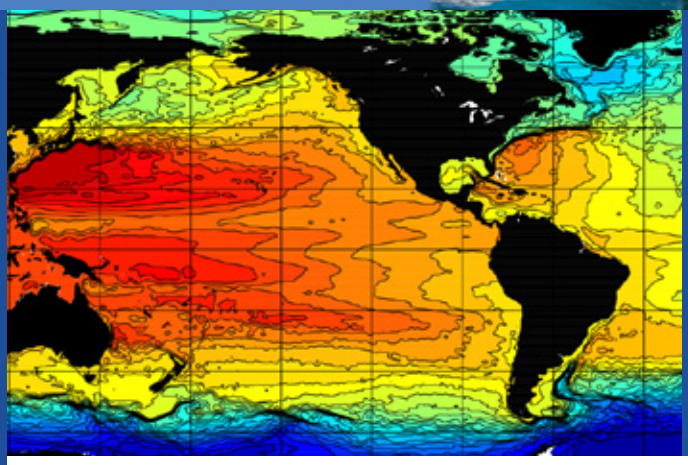
Center for Ocean-Atmospheric Prediction Studies

About COAPS

The Florida State University Center for Ocean-Atmospheric Prediction Studies performs interdisciplinary research in ocean-atmosphere-land-ice interaction to increase our understanding of the physical, social, and economic consequences of climate variability.

COAPS is located in Tallahassee's Innovation Park and has a staff of approximately 50, including teaching faculty, research scientists, and students from the fields of meteorology, physical oceanography, statistics, and the computer and information sciences.

COAPS is a NOAA Applied Research Center and is home to the Florida Climate Center (Office of the State Climatologist) and the Research Vessel Data Center. Sponsors include NASA, NOAA, NRL, NSF, ONR, the State of Florida, USDA, and the U.S. DOE.



Mean sea surface height as shown by a HYCOM model run.
Credit: Eric Chassignet.

Newsletter
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HYCOM: *The Next Generation Global Ocean Prediction System*

by Flavien Gouillon, Ph.D. Student, Oceanography

Oceans are crucial in shaping our weather, climate and environment. They also provide an important source of food and fun activities and thus are an essential component of our everyday lives. Yet, we do not fully understand them.

Through the years, measurements of the oceans taken from ships and satellites have helped to fill in some gaps in our understanding of oceanic processes, such as circulation, and properties, such as temperature and salinity, but these methods are often expensive and otherwise limited. Therefore, a new tool has been developed to better comprehend the oceanic state: numerical ocean models.

A numerical ocean model is a set of mathematical equations programmed into a computer which, when solved in a process called a model simulation run, describe the ocean circulation. At COAPS, much of our oceanic research is conducted using the HYbrid Coordinate Ocean Model (HYCOM; http://www.hycom.org). HYCOM is a complex tool that combines many of the features of other numerical models, and is better able to capture the essence of all oceanic dynamical processes.

HYCOM is being developed and tested by a large consortium of institutions, including COAPS, the Naval Research Laboratory, and NOAA. One of the primary goals for HYCOM is to depict and forecast the three-dimensional global ocean at a fine resolution (four to eight kilometers on the equator); it is also planned as the next generation operational global ocean nowcast/forecast system for the United States Naval Oceanographic Office.

Many oceanographic institutions around the world use HYCOM in combination with ship and satellite observations to increase our ability to simulate and comprehend oceanic processes, monitor the current ocean state and even predict its evolution. At COAPS, we use HYCOM to: simulate the global ocean circulation and tides; study the Mediterranean outflow and its influence on the Atlantic Ocean circulation; understand the representation of the internal wave dynamics; and understand the Arctic Ocean water masses properties and circulation.

While numerical ocean models such as HYCOM are now universally accepted as tools for research and education, they also have limitations: the mathematical methods used to resolve equations in the model simulations require some approximations, in addition to high performance computing resources. There is also a perpetual need to maintain, develop and test the models. The benefits, however, are well worth the effort, as HYCOM and other ocean models help the oceanography community to increase understanding and knowledge of our oceans.

Climate & Foodborne Illness

by Vasu Misra, Assistant Professor of Meteorology

COAPS has recently received funding to examine possible links between the waters of the Atlantic Warm Pool, which extend from the Gulf of Mexico to the Caribbean and the western tropical north Atlantic, and the occurrence of a foodborne illness called Ciguatera.

Ciguatera is caused by eating fish contaminated with a toxin found in many tropical microorganisms. There are an estimated 500,000 cases/year worldwide, and the impact is particularly severe among lower socio-economic groups, who are often dependent on local reef fish as a primary food source. The Caribbean region is especially endemic to Ciguatera.

