

**Satellite Analysis of Sea Surface Temperatures in the Florida Keys
to Monitor Coral Reef Health
NASA Stennis Space Center
Earthzine/DEVELOP Virtual Poster Session, Summer 2011
Video Transcript**

Slide 1

“Greetings from NASA’s Stennis Space Center here in southern Mississippi! My name is Jason Jones, and I want to say thank you for taking your time to watch the presentation by the Florida Keys Climate DEVELOP team.”

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“There are four students on the Florida Keys Climate Team here at Stennis. As I’ve already mentioned, my name is Jason Jones. I recently graduated from the University of Southern Mississippi with a Bachelor Science degree in geography with a minor in computer science. Amanda Billiot from Louisiana State University, a graduate student there studying meteorology is the project lead for this project. Amanda is not with us today, but we will be presenting on her behalf. She is presently at NASA headquarters presenting our research. Renane Burbank is at the University of West Florida as a graduate student studying earth and environmental science with a focus on education. And I will let Logan introduce himself. I’m Logan Schultz, and I’m a senior at Gulfport High School in Gulfport, Mississippi. Our advisors are Joseph Spruce from the Computer Science Corporation and Dr. Frank Muller-Karger from the University of South Florida’s Institute for Marine Remote Sensing.”

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“As you are probably already aware if you are viewing this presentation, each DEVELOP project is formed with the specific goal of addressing one or more community concerns and showing how NASA Earth Science and remote sensing datasets can be used to address these concerns and enhance decision support for various local, state, regional, and even national and international agencies. For this particular project we were concerned with the value of coral reefs to the Florida Keys and to Florida’s economy. According to a report led by Dr. Grace Johns with Hazen and Sawyer Environmental Consultants in association with Florida State University and the National Oceanic and Atmospheric Administration, the coral reefs annually produce nearly 4.4 billion dollars in local sales and almost 2 billion dollars in local income just from activities associated with the coral reef ecosystem. This encompasses a number of things – everything from ecotourism to fishing. So coral reefs are an extremely economic asset to Florida. Unfortunately, however, as climates are changing and as water temperatures vary over time, climate change could be negatively impacting these reefs. The reason for that is that rising sea surface temperature can cause coral bleaching, which is a condition in which zooxanthellae algae

that live in a symbiotic relationship with the coral basically turn loose from the corals. And if left in this condition long enough, the reef will die. In a three year period alone, the Florida Keys Marine Sanctuary lost roughly 38 percent of its coral cover.”

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“The Stennis Space Center DEVELOP team has been very fortunate in partnering with the National Oceanic and Atmospheric Administration’s Office of National Marine Sanctuaries as well as with the Institute for Marine Remote Sensing at the University of South Florida. Our goal for the project is to enhance the efforts that the Coral Reef Watch Program at NOAA is already conducting. Presently the Coral Reef Watch Program monitors sea surface temperature (SST) around the globe using 50 kilometer resolution AVHRR satellite data combined with *in situ* measurements of sea surface temperature. Our goal is to work with our partners to integrate NASA remote sensing measurements at a much higher spatial resolution and study local SST conditions in the Florida Keys. We’ve been very fortunate to work with Dr. Bill Kiene with NOAA’s Office of National Marine Sanctuaries as well as Scott Donahue, who is the science coordinator in the Florida Keys National Marine Sanctuary. We’ve also had the privilege of working with Dr. Billy Causey and Dr. Frank Muller-Karger as well as several other faculty at the Institute for Marine Remote Sensing.”

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“Before we begin our research and analysis, the first task was to define a study area. And we actually chose two different study areas for this project. The image you see on the left side of the screen represents an area that the Coral Reef Watch program has used previously. This is the outline of 11 50 km pixels that the Coral Reef Watch program has used to generate time series graphs of SST and look at annual means, maximum, and minimum SST values. And Scott Donahue had requested that DEVELOP program replicate this study using higher resolution MODIS and AVHRR data. The area on the right represents a study area that we created breaking the Florida Keys National Marine Sanctuary into a west and east study area, so that we could use zonal statistics to analyze multi-year time series trends of sea surface temperature. And now Logan is going to get into some of the methodology and explain what we actually did.”

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“We gathered from the two NASA missions and the NOAA mission that you see on the screen and imported into the software, like ENVI and ERDAS, to analyze the regional SST trends for the two study areas and compare each of the datasets against each other. And from those datasets we produced time series SST rasters, monthly mean rasters, and monthly anomaly maps of the SST to give an increased understanding of the effect of the trends in the Florida Keys and enhance the methodologies they use for monitoring SST.”

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“4 km MODIS and AVHRR data was pulled from the NASA Oceanographic Data Center with the tool called the Marine Geospatial Ecology toolbox developed at Duke University. The images were then subset to include the Gulf of Mexico Area and our study areas in the Florida Keys.”

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“We then processed the data with quality flags that are used to filter out bad data such as cloud values, land values, and pixels where there was no data recorded for that day. And then after we filtered that data, we put it into ArcMap and produced a single ArcGIS raster for each yearly, monthly, and daily image.”

