Improving coastal erosion assessments for Victoria

Program Chief Investigators
Assoc. Prof David Kennedy (UoM)
Assoc. Prof Daniel Ierodiconou (Deakin)

Project

- ## $1.7M DELWP PLUS $1.9M co-investment (Deakin, Uni Melb) -VCMP, Port Phillip Bay Fund

Staffing

Postdocs

- Dr Rafael Carvalho- Coastal Compartments, Shoreline sediment dynamics (DU- VCMP)
- Dr Blake Allan- UAV Science Team and Citizen Program lead (DU-VCMP)
- Dr Chloe Morris- Coastal Modelling (UoM- VCMP)
- Dr Teresa Konlechner- Shoreline sediment dynamics (UoM-NCCC funded)

Research Assistants

- Karina Sorrell- UAV Science Team and Citizen Program UoM- PPB Fund)
- Deakin Yolla crew for offshore data acquisition (65-90 days budgeted)

PhDS

- Nicolas Pucino- UAV Science Team, Shoreline sediment dynamics , Coastal Compartments (DU-VCMP
- PhD X TBC (UoM- VCMP)

Associated personnel

- Yakupsan Nyazi (PhD) – Basin scale sedimentary processes and drivers of geomorphology (with GSV)

Critical Issue: Beaches are dynamic

Problem: We don't know how dynamic, as we are lacking data.

Source: McLean & Shen 2006
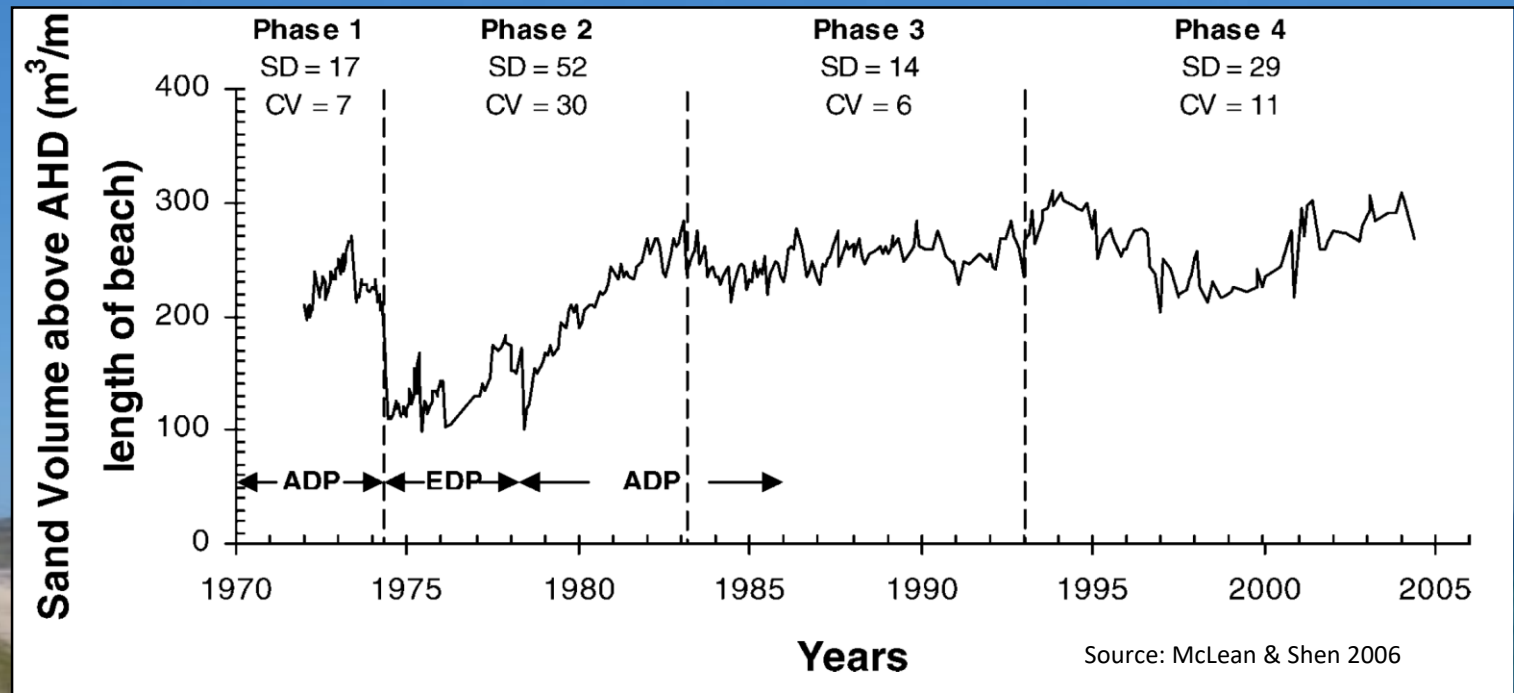
- Beach envelop of up to 80 m wide and 6 m thick
- Beach response to storm events- non linear relationship with wave energy.
- Same magnitude wave events may cause little erosion while others cause significant shoreline retreat
- Uncertainty in sources and sinks

3 Components

1. **Data consolidation**
   - Integration of all LIDAR, MBES and hydrographic data to create an updated topography and bathymetry product at 2.5m and 10m resolution
   - Historical aerials discovery
   - Prioritisation/ Gap analysis

2. **Data Collection**
   - Coastal data collection
   - Offshore data collection
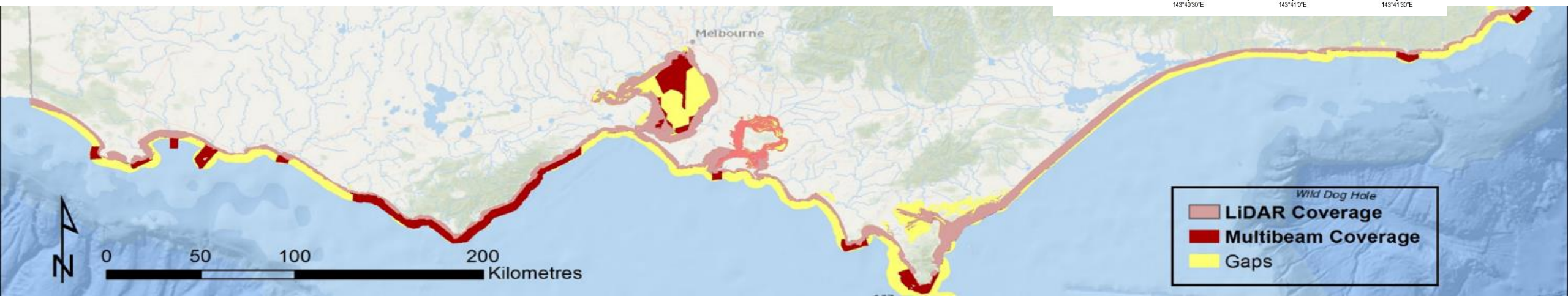   - Citizen science UAV program

