Ocean acidification increases the impact of typhoons on algal communities

Callum J. Hudson, Sylvain Agostini, Shigeki Wada, Jason Hall-Spencer, Sean D. Connell, and Ben P. Harvey

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UNIVERSITY OF PLYMOUTH

OIST 沖縄科学技術大学院大学

筑波大学 University of Tsukuba

SHIMODA MARINE RESEARCH CENTER SINCE 1933 UNIVERSITY OF TSUKUBA

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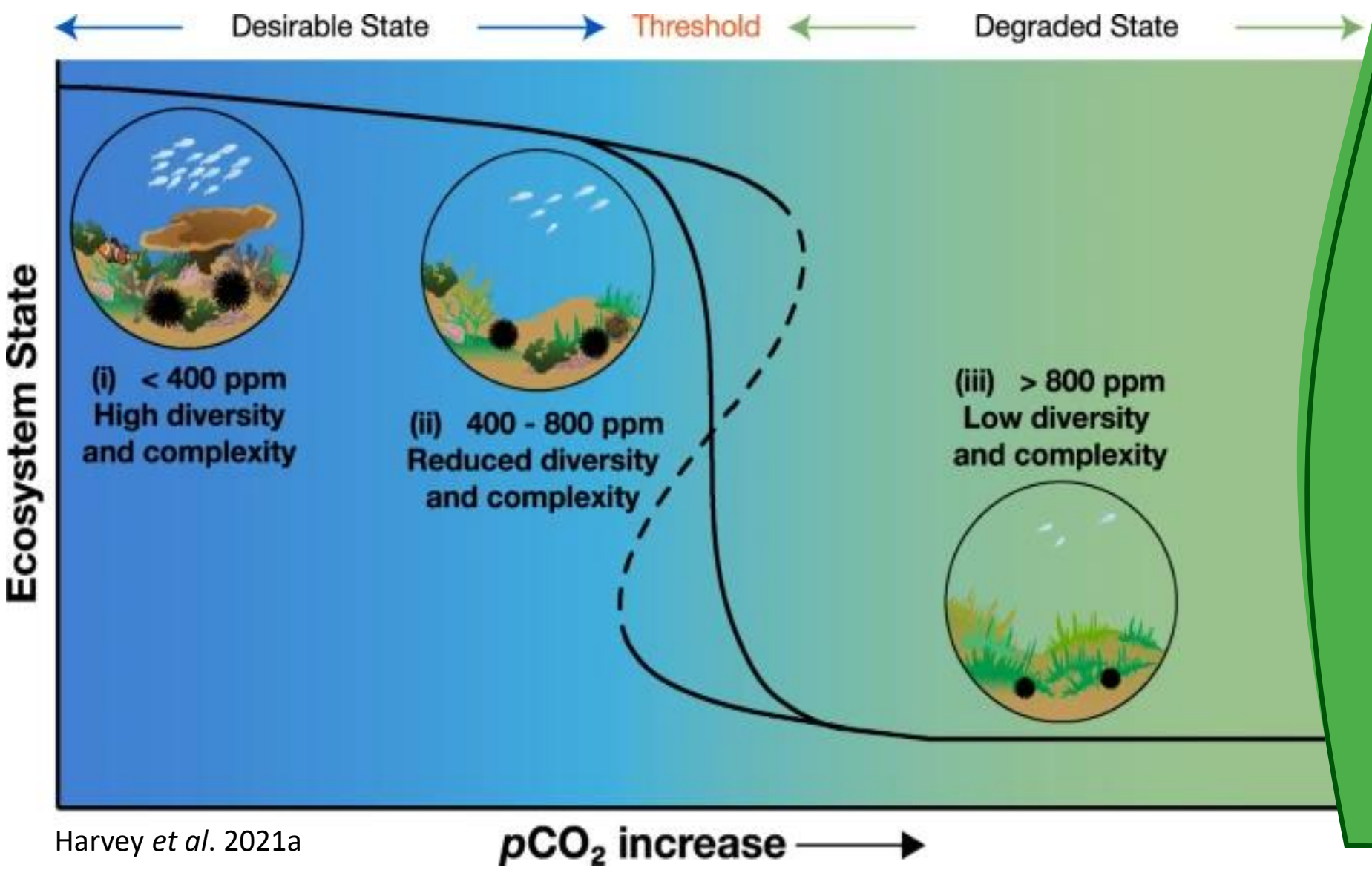
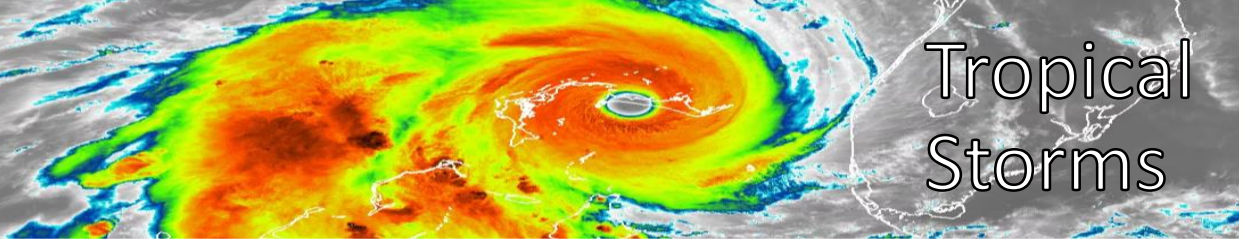
Ocean acidification

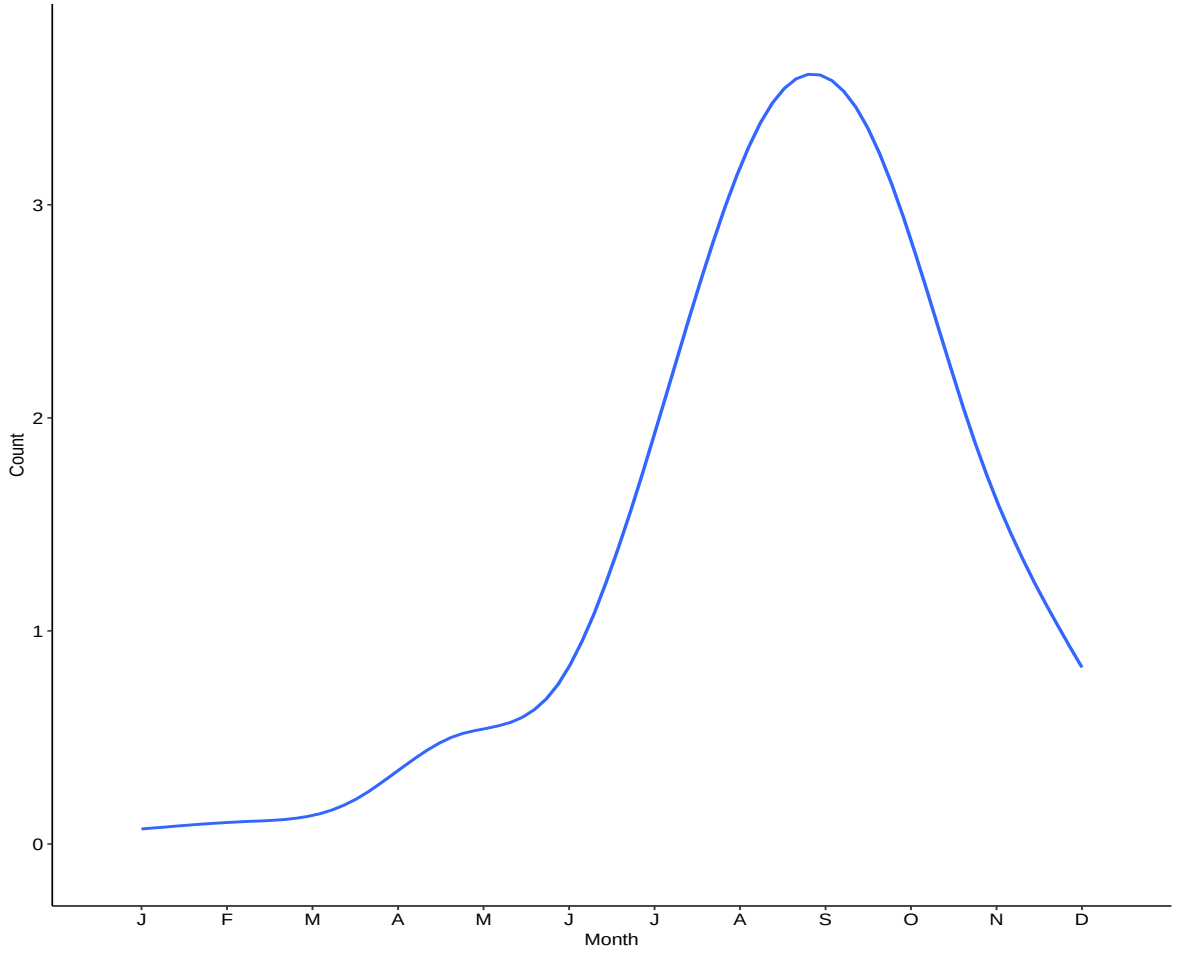
Rising CO_2 will reconfigure marine communities



