NORTH WEST SHOALS TO SHORE RESEARCH PROGRAM

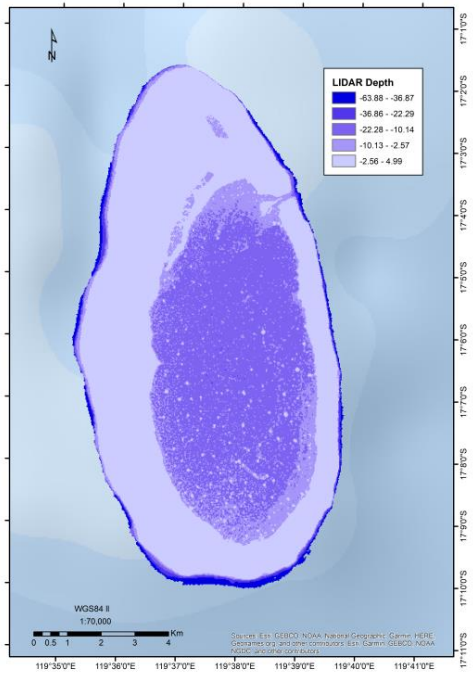
Coral reef communities at the Rowley Shoals: enhanced and scalable monitoring

Ben Radford, James Gilmour, Sharyn Hickey, Matt Wyatt,

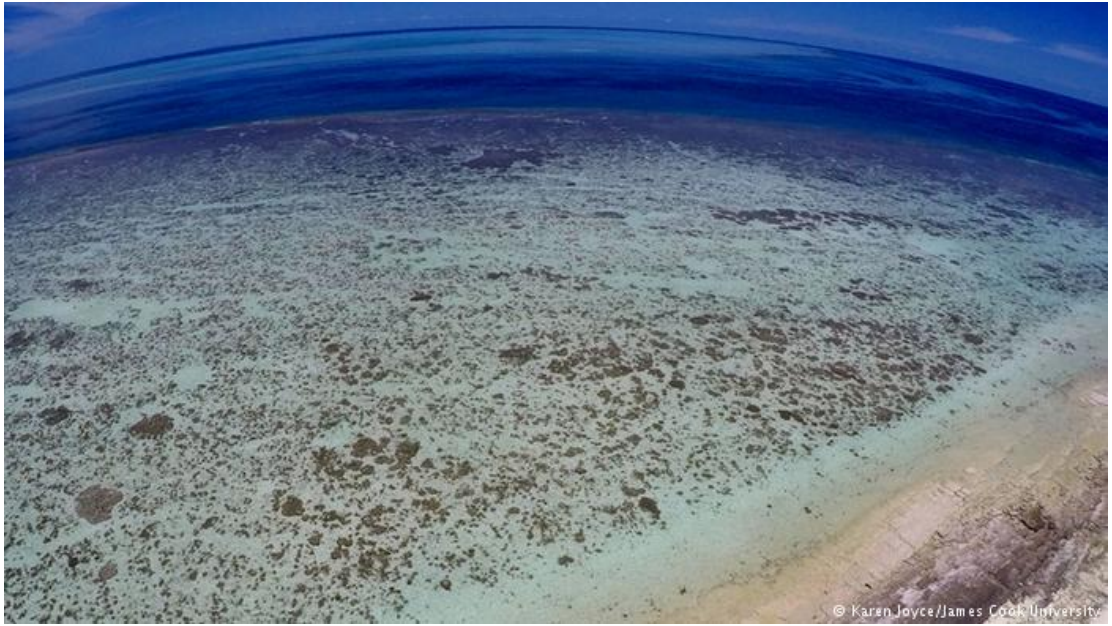
Motivations

- Understanding condition of reef systems is key to effective management
- Vast marine and coastal areas with many remote reefs to map and monitor and assess for impacts.
- With a few expectations may reef areas are not regularly monitored and there condition and response to impacts is unknown.
- Capitalize and look for applications for new remote cheaper sensing data, cheaper data , analysis methods that's scale and online process capacity
- Look for ecological robust, scalable applications that increase our knowledge of changing

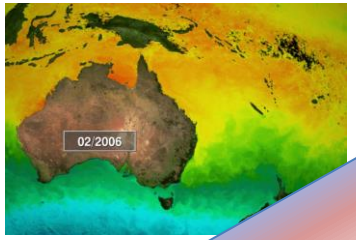
With reefs systems a number of habitats we don't monitor (deep, shallow, exposed)

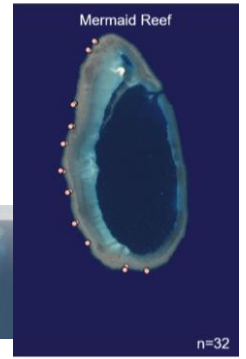


Clerk



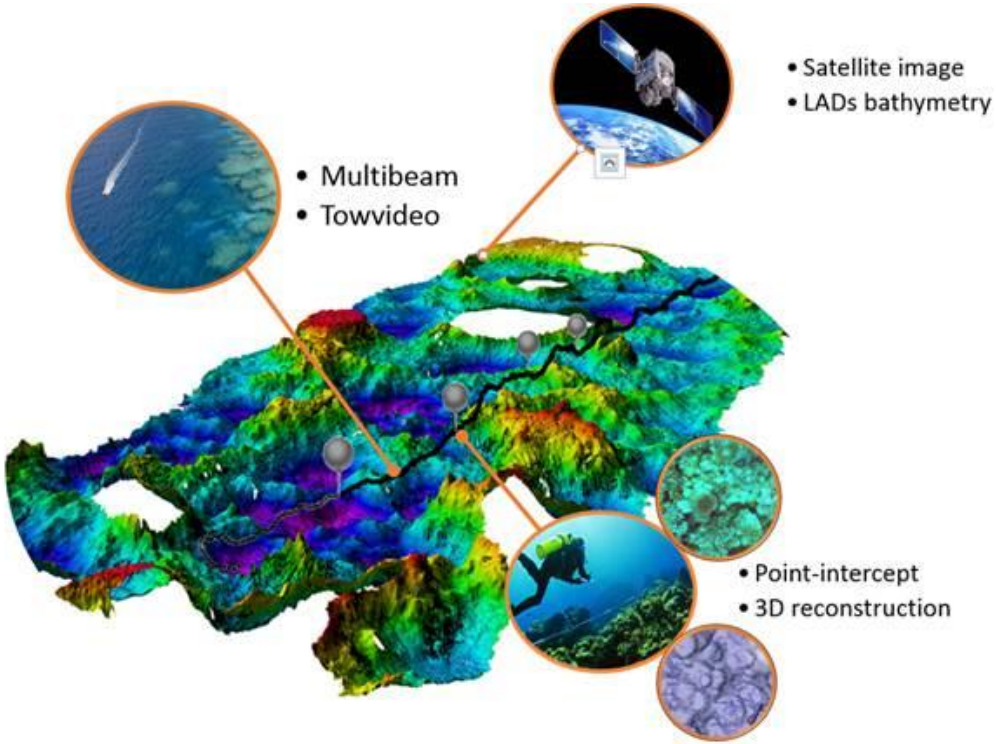
Does the scale of monitoring fit with ecological patterns and impacts?