3. **Data analysis themes**
   - Shoreline Sediment Dynamics
   - Marine (subtidal) sediment dynamics
   - Coastal compartment modelling
   - Coastal UAV and citizen science

Data consolidation

- Consistent classification of seabed characteristics across the state where high resolution coverage exists

- Over 16TB of historical aerial photos digitised across the state. Game changer for shoreline change analysis.

Shoreline change rates, Apollo Bay (1946 – 2019)

LRR (m/yr)
- 1.7 - 1.8
- 1.5 - 1.6
- 1.3 - 1.4
- 1.1 - 1.2
- 0.9 - 1.0
- 0.7 - 0.8
- 0.5 - 0.6
- 0.3 - 0.4
- 0.1 - 0.2
- -0.1 - 0.0
- -0.3 - -0.2
- -0.4

- LiDAR Coverage
- Multibeam Coverage
- Gaps

Substrate

Sediment
Rock

LiDAR Coverage
Multibeam Coverage
Gaps

**Translating data
to information**

Cape Otway - Level 5

BC 5 - Map Key
- Circalittoral flat sand
- Circalittoral rippled sand
- Dense erect octocorals with erect sponges on fine sand
- Rippled fine sand
- Sparse to moderate density erect octocorals on fine sand
- Lower circalittoral sandy sponge community with fine bushy and purple branching sponges (Surf Coast E)
- Lower circalittoral sandy sponge community with Pyura spinifera, taco sponge and flabellate sponges (Surf Coast P)
- Lower circalittoral sandy veneer community with Pyura spinifera and abundant and diverse low erect and lamellate-covering sponges (Cape Otway E)
- Lower circalittoral sandy veneer community with Pyura spinifera, sea whips and abundant and diverse low erect and lamellate-covering sponges (Cape Otway F)
- Upper and lower circalittoral sandy sponge community with ear sponges and low fine bushy branching sponges (Surf Coast B)
- Upper circalittoral sandy sponge community with seabed covering and erect laminate sponges and ear sponge (Surf Coast C)
- Algal tufts, sparse sponges and Caulerpa trifaria patches in circalittoral sand and sandy veneer
- Circalittoral rock crustose coralline algae with thallose red algae and scattered low erect sponges (Shipwreck Coast A)
- Circalittoral rock with moderate density of lamellate covering and thickly encrusting sponges (Cape Otway B)