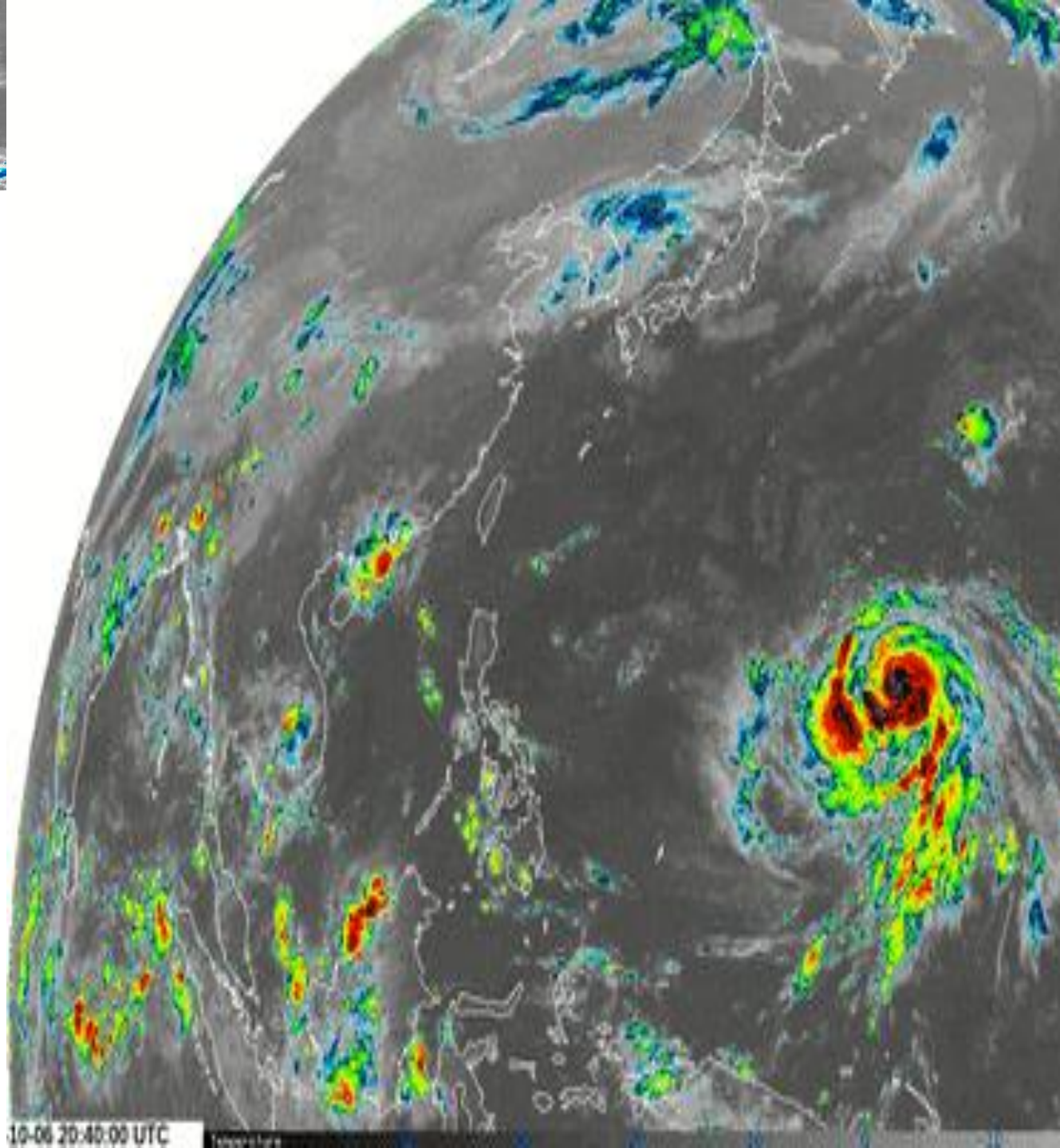
Harvey *et al*. 2021a

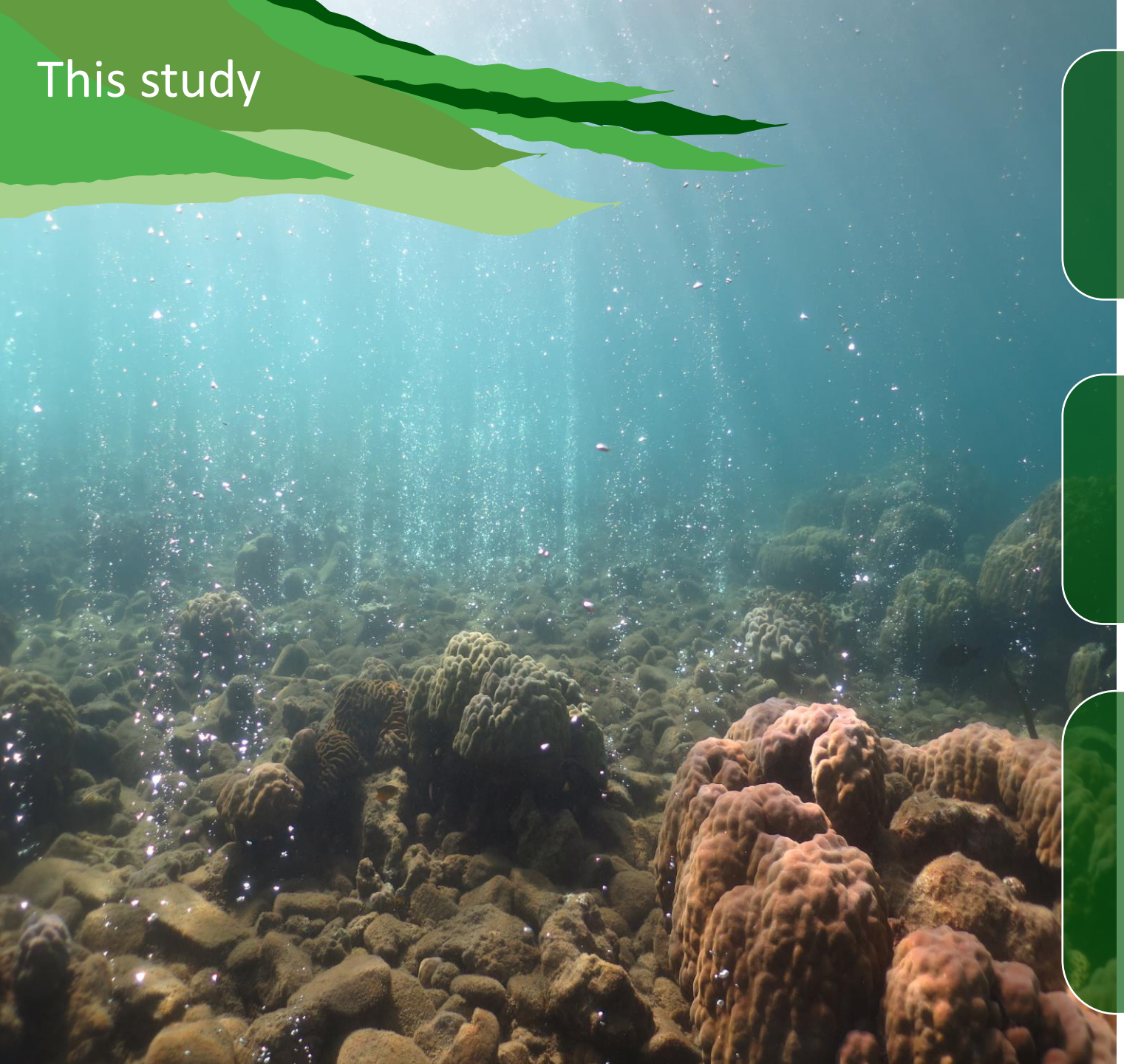
- Calcification
- Dissolution
- Recruitment
- Community structure
- Taxonomic diversity
- Structural complexity
- Primary Productivity*





