Gulf of Mexico Cable Prioritization

Study Area

Offshore wind farms development in the Gulf of Mexico requires laying cable to onshore infrastructure to connect to the power grid. For the interested offshore wind energy area (WEA I), the cable will connect to the power grid in Texas. In order to identify options for the cable pathway, the analysis created a boundary box for the study area using the following limits: 94°W 30°N (northeastern), 94°W 28°N (southeastern), 95.5°W 28°N (southwestern), and 95.5°W 30°N (northwestern). As the analysis focused on the offshore pathway, it removed all land areas from the study area. These land areas came from the Global Islands dataset as generated by Sayre et al. 2018. The dataset contains four land datasets: continents, big islands, small islands, and very small islands. All of these land masses were removed from the boundary box polygon to generate a study area of coastal waters. A raster with 100-meter cells was generated from the coastal study area polygon with cells having values of zero. To maintain consistency with the Bureau of Energy Management Wind Energy Areas data, all data were projected into NAD83 / Conus Albers (EPSG:5070).

Data Components

All data were given a coordinate reference system of NAD83 / Conus Albers (EPSG:5070) to ensure they could be layered together and analyzed. Data for constraints and suitability analyses were limited to the boundary of the study area. For constraints data, a value field was added and given a value of 0. When a layer had multiple datasets, those datasets were combined; then the combined datasets were flattened so any overlapping features did not result in producing double cost values.

Seagrass

To create a constraints layer for seagrass, the analysis compiled data from five different sources. Texas Parks and Wildlife Department compiles seagrass data across the state. While it has a 2012 state level dataset, the department also provides a 2015 dataset for Christmas and West Bays as well as data from a 2012 NOAA study. NOAA has an additional seagrass dataset for the United States and its territories. The fifth seagrass area came from a gulfwide survey.

Oyster

Texas Parks and Wildlife Department provided five surveys on oysters in its state waters. Two surveys have data that fall within the study area (Galveston Bay – 2004 - 2015, West Galveston Bay), while Capano Bay, Espiritu Santo, and Lavaca Tres Palacios surveys reside outside the survey area. Texas Parks and Wildlife Department maintains an oyster restoration site dataset. Aside from the oyster restoration site dataset, it maintains a dataset of private oyster lease areas. The data are viewable on the Texas HHS Shellfish ArcMap page. In 2011, the United States Geological Survey produced data for oysters in the Gulf of Mexico. The Gulf of Mexico Atlas hosts the same Eastern oyster dataset along with a separate download option for only Texas oysters. An oyster data layer called Powell 1995 did not have source details provided, but they appear to be similar to the oyster data

under the sensitive areas group layer on the Texas GLO Coastal Resource Map viewer; while one can view the data there is no functionality to download the data, as of 27 October 2022. Texas Parks and Wildlife Department had to share the data given they were not publicly available. The analysis included two datasets (Lavaca oysters harper [2002] and NOAA Atlas [2007]) whose sources are unknown; no data from those two datasets were located in the study area. Another dataset that did not have a source was on oyster leases. None of the Texas areas fell within the study area.

Bathymetry

Bathymetry data for the study area came from a NOAA dataset that covered the western Gulf of Mexico. According to metadata, the coordinate reference system was EPSG:4269, so the data projected to EPSG:5070 before being constrained to only the study area. These constrained data then produced the slope dataset using the terrain function within the raster R package. The terrain function used all 8 neighbor cells for any location to provide a slope output in degree values. A linear function normalized the bathymetry data so the shallowest depth received a value of 0 while the deepest depth received a score of 1. Slope has normalized based on the s-shaped membership function. As slope increases, the new score would go from 0 to 1.

Vessel Traffic

Due to the COVID-19 pandemic, data from 2019 provided the last annual dataset that had more ordinary and expected vessel traffic. Vessel transit counts for 2019 provided a finer use resolution than the track data. These transit counts were for six types of vessels: cargo, fishing, passenger, pleasure craft and sailing, tanker, and tug and tow. Only the track data contained the transit information for "Other" vessels. A specialized tool for ArcGIS Pro created the "Other" vessel traffic into comparable vessel transit count data. All vessel traffic were normalized using the s-shaped membership function so values were between 0 and 1; a zero was given to the smallest amount of vessel traffic and scaled to 1 as vessel traffic increased.

Shipping Lanes

NOAA Electronic Navigational Chart detailed shipping lanes with federal waters. Texas Railroad Commission contained shipping channels for state waters. All the data were separated by county. Five counties intersected with the study area: Brazoria, Chambers, Galveston, Harris, and Jefferson. These five counties had their shipping channels combined into a single layer. Federal shipping lanes and Texas shipping channel data expanded with a 500-meter setback.

Conservation Areas

Three separate datasets comprised the final conservation areas constraints layer. Texas Parks and Wildlife Department provided boundaries for wildlife management areas and state parks. The third dataset detailed United States Fish and Wildlife Service's national realty boundaries.

Lightering Zones

MarineCadastre housed the lightering zone data used as a constraint layer.