- Diverse sponge assemblage including lamellate covering and mounded sponges and with Pyura spinifera and Pteronisis (Cape Otway C)
- Ecklonia radiata and Phyllospora comosa on exposed subtidal rock with low abundance of thallose red algae
- BC4 - High energy Durvillaea communities
- Ecklonia radiata park
- Ecklonia radiata with crustose coralline algae and sparse foliose red seaweeds on exposed infralittoral rock
- Foliose red algae with sessile invertebrates
- High density of lamellate covering and erect sponges with seawhips on circalittoral rock (Surf Coast R)
- Hydroid fans, Pteronisis sea plumes, Pyura spinifera, lamellate sponges and crustose coralline algae on circalittoral rock(Shipwreck Coast G)
- Low complexity lower circalittoral rock with crustose coralline algae and seabed covering lamellate sponges (Shipwreck Coast F)
- Low to moderate complexity upper circalittoral rock with crustose coralline algae and seabed covering lamellate sponges (Shipwreck Coast E)
- Moderate to high circalittoral reef complexity with high density of lamellate-angled and ridged covering sponges (Surf Coast F)
- Moderate to high circalittoral reef complexity with non-crowded lamellate-angled, ridged and ear sponges (Surf Coast S)
- Moderate to high complexity circalittoral rock with Pteronisis, Pyura spinifera, hydroid fans and lamellate sponges (Surf Coast G)
- Moderate to high complexity circalittoral rock with Pteronisis, Pyura spinifera, hydroid fans, palmate and ear sponges (Surf Coast H)
- Moderate to high complexity upper circalittoral reef with thallose red algae and high density of lamellate and ridged seabed covering sponges (Shipwreck Coast C)
- Phyllospora comosa forest with coralline crusts and/or thallose red algae
- Sea tulips Pyura spinifera, Pteronisis sea plumes and sea whips with diverse low sponge assemblage (Cape Otway D)
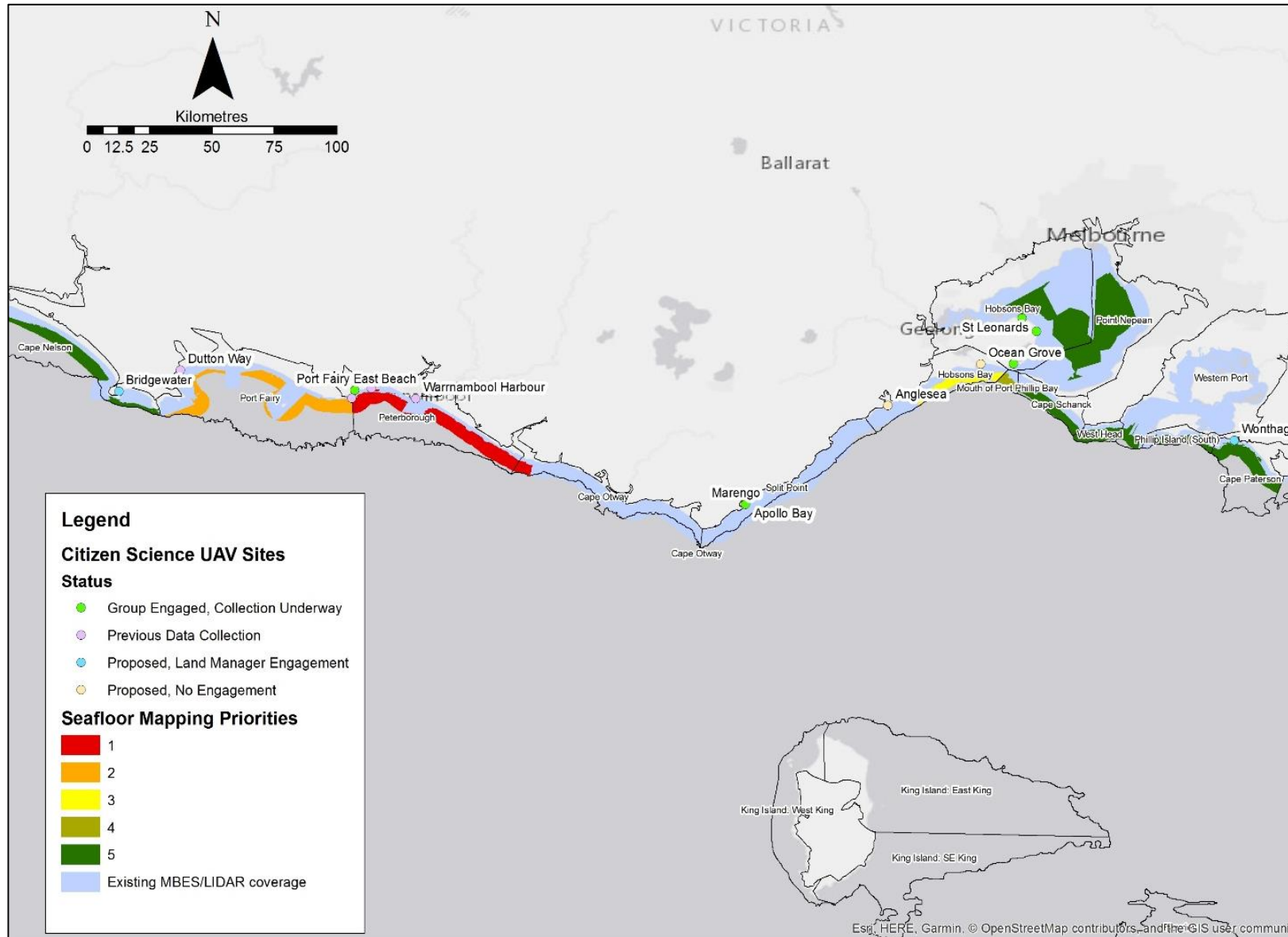
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community
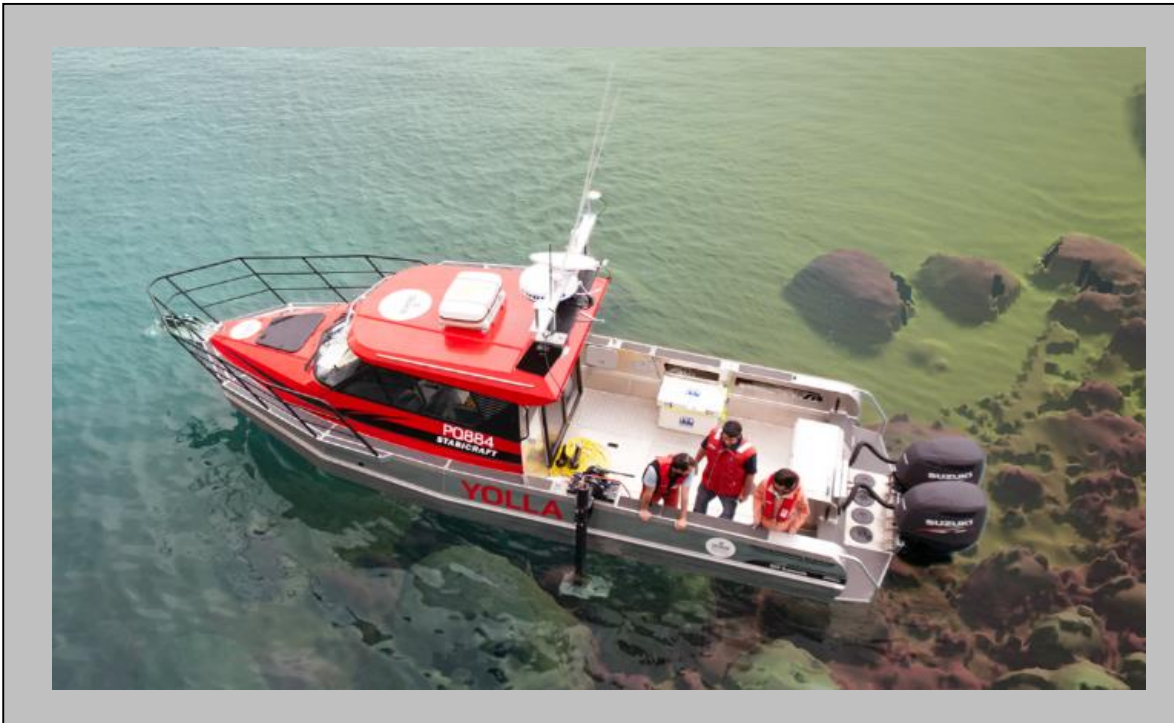
LiDAR Coverage
Multibeam Coverage
Gaps

0   50   100   200
Kilometres

Regional Prioritisation/ Gap analysis
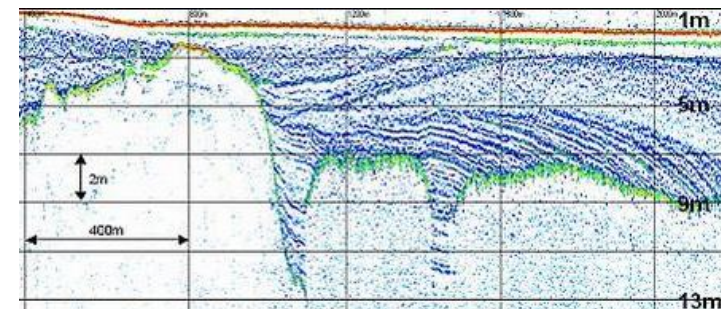
Offshore data collection

