

# Returning the Great to the Great Barrier Reef



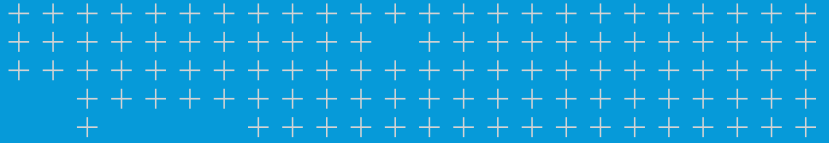
*Dr. Eva Kovacs collects a photo validation data survey within a 1m<sup>2</sup> footprint along the GBR. At the surface, she tows a GPS unit to track her position.  
Photo: C.Roelfsema*

## How eCognition is helping chart a path to restoration

Scientists leverage Trimble technology to develop first-ever topographic map of the Great Barrier Reef

## Solution

Trimble® eCognition®



# overview

The latest victim of global warming, the Great Barrier Reef (GBR) is under serious threat, and its outlook is dire. The challenge in conserving the Reef has been partly due to the lack of a complete map of the GBR's topography. That may change with an eCognition-based mapping technique that's enabled one project team to produce the world's first-ever topographic map of the GBR.



Location  
AUSTRALIA



Since 2007, Dr. Chris Roelfsema, a researcher and lecturer at Queensland University, has been experimenting with satellite data and Trimble eCognition Object-Based Image Analysis (OBIA) software to develop a scalable, coral reef mapping approach. In 2016 he led a successful pilot project that used eCognition to produce topographic and benthic composition maps of 20 GBR reefs. The success and promise of that study led to funding in 2017 to expand the technique across 237 northern GBR reefs that are in dire condition.

To map the reefs, Roelfsema used eCognition with satellite image mosaics and integrated ancillary data. eCognition classified geomorphic zones first. Moving from one reef to the next, it analyzed the depth values of the image mosaic and distinguished reefs from non-reefs to create a reef map. The software then differentiated between the shallow reef top and not reef top. Within the identified reef top, it classified shallow geomorphic zones such as reef crest, inner reef flat, outer reef flat and

lagoon. Then for the deeper, not-reef zones it used depth, wave and wind information to distinguish exposed and sheltered slopes and plateaus. Once all the geomorphic zones were classified, eCognition used field data and depth characteristics to differentiate benthic habitats such as coral/algae.

In total it took eCognition 45 minutes to produce geomorphic and benthic habitat maps for all 237 reefs.

Impressed with the mapping results, the GBR Marine Park Authority (GBRMPA) funded Roelfsema to scale the methodology to the GBR's 2,900 reefs.

## “A DREAM COME TRUE”

In early 2019, the GBR Habitat Mapping Project (GBRHM) was launched. A three-year initiative, it aims to develop a comprehensive, seamless map of the GBR, detailing the





*The mv Kalinda sits anchored at Ellison Reef in the Central Great Barrier Reef. Two smaller boats launch from here to drop divers and snorkelers off to collect georeferenced photo quadrat data along and on top of the reef to calibrate and validate habitat maps. Photo: K. Joyce*

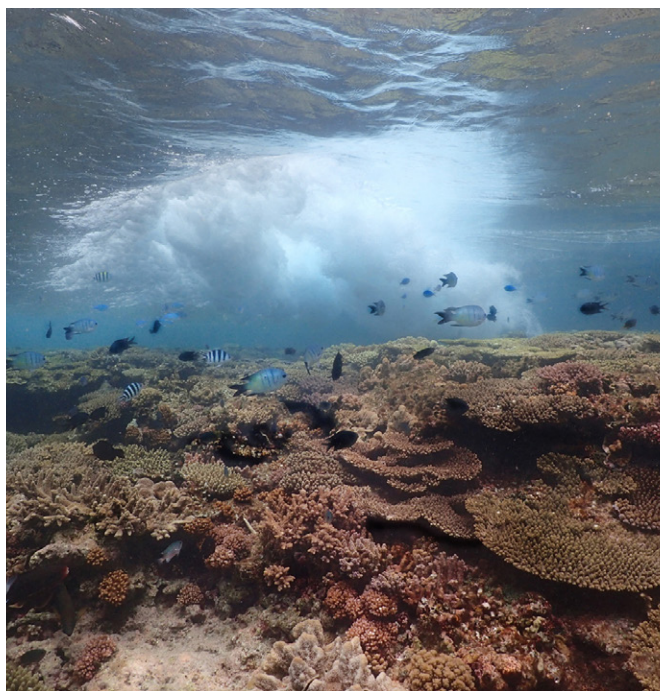
Reef's geomorphology, its benthic habitats and specific coral types.

