Citizen Science and UAVs:

How to monitor the Victorian coast

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VICTORIA State Government | Environment Land, Water and Planning

The Citizen Science UAV Project

Dan

From: Daniel Ierodiaconou <daniel.ierodiaconou@deakin.edu.au>
Sent: Tuesday, March 27, 2018 2:16:41 PM
To: Nicolas Pucino
Subject: RE: junior architect opportunities

Dear Nicolas, completely understand and wish you and your partner all the best in the future.

I would suggest if you are keen on the project that you apply anyway. We really have no idea what applicants we will get and whilst not ideal the steering committee may consider an alternate location. The key for them is that we secure the best candidates to grow the program

Key is to make it very clear in the cover letter. Make sure also that you address the selection criteria. As you are aware we also have a campus in Melbourne and Geelong with a research station at Queenscliffe that could also be an option if the Geelong (big town) area is of interest. There is a push to have more marine and coastal postdocs at Queencliffe.

Thanks for the kinds words. Hopefully if you meet me in person you feel the same!

Family is the most important thing Nicolas- if you keep that the focus my experience is everything else tends to work out someway

We have started the citizen science UAV flights- seems to be going well and picking up momentum now

Cheers
Dan
Daniel Ierodiaconou
Associate Professor VVVVV ><))))*> VVVVV
School of Life and Environmental Sciences,
Faculty of Science, Engineering and Built Environment
Deakin University
Warrnambool Campus, (room J314)
Princes Hwy, Sherwood Park,Warrnambool, VIC 3280, Australia
PH: +61409502980

The Citizen Science UAV Project

Dan

[redacted]

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Cheers

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[redacted]

The Citizen Science UAV Project

Dan

Nick

That's cool you started the Citizen UAV-flights.
Where can I find more info ?
What does the Citizen component actually mean ? I know Citizen-GIS, app-based observations in the field, added from citizens (users) to an online database, processed server-side and rendered to the client in a webmapping application. But Citizen-UAV is novel to me.
Doeas that mean that private owners who flies UAV along the coast provide imagery to be collected and analysed ? that would be awesome, crowdsourced uav imagery to monitor coastal sedimentation !

???

Citizen Science + Drones

The Citizen Science UAV Project

People

- 14 groups
- Volunteers
- Locals

Training

- Training
- Protocol

Drone Set

- DJI Phantom 4pro
- 10 Smart GCPs
- Tablet, batteries, spares

Victoria Coast

- From June 2018
- 14 locations
- 60 datasets

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SfM

3D

DSM

Orthophoto

The Citizen Science UAV Project

People

Training

Drone Set

Victoria Coast

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SfM

DSM

Orthophoto

Data Quality + Validation

Data Quality and Validation

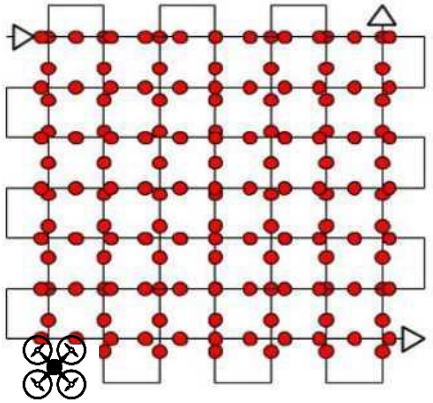
Hardware

Software

PIX4D

propeller

Planning



Professional Support

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Data Quality and Validation

propeller

	X variance (mm)	Y variance (mm)	Z variance (mm)
count	58.000000	58.000000	58.000000
mean	6.815517	4.103448	7.934483
std	4.764555	4.739900	8.424620
min	0.400000	0.400000	0.700000
25%	4.350000	1.225000	3.375000
50%	6.200000	2.450000	5.850000
75%	8.150000	5.725000	9.875000
max	24.400000	27.900000	53.400000

- **58** Smart GCPs
- **2-3** hours acquisition time
- **7,4 and 8 mm** XYZ variance during GCP acquisition time

PIX4D

Project	20181129_Warrnambool_Harbour
Processed	2018-12-03 17:23:53
Camera Model Name(s)	FC6310_8.8_5472x3648 (RGB)(1), FC6310_8.8_5472x3648 (RGB)(2), FC6310_8.8_5472x3648 (RGB)(3)
Average Ground Sampling Distance (GSD)	2.56 cm / 1.01 in
Area Covered	1.616 km^2 / 161.5825 ha / 0.62 sq. mi. / 399.4857 acres
Time for Initial Processing (without report)	01h:52m:01s