- ~90 sea days
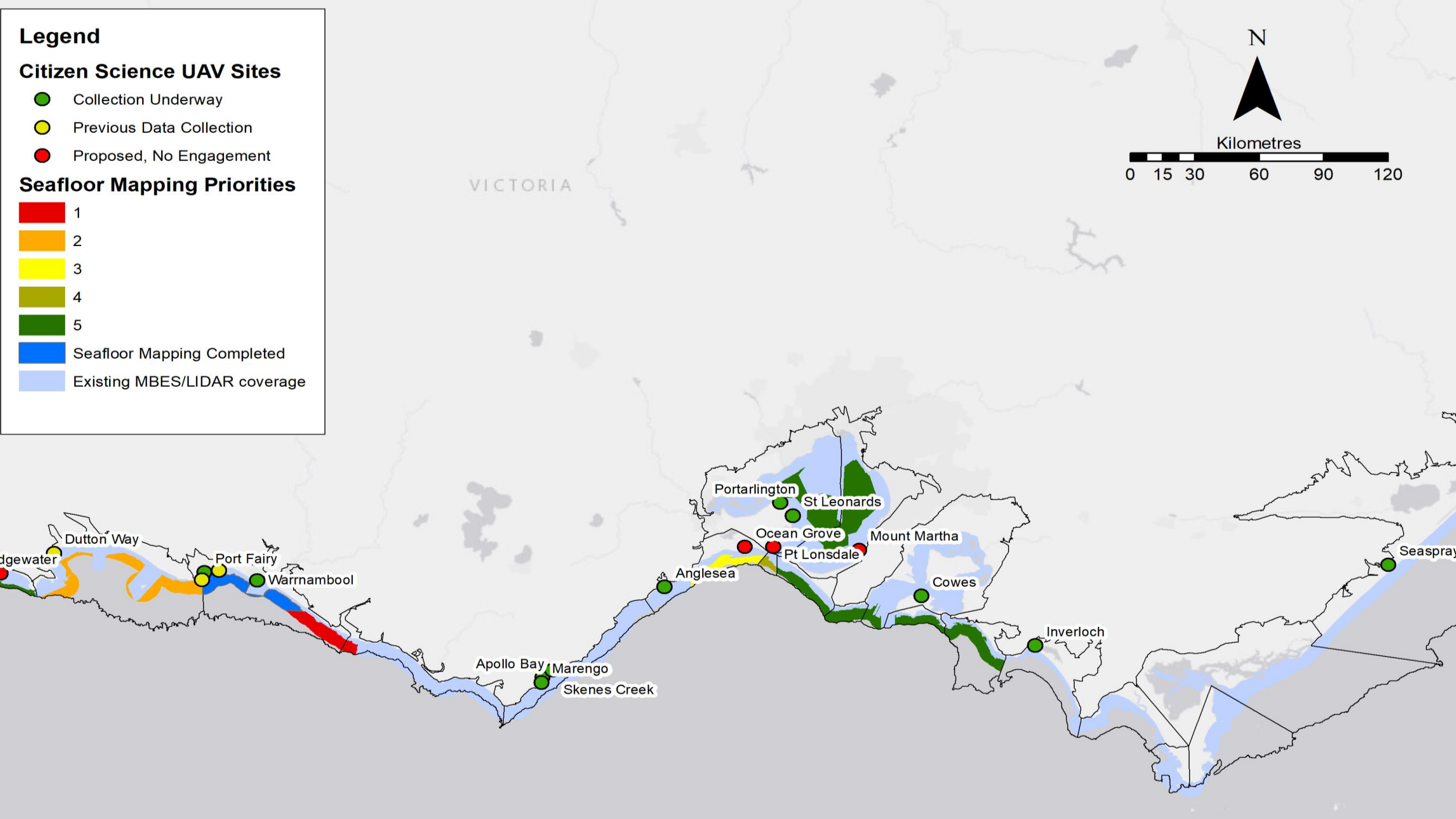