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Assessing the potential for satellite image monitoring of seagrass thermal dynamics: for inter- and shallow sub-tidal seagrasses in the inshore Great Barrier Reef World Heritage Area, Australia

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ABSTRACT
Seagrass meadows are at increasing risk of thermal stress and recent work has shown that water temperature around seagrass meadows could be used as an indicator for seagrass condition. Satellite thermal data have not been linked to the thermal properties of seagrass meadows. This work assessed the covariation between 20 *in situ* average daily temperature logger measurement sites in tropical seagrass meadows and satellite derived daytime SST (sea surface temperature) from the daytime MODIS and Landsat sensors along the Great Barrier Reef coast in Australia. Statistically significant ($R^2 = 0.787–0.939$) positive covariations were found between *in situ* seagrass logger temperatures and MODIS SST temperature and Landsat sensor temperatures at all sites along the reef. The MODIS SST were consistently higher than *in situ* temperature at the majority of the sites, possibly due to the sensor's larger pixel size and location offset from field sites. Landsat thermal data were lower than field-measured SST, due to differences in measurement scales and times. When refined significantly and tested over larger areas, this approach could be used to monitor seagrass health over large (10^6 km^2) areas in a similar manner to using satellite SST for predicting thermal stress for corals.

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1. Introduction

Monitoring and managing seagrasses relies significantly on understanding their spatial and temporal dynamics in relation to environmental conditions. These conditions, including light availability and temperature, have been established as the main factors controlling seagrass health and extent, Figure 1 (Collier, Waycott, and McKenzie 2012; Petus et al. 2014; Campbell, McKenzie, and Kerville 2006; Collier et al. 2016). Seagrasses exhibit latitudinal gradients in spatial distribution in response to sea surface temperature (SST) gradients (McKenzie 2013), and seasonal variability in growth is strongly affected by SST (McKenzie 1994).

Seagrass meadows are at increasing risk of thermal stress from climate change, particularly those living at their thermal limits (Pedersen et al. 2016) and this will structure futures changes in seagrass distribution (Hendricks, Olsen, and Duarte 2017). Temperature extremes have already contributed to significant seagrass mortality (Thomson et al. 2015; Marba and Duarte 2010). Extensive measurements have shown species-specific thermal optima for seagrass species common in Australia,

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