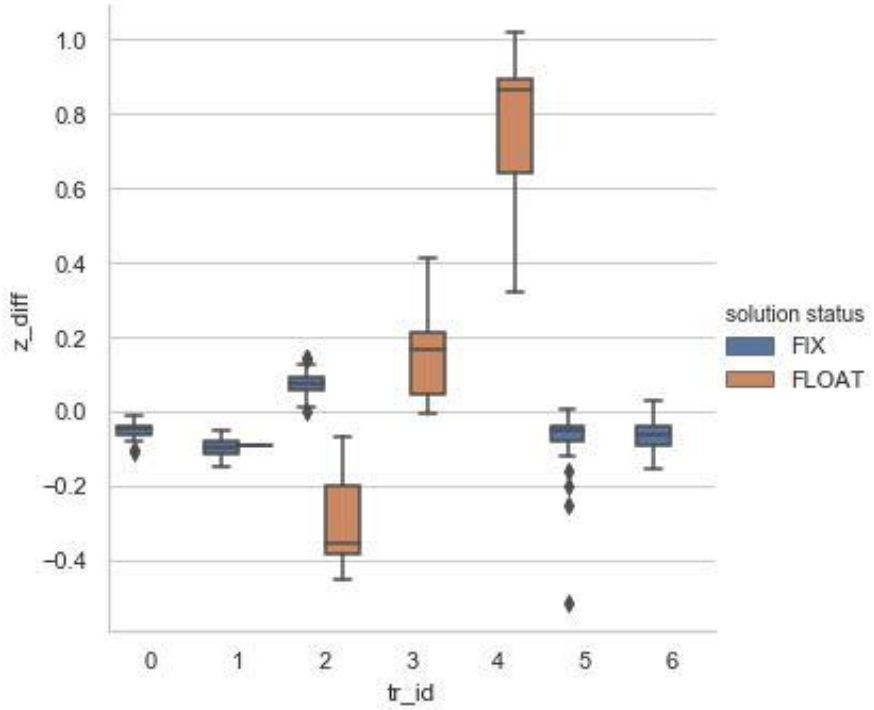
Quality Check

Images	median of 37454 keypoints per image	✓
Dataset	1073 out of 1109 images calibrated (96%), all images enabled	✓
Camera Optimization	0.49% relative difference between initial and optimized internal camera parameters	✓
Matching	median of 7556.25 matches per calibrated image	✓
Georeferencing	yes, 53 GCPs (53 3D), mean RMS error = 0.024 m	✓

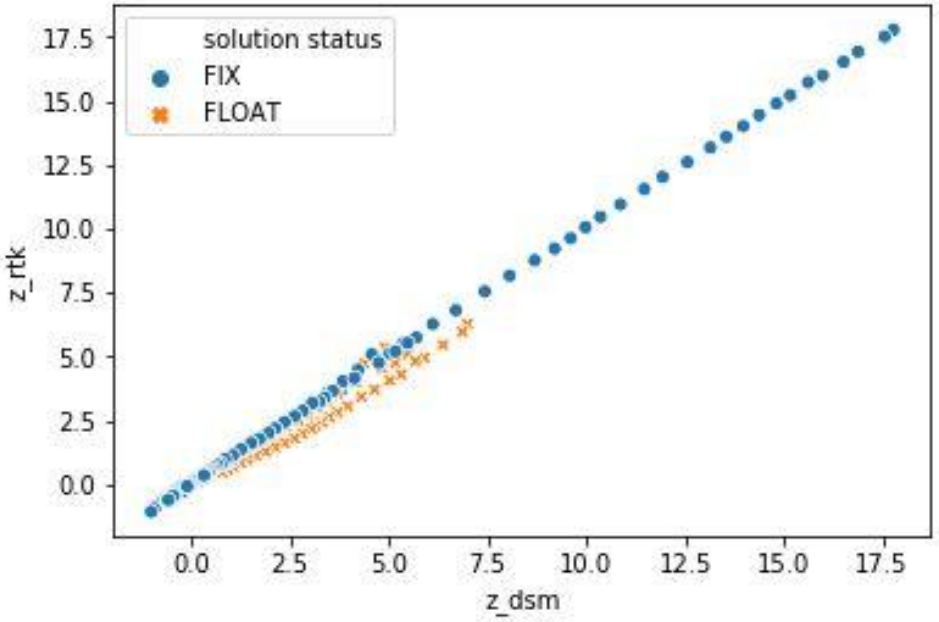
- Lady Bay, 1.6 km2 (161.6 ha)
- **2.4 cm** RMSE 3D absolute accuracy
- **2.56** cm GSD → 1 pixel of error

Data Quality and Validation

Data Quality and Validation



	fid	x	y	z_dsm	lateral rms	tr_id	z_rtk	new_field	z_diff
count	150.000000	150.000000	1.500000e+02	150.000000	150.000000	150.000000	150.000000	150.000000	150.000000
mean	109.673333	630516.725701	5.748889e+06	2.893818	0.004704	3.613333	2.937904	107.233333	-0.044086
std	68.745567	1139.485686	3.414026e+02	4.739371	0.001037	2.382224	4.750810	67.005300	0.077730
min	1.000000	628838.900500	5.748539e+06	-1.013198	0.002600	0.000000	-1.075440	1.000000	-0.514993
25%	39.250000	629083.574250	5.748563e+06	-0.138148	0.003925	1.000000	-0.095515	39.250000	-0.081568
50%	133.500000	631189.392150	5.748789e+06	0.770039	0.004700	5.000000	0.790380	129.500000	-0.047882
75%	170.750000	631634.218100	5.749270e+06	3.828357	0.005400	6.000000	3.946635	166.750000	-0.023891
max	208.000000	631679.697000	5.749501e+06	17.777303	0.008000	6.000000	17.797445	204.000000	0.141925



Mean Error (ME) = -0.04m (4cm)

→ DSM values are slightly overestimated, but acceptable.

Root Mean Squared Error (RMSE) = 0.09m (9cm)

→ RMSE over PR method are known to overestimate the error estimations (Carrivick et.al, 2016).

Analysis + Communication

Analysis and Communication

By the end of the **3 years** time Citizen Scientists will have produced more than **200 datasets** ...

... there will be **1 Tb of DSM and orthophotos** to analyse ...