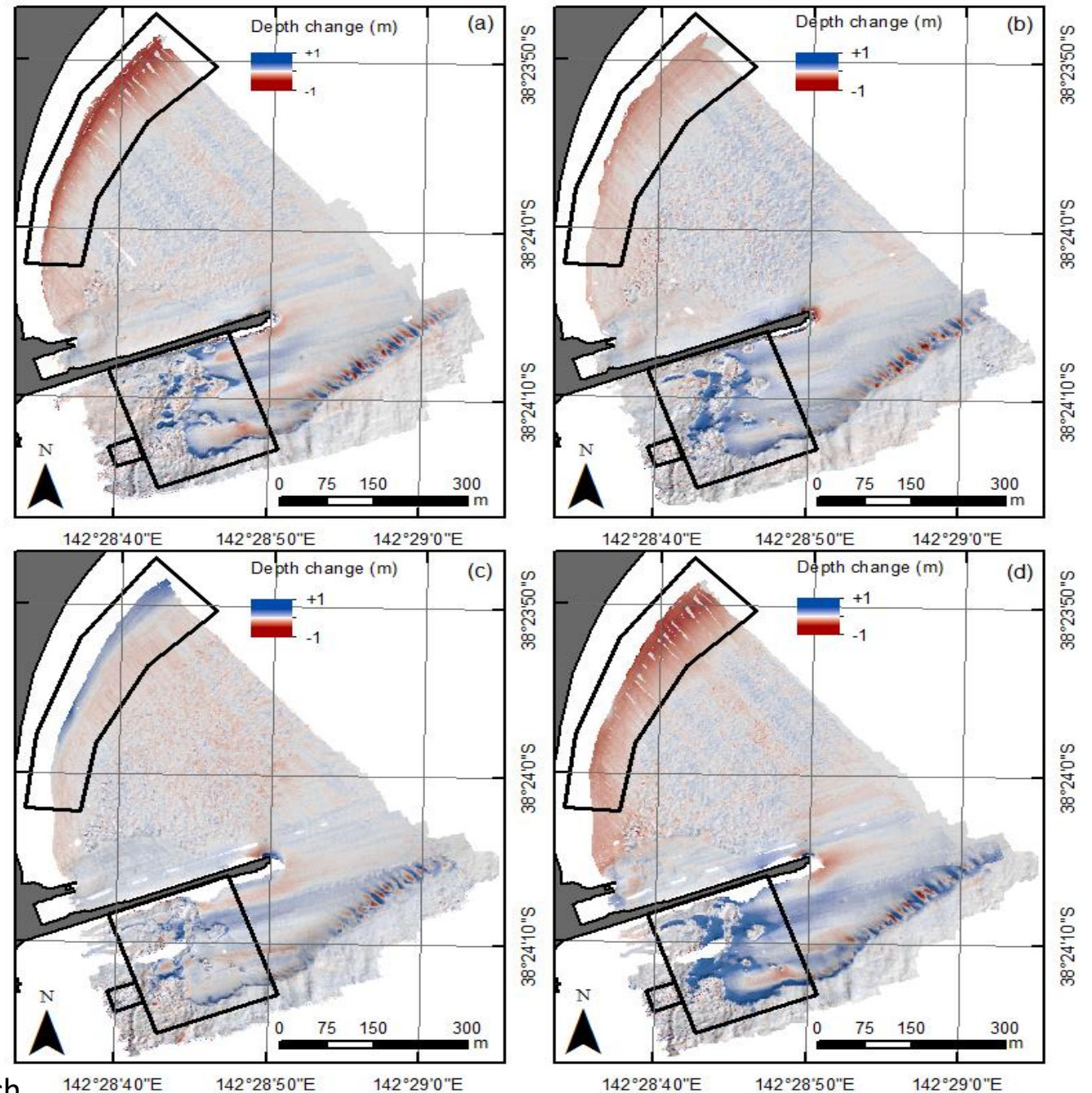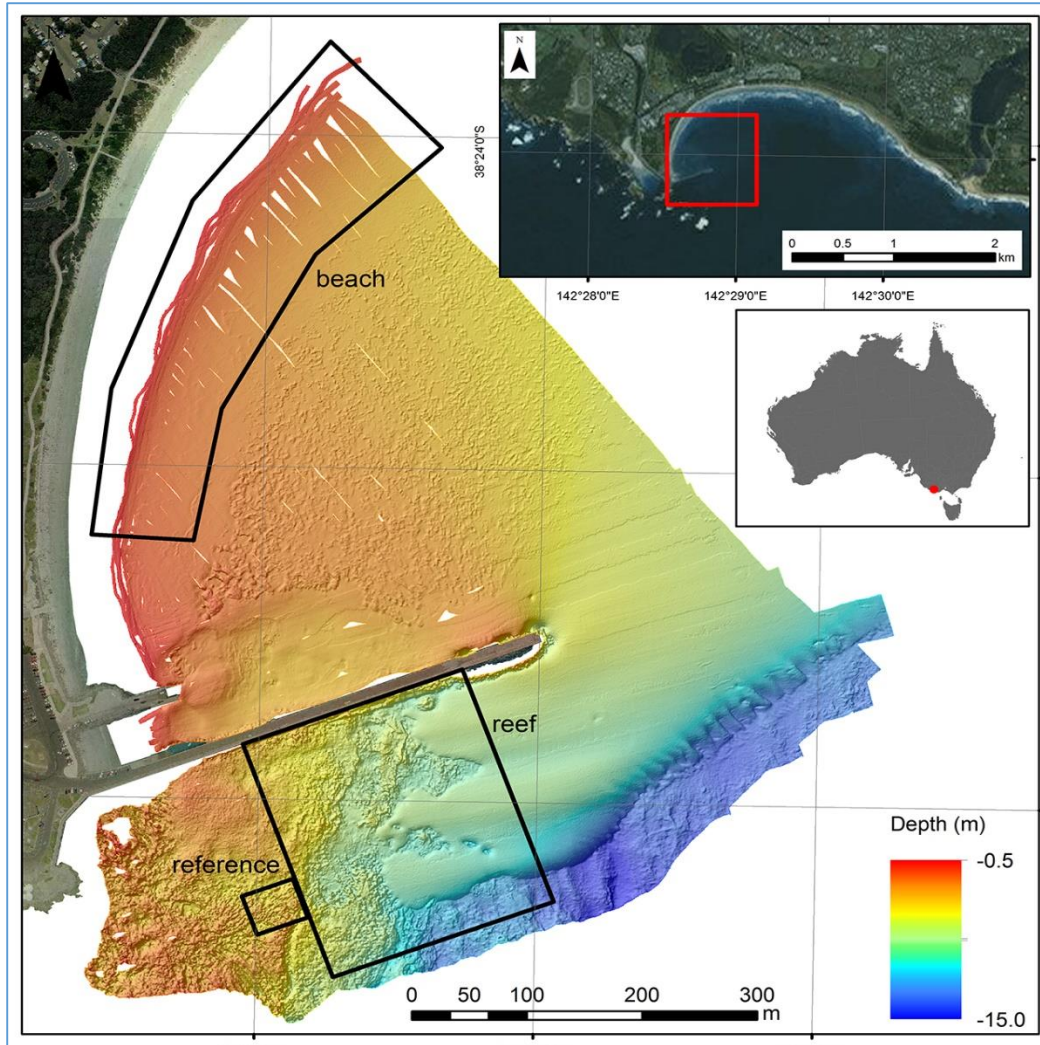