Observations suggest that the incidence and symptoms of Ciguatera are worsening over time. COAPS will investigate whether changes in environmental conditions (especially sea surface temperatures) can lead to the modulation of *Gambierdiscus toxicus*, the microalgae implicated as the source for Ciguatera-associated toxins.

Wind Energy: *How Much Power Can Florida's Winds Provide?*

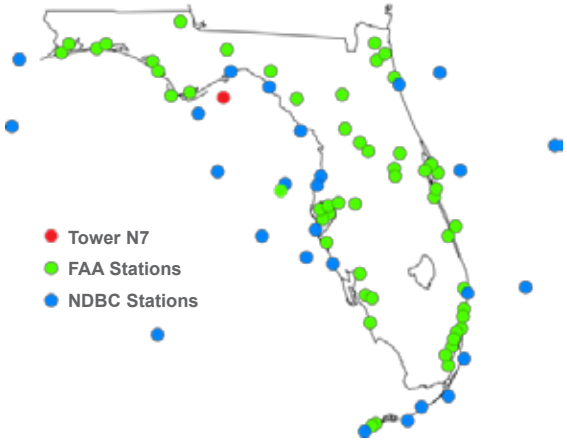
by Mark Powell, NOAA Scientist stationed at COAPS, Shawn Smith, Research Associate, and Steve Cocke, Associate Scholar Scientist

With all the discussion on the climate bill and a national renewable energy standard, all sources of clean renewables are on the table: wind, photovoltaic solar, solar thermal, biofuels, biomass, and ocean currents. The U.S. is a world leader in wind energy, but what about Florida? Do we have enough wind to support a new industry and the jobs and revenue that could come with it? COAPS scientists are launching a pilot study to examine offshore and coastal wind potential in our state.

According to previous research conducted by the Lawrence Berkeley National Laboratory and Navigant Consulting at the request of Florida's Public Service Commission, offshore wind has "large technical potential" in Florida, and certain sections off the northeast and northwest panhandle are economically sustainable. About 40,000 Megawatts (MW) of offshore power were identified, enough to power ~2.6 million homes and about four times the current installed capacity of wind energy in the U.S. Coastal wind (within 300 m of the coast) was also recognized as a marginally economically viable wind resource, with a potential power of 186 MW (~120,000 homes).

However, this study and similar research have largely been based on climate data from surface and upper air stations, and little information is known about offshore wind power and its dependence on mesoscale processes or the impact of coastal circulations, like sea and land breezes, on coastal wind power. A map of coastal and offshore Florida wind measurement stations by Melissa Griffin at COAPS suggests that we may have sufficient data to explore potential wind resources in further detail. In particular, tower N7 – instrumented by FSU as part of the Northern Gulf of Mexico Institute - is uniquely sited, and can collect wind measurements at a height similar to most standard offshore turbines.

Tower N7. Credit: Steve Morey.



Distribution of surface wind observing stations available from the Federal Aviation Administration (FAA, green), National Data Buoy Center (NDBC, blue), and the FSU instrumented tower N7 (red). Credit: Melissa Griffin.

In our pilot study supported by The Florida State University's Institute for Energy Systems, Economics, and Sustainability (IESES), we will examine the climate data to compute the annual wind resource and its seasonal variability at selected stations. We will compute the wind power density by summing the product of the air density and the cube of the hourly wind speed. The hourly wind speed is estimated at the turbine hub height so we will be using stability-dependent surface layer wind-height relationships that were developed by Prof. Mark Bourassa for the FSU marine flux program at COAPS. Once that is completed the next step will be to evaluate regional scale models to see how well they capture the wind climate at the station locations. If the pilot study shows potential based on selected stations, a full-scale study will be proposed.

Young Scholars Assist with Research for the Northern Gulf Institute

by Shawn Smith, Research Associate

This summer, three high school students taking part in Florida State's Young Scholars Program (YSP) worked with scientists at COAPS on a research project for the Northern Gulf Institute (NGI). YSP is a six-week residential science and math program for Florida high school juniors and seniors with significant potential for careers in the sciences, engineering, and health professions (http://bio.fsu.edu/ysp/).

The three YSP students - Yilin "Linda" Cao, Danielle Howard, and Janaki Perera - spent two days a week at COAPS, working with Shawn Smith, Steve Morey, Austin Todd, and Jacob Rettig to analyze meteorological and oceanographic data collected at NGI tower N7 in the northern Gulf of Mexico. The students identified differences between the meteorological sensors that could be attributed to the exposure of the instruments and blockage of the airflow around the tower from specific wind directions.

Using the best-exposed instruments, Janaki searched for evidence of a nocturnal increase in easterly winds over Apalachee Bay, a feature that has been observed by recreational fishermen in the region. Her preliminary results showed evidence of these nocturnal easterlies during the spring months.