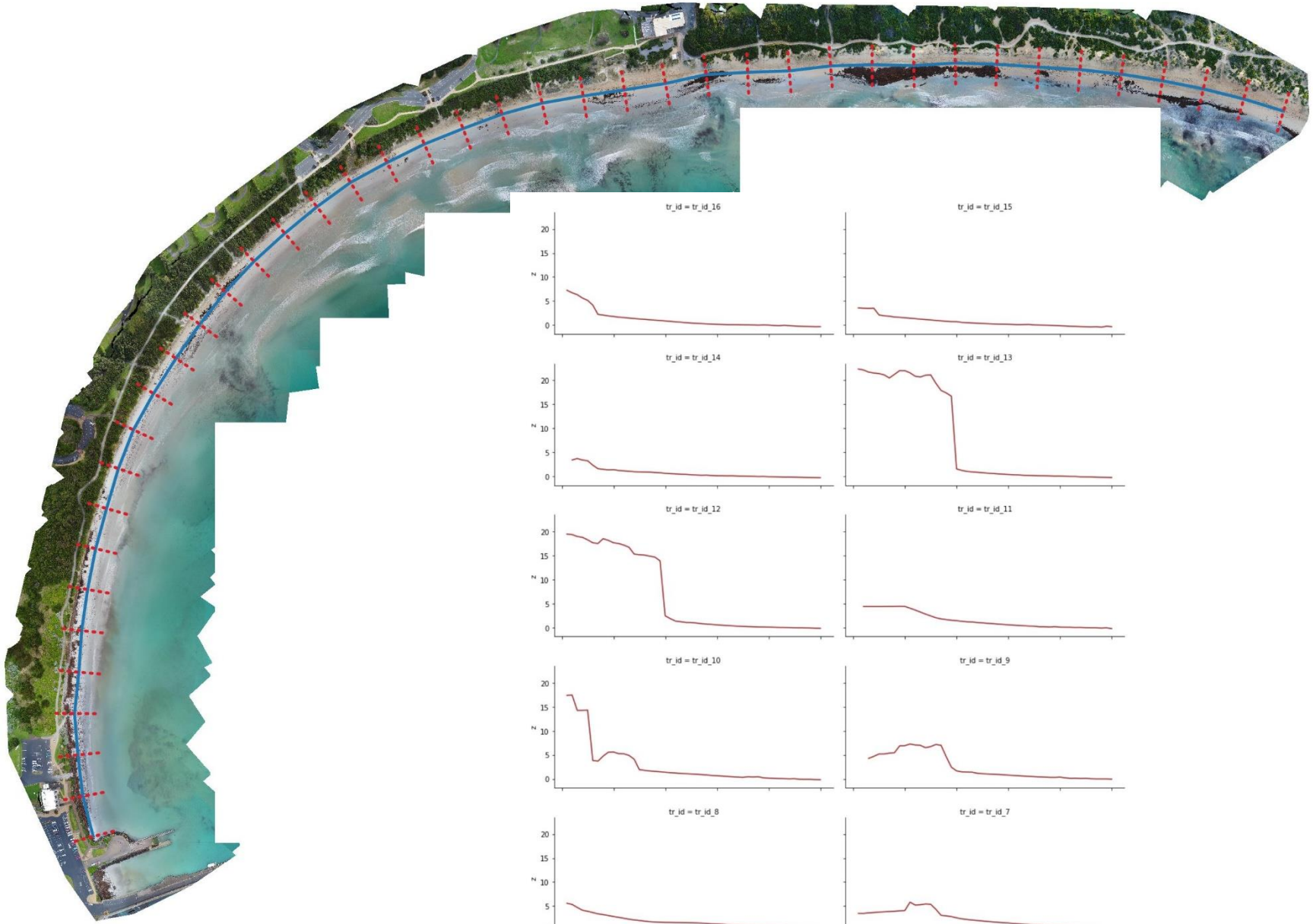
... **14 locations** with differences in wind, wave and sediment regimes. **Good research** possibilities!

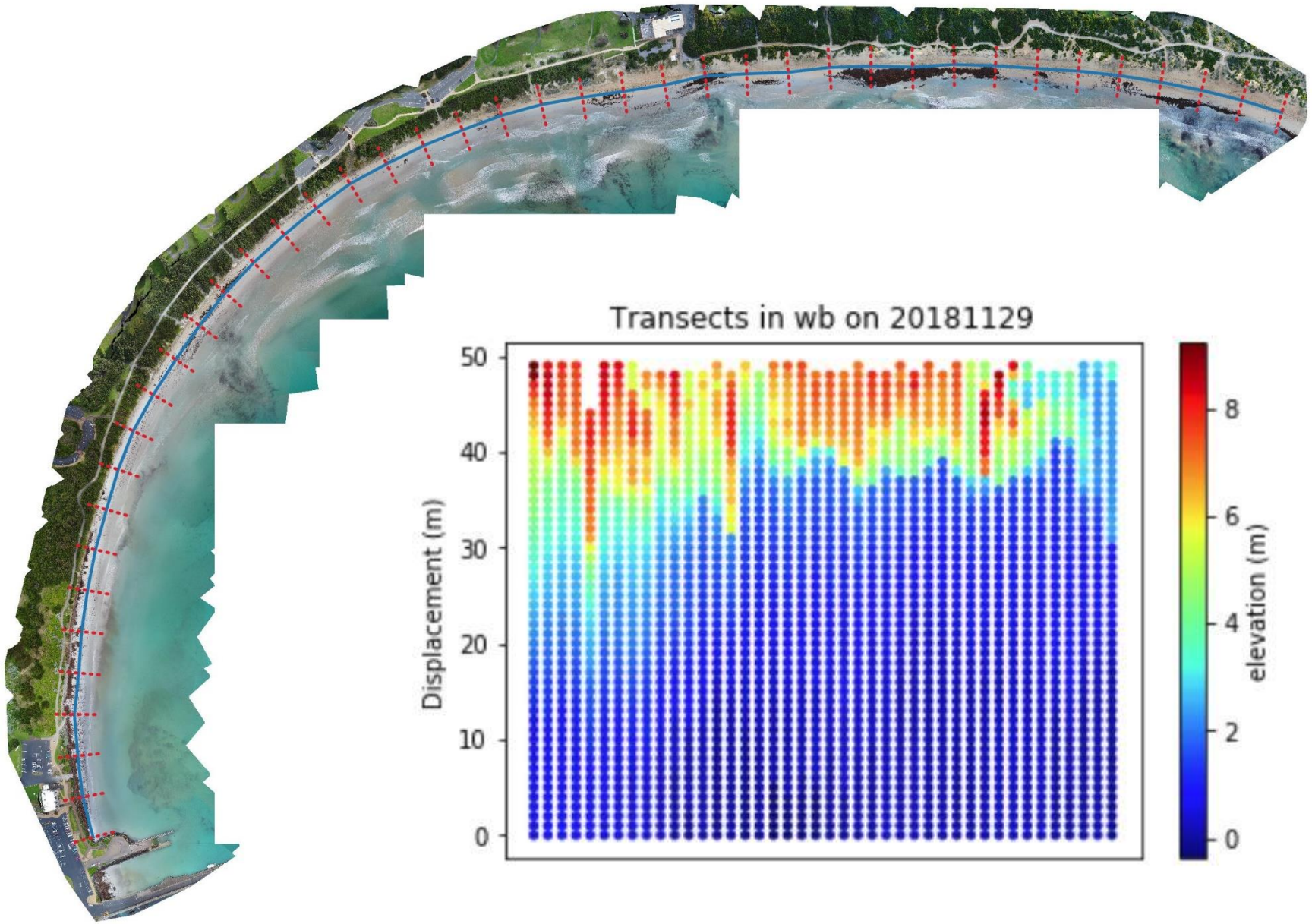
How to analyse such an amount of geospatial data in an efficient way?

