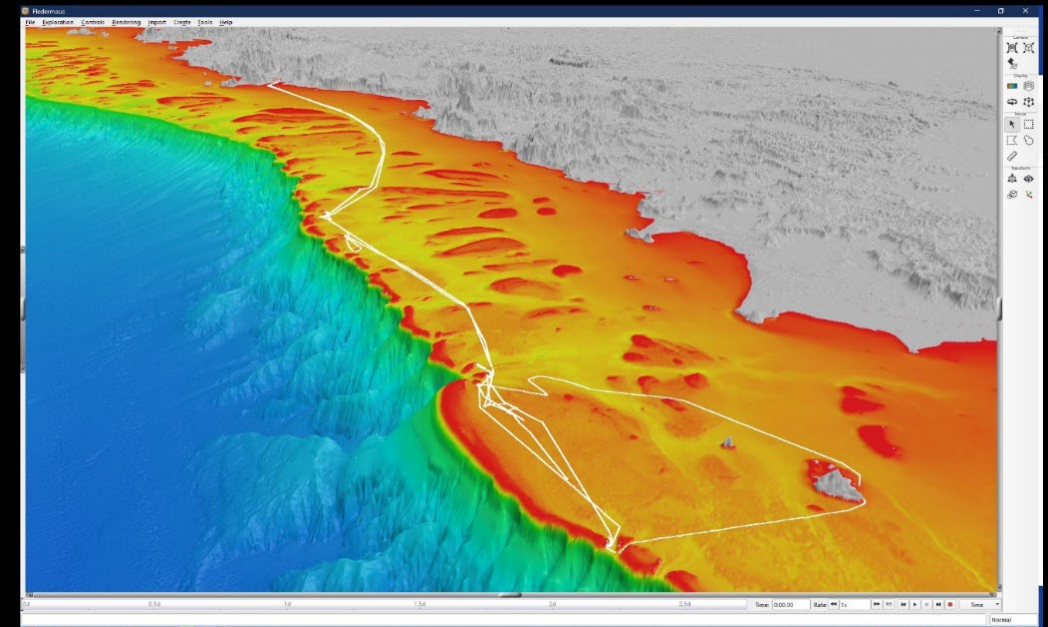
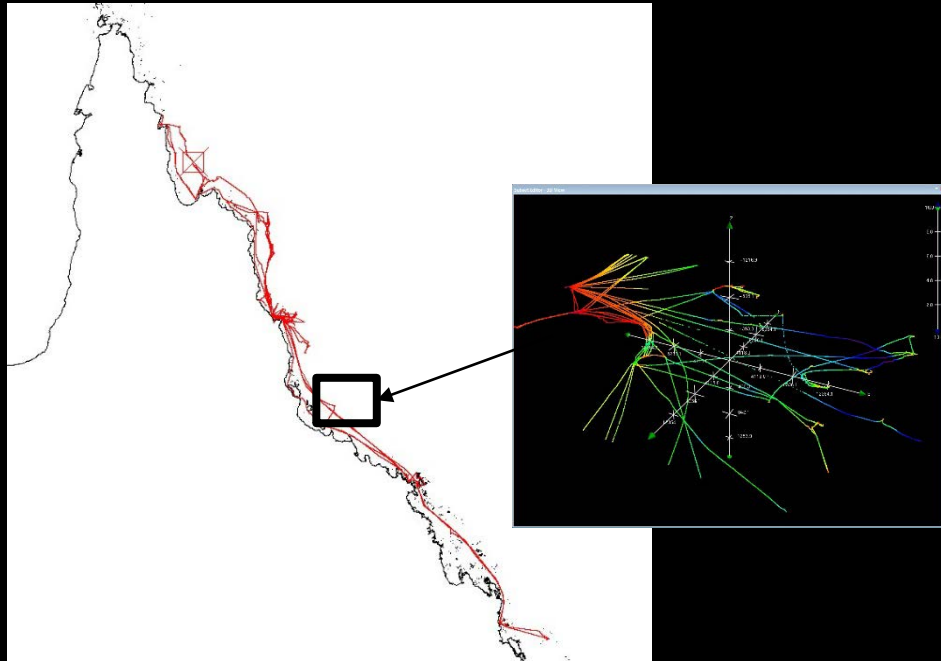
```
Input dir: C:\temp\Charlie1_download_20210302
Output dir: C:\temp\Charlie1_download_20210302_NMEAoutput_1
Process
```

Processing Summary:

