Gulf of Mexico's Offshore Oil Platform Wind Potential

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ES212 - INTRODUCTION TO GIS

Introduction

There are over 6000 natural resource drilling platforms in the Gulf of Mexico, all of which will become obsolete once their deposits are extracted. The goal of this study was to examine one of the possible alternate uses for these platforms, wind power potential. Specifically, the study examined how many existing platforms were situated in shallow enough water to all for expansion wind farms using the platform as the base site.

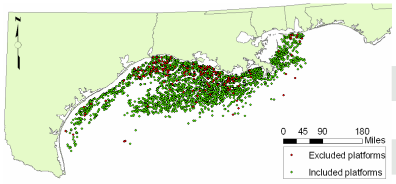


Figure 1: A map of the Gulf of Mexico showing the location of all 6357 oil platforms in the Minerals Management Database system. Useable locations were selected based on the presence of a platform complex identification number in the platforms GIS layer that matched the MMD master platform database list.

Methods

The GIS layer of platform locations in the Gulf of Mexico was downloaded from Minerals Management Service's (MMS) database. Tabular data (master platform list) was downloaded and sorted using Microsoft Excel. The table was then joined to the platforms layer as a .dbf file using the oil rig's unique complex identification number assigned by the MMS. Platforms that did not have a complex identification number that matched the master platform list were excluded from the analysis (Figure 1). Platforms were then selected from the remaining group based on the water depth they were situated in (Figure 5). Fifty meters is typically considered the maximum efficient depth for installation of wind towers. Platforms were then sorted into groups based on their distance in miles from the nearest offshore National Data Buoy Center (NDBC) buoy (Figure 6). In order to maintain the accuracy of the buoy data, platforms greater then 20 miles from the buoys were dropped from the analysis. Wind speed data was taken from selected offshore NDBC buoys (Figure 2). A hypothetical wind speed map based on the 45 day search and rescue average (from dates March 5, 2005 through April 20, 2005) was calculated from the center of each buoy using inverse distance weighting (Figure 3). This wind speed map was then converted to show what percent of the maximum useable turbine wind speed was occurring throughout the Gulf (Figure 4). Figure 4 was then combined with the platform distances from the NDBC buoys to produce a final map (Figure 7) of the optimal existing platform locations in the Gulf of Mexico. Analysis was done using ArcGIS and elements of ArcInfo and ArcToolbox.

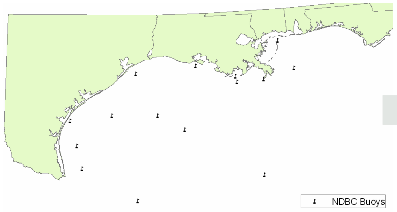


Figure 2: Locations of the NDBC buoys used to create the surface winds map.

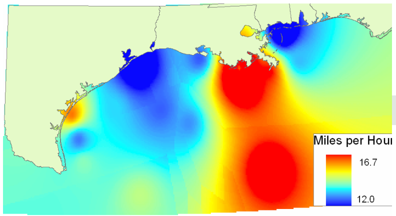


Figure 3: Average hypothetical wind speeds from March 5, 2005 through April 20, 2005 in the Gulf of Mexico. Bulls-eye distribution is a result of the IDW calculation process, which assumed maximum wind speed at the buoy and that wind decrease as measurements proceed away from the buoy in any direction.

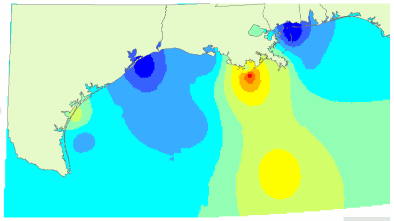
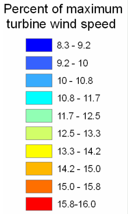


Figure 4: Regional wind speeds as a percent of the maximum operational wind speed in the Gulf of Mexico. Data from Figure 3 was reclassified to produce an easier to understand map of the existing wind potential rather then simply represent the speeds.



