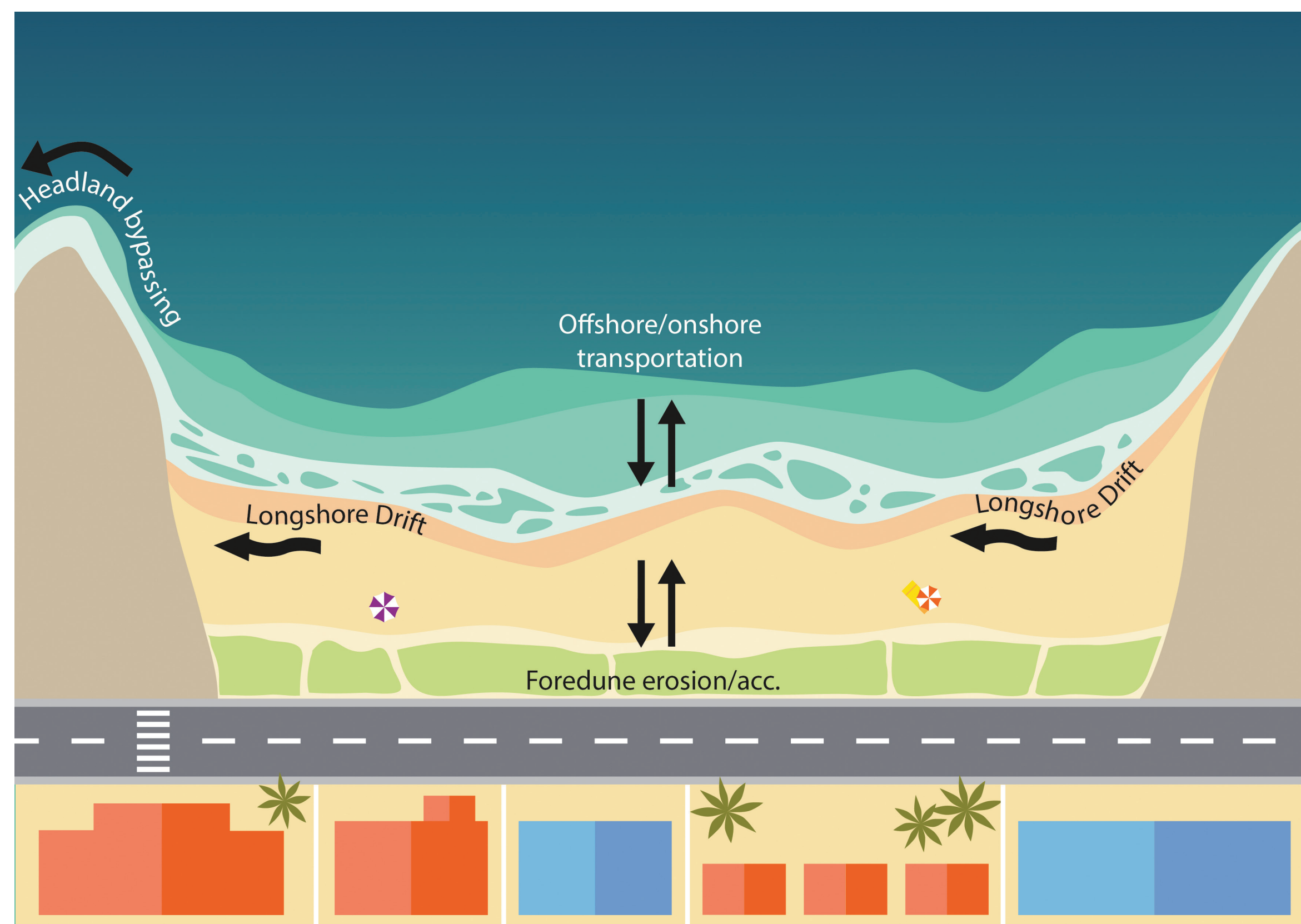


UAV CONTRIBUTION TO COASTAL COMPARTMENTS

Tracking sand classes with UAV hyperspectral imaging



Nicolas Pucino¹, Blake Allan¹, Daniel Ierodiaconou¹, Rafael C. Carvalho¹, David M. Kennedy²
¹Deakin University, ²Melbourne University



Conceptualisation of a coastal compartment with main sediment transportation processes.

The Coastal Compartment

- Inspired by the river catchment basin, it is the “unit” for coastal management.
- Framework used in **Australia**, UK, USA and Europe.
- Quantifies **sediment fluxes** interacting with the system, taking into account local sources and sinks.
- Allows for **sediment budget** calculations.

Bathymetry and subaerial topography must be monitored for volume estimations and beach volume changes. **UAVs and Structure From Motion** have been widely adopted for subaerial volumetrics.