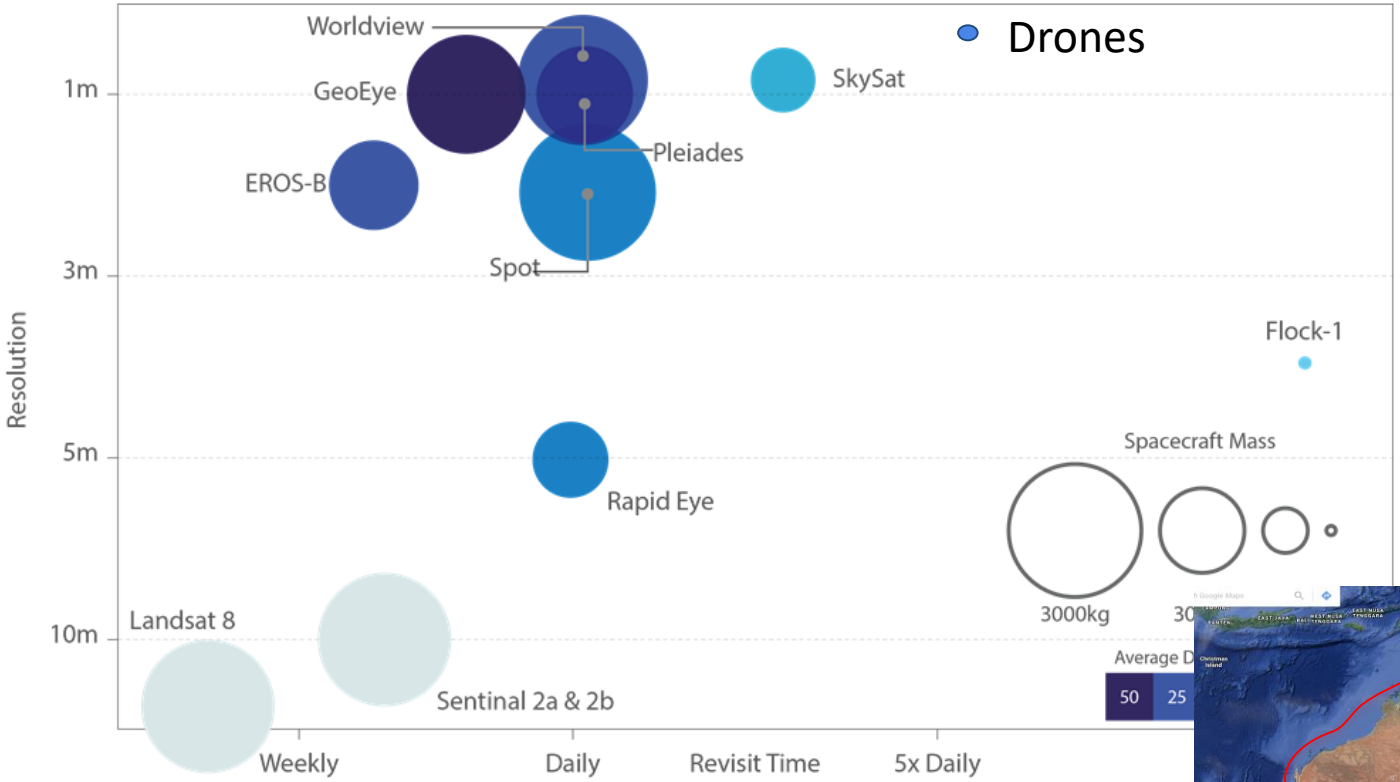


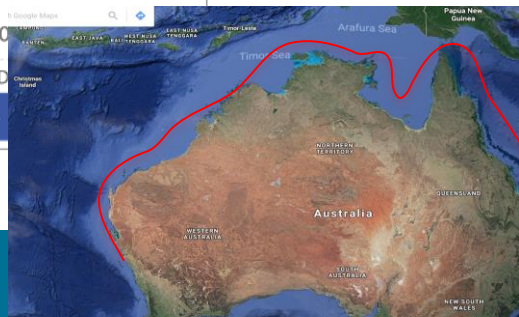
Capitalize on new remote sensing data and methods

- cheaper data , analysis methods that's scale and online process capacity



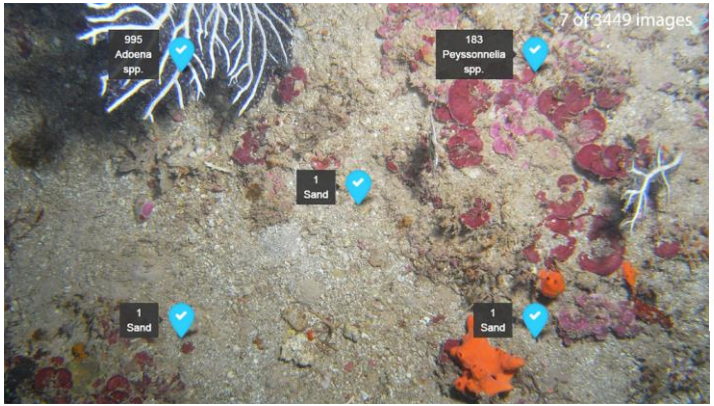
Capitalise on new data





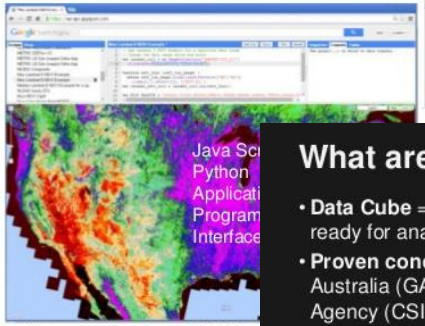
https://business.esa.int/newcomers-earth-observation-guide

Cloud processing

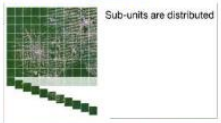


Google Earth Engine Cloud Computing

- Google has the entire archive of Landsat and MODIS imagery and CFSR, NLDAS, and downscaled NLDAS gridded weather data available for massive parallel processing in the cloud
- This technology has changed the paradigm of how we process and analyze satellite imagery and gridded weather data
- https://earthengine.google.org/#timelapse/v=40.86687,-117.50682,8.988,latLng&t=2.85



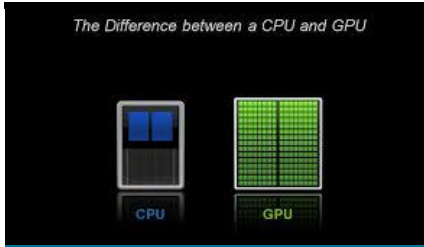
Max 30m Landsat 8 NDVI 5/



What are (EO) Data Cubes?

- **Data Cube** = Spatially aligned pixels ready for analysis
- **Proven concept** by Geoscience Australia (GA), the Australian Science Agency (CSIRO) and a super-computer facility (NCI)
- **Shift in Paradigm** ... Pixels vs Files
- **Analysis Ready Data (ARD)** ... Reduce processing burden on users
- Supports **integration** of multiple datasets.
- **Multi-platform** ... PC, HPC, Cloud

Open Source Software
https://github.com/opendatacube



Objectives

- Map habitats identify where we do and don’t monitor
- Develop methods to monitor gaps.
- Building on LTM by incorporating new multiscale and saleable remote sensing data and methods
- Calibrate methods against natural turnover and disturbances
- Work towards adaptive monitoring and disturbances triggering monitoring ondemand

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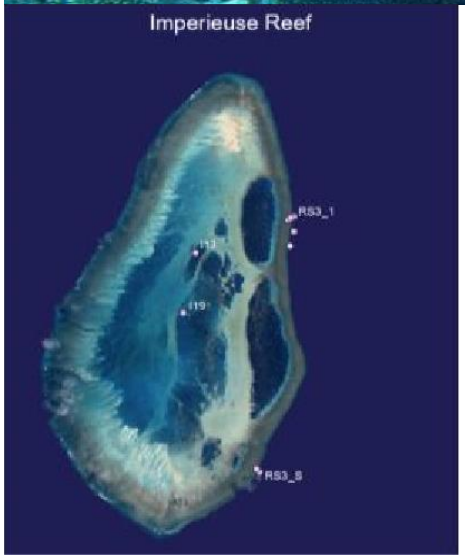
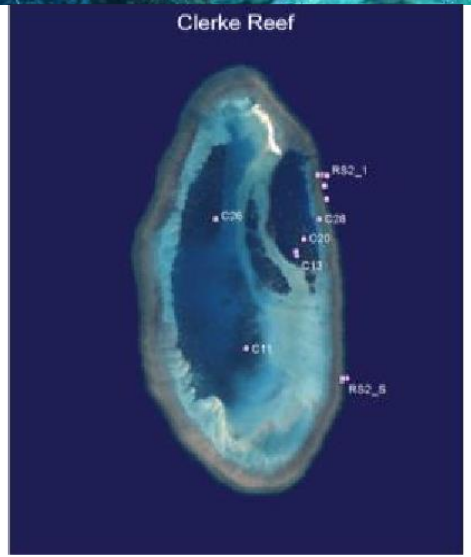
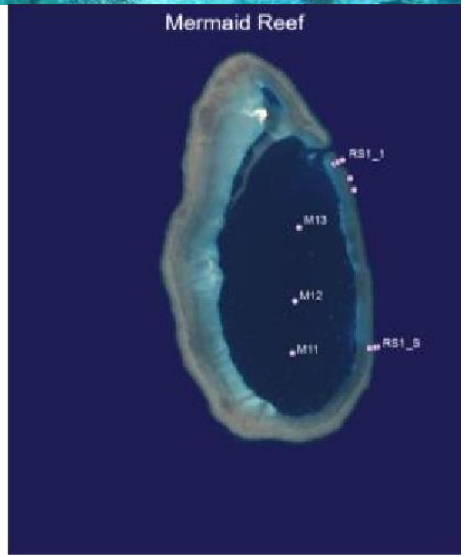
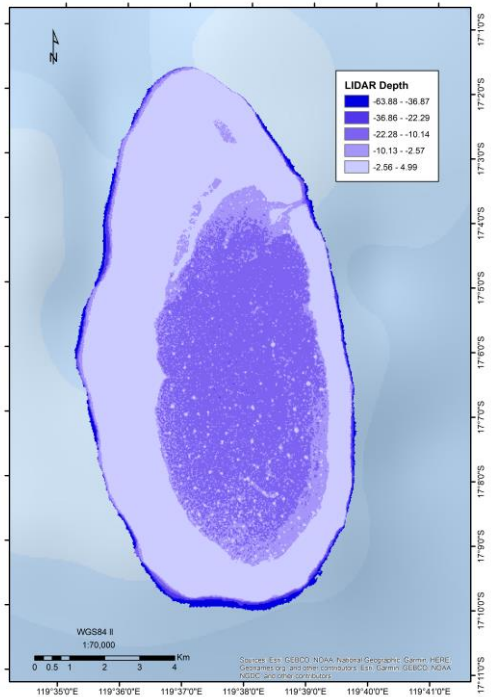