PostgreSQL + PostGIS

Python Geospatial Scripting

Analysis and Communication





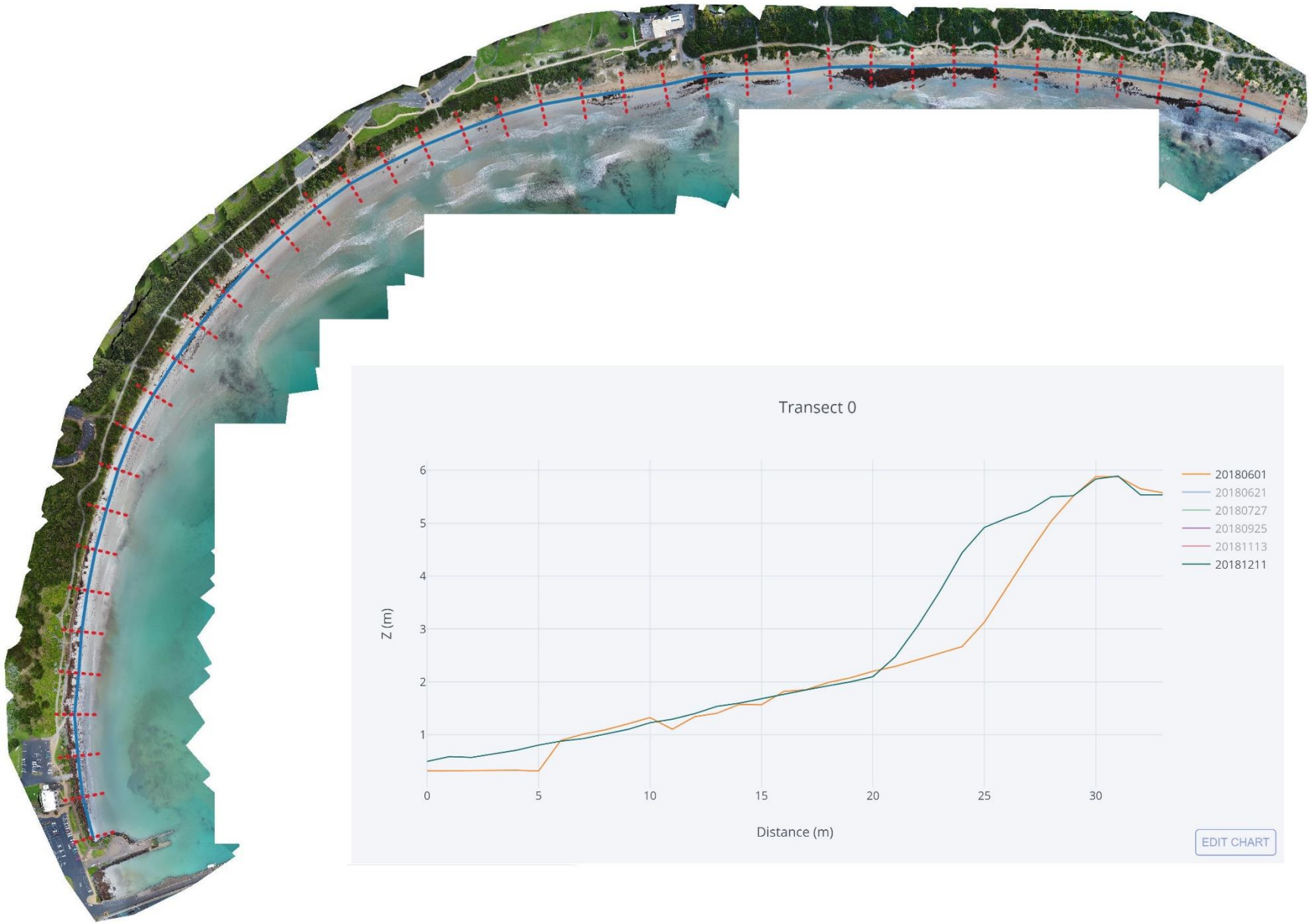
Virtual Network of Elevation Profiles

Several hundreds virtual profiles will be monitoring the UAV sites at unprecedented accuracy.

