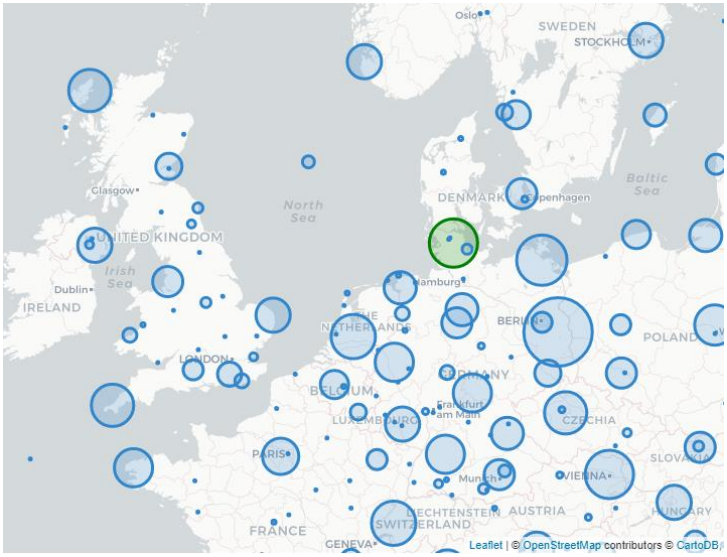
Answers in the wind: long term wind trends remain as elusive as ever

The current post analyses long-term wind speed data in the German Northern sea, with the objective to find **long-term wind patterns**. The topic is of importance to energy companies that have offshore wind parks and which could use it to better plan future energy production.

The performed analyses strived to answer 4 business related questions:

1. Which meteorological station should be used to understand long-term wind trends in the German North Sea?
2. Is the wind in the North Sea similar to what it was decades ago?
3. What is the monthly seasonality of wind?
4. What multi-year wind trends do we observe?

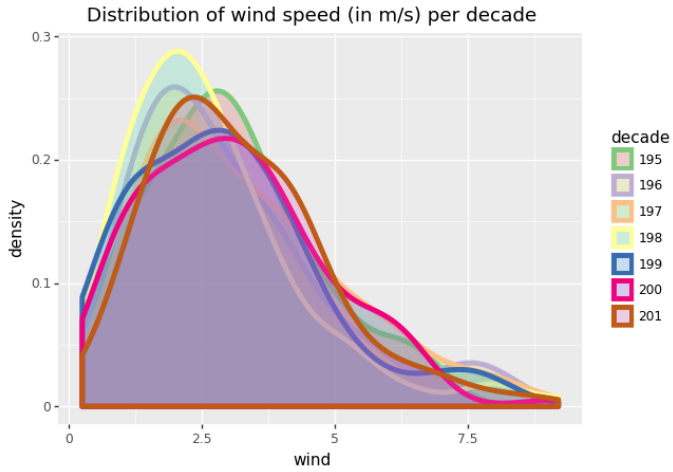
1. Which meteorological station should be used to understand long-term wind trends in the German North Sea?



The Integrated Global Radiosonde Archive (IGRA) Version 2 provides weather data from various meteorological stations across all continents. A quick look at available stations in the German Northern Sea coastal area, reveals that “Schleswig” station has some of the longest records in the area dating back to 1954 (see green dot on the map; circle size represents record length).

The further analyses are done based on Schleswig’s historical monthly averages of wind speed.

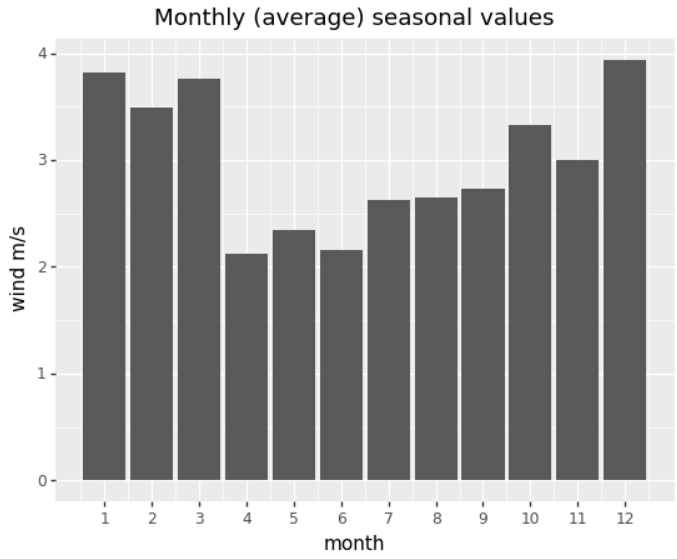
2. Is the wind in the North Sea similar to what it was decades ago?



The wind speeds observed in the last decades seem similar to the decades before. The data also does not seem to support the hypothesis that there are linear long-term trends (i.e. that the Northern Sea is becoming less windy – potentially due to global warming).

Although some decades do seem to be more windy (1990s and 2000s), some less so (1980s), there is no linear trend in the data. Also the month-to-month behavior of wind (i.e. variability and auto-correlation from one month to the next) seems constant across decades.

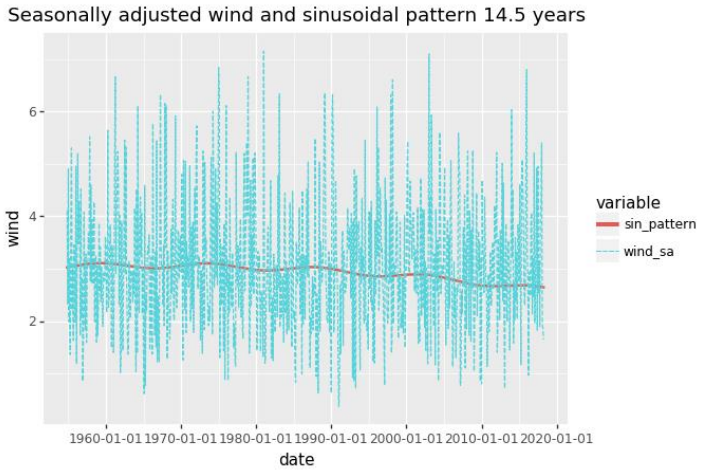
3. What is the monthly (i.e. intra-year) seasonality of wind?



As expected, winter is the most windy season. December to March months are almost twice as windy as April to June months.

What is remarkable is the sharp drop in average monthly wind speeds from March (~4m/s) to April (~2m/s). This is probably due to weather regimes' influence dropping considerably in April (weather regimes are large-scale atmospheric clusters - of at least several hundreds of kilometers - circulating in a few recurrent and persistent patterns; spring and summer months are expected to show a weaker link between large-scale circulation and local climate).

4. What multi-year wind trends do we observe?



To analyze the long-term trends, the monthly wind speed data was first de-seasonalized. Afterwards, a sinusoidal pattern of varying length was applied to the data. All tried frequencies from 1 to 15 years provided worse results than assuming a constant number.

The answers for long-term wind trends are… in the wind.

Conclusions

- The wind speeds observed in the last decades in the German Northern Sea seem similar to the decades before.
- Winter months are the most windy ones probably due to stronger influence of large-scale circulation on local climate.
- The wind in the German Northern Sea doesn't seem to follow any linear or sinusoidal trend. More research is needed… 😊

P.S. Hello world! This is my first post for Udacity's Data Science nanodegree. I hope you enjoyed it and learned something about the wind.