Imperieuse Reef
RS3_1
I13
I19
RS3_5

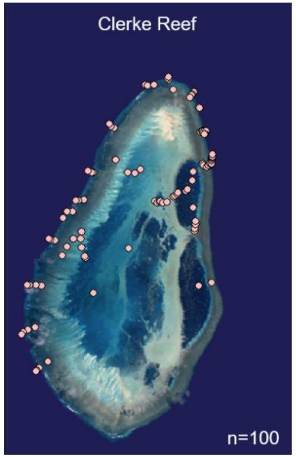

Clerke Reef
RS2_1
C26
C28
C20
C13
C11
RS2_5

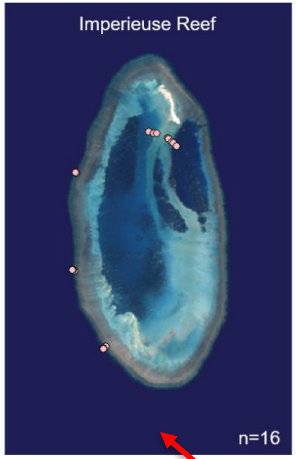

Mermaid Reef
RS1_1
M13
M12
M11
RS1_5

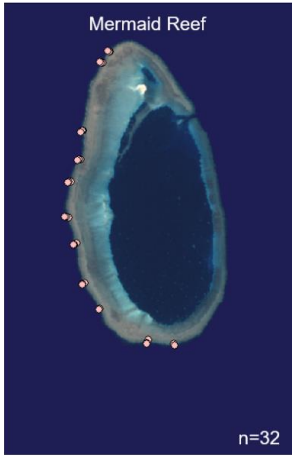
Lidar



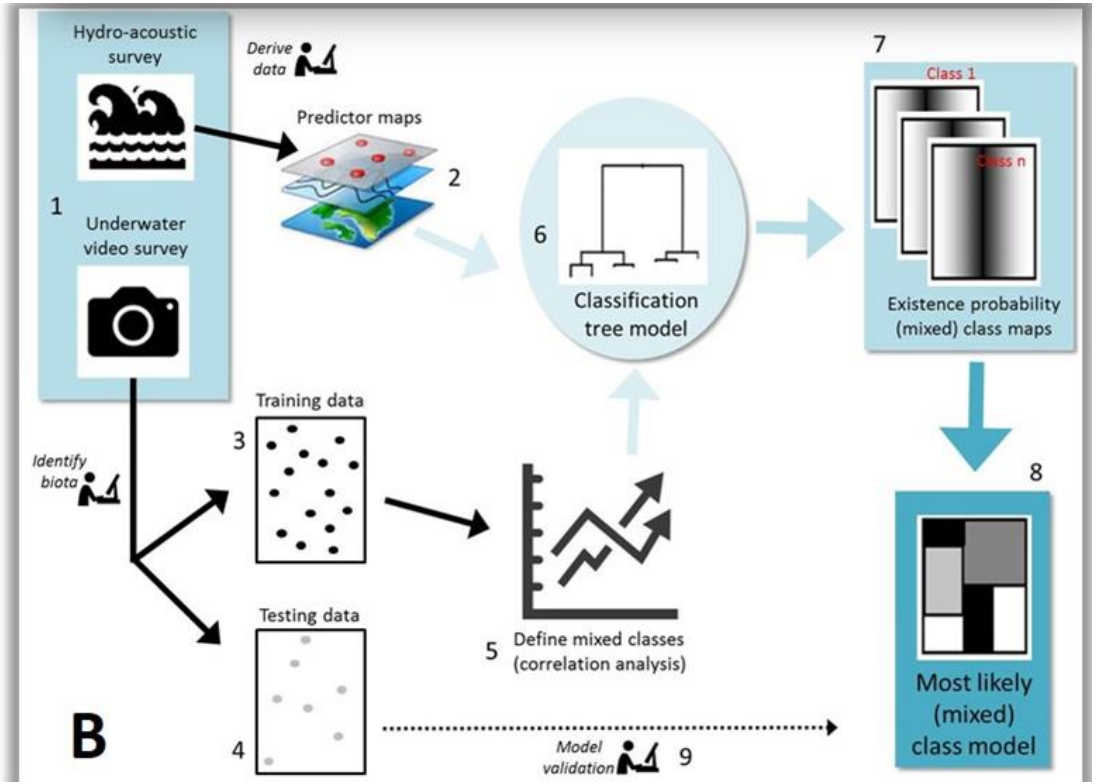
Trip 6854 March 2018 Rowley Shoals Habitat Assessment Points