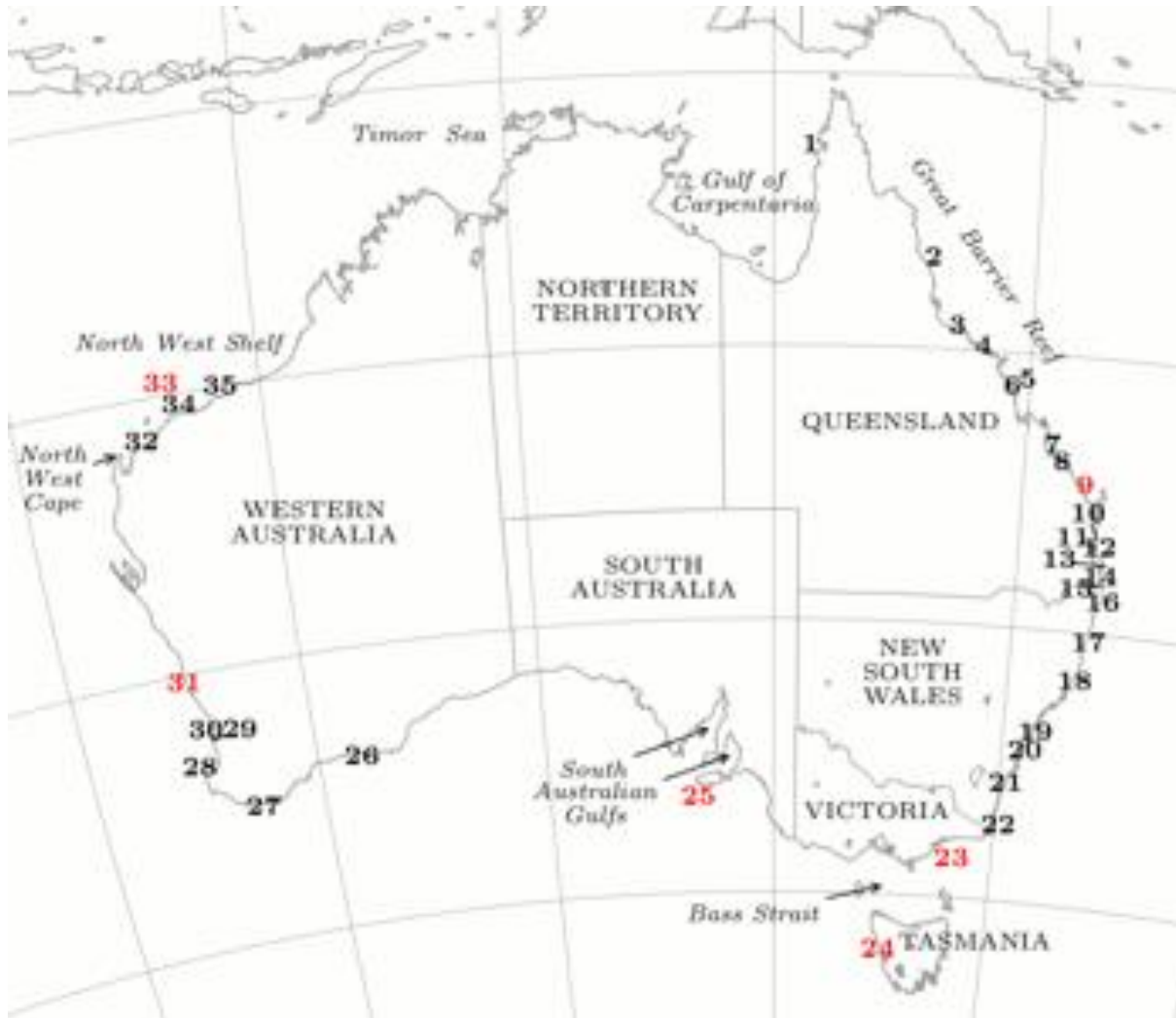Backscatter and bathymetry

Benthic grab

Sub-bottom profiling

- Sub-bottom profiling key to understand sediment volumes and depth to Pleistocene calcarenite
- Benthic grabs to characterise sediment

Legend

Citizen Science UAV Sites
- 🟢 Collection Underway
- 🟡 Previous Data Collection
- 🔴 Proposed, No Engagement

Seafloor Mapping Priorities
- 🟥 1
- 🟧 2
- 🟨 3
- 🟫 4
- 🟩 5
- 🟦 Seafloor Mapping Completed
- 🟦 Existing MBES/LIDAR coverage

N

Kilometres
0 15 30   60   90   120

VICTORIA

Bridgewater
Dutton Way
Port Fairy
Warrnambool
Apollo Bay
Marengo
Skenes Creek
Anglesea
Portarlington
St Leonards
Ocean Grove
Pt Lonsdale
Mount Martha
Cowes
Inverloch
Seaspray

Gaps vs Time series?

