Florida State University

Planning Grant: Climate modeling and outreach activities

PI: Shawn R. Smith
Co-PIs: Steve Cocke, David Zierden, James O'Brien, Julie Harrington

Students (name/degree sought): Cristina Collier / B.S. Meteorology (completed May 2010)

Description:
The objective of the planning grant is to develop at least one external funding proposal that focuses on areas of climate modeling and/or climate outreach that support the activities of the Institute for Energy Systems, Economics, and Sustainability (IESES). The focus of our activities has centered on evaluating the potential offshore wind resource in the northeastern Gulf of Mexico and elsewhere in Florida's waters. Preliminary research has been completed using observations from instrumented Air Force towers and buoys in the waters around Florida. The existence of wind power capacity has been identified at the assessed locations. Due to the sparseness of in-situ wind data in the region, a numerical modeling approach will need to be pursued to develop a wind climatology with sufficient spatial and temporal scales to further define the offshore wind power capacity. We have connected with members of the wind power industry in Florida and have had initial meetings with members of the Florida Legislature.

Budget: $15,000
Universities: FSU
External Collaborators: Mark Powell (National Oceanographic and Atmospheric Administration)

Progress Summary

We have completed a pilot study that examines the offshore climate data and computes the annual wind resource and its seasonal variability at a select sites. The study focused on (1) examining the differences in methods used to adjust winds from an observation height (30 m for examined locations) to a nominal hub height of 85 m, (2) computation of wind power density and wind power capacity at each location, and (3) assessing the suitability of one regional climate model's wind output for spatially expanding the wind power study beyond the few in-situ sites. The hourly wind speed must be estimated at the turbine hub height so we used three different adjustment methods, the power law, log law, and a stability-dependent surface boundary layer model developed by FSU professor Mark Bourassa (and colleagues). Preliminary results show the effects of atmospheric stability to reduce the wind at hub height by ~0.5 m/s as compared to values adjusted using the power law (in common use by engineering firms). Although the stability does reduce the wind at hub height, the results for two towers offshore of the Florida panhandle reveal wind power capacity factors between 25% and 31%. Background research by Dr. Mark Powell from NOAA's Atlantic Oceanographic and Marine Laboratory (currently stationed at COAPS) have shown that capacities over 20% have proven economically viable for land-based wind farms (higher capacity factors are expected to be necessary for offshore projects). Analysis of other buoys around Florida found capacity factors ranging from 31% off St. Augustine to ~27% in South Florida. By comparison, the capacity factor is ~40% in Nantucket Sound, the location of the recently approved Cape Wind offshore project. We note that the capacity factors are dependent upon the specific power curve for a given wind turbine. Our analysis was completed using the GE 3.6 MW turbine and one could expect different results for other turbines.

Results from the pilot study confirm the need for a high-quality wind climatology for the offshore regions of Florida. We have the necessary background research completed to initiate a full scale project, but we have yet to identify a potential funding source. Determining the viability of offshore wind power will target FESC and IESES goals to expand economic development in sustainable energy industry in Florida. The results will provide policy makers with essential information to determine which offshore regions are suitable for wind energy production.

We have been actively pursuing partners who may provide technical and/or financial resources to continue our research beyond the 31 December 2010 end date of the planning grant. We have opened a dialog with and submitted a white paper proposal to Siemens Wind Power in Orlando. We have an active partnership with Greenberg Traurig PA in Tallahassee, who have been instrumental in engaging COAPS in a dialog with members of the Florida Legislature.

Finally, we have conducted a number of outreach activities via workshop presentations, university seminars, the development of an offshore wind power fact sheet, and the initiation of a renewable energy web page at COAPS.

Following the FESC Summit, we will have reached the end of our planning grant resources. We will continue to seek a suitable federal or state funding opportunity to extend our research; however, to date no appropriate RFPs have been identified.

2010 Annual Report

Overview:

The project team has assessed available information regarding offshore wind power generation potential around Florida and in the Eastern Gulf of Mexico. 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.

Previous studies have largely been based on climate data from land-surface and upper air meteorological observations, and little information is known about offshore wind power and its dependence on mesoscale processes or the impact of coastal circulations (e.g., sea and land breezes). Taking advantage of COAPS expertise in marine climatology and our access to a number of offshore observing sites, we conducted a pilot study to assess the potential for wind power on the shallow West Florida Continental Shelf and at other sites surrounding Florida. One key data source was Air Force tower N7 – with a suite of weather instrumentation deployed by FSU as part of the Northern Gulf of Mexico Institute – which collects wind measurements at a height closer to most standard offshore turbines heights than most surface moorings (thus reducing errors in corrections to turbine hub heights).