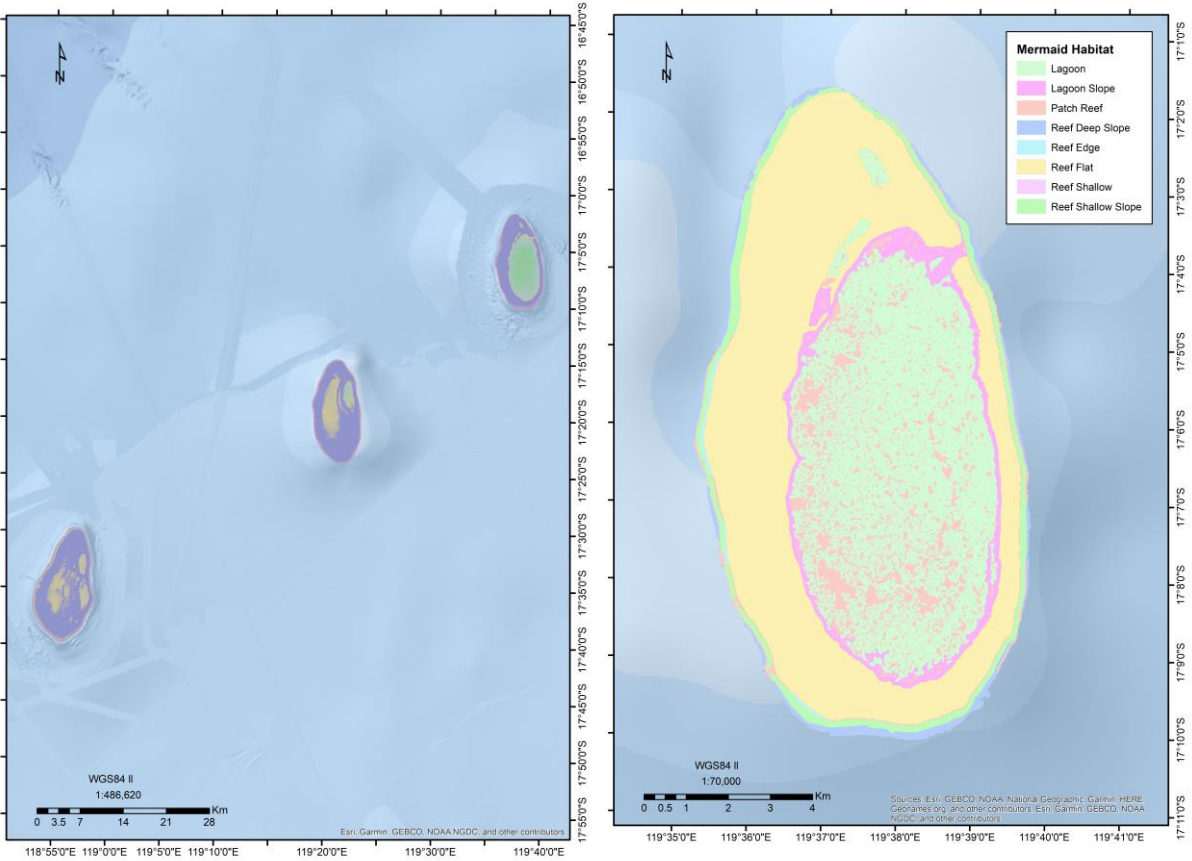






Methods


Hydro-acoustic survey
Derive data
Predictor maps
2
1
Underwater video survey
6
Classification tree model
7
Class 1
Class n
Existence probability (mixed) class maps
Training data
3
Identify biota
8
Most likely (mixed) class model
Testing data
5
Define mixed classes (correlation analysis)
B
4
Model validation
9



Outcomes

- Of 8 habitats mapped were only monitoring in 3
- Largest area is reef flat with no monitoring
- Potentially important habitat (diverse, temperature resistant) but difficult to access
- Assess new remote sensing data, cheaper data , analysis methods to solve this problem

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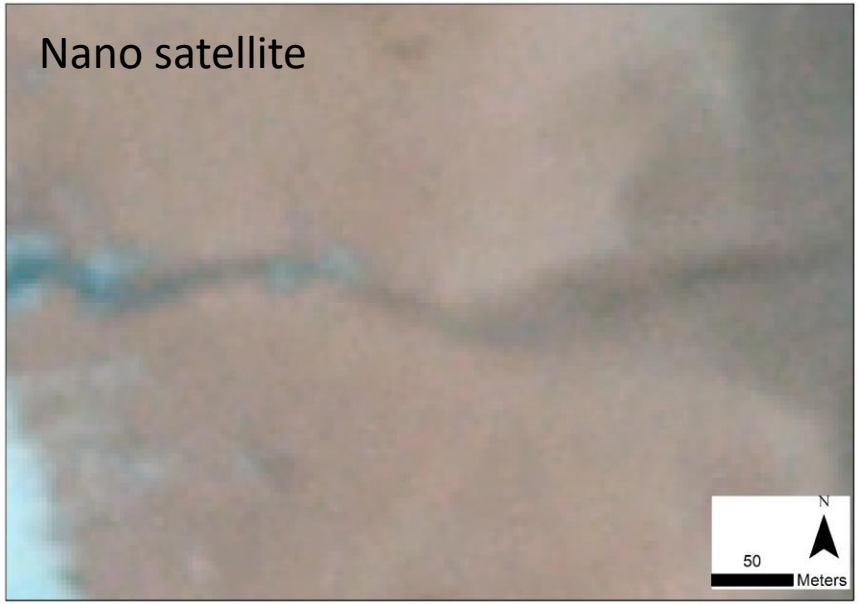
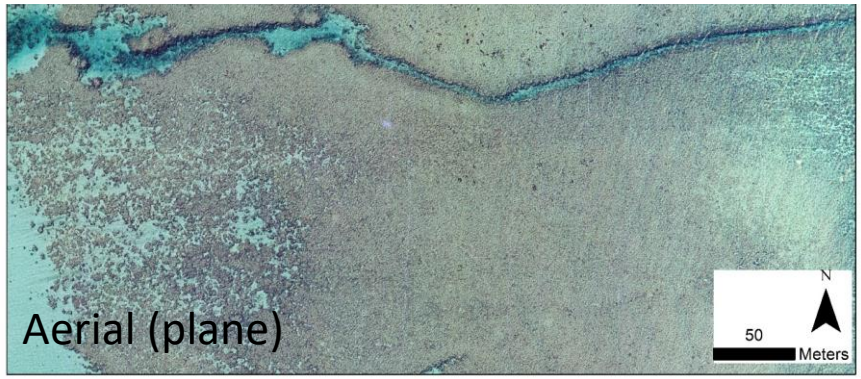
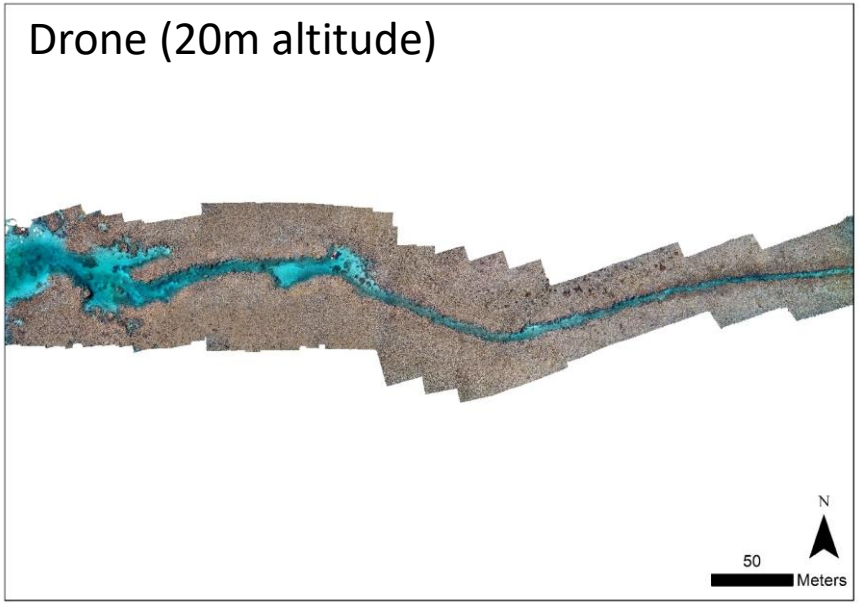
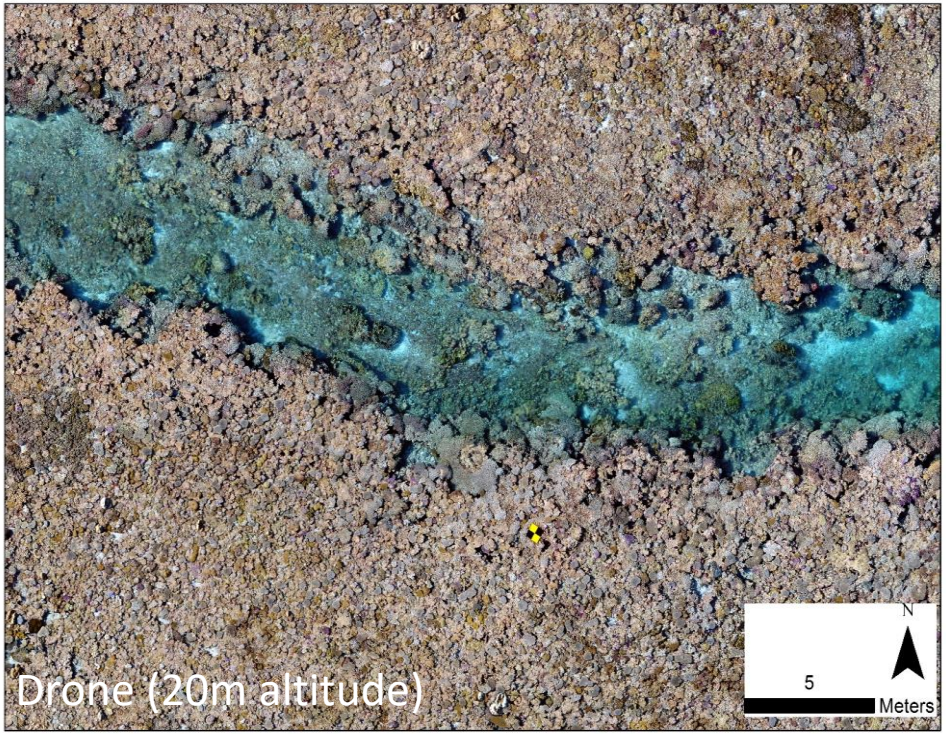
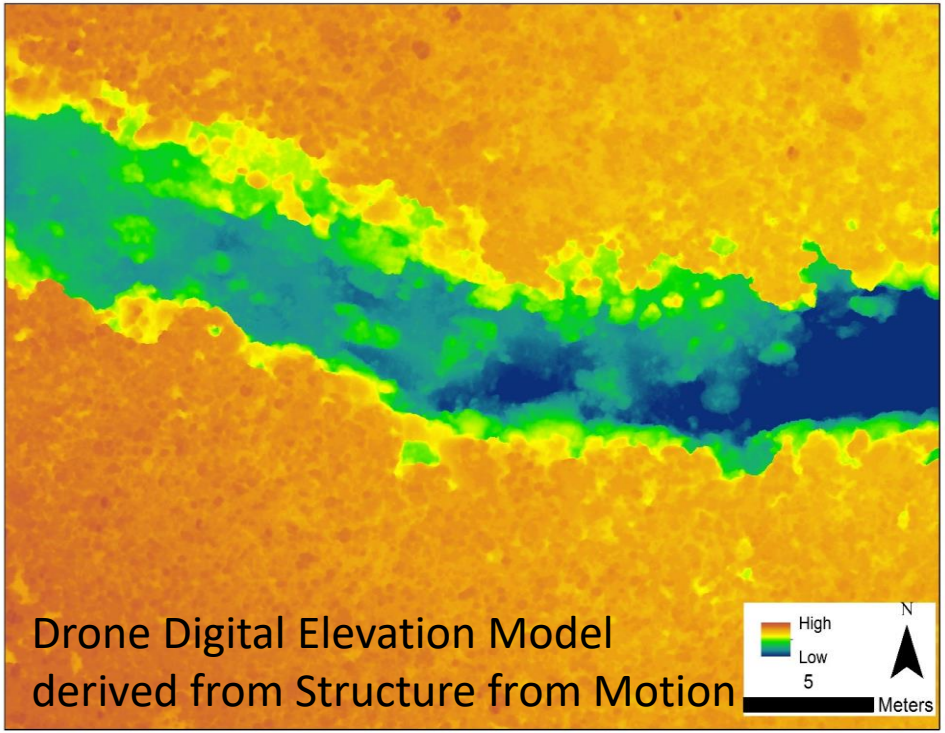




