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Use of mesoscale wind data: contribution to a better and cheaper resource assessment for offshore windfarm development?

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Abstract

The offshore wind development has reached 8,1GW installed capacity on December of 2014 in Europe. In terms of installed capacity four countries (UK, Denmark, Belgium and Germany) have a percentage of approximately 94% of the total. The offshore windfarms have mainly installed in North Sea and Atlantic Sea (total 86%). In the Mediterranean Sea, there are only planned offshore windfarms and the project activity is quite low in the countries of South Europe. Also, the financial crisis and the latest legislative changes have created more difficulties in offshore development, especially in countries in Southern Europe. One of the main factors for a development of an offshore windfarm is the forecasting of the wind resource, especially in Mediterranean Sea where the exploitable wind resource is lower than other seas. The objective of this study is the presentation and evaluation of mesoscale wind data for the wind resource assessment of sea areas, especially in Mediterranean Sea. For this aim, EMD ConWx data used and compared with data from two seashore masts and two buoys. The cost of installation an offshore meteorological mast is high (1-3 million Euro) and isn't financial affordable or preferred at the first stages of technical development and licensing of an offshore windfarm. So, the use of mesoscale data and mesoclimatic maps is incomparable cheaper solution for the primary wind resource assessment. EMD ConWx are mesoscale dataset which are modeled and computed in-house in ConWx and EMD. The model is run at high spatial resolution of 0,03˚ x 0,03˚ (appr. 3x3km) with 1h temporal resolution. Interim data from ECMWF are the global boundary data. The temporal coverage is from 1993 until present and the available data are from the heights of 10-24-50-75-100-150-200m agl. The mesoscale data have been compared with the measurements of two seashore meteo masts (10 & 25m agl) – 1 year (10min measurements) and two buoys measurements (3,3m asl – 3 & 11years) – (3h measurements) which are operated by Hellenic Centre for Marine Research (Poseidon System). Area of the study is the Northern Aegean Sea, Greece where there is remarkable offshore wind projects development (more than 2GW). The strength of the relationship has been measured by means of correlation coefficient R using the matrix MCP method (EMD WindPro software). Concurrent data at common temporal resolution and monthly values have been used. The EMD ConWx data show a high spatial and resolution which allows a better representation of the local wind climate but the issue of the thermal driven wind gives a some lower predictability, especially in coastal zones.

There is experience using mesoscale data for primary assessments for under development offshores mainly in the Baltic Sea, North Sea and Irish Sea, where it is presented quite high correlation for offshore wind with met masts in the area, this paper gives the opportunity to evaluate the use of mesoscale data for wind resource assessments in Mediterranean Sea, though comparison with measurements from seashore mast and buoys. In general, this paper gives the opportunity to study real offshore winds in Mediterranean Sea and to examine the usefulness of the mesoscale data for the primary wind resource assessment for offshore windfarms.

Evaluation of the state-of-the-art long-term mesoscale wind database and the comparison with real measurements, at the stage of primary wind resource assessment, provides useful information to the research and business community of wind energy. This study contributes to a better and cheaper resource assessment for offshore windfarm development, especially in countries where offshore wind energy is at the first steps.

Used data - Methods

Mast/buoy	Study period (years)	Temporal resolution
25m mast Alexandroupolis	1	10 min
10m mast Samothraki island	1	10 min
Athos buoy - 3.3m	11	3h
Skiros buoy - 3.3m	3	3h

Dataset	Used height (m) agl	Spatial resolution	Temporal resolution	Type
EMD ConWx	10 and 25	0,03 deg.	1h	Reanalysis Mesoscale dataset

MCP method	Used software
Matrix Method MCP	EMD WindPro
Wind Index MCP	EMD WindPro