Roelfsema and his team began with the topographic map.

They processed 129 Sentinel-2 satellite images into seamless mosaics, and water depth, slope and wave values were derived using a previously established algorithm. They also incorporated any field survey data they could find on the GBR.

To create a larger reference dataset, they applied the same eCognition rules from the initial set of 237 geomorphic reef maps to an additional 63 GBR reefs, producing geomorphic and benthic habitat maps for 300 reefs total.

Given the enormity of the GBR and the terabytes of data to be analyzed, the team switched the classification and mapping process to Google Earth Engine (GEE). Using the

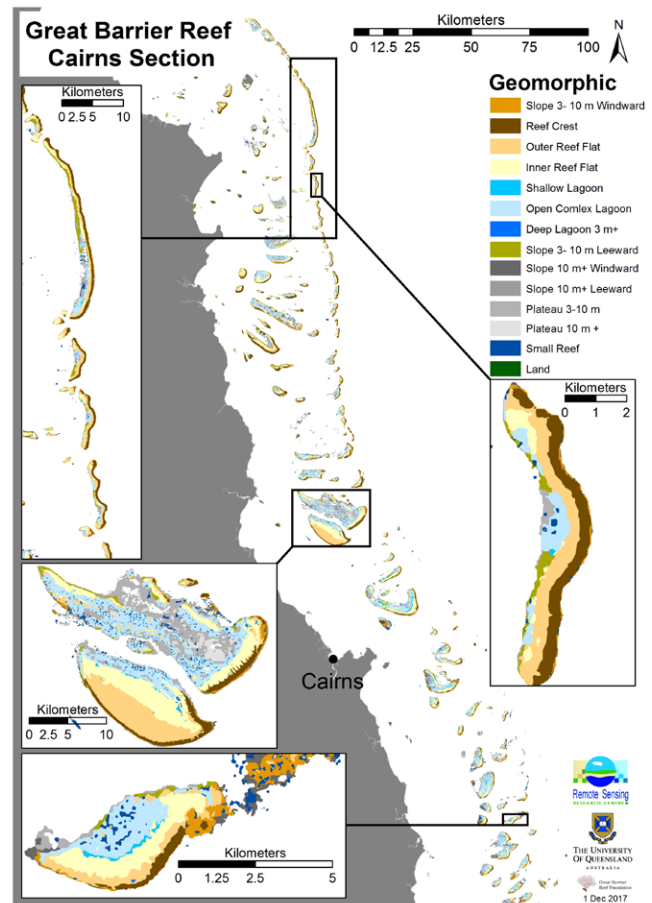


*Dense healthy coral just under the water surface close to the reef crest at Heron, Southern Great Barrier Reef. Photo: C.Roelfsema*

eCognition-based reference dataset of 300 reefs, they created a set of training and validation points. Those points were fed into GEE's machine-learning classifier to classify and produce a geomorphic map of the whole GBR. They then applied OBIA neighborhood rules to strengthen the map results.

In October 2019, they presented the premiere GBR geomorphic map to the GBRMPA; the final map was delivered in December. In 2020, the team will refine the map to classify and map the GBR's benthic communities; and in 2021, they will layer in specific coral types. All maps will be publicly available through the GBRMPA.

"This map has been a dream come true," said Roelfsema. "We're providing more detail than scientists have ever had before. Now they'll be able to make spatial, ecological and biophysical connections that they haven't been able to before. And it's only going to get better."



Above: The eCognition-based classification and map of the benthic habitats across the 237 Cairns/Cooktown (CC) reefs, a group of northern GBR reefs about 10 to 50 km offshore that are in dire condition

Left: Branching coral just under water surface captured on the reef flat of Heron Reef, Southern Great Barrier Reef Australia  
Photo: C.Roelfsema

"We have never been able to map so many reefs with such little field data to that level of detail. And in such little time."

— Dr. Chris Roelfsema, Researcher and Lecturer, Remote Sensing Research Centre, School of Earth and Environmental Sciences, Queensland University

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