Why elevation profiles?

- **Convenience** (data format and size)
- **Cut/Fill** observations → seasonal? Storm-dependent?
- **Dynamic equilibrium?**
- Lack of wave data → wind+profiles= wave conditions?

Analysis and Communication



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Analysis and Communication

jupyter Plot Transects Data Last Checkpoint: 10 minutes ago (unsaved changes)

Logout

File Edit View Insert Cell Kernel Widgets Help

Trusted | Python [conda env:plot_pd]

Run Code

In [1]:
```
%matplotlib inline

import geopandas as gpd
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from shapely.geometry import Point
import plotly as py
from plotly.offline import download_plotlyjs, init_notebook_mode, iplot
from plotly.graph_objs import *
import cufflinks as cf
import plotly.figure_factory as ff

py.tools.set_credentials_file(username='npucino', api_key='52QvrqD79F3zycqV3gFB')
init_notebook_mode(connected=True)
```

In [ ]:
```
profiles = pd.read_csv(r"C:\Users\Nicolas Pucino\Desktop\inverloch\profile_points.csv")
mean_pf=pd.read_csv(r"C:\Users\Nicolas Pucino\Desktop\inverloch\profile_points.csv")
```

In [ ]:
```
mar=profiles.loc[profiles['location']=='portfairy']
```

Marengo

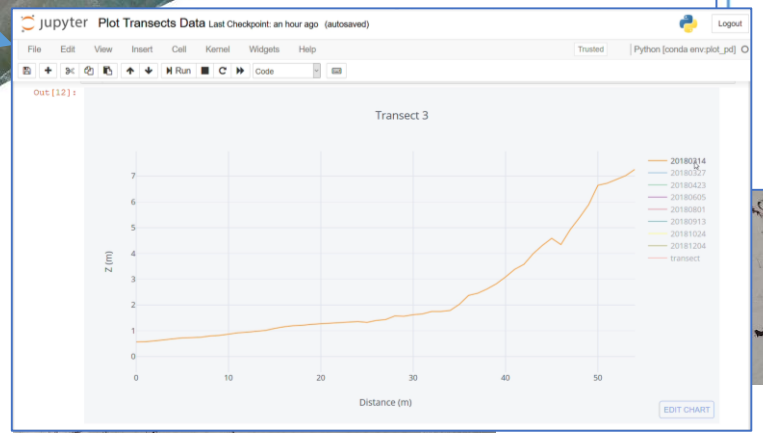
In [ ]:
```

mar_date1=mar.loc[mar['date'] == 20180601]
mar_date2=mar.loc[mar['date'] == 20180621]
mar_date3=mar.loc[mar['date'] == 20181113]
mar_date4=mar.loc[mar['date'] == 20180925]
mar_date5=mar.loc[mar['date'] == 20180727]
mar_date6=mar.loc[mar['date'] == 20181211]

z_marengo_date1=list(mar_date1['z'])
z_marengo_date2=list(mar_date2['z'])
z_marengo_date3=list(mar_date3['z'])
z_marengo_date4=list(mar_date4['z'])
z_marengo_date5=list(mar_date5['z'])
z_marengo_date6=list(mar_date6['z'])

dist_mar_index1=list(mar_date1['distance'])
dist_mar_index2=list(mar_date2['distance'])
dist_mar_index3=list(mar_date3['distance'])
dist_mar_index4=list(mar_date4['distance'])
dist_mar_index5=list(mar_date5['distance'])
dist_mar_index6=list(mar_date6['distance'])
```

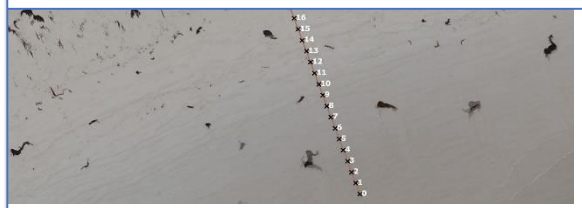
jupyter

- **Automatic** extraction of all elevation profiles along the multitemporal DSMs
- **2 main inputs**: the DSM and the transects (vector lines)
- **1 big data table**, text format, full of information
- **Python** geospatial processing is fast and efficient
- **Interactive plotting** inside Jupyter Notebooks
- **Powerful** geostatistical analysis with Geopandas
- **Big Data** table feeds directly into PosgreSQL to be amnipulated and queried with PostGIS
- Fits perfectly with **Qgis** and ArcGIS

