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Should Wind Resource Assessments in the Gulf of Mexico be done with Floating or Scanning Lidar?

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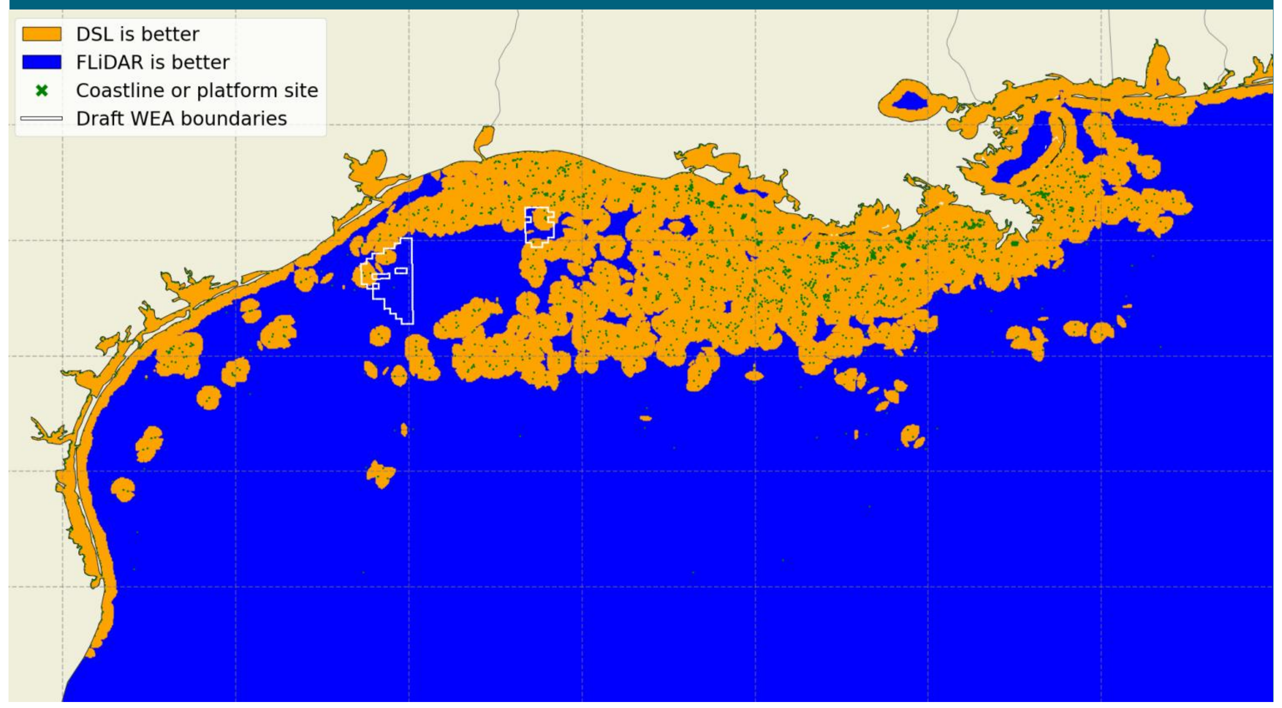
Map showing which lidar to use for an offshore WRA in the Gulf of Mexico ↓



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Summary

The Gulf of Mexico has been identified by the US government as a key area of expansion for offshore wind power. The high concentration of platforms from the oil and gas industry in the Gulf allows dual scanning lidars to be used for the wind resource assessments of these prospective wind farms, in addition to the now commonly used floating lidar. A theoretical model of the uncertainty of dual scanning lidar measurements, combined with coastline and platform data is used to create a map of dual scanning lidar uncertainty across the Gulf of Mexico. This is compared to the uncertainty of a stage 2 floating lidar to provide information on where each type of instrument is preferable to be used for an offshore WRA