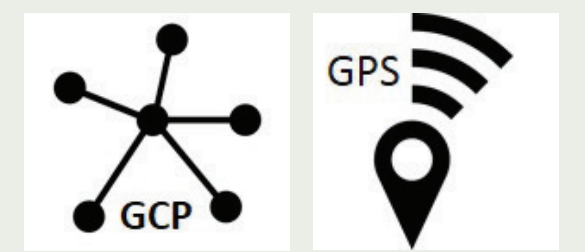
Volumetric Change Toolbox

UAVs



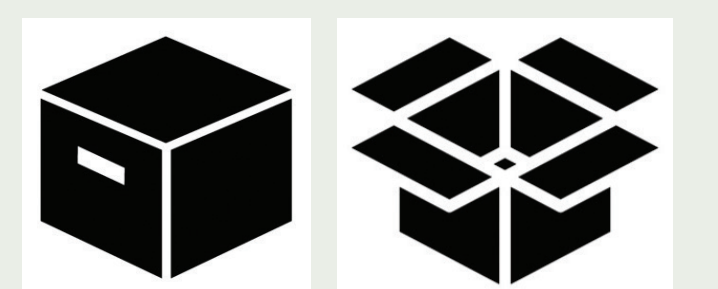
Multirotors and fixed-wings.

Georeferencing



Network of GCPs for aerotriangulation or in-built RTK-GPS for direct georeferencing.

SfM Software



Commercial and Open-Source SfM softwares.

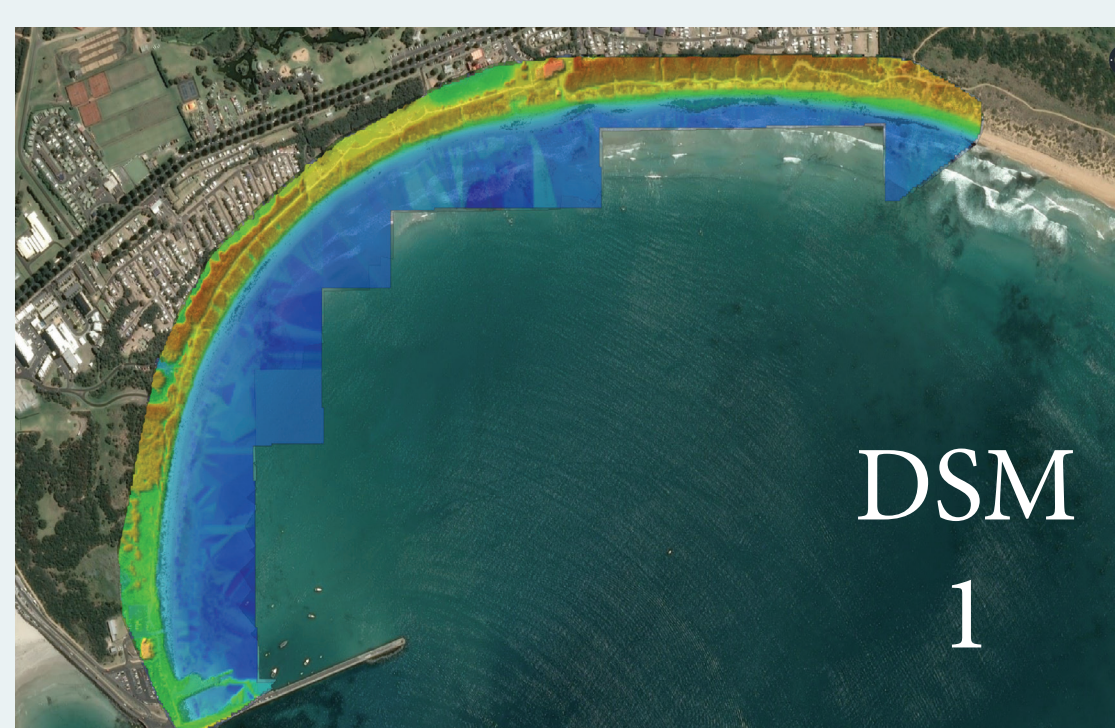
Orthophoto and DSM



These are the common input to GIS analysis.

