Citizen Science and UAVs: How to monitor the Victorian coast

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From: Danie1 Ierodiaconou <danie1.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 Queenscliffe.

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

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The Citizen Science UAV Project
Dan

Subject: Citizen Science UAV Project

Dear [Recipient],

I hope this email finds you well. I'm writing to update you on the progress of the Citizen Science UAV Project.

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

Cheers,
Dan
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.

Does 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

SfM
- DSM
- Orthophoto
The Citizen Science UAV Project

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People

• Training
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Training

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Drone Set

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Victoria Coast

Warrnambool Harbour Before and After an Major Storm Event

SfM

DSM

Orthophoto
Data Quality + Validation
Data Quality and Validation

Hardware

Software

Planning

Professional Support
Data Quality and Validation

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

### 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

### Technical Specifications

- **Propeller**: Lady Bay, 1.6 km² (161.6 ha)
- **PIX4D**: 2.4 cm RMSE 3D absolute accuracy
- **2.56 cm** GSD → 1 pixel of error
Data Quality and Validation

7 cross-shore transects of varying lengths with RTK-GPS location surveyed every meter.

- Independent set of 208 RTK-GPS checkpoints used to validate DSM Z values.
- Point to Raster (PR) method.
- Low quality points discarded → lateral error < GSD.
**Data Quality and Validation**

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

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

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

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

pgAdmin 4 + Jupyter

PostgreSQL + PostGIS

Python Geospatial Scripting
Analysis and Communication

Virtual Network of Elevation Profiles

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

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

Why 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 \(\rightarrow\) seasonal?
  - Storm-dependent?
- **Dynamic equilibrium**?
- Lack of wave data \(\rightarrow\)
  - wind+profiles= wave conditions?
Several hundreds virtual profiles will be monitoring the UAV sites at unprecedented accuracy.

**Why elevation profiles?**

- **Convenience** (data format and size)
- **Cut/Fill** observations $\rightarrow$ seasonal? Storm-dependent?
- **Dynamic equilibrium?**
- **Lack of wave data** $\rightarrow$ wind+profiles $= \text{wave conditions?}$
• **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 PostgreSQL to be manipulated and queried with PostGIS
• Fits perfectly with Qgis and ArcGIS
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
Marengo Beach

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

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Acknowledgment
DELWP
ANZGG Grant for Postgraduate Student