Research Position at CEREA (18 months)

«Wind resource assessment for offshore wind farms using satellite data »

Context

The current strong development of offshore wind energy capacity is expected to continue the next years. However, this development is linked to the need of LCOE (Levelized Cost of Energy) reduction in order to insure a good profitability of the farms. Improving the accuracy of the wind resource assessment is one of the promising way to obtain this LCOE reduction.
The wind resource assessment needs a combination of measurements and numerical modeling. Offshore measurements are much more difficult and expensive to carry out than for onshore wind farms. Floating lidars are now considered as reliable enough, but the obtained measurements remain limited both in terms of spatial and temporal representativeness.
The project CARAVELE funded both by France Energies Marines and ANR (The French Research Agency) aims to better characterize the spatial and temporal variability of offshore wind, especially close to the coasts where this variability is strongly influenced by local effects due to the orography and thermal gradients. Other objectives of the project are related to the characterization of the turbulence and its impact on turbines loads, and to the characterization of extreme winds. In particular, the project will study how satellite measurements can be used to provide useful information for these objectives. EDF and ENPC are partners of this project and a post-doc position for 18 months is open in order to work on one task of the CARAVELE project.

Work program

Within the CARAVELE project, a work package is dedicated to the vertical variation of the wind in the marine atmospheric boundary layer. SAR radar (Synthetic Aperture Radar) allows retrieving the wind speed at a height of 10 m above sea level, using empirical relationships between this wind speed and measurements of radar backscatter from the sea surface. However, wind resource assessment requires wind speed map at the height of turbines hub, which is around 100 m for the current turbines.
The post-doc will be in charge of a contribution to the CARAVELE project which will consist in developing a methodology to extrapolate wind speed between 10 m and 100 m, using a combination between satellite measurements and the meteorological model WRF (Weather Research and Forecasting). The model WRF will be used to calculate the stability correction which is needed to retrieve the wind speed profile. A site will be selected for which in situ wind measurements are available in order to be used for comparison with the modeled values.

The main steps are:

Bibliographic survey
A bibliographic survey will be performed on SAR wind measurements and existing methods for vertical profiles reconstruction.

Pre-processing
Some scripts will be written (preferably in Python) to read input data (SAR data) and validation data.

WRF simulations
After defining an optimal configuration, the WRF model will be run over 5 complete years for the selected site.

Computation of extrapolated wind speed at 100 m

The friction velocity will be computed using SAR data, and the stability correction will be derived from WRF simulation. Then the wind speed at 100 m will be computed without and with the stability correction. Different methods to compute the stability correction will be tested. Then, this extrapolated wind speed will be compared to the WRF value and to the in-situ measurements.

Sensitivity analysis

A sensitivity analysis to different parameters in WRF configuration (especially horizontal resolution and Planetary Boundary Layer scheme) will be performed.

Direct assimilation

The previous approach will be compared to a direct assimilation of the satellite measurements in WRF.

Report writing

A report will be written describing the methodology and the results.

Profile of candidates

- Ph.D. or Engineer degree in Atmospheric Sciences
- Strong experience in computer use (Linux, Fortran, C, Python)
- Experience in numerical modelling with WRF will be highly appreciated

Location

The postdoctoral fellow will work within the CEREA (Atmospheric Environment Teaching and Research Center), which is a joint laboratory between Ecole des Pont-ParisTech and EDF-R&D. He will be mainly based in Ecole des Ponts Office, in Champs sur Marne, in Paris area, and will spend a part of his time in EDF-R&D Office in Chatou.

Application

The interested candidate should send a CV with motivation letter to:

Eric Dupont, researcher at CEREA: eric.dupont@edf.fr
Yelva Roustan, researcher at CEREA: yelva.roustan@enpc.fr