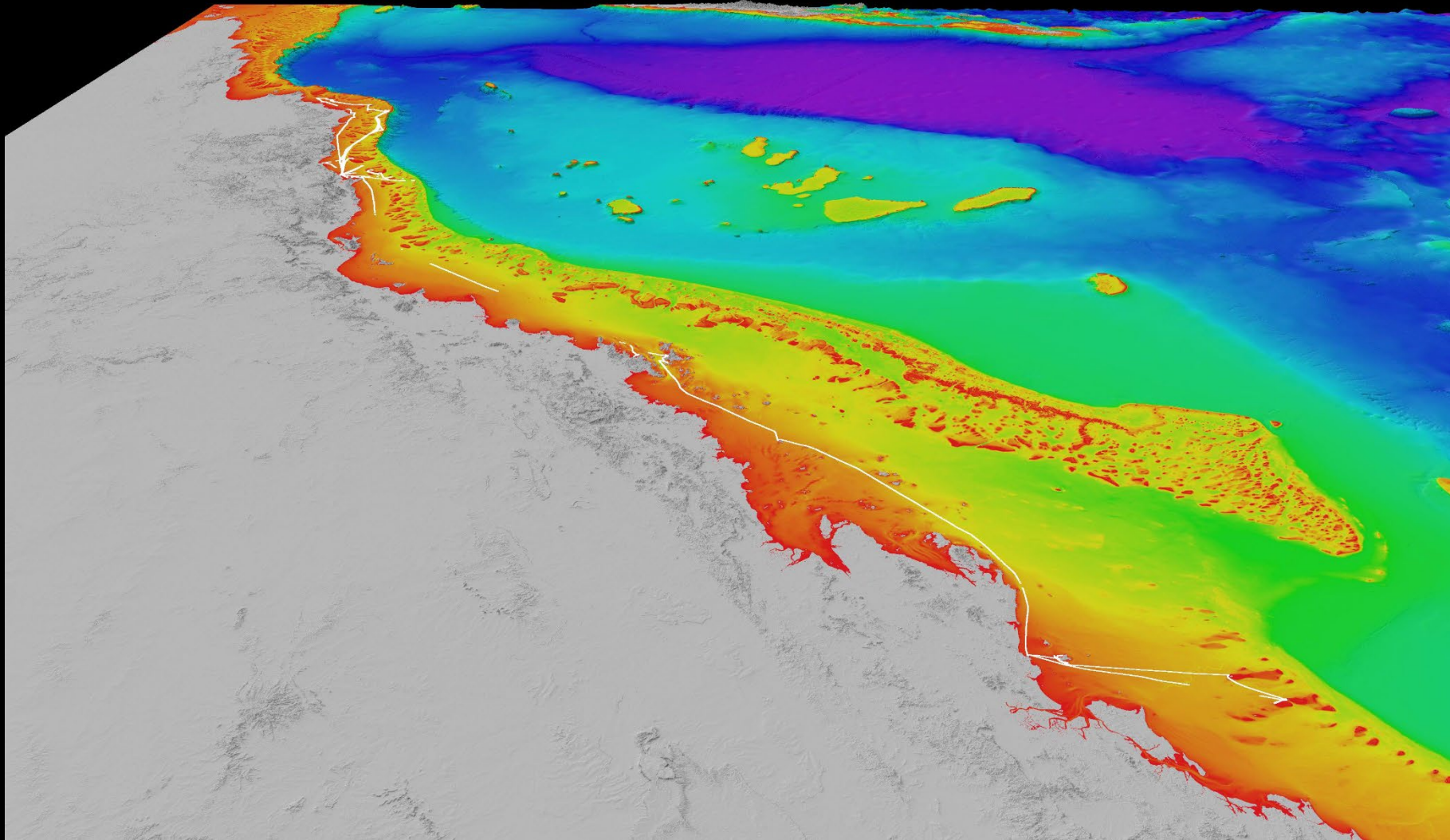
```
valid data points: 43175
processing errors: 94
percentage passed: 99.783%
```