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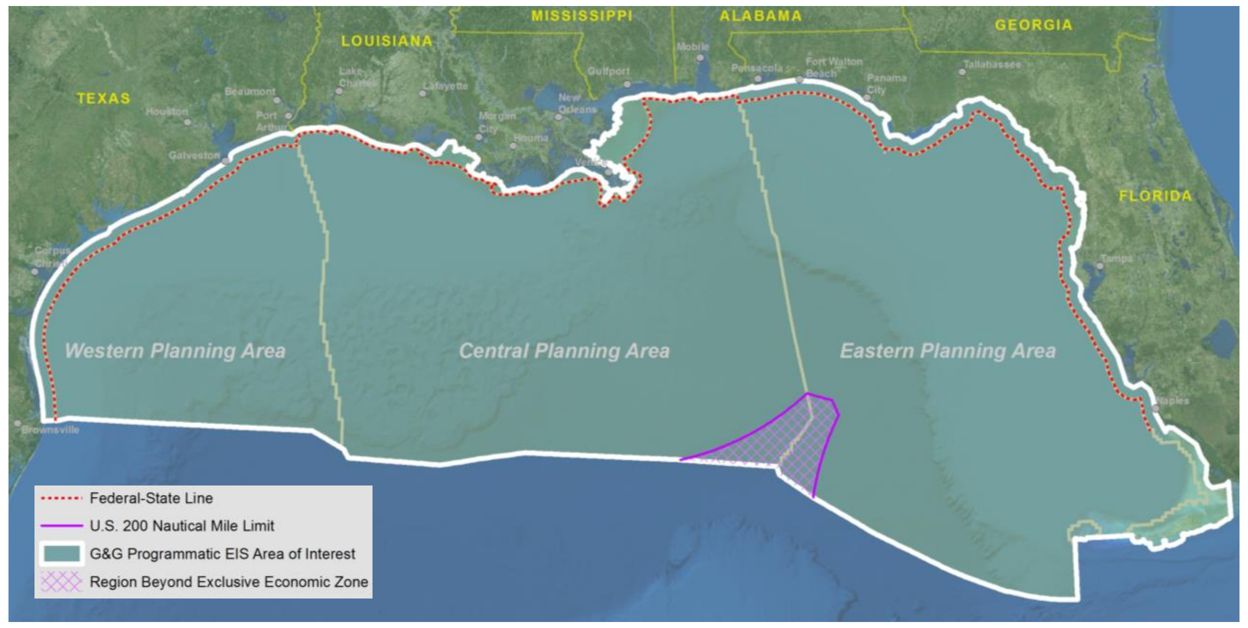
Why the Gulf of Mexico?

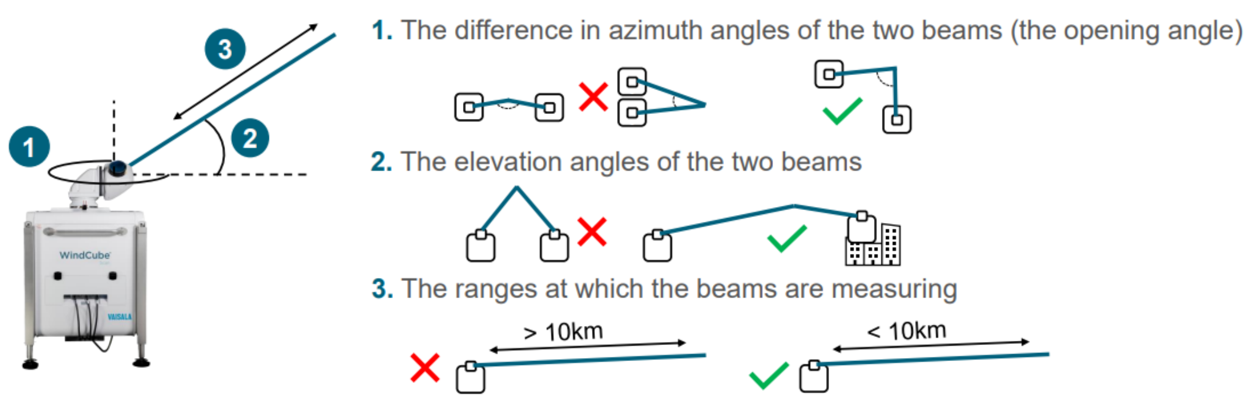
The U.S. government has the committed to the expansion of offshore wind power, intending to develop some 30 GWs before 2030. The department of the interior has stated that a key area of development will be the gulf of Mexico [1]. Indeed, a 30-million-acre area call area [2] has been set within the gulf within which the Bureau of Ocean Energy Management has identified two draft wind energy areas (WEAs) totaling more than 700,000 acres, with the capacity to power over 3 million homes.



While floating lidars have become standard for the non-near-shore offshore wind resource assessment (WRA), the Gulf of Mexico's previous status as an energy hub for the oil and gas industry presents a unique opportunity to place dual scanning lidars (DSLs) on existing offshore platforms. This allows for the high precision and cost-effectiveness of DSL to be exploited beyond the limit of their range from the coast.

Dual scanning lidar geometry and uncertainty

The uncertainty of a dual scanning lidar measurement depends on the geometry between the beams of the two lidars. The key geometric factors that affect the measurement uncertainty are summarized below:



How dual scanning lidar siting was assessed

Vaisala has developed a theoretical model of dual scanning lidar measurement uncertainty, taking into account the three main sources of error:

- The base uncertainty of the individual scanning lidars
- Assumptions made when reconstructing the horizontal wind speed
- Measuring the wrong part of the shear profile due to pointing inaccuracy