Average number of typhoons recorded by the JMA per month (1980-2019) – Japan Meteorological Agency





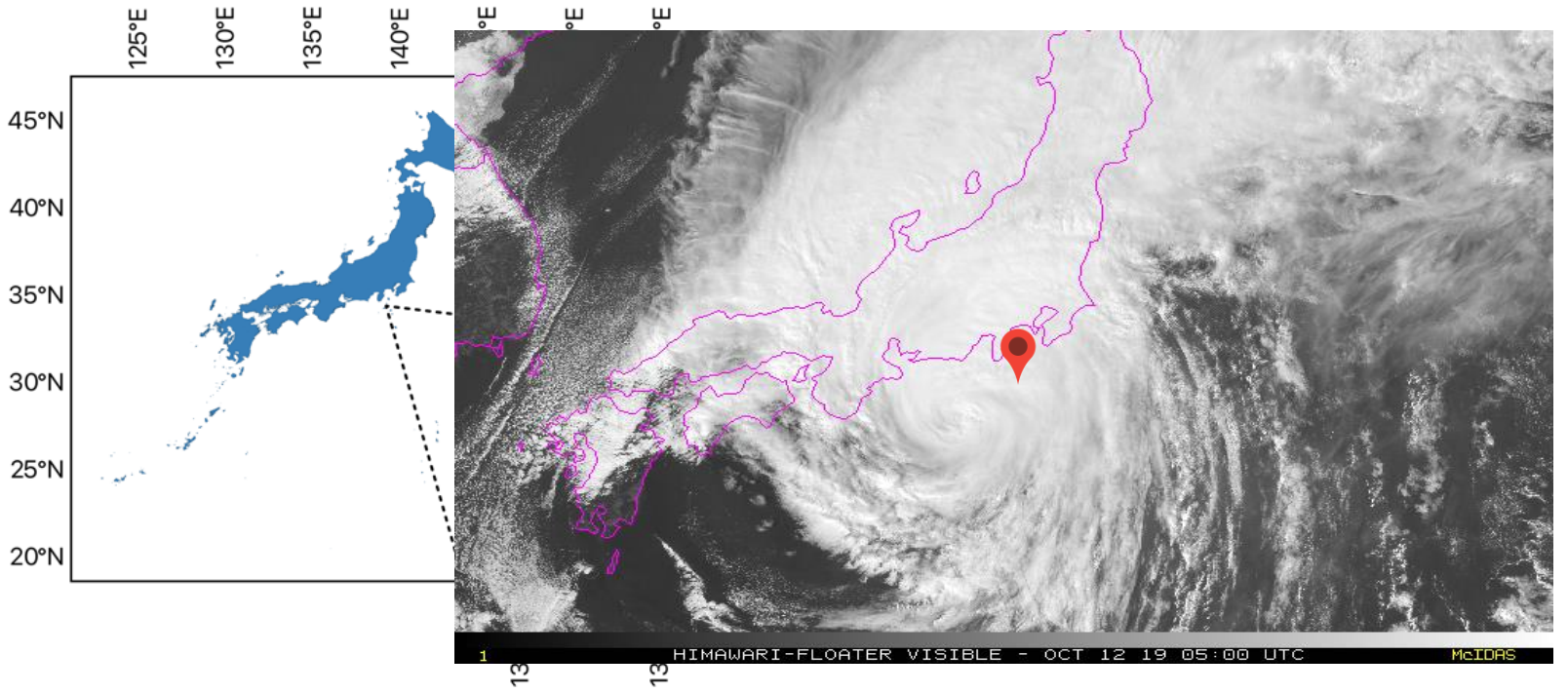
This study

Three-year monthly surveys at a CO_2 seep

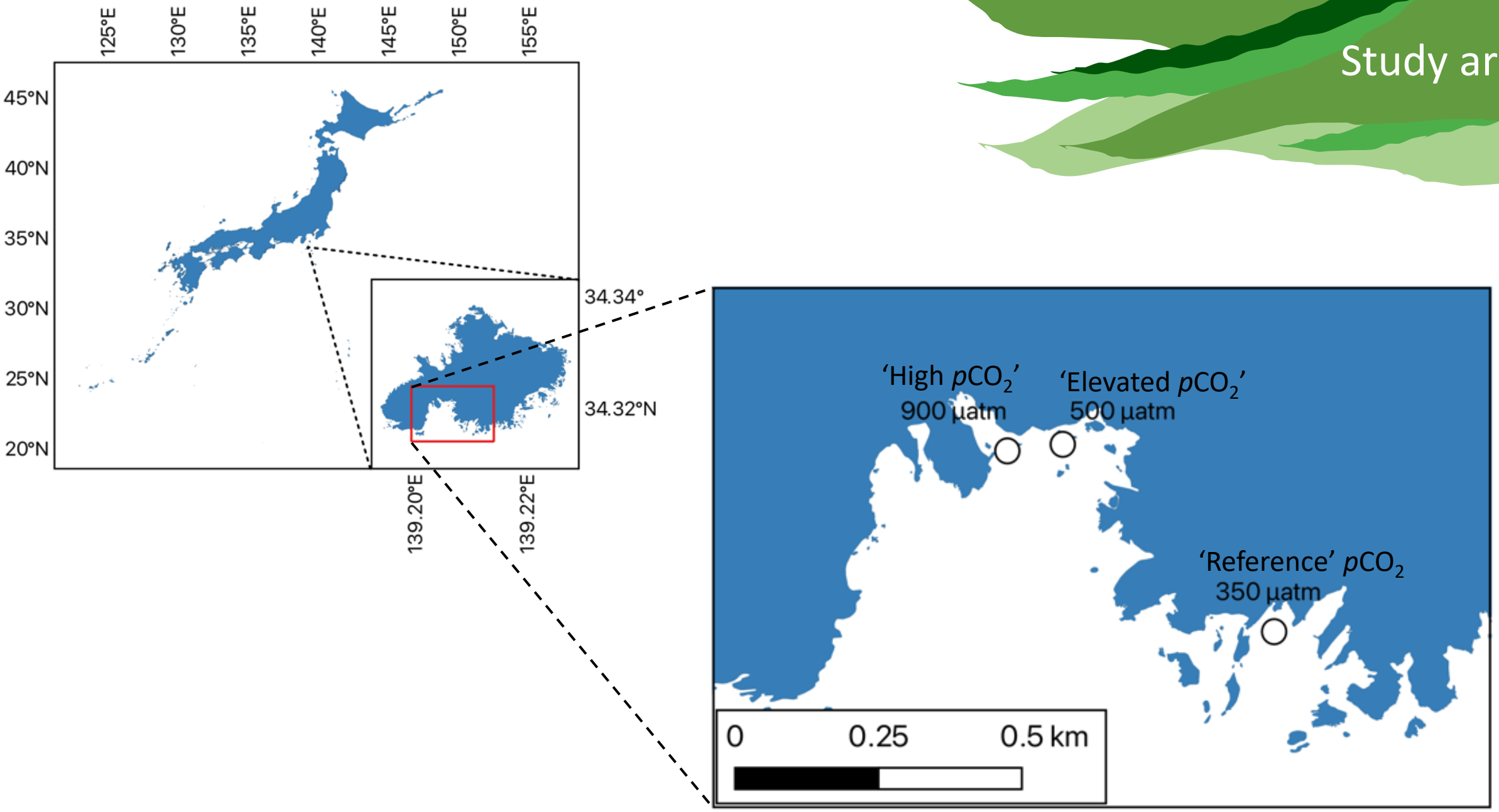
Algal community analysis

OA-driven community change and response to typhoon disturbance

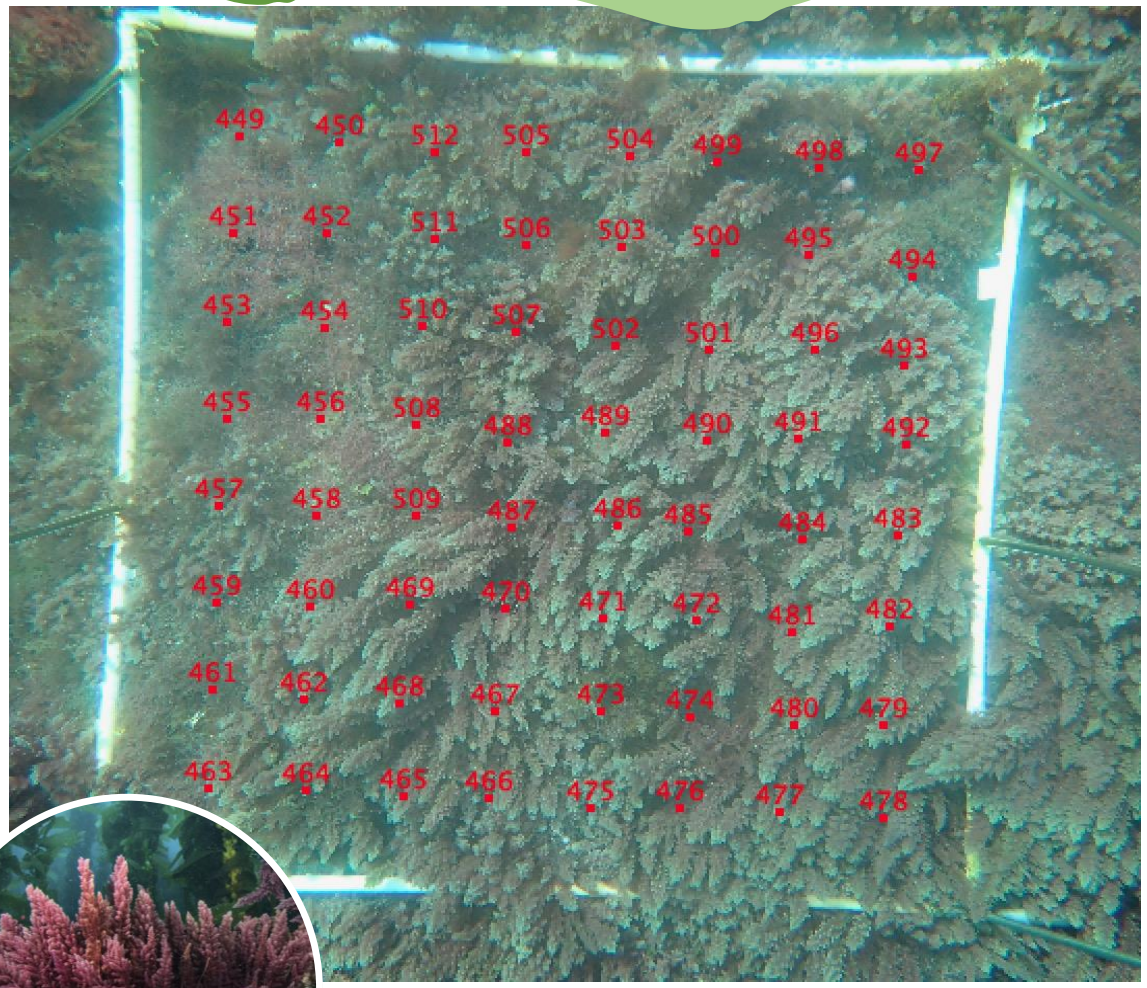
CO_2 vents: Shikine-jima, Japan



Study area


125°E
130°E
135°E
140°E
145°E
150°E
155°E
45°N
40°N
35°N
30°N
25°N
20°N
34.34°