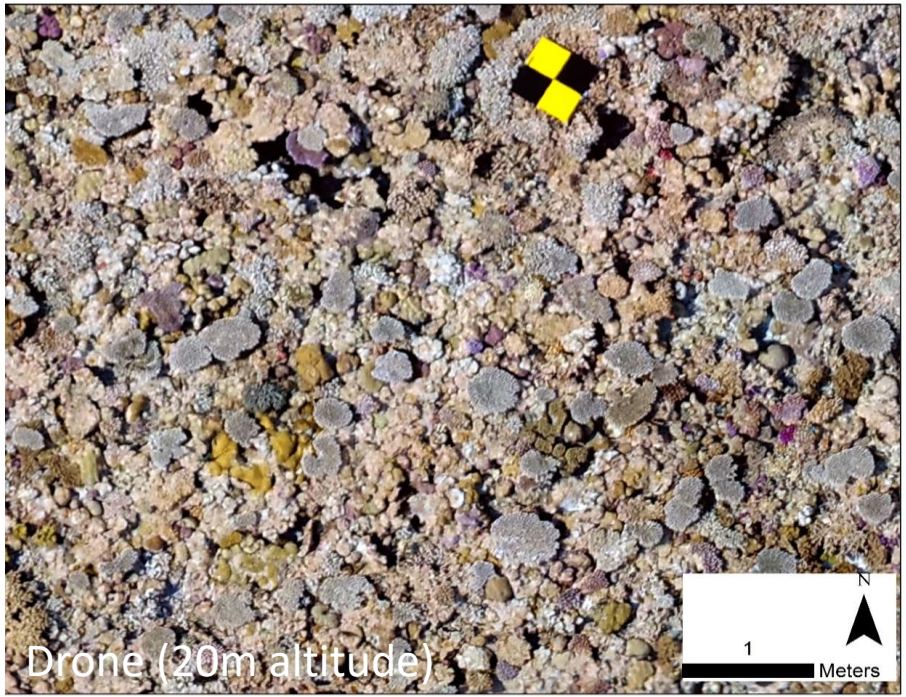


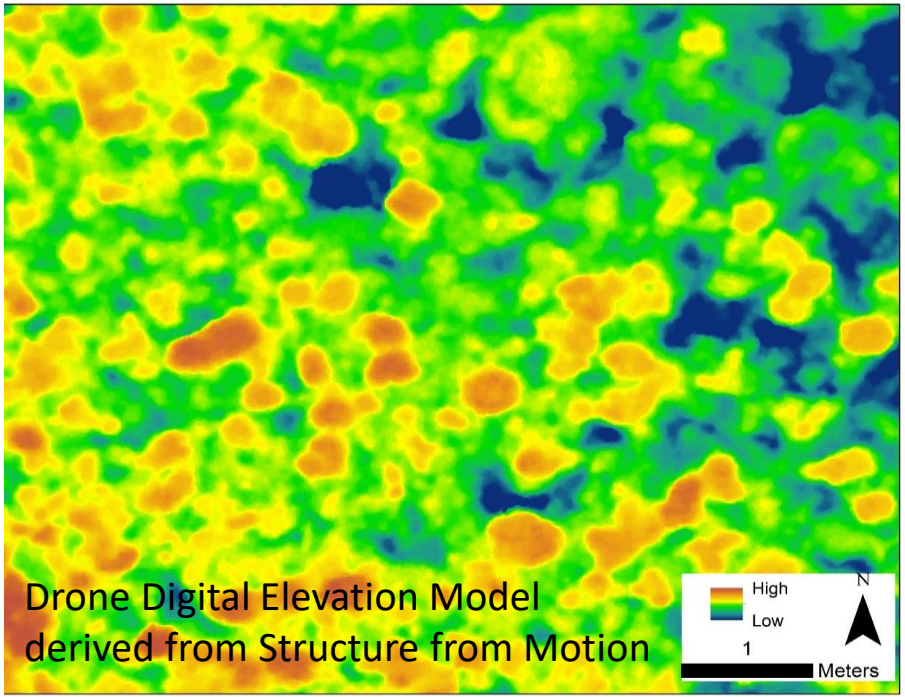
Drones can increase resolution across small – to – medium areas





- Structure of reef flat can be determined from when imagery clear
- i.e., water level and movement low