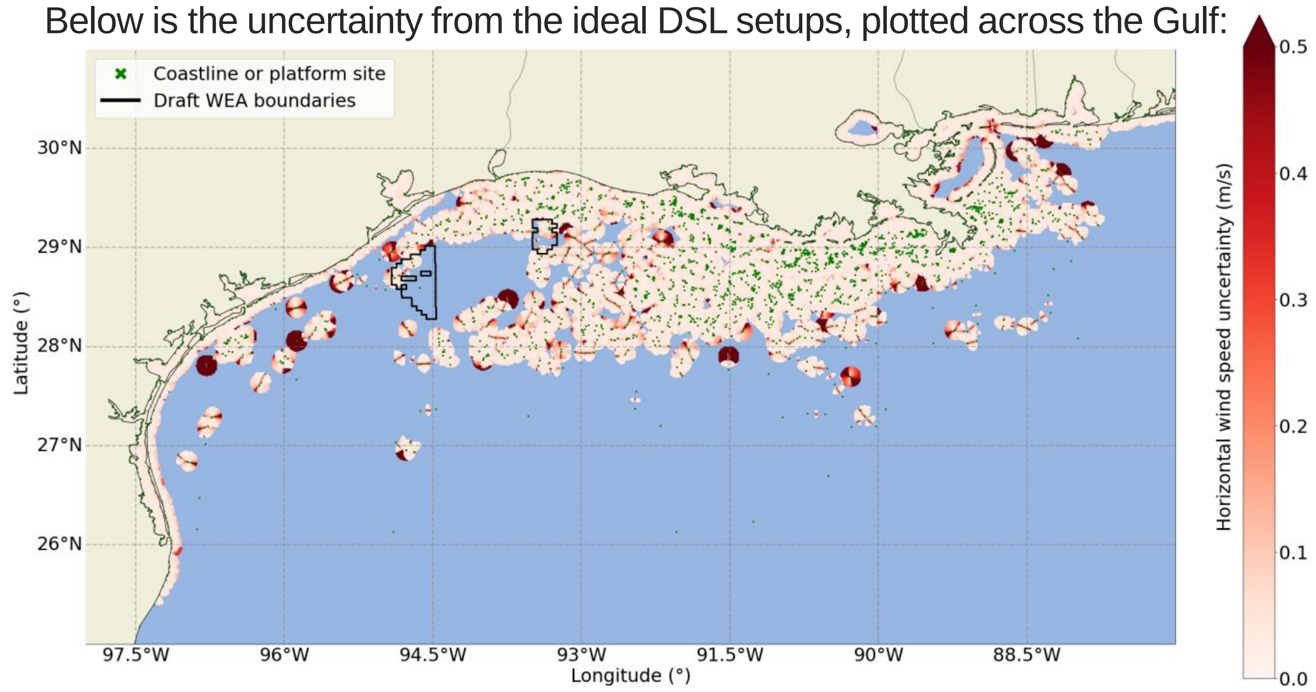
This error model has been presented and validated in [3].

Data on where lidars could be placed to measure above the ocean was taken from two sources: coastline data from the CartoPy library [4] and offshore platform data from [5].

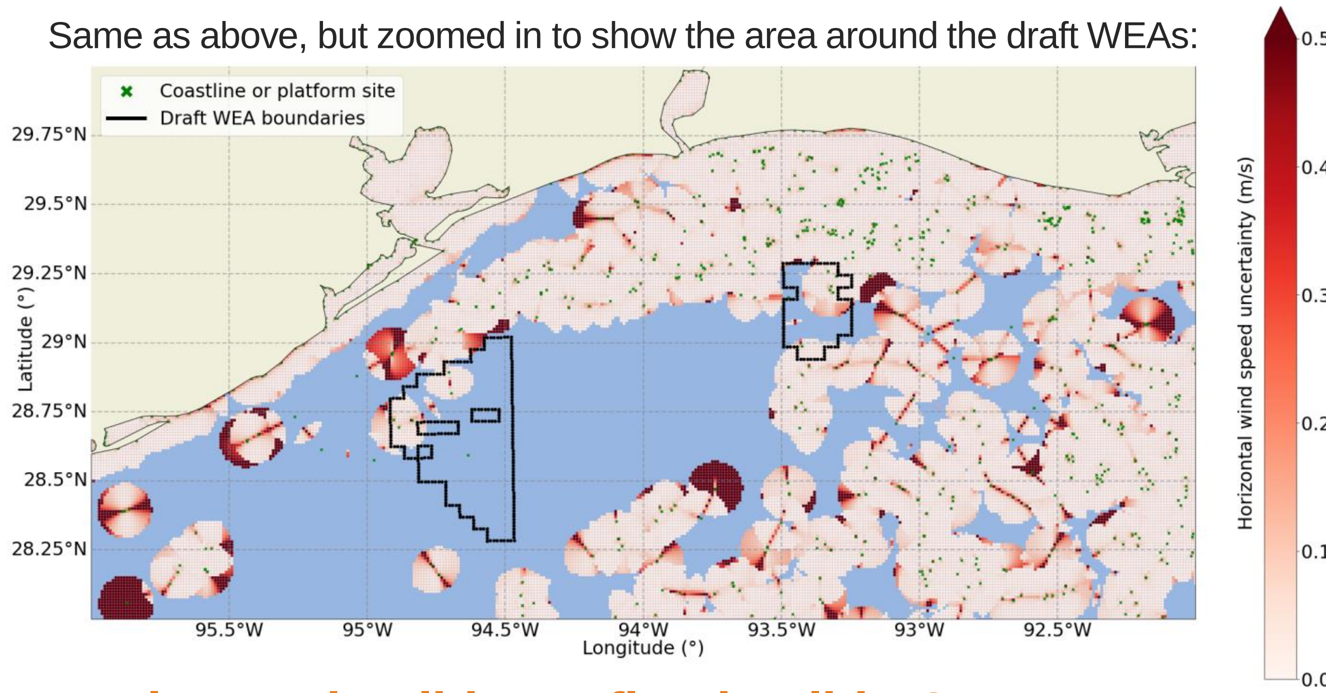
A fine grid of potential measurement locations was defined and a quad trees algorithm used to link each to nearby coastline or platform sites within the range of the lidar. For each possible pair of lidar sites, the error model calculated the measurement uncertainty. The pair with the lowest uncertainty were used to plot the map.