The Current Methodology

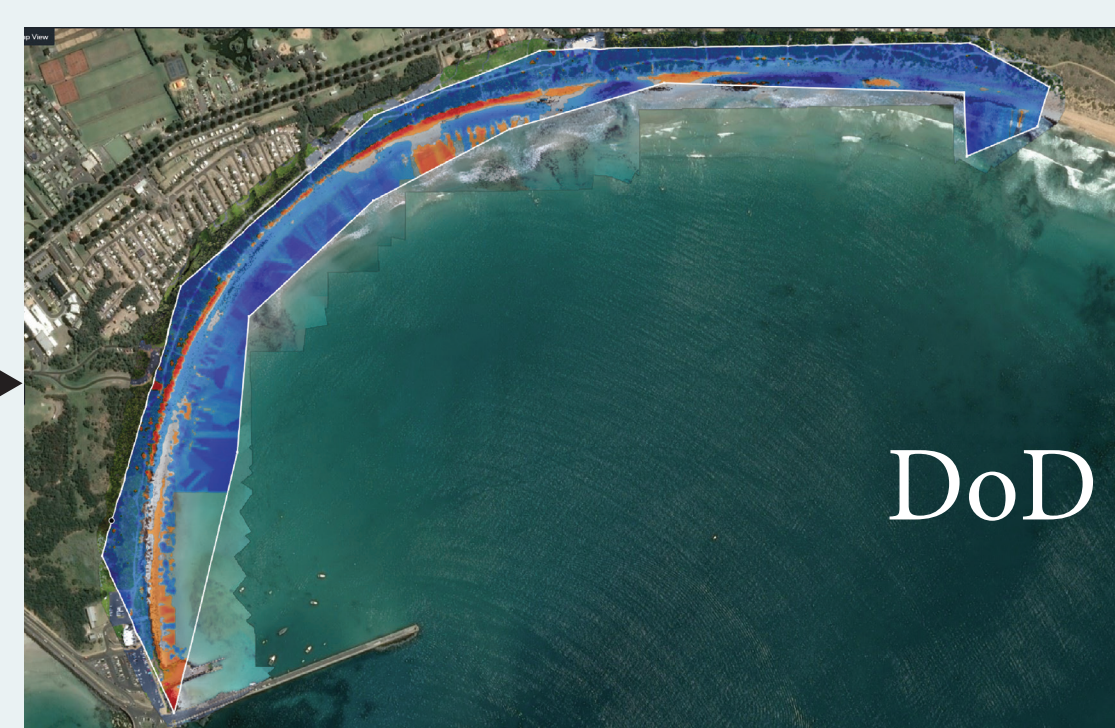
So far, UAVs for beach monitoring have operated mostly with RGB cameras and Structure From Motion algorithms to create **multitemporal Digital Surface Models (DSM)** and orthophotos. **Diffs Of Difference (DoD)** are then calculated to monitor volumetric changes in the **subaerial component** of the coastal compartment.



DSM 1
Elevation map of part of Lady Bay, Warrnambool, surveyed with UAVs in June 2018.



DSM 2
Elevation map of part of Lady Bay, Warrnambool, surveyed with UAVs in October 2018.



DoD
DoD calculated subtracting the June DSM from the October DSM in Lady Bay, Warrnambool.

voldiff/long	input	output	net
beach	721,8645	41603,446	-40881,6
foredune	49886,681	224872,93	-174986
deflation basin	48165,791	186560,79	-138395
tot	98774,336	453037,17	-354263

Sand loss and accumulation from t1 to t2, as calculated within discrete depositional environments.

From DoD to Sediment Facies Map with Hyperspectral Surveying



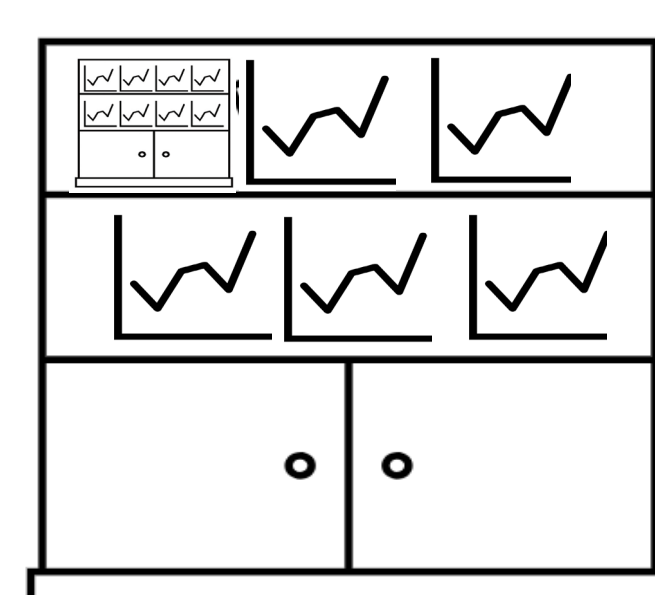
Field Spectroscopy

Spectrum of inter/supratidal sediments are sampled across the beach systems, including as much variability as possible, from backdune to swash areas.