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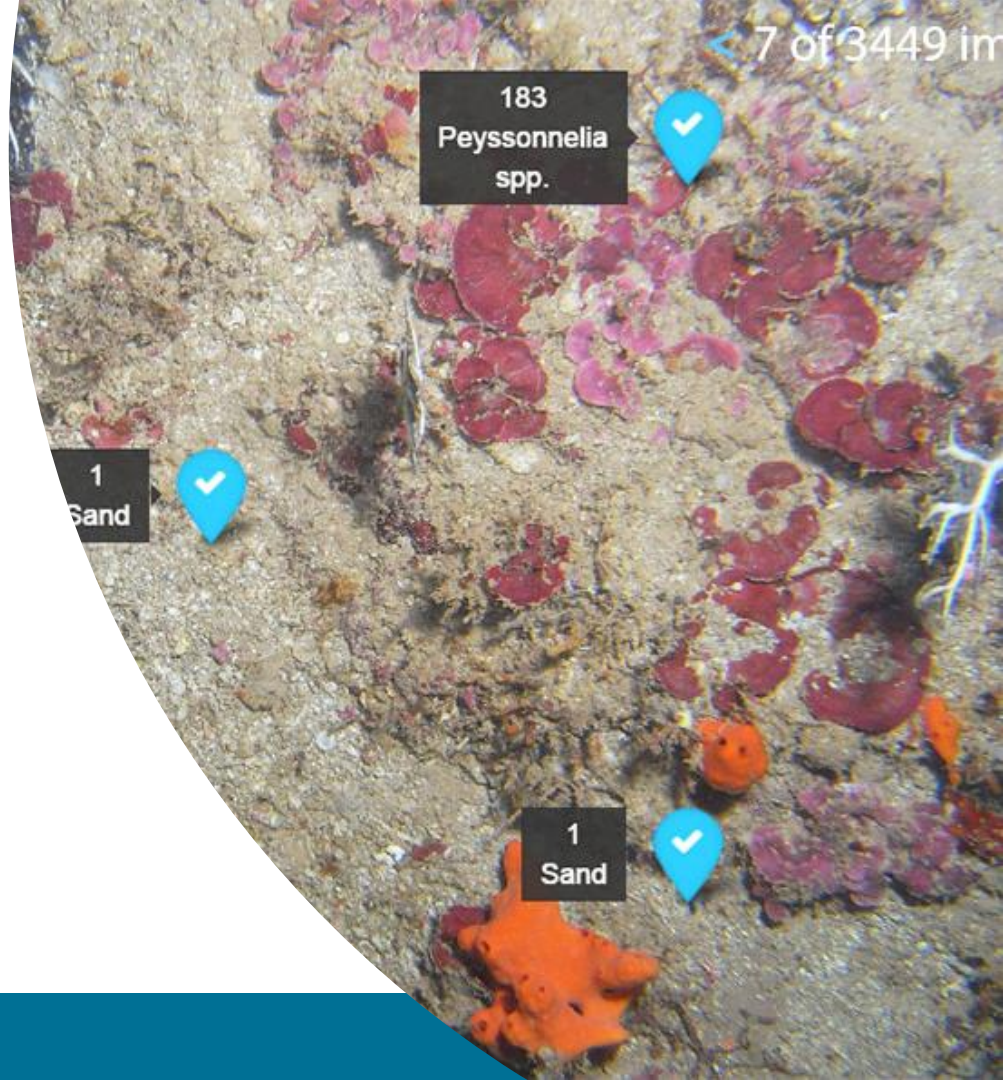
Building on LTM by incorporating new multiscale and saleable remote sensing data and methods; benthic image example

- As an institution collect ~100,000 still images a year as well as benthic video, and BRUVS fish videos.
- Historically analysed manually- very resource intensive, a bottle neck to rapid monitoring & reporting.
- At capacity and not scalable, laborious work prone to human error.

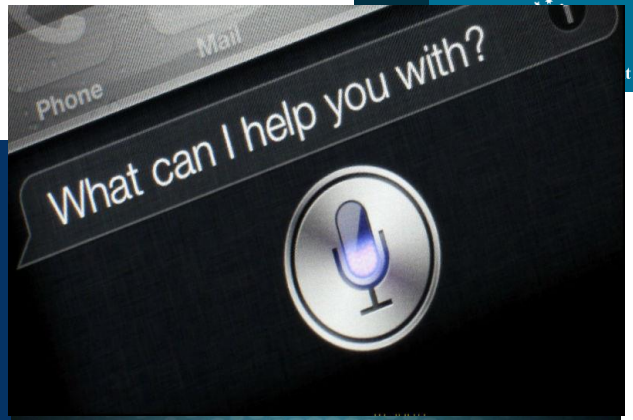


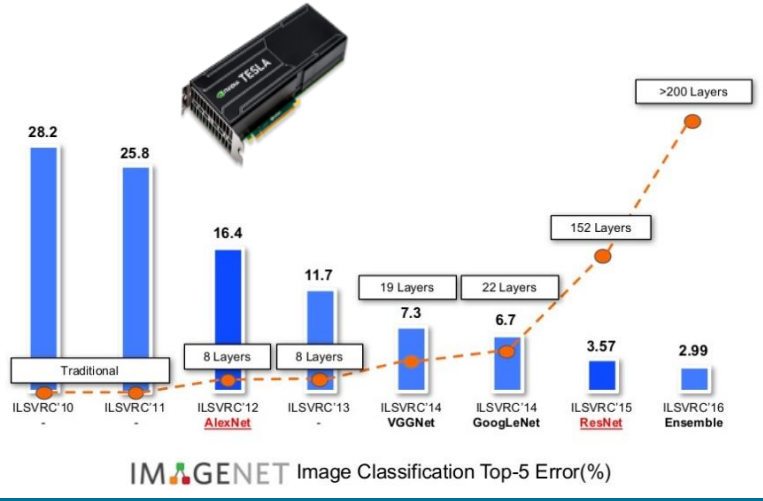
'AI IS THE NEW ELECTRICITY'

"Just as electricity transformed almost everything 100 years ago, today I actually have a hard time thinking of an industry that I don't think AI will transform in the next several years."

Andrew Ng

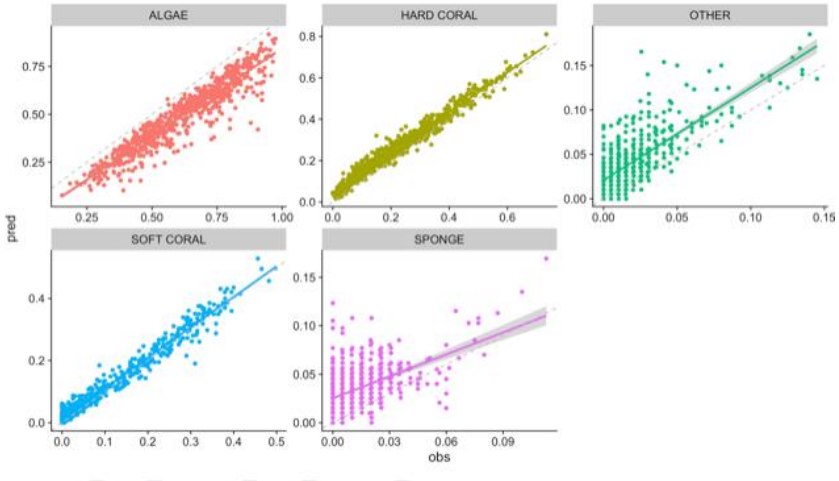
Former chief scientist at Baidu, Co-founder at Coursera