Spatial filter

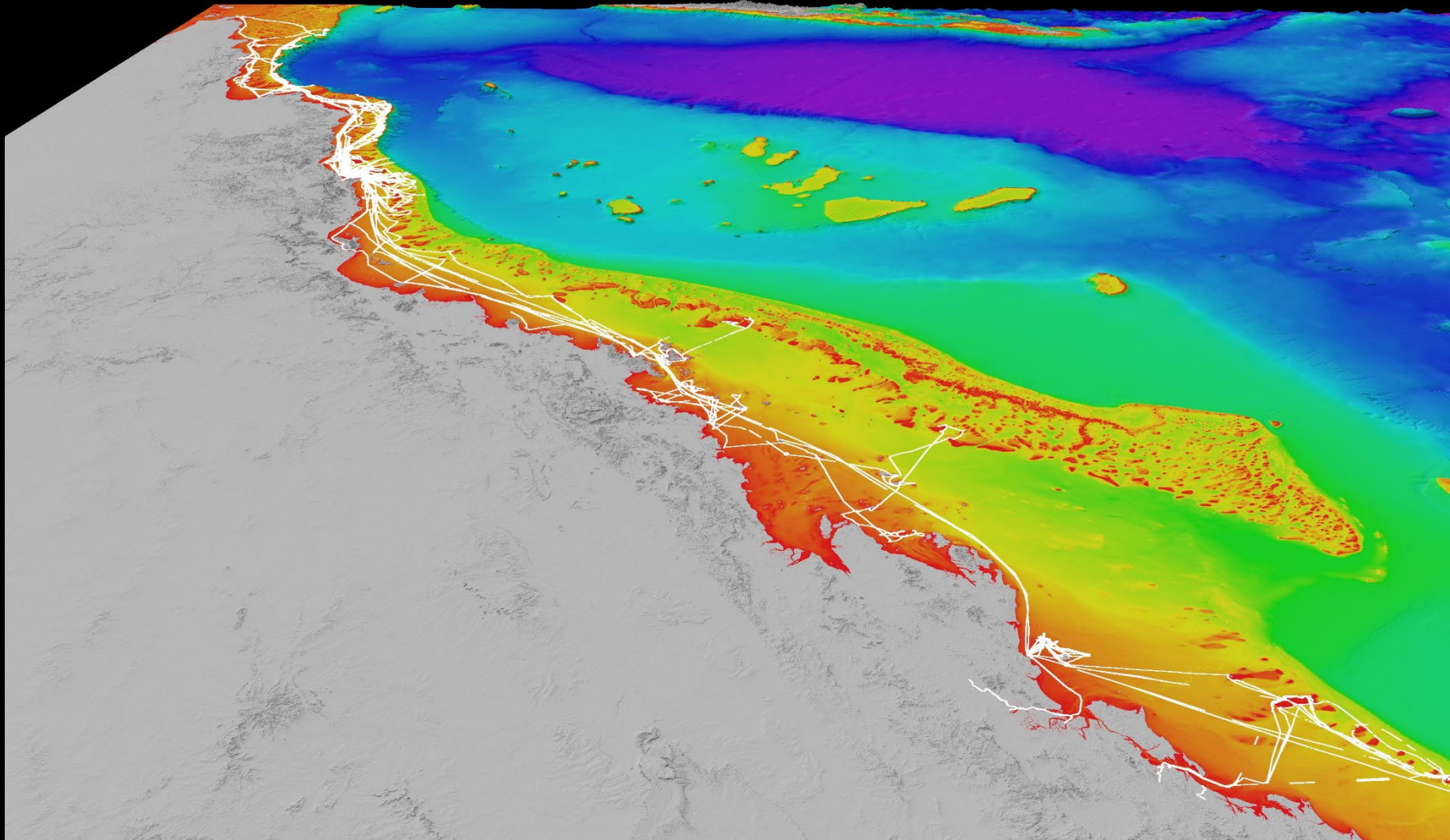
- import data tables into spatial visualisation software
 - Fledermaus, HIPS, GIS, Google Earth
 - ideally viewed as 3D point cloud
- filter and remove anomalous points
 - very little noise, e.g. few 0 m values
 - very few nav spikes (using raw GPS)
 - sound speed (usually) 1500 m/sec