Danielle and Linda collaborated to associate variations in the vertical structure of ocean water temperature and salinity at N7 with occurrences of strong winds.

In addition, the students identified an occurrence of increased fresh water in the upper ocean at N7 that may be associated with the propagation of flood water from the Suwannee River in late April 2009.

The students presented their research findings at the YSP poster session held on 22 July 2009 at Florida State's King Life Sciences Building.

NGI is a National Oceanic & Atmospheric Administration (NOAA) Cooperative Institute studying coastal hazards, climate change, water quality, ecosystem management, coastal wetlands and pollution in the northern Gulf of Mexico. Florida State is one of five academic institutions participating in the NGI consortium.

Preliminary analysis completed by the YSP students will support ongoing research by Austin Todd into the life cycle of the gag grouper. For more information on NGI research at COAPS, please visit http://coaps.fsu.edu/ngi/.

From left: Janaki Perera, Austin Todd, Linda Cao, Danielle Howard, and Shawn Smith.

Improving Crop Yield Forecasts

COAPS scientists Dong-Wook Shin, Young-Kwon Lim, Steve Cocke, Tim LaRow, and James O'Brien recently participated in a study assessing crop yield simulations using various seasonal climate data.

For the study, the scientists evaluated the sensitivity of a crop model to different seasonal climate data for maize and peanut yield simulations.

They found that dynamically and statistically downscaled climate data improved the crop yield simulations in comparison to the more commonly used El Niño Southern Oscillation (ENSO)-based historical data.

The scientists are now working to further improve crop yield predictions through the inclusion of more accurate rainfall data and the development of a coupled climate-crop model system.

Related article in Science and Technology Infusion Climate Bulletin: http://www.nws.noaa.gov/ost/climate/STIP/RServices/dshin_032509.htm.

Family Activity: Make Your Own Thermometer

Equipment:

- Tap water
- Rubbing alcohol
- Clear, narrow-necked plastic bottle (11 ounce water bottles work well)
- Food coloring
- Clear plastic drinking straw
- Modeling clay

Steps:

1. Pour equal parts of tap water and rubbing alcohol into the bottle, filling about 1/8 to a 1/4 of the bottle.
2. Add a couple of drops of food coloring and mix.
3. Put the straw in the bottle, but do not let the straw touch the bottom.
4. Use the modeling clay to seal the neck of the bottle, so the straw stays in place.
5. Now put the bottle someplace warm and watch what happens! The mixture expands when warmed, and is forced to rise up through the straw.

Source: Colorado State University Extension.

Student Spotlight: *Steve Guimond* (Ph.D. Student, Meteorology)

My research interests are in remote sensing and dynamics.

I began my studies at COAPS in the Fall of 2004 as a Masters student under the direction of Dr. Mark Bourassa. My thesis analyzed the influence of mid-latitude troughs on hurricane quantitative precipitation forecasting using satellite retrievals of rainfall. During my Masters, I spent two summers at the Naval Research Laboratory furthering my studies of remote sensing and hurricanes.

I am currently a PhD student under the direction of Drs. Paul Reasor and Mark Bourassa. My dissertation involves characterizing the latent heating field in hurricanes and understanding the role of deep convective clouds in intensity and structure change.

During the course of my PhD, I have spent time at NASA Goddard Space Flight Center and Los Alamos National Laboratory as a visiting scientist studying Doppler radar and numerical models. At Los Alamos, I am part of a project that hopes to improve the forecasting of hurricane intensification by using lightning observations from a new dual band array developed and deployed by team members from the lab.

Upon graduation (by mid-late 2010), I hope to become a scientist at one of the laboratories mentioned above with a strong connection to applied research.

Alumnus Spotlight: *Annette Samuelsen* (Ph.D./M.S. Oceanography, 2005/2000)

I work as an oceanographer at the Nansen Environmental and Remote Sensing Center (NERSC), which is a private research institute in Bergen, Norway. After I completed my Ph.D. at COAPS in the spring of 2005, I got a position as a postdoctoral scientist here, and I have been working here ever since.

My work consists of using and developing computer models for plankton in the ocean, which was also the topic of my dissertation at COAPS. The models we develop are used to learn about how ocean currents, temperature, and climate influence the growth and abundance of plankton in the ocean. This knowledge is one piece of the puzzle that we need to understand how climate influences the production of fish and other larger organisms.

I also help supervise some of the graduate students here; this is a lot of fun and I've learned a lot from it. Another exciting part of my work is going to international meetings and conferences. This winter, a group of us went to India, which was quite an exotic experience.

In my free time I practice yoga and go surfing on the weekends. Every spring a few of us organize a surf-weekend for the employees.

If you are an alumnus interested in sharing your experiences, please contact Meredith Field (mfield@coaps.fsu.edu).

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