Progress:

Florida's offshore wind resource

We have completed a pilot study that examines the offshore climate data and computes the annual wind resource and its seasonal variability at a select sites. The study focused on (1) examining the differences in methods used to adjust winds from an observation height (30 m for examined locations) to a nominal hub height of 85 m, (2) computation of wind power density and wind power capacity at each location, and (3) assessing the suitability of one regional climate model's wind output for spatially expanding the wind

power study beyond the few in-situ sites. The hourly wind speed must be estimated at the turbine hub height so we used three different adjustment methods, the power law, log law, and a stability-dependent surface boundary layer model developed by FSU professor Mark Bourassa (and colleagues). Preliminary results show the effects of atmospheric stability to reduce the wind at hub height by ~0.5 m/s as compared to values adjusted using the power law (in common use by engineering firms). Although the stability does reduce the wind at hub height, the results for two towers offshore of the Florida panhandle reveal wind power capacity factors between 25% and 31%. Background research by Dr. Mark Powell from NOAA's Atlantic Oceanographic and Marine Laboratory (currently stationed at COAPS) have shown that capacities over 20% have proven economically viable for land-based wind farms (higher capacity factors are expected to be necessary for offshore projects). Analysis of other buoys around Florida found capacity factors ranging from 31% off St. Augustine to ~27% in South Florida. By comparison, the capacity factor is ~40% in Nantucket Sound, the location of the recently approved Cape Wind offshore project. We note that the capacity factors are dependent upon the specific power curve for a given wind turbine. Our analysis was completed using the GE 3.6 MW turbine and one could expect different results for other turbines.

Understanding the wind resource requires examination of the temporal variation in the winds on daily and seasonal scales. Initial evaluation for the Northeastern Gulf of Mexico show strongest winds in the winter (with an peak in October) and a minimum in the summer months. Understanding and being able to forecast wind variations on daily to seasonal time scales will support load balancing across the power network. Further examination of the economics of offshore wind power generation in Florida are needed and are beyond the scope of the planning grant.

Finally, the future development of high-spatial and temporal resolution wind resource maps for Florida's waters will require the application of numerical weather models. An assessment of the offshore wind using the North American Regional Reanalysis (a numerical weather prediction model) revealed the model winds to be wholly inadequate for assessing wind power resources. When compared to the tower observations in the northern Gulf of Mexico, the model winds lack any indication of the seasonal wind variability that exists in the in-situ data. Any future wind resource map development would require employing a modern meso-scale numerical model combined with available in-situ and remotely-sensed (e.g., satellite) wind observations.

Results from the pilot study confirm the need for a high-quality wind climatology for the offshore regions of Florida. We have the necessary background research completed to initiate a full scale project, but we have yet to identify a potential funding source. Determining the viability of offshore wind power will target FESC and IESES goals to expand economic development in sustainable energy industry in Florida. The results will provide policy makers with essential information to determine which offshore regions are suitable for wind energy production.

Collaborations

In June 2010, we opened a dialog with Siemens Wind Power in Orlando, Florida. Through a series of emails and a teleconference, the Siemens personnel provided COAPS with valuable insight into the needs of the wind power industry to further expand offshore development. In August, COAPS submitted a white paper to propose a formal partnership with Siemens, whereby COAPS would develop products for the Florida wind power industry. The proposal is still under review at Siemens.

Over the past year, we have established a working relationship with Greenberg Traurig PA through their offices based in Tallahassee. Our contacts at GT Law are very interested in expanding the offshore wind industry within Florida. They have provided opportunities for COAPS scientist to meet with Florida

policy makers and have been a key resource for information on upcoming meetings and events sponsored by the wind power industry.

Outreach

The members of the COAPS offshore wind research team have conducted extensive outreach activities to educate policy makers and the public and research communities to the potential of this renewable resource. These activities include

May 2010 – C. Collier presented her preliminary research into the offshore wind power potential in the Northeastern Gulf of Mexico at the 2010 annual meeting of the NOAA Northern Gulf of Mexico Institute. The poster presented was titled *Wind Power Potential in the Northern Gulf*.

July 2010 – Dr. Mark Powell conducted a seminar at the NOAA Atlantic Oceanographic and Meteorological Laboratory titled *Offshore Wind Energy: Prospects for Florida and the Gulf of Mexico.* The seminar was attended by scientist considering NOAA's role in alternative energy research.

July 2010 – Mr. Smith and Dr. Bourassa from COAPS were invited to meet with Senator M. Bennett and Rep. S. Precourt from the Florida Legislature to brief them on COAPS offshore wind research. This was the start of an effort to educate Florida policy makers that offshore wind power has potential as a component of a renewable energy portfolio. A two-page brief discussing offshore wind power in Florida was prepared and is available at http://coaps.fsu.edu/docs/offshorewindenergyfactsheet.pdf.

August 2010 – COAPS developed and deployed an Alternative Energy web page highlighting our ongoing offshore wind and ocean current (separate funding source) power studies. See http://coaps.fsu.edu/energy.php.

September 2010 – Dr. Mark Powell conducted a seminar in the Department of Earth, Ocean, and Atmospheric Science at FSU titled *Offshore Wind Energy: Prospects for Florida and the Gulf of Mexico.* The seminar was attended by a wide range of student, faculty members, and members of the Tallahassee private sector. The presentation is available at http://coaps.fsu.edu/docs/news/201009powell.pdf.

September 2010 – C. Collier and Mr. Smith will attend the 2010 FESC Summit. Ms. Collier will present a poster summarizing the findings of the COAPS offshore wind energy team.