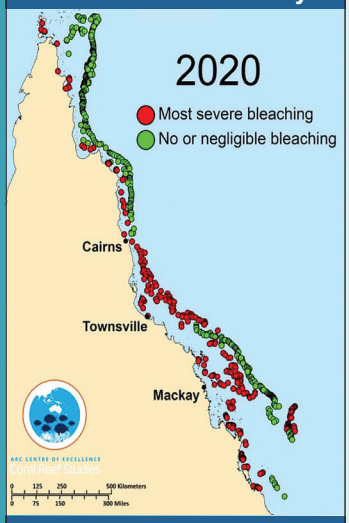
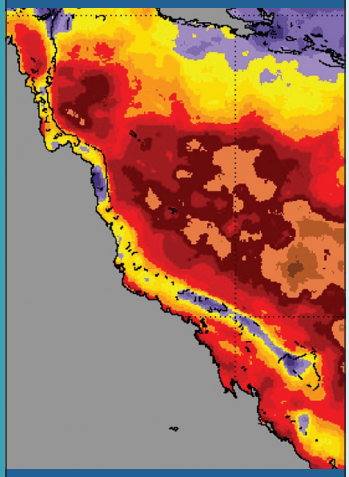
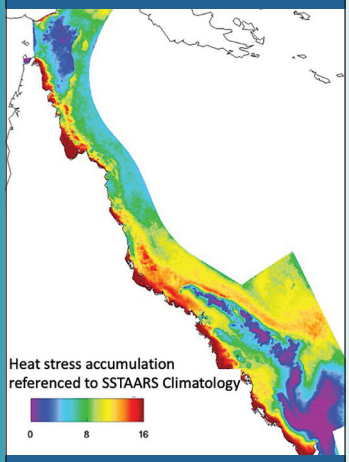
ARC CoE Aerial Survey



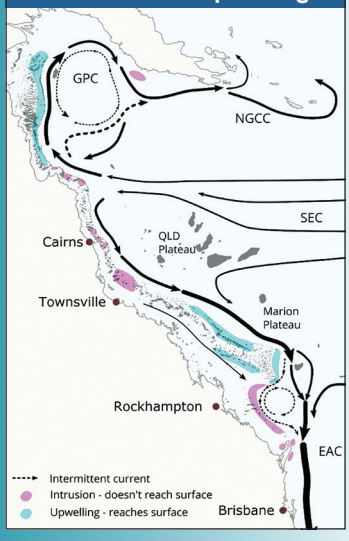
NOAA CRW DHW



eReefs 1km Model



Circulation & Upwelling



Outcomes Factsheet

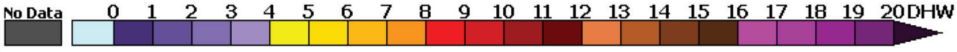
Project 4.2 Oceanographic drivers of bleaching in the GBR: from observations to prediction

The Great Barrier Reef (GBR) has just experienced the most widespread coral bleaching event, after being previously exposed to two successive bleaching events in 2016 and 2017. Earlier events were in 2002 and 1998.

By analysing and modelling past bleaching events scientists can now identify regions most at risk of bleaching and importantly those areas that are persistently cooler – regardless of the vagaries of weather associated with each bleaching event.

Aerial surveys conducted by the ARC Coral Reef Studies Centre of Excellence (left) reveal the bleaching occurred over the length of the GBR from central Torres Strait to Gladstone with coastal to mid-shelf waters being the worst affected, including the reefs offshore from Mackay. Outer edge reefs north of Cairns and the Pompey and Swains reefs offshore and southeast of Mackay were least affected. Offshore reefs north of Cairns and offshore from Mackay were least affected. *Source:* **https://www.coralcoe.org.au/media-releases/climate-change-triggers-great-barrier-reef-bleaching**

The NOAA Coral Reef Watch (CRW) Degree Heating Week (DHW) map is a satellite product derived from sea surface temperature measured as accumulated heat stress above a typical summer maximum temperature over a 3-month period of the recent 2019-20 summer. The DHW map shows the spatial variability of the patterns of heat stress correlates quite well with the aerially observed bleaching.



Source: **https://coralreefwatch.noaa.gov/product/5km/index_5km_dhw.php**

Satellite derived products (such as the DHW map) can be affected by cloud cover, which obscures the measurement of the ocean temperature. In order to tackle these issues, NESP TWQ Hub Project 4.2 has employed the 3-dimensional eReefs hydrodynamic model to predict the changes in temperature accumulation from the ocean surface to the seafloor, at a horizontal resolution of 1km. The model can run in a hindcast-forecast mode (like a weather forecast model) and simulates the daily warming of the reef waters, providing data every few minutes. This is an enhancement over satellite products that only provide a snapshot of the surface temperature at a coarser resolution, and at irregular times when they pass overhead.

A preliminary output from the eReefs model (map on left) reveals more detailed patterns of sea surface temperature that correlates with the aerial survey of bleaching response, including the widespread cool region off Cape York Peninsula and the eastern Torres Strait. The model can also estimate and map the heat stress experienced at the seafloor where corals may experience cooler waters.

Based on our understanding of the GBR circulation, the project has identified regions of persistent cold-water upwelling and intrusions (map, bottom left). Cool-water upwelling and intrusions are caused by the interaction of tidal and ocean currents (such as the East Australian Current) with reef and seafloor topography. The regions with identified upwelling correlate well with areas where there were observations of no bleaching. Upwelling and intrusions can often go hand-in-hand, and in the central GBR, temperature observations from IMOS underwater gliders, moorings and the eReefs model reveal the layer of warm surface water was confined to the upper 25-30m of the ocean, with much cooler water below. The outer shelf region between Cairns and Townsville did experience cool water intrusions at depth, however these intrusions had limited ability to provide widespread cooling of the surface waters.

Tropical Water Quality Hub
National Environmental Science Programme
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NOAA

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