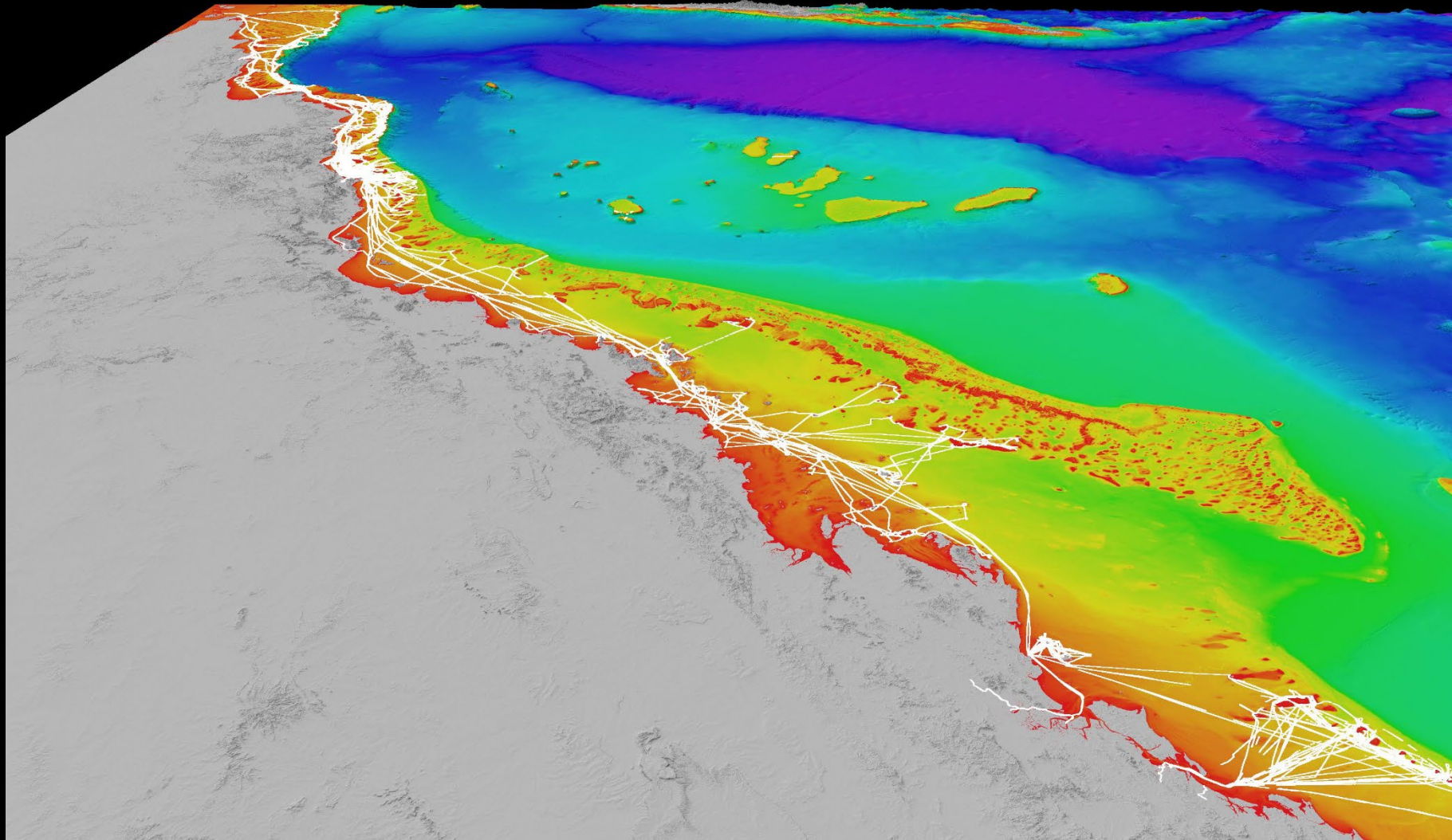
2018



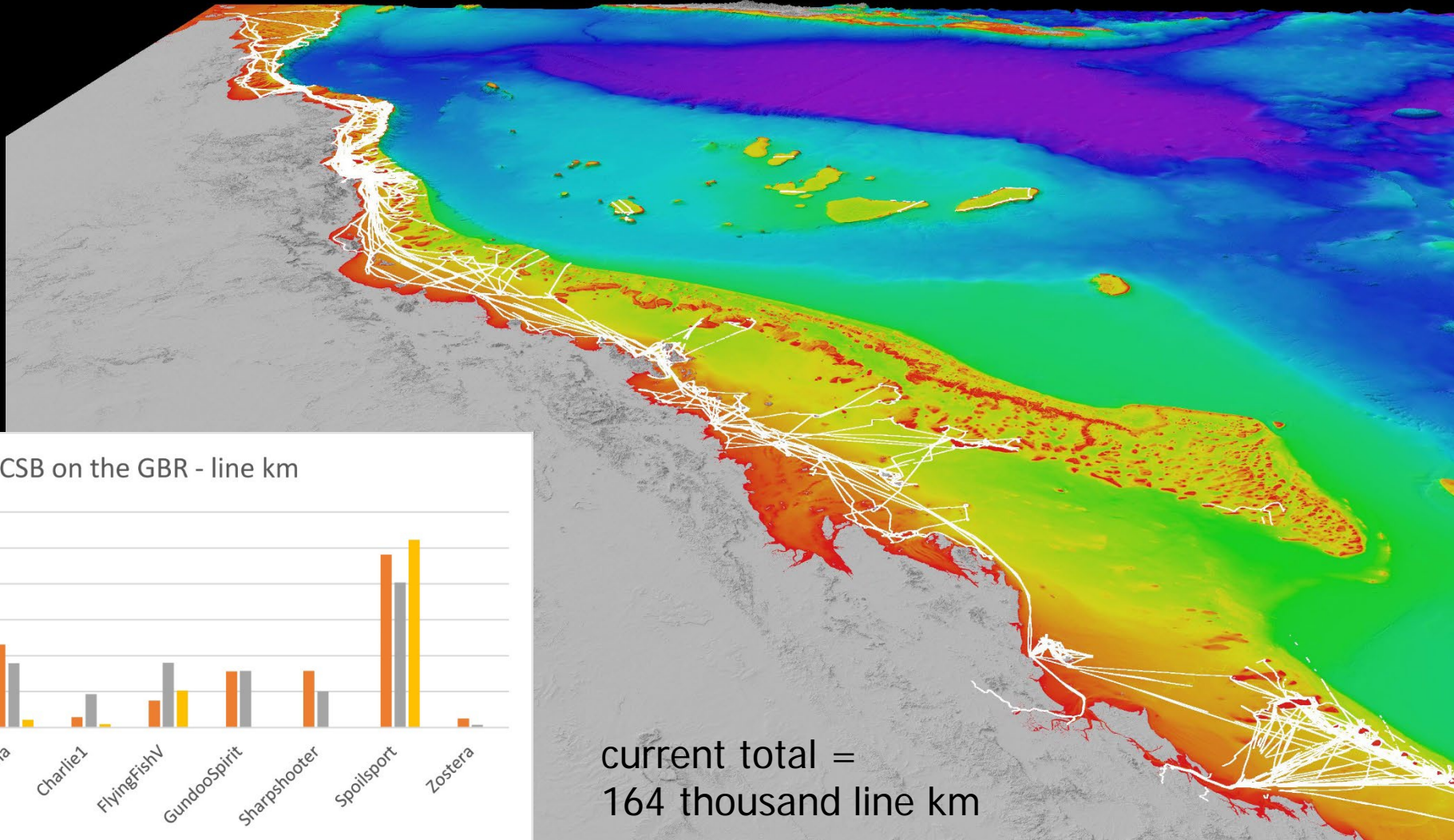
2018-2019