Schimel, Ierodiaconou, Kennedy, 2015, Continental Shelf Research

Lack of wave observations

Wave climate impacts on coasts

- How wave climate interacts with sediment compartments and the shoreline so we can better understand erosion and inundation.
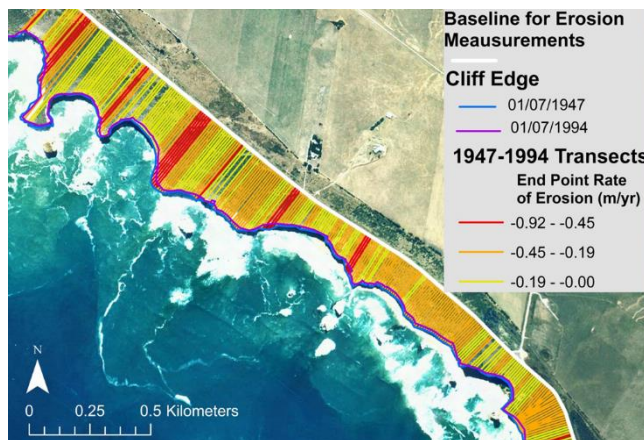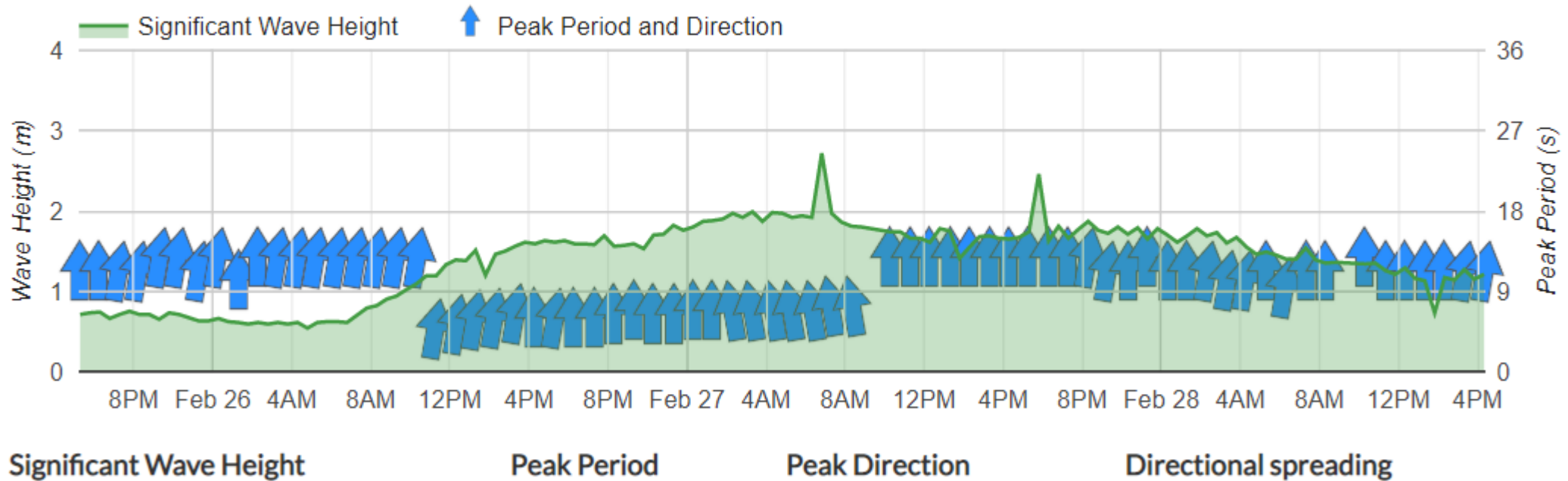
Lack of wave observations
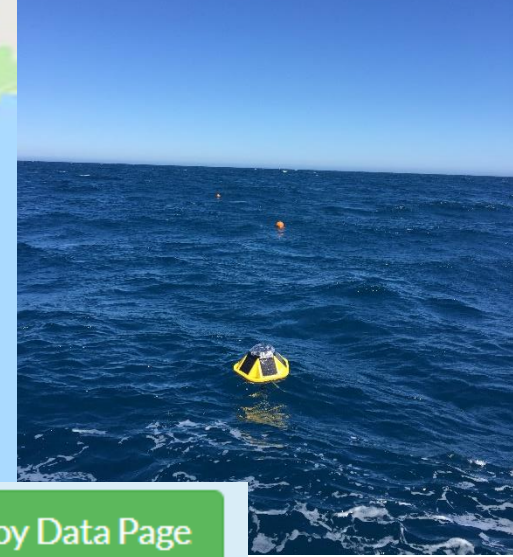
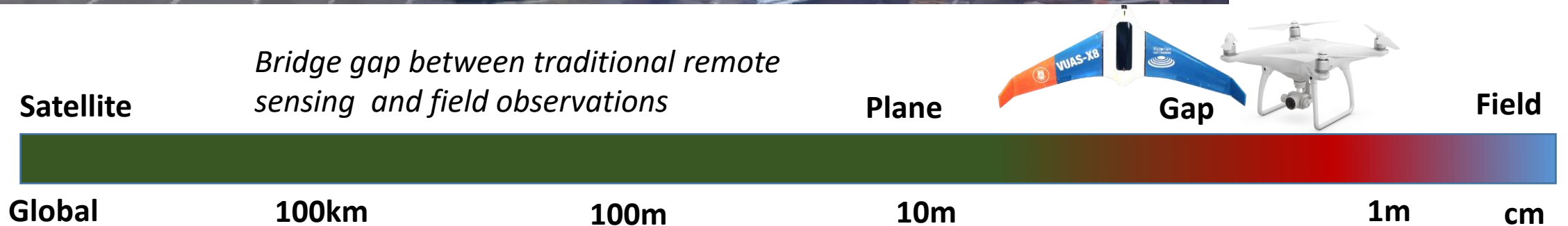Port Fairy Buoy — [-38.3815°, 142.2893°] — Latest Observations at 28 Feb, 13:49

