FLORIDA STATE UNIVERSITY

Planning Grant: Climate Modeling and Outreach Activities

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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. Preliminary research has been completed using observations from instrumented Air Force towers and confirms the existence of wind power capacity 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 seek interested collaborators from academia, industry, and government.

Budget: $15,000

Universities: FSU

External Collaborators: Mark Powell (National Oceanographic and Atmospheric Administation)

Progress Summary

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. One key data source was 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:
In Fall 2009, we initiated a pilot study that to examine the offshore climate data to compute 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 capacities 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 other wind farms. Finally, assessing 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. The model lacks any indication of the seasonal wind variability that exists in the in-situ data for the region studied.

Results from the pilot study confirm the need for a high-quality wind climatology for the offshore regions of Florida. A full proposal is under development. 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.