2018-2019-2020



2018-2019-2020-2021



Making a difference

Channel separating Ribbon Reefs No. 10 and 9

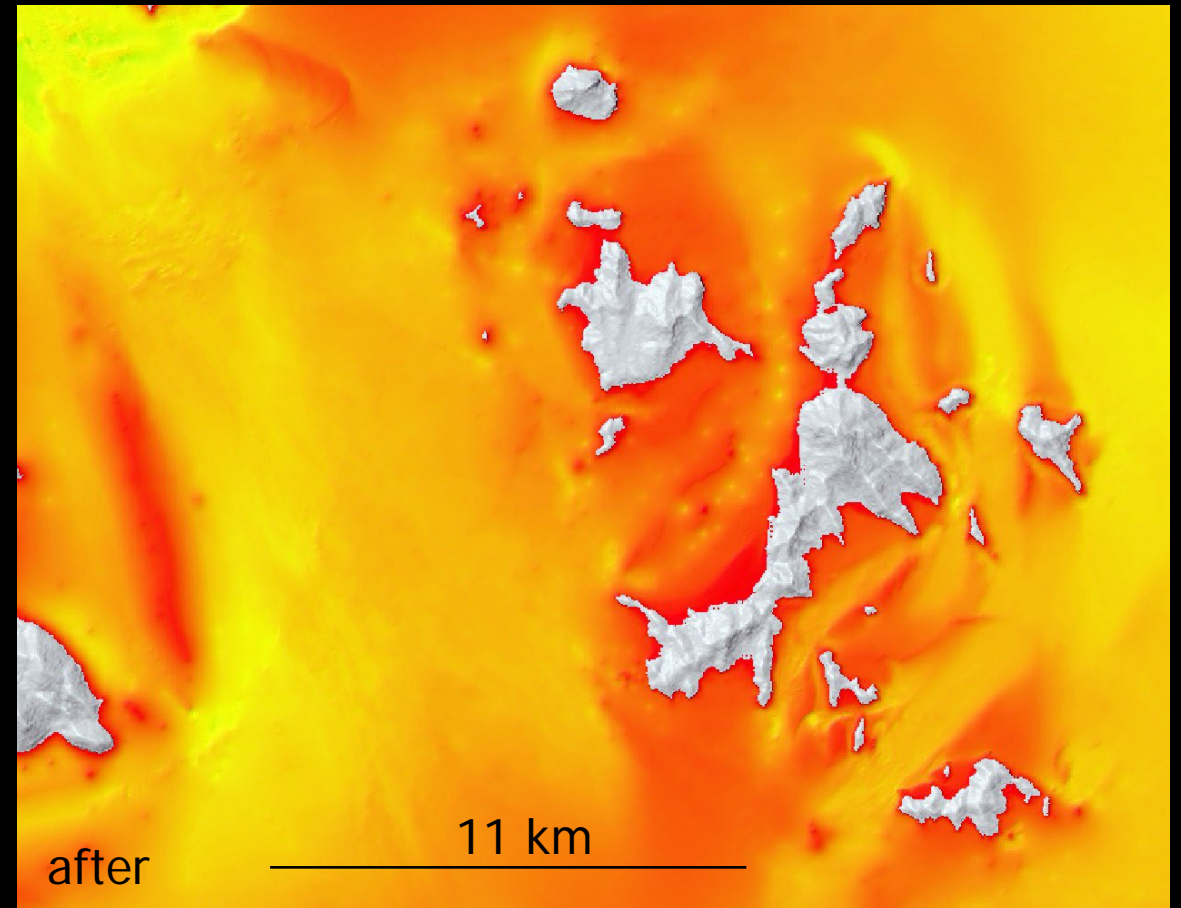
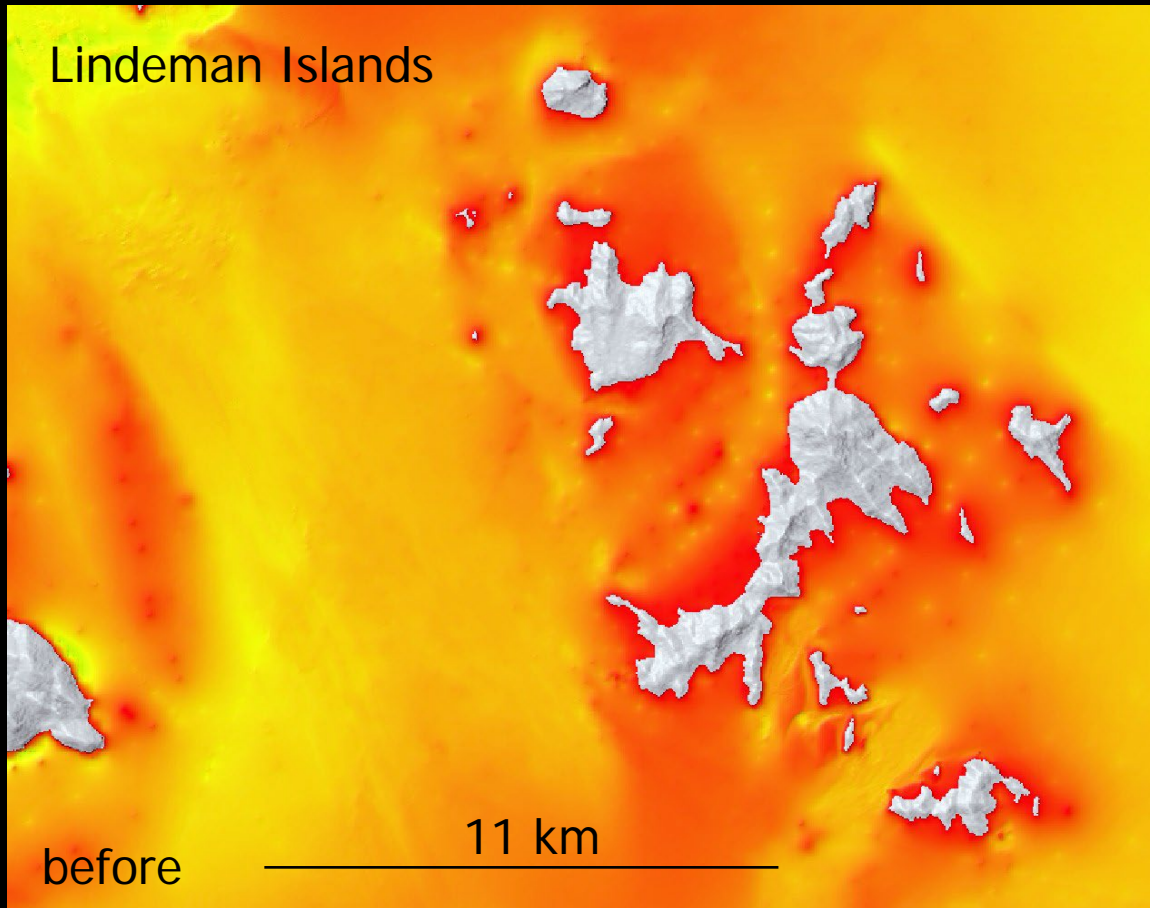
before