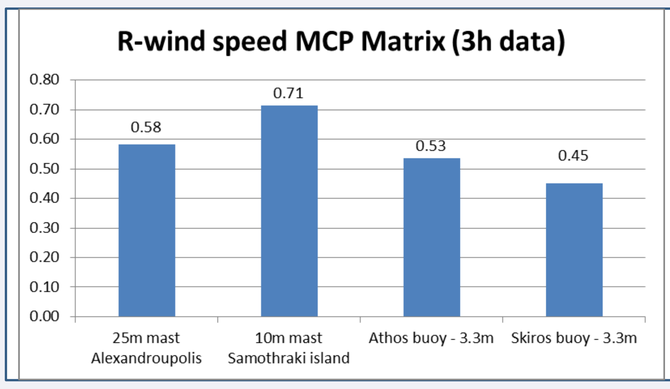
SEAWATCH Wavescan buoy with met mast

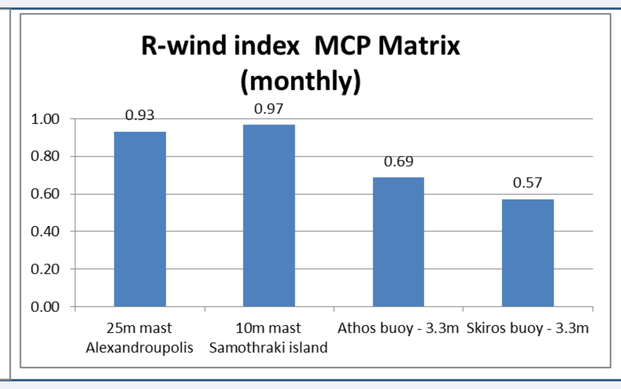
The Seawatch Buoy

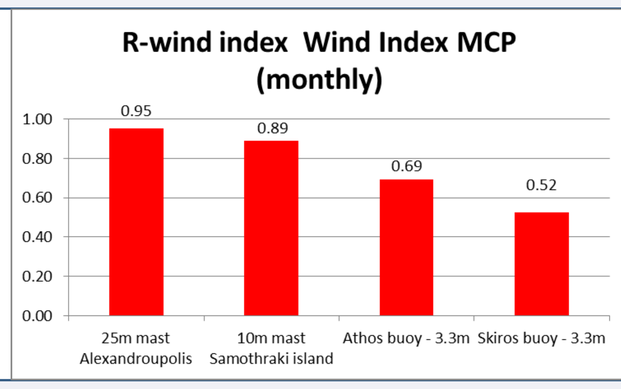
Work description

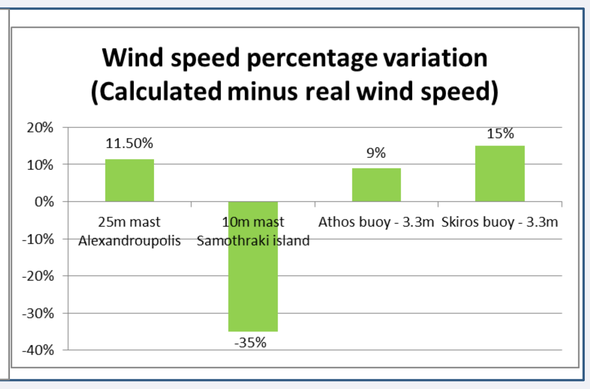
- Correlation study of measurements of 2 buoys and met masts with mesoscale EMD ConWx data, using two different MCP methods through WindPro software package.
- Calculation of mean wind speed at buoys and met masts based on nearest grid point of EMD ConWx database, using EMD WindPro and DTU WAsP.
- Evaluation of the results. Extract of conclusions and learning objectives.

Results









Conclusions

- For 2 seashore masts: Relative moderate correlation in wind speed (3h data), very good correlation using monthly data.
- For 2 buoys: Moderate and low correlation, high standard error. The low measurement and reference height and the thermal driven wind are possible reasons.
- The calculations without special downscaling model, showed in 3 cases overestimation of 9-15% and in one case high underestimation of 35%.
- Mesoscale wind data are useful for the primary wind resource assessment for offshore windfarms, using the best method which will minimize the overall uncertainty.

References

1. E. Holtslag, In-depth validation key to acceptance mesoscale results, EWEA 2014. 2. The European offshore wind industry - key trends and statistics 1st half 2014, EWEA. 3. Guide to longt erm correction, EMD A/S, 2014.