# Exercise 2
# WPMP - Energy Meteorology

## Energy Meteorology Exercise

The goal of this exercise is to derive several statistical parameters from time series of wind data of two different met masts within the North and the Baltic Sea (FINO1, FINO2, (see: `http://fino-offshore.de/en/`)) and to compare the results. Like in the previous exercise, we expect one report for the entire exercise, including an explanation of the methods you used to derive your results, figures showing your findings and a discussion afterwards. Please attach the important parts of your e.g. Matlab code. Points are given for the different tasks of this exercise, which are noted in the following such as [1].

Preparation:

1. Copy the File `WMP_WEnMet_data.mat` to your computer
2. Load this file into your `Matlab` or `Octave` work-space
3. The file contains a structure for each met mast with several arrays for the time (matlab serial date number), the wind speeds (ws) and wind directions (wd) of different heights. For an easy use all data gaps were filled with the missing value flag (`NaN`). Please don't perform additional quality checks here. You already did that in the last exercise. Concentrate on the meteorological questions.

Tasks:

1. Plot the wind rose of wind direction and speed for both met masts. Use the wind measurements at around 90 m height. You are free to use existing routines for plotting wind roses in e.g. Matlab that can be found online. Be careful to understand what the routines are doing and what input parameters you need to provide, because they might be for oceanographic purposes in default configuration. [1]
   What are the differences between the two wind roses? Do you have an explanation why there are differences? Do you find an influence of any obstacles to the flow on the wind roses? [1]
2. Select one height applicable for the utilization of wind power production and plot the wind speed histograms for both sites for the entire time period provided. [1]
   Discuss the differences between the histograms. Which region is more favourable for wind power utilization? [1]
   Calculate the Weibull distribution parameters from mean and standard deviation of measured wind speeds. Please explain your approach and the method used shortly. [1]

Hint: The gamma function is implemented in Matlab and can be used for the calculation of the Weibull parameters.

3. Select a westerly wind sector (240-285°) from the FINO1 90 m direction data and calculate the average vertical wind speed profile for this sector. [1]
   Try to fit the logarithmic wind speed profile and the empirical power law profile to the data. Explain your starting values for the fit. What are the differences between the two possible methods and why? Which method would you prefer? [1]
   Hint: The `Matlab` function `nlinfit` will be helpful in this context.

Presentation Topic:

Explain your solution and results concerning all Tasks.
(a) Extra Work in Task 2: Evaluate Weibull distribution for all heights (should only require very small changes to your code) and plot shape and scale parameters vs height. Discuss similarities or differences to onshore conditions (e.g. Gryning, 2013).
(b) Extra work in Task 3: Select the months May-July, November-January for the westerly wind sector and fit the logarithmic profiles again. Do you see any differences in between the seasons, if yes, what might be the reason for this? Hint: For the comparison it might be useful to normalize the profiles at one height

The FINO data was kindly provided by the 'Bundesamt für Seeschifffahrt und Hydrographie' (BSH) and is free of charge for scientific use within the EU. Please delete all the data when you successfully passed the Laboratory Project. If you are interested in using FINO data for your own research, apply for an account via: `http://fino.bsh.de`

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