Go to Port Fairy Buoy Data Page

Significant Wave Height — Peak Period and Direction

Significant Wave Height | Peak Period | Peak Direction | Directional spreading
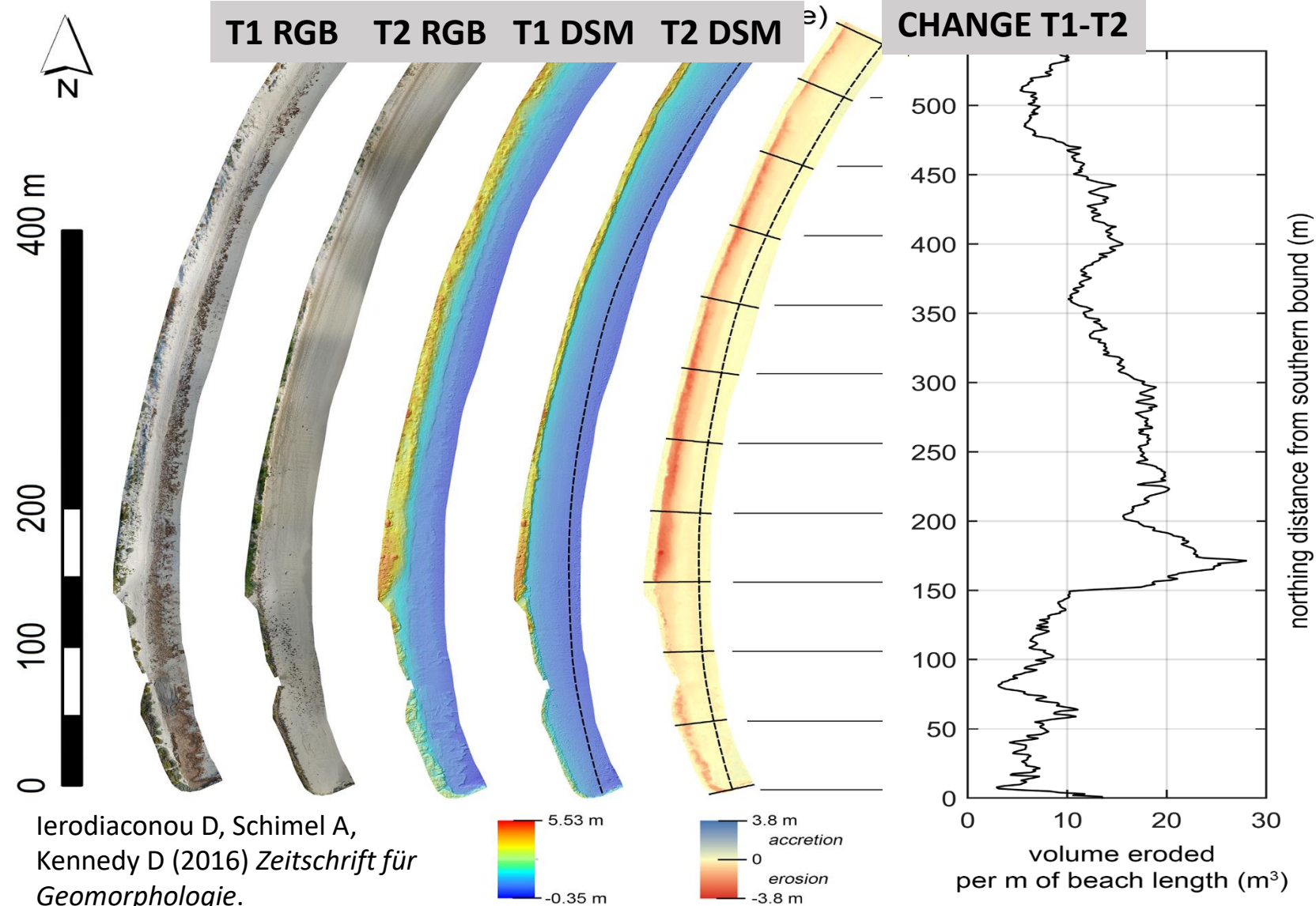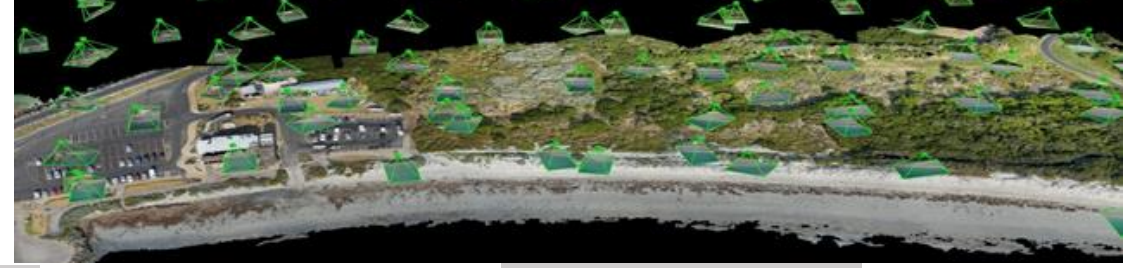
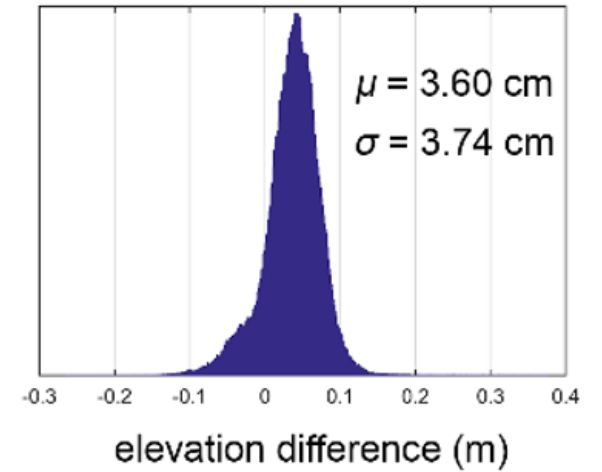**https://vicwaves.com.au/**

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Drones and coastal erosion

- Landward displacement of the shoreline
- Incipient foredune was removed and the main foredune scarped leaving a near-vertical slope over 3 m high
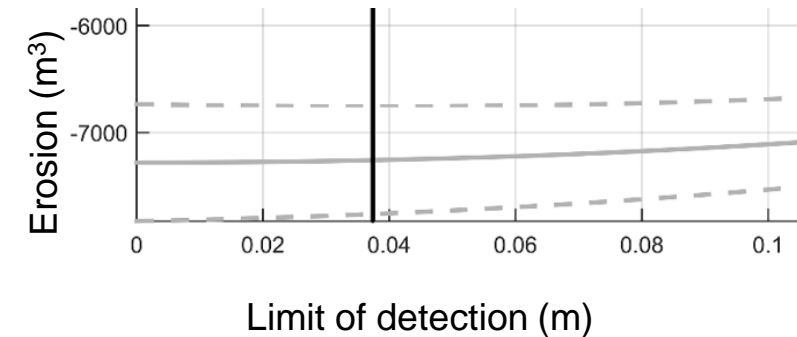
Bridge gap between traditional remote sensing and field observations

Satellite **Plane** **Gap** **Field**

Global **100km** **100m** **10m** **1m** **cm**

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Shoreline Change

T1 RGB T2 RGB T1 DSM T2 DSM

CHANGE T1-T2

CARPARK T1-T2

$\mu = 3.60$ cm
$\sigma = 3.74$ cm

elevation difference (m)

Erosion= 7,256± 504 m³

Erosion (m³)

Limit of detection (m)

northing distance from southern bound (m)

volume eroded
per m of beach length (m³)

5.53 m

-0.35 m

3.8 m
accretion

0

erosion
-3.8 m

400 m

200

100

Ierodiaconou D, Schimel A,
Kennedy D (2016) *Zeitschrift für
Geomorphologie*.

Citizen Science Drones

Aeropoints