Sediment

Artificial Reefs

Texas Parks and Wildlife hosted the artificial reef data. Any observations with NA values were removed. The coordinate system seemed to be in WGS84 (EPSG:4326) given the field names for longitude and latitude in the CSV. A "Read Me" document stated that the data are in decimal degrees and in Web Mercator (EPSG:3857). After reprojecting to match all other data, a setback distance of 304.8 meters (1000 feet) was applied.

Fish Havens and other Obstruction Areas

The analysis extracted fish haven and other obstruction area data from NOAA's Electronic Navigational Chart. These were the "Coastal Obstruction area" data within the DangersA category within "Extract Coastal." While originally the data aimed to designate fish haven areas, the acquired data contained areas without an obstruction category description. All obstruction areas were included regardless of category. All areas were extended by 152 meters (500 feet) due to the setback.

Unexploded Ordnances

Unexploded ordnance data came as points and areas. Points received a setback distance of 500 meters before being combined with the area data.

Active Oil and Gas Leases

The Bureau of Ocean Energy Management kept the records of active oil and gas lease areas.

BOEM Lease Blocks with Significant Sediment Resources

Lease blocks with significant sediment resources were identified by the Bureau of Ocean Energy Management.

Oil and Gas Boreholes, Test Wells, and Wells

Borehole data were obtained by running a query for all data from the Bureau of Ocean Energy Management's database. According to the bureau, the Gulf of Mexico coordinate values were derived from North American Datum (NAD) 1927. The dataset contained twelve status codes. Boreholes with three codes were excluded as the boreholes were interrupted for one reason or another: cancellation (CNL), abandoned (PA), or side tracked (ST). For remaining boreholes, a setback of 60.96 meters (200 feet) was created.

BOEM No Activity Zones

From the shared non-public topographic features dataset, only areas designated as "no activity zones" were included in the analysis.

Anchorage Areas

Anchorage areas used in the analysis were downloaded from MarineCadastre.

Oil and Gas Drilling Platforms

Oil and gas drilling platform data came from running a query of platform locations kept by the Bureau of Safety and Environmental Enforcement. Other platform data are hosted on the BSEE webpage; while it contains more observations than the query dataset, it is older (October 3 2022 compared to October 27 2022 at last check), they both produce the same number of platforms in the study area. The unique codes of each dataset for the 31 platforms are the same. Thus, the analysis selected the more recently updated dataset. Any platforms without an install date and lack a removal date were removed, given the assumption that they no longer exist. If the assumption is wrong, it is more likely that a platform exists still despite the removal date than existing lacking an installation date. All remaining platforms had a setback distance of 152.4 meters (500 feet) applied to its location.

Submarine Cables

The constraints layer included three datasets on submarine cables. MarineCadastre hosted two publicly available datasets on submarine cable areas and another that had the submarine cable paths. The analysis filtered submarine cable areas for only ones designated operational for they, more than others, could impact the wind farm cable installation and maintenance. Submarine cable areas have an inactive status, but no areas within the study area had those designations. Any area with an NA designation, the only other option in the study area, were excluded due to the fact that no verification process could occur to determine how the area could affect the cable routing given they mostly lacked any other data. A third cable layer came confidentially. It detailed additional cable paths, often privately held and operated. All submarine cable paths and areas received a setback distance of 152.4 meters.

Aids to Navigation

MarineCadastre hosted the locations for the aids to navigation. All locations were given a 500 meter setback distance.

Environmental Sensors

The National Data Buoy Center exported its environmental sensor network as a KML file. Given to the structure of the data, R and QGIS could not read the data. Esri software converted the NDBC environmental sensor data into a more usable format. The Gulf of Mexico Coastal Ocean Observing System maintains records of federal and regional assets. These assets were restricted to only ones with an "active" status. All duplicated assets were further removed; assets could be duplicated as some sensors could record multiple data types. No regional assets were located in the study area. A third source for environmental sensor data came from the United States Integrated Ocean Observing System program. These data came from the most recent raw asset inventory, which was 2020 - 2021. Only records with longitude and latitude values and a "currently operational" status were kept. No IOOS buoys in the study area had a status of not operational (N), offline (O), nor unknown (U). The combined data of the three datasets received a 500 meter setback.

Pipelines

The Bureau of Ocean Management pipeline data used in the analysis was the one that already existed in a spatial format. A separate query based system exists that can reconstruct the data, but the query generated an error when trying to download the data in a single batch. Given that the offshore site prioritization examined only active oil and gas pipelines, the analysis filtered for pipelines that had a production code indicating oil and gas and a status code suggesting active pipelines. This detailed the field definitions used for the inclusion aspect. A 500-meter setback was added to all active oil and gas pipelines.

Constraints layer

Suitability layers

Software and packages

All data cleaning and analyses were performed using the R programming software (version X.X.X, R Core Team XXXX). Especially important R packages used include: fasterize (), ncdf4 (), raster (), sf (), tidyverse (),

Script Availability

The codes that support the analysis are available on GitHub.

Data Availability

The data that the scripts incorporate have been hosted on GitHub when possible. The entire data can be accessed and downloaded from this Google Drive directory.

Known Limitations

The seagrass and oyster datasets in the analysis geopackage will not open in ESRI software. To view and work with those data, open them in QGIS and then export as separate shapefiles.