34.32°N
139.20°E
139.22°E
'High pCO_2'
900 µatm
'Elevated pCO_2'
500 µatm
'Reference' pCO_2
350 µatm
0
0.25
0.5 km

Methods



Reference pCO_2

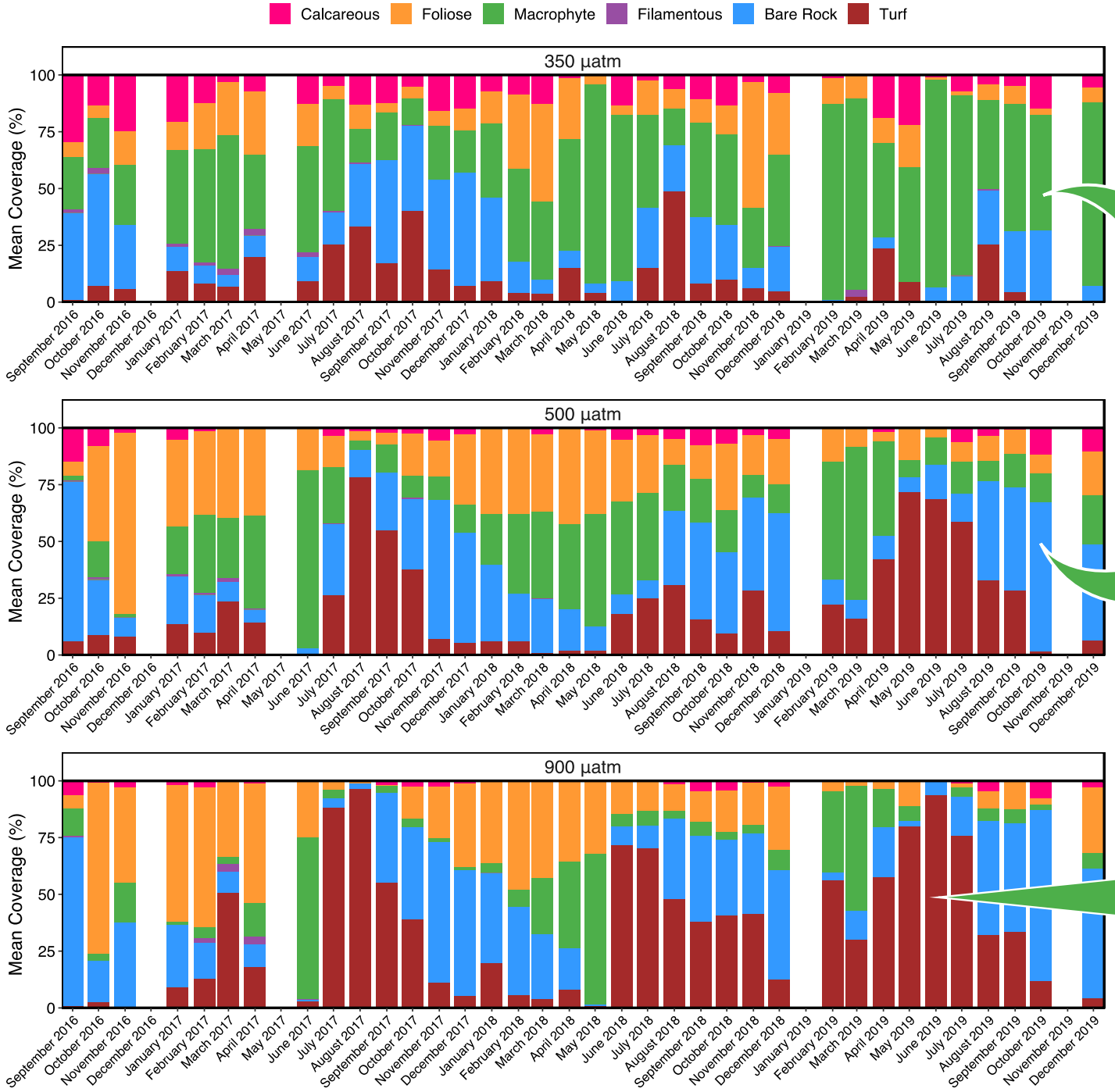
~350µatm

June 2019

Summer

High pCO_2

~900µatm



Algal community composition changes with time and increasing pCO_2

Greater macrophyte coverage at ambient CO_2

Cycling of group coverage between months and across years

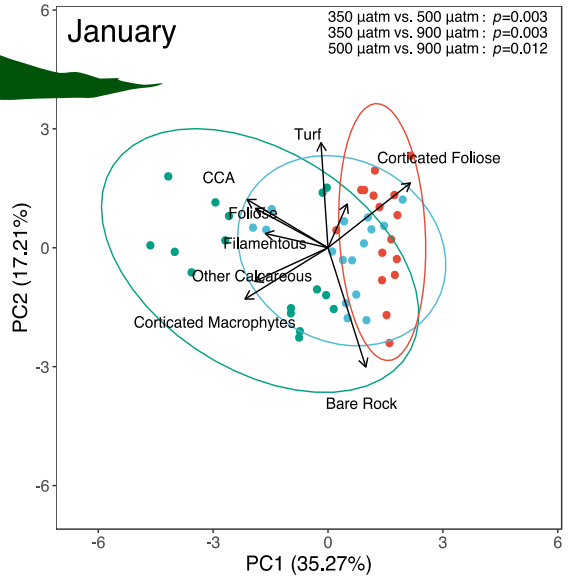
Higher levels of turf and bare rock at high CO_2

