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Corrosion in offshore wind energy: assessment of marine aerosol concentration using the CALIOPE air quality modelling system in Europe

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Introduction

Corrosion of wind turbine components in offshore environments is a major issue. Sea salt aerosols greatly affect metallic structures when surfaces are wet. In Europe, wind power installed capacity has experienced a rapid growth. In regions such as the North Sea, Celtic Sea and the Baltic Sea a few offshore wind farms have been already installed and many others are under consideration. Offshore wind turbines are exposed to corrosive attack affecting their efficiency and their components' lifetime. Such corrosion attack and the corrosion rate depend on: the metallic materials, technical parameters, operating conditions and the atmospheric environment.

Approach

In this study, marine aerosol concentration in Europe is assessed by using the CALIOPE air quality modelling system (http://www.bsc.es/caliope/?language=en). The system integrates the WRF-ARW meteorological model coupled with the CMAQv5.0.2 photochemical model. The simulations are run for three years: 1990, 2000 and 2010. Sodium, chloride and total sulfate aerosols are studied. An evaluation of the modelled aerosol concentration is performed using the EBAS database.

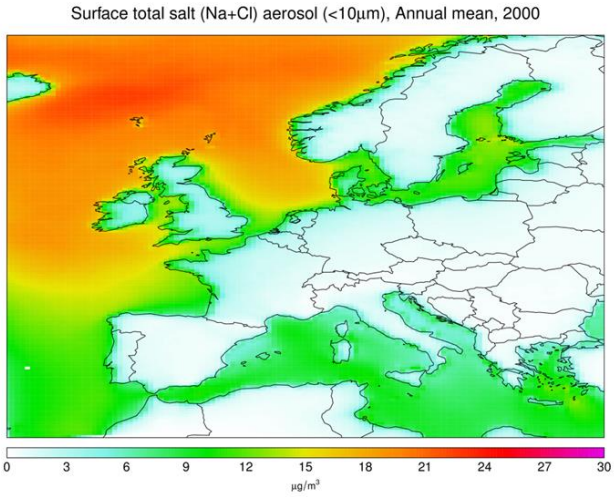

Figure 1. Annual mean surface total salt (Na^+ and Cl^-) aerosol for Europe, year 2000. Particle size below 10 micrometers. Units in micrograms per cubic meter.

Main Body of abstract

This study has been motivated by the interest of EDPR in assessing marine aerosol concentration in a specific location where a new wind farm is under consideration.

According to the ISO9226, data on the corrosivity of the atmosphere are essential for the development and specification of optimized corrosion protection for manufactured products. This corrosivity determination can be based on either in-situ corrosivity assays for a specific location or estimations based on atmospheric environmental information. Since there are only a few offshore observations of atmospheric composition and corrosivity determination tests need long exposition periods, model data can be used to estimate local atmospheric parameters,.

Conclusions

Corrosion of wind turbine components in offshore environments affects their efficiency and life cycle. In general terms, in the pre-construction stages of a wind farm there is not available information about the atmospheric composition conditions for a specific location. The CALIOPE air quality modelling system proves to be an important tool to estimate local atmospheric parameters and determine corrosivity in Europe.

Learning objectives

This work will illustrate the added value of air quality modelling systems for estimating the risk of metal corrosion of offshore wind turbine components.