

Accuracy of satellite SST measurements compared to in-situ SST measurements in the central Red Sea: implications for coral bleaching studies

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ABSTRACT

Sea surface temperature (SST) is one of the most important oceanographic parameters dictating life on Earth. Global climate change is causing dramatic rises in SST. Increased SST can cause massive bleaching and mortality in coral reefs, which are among the most productive ecosystems on the planet. Countless bleaching studies rely on SST from satellite measurements. We assessed the accuracy of those measurements to determine if they should be used in coral bleaching studies. A T-Test measuring the differences between in-situ measurements and satellite measurements from April 2015-April 2016 failed to detect a statistical difference. The hottest months, when bleaching is most severe, yielded a significant difference between the two sets of measurements, indicating that satellite SST measurements should be used sparingly in coral bleaching studies in the Red Sea.

INTRODUCTION

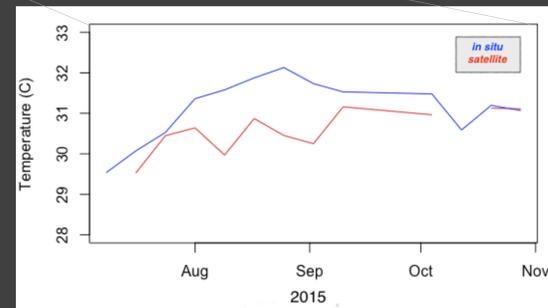
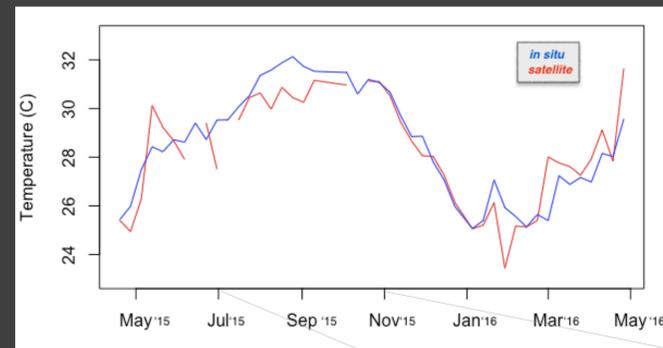
- Maintaining a specific temperature range is vital for the survival of nearly all living organisms.
- Coral reefs are among the most productive ecosystems on the planet. They are vitally important for countless species.
- When temperature increases, the symbiosis between coral and their symbiotic algae, which can supply 95% of their nutrients, breaks down.
- Temperature measurements can be measured from satellites or in-situ data loggers.
- Red Sea corals are adapted to uniquely warm conditions which may offer insight into the mechanism and physiology of coral bleaching.



METHODS

- In-situ data: Argo Profiling float #1900960
 - Deployed in central Red Sea off Jeddah, KSA during April 2015-April 2016
 - 8 day averages were calculated
- Satellite data: NOAA ERDAPP webpage
 - Downloaded 8 day composites
- All statistical analyses were conducted in Rstudio
 - T-Test and Mann-Whitney U Test

RESULTS



- Line plot from April 2015-April 2016 shows variation between in-situ (blue) measurements and satellite (red) measurements.
- Three times during study period that satellite data was unavailable
- No significant difference between data from whole year ($p=0.58$)
- Significant difference between data from July- October 2015, the hottest months when bleaching was the most severe

DISCUSSION

- Clear variation in data shows that there are differences between the two sets of measurements.
- Changes in temperature as low as one degree Celsius can trigger bleaching. These changes may have been undetected by T-Tests.
- All data was averaged, which may cause extreme warming data to be lost.
- Local temperatures can increase by several degrees on scales so small that the satellite cannot detect it.
- Cloud and dust cover over the Red Sea can impede the satellite measurements. Cloud cover is most common during the winter months. Dust cover over the Red Sea is most common during the summer months, when the measurements for bleaching studies are the most important.
- Satellite measurements are the most accurate in deep/ open water environments.
- Coral reefs occur in shallower water, but the shallow water and reefs themselves can impede the accuracy of satellite measurements.

CONCLUSIONS

- SST is among the most important metrics dictating life on this earth.
- Anthropogenic climate change is increasing SST and threatening the health and survival of coral reefs globally
- Important measurements of SST are vital.
- Satellite measurements are widely used in bleaching studies.
- In the Red Sea, due to dust cover and shallow reefs, satellite measurements should be used cautiously.
- In-situ temperature measurements should be used when possible in this region.

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