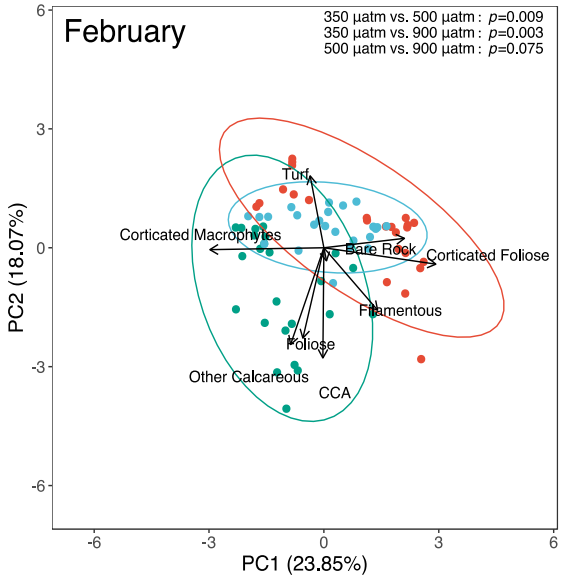
Community Analysis

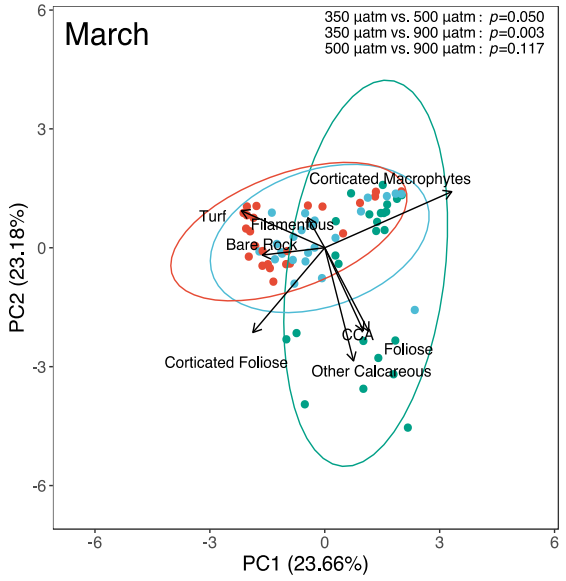
CO_2 driven differences maintained between months

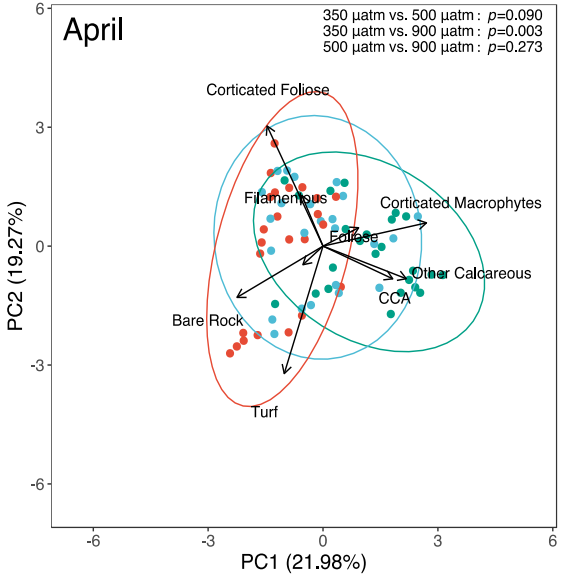
***Reference* different to *acidified* communities 9/12 months**

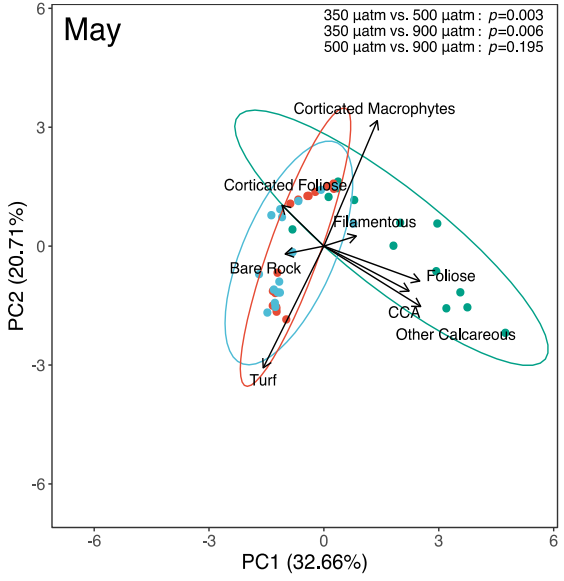
Communities display different seasonal change