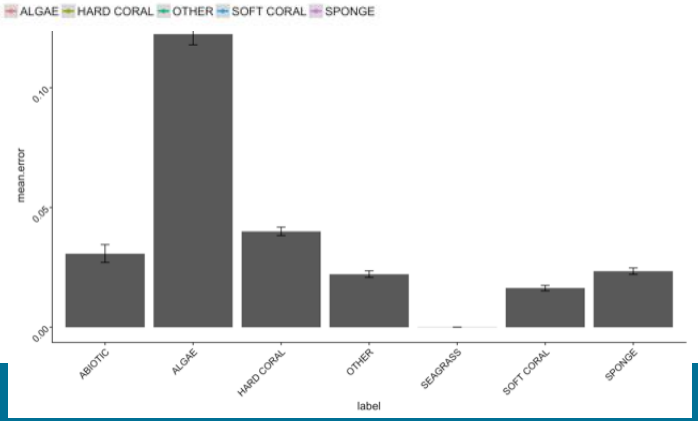




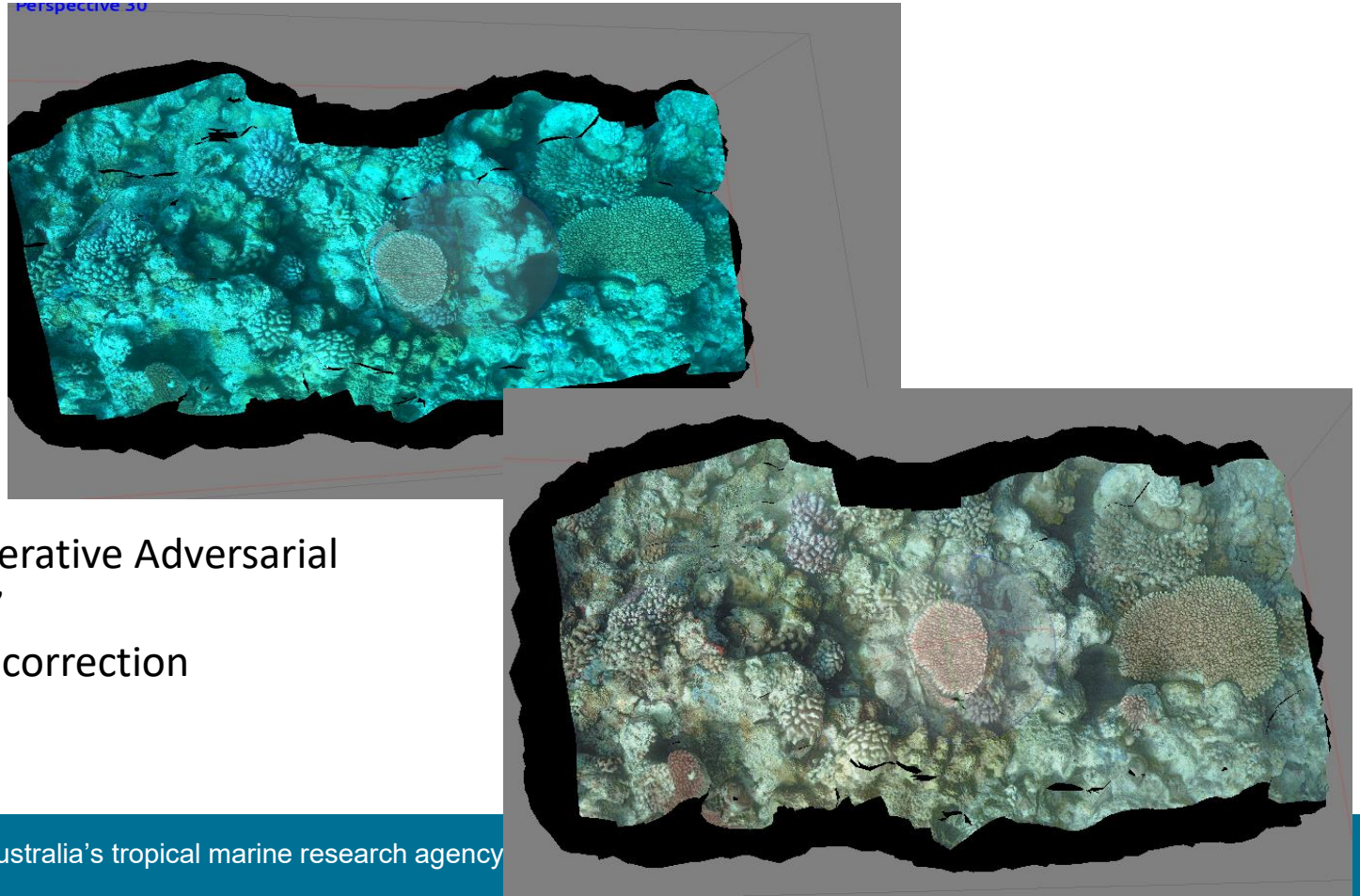
Three years of training data: 2008, 2010, 2012

5 point validation on 2014 50,000 images
~1 hour per 50k images



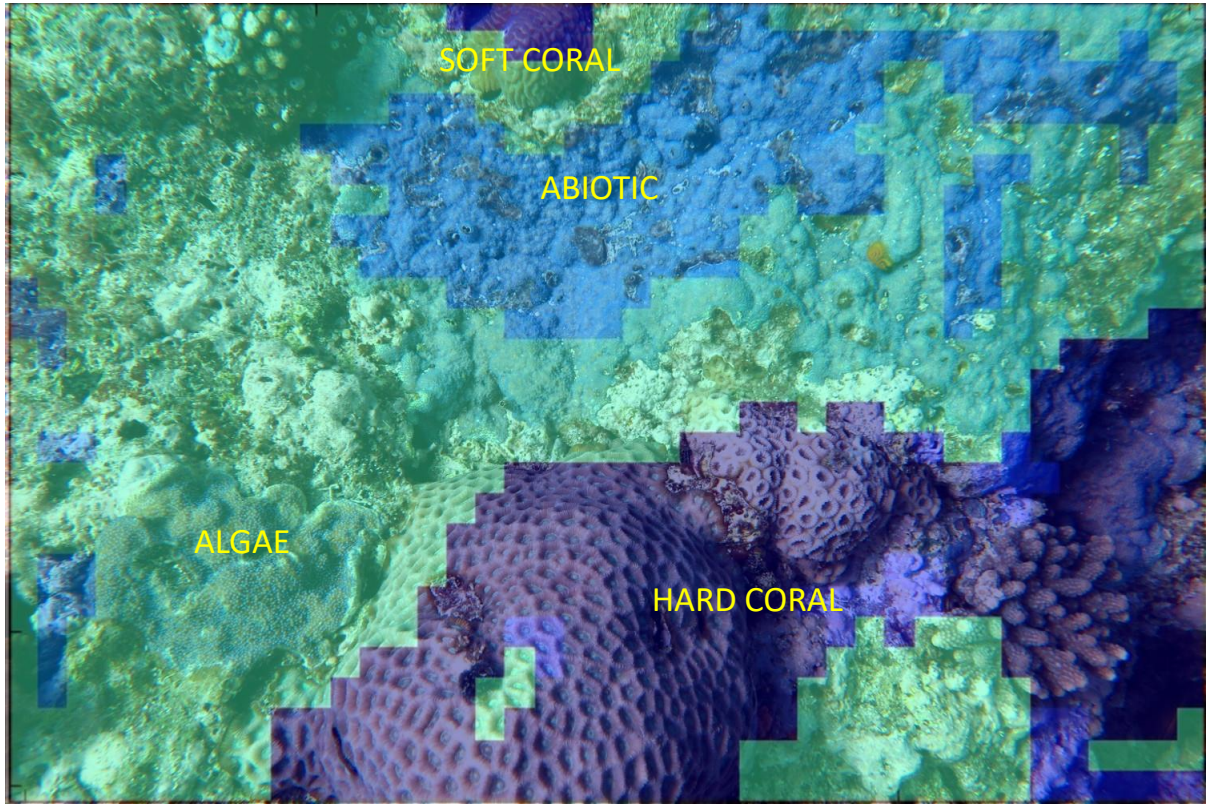


Going beyond image points to image moacis



GAN “Generative Adversarial Networks”
For image correction

Deep nets scalability, autoscoring point, to patch to reef scale



14 May 2018

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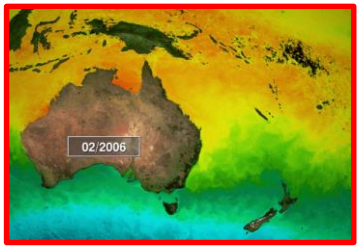
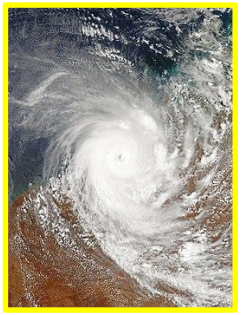
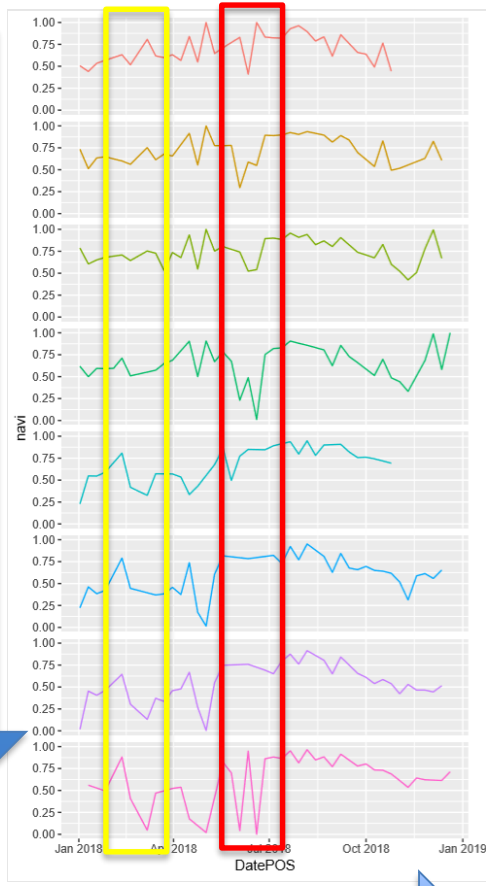
habitat cover index

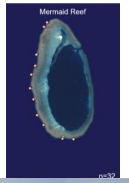




SCALE



TIME



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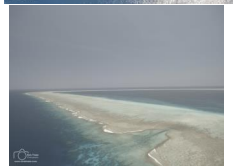

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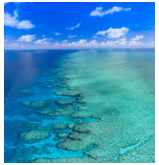