Port Fairy Beach

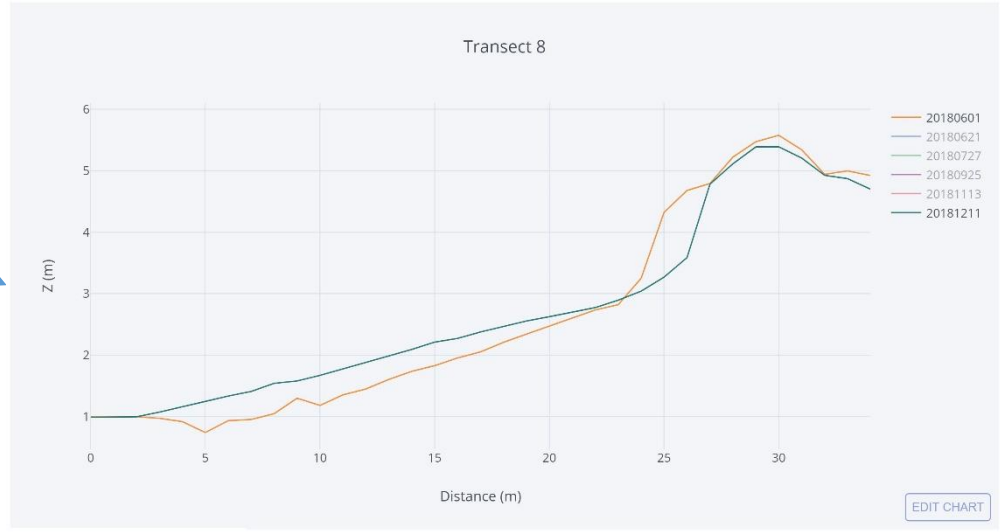
Beach length: 5800 m
Surveyed section: 2200m
Orientation: SE
Waves: avg 1.5m