4 km

after

4 km

Making a difference



Keeping track

The screenshot displays the MarineTraffic website interface. The main map shows Australia with several vessels tracked. A sidebar on the left, titled "My Fleets", includes a toggle for "Show other vessels" and a "Filter by colour" section with a green checkmark. Below this, a list of vessels is shown, including "CSB Fleet", "ARGO", "AROONA", "CORAL DISCOVERER", "FLYING FISH IV", and "SPOILSPORT". A "Research Vessel Fleet" option is also present. The right sidebar provides detailed information for the selected vessel, "SPOILSPORT", which is a "Dive Vessel". It includes a "Vessel Details" button, a "PAST TRACK" button, and a "USE ROUTE TOOL" button. The vessel's status is "Class B", and its speed/course is "8.6kn / 95°". The draft is "N/A". The vessel was received 19 hours, 16 minutes ago (AIS Source: 2671). The bottom of the page features a footer with links for "Terms", "Privacy", "User Agreement", "English (EN)", "About", "MarineTraffic Blog", "Help Centre", and a "Support" button.

MarineTraffic: Global Ship Trac

https://www.marinetraffic.com/en/ais/home/shipid:3950919/zoom:7

Live Map Explore Community Pricing

Search MarineTraffic

My Fleets

Show other vessels

Filter by colour

Show all fleets

CSB Fleet

ARGO

AROONA

CORAL DISCOVERER

FLYING FISH IV

SPOILSPORT

Research Vessel Fleet

SPOILSPORT

Dive Vessel

OFF ON SAT Vessel Details

AU CNS

ATD: 2021-11-18 17:49 ETA: -

PAST TRACK USE ROUTE TOOL

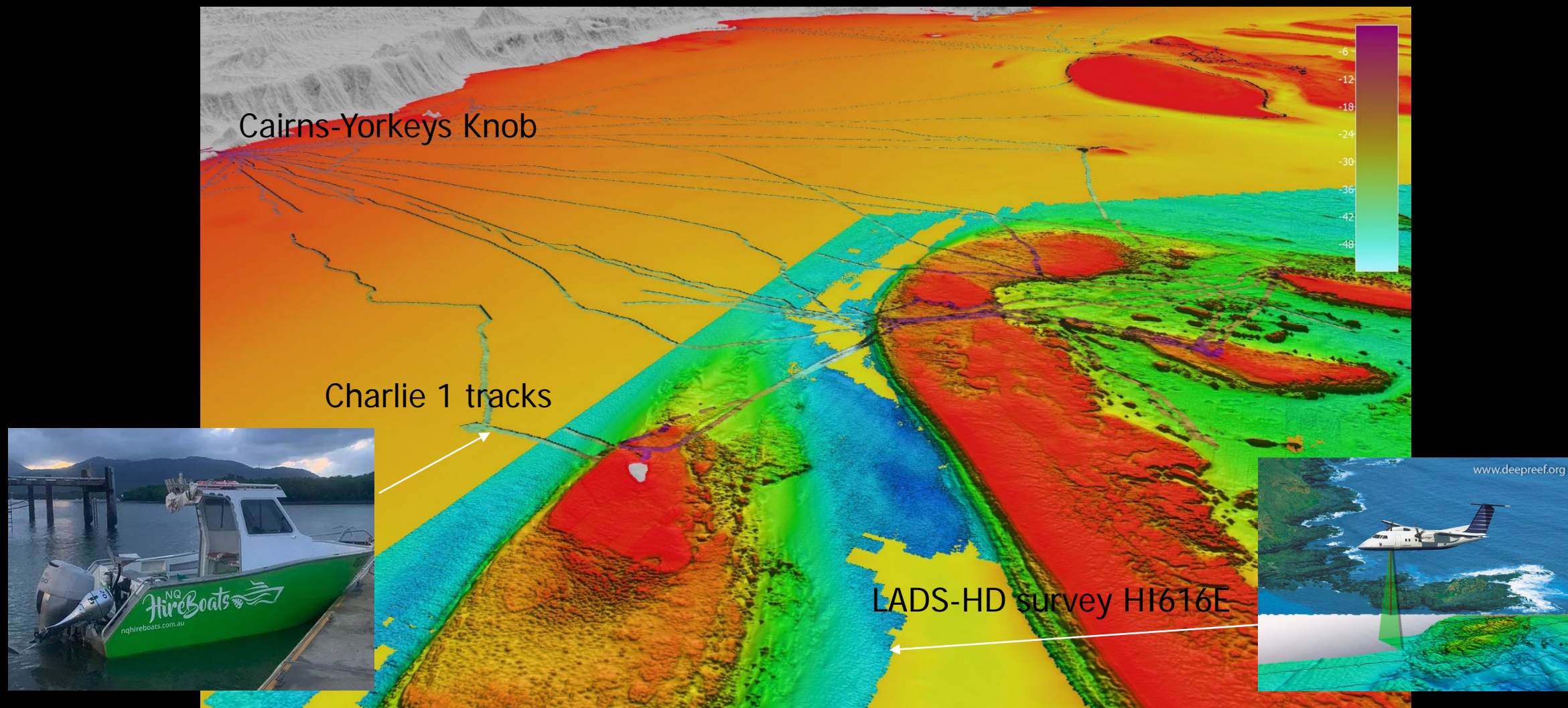
Status: Class B Speed/Course: 8.6kn / 95° Draught: N/A

Received: 19 hours, 16 minutes ago (AIS Source: 2671)