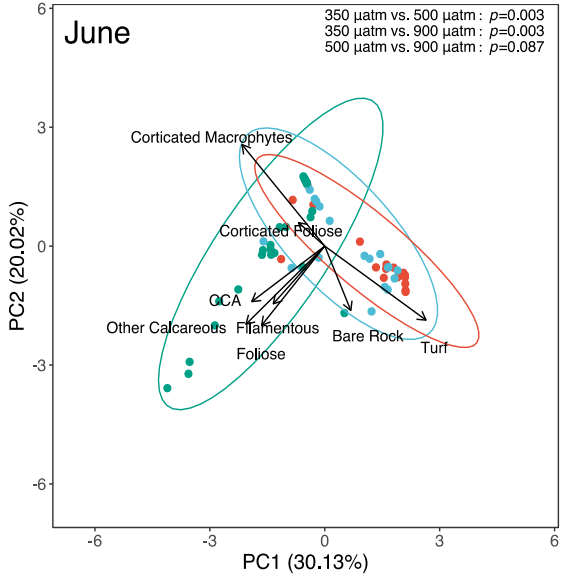




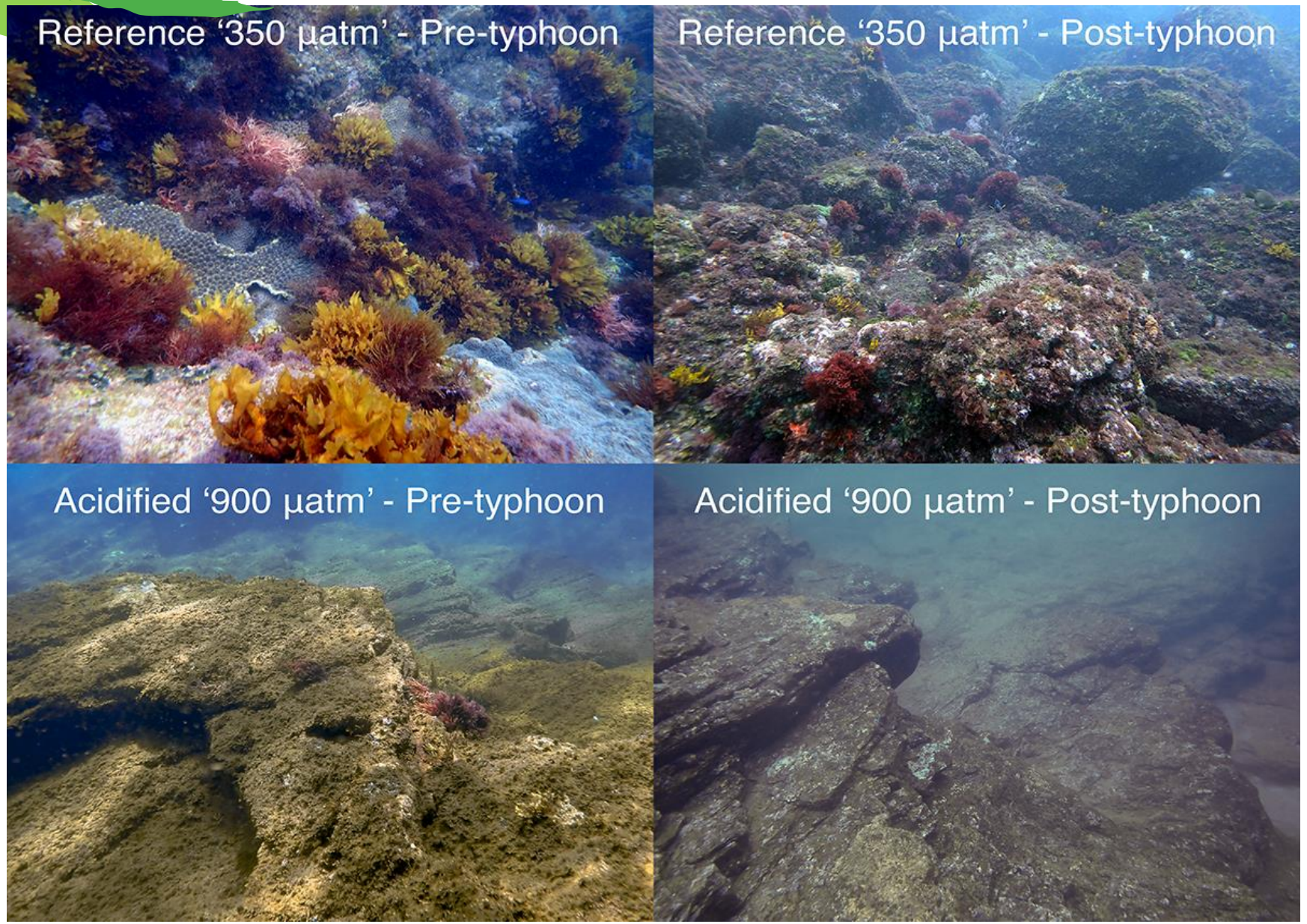








How does OA impact resistance and recovery?