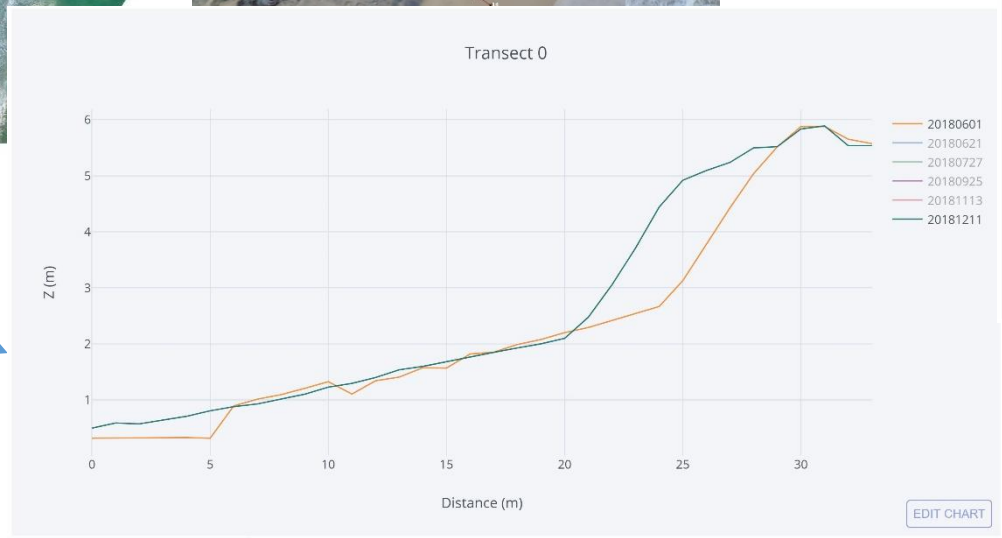


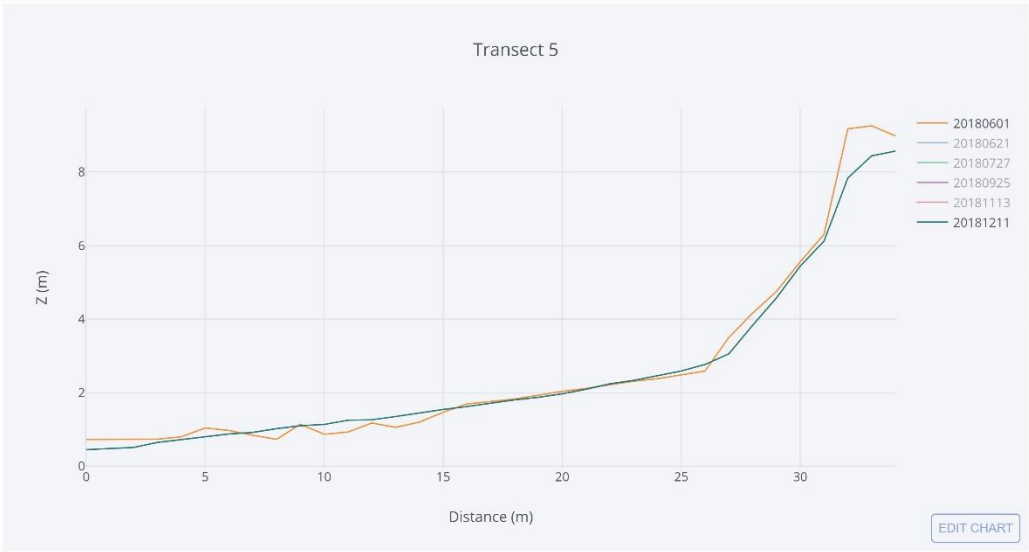


Marengo Beach

Beach length: 150 m
Surveyed section: 170m
Orientation: EAST
Waves: avg 0.5m







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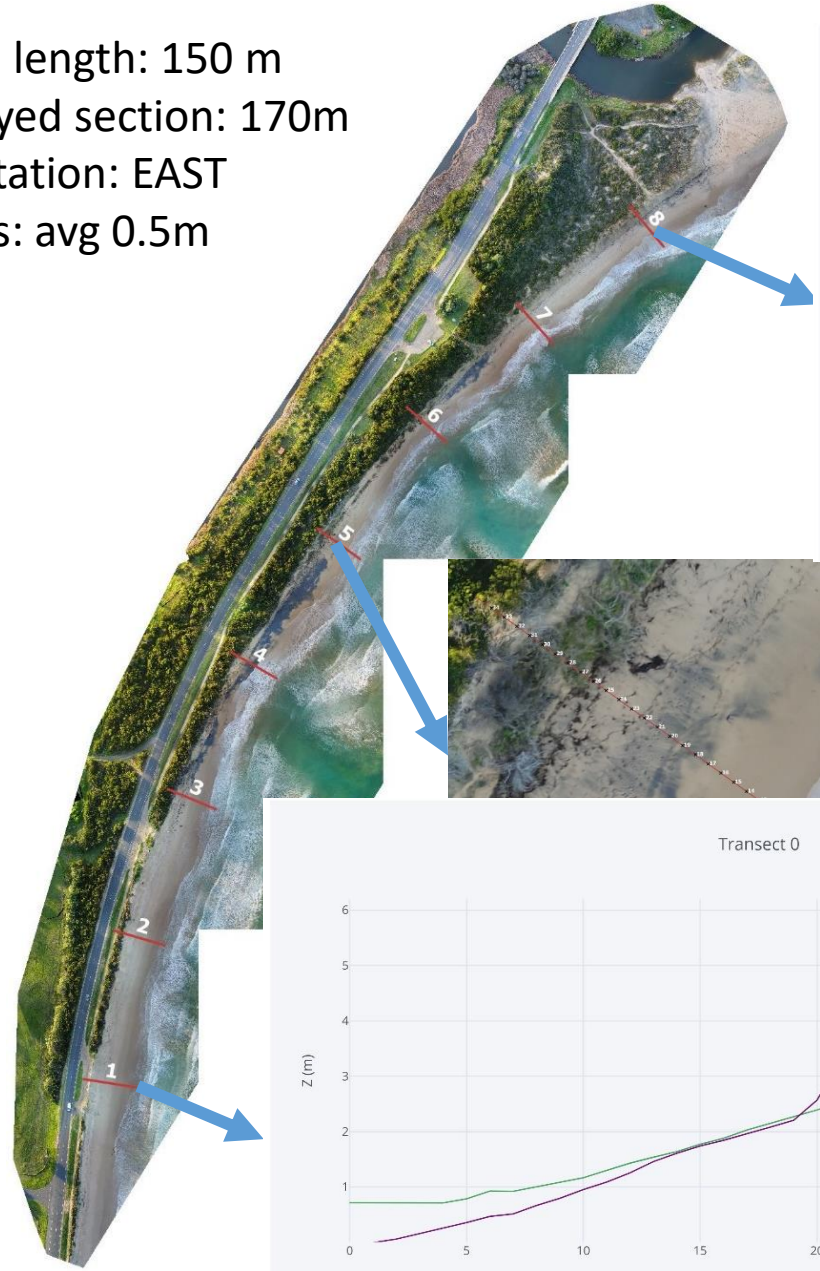
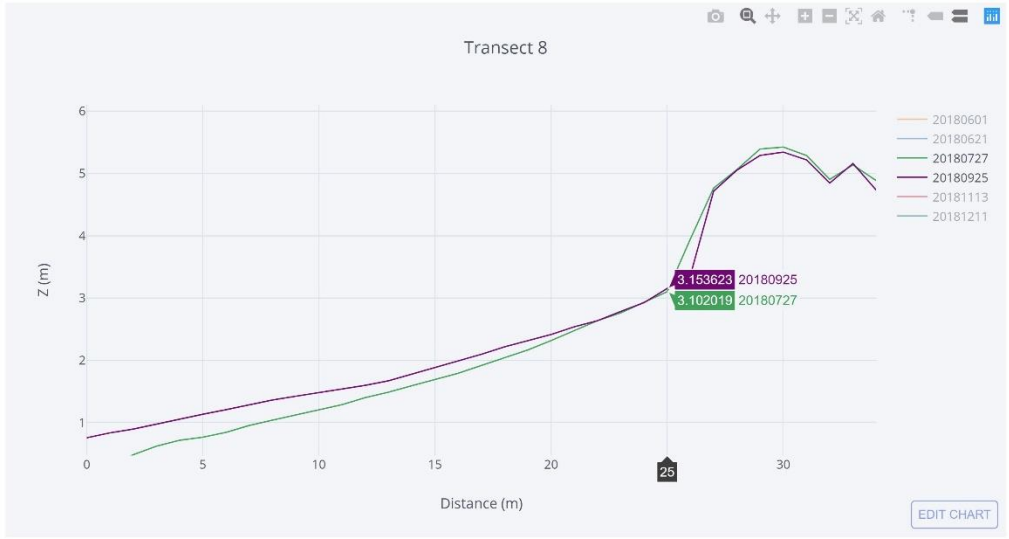
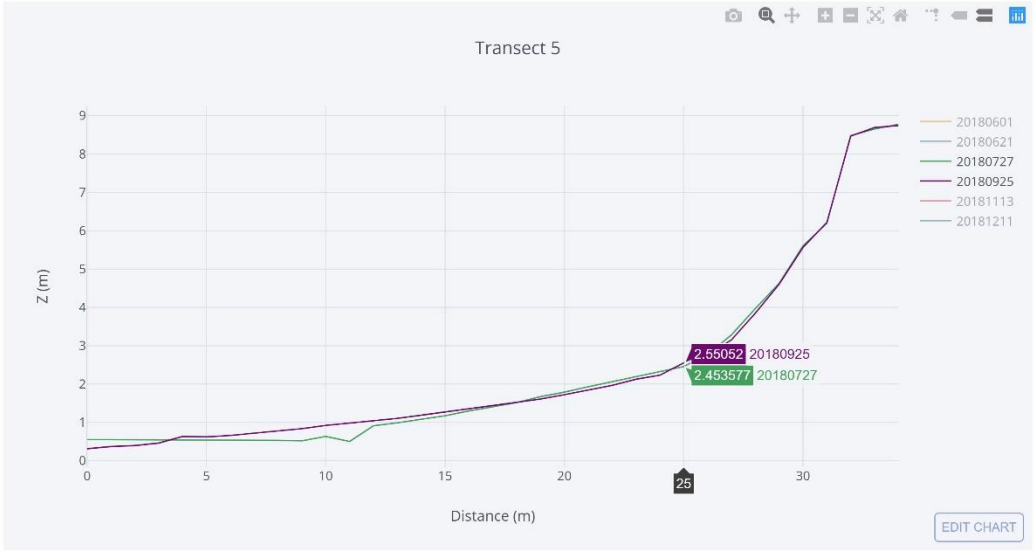






