Can spatial and temporal variation in solar radiation provide clues to managing bleaching stress in coral reefs?

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Background

Experiments have demonstrated that corals and reef-building organisms bleach more readily when exposed to high energy, short wavelength solar radiation (blue, violet and ultraviolet (UV) — 280-390 nm). In seawater, colored dissolved organic matter (CDOM) and dissolved UV-absorbing chromophores filter shorter wavelengths, which consequently bleach and degrade the GOM, allowing further penetration of UV. Alteration and destruction of watershed and coastal wetlands have reduced the natural sinks of CDOM that are usually filtered by these waters. We have measured absorption of UV and incident UV at two reefs in the Florida Keys that differ in distance from shore and in the degree of anthropogenic development versus intact mangrove habitat. While the adjacent shorelines have similar UV irradiances, the differences in the intensity of UV reaching the benthos was more variable and more intense at KL6m (developed shoreline, 0.215 – 0.444 W/m²) than at Algae Reef (mangrove shoreline, 0.113 – 0.215 W/m²). Concurrent differences in biotic response, including the prevalence and persistence of the UV-absorbing compounds, mycosporine-like amino acids, were also observed. Offshore-to-shore transects from mangrove (low UV) through a patch reef and reef margin, to deep (blue) water showed a steady decrease in absorption due to CDOM. These results can provide guidance to resource managers regarding management of CDOM sources to reefal waters, including preservation of shorelines and tidal wetlands.

Methods

1. Coral cover on patch reefs, along the Florida Reef Tract has declined, but remains higher than on offshore reefs.

2. Lesson on corals at Algae Reef heal more quickly than at KL 6 m.

Hypothesis

Colored Dissolved Organic Matter (CDOM) transported from intact shorelines protects corals on patch reefs from photic stress.

Visual examples of water transparencies

Results

Absorption and Irradiance

 Relative expression of UV-absorbing compounds

Conclusion: Photobleaching is a major cause of coral bleaching. Intact shorelines provide continuous sources of CDOM that can limit photobleaching stress, even during times of higher temperatures.  