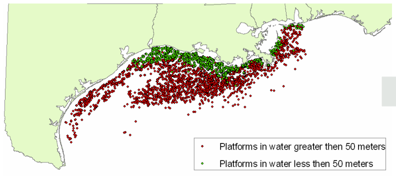


Figure 5: Locations of platforms in less then 50 meters of water, which was determined to be the current maximum economically viable wind tower water depth.

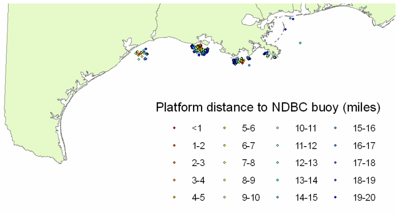


Figure 6: Platforms located within a 20 mile euclidian distance of a NDBC buoy. 20 miles was chosen arbitrarily to minimize the amount of data misrepresentation that might occur when this map was projected over the operational wind speed (percent) map.

Discussion

The Gulf of Mexico's wind conditions are more then adequate to power turbines using existing platforms as the base location to situate the turbines while providing the ability for expansion of wind farms around the platform as necessary. Out of the original 6357 platforms 2760 were located in depths of 50 meters or less. By limiting the results to platforms located within 20 miles of at least one buoy the data points were reduced to 912 possible platforms. The distribution of these platforms can be seen in Figure 8. The platforms were selected based on the available wind data which provided an excellent base map, but by no means are the platforms presented in Figure 7 the only potential wind power sites in the Gulf of Mexico. They are simply the best locations given the wind data for the sample period. The significant finding of Figure 7 is that is the coast of Louisiana is an optimal location for placement of wind power utilizing the existing platforms. 341 of the 912 potential sites are located in this region, which is projected to return average wind speeds that are greater then 14% of the maximum useable speeds. Lower wind speeds off the coast of eastern Texas may be a result of the Yucatan peninsula, just as the higher wind speeds extending down from Louisiana may be a result of wing getting funneled between the Yucatan and Cuba.

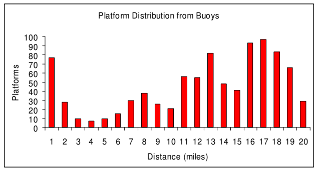


Figure 8: Graphic distribution of platform distances in Figure 7

Data Sources

Nation Data Buoy Center (http://www.ndbc.noaa.gov/)
Minerals Management Service (http://www.gomr.mms.gov/index.html)
Latitude Conversion Calculator (http://www.fcc.gov/fcc-bin/convertDMS)
US Geological Service (http://pubs.usgs.gov/of/of00-019/htmldocs/data.htm)

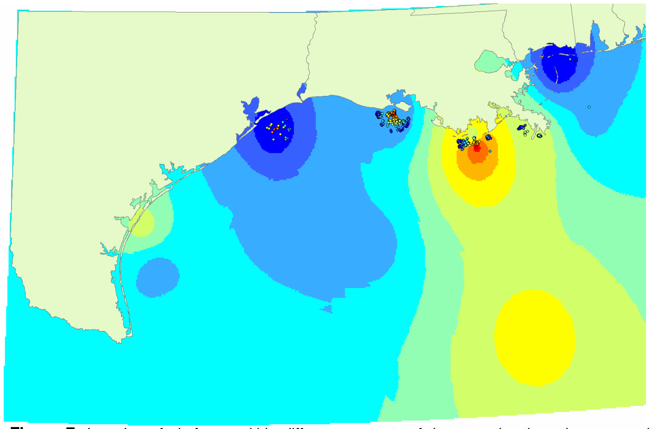


Figure 7: Location of platforms within different percents of the operational maximum speed (legend from Figure 4). To reflect the accuracy of specific platforms locations in comparison to its projected wind speed the same legend from Figure 6 may be used. Warmer colors in the wind map indicate higher operational wind percent. Warmer colors in the platform map indicate a higher degree of certainty that the platform will receive the projected wind speeds.