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“We then took the monthly mean from the toolbox and subtracted them against the NOAA standard climatology given to us by the Institute for Marine Remote Sensing to produce monthly SST anomaly maps. The red areas are areas where the temperature increases by 3 degrees or more and the blue areas are areas where the temperature decreased by 3 degrees Celsius or more.”

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“AMSR-E data was acquired from the National Snow and Ice data center and imported into ENVI to export as an ArcGIS raster. When we analyzed the AMSR-E data, we found that the Keys were blocked by a NO DATA value. And this is because any data from AMSR-E is filtered through quality flags that mask out any pixels within 75 km of land.”

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“Here in the last couple of weeks in the DEVELOP summer term, since we’ve already completed the processing of the 4 km MODIS and AVHRR datasets, we have now begun experimenting with 1 km MODIS SST products from IMaRS. These are SeaDAS hdf files, and we have been using SeaDAS to manually open each image and export the data into an ASCII file, consisting of latitude, longitude, SST, and quality flag information. We’ve been using ERDAS Imagine to produce imagine files, in raster format, of the data. And we will be using ERDAS modeler to layerstack and process the quality flags for each of these images. Our goal is to produce zonal statistics for the study area, so that we can compare monthly and yearly means, maximum, and minimum SST values with 4 km data that we’ve already produced.”

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“This animation shows a time series of monthly SST mean values for the year 2005. Notice on the left center of the screen, the warm loop current during the winter months. As the months

progress into the summer, you can see the loop current is not as pronounced because the background water is warmer. Also notice that the entire Gulf of Mexico, including the area around the Florida Keys is beginning to warm up. Using this type of data we can monitor the SST trends on a very localized scale with the 4 km pixels. And we will be able to compare this against a benchmark NOAA climatology that measures what typical our standard conditions should be. This type of data is very useful for monitoring what the SST trends are doing over a long time period and can be used to enhance decision support for coral reef managers with NOAA's National Marine Sanctuaries program.”

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“These two graphs compare the MODIS and AVHRR data for the Florida Keys Marine Sanctuary. As you can see we have the max, the min, and the mean values from the data that we gathered for 2001 – 2009. We plan to go back to the 1980's with AVHRR to see if the trends you see in these graphs continue.”

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“One of the things that we wanted to do was compare the MODIS and AVHRR monthly mean SST values side-by-side to get a look at what the data looked like from each sensor to see if both sensors were telling us the same story. And here is an example from January 2001 using the nighttime sea surface temperature. We used the nighttime sea surface temperature in all of our measurements. And you can see that the patterns of SST on both datasets are the same. However you can notice that the MODIS image here on the left looks a little cleaner than the AVHRR data on the right. We would like to take a closer look into why this is the case, but our initial hunch is that it probably has to do with the quality flags and how the marine geospatial ecology toolbox processed the data in the time series. We will be taking a closer look at this during the last couple of weeks of the DEVELOP term.”

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“One of the most important things generated from the SST datasets that we produced are the coral reef SST anomaly maps. These are just a couple of examples from June 2003 and August 2005. As Logan discussed earlier in the presentation, we can compare each monthly mean against a NOAA benchmark climatology dataset to determine when temperatures are above typical and when temperatures are below the standard. Your red areas indicate warmer temperatures whereas the bluer areas indicate cooler temperatures. We chose these two particular months as a demonstration because these were particularly active for coral bleaching in the Florida Keys. Each of the little black X's that you see on the screen are point locations where coral reef bleaching was reported. So these types of datasets can be used to look back through time and also be used in the future to alert coral reef managers using high resolution data when temperatures are not standard and when coral bleaching could occur.”

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“So just to quickly recap before we conclude our presentation the MODIS data and the AVHRR SST information is very useful for studying SST trends. The MODIS data appears cleaner than the AVHRR data and the DEVELOP team will be investigating this further. After looking at the AMSR-E data and analyzing its effectiveness for coastal applications we have determined that AMSR-E is not feasible for this particular study because pixels within 75 km of the shoreline are masked out. One of the greatest uses of the project and the results that we generated are the SST anomaly maps and from several of the example that we looked at you can see that there are temperatures that are greater than the climatology standard.”

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“In the future we plan on doing a thorough statistical analysis of the trends that we saw in the data and change products that we need to change to further assess the trends in the Florida Keys. And this fall we plan on using ocean color data from SeaWiFS and MODIS to characterize chlorophyll concentrations in the Florida Keys Sanctuary as well as the Gray’s reef sanctuary and the Flower Garden Banks Sanctuary.”

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“This project would not be a big success without all of our partners especially the ones at the NOAA office of Marine Sanctuaries and IMaRS. We would also like to thank Dr. Jason Roberts from Duke University for his MGET tool and the support he provided us with. And especially our science advisors Dr. Kenton Ross and Mr. Joe Spruce that helped us with every question we had. And we would also like to thank Cheri Miller for her programmatic support as well.”

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“That concludes our presentation. If you have any questions or comments or would like to learn more about the research or about the DEVELOP Program I encourage you to contact Mrs. Brandie Mitchell or myself here at Stennis Space Center at the email addressed listed on the screen. Thank you again for your time. I hope you have a great day.”