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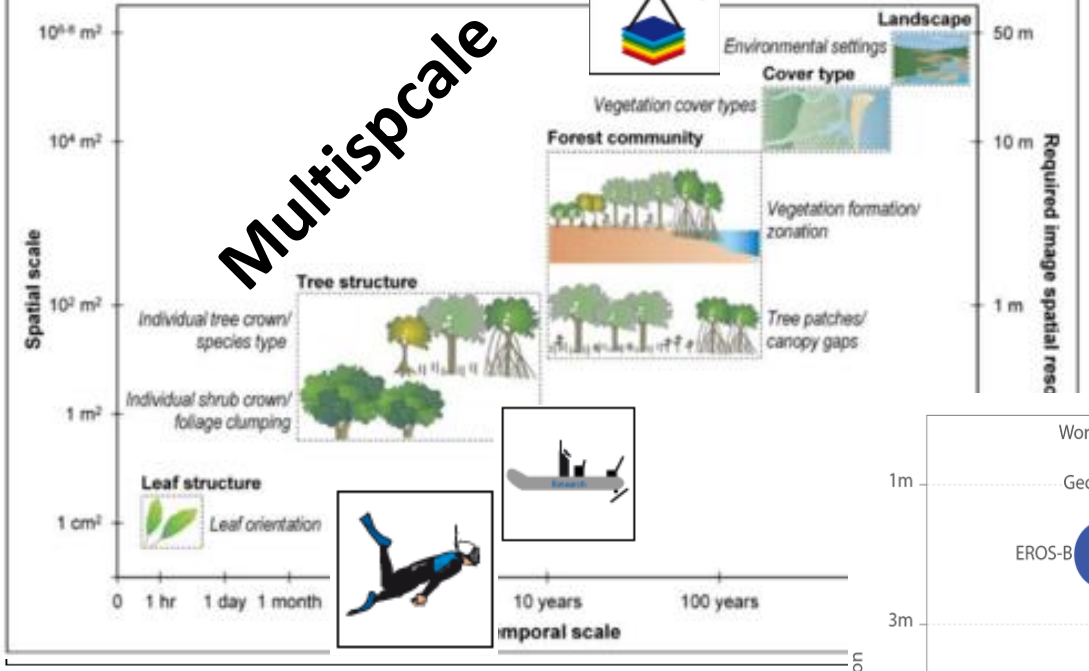
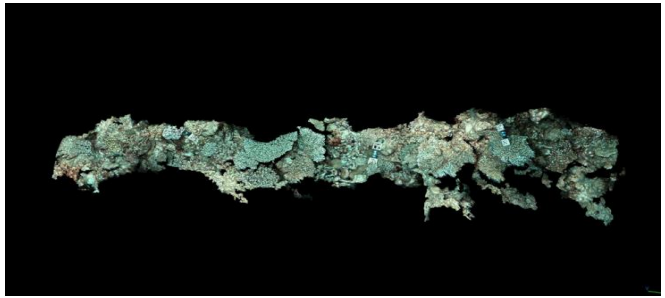
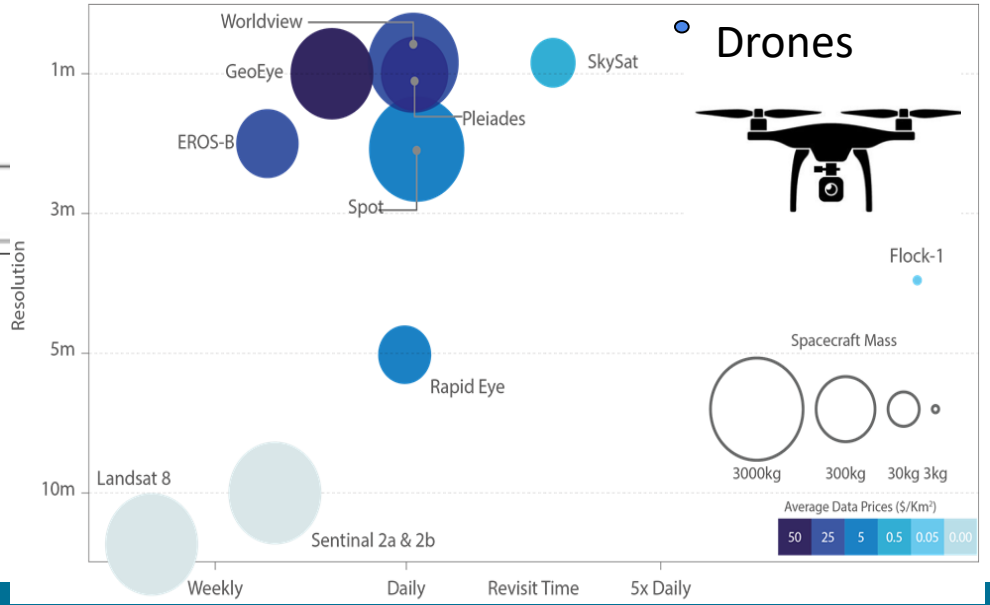
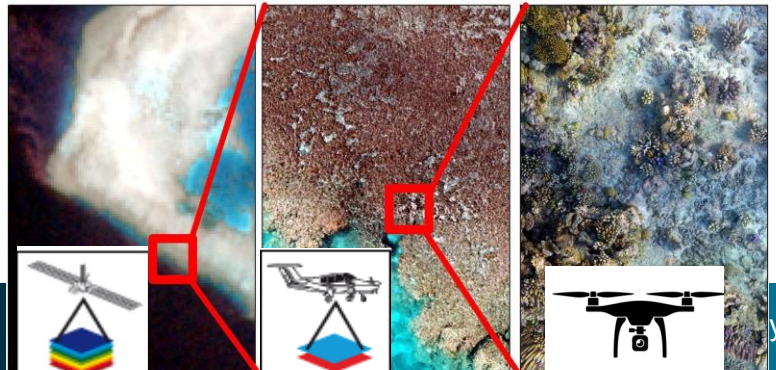
Multispcale

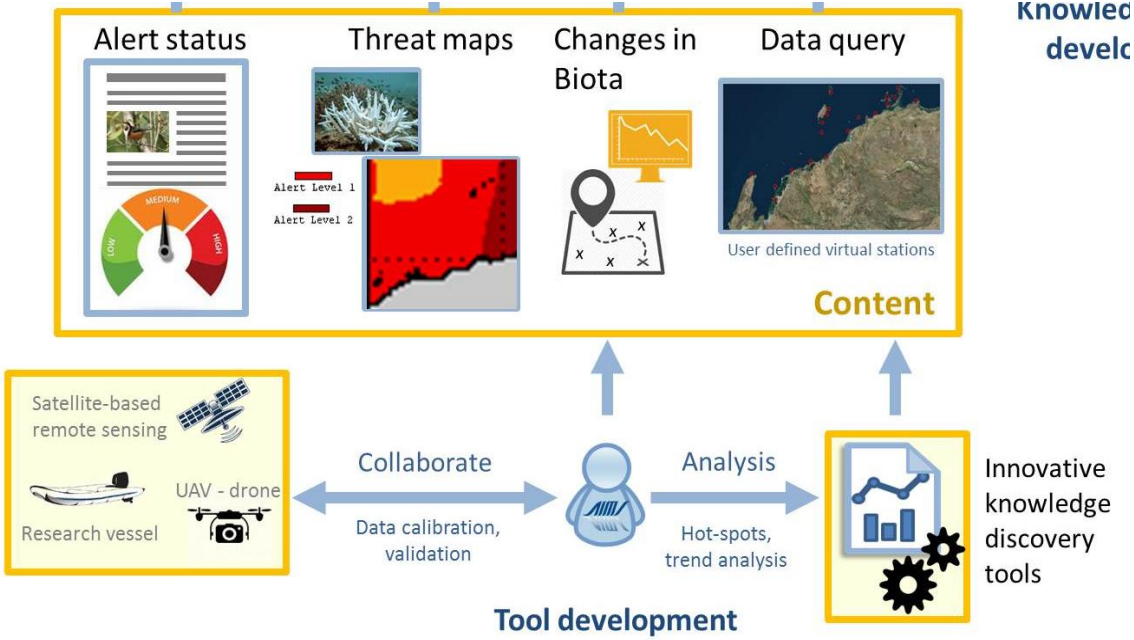








Work towards adaptive monitoring and disturbances triggering monitoring ondemand



Data.aims.gov.au
Bleaching risk models