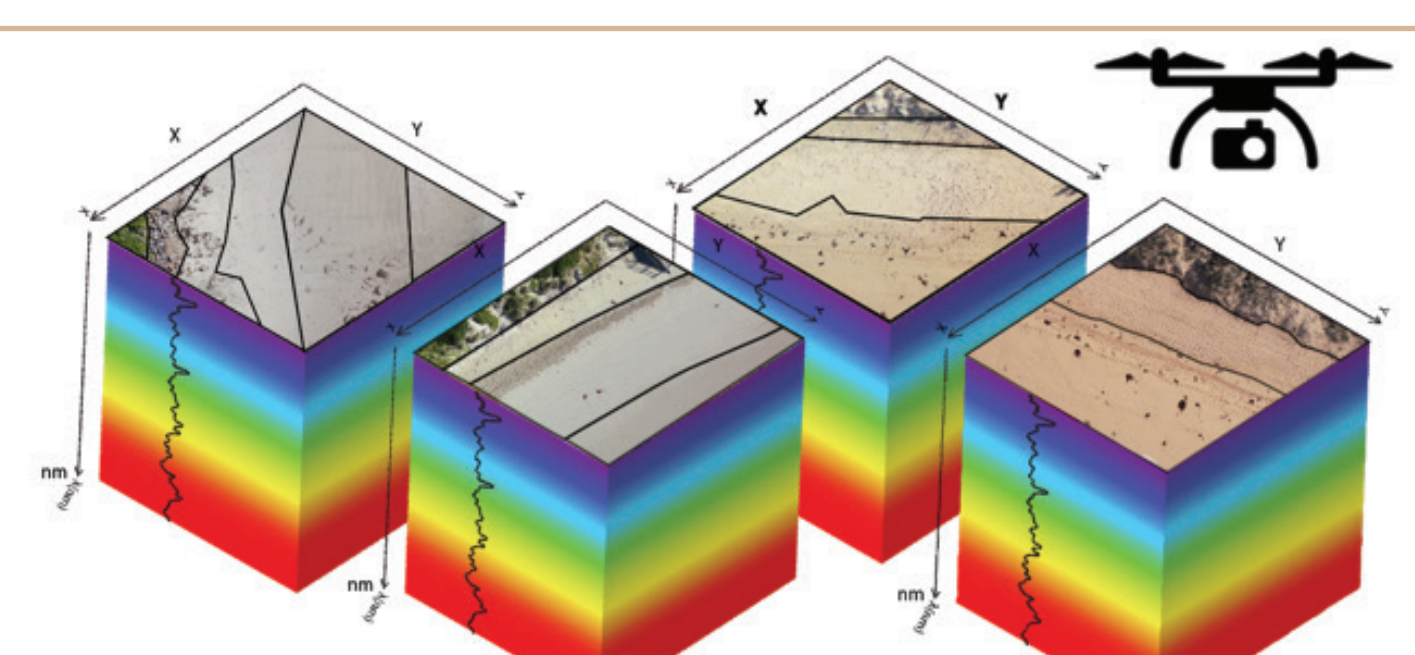
Sand Sampling

With spectrum, sand samples are collected. Their position, grain size, composition, %OM, %carbonates, %H2O and %F2O3 attributes are recorded.



Spectral Library

AI is used to classify each sample into its source. Spectral endmembers from each classes are stored in a spectral library, used for further analysis.



Hyperspectral UAV Imaging

Multi-temporal SfM and hyperspectral UAV (H-UAV) surveys are conducted. Supervised Classification (spectral library) is performed to the surface reflectance maps and sand samples are collected as ground-truth. Sediment facies maps are so created and are ready to be interpreted. Volumetrics could also be coupled with these maps.

Sediment Facies Map

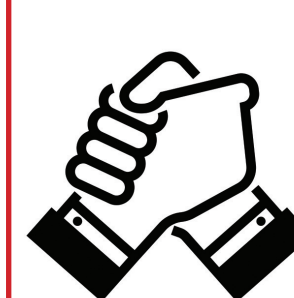


Conceptualisation of a sand facies map in Lady Bay, Warrnambool. The classes are derived from sediment spectrum, which is in turn a function of sediment humidity, granulometry, mineralogy, composition, texture and location.



Purpose and Potentials

The purpose of this project is to classify supra and intertidal sediments based on their spatial, sedimentological and optical properties, with unprecedented spatial resolution. The sand facies maps will provide a spatially explicit view of the distribution of classes of “sands” with distinct properties, revealing significant insights about the importance of marine, erosional and aeolian processes in shaping the modern shorelines. Also, the spectral library is useful not only for the H-UAV surveys but also for satellite-based analysis. These maps will also allow us to couple citizen science UAV volumetric analysis to sand classes, adding important information about the source of the sediments that have been eroded or accumulated across the sites.



Any Spare Sensors?

We are looking for **field spectroradiometers** and **UAV hyperspectral imagers**. If you like, why not to collaborate?