Dual scanning lidar uncertainty in the Gulf of Mexico

Below is the uncertainty from the ideal DSL setups, plotted across the Gulf:



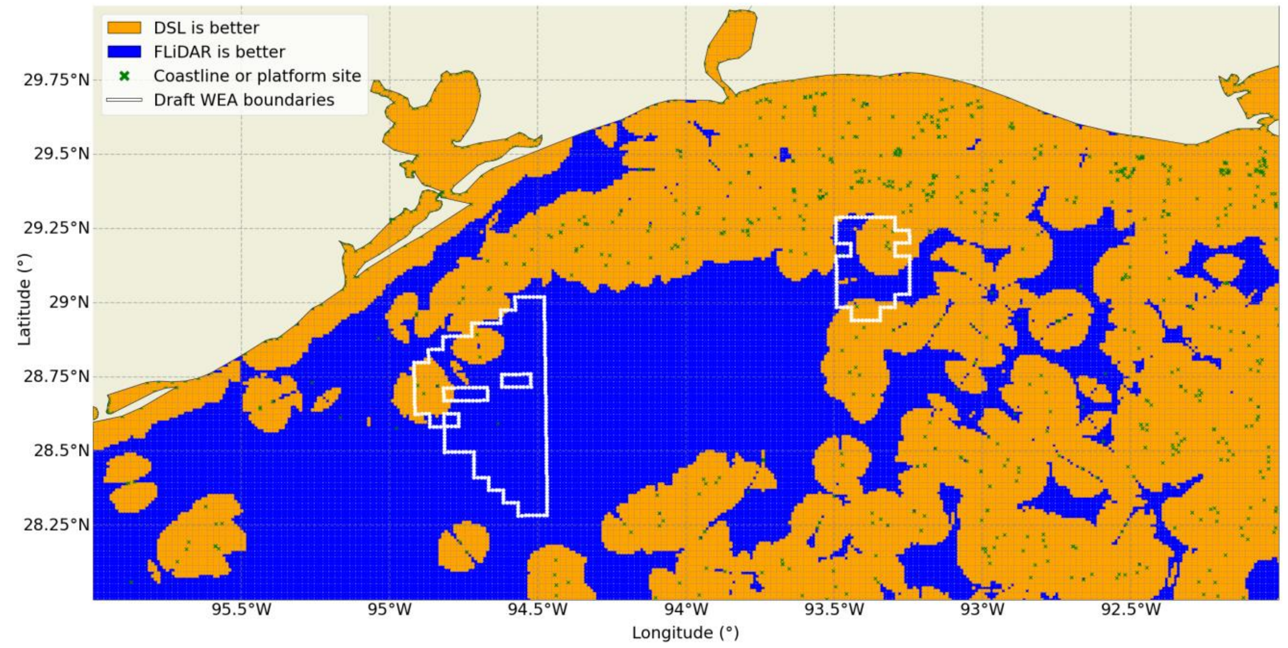
Same as above, but zoomed in to show the area around the draft WEAs:



Dual scanning lidar or floating lidar?

To do a geographical comparison of where DSL can achieve lower uncertainty than floating lidars (FLiDARs) in the Gulf of Mexico, a typical FLiDAR measurement uncertainty was assumed. As a conservative estimate for a stage 2 FliDAR, 3.5% is taken [6].

The map below shows the areas where DSL or FLiDAR has the lower uncertainty, in the region around the draft WEAs:



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