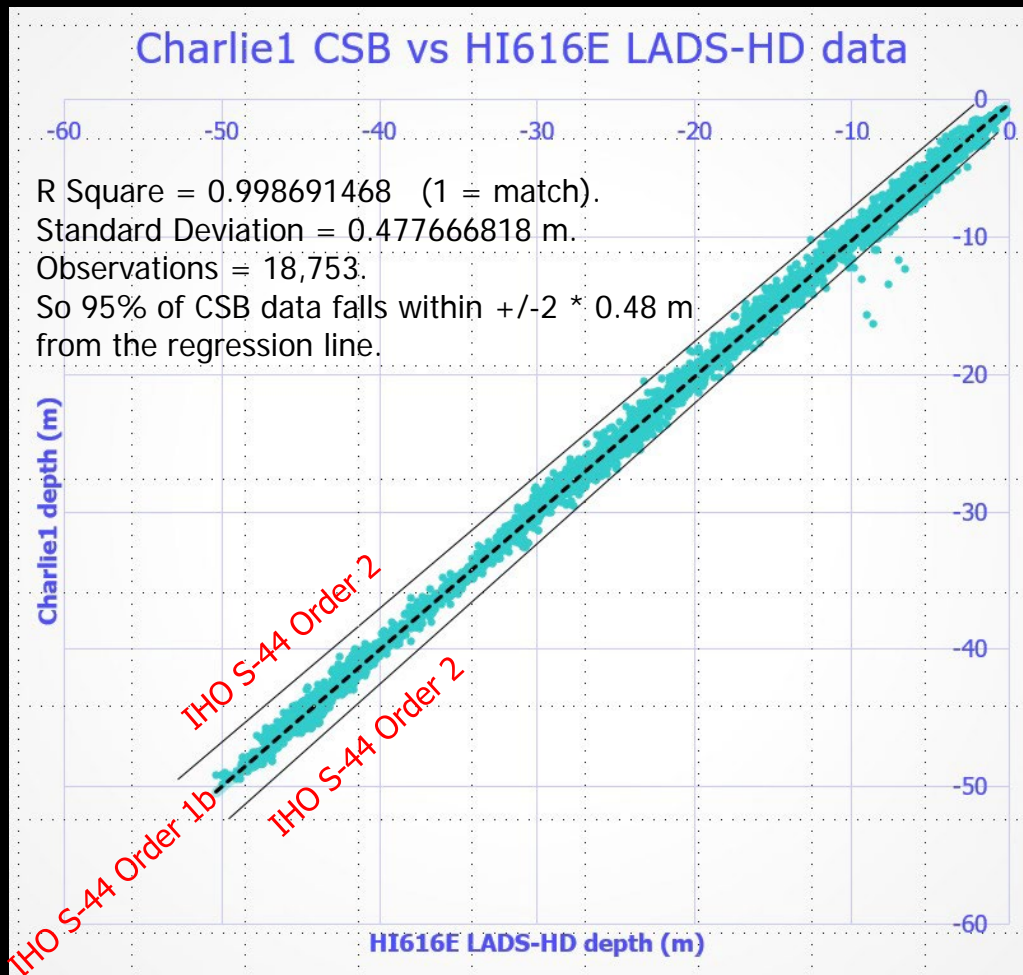
Support

Terms Privacy User Agreement English (EN) About MarineTraffic Blog Help Centre

Compare CSB to LADS-HD



TPU conclusions



- CSB data comparison with LiDAR ± 0.80 - 0.96 m (95% confid level)
- So is reasonable to say that CSB data TVU $\pm \sim 1$ m (95% confid level)
- And CSB data conforms to IHO S-44 Order 1b* or (minor) Order 2
- Improved TVU if offsets to waterline RP, tide applied, cleaned of noise etc.
- Improved THU if able to use SBAS, modern GNSS receiver etc.

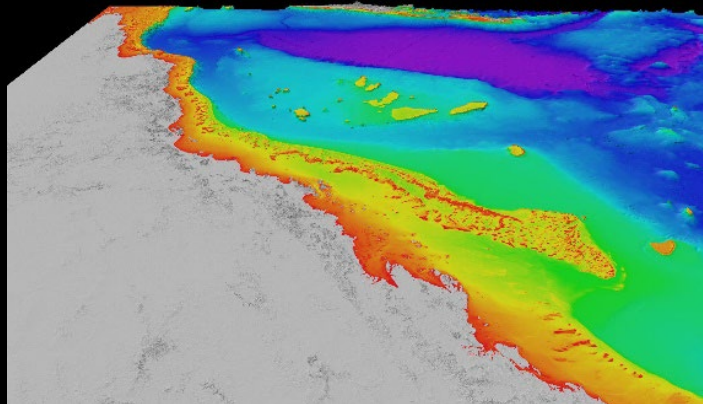
* Classified according to the S-44 Matrix as: Ba7 (THU=7.37 m), Bc8 (a=0.5 m), Bd6 (b=0.013)

Data delivery

JCU (Trusted Node)

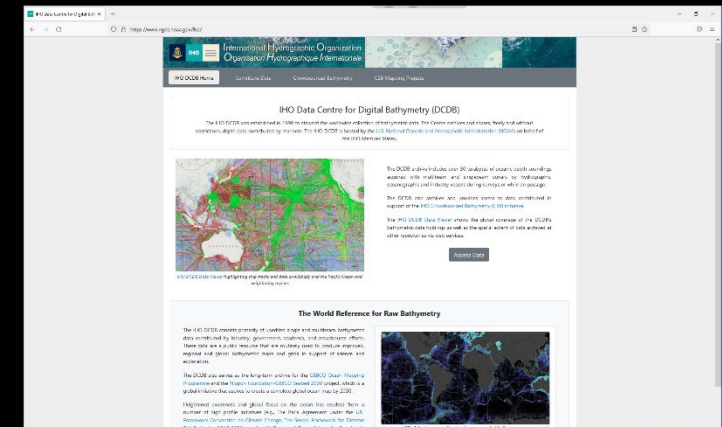
raster grids of
integrated data

Deepreef Explorer
AusSeabed Marine Data Portal



ftp transfer of xyztime
points + metadata
(currently hidden)

IHO Data Centre for Digital
Bathymetry (DCDB)



Future work

- Add more volunteer vessels to CSB on GBR project
- Put python script online for tsv-csv file conversion
- Upload more CSB on GBR data to the IHO DCDB
- Get approval by AHO to release CSB on GBR via IHO DCDB
- Continue advising Australian efforts for acquiring CSB data