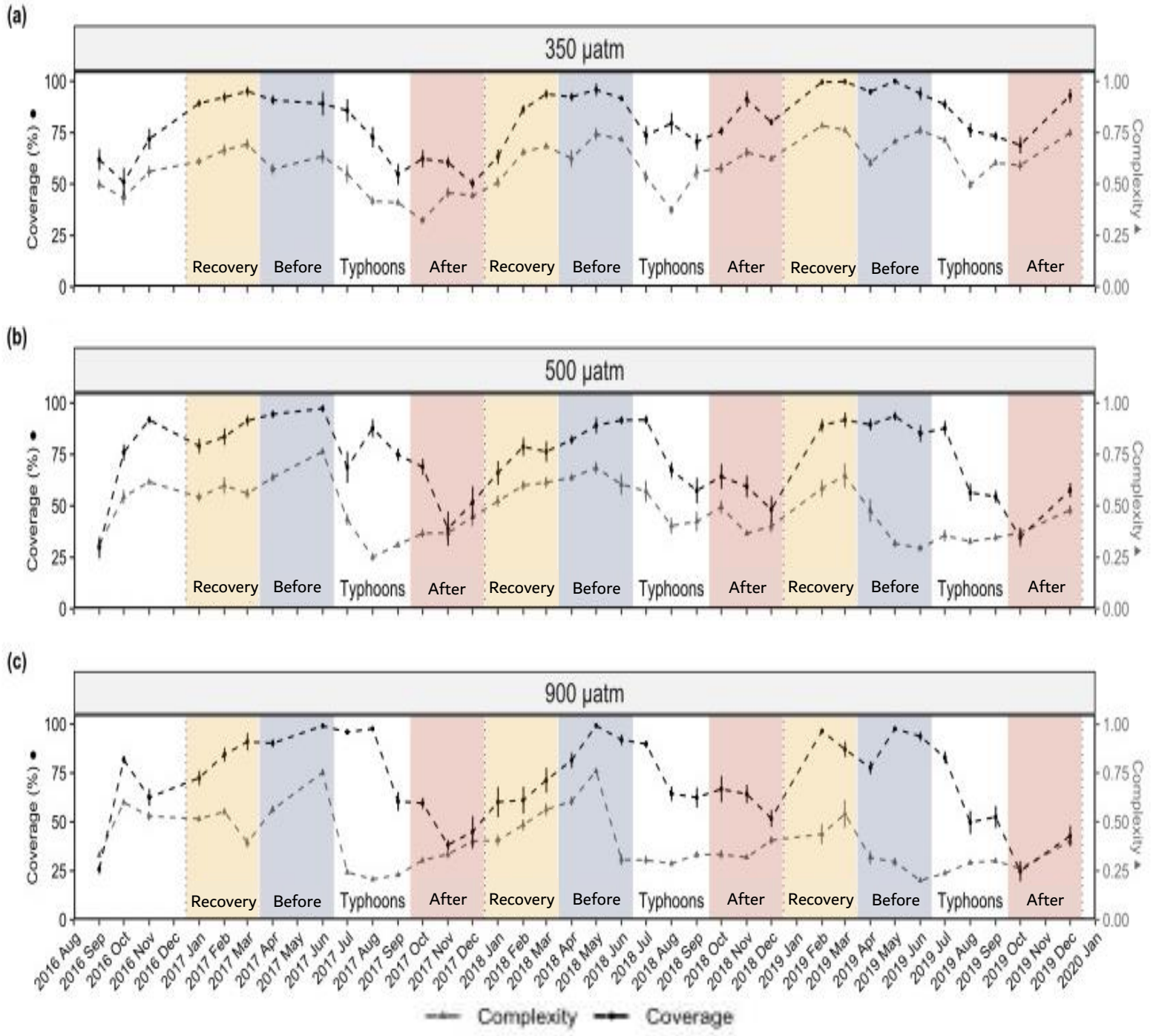


Algal Coverage

Greater impact of typhoons with rising pCO_2

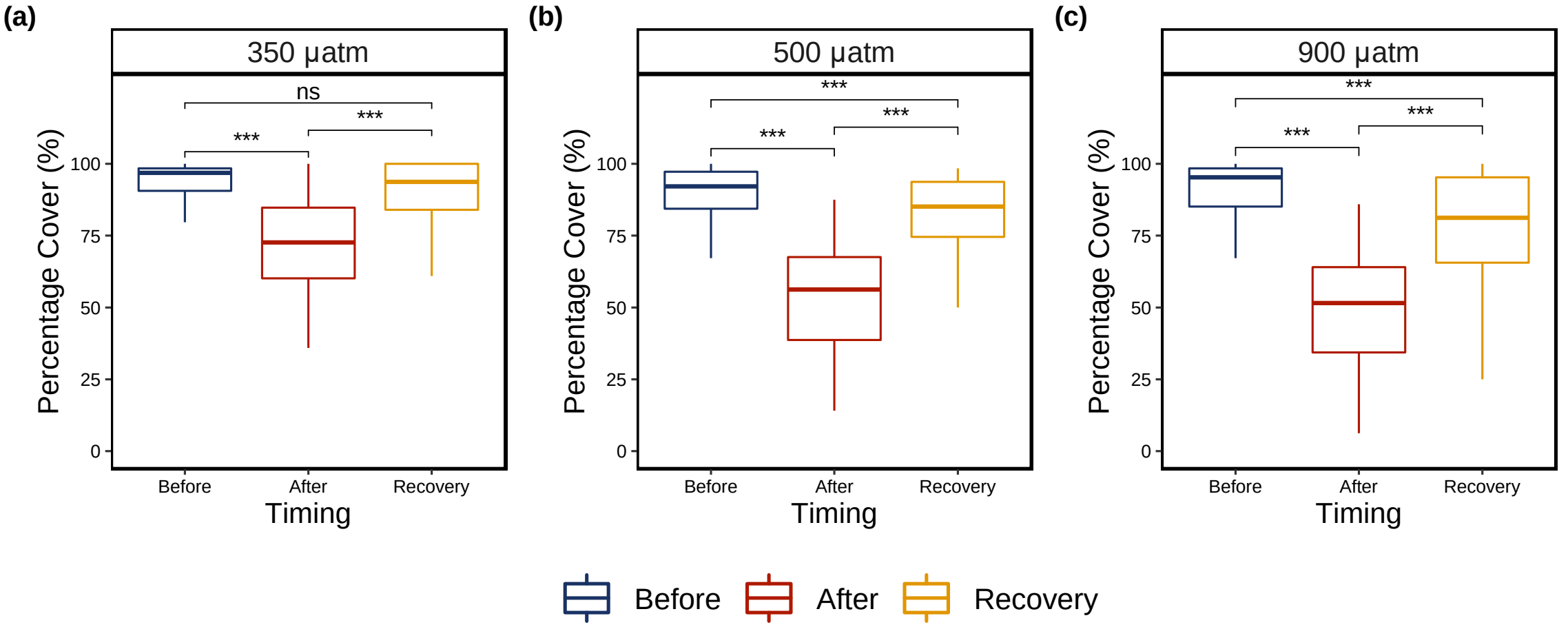
Large loss of algal cover at high pCO_2

Rapid recovery to pre-disturbance levels



Algal coverage is significantly impacted by typhoon disturbance

Longer lasting impact at high pCO_2

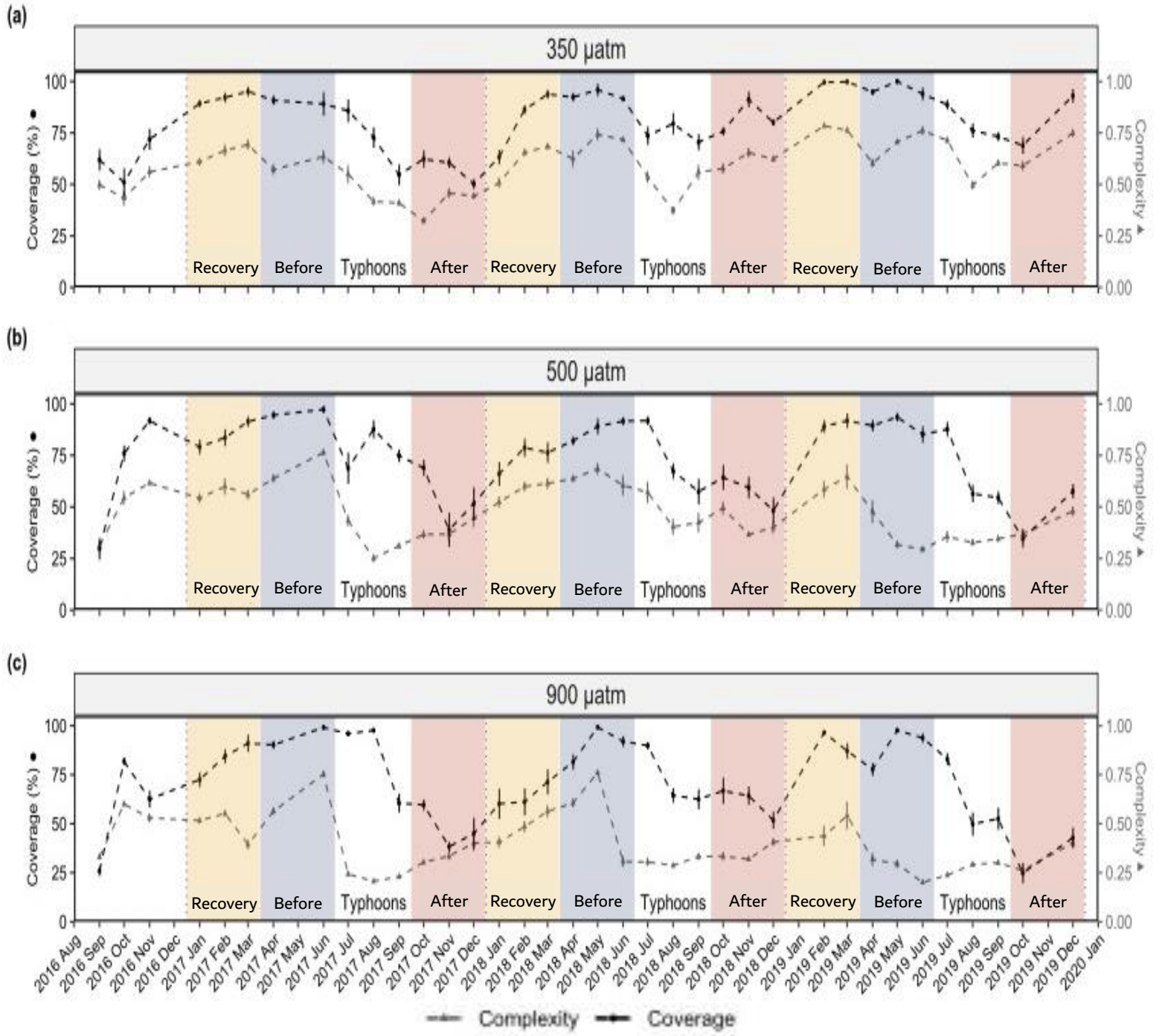


Structural Complexity

Lower structural complexity at high pCO_2

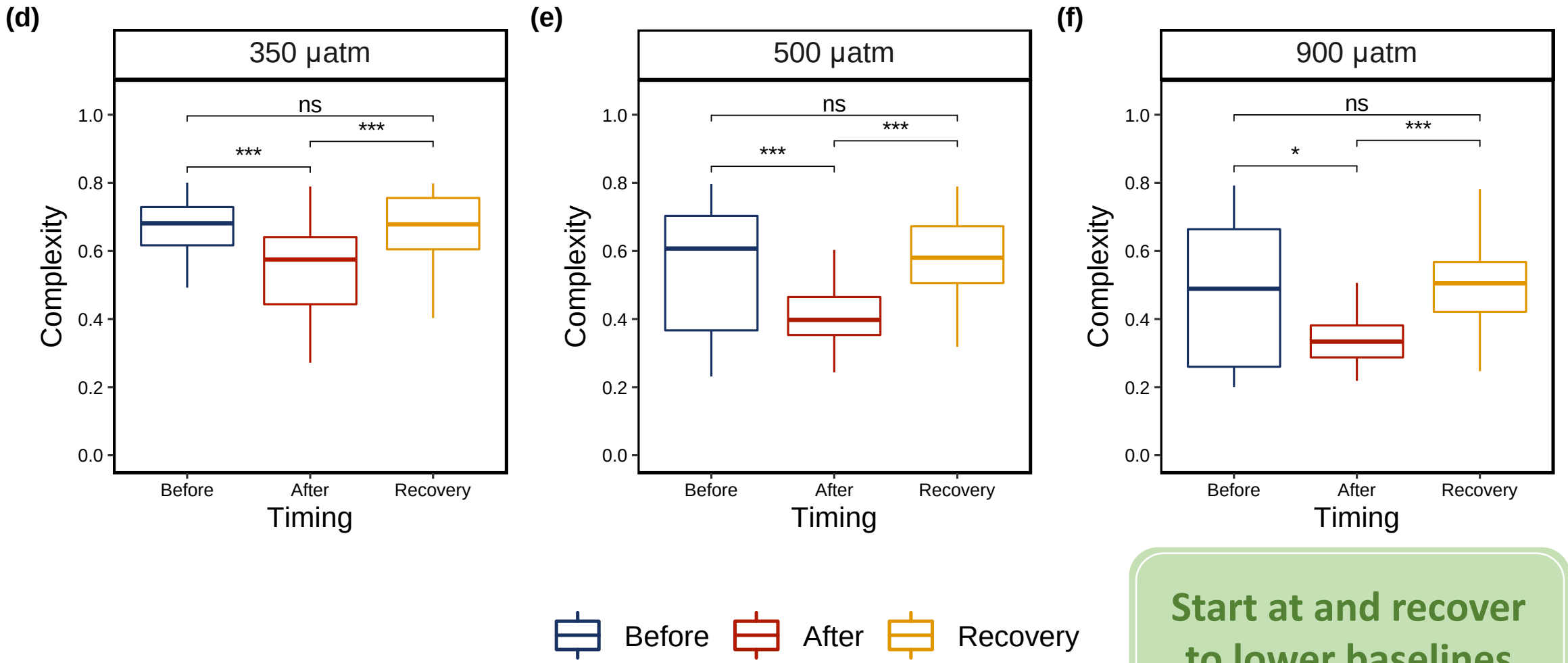
Less typhoon resistance at high pCO_2

Recovery to low baseline



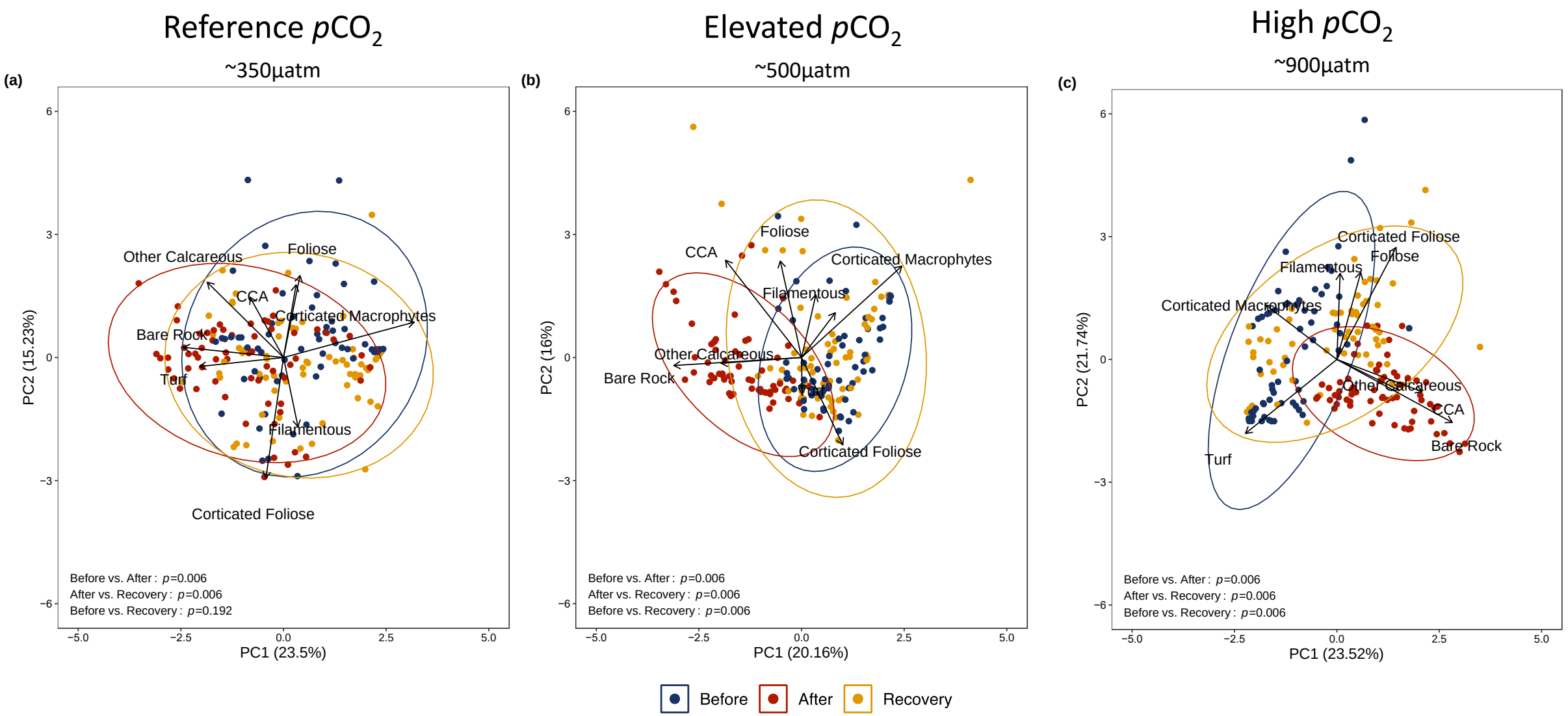
Structural complexity of communities also impacted by typhoon disturbance

Coverage differed 'Before' vs. 'Recovery' for acidified communities, but not Complexity

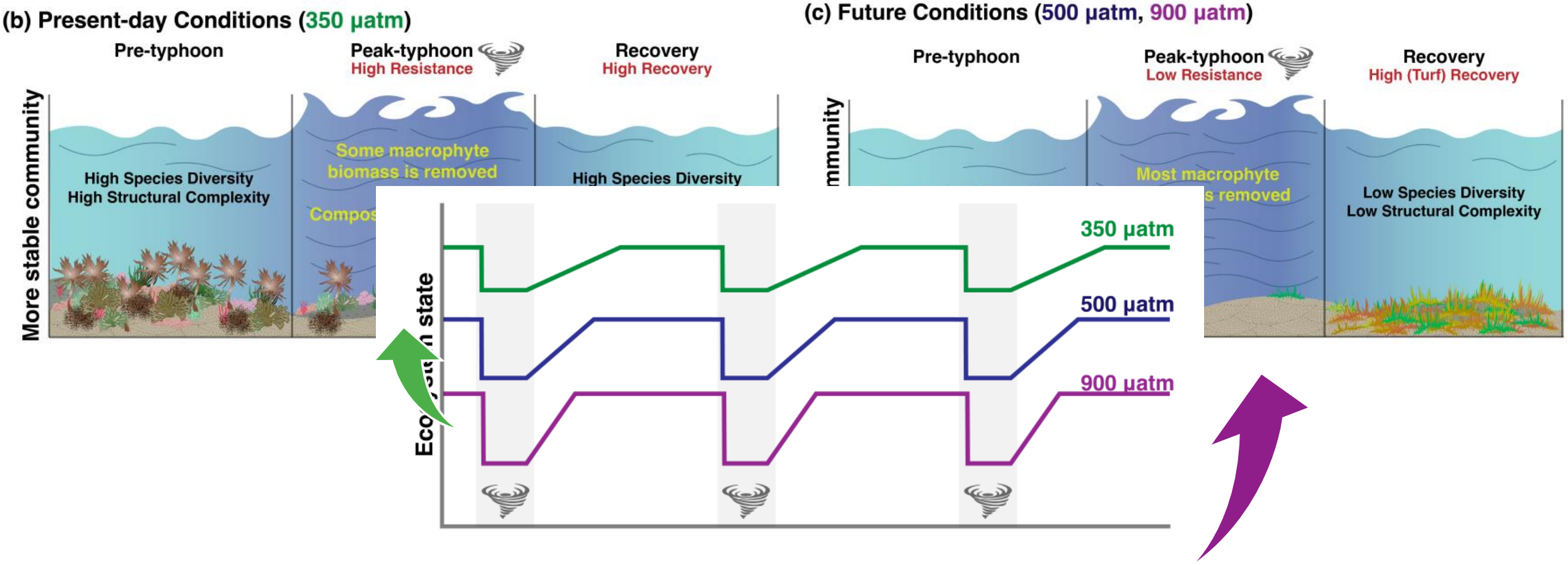


Start at and recover to lower baselines

Changes explained by community composition and responses of functional groups



Synthesis


(b) Present-day Conditions (350 µatm)
Pre-typhoon
Peak-typhoon
High Resistance
Recovery
High Recovery
More stable community
High Species Diversity
High Structural Complexity
Some macrophyte
biomass is removed
High Species Diversity
(c) Future Conditions (500 µatm, 900 µatm)
Pre-typhoon
Peak-typhoon
Low Resistance
Recovery
High (Turf) Recovery
Most macrophyte
Low Species Diversity
Low Structural Complexity
350 µatm
500 µatm
900 µatm

Thanks for listening !

callum.hudson@oist.jp

13TH INTERNATIONAL TEMPERATE REEFS SYMPOSIUM
HOBART, UNIVERSITY OF TASMANIA

UNIVERSITY OF PLYMOUTH

OIST
沖縄科学技術大学院大学

筑波大学
University of Tsukuba

SHIMODA MARINE RESEARCH CENTER SINCE 1933 UNIVERSITY OF TSUKUBA

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