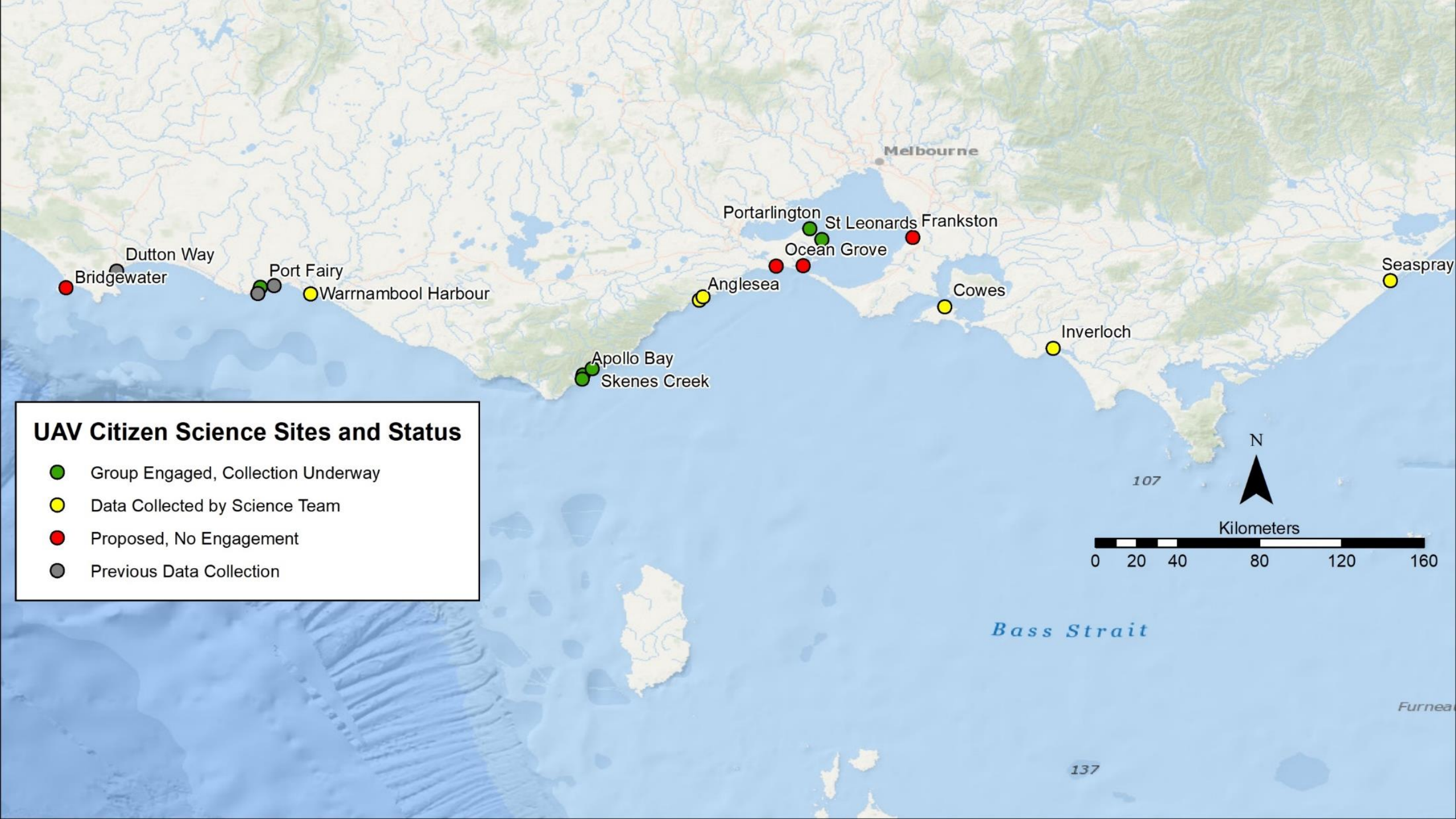
Ongoing + Future

- Postgres database population
- Filtering of elevation points based on colour class (Callow et al., 2018)
- Volumetric analysis (DoDs) into database
- Getting better notebooks for Citizen Science distribution

Thank You

npucino@deakin.edu.au

Acknowledgment
DELWP
ANZGG Grant for Postgraduate Student


Melbourne
Portarlington
St Leonards
Frankston
Ocean Grove
Seaspray
Anglesea
Cowes
Inverloch
Dutton Way
Bridgewater
Port Fairy
Warrnambool Harbour
Apollo Bay
Skenes Creek
Bass Strait
107
137
N
Kilometers
0 20 40 80 120 160
UAV Citizen Science Sites and Status
Group Engaged, Collection Underway
Data Collected by Science Team
